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BLOCKING OUT THE LAME FOOT: NOT SO STRAIGHT FORWARD!
Denis Verwilghen
DVM, MSc, PhD, DES, Dipl ECVS
Equinespecialists Ltd
Belgium
denis@equinespecialists.eu

More than one third of lameness’s originates from somewhere in the foot, making it a very common area of investigation. The arrival of magnetic resonance imaging (MRI) has definitively improved the diagnostic ability of imaging within that closed box that is the hoof. However, does the visualised lesion really cause the demonstrated pain? Back to basics, let’s block the nerves. But loco-regional analgesia of the foot is not that easy to interpret.

We have all been thought that palmar digital nerve blocks alleviate pain located in the palmar third of the foot. However, in a study by Easter et al.\(^{(1)}\), it was shown that palmar digital nerve block also desensitizes the distal interphalangeal joint (DIPJ). In other words, palmar digital nerve block can not differentiate between DIPJ, navicular pain, solar pain or other causes of palmar heel pain. Performing this block as far distally as possible i.e. at the proximal margin of the ungular cartilage therefore only provides a theoretical advantage of avoiding the dorsal branches of the palmar digital nerve since those do not seem to play a role in pain alleviation of the dorsal coronary band and laminae of the hoof\(^{(2)}\). Deposition close to the ungular cartilage may increase the risk of penetration into the palmar recesses of the DIPJ if needle position is inclined distally. More proximal deposition of local anesthetics, particularly if volumes above 1.5 cc are used, may also result in analgesia of the proximal interphalangeal joint (PIPJ).

The abaxial sesamoidian nerve block is performed over the palmar digital nerves at the level of the proximal sesamoid bones. This block will provide full desensitization of the foot, including the pastern area and occasionally the distal palmar metacarpophalangeal joint depending on exact location and injected volume. However, horses with lameness originating from proximal PI fissures may not block out on this. Careful interpretation is therefore warranted.

Intrasynovial analgesia can be performed in the DIPJ or the navicular bursa. Analgesia of the DIPJ will be more specific than that of palmar digital nerve since DIPJ analgesia does not eliminate pain originating from solar or heel pain\(^{(3)}\). However, analgesia of the DIPJ will result in concurrent desensitization of the navicular bursa. Further analgesia of the navicular bursa will help differentiate from purely navicular pain or DIPJ pain since navicular analgesia was shown not to affect pain originating from the DIPJ. The additional analgesia of the digital tendon sheath will provide desensitization of pain originating from the digital portion of the deep digital flexor tendon. This intratechal analgesia seems to have little effect on pain originating from the sole, DIPJ or navicular bursa when evaluated at 10min post injection\(^{(4)}\).

Due to variations in technique, misdirection of needles, volumes used, use of old anesthetic solution and differences in neurological anatomy, misleading information about the origin of foot pain can be obtained. Repeat analgesia may have to be performed for conclusive pain identification.

**Something about preparation**

Even for perineural anesthesia, good preparation of the injection site is best practice. Considering the different synovial cavities that lay in the region of interest when performing a palmar digital, proximal palmar digital or even an abaxial sesamoidian block, the risk of septic synovitis is real. Long and dirty hair should be trimmed in all cases and a combination of soap and alcohol used for preparation. Although decreased infection rates have not been proven after clipping, in the author opinion, site preparation for intrasynovial anesthesia should always include clippings or shaving of the area before antiseptics is performed. In fact hair can easily be pushed into a joint with a needle, a surprise that those of you performing arthroscopy have surely already encountered. Disposable gloves are preferably worn during the preparation procedure in order not to contaminate your own hands. The use of sterile gloves vs non sterile for injecting synovial cavities can be debated. Although gloving may give a false sense of protection and hands have been shown sufficiently sterile after alcohol rubbing\(^{(5)}\), the use of sterile gloves when performing intrasynovial anesthesia is still highly recommended. It is always better to be safe than sorry!
This presentation will review the anatomy, common approaches and effects of analgesia performed in the equine foot.

References:

**Conservative and medical management**
Rest alone has a very poor prognosis in the hindlimb, with a success rate of less than 20%. One-off regional infiltration with corticosteroids (e.g. 10mg triamcinolone in 3mls of local anaesthetic) can be beneficial in decreasing the inflammation in acute cases. It can also be useful in managing low-grade chronic/active cases in the short term. Platelet rich plasma (PRP) is the currently favoured biological product for the treatment of PSD. It contains a number of anabolic growth factors, and there are a number of commercially available systems that allow the product to be easily used in practice. It can be used on its own in cases of acute desmitis, or can be used in conjunction with other forms of treatment. Intravenous infusion of bisphosphonates can been useful in some cases of enthesis-related pain.

**Extracorporeal Shockwave Therapy (ESWT)**
ESWT has now been employed for a number of years in the treatment of hindlimb PSD, and improves the outcome to about 40%.

Cases of hindlimb proximal suspensory desmitis (PSD) often stay lame despite protracted periods of convalescence and apparent healing of the ligament. It has been hypothesised that this is due to the development of a local compartment syndrome and neuritis.
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(Fig 1) I tend to use it in either mild, acute cases or for the management of low-grade, chronic cases, and continued treatments may be necessary. Clinically there does not seem to be any difference between radial and focused machines in the outcome following treatment. I now use higher settings for the hindlimb than the forelimb: with the EMS Swiss DolorClast Vet 2500 pulses at 3.5 bar with a 10mm applicator versus 2000 pulses at 3 bar.

Surgery

a) **Ligament splitting (desmoplasty)**

Ultrasound guided percutaneous ligament splitting under general anaesthesia has been described for the management of chronic hindlimb PSD [1], with encouraging results. However, there is less decompression than can be achieved with the open surgical technique which I will describe later.

b) **Osteostixis**

The drilling of multiple holes into the region of the origin of the suspensory ligament was originally described for the treatment of non-healing fractures in this region but has also been employed for the management of proximal suspensory desmitis [2]. This is a relatively crude technique however, and there must be questions over its benefits in a true case of desmitis, although there is logical application in the management of non-responsive bone-related pain. I used it in combination with plantar metatarsal neurectomy and fasciotomy for treating hindlimb PSD with a component of bone or enthesis-related pain, but poor results led to it more sparingly.

c) **Plantar metatarsal neurectomy and fasciotomy**

This treatment was developed as the surgical option for the management of proximal suspensory ligament desmitis in the hindlimb. This procedure combines decompressive fasciotomy of the deep laminar plantar metatarsal fascia with neurectomy of the deep branch of the lateral plantar nerve. This nerve branch is the common origin of the medial and lateral plantar metatarsal nerves, which apply sensory innervation to the origin of the suspensory ligament. Surgery has been restricted to those cases that have had a