

EQUINE VETERINARY COMPENDIUM

quarterly online

Short reports of selected publications of the current international equine medical literature

Edited by Hans D. Lauk, Heidrun Gehlen and Anja Gabe

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Equine Veterinary Education

Equine Veterinary Journal

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EQUINE MEDICAL COMPENDIUM

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Short reports on current publications of the international equine medical literature

Edited by Hans D. Lauk, Heidrun Gehlen and Anja Gabe

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General

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Animals, Australian Veterinary Journal
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Canadian Journal of Veterinary Research
Equine Veterinary Education
Equine Veterinary Journal
J. American Veterinary Medical Assoc.
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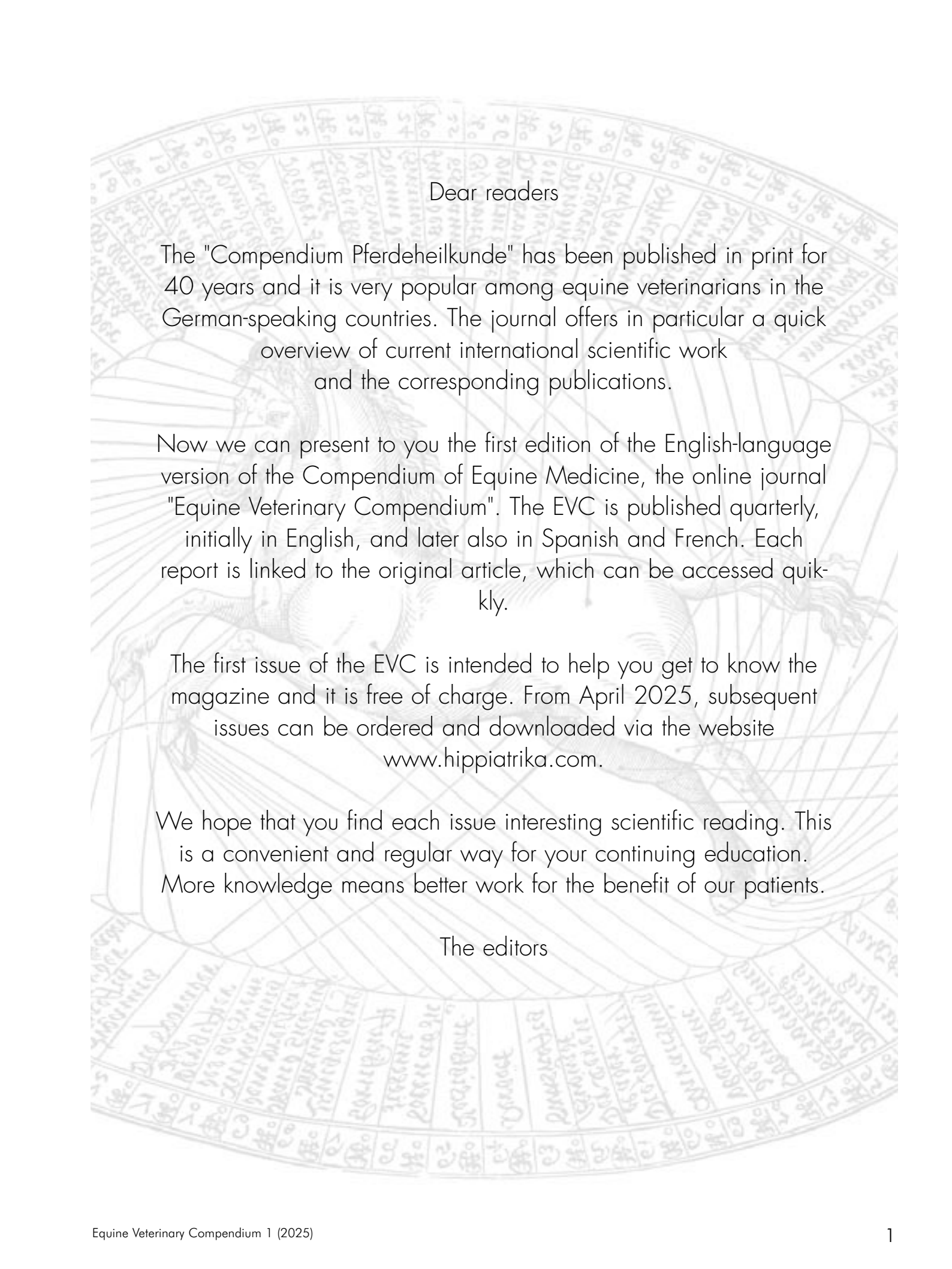
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Dear readers

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The editors

Fasting horses perioperatively decreases manure production and increases time to manure output postoperatively: a controlled randomized trial

Barton CK, Hector RC, Hendrickson DA, Kawcak CE, Nelson BB, Goodrich LR (2024)

J Am Vet Med Assoc | <https://doi.org/10.2460/javma.24.04.0235>

Post-anesthetic colic (PAC) is one of the most common complications associated with general anesthesia in horses, contributing to more than 65% of anesthetic complications with an incidence of 3% to 11%. Because PAC is associated with a significant risk of mortality as well as additional costs to livestock owners, there is a need for evidence-based recommendations for perioperative feeding strategies to reduce the incidence of this complication. Traditionally, withholding hay prior to anesthesia has been considered standard practice, with fasting periods of 6 to 12 hours documented in the literature. However, it has been found that various medications used during anesthesia, such as sedatives, anesthetics, analgesics, and antibiotics, can decrease gastrointestinal motility and increase the risk of PAC. Despite the widespread practice of fasting, there is no solid scientific basis to support this measure, and it has been shown that sudden feed restriction can lead to adverse effects such as reduced water intake, reduction in gastric pH, and colic. A recent retrospective analysis of non-fasted horses undergoing elective surgery found a PAC incidence of only 2.5%, which is lower than in fasted animals.

The main aim of the present study was to compare fecal output, anesthetic outcomes (particularly hypoxemia and hypotension), water intake and the occurrence of PAC in horses that were not fasted before and after anesthesia with animals that were fasted before anesthesia and gradually fed after anesthesia. Furthermore, it was investigated whether wearing a muzzle in fasting horses had a negative effect on water intake and fecal production. For this purpose, 45 horses undergoing elective orthopedic surgery were randomly divided into three groups: first, the NF group (not fasted), which received continuous hay feeding perioperatively; second, the FM group (fasted, with muzzle), which received hay up to 10 hours preoperatively, then fasted and gradually fed hay postoperatively with a muzzle. The third group, the FNM group, had fasted and the same procedure as FM, but without a muzzle. The parameters collected included anesthesia variables (hypoxemia, hypotension), fecal production, time to first defecation and PAC incidence. Furthermore, it was investigated whether the muzzle influences water intake and fecal production.

This study shows that horses in the NF group had a significantly smaller reduction in fecal volume postoperatively (-39%) compared to FM (-81%) and FNM (-70%). The number of defecations was also higher in the NF group (-22%) compared to FM (-63%) and FNM (-55%) groups. The time to first defecation was significantly shorter in the NF group (238 ± 13 minutes) compared to FM (502 ± 174 minutes) and FNM (444 ± 171 minutes). PAC did not occur in the NF group, but did occur in 13% of horses in the fasting groups (FM and FNM). The difference was not statistically significant. There were no significant differences between groups in terms of hypotension, hypoxemia, or recovery time. All horses had adequate oxygen levels under mechanical ventilation, regardless of feeding regimen. The results confirm that continuous hay feeding perioperatively improves post-

operative fecal production and shortens the time to first defecation without compromising anesthetic safety. This means that the traditional perioperative fasting regime in horses should be reconsidered. Horses with continuous access to hay had better postoperative gastrointestinal tract (GIT) function, which may reduce PAC risks. Future studies should measure objective parameters such as GIT motility or transit time to more accurately capture the physiological mechanisms.

Department of Clinical Sciences, College of Veterinary Medicine and Biomedical Sciences, Colorado State University, Fort Collins, CO

Increased body condition score has a detrimental effect on arterial oxygen tension and increases the risk of hypoxaemia in anesthetized horses

Loomes K (2024)

Equine Vet Educ | <https://doi.org/10.1111/eve.13903>

During general anesthesia, the alveolar-arterial oxygen partial pressure gradient of a horse is high and the arterial oxygen partial pressure is low. This can limit the oxygen supply to tissues. Intra-operative hypoxemia in horses can increase the risk of suture infection after laparotomy and negatively affect the quality of the recovery phase. Various study results suggest that a higher-body weight in oxygen partial pressure during anesthesia. A correlation has been demonstrated between height per body mass and thoracic circumference per body mass and in partial pressure of oxygen. It is also known that increased body weight, a reduction in thoracic circumference and height dimension per kilogram of body weight have a negative influence on partial pressure of oxygen (PaO₂) under general anesthesia. The effect of the body condition score (BCS) on PaO₂ is unknown. This study aimed to assess the extent to which the BCS influences PaO₂ and alveolar dead space fraction (measure of ventilation/perfusion heterogeneity) during general anesthesia in the supine position of healthy horses.

For this study, 524 anesthesia records of horses over 12 months of age were evaluated. The horses were anesthetized with isoflurane in the supine position with controlled mechanical ventilation and complete arterial blood gas analysis. The BCS (1–9) was assessed by one person. Horses with a large BCS of less than 6/9 were assigned to group N and those with a BCS of ≥ 6/9 were in group O. Pre-anesthetic medication included azepromazine, romifidine and morphine. Anesthesia was induced with ketamine and diazepam. Controlled mechanical ventilation with a tidal volume of 10–15 ml/kg at a respiratory rate of 6–12 per minute to achieve a PE CO₂ between 5.3 kPa and 3.6 kPa. Dobutamine was administered optionally to ensure an arterial pressure of over 70 millimeters Hg. Of the 524 anesthetic protocols, 135 met the inclusion criteria. In 85 horses the BCS was less than 6/9 and in 50 it was greater than or equal to 6/9.

There were 46 warmbloods, 26 Welsh Cobs, 19 thoroughbreds, 18 Irish Sport Horses and 4 Connemara. Horses in group O had a significantly lower partial pressure of oxygen compared to animals in group N. This difference remained even when the hor-

ses were categorized by body weight (under 500 kg or over 500 kg). Horses in group O had a 34-fold higher probability of developing hypoxemia compared to horses in group N. The alveolar dead space fraction was higher in group O than in animals in group N. The multivariate logistic regression analysis identified a significant correlation between the partial pressure of oxygen and body weight as well as between the BCS and the alveolar dead space fraction. Horses in group O also required higher doses of dobutamine compared to animals in group N. According to the results of this study, a higher BCS ($\geq 6/9$) is a risk factor for the development of hypoxemia in horses under general anesthesia in the supine position. ag

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Outcome and racing performance following standing repair in 245 horses

Colgate V A, Robinson N, Barnett T P, Bathe A P, Coleridge M O D, Smith L C R, Payne R J (2024)

Equine Vet J | doi.org/10.1111/evj.14016

Distal limb fractures contribute significantly to economic losses in racing. These fractures most commonly affect the cannon bone and pastern bone. Fracture treatment is typically performed under general anesthesia with the risk of a fracture during induction or during the standing phase. Almost 20 years ago, the first reports of standing osteosynthesis of the cannon bone in thoroughbreds appeared, which, depending on the study, could be brought back to the start with a success rate of 67%-100%. The present study was designed to use a larger cohort of horses to analyze the treatment results after standing screw fixation of the cannon bone and pastern bone and to analyze the further racing career of the thoroughbreds. For this purpose, the medical records of horses in which standing osteosynthesis had been performed between 2007 and 2021 due to a cannon bone or pastern bone fracture were retrospectively reviewed. Horses younger than 2 years were excluded. For the procedure, sedation with acepromazine, detomidine and butorphanol was used, as well as local anesthesia using a high 4- or 6-point block on the front or hind leg, combined with a ring block at the level of the fracture. The affected limb was draped sterilely and fitted with skin staples as radiographic landmarks. The fractures were screwed together using 4.5 or 5.5 mm compression screws inserted through stab incisions under intraoperative X-ray control. The application of an Esmarch bandage was abandoned over the years in order to reduce the risk of limb movements during the procedure.

Rubber floors reduce drilling vibrations. The recovery box is therefore an ideal operating room, particularly as it allows the horse to be laid down quickly if necessary. As surgical experience increased, operations were also carried out while the horse was still under examination. In addition to the information from the medical records, the racing results were collected and evaluated using the Racing Post Database (www.racingpost.com). These had to go back at least 6 months in order for the corresponding cases to be included in the evaluation for the study. The age of the horses at the time of the operation was between 2.5 and 3.9 years, with a gender distribution of 93 mares, 87 stallions and 65 geldings. They were predominantly thoroughbreds ($n = 228$), followed by Arabians (13) and other breeds. The fracture location

mainly affected the forequarters, and in some cases both front legs. Condyle fractures outweighed pastern fractures by a ratio of 3:2. Two thirds of the fractures were bicortical, one third were unicortical fissures. One or two cortical screws were implanted per fracture or fissure. The intraoperative complication rate was around 15% and resulted from unexpected limb movements, damage to the screw drive during insertion, bleeding or drill bit breakage. The length of hospital stay was 2-4 days. Of 245 horses operated on, 240 were able to leave the clinic alive.

Of the remaining 5, 3 were euthanized during the hospital stay due to a low fracture and one each due to an appendix obstipation that could not be controlled conservatively and colitis. Less serious postoperative complications during the hospital stay affected 55 cases in the form of severe lameness, colic, impaired wound healing, pressure sores from bandages or phlebitis of the jugular vein. In 15% of the horses, it was later discovered after discharge that another fracture had occurred. Information on postoperative racing performance could be evaluated for 191 thoroughbreds. Of these, 131 (75%) started racing after fracture treatment. Their postoperative complication rate during the hospital stay was 17%, lower than the overall complication rate of thoroughbreds (25%) that did not start racing after fracture treatment. When comparing the racing performance of thoroughbreds that competed preoperatively and postoperatively, no significant difference was found in terms of the winnings per race, the number of first places or the number of places in the top three. A bicortical fracture required a longer hospital stay and a higher number of screws compared to a unicortical fracture, combined with a higher postoperative complication rate. However, the type of fracture was not relevant for answering the question of whether a horse did not take part in races after the operation. The results of this large cohort study confirm the results of earlier publications with small case numbers. With osteosynthesis in the standing position, the effect of large shear forces on the fracture in the standing phase after general anesthesia can be avoided.

Limiting factors for standing surgery include the temperament of the affected horse and the limited options for fracture reduction. If you take all the study results on standing osteosynthesis together, the median time from fracture treatment to the first start was between 250 and 350 days. In addition to fracture healing, this period is also determined by the duration of the rehabilitation training, the age of the horse, the timing of the current racing season and the trainer's decision. Severe postoperative lameness could indicate poor fracture stabilization. However, due to the retrospective nature of the study, these and all other postoperative complications could not be causally linked to the further course of the disease. A relatively high wound secretion rate of 7% was determined after the procedure. However, the files did not contain any evidence of positive bacterial culture results or prolonged antibiotic administration, so the infection rate may have been lower. In order to keep these risks as low as possible, care must be taken to ensure that sterility is not breached during the procedure, for example during intraoperative X-ray examinations, when lifting the contralateral limb when screwing in the screws, through spontaneous movements or through spontaneous urination by the horse. Racing success is defined inconsistently in different studies. It is recommended to always use several parameters, as was done in this study. A control group was not available. Therefore, at least the individual racing results before and after the operation were compared, so that each tho-

roughbred served as its own control. No further information was available on the horses that sustained another fracture later in their lives. pp

Rossdale's Equine Hospital, Suffolk, UK

Successful reconstruction of a bilaterally comminuted mandibular fracture in a foal using 2.7 locking compression plates

Henriksson S, Gorvy D, Skärлина E (2024)

Equine Vet Educ, <https://doi.org/10.1111/eve.13980>

The skull is considered a common body region for traumatic fractures in horses. Mandibular fractures often result from kick injuries. Unilateral unstable or bilateral mandibular fractures require osteosynthetic treatment using intraoral wiring, external fixation or internal plating. Locking plates ensure the highest degree of stabilization. The plating of proximal fractures of the corpus mandibulae represents a particular surgical challenge due to the low bone layer thickness, the close proximity to important vessels and regional lymph nodes, the facial nerve and the parotid duct, and the access route restricted by the atlas wing. The present case report describes such an operation in a foal with a successful outcome. The foal was a 23-day-old Swedish Warmblood filly weighing 108 kg, which had been injured on the head by a kick from the mother mare 2 days previously. After bleeding from the oral cavity, swelling developed in the area of the left jaw joint. The skin remained unharmed. The mouth was slightly open, with the rostral mandible pointing to the right. Sucking on the udder was still somewhat possible. The CT showed a closed, slightly dislocated multi-fragment fracture of the corpus mandibulae on both sides.

Despite a two-day conservative therapy attempt with meloxicam, sucralfate and milk administration via nasogastric tube, the difficulties with sucking persisted, so osteosynthetic treatment was decided upon. For this purpose, the foal was placed in a supine position under general anesthesia with xylazine, butorphanol, midazolam, ketamine and isoflurane. After tilting the head to the right, the procedure began on the left side with a 25 cm long skin incision along the caudolateral edge of the corpus mandibulae. The fracture was exposed by blunt and sharp dissection of the soft tissues, and the facial nerve was kept away from the surgical field using a Penrose drain. Then a 2.7 mm locking plate contoured along the angle of the mandible was inserted and fixed with two locking screws in the corpus mandibulae at the level of the condyle of the mandible and two further locking screws on the caudal ramus mandibulae. In addition, three cortical screws were inserted close to the more bony angle of the mandible. After a wound drain was inserted, the wound was closed in four layers. The surgical field was protected using suction swabs and sewn-on rolled compresses. After the same procedure on the right side and hand-assisted standing up, the foal was also given a head bandage made of tube gauze. The anesthesia lasted just over 6 hours with an operation time of 5 hours. The foal received flunixin, sucralfate, gentamicin and penicillin until discharge one week after the procedure. Drains could be removed on the 3rd postoperative day. The dressing was changed every 3 days, or initially daily on the left side due to self-limiting wound secretion. The foal had to wear a muzzle for 3 weeks between suckling periods.

The radiological follow-up examinations on the 4th and 14th postoperative days showed that the implants were in the correct position. Bilateral postoperative facial paralysis resolved a few days after discharge. The control CT scan in the 7th week after the operation showed a fracture that was healing with slight callus formation, so that the implant could be removed. The foal recovered completely. Immediately after the implantation of the locking plates, the foal was able to suckle independently and did not require any further feeding via a nasogastric tube, which was also important for the further development of the interaction between the mother mare and foal. The chewing load on the implants is much lower in suckling foals than after weaning, so that a plate thickness lower than the 3.5 - 4.5 mm usual for adult horses was sufficient, especially since these could not be used in this case anyway due to the thin bone thickness. Given the low level of mineralization in the foal's jaw, the exclusive use of cortical screws is not recommended, as these are more likely to break out of softer bone. Cortical screws could be placed in the area of the strong mandibular angle in order to withstand higher shear forces in the curved course of the plate. Fortunately, callus formation was limited. The control CT made it easier to assess the fracture progression in bones that were still weakly mineralized at a young age. The risks of a long anesthetic and considerable expense were accepted, with a favorable outcome. pp

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Closed inguinal castration technique in horses compared with field castrations using post-operative serum amyloid A analysis

Riemersma DJ, Fahlbusch G, Rijkenhuizen ABM (2024)

Equine Vet Educ | <https://doi.org/10.1111/eve.14014>

One surgical option for castration in stallions is closed inguinal castration. This involves closing the proximal processus vaginalis through an inguinal incision with a ligature under general anesthesia before removing the testicle. This technique has a low complication rate of about 2%, which is well below the 10-48% frequently reported for castrations under field conditions. Due to the subjective nature of some complications, it is suggested that postoperative inflammatory reactions can be assessed by measuring serum amyloid A (SAA) levels. These SAA levels have proven to be reliable markers of postoperative inflammation in horses after castrations under field conditions. It has been described so far that infection after castration is not necessarily clinically detectable until the fourth day. In the first three days after surgery, SAA can indicate surgical trauma. The SAA values measured in the subsequent period up to several weeks postoperatively could indicate an infection. Previously published data from various studies on average SAA values after castration under field conditions, measured after three days postoperatively, are 480 and 570 mg/L, 543-708 mg/L, 698 mg/L and 570-608 mg/L.

The aim of this study was to evaluate whether closed inguinal castration results in significantly lower SAA measurements three days after surgery compared to known data from castrations under field conditions. The study included 51 healthy horses that underwent closed inguinal castration under strict aseptic condi-

tions. SAA samples were taken before surgery and on the third postoperative day. The results showed that the average SAA value in horses that underwent closed inguinal castration was 94 mg/L, which was significantly lower than the SAA values observed after castrations under field conditions using the scrotal technique. The results are consistent with previous studies that have shown that SAA is a sensitive marker of surgical trauma and infection. The lower SAA values measured in the closed inguinal castration group suggest that this method is associated with a lower inflammatory response and possibly a faster recovery compared to traditional field castrations. In summary, the results of this study confirm the hypothesis that closed inguinal castration induces a significantly lower inflammatory response than castrations under field conditions, as evident from the lower SAA values. This suggests that closed inguinal castration may be a preferred method as it is associated with a lower complication rate and a less pronounced postoperative inflammatory response. vh

Horse practice Den Heyberg, Kevelaer, Germany

Flowmetry and spectrophotometry can detect reduced intestinal microperfusion in nonsurvivors during equine colic surgery for large intestinal strangulation

Verhaar N, Reineking W, Hewicker -Trautwein M, Grages A, Kästner SBR, Geburek F (2024)

Am J Vet Res | <https://doi.org/10.2460/ajvr.24.05.0142>

colic surgery is one of the most challenging procedures in veterinary medicine. Often, the survival of a horse depends on an accurate assessment of intestinal functionality. However, traditional visual methods for assessing intestinal blood flow have proven inadequate. An innovative approach may now offer a more precise prediction of intestinal functionality: laser Doppler flowmetry (LDFS) in combination with spectrophotometry. The present study investigated the potential of this technology to improve the intraoperative assessment of intestinal blood flow in horses with strangulated colon segments and ultimately to optimize survival prognosis. The aim of the study was to develop a method that can accurately determine intraoperatively whether the affected colon segment is sufficiently perfused after strangulation. To date, decisions about removing or preserving strangulated colon segments have been based predominantly on visual indicators and the surgeon's experience, which often leads to misjudgments. As a result, some horses survive with poor prognoses, while others with better chances of survival are euthanized. The LDFS was used in this study to measure intestinal microcirculation by quantifying tissue oxygen saturation (tSO₂), hemoglobin content (tHB) and blood flow (tBF). These measurements were performed on 17 horses that had undergone surgery for strangulating colic. The study also included biopsies from the affected intestinal segments to assess histological damage and correlate LDFS measurements with tissue damage.

Before the strangulation was repaired, no significant differences in the tSO₂ and tBF measurements were found between the surviving and non-surviving horses. After repair, however, the surviving horses showed significantly higher tSO₂ and tBF values. In contrast, the tHB value was increased in the non-surviving hor-

ses, indicating more severe damage to the intestinal tissue. A clear correlation between tBF and the histological findings, in particular the ratio of interstitium to crypts, indicated that lower blood flow was associated with more severe tissue damage. The tSO₂ values of the survivors were over 90% after the strangulation was repaired, a value that is also considered an indicator of adequate blood flow in human medicine. This suggests that tSO₂ measurement could serve as an intraoperative decision aid to more accurately determine the functionality of intestinal sections and thus avoid unnecessary resections. Interestingly, the microcirculation after the removal of the strangulation was not homogeneous in different areas of the intestine. In particular, the area of the flexure pelvina showed a lower blood flow than the left ventral colon, which may be related to a different anatomical location and blood supply. Another interesting finding was the strong correlation between tHB values and histological bleeding, especially in the mucosa and submucosa.

This suggests that LDFS technology could be used not only to assess oxygen saturation and blood flow, but also as an indicator of tissue bleeding, which is clinically relevant since extensive mucosal bleeding is associated with a worse prognosis. The results of the study provide valuable evidence that LDFS in combination with spectrophotometry could be a valuable tool for intraoperative assessment of intestinal perfusion. It could help surgeons make more informed decisions about preserving or removing strangulated intestinal segments, which could ultimately improve patients' chances of survival. However, the data from the study also show that there are still many open questions. For example, it would be interesting to investigate whether this technology is also applicable to other forms of intestinal strangulation, such as ischemic obstruction. One of the greatest strengths of this technology is its ability to provide real-time microcirculation data. This could be particularly useful to better predict postoperative complications such as endotoxemia and colitis. In fact, four of the eight horses that survived after surgery developed severe colitis and ultimately had to be euthanized. This highlights that even with a successful operation, the postoperative period remains critical and requires close monitoring. The researchers acknowledge that the study has some limitations. The sample size was relatively small and measurements were only taken at two intestinal sites. In addition, most horses were not autopsied, so the exact cause of postoperative intestinal failure could not be conclusively determined. Further studies with larger sample sizes are therefore needed to establish precise cutoffs for the various measurements and to standardize the clinical application of this technology. aa

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Does the proximal screw type affect stress and strain in pastern arthrodesis with locking plate in horses?

Souza AF, Pereira CAM, Fürst A, Kümmerle JM, De Zoppa AL (2024)

Res Vet Sci | <https://doi.org/10.1016/j.rvsc.2024.105378>

Diseases of the coronal joint are relatively common in sport horses. Due to the limited natural mobility of the coronal joint, treatment by arthrodesis has become established. For this purpose,

a 3-hole, 4.5 mm narrow locking plate specially configured commercially for this indication is used in conjunction with a unicortical, eccentrically positioned cortex screw for the proximal plate hole and two transarticularly inserted 5.5 mm cortex screws. The idea behind a unicortical screw at the edge of the plate is based on the assumption that this will reduce the stiffness of the implant and lower the periprosthetic fracture risk. On the other hand, this could result in a loss of stability of the implant. The aim of the present study was to investigate the effect of different implantation methods of the proximal screw on the load on the pastern bone and the implant on a cadaver. For this purpose, 20 forelimbs were removed from euthanized adult horses with a body weight of 370-470 kg and pathological changes were excluded using a CT scan. The pastern and coronary bones as well as the coronary joint capsule and collateral ligaments were then freed from other surrounding soft tissue, frozen and thawed for further examination. Four groups were formed depending on the implantation procedure. In all four groups, a 3-hole, 4.5 mm narrow locking plate for horses (AISI 316 L, Focus Ortopedia Veterinaria, Indaiatuba, Brazil) was used uncountoured.

The middle and distal screw holes were each filled with a 4.5 mm bicortical locking screw. The proximal screw hole was filled with either a 4.5 mm unicortical cortex screw (group uK), a bicortical Cortex screw (bK) with a 5.0 mm unicortical locking screw (uV) or in the 4th group with a bicortical locking screw (bV). The torque when inserting the locking screws was 4 Nm. Another 5.5 mm cortex screw was placed transarticularly after incision of the collateral ligaments to create the drill hole. The correct position of the implants was checked radiographically. Uniaxial strain gauges (Excel Sensores LTDA, Embu, SP, Brazil) were applied in the longitudinal direction of the plate between the proximal and middle plate holes and 1.5 cm proximal to the distal plate hole. Triaxial strain gauges were applied 2 cm proximal to the plate, dorsal and volar to the pastern bone. The specimens equipped with test strips were clamped into a universal testing machine and subjected to axial compression at a compression speed of 10 mm/min until a load equivalent to twice the body weight of the donor horses during jumping, corresponding to 8700 N, was reached. From the continuous recordings of the measuring strips, the material deviations were recorded according to strength and direction and tension, compression and shear forces were calculated.

Stronger tension forces occurred on the volar surface of the pastern than dorsally, regardless of the screw type in the proximal plate hole. In the area of the plate, the tension forces under different loading levels at the level of the joint were about five times greater than in the proximal area. In group uK, greater changes in the direction of tension forces occurred in the proximal plate area than in the other groups. In group bK, the smallest changes in tension under load generally occurred. Based on literature data and in accordance with the present results, plate ends should rather be connected with bicortical Cortex screws are used. Using a unicortical screw in the proximal plate hole carries the risk of inadequate plate fixation. It was not surprising that the plate was exposed to higher load forces in the area of the joint space. It underlines the advantage of a 3-hole plate over a 4-hole plate, because an unoccupied plate hole above a joint is more likely to lead to material fatigue. The present results are based solely on forces in the axial direction without the influence of adjacent joints and soft tissue structures. The test conditions chosen here most closely resembled postoperative loads.

Overall, clinical cases are more complex and variable, so the present results require further validation. pp

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Histological and chemical view on parotid duct sialolithiasis in the Slovakian warm-blood mare

Korim F, Revajová V, Kolvek F, Buják L, Hreus S, Všianský D (2024)

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The parotid gland is the largest salivary gland in horses. The parotid duct runs along the facial vasorum incisura of the mandible, together with the facial artery and facial vein. It transports saliva from the parotid gland along the cheek into the buccal vestibule, which is opposite the third premolar. Sialolithiasis is a rare disease. It is characterized by a painless, hard, mineralized mass that lies rostral to the facial crest at the level of the third and fourth premolars. Studies have shown that the parotid duct is the salivary duct most commonly affected by salivary stone formation. Salivary stone formations initially occur when there is a foreign body in the salivary duct. This foreign body triggers an inflammatory reaction, which causes calcium salts (calcium carbonate/calcium phosphate) to accumulate around the foreign body. However, the exact etiology of salivary stone formation is not fully known. In this case report, we describe the first confirmed case of sialolithiasis in Slovakia. A 14-year-old Slovak warm-blood mare was presented with a hard, solid, subcutaneous, egg-sized mass on the right cheek. The horse was not in pain and was not affected by the mass when eating or riding. Oral cavity examination revealed no abnormal findings. According to the owner, the mass had been growing for approximately 6 years. It was decided to perform surgical transcutaneous excision of the mass in a standing, sedated patient. The mare received a venous catheter and was sedated with detomidine and butorphanol. Anesthesia was maintained with a detomidine/butorphanol continuous drip infusion.

The mass was percutaneously injected with 2% lidocaine. The region of the right maxilla was aseptically prepared. An incision was made in the skin and subcutaneous tissue over the mass. An oval capsule was then exposed. With great effort, it was possible to avoid damaging the facial artery and vein, which run with the parotid duct. The mass was gently removed and the duct was catheterized with a canine urinary catheter and flushed with saline solution to remove all salivary stones and tissue debris. The duct was then ligated with a Cushing suture, and the subcutaneous tissue and skin were closed. Postoperatively, the mare received antibiotics (twice daily trimethoprim sulfadiazine) and anti-inflammatory drugs (twice daily phenylbutazone) for 5 days each. No complications occurred. At the follow-up examination on day 10 postoperatively, the skin sutures were removed. The owner reported 6 months after surgery that the mare had no clinical problems. The mare's saliva production was physiological and she had no problems swallowing. Pathological-anatomical and histological examination confirmed that the lesion was a dilatation of the parotid duct caused by a stone. The mineral compo-

ment of the sialolith was investigated using atomic absorption spectroscopy using X-ray powder diffraction. The data were evaluated using Panalytic High Score Plus software. The analysis showed that the only component of the stone was calcium carbonate (CaCO₃).

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Treatment of a urethral stricture by image-guided placement of a custom-made absorbable stent in a standing, sedated horse

Baltrimaite M, Kearny C, O'Brien A, Duggan M, Benoit C (2024)
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Urethral stricture is characterised by dysuria, stranguria and tenesmus, pollakiuria, urinary dribbling and penile prolapse. Numerous treatment options have been described in dogs and cats, such as balloon dilatation, insertion of a urethral stent, focal urethral resection with anastomosis, urethrostomy or insertion of a prepubic indwelling catheter. In horses, this usually results in a perineal urethrostomy. In one case, an absorbable urethral stent was inserted in a stallion under general anaesthesia. This article describes such a stent insertion in a standing sedated horse under sonographic and endoscopic control. The horse was a 10-year-old Irish sport horse gelding with a body weight of 720 kg. The gelding developed postanesthetic myopathy neuropathy syndrome (PAMNS) following bilateral arthroscopy of the tibiotarsal joint with subsequent support in a hoist and repeated catheterisation of the urinary bladder over 48 hours. The gelding recovered well, but 10 weeks later he presented with pollakiuria. Urinalysis revealed leucocyturia, haematuria, bacteriuria and the growth of *Sc. zooepidemicus* in high numbers. Urethrocystoscopy revealed a sand-like deposit in the bladder. The bladder was flushed and the gelding was given a trimethoprim-sulfonamide combination plus phenylbutazone for 5 days. This treatment was repeated over the next two years due to recurrent dysuria, until 29 months after the arthroscopy a re-endoscopy revealed a 10 cm long urethral stricture starting 30 cm proximally from the ostium urethrae externum.

Endoscopic and transcutaneous sonographic measurements revealed a stricture length of 10 cm and a stricture diameter of 6.5 mm at the narrowest point. Over the next 5 months, the stricture was ballooned a total of eight times under standing sedation with azepromazine, detomidine and morphine. A balloon catheter with an 8 cm long and 2 cm wide balloon was used for this, which was inserted into the stricture parallel to the endoscope, a 5 mm video gastroscope. After application of a splash block with 20 ml lidocaine and 20 ml dexamethasone, removal of the endoscope and transcutaneous sonographic position control, the balloon was filled with water to 4.1 bar for 60 seconds. The effect of the balloon dilatation was short-lived. Therefore, the stricture was measured again endoscopically and sonographically in standing sedation with maximum dilatation of the stricture with the aid of a fluid pump and the production of a corresponding stent made of polydioxanone was ordered with the dimensions of 120 mm length and 20 mm diameter (Infiniti Medical, USA). One week before stent placement, the gelding was given

prednisolone 1 mg/kg daily. During this time, three further high-pressure balloon dilatations were also performed (X-Force U30 Ureteroscopic Balloon Dilatation Catheter, BD, USA). Stent placement was performed under standing sedation under epidural anaesthesia, under a pudendal block and after transurethral instillation of 20 ml lidocaine. The stent carrier catheter was inserted parallel to the endoscope and the stent was ejected under endoscopic view. Sonography revealed a fully deployed stent with an average diameter of around 20 mm. Postoperatively, the gelding received a Tetracycline preparation for 4 days and further prednisolone in full dose for 5 days in order to subsequently taper it off.

Initially, the gelding was able to pass urine without any problems. Two weeks later, slight signs of colic and haematuria appeared. Control endoscopy revealed that the stent was embedded in the mucosa, partially surrounded by hypertrophic haemorrhagic mucosa. The prednisolone dose was increased again for 7 days, then reduced for 1 week. In the next control endoscopy 4 weeks after stent placement, the stent was partially overgrown by the mucosa, which also narrowed the urethral lumen at the stent ends. Stenosing areas were injected transendoscopically with triamcinolone. In the last control endoscopy 6 months after stent placement, the stent was completely resorbed and the mucosa had a regular smooth surface. The narrowest point had a diameter of 12 mm. Urine output was unremarkable. The gelding had regained his previous level of performance. This was still the case 1.5 years after the operation. In the present case, repeated catheterisation of the urinary bladder with injury to the urethral mucosa is assumed to be the cause of the urethral stricture. The risk factors for the development of a sabulous cystitis or sedimentary cystitis with secondary bacterial infection are incomplete bladder emptying, which can be neurogenic or obstructive. After removal of the obstruction by the stent, urination normalised and the sedimentary cystitis healed. Stenting is recommended in the early stages of urethral stricture, as it must be expected that ballooning will only improve urine output for a short time. With a PAMNS and a body weight of over 700 kg, an approach in a standing sedated horse was considered to be less risky than under general anaesthesia, or even feasible in the first place using the chosen method. Whether the local triamcinolone injections contributed to the success of the treatment remains an open question. pp

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Antinociceptive and wound healing effects of a commercial formulation of lidocaine, bupivacaine, adrenaline and cetrimide applied topically to superficial skin wounds in horses

Pratt S, Sole-Guitart A, de Klerk K, Evans E, Hume J, Palmieri C, Rainger J, Goodwin W (2024)
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The treatment of wounds on the distal limbs of horses is particularly challenging. These wounds are often painful and slow to heal, which can lead to prolonged discomfort and reduced performance. A recent study investigated the effect of the commer-

cial formulation Tri-Solfen, containing lidocaine, bupivacaine, adrenaline and cetrimide (LBAC), on pain reduction and wound healing in horses. Until now, little was known about the effects of tri-solfen on wound healing in horses, although it is already used as a post-operative analgesic in other animals. The study was conducted with ten healthy horses (nine geldings and one mare) as part of a randomised, controlled trial. The horses were treated under aseptic conditions with symmetrical, superficial wounds measuring 20x20 mm on both front legs. On one leg the wound was treated with LBAC, on the other leg a saline solution served as a control treatment. The wounds were treated daily with the respective solutions for seven days. After the initial observation over seven days, the healing process was documented for a total of 25 days. The antinociceptive, i.e. pain-relieving, effect of LBAC was measured using the mechanical threshold test (MT), an established method for recording pain sensitivity. The pressure required to trigger a recognisable reaction in the horse, such as lifting or retracting the leg, was determined.

The mechanical pressure tests used in the study to measure pain relief are considered sensitive and repeatable for non-invasive pain testing in animals. The research design also minimised the risk of learning expectancy of the horses as the test procedures and the sequence of legs tested were varied. To study wound healing, digital images were taken and wound sizes were measured using image analysis software. This allowed the researchers to precisely and objectively quantify wound size over the entire healing period. The results showed that LBAC treatment significantly increased the pain threshold on the first day after wound initiation - the average pressure strength that elicited a response increased by approximately 3 Newtons. However, this effect was short-lived, as the pain relief decreased significantly after the first day and was no longer significant on the following days. This suggests that LBAC provides temporary pain relief that may be beneficial for the first post-traumatic day, but does not provide long-term analgesia in this application. The researchers also investigated whether the topical application of LBAC had an effect on wound healing. The observations showed that LBAC application did not impair the healing process of the wounds. The size of the wounds decreased over time in both the LBAC and saline groups, with no significant differences in terms of healing rate.

This was also evident in the histopathological examination of the wounds on day 25, which showed no negative effects on the collagen structure or the amount of granulation tissue. Both LBAC and saline treatment resulted in healthy wound healing and neither group showed an increased incidence of exuberant granulation tissue (EGT). The application of LBAC therefore appears to be a promising, non-intrusive method to achieve initial pain relief in acute superficial wounds without adversely affecting healing. However, the conditions of the study were strictly controlled; the wounds were created and maintained sterile, minimising external influences and contamination. It remains to be seen what effect the treatment would have on naturally occurring, contaminated wounds, as these are often present in horses in practice. The study also showed that the horses did not develop any wound complications due to the sterile conditions. However, in clinical practice, especially in open and contaminated wounds, the healing process can be significantly different, which could potentially vary the influence of LBAC on wound healing. aa

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Histo-morphological effects on equine synovium after arthroscopic synovectomy using two different motorised synovial resectors

Troillet A, Hildebrand J, Stoffel M H, Schwabe S, Winter K, Brehm W (2024)

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Synovectomy means the complete removal of the inner synovial tissue, the intima synovialis and the lamina propria synovialis of the joint capsule. The procedure is performed as part of arthroscopic examinations to improve visual acuity in the joint in the case of highly inflammatory changes. The aim of the synovectomy is to remove chronically inflamed or infected synovial tissue. Various methods of mechanical synovectomy have already been described for the horse. It can be performed with motorised synovial resectors, with a laser or by means of radiation. The long-term consequences of synovectomy have not yet been reliably investigated. It is known that the synovial parameters do not change significantly and that the regenerative abilities of the synovium are incomplete. Studies have shown that the villi have not regenerated after 30 and 120 days. The subintimal layer thickens and shows fibroblastic remodelling. The consequences of this structural remodelling of the joint capsule remain unclear. The depth to which parts of the synovium are removed depends on the surgeon's individual experience. To date, there are no guidelines as to which motorised resector should be used to achieve the desired effect. In the present study, the influence of two different motorised synovial resectors on the morphology of the villous surface of the synovium was examined.

Furthermore, the reliability of a single rotation was to be compared with that of a triple rotation along the synovium with a motorised resector type. It was hypothesised that the postoperative morphology of the synovium would indicate the type of resector and that the triple movement would leave a typical morphological pattern. The study material came from horses killed at the abattoir, from which 33 fetlock joints were removed for the test series. For this purpose, the limbs were cut off at the carpal/tarsal joint and stored at room temperature. Within the following 12 hours, the test series of the resectors was performed on the limbs clamped in a fixture. The fetlock joints were prepared for arthroscopy as standard and the arthroscope was inserted via the dorso-medial or dorso-lateral approach. Two different resectors were used: the 4.2 millimetre „high speed aggressive full radius resector“ (AFRR) and the 4.2 millimetre „high speed aggressive meniscus side cutter“ (AMSC). All synovectomies were performed by the same surgeon in the same manner. Both resectors were tested at different intensities (single or triple treatment).

The arthroscopic images were analysed in a blinded fashion. The histological images were used to analyse the morphology and determine the degree of tissue loss. In addition, the synovial morphology was analysed using an electron microscope. On the postoperative arthroscopy images, the treated regions were clearly defined by the loss of the synovial villi. The use of the AFRR resector allowed a clear demarcation between treated and untreated regions after a single application. The single application of the AMSC resector enabled the differentiation, but the villous structure was preserved. All arthroscopy images could be assigned to the correct resection sector postoperatively based on the morphological structure. The second hypothesis, that the intensity of the synovectomy (single or triple movement) can be determi-

ned from the postoperative images, was not confirmed. Tissue loss due to synovectomy can only be determined using histological images; the arthroscopic images were not suitable for this purpose. sl

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Computed tomographic imaging and surgical management of distal insertional avulsion fragments of the caudal cruciate ligament in horses

Bolz NM, Ehrle A, Mählmann K, Lischer CJ (2023)

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The caudal cruciate ligament of the horse originates medially in the intercondylar fossa of the femur and runs in a caudodistal direction to the insertion in the intercondylar area and the popliteal notch of the tibia. The central position of the ligament makes sonographic imaging difficult. For this reason, various computed tomography studies and computed tomography arthrography (CT-arthrography) describe diseases of the posterior cruciate ligament. The overstretching of the ligament presents itself in the form of a significant increase in size and weaker contrast, in arthrography with the deposition of contrast medium. To date, there are only two case reports of avulsion fractures of the tibial plateau. In the past, the connection between the avulsion fragments and the involvement of the caudal cruciate ligament could only be demonstrated in the autopsy. With CT arthrography, this can be demonstrated in the living animal. The intracapsular position of the caudal cruciate ligament in the medial femorotibial joint allows arthroscopic assessment via the caudomedial arthroscopic approach. The proportion of lesions of the caudal cruciate ligament diagnosed arthroscopically is lower than the proportion diagnosed by CT, which is probably due to the limited visualization of the middle and distal parts of the ligament. A better visualization of the caudal cruciate ligament body and the insertion is possible with a cranial intercondylar approach.

The aim of the present case study was to describe clinical cases with avulsion fractures of the caudal cruciate ligament based on the results of CT-examinations. In addition, the feasibility of arthroscopic fragment removal was to be examined. The inclusion criterion for the study was that at least one radiopaque isolated fragment had to be present on the tibial plateau. Patients 1-3 underwent a supine CT scan before the arthroscopic examination. The fourth patient had a CT scan before admission to hospital. In the soft tissue window, it was possible to follow the course of the posterior cruciate ligament from axio-medial on the femur to disto-proximal. In horse number 3, there was an isolated large fragment on the tibial plateau, the other horses had several small fragments distal and proximal to the large fragment. In horses 2 and 4, the intra-articular localization of the proximal fragment could be confirmed by contrast arthrography. For arthrography, iodinated, diluted contrast medium with a volume of 60 to 80 milliliters was injected into each part of the knee joint. Enlargement of the caudal cruciate ligament with heterogeneous structure or centrally reduced density was observed in all patients.

The surgical procedure was performed under general anesthesia in the supine position with the knee joint flexed to approximately 90°. The caudal part of the medial femorotibial joint and the attachment of the caudal cruciate ligaments to the tibia were assessed. The removal of the avulsion fragment was attempted in three horses via the cranial intercondylar approach. In one horse, the fragment was not accessible via the caudomedial approach. In three horses, the fragment was completely removed via the cranial intercondylar approach; in the last horse, only two-thirds of the fragment could be removed via this approach. During the operation, this horse experienced profuse arterial bleeding, which led to significant postoperative swelling. Accompanying findings in the knee joints were cartilage defects of the medial femoral condyle, lesions of the cranial cruciate ligaments, and medial collateral ligament injuries. The horses were followed up for up to 16 months. At this point, all horses were already back to normal work. The cranial intercondylar approach can provide access to avulsion fragments of the caudal cruciate ligament. However, complications can arise and in some cases the fragment can only be partially resected. sl

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Multimodal imaging and surgical repair of a dorsal-oblique plane, proximal third metacarpal fracture and the diagnostic challenge of radiographic visualization

Fletcher O, Osborne C, Dixon J (2024)

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The present case report concerned a 10-year-old Connemara mare with a known lameness in the right front leg for 8 weeks. The lameness was originally caused by a hunting accident in which the affected limb had become trapped in a hole in the ground in a backward position, causing the carpus to overextend until it fell. The degree of lameness was 3/5, and the lameness was particularly evident on soft ground when lunging on the right hand. The carpal flexion test was positive. Anesthesia of the lateral palmar nerve resulted in a 50% improvement in lameness. At a subsequent examination, joint anesthesia of the middle carpal joint was positive. X-ray examinations of the carpus in 2 planes showed increased bone density in the proximomedial cannon bone. Ultrasound revealed nonspecific heterogeneity in the origin of the suspensory ligament. A conservative treatment approach with intra-articular injection of 10 mg triamcinolone into the middle carpal joint was initiated, followed by 1 week of box rest and subsequent walking exercise in hand with the opportunity to exercise in a small paddock.

Three weeks later, the lameness was more pronounced on the right hand when lunging on hard ground, although the degree of lameness remained unchanged. Sonography showed synovial proliferation in an increasingly filled palmar recess of the middle carpal joint. For further diagnostics, a CT scan of the right carpus was performed under general anesthesia in the right lateral position. This revealed an incomplete, mono-articular fracture in the medial epiphysis and the medial cortex of the diaphysis, extending from the proximomedial articular surface of the cannon bone and running palmaromedially to dorsoaxially. The length of the fracture line was 22 mm. It was surrounded by bony compac-

tion. The proximomedial cortex of the cannon bone was focally roughened. Mild signs of arthrosis were found in the middle carpal joint. This was followed by osteosynthetic treatment under the same anesthesia after applying metal skin staples as orientation points, after administering penicillin, gentamicin and flunixin and after repositioning the patient in the supine position. An 8 mm wide skin incision was made over a metal staple indicating the bony entry point of the drill channel and the fracture was treated with a 36 mm long 3.5 mm cortical lag screw. The length of the gliding hole had been determined in advance using the CT. Before the screw was tightened, its position was checked radiologically. The skin access was closed with Monocryl 3-0.

After bending the front leg to 70 degrees, an arthroscopy of the middle carpal joint was performed using a standardized dorsolateral approach. Only small notches were found in the cartilage of the ossa carpalia intermedium and III. Finally, 30 mg of morphine was injected intra-articularly, the arthroscopic access was sutured and a double-layer bandage was applied. The perioperative medication was continued for 3 days until the mare was given phenylbutazone to rest at home in a box for 6 days. After 2 weeks of box rest, she walked in hand for 5 weeks and was allowed to exercise in the paddock for 5 weeks. The subsequent X-ray follow-up showed that the screw position *in situ* had not changed. The mare was now lame on the left front leg on hard ground and a deep palmar anesthesia was positive. The mare was shod and slowly worked under the rider. Another 20 weeks later, the horse was walking at its previous level of performance without lameness.

Fractures in the proximal cannon bone are very rarely reported in horses, possibly because they are covered by the medial head of the splint bone on X-rays and are rarely recognized. Arthroscopy was also not conclusive in this case. Suspicion could arise from the bony densities in the proximomedial cannon bone that were noticed on X-rays, although in this case it is assumed that these were not already present before the fracture. Differential diagnosis would include enthesopathy of the suspensory ligament origin, which, like the image of the fracture, could only be clarified morphologically by CT. In this case, the screw fixation was carried out with the intention of suppressing callus formation as far as possible, as can be observed after conservative treatment of proximal cannon bone fractures. Standing up after anesthesia should be as controlled as possible and assisted so that the fracture gap does not expand. The use of a single screw proved sufficient in this case. In atypical cases of lameness, the indication for a CT scan should be made early.

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Surgical treatment of cervical (C7-T1) instability caused by discospondylitis in a horse

Santos MM, Martinez J, Mollenhauer L, Schulze-Gronover B, Lescun TB, Gudehus HT (2023)

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Diskospondylitis, which rarely occurs in horses, is an inflammatory process of an intervertebral disc involving neighboring vertebrae. Diskospondylitis is often caused by an infectious process, whether through hematogenous bacterial colonization, spread

ing local infections, penetrating injuries, or as a complication of a surgical procedure. Bacterial pathogens include streptococci, staphylococci, *Rhodococcus equi*, and *Brucella abortus*. Traumatic causes can also be mentioned. The clinical picture of discospondylitis is characterized by painful stiff neck, sometimes in conjunction with foreleg lameness or ataxia. Further diagnostics are based on imaging of the spine. Treatment is based on the administration of non-steroidal anti-inflammatory drugs and systemic broad-spectrum antibiotics for 2-3 months. If treatment is unsuccessful, if there are signs of spinal cord compression or if neurological deficits are progressive, surgical treatment is indicated. While hemilaminectomies, curettage and vertebral fusions have been described in detail in dogs, there is only one report of a cervical vertebral fusion in a dressage horse. The present report describes another case of discospondylitis with vertebral fusion C7-T1 using LCP and transvertebral screw fixation.

The case was a 3-year-old Quarter Horse gelding with a month-long history of stiffness and reluctance to move, similar to that of laminitis. The gelding was very slim. He showed no head nerve deficits or proprioceptive deficits, but had difficulty lowering his neck to the ground. Hematological examination revealed mild anemia. Serum amyloid A was within the reference range, and the test result for equine protozoal myeloencephalitis was negative. A CT scan with myelogram was performed because cervical compression of the spinal cord was suspected. General anesthesia was used with ketamine, midazolam, and triple drip (guaifenesin, ketamine, xylazine). The examination was carried out in the supine position with the head and neck hyperextended and the forelimbs bound caudally in a 16-row Qalibra CT with a gantry opening of 90 cm. The left articular processes at C3-C4, C4-C5 and C5-C6 were slightly expanded and slightly narrowed the intervertebral foramina. The intervertebral space C7-T1 was almost completely collapsed with moderate sclerosis of the end plates involved and small lytic regions. In addition, periosteal reactions were found on the ventral edge of the vertebral bodies involved. The myelogram showed slight flattening of the spinal cord at C5-6 and mild to moderate compression over the intervertebral disc space C7-T1. This led to the diagnosis of discospondylitis C7-T1 with secondary instability of the intervertebral disc space and slight narrowing of the left foramen at C4-5.

After initial administration of phenylbutazone for 3 days, the gelding was no longer so stiff in his movements. With serum amyloid A repeatedly normal, a ventral vertebral body fusion C7-T1 was to be attempted. For the procedure, the gelding received penicillin, gentamicin and was placed in a supine position with the head and neck stretched under general anesthesia with xylazine, ketamine, midazolam, isoflurane and a dopamine drip to stabilize blood pressure. The sternohyoid and sternothyroid muscles were bluntly separated via a 20cm long skin incision in the ventral median, the trachea was moved to the left and the right external jugular vein, carotid artery and vagus nerve to the right. Further blunt dissection and incision of the longus colli muscle led to the ventral surface of C7-T1. After flattening the ventral surface of C7 using an osteotome, the intervertebral space C7-T1 was accessible for debridement of disc material using a spoon curette and rongeur. Then two 5.5 mm cortex lag screws were screwed from C7 through the intervertebral space into T1 and both vertebral bodies were fused ventrally with a 4-hole LCP. For this purpose, a 5.0 mm locking screw and a 4.5 mm cortical screw were inserted into C7. Both T1 holes were filled with locking screws. The soft tissues were closed routinely, a pressure bandage

was applied and the gelding was supported in getting up from the awakening phase. Preoperative antibiotics and phenylbutazone were continued for 3 days and supplemented with gabapentin (17 mg/kg twice daily) for 21 days and prednisolone (1 mg/kg) twice daily for 5 days. The gelding was able to be discharged into his stable at home on the fourth postoperative day with a significantly improved general condition and a Horner syndrome. Almost three weeks after the operation, the surgical wound had healed without any external irritation. The X-ray showed that the position of the implants had not changed. This was also true for the follow-up X-ray four months after the operation. The gelding was free in his movements with an almost unrestricted range of motion of the neck. There were only minor residual symptoms of Horner syndrome in the form of ptosis and enophthalmos.

In the present case, the authors assume that trauma is a possible cause of the discospondylitis, since there was no previous systemic disease, nor were there any indications in the blood test of a systemic infection as a possible cause of hematogenous colonization of the intervertebral disc. Typical radiological findings of discospondylitis are signs of destruction of the end plates, sclerosis, changes in the size of the intervertebral space, ventral bony growths on the vertebral bodies and occasionally subluxations. CT scans are more informative in this regard than conventional X-rays, also in differentiating osteomyelitis from discospondylitis and in spinal cord compression. Conservative treatment attempts with non-steroidal anti-inflammatory drugs and antibiotics have been unsuccessful in the few cases described so far. The present case also shows that long-term antibiotics are not always necessary. Previous procedures for vertebral body fusion involved the insertion of metal baskets (kerf-cut cylinders) or pedicle screws. This report describes the use of an LCP for the fusion of C7-T1 for the first time. Access to these vertebral bodies is spatially restricted by the sternum and first rib and offers little opportunity for angulation of instruments in the depth of the soft tissue mantle intraoperatively, which supports the selection of the implant material chosen in this case. The two transvertebral screws were inserted because the relatively short vertebral bodies of C7 and T1 only allow for a 4-hole LCP. The rapid improvement in clinical symptoms after the procedure suggests that the complaints were mainly due to the instability of the spine in the operated area. The postoperative Horner syndrome is probably due to damage to the vagosympathetic trunk as a result of temporary retraction from the surgical field. pp

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Neurologic deficits and surgical treatment in a horse affected with internal carotid artery tortuous elongation

Rijkenhuizen ABM, Kaske F, Rikart J, Racine J, Engerand C (2023)
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Neurogenic dysphagia in horses is often associated with mycosis of the air sac due to damage to the pharyngeal branches of the glossopharyngeal and vagus nerves. Due to the anatomical proximity, there is a possibility that an arterial tortuous aneurysm can also cause deficits in the cranial nerves if the internal carotid artery (ICA) is bound around the neural structures and exerts pressure on them. This case report describes the clinical symp-

toms, diagnosis and treatment of compression of the cranial nerves due to a tortuous aneurysm of the ICA in a two-year-old warmblood. Before admission to the clinic, the gelding had shown bilateral nasal discharge with food since the age of six months, accompanied by dysphagia, coughing and impaired physical development. On examination in the clinic, the animal had a BCS of 3 out of 5. The gelding showed nasal discharge with food components. The neurological examination of the cranial nerves was unremarkable, as were the results of the blood tests. After feeding, the animal showed dysphagia and nasal discharge with food components was increased. Under sedation, an endoscopy of the upper and lower respiratory tract, the air sac and the esophagus was performed. Mucus with food particles was found in the nasal passage, the nasopharyngeal region and the proximal trachea. The swallowing reflex was unremarkable, as were the esophagus and the right air sac.

However, a dilated (aneurysm), pulsating, curved and elongated ICA was observed in the left air sac. CT scan performed in the standing position showed that in the dorsal region of the middle compartment of the left air sac, the ICA rotated counterclockwise and formed a small loop with a diameter of 1 cm. This loop had a weak linear soft tissue connection to the caudodorsal wall of the air sac and was slightly larger in diameter compared to the right ICA. A malformation of the left ICA was diagnosed, which was most likely congenital. Secondary pressure and neuropathy of one or more nerves of the associated lower cranial nerves in the neurovascular fold (IX, X) was suspected, which could explain the clinical signs of dysphagia. The slightly larger diameter of the left ICA could represent congestion of the vessel or early aneurysm formation. Based on these findings, endovascular balloon occlusion of the left ICA was performed to relieve pressure on the affected nerves. The procedure was performed under general anesthesia in the right lateral position with the head extended and a roll placed under the parotid region. The proximal portion of the left air sac was bluntly opened and the origin of the ICA was ligated. The arteriotomy was performed distal to the literature and an 80 cm 6 French vein thrombectomy catheter was inserted. This was advanced rostrally and under endoscopic control the ICA was occluded by placing the balloon distal to the tortuous region. The balloon was filled with 2 ml of saline and the free end of the catheter was left subcutaneous. In the last step, a subcutaneous suture and a skin suture were performed.

Medical follow-up care included the administration of antibiotics for 16 days, flunixin for 4 days, and omeprazole for 16 days. The first food was offered 20 hours after the operation. Postoperative bleeding caused swelling in the area of the parotid gland. The air sacs showed no abnormalities endoscopically, with the exception of ventral medial and lateral swelling corresponding to the hematoma cranial to the incision site. This swelling reduced daily. A check-up seven days after the procedure showed complete occlusion of the ICA. The rest of the postoperative course was unremarkable. Two weeks after the procedure, the animal was sedated again and local anesthesia was administered in the area of the incision. The catheter was pulled through a 3 cm incision with gentle traction. The balloon was no longer inflated at this time. Three weeks after the procedure, nasal discharge with food particles was still visible. Seven weeks after the operation, mucous nasal discharge was still present, but without food particles. The dysphagia was no longer evident. ag

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Effects of a 10% dimethyl sulfoxide solution on radiocarpal joint amikacin pharmacokinetics during intravenous regional limb perfusion in standing sedated horses

Kilcoyne I, Nieto J, Magdesian KG, Nottle BF (2023)

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A lack of soft tissue mantle often leads to involvement of osseous or synovial structures in the case of injuries to distal limb sections. In the case of infected limb wounds, intravenous regional perfusion (IVRP) of affected limbs is an established measure for the application of high therapeutic levels of antibiotics in the wound area. Aminoglycosides are the most commonly used antibiotics. Their effect depends on the concentration. The higher the maximum active ingredient concentration in relation to the minimum inhibitor concentration, the more effective the therapy. In addition to the antibiotic selected, IVRP depends on the type of tourniquet (pneumatic versus rubber), the width of the tourniquet, the ischemia time, any previous blood loss and the perfusion volume. In the present experimental study, the maximum concentration of amikacin in the target area was to be increased by adding DMSO as a carrier substance. The experiments were carried out on seven non-lame adult geldings with a body weight of 486-599 kg. To prepare the DMSO perfusate, 6 ml of medically pure DMSO (FWI, Tulsa, Oklahoma) and 2 g of amikacin were added to physiological saline ad 60 ml. After sedation of the horses with detomidine/butorphanol in the examination position and after conduction anesthesia of the median, ulnar and cutaneus antebrachii medialis, a 10 cm wide rubber tourniquet was applied 10 cm proximal to the os carpi accessory.

The perfusate was administered intravenously in crossover with or without DMSO over a three-minute injection period via a sterile puncture of the cephalic vein. Joint punctures with removal of 0.5 ml of synovial fluid were performed 6 times, each at 5-minute intervals. The tourniquet was removed after the last joint puncture. In parallel to the joint punctures, blood samples were also taken in heparin tubes, all samples were centrifuged and the plasma supernatant was frozen until further analysis. A fluorescence polarization immunoassay with a measuring range of 0.8-40 g/ml was used to determine the amikacin levels. According to the Clinical and Laboratory Standards Institute, the minimum inhibitor concentration of sensitive bacteria is 4 g/ml, and the intermediately sensitive is 8 g/ml. Tissue levels ten times higher are considered therapeutic. The maximum inhibitor concentration C_{max} and the time to reach the same T_{max} were read from the mean curves of the serial sample results. One of the 7 horses developed a carpal phlegmon 2 days after IVRP, which was manageable with bandaging, diclofenac ointment and flunixin orally for 3 days. In all cases, amikacin could be detected in the blood samples and thus in the systemic circulation during tourniquet ischemia. With the addition of DMSO, the average C_{max} was 1360 g/mL, without DMSO it was an average of 860 g/mL. The difference was not significant. The maximum concentration was reached on average after 23 minutes with DMSO, without DMSO after 18 minutes.

The difference was also not significant. In 4 cases, the maximum concentration was only reached after 30 minutes. The tourniquet should be left in place for at least 18-23 minutes until the maximum concentration is reached. The usual practice is 30 minutes, which seems reasonable, since in individual cases in this study,

maximum concentrations were only reached after 30 minutes without any obvious reason. In addition, the test protocol did not allow for subsequent measurements. The only conclusion that can be drawn from this study is that DMSO as a carrier substance did not have a negative effect on the intra-articular synovia levels of amikacin and that only studies on larger study populations could possibly attribute an effective carrier effect to DMSO. The data on the anti-inflammatory effect of DMSO, which could be used for regional application, is also limited. An anti-inflammatory effect of DMSO was indicated in at least two studies in the treatment of phytiosis using IVRP in horses. In one of the two studies, amphotericin B was used. This resulted in an inflammatory reaction at the venous puncture site and painful limb edema. In a second study, these complications did not occur when DMSO was added to the perfusate. pp

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Long-term outcome of autologous fascia lata grafting with conjunctival flap overlay in horses with ulcerative keratitis and keratomalacia

Hoerdemann M, Yarbrough T (2023)

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While superficial, non-infected corneal ulcers usually heal without complications, the development of keratomalacia can lead to stromal destruction and corneal perforation. If keratomalacia cannot be controlled medically and the ulcer reaches a critical depth (over 50%-75%), surgical intervention is required. Different biomaterials are used for this purpose. Inflammation, corneal neovascularization and protease activity can lead to transplant failure regardless of the biomaterial used. In human medicine, autologous fresh and preserved fascia lata is also used in ophthalmological procedures. This retrospective case series describes the technique, complications and short- and long-term results of a surgical technique using fascia lata in combination with a conjunctival flap to cover a corneal ulcer with keratomalacia. During the period 2008-2020, eleven horses (median age 7 years) with ulcerative keratitis and keratomalacia were treated using the above-mentioned surgical technique. The procedure was used when the depth of the corneal lesion affected more than 75% of the cornea and/or corneal perforation and iris prolapse were already present. A subpalpebral lavage system (SPL) was placed before the procedure. All horses were treated topically with antifungal (voriconazole 1%, itraconazole 1% in 30% DMSO or natamycin 5%) and antimicrobial (ofloxacin 0.3% + neomycin-polymyxin B-gramicidin 0.175%-10,000 IU - 0.003% or oxacin and chloramphenicol 1%) medication every 2 hours, according to the results of cytological examination or bacterial culture or based on empirical data.

Collagenase inhibitors, including autologous serum or EDTA, and atropine were also administered. Horses were given systemic doxycycline (10 mg/kg orally every 12 hours) and flunixin preoperatively, and in some cases with suspected fungal infection, itraconazole (6 mg/kg orally). Surgery was performed under general anesthesia. The adnexa were aseptically prepared with povidone iodine (diluted 1:50 with 0.9% sterile saline). The conjunctival and corneal regions were irrigated with 0.9% sterile saline or the above iodine solution if there was no perforation.

The lateral region of the thigh was also aseptically prepared. Two surgeons worked simultaneously, one of whom removed the fascia lata graft and a second prepared the cornea. To harvest the fascia, a 5-7 cm skin incision was first made and the skin, subcutaneous tissue and fatty tissue were bluntly undermined to expose the fascia. The size and shape of the transplant to be harvested depended on the size and shape of the corneal lesion. This was followed by a sharp incision and undermining with Metzenbaum scissors. Until the transplant was used, it was stored between two swabs soaked with blood. At the same time, the cornea was prepared by removing infected and altered tissue. If the anterior chamber was opened, iris tissue was removed if necessary and a discoelastoc medication was introduced into the anterior chamber.

The graft was designed to extend 1 to 2 mm beyond the corneal defect, and the graft was secured with single staples of 6-0 (8 mm 1/4 c spatula needle) or 8-0 (6.5 mm 3/8 c spatula needle) Polyglactin 910. In the next step, the conjunctival flap, which was 2 mm larger than the graft, was secured with single staples of the same material. In most cases, a temporary tarsorrhaphy was used. Postoperatively, the eyes were protected with a mask, and clinical examination was performed twice daily. Drug therapy, both topical and systemic, was continued in all cases for at least 10 days. Systemic flunixin was adjusted in some cases according to ocular pain and laboratory data for total protein and azotemia. Corneal perforation was already present in 4 of the 11 cases. Postoperative complications included complete (1/11) or partial (2/11) dehiscence of the conjunctival flap and fascia lata graft, postoperative pneumonia (1/11), intermittent hypercreatinemia (2/11), and minor uveitis after trimming the conjunctival flap (9/10). Donor sites healed without complications. A satisfactory short-term outcome (at cessation of medical therapy) was achieved in all horses (11/11). Long-term follow-up (median 29 months, range 7–127 months) was available for 10/11 horses. A pain-free eye with functional vision was achieved in 9/10 horses. This included 3/4 horses with previous corneal perforation and 1/11 horse in which the fascia lata graft had completely detached 15 days after surgery. Enucleation was required in one horse (1/10) after phthisis bulbi developed seven months after surgery. ag

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Evaluation of cartilage injury in horses with osteochondral fragments in the metacarpal/metatarsophalangeal joint: a study on 823 arthroscopies

Goldkuhl JEC, Zablotzki Y, Sill V, Jahn W, Lorenz I, Brunk J, Gerlach K, Troillet A (2023)

Equine Vet J | <https://doi.org/10.1111/evj.13937>

Osteochondral fragments are often found in the pastern joints during purchase examinations or in routine lameness diagnostics. Depending on their location, they can arise traumatically or as part of endochondral ossification. Osteochondral fragments on the sagittal crest of the cannon bone usually have their origin in a disturbance of endochondral ossification. These lesions often involve the condyles of the cannon bone. Fragments of the dorsal pastern bone are often found in racehorses. These have a

traumatic genesis and are often located medial to the sagittal crest. Palmar or plantar osteochondral fragments are located intraarticularly and have their origin on the proximal pastern bone medial or lateral to the sagittal groove. These fragments are often associated with pathologies of the short sesamoid ligaments and also have a traumatic cause. Unconnected fragments of the palmar/plantar tuberosity of the pastern are more frequently diagnosed as incidental findings. However, they do not represent an indication for surgical intervention per se.

Osteochondral fragments should be surgically removed if clinical symptoms such as lameness and joint fillings occur. The prognosis depends on the location, the cartilage damage and the accompanying arthroscopic findings. In warmbloods, the presence of multiple fragments in combination with an age of more than seven years was associated with lameness. Cartilage defects and severe synovitis are common in this age group. There are conflicting opinions regarding the prophylactic removal of fragments in healthy horses. In addition, information is lacking on the relationship between fragment size, location and cartilage damage. The aim of the present study was to determine the prevalence of cartilage lesions in the fetlock joints with fragments. Furthermore, the influence of fragment size, location, age and clinical symptoms should be taken into account. It was hypothesized that dorsally located fragments cause more clinical symptoms and lead to more arthroscopically diagnosed findings than palmar/plantar fragments. Furthermore, it was assumed that fragments larger than >5 millimeters would lead to significant synovitis or cartilage lesions. Another assumption was that older horses have more frequent cartilage lesions than younger horses.

The material of the retrospective analysis included the clinical findings and X-ray images of 823 fetlock joints from a total of 640 horses from which fragments had been removed arthroscopically. In addition to the size and location, the focus was on potentially existing accompanying cartilage damage. Cytological examination was carried out in 157 fetlock joints for the presence of potential synovitis. All examination parameters were statistically evaluated. Of the 823 fetlock joints examined arthroscopically, cartilage damage was present in 237. Lameness was not associated with the size of the fragments or with the location. The fragment size also had no influence on cartilage lesions in the joint. Increasing age and existing lameness were associated with articular cartilage lesions, as was the location of the fragments. The probability of cartilage lesions was higher in the dorsal fragments than in the palmar/plantar fragments. There was a significant correlation between age and cartilage score. Early removal, especially of the dorsal fragments, can help prevent future cartilage lesions. sl

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Successful reconstruction of a bilaterally comminuted mandibular fracture in a foal using 2.7 locking compression plates

Henriksson S, Gorvy D, Skärilina E (2024)

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The skull is considered a common body region for traumatic fractures in horses. Mandibular fractures often result from kick injuries. Unilateral unstable or bilateral mandibular fractures require osteosynthetic treatment using intraoral wiring, external

fixation or internal plating. Locking plates ensure the highest degree of stabilization. The plating of proximal fractures of the corpus mandibulae represents a particular surgical challenge due to the low bone layer thickness, the close proximity to important vessels and regional lymph nodes, the facial nerve and the parotid duct, and the access route restricted by the atlas wing. The present case report describes such an operation in a foal with a successful outcome. The foal was a 23-day-old Swedish Warmblood filly weighing 108 kg, which had been injured on the head by a kick from the mother mare 2 days previously. After bleeding from the oral cavity, swelling developed in the area of the left jaw joint. The skin remained unharmed. The mouth was slightly open, with the rostral mandible pointing to the right. Sucking on the udder was still somewhat possible. The CT showed a closed, slightly dislocated multi-fragment fracture of the corpus mandibulae on both sides.

Despite a two-day conservative therapy attempt with meloxicam, sucralfate and milk administration via nasogastric tube, the difficulty in sucking persisted, so osteosynthetic treatment was decided upon. For this purpose, the foal was placed in a supine position under general anesthesia with xylazine, butorphanol, midazolam, ketamine and isoflurane. After tilting the head to the right, the procedure began on the left side with a 25 cm long skin incision along the caudolateral edge of the corpus mandibulae. The fracture was exposed by blunt and sharp dissection of the soft tissues, and the facial nerve was kept away from the surgical field using a Penrose drain. A 2.7 mm locking plate contoured along the angle of the mandible was then inserted and fixed with 2 locking screws in the corpus mandibulae at the level of the condyle of the mandible and 2 further locking screws on the caudal ramus of the mandible. In addition, three cortical screws were inserted near the more bony angle of the mandible. After a wound drain was inserted, a four-layer wound closure was performed. The surgical field was protected using absorbent swabs and sewn-on roll compresses. After the same procedure on the right side and hand-assisted standing up, the foal was also given a head bandage made of tubular gauze. The anesthesia lasted just over 6 hours with an operation time of 5 hours. The foal received flunixin, sucralfate, gentamicin and penicillin until discharge one week after the procedure. Drains could be removed on the 3rd postoperative day. The dressing was changed every 3 days, or initially daily on the left side due to self-limiting wound secretion. The foal had to wear a muzzle for 3 weeks between suckling periods.

The X-ray follow-up on the 4th and 14th postoperative days showed that the implant was in the correct position. Bilateral postoperative facial paralysis resolved a few days after discharge. The control CT in the 7th week after the operation showed a fracture that was healing with slight callus formation, so that the implant could be removed. The foal recovered completely. Immediately after the implantation of the locking plates, the foal was able to suckle independently and did not require any further feeding via a nasogastric tube, which was also important for the further development of the interaction between the mother mare and the foal. The chewing load on the implants is much lower in suckling foals than after weaning, so that a plate thickness smaller than the 3.5-4.5 mm usual for adult horses was sufficient, especially since these were not usable in this case anyway due to the low bone thickness. Given the low level of mineralization in the foal's jaw, the exclusive use of cortical screws is not recommended, as these are more likely to break out of softer bone.

Cortical screws could be placed in the area of the strong mandibular angle in order to withstand higher shear forces in the curved course of the plate. Fortunately, callus formation was limited. The control CT made it easier to assess the fracture progression in bones that were still weakly mineralized at a young age. The risks of a long anesthetic and considerable expense were accepted, with a favorable outcome. pp

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Pharmacokinetics, clinical efficacy and safety of acetaminophen (paracetamol) in adult horses with naturally occurring chronic lameness

Mercer MA, Davis JL, McKenzie HC, Byron CR, Kelleher ME, Trager L, Cecere TE, Wilson KE, Council-Troche RM, Werre SR (2023)

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Traditional non-steroidal anti-inflammatory drugs (NSAIDs) such as non-selective cyclooxygenase inhibitors, including flunixin and phenylbutazone, are the most commonly used analgesic agents in horses. However, side effects occur with long-term use of these drugs. Selective COX-2 inhibitors carry a lower risk of side effects but are less effective for treating lameness. Acetaminophen is classified as an NSAID because it inhibits COX enzymes. At the same time, it is only a weak inhibitor of prostaglandins and has only a minimal anti-inflammatory effect. In horses, the drug is administered at a dosage of 20 mg/kg body weight as an adjunct therapy for laminitis and as an effective analgesic agent for experimentally induced pain in the hoof area. The aim of the present study was to evaluate the pharmacokinetics, safety and efficacy of acetaminophen at a dose of 30 mg/kg body weight every 12 hours for 21 days in adult horses with natural lameness. Twelve adult horses aged between 13 and 23 years and weighing between 405 and 186 kg with chronic lameness were available for the study. These horses were eight Quarter Horses, two Tennessee Walking Horses and one Percheron and one Suffolk Punch. The degree of lameness varied between 2/5 and 4/5.

Lameness was caused by osteoarthritis (7), navicular syndrome (4), chronic flexor tendinitis (1), osteochondral fragment and enthesopathy (1), patellar enthesopathy and desmitis of the patellar ligament (1), desmopathy of the lateral collateral ligament of the coffin joint and medial distal oblique sesamoid ligament and medial collateral ligament of the fetlock joint. Acetaminophen (30 mg/kg po) was administered orally every 12 hours for 21 days. Blood samples were collected on days 7 and 21, immediately before drug administration and 15, 30, 60 minutes and 2, 4, 8, 12 hours afterward. Acetaminophen plasma concentrations were analyzed by LC-MS/MS and noncompartmental pharmacokinetic analysis. Lameness was assessed on day 21 using body inert sensors (BMIS) and a subjective lameness rating on a 10-point scale and compared to the untreated baseline score on day 35. Additional blood samples were taken one day before the first drug administration and on day 21 for differential blood count and biochemistry and to determine the concentration of SDH. A gastroscopic examination (n = 6) was performed one day before drug administration and on day 22. In addition, a sonographic examination of the liver and a liver biopsy (n=6) were performed.

med. The biopsy samples obtained were examined histopathologically.

The maximum plasma concentration of acetaminophen (C_{max}) was 20.83 ± 10.25 g/mL within 0.40 ± 0.22 hours on day 7. The C_{max} on day 21 was 17.33 ± 6.91 g/mL with a T_{max} of 0.67 ± 0.26 hours. The statistically significant differences between T_{max} on day 7 and day 21 were most likely due to differences in gastric emptying. Subjective lameness improved significantly 2 and 4 hours after treatment. A significant percentage improvement in lameness was observed in horses with hind limb lameness 1, 2 and 8 hours after treatment. This significant improvement in lameness grade was not achieved in clinically significant forelimb lameness. Statistically significant increases in the concentration of calcium, chloride, magnesium and GGT activity were observed. However, the values remained within the reference range. Furthermore, a statistically significant decrease in the values of total bilirubin, globulin and BUN was observed. The findings from gastroscopy and the results of the histopathological examination of the liver biopsy samples showed no significant differences depending on the time of the examination or sampling. The results of the study show that acetaminophen is rapidly absorbed orally at a dose of 30 mg/kg. In horses with natural chronic lameness, acetaminophen at this dose led to a temporary improvement in subjective lameness and BMIS score. Since the clinical improvement in forelimb lameness was not significant, acetaminophen may not be effective as monotherapy.

ag

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Total removal of the fourth metacarpal bone in an Icelandic horse

Vidovic A, Kuhn S. (2023)

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Splint bone fractures are among the most common fractures in horses, regardless of breed and intended use. Due to their structure and location, the bones are predisposed to external trauma. In addition to the location and potential involvement of the joints, the type of fracture, geometry, displacement of fragments and degree of contamination are also important for the classification of fractures. Fractures can affect the proximal, middle or distal part of the bone. The treatment of splint bone fractures should depend on the type, location and involvement of the surrounding structures. Therapy can be conservative or surgical. This report describes an acute splint bone fracture caused by external trauma in a 17-year-old Icelandic mare. It was an open multi-fragment fracture in the proximal third of the os metacarpale quartum. Numerous light spots were visible in the soft tissue, which sonographically could be attributed to lesions in the suspensory ligament and the supporting ligament of the deep flexor tendon. Initially, the mare showed grade 4/5 lameness. The wound extended over a length of two centimeters and was heavily contaminated.

Under general anesthesia, all fragments distal to the fracture were removed. The distal end of the remaining proximal splint bone stump was cleanly severed with an osteotome. The day after surgery, the mare developed stress laminitis of the contrala-

teral limb, although the lameness had improved to grade 3/5. The wound was closed and clinically unremarkable. The routine X-rays taken two days later showed a longitudinal fracture in the remaining proximal splint bone with a large dislocated fragment in the direction of the carpometacarpal joint. As a consequence of this complication, a second surgical procedure was necessary. During the second operation, the entire fourth metacarpal bone was removed. The dislocated fragment was part of the carpometacarpal joint; after its removal, the joint was opened. To prevent septic arthritis, the joint was rinsed with large amounts of saline solution and gentamicin was injected locally. After an uncomplicated postoperative course and a five-month convalescence, the mare returned to her original level as a leisure horse. During a clinic visit six years later, the mare was examined orthopedically and presented herself as free of lameness. sl

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Post-mortem ultrasonographic and computed tomographic features of the anatomical variations and acquired pathological bone changes of the lumbosacroiliac region in a mixed population of horses

Scilimati N, Beccati F, Pepe M, Angeli G, Dall'Aglio C, Di Meo A (2024)

Equine Vet J | doi.org/10.1111/evj.14033

Back pain is increasingly being identified as a cause or contributing factor to lameness in riding horses. In the past, it was regularly classified as a result of primary lameness, as the altered movement pattern also has a negative impact on the spine. Back pain in horses is difficult to objectify due to poor access to the region and the very high variability of symptoms. The soft tissues of the back can be visualized sonographically via the dorsal approach, and the lumbar intervertebral discs up to L3/L4, the lumbosacral disc, the lumbosacral intertransverse joints, and the sacroiliac joint can be visualized via the ventral transrectal approach. Diseases of the sacroiliac joint have already been identified as causes of poor performance, hindquarter lameness, and immobility of the back. Due to the deep location of the sacroiliac joint, definitive diagnoses are difficult. The lumbosacral junction has so far played a minor role in horses with clinical back pain, although diseases such as L5/L6 ankylosis, lumbosacral ankylosis and ventral luxation of the sacrum or spondylolisthesis have already been documented. Sonographic examinations of the region have described dystrophic mineralization of the intervertebral disc and ventral hernia formation. Further imaging procedures are used to diagnose spinal diseases and the surrounding soft tissues.

However, the visualization of the lumbosacral junction is difficult and depends on the size of the horse being examined, the gantry size of the CT and the coils of the MRI. The aim of the study was to investigate anatomical variations and acquired pathological findings of the lumbosacral region in euthanized horses using ultrasound and CT. The working hypothesis was that age, body stature, direction of use and some anatomical variations correlate with the presence and severity of acquired bony pathological findings. The study material came from 51 horses that had been sacrificed and the lumbosacral region from L3 to the sacrum was removed. A CT and sonographic examination were performed

on all specimens within 24 hours of sacrifice. Information on the age, breed, body mass index and intended use of the horses was available for evaluation. The sonographic examinations were carried out in dorsal position according to the described examination procedure using a linear transducer. First, the morphology and echogenicity of the lumbosacral disc were assessed in transverse and longitudinal sound using an evaluation system. In addition, the cranial and caudal extremities of the lumbosacral transition were evaluated. A potential ventral protrusion of the disc was recorded and measured. This was present if the disc protruded more than two millimeters above the level. The intervertebral disc between L5/L6 was assessed using the Denoix evaluation system. Potentially existing uni- or bilateral acquired bony findings of the intertransverse joints were evaluated.

Due to the formation of post-mortem artifacts, the sacroiliac joints were not examined sonographically. The CT was performed after the sonographic examination. In addition to the morphology, the exact position of the vertebral promontory was determined. The study material from 42 horses of different breeds was available for evaluation. There were 28 mares and 14 male animals with an average age of 16 ± 6.7 years. 32 horses had previously been used in sports in various disciplines. Nine horses were leisure or breeding horses. The most common finding in the lumbosacral disc was a type 2 lesion, i.e. a dorsal narrowing of the disc, which occurred in 21/42 horses. Protrusions were present in 15/42 horses. The most common changes in the echogenicity of the discs were between L6/L6 and in the lumbosacral transition. The orientation of the L6 spinous process was mostly convergent. The promontoria were most regularly located between L6 and S1 (36/42). Lumbosacral spondylosis was present in 24/42 animals, spondylolisthesis in only one horse. Age was associated with the severity of most findings. Lumbosacral spondylosis or irregularities of the L6 extremitas caudalis were associated with lumbosacral angulation, variability in the size of the intervertebral disc from L5-L6 and localization of the promontorium. The orientation of the spinous process and the irregularity of the extremitas caudalis were associated with unphysiological echogenicity of the lumbosacral intervertebral disc. sl

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Acupuncture has potential in managing axial stiffness in steeplechase racehorses: a blinded randomized preliminary study

Terlinden A, Szymkowiak M, Jonville E, Hatrisse C, De Azevedo E, Coudry V, Denoix JM, Pilot-Storck F, Desquilbet L, Bertoni L (2023)

J Am Vet Med Assoc | doi.org/10.2460/javma.23.04.0197

The musculoskeletal system is the main location for reduced performance in sport horses. The management of these problems is a core part of equine medicine. The back also plays an important role in racehorses with regard to performance. Back pain and axial immobility have been underestimated, especially in the racehorse industry. The clinical symptoms are often inconspicuous and the findings of imaging procedures vary greatly, so that a clear diagnosis of back problems is often difficult. Over the last few years, back problems in sport horses have become more of a focus for veterinarians and various treatment approaches have

been developed. Most of these procedures are either invasive or doping-relevant, so that they must not be used in the last two weeks before the race. Managing training is also very important in the prevention of back diseases, but it is difficult to implement, especially in racehorses. This situation has led to great interest in alternative therapies. Acupuncture is a part of traditional Chinese medicine and is used in veterinary medicine to treat painful processes. The acupuncture points are located near regional nerves, blood vessels, lymph vessels in the area of penetration through the muscles, bony foramina or neurovascular bundles.

Stimulation of an acupuncture point results in tissue injury, activation of the inflammatory cascade and neurogenic stimulation. This leads to the release of various neurotransmitters that cause local or peripheral effects, such as increased local microcirculation or relaxation of muscle spasms. The aim of the present study was to investigate the short-term and long-term effect of acupuncture on axial immobility in steeplechase horses. The hypotheses were that trainers and riders would notice an improvement 14 days after treatment compared to untreated horses and that back mobility in treated horses would be improved after just two days compared to control animals. The study group included 12 steeplechase horses presented with clinical symptoms of axial immobility. These included tightness of the back muscles, shortened presentation phases in the gallop and poor propulsion of the hind limbs. Using a randomization app, the horses were randomly assigned to either the treatment or control group. Three days before treatment, all horses were ridden and the riders or trainers had to answer a questionnaire. On day 0 before treatment and after two days, back mobility was assessed while trotting and free jumping at a gallop.

On day 1, all horses were only exercised in the horse walker. On days three to six and eight to 13, all horses had an identical training program with horse walker, paddock and riding. All riders had the same equipment during each work session. On days 7 and 14, trainers and riders had to answer the questionnaire on rideability again. Both trainers and riders were blinded to their group membership. The effect of the acupuncture treatment on rideability was significant. All horses in the treatment group showed an improvement on days 7 and 14 compared to the control group. The subjective assessment of dorsal flexibility also showed a significant improvement compared to the control animals. Acupuncture is an interesting doping-free treatment method for improving back mobility and performance. sl

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Post-mortem ultrasonographic and computed tomographic features of the anatomical variations and acquired pathological bone changes of the lumbosacroiliac region in a mixed population of horses

Scilimati N, Beccati F, Pepe M, Angeli G, Dall'Aglio C, Di Meo A (2024)

Equine Vet J | doi.org/10.1111/evj.14033

Back pain is increasingly being identified as a cause or contributing factor to lameness in riding horses. In the past, it was regularly classified as a result of primary lameness, as the altered

movement pattern also has a negative impact on the spine. Back pain in horses is difficult to objectify due to poor access to the region and the very high variability of symptoms. The soft tissues of the back can be visualized sonographically via the dorsal approach, and the lumbar intervertebral discs up to L3/L4, the lumbosacral disc, the lumbosacral intertransverse joints, and the sacroiliac joint can be visualized via the ventral transrectal approach. Diseases of the sacroiliac joint have already been identified as causes of poor performance, hindquarter lameness, and immobility of the back. Due to the deep location of the sacroiliac joint, definitive diagnoses are difficult. The lumbosacral junction has so far played a minor role in horses with clinical back pain, although diseases such as L5/L6 ankylosis, lumbosacral ankylosis and ventral luxation of the sacrum or spondylolisthesis have already been documented. Sonographic examinations of the region have described dystrophic mineralization of the intervertebral disc and ventral hernia formation. Further imaging procedures are used to diagnose spinal diseases and the surrounding soft tissues.

However, the visualization of the lumbosacral junction is difficult and depends on the size of the horse being examined, the gantry size of the CT and the coils of the MRI. The aim of the study was to investigate anatomical variations and acquired pathological findings of the lumbosacral region in euthanized horses using ultrasound and CT. The working hypothesis was that age, body stature, direction of use and some anatomical variations correlate with the presence and severity of acquired bony pathological findings. The study material came from 51 horses that had been sacrificed and the lumbosacral region from L3 to the sacrum was removed. A CT and sonographic examination were performed on all specimens within 24 hours of sacrifice. Information on the age, breed, body mass index and intended use of the horses was available for evaluation. The sonographic examinations were carried out in dorsal position according to the described examination procedure using a linear transducer. First, the morphology and echogenicity of the lumbosacral disc were assessed in transverse and longitudinal sound using an evaluation system. In addition, the cranial and caudal extremities of the lumbosacral transition were evaluated. A potential ventral protrusion of the disc was recorded and measured. This was present if the disc protruded more than two millimeters above the level. The intervertebral disc between L5/L6 was assessed using the Denoix evaluation system. Potentially existing uni- or bilateral acquired bony findings of the intertransverse joints were evaluated.

Due to the formation of post-mortem artifacts, the sacroiliac joints were not examined sonographically. The CT was performed after the sonographic examination. In addition to the morphology, the exact position of the vertebral promontory was determined. The study material from 42 horses of different breeds was available for evaluation. There were 28 mares and 14 male animals with an average age of 16 ± 6.7 years. 32 horses had previously been used in sports in various disciplines. Nine horses were leisure or breeding horses. The most common finding in the lumbosacral disc was a type 2 lesion, i.e. a dorsal narrowing of the disc, which occurred in 21/42 horses. Protrusions were present in 15/42 horses. The most common changes in the echogenicity of the discs were between L6/L6 and in the lumbosacral transition. The orientation of the L6 spinous process was mostly convergent. The promontoria were most regularly located between L6 and S1 (36/42). Lumbosacral spondylosis was present in 24/42 animals, spondylolisthesis in

only one horse. Age was associated with the severity of most findings. Lumbosacral spondylosis or irregularities of the L6 extremity caudalis were associated with lumbosacral angulation, variability in the size of the intervertebral disc from L5-L6 and localization of the promontorium. The orientation of the spinous process and the irregularity of the extremity caudalis were associated with unphysiological echogenicity of the lumbosacral intervertebral disc. sl

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Equine intervertebral disc disease with dorsal protrusion and spinal cord compression: A computed tomography, myelography, MRI, and histopathologic case study

*Móll M, Garrett K, Ruby R, Janes J, Reed S (2024)
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A 3-year-old gelding had previously shown progressive ataxia and tetraparesis for over 2 weeks, but was otherwise in an otherwise normal general condition. Furthermore, hyperesthesia was found in the caudal region of the cervical spine. According to neuroanatomy, these findings corresponded to the spinal cord segments C1-C5 and C6-T2. As a diagnostic measure, the cervical spine was initially x-rayed, which revealed a narrowing of the spinal canal at the level of C6-C7 and changes in the joint facets. Under general anesthesia, cerebrospinal fluid was taken and X-rays were taken again in different positions of the neck. The dorsal contrast medium column was significantly narrower at the levels of C4-5 and C6-7. In the next step, a CT myelography was performed. The spinal cord was deformed and shifted to the left, and soft tissue originating from the intervertebral space was visible in the spinal canal. The facet joints from C3 to T1 showed significant bilateral enlargement of the articular processes. The former could not be visualized and the right transverse offset of T1 was deformed with remnants of the 1st rib.

Due to the severity of the findings and the poor prognosis, the horse was euthanized. The spine was removed in the C3 area and an MRI of the cervical spine was performed post mortem. This revealed a severe protrusion of disc material with deformation in the direction of the spinal cord at the level of C6-7. The disc from C3 to T1 showed degeneration, at the level of C6-C7 the ligamentum flavum was hypertrophic and the dorsal lamina at the level of C6-C7 was also thickened. A moderate protrusion of the disc was also found between C4-5 and C7-T1. In this area the disc did not reach the spinal cord. The next step was a macroscopic examination of the cervical spine, which revealed generalized osteochondrosis of the joints. This also verified that disc material had entered the vertebral canal at the level of C6-7 and that a synovial cyst was also present in this region. Histological examination of the disc material from C6-7 revealed necrosis of the cartilage as well as mineralization and disorganization. Microscopic findings - multifocal bleeding with spheroids, dilated myelin sheaths and rarefaction - were present, consistent with Wallerian degeneration of the white matter. This is the first report of degeneration of the intervertebral discs accompanied by compression of the spinal cord in a horse. ag

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Mirovasculature of the suspensory ligament of the equine hindlimb

Williams MR, Crisman E, Taylor B (2024)

Am J Vet Res | doi.org/10.2460/ajvr.24.01.0019

Injuries to the suspensory ligament can mean the end of a sporting career in horses of various disciplines. Lesions are divided into three regions. A distinction is made between injuries to the suspensory ligament origin, the suspensory body and the suspensory ligament thighs. In sport horses, the suspensory ligament origin of the hind limb is most frequently affected. Injuries to the suspensory body predominate in racehorses, while lesions of the suspensory thighs are common in racehorses and sport horses. In contrast, diseases of the suspensory ligament origin occur in horses of all breeds and sporting disciplines. The prognosis is better in the forelimb than in the hind limb. Here, fewer than 13 % of affected horses return to sport and the recurrence rate is high after conservative treatment. Numerous therapies focus on neovascularization in order to improve healing and the prognosis. Focused shock wave therapy, high-intensity laser therapy and the injection of various orthobiologics are used. Surgical procedures include fasciotomy with neurectomy of the deep branch of the lateral plantar nerve and splitting of the tendon. The microvascularization of the main motor tendons has already been investigated in various studies. Avascular locations are predisposed to injuries and heal only with difficulty. While there are already studies on the microvascularization of the suspensory ligament for the forelimb, there are no studies at all for the hind leg.

The aim of the present study was to examine the microcirculation of the hind limb using contrast-enhanced CT and to perform microvascular injection using the Spaltholz tissue-dissolving technique. In addition, the vascular supply of the suspensory ligament origin was to be checked histologically. It was assumed that there is a rigid intraligamentous blood supply in the area of the body and thighs and that, in contrast, the region of origin is deficient. It was also assumed that the supply of the origin on the hind leg is also deficient compared to the front leg. This would be a possible explanation for the significantly worse prognosis and higher recurrence rate on the hind leg. The study material came from horses of different breeds that had been killed and had no known lameness or diseases of the suspensory ligament origin. The horses were between 5 and 20 years old and there were no clinically palpable abnormalities in the area of the suspensory ligament origin. The limbs were severed in the middle or distal third of the tibia and deep-frozen. A catheter was inserted into the end of the tibial artery of two hind limbs and 150 ml of contrast medium was instilled into each artery under constant manual pressure. The examination was then performed using a CT scan. 11 limbs were injected with India ink via a catheter placed in the cranial tibial artery.

The complete distribution of the ink was checked by making an incision in the area of the coronary plexus. After successful distribution, the limb was deep-frozen and prepared for histological examination. The histological examination was carried out on four limbs. The suspensory ligament on the hind limb is supplied with blood by the branches of the medial and lateral plantar metatarsal artery, and to a lesser extent by the medial and lateral plantar artery and the associated proximal and distal plantar deep branches. There was a very evenly distributed intraligamentous microvascular supply in both the proximal, middle and distal

parts of the suspensory ligament. These results were also confirmed in the histological examination. Here there was a network of connective tissue that envelops the suspensory ligament and enters the suspensory ligament together with the vascular branches. During the examination, no deficits in the vascular supply of the suspensory ligament on the hind leg were found. Hypovascularity cannot therefore be the explanation for the poor prognosis and the high recurrence rates of diseases in the area of origin on the hind leg. sl

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Findings consistent with equine proximal suspensory desmitis can be reliably detected using computed tomography and differ between affected horses and controls

Müller EM T., Vanderperren K, Merle R, Rheinfeld S, Leelamankong P, Lischer C, Ehrle A (2024)

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The pathology of diseases of the suspensory ligament origin is characterized by various bony findings in the proximo-palmar/plantar tube as well as by desmopathies of the suspensory ligament origin, which can lead to nerve compression due to space-occupying lesions. The diagnosis of the disease is based on the results after local anesthesia in combination with radiological and sonographic imaging. It is known that sonographic examination is not very accurate and that X-ray examinations cannot reliably predict a disease or its severity. The findings at the suspensory ligament origin can be most reliably shown in high-field MRI. Due to a lack of availability, however, most examinations are carried out in low-field MRI, which can also reliably show the findings in the suspensory ligament origin region. In recent years, the use of CT in the diagnosis of orthopedic diseases in horses has increased considerably. Due to the short recording times and the wide availability of standing CT scans, this offers a useful alternative to MRI examinations. There are only a few reports in the literature on the CT appearance of insertional desmopathies of the suspensory ligament origin. The aim of the present study was to compare the soft tissue and the bone window of the suspensory ligament origin in horses with and without pain in the region. The evaluation results were compared between different examiners with different levels of experience.

The retrospective study included cases with positive anesthesia of the lateral plantar nerve and a CT scan of the proximal metatarsus. These patients belonged to the PSD group (n = 20). The control group consisted of age- and gender-matched horses without positive anesthesia of the region (n = 20). The images were reconstructed using an algorithm. All horses also underwent a radiological examination of the proximal metatarsus. All examination parameters were subjected to extensive statistical analysis. The computed tomography examination identified significantly more findings in the disease group compared to the control group. In particular, the scores for bony exostoses and for tendon enlargement were significantly higher in the disease group. The agreement within an examiner was high overall, the agreement between the examiners was moderate with regard to the identification of mineralizations, moderate with regard to sclerosis and exostoses, and good with regard to tendon enlargement. The measurements in the soft tissue window were signifi-

ificantly smaller than in the bone window. Characteristic findings in the disease group were bony proliferations, sclerosis, enlargement of the soft tissue, mineralization and avulsions. The findings of the present study support the use of CT to examine horses with suspected disease of the suspensory ligament origin, especially in cases where high-field MRI is not available. sl

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International survey of equine orthopedic specialists reveals various treatment strategies for horses with overriding spinous processes

Treß D, Lischer C, Merle R, Ehrle A (2024)

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Spinous processes that are in contact or overridden are also known as kissing spines syndrome. They often lead to pain and reduced performance in sport horses. Kissing spines syndrome is defined as a distance between the spinous processes of less than four millimeters. These are most commonly diagnosed between the fourteenth thoracic vertebra and the first lumbar vertebra. Although the finding is easy to diagnose on latero-lateral X-rays, the final assessment is often difficult because the X-ray diagnosis is made in both asymptomatic ridden horses and horses with clinical back pain. The clinical symptoms are very variable; they range from nonspecific loss of shape, tenderness to pressure, subtle gait abnormalities to behavioral changes. X-ray and scintigraphic findings do not always correlate with pain in the thoracolumbar region. Some authors recommend local infiltration of local anesthetics to confirm the diagnosis. Due to the proximity to the facet joints and the surrounding soft tissue, specific anesthesia of the spinous processes alone is not possible. If clinical symptoms occur, various conservative treatment options are recommended: In addition to physiotherapy and manual therapy, interspinal injections with cortisone are often performed. Surgical treatment involves desmotomy of the interspinal ligament and partial or complete ostectomy of the spinous process.

Local injections for anesthesia or for the treatment of kissing spines syndrome of the thoracolumbar spine are routinely performed. The injection techniques vary greatly; methods under X-ray or sonographic control are described. The aim of the present study was to determine which methods are preferred by equine orthopedists to diagnose and treat kissing spines syndrome. Another focus was on the respective injection technique, the materials used and the medication used. The evaluation was carried out using an online questionnaire provided by leading equine orthopedists. It contained 19 multiple choice questions and seven questions for free response. The first part of the questionnaire collected demographic data on the respective examiners, the second part followed with specific questions on the examination and diagnosis of back diseases in horses. The third part dealt with specific questions about the injection technique of the individual colleagues. The last part asked about specific management options for affected patients. The data collected was subjected to extensive statistical analysis. The questionnaire was sent to 1505 equine orthopedists worldwide, 353 answered it and 285 of them completed it and could be included in the evaluation. Most of the completed forms came from Europe,

North America and Australia. Within Europe, England dominated. Members of the ECVS and ACVS made up 50% of the participating veterinarians. Most veterinarians had been working with orthopedic patients for more than 15 years and 55% of the veterinarians had more than six clinical back patients per month. Back patients were regularly diagnosed by palpation. This was very regularly supplemented by radiological examination. 23% of colleagues practicing in Europe used X-ray examinations in every case.

The number of X-rays taken also correlated positively with the number of injections. In contrast, the back was rarely examined using sonography or scintigraphy. Thermography of the back was used even less frequently. Overall, 73% of orthopedic surgeons performed diagnostic anesthesia on the back. Interestingly, these were mainly ECVS and ACVS members. Very few of the ISELP members performed diagnostic anesthesia on the back. 61% used sedation with xylazine to perform local anesthesia on the back. Orthopedic surgeons with higher case numbers used sedation less frequently. Three different injection techniques were used. In the first technique, the needle was inserted between the spinous processes, in the second technique two needles were inserted abaxially of the affected pair of spinous processes. The third method involved inserting the needle obliquely between the spinous processes. Techniques two and one were used most frequently. Depending on the narrowness of the spinous processes, the techniques were also combined. The correct needle position was checked partly by X-ray and partly by sonography. Overall, the yellow spinal cannula was used most frequently for injections. In Europe, a green needle was also used more frequently and in the USA a pink needle. The medications used were triamcinolone, methylprednisolone and dexamethasone. It was noticeable that dexamethasone was used primarily by ISELP members and sports veterinarians and that triamcinolone is used in higher doses in the USA than in Europe. Lidocaine and mepivacaine were used as local anesthetics. The injections were supplemented with Traumeel, Zeel and various vitamins. Most equine orthopedists recommended conservative injection therapy in combination with controlled exercise. Manual therapy was recommended by 42% of Europeans and 25% of American colleagues. Surgical intervention was only recommended after conservative therapy had failed. sl

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Post-mortem ultrasonographic and computed tomographic features of the anatomical variations and acquired pathological bone changes of the lumbosacroiliac region in a mixed population of horses

Scilimati N, Beccati F, Pepe M, Angeli G, Dall'Aglio C, Di Meo A (2024)

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Back pain is increasingly being identified as a cause or contributing factor to lameness in riding horses. In the past, it was regularly classified as a result of primary lameness, as the altered movement pattern also has a negative impact on the spine. Back pain in horses is difficult to objectify due to poor access to the region and the very high variability of symptoms. The soft tissues of the back can be visualized sonographically via the dorsal

approach, and the lumbar intervertebral discs up to L3/L4, the lumbosacral disc, the lumbosacral intertransverse joints, and the sacroiliac joint can be visualized via the ventral transrectal approach. Diseases of the sacroiliac joint have already been identified as causes of poor performance, hindquarter lameness, and immobility of the back. Due to the deep location of the sacroiliac joint, definitive diagnoses are difficult. The lumbosacral junction has so far played a minor role in horses with clinical back pain, although diseases such as L5/L6 ankylosis, lumbosacral ankylosis and ventral luxation of the sacrum or spondylolisthesis have already been documented. Sonographic examinations of the region have described dystrophic mineralization of the intervertebral disc and ventral hernia formation. Further imaging procedures are used to diagnose spinal diseases and the surrounding soft tissues.

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Due to the formation of post-mortem artifacts, the sacroiliac joints were not examined sonographically. The CT was performed after the sonographic examination. In addition to the morphology, the exact position of the vertebral promontory was determined. The study material from 42 horses of different breeds was available for evaluation. There were 28 mares and 14 male animals with an average age of 16 ± 6.7 years. 32 horses had previously been used in sports in various disciplines. Nine horses were leisure or breeding horses. The most common finding in the lumbosacral disc was a type 2 lesion, i.e. a dorsal narrowing of the disc, which occurred in 21/42 horses. Protrusions were present in 15/42 horses. The most common changes in the echogenicity of the discs were between L6/L6 and in the lumbosacral transition. The orientation of the L6 spinous process was mostly convergent. The promontoria were most regularly located between L6 and S1 (36/42). Lumbosacral spondylosis was present in 24/42 animals, spondylolisthesis in only one horse. Age was associated with the severity of most findings. Lumbosacral spondylosis or irregularities of the L6 extremitas caudalis were associated with lumbosacral angulation, variability in the size of the intervertebral disc from L5-L6 and localization of the promontorium. The orientation of the

spinous process and the irregularity of the extremitas caudalis were associated with unphysiological echogenicity of the lumbosacral intervertebral disc. sl

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Investigating associations between horse hoof conformation and presence of lameness

Mata F, Franca I, Arujo J, Paixao G, Lesniak K, Cerqueira JL (2024)

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The slanted position of the solid hoof in relation to the limb enables the transfer of body weight to the ground. The strength of the hoof also protects the sensitive structures within the hoof. Variations in growth and wear patterns determine the conformation of the hoof and influence the mechanical load on the entire limb. Wear and growth of the hoof depend on the surface and various nutritional factors; discrepancies in growth and wear influence the dorsal hoof angle to the ground. In riding horses, hoof trimming or the fitting of horseshoes also influence the hoof shape and balance. It plays an important role in the biomechanics of the entire limb and also has a significant influence on the development of musculoskeletal injuries. In older studies on hoof conformation and the resulting risk of injury, various parameters were used, such as the coronary band circumference, the coronary band width, the toe axis, the dorsal hoof wall angle and the palmar/plantar angle of the coffin bone. The toe axis is ideal when the dorsal hoof wall is parallel to the alignment of the pastern. The palmar/plantar coffin bone angle should be between 2° and 10° , ideally 5° .

The toe axis can be broken forwards in the form of a steeper pastern and a flat hoof, which leads to a comparatively higher position of the pastern joint. Furthermore, the axis can be broken backwards due to the so-called „low heel-long toe“ conformation. The toe axis not only influences the joints of the distal toe but also has an impact on the higher joints. The ideal alignment of the toe axis reduces the risk of injury to the limb. Genetics also play an important role in hoof conformation. The aim of the present study was to examine the connection between the parameters coronary band circumference and dorsal hoof wall angle and lameness. While the dorsal hoof wall angle has a direct influence on the toe axis, this is not the case with the coronary band circumference. The study material came from 73 adult horses in an equestrian center in Portugal. All horses were kept in boxes and had access to a paddock for a few hours. They were used in show jumping, dressage or in riding school. The horses were exclusively Portuguese and Northern European. Both parameters were measured on a flat surface in a neutral position. The coronary band circumference was determined with a tape measure. The dorsal hoof angle was measured with an iPhone 13.

All horses were examined under the rider and in hand in different gaits on different terrains for potential lameness and potential lameness for the respective leg was recorded. The parameters collected were statistically evaluated. Overall, show jumping and dressage horses were lame more often. Horses with a smaller coronary band circumference and a larger hoof wall angle or with a larger coronary band circumference and a smaller hoof wall angle had a higher probability of lameness on the respective

leg. A smaller coronary band circumference with a larger hoof wall angle leads to a steeper limb position, which predisposes to increased impact loads on the limb. A larger coronary band circumference with a small dorsal hoof wall angle leads to a toe axis that is broken backwards, which leads to increased loads on the pastern. The study also shows that a straight toe axis with a dorsal hoof wall angle of 50° can prevent lameness. sl

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Composition, architecture and biomechanical properties of articular cartilage in differently loaded areas of the equine stifle

Fuggazola M, Nissinen MT, Jäntti J, Tuppurainen J, Plomb S, te Moller N, Mäkela JTA, van Weeren R (2024)

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The heterogeneity of the articular cartilage in terms of biomechanical properties is acquired in late pregnancy and in the early postnatal phase. It is essentially based on a different distribution of glycosaminoglycans and collagen. These depend to a large extent on the load on the areas in the postnatal phase. The biochemical properties of the horse's knee joint have already been investigated. Information on the structural characteristics and architecture of the articular cartilage is not yet available. The composition of the extracellular matrix and the architecture of the articular cartilage have a major influence on functionality. In addition, topographical differences in the joint must be taken into account. Strategies for treating articular cartilage injuries should take these special features into account. The horse's knee joint is a very versatile joint with a unique load pattern. Pressure, compression, tension and shear forces act on the different areas. In addition, there are areas that are not exposed to any load. Trauma or excessive loads can cause focal cartilage lesions from which osteoarthritis can develop. OCD lesions most commonly occur at the lateral trochanteric crest. Cysts have a predilection site at the medial femoral condyle.

In human medicine, autologous osteochondral blocks are already taken from the unloaded regions and inserted into the cystically altered condyles. The aim of the present study was to assess the tissue characteristics at three locations in the knee joint that are exposed to different loads. For this purpose, the lateral trochlear crest of the femur, the medial femoral condyle and the distal intertrochlear groove were selected. The working hypotheses were that there are biochemical and biomechanical differences as well as a different architecture. Furthermore, the relationship between the structural differences and the biomechanical load was to be investigated. The material for the experimental study came from four- to six-year-old slaughtered Criollo horses whose hind limbs were frozen at -20°C immediately after slaughter. Before sampling, they were first thawed and assessed macroscopically after preparation of the joints. Joints with pathological findings were removed from the study, so that a total of 30 healthy joints were available for taking samples from the locations mentioned. For this purpose, a drill was used to drill out so-called plugs with a depth of 10 mm and a diameter of 8.5 mm. The plugs were initially preserved at -80°C. The sample from the medial femoral condyle represented the area with the greatest pressure load, the sample from the lateral femoral condyle

represented the location with the greatest biomechanical load and shear force load from the patella.

The area of the groove between the condyles represented the non-weight-bearing part of the femur. After the plugs were prepared, the biochemical, biomechanical and structural characteristics of the individual samples were examined. The results were statistically processed and the relationships analyzed. The glycosaminoglycan content was statistically significantly higher in the samples from the medial femoral condyle than at the other two locations. In contrast, the DNA content, as well as the collagen content, was highest in the intercondylar groove. The difference was only significant in comparison to the lateral trochanter. In the biomechanical testing, the equilibrium modulus, the dynamic modulus and the viscosity were significantly different at the three test locations. For the samples from the lateral trochanter, they were comparatively significantly higher. The samples from the lateral and medial condyle as well as from the non-weight-bearing area of the femur differed in terms of collagen content, the parallelism index and the angle of the collagen fibers. Overall, clear correlations were seen between the biochemical composition, structural arrangement and mechanical load in the three different regions. These differences should be taken into account when developing therapeutic options. sl

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Intra-articular injection of an extended-release flavopiridol formulation represents a potential alternative to other intra-articular medications for treating equine joint disease

Katzman SA, Cissell D, Leale D, Perez-Nogues M, Hall MD, Bloom G, Hamamoto-Hardman B, Wu CY, Haudenschild AK, Liu GY, Yik JHN, Haudenschild DR (2024)

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Lameness in horses is often caused by osteoarthritic joint diseases. They are of great economic importance, as health and athletic performance are often affected over a long period of time. Clinically, the disease is characterized by pain and inflammation. Affected joints are routinely treated intra-articularly with anti-inflammatory drugs. In addition, orthobiologics, polyacrylamide hydrogel, hyaluronic acid and polysulfated glycosaminoglycans are also available for therapy. Steroids have undesirable side effects such as laminitis or the destruction of articular cartilage, especially when used for a long time. For this reason, the development of new substances for the treatment of osteoarthritis is urgently required. Recent research is looking at the role of cyclin-dependent kinase-9. It plays an essential role in the transcription of inflammatory genes and mediators in the development of osteoarthritis. Pharmacological inhibition of CDK 9 protects against the catabolic effects of proinflammatory cytokines in vitro. It also prevents inflammatory cytokine synthesis, apoptosis and the degradation of the cartilage matrix. CDK inhibitors were primarily developed as chemotherapeutic agents. One of the best-studied inhibitors is flavopiridol, a semi-synthetic small molecule. It is used intravenously to treat leukemia.

In joints, the relatively impermeable capsule membrane protects against systemic absorption of the molecule. Corticosteroids are

small-molecular substances that penetrate the synovial membrane and thus have systemic side effects and a shorter duration of action in the joint. Newer generations of intra-articular therapeutics are encapsulated, which leads to a delayed release of the active ingredient and a longer persistence in the joint space. The aim of the present study was to test the tolerance and pharmacokinetics of a flavopiridol formulation coated with PLGA (polylactic-co-glycolic) after intra-articular injection into the middle carpal joint. The working hypothesis was that there would be measurable levels of flavopiridol in the joint and only low plasma concentrations of the substance. The patient population of the experimental study included four clinically healthy horses from the university herd. As part of the clinical control, X-ray images were taken in the standard projections to exclude diseases. Control radiographs were taken after 4 and 14 months. In the first phase of the study, PLGA-flavopiridol microparticles were injected into the left middle carpal joint and empty PLGA microparticles were injected into the right middle carpal joint. Synovia was harvested at two-week intervals until week 6.

This was followed by a five-week rest period before the second part of the study began. The second phase was similar to the first phase, with the joints selected in reverse. Synovia samples were taken in weeks 0, 1, 3 and 5. The degree of lameness was assessed at each observation time and before each arthrocentesis. Parallel to the arthrocentesis, plasma samples were taken in which the concentration of flavopiridol was determined. All injections were well tolerated by the horses. No horse experienced any undesirable side effects. Flavopiridol was detected in high concentrations in the synovia in the first week. The substance was detectable in the joint up to the fourth week, and in the fifth and sixth weeks the substance was below the detectable limit. The substance could not be detected in any plasma sample, which underlines the lack of systemic side effects. The substance has potent analgesic and anti-inflammatory activity. The delayed release after coating with PLGA offers an effective alternative to repeated steroid treatments. sl

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Microvasculature of the suspensory ligament of the equine hindlimb

Williams MR, Crisman E, Taylor B (2024)

Am J Vet Res | <https://doi.org/10.2460/ajvr.24.01.0019>

Injuries to the suspensory ligament can mean the end of a sporting career in horses of various disciplines. Lesions are divided into three regions. A distinction is made between injuries to the suspensory ligament origin, the suspensory body and the suspensory ligament thighs. In sport horses, the suspensory ligament origin of the hind limb is most frequently affected. Injuries to the suspensory body predominate in racehorses, while lesions of the suspensory thighs are common in racehorses and sport horses. In contrast, diseases of the suspensory ligament origin occur in horses of all breeds and sporting disciplines. The prognosis is better in the forelimb than in the hind limb. Here, fewer than 13% of affected horses return to sport and the recurrence rate is high after conservative treatment. Numerous therapies focus on neovascularization in order to improve healing and the prognosis. Focused shock wave therapy, high-intensity laser therapy and the injection of various orthobiologics are used. Surgical procedures

include fasciotomy with neurectomy of the deep branch of the lateral plantar nerve and splitting of the tendon. The microvascularization of the main motor tendons has already been investigated in various studies. Avascular locations are predisposed to injuries and heal only with difficulty. While there are already studies on the microvascularization of the suspensory ligament for the forelimb, there are no studies at all for the hind leg.

The aim of the present study was to examine the microcirculation of the hind limb using contrast-enhanced CT and to perform microvascular injection using the Spaltholz tissue-dissolving technique. In addition, the vascular supply of the suspensory ligament origin was to be checked histologically. It was assumed that there is a rigid intraligamentous blood supply in the area of the body and thighs and that, in contrast, the region of origin is deficient. It was also assumed that the supply of the origin on the hind leg is also deficient compared to the front leg. This would be a possible explanation for the significantly worse prognosis and higher recurrence rate on the hind leg. The study material came from horses of different breeds that had been killed and had no known lameness or diseases of the suspensory ligament origin. The horses were between 5 and 20 years old and there were no clinically palpable abnormalities in the area of the suspensory ligament origin. The limbs were severed in the middle or distal third of the tibia and deep-frozen. A catheter was inserted into the end of the tibial artery of two hind limbs and 150 ml of contrast medium was instilled into each artery under constant manual pressure. The examination was then performed using a CT scan. 11 limbs were injected with India ink via a catheter placed in the cranial tibial artery.

The complete distribution of the ink was checked by making an incision in the area of the coronary plexus. After successful distribution, the limb was deep-frozen and prepared for histological examination. The histological examination was carried out on four limbs. The suspensory ligament on the hind limb is supplied with blood by the branches of the medial and lateral plantar metatarsal artery, and to a lesser extent by the medial and lateral plantar artery and the associated proximal and distal plantar deep branches. There was a very evenly distributed intraligamentous microvascular supply in both the proximal, middle and distal parts of the suspensory ligament. These results were also confirmed in the histological examination. Here there was a network of connective tissue that envelops the suspensory ligament and enters the suspensory ligament together with the vascular branches. During the examination, no deficits in the vascular supply of the suspensory ligament on the hind leg were found. Hypovascularity cannot therefore be the explanation for the poor prognosis and the high recurrence rates of diseases in the area of origin on the hind leg. sl

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Clinical effects of a combination of phenylbutazone and omeprazole on chronic lameness in Mongolian horses

Li Z, Du S, Wang X, Zhang L, Liu X, Fan Q, Yang H, Gao R (2024)

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Lameness is very common in horses and is an expression of pain and biomechanical dysfunction. NSAIDs, particularly phenylbu-

tazone (PBZ), are primarily used for treatment. These often lead to side effects such as lethargy, loss of appetite and weight, kidney damage, oral and gastrointestinal ulcers, colic, diarrhea, protein-losing enteropathy, reduced blood volume and endotoxin shock, with the accompanying symptoms in the gastrointestinal tract being particularly prominent. The so-called proton pump inhibitors (PPIs) have been specially developed for the prevention and treatment of gastrointestinal side effects. Omeprazole (OMP) is used in particular, and is used at the same time as PBZ. The aim of this study was to investigate the clinical effects of the combined administration of PBZ and OMP on chronic lameness in Mongolian horses. In general, lameness is a common problem in Mongolian horses, which are among the most similar to wild horses in the world. The authors assumed that the combination of the drugs could have a positive effect on the effectiveness of PBZ. The study included 18 Mongolian mares from the Inner Mongolia Agricultural University's breeding base, which were initially graded according to the severity of their lameness using the AAEP score. All mares had unilateral osteoarthritis, which had caused them to be lame for at least two months. Each horse was given a clinical examination to rule out other diseases. The mares were given free access to hay, concentrate and water. For the study, Minitab Statistical Software was used to analyze power.

The 18 mares were randomly assigned to one of three groups and received one of three treatment regimens according to their group. These were in group 1 ($n = 6$) a placebo of 10ml corn syrup per os every 24 hours, in group 2 ($n = 6$) PBZ in a dosage of 4.4 mg/kg body weight (BW) every 24 and in group 3 ($n = 6$) PBZ in a dosage of 4.4 mg/kg body weight orally and 4 mg/kg body weight omeprazole in addition at 24-hour intervals. The health status was constantly monitored during the experiment. The AAEP scoring was repeated on days 0, 1, 3, 5, 7, 9, 11, 13 and 15 after administration of PBZ. After this, a blood sample was taken from each horse. This was followed by determination of the total protein and albumin concentrations and the activity of the oxidative stress markers myeloperoxidase (MPO), superoxide dismutase (SOD) and catalase (CAT) as well as the concentrations of gastrin 17, pepsinogen-1 and -2, which can indicate gastric damage. Faecal samples were taken from the rectum and tested for occult blood. On days 0, 5, 7 and 12, the horses underwent a gastroscopy after a 12-hour food fast and a 4-hour water fast. The findings were graded and classified into Equine Glandular Gastric Disease (EGGD) or Equine Squamous Gastric Disease (ESGD). The gastric juice sample taken during the endoscopy was examined for its pH value.

The study showed that the horses that had received PBZ alone or in combination with OMP were significantly less lame than before treatment. The administration of PBZ alone significantly increased the risk of developing EGGD. The concentrations of gastrin 17 and pepsinogen-1 increased significantly compared to the concentrations in the horses from the other groups. The concentrations of total protein and albumin, on the other hand, decreased. In the horses that also received OMP, the situation was the opposite: the EGGD score, gastrin 17 and pepsinogen-1 content decreased, but pH, total protein and albumin levels increased significantly in this group. After the administration of PBZ, a decrease in the activity of MPO was observed. This was also the case in the group that had received PBZ and OMP. The differences were significant compared to the placebo group. On day 7, the MPO activity of the horses that had received PBZ and that of

the horses that had also received OMP decreased. SOD activity increased significantly with PBZ compared to the placebo group from day 7. A similar increase was also recorded in the PBZ + OMP group from day 5. In contrast, CAT activity decreased significantly from day 3 with PBZ. In the horses that had also received OMP, this was the case from day 5.

The authors concluded from these results that the simultaneous administration of PBZ and OMP not only alleviates chronic lameness, but also provides good protection against the development of EGGD. This is particularly the case when PBZ is used over a longer period of time. As assumed, the administration of PBZ and OMP led to an increase in the pH value of the gastric juice with a simultaneous decrease in the EGGD score. Alkalinization plays a key role in the development of EGGD and can effectively prevent it. However, this effect could not be demonstrated for the development of ESGD, as PBZ generally plays no role in the pathogenesis. In addition, no side effects on the intestines that had been observed with the simultaneous administration of PBZ and OMP in human patients were found in the present study. In contrast, in the present study, it must be assumed that gastric ulcers developed in the horses that had received PBZ. In groups 2 and 3, there was a significant drop in serum protein and albumin concentrations. In group 2, this was even significantly lower than in group 3. This can be explained by a reduction in albumin and acute phase protein synthesis in the liver caused by PBZ, as well as by a loss of plasma into the stomach and the formation of gastric ulcers. This assumption contradicts previous information in the literature.

The connection between the activity of stress markers and the administration of PBZ could not be fully clarified. In groups 2 and 3, the activity of MPO decreased significantly, which indicates that NSAIDs such as PBZ could directly inhibit MPO. This would also result in an inhibitory effect on the adhesion of neutrophils and endothelial cells, which prevents the healing of gastric ulcers. The administration of OMP has no influence on this effect. The finding that the activity of SOD increased significantly, but that of CAT decreased, is contrary to previously published results. Both events contribute to the destruction of gastric mucosal cells and would explain the ulcerogenic effect of PBZ, which the administration of OMP also had no effect on. GT-17 is produced in the G cells of the stomach and plays an important role in the regulation of gastric acid secretion. Nevertheless, the serum concentration of gastrin is also of great importance, which in turn is influenced by GT-17 production. In the present study, it was shown that the significant increase in GT-17 in group 2 could be effectively prevented by OMP in group 3, which once again underlines the protective nature of the drug. The same applies to the pepsinogen level, which increases particularly when the gastric mucosa is inflamed. This was particularly the case in group 2 and could be effectively reduced by the administration of OMP. In summary, it can be said that the administration of PBZ can effectively reduce the symptoms of chronic lameness, but it is necessary to administer OMP at the same time to counteract the development of EGGD. The administration of OMP leads to an increased pH value with a simultaneous decrease in the G-17 and pepsinogen-1 concentrations, which have a protective effect on the gastric mucosa. Nevertheless, the reduction in MPO activity is counteracted. OMP, on the other hand, has no effect on the anti-inflammatory effect of PBZ. sp

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Radiographic analysis in thoroughbred reveals morphological changes in healthy maturing stifle joints and possible association between subchondral lesions and femoral condyle width

Waddled L, Finck C, Santschi E, Morehead JP, Fogarty U, Lemirre T, Beauchamp G, Richard H, Levery S (2024)

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In young thoroughbreds, subchondral lightening occurs axially in the medial femoral condyle. As the horse continues to grow, its position changes centrodial in the medial femoral condyle and it takes on an oval shape. In adult horses, these findings are often associated with lameness and expensive treatments. The exact etiology of subchondral bone cysts has not yet been fully clarified. Focal trauma to the joint surface is one of the causes discussed. Experimental surgical trials on adult horses have shown that local trauma can induce the development of bone cysts. Disturbances of endochondral ossification due to ischemic necrosis of the vascular supply to the epiphyseal plate are also postulated as a cause of subchondral cysts. As the horse develops, the biomechanical forces in the knee joint change. It is known from human medical studies that a narrow confirmation of the intercondylar fossa of the femur predisposes to osteochondritis dissecans of the medial femoral condyle. In addition to the width, the notch wide index (NWI) is also determined for this purpose. This is made up of the ratio of the width of the intercondylar fossa to the bicondylar width. A reduced NWI can lead to impingement of the intercondylar eminence and resulting microtraumas, which promote the development of subchondral lesions. In children, a narrow intercondylar fossa also promotes the development of anterior cruciate ligament tears.

It is assumed that the knee joint arthrokinematics also change in young horses during musculoskeletal development and thus may contribute to the development of lesions of the medial femoral condyle. To date, no study has been carried out on the change in the shape of the knee joint during growth or a possible association with the development of lesions in horses. It is also of interest that subchondral lesions of the medial femur in horses occur more frequently in the right hind limb. In adult horses, limb asymmetries are present, accompanied by a longer cannon bone and a wider femoral diaphysis of the right hind limb. This has not yet been described in juvenile horses. The aim of the present study was to record morphological properties of the juvenile knee joint in healthy thoroughbreds. In foals with subchondral lightening in the medial femoral condyle, differences that lead to the genesis should be evaluated. In the first part of the study, bilateral knee joint radiographs of young Thoroughbred foals aged 3 to 23 months were examined to measure morphological data of the femur and proximal tibia. On the distal femur, the width of the medial and lateral condyles and the bicondylar width were measured, as well as the width of the intercondylar fossa and the height of both femoral condyles. On the tibia, the width of the tibial plateau, the height of the medial intercondylar eminence and the width of the intercondylar intereminental gap were determined. In the second part of the study, the knee joints of a population of slaughtered animals aged two weeks to 19 months were radiographed.

Here, the focus was on the assessment of femoral intercondylar retraction in two different age groups. In the third part of the

study, newborn foals were x-rayed at the age of one month to check whether limb asymmetries were already present at this age. In the knee joints without subchondral radiolucencies (n = 183), with the exception of the width of the intercondylar fossa, which decreased, there was an increase in all parameters measured in the first study. In the group of knee joints with subchondral radiolucencies (n = 53), in contrast to the other group, three parameters – width and height of the femoral condyles and intercondylar width – showed no change. The width of the tibial plateau increased in both groups. In the second study, the decrease in the width of the intercondylar fossa was confirmed in the group without subchondral radiolucencies. In study 1, the left knee joints of female foals without subchondral lightening that were older than seven months had significantly wider bicondylar values and a wider intercondylar fossa. The right knee joints had a wider medial femoral condyle in female foals of the same age group. The newborn foals from study 3 did not show any subchondral lightening. Here, the width of the medial condyle, the bicondylar width and the height of the lateral femoral condyle were larger on the left than on the right. The intereminental gap was larger on the right than on the left. In summary, the results presented here imply that in knee joints with subchondral lightening, the femur undergoes divergent development. This deviation from normal maturation was evident in a wider medial femoral condyle in older foals. The subchondral lightening was diagnosed more frequently on the right and so there could be a connection between the morphology of the medial femoral condyles and this finding. sl

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Atlanto-occipital fracture: Intrathecal corticosteroid medication of the subarachnoid space – A novel treatment method

Hall S, Meehan-Howard L, Prutton J (2024)

Equine Vet Educ | <https://doi.org/10.1111/eve.13977>

An 11-year-old warmblood gelding underwent a melanoma resected on the prepuce under general anesthesia. When standing up, while being supported by ropes on the head and tail, ventroflexion of the neck occurred with an unspecified entrapment of the head. When awake, ataxia remained, which improved significantly over the next few days with the administration of phenylbutazone, morphine and dexamethasone. Three months later, the gelding was still frequently leaning his head and neck against the wall, and the neck region was not warm enough. Passive flexion of the neck to the left was restricted. An X-ray of the cervical spine showed signs of arthrosis of the caudal facet joints. Triamcinolone was then injected into the joint spaces C4-C5 and C5-C6 on both sides. Five months later, the gelding was referred to the authors with severe hindquarter ataxia and mild forequarter ataxia, with limited mobility of the cervical spine and caudocervical and left gluteal muscle atrophy. The clinical picture suggested a lesion in the region of C1 to C7. A native CT examination was then performed with a 16-row scanner with a soft tissue layer thickness of 3.75 mm and a bony layer thickness of 0.625 mm, followed by a CT myelogram after atlanto-occipital CSF sampling and contrast medium injection. The standing phase was uncomplicated with the administration of two xylazine bolus injections.

While the cerebrospinal fluid showed no pathological changes, CT morphology revealed a chronic, complete, moderately displaced, multi-fragmentary joint fracture on the left side in the area of the ventral tubercle of the atlas. In addition, there was a small-fragment fracture on the caudodorsal joint edge of the left occipital condyle. In the vertebral canal, soft tissue displaced the spinal cord to the right dorsal side by 50%. On the left caudal side of the occiput, enthesophytes were present in the area of the capsule and ligament attachments. Under sedation with acepromazine, detomidine and morphine, the subarachnoid space between C1 and C2 was punctured under ultrasound control in order to inject 120 mg of methylprednisolone. This resulted in a temporary injection reaction with excitement, spastic ataxia and spontaneous urination. An additional 40 mg was then injected into the left atlanto-occipital joint. The following day, there was a slight residual ataxia of the forelegs, a stronger counter-movement when tilting by pulling on the tail, and improved mobility of the neck. In the follow-up check 4 months after the injection therapy, only a slightly reduced mobility of the cervical spine was noticeable. The control CT scan in standing sedation showed increased degenerative remodeling processes in the atlas and atlanto-occipital joint. The previous intra-articular injection was repeated with 80 mg methylprednisolone. The gelding was then able to bear full weight as a hunter 5 years later.

Diseases of the atlanto-occipital joint are rarely described in horses, possibly because the detection of morphological changes requires three-dimensional imaging, which is not available everywhere. In the present case, the atlanto-occipital fracture was not visible on the X-rays of the cervical spine taken at the time of the injury. Retrospectively, the later CT images made it possible to identify a single fragment on the initial X-rays, but not the full extent of the fractures. The soft tissue masses accumulated in the spinal canal could have been characterized more precisely using MRI than using CT. However, an MRI option in large horses is limited by the size of the magnetic coils. Due to the fracture pattern and a lack of experience in the affected area, osteosynthesis was not performed. Decompression of the spinal cord using hemilaminectomy has also only been described sporadically in horses and the prognosis is therefore questionable. The less invasive local steroid injections chosen here did not require general anesthesia and were carried out with the aim of reducing swelling of the soft tissue in the spinal canal. The side effects of the injection were self-limiting. pp

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Equine intervertebral disc disease with dorsal protrusion and spinal cord compression: A computed tomography, myelography, MRI, and histopathologic case study

Móll M, Garrett K, Ruby R, Janes J, Reed S (2024)

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A 3-year-old gelding had previously shown progressive ataxia and tetraparesis for over 2 weeks, but was otherwise in an otherwise normal general condition. Furthermore, hyperesthesia was found in the caudal region of the cervical spine. According to neuroanatomy, these findings corresponded to the spinal cord segments C1-C5 and C6-T2. As a diagnostic measure, the cervical spine was initially x-rayed, which revealed a narrowing of the spinal canal at the level of C6-C7 and changes in the joint

facets. Under general anesthesia, cerebrospinal fluid was taken and X-rays were taken again in different positions of the neck. The dorsal contrast medium column was significantly narrower at the levels of C4-5 and C6-7. In the next step, a CT myelography was performed. The spinal cord was deformed and shifted to the left, and soft tissue originating from the intervertebral space was visible in the spinal canal. The facet joints from C3 to T1 showed significant bilateral enlargement of the articular processes. The former could not be visualized and the right transverse offset of T1 was deformed with remnants of the 1st rib.

Due to the severity of the findings and the poor prognosis, the horse was euthanized. The spine was removed in the C3 area and an MRI of the cervical spine was performed post mortem. This revealed a severe protrusion of disc material with deformation in the direction of the spinal cord at the level of C6-7. The disc from C3 to T1 showed degeneration, at the level of C6-C7 the ligamentum flavum was hypertrophic and the dorsal lamina at the level of C6-C7 was also thickened. A moderate protrusion of the disc was also found between C4-5 and C7-T1. In this area the disc did not reach the spinal cord. The next step was a macroscopic examination of the cervical spine, which revealed generalized osteochondrosis of the joints. This also verified that disc material had entered the vertebral canal at the level of C6-7 and that a synovial cyst was also present in this region. Histological examination of the disc material from C6-7 revealed necrosis of the cartilage as well as mineralization and disorganization. Microscopic findings - multifocal bleeding with spheroids, dilated myelin sheaths and rarefaction - were present, consistent with Wallerian degeneration of the white matter. This is the first report of degeneration of the intervertebral discs accompanied by compression of the spinal cord in a horse. ag

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Neck pain but not neurologic disease occurs more frequently in horses with transposition of the ventral lamina from C6 to C7

Henderson CS, Story MR, Nout-Lomas YS (2024)

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If problems occur in the neck region of horses, these are correlated with neurological deficits, pain and stiffness of the neck. The neurological symptoms are based on compression of the spinal cord by narrowing of the vertebral canal. Horses with osteoarthropathy of the facet joints show symptoms such as stiffness or pain, but may also be completely asymptomatic. Recently, forelimb lameness, slumping and other gait changes have been described with diseases of the cervical spine. In recent years, morphological variations have been described, particularly with regard to the ventral lamina of the transverse process of the 6th cervical vertebra, which can show a transposition (TC67) either unilaterally or bilaterally to the transverse process of the 7th cervical vertebra. Certain breeds appear to show these variations more frequently. The aim of the present study was to determine the final diagnosis for the cause of the clinical symptoms in diseases for which X-rays of the cervical spine had been taken. The study was based on the hypotheses that 1. the reasons for cervical spine radiographs were clinical neurological signs, neck stiffness, pain and forelimb lameness, 2. the incidence of ventral lamina transposition is similar to that previously published, 3. there is no cor-

relation between the occurrence of neurological signs and this transposition, and 4. that horses with transposition are more likely to have neck pain or an unclear diagnosis. This was a retrospective observational study in which the clinical records of 135 horses that had cervical spine radiographs were evaluated.

The study period covered the years 2020 - 2022. The evaluation included information on the signalment, reasons for taking the X-rays, their findings and diagnoses. The horses had been subjected to a neurological and clinical examination and lateral images of the cervical spine and oblique images had been taken. This was done under sedation. The final diagnoses were cervical vertebral compressive myelopathy (CVCM), cervical orthopedic disease, appendicular lameness, pain in the neck region, other neurological disease or others. In the former case, there had to be symmetrical ataxia of the 4 limbs accompanied by a narrowing of the spinal canal and compression of the spinal cord shown by myelography. The cervical orthopedic diseases included osteophytosis, osteochondrosis, osteoarthropathy or degenerative joint disease of the facet joints or any other region of the cervical vertebrae, and fracture of the corpus vertebrae. Pain in the cervical spine region was defined as limited range of motion of the neck, pain on palpation of the region, and signs of pain on manipulation of the neck. Other neurological disorders – with the exception of CVEM – were ataxia, paresis, dysmetria not caused by a musculoskeletal or muscular disorder, such as equine degenerative myeloencephalopathy or polyneuropathy. Other disorders included vitamin E-dependent myopathy, osteoarthropathy of the lumbar spine, or overriding of the spinous processes of the spine.

For further analysis, the horses were divided into 4 groups. One group included horses that showed signs of neurological disease and had TC67, another group included animals that also showed a transposition but no neurological symptoms, the third group included horses with no signs of neurological disease and no TC67, and the fourth group included horses with the transposition but no neurological symptoms. A transposition of the ventral lamina was identified in 27 (20%) of the 135 horses. Clinical neurological symptoms were diagnosed with equal frequency in horses with and without this transposition. There was no significant difference in age between the groups. However, warmbloods (63%) were overrepresented among the horses with transposition. 73% (11) of the animals with transposition but no neurological signs were warmbloods. The gender distribution was the same across groups. When analyzing data from horses with neck pain alone, 5 animals (31%) had TC67 and 11 (69%) did not. In horses without neck pain, TC67 was diagnosed in only 18% of the animals (22) and 97 (82%) of the horses without such pain were not found to have TC67. The ultimate diagnosis in the animals was mostly lameness or cervical orthopedic disease (36% each). The analysis of the data showed no significant differences in the occurrence of neurological disease, lameness or cervical orthopedic problems when horses were compared based on the presence or absence of ventral lamina transposition. Only with regard to neck pain was it found that almost twice as many animals with this problem had TC67 as horses without a transposition. It should be noted that the number of horses was too small to demonstrate a correlation between disease and TC67. The results regarding neck pain in combination with a TC67 should also be assessed with caution. ag

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Detection times of clodronic acid in horses with orthopedic disease

Pedrosa BS, Dujardin C, Moses B, Thompson C, Sarasola P, Gattacceca F, Loup B, Garcia P, Popot MA, Bailly-Chouriberry L (2024)

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Clodronic acid is used to control the clinical symptoms of navicular syndrome. Racehorses under 3.5 years of age and 30 days before race day are not allowed to use this medication. According to FEI regulations, the use of nitrogenous bisphosphonates from human medicine such as alendronate and neridronate is not permitted, unlike tiludronic and clodronic acid. There are different results with regard to the detection times of clodronic acid in the blood and it appears to be very variable between individual horses. To date, all studies have been carried out on healthy horses in training and not on horses with an orthopedic disease. This study was intended to record the detection times in horses with such a disease. 35 horses in 3 clinics were available for the study, which had been treated once with 1.53 mg clodronic acid per kilogram of body weight intramuscularly. Before the drug is administered, a general clinical examination is carried out, body weight is determined using a tape measure, and the severity of the orthopedic disease is characterized by the doctors as mild, moderate, or severe. The drug was distributed to 3 different injection sites. Blood samples were taken before treatment, 10, 20, 30, and 40 days after treatment. 3 horses were not allowed to take part in the study because they had concentrations of the substance in their blood before the administration of clodronic acid. Thus, 32 horses between the ages of 4 and 17 and an estimated weight of 350-654 kg took part in the study. Navicular syndrome was diagnosed in 12 of 32 cases. The majority of horses showed mild symptoms. The calculation of the elimination half-life resulted in an estimated time of 10.6 days. None of the parameters measured, such as age, body weight, gender, dose, and severity of the disease, had a significant influence on this half-life. A simulation of clodronic acid concentrations showed that the percentage of horses that had a concentration below the assay's detection level (1.0 ng/ml) 30 days after administration of the drug was 93.9% and 40 days after administration of the drug was 99.4%. ag

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Equus caballus papillomavirus type 7 is a rare cause of penile squamous cell carcinomas

Munday JS, Knight CG, Bodaan CJ, Codaccioni C, Hardcastle MR (2024)

Vet J | <https://doi.org/10.1016/j.tvjl.2024.106155>

Papillomaviruses are epitheliotropic and, with a few exceptions, species-specific. They produce proteins that support the growth and differentiation of cells and can therefore lead to the development of hyperplastic papillomas and, in rarer cases, neoplasia. To date, 10 papillomavirus types have been fully sequenced for horses. EcPV1 causes small hyperplasias („warts“) in young horses. EcPV2 is the best researched and can cause papillomas and squamous cell carcinomas in the genitals, oropharynx and stomach. EcPV3, EcPV4, EcPV5 and EcPV6 cause aural plaques. EcPV3 was detected as a co-infection with EcPV2 in a squamous cell carcinoma on the penis and EcPV7 was detected once in a

penile swab. EcPV7 has not yet been associated with a specific clinical picture. EcPV8, 9 and 10 are not yet classified. Squamous cell carcinoma of the penis is a common neoplasm in horses, usually with infiltrative growth, and often leads to penile amputation or even euthanasia. Oropharyngeal squamous cell carcinoma is diagnosed less frequently. EcPV2 is usually, but not always, detected in the neoplasms. The following describes a case in which EcPV7 was exclusively detected in squamous cell carcinoma of the penis for the first time. To determine how frequently EcPV7 occurs in equine squamous cell carcinomas, 30 archived samples from the penis and oropharynx were examined using specific PCR primers.

A 23-year-old trotter gelding was presented with multiple plaques and exophytic changes in the penis. Histological examination of 3 biopsies was performed, which revealed multiple in situ carcinomas and epithelial hyperplasia with characteristics typical of papillomaviruses. After a period of 10 months, the gelding had developed further changes in the penis and an increase in circumference at the tip had a diameter of 5 cm. Subsequently, the penis was amputated and 3 further biopsies were taken, one of which was from the change in the penis tip. All 6 biopsies were examined using consensus and specific PCR primers and EcPV7 was detected in all biopsies, but not EcPV2 or any other type. 20 archived samples of squamous cell carcinoma from the penis and 10 from the oropharynx were then tested for the presence of EcPV2 and EcPV7 DNA using specific primers. In one sample from the penis, only EcPV7 was detected, in 5 samples both EcPV7 and EcPV2, and in 14 samples only EcPV2. Furthermore, EcPV7 was detected in 3 of 10 samples from the oropharyngeal region, but only as a co-infection with EcPV2.

The present study provides the first evidence that EcPV7 can be a disease-causing agent. Although EcPVs can infect the penis asymptotically, in this case characteristic histological changes were present that supported a viral etiology. This suggests that EcPV4 may play a causal role in the development of squamous cell carcinoma. No clinical or histological features were found that distinguish changes with EcPV7 DNA from those with EcPV2 DNA. The occurrence of mixed infections makes it difficult to determine which EcPVc was causal. A synergistic effect of both virus types is also possible. Further research in this area is required. EcPV7 may not have been detected in the past, although it was present in some cases, because a primer specific for this type was not used. The detection of EcPV7 in oropharyngeal samples suggests that the virus may also play a role in the development of squamous cell carcinoma in this area. The knowledge that EcPV7 can be involved in the development of squamous cell carcinoma in the penis is of crucial importance for the development of a vaccine against this neoplasia, as this would have to contain both EcPV2 and EcPV7 in order to be able to protect horses effectively.

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Intestinal hemangiomas in 8 horses

Metcalf A and Craig LE (2024)

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Hemangiomas are benign tumors of endothelial origin that can occur anywhere in the body. To date, hemangiomas have rarely been described in horses. This study describes 8 horses with inte-

stinal hemangiomas diagnosed by biopsy or autopsy and archived in the pathology database of the University of Tennessee College of Veterinary Medicine from 2005 to 2022. A total of 1092 pathological examinations and 359 biopsies (including 31 from the intestine) were performed on horses during this period. 7 of the 8 intestinal hemangiomas were detected postmortem, only 1 hemangioma was diagnosed by surgical biopsy. In all cases, the intestine was the only organ affected. The lesions were local in 3 cases and multilocal in 5 cases. The hemangiomas occurred almost exclusively in the small intestine (7 of 8), predominantly in the jejunum (5 of 7). Only one lesion was found in the left dorsal colon. This was the first diagnosis of a large colon hemangioma in horses. The lesions were solitary, raised, soft, black to red, and 2 to 15 mm in diameter. Microscopically, the lesions were cavernous and connected to the wall. In most cases they were located in the muscularis (6 of 8). The affected horses were usually middle-aged or older (average 19.3 years). No breed or sex predisposition could be identified. The hemangiomas were all incidental findings and not causative for euthanasia or surgical biopsy. In other species, intestinal hemangiomas can be associated with severe symptoms. ir

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A multicentric intermediate-size B-cell lymphoma with epitheliotropism in a Freiberger mare

Berenguer Veiga I, Affolter V, Moore P, de Jesus Maia-Nussbaumer P, Gerber V, Unger L, Dettwiler M (2024)

Vet Dermatol | doi.org/10.1111/vde.13270

Equine cutaneous lymphomas are typically T-cell-rich B-cell lymphomas (TCRBCL), whereas T-cell lymphomas (ETCL) are rare. Progression of the latter to Sézary syndrome is extremely rare. T-cell-rich B-cell lymphomas are composed of sheets of numerous reactive small T lymphocytes, interspersed with histiocytic cells and occasional eosinophilic cells, and usually small numbers of neoplastic large B cells that do not show epitheliotropism. Cutaneous and subcutaneous nodules and masses frequently occur on the abdomen, thorax, and limbs and can develop anywhere on the body. Basically, TCRBCL lesions come and go over several years and potentially develop into disseminated large B-cell lymphomas (DLBCL). This case report describes a multicentric medium-sized B-cell lymphoma with epitheliotropism in a 15-year-old Freiberger mare. The mare suddenly developed bilateral purulent conjunctivitis and swelling of the upper eyelids. She suffered from ulcerative stomatitis and extensive crusting of the mouth region. The lesions of the eyes and mouth improved after anti-inflammatory therapy and systemic administration of antibiotics. However, the stomatitis worsened over the next 2 weeks. In addition, the mare exhibited inspiratory stridor, tachycardia, tachypnea, enlarged mandibular lymph nodes and weight loss despite a good appetite.

Blood tests revealed mild anemia, pronounced lymphocytosis, mild neutrophilia and mild monocytosis. After the mare showed increasing loss of appetite, she was euthanized and subjected to a postmortem examination. This revealed multiple firm, well-demarcated white masses in both the upper and lower eyelids measuring up to 3x3x2 cm. Extensive crusting covered the mouth and nostrils. Multifocal ulcerations were found in the

nasal and oral cavities and on the tongue. The tongue and esophagus were covered with diphtheroid deposits. Additional masses measuring up to 15x15x10cm were found in the mediastinum between the pulmonary artery and aorta, in the substernal and perirenal fatty tissue and in the subserosal tissue of the colon. Samples from all affected organs were fixed and examined histologically and immunohistochemically, confirming the diagnosis of multicentric medium-sized B-cell lymphoma with epitheliotropism. Epitheliotropism in animals is usually associated with T-cell lymphomas. In this case, heteromorphic neoplastic lymphocytes infiltrated the epidermis of the mouth, the conjunctival, lingual, nasal, oral and esophageal mucosa, and masses were also present in various internal organs. The presence of intraepithelial medium-sized neoplastic B cells in the mouth and the lingual and conjunctival mucosa was demonstrated, as was the presence of reactive T cells. However, these findings are inconsistent with TCRBCL, the most commonly described type of lymphoma in horses, as this consists of large centroblast-like B cells and is not associated with epitheliotropism. In human medicine, this is considered typical for B cell lymphomas. sd

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Sarcoid within the oral cavity of a horse

Munday JS, Lewis MC, Leyland MH (2024)

J Equine Vet Sci | <https://doi.org/10.1016/j.jevs.2024.105003>

Sarcoids in horses are common skin tumors that may be locally invasive but do not metastasize. Previously, sarcoids were thought to usually recur after surgical removal. However, recent studies have reported that fewer than half of sarcoids resolve spontaneously even after incomplete excision and up to half resolve spontaneously without treatment. The increasing evidence of spontaneous regression suggests that at least some sarcoids may be considered a hyperplastic process rather than a true neoplasm. Sarcoids often develop in areas of the skin predisposed to trauma. The skin around the head is a common site of origin, and sarcoids of the hairy skin of the lips are not uncommon. To date, sarcoids have not been reported to occur in the oral cavity of horses. Sarcoids are believed to be caused by bovine papillomaviruses (BPV), of the genus Deltapapillomaviruses, including BPV1, 2, and 13. There is considerable geographic variation. BPV1 is detected in most sarcoids in Europe and Australia, while BPV2 is more commonly detected in sarcoids in North America and New Zealand. Although BPVs play an important role in the development of sarcoids, the epidemiology of the infection is unclear, and BPV DNA has been detected in normal equine skin and some non-sarcoid lesions in horses. Both histology and PCR to amplify BPV DNA can be helpful in making the diagnosis of equine sarcoids. Although sarcoids have some histologic features suggestive of this diagnosis, definitive differentiation from other soft tissue sarcomas can be problematic.

The detection of BPV DNA in some non-sarcoid lesions also shows that a lesion cannot be definitively diagnosed as sarcoid based on PCR results alone. Currently, the detection of BPV DNA in a skin lesion and the histological features of a sarcoid provide the highest possible certainty for making the diagnosis of equine sarcoid. This case report presents, according to the authors, for the first time, a gingival mass in the mouth of a horse whose gingival tissue was histologically consistent with an equine sarcoid.

The animal is a 16-year-old horse that developed a gingival mass of 1 cm diameter in the mandible opposite the right second premolar (406) and a mass of 2 cm diameter near the lip border on the same side of the mouth. The right cheek was diffusely thickened. Histology of the smaller mass revealed a proliferation of mesenchymal cells covered by hyperplastic epithelium forming thick rete cones. BPV2 DNA was amplified from the mass. The mass was incompletely excised. When the horse was re-examined five months later, no regrowth of the lesion was evident. In addition, the lip mass was no longer detectable and the right cheek was judged to be only slightly thicker than the left. The histologic features and the detection of BPV2 DNA are consistent with a diagnosis of equine sarcoid. It is suspected that trauma to the oral cavity may have been important in the development of sarcoids. In addition, different BPV types may infect the gingiva with varying degrees of success. Oral sarcoids, although rare, may be considered as a differential diagnosis for an oral mass in a horse.

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Equine sarcoids: A clinicopathological study of 49 cases, with mitotic count and clinical type prediction of recurrence

Karalus W, Subharat S, Orbell G, Vaatstra B, Munday JS (2023)

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Sarcoids are common mesenchymal neoplasms of the skin in horses. There is no age or gender-related predisposition. The most common locations are the head, neck, lip, eyelids, ear, extremities and ventral abdomen. Papilloma viruses are believed to play a role in the pathogenesis. The recurrence rate varies between 10% and 80%, although this variability may be due to the very different treatment approaches. The changes are divided into seven types depending on the clinical symptoms. Sarcoids are considered non-metastatic, but show locally invasive growth due to the expression of MMPs. Activation of PDGF receptor may also contribute to increased fibroblast proliferation and invasion. There are few data on prognosis depending on the classification of sarcoid. In this study, the risk of recurrence was assessed depending on the type. In addition, the histological characteristics of the sarcoids were examined to determine a possible connection with the probability of recurrence.

The clinical data from 2015 to 2021 were reviewed. 49 cases with histopathological confirmation of the diagnosis were available for evaluation. In addition to the histological findings, a PCR was performed to detect BPV DNA. The recurrence status of the cases evaluated was known. BPV DNA was detected in all cases. In 88% of cases were BPV2 DNA, 10% at BPV1 and at 2% had both types. The following histological criteria were assessed and correlated: mitotic count, necrosis, cellularity, nuclear pleomorphism and inflammation. Of the 49 horses, 24% were warm-blooded, 22% Thoroughbreds, 14% Trotter, 6% Quarter Horses, 6% sport horses, 6% Clydesdales, 6% mixed race, 4% Arabs, 4% ponies, 2% Appaloosa, 2% Paint Horses and one horse's breed was unknown. The age of the animals varied between 1 and 16 years (median: 7 years). The sarcoids were most frequently found in the head and neck area (50%), followed by the lower limb distal to the tarsus (20%), the upper limb, proximal to the tarsus (10%), the flank (8%) and the abdomen, groin and prepuce at 4% each. 43% of the nodular type, to 29%

about the mixed type, 20% of the sarcoids were verrucous and 8% fibroblastic.

In 23 horses, surgical excision of the lesion was the only treatment. In the remaining animals, various additional treatments were used: 5-fluorouracil, thiouracil, heavy metal salts and steroids (AW-5-Ludes from Equine Medical Solutions, 9 cases), intralesional 5% 5-fluorouracil (3 cases), topical 5-fluorouracil (Efudix ointment) (4 cases), injectable cisplatin (4 cases), injectable carboplatin (1 case), intralesional cryotherapy (1 case), topical turmeric powder (1 case), and topical tormentil ointment (Xterra cream, 1 case). One case received multiple treatments (combination of topical Efudix, intralesional cryotherapy, and topical AW-5-Ludes), and another case received an unknown chemotherapy agent. Mitotic count was 70% of sarcoids under 9, at 20% between 10 and 19 and at 10% over 20. 22% of the changes showed no inflammation, 41% superficial and deep inflammation and 37% a superficial inflammation. 86% of the lesions showed no visible necrosis. In 41% had mild nuclear pleomorphism. 19% of the surgically removed sarcoids were completely removed, while 81% had atypical fibroblasts in the tissue margins. 24% of sarcoids developed a recurrence. The recurrence rate was not significantly associated with cellularity, nuclear pleomorphism or inflammation. In contrast, the recurrence rate correlated with the mitotic count (MC). Four out of five (80%) Sarcoids with a $MC \geq 20$ in 2.37 mm² recurred, which represents a significantly higher recurrence rate than in sarcoids with a $MC < 20$, of which eight of 44 cases returned (18%). The clinical type also correlated with the risk of developing a recurrence. Three out of four (75%) fibroblastic types recurred. This was a significantly higher recurrence rate compared to sarcoids of other clinical types, of which 9 of 45 cases recurred (18%). In addition, univariate Cox regression analysis confirmed the fibroblastic type and $MC \geq 20$ as significant predictors of recurrence. The recurrence rate did not differ significantly between cases in which only surgical excision was performed and those in which additional therapies were used. Complete excision could also not be associated with a lower recurrence rate. ag

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A multicentric intermediate-size B-cell lymphoma with epitheliotropism in a Freiburger mare

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Equus caballus papillomavirus type 7 is a rare cause of equine penile squamous cell carcinomas

Munday J, Knight C, Bodaan C, Codaccioni C, Hardcastle M (2024)

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Papillomaviruses are small circular, double-stranded DNA viruses. They are basically epitheliotropic and, with some exceptions, species-specific. While most papillomavirus infections are asymptomatic, papillomaviruses produce proteins that promote cell growth and differentiation. These proteins can lead to the development of hyperplastic papillomas (warts) and (less frequently) neoplasia. Papillomaviruses are classified based on the sequence of the highly conserved ORF L1 gene. Papillomaviruses typically cause the same lesions in closely related animal species within the same genus. There are currently 10 different fully sequenced *Equus caballus* papillomavirus (EcPV) types, which are divided into 3 genera: Zetapapillomavirus, which includes the gene sequences that cause the so-called „grass warts“ that typically occur in young horses, Dyoiotapapillomavirus, which includes gene sequences that are believed to cause papillomas

of the genitals and squamous cell carcinomas, and Dyorhopapillomaviruses. Squamous cell carcinomas of the horse's uterus are common and potentially life-threatening. They are generally recognized as belonging to type 2 EcPV type 2, although EcPV2 has not been detected in all cases.

A 23-year-old warmblood gelding developed multiple and invasive squamous cell carcinomas in situ. Biopsies were taken from 3 sites and submitted for histological examination. All biopsies showed histological evidence of papillomavirus infection. Using both general and specific PCR primers, these lesions were found to contain EcPV7 DNA, but not EcPV2 DNA or DNA of any other PV type. The horse was monitored for the next 10 months, during which time it developed an exophytic lesion on the tip of the penis. To determine the frequency of EcPV7 in equine squamous cell carcinoma of the penis of horses, 20 samples archived at the University of Calgary were examined. DNA was extracted from sections of the histological tissue blocks as before. Specific primers were used to detect EcPV2 and EcPV7.

EcPV7 was the only papillomavirus found in one sample. Both EcPV7 and EcPV2 were found in five samples. EcPV2 was the only papillomavirus found in a total of fourteen samples of equine penile squamous cell carcinomas. Furthermore, EcPV7 DNA was also found in three of ten archived oropharyngeal squamous cell carcinomas, but only as a co-infection with EcPV2. This is the first report of EcPV7 causing disease in horses. These results suggest that EcPV7 may cause a subset of equine penile squamous cell carcinomas. In addition, this is the first evidence that PV types other than EcPV2 can cause these neoplasms. The detection of EcPV7 in the oropharyngeal squamous cell carcinomas suggests a potential role for this PV type in the development of these squamous cell carcinomas. There were no clinical or histological characteristics to distinguish the lesions containing EcPV7 DNA from those containing EcPV2 DNA. If EcPV7 causes a proportion of equine penile squamous cell carcinoma in horses, this may mean that vaccination against EcPV2 infection may not prevent all equine penile squamous cell carcinoma in horses. sd

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A randomized placebo-controlled double-blinded study comparing oral and subcutaneous administration of mistletoe extract for the treatment of equine sarcoid disease

Beermann A, Clottu O, Reif M, Biegel U, Unger L, Koch C
J Vet Intern Med | <https://doi.org/10.1111/jvim.17052>

Equine sarcoid (ES) is the most common cutaneous neoplasm in horses. It is considered benign but has the potential for locally aggressive and invasive growth. The etiology is multifactorial and treatment is difficult. Different treatment approaches exist, including both surgical procedures and local chemotherapy. *Viscum album* (VAE) extract is thought to have immunomodulatory effects and is administered subcutaneously. There is an injection solution approved for cancer therapy in humans in several countries. Subcutaneous injection of VAE increased the survival rate by 69% in humans with cancer. In horses, VAE injections have been des-

cribed as an effective phytotherapeutic measure for the treatment of equine sarcoid, and oral administration could also be used for the treatment of ES according to a pilot study. The present study aimed to investigate the therapeutic efficacy of oral administration of VAE for the treatment of ES. This was a randomized, placebo-controlled, double-blind study in a double-dummy design. The horses received either VAE or a placebo, either orally or subcutaneously injected, for 7 months. In the first step, the number, location, size and type of ES were recorded in the horses, as well as previous therapies. Of the 45 horses in the study population, 14 animals received the mistletoe extract by injection, 15 animals orally and 16 animals received the placebo (0.9% saline solution). The assessment of the sarcoids at the end of the study was carried out by 3 clinicians. No significant difference in ES regression could be demonstrated between the groups. At the end of the study, 27% (4) of the horses in the oral VAE group showed regression, 20% (3) in the subcutaneous injection group and 13% of the animals in the placebo group. Complete or partial regression was observed in 6 horses that had received oral VAE; this was observed in 4 animals in the subcutaneous injection group and also in 4 animals in the placebo group. No significant side effects were observed after either subcutaneous injection or oral administration. The results of this study show that oral administration of a mistletoe extract over a longer period of time showed no statistically significant difference in terms of efficacy in the treatment of equine sarcoid compared to placebo. ag

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Bacterial and fungal isolates from 107 cases of ulcerative keratitis in Japanese Thoroughbred racehorses (2017–2021)

Uchida-Fujii E, Kuroda T, Niwa H, Kinoshita Y, Kano R, Tamura T, Makimura K, Ueno T (2024)

J Equine Vet Sci | <https://doi.org/10.1016/j.jevs.2023.104990>

Because of the position of the eyes of horses, presentation is often due to epithelial defects of the cornea. Loss of epithelial protection can lead to bacterial and fungal infections of the cornea, ultimately leading to the development of keratitis and ulcers. Keratitis often occurs after racing due to foreign bodies, including sand particles. Various bacterial species have been isolated from horses with infectious keratitis, particularly gram-negative rods such as *Pseudomonas* and *Enterobacteria*, and positive pathogens such as *Streptococcus equi* subsp. *equi* and *Staphylococcus*. Isolated fungi have included *Aspergillus*, *Fusarium*, and the yeast *Candida*. Some of these organisms are also found as commensal bacteria and fungi in the conjunctiva, particularly *Staphylococcus* and various fungi such as *Aspergillus*, *Fusarium*, and *Candida*. Therefore, identification of the causative pathogens is difficult. In addition, increasing antimicrobial resistance of bacteria isolated in equine keratitis has been observed. To improve treatment outcomes, this study aimed to evaluate the susceptibility to antimicrobial agents of bacterial and fungal isolates isolated from Japanese Thoroughbred racehorses with infectious ulcerative keratitis. During the study period from 2017 to 2021, 107 racehorses aged 2 to 8 years were presented post-training due to eye pain and fluorescence-positive corneal lesions.

Bacterial and fungal cultures were performed for 166 corneal swabs from 107 cases. A disk diffusion test and a minimum inhibitory concentration test were also performed to evaluate the susceptibility of the bacterial and/or fungal isolates to antimicrobial agents, respectively. Bacterial and/or fungal isolates were isolated in 85% (91/107) of the cases. Among the 237 bacterial organisms, 32 species were identified. Of the 50 fungal isolates, 13 filamentous species and 7 yeast-like species were isolated. In 59 cases only bacteria were detected, while in 2 cases only filamentous fungi and in one case only a yeast were identified. In 14% of horses both bacteria and filamentous fungi were detected, in 6.5% yeast and bacteria, in 0.9% yeast and filamentous fungi, and in 5.6% bacteria, yeast and filamentous fungi. The primary bacterial pathogen was *Staphylococcus* (45.6%), followed by *Aerococcus* (7.1%), *Streptococcus* (5.9%), *Actinobacter* (6.3%), and *Pseudomonas* (4.5%). The primary filamentous fungus isolated was *Aspergillus* (42.4%), and *Debaryomyces* (52.9%) was the most commonly isolated yeast. Regarding antimicrobial sensitivity, ofloxacin resistance was found in 100% (12/12) of MRSA, and in 15.9% (7/44) and 25.0% (3/12) of *Staphylococcus* and *Streptococcus* isolates, respectively. The prevalence of quinolone-resistant staphylococci and streptococci has thus increased over the last two decades. All *Aspergillus* isolates were susceptible to voriconazole, while other filamentous fungi, including *Fusarium*, were less susceptible to voriconazole. ag

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In vitro antibacterial efficacy of autologous conditioned plasma and amniotic membrane eye drops

Yates KM, Stilwell NK, Fontenot RL, Betbeze CM (2023)

Vet Ophthalmol | <https://doi.org/10.1111/vop.13120>

Corneal ulcers are one of the most commonly diagnosed eye diseases in dogs, cats, and horses. When signs of ulcer progression, such as increasing depth, cellular corneal infiltrate, or corneal malacia, are noted, these ulcers should be cultured for pathogenic organisms. The most common aerobic bacteria isolated from corneal ulcers in animal species include *Staphylococcus* spp., *Streptococcus* spp, *Corynebacterium* spp., *Escherichia coli*, and *Klebsiella* spp. When corneal ulcers are diagnosed, broad-spectrum topical antibiotics are routinely prescribed to prevent and/or treat bacterial infections. With increasing antibiotic resistance, the use of biologic agents that can support or replace traditionally used antibiotics is of increasing interest. In-house processing systems allow veterinarians to produce autologous conditioned plasma (ACP) at the point of care. ACP is a platelet-rich plasma product produced by centrifuging a blood sample of anticoagulated whole blood containing platelets, growth factors and bioactive proteins. Amniotic membrane (AM) was first used in ophthalmology to repair conjunctival defects. Over the last three decades, AM has been widely used as a biomaterial in ocular surface reconstructive surgery due to its anti-inflammatory, immunomodulatory and antibacterial properties.

While AM grafts have structural advantages, amniotic membrane extract eye drops (AMEED) show beneficial effects of AM when applied topically. Amniotic membrane has been shown to reduce bacterial counts, prevent biofilm formation, and inhibit bacterial

growth in chronic wounds in vitro. However, it is unknown whether AM retains these properties when used as an ophthalmic suspension. The aim of this study was to determine the in vitro antibacterial efficacy of autologous conditioned plasma (ACP) and amniotic membrane extract eye drops (AMEED) against aerobic bacteria found on the corneal surface. Anticoagulated whole blood samples from dogs (n = 4) and horses (n = 4) were collected sterilely, pooled for each species, and processed using the Arthrex ACP® double syringe system. Platelet counts were performed using ACP and pooled blood. AMEED were obtained from a commercial source. A search of electronic medical records (2013-2022) identified aerobic bacteria identified in cultures of corneal ulcers in dogs and horses at the Mississippi State University College of Veterinary Medicine (MSU-CVM). Ten commonly isolated bacteria for each species were obtained from cultures previously frozen at -80°C.

The Kirby-Bauer disk diffusion method was used to determine the susceptibility of these isolates to ACP and AMEED. The bacterial isolates were plated on Mueller-Hinton agar + 5% sheep blood agar and sterile blank disks soaked with 20µl of ACP or AMEED were tested in duplicate. Imipenem disks served as positive controls and blank disks as negative controls. Inhibition levels were measured after 18 hours. ACP platelet counts were 1.06 and 1.65 times higher in horse and dog samples than in blood, respectively. No bacterial growth was observed in aerobic or anaerobic cultures of the ACP or AMEED products. After 18 hours of incubation at 37°C, the growth of the isolates was not affected by the addition of ACP or AMEED. The growth of a multi-resistant *Enterococcus faecalis* was partially inhibited by ACP in dogs and horses. AMEED did not inhibit the growth of the bacteria studied. vh

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Prevalence, differences, and potential correlation to age, sex, breed, coat color, iris color, and geographic location in naturally occurring refractive errors in the normal equine eye from Germany and North Carolina

Charnock LN, Davidson MG, Keys DA, Gilger BC, McMullen Jr RJ (2023)

Vet Ophthalmol | <https://doi.org/10.1111/vop.13061>

The present study investigates the prevalence and variation of naturally occurring refractive errors in horses. The aim of the study was to evaluate the normal refractive state in horses at North Carolina State University (NCSU) and the Equine Clinic Munich-Riem (ECMR) and to determine the prevalence of naturally occurring refractive errors and their relationship with breed, age, coat color, iris color, sex, and geographic location. Horses from NCSU (January 2009 to November 2012) and ECMR (January 2013 to September 2016) were examined in the study. The horses underwent an ophthalmological examination and strip retinoscopy. Data on location, color, breed, sex, and iris color were collected. Gross and net refraction values were recorded and statistically analyzed for each meridian direction (horizontal and vertical), as well as for spherical refraction, astigmatism of both eyes, and anisometropia. The study showed excel-

lent agreement of refractive values between the eyes of the same horse (intra-class correlation coefficient, ICC = 0.89).

The median net horizontal (H), vertical (V) and spherical refraction for the total population (n = 690) were H: +0.25 D (min. -6.50 D, max. +2.34 D), V: +0.25 D (min. -7.13 D, max. +2.75 D) and spherical: +0.25 D (min. -6.82 D, max. +2.17 D). Emmetropia (> -0.50 D and < +0.50 D; > -0.75 D and < +0.75 D) was present in 769/1380 eyes (55.7%) and 926/1380 eyes (67.1%), respectively. Anisometropia was present in 86/690 horses (12.5%). Anisometropia was detected in 12.5% of horses. Sex, iris color and site were significantly associated with refractive values, while age, breed and coat color showed no significant association. The study is the most comprehensive collection and analysis of refractive data from ophthalmologically normal horses of different breeds and age groups. Statistical analyses included linear mixed models and generalized linear mixed models adjusted for multiple comparisons using Tukey's test. The results contribute to the understanding of naturally occurring refractive errors in horses and provide a basis for future studies.

The study results found that most eyes examined were emmetropic or had a myopic shift, with excellent agreement noted between eyes from the same horse. Sex, iris color and geographical location appeared to influence refraction in horses. The high prevalence of emmetropia suggests that most horses in the study had normal vision. However, the anisometropia noted, although present in a minority of cases, could have clinical significance, particularly when pronounced. Anisometropia can lead to impaired depth perception and potentially behavioral changes in horses. The association of refraction values with sex, iris color and geographical location could indicate genetic or environmental factors affecting the eye health of horses. These findings could be taken into account in breeding and when selecting horses for specific disciplines or working environments. In addition, they could contribute to the development of more targeted treatment and management strategies for horses with specific refractive errors. aa

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Autoimmune uveitis in a Thoroughbred gelding with common variable immunodeficiency

Plotsker N, Felipe JMB, Pearson E, Lucyshyn DR, Cercone M, Perkins G, Taylor R, Musciano A, Knickelbein KE (2024)

Equine Vet Educ | <https://doi.org/10.1111/eve.13981>

Primary immunodeficiency is rare in horses. The most common is general variable immunodeficiency (CVID). This is characterized by persistent hypo- or agammaglobulinemia, progressive B-cell lymphopenia and a lack of response to protein-based vaccinations. The clinical symptoms include recurrent fever and respiratory infections and, less frequently, meningitis, hepatitis, diarrhea and abscess formation. The occurrence of uveitis in combination with CVID has been described. A recently published review article described the clinical symptoms of the disease in 100 horses with a median age at the onset of clinical symptoms of 12 years. Neither a breed-related predisposition nor environmental risk factors could be identified. Recurrent respiratory infections also occur in human medicine in connection with this disease. In humans, the frequency of autoimmune uveitis in the context of CVID is 1.6%. The diseases correlated with CVID are based on

a reduced tolerance of the immune system due to changes in regulatory T cells or T cell activation. The present publication describes a case of severe, non-infectious, autoimmune-related uveitis in a horse with CVID. A 19-year-old thoroughbred gelding was presented to the clinic for evaluation of recurrent pneumonia and mandibular lymphadenopathy.

The symptoms noted when the animal was presented were consistent with pneumonia; hypoproteinemia was also detected due to hypoglobulinemia. The proportion of CD8+ T cells was significantly increased and the proportion of CD21+ B cells was decreased. The IgG concentration in the serum was low and the IgM concentration was unremarkable. Based on these findings, CVID was diagnosed and lymphoma was considered in the differential diagnosis. Based on the results of the cultivation of tracheal secretion, in which *Streptococcus equi* subspecies *zooepidemicus* was detected, the gelding received trimethoprim-sulfamethoxazole for 14 days. Six months later, pneumonia recurred and eight months after the CVID diagnosis, the gelding showed acute, severe uveitis. Regardless of locally administered therapy with atropine, neomycin-polymyxin B-dexamethasone and oral flunixin, the uveitis continued to progress and the gelding was admitted to the clinic. At this time, the gelding showed no further clinical symptoms except for the changes in the eye area. The symptoms included blepharospasm, no threat reflex, no pupillary reflex, moderate diffuse corneal edema and 360° perilimbal neovascularization. There were severe opacities in the vitreous body including cell accumulations and some fibrin in the anterior chamber. The pupil was miotic.

The only findings in the collateral eye were countless fine precipitates in the ventral area of the corneal endothelium and opacities (slight) of the vitreous body. Hypoproteinemia and hypoglobulinemia were also diagnosed and the serum leptospira agglutination tests were negative. The aqueous humor PCR result for *Borrelia* and the bacterial culture were also negative. Due to the poor treatment outcome, an intravitreal injection of 4 mg gentamycin was performed. Local therapy included atropine, ofloxacin, diclofenac. Flunixin and minocycl were administered systemically. These therapeutic measures were also unsuccessful and so the eye was removed 3 weeks later. Cytological examination of the aqueous humor showed mixed inflammation with 71% lymphocytes, 20% macrophages and 9% non-degenerative neutrophils. Histopathology revealed severe, chronic primary lymphocytic anterior uveitis. The retina was unremarkable. The chronic lymphocytic and neutrophilic keratitis was probably secondary. This case report describes severe autoimmune uveitis in a horse with CVID. ag

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Subconjunctival autologous muscle-derived mesenchymal stem cell therapy: a novel, minimally invasive approach for treating equine immune-mediated keratitis

Narinx N, Sauvage A, Ceusters J, Grulke S, Serteyn D, Moclin S (2024)

Vet Ophthalmol | <https://doi.org/10.1111/vop.13175>

Equine immune-mediated keratitis, characterized by varying degrees of corneal vascularization, opacities, and mild pain, is a non-ulcerative keratitis of idiopathic origin. Dysregulation of the adaptive immune responses is suspected as the immunopatho-

genetic trigger. The cells involved are CD4+T helper cells and CD8+cytotoxic T cells. IMMK usually requires long-term immunomodulatory and anti-inflammatory therapy. Long-term local administration of steroidal anti-inflammatory drugs can lead to corneal degeneration. Various surgical procedures have been described for therapy, as well as the insertion of a ciclosporin implant. The latter only showed limited effectiveness. The invasive procedure of lamellar keratectomy with and without a conjunctival flap showed a better success rate in cases with frequent recurrences. However, this is invasive, and potential complications including secondary infection can occur. Mesenchymal stem cells have regenerative potential and can differentiate into keratocytes. Furthermore, these cells modulate the adaptive immune system through cytokine secretion and can alter immune cell functions. To date, the treatment of IMMK with stem cells has only been described once. In this study, the procedure of subconjunctival injection with autologous mesenchymal stem cells derived from muscle biopsy samples was initially to be tested in healthy horses and then used in 6 horses with severe, chronic IMMK.

The muscle samples were taken from the triceps brachii using a semi-automatic 14-gauge microbiopsy needle. The mesenchymal stem cells were then cultivated. The subconjunctival injection was performed under sedation combined with a palpebral nerve block. Tetracaine hydrochloride drops were applied locally. 1 ml of the suspension containing 2.5 or 5 million cells was drawn into a 3 ml syringe using a 22-gauge needle and injected using a 25-gauge needle. The healthy horses were initially injected with 2.5 million cells and after one month with 5 million cells. In the first week after the injection, the eye was examined ophthalmologically twice a day, then once a week for one month. The sick animals included in this study had to have shown signs of illness for at least one year and the anti-inflammatory treatment including glucocorticoids and ciclosporin had been unsuccessful or only partially successful. The unsuccessful therapy had to have been carried out for at least 6 months. The data analysis took into account information on race, gender, age, time of onset of the disease, drug treatment history and classification of IMMK (epithelial, anterior, deep-stromal, mid-stromal). Initially, 2.5 million cells were administered; if there was no positive response, 5 million cells were injected. The treatment was repeated 4-7 times at intervals of 4-6 weeks. A grading system was used to assess the success of the treatment.

The safety study was conducted in 4 mares. None of the horses developed blepharospasm, ocular discharge, corneal edema, cellular infiltration or corneal ulcers. Mild chemosis and conjunctival hyperemia were visible 24-48 hours after injection. Two warmbloods and two quarter horses with IMMK between the ages of 11 and 24 were treated and the data evaluated. The duration of the disease before injection was 1 to 7 years. In the horses, the middle or anterior stroma of the cornea was affected. The injection and administration of the cells did not provoke pain, but mild conjunctival hyperemia. Cellular infiltration improved in four cases, but recurred in three animals. Improvement was observed in only one horse after a further injection. In all cases, vascularization was less pronounced or remained stable. With regard to the grading of the findings, all animals initially showed improvement after a single injection. Recurrence occurred between injections in three eyes. Over a follow-up period of 9.2 months, the changes were controlled by repeated injections in four eyes. ag

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Complete abdominal wall rupture in a late-term pregnant mare with pre-existing prepubic tendon rupture

*Timmins J, Ruby R, Wong D, Galow N, Gillen A (2024)
Equine Vet Educ | <https://doi.org/10.1111/eve.13983>*

The cranial pubic ligament consists of tendinous structures that reinforce the periosteum, running transversely to the symphysis between the two pubic branches. The ligament (prepubic tendon) serves as a tendon attachment for the linea alba and the Mm. abdominis rectus et externus in parts. If this ligament ruptures, the abdominal muscles concerned lose their supporting function, resulting in a large abdominal wall defect. Differential diagnosis and clinical differentiation can include a rupture of individual abdominal wall muscles or a hernia. Lordosis and ventral abdominal wall edema develop. Risk factors include belonging to a cold-blooded breed, hydroallantoic disease or twin pregnancy. Repeated use of breeding mares with a known rupture of the cranial pubic ligament can have fatal consequences. The following case report deals with this. This was a multipara American Quarter Horse mare that was presented with mild colic on the 310th day of pregnancy. A rupture of the cranial pubic ligament had been diagnosed during a previous pregnancy. It was not known why the mare was mated again. The mare had a protruding ventral abdominal wall. The trans-abdominal ultrasound showed a foal with regular heartbeat and no signs of premature placental abruption. The vaginal examination revealed that the cervix had elongated to 4 cm at the time of pregnancy. The mare did not tolerate a hernia belt or an elastic abdominal bandage. She was given box rest in a sawdust box, flunixin as an analgesic and dexamethasone twice at 24-hour intervals to promote fetal lung maturity. After the second dose of dexamethasone, the colic became more severe and it was decided to perform a Caesarean section. Immediately before induction of anesthesia, a complete loss of stability of the ventral abdominal wall with eventration of the abdominal cavity contents was observed.

The mare was immediately euthanized with pentobarbital and phenytoin, the uterus was incised and a premature foal was extracted. The foal was weakly muscled, had short hair, a convex face and floppy ears, as well as reduced limb tone. Due to the ongoing need for artificial ventilation, the foal was euthanized on the third day. This case describes the first complete rupture of all abdominal wall layers with prolapse of the intestines in a horse. The individual dexamethasone doses are most likely not to be seen as the trigger of the rupture. It is possible that breeding mares with a rupture of the cranial pubic ligament during pregnancy foal normally. These mares require adapted pain therapy and abdominal wall support in a hammock, provided this is tolerated. The amount of roughage in the feed should be reduced in order to keep the large intestine contents as small as possible. These mares also require obstetric care, as the abdominal wall contractions are insufficient for a regular birth. Birth should be induced at the end of the pregnancy. The choice of the appropriate time is based on the electrolyte profile of the udder secretion. The present case report emphasizes that these mares should not be mated again afterwards. Instead, the breeder should be informed about the options for embryo transfer. If these mares reach a critical state of health, a caesarean section or euthanasia may be necessary in an emergency. A dilated and elongated cervix could provide an initial indication of a gravita-

tional displacement of the uterus due to a reduced support function of the ventral abdominal wall. pp

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Collagen and collagenases in mare's endometrium with endometrisis

Centeno L, Bastos H, Bueno V, Trentin J, Fiorenza M, Panziera W, Winter G, Kretzmann N, Fiala-Rechsteiner S, Mattos R, Rubin M (2024)

Theriogenology | <https://doi.org/10.1016/j.theriogenology.2024.08.031>

Endometriosis in mares is a degenerative disease of the uterus in which deposits of components of the extracellular matrix and pathological changes occur around the glands in the endometrium. This disease is more common in older mares. Damage to the uterine lining leads to disturbances in the development of the fetus. Picro-Sirius red staining can be used to visualize fibrotic areas in the endometrium and to classify and quantify collagen. The accuracy of the result and thus the prediction of the mare's suitability for breeding depends heavily on the experience of the evaluator. A method has now been developed with which the fibrotic changes can be evaluated on a computer. However, studies are still lacking to evaluate the results of different methods. Collagen fibers are important both for the integrity of healthy tissue and for pathological processes. Reduced expression and activity of matrix metalloproteinases can reduce the degradation of collagen fibers. This leads to the accumulation of collagen in the stroma and around the glands of the endometrium. The aim of the present study is to quantitatively investigate collagen deposition in the endometrium using morphometric methods and to evaluate the gene expression of collagen types 2 and 3, matrix metalloproteinases 1 and 2, their tissue inhibitor and tumor necrosis factor- from uterine biopsies of mares with different degrees of periglandular fibrosis. The results are intended to be helpful in the diagnosis and prognosis of endometrisis.

34 biopsies of the endometrium were examined. For the evaluation, the biopsies were assigned to one of the following three categories: healthy endometrium (n=12), moderate fibrosis (n=12) and severe fibrosis (n=10). The average age of the mares increased with the degree of fibrosis and was 9.9 years, 13.4 years or 20.2 years. The proportion of collagen increased proportionally to the degree of fibrosis. More collagen type 2 was seen in biopsy samples with moderate fibrosis than in biopsies from healthy endometrium or with severe fibrosis. Matrix metalloproteinases 1 were also detected more frequently in biopsy samples with moderate than with severe fibrosis. Matrix metalloproteinases 2 were more highly concentrated in biopsies with severe fibrosis than in samples from tissue belonging to the other two categories. In this study, the collagen in the uterine lining could be quantitatively determined using picro-Sirius red staining. By analyzing gene expression, matrix metalloproteinases 1 were more likely to be associated with physiological remodeling processes in the uterine lining, and matrix metalloproteinases 2 and tissue inhibitor were more likely to be associated with fibrosis. Collagen type 2 and tumor necrosis factor- were identified as suitable biomarkers for the progression of endometrisis. During endometrisis, massive remodeling processes occur in the extracellular matrix with progressive collagen deposits. Therefore, biopsy remains the gold standard for examining the

uterus. Picro-Sirius red staining can be a valuable aid in evaluating the biopsy and is also suitable for routine examinations. The correlation between the age of the mares and the amount of collagen deposited confirms the hypothesis that endometrisis is more common in older mares and leads to reduced fertility. ir

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The influence of lactation on insulin and glucose metabolism, lipid profile, and cytokines in pregnant mares

Affonso FJ, Alonso MA, Bringel B, Douglas R, de Paula Nogueira G, Boakari YL, Barbosa Fernandes C (2024)

Theriogenology | <https://doi.org/10.1016/j.theriogenology.2024.09.003>

In the wild, mares come into heat and are covered again approximately 12 days after birth, even though the foal has not yet been weaned and the mare is still lactating. However, this is usually not the case for the recipient mares, particularly during embryo transfer. Little is known about the physiological insulin and glucose metabolism during pregnancy and the additional influence of lactation. An additional factor that must be taken into account is that more than 50% of horses are now obese. Obesity in horses is related to an increased risk of laminitis, altered metabolism and fertility, and reduced insulin sensitivity. During pregnancy, glucose metabolism adapts, leading to progressive insulin resistance and increased insulin secretion to provide glucose for the developing foal and to ensure a constant glucose level for the mare. The aim of this study was to compare body condition, local fat accumulation, insulin and glucose levels, fat metabolism and cytokine production of lactating and non-lactating mares before and during pregnancy and shortly after birth. Twelve pregnancies of nine broodmares were examined for the study. Of these, five were non-lactating (NL) and seven were lactating (L). Blood samples and all other examinations were performed on the day of ovulation and on days 55, 110, 165, 220, 275 and 330 of pregnancy and 21 days after birth.

In lactating mares, body condition score and trunk fat deposition were lower than in non-lactating mares, while nuchal fat deposition was not statistically different between the two groups at any time point. Lactating mares had lower insulin and glucose levels at the beginning of pregnancy, lower area under the curve (AUC) for insulin and glucose, lower adiponectin and tumor necrosis factor (TNF α) concentrations, and greater insulin sensitivity and glucose tolerance. Resistin concentration was higher on days 110 and 165 than on days 0, 275, 330, and 21 postpartum. Leptin concentration was higher on day 55 and the same on day 110 as on days 0, 220, and 275, but higher than on days 330 and 21 postpartum. There were no changes in non-esterified fatty acid concentrations over time in lactating mares, while non-lactating mares had higher concentrations on day 275 than on days 0, 55, and 110. Non-lactating mares had higher non-esterified fatty acid concentrations on days 165 and 275 than lactating mares. These study results suggest that the metabolic profile of lactating and non-lactating pregnant mares differs, with the metabolism of non-lactating mares being close to the threshold for metabolic syndrome. A better understanding of the influence of lactation on the metabolism of pregnant mares is important

for maintaining the health of mares, particularly non-lactating recipient mares undergoing embryo transfer, and their foals. Further studies are needed to fully understand the metabolism of pregnant mares. ir

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Effect of Mitoquinone on sperm quality of cryopreserved stallion semen

Elkhawagah AR, Donato GD, Poletto M, Martino NA, Vincenti L, Conti L, Necchi D, Nervo T (2024)

J Equine Vet Sci | <https://doi.org/10.1016/j.jevs.2024.105168>

Artificial insemination in horses is a widely used technique in modern breeding. Cryopreservation of stallion semen has advantages in this context. It increases genetic diversity and reduces risks associated with animal transport and natural mating. However, compared to fresh semen, cryopreservation significantly reduces quality, mainly through oxidative stress and damage to the cell membrane. These effects are due to the low antioxidant capacity of sperm cells and the loss of antioxidant protection due to removal of seminal plasma. Mitoquinol (MitoQ), a lipophilic cation complex with antioxidant properties, was investigated as a potential agent to improve semen quality. The aim of this study was to investigate the effect of MitoQ on the quality of frozen and thawed stallion semen. For this purpose, semen was collected from three healthy trotter stallions aged 10 to 13 years once a week over a period of six weeks. After collection, the semen was treated with a diluent and then frozen. Different concentrations of MitoQ (0, 25, 50, 100 and 200 nM) were added to the diluent to test the effect on sperm quality. After cryopreservation and thawing, parameters such as motility, kinetics, membrane and DNA integrity, acrosome integrity and mitochondrial membrane potentials were analyzed.

Sperm motility was assessed using computer-assisted sperm analysis (CASA), while fluorescence-based methods were used to assess oxidative stress and apoptosis. The results showed that addition of MitoQ at concentrations of 25, 50 and 100 nM significantly increased overall sperm motility, especially after 30 minutes. The highest effectiveness was observed at 25 nM. Higher concentrations of 200 nM MitoQ, on the other hand, had negative effects on sperm motility and vitality. There was no significant effect of MitoQ on plasma membrane integrity or sperm acrosome. Regarding mitochondrial activity, MitoQ treatment showed no significant change in mitochondrial membrane potential, DNA integrity or ROS levels. The beneficial effects of MitoQ may be due to its ability to stabilize mitochondrial functions by reducing oxidative stress. The harmful effects of high concentrations may be due to pro-oxidative effects of excess MitoQ, which overwhelm the already weakened antioxidant capacity of cryopreserved sperm. MitoQ at concentrations of 25–100 nM shows potential to improve motility and kinetics of cryopreserved stallion sperm, while higher concentrations are harmful. Future studies should investigate lower concentrations to determine the optimal dosage. vh

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Potential risk factors for fetal loss to umbilical torsion in the mare

Christoffersen M, Bøgelund Nielsen S, Breining Madvig C, Agerholm JS (2024)

Theriogenology | <https://doi.org/10.1016/j.theriogenology.2023.10.026>

Up to 52% of Thoroughbred mares in the UK and a heterogeneous mare population in Denmark lose their fetuses due to umbilical cord torsion. Twisting or strangulation of the umbilical cord as it wraps around the fetus results in complete or partial interruption of the blood supply. If the fetus itself rotates within the amnion, proximal cord torsion occurs, while rotation of the entire amniotic sac results in distal cord torsion. The fetus is very mobile within the amnion, particularly during the first five months of pregnancy, after which mobility decreases due to fetal growth. Most abortions occur in mid or late pregnancy. Spiralization of the umbilical cord (supercoiling) is considered pathological if it leads to occlusion of the blood vessels and thus death of the fetus. The fetus is usually already autolyzed at the time of abortion, as death occurs before abortion. So far, the only risk factor for torsion that has been identified is an umbilical cord that is too long. The present study aims to identify other risk factors in Danish warmblood mares and to evaluate the potential risk in relation to the length of the umbilical cord. In this retrospective cohort study, aborted fetuses or stillborn premature babies that were pathologically examined were examined and evaluated. In addition, a questionnaire was sent to the mare owner to obtain additional information. A total of 72 fetuses were examined for this study. The size of the mare, the length of pregnancy, the number of births, previous abortions, the length of the umbilical cord, the age of the mare and the sex of the fetus were evaluated.

To evaluate the risk factors associated with umbilical cord torsion and umbilical cord length, multivariable regression analysis and the Wilcoxon rank sum test were used for pairwise evaluation of umbilical cord length and mare size, gestation period and cause of abortion. In 37 cases, umbilical cord torsion was identified as the cause of the abortion. These abortions occurred after a shorter gestation period (8.1 ± 0.3 months) than abortions that had another cause (8.9 ± 0.2 months). Thus, abortions due to umbilical cord torsion occurred more frequently in the middle third of pregnancy. The cause of the abortion was related to the gestation period and the length of the umbilical cord. The length of the umbilical cord was 98.84 ± 5.14 cm, which was significantly longer in fetuses with umbilical cord torsion than in fetuses in which the abortion was due to other causes (67.2 ± 4.9 cm). Mares in the middle third of pregnancy had 7.9 times more frequent abortions due to umbilical cord strangulation than in the last third of pregnancy. The umbilical cord length was related to the size of the mare, the duration of the pregnancy and the cause of the abortion. In conclusion, it can be summarized that abortions due to umbilical cord torsion are significantly associated with the length of the umbilical cord and the duration of the pregnancy. The frequency of abortions due to umbilical cord torsion is not influenced by the size of the mare, but fetuses from pony mares had a significantly shorter umbilical cord than fetuses from large horse mares. If the umbilical cord in ponies is longer than 54 cm, there is a predisposition for umbilical cord torsion. No other risk factors for umbilical cord torsion were found.

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Can the reduced GH, IGF-1, and ovarian steroids concentrations be considered as suspected biomarkers of age-associated functional deficit in mares?

Satué K, Fazio E, Velasco-Martinez MG, La Fauci D, Barbiera G, Medica P, Cravana C (2024)

Theriogenology | <https://doi.org/10.1016/j.theriogenology.2024.08.001>

In humans and some animal species, the aging process has been studied in relation to growth hormone (GH) and insulin-like growth factor (IGF-1), both of which decline with age. In many tissues, IGF-1 production is triggered by the binding of GH to the GH receptor. However, the role of these two substances in the aging process in mares is still unclear. It is also unclear whether GH and IGF-1 correlate with circulating ovarian steroid concentrations, as they influence the formation of follicles. However, there are differences between GH and IGF-1, such as the half-life, which is short for GH and between 16 and 24 hours for IGF-1. GH has a greater effect on growth. In this study, GH, IGF-1, estradiol and progesterone concentrations are determined in mares of the following age groups: 6 to 9 years, 10 to 13 years, 14 to 16 years and over 16 years. A total of 56 healthy Andalusian mares with normal cycles were sampled. In the two younger age groups, GH concentrations were higher than in the two older age groups and the 14 to 16 year old mares had higher GH concentrations than the mares over 16 years. The mares over 16 years had the lowest IGF-1 concentrations compared to the other age groups. Estradiol and progesterone concentrations showed no significant differences between the different age groups. There were no correlations between the values of GH and IGF-1 or between estradiol and progesterone. The results of the study show that with increasing age, the activity of the GH and IGF-1 axis is reduced in healthy mares. However, this change in GH/IGF-1 levels had no detectable influence on estradiol and progesterone concentrations. ir

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Assessment of fetal development during mid and late term pregnancies by standard B-Mode

Wagner LH, Aurich J, Claaßen S, Melchert M, Kaps M, Aurich C (2024)

J Equine Vet Sci | <https://doi.org/10.1016/j.jevs.2024.105162>

Ultrasound examinations are widely used in veterinary medicine, particularly for monitoring fetal growth and development during pregnancy. In small animals such as dogs and cats, transabdominal ultrasound can be used to diagnose pregnancy without any problems. The size of the animal is important here to guarantee successful execution. In larger animals, such as horses, this is more difficult due to the greater distance between the ultrasound probe and the uterus. Particularly at the beginning of pregnancy, when the uterus has not yet moved into the abdominal cavity, a deeper penetration depth of the ultrasound is required, which can impair image quality. For this reason, transrectal ultrasound is often used in horses and ponies in the middle part of pregnancy. This also has limitations because, due to the anatomical conditions of both the examiner and the patient, the fetal skull can only be assessed in an anterior position. Clues to esti-

mate the gestational age and size of the fetus include the size of the eyes and the diameter of the fetal aorta.

Growth charts for fetal development with different parameters have already been collected. These two parameters have so far been the most precise in predicting the time of fetal development and the onset of birth. For smaller horse breeds such as Shetland ponies, however, there are hardly any studies that offer a detailed ultrasonographic analysis of fetal development. The aim of this study was to record fetal biometry during mid- and late pregnancy in Shetland ponies and to collect detailed data on physiological organ development. It was also investigated whether these measurements can be used to estimate the length of pregnancy and the time of birth. Five Shetland ponies with an average age of 12 years were examined. The animals were kept in groups and regularly checked for their reproductive status. Pregnancy was monitored by transrectal ultrasound from the 10th day of pregnancy and then by transabdominal ultrasound from the 101st day. Fetal biometric measurements such as eye diameter, aortic size, combined rib and intercostal distance (CRID), stomach length and width, and various cardiac parameters were recorded. Fetal activity and organ development in terms of differentiation and changes in echogenicity were also recorded. Fetal CRID at ± 13.6 days was the most accurate parameter for predicting gestational age. Fetal aortic diameter was the most accurate to estimate the remaining days until birth with ± 16.2 days. The development of fetal organs such as the intestine and stomach followed a clear chronological sequence.

The intestine showed increasing echogenicity from the beginning of the transabdominal examination (day 101) until birth. The stomach was always visible and continuously increased in size. The kidneys and gonads of the fetus could not be clearly distinguished from the surrounding tissue in most cases, so their measurements were not included in the final analysis. The development of the lungs and liver showed marked differences in echogenicity from day 115 of gestation, which allowed for later differentiation. This study provides, for the first time, detailed ultrasonographic data on fetal development in Shetland ponies. The aorta and combined rib distance were the most accurate parameters for determining gestational age and estimating the due date. Studying fetal organ development is more difficult in small horse breeds than in smaller animals such as dogs and cats, but provides valuable insights into the course of pregnancy. The results of this study serve as a basis for future work aiming at a more detailed characterization of fetal development in Shetland ponies. vh

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The effect of uterine massage and number of embryo flushing attempts on embryo recovery in mares

Sala-Ayala L, Martínez-Boví R, Querol-Paajanen A, Cuervo-Arango J (2024)

Theriogenology | <https://doi.org/10.1016/j.theriogenology.2024.05.017>

Embryo transfer is a common equine reproductive technique that, among other things, can increase the number of offspring per mare per year. The procedure involves obtaining embryos from the uterus of a donor mare by embryo flush. The embryo is then transferred transcervically to and carried to term by a reci-

patient mare that is at the same stage of the estrous cycle. The standard method involves flushing the embryo out using a suitable medium using a transcervical uterine flush and then collecting it using a filter. There are various techniques for performing this procedure, but little scientific evidence as to which factors are particularly important. Clinicians can perform transrectal massage while the medium is flowing in or out of the uterus with the goal of retrieving the embryo from the endometrial folds using turbulence. Another method is to use gravity to retrieve the flushing fluid without manipulating the uterus. Oxytocin can also be used in this process. Typically, 3 to 4 flushes with 1 to 2 liters of flushing fluid each are performed to obtain embryos. If no embryos are obtained, further flushing attempts on the same day or the next day may be successful.

However, there may have been no embryo in the uterus, the lavage fluid may not have been distributed throughout the uterus, or the embryo may not have been found in the filter due to a large amount of cellular debris. Investigating the most relevant factors for embryo retrieval is important to develop the most effective and cost-effective method of embryo retrieval. This study aims to compare the recovery rate between two different embryo lavage methods: uterine massage and gravity retrieval of the medium. In addition, 1) the possibility of the embryo remaining in the tubing system that carries the lavage fluid to the filter, 2) the influence of the operator's experience on the rate of embryos retrieved, 3) the relationship between the degree of expansion of the uterine horn by the lavage fluid, the fluid remaining in the uterus after each lavage attempt, and the embryos retrieved, and 4) the probability of retrieving an embryo in each subsequent lavage attempt. It was hypothesized that uterine massage leads to the recovery of more embryos in the first flushing attempt. 10 non-lactating mares were each inseminated 6 times with semen from one stallion ($n=60$). Embryo flushes were performed 7-9 days after ovulation by 3 different veterinarians. Veterinarian 1 had already > 500 embryo flushes had been performed, while veterinarians 2 and 3 had not performed any embryo flushes to date.

Each flush consisted of 2 attempts, each using 1 liter of Ringer's lactate solution. Either the uterine massage technique (ballottement and massage of the uterus through the rectum while the Ringer's lactate solution was recovered) or the gravity technique (the return of the Ringer's lactate solution occurred without massage) was used. In both groups, 20 IU oxytocin was applied during the second flush attempt and the Ringer's lactate solution remained in the uterus for 3 minutes before the recovery was started. An additional flush attempt was performed in each group with 0.5 L of Ringer's lactate solution and uterine massage. More embryos were recovered per ovulation in the uterine massage group (17/33) than in the gravity group (8/36). In the uterine massage group, 16 embryos were recovered in the first flushing attempt and only 1 embryo in the second attempt. In the gravity group, 4 embryos were recovered per flushing attempt. The additional flushing attempt resulted in no additional embryos being recovered in the uterine massage group, while 7 additional embryos were recovered in the gravity group. Of these 7 embryos, 5 were recovered by the experienced veterinarian 1 and only 2 by the inexperienced colleagues. Overall, the embryo recovery rate for veterinarian 1 was 70% and for veterinarians 2 and 3 40% or 45%. Conclusion: Most embryos were obtained using the technique of uterine massage by the experienced veterinarian 1. ir

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Characterization of the equine placental microbial population during nocardioform placentitis

van Heule M, El-Sheikh Ali H, Monteiro HF, Scoggin K, Fedorka C, Weimer BC, Ball B, Daels P, Dini P (2024)

Theriogenology | <https://doi.org/10.1016/j.theriogenology.2024.05.025>

Nocardioform placentitis is one of the main forms of focal mucoid placentitis, which is characterized by a pronounced amorphous and lymphoplasmacytic mucoid reaction and usually forms a thick brownish exudate on the chorionic side of the placenta. This type of placentitis is recurrent and occurs more frequently in dry, hot weather. Originally, nocardioform placentitis only occurred in central Kentucky, USA, but has since also occurred in Italy, South Africa, Brazil, Australia, New Zealand and several other countries. The occurrence of nocardioform, thread-like branching bacteria such as *Crossiella equi*, *Amycolatopsis* spp. and *Streptomyces* spp. is typical. However, these bacteria are not detected in all affected mares and on the other hand they are found in the normal postpartum placenta of healthy mares. Nocardioform placentitis has not been induced experimentally. Overall, this disease in late pregnancy in mares has been little studied. Recently, it was found that nocardioform placentitis correlates with the upregulation of genes that have key functions in regulating the inflammatory cascade.

These include pattern recognition receptors such as Toll-like receptors (TLRs). TLRs are the primary and earliest recognition mechanisms for pathogen-associated and damage-associated molecular patterns, which lead to subsequent activation of the inflammatory cascade. How exactly this mechanism works is not yet known. Recently, it was discovered that the placenta, which was previously thought to be sterile, contains a microbiome. A change in the microbial composition can lead to placental diseases. In this study, the microbiome of healthy mares and mares with clinically diagnosed nocardioform placentitis was investigated. 16S rDNA sequencing was used for this purpose. For this study, the bacterial composition in the placenta (chorioallantois) of 11 healthy mares after foaling and of 22 mares with nocardioform placentitis was analyzed using 16S rDNA sequencing. A lower Shannon index and a higher Chao1 index were found in the nocardioform samples. The difference in beta diversity between the control and nocardioform samples suggests dysbiosis during the disease. In the majority of nocardioform samples (77 %) one of the following genera was found: *Amycolatopsis*, *Crossiella*, *Lentsea*, unidentified members of the *Pseudonocardiaceae* family, *Mycobacterium* or *Enterococcus*. These genera accounted for over 70% of the relative frequency. The cases examined are characterized by a high degree of variability.

While in some cases a single genus was very common, there were other cases where the 10 most common genera were each with less than 25%. Nocardioform placentitis therefore appears to have diverse pathogenic mechanisms, which would also explain the different clinical outcomes of the disease, ranging from the birth of a healthy foal to abortion. It was also interesting that 7 genera (*Actinobacter*, *Clavibacter*, *Corynebacterium*, *Curtobacterium*, *Escherichia-Shigella*, *Rhodococcus* and an unclassified species of the *Lachnospiraceae* family) were found less frequently in the nocardioform placentitis samples than in the control samples. Whether these genera may have a protective effect on the placenta still needs to be investigated further. In

summary, these data suggest that a broader spectrum of potentially opportunistic pathogens is involved in nocardioform placentitis that goes beyond the germs normally isolated. ir

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Treatment of mares with the non-steroidal anti-inflammatory drug (NSAID) phenylbutazone transiently affects in vitro maturation of equine oocytes and blastocyst development after Intracytoplasmic Sperm Injection (ICSI)

Ramírez-Agámez L, Hernández-Avilés C, Whitfield-Cargile CM, Coleman MC, Love CC (2024)

Theriogenology | <https://doi.org/10.1016/j.theriogenology.2024.04.017>

Mares used in assisted reproductive technology programs are often treated with non-steroidal anti-inflammatory drugs (NSAIDs), especially phenylbutazone, due to chronic lameness. Various studies have shown that treatment with NSAIDs during the periovulatory phase in mares leads to an increased incidence of ovulatory failure, resulting in the development of anovulatory hemorrhagic follicles. This effect is attributed to the inhibition of prostaglandin synthesis in the dominant follicle, since this hormone has been shown to be produced in increased amounts as a byproduct of the activation of inducible cyclooxygenase 2 (COX-2) in the periovulatory phase. To date, there are no studies that have investigated the effect of NSAIDs, specifically phenylbutazone, on the developmental competence of in vitro maturing oocytes intended for intracytoplasmic sperm injection. In a precursor study, immature cumulus oocyte complexes were isolated post-mortem from the ovaries of 2 healthy mares that had been treated for 10 days with 4.4 mg/kg phenylbutazone and obtained from the ovaries of 4 healthy, untreated mares and then matured and subjected to piezo-ICSI. Lower oocyte in vitro maturation (phenylbutazone 25%, 3 of 12 vs. control 61%, 28 of 46) and blastocyst rate (phenylbutazone 0%, 0 of 3 vs. control 18%, 5 of 28) was observed in the phenylbutazone-treated mares compared to the untreated control mares.

In the main study, 9 healthy mares received 4.4 mg/kg phenylbutazone for 10 days. A control group of 10 mares was treated with a placebo for 10 days. The mares underwent transvaginal oocyte aspiration under ultrasound guidance on days 3, 33 and 77 after the last day of phenylbutazone administration. Cumulus oocyte complexes obtained from both groups of mares matured in vitro and were subjected to piezo-ICSI. On day 3 after the last phenylbutazone administration, the rate of matured oocytes was similar in both groups (phenylbutazone 65%, 36 of 55; control 67%, 78 out of 116), while the recovery rate (phenylbutazone 53%; control 70%), the cleavage (phenylbutazone 31%; control 62%) and the blastocyst rate (phenylbutazone 0%; control 28%) were significantly different. On days 33 and 77 after the last phenylbutazone administration, no differences were found in oocyte recovery, in vitro maturation, cleavage and blastocyst rate between the treatment and control groups. In summary, administration of phenylbutazone for 10 consecutive days is associated with a decrease in the ability of immature oocytes to mature in vitro (precursor study) and the development to the blastocyst stage after ICSI (precursor study and main study). This negative effect

appears to be temporary, as it was no longer observed after 33 and 77 days after treatment. ir

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Success rates and factors influencing pregnancy outcome after 464 transvaginal ultrasound-guided twin reductions in the mare

Sielhorst J, Baade S, Neudeck K, Tönissen A, Rohn K, Hollinshead F, Sieme H (2024)

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The incidence of twin pregnancies after implantation in the mare has decreased over the past few years due to improved ultrasound quality. Veterinarians routinely perform early ultrasound pregnancy checks (<day 16 post ovulation) and the reduction of twins by manual expression before implantation in the uterus has a success rate of > 95%. Nevertheless, twins do occasionally occur after implantation in the uterus due to asynchronous ovulation, confusion with endometrial cysts, poor examination conditions or lack of experience of the examiner. Undetected and untreated twin pregnancies often result in abortion, stillbirths or the birth of weak foals. The management of twin pregnancies after embryo implantation in the uterus remains a challenge. There are several techniques described for twin reduction after implantation in the uterus, with the method depending on several factors including age of the embryo, location in the uterus, available equipment, experience of the performer and whether re-pregnancy is a feasible option. One of the possible methods for reducing twin pregnancies after embryo implantation in the uterus is transvaginal aspiration under ultrasound guidance (TUA). However, there is limited information regarding the factors influencing pregnancy outcomes after TUA.

This retrospective case series aimed to investigate the effects of the day of pregnancy on which TUA was performed, aspiration volume, embryo puncture, medication administered before and after TUA, age of the mare and childbearing potential, and the experience of the performing veterinarian on pregnancy and foaling rates after TUA. Data from 464 TUAs performed by 14 different veterinarians on 422 mares were evaluated. The mares were each pregnant with dizygotic twins in two different facilities between 2010 and 2019. Pregnancy status was determined by ultrasound examination between days 5-7 and 3-4 weeks after TUA was performed. Pregnancy and birth outcomes were then collected by follow-up communication. The effects of mare, pregnancy and TUA dependent variables on pregnancy and foaling rates were analyzed using a chi-square test for homogeneity and Fisher's exact test as well as logistic regression.

The result was that between days 21 and 82 of gestation in unilateral (74.4%) and bilateral (25.6%) of the twin pregnancies implanted, a TUA was performed. 5-7 days after the TUA was performed, 218/381 twin pregnancies (57.2%) had a single pregnancy, and 60/381 had twin pregnancies (15.8%) had a persistent twin pregnancy and in 103/381 twin pregnancies (27%) a loss of both embryos was found. At 3-4 weeks after the TUA was performed, 50.3% of mares pregnant with a live embryo and 40.1% gave birth to a foal. If the TUA was carried out between 25 and 35 days of pregnancy, 49.3% of mares had

a foal. These results show that transvaginal ultrasound-guided aspiration performed in early pregnancy (< 40 days) to reduce twin pregnancies achieves acceptable pregnancy and foaling rates. sd

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Intravenous administration of quinidine and metoprolol for treatment of atrial fibrillation in 2 neonatal foals

Leduc L, Abraham M, Slack J (2024)

J Vet Intern Med 38 | <https://doi.org/10.1111/jvim.17164>

The present case study describes the intravenous administration of quinidine and metoprolol to treat atrial fibrillation (AF) in two neonatal Thoroughbred foals. To date, there is only one report of a newborn foal receiving cardioversion with procainamide, as atrial fibrillation is a rarely reported arrhythmia in foals. The goal of treatment was to control heart rate and restore sinus rhythm, as AF was associated with clinical signs such as poor milk intake and reduced cardiac output. In the first case, a 15-hour-old, 52-kg colt presented with tachyarrhythmia (over 200 bpm) and difficulty suckling. Diagnostic tests, including ECG and echocardiography, confirmed atrial fibrillation without structural heart disease. After initial heart rate control with intravenous metoprolol (total 0.04 mg/kg), quinidine gluconate (1-2 mg/kg every 10 minutes, total dose: 12.5 mg/kg) was administered. The foal converted to sinus rhythm after 85 minutes, which was accompanied by a significant improvement in behavior and food intake. Despite initial atrial extrasystoles, the ECG after discharge on the fifth day continued to show a sustained sinus rhythm. The foal was later euthanized due to non-cardiac disease. The second case describes a 24-hour-old 47 kg colt that was presented due to a similar tachyarrhythmia (220 bpm).

After administration of a single bolus of metoprolol (0.04 mg/kg), the foal spontaneously converted to sinus rhythm. Echocardiography also showed no structural cardiac abnormalities. After monitoring and supportive care, the foal was discharged four days later in stable condition. Two years later, the animal remained healthy and in racing training. Atrial fibrillation in newborn foals is extremely rare and usually occurs during the transition period from intra- to extrauterine life. In both cases, no structural cardiac defects were found, and the course suggested possibly reversible myocardial compromise related to the arrhythmia or a nonspecific neonatal event. Rapid reduction of heart rate was critical because sustained rapid AF can lead to impaired ventricular filling and reduced cardiac output. Treatment with quinidine and metoprolol was effective in controlling heart rate and cardioversion. While metoprolol was used primarily for rate control, quinidine was able to achieve rapid and safe restoration of sinus rhythm. Both drugs offer a viable option for the treatment of AF in neonatal foals, particularly in the absence of structural heart disease. Long-term success depends on early diagnosis and intervention to minimize the risk of complications such as tachycardiomyopathy or heart failure. vh

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Effects of fecal microbiota transplantation on clinical outcomes and fecal microbiota of foals with diarrhea

Bell J, Raidal SL, Cuming RS, Trope G, Hughes KJ (2024)

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Diarrhea in foals is a common and potentially serious disease. Up to 80% of foals up to six months of age are affected. The causes of diarrheal diseases range from infectious pathogens such as rotaviruses, clostridia and salmonella and other pathogens to non-infectious factors. One of the most common accompanying symptoms of this disease is a disruption of the gut microbiome, known as dysbiosis. Dysbiosis can result in disruption of intestinal function, mucosal dysfunction, increased risk of inflammation and reduced immunity, which can significantly affect the health of the foal. Modifying the gut microbiome, particularly through the use of fecal microbiota transplantation (FMT), offers a promising opportunity to restore gut health. A recent study investigated the effects of FMT on foals with diarrhea. The aim of this prospective, randomized, placebo-controlled cohort study was to determine whether FMT can positively influence clinical outcomes and microbiota composition in foals with diarrhea. This study was conducted on 25 foals under six months of age treated at three different veterinary clinics. Foals were divided into either a treatment group that received FMT or a control group that received an electrolyte solution. The method of FMT involved three days of administration of freshly prepared fecal solutions through a nasogastric tube.

At the same time, clinical parameters such as heart rate, respiratory rate, white blood cell count (WBC) and other laboratory parameters were monitored. Fecal samples were also taken and analyzed for changes in the microbiome using DNA sequencing. The results of the study show interesting, but not consistently significant effects. The survival rate of the foals was comparable between the two groups (FMT: 79%; control: 100%), as was the cessation of diarrhea within seven days (FMT: 68%; control: 55%). However, a significant improvement in terms of WBC value was found in the FMT group. On day 3, the foals in the FMT group had significantly lower WBC values than the foals in the control group, indicating reduced systemic inflammation. This suggests that FMT may have an anti-inflammatory effect that contributes to improving the clinical condition. Another notable result of the study was the change in heart rate. The FMT group showed a significant reduction in heart rate over time, indicating an improvement in hemodynamic stability. This stabilization could be due to improved hydration and increased gut health through the restoration of the gut microbiota. Interestingly, microbiota analysis on day 1 showed an enrichment of bacteria from the genus *Akkermansia* and the family *Prevotellaceae* in the FMT group. *Akkermansia*, a well-known gut inhabitant, is known for its ability to maintain the integrity of the intestinal mucosa and reduce inflammation.

The enrichment of *Akkermansia* after FMT could therefore be interpreted as an indication of a positive influence on gut health. *Prevotellaceae* is also attributed an anti-inflammatory effect, which could also contribute to improved gut function and immune modulation. Despite these positive trends, the results of the microbiota analysis showed no significant changes in the relative abundance of bacteria at the phylum or genus level overall. The alpha and beta diversity analyses, which assess microbial diver-

sity within and between groups, also showed no significant differences between the FMT and control groups. These results could be due to the concomitant administration of antibiotics in many foals. Antimicrobial therapies are known to disrupt the gut microbiome and mask the effects of FMT. It must also be noted that the study was conducted across multiple clinics and regions, which could also potentially cause geographical differences in the foals' microbiome. In addition, the microbiome of young foals is not fully mature compared to adult horses, which may also have influenced the results. However, the study confirms that FMT is safe in foals and does not lead to a deterioration in clinical condition. Although no significant differences in survival rate or resolution of diarrhea were found, the improvements in certain clinical parameters show that FMT could be a potentially useful therapeutic tool for treating foals with diarrhea. Of particular note is the potential positive influence on the microbiota, which could lead to improved gut health and immune function in the long term. aa

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nonspecific neonatal event. Rapid reduction of heart rate was critical because sustained rapid AF can lead to impaired ventricular filling and reduced cardiac output. Treatment with quinidine and metoprolol was effective in controlling heart rate and cardioversion. While metoprolol was used primarily for rate control, quinidine was able to achieve rapid and safe restoration of sinus rhythm. Both drugs offer a viable option for the treatment of AF in neonatal foals, particularly in the absence of structural heart disease. Long-term success depends on early diagnosis and intervention to minimize the risk of complications such as tachycardiomyopathy or heart failure. vh

Department of Clinical Studies, New Bolton Center, University of Pennsylvania, SVM, Philadelphia, Pennsylvania, USA

Successful reconstruction of a bilaterally comminuted mandibular fracture in a foal using 2.7 locking compression plates

Henriksson S, Gorvy D, Skärllina E (2024)

Equine Vet Educ | <https://doi.org/10.1111/eve.13980>

The skull is considered a common body region for traumatic fractures in horses. Mandibular fractures often result from kick injuries. Unilateral unstable or bilateral mandibular fractures require osteosynthetic treatment using intraoral wiring, external fixation or internal plating. Locking plates ensure the highest degree of stabilization. The plating of proximal fractures of the corpus mandibulae represents a particular surgical challenge due to the low bone layer thickness, the close proximity to important vessels and regional lymph nodes, the facial nerve and the parotid duct, and the access route restricted by the atlas wing. The present case report describes such an operation in a foal with a successful outcome. The foal was a 23-day-old Swedish Warmblood filly weighing 108 kg, which had been injured on the head by a kick from the mother mare 2 days previously. After bleeding from the oral cavity, swelling developed in the area of the left jaw joint. The skin remained unharmed. The mouth was slightly open, with the rostral mandible pointing to the right. Sucking from the udder was still somewhat possible. The CT showed a closed, slightly dislocated multi-fragment fracture of the corpus mandibulae on both sides.

Despite a two-day conservative therapy attempt with meloxicam, sucralfate and milk administration via nasogastric tube, the difficulty in sucking persisted, so osteosynthetic treatment was decided upon. For this purpose, the foal was placed in a supine position under general anesthesia with xylazine, butorphanol, midazolam, ketamine and isoflurane. After tilting the head to the right, the procedure began on the left side with a 25 cm long skin incision along the caudolateral edge of the corpus mandibulae. The fracture was exposed by blunt and sharp dissection of the soft tissues, and the facial nerve was kept away from the surgical field using a Penrose drain. A 2.7 mm locking plate contoured along the angle of the mandible was then inserted and fixed with 2 locking screws in the corpus mandibulae at the level of the condyle of the mandible and 2 further locking screws on the caudal ramus of the mandible. In addition, three cortical screws were inserted near the more bony angle of the mandible. After a wound drain was inserted, a four-layer wound closure was performed. The surgical field was protected using absorbent swabs and sewn-on roll compresses. After the same procedure on the

right side and hand-assisted standing up, the foal was also given a head bandage made of tubular gauze. The anesthesia lasted just over 6 hours with an operation time of 5 hours. The foal received flunixin, sucralfate, gentamicin and penicillin until discharge one week after the procedure. Drains could be removed on the 3rd postoperative day. The dressing was changed every 3 days, or initially daily on the left side due to self-limiting wound secretion. The foal had to wear a muzzle for 3 weeks between suckling periods.

The X-ray follow-up on the 4th and 14th postoperative days showed that the implant was in the correct position. Bilateral postoperative facial paralysis resolved a few days after discharge. The control CT in the 7th week after the operation showed a fracture that was healing with slight callus formation, so that the implant could be removed. The foal recovered completely. Immediately after the implantation of the locking plates, the foal was able to suckle independently and did not require any further feeding via a nasogastric tube, which was also important for the further development of the interaction between the mother mare and the foal. The chewing load on the implants is much lower in suckling foals than after weaning, so that a plate thickness smaller than the 3.5–4.5 mm usual for adult horses was sufficient, especially since these were not usable in this case anyway due to the low bone thickness. Given the low level of mineralization in the foal's jaw, the exclusive use of cortical screws is not recommended, as these are more likely to break out of softer bone. Cortical screws could be placed in the area of the strong mandibular angle in order to withstand higher shear forces in the curved course of the plate. Fortunately, callus formation was limited. The control CT made it easier to assess the fracture progression in bones that were still weakly mineralized at a young age. The risks of a long anesthetic and considerable expense were accepted, with a favorable outcome. pp

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Effect of the use of different roughages on the consumption and behavior of newly weaned foals

Grossi de Sousa P, Raposo VS, de Magalhães HE, Lima D, Sales BP, de Oliveira AF, Jayme DG (2024)

J Vet Behav | <https://doi.org/10.1016/j.jveb.2024.06.002>

In Brazil, horses are usually fed hay, haylage or silage in combination with a supplement. Various factors, such as the challenges of producing roughage during the dry season, contribute to the increased costs of roughage production. Feed loss during feeding also plays a role. On 82.72% of farms in Brazil, maize silage represents the most important part of roughage due to climatic conditions. However, there is little scientific information on the use of maize silage in horse feeding. There are concerns about the risk of colic, as the manure has a higher dry matter content and horses ingest more starch. In addition, when feeding pelleted or highly chopped feed, there is concern that salivation is too low due to the shorter chewing phase and could result in an increased risk of gastric ulcers. The aim of this study was to assess the feed intake and behaviour of weanlings when fed different types of roughage. The study population comprised 20

recently weaned foals with an average age of 6 months and a weight of 136 kg at the beginning of the experiment. The foals were weighed at the beginning, dewormed, vaccinated and clinically examined daily throughout the study period.

Foals were divided into 4 groups of 5 animals each, fed with maize silage, conventional hay, pelleted hay or haylage. Foals were given roughage ad libitum and, to ensure adequate nutritional intake, they were also given a commercial concentrate, soybean meal and soybean oil. Dry matter intake was recorded at the beginning, middle and end of the experiment for all 20 foals. Feed intake and feeding behaviour of ten foals were additionally monitored using an automated system (Intergado®). Two behavioural observations were carried out (at the beginning and at the end of the experiment) where the foals were visually observed at 5-minute intervals for 24 hours. The results on feed intake and behaviour were analysed in a randomised block design (RBD) with split plots and the data from the Intergado® feeding system were also analysed in the RBD. Means were calculated using the Tukey test at a significance level of 5% compared. Roughage intake from pellets and haylage increased by 30.5% or 39.8%. At the beginning of the study, the highest feed intake was when hay was fed and the lowest when maize silage was given.

The foals took 64.4% more roughage dry matter in the form of hay compared to maize silage and 37.1% more than in the form of haylage or pellets. At the end of the experiment, no difference could be found between the intake of hay and pellets. However, the low intake of maize silage remained until the end of the experiment. Similar results were observed for feed intake time (FDMI) measured with the Intergado® feeding system. At the beginning of the experiment, feed intake time was the lowest with maize silage and pellets, while periods of inactivity were the longest and the frequency of stereotypies was the highest. The most common stereotypies were coprophagia and biting into steel cables or feed troughs. A comparison between feed intake at the beginning and at the end of the experiment showed a reduction in feed intake time with hay and haylage. Foals fed pellets had the shortest time for roughage consumption. The results of this study suggest that maize silage should not be used as the main feed for recently weaned foals, as this feeding led to longer periods of inactivity and increased stereotypies. For the same reasons, the use of pelleted hay at this age should be carefully considered. ag

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Effects of fecal microbiota transplantation on clinical outcomes and fecal microbiota of foals with diarrhea

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intestinal function, mucosal dysfunction, an increased risk of inflammation and reduced immunity, which can significantly affect the health of the foal. Modifying the gut microbiome, particularly through the use of fecal microbiota transplantation (FMT), offers a promising opportunity to restore gut health. A recent study investigated the effects of FMT on foals with diarrhea. The aim of this prospective, randomized, placebo-controlled cohort study was to determine whether FMT can positively influence clinical outcomes and microbiota composition in foals with diarrhea. This study was conducted on 25 foals under six months of age treated at three different veterinary clinics. Foals were divided into either a treatment group that received FMT or a control group that received an electrolyte solution. The method of FMT involved three days of administration of freshly prepared fecal solutions through a nasogastric tube.

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Despite a two-day conservative therapy attempt with meloxicam, sucralfate and milk administration via nasogastric tube, the difficulties with sucking persisted, so osteosynthetic treatment was decided upon. For this purpose, the foal was placed in a supine position under general anesthesia with xylazine, butorphanol, midazolam, ketamine and isoflurane. After tilting the head to the right, the procedure began on the left side with a 25 cm long skin incision along the caudolateral edge of the corpus mandibulae. The fracture was exposed by blunt and sharp dissection of the soft tissues, and the facial nerve was kept away from the surgical field using a Penrose drain. A 2.7 mm locking plate contoured along the angle of the mandible was then inserted and fixed with two locking screws in the corpus mandibulae at the level of the condyle of the mandible and two further locking screws on the caudal ramus mandibulae. In addition, three cortical screws were inserted close to the more bony angle of the mandible. After a wound drain had been inserted, the wound was closed in four layers. The surgical field was protected using absorbent swabs and sewn-on roll compresses. After the same procedure on the right side and hand-assisted standing up, the foal was also given a head bandage made of tubular gauze. The anesthesia lasted just over 6 hours, with an operation time of 5 hours. The foal received flunixin, sucralfate, gentamicin and penicillin until discharged one week after the procedure. Drains could be removed on the 3rd postoperative day. The dressing was chan-

ged every 3 days, or initially daily on the left side due to self-limiting wound secretion. The foal had to wear a muzzle for 3 weeks between suckling periods.

The radiological follow-up examinations on the 4th and 14th postoperative days showed that the implants were in the correct position. Bilateral postoperative facial paralysis resolved a few days after discharge. The control CT scan in the 7th week after the operation showed a fracture that was healing with slight callus formation, so that the implant could be removed. The foal recovered completely. Immediately after the implantation of the locking plates, the foal was able to suckle independently and did not require any further feeding via a nasogastric tube, which was also important for the further development of the interaction between the mother mare and foal. The chewing load on the implants is much lower in suckling foals than after weaning, so that a plate thickness lower than the 3.5-4.5 mm usual for adult horses was sufficient, especially since these could not be used in this case anyway due to the thin bone thickness. Given the low level of mineralization in the foal's jaw, the exclusive use of cortical screws is not recommended, as these are more likely to break out of softer bone. Cortical screws could be placed in the area of the strong mandibular angle in order to withstand higher shear forces in the curved course of the plate. Fortunately, callus formation was limited. The control CT made it easier to assess the fracture progression in bones that were still weakly mineralized at a young age. The risks of a long anesthetic and considerable expense were accepted, with a favorable outcome. pp

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Serum activities of complement 1q and antibodies to the virulence-associated protein A are lower in foals that develop rhodococcal pneumonia

Bettencourt A, Reiskind D, Flores-Ahlschwede P, Kahn S, Bray J, Villafone E, Ahlschwede S, Bordin A, Cohen N (2024)

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Rhodococcus equi, a gram-positive intracellular pathogen, can cause a severe form of pneumonia in foals worldwide. Virulent strains of *R. equi* express virulence-associated protein A (VapA), which is important for the replication of the bacterium in macrophages and in mice and foals to cause disease. To the author's knowledge, no licensed vaccine is available to prevent rhodococcal pneumonia in foals. In the United States, control and prevention are based on transfusion of plasma from donor horses hyperimmunized against *R. equi*. Most experimental and field studies have demonstrated a reduced incidence or severity of rhodococcosis after transfusion of hyperimmune plasma. However, conflicting evidence exists with only partial efficacy. This study aims to investigate the effects of transfusion of *Rhodococcus equi* hyperimmune plasma (REHIP) on serum concentrations of complement component 1q (C1q) and the association between serum C1q and anti-rhodococcal antibodies of newborn foals with subsequent rhodococcal pneumonia. A total of 205 foals participated in the study. All foals were born on one of 2 New York Thoroughbred breeding farms and had a history of *R. equi*-related pneumonia. All animals were treated by a co-

author. The selected foals were each born healthy between January 1, 2022 and December 1, 2022 and transfused with REHIP during their first 48 hours of life.

If the foals had other serious illnesses (neonatal isoerythrolysis, diarrhea or sepsis) they were excluded from the study. A blood sample was taken immediately before the transfusion and from the contralateral vein immediately after the transfusion. The foals were monitored for clinical and ultrasonographic evidence of rhodococcal pneumonia until weaning. Serum samples were analyzed using ELISA. C1q concentrations and IgG1 and IgG4/7 activities were determined, and virulence-associated protein A (Vap A) of *R. equi* was detected. A logistic regression analysis was performed to determine the relationship between rhodococcal pneumonia and C1q and anti Vap A IgG1 and IgG4/7 concentrations. Serum C1q concentrations varied considerably before and after transfusion. Serum C1q concentrations before and after transfusion were highly correlated. Serum concentrations were significantly lower after transfusion than before. The mean difference in serum C1q concentrations after transfusion was $-18\mu\text{g/ml}$ (95%CI, -18 to $-12\mu\text{g/ml}$). The activities of anti Vap A IgG1 and IgG4/7 recognizing Vap A were expressed as a percentage of the positive control.

Pretransfusion IgG1 activities ranged from $< 0.1\%$ to 120.5% of the positive control (average value 12.7%; SD, 18%, median value 6.7%, 25th percentile, 2.0). Pretransfusion IgG 4/7 activities ranged from $< 0.1\%$ to 173.2% of the positive control (average value 17.2%; SD, 24.8%, median value 8.2%, 25th percentile, 2.7%). Posttransfusion IgG1 activities ranged from $< 1.6\%$ to 36.8% of the positive control (average value 14.5%; SD, 7.8%, median value 13.3%, 25th percentile, 7.9%) and the posttransfusion activities of IgG4/7 ranged from 20.2% to 177.4% of the positive control (average value 80.8%; SD, 25.7%, median value 80.8%, 25th percentile, 67.8%). Taking into account farm and month of birth, the estimated probability of foals developing pneumonia was 2.1 times higher for foals whose pretransfusion C1q concentration was lower than or equal to the population median and 3.3 times higher for foals whose posttransfusion IgG1 activities were in lower quartiles. Both C1q and IgG appear to contribute to protection against rhodococci, with IgG1 appearing to be of particular importance. Increasing IgG1 concentrations, which target rhodococcal proteins in REHIP or in foal serum, appear to improve protection against foal pneumonia caused by *R. equi*. sd

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Juvenile idiopathic epilepsy in Egyptian Arabian foals, a potential animal model of self-limited epilepsy in children

Aleman M, Benini R, Elestwani S, Vinardell T (2024)

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Seizures and epilepsy are relatively rare in the horse compared to other species, and limited information exists on etiology. Juvenile idiopathic epilepsy (JIE) is the only well-characterized epileptic disorder in animals based on clinical, neurological, electroencephalographic (EEG), and histopathological investigations. Juvenile idiopathic epilepsy (JIE) has been described in

Egyptian Arabian foals. The disease typically begins between 2 days and 6 months of age. Apparent recovery without short- or long-term sequelae by 1 to 2 years of age has been noted. No sex or coat color preference has been described in affected foals to date, and no obvious precipitating events or underlying diseases have been identified. Epilepsy is manifested by sudden generalized tonic-clonic seizures with loss of consciousness without any pre-seizure signs. Postictally, cortical blindness, disorientation, drowsiness, behavioral changes, dysphagia, and abnormal gait are common. Cortical blindness is the most common postictal sign and can last from a few minutes to weeks, with vision returning within 24 hours in most foals. Affected foals are clinically and neurologically normal during the interictal period. The prognosis is good in terms of survival and also for later performance, as long as complications such as head and body trauma, corneal ulcers, and aspiration pneumonia are avoided or properly treated.

Similar to human medicine, JIE has a familial clustering and an autosomal dominant inheritance with a self-limiting pattern is suspected. The aim of the present study was to characterize epilepsy in Egyptian Arabian foals with JIE using EEG. This was a retrospective case-controlled study. The inclusion criteria were Egyptian Arabian foal breed and the diagnosis of JIE based on observed or recorded seizures as well as neurological and EEG findings. Furthermore, clinically healthy age-matched Egyptian Arabian foals without a history of epileptic seizures were selected as control animals. The foals were sedated either intravenously with xylazine hydrochloride at a dosage of 0.5 to 1 mg/kg for foals under 2 months of age or with detomidine hydrochloride at a dosage of 0.01 mg/kg for foals over 2 months of age for placement of SC needle electrodes and video-EEG recording. Foals from the second clinic were sedated with sublingual detomidine hydrochloride and lidocaine ointment was applied locally. Electroencephalography with photic stimulation was then performed under standing sedation in 37 JIE foals and 21 controls. The median age of the affected foals was 2 months, with a variation between 2 days of life and 9 months. The gender distribution was 25 female and 23 male animals. Of the 48 foals with JIE, 32 had affected siblings, 5 had no affected siblings, and 11 had an unknown sibling. There was no apparent predisposition in coat color. Among the control foals, 15 had affected siblings and 6 had no affected siblings.

Of the 48 foals with JIE, 41 animals had generalized seizures and 4 had focal seizures; the remaining 3 foals were unknown, but these horses had postictal signs such as cortical blindness, tongue paresis, and ataxia. Focal seizures in foals included changes in facial motor function, increased chewing, trismus, and tongue paresis that occurred. The duration of the seizures (focal-generalized) ranged from 20 seconds to 2 minutes, with 65% of foals lasting less than 1 minute. Postictal signs included disorientation, cortical blindness, mydriasis, decreased palpebral reflex, loss of sucking reflex, dysphagia, tongue prolapse, proprioceptive deficits in the limbs, and ataxia. The duration of these signs varied from a few minutes to days. Blindness was the sign that was observed for a few minutes to weeks. The foals were neurologically normal between seizures. The majority of the foals received monotherapy with phenobarbital (28), levetiracetam (8) or gabapentin (1). Combination therapy to control seizures was necessary in 7 foals. These received the combination of phenobarbital/levetiracetam (4) or phenobarbital/potassium bromide (3). A positive response to this treatment was observed in 39 of 44 foals.

Therapy was administered to the majority of foals for a median of 6 months, with a variation between 2.5-9 months. EEG changes were observed in 95% of epileptic foals (35 of 37) and in 3 of 21 symptom-free control foals with affected siblings. Focal epileptic discharges were mainly observed in the central vertex with spread to the centroparietal or frontocentral regions (35). Generalization of epileptic discharges occurred in 14 JIE foals. Epileptic discharges were frequently observed during wakefulness (27/37 JIE foals) and during sedation sleep (35/37 JIE foals; 3/21 controls). Photic stimulation elicited focal central epileptic discharges in 15 of 21 JIE foals. In 3 foals, in which no previous history of seizures had been observed, the interictal EEG examination was able to detect epileptic discharges. The results of this study show that juvenile idiopathic epilepsy has a focal onset of epileptic discharges in the central vertex with spread, resulting in clinical generalized tonic-clonic seizures with facial motor activity and loss of consciousness. ag

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Carbohydrate digestion in the stomach of horses grazed on pasture, fed hay or hay and oats

Bachmann M, Schusser G F, Wensch-Dorendorf M, Pisch C, Bochnia M, Santo M M, Netzker H, Weitow G, Thielebein J, Kesting S, Riehl G, Greef J M, Heinichen K, Zeyner A (2024)

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The microflora that colonizes the gastric mucosa and lumen appears to participate in digestion through the fermentation of carbohydrates. Starch is a biopolymer composed of amylose, amylopectin, and lipids embedded in a protein matrix. The pre-caecal digestibility of starch is influenced by the morphology of the starch granules. In pasture grass, the carbohydrate fructan, of the levan type, predominates. As the grass matures, this storage carbohydrate accumulates. In the stomach and small intestine, starch is hydrolyzed to glucose by gastric acid as well as by microbial enzymes or endocrine enzymes. Fructans, on the other hand, are fermented microbially. The microbial fermentation of glucose and fructose, which also occurs in the stomach, produces organic acids. The pre-caecal digestibility of starch is limited. However, digestibility is still up to 98% even when high intake levels are exceeded. Excessive starch intake is correlated with equine gastric ulcer syndrome and also with the risk of inflammation of the entire gastrointestinal tract, colic, dysbiosis and altered carbohydrate metabolism. Fructose, which comes from the fermentation of fructans, is metabolised differently than glucose and triggers a less strong insulin reaction, but could cause similar problems to starch. Hyperinsulinemia triggered by glucose or fructose can reduce insulin sensitivity and thus trigger insulin resistance, and hyperinsulinemia is correlated with the development of laminitis. The dose of 7.5 g oligofructose/kg LM thought to be responsible for laminitis is reached when horses eat grass in the pasture, although horses do not become ill when they eat it in the pasture.

The aim of the present study was to assess the extent to which carbohydrates are metabolized in the stomach. Ash insoluble in hydrochloric acid was used as a potential non-digestible marker.

The study population comprised 24 horses with an average age of 11 years, a weight of 471 kg, an average body condition score of 5.1 out of 9 and a fat comb score of 1.0 out of 5. Four of the animals were pastured for 24 hours, 8 horses received hay ad libitum, 6 animals received hay ad libitum and grain in an amount of 1 g starch per kg body weight per meal (OS1) and 5 horses received hay ad libitum and grain in an amount of 2 g starch per kg body weight per meal (OS2). This feeding was carried out for at least 34 days. Grass samples were taken before being moved to the pasture and at the end of the experiment. Furthermore, there was a gradual adaptation to grazing, in that this was initially increased to 8 hours by day 13 and the horses then remained on the pasture for 24 hours. At the end of the test, the horses were euthanized and a necropsy was performed. The stomach was removed, weighed and the entire contents were taken. Samples were taken from the area of the pars glandularis as well as the pars non- glandularis . The next step was to determine the concentrations of starch, mono- and disaccharides, fructans and amino acids, dry matter (TS), crude ash (RA), crude protein (RP), crude fat (crude fat content after acid ether extraction , AEE), crude fiber (RF), neutrally detergent fiber (aNDFom), acid- detergent fiber (ADFom) and acid - detergent lignin (ADL).

The starch concentration in the stomach contents of horses that had consumed 1 g of starch was 337 g/kg of dry matter, and in horses that had consumed 2 g of starch per kilogram of body weight it was 414 g/kg of dry matter. The starch concentration in the stomach contents decreased depending on the amount administered. A 44% reduction was found when 1 gram of starch per kilogram of body weight was administered, and a 29% reduction was found when 2 g of starch per kilogram of body weight was administered. In horses that were kept on pasture alone, fed hay alone, and fed hay and grain (1 g of starch per kilogram of body weight), the reduction in the glucose, fructose, and sucrose concentration in the stomach contents was much more pronounced than in horses that had received 2 g of starch per kilogram of body weight. If the horses were only fed hay or were left to pasture, the sucrose was completely broken down in the stomach. The fructans were mainly broken down in the pars non- glandularis in horses that were kept on pure pasture (84% reduction) and in horses that were fed pure hay (54 % reduction). If the ration contained a higher proportion of starch (OS2), no reduction in the fructan concentration could be detected. Horses that were fed pure grass showed signs of fiber breakdown in the stomach. The results of this study show that, depending on the ration composition, soluble carbohydrates are broken down in the stomach , which may change the composition of the microbial stomach flora and the endogenous reaction. ag

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Chewing analysis of horses consuming bermudagrass hay in different styles of slow feeders as compared to loose hay

Hart R, Bailey A, Farmer J, Duberstein K (2024)

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Due to the intensive horse husbandry, the feeding of the horses changed. The animals were no longer kept in the pasture all day, but in the stable and were fed grain and hay. Compared to fresh

grass, the water content of hay is lower and therefore the feed mash that passes through the gastrointestinal tract may be drier and possibly more concentrated in terms of nutrients. These factors may account for the higher prevalence of gastrointestinal diseases including gastric ulcers and colic. In the southeastern United States, bermudagrass is the main crop and is both grazed and processed into hay. It appears to be a potential risk factor for the development of constipation. The mechanisms underlying this problem are not known. Bermudagrass appears to linger longer in the intestinal tract due to its higher hemicellulose and lignin content. The effects of stalk size on the chewing process of horses have not yet been investigated. It is known that hay with fine stems is chewed less well. An inadequate reduction in particle size and saliva production increases the risk of constipation. Saliva is produced during hay intake. This contains sodium bicarbonate, which has buffering properties and is therefore of particular importance with regard to gastric ulcers. Horses should therefore have the opportunity to continuously consume roughage.

Different hay nets are offered to ensure longer hay intake. The aim of this study was to determine whether the feeding of bermudagrass hay via a hay net influences the purchase frequency compared to the feeding of loose hay. Furthermore, the influence of different types of hay nets was assessed. On the one hand, the chewing frequency and duration as well as the distribution of chewing processes over the feeding period were recorded. The different hay nets had different mesh sizes (large and small) and a varying number of openings. In one hay net, the horses could only pick up the hay through a single hole. It was an experimental setup corresponding to a Latin Square 4 x 4 with 8 horses. The animals were first given a 24-hour familiarisation phase before the chewing pattern of the animals was recorded over 24 hours. The latter was recorded using a halter with pressure sensors in the noseband. Initially, the horses consumed the hay via a hay net with a single large hole (346 cm²), in the next phase the hay net had many large openings (132.25 cm²), the hay net used thereafter had openings of 30.25 cm² and in the final stage of the experiment the hay was made available directly on the ground. The amount of hay fed was 1.5% of the horses' body weight divided into two feedings. Any hay not consumed was collected and weighed.

On the one hand, the number of chewing strokes required per kilogramme of hay was recorded and thus the duration of the chewing process calculated and, on the other hand, the chewing frequency was determined. Furthermore, the proportion of chewing strokes in the first 120 and 240 minutes of the feeding phase was determined. The results of the study imply that the use of a hay net is not able to influence the total hay intake. The horses consumed an average of 6.8 kg of hay per day regardless of how the hay was offered. For the intake of 1 kg of hay, 3538 ± 138 chewing strokes occurred regardless of whether the hay intake was via a net or the hay was loose on the ground. However, the use of hay nets was found to have an influence on the duration of the chewing process. When using the hay net with the small meshes, the time in which the horse chewed was longer than when the hay was lying on the ground (518 ± 36 vs. 378 ± 21 min.). The horses showed a higher proportion of chewing during the first 120 and 240 minutes in the morning compared to the evening feeding. The authors hypothesise that this was due to the longer starvation phase during the night. The results of this study therefore show that the time of feed intake can be increased when using hay nets with a small mesh size.

When hay was fed through a hay net with small mesh openings, the horses chewed for an average of 140 minutes longer per day compared to eating loose hay on the ground. However, the frequency of chewing was not influenced by the way the hay was presented. ag

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Nutritional management of hyperlipaemia in a jenny: a brief report

Morrone S, Sechi S, Carta C, Senes A, Cocco R, Pinna P, Pargaglia M L, Sanna Passino E, Cappai M G (2024)

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Donkeys are very efficient at digesting fiber. Compared to horses, donkeys have lower energy requirements (50-75% of the horse's maintenance requirements). Diseases that are often caused by incorrect feeding of donkeys include obesity, metabolic or hormonal changes, hyperlipidemia and laminitis. Donkeys are very susceptible to developing hyperlipidemia when there is a negative energy balance. This involves fat mobilization, and if the low energy intake continues for a long time, fat stores are depleted and liver function is strained. With long-term low energy intake, insulin synthesis is downregulated due to the low glucose concentration in the blood. This triggers the activation of lipase and fat mobilization in the fat deposits. The mobilized fatty acids from the fat cells bind to albumin and are transported to the liver via the bloodstream. High plasma concentrations of free fatty acids and thus of the measured parameter triglycerides (> 4.4 mmol/L) are referred to as hyperlipidemia. If the liver is overloaded, the fats cannot be converted into energy substrates and ultimately there is a possibility that acetoacetic acid, acetone and beta-hydroxybutyric acid (ketone bodies) are synthesized and these mediators can cause loss of appetite. There is also the possibility that liver lipidosis can develop due to an excessive concentration of circulating fatty acids that reach the liver and overburden it.

The severity of the clinical symptoms and the development of liver lipidosis are influenced by the body condition score and the body fat percentage. This publication describes the care of a donkey mare with hyperlipidemia. The 5-year-old mare weighing 88 kg (normal weight for this breed is 100-130 kg) was referred to the clinic with loss of appetite, jaundice, increased heart rate (60 beats per minute), dehydration, reduced intestinal motility and recurrent fever. The mare's body condition score was 3 out of 9 and the animal was severely malnourished. The oral cavity examination was unremarkable. The blood test showed a reduced albumin concentration as well as signs of a systemic inflammatory reaction and increased liver enzyme activity. The triglyceride concentration was 8.7 mmol/l with a normal value of 0.6-2.87 mmol/l. Ultrasound examination revealed an enlarged liver with hyperechogenic parenchyma. Based on the clinical findings, hepatic lipidosis was diagnosed. First, the donkey was rehydrated and given anti-inflammatory, antipyretic and analgesic medication with flunixin for 5 days. The animal was also given omeprazole and, based on the results of the stool sample – positive for anoplocephala and strongyles – ivermectin and praziquantel. Feeding management was divided into 2 phases. During the first phase, in which the donkey showed reduced feed intake and

severe malnutrition, straw and highly digestible hay were offered on the one hand and increasing amounts of muesli (starting with 50 g per day) and a vitamin supplement were fed by hand.

Hay intake was 1.8 kilos per day and straw was provided ad libitum. The vitamin supplement contained the following nutrients: 6 mg canocobalamin, 500 mg thiamine hydrochloride, 1 g dl-acetylmethionine, 250 mg l-carnitine and 150 mg dl-[7:a] α -tocopherol. The donkey mare also had free access to pasture. After a week in the clinic, the mare was able to eat hay and straw and her body condition score rose to 4 out of 9 and her weight to 97 kg. The second phase of feeding management now began with the aim of achieving a physiological nutritional status. The mare now had 1.5 kg of hay per day available, as well as straw and unlimited grazing. Concentrated feed was also continued to be fed in an amount based on energy requirements, assuming an optimal weight of 110 kg. The energy requirements were calculated using the following formula: $DEm = 109.94 \text{ Kcal} \times 110 \times 0.75 = 3734.22 \text{ Kcal} = 3.73 \text{ Mcal}$ required per day. 4 weeks after the start of the 2nd feeding phase, blood samples were taken again and the values had improved significantly. The donkey's weight was now 112 kg. The weight gain per day was therefore 0.53 kg in the 2nd phase. ag

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Feeding behaviour related to different feeding devices

Greppi M, Bordin C, Raspa F, Maccone E, Harris P, Ellis A D, Cavallini D, Bergero D, Valle E (2024)

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For stabled horses, it is often not possible to limit the fasting period during the day to no more than 4-5 hours. Since long fasting periods in horses are correlated with problems of the gastrointestinal tract, the aim is always to keep this fasting period as short as possible. Different feeding systems are used in this regard, including hay nets, hay bags and 'slow feeders'. These have the advantage of slowing down hay intake. However, this effect depends on the type of system and the breed and the individual. Studies on Shetland and Welsh ponies have shown that the time for hay intake can be increased by up to 61 % compared to hay intake from the floor. Other advantages of these systems are the reduction in hay loss, improved hygiene and the horses ingest less bedding. However, there are also negative aspects in that behavioral changes occur which indicate frustration in the animals. Horses also exhibit laterality, similar to humans, one indicator of this is the preference for one forelimb. With regard to feeding, there are no study results on whether this laterality influences the preference for different feeding systems. The aim of the present study was to record the feeding behavior of ponies depending on different feeding systems and depending on the breed type.

The 9 ponies, belonging to two different breeds (Shetland and Welsh/ Cob), were video monitored during feeding and their behavior was analyzed. The ponies had an average age of 12 years and a body weight of 222 kg. The BCS was between 6.5 and 8.5 out of 9. At the beginning of the study, their dental

health was checked. Before the experiment began, the ponies were given hay three times a day to ensure they consumed 2% of their body weight. The ponies were divided into two groups according to the animals' morphology. The hay is given in four different ways: from the floor (G), a completely filled hay net (HF), a partially filled hay net (HL) and via a 'slow feeder box'. Before the video recordings began, there was an adaptation phase lasting 5 days and according to a 2x4 Latin square design, the animals were given either 3 kg of hay from the ground, 3 kg of hay in a hay net with small openings, 1 kg of hay in a hay net with small openings or 3 kg of hay in the 'Slow Feeder Box'. During the 3-hour observation phase, video recordings were made for 15 minutes at the beginning, middle and end of the phase. When reviewing the video recordings, the behaviors were divided into laterality-related behavior (head tilting and forelimb preference), signs of frustration and postural feeding behavior.

The reference to placing the left or right front leg forward when eating was evenly distributed. A connection between placing the front leg forward and the side to which the head was tilted when eating could not be proven. In comparison to feeding from the floor and from the hay box, the head was turned to the side more often when fed from a hay net. In contrast, placing the front limbs forward while eating was less common when fed from a hay net. The ponies, especially the Welsh/ Cob, showed more laterality to the left. When the hay was offered in a net - especially when the hay net was filled with 3 kg - the ponies' ears were laid back more often. This was also observed more often in Welsh/ Cobs. The blink rate was higher when fed from the floor. Head butting against the hay net, pawing with the front legs or bumping with the front legs against the hay net or the box were not observed. Hay feeding significantly influenced the postural eating behavior of the ponies. When the hay net was filled with 3 kg, more feed was taken from the upper part of the hay net and the neck was more bent compared to when fed from a half-full hay net. This behavior was not observed with either the hay box or when fed from the floor. If the hay net was not completely full or the hay was taken from the box, the neck was more bent than with the other two feeding methods. The study shows that posture when eating, frustration behavior and laterality as well as limb position are influenced by the feeding system. When hay is fed from nets, the head is more inclined and the ears are laid back more often than when fed from the floor or from a hay box, which could indicate increased frustration when fed from the hay net. Thus, feeding hay from the 'Slow Feeder Box' is a variant that is most similar to natural feed intake. ag

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Monitoring the physiological inflammatory alertness in horses after road transport

Arrigo F, Aragona F, Faggio C, Giudice E, Giannetto C, Piccione G, Rizzo M, Arfuso F (2024)

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Transport, including loading and the vibrations during the journey, can be very stressful for animals and inflammatory reactions may be activated. One of the better-known inflammatory reactions in this regard is the acute phase reaction. After activation of receptors, the acute phase proteins are synthesized in the liver

and a rapid, non-specific reaction occurs after any type of injury. The psychological stress of transport causes catecholamines and glucocorticoids to be released as a mark of acute stress. Other hormones that are increasingly synthesized in a stressful situation are pro-inflammatory cytokines, the interleukins. Long transport can influence the immune function of horses. The present study was intended to record the changes in pro-inflammatory interleukins in horses that had been transported over a distance of 150 km for training. 10 horses that were regularly trained were available for the study. The transport began immediately after the animals were loaded and the horses received neither water nor feed during the transport. The outside temperature during transport was 22°C and the relative humidity was 50%.

The horses had been clinically examined before transport and showed no signs of disease-related problems and were not agitated. There were two transports from the training site to the competition site and back, the latter after three days of competition. Before loading and after each transport (5 minutes; 1 hour), blood samples were taken and the concentrations of the following parameters were determined: interleukin 1, 1, 2 and 6 (IL-1, IL-1, IL-2, IL-6). This study was carried out on 10 show jumpers. After the first transport, a significant decrease in the IL-1 alpha concentration was found both after 5 minutes and after 1 hour. 5 minutes after the first transport, the concentrations of IL-1 beta, IL-2 and IL6 had increased compared to the values before transport and 1 hour after the first transport. Statistically significant changes in the pro-inflammatory interleukin after the second transport could not be detected. The IL-1 alpha values tended to be higher before the first transport than before the second transport and the interleukins 1 beta, 2 and 6 showed higher concentrations after the first transport compared to the values after the second transport. These results imply that the first transport triggered an inflammatory reaction. Although the horses were all used to transport, the transport represented a stressful situation for them. ag

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The effect of pre-dosing with metformin on the insulin response to oral sugar in insulin-dysregulated horses

Colmer SF, Adams AA, Adam E, Miller R, Stefanovski D, Kulp JC, van Eps A (2024)

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Laminitis, as a result of an underlying endocrinopathy, either due to pars intermedia pituitary dysfunction (PPID) or equine metabolic syndrome (EMS), affects 15% of horses in industrialized countries. Insulin dysregulation appears to be the critical component in PPID and EMS leading to laminitis. Hyperinsulinemia directly damages the hoof lamellae. Despite this knowledge of the importance of controlling hyperinsulinemia, drug therapy is limited. Velagliflozin is able to effectively reduce hyperinsulinemia and prevent laminitis in experiments, and other SGLT-2 inhibitors also appear to be successful in treating insulin dysregulation (ID). However, no approved products exist for horses. Metformin is an anti-hyperglycemic drug used in humans to treat type 2 diabetes. Studies conducted in horses have shown conflicting results regard-

ding its effect on insulin sensitivity in horses and ponies. In addition to its effects on insulin sensitivity, metformin is able to reduce glucose absorption in the gastrointestinal tract. This mechanism is believed to be the most important in horses. It has been shown that when metformin is administered 1 hour before oral dextrose, the maximum concentration of glucose and insulin is reduced in both healthy and ID horses.

The aim of the present study was to compare the insulinemic and glycemic responses to an oral glucose test at different times after administration of a single dose of metformin in horses with naturally occurring ID. Eight adult horses with ID were available for the study. ID was diagnosed via an oral glucose test in which a blood sample was taken 75 minutes after administration of the grain syrup. In the horses for this study, the insulin concentration had to be $>65 \mu\text{IU/ml}$ at this time in order to theoretically achieve a 50% reduction in concentration due to metformin administration during the further course of the study. The next step was acclimatization 6 weeks before the start of the experiment. The horses were given hay ad libitum and kept in a paddock. The next step was the oral glucose test. Blood samples were taken at 0, 60 and 90 minutes after administration of 0.45 ml/kg light corn syrup and insulin, glucose and C-peptide concentrations were measured. After one week, the oral glucose test was repeated one hour after administration of metformin at a dosage of 30 mg/kg.

After a wash-out period of 7 days, the test was repeated 2 or 6 hours after metformin administration. Metformin administration had no significant effect on glucose, insulin or C-peptide concentrations at any time compared to placebo (water). When metformin was administered 1 hour before the test, the median plasma insulin concentration 60 minutes after corn syrup administration was 91.3 (62.4-114.9) IU/mL compared to 76.2 (59.1-134.5) after placebo and 62.7 (31.4-109.7) after 90 minutes compared to 51.8 (29.2-126.3) after placebo. These results indicate that treatment with metformin is not effective in reducing postprandial hyperinsulinemia in horses with naturally occurring insulin dysregulation. ag

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Obesity and obesity-associated metabolic disease conditions in Connemara ponies in Ireland

Al-Ansari AS, Golding E, Walshe N, Mooney CT, Duggan V (2024)

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Obesity in horses is associated with insulin dysregulation (ID), hyperlipidemia and endocrinopathic laminitis. Equine metabolic syndrome (EMS) causes a number of risk factors that can ultimately lead to endocrinopathic laminitis. Horses and ponies with this condition are predisposed to laminitis, which develops in the absence of other causes such as excessive grain intake or systemic high-grade inflammatory disease. Insulin dysregulation is the key feature of EMS and is characterized by an alteration of the physiological homeostatic balance of insulin, glucose and lipid

concentrations in plasma. Insulin dysregulation can include an increased basal insulin level, an altered insulin response to oral or intravenous carbohydrate administration or insulin resistance in tissues, which is manifested by hypertriglyceridemia. The prevalence of obesity in ponies is significantly higher than in horses and varies from 24% in adult Icelandic horses in Denmark to 54% in the United Kingdom in recreational horses. In Ireland this percentage was 45%. The aim of the present study was to assess the prevalence of obesity in Irish Connemara ponies and to evaluate whether the evidence of ID or laminitis in these ponies could be predicted by morphometric or metabolic parameters.

The study population included registered Connemara ponies recruited through public and veterinary social media. Ponies were clinically examined and information on their husbandry and clinical history was collected via an owner questionnaire. Body condition score (BCS) was measured using the Henneke system; fat crest score (CNS) and distribution of regional fat pads were also assessed. Hyperinsulinemia was confirmed by measuring serum basal insulin concentration (BIC) or insulin concentration after an oral glucose test (OST). Blood glucose and triglyceride concentrations were also measured. In addition, ACTH concentrations were determined in ponies over 10 years of age. Characteristics of hyperinsulinemic and insulin-sensitive ponies were compared by logistic regression.

Data from 200 ponies could be evaluated. Samples were taken in September 2021, February 2022 and April-July 2022. 56% of the samples were taken between May and July 2022. The age of the animals varied between 5 and 26 years and was on average 13 years. There were 135 mares and 65 male animals. 100 of the horses were used for sport and the remaining 100 horses were breeding animals or were kept on pasture and had only limited contact with people. 59 ponies (29.5%) had a BCS ≥ 7 , 58 (29.0%) a CNS ≥ 2.5 and 135 (67.5%) had regionally limited fat pads. 137 (68.5%) ponies showed at least one of the characteristics mentioned. 12.5% of the animals had previously suffered from laminitis. Divergent hoof rings were found in 82 ponies (41%). Overall, 46% of the ponies were categorised as suffering from laminitis. Plasma glucose concentrations varied between 2.75 and 10.15 mmol/l. 5.6% of the ponies showed hyperglycemia. Triglyceride concentrations varied between 0.1 and 1.9 mmol/l and 6.1% of the animals had hypertriglyceridemia.

The oral glucose test was performed on 91 ponies and in 23 ponies the insulin concentration 60-90 minutes after administration of the sugar solution was $>45 \mu\text{IU/l}$, corresponding to hyperinsulinemia. The basal insulin concentration was determined in 109 ponies and varied from less than 2 to $282 \mu\text{IU/L}$. Hyperinsulinemia was diagnosed in 8.3% of the horses. In total, 32 ponies had hyperinsulinemia. The logistic regression analysis of 200 ponies with hyperinsulinemia and 168 ponies with physiological insulin concentration showed that the probability of hyperinsulinemia increased by a factor of 6.53 when the BCS was ≥ 7 . In addition, a high comb fat score was associated with hyperinsulinemia in 43% of the ponies. The results of the study show that the prevalence of obesity in the Connemara ponies was 30%. Hyperinsulinemia was diagnosed in 25% of the ponies via the oral glucose test and in less than 10% via the basal insulin level. ag

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Relationships between total adiponectin concentrations and obesity in native-breed ponies in England

Barnabé MA, Elliott J, Harris PA, Menzies-Gow NJ (2024)
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Basal hyperinsulinemia and hypoadiponectinemia are independent risk factors for the development of endocrinopathic laminitis. Both hormones can be measured in the blood. The determination of morphometric parameters is a non-invasive alternative. Correlations between different morphometric measurements and adiponectin concentrations have been found in both horses and ponies. Both subjective measurements such as the body condition score (BCS) and the comb fat score (CNS) as well as objective measurements such as weight, neck and thorax circumference were taken into account. In previous studies, BCS was positively correlated with total weight, fat mass and fat percentage, as well as inversely associated with adiponectin and positively associated with basal insulin concentration. However, it should be noted that the relationship between BCS and fat content is not linear in horses with a high BCS >7. Furthermore, owners are not able to accurately determine the BCS of their animals. The CNS is associated with an increased risk for the development of metabolic diseases and the development of pasture-associated laminitis. Furthermore, the CNS is associated with low adiponectin concentrations. The aim of the present study was to determine the relationships between obesity, morphometric measurements and the total concentration of adiponectin in the blood. In addition, a statistical model was to be developed with which ponies with an increased risk for altered adiponectin levels could be identified using simple and inexpensive measurements.

Data from three previous studies were retrospectively analyzed and cohorts were combined where possible ($n=734$ ponies). Cohort 1 comprised 446 clinically healthy ponies with no history of laminitis at an age of ≥ 7 years who were examined once in August 2010. Cohort 2 comprised 209 clinically healthy ponies who were assessed once in September or October 2015. Cohort 3 comprised 79 ponies examined in May 2010. Of these, 38 had a history of laminitis and 41 did not. Age, breed, sex, weight, height and weight-to-height ratio were recorded for all animals. In cohort 2, weight was determined using a scale and estimated using a tape measure in cohorts 1 and 3. BCS was recorded according to the method of Henneke et al., and in cohort 2 ponies the comb fat score was also determined. Blood samples were taken from non-fasted animals and basal insulin concentration and adiponectin (TA) concentration were analyzed. Correlations between TA, age and morphometric parameters were assessed using the Spearman correlation coefficient. The level of TA concentration was compared between animals of different body condition classes (ideal weight, overweight and obese), breeds and body shapes using the Kruskal-Wallis test with Dunn's post hoc tests and between sexes using the Mann-Whitney U test. The proportions of obese and normal weight ponies with basal hyperinsulinemia and/or hypoadiponectinemia were compared using a chi-square test for homogeneity and a post hoc z-test.

BCS, weight, height, and height-to-weight ratio were significantly positively correlated with TA. No correlation was found between TA and crest fat level, thickness, or CNS. There were significant differences in TA in ponies of different BCS group classification,

body shape, and breed. Obese ponies had the highest concentrations of total adiponectin ($1.96\text{--}4.79\mu\text{g/ml}$) and ideal weight ponies had the lowest ($1.04\text{--}3.03\mu\text{g/ml}$). A greater percentage of obese (54.6%) than normal weight ponies (33.1%) had both physiological TA and physiological basal insulin concentrations, and a greater percentage of normal weight (38.6%) compared to obese (16.5%) ponies had hypoadiponectinemia. TA was significantly lower in Shetland ponies compared to Welsh ponies. Neither gender nor age had a significant effect on TA. Weight:height and BCS group were significant variables in a logistic regression of hypoadiponectinemia, but model fit and prediction accuracy were poor. The results of this study showed that the expression of morphometric parameters such as BCS does not allow conclusions to be drawn about the level of total adiponectin concentration. ag

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Insulin dysregulated horses metabolic responses to forage pellets

Macon EL, Harris P, McClendon M, Perron B, Adams A (2024)
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Insulin dysregulation is a collective term for basal and postprandial hyperinsulinemia and tissue insulin resistance. Hyperinsulinemia is a characteristic of equine metabolic syndrome, but any horse can exhibit hyperinsulinemia, particularly with diseases such as dysfunction of the pars intermedia of the pituitary gland and/or the ingestion of a diet with a high carbohydrate content. The most important problem of ID is the development of laminitis. The ingestion of feed with a high content of easily soluble carbohydrates (NSC; starch + water-soluble carbohydrates) can trigger hyperinsulinemia-associated laminitis. Therefore, the intake of NSC should be reduced. The current recommendation is to feed a roughage-based ration with a low NSC content (< 10%–12% of dry matter). There is only limited scientifically based information on the insulinemic response to roughage in horses with insulin dysregulation. One study showed that ponies with insulin dysregulation (ID) had a more pronounced insulin response after feeding roughage compared to ponies without ID. All ponies with ID had a more pronounced insulin response after feeding roughage, and when comparing the different roughages, the response after feeding hay dipped in water was less pronounced. In the present study, the acute metabolic response after feeding a small amount of roughage pellets with varying crude protein content and at the same time low NSC content (–10% NSC, DM basis) was compared with a positive control (high NSC) and negative control (low NSC) in both horses with ID and without ID. This was a randomized crossover study.

Eight adult horses with ID and seven animals without ID were available for the study. For this classification, an oral sugar test was carried out before the start of the study. All animals received five different rations according to a 5×5 Latin square design. Insulinemic responses to three roughage pellets (1 g/kg BW) (timothy hay, TH, 9.5% CP & 10% NSC TS; alfalfa hay, AH, 16.3% CP & 9.8% NSC TS; timothy alfalfa hay; TAH, 17.2% CP & 9.8% NSC TS) as well as to a positive (oat; OG, 14.7% CP & 59.7% NSC TS) and negative control (low NSC content; LNSC, 12.8% CP & 5.4% NSC TS) in ID ($n=8$; 16.1 ± 2.2 years;

565.4 ± 99.1 kg) were recorded. Blood samples were taken before and 60, 90 and 120 minutes after pellet administration and serum insulin and glucagon-like peptide 1 concentrations were determined. To assess differences in insulinemic responses, the positive incremental area under the curve for insulin (IAUC_i) was calculated for all horses and diets. IAUC_i is the summation of increases from baseline insulin for each animal (ie, the calculation only takes into account values above the baseline insulin for each individual animal). Delta insulin (DI) values were calculated by peak insulin - baseline insulin.

All horses were healthy throughout the study and showed no signs of laminitis. The IAUC_i of the positive control in horses without ID was higher compared to all other pellets. The maximum insulin values were higher when fed the oats and the timothy alfalfa hay compared to the other pellets. The insulin concentrations of the NID horses at the 60 and 90 minute time points did not differ from each other for LNSC, TH, AH and TAH (~ 18.4 ± 1.5 IU/mL). However, they were different from the positive control. The delta values of the pellets differed in the NID horses only compared to the positive control. All IAUC_i values for ID horses were higher than the corresponding IAUC_i for NID horses. The maximum insulin values as well as the delta values were higher in ID horses after oats compared to all other diets. Maximum insulin concentrations of the different diets did not differ in the ID horses from those obtained when feeding the negative control. Incretin (tGLP-1) did not differ with time, diet, or the interaction of time and diet for NID or ID, and between NID and ID horses. No statistical significance was found when only incretin values from individual animals that showed an insulin response were evaluated. The lack of greater insulin response of the ID horses to the low NSC feed pellets (fed in small amounts) suggests that they may be a safe feed source for ID animals. ag

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Upper airways endoscopy in exercising horses: Findings in 164 barrel racing horses with respiratory clinical signs and/or poor performance

Massie SL, Léguillette R (2023)

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Upper airway obstructions are common in sport horses and can impair performance under stress by negatively affecting lung ventilation and gas exchange. The animals often show no abnormalities when at rest and the symptoms are not always associated with abnormal breathing sounds during work. High-speed treadmill studies have shown that, depending on the breed and discipline, 30-81 % of horses with breathing sounds and/or poor performance have upper airway obstructions. In field studies, the proportion was as high as 80-91 %. Western horses, especially Quarter Horses, have not yet been explicitly included in these studies. Barrel racing is a high-performance anaerobic sport in which the animals gallop through a cloverleaf-shaped course in a prescribed, standardized pattern in under 20 seconds. The aim of the present study was to determine the prevalence of upper airway obstructions in this sport horse population and to document the findings. For this purpose, the medical records of 164

Quarter Horses were retrospectively evaluated. They had been subjected to stress endoscopy under standardized conditions with video documentation due to respiratory symptoms and/or poor performance. The following clinical symptoms were documented in the previous report: abnormal breathing sounds, coughing, exercise-induced pulmonary bleeding, behavioral abnormalities (e.g. stress/anxiety, refusal to enter the track, constant head shaking) and poor performance.

For the stress endoscopy, the endoscope was inserted into the animal's left nostril without sedation, if necessary with the application of a nose brake, and advanced to the level of the air sac valve so that the epiglottis and soft palate were clearly visible. In this position, the endoscope was attached to the bridle. The endoscope's working unit was either in a pocket on the saddle pad or in a backpack on the rider's back. Video recordings were made at rest, immediately after insertion of the endoscope, and during a standardized stress test under the usual rider. The test consisted of 10 minutes of light warm-up work („low stress“) followed by up to 3 barrel racing laps under test conditions or a comparable sprint stress on a straight 100m track with a 180° turn („high stress“). The video recordings were evaluated and the findings classified according to the standardized nomenclature. The subjects were between 2 and 23 years old (mean 9.1 ± 3.9). They tolerated the stress endoscopy well. More than one bronchoscopy was performed on 8 animals, with an interval of at least one year. The most common clinical symptom described was an abnormal breathing sound (34.1 % of subjects), followed by poor performance (22 %) and behavioral abnormalities (17 %). 11 animals had previously undergone surgery in the upper respiratory tract, including 6 „tie forward“ operations, 2 laser cordectomies, 2 arytenoidectomies and one removal of an epiglottic cyst. These patients either showed new symptoms or persistent abnormal breathing sounds and/or poor performance. 76.8 % of the subjects showed no endoscopic abnormalities at rest.

Of the 23.2 % of horses with pathological findings, 42.1 % had neuropathy of the recurrent laryngeal nerve (RLN), 26.3 % had pharyngeal lymphoid hyperplasia, 18.4 % had intermittent dorsal displacement of the soft palate (iDDSP), 10.5 % had persistent dorsal displacement of the soft palate (pDDSP), 5.3 % had a subepiglottic cyst and 2.6 % had granulation of the vocal fold. 5 of these subjects had 2 clinical pictures and one had 3. During exercise, 15.1 % of the horses showed no pathological abnormalities during endoscopy, whereas 56.1 % had two or more. Of the 84.8 % with pathological findings, 49 % had nasopharyngeal collapse, 42 % had instability of the soft palate, 39 % had iDDSP, 27 % had collapse of the vocal fold, 19 % had RNL, 10 % had ventromedial luxation of the apex of the corniculate process of the arytenoid, 6 % had medial deviation of the aryepiglottic plica and 6 % had collapse of the cricotracheal ligament. The intensity of stress at which they occurred was documented in 77 % of the diagnoses, and 55 % were found to occur under low stress and 20 % under high stress. Instability of the soft palate and nasopharyngeal collapse were observed twice as often with low than with high stress, and iDDSP was even nineteen times more common. There was no correlation between age and gender and the findings, but there was a correlation between some clinical pictures.

In the present study, 88 % of Quarter Horses used for barrel racing had one or more upper airway obstructions, which is

approximately the same prevalence as reported in other breeds in the literature. The soft palate was affected in 62% of horses, the pharyngeal walls in 41%, the arytenoid cartilages in 30% and the vocal folds in 24%. It is believed that iDDSP occurs more frequently during exercise in relation to fatigue of the animals. Barrel racing is a short-term, very intense exercise, which suggests that other factors must be involved in the pathophysiology. In most Quarter Horses, iDDSP was short-lived, but in some it lasted up to one minute. It usually occurred during the less exertional phase and was often corrected by coughing. In sport horses, there is a known association between the occurrence of nasopharyngeal collapse and the flexion and position of the poll. Since Quarter Horses tend to gallop with a stretched head and neck position during barrel racing, other factors must be involved in the pathophysiology of the disease. However, the diagnosis was made more frequently during the phase of lower exertion, in which the subjects tended to be worked with more flexion in the neck area, than during the simulated competition situation in the phase of high exertion. Overall, 62% of the subjects showed two or more symptoms, 56% under exertion. It can be assumed that the change in flow resistance in an anatomical region changes pressure and ventilation in the surrounding areas. In the present study, obstructions in the laryngeal region, specifically ventromedial luxation of the apex of the corniculate process of the arytenoid, collapse of the vocal fold, the RLN, medial deviation of the plica aryepiglottica and collapse of the cricotracheal ligament, were associated with an increased occurrence of changes in the pharyngeal region, specifically nasopharyngeal collapse, instability of the soft palate or DDSP.

Surprisingly, most upper airway obstructions occurred during the phase of lower exertion. It is possible that not only extreme pressure and muscle fatigue play a role in their development, but also muscle tension or upper airway contraction secondary to environmental stressors or the anticipation of competition. In the course of the present study, it was found that horses often actively closed their glottis during barrel racing. This phenomenon is also observed during jumping and in the initial phase of sprints. This leads to an increase in intra-abdominal pressure and stabilization of the thorax during extreme movements and this process can be considered a functional adaptation mechanism. Due to the retrospective nature of the study, neither the causality of the diagnosed obstructions with the symptoms observed by the owners nor the influence of stressors in the context of a real competition situation could be assessed. Further studies under standardized conditions are required, in particular to investigate the possible involvement of active contraction of the muscles of the upper airways in the development of obstructions.

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Efficacy of androstenone in reducing stress- or fear-related responses of horses during riding

Choi Y and Yoon M (2023)

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Horse riding is a high-risk sport and riding accidents can result in serious injuries or death. This happens more often than in motorcycle and car racing. Accidents happen depending on the

interaction between rider and horse and are not only dependent on the competence of the rider or caretaker. To minimize the number of accidents, studies on the optimal management of horses are helpful. One could also look for certain genetic markers in uncooperative horses or evaluate the temperament of the horses using behavioral tests. However, a horse's personality is not only determined genetically, but is influenced by the environment and experiences. Training can reduce undesirable behavior in horses; however, this is time-consuming and requires competent trainers. In addition, undesirable behavior in horses can also occur suddenly as a reaction to the rider or the environment. Therefore, alternative methods are being sought to reduce the risk to riders from undesirable behavior in horses. Recently, studies have shown that therapy with pheromones can increase safety when dealing with horses and when riding. These chemical molecules are found in the vomeronasal organ and the olfactory epithelium of the nose. Pheromones induce endocrinological and behavioral changes in the recipient and have therefore been used as an alternative therapy in cats, dogs and horses. Pheromones generally have a species-specific effect, but interomones can also induce unpredictable behavioral changes in other species.

Studies using androsterone as an interomon are designed to test the effect on behavior in horses. Horses can apparently perceive androstenone via a special receptor. This study was designed to investigate the effectiveness of androstenone in reducing conflict behavior in horses while they are being ridden. To do this, the frequency of undesirable behavior such as head shaking, running, bucking, or resistance to the rider was monitored. In addition, the horses were ridden over obstacles to evaluate the effect of androstenone in stressful situations. In this study, the effect of androstenone was investigated in 14 horses that showed undesirable behavior during riding lessons (mostly among beginners). In the study, all horses were ridden by the same, good rider. The rider did not know whether the horses were treated or untreated. The androstenone was diluted with jojoba oil and 2 ml of the substance containing 20 µg androstenone was rubbed into the horses' nostrils for 5 seconds. As a placebo, jojoba oil without androstenone was rubbed into the horses' nostrils. In a cross-over design, each horse was treated with androstenone and only with jojoba oil for each of the two riding tests. The first riding test consisted of a 30-minute session with 5 minutes of walking, 10 minutes of trotting, 10 minutes of galloping and finally 5 minutes of walking. The riding sessions were monitored for undesirable behavior. The second riding test took place over obstacles. The time between the start and finish line was measured.

The course consisted of three blue plastic sheets placed one behind the other. In the 30-minute riding session without obstacles, the horses that had been treated with androstenone showed a significantly lower frequency of undesirable behavior. The horses that had been treated with androstenone completed the series of obstacles faster than untreated horses. The placebo treatment did not lead to any significant behavioral changes in either riding test. The study results are limited by the small number of participating horses and only one rider, so further research is necessary to prove the effectiveness of androstenone. However, the study gives hope that treatment with androstenone can contribute to greater well-being in the horses, the safety of the riders and better competition results. *ir*

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Insulin, but not adiponectin, is detectable in equine saliva using an automated, commercial assay

Barnabé MA, Elliott J, Harris PA, Menzies-Gow NJ (2024)

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Equine endocrinopathic laminitis is a painful and potentially fatal disease that affects horses, ponies and donkeys. Although multiple risk factors are known, insulin and adiponectin are currently considered the most important predictors of the risk of this disease. The two hormones are usually measured in serum or plasma. In some cases, venous puncture may be stressful and even impossible. Saliva samples are easier to collect and insulin concentrations in saliva have been measured in humans, dogs and pigs and correlated significantly with serum concentrations. Adiponectin is also measured in saliva in humans and dogs and correlates with blood concentrations. Saliva samples in horses are used to determine cortisol concentrations and to examine antibody levels against tapeworms. The primary objectives of this study were to evaluate whether salivary insulin and adiponectin concentrations can be determined using a commercial automated assay and to capture indicators of stress during saliva sampling compared to blood sampling.

The study population included 8 healthy ponies aged between 5 and 18 years. Blood and saliva samples were taken on the same day and this was repeated several times. Saliva samples were collected using EquiSal® saliva swabs to obtain a volume of 500 µl. Blood samples were collected by puncture of the jugular vein. Insulin was determined using the Immulite 2000 xpi from Siemens and the Tosoh AIA-360 Analyzer, and adiponectin was determined using the immunoturbidimetric assay from Wiener Jubilars. Blink frequency was recorded via video recordings and heart rate via a portable monitor. Adiponectin was not detectable in saliva. However, insulin was measurable in saliva, but only with the Tosoh AIA-360 Analyzer, and showed acceptable inter-assay and intra-assay variability. Blink and heart rate during saliva collection were not significantly different from those during the control period without manipulation. Serum and salivary insulin levels were not significantly correlated. The results of the study demonstrate that insulin in equine saliva is measurable using automated commercial assays available in the UK. However, further validation and the determination of specific diagnostic thresholds are required. Saliva collection was not associated with changes in stress indicators. ag

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Survival of *Streptococcus equi* subsp. *zooepidemicus* on environmental samples is affected by material type and incubation temperature

Koirala S, Pantuzza C, de O. Costa M (2024),

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Streptococcus equi subsp. *zooepidemicus* is an opportunistic pathogen associated with disease in a wide range of domestic and wild animals. It is a Gram-positive, facultative anaerobic organism that is usually found in the upper respiratory tract or

genital tract mucosa of adult animals without signs of disease. Despite its importance, very limited data are available on survival and persistence in the environment. The aim of this study was to evaluate the survival of *S. zooepidemicus* under ideal culture conditions and in an agricultural environment on different surface types. Rubber, plastic, wood and concrete samples were sterilized and inoculated with 10⁹ CFU/ml of *S. zooepidemicus* with or without feces and cultured under ideal conditions (37 °C, 5% CO₂) or equivalent to an agricultural environment (20 °C in air) for a maximum period of 25 days (n=3/material/environment/feces group/time point). Viable bacteria were detected immediately after inoculation regardless of the materials. On rubber and plastic samples, the germ survived incubated without feces for up to 14 days under ideal conditions (37 °C, 5% CO₂). This survival period differed significantly from wood and concrete surfaces in that the survival period for the latter was 4 and less than one day, respectively. The addition of feces resulted in bacterial inactivation within one day after inoculation. Thus, under ideal conditions, no *Streptococcus equi* subsp. *zooepidemicus* could be detected by adding feces. At an incubation temperature of 20 °C without the addition of feces, the bacteria did not survive for more than 24 hours. In contrast, the presence of feces extended the germ survival rate up to 3 days on concrete and wood, whereas the results on plastic and rubber surfaces were negative within one day after inoculation even in the presence of feces. These data suggest that the environmental persistence of *S. zooepidemicus* is influenced by the surface type and the incubation temperature. Interestingly, under ideal conditions, the presence of feces inhibits the growth of the bacteria regardless of the surface material. The opposite was found at room temperature when the surfaces were inoculated with feces and the germ, in these cases the bacterial survival time was extended. ag

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Changes in the saliva proteome analyzed by gel-proteomics in horses diagnosed with equine gastric ulcer syndrome (EGUS) at diagnosis and after successful treatment

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Henriksen I, Muñoz-Prieto A (2024) Res Vet Sci 167, 105112 |

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Saliva is a biological fluid that is considered a source of various analytes related to various organic processes such as stress, immune system response, inflammation or redox status and general metabolism. It is increasingly used in animals and humans because it can be obtained without invasive sampling and can provide a lot of biological information for analysis. This makes saliva the ideal sample, especially for monitoring health and well-being. Equine Gastric Ulcer Syndrome (EGUS) is very common in horses and is one of the most common diseases in this species, with a prevalence of up to 93% in racehorses during the season. This makes EGUS currently one of the most common diseases in horses. The term EGUS covers two different forms: equine squamous gastric ulcers (ESGD) and equine glandular gastric ulcers (EGGD), which have different physiopathological mechanisms. This problem can be diagnosed individually or in combination. Our aim is to detect changes in the saliva proteo-

me of horses with EGUS at the time of diagnosis and after successful treatment using gel proteomics. A total of nine horses diagnosed with EGUS and a total of nine healthy horses as control animals were used for the proteomic investigations.

In addition, a validation study was conducted with 12 horses suffering from EGUS to analyze thioredoxin (TRX). This protein was identified in the saliva of horses and showed significant changes in horses with EGUS before and after treatment and was investigated as a biomarker candidate for validation in the additional group of horses with EGUS (mean age = 9.58 years; range = 3-14). In this group of horses, saliva samples were examined for analysis at the time of EGUS diagnosis and after six weeks of treatment with omeprazole (4 mg/kg). TRX was measured using a commercially available ELISA kit originally developed for human samples. All horses referred to in this report were presented at the University of Copenhagen Large Animal Teaching Hospital between February 2022 and March 2023. SDS-PAGE (1DE) and two-dimensional gel electrophoresis (2DE) were performed. Significantly different protein bands and spots were identified by mass spectrometry. The mean total protein concentration of the saliva samples was 1622 ± 740 g/ml in the healthy group, 2841 ± 1165 g/ml in the horses with EGUS before treatment and 2192 ± 988 g/ml after successful treatment. No statistical differences were found between the different groups. A total of 15 protein bands were observed in the majority of animals, of which 5 bands were not seen in all groups.

The other 10 bands were observed in animals from all groups and 6 of them showed statistically significant differences. In horses with EGUS, 11 protein spots showed statistically significant decreases, while 5 protein spots were significantly increased compared to the healthy controls. The spots that were decreased in the diseased horses identified proteins such as CA and albumin, while the increased spots were proteins such as Ig-like domain-containing protein, heavy constant immunoglobulin mu, triosephosphate isomerase, adenosine deaminase, glutathione S-transferase, EF-hand domain-containing protein, 14-3-3 domain-containing protein, and BPI fold containing family A member 2. According to molecular function classification using the PANTHER tool, it was found that 60% of the proteins in horses with EGUS (before and after treatment) were proteins with catalytic activity, 20% were proteins with binding function and 20% were proteins with unknown molecular function. TRX was increased in diseased animals before treatment and showed a significant decrease after treatment. In summary, it can be said that horses with EGUS show protein changes in their saliva when analyzed by gel proteomics compared to healthy horses. TRX values changed after successful treatment. These proteins could be potential biomarkers for detecting and monitoring treatment success in EGUS. sd

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Factors associated with insulin responses to oral sugars in a mixed-breed cohort of ponies

Knowles EJ, Harris PA, Elliott J, Chang YM, Menzies-Gow MJ (2024)

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Insulin dysregulation (ID) manifests itself in three forms: hyperinsulinemia, an excessive insulin response to oral sugar or starch intake, and peripheral insulin resistance in tissues. Dynamic tests

such as the oral sugar test exist for the clinical diagnosis of ID, which is said to be more sensitive than the determination of basal hyperinsulinemia. There is a proven correlation between ID and laminitis. It has been shown that the level of insulin concentration, measured before (T0) or 60 minutes after oral administration of 0.3 mm/kg corn syrup, is an important indicator for predicting the risk of developing laminitis. Insulin dysregulation is a central point in equine metabolic syndrome, but affected horses also show altered concentrations of other metabolic markers such as adiponectin or triglycerides. The present study aimed to assess the associations between binary insulin T60 and season and owner-reported parameters, as well as the associations between continuous insulin T60 and other metabolic markers and owner-reported data.

In a cohort of ponies with a history of laminitis and over 5 years of age, oral glucose tests (OSTs) (0.3 ml/kg of grain syrup) were performed up to 6 times at 6-month intervals (spring and autumn) between 2015 and 2019. Before the test, the horses were not fasted but were only allowed to receive hay or pasture grass. Blood samples were taken before administration of the syrup and 30 and 60 minutes after administration. Concentrations of insulin, adiponectin, triglycerides, glucose and ACTH were determined in samples taken before administration of the syrup. In samples taken 30 and 60 minutes after administration of the syrup, only insulin concentration was determined. Factors associated with insulin T60 were determined using mixed-effects models with physical, owner-reported, seasonal and serum/plasma markers as fixed effects and pony and stable identifiers as random effects. Physical data included body condition score (BCS), crest fat level, supraorbital fat level, hypertrichosis present, diverging hoof horn growth rings, body length, neck length and abdominal girth. Autumn and spring data were analyzed separately for full models.

A total of 1763 oral sugar tests from 367 ponies were evaluated. The average age was 13.5 years and the ponies were Welsh ponies, cobs or Shetland ponies. Of these, 76% were either ridden or otherwise worked. The ponies were categorised based on the results of a previous study. Based on the insulin T60 value, the risk of future development of laminitis was classified into low, medium or high risk. Horses in the high-risk group had an estimated cumulative laminitis incidence over the next 4 years of 73% and horses with a low risk of 3%. The median insulin concentration at T0 was 8.5 (5.5-14.1) IU/ml in low-risk ponies, 23 (14.2-34.9) IU/ml in intermediate-risk ponies, and 55.4 (32.9-92.7) IU/ml in high-risk ponies. The median insulin concentrations at T60 were 26.3 (17.4-37) IU/ml, 81.5 (65.6-105.6) IU/ml, and 229.3 (183-311.4) IU/ml, respectively, depending on the risk group. A high risk for insulin T60 (>153 IU/ml) was independently associated with increasing age, higher body condition score (BCS), and pronounced supraorbital fat pads.

The risk of being in the high-risk insulin T60 group increased seven-fold when animals had prominent supraorbital fat pads. Log insulin T60 was associated with: increasing age, Welsh/Welsh X breed, sex, higher BCS, plasma diponectin (inversely associated) and basal insulin in spring, as well as prominent supraorbital fat pads, run-out score, plasma diponectin, ACTH (per 10 pg/ml), triglycerides and insulin T0. Season and physical characteristics of the ponies could explain 19-27% of the variation in insulin T60 risk status, so characteristics such as BCS and the extent of supraorbital fat pads can be used to identify ponies

at high risk for insulin dysregulation. However, the variables used in this study were not sensitive indicators and thus ponies with insulin dysregulation would be falsely underdiagnosed. Insulin T60 concentrations corresponding to a high risk of insulin dysregulation were also found in ponies of any BCS, any strain and any degree of comb fat. 8% of ponies with a BCS $\leq 6/9$ were in the high-risk group. ag

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Multi-locus sequence typing and in vitro antimicrobial resistance of equine *Streptococcus equi* subspecies *zooepidemicus* strains

Nocera FP, Capozzi L, Simone D, Pizzano F, Iovane A, Bianco A, Parisi A, De Martino L (2024)

Vet Res Comm | <https://doi.org/10.1007/s11259-023-10165-3>

Streptococcus equi subsp. *zooepidemicus* (*S. zooepidemicus*) is a beta-hemolytic zoonotic bacterium. In healthy horses, the germ is usually found in the upper respiratory tract and is also part of the physiological microflora in the genital area of the mare. It is an opportunistic pathogen that, like *E. coli*, is detected in mares with infectious endometritis. There are few studies regarding the genotyping of a specific population of *S. zooepidemicus* associated with endometritis in mares. Recently, a high genetic variability of the germ was described in Italy by analyzing the 16-23 SrRNA intergenic spacer region (ISR). This study aimed to define the associated sequence types and antimicrobial resistance profiles of equine *S. zooepidemicus* strains isolated from mares with fertility problems and to describe the potential correlation between these two aspects. In 2021, a total of 103 uterine swab samples were collected from mares with a suspected diagnosis of bacterial endometritis. These mares were between 4 and 18 years old and had a history of subfertility with recurrent bacterial uterine infections, intra-uterine fluid, vaginal discharge, early embryonic death, resorption and/or abortion.

The samples were cultured and *S. zooepidemicus* was isolated using Columbia CNA agar with 5% sheep blood. The suspected strains were examined using standard methods and the isolates were then identified using matrix-assisted laser desorption/ionization mass spectrometry analysis using the MALDI Biotyper® Sirius system. To determine the genetic variability of the isolated strains, multi-locus sequence typing (MLST) was performed from whole genome sequencing (WGS) data. In addition, the antimicrobial sensitivity of the strains was assessed. Of the 103 uterine swab samples, 22 strains of *S. zooepidemicus* were isolated. All strains grew on the CNA agar plates and were catalase and oxidase negative. The average length of the reconstructed genomes was 2,088,286 bp (95% CI: 2,061,569 bp - 2,114,967 bp), which was expected for *S. zooepidemicus* genomes. The assembled genomes were assigned to sequence types (STs) using the *S. zooepidemicus* scheme targeting seven loci (*arcC*, *nrdE*, *proS*, *spi*, *tdk*, *tpi*, *yqiL*) available in the PubMLST database.

MLST revealed a wide variability of STs, with two (9.1%) new STs identified in this study, namely ST521 with two isolates and ST522 with one isolate. In addition, 4/22 (18.2%) isolates were

assigned to ST92, 3/22 (13.6%) to ST205, 2/22 (9.1%) to ST475, and one strain (4.5%) each to the following STs: ST10, ST30, ST39, ST49, ST101, ST132, ST147, ST314, ST369, ST467. The isolates were also tested for antimicrobial resistance using the Kirby-Bauer disk diffusion test. Resistance to amoxicillin-clavulanic acid, ampicillin, amikacin, gentamicin, streptomycin, enrofloxacin, sulfamethoxazole-trimethoprim, tetracycline and oxytetracycline represented the most common resistance profile (13/22, 59.1%). No correlation was found between a specific ST and the antimicrobial resistance profile. The study provides a comprehensive insight into the epidemiology, ST diversity and antimicrobial resistance profile of *S. zooepidemicus* strains isolated in Italy causing fertility problems in mares. ag

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Strongyle egg reappearance periods following moxidectin treatment in horses in Southeast England

Mair TS, Opie R, Clack MM, Parkin TD, Matthews JB (2024)

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Horses are always exposed to endoparasites in the pasture, most commonly Cyathostominae. These parasitic nematodes include over 40 species. Current recommendations for Cyathostominae control aim to reduce contamination of the pasture and minimize the risk of disease caused by parasites. Deworming is either strategic or targeted treatment is carried out based on the fecal egg count (EPG) and assessment of the effectiveness of the anthelmintics used. There are three classes of anthelmintics: benzimidazoles (fenbendazole), tetrahydropyrimidines (pyrantel salts) and macrocyclic lactones (ivermectin and moxidectin). Resistance to benzimidazoles and tetrahydropyrimidines is currently occurring worldwide. Although in most regions the effectiveness of macrocyclic lactones is significantly higher than drugs in the other classes, there are publications demonstrating resistance to macrocyclic lactones. Due to the development of resistance to benzimidazoles and tetrahydropyrimidines and the effectiveness of moxidectin against the mucosal larval stages, this active ingredient is routinely used in horses on pasture in autumn and early winter. However, this results in increased selection pressure and thus the risk of developing resistance. The egg reappearance period (ERP) is defined as the time between administration of an effective anthelmintic and the reappearance of egg excretion in the faeces. Determining the ERP after anthelmintic therapy is considered a valuable indicator of the early development of resistance.

This study was designed to determine the ERP of strongyles after moxidectin treatment of horses in the south-east of England. This was a prospective study. For the study, data from 48 horses in which the faecal egg count (FEC) was ≥ 400 strongyle eggs per gram of faeces (EPG) in a routine screening sample were evaluated. The weight of the horses was determined using a weight tape (10), a scale (6) or both (32). Depending on the weight, the horses were given moxidectin orally at a dosage of 400g/kg. The FEC tests were repeated twice weekly for 16 weeks. The age of the 48 horses was on average 11.8 years with a variation bet-

ween 1-26 years. There were 15 ponies, 8 thoroughbreds, 8 warmbloods, 8 sport horses, 4 cobs and one draft horse. On average, 3 horses were on the same pasture at the time of sampling. The average time spent on pasture was 15 hours per day during the study period between August 2017 and March 2018. Pasture hygiene was performed on pastures of 29 horses, including daily, once weekly, 2 to 3 times weekly removal of feces. The mean EPG before treatment was 1047 (range 375-2137 EPG). In all animals except 2 horses, the FEC was 0 EPG 2 weeks after moxidectin administration. In the remaining 2 horses, the FEC was 12.5 EPG each (97.8%-98.3% reduction compared to pre-treatment value).

Four weeks after administration of moxidectin, 6 horses had parasite eggs in their feces and the egg count reduction compared to the initial value was 96.6%-99.2%. After 6 weeks, 11 horses had positive FECs (83.8% reduction in one horse; >90% reduction in 10). After 8 weeks, 21 horses had positive FECs (<90% reduction in 2). After 10 weeks, 27 horses again had eggs in their feces (<90% reduction in 6). After 12 weeks, 31 horses had positive FECs (<90% reduction in 11). After 14 weeks, 34 horses (<90% reduction in 13) and after 16 weeks, 38 horses had positive FECs (<90% reduction in 17). In none of the 48 horses did the reduction in the number of eggs in the faeces 14 days after administration of moxidectin correspond to resistance to this anthelmintic. Although 2 horses in the present study had positive results within the first 2 weeks after administration, but the percentage reduction in the FEC was between 95%-100%, it can still be assumed that the drug is effective. However, the increasing proportion of horses in which there was a reduced reduction in the number of eggs after 6-16 weeks compared to the initial value indicates a significantly shorter suppressive effect on the excretion of strongyle eggs compared to the effectiveness when moxidectin was introduced (12-16 weeks). ag

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Common and atypical presentations of *Anaplasma phagocytophilum* infection in equids with emphasis on neurologic and muscle diseases

Aleman M, Vedavally U, Pusterla N, Wensley F, Berryhill E, Madigan JE (2024)

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Granulocytic anaplasmosis (EGA) is caused by obligate intracellular, gram-negative rickettsiae that infect leukocytes. Cases have been reported in North America, Brazil, Europe and North Africa. Transmission occurs via ticks. Clinical symptoms vary depending on the severity and the organ or tissue affected. After an incubation period of a few days after the tick bite, typical clinical signs appear, including fever, which can reach up to 41.7°C, lethargy, anorexia, jaundice, mild petechiae, edema of the limbs, stiffness and, in some cases, ataxia. Tachycardia and tachypnea are observed in parallel with the febrile phase, usually lasting a few days. Younger animals (< 3 years) appear to develop milder symptoms. The laboratory findings include anemia, leukopenia - due to neutrophilia and lymphopenia - thrombocy-

topenia and hyperbilirubinemia. Inclusion bodies in the neutrophils or eosinophils are characteristic findings. The detection of the organism by qPCR in buffy coat samples has a high sensitivity and specificity. Positive qPCR results can be detected 2-3 days before the onset of clinical symptoms, whereas inclusion bodies in the neutrophils can only be detected 2-3 days after the onset of fever. Atypical courses also occur and the horses develop rhabdomyolysis, respiratory distress, body cavity effusions, disseminated intravascular coagulation (DIC) and recumbency associated with neurological disease. The present study was intended to retrospectively describe cases of EGA with particular regard to neurological and muscular manifestations.

Electronic data from January 2000 to December 2022 were reviewed using the terms anaplasmosis, ehrlichiosis, granulocytic and rickettsia and corresponding cases were selected. Data on signalment, history and clinical findings were included in the evaluation. Cases were divided into 2 groups: no neurological or muscular diseases (no-NM) or neurological or muscular diseases (NM). Gene typing was performed for hyperkalemic periodic paralysis (HYPP), malignant hyperthermia (MA), polysaccharide storage myopathy type 1 (PSSM1), glycogen branching enzyme deficiency (GBED), myosin heavy chain myopathy (MYHM) and myotonia congenita (MC). Diagnosis was confirmed by cytological examination or molecular analysis of *Anaplasma phagocytophilum* in buffy coat samples. In addition, a blood count and a urine analysis were performed, as well as muscle biopsy samples. The diagnosis was made in 39 horses, including 30 males and 9 females. These included 14 Quarter Horses, 8 warmbloods, 3 Arabians, 3 Friesians, and animals of various breeds. The animals were presented to the clinic a few hours to 5 days after the onset of fever. The median age of the horses was 14 years. The horses were presented throughout the year, with the exception of the months of July, August and September. An overrepresentation of male animals was found in this population.

Of the 39 affected horses, 23 animals showed either a neurological or muscular disease, cardiomyopathy, body cavity effusion or DIC. 20 animals showed signs of a neurological or muscular disease and 19 horses were classified as no-Nm. The affected horses showed fever, lethargy, anorexia, jaundice and limb edema and no symptoms consistent with a neurological or muscular disease. 41% of the horses with neurological symptoms were diagnosed with diffuse symmetrical proprioceptive ataxia. Brain diseases were less common and manifested as fatigue and cranial nerve deficits. The animals showed altered behavior (pushing forward, pressing the body against a wall), dysphagia and paresis of the tongue. If the cranial nerves were affected, an ipsilateral tilt of the head was observed along with mild facial paralysis and dysphagia. In 15 of the 16 horses, the neurological signs were symmetrical. Muscle diseases were less common. 7 geldings showed clinical manifestations of muscle diseases. The Quarter Horses showed tight, painful and swollen muscles, a reluctance to walk or a stiff gait. These horses had the gene variant that causes myosin heavy chain myopathy (MYHM).

Cardiomyopathy was suspected in 4 animals. This cardiomyopathy occurred in combination with a neurological disease in one horse and with a muscular problem in 3 animals. 3 other horses showed the combination of neurological disease and peritoneal effusion and one animal the combination of muscular disease and peritoneal effusion. *Anaplasma phagocytophilum* was identified by qPCR in 9 animals, by cytological exami-

nation in 8 and by both in 22. Clinical laboratory results varied depending on the stage of the disease. Findings included anemia, leukopenia with neutropenia and lymphopenia, thrombocytopenia and hyperbilirubinemia. Despite these findings, with the exception of the number of leukocytes in horses in the non-NM group, all median values were within the normal range. Muscle enzyme activities were significantly higher in horses with muscle diseases. Examination of the muscle biopsy revealed myonecrosis and a slight histiocytic infiltration consistent with rhabdomyolysis. All horses were treated with tetracycline, initially intravenously for 3 days (6-7.5 mg/kg, 12-24 hours each), followed by either doxycycline (7-10 mg/kg, 12 hours each) or minocycline (4.4 mg/kg, 12 hours each) orally for 5-14 days. In addition, some horses received intravenous non-steroidal anti-inflammatory drug infusions, oral vitamin E and anti-ulcerative medication. Corticosteroids were administered to horses with immune-mediated myositis. Despite severe symptoms, the administration of tetracyclines resulted in rapid improvement in symptoms. ag

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Intraluminal administration of a carboxymethyl-starch powder for bladder hemorrhage treatment in two adult horses

Memoli G, Fontana L, Basano I, Pallante M, Bertuglia A, Bullone M (2024)

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Internal and mucosal bleeding from hollow organs are rare conditions in equine medicine. Hematuria refers to the presence of red blood cells in the urine and can be macroscopic or microscopic. Specific data on the incidence of hematuria in equine practice are lacking. Nevertheless, based on the available evidence, pathological hematuria is considered to be a rare occurrence. In macroscopic hematuria, the urine is red to brown in color. Differentiating hematuria from pigmenturia (presence of hemoglobin, myoglobin or pigments in the urine) can be challenging and requires laboratory analyses. The most common problems associated with hematuria are, in presumed order of frequency of occurrence: urethral lacerations, urethritis, urolithiasis, trauma and neoplastic masses, pyelonephritis, cystitis, long-term administration of nonsteroidal anti-inflammatory drugs and bleeding disorders. Most cases of hematuria respond to treatment of the underlying cause. However, there are rare cases where rapid and effective control of blood loss is required and the animal is not fit for surgery or anesthesia. This case report describes the clinical presentation and management of two adult horses presented to the Veterinary Teaching Hospital in 2021 with macroscopic hematuria due to hemorrhagic cystitis, each diagnosed by cystoscopy, and successfully treated with topical administration of a hemostatic carboxymethyl starch powder (CSP).

In the first case, a 13-year-old Quarter Horse gelding was presented with stranguria that had been ongoing for 12 hours with suspected intravesical mass. The horse showed constant dripping of urine from the penis and was obviously in pain when walking. All blood laboratory values indicated myosin heavy chain myopathy (MYCH), for which the horse was treated with cortisone

preparations, intravenous fluid therapy and flunixin meglumine. The stranguria was initially explained by muscular pain when assuming the posture for urination. The bladder was initially catheterized, 7 l of dark urine with sand admixture were drained and the bladder was flushed with saline solution. In the following days, macroscopic blood clots were found in the horse's urine. Cystoscopy revealed hyperemic mucosa and petechial bleeding and deep ulcers. The urine from the ureters appeared unremarkable. Treatment with ampicillin was initiated according to the urine culture with antibiogram. Despite clinical improvement, severe bleeding from the bladder ulcer persisted over the next 10 days and the hematocrit value slowly decreased. Under endoscopic control, after emptying the bladder, 5 g CSP via a catheter of 1.8 mm diameter was introduced through the working channel of the endoscope with air. A gel formed immediately, which covered the bleeding, ulcerated mucosa. 24 hours after the CSP application, the bleeding stopped completely.

In the second case, a 26-year-old Argentinian gelding was presented with 36 hours of anuria and anorexia. Both began after the horse suffered a serious fall into a ravine while on a trail ride through the Alps. The horse was rescued by a trained team of colleagues, and after sedation and immobilization, the horse was recovered by a specially equipped tractor. The horse was monitored at home and 2 attempts to catheterize the bladder failed to obtain urine. In the clinic, the bladder appeared enlarged on rectal examination, but there was no pain response. The gelding was catheterized and the bladder emptied. Macroscopically, the urine appeared dark yellow and concentrated. No further investigations were performed. The gelding received intravenous fluid therapy with Ringer's lactate solution and esmoprazole. After 12 hours, the gelding began to urinate normally, but the anorexia only partially improved. Fluid therapy was continued and on day 4 of the hospital stay the gelding developed hematuria. Cytological examination of the urine showed an increased number of white and red blood cells and numerous intracellular bacteria. Cystoscopy revealed a hemorrhagic inflamed mucosa. Despite antimicrobial therapy with trimethoprim-sulfamethoxazole and administration of ketoprofen, the hematuria did not improve over the next 5 days. Topical treatment with 5 g CSP powder through a 2 m long Foley catheter, which after 48 h led to the bleeding stopping. Antimicrobial therapy was continued. Following this, urine cytology showed no abnormalities. The application of the hemostatic powder appears to be easy to perform, safe and helpful in controlling mucosal bleeding in hollow organs. Hemostasis appears to occur within a short time without undesirable side effects. This approach should also be considered in outpatient practice in cases of endoscopically diagnosed mucosal bleeding that require prompt control of blood loss. sd

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Seroprevalence of Anaplasma species in an equine population of Southwest Virginia

Hinson HL, Lahmers KK, Boes KM, Funk RA (2024)

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Equine granulocytic anaplasmosis (EGA) is manifested by non-specific symptoms such as fever, apathy, decreased appetite,

limb swelling, and ataxia. The severity of symptoms depends on the age of the horse and the duration of infection. The most common tick species that act as vectors belong to the genus *Ixodes*, particularly *Ixodes scapularis* and *Ixodes pacificus*, which are widespread in various parts of the United States. In Virginia, *Ixodes scapularis* was detected in large numbers in 2015. The seroprevalence of EGA has been studied in various states, but not in southwest Virginia. Suspected diagnoses have been based on clinical signs and hematological findings (lymphopenia, thrombocytopenia, anemia), while the definitive diagnosis is often made cytologically by detection of the pathogen in granulocytes. Other diagnostic methods include PCR tests and antibody titer determinations. Diagnostic tests include the IDEXX SNAP 4DX Plus Test[®], which is also used in horses and shows high agreement with the immunofluorescence antibody test (IFAT). The aim of this study was to determine the seroprevalence of EGA in southwest Virginia, to determine the frequency of *Anaplasma* infection in clinically affected horses and to examine the relationship between clinical findings, hematological results, various diagnostic tests such as the results of the IDEXX SNAP 4DX Plus Test[®], IFAT and PCR tests and the detection of morulae in blood smears in clinically affected horses.

Seroprevalence was determined using serum samples collected from horses presented for the Coggins test between January and December 2013 and March 2019 and February 2020. Horses were included in the study if they had fever (temperature > 101.5°F) during the initial examination or had fever 24 hours before presentation or had two of three clinical signs of loss of appetite, apathy and distal limb edema. All horses were asymptomatic with respect to clinical signs of EGA at the time of sample collection. Blood was collected from the horses' jugular vein using a vacuum system and serum was stored at -75°C. Samples were tested using the IDEXX SNAP 4DX Plus Test[®] according to the manufacturer's specifications. Results for *Anaplasma phagocytophilum*/platus were recorded as positive or negative for each horse. Of the total of 255 samples from 2013, 200 were randomly selected for seroprevalence testing using the IDEXX SNAP 4DX Plus Test[®]. The results showed a seroprevalence of 8.5% in 2013 and 11.2% in 2019-2020, with the increase not being statistically significant. The IDEXX SNAP 4DX Plus Test[®] was used for testing and proved to be a reliable diagnostic tool. Age, sex and place of residence of the horses had no significant influence on the presence of a positive test, although mares were more frequently seropositive than geldings.

PCR testing was used in clinical cases where horses presented with fever, lethargy, and other signs suggestive of EGA. *A. phagocytophilum* was detected in 35% of cases. Morulae were found in blood smears in some cases. The most common hematologic abnormalities were thrombocytopenia and lymphopenia. All PCR-positive horses responded well to treatment with minocycline. The study concluded that EGA is a significant disease in southwest Virginia, with a moderate seroprevalence and seasonal variations in incidence. The results support the use of the IDEXX SNAP 4DX Plus Test[®] as a diagnostic tool in the field and emphasize the importance of considering EGA as a differential diagnosis in horses with fever of unknown etiology. Further studies are needed to more comprehensively investigate the geographic and seasonal patterns of the disease. vh

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A CONSORT-guided, randomized controlled clinical trial of nebulized administration of dexamethasone and saline on lower airway cytokine mRNA expression in horses with moderate asthma

Bond S, Léguillette R (2024)

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Nebulization of dexamethasone injection solution usually results in minimal systemic availability in healthy horses and does not induce airway inflammation. Inhalation of dexamethasone does not improve lung function in horses with severe asthma, while at the same time significantly inhibiting endogenous cortisol synthesis. Systemic administration of dexamethasone in horses with mild asthma causes a reduction in IL-5 mRNA and thus an inhibition of the dysregulated T2 response of cells in the bronchoalveolar lavage fluid (BALF) obtained after challenge with allergens. Inhalation of saline solution is often used as a placebo in human medicine because it improves mucociliary clearance in people with chronic obstructive pulmonary disease without affecting lung function. Previous studies suggest that nebulization of dexamethasone may have good bioavailability in the lower respiratory tract in horses, but this is not proven. Administration of 5 mg dexamethasone by inhalation was not clinically effective in horses with severe asthma. Therefore, this study was designed to evaluate the efficacy of a dose of 15 mg dexamethasone in horses with moderate asthma.

Another aim of this study was to evaluate the influence of housing in dusty environments on BALF cell cytokine expression in healthy horses and the effects of inhaled administration of dexamethasone and saline. The study population included horses with moderate asthma (16) and healthy controls (4) that were housed in a dusty environment during the study. This was a prospective, parallel, randomized, controlled, blinded clinical trial. Eight horses with moderate asthma, classified based on BALF examination and clinical findings, received either dexamethasone or saline by inhalation. The control horses received no therapy but were kept in the same dusty conditions. Due to stable cleaning, feeding and lunging, dust exposure was 0.05 to 0.1 mg/m³. Before and after a 13-day treatment with either inhalation of dexamethasone (15 mg once daily) or 0.9% saline solution (3 ml), blood samples were taken to determine the endogenous cortisol concentration as well as samples of tracheal mucus and BALF. The mRNA expression of IL-1 β , IL-4, IL-5, IL-6, IL-8, IL-10, IL-12, IL-17, IL-23, IFN- γ , eotaxin-2 and TNF- α in the BALF and the relative expression of inflammatory cytokine mRNA was analyzed.

The severity of mucus accumulation in the trachea did not differ significantly between horses treated with saline and dexamethasone. The proportion of specific cells in the BALF also showed no significant differences after inhalation of dexamethasone or saline. However, a significant decrease in the endogenous cortisol concentration in the blood was observed in horses that had received dexamethasone by inhalation. Inhalation of dexamethasone increased the relative expression of IL-5 (1.70-fold), IL-6 (1.71-fold), IL-17 (3.25-fold), IL-12 (1.66-fold) and TNF- α (1.94-fold) compared to the values of day 0 and day 14, while the expression of IL-23 was reduced (1.76-fold). Inhalation of saline solution did not result in any significant differences in the relative expression of any gene. Control horses kept in a dusty

environment for 14 days without treatment showed a reduction in the relative expression of IL-23, IL-4, IL-5, IL-1 and IFN- γ as well as an increase in the expression of IL-10, IL-12 and TNF β . No change in relative gene expression was found for the other cytokines. The results of this study show that inhalation of dexamethasone is associated with increased expression of inflammatory cytokine mRNA. At the same time, neither inhalation of saline nor inhalation of dexamethasone could demonstrate an improvement in cell counts in the bronchoalveolar lavage fluid. ag

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Gut microbiome characteristics of horses with history of cribbing behavior: An observational study

Arias-Esquivel AM, Jeong KC, Fan P, Lance J, DeNotta S, Wickens C (2024)

J Behavior | <https://doi.org/10.1016/j.jveb.2023.12.008>

Stereotypies are repetitive behaviors without an identifiable goal or function that often result from a number of factors, such as the inability to perform desired behaviors, exposure to stressful situations, or confinement/social isolation. The behavioral pattern of cribbing (CB) is characterized by a horse anchoring its upper incisors to a fixed object, pulling backwards, tensing the neck muscles, and emitting a grunt. It is defined as a specific oral stereotypical behavior. Stress and suboptimal management, such as early weaning, long fasting periods, isolation, and lack of exercise, can affect the well-being and behavior of horses. In addition, a possible link has been identified between aberrant behaviors such as cribbing and gut microbial flora, which may be related to gastrointestinal irritation. Previous research has failed to establish a definitive link between the gut-brain axis and CB using directly measured variables. Feeding concentrates and its effects on lowering gastric pH have been associated with an increased risk of stereotypic behaviors. The theory is that CB may serve as an adaptive response to gastric acidosis by increasing gastric pH through increased alkaline salivation. CB stimulates salivation, which can affect pH in a similar way to chewing. In adult horses, cribbing has been associated with lower basal and post-feeding gastric pH, and long-term treatment with antacids has been shown to reduce the frequency of cribbing.

CB has also been linked to gastric ulcers and inflammation in foals. Research suggests differences between the brains of cribbing (CBH) and non-cribbing (NCBH) horses, with CB being correlated with increased intra-abdominal pressure, oxidative stress and a higher risk of colic and displacement into the epiploic foramen. The aim of this study was to determine whether there were differences in the microbiota of the gastrointestinal tract of horses receiving a nutritional supplement to support gastric health (Treatment, Legends GastroCare™) or a placebo (Alfalfa Timothy Pellets®). Furthermore, to determine whether there were differences in the microbiota between cribbing (CBH) and non-cribbing (NCBH) horses. Adult Quarter Horses with CB (n=4) and non-cribbing horses of the same sex (n=4). Animals were randomly assigned to receive either a nutritional supplement (TRT) to support the gastrointestinal tract or a placebo for 21 days, followed by a two-week washout period. The treatment

group was then switched and the horses were treated for an additional 21 days. Fecal and gastric fluid samples were collected for microbiome analysis before and after each treatment period.

The horses were acclimatized for 2 weeks before the start of the study, individually stabled for 16 hours per day with Bermuda grass hay (1.2% body weight [BW], dry matter [DM]) and concentrates (0.5% BW) and were released into the paddocks in pairs for 8 hours per day throughout the study. The faecal microbiota differed between CBH and NCBH. The microbiota was not affected by TRT. Regarding the gastric microbiota, no differences were detected between CBH and NCBH or due to TRT or placebo. Administration of the supplement did not alter the gastrointestinal environment of NCBH or CBH. An association between gastrointestinal health and oral stereotypical cribbing behavior was demonstrated. In particular, the microbial flora in the faeces of CBH differed from that of non-cribbing horses, suggesting that CBH may be colonized by more pathogenic bacteria in the lower gastrointestinal tract than non-cribbing animals. The dose of treatment, duration of administration and differences between individuals may not have led to the expected results. Future research with variations in the duration of administration is essential to understand the relationship between supplementation to support gastric health and CBH. vh

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Changes in saliva analytes in equine gastric ulcer syndrome (EGUS) after treatment: a pilot study

Munoz-Prieto A, Llamas-Amor E, Ceron JJ, Hansen S (2024)

Res Vet Sci | <https://doi.org/10.1016/j.jveb.2024.04.003>

Equine Gastric Ulcer Syndrome (EGUS) is currently one of the most common diseases in horses. This syndrome includes two different diseases: Equine Squamous Gastric Disease (ESGD) and Equine Glandular Gastric Disease (EGGD). ESGD is associated with damage to the glandless cutaneous mucosa, usually resulting from increased acid exposure. In contrast, the pathophysiology of EGGD is not yet fully understood, but it is thought to be related to impaired defense mechanisms of the gastric mucosa and immune-mediated changes that can lead to inflammation of this mucosa. Saliva is gaining interest as a source of biomarkers in horses because it can be obtained without pain and through simple sampling procedures. Previous results showed that EGUS can induce changes in saliva analyses related to stress, the immune system and redox status. Therefore, saliva may be a potential source of biomarkers of this disease. EGUS findings often require medical therapy, for example with the proton pump inhibitor omeprazole, in addition to changing and optimizing environmental and husbandry conditions. The only way to diagnose and monitor EGUS treatment is currently gastroscopy and a follow-up gastroscopy to determine treatment success. Recently, it was found that thioredoxin decreases after successful EGUS treatment and has been postulated as a possible biomarker for treatment monitoring. However, thioredoxin can only be measured with an ELISA test, which has the limitation that the analysis takes a long time and requires a minimum number of samples to be economically viable.

The aim of this study was to investigate changes in saliva samples before and after EGUS treatment in order to identify biomarkers that indicate treatment success or failure. A total of 28 horses diagnosed with EGUS were treated with omeprazole for six weeks and then transferred to a successful ($n=15$) and an unsuccessful one ($n=13$) treatment group. Saliva samples were collected before and after treatment, and the samples were analyzed for the enzymes, metabolites, proteins, redox biomarkers and minerals contained using an automated chemical analyzer. The results showed that horses with successful treatment, characterized by an improvement in EGGD and ESGD findings, had a significant increase in bicarbonate and urea and a decrease in adenosine deaminase (ADA) and creatine kinase (CK). Conversely, horses in which the treatment was unsuccessful did not show significant changes in saliva analysis. Successful treatment of horses with EGUS may be associated with changes in saliva composition, which are accompanied by an increase in bicarbonate and urea and a decrease in ADA and CK. This sampling method has the advantage of being simple and rapid to measure and the possibility of being used in routine practice. Further studies with larger populations should be conducted to determine the analysis of saliva samples as a biomarker for treatment. *vh*

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Haemopneumothorax as a complication of bronchoalveolar lavage

Kopec EK, Hepburn R, Jones B, Smith S (2024)

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Bronchoalveolar lavage (BAL) is used to diagnose non-infectious diseases of the respiratory tract such as equine asthma or exercise-induced pulmonary hemorrhage. The procedure is considered safe, with a minimal risk of complications, and is performed either endoscopically or blindly. The self-limiting complications described are fever, severe cough and hypoxemia. Hemothorax in horses is a rare, critical condition and is usually associated with trauma, neoplasia, coagulation disorders, cardiovascular diseases such as aortic rupture in the Friesian horse or as a complication of exercise-induced pulmonary hemorrhage (EIPH). Clinical signs include tachypnea, dyspnea and signs of cardiovascular shock in severe cases. Pneumothorax is associated with the same causes. This case report describes hemopneumothorax after BAL, including successful treatment. An 8-year-old Thoroughbred gelding was presented due to poor performance and worsening exercise-induced pulmonary haemorrhage. Tracheal samples had been taken one and two months previously and the horse had been treated with inhaled fluticasone for 12 weeks. Airway endoscopy was then performed and EIPH grade 3/5 was diagnosed. Three days later, BAL was performed under sedation without endoscopic visual control, with 280 ml of sterile Hartmann solution were instilled.

The procedure was initially uneventful, but towards the end the horse coughed and fresh blood was detected in the recovered bronchoalveolar fluid. The coughing stopped when the catheter was removed. Initially the horse appeared clinically normal. Two days after the BAL the gelding was in a reduced general condition accompanied by tachypnea and reduced lung sounds. On presentation to the clinic he had tachycardia (44 beats per

minute) and tachypnea (32 breaths per minute) with a moderately increased work of breathing. No lung sounds could be detected on the left side of the lung compared to the right side. Auscultation of the heart was unremarkable. Palpation of the thorax was painful. A ventral consolidation of the left lung was shown by sonography, corresponding to atelectasis due to pressure. This area, surrounded by a homogeneous, echogenic fluid, was typical of a hemothorax. Radiological findings were consistent with a liquid-gas interface. Based on these findings, the diagnosis of hemothorax was made. Thoracentesis was performed under ultrasound guidance and the appearance of the fluid was consistent with that of blood. This was confirmed by histological examination of the fluid. The microbiological cultivation result showed a profound growth of lactose-fermenting coliform bacteria.

During the endoscopic examination, a small amount of blood was found in the left bronchial tree at the tracheal bifurcation. Cytological analysis of the tracheal secretion sample indicated septic inflammation with 99% degenerated neutrophils, which included some gram-positive cocci. Microbiological examination of this fluid identified *Actinobacillus equuli*. The differential blood count and blood chemistry were unremarkable. Only the fibrinogen concentration was slightly increased and the concentration of serum amyloid A moderately increased (947 mg/L). This was a case of hemopneumothorax in combination with pleuropneumonia. The authors assumed that the BAL performed two days previously had led to trauma to the lung, accompanied by a rupture of pulmonary vessels and the visceral pleura. After the thoracentesis, the gelding was given a single dose of tranexamic acid at a dose of 20 mg/kg administered intravenously slowly. This is an antifibrinolytic drug to improve pulmonary hemostasis. Sonography showed no increase in blood volume in the chest over the next 24 hours, but subsequent sonography and radiology studies continued to show hemopneumothorax. Since the clinical symptoms were not severe and there was a possibility that medical management would be sufficient, no further drainage was performed.

Antibiotic therapy with gentamicin, penicillin and metronidazole was started. Over the next five days, the gelding's condition initially improved, but the SAA concentration rose to 4594.1 mg/L and the horse developed fever. Thoracentesis was performed again and 5 l of fluid was removed from the left side and 500 ml from the right side. Cytological examination of this fluid was consistent with bleeding. No intra- or extracellular bacteria were visible. A tracheal secretion sample was taken transcutaneously. Cytological examination of this sample showed mucopurulent inflammation and microbiological cultivation demonstrated non-hemolytic staphylococcus. After renewed drainage, both the clinical condition and the sonographic and radiological findings improved. However, a horizontal liquid-gas interface remained across three intercostal spaces. The antibiotic therapy was switched to doxycycline. Nine days after renewed drainage, the gelding was discharged (hospital stay: 15 days) with instructions for oral doxycycline and administration of phenylbutazone. The renewed examination twelve days after discharge showed unremarkable inflammatory parameters and no significant radiological changes. The medication was then stopped. 297 days after discharge from the clinic, the gelding started racing again. The authors assume that the hemopneumothorax was a complication based on the previously diagnosed pathology of the EIPH and BAL. *ag*

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Evidence of tapeworm treatment failure on a Central Kentucky Thoroughbred farm

Finnerty CA, Bonometti S, Ripley NE, Smith MA, Nielsen MK (2024)

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Equine cestodes are diagnosed in horses worldwide, and there are three different tapeworm species that can infect horses: *Anoplocephala perfoliata*, *A. magna* and *Anoplocephaloides mamillana*. Of these three species, the first is the most commonly detected tapeworm in horses. Infestation with the latter two tapeworms does not cause clinical symptoms. They are considered small intestinal parasites. In contrast, *A. perfoliata* attaches itself to the ostium ileale in the caecum and can cause clinical symptoms. The parasite causes inflammatory reactions at the site of attachment. Infestation with this parasite has been correlated with colic in various studies. Conditions such as obstructions, peritonitis, cecal perforations and intussusceptions have been described. Two commercially available anthelmintics are available: pyrantel and praziquantel. Pyrantel achieves an efficacy of 95-98% at a dosage of 13.2 mg/kg body weight. Praziquantel, which is often combined with ivermectin or moxidectin, shows an efficacy of 90.8-100% against *A. perfoliata* at a dosage of 1.0-2.5 mg/kg. There are different detection methods for diagnosing tapeworm infection. The use of ELISA tests from serum or saliva samples is not reliable for evaluating the effectiveness of therapeutic measures, as antibodies can be detected in the blood for a long time and can therefore cause false-positive results. Various methods for detecting tapeworm infection via feces are available, but with low sensitivity when there are fewer than 20 worms.

Nevertheless, fecal examination seems to be useful for efficacy studies. For pyrantel, a reduction in egg excretion of 95% must be achieved, for praziquantel between 90.9% and 100%. The present study describes a treatment failure of pyrantel and praziquantel in a group of yearlings. This is a case study of 24 thoroughbred yearlings in Kentucky in which tapeworm eggs were detected in the feces. At the stud farm, both praziquantel and pyrantel were used as part of the deworming management. The yearlings were treated for a period of six months in 2022: with pyrantel (13.2 mg/kg), moxidectin/praziquantel (0.4 and 2.5 mg/kg) and ivermectin/praziquantel (0.2 and 1 mg/kg) In March and April 2022, the animals received the combination praziquantel/ivermectin, in May, July and August moxidectin/praziquantel, and in June pyrantel. Fecal samples were collected 14 days after administration of the anthelmintics and in July and August. Mini-Flotac was used to determine the faecal egg count reduction. Between March and June 2022, 19.8% of the fecal samples contained tapeworm eggs. By the end of the study, no tapeworm eggs could be detected in 9 of 24 animals. Two weeks after administration of ivermectin/praziquantel, 5-10 eggs per gram of feces were found in 11 of 24 (45.8%) horses. In April, this proportion of horses was 12.5%.

Tapeworm eggs were still detected in two animals after administration of moxidectin/praziquantel, and in three others after administration of pyrantel. Even in summer (July–August), the horses continued to excrete tapeworm eggs despite treatment. After administration of moxidectin/praziquantel, egg excretion

could not be prevented in 2 of 6 horses in July and in 4 of 14 horses in August. The horses showed no clinical signs during the entire study period. The results of this study suggest insufficient efficacy of the active substances praziquantel and pyrantel in reducing tapeworm egg excretion. These results contradict previously published data from 2017, 2006, and 2007, which stated an efficacy of 90-100%. Previous studies showed that the number of detectable tapeworm eggs in feces increases 24-48 hours after anthelmintic administration. This is attributed to the fact that dead or dying tapeworms are excreted, along with the eggs. However, this effect is not detectable over weeks. Thus, the detection of tapeworm eggs 14 days after administration of an anthelmintic indicates insufficient effectiveness of the drug.

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Ponies, miniatures, and younger equids are at higher risk of fecalith obstruction compared to a general colic population

Miklavcic M, Dechant JE, Kilcoyne I (2024)

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A fecalith is a solid, ovoid accumulation of ingesta or matted plant material (phytoconglobate) that can cause intraluminal obstruction of the ascending, transverse or descending colon in equids. Obstruction caused by a fecalith often requires surgical treatment due to the difficulty of conservatively softening an obstruction such as this one and the severity of the intestinal distension and pressure necrosis associated with focal obstructions. According to current literature, obstruction occurs predominantly in miniature breeds, ponies, young horses (≤ 1 year old) and older horses with poor dentition, which are also considered predisposed to fecaliths. Medical management may include maintaining fluid intake, stimulating gastrointestinal motility, softening constipation by administering osmotic laxatives or lubricants, and pain control. Surgery is necessary if horses do not respond to medical treatment, persistent pain, or severe abdominal distension. Other indications for surgery include changes in peritoneal fluid parameters that indicate intestinal compromise. The short-term survival rate for this condition is similar to the survival rate after exploratory laparotomy for the treatment of displacement and simple obstructions (without fecaliths) of the large and small intestine (77.8% to 100%)

The aim of this study was to determine the breed, age and sex predispositions for fecal obstruction and to evaluate the short-term survival rate and prognostic factors after surgical treatment of such obstruction in horses. Data from 151 equids were evaluated. These were 64 mares, 53 geldings and 31 stallions. Miniature horses, ponies and miniature donkeys/mules accounted for 48% (71/148) of the affected horses, while 52% (77/148) were represented by large horse breeds. Miniature horses and ponies as well as horses under one year of age had more frequent fecalithiasis compared to other causes of colic. 139 equids (92%) survived until discharge, 6% (9/148) were euthanized intraoperatively and 2% (3/148) were euthanized during hospitalization. Non-surviving animals had more severe colic symptoms, tachycardia and hyperlipidemia on admission. Horses with postoperative colic and complications had a lower

probability of survival. In summary, miniature horses and ponies are predisposed to obstructions caused by a fecolith, but other large horse breeds can also be affected. Surgical treatment of fecal obstruction is associated with a very favorable prognosis for short-term survival. Severe colic symptoms, tachycardia, hyperlipidemia, postoperative colic and surgical complications compromised short-term survival. Further investigation is needed to determine etiological factors associated with this type of intestinal obstruction. *vh*

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Comparison of oral esomeprazole and oral omeprazole in the treatment of equine squamous gastric disease

Sundra T, Gough S, Rossi G, Kelty E, Rendle D (2024)
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Equine squamous gastric disease (ESGD) occurs in all horses regardless of breed and performance level; however, the prevalence increases with increasing training intensity. The lesions are caused by the exposure of squamous gastric mucosa to gastric acid, which has a limited defense mechanism against low pH. Therefore, suppression of gastric acid production is the most important component of therapy. Proton pump inhibitors are considered an effective therapy for reducing gastric acid production and increasing intragastric pH. Omeprazole is the only proton pump inhibitor approved for horses and consists of a mixture of S-omeprazole (esomeprazole) and R-omeprazole. In general, oral administration of omeprazole for ESGD achieves a cure rate of 70-77%. Esomeprazole is the most commonly prescribed proton pump inhibitor in human medicine. This S-enantiomer of omeprazole is many times more potent than the R-enantiomer. In humans, esomeprazole has a rapid onset of action, is metabolised much more slowly in the liver and results in a 3- to 4-fold higher AUC compared to omeprazole. Unpublished data showed similar results in horses, in that the AUC for esomeprazole was 50% higher than that of omeprazole. A subsequent pharmacodynamic study of this drug showed that esomeprazole maintained pH above 4 for twice as long. This study was designed to compare the efficacy and safety of orally administered omeprazole and esomeprazole paste for the treatment of ESGD.

This was a randomized, single-blind controlled study. Horses with lesions corresponding to an ESGD grade of ≥ 2 were randomly assigned to one of the following treatment groups: 4 mg/kg omeprazole or esomeprazole administered orally once daily for 28 days. A repeat gastroscopic examination was performed within 3 days after the end of therapy. During the study period, 233 horses were gastroscopically examined, of which 151 (71%) an ESGD level of ≥ 2 . Thus, 77 animals were treated with esomeprazole and 74 horses with omeprazole. 147 horses were included in the analysis, of which 73 were treated with omeprazole and 74 with esomeprazole. There were no significant differences between the groups in terms of age, sex, breed or use. The severity of the findings did not differ before the start of treatment. After treatment with esomeprazole, the ESGD changes healed in 63 of 74 animals (85%) compared to 43 of 73 animals (59%) of animals treated with omeprazole. Of the 51 horses that also had ulcers of the glandular mucosa of the

stomach (EGGD) and received treatment with esomeprazole, 55% were cured after treatment, compared to 6 of 24 horses with ESGD and EGGD treated with omeprazole. The difference in cure rate was significant. These results show that oral administration of esomeprazole is more effective for the treatment of ESGD, even in association with EGGD, compared to omeprazole therapy. *ag*

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A practical approach to hyperinsulinemia in horses with equine metabolic syndrome

Sundra T, Rossi G, Rendle D, Lester G (2024)
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Laminitis is associated with insulin dysregulation (ID). This is defined as either basal hyperinsulinemia, postprandial hyperinsulinemia or tissue insulin resistance, or a combination of the above. In hyperinsulinemia, the concentrations of circulating insulin are too high, whereas in tissue insulin resistance, the tissue does not respond adequately to insulin. Horses with postprandial hyperinsulinemia show an increased insulin response after ingesting carbohydrates. This can be associated with or without tissue insulin resistance. The extent to which hyperinsulinemia triggers laminitis is unclear. However, it has been shown that exogenous administration of insulin induces laminitis in normal horses. This review article provides an overview of the diagnostic options, management approaches and new available therapies. Measuring serum insulin concentrations is of particular importance for diagnosis. However, the exact threshold responsible for triggering laminitis has not yet been determined under practical conditions. It is possible that the threshold for lamellar damage varies between horses and individual factors such as previous laminitis, genetics, age and body weight may play a role. Chronic ID in humans causes impaired pancreatic beta cell function, but this is not known in horses but should be considered. Hyperglycemia, polyuria, polydipsia and weight loss in association with normal insulin concentrations are observed.

Obesity is an important factor in EMS, and in horses, inappropriate diet composition with too high an energy content plays a particular role in this regard. Obesity is a common feature in horses with EMS, but not all horses have hyperinsulinemia. In some horses, hyperinsulinemia cannot be determined from a specific phenotype with a high BCS and fat comb score. A genetic component is suspected, since the insulin response to an oral glucose test varies depending on the breed and the prevalence of hyperinsulinemia is higher in pony breeds in the UK and Andalusians. The authors recommend routinely measuring insulin concentrations in horses, ponies or donkeys with the following characteristics: laminitis, divergent hoof rings, chronic lameness, generalized obesity, regional obesity, infertility, routine examinations in high-risk breeds or horses with the corresponding phenotype and when considering intra-articular or systemic administration of corticosteroids. Since insulin concentration results vary depending on the assay used and the reference ranges of diagnostic laboratories, the use of the open web app (<https://www.equine-insulin-converter.org>) to evaluate the results is recommended. The practical diagnostic methods include determining the basal insulin level without prior fasting and/or the oral sugar test. The

former has a low sensitivity, but is considered a good predictor for the development or recurrence of laminitis. A study was able to demonstrate that with an insulin level of $> 21.6 \mu\text{U/ml}$ 6 % of the animals developed laminitis within 4 years and 69% with an insulin level above $45.2 \mu\text{U/ml}$. It is not recommended to determine insulin concentration if the horse has been starved beforehand. The oral glucose test (OST) tests the response to ingestion of a carbohydrate-rich meal. This test includes digestion, absorption, hormonal response and insulin secretion from the pancreas. It should be noted that feed intake and chewing are not taken into account. It is currently recommended that animals be fasted for 3-6 hours before the test, followed by oral administration of 0.15 or 0.45 ml/kg corn syrup (Karo Light, 1 g/ml carbohydrates) and blood samples are taken before sugar administration and 60 minutes and/or 90 minutes after, and the insulin concentration is determined. At present, a sample is recommended 60 minutes after administration of the syrup. The reproducibility of the test depending on the time of year has produced contradictory results in different studies. Studies on the influence of food intake before the test have also produced contradictory results.

Pars intermedia pituitary dysfunction (PPID) affects older horses and is due to a loss of dopaminergic inhibition of the pars intermedia, which increases the concentrations of circulating adrenocorticotropic hormone (ACTH), alpha-melanocyte-stimulating hormone (α -MSH), corticotropin-like intermediate lobe peptide (CLIP), beta-endorphin and other peptides. Basal ACTH with seasonal adjustment is usually used for diagnosis. In some cases, the thyrotropin-releasing hormone stimulation test is used. ACTH may be increased by stress, transport and severe pain and these factors should be considered in interpretation. Whether PPID and EMS are related is not known. However, it is known that in 30-60% of horses with PPID have hyperinsulinemia and that horses with PPID and hyperinsulinemia are at increased risk of developing laminitis. It is believed that α -MSH and CLIP increase insulin secretion and that there is a high probability of insulin dysregulation in severe cases of PPID. Recent studies have shown that lamella changes in PPID are similar to those following experimentally induced insulin infusion. The TRH stimulation test used for diagnosis and the oral glucose test can be performed on the same day, with the TRH stimulation test first and then the oral glucose test, according to a recent study. Management of hyperinsulinemia includes changes in ration, training and, depending on the case, drug therapy.

Since it is assumed that the insulin response to sugar intake is the most important parameter for predicting the risk of laminitis in ponies with ID, postprandial hyperinsulinemia should be reduced. Feeding feeds with a high content of non-structural carbohydrates, such as grain, should be avoided. In obese horses with insulin dysregulation, weight loss should be achieved by reducing energy intake and increasing energy requirements through exercise. A weight loss of 0.5 to 1 percent of body weight is considered safe. It should be noted that the success of a diet varies greatly due to differences in genetic predisposition to EMS and obesity. The basis of the feed is hay, which ideally contains less than 10% water-soluble carbohydrates. The animals should consume 1.5-2.0 percent of body weight and additionally a supplementary feed that provides the essential vitamins, minerals and amino acids. According to the authors, in horses with obesity and active laminitis, feed intake can be reduced to one percent of body weight (dry matter) to improve insulin sensitivity and achieve faster weight loss if no weight loss is achieved by feeding

1.2-1.5% of body weight. With such a large reduction in feed intake, a weight loss of one percent of body weight per week was achieved and a rapid reduction in hyperinsulinemia without complications. Two studies showed that feed reduction and overnight fasting were not associated with the development of squamous gastric ulcers.

Feeding hay submerged in water may be particularly useful when hay nutrients have not been analyzed to reduce the glycemic and insulinemic response. Factors such as water temperature, volume of water and time in water affect the change in sugar content of hay. When immersed for 7-16 hours, the levels of nutrients, including water-soluble carbohydrates, were increased by 24-34%. However, microbial contamination increases at the same time. If thin horses have hyperinsulinemia, additional calories in the form of fats and highly digestible fibers, such as unmolassed beet pulp, should be used to maintain weight. In these cases, changing the ration is usually not able to reduce the insulin concentration in the blood and drug therapy must be used. An increase in hyperinsulinemia has been shown when pasture grass with a high content of non-structural carbohydrates is consumed. Therefore, horses with ID or active laminitis should not be kept on pasture. Once insulin dysregulation is under control, there is a possibility that the horses will have access to pasture again. Estimating the carbohydrate content of pasture grass is difficult. It has been shown that the sugar content is lower in the morning hours. However, other factors such as frost, the use of herbicides and low soil value also cause an accumulation of sugar in the plant. To assess the insulinemic response to grass, insulin concentration should be checked 1 to 2 hours after grass ingestion.

In obese ponies, light exercise combined with a change in diet composition is known to improve insulin sensitivity compared to a change in diet alone. However, few scientifically based recommendations exist for the amount of exercise. In horses with a history of laminitis, exercise (fast trot to canter) for over 30 minutes more than three times per week at a heart rate of 110-150 beats per minute on soft ground is recommended. In horses without a history of laminitis with ID, the minimum requirement is canter exercise for over 30 minutes, five times per week, at heart rates of 130-170 beats per minute. If changes in diet and increased exercise fail to reduce hyperinsulinemia within 4-6 weeks, or in horses with laminitis that cannot be exercised, drug therapy should be considered. Levothyroxine increases the basal metabolic rate and thus causes weight loss and improved insulin sensitivity in obese horses. A dose of 0.1 mg/kilogram once daily for 3-6 months is recommended, with simultaneous control of the diet, as the drug increases appetite. No side effects have been observed so far. However, when stopping the hormone administration, a slow reduction should be made: halve the dose (0.05 mg/kg) for 2 weeks and halving this dose again (0.025 mg/kg) for a further 2 weeks.

Metformin is used in human medicine as an anti-glycemic drug and improves insulin sensitivity. Due to its limited bioavailability, its effectiveness in horses is limited. Sodium-glucose cotransporter 2 inhibitors (SGLT2i) appear to be effective in rapidly reducing insulin concentrations. However, there are only a few studies on this group of drugs to date. In human medicine, SGLT2i are used to manage type 2 diabetes. This inhibitor reduces glucose reabsorption in the kidneys and increases the amount of glucose excreted in the urine. This lowers the glucose concentration in the blood and subsequently less insulin is produced in the pancreas.

It is not known whether this mechanism is comparable in horses. Studies have so far been carried out on the three inhibitors velagliflozin, canagliflozin and ertugliflozin. Velagliflozin was able to reduce hyperinsulinemia and experimentally prevent the development of laminitis. The recommended dose is 0.3 mg/kg orally once daily. Canagliflozin was administered at a dose of 0.6-3.6 mg/kg orally once daily was able to reduce the insulin response in an oral glucose test. A study conducted in 2023 described a rapid reduction in insulin concentration and improvement in laminitis when management changes did not achieve the desired result.

In human medicine, the risk of infections of the urogenital tract and the risk of diabetic ketoacidosis are described as side effects. In horses, only polyuria and polydipsia are known to occur, but no infections of the urogenital tract have been described to date. Due to the osmotic effect of glucosuria, there is a risk of excessive volume loss. Horses should therefore always have access to clean and fresh water and attention should be paid to signs of dehydration. Regardless of the type of inhibitor, hypertriglyceridemia was observed in horses. According to the author's experience, the majority of horses appear to have returned to normal values after 60 days. Clinical symptoms corresponding to hyperlipidemia were not observed. When treating with SGLT2i, the concentration of triglycerides and creatinine and the activities of GGT and GLDH should be recorded before starting treatment, then again after 7 days and then monthly to monitor the response to treatment. If there is a significant improvement in insulin sensitivity and healing of the laminitis, the medication can be reduced. The authors reduce the dose by half for 2 weeks and then by half again for a further 2 weeks before stopping the medication completely. Regular monitoring of insulin concentrations should continue. In some cases, a dose of 0.025 mg/kg ertugliflozin is sufficient to reduce insulin concentration. There is ongoing debate as to whether there is a correlation between the administration of corticosteroids and laminitis. Corticosteroids are able to increase insulin concentration by reducing the uptake of glucose into fat tissue and muscle and by stimulating gluconeogenesis. The administration of dexamethasone at a dosage of 0.08 mg/kg orally for 7 days worsened insulin dysregulation in healthy horses. ag

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Iron-related markers of inflammation in horses with colic

Canola PA, de Salles RF, Daneze ER, Sobreira MFR, de Oliveira BE, Favero ML, Antonioli ML (2024)

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Iron is considered a suitable acute phase marker for the prognosis of horses with systemic inflammation, including gastrointestinal inflammation. Its metabolism can be determined by measuring blood iron levels and the ability of the blood to transport iron can be determined by quantifying ferritin. Low transferrin levels have been observed in the postoperative phases after colic surgery. The aim of this study was to compare the levels of ferritin, transferrin, iron and acute phase proteins (APP) of healthy horses with those of horses operated on for strangulation colic. At admission, iron-related inflammatory markers were measured:

total protein, fibrinogen, albumin, haptoglobin and ceruloplasmin were determined. 22 horses were examined for the study: 10 healthy horses represented the control group and 12 horses were surgically treated for intestinal obstruction. The group of horses with colic was further divided into horses in which either the small intestine or the large intestine was affected and according to the outcome of the disease (survival or non-survival). The horses in the colic group had higher haptoglobin and transferrin levels and lower iron levels than the horses in the control group. Horses with large intestine disease had lower transferrin levels than horses with small intestinal obstruction. There was no difference in the outcome of the disease between horses with small intestinal or large intestinal obstruction. In the colic group, ferritin levels correlated moderately with total protein and albumin. In the multivariate extrapolation analysis, fibrinogen levels were higher in horses that did not survive. Conclusion: Haptoglobin, transferrin and iron are useful markers of inflammation in colic in horses. The correlation of ferritin with other acute phase proteins shows the possible role that ferritin could have as an acute phase protein in horses. If fibrinogen levels are elevated in horses with strangulation colic, there is an increased risk that these horses will die.

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Current insights into equine neuroaxonal dystrophy/equine degenerative myeloencephalopathy

Young AE, Finno CJ (2024)

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Equine neuroaxonal dystrophy/equine degenerative myeloencephalopathy (eNAD/EDM) causes spinal ataxia and is considered a hereditary neurodegenerative disease that is associated with a vitamin E deficiency in the first year of life. It is not possible to clinically differentiate between the two diseases and it is assumed that eNAD is the basis for EDM. The problem very often affects Quarter Horses and horses of the Lusitano, Trotter, Thoroughbred and Warmblood breeds. The clinical symptoms are usually observed between 6 and 24 months of age, but horses can also become noticeable as early as 5 years of age. The clinical characteristics include symmetrical, proprioceptive ataxia (> grade 2/5) and widely spaced limbs when standing. In this disease, the ataxia not only affects the hind limbs, but there are also cases in which the forelimbs show movement disorders. Neuroaxonal dystrophy in combination with a vitamin E deficiency is often associated with retinal degeneration in other species. This is diagnosed in warmbloods in the form of pigment retinopathy, but not in Quarter Horses. The diagnosis without performing a necropsy with histological examination of the brain stem and spinal cord is based on excluding other possible causes of the ataxia. A low vitamin E concentration in the serum is suspect.

eNAD is diagnosed post mortem through the histological presentation of bilateral and symmetrical axonal degeneration in the caudal brain stem and spinal cord (gray matter). In EDM, the same signs of degeneration occur, but more extensive and also affect the white matter in the spinal cord. In both diseases, the afferent proprioceptive tracts are the primarily altered regions. It

should be noted that horses may have both eNAD/EDM and equine motor neuron disease (EMND). The latter is also a disease that can be caused by a vitamin E deficiency. There is a biomarker test for ante mortem diagnostics, which can detect a protein-phosphorylated neurofilament heavy chain (pNfH), which enters the blood and cerebrospinal fluid (CSF) through axonal damage. However, there are both breed-specific and age-specific differences. If the concentration is > 1 ng/ml in the serum or > 3 ng/ml in the CSF, the test is highly specific for diagnosing eNAD/EDM. It should be noted that the disease can still be present despite physiological values. There are other biomarkers whose significance is currently being scientifically investigated.

Vitamin E is a fat-soluble antioxidant and plays an important role in the prevention of neurological, cardiovascular and age-related diseases in many species. It neutralizes hydroxyl radicals and the products of lipid peroxidation, thus protecting the cell from damage due to oxidative stress. Vitamin E is absorbed in the small intestine as a mixture of 8 isoforms. Of these isoforms, alpha-tocopherol is considered to be the most metabolically active form. After absorption in the small intestine, the isoforms circulate in the blood as chylomicrons. The liver takes them up, stores alpha-tocopherol and metabolizes the other isoforms. Horses with eNAD/EDM appear to show no change in the absorption of vitamin E or in its transport to the target tissue. Diseased Quarter Horses have a higher metabolic rate of the alpha-tocopherol form and increased lipid peroxidation has been found in the spinal cord of diseased horses. Both diseases are increasingly found in related horses, but no causative genetic variant has yet been identified. With regard to the prevention of eNAD/EDM, the administration of water-soluble RRR-alpha-tocopherol is recommended for genetically at-risk quarter horses and trotters in the last trimester of pregnancy, as well as supplementation of foals in the first two years of life. Since there are no genetic tests for diagnosing a predisposition and vitamin E administration is very expensive, the best way to provide sufficient vitamin E seems to be to allow pregnant mares and young horses to graze.

If it is not possible for horses to graze, vitamin E should be given, as most hay sources contain vitamin E, but this oxidizes quickly after cutting. Commercially available vitamin E supplements contain both natural and synthetic sources. The synthetic form is a combination of the 8 isoforms with only 12.5% RRR-alpha-tocopherol. These products are labeled as DL-alpha-tocopherol, all-racemic or all-rac vitamin E. Products that have vitamin E from natural sources contain 100% RRR- α -tocopherol and can be referred to as D- α -tocopherol. Studies have shown that this formulation increases the level in the blood more effectively, and when water-soluble micellized D- α -tocopherol was administered, vitamin E was detected in the brain and spinal cord. It is recommended that pregnant mares from families with a corresponding history receive RRR- α -tocopherol at a dose of 10 IU/kg orally once daily in the last trimester and that foals receive this dose for the first two years of life. It is known that if clinical symptoms occur, supplementation with vitamin E no longer improves the condition. The authors recommend determining the serum vitamin E level before any supplementation and values of over 2 μ g/ml are considered sufficient and values below 1.5 μ g/ml are considered inadequate. An overdose of vitamin E is very rare and can, if at all, lead to coagulopathy. ag

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Effect of repetitive transcranial magnetic stimulation on trigeminal-mediated headshaking in 17 horses

Franzen V, Gruber NA, Klußmann S, Schoster A, May A (2024)
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Clinical symptoms such as vertical shaking of the head, rubbing of the nose and increased lip and tongue movement are characteristic of the headshaking syndrome. There are various causes for this problem, but neuropathic pain in the trigeminal nerve without an underlying disease often seems to be the trigger. In human medicine, the nerve becomes more sensitive and the stimulus threshold is reduced, so that small stimuli such as wind or touch can trigger intense pain. In humans, lesions or diseases of the nervous system that were the cause of neuropathic pain have been identified. In horses, no histopathological changes in the trigeminal nerve have been identified. Neither local, medicinal nor surgical measures are successful in all cases for this problem. Repetitive transcranial magnetic stimulation (rTMS) has been used in human medicine for recurrent neuropathic pain. In these cases, high-frequency rTMS (5-20 Hz) is used with good analgesic effects. The reduction in pain occurs immediately. In veterinary medicine, the procedure has also been used to localize spinal cord lesions. Stimulation of the motor cortex via a magnetic field is able to modulate pain, although the exact mechanism is not known. Furthermore, rTMS reduces the synthesis of pro-inflammatory cytokines.

In the present study, rTMS was used on horses with headshaking and the feasibility and duration of the pain reduction were recorded. 17 horses with non-seasonal headshaking were available for the evaluation. Before starting therapy, other causes for the development of headshaking had been ruled out. This included a neurological and ophthalmological examination and an assessment of the oral cavity including the teeth. An endoscopic examination of the upper and lower respiratory tract including the air sac, an otoscopy, as well as computed tomography images of the head and radiological images of the neck and a blood test were part of the preliminary examination. To assess the severity of the disease and the success of the therapy, a score was used that took into account both the history and the clinical symptoms. The symptoms were assessed independently by 2 people 5 days after the start of therapy, 2 weeks after therapy and 4 weeks after therapy. The rTMS was performed under sedation with detomidine and butorphanol on 5 days. The horses received 1500 impulses per day at 5 Hz, three sets of 500 impulses. The MagPro Compact MMC-140-II, MagVenture, Farum, Denmark, was used.

On the treatment days, the clinical symptoms were recorded at rest and during 20 minutes of lunge work. This was done again 2 and 4 weeks after the therapy. The procedure was well tolerated and only 3 of 17 horses showed defensive movements. No side effects were detected. Over the course of the 5 days, the dose of sedation was reduced. Subjectively, 9 of the animals appeared to relax and show a reduction in pain under rTMS. The signs of headshaking on the lunge decreased by 70% after the 5-day therapy. 4 weeks after the therapy, an average reduction of 50% was still observed during work. The improvement in the scores recorded at rest and during work was significant. However, in some horses the symptoms partially reappeared 2 and 4 weeks after treatment (15 of 17 animals). The lack of long-

term effect could be due to the fact that the stimulation was carried out at a low frequency. According to the results presented here, repetitive transcranial magnetic stimulation seems to be a possible treatment for neuropathic pain and headshaking. ag

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Population pharmacokinetics of butorphanol following intramuscular administration to exercised thoroughbred horses

Knych HK, Weiner D, McKemie DS, Traynham M, Blea, J (2024)
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Butorphanol is a partial opioid agonist that is widely used in veterinary diagnostic procedures such as horse X-rays, among others. To avoid potential positive doping findings, including in racehorses, a precise knowledge of the pharmacokinetics of the drug when it is used is important. In the United States, there are published screening limits (SL) and detection times (DT) for various therapeutic drugs in Thoroughbred racehorses. These SL and DT are established based on the determination of irrelevant plasma and urine concentrations (IPC and IUC) using the Toutain and Lassourd approach. The IPC is the concentration at which the drug no longer has any pharmacological effect and is equivalent to the SL. The DT is the time period during which the concentrations in a blood or urine sample fall below the SL for the respective biological matrix, based on a sample of research horses. Based on the published DT and the clinical scenario, an appropriate withdrawal time (WDT) is recommended. While the pharmacokinetics of intravenously administered butorphanol are well described, there are few studies on intramuscular administration in horses. The aim of the present study was to determine the pharmacokinetics of butorphanol after intramuscular (IM) administration in healthy, trained racehorses and to publish data for setting withdrawal times (WDT) in the context of doping controls.

For this purpose, twelve thoroughbred horses (five mares and seven geldings, mean body weight: 541.3 ± 44.3 kg, age: 5.3 ± 1.2 years) were included in the study. Before the start of the study, all horses were clinically examined and considered healthy and it was recorded that they had not received any other medication in the last two weeks. Butorphanol was administered to the animals at a dose of 0.1 mg/kg im. Serum samples were taken at intervals from 0 to 72 hours after injection, while urine samples were collected at hours 24, 48, 72, 96 and 120. The concentrations of butorphanol in serum and urine were quantified by liquid chromatography-mass spectrometry. Pharmacokinetics were investigated using non-compartmental analysis (NCA) and nonlinear mixed effects modeling to describe the absorption, distribution and elimination of butorphanol. The study found that butorphanol was rapidly absorbed into the systemic circulation following intramuscular administration. The maximum serum concentration (C_{max}) was reached approximately 0.43 hours after injection, indicating rapid absorption of the drug. The elimination phase was also rapid, with the majority of the administered dose eliminated within the first two to three hours. The terminal half-life of butorphanol was 7.67 hours. This is significantly longer than the half-life of 0.57 hours found in previous studies. This discrepancy may be due to the use of different pharmacoki-

netic models (one-compartment model vs. three-compartment model).

Serum concentrations fell below the threshold of 0.01 ng/ml set by the anti-doping authorities up to 96 hours after injection. Urinalysis showed concentrations below the threshold of 1 ng/ml up to 96 hours after administration in 11 of 12 horses, while in one case the value was 1.5 ng/ml. The present study provides important pharmacokinetic data on the intramuscular administration of butorphanol in racehorses. The results show that butorphanol is rapidly eliminated but has a longer terminal half-life, which is important for determining the withdrawal period. Based on the available data, a period of at least 96 hours should be considered when setting the WDT in order to minimize the risk of a positive doping test after administration of butorphanol. vh

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Systematic evaluation supports the use of ELISA for quantification of calprotectin in equine feces, a first step toward noninvasive quantification of intestinal inflammation in horses

Bishop RC, Graham SM, Connolly SL, Wilkins PA, McCoy AM (2024)
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Inflammation of the colon is common in horses and represents a major diagnostic challenge. Since invasive examination methods such as endoscopy and biopsies often involve considerable effort, costs and stress for the animal, the development of non-invasive diagnostic tools is becoming increasingly important. In the present study, the measurement and quantification of calprotectin (CP) was investigated as a potentially meaningful biomarker in the feces of horses. The aim was to validate a method for determining calprotectin and to test its application in diagnostics in order to detect inflammation in the intestine early and reliably. The researchers chose an ELISA (enzyme-linked immunosorbent assay) as the detection method for calprotectin and myeloperoxidase (MPO) and analyzed fecal samples from a total of 38 horses (28 healthy and 10 with diagnosed intestinal inflammation). The ELISA was originally developed for use with horse serum and therefore required specific validation for fecal samples, as the complex biological matrix of feces can pose additional challenges in terms of measurement accuracy and the stability of the biomarker. The hypothesis of the study was that CP and MPO can be reliably and with high precision detected in horse feces and that CP in particular would have clinical relevance as a marker for inflammatory processes in the colon.

However, the validation phase initially showed that standard sample preparation methods did not meet the requirements for analytical precision. An analysis of the variability between samples showed that factors such as centrifugation speed, type of buffer solvent and condition of the samples (fresh or frozen) had a significant impact on the accuracy of the results. In this study, frozen samples treated with conventional PBS buffer and processed at high centrifugation speed yielded inaccurate and inconsistent values for both biomarkers. It was shown that processing fresh fecal samples and using a specific fecal extraction buffer

(FEB) in combination with filtration of the samples could significantly improve the repeatability and reliability of the measurement. After these changes were introduced, the results showed a significant improvement in intra- and interassay variability for CP, but not for MPO. Calprotectin samples prepared using the FEB and a filtration step showed a recovery of up to 64% and a variability of only 0.5% to 3.8%. These values met the criteria for acceptable variability and confirmed that calprotectin can be used as a stable, quantifiable marker in horse feces. MPO, on the other hand, continued to show inconsistent and difficult to reproduce results, indicating possible matrix interference in the feces or insufficient sensitivity of the ELISA for MPO.

Clinically, the determination of calprotectin in horse feces could have great potential, as CP is considered a meaningful indicator of intestinal inflammation and is already used in human medicine for the diagnosis and monitoring of chronic inflammatory bowel diseases such as Crohn's disease and ulcerative colitis. In equine medicine, however, there is currently a lack of standardized, non-invasive methods for measuring inflammatory markers in the intestine. The measurement of calprotectin could be used not only to diagnose acute inflammation of the colon, but also for long-term monitoring of patients, thus reducing the need for invasive examinations. The calprotectin concentrations measured in this study varied depending on the sample preparation. In the FEB-filtered protocol, values between 399.3 ng/mL and 564.1 ng/mL were found, indicating robust detectability of the biomarker. However, the sample was relatively small and the measured concentrations only related to horses without pronounced inflammatory indications in the colon. For clinical application of the CP assay, further studies would be required to establish normal reference values for calprotectin in horse feces and to define threshold values for inflammation. aa

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Microbial populations vary between the upper and lower respiratory tract, but not within biogeographic regions of the lung of healthy horses

Bishop RC, Migliorisi A, Holmes JR, Kemper AM, Band M, Austin S, Aldridge B, Wilkins PA (2024)

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Bacterial respiratory disease has various causes including transport, aspiration of feed and primary infectious diseases. There is a possibility that lung function may be secondarily negatively affected due to bacterial disease, allowing commensal microbes to proliferate and be responsible for the progression of clinical disease. Recent research has shown that the lungs, which are supposed to be sterile, contain microbial populations. The large temperature difference between the air in the nasopharynx and the alveoli allows different bacteria to survive. Other parameters that influence bacterial growth include temperature, pH and oxygen saturation. If these conditions change, there is a possibility that certain bacteria, fungi or viruses can multiply. The microflora of the lower respiratory tract is altered in horses with mild asthma compared to healthy animals, and also after treatment with

dexamethasone and after transport. The aim of this study was to characterize the microbiological population with particular attention to the variability due to the sampling location (upper-lower respiratory tract) and the biogeographical region of the lung in healthy horses. Samples were taken from horses scheduled for euthanasia due to non-infectious, non-systemic musculoskeletal problems and without respiratory disease.

A nasopharyngeal lavage sample was obtained under sedation. Immediately afterwards, a transtracheal lavage (TTA) was performed. After this, the horses were euthanized and the heart and lungs were removed post mortem. Secretion samples were taken from 6 specific segments of the lung in random order using bronchoalveolar lavage. 16S ribosomal DNA sequencing and an analysis of the microbial profile were performed. This sampling was carried out from 2 warmbloods aged 25 years and 10 years, an 11-year-old thoroughbred and a 10-year-old trotter mare. The DNA concentrations were significantly higher in the transtracheal lavage samples compared to the BALF samples and nasopharyngeal lavage samples. Microbial DNA was detected in each sample. The number and identity of the taxa varied greatly between the animals and the sample type as well as the location of the BALF samples. The dominant phyla were Firmicutes, Actinobacteria and Proteobacteria. The trachea samples had a higher proportion of Firmicutes and the BALF samples of Actinobacteriota. There was a significant difference in phylogenetic diversity and richness between the types of samples. Neither alpha nor beta diversity differed significantly due to the different locations of BALF sampling. These results indicate that microbial populations vary between the upper and lower respiratory tract, but not depending on the biogeographical regions of the lung. Thus, BALF fluid can still be collected blindly. ag

Concurrent *Streptococcus equi* subsp. *equi* infection, purpura haemorrhagica and immune-mediated myositis in a Quarter Horse filly

Hepworth-Warren KL, Young KAS, Armwood A, Roessner H, Veerasammy B (2024)

Equine Vet Educ | <https://doi.org/10.1111/eve.13954>

Streptococcus equi subsp. *equi* frequently causes diseases such as strangles and can lead to serious complications, including abscesses and immune-mediated syndromes such as purpura haemorrhagica (PH) and immune-mediated myositis (IMM). While PH is well documented, studies examining the frequency of PH together with active strangles are lacking. IMM, which can occur secondary to streptococcal infections, has only recently been linked to a genetic mutation, the MYH1 mutation. The present case report describes the case of a Quarter Horse mare who was diagnosed with active strangles infection, PH, and IMM simultaneously. A 2-year-old Quarter Horse mare was referred to an equine clinic because of fever, weight loss, diarrhea, and loss of appetite. Two to three days before presentation, her condition deteriorated dramatically, with rapid weight loss and muscle wasting, particularly of the epaxial and gluteal muscles. Despite treatment with ceftiofur, the mare showed no improvement. Clinical examination revealed high body temperature (40.3°C),

edema in all limbs, and moderate tachycardia. Blood tests revealed hypokalemia, hypoalbuminemia, and elevated muscle enzymes (AST and CK). Suspicion of colitis led to administration of metronidazole and flunixin. On day 2, the horse developed painful lymphadenopathy and petechial and ecchymotic hemorrhages occurred in the non-pigmented areas of the mouth. A lymph node sample confirmed *Streptococcus equi* infection. Further testing for PH revealed a SeM titer consistent with recent exposure to *Streptococcus equi*, and investigations revealed the presence of leukocytoclastic vasculitis.

Genetic testing confirmed the presence of the MYH1 mutation, suggesting IMM. The mare's treatment regimen included fluid therapy, antibiotics (ceftiofur), anti-inflammatory drugs (flunixin and corticosteroids), and plasma transfusion. The air sacs were also flushed several times to treat the strangles infection. Digital cryotherapy was also used to prevent laminitis. The treatment resulted in an improvement in the clinical condition. The mare was discharged after 11 days, with treatment to be continued with flunixin and dexamethasone. Genetic testing confirmed that the mare was a carrier of the MYH1 mutation, but a biopsy of the affected muscle did not confirm IMM. This case is the first to document concurrent infection with *Streptococcus equi* subsp. *equi*, PH, and IMM. Although each disease was mild, the case highlights the importance of a thorough history to make an accurate diagnosis. Quarter Horses have been found to be at higher risk for IMM and PH when exposed to *Streptococcus equi* subsp. *equi*. In diagnosing IMM, the mildness of muscle symptoms and low enzyme levels (AST, CK) were notable compared to the typical higher levels. This case highlights the importance of considering all clinical signs and an animal's history, especially when symptoms appear nonspecific. A thorough understanding of genetic predispositions and potential complications from *Streptococcus equi* subsp. *equi* can be critical to diagnosis and treatment. *vh*

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Evaluation of gastrointestinal tract lesions and serum malondialdehyde levels after repeated oral administration of phenylbutazone in horses

Tesan P, Vinijkumthorn R, Preuksathaporn T, Piyakul P, Chotikaprakal T, Sirireugwipas R, Wongaree K, Prapaiwan N (2024)

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Phenylbutazone (PBZ) is one of the oldest non-steroidal anti-inflammatory drugs used in veterinary medicine. It is frequently used in horses to treat pain and inflammation in the musculoskeletal system. Undesirable side effects in the gastrointestinal tract are known. It can contribute to the development of equine gastric ulcer syndrome (EGUS), particularly equine gastric glandular disease (EGGD). There is also a connection with the development of protein-losing enteropathies, which frequently affect the right dorsal colon. Therapy according to the recommended treatment regimen is generally well tolerated, but measures for good monitoring are of great importance in order to detect problems at an early stage. The aim of the present study was to

assess hematological and gastrointestinal changes in horses that received the recommended dose of PBZ over a short period of time. The hypothesis was put forward that subclinical changes are present without the simultaneous occurrence of clinical symptoms. Furthermore, malondialdehyde (MDA) was evaluated as a biomarker for the early detection of gastrointestinal side effects. It was hypothesized that there would be a significant increase in serum MDA concentrations in parallel with the occurrence of hematological and gastrointestinal changes.

The subjects were 14 healthy horses with an EGUS score ≤ 2 and a sonographic thickness of the right colon wall of < 5 mm. The horses were kept and fed under standardized conditions and randomly divided into a treatment and a control group. The treatment group received a syrup containing 4.4 mg/kg PBZ, the control group only the syrup as a placebo. Over the study period, the vital parameters, general condition, food and water intake, feces and urine output of the test subjects were monitored. On days 0, 4 and 8, blood samples were taken to carry out a hematological and blood biochemical examination and on days 0 and 8, MDA was also determined using an ELISA (enzyme-linked immunosorbent assay) validated for horses. Before and after the treatment period, i.e. on days 0 and 8, a gastroscopy and a sonographic measurement of the wall thickness of the right colon were carried out. The gastroscopy was recorded and the video evaluated by 5 experts who independently determined the EGUS score and the EGGD score according to the established scheme. The wall thickness of the right colon was measured twice by 2 examiners. In addition, the pH value of the feces was measured on days 0 and 8. Finally, the results were statistically evaluated.

During the study period, no abnormalities were observed in the subjects with regard to vital parameters, general condition, food and water intake, and excretion of feces and urine. In the hematological and blood biochemical examination, all parameters were within the reference range. However, the treatment group had significantly lower albumin and total protein values on day 8 than on day 0 and than the control group on day 8. All subjects in the treatment group had higher scores for ulcers in the cutaneous mucosa on day 8 than on day 0, and 4 animals also had higher scores for ulcers in the glandular mucosa. In the control group, 5 horses had higher scores for ulcers in the cutaneous mucosa on day 8 than on day 0 and one animal had higher scores for ulcers in the glandular mucosa. There were no significant differences in the comparison between the groups. The wall thickness of the right colon was higher in the treatment group on day 8 than on day 0. There was no difference in the control group. There was also no significant difference in the comparison between the two groups. The wall thickness was less than 5 mm in all subjects. mm. The MDA concentration in serum was higher in the control group on day 8 than on day 0, but did not differ significantly from that in the control group. The pH of the faeces did not differ within the groups between day 0 and day 8, but was lower in the treatment group on day 8 than in the control group. As expected, the albumin and total protein concentration in the blood decreased in the treatment group, presumably due to increasing permeability of the intestinal wall. Although the values were still within the reference range, prolonged therapy could lead to the development of clinically relevant protein loss enteropathy.

Furthermore, there was an increase in EGGD scores in the treatment group. PBZ is a cyclooxygenase inhibitor and this is respon-

sible for the conversion of arachnoidonic acid to prostaglandin E2. Prostaglandin E2 plays a key role in lowering the pH value in the stomach and in the integrity of the intestinal wall. The increase in EGGD scores in the treatment group was not statistically significant, possibly indicating that a dose of 4.4 mg/kg twice daily over a period of 7 days had no serious effects. In both groups, ESGD scores increased, in 7 animals in the treatment group and in 5 animals in the control group. Fasting before gastroscopy may have played a role, as did the feeding of the subjects, who received part of the roughage in the form of straw, as hay and grass were only available to a limited extent. As expected, the animals in the treatment group experienced an increase in the wall thickness of the right colon, which indicates inflammation of the intestinal wall. However, the increase was not significant at a dose of 4.4 mg/kg over a period of 7 days was not statistically significant and the wall thickness was less than 5 mm. The effects of orally administered NSAIDs on fecal pH have not yet been studied in horses. A decrease in pH was observed in the treatment group compared to the control group.

Values between 6.0 and 6.2 were found, indicating the presence of subclinical intestinal acidosis. Values below 6.0 result in clinically relevant damage to the intestinal flora, production of endotoxins and clinical symptoms such as diarrhea, colic and laminitis. MDA is a biomarker for oxidative stress and has already been classified as a non-specific biomarker for the diagnosis of gastric ulcers in horses. The results of the present study suggest that therapy with the prescribed PBZ dose after 7 days may have led to oxidative stress, but not yet in a statistically relevant form. A high variability in serum concentrations occurred, suggesting that MDA is not a suitable biomarker for the early detection of gastrointestinal lesions when treating horses with PBZ. In summary, the results of the present study demonstrate that when PBZ is administered according to the recommended treatment regimen, subclinical hematological and gastrointestinal changes can be observed without the occurrence of clinical symptoms. This underlines the need for careful monitoring. Further studies to find a suitable biomarker for the early detection of gastrointestinal damage are urgently needed.

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Successful management of pneumonia and pyogranulomatous cranial mediastinitis due to *Coccidioides* species infection with fluconazole in a 3-year-old horse

Mullen KR, Fenn M, Hill JA, Alexander K, Gonzalez-Barrientos CR, Rodrigues Hoffmann A, Duhamel GE (2024)
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coccidioidomycosis, also known as San Joaquin Valley Fever, is a rare but important cause of fever, anorexia, and respiratory signs in horses, particularly in regions where the condition is endemic, such as the western and southwestern states of the United States, northern Mexico, parts of Central and South America, and Australia. It is caused by the dimorphic fungi *Coccidioides immitis* and *Coccidioides posadasii*, which occur in alkaline, sandy soils with little rainfall and few winter frosts. In their myce-

lial form, these fungi produce arthroconidia (spores) that are released into the air and enter the host via inhalation or, in rare cases, direct cutaneous inoculation. In the lungs, these arthroconidia transform into spheres (spherules) which, upon maturation, burst and release endospores. These endospores can spread hematogenously or lymphogenously and form new spherules, which can lead to disseminated disease. This case report describes the diagnosis and successful treatment of pyogranulomatous mediastinitis in a 3-year-old Quarter Horse gelding with *Coccidioides* infection using long-term oral fluconazole therapy.

The authors note that this is the first known case of successful use of fluconazole to treat extrapulmonary coccidioidomycosis in a horse. The Quarter Horse gelding weighing approximately 400 kg was referred to an equine clinic with fever and anorexia that had been present for three days. The horse's vaccination and deworming history was unknown. Antibiotic treatment with ceftiofur did not resolve the symptoms. The horse's clinical condition showed signs of a chronic inflammatory reaction, with leukocytosis and elevated fibrinogen, as well as moderate anemia. Thoracic ultrasound revealed a dense picture in the right cranioventral region of the lung tissue and a large, well-demarcated mass in the mediastinum. Further diagnostic investigations included histopathology of the biopsy specimens, which showed severe pyogranulomatous mediastinitis with fungal structures typical of *Coccidioides* species. The diagnosis was confirmed by PCR and *Coccidioides* species were detected in the biopsy samples. Treatment with oral fluconazole was started at an initial dose of 14 mg/kg and continued at a daily dose of 5 mg/kg. Intravenous antibiotics were discontinued. After two months, treatment was switched to fluconazole tablets and the horse showed significant clinical improvement.

The general condition improved, fever and tachycardia subsided, and the thoracic mass shrank on ultrasound. At the 24-month follow-up, the horse's clinical condition was stable and fluconazole therapy was successfully completed. This case highlights that coccidioidomycosis should be considered as a possible cause of fever, anorexia, and respiratory or extrapulmonary disease in horses in endemic regions. The fluconazole used is a preferred treatment option due to its good bioavailability and few side effects and showed good efficacy in extrapulmonary coccidioidomycosis in this case. Further research on the optimal duration of therapy and standardization of monitoring options such as regular ultrasound examination would be helpful to determine the best treatment approach. vh

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Fasting horses perioperatively decreases manure production and increases time to manure output postoperatively: a controlled randomized trial

Barton CK, Hector RC, Hendrickson DA, Kawcak CE, Nelson BB, Goodrich LR (2024)
J Am Vet Med Assoc | <https://doi.org/10.2460/javma.24.04.0235>

Post-anesthetic colic (PAC) is one of the most common complications associated with general anesthesia in horses, contributing

to more than 65% of anesthetic complications with an incidence of 3% to 11%. Because PAC is associated with a significant risk of mortality as well as additional costs to livestock owners, there is a need for evidence-based recommendations for perioperative feeding strategies to reduce the incidence of this complication. Traditionally, withholding hay prior to anesthesia has been considered standard practice, with fasting periods of 6 to 12 hours documented in the literature. However, it has been found that various medications used during anesthesia, such as sedatives, anesthetics, analgesics, and antibiotics, can decrease gastrointestinal motility and increase the risk of PAC. Despite the widespread practice of fasting, there is no solid scientific basis to support this measure, and it has been shown that sudden feed restriction can lead to adverse effects such as reduced water intake, reduction in gastric pH, and colic. A recent retrospective analysis of non-fasted horses undergoing elective surgery found a PAC incidence of only 2.5%, which is lower than in fasted animals.

The main aim of the present study was to compare fecal output, anesthetic outcomes (particularly hypoxemia and hypotension), water intake and the occurrence of PAC in horses that were not fasted before and after anesthesia with animals that were fasted before anesthesia and gradually fed after anesthesia. Furthermore, it was investigated whether wearing a muzzle in fasting horses had a negative effect on water intake and fecal production. For this purpose, 45 horses undergoing elective orthopedic surgery were randomly divided into three groups: first, the NF group (not fasted), which received continuous hay feeding perioperatively; second, the FM group (fasted, with muzzle), which received hay up to 10 hours preoperatively, then fasted and gradually fed hay postoperatively with a muzzle. The third group, the FNM group, had fasted and the same procedure as FM, but without a muzzle. The parameters collected included anesthesia variables (hypoxemia, hypotension), fecal production, time to first defecation and PAC incidence. Furthermore, it was investigated whether the muzzle influences water intake and fecal production.

This study shows that horses in the NF group had a significantly smaller reduction in fecal volume postoperatively (-39%) compared to FM (-81%) and FNM (-70%). The number of defecations was also higher in the NF group (-22%) compared to FM (-63%) and FNM (-55%) groups. The time to first defecation was significantly shorter in the NF group (238 ± 13 minutes) compared to FM (502 ± 174 minutes) and FNM (444 ± 171 minutes). PAC did not occur in the NF group, but did occur in 13% of horses in the fasting groups (FM and FNM). The difference was not statistically significant. There were no significant differences between groups in terms of hypotension, hypoxemia, or recovery time. All horses had adequate oxygen levels under mechanical ventilation, regardless of feeding regimen. The results confirm that continuous hay feeding perioperatively improves postoperative fecal production and shortens the time to first defecation without compromising anesthetic safety. This means that the traditional perioperative fasting regime in horses should be reconsidered. Horses with continuous access to hay had better postoperative gastrointestinal tract (GIT) function, which may reduce PAC risks. Future studies should measure objective parameters such as GIT motility or transit time to more accurately capture the physiological mechanisms.

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Effect of repetitive transcranial magnetic stimulation on trigeminal-mediated headshaking in 17 horses

*Franzen V, Gruber NA, Klußmann S, Schoster A, May A (2024)
J Vet Intern Med. | <https://doi.org/10.1111/jvim.17194>*

Clinical symptoms such as vertical shaking of the head, rubbing of the nose and increased lip and tongue movement are characteristic of the headshaking syndrome. There are various causes for this problem, but neuropathic pain in the trigeminal nerve without an underlying disease often seems to be the trigger. In human medicine, the nerve becomes more sensitive and the stimulus threshold is reduced, so that small stimuli such as wind or touch can trigger intense pain. In humans, lesions or diseases of the nervous system that were the cause of neuropathic pain have been identified. In horses, no histopathological changes in the trigeminal nerve have been identified. Neither local, medicinal nor surgical measures are successful in all cases for this problem. Repetitive transcranial magnetic stimulation (rTMS) has been used in human medicine for recurrent neuropathic pain. In these cases, high-frequency rTMS (5-20 Hz) is used with good analgesic effects. The reduction in pain occurs immediately. In veterinary medicine, the procedure has also been used to localize spinal cord lesions. Stimulation of the motor cortex via a magnetic field is able to modulate pain, although the exact mechanism is not known. Furthermore, rTMS reduces the synthesis of pro-inflammatory cytokines.

In the present study, rTMS was used on horses with headshaking and the feasibility and duration of the pain reduction were recorded. 17 horses with non-seasonal headshaking were available for the evaluation. Before starting therapy, other causes for the development of headshaking had been ruled out. This included a neurological and ophthalmological examination and an assessment of the oral cavity including the teeth. An endoscopic examination of the upper and lower respiratory tract including the air sac, an otoscopy, as well as computed tomography images of the head and radiological images of the neck and a blood test were part of the preliminary examination. To assess the severity of the disease and the success of the therapy, a score was used that took into account both the history and the clinical symptoms. The symptoms were assessed independently by 2 people 5 days after the start of therapy, 2 weeks after therapy and 4 weeks after therapy. The rTMS was performed under sedation with detomidine and butorphanol on 5 days. The horses received 1500 impulses per day at 5 Hz, three sets of 500 impulses. The MagPro Compact MMC-140-II, MagVenture, Farum, Denmark, was used.

On the treatment days, the clinical symptoms were recorded at rest and during 20 minutes of lunge work. This was done again 2 and 4 weeks after the therapy. The procedure was well tolerated and only 3 of 17 horses showed defensive movements. No side effects were detected. Over the course of the 5 days, the dose of sedation was reduced. Subjectively, 9 of the animals appeared to relax and show a reduction in pain under rTMS. The signs of headshaking on the lunge decreased by 70% after the 5-day therapy. 4 weeks after the therapy, an average reduction of 50% was still observed during work. The improvement in the scores recorded at rest and during work was significant. However, in some horses the symptoms partially reappeared 2 and 4 weeks after treatment (15 of 17 animals). The lack of long-

term effect could be due to the fact that the stimulation was carried out at a low frequency. According to the results presented here, repetitive transcranial magnetic stimulation seems to be a possible treatment for neuropathic pain and headshaking. ag

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Influence of climatic changes on respiratory health in a teaching herd of outdoor-housed horses

Stefano Strano Calomeno S, de Freitas Santi T, Barbosa B, Weber SH, Oliveira TM, Machado GF, Michelotto PV (2024)

Vet J | <https://doi.org/10.1016/j.tvjl.2024.106198>

In horses with the respiratory disease equine asthma, symptoms worsen when kept in stables and fed dry hay. The associated clinical symptoms improve after 7 days of pure grazing. It has been found that the inhalation of endotoxins is reduced in pastures compared to stables. Despite this, horses kept in pastures can also develop asthma. The triggering mechanisms of summer-associated asthma are not known. In 2006, it was published that 70% of horses kept in pastures had an increased proportion of neutrophils in their tracheal secretions during the winter. In this study, feeding hay was also associated with the increase in these cells. The aim of this study was to assess the extent to which the seasons influence respiratory parameters. 17 horses kept in open stables were available for the study. The horses were kept in paddocks, received hay and commercial concentrate and had access to pasture. With the exception of one mare, all horses were considered healthy. The lower respiratory tract was assessed in winter, spring and summer. This examination included endoscopy of the respiratory tract including bronchoalveolar lavage. The lavage fluid was subjected to cytological examination. In addition, endobronchial biopsy samples were taken and the samples were examined histopathologically. During the endoscopic examination of the respiratory tract, the accumulation of tracheal secretion was graded (0-5) and the thickness of the bronchial septum (1-5).

Meteorological data was included in the analysis, including maximum and minimum temperatures and humidity recorded over a period of 15 days before and after the animals were examined. The time of year had no influence on the accumulation of tracheal secretion or the thickness of the bronchial septum. Compared to the summer months, the proportion of neutrophils in the BALF was higher in spring; no significant difference could be found between spring and winter, nor between winter and summer. Only in spring was the proportion over 5%. This trend could also be seen in the only horse with asthma, in that the proportion of neutrophils was 52% in spring, 49% in summer and 25% in winter. But even if the values of this horse were not included in the analysis, it was shown that the average number of neutrophils in the BALF was higher in spring compared to summer and spring. The average proportion of eosinophils, on the other hand, was higher in winter than in summer. The histopathological examination of the bronchial epithelium showed no differences in terms of the influence of the season. In winter, a positive correlation was found between the eosinophils in the BALF and the accumulation of tracheal secretion. In summer, the propor-

tion of macrophages was negatively correlated with the grading of the tracheal mucus. The results of this study show that the cytological results of the BALF show changes over the course of a year in horses that do not live in a stable and that these may be influenced by external factors. However, no histopathological results of the bronchial epithelium could support this result. ag

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Oral sugar test responses to ertugliflozin in ten horses with insulin dysregulation

Sundra T, Rossi G, Kelty E, Lester G, Rendle D (2024)

Equine Vet Educ | <https://doi.org/10.1111/eve.13924>

Equine metabolic syndrome (EMS) is characterized by obesity, insulin dysregulation (ID) and an increased risk of developing laminitis. Hyperinsulinemia is considered to be a key factor in the development of laminitis in horses. The oral sugar test is considered to be a reliable method for identifying insulin dysregulation in horses. Sodium glucose cotransporter 2 inhibitors (SGLT2i) are relatively new antidiabetic drugs from human medicine. They inhibit the reabsorption of glucose in the kidneys, thus increasing glucose excretion in the urine, which leads to a reduction in the glucose concentration in the plasma and thus to a reduced secretion of insulin by the pancreas. This leads to a reduction in the insulin concentration in the blood. Under physiological conditions, SGLT2 is responsible for approximately 90% of glucose reabsorption in the kidney. Experimental studies have shown that velagliflozin reduces insulin concentration in ponies and prevents the development of laminitis due to a diet high in non-structural carbohydrates. This study describes the effects of 4 days of ertugliflozin administration on the results of the oral sugar test in clinical cases with ID. For this purpose, the medical data from October 2022 to January 2023 were reviewed and cases of horses with hyperinsulinemia-associated laminitis treated with ertugliflozin and in which an oral sugar test had been performed were selected. For the oral sugar test, Karo-Light syrup was used at a dosage of 0.45 ml/kg and blood samples were taken before and 60 or 90 minutes after administration. The dose of ertugliflozin was 0.05 mg/kg, administered once daily.

The oral glucose test was performed before drug administration and 4 days after the start of therapy. Ten horses met the inclusion criteria. Many of these horses also had dysfunction of the pars intermedia of the pituitary gland and received pergolide (2 µg/kg). Insulin concentrations decreased in all horses after 4 days of therapy. The average insulin concentration before sugar administration was 22.4 U/ml (6.5–39) and after four days of treatment at 4.8 U/ml (3.7–9.2). One hour after administration of corn syrup, the insulin level was 165 U/ml (60.2–222) and after 90 minutes at 170 U/ml (88.6–269). After 4 days of treatment, these values were 78.1 U/ml (30.5–137) or 84.7 U/ml (28.7–122). No significant reduction in glucose concentration was observed either before or after sugar administration after 4 days of ertugliflozin treatment. Although not significant, these concentrations were reduced after 4 days of therapy. Treatment with ertugliflozin was associated with an increase in triglyceride concentration of 0.2–2 mmol/l to 0.3–3.8 mmol/l. In one horse each, the activity of GGT and GLDH was above the reference

value given by the laboratory both before and after the 4-day therapy. No significant difference was found due to the therapy. Creatinine values always remained within the normal range. The results of the study show that the administration of ertugliflozin for 4 days is associated with a significant reduction in insulin concentration and insulin responses to oral sugar administration. A statistically significant improvement in lameness in the 10 cases after four days of therapy could not be found. ag

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Fatal acute clinical babesiosis in an adult gelding pony living in an endemic area

Hermans LM, Tortereau A, Riccio B, Desjardins I (2024)

Equine Vet Educ | <https://doi.org/10.1111/eve.14009>

Babesiosis is a serious threat to horses in endemic regions. It is caused by the blood parasites *Babesia caballi* and *Theileria equi*, which are transmitted by ticks and can lead to a variety of clinical pictures, from asymptomatic infections to life-threatening courses, depending on the animal's immune status. This case study describes the rare case of an acute, fatal course of babesiosis in a 10-year-old pony gelding from an endemic region of France. The pony was admitted to the clinic with high fever and increasing respiratory difficulties. After the initial examination, the animal's condition deteriorated rapidly. It showed symptoms of hypovolemic shock, associated with severe respiratory difficulties, poor capillary refill time and congestive mucous membranes. Blood tests confirmed mild anemia and thrombocytopenia, and the blood smear showed intraerythrocytic inclusions suggestive of *B. caballi*. Laboratory diagnostics also revealed an increased serum concentration of amyloid A and hyperglobulinemia, indicating a systemic inflammatory reaction. Metabolic acidosis, azotemia and hypocalcemia underlined the seriousness of the systemic effects. The pony also developed severe sternal edema and *Babesia* parasites were detected in the pleural fluid.

The diagnosis was acute babesiosis with secondary systemic inflammatory response syndrome (SIRS) and multiple organ failure affecting the lungs, heart, kidneys and pancreas. This is an extremely rare and severe clinical picture of babesiosis, as horses in endemic areas usually develop immunity and rarely show acute symptoms. Therapeutic measures were limited to supportive care, as the use of imidocarb, a drug used to treat babesiosis, was not an option due to the potentially fatal side effects in horses in shock. The administration of fluids and oxygen failed to stop the progression of the disease. The pony developed acute pulmonary edema and disseminated intravascular coagulation disorders (DIC), which ultimately led to euthanasia. The post-mortem examination confirmed the formation of microthrombi in small vessels, venous congestion and generalized vasculitis - all indications of the destructive influence of babesiosis on the vascular system. The most reliable way to diagnose babesiosis is to directly detect the pathogens in blood or pleural fluid using a blood smear or PCR, as antibody tests are less informative, especially in the acute phase of the disease. However, it should be noted that blood smears often do not provide reliable information even in the acute phase of a *B. caballi* infection, as less than 1% of the erythrocytes are affected.

PCR could help to detect mixed infections with other pathogens such as *Theileria equi*, but was not performed in this case. The case of this pony illustrates that even in endemic areas where many horses are immune due to previous exposure, acute and fatal disease courses are possible. The course may have been influenced by the previous administration of corticosteroids, which weaken the immune system and thus may have promoted parasite proliferation. However, it is still unclear whether the use of corticosteroids actually increases the severity of clinical signs. This rare course of babesiosis shows how crucial early detection and targeted therapeutic interventions are to prevent disease progression. Further research is needed to determine whether and how imidocarb can be used safely in horses in shock, as stabilizing measures are often not sufficient to alleviate life-threatening symptoms. aa

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Cytological diagnosis of exercise-induced pulmonary hemorrhage: Comparison of tracheal wash and bronchoalveolar lavage in standardbred racehorses

Barbazanges P, Richard EA, Lemonnier LC, Wouters CP, Toquet MP, Couroucé A (2023)

Vet Rec | <https://doi.org/10.1102/vetr.3826>

Performance-induced pulmonary hemorrhage (EIPH) primarily affects racehorses and is characterized by bleeding from the lungs during intense exercise. EIPH is diagnosed by the visibility of nosebleeds after strenuous exercise or by endoscopic examination including bronchoalveolar lavage (BAL). Endoscopy is often performed 3-120 minutes after exercise and has a high specificity and low sensitivity. In cases where no blood can be detected by endoscopic examination, cytological examination of fluid obtained from the lower respiratory tract offers better sensitivity due to the possible detection of hemosiderophages. Bronchoalveolar lavage (BAL) and tracheal lavage (TW) can be used to obtain fluid from the lower respiratory tract. This study was designed to assess whether the choice of procedure (BAL vs. TW) has an impact on the diagnosis of EIPH by measuring the ratio between hemosiderophages and macrophages (H/M). This was a prospective, cross-sectional study. TW and BAL were performed on 21 horses 4 to 20 hours after the last training or race. The horses were partially sedated or the samples were taken only with a nose brake. TW was performed endoscopically by inserting 40 ml of warm, sterile saline solution (0.9%) and the recovery of the fluid. The fluid was filled into an EDTA tube. BAL was also performed endoscopically with 500 ml of warm, sterile, physiological saline solution and the recovered fluid was also filled into EDTA tubes.

The samples were centrifuged and examined within 8 hours. The definition of an EIPH was a ratio of H/M > 17% in the BAL of the right or left lung or over 9% in the pooled sample. The H/M ratio in the TW samples was classified as follows: 0%, < 10%, 10-20%, 25-50% or > 50%. The horses were 2-8 years old and came from 6 training stables. The samples were taken a median of 16 days after the last race. The horses were clinically unremarkable. 20 horses had a ratio of less than 10% on, 9 animals 10-24%, a horse 25-50% and 3 horses a ratio of > 50%. The

results of BAL were consistent with a diagnosis of EIPH in 21 horses, with 3 animals having a ratio of > 17% in both lungs. In 9 animals the value was only above 17% in the right or left lung. 6 horses had a ratio of less than 17% in both lungs, but a too high ratio in the pooled sample. Overall, no significant difference was found in the H/M ratio between the TW and right, left and pooled BAL samples. However, there was a poor correlation between the TW and BAL results. Thus, no correlation could be demonstrated for the cytological diagnosis of EIPH by examining tracheal lavage samples and BAL fluid samples. Based on the ratio of hemosiderophages to macrophages, the sample type of choice for cytological examination to diagnose EIPH is the bronchoalveolar lavage. ag

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Association between the levels of serum cortisol and the presence of gastric ulcers in working mules

Calixto-Vega LC, Martínez-Aranzaes RC (2024)

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The presence of Mule Gastric Ulcer Syndrome (MGUS) was found in 44.6% of mules used in agriculture. Traits such as hardiness, rusticity and stoicism, anecdotally attributed to mules, distinguish them and lead to them being preferred over other equids for certain tasks. Equine Gastric Ulcer Syndrome (EGUS) in horses is considered to be multifactorial, depending on both the use and husbandry systems and the activities they perform. In terms of research and their work purpose, mules are subjected to long working hours and prolonged periods of fasting in order to take advantage of the resilience and performance capacity of this species. These factors are the main stressors that could potentially be involved in the pathophysiology of MGUS. Stress induced by various activities resulting from the husbandry systems and the intensity of work or sports training has been associated with the occurrence of EGUS in horses. This stress can lead to neuroendocrine imbalances such as increased production of gastrin and histamine, which leads to the production of hydrochloric acid, which has a corrosive effect on the glandless cutaneous mucosa, while high cortisol levels can impair the protective mechanisms of the glandular mucosa of the stomach. Cortisol is often seen as a marker of stress, lack of well-being, an indication of disease and an indicator of the horse's athletic condition.

It can be measured in various substrates such as blood, saliva, sweat, tears, feces and hair. Recently, there has been increased interest in understanding the role of cortisol levels in the pathogenesis of ulcerative lesions in the setting of EGUS. The aim of this study was to investigate the association between serum cortisol levels and the presence of ulcerative changes in both types of gastric mucosa. For this purpose, blood samples were collected from 97 clinically healthy mules of both sexes with an average age of 8.7 ± 4.4 years, a mean body weight (BW) of 290.5 ± 37.6 kg and a Body Condition Score (BCS) of 5 ± 0.8 to measure serum cortisol concentration using a commercial sandwich ELISA kit (AccuBind®, Monobind Inc., CA, USA). In addition, these animals underwent gastroscopy to evaluate and

classify the gastric mucosa. MGUS was performed at 44.6% diagnosed, of these animals 27.8% Mule Squamous Gastric Disease (MSGD) and 19.6% Mule Glandular Gastric Disease (MGGD). The mean cortisol concentration was 10.59 ± 4.06 g/dL, with concentrations very similar in the groups with and without ulcerative changes. Under the conditions of this study, no relationship was found between serum cortisol levels and the degree of ulceration of both gastric mucosa, in contrast to the results in horses. These data suggest that the response to stress factors in mules must be different from that in horses exposed to extreme working conditions. vh

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Evaluation of pharmacokinetics of metoclopramide administered via subcutaneous bolus and intravenous constant rate infusion to adult horses

Brandon AM, Williams JM, Davis JL, Martin EG, Capper AM, Crabtree NE (2024)

Vet Surg | <https://doi.org/10.1111/vsu.14128>

Metoclopramide is a prokinetic agent used in intestinal ileus. It has been shown to improve jejunal motility and gastric emptying in healthy horses and to reduce nasogastric reflux in clinically ill animals. Metoclopramide has various mechanisms of action. It acts as an antagonist at dopamine receptors, as a mixed agonist/antagonist at serotonin receptors, causes a slight blockade of alpha-2 receptors and has a limited direct stimulating effect on the smooth muscles of the gastrointestinal tract via acetylcholine receptors. In addition, the agent can cross the blood-brain barrier, whereby the antagonistic effect at the dopamine receptors can lead to side effects such as restlessness and agitation. This can manifest itself in aggressive and dangerous behavior. Metoclopramide is usually administered as a continuous intravenous infusion at a dosage of 0.04 mg/kg/h. This dose resulted in clinical improvement of nasogastric reflux without significant side effects. An alternative administration consists of a single subcutaneous dose of 0.08 mg/kg. The present study aimed to evaluate the pharmacokinetic properties of these two dosage forms, including the effect on gastrointestinal motility and the occurrence of possible adverse reactions.

The study involved six healthy, adult horses of different breeds, aged between 8 and 20 years and weighing between 415 and 561 kg. Each horse received metoclopramide either intravenously as a continuous infusion at a dosage of 0.04 mg/kg/h over 24 hours or as a single subcutaneous bolus at a dose of 0.08 mg/kg with a wash-out phase of one week. Blood samples were taken before the start of treatment and at regular intervals up to 48 hours after the end of treatment. The drug concentration was analyzed using ultra-high performance liquid chromatography in combination with tandem mass spectrometry. The motility of the small intestine was recorded every two hours using ultrasound and auscultation of the bowel sounds was also performed. Video recordings were made 24 hours before and up to 24 hours after the drug was administered and then evaluated. The maximum concentration after subcutaneous administration

was 0.583 ± 0.204 hours, compared to 17.3 ± 6.41 hours after intravenous continuous infusion. The maximum drug concentration (ng/ml) after subcutaneous bolus was 27.7 ± 6.38 and after intravenous infusion 43.6 ± 9.97 .

The calculated AUC ($h \times ng/ml$) was 902 ± 189 for the 24-hour intravenous administration and 244 ± 730.4 for simulated subcutaneous administration every 8 hours with 0.08 mg/kg. Based on the AUC of the different administration routes, the bioavailability was high after subcutaneous administration (110%). No clear changes in gastrointestinal motility were observed. No side effects occurred. Since the active substance was rapidly absorbed after subcutaneous administration and the calculated bioavailability was high, this form of administration represents a potential option for drug administration. Simulated dosing protocols resulted in administration intervals of 0.16 mg/kg every 4 hours, 0.24 mg/kg every 6 hours and 0.32 mg/kg every 8 hours. These dosing regimens could provide a drug concentration comparable to that achieved with continuous intravenous infusion of 0.04 mg/kg/h over 24 hours. However an administration of 0.08 mg/kg every 8 hours would not be sufficient to achieve an adequate drug concentration. Therefore, higher doses and/or more frequent injections would have to be used. ag

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Comparative pharmacokinetics of phenylbutazone in healthy young-adult and geriatric horses

Zaghloul IY, Bedenice D, Ceresia ML, Jones PH, Sanchez-Londono A, Lobo MN, Böhlke M, Paradis MJ (2024)

Am J Vet Res | <https://doi.org/10.2460/ajvr.24.01.0012>

In old horses, reduced metabolism in the liver and declining kidney function usually lead to a delayed elimination of pharmaceuticals, resulting in an increased risk of intoxication. Phenylbutazone is a non-selective cyclooxygenase inhibitor and is often used in equine medicine due to its analgesic, anti-inflammatory and antipyretic effects, particularly in geriatric patients to control inflammation and pain in orthopedic problems. Damage to the gastrointestinal tract has been described as undesirable side effects. The aim of the present study was to compare the pharmacokinetics of phenylbutazone and its active metabolite oxyphenbutazone between healthy young adult and geriatric horses after a single intravenous application of 2.2 mg/kg phenylbutazone. It was hypothesized that the pharmacokinetics are influenced by the age of the animals. 16 subjects were available, who were divided into two groups, consisting of 8 young adult horses aged between 4 and 10 years and 8 geriatric horses aged over 25 years. The animals received a single dose of 2.2 mg/kg phenylbutazone intravenously. Serum samples were taken at regular intervals before administration and up to 44 hours after administration for pharmacokinetic analysis. The study was performed by liquid chromatography tandem mass spectrometry using Phoenix WinNolin, version 8.0 (Centara). The comparison of clinical and pharmacokinetic parameters was performed using independent sample t tests. With the exception of age, weight and hematocrit, the characteristics did not differ between the groups. The plasma concentration of phenylbutazone was best represented in the form of a two-compartment model. The maximum concentration of oxyphenbutazone was reached in both

groups 5 hours after administration. The metabolite to parent area under the curve ratios were 20% for both groups. There were no significant differences between the groups in the pharmacokinetic parameters for phenylbutazone and oxyphenbutazone. The hypothesis was not confirmed by the results of the present study. There was no difference in the metabolism of phenylbutazone between young and old horses, so that at the recommended horse dosage of 2.2-4.4/mg/kg and a duration of administration of not more than 5 days, there is no need for dose adjustment for healthy geriatric patients.

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Clinical findings and outcome predictors for multinodular pulmonary fibrosis in horses: 46 cases (2009–2019)

Craven A, Todd-Donato A, Stokol T, Liepman R, Glasberg I, Wilkins P, Luethy D, Wong D, Schoster A, van den Brom-Spiereburg AJ, Tomlinson JE (2024)

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Equine multinodular pulmonary fibrosis (EMPF) is a clinical syndrome characterized by interstitial fibrosis with diffuse or nodular radiographic patterns. The gammaherpesvirus EHV-5 is thought to be the etiological agent of this disease. However, there are cases where both radiographic and histological findings suggest EMPF, but tests for EHV-5 are negative. Making a definitive diagnosis of this disease antemortem is extremely difficult. Histological examination of biopsy specimens from pleural nodules is used, and PCR is used to detect EHV-5 DNA in either tissue or bronchoalveolar lavage fluid. If a biopsy cannot be performed, a presumptive diagnosis is made based on radiographic findings, BALF neutrophilia, and detection of EHV-5 DNA. The present study aimed to retrospectively evaluate clinical and diagnostic findings to determine prognostic indicators for EMPF. Clinical symptoms, hematological and cytological results of BALF, and sonographic and radiological findings were recorded. This was a retrospective multicenter case series study from 2009-2019. Inclusion criteria were age over 2 years, increased respiratory rate, increased work of breathing, or both, and a diagnosis of EMPF.

46 cases from 9 clinics were included in the evaluation. X-rays were available for 27 of these animals, sonographic examinations for 19 and results of a bronchoalveolar lavage for 6 horses with EMPF and 13 animals with asthma. There were 24 mares, one stallion and 21 geldings. The median age of the animals was 15 years (5-26 years). There were 28% Thoroughbreds, 41% warm-blooded, 8% Quarter Horses, and 22% of the horses belonged to other breeds. 35% of cases, the definitive diagnosis of pulmonary fibrosis was made by histopathological examination of a biopsy, in 57% of cases were diagnosed from samples taken at necropsy. The remaining 12 cases were suspected. EHV-5 DNA was detected in 24 of 30 BALF samples examined. EHV-5 DNA was detected in 8 of 20 horses with a histopathological diagnosis of EMPF, as well as in 6 of 7 horses with a suspected diagnosis. The median duration of clinical signs prior to presentation was 28 days. Clinical signs included weight loss (78%), increased respiratory work (72%), tachypnea (more than

24 breaths per minute, 70%), fever (39%), nasal discharge (30%) and shortness of breath (13%). Some horses showed inflammatory or stress leukocytosis, characterized by neutrophilia with or without left shift without monocytosis. In 64% of the horses had lymphopenia, 89% had hyperfibrinogenemia. When serum amyloid A (SAA) was determined (in 11 animals), the value was always elevated. The inflammatory parameters fibrinogen and SAA as well as the lymphocyte count could be used to differentiate from asthma in horses with increased respiratory rate and increased respiratory work, since these parameters are not elevated in asthma and no lymphopenia occurs.

An independent assessment was performed on 20 X-rays, which showed: interstitial (100%), bronchial (75%), alveolar (70%) and nodular markings or shadows. Nodular changes were detected by ultrasound in 22 of 37 horses. Bronchoalveolar lavage was performed in 20 horses. Macrophage atypia was found more frequently in horses with EMPF than in horses with asthma. The proportion of neutrophils in the BALF was 17%, the proportion of lymphocytes at 24% (EMPF) or 32% (asthma), the proportion of macrophages at 42% (EMPF) or 37% (asthma) and the proportion of mast cells at 0.2% (EMPF) or 1.3% (asthma). 27 of the 46 horses were treated, 15 of them with corticosteroids and antiviral drugs. Of the 46 horses, 11 animals survived the following 3 months. This 3-month survival time was associated with a lower median respiratory rate (30 versus 41 breaths per minute) and a higher ratio of lymphocytes to neutrophils (4.7 versus 0.47) in the BALF as well as higher lymphocyte counts in the blood. Neither the radiological or sonographic findings, the detection of EHV-5 nor the administration of corticosteroids were associated with the survival rate. The results of the study show that the prognosis of EMPF remains poor and that fever has a low sensitivity for differentiating between asthma and EMPF. Weight loss in combination with increased respiratory rate and increased respiratory work is more likely to indicate EMPF. ag

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Clinicopathological and pedigree investigation of a novel spinocerebellar neurological disease in juvenile Quarter Horses in North America

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In March 2020, a new neurological disease was observed in juvenile Quarter Horses in North America. Based on the young age at onset of clinical signs, these foals were initially thought to have equine neuroaxonal dystrophy/degenerative myeloencephalopathy (eNAD/EDM), spinal abscess, osteomyelitis, trauma, or congenital myopathy. These diagnoses were ruled out over time, and since 2020, this new neurological disease has been

identified in a total of 12 Quarter Horse foals. Based on the clinical phenotype and neuropathological findings, the term equine juvenile spinocerebellar ataxia (EJSTA) is proposed for the disease. This case series describes the clinical findings, treatment outcomes, and postmortem findings. Apart from the evaluation of the clinical data, genomic DNA was isolated and pedigrees were manually constructed. The median age of the foals was 16 days, and fillies (10) were overrepresented compared to 2 colts. The foals were born healthy and developed neurological symptoms within the first month of life. The onset of the disease was acute, and all physiological variables, except for neurological deficits, were within the reference ranges.

All 12 foals showed the same neurological examination findings at admission. The foals were alert and reactive, and cranial nerve and segmental reflexes were normal. Asymmetric general spinal ataxia was noted, showing increased unilaterality. The ataxia of the hind limbs (grade 4-5/5) was more severely affected than that of the forelimbs (1-3/5). Based on the neurological examination, multifocal progressive myelopathy was diagnosed, which caused the spinal ataxia. Blood tests of 5 horses were unremarkable except for slightly elevated gamma-glutamyltransferase and hyperglycemia. Cerebrospinal fluid was obtained from 5 foals, and again no cytological changes were detected. Radiographic images of the spine were also unremarkable in the 6 foals for which they were taken. An MRI was performed on 2 animals and a CT on one foal, and no changes were found. All horses showed rapid progression of the disease.

The forelimbs developed moderate to severe hypermetria, and in some foals, tremor of the head and neck was observed during suckling. Shortly thereafter, the foals became recumbent (median 3 days) and were euthanized because they were no longer able to stand up independently. Necropsy was performed on 12 foals. No macroscopic changes were observed. Histological evaluation showed dilated myelin sheaths throughout the spinal cord, accompanied by particularly severe findings in the cervicothoracic region. The lesions were particularly pronounced in the dorsal spinocerebellar tract, but were also found in the cuneate fasciculus and the ventromedial tracts. Affected animals also showed rare proliferation of glial cells. No lesions were identified in the brainstem, including the medial and lateral cuneate nuclei, nucleus gracilis, or cerebellum. These findings most likely indicate a degenerative axonopathy, which is different from eNAD/EDM. Analysis of the foals' pedigree indicated an autosomal recessive inheritance. ag

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Comparative study of the bronchodilator efficacy and adverse effects of salbutamol and hyoscine butylbromide in horses with severe asthma

Mozo Vives B, Mainguy-Seers S, Pierre Lavoie JP (2024)

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Severe asthma occurs in 14% of the equine population in the Northern Hemisphere. It is characterized by airway obstruction due to inflammation, bronchoconstriction, mucus accumulation

and structural changes in the airways. Treatment of this condition is based primarily on changes in housing conditions to avoid exposure to inhaled antigens. If such changes are not possible or are insufficient to control airway obstruction, corticosteroids, bronchodilators or both are administered. Bronchodilators are either 2-adrenergic agonists such as salbutamol or anticholinergic agents such as atropine and hyoscine butylbromide (HBB). HBB is used in preference to atropine due to fewer side effects. However, HBB can induce tachycardia and reduce intestinal motility. The cardiovascular effects of HBB may be of particular importance in horses with severe asthma, as they frequently develop tachycardia, right ventricular dysfunction and pulmonary hypertension during an attack. The primary aim of this study was to assess the duration of bronchodilation and the efficacy of salbutamol and hyoscine butylbromide in horses with severe asthma. Six horses were available for this study and were experiencing a severe asthma attack at the time of the study.

This was a randomized, blinded crossover experiment. To trigger the attack, the horses were stabled three weeks before the start of the study and fed dry hay. The horses were given either 1000 µg salbutamol by inhalation or 150 mg HBB administered intravenously. The medication was administered once daily in the morning. Lung function was assessed using oscillometry in a blinded manner before and 5, 10, 15, 30, 60, 90, 120 and 180 minutes after therapy. In addition, gastrointestinal motility was recorded by auscultation and heart rate was recorded at these time points. After 72 hours, the other medication was administered. Both therapies led to an improvement in lung function. Pulmonary resistance and reactance returned to baseline within 30 minutes of HBB administration, while both parameters improved after salbutamol inhalation from the 5th minute to 180 minutes after inhalation. 5 to 30 minutes after intravenous administration of HBB, heart rate increased by an average of 3.3 beats per minute and motility sounds decreased. Regarding gastrointestinal motility, inhalation of salbutamol also resulted in a reduction in motility sounds as assessed by auscultation 15 minutes after administration. The results of this study demonstrate that the use of salbutamol is recommended due to its longer duration of action in terms of bronchodilation and the absence of cardiovascular side effects compared to HBB.

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History, rest and exercise Score (HRE-S) for assessment of disease severity in horses with trigeminal-mediated headshaking

Kloock T, Pickles KJ, Roberts V, Uhlendorf F, Twele L, Wilkens HL, Stehle E, Feige K, Niebuhr T (2024)

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Headshaking (HS) is characterized by spontaneous, involuntary, violent head movements without any clear external triggers. The movement is usually vertical, but can also be horizontal or rotating. Horses often also show signs of irritation of the nose with a reduced stimulus threshold of the trigeminal nerve compared to healthy horses. This is why the term trigeminal-associated headshaking (TMHS) was coined. Various diseases can secondarily irritate the nerve, while idiopathic TMHS is assumed to be caused by a dysfunction of the nerve. Based on trigeminal neuralgia in

humans, it is assumed that this is also painful in horses. Assessing pain in horses is difficult, so a pain grading system with 6 different facial expressions, taking into account ears, eyes, chewing muscles, mouth and nostrils, was developed. The clinical symptoms of HS are considered to be an expression of neuropathic facial pain. There are three different grading systems for TMHS based on subjective observations. The aim of this study was to develop a grading system for horses with TMHS that takes into account history, symptoms at rest and during exercise, and any trigger factors. Furthermore, the most important characteristics of the scheme were to be assessed in terms of reliability, validity and practicability. This was a retrospective observational study.

The digital clinical records from 2006-2021 included 240 horses presented to the clinic for HS. A history was taken of all horses and the diagnostic procedures performed included blood analysis, examination of the oral cavity, endoscopy of the airways including the air sacs, and taking X-rays of the head and a CT scan of the same. Horses whose symptoms and findings were consistent with idiopathic TMHS were included in the study. 30 horses met these criteria. 3 horses with the best quality video for each grade were selected. The videos were assessed, including 5 duplicates of 9 horses with i-TMHS and 3 control horses. The assessment was carried out by 6 observers with varying experience using the HRE-S score. The videos were recorded at rest and during work on the lunge. The assessment recorded the frequency, type and severity of clinical signs. The inter- and intra-observer reliability and practicability of HRE-S were evaluated. For each video recording, the severity of clinical signs was rated by each observer using an intuitive global scale, and the inter-observer reliability was calculated. Convergent validity was analyzed by comparing HRE-S with groups created according to an existing score (grade 0-3). Discriminant validity was examined by comparing HRE-S with groups created according to an intuitive global scale.

The HRE-S comprises three subgroups and takes into account parameters of the history and HS at rest and during work. The grading with regard to history takes into account whether the symptoms are permanent or dependent on certain factors including weather, activity, location and season. It also takes into account the duration of the symptoms (≤ 1 year or ≥ 1 year). The score points collected at rest depend on whether the symptoms occur less than once per minute, one to three times per minute or more than three times per minute. Vertical, horizontal, rotating HS, primary ear shaking, vertical head and neck shaking, severity of facial pain, tongue and lip movements and other clinical symptoms are taken into account. The score points collected during movement take into account the same points, with the severity expressed in terms of data per lap on the lunge. The reliability for HRE-S was excellent, regardless of the experience of the observers: Spearman's $\rho=0.946$, $p < 0.001$ (intra-observer reliability) and intraclass correlation coefficient = 0.98, $p < 0.001$ (inter-observer reliability). The inter-observer reliability for the intuitive global scale was fair to substantial: Fleiss' Kappa = 0.48 (RS) to 0.63 (ES). The groups created by the intuitive global scale had significantly different rest scores and movement scores. Convergent validity was demonstrated as horses with grade 3/3 had significantly higher mean movement scores and total scores compared to an existing score than those with grade 0/3 or 1/3. ag

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Dry matter concentration, particle size distribution and sand presence in faeces from horses with and without colic

Müller CE (2024)

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Colic is one of the most common reasons for requiring veterinary care. In these cases, the amount and characteristics of the faeces passed are often assessed. One study described that the characteristics of the faeces varied between horses depending on the different types of colic and on the survival rate. This study showed that horses with obstructive colic had a faecal consistency that was characterized as small and dry. Comprehensive studies have not yet been conducted to determine the extent to which the characteristics of the faeces differ due to colic disease or whether they differ due to a specific type of colic. The aim of this study was to assess whether the faeces of horses with colic symptoms differ in terms of dry matter, particle size distribution and sand content from the faeces of horses without signs of colic. Furthermore, it was to determine whether these variables are influenced by the different types of colic. The study was conducted between January 2016 and 2017. Fecal samples from 74 horses suffering from colic and from 74 horses not suffering from colic that were admitted to the clinic were examined. The fecal samples were taken either rectally or from freshly defecated feces. The dry matter content of the feces, the particle size distribution and a sand sedimentation test were determined. The sand content in the feces was graded subjectively (0-3). Neither the age, sex nor breed of the horses differed between the groups. Of the 74 horses with colic, 18 animals had constipation of the cecum and/or colon, 21 horses had gas colic and/or torsion, 7 animals had sand colic and in 28 horses the cause of the colic symptoms could not be determined. The dry matter content of the feces was no different in the horses in the control group compared to the animals with colic. The faecal particle size distribution was also similar. Only horses with colic of unknown cause had a higher, albeit minimal, proportion of particles with a size of 0.5 mm compared to horses with other colics. The subjective accumulation of sand also did not differ between the horses with colic and the control animals. ag

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Detection of equine herpesvirus-1 (EHV-1) in urine samples during outbreaks of equine herpesvirus myeloencephalopathy

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Equine herpesvirus is endemic in horses worldwide and causes respiratory disease, abortion, neonatal foal loss and outbreaks of neurological disease. Equine herpesvirus myeloencephalopathy (EHM) occurs in 10% of infected horses during an outbreak. If infection is suspected, immediate nasopharyngeal sampling is recommended, as EHV-1 excretion is only brief, parallel to the first bout of fever in the first five days. EHM often occurs during viremia after the second fever peak, usually without respiratory symptoms, about 6-10 days post infection at the end of the vire-

mic phase. Since recording viral excretion is of particular importance and information on the detection of EHV in urine is limited, the aim of this study was, on the one hand, to determine EHV-1 in urine during an EHV outbreak and, on the other hand, to assess the DNA pattern (viral DNA load over time) in urine, blood and nasopharyngeal swab samples. For this study, urine and whole blood or nasopharyngeal samples were collected from 21 horses at different times during two EHM outbreaks in Valencia in 2021 and 2023. In 2021, blood samples were collected from 11 horses at four different time points, starting with the fever phase on days 6-9, 10-13, 14-17 and 18-22.

Urine samples were collected by catheter or as spontaneous urine at 0-4, 5-8 and 9-14 days. During the 2023 outbreak, nasopharyngeal samples were taken at 2-6 time points and urine samples at 1-7 different time points. For evaluation, the date of the first day of fever, sex, age, breed, neurological symptoms, vaccination status and treatment were recorded. A quantitative real-time PCR was performed to compare the level of viral DNA in urine and nasopharyngeal samples. A total of samples were taken from 21 horses with an average age of 9.6 years. In 2021, 4 of 11 affected horses were vaccinated against EHV-1, and the vaccination status of 6 animals was unknown. Of 10 hospitalized horses in 2023, 9 were vaccinated, 3 of them not fully. Neurological symptoms included ataxia (17/21), ataxia grade 5 in 2 of 21 animals and urinary incontinence in 6 of 21 horses. In 2023, 3 horses showed ataxia as well as convulsions. All affected animals received flunixin and valacyclovir, the majority also received dexamethasone and DMSO. Of the 21 hospitalized horses, 18 animals had a positive DNA result and viral DNA was detected in the urine of 11 horses. Compared to detection in the blood, the horses excreted DNA in the urine for longer and had a higher concentration.

In 2021, EHV-1 DNA was detected in blood samples from all horses up to 12 days after the onset of fever (average 9 days). Many horses excreted DNA in urine, on average for 16.5 days, up to 10 days longer than in blood. In 2 animals, DNA detection was not possible. In 2023, 8 of 10 nasopharyngeal swabs were positive 4-14 days after the onset of fever. 3 of 8 horses had DNA in their urine. In 2 animals with fever and ataxia, EHV-1 DNA could not be detected at any time. The results show that EHV-1 DNA can be detected in urine during an EHV-1 outbreak and that in some horses the DNA load in urine is higher and detectable for longer than in blood. The latter could be due to possible replication of the virus in the bladder. The proven excretion of the virus via urine suggests contamination of the bedding. Since a previous study found lower DNA concentrations on shavings compared to straw, shavings should be chosen as bedding in the event of an outbreak. ag

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Evaluating insulin dysregulation in horses: A two-step insulin-tolerance test using porcine zinc insulin

Grob AJ, Delarocque J, Feige K, Warnken T (2024)

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Insulin dysregulation (ID) is an important factor in endocrinological diseases in horses and is central to the development of equi-

ne metabolic syndrome (EMS). Insulin dysregulation is present in approximately 32-76.5% of horses with dysfunction of the pars intermedia of the pituitary gland. Insulin dysregulation includes tissue insulin resistance (IR), a prolonged insulinemic response after carbohydrate ingestion and hyperinsulinemia after a fasting period. The exact physiological relationships between these aspects are unclear, in particular whether IR is the cause or a consequence of basal or dynamic hyperinsulinemia. Since hyperinsulinemia can also be observed in the absence of insulin resistance, it is possible that increased pancreatic beta cell activity, reduced hepatic insulin clearance, increased incretin secretion after carbohydrate ingestion or genetic factors contribute to the development of hyperinsulinemia. Several studies have shown that hyperinsulinemia triggers laminitis, which is why early and accurate diagnosis of insulin dysregulation is of particular importance. There are two recommended dynamic test procedures for diagnosing ID under field conditions, since determination of basal insulin levels has a low diagnostic sensitivity. The postprandial insulin response can be assessed using either an oral glucose test or an oral sugar test.

These results are influenced by the entero-insular axis, pancreatic beta cell function and insulin sensitivity. Tissue insulin sensitivity can be assessed using the two-stage insulin tolerance test (ITT). This method is not influenced by animal feeding, differences in gastric and intestinal transit or intestinal sugar absorption. The ITT is more sensitive and specific in detecting insulin dysregulation, while the oral sugar test is better for predicting laminitis. The ITT involves the intravenous administration of 0.1 IU/kg body weight of insulin and the blood sugar level should be more than 50% lower 30 minutes after the injection. In Germany, veterinarians mainly have porcine zinc insulin (PZI) available, which has a depot effect and a prolonged duration of action. However, little is known about the pharmacokinetics and dynamics of action of the various insulin preparations used in horses. The primary aim of this study was to record changes in insulin and glucose concentrations during an ITT using two different insulin formulations. Furthermore, a cut-off value for insulin resistance when using PZI was to be developed and the extent of the association between insulin resistance and hyperinsulinemia, as assessed by an oral glucose test, was to be determined. 12 Icelandic horses aged between 15 and 29 years were available for the study. The body condition score of these horses varied between 3 and 8, and the comb fat score between 0 and 4.

Three of these animals had already been diagnosed with pituitary pars intermedia dysfunction and received pergolide mesylate

during the study. All horses fasted overnight and received 0.5 g/kilogram body weight of dissolved sugar in 2 liters of water via nasogastric tube. Blood samples were then taken at regular intervals up to 140 minutes later and the insulin concentration was determined. A concentration of $> 110 \mu\text{IU/ml}$ was considered the cut-off value for hyperinsulinemia. In the two-stage insulin tolerance test, either PZI in a dose of 0.1 IU/kg body weight or human recombinant insulin (RHI) was administered intravenously. This was a randomized cross-over design with a wash-out phase of 48 hours. 30 minutes after insulin administration, 150 mg glucose per kg body weight in the form of a 50% dextrose solution was administered to prevent clinical hypoglycemia. Blood samples were taken up to 180 minutes after insulin administration. In addition, blood glucose was determined using a glucometer to detect possible subclinical hypoglycemia. Serum samples were stored at room temperature for 30 minutes and then centrifuged for 6 minutes within 3 hours and stored at -80°C until analysis. Nine of the twelve horses developed hypoglycemia within the first 30 minutes after the ITT, regardless of the insulin used. The animals showed no clinical signs of hypoglycemia. No side effects of intravenous administration of PZI were observed.

Within the first 30 minutes after insulin administration, blood glucose concentration decreased regardless of the type of insulin used and increased in the second phase (30-180 minutes after insulin administration) after intravenous glucose administration with a maximum value after 45 minutes. Glucose concentrations and the percentage reduction in glucose concentration did not differ depending on the type of insulin. However, $\text{AUC}_{\text{glucose}}$ was significantly higher when PZI was used. At a cut-off of 50% reduction in blood glucose, 3 of 12 horses were classified as insulin resistant by the ITT-RHI, while the ITT-PZI diagnosed insulin resistance in 7 of the 12 horses. In this classification, a glucose concentration reduction of 50% as the cut-off for insulin resistance. According to the results of this study, PZI can be used intravenously without complications, provided that glucose is administered after 30 minutes. However, PZI appears to be less effective than RHI, which according to the authors may be due to the persistence of the hexamer structure. This should be taken into account when evaluating the results. If a cut-off of 40% after 30 minutes, better test accuracy is achieved. Considering the lower efficacy of PZI and the adjusted cut-off value, PZI can be used as a replacement for RHI in ITT. ag

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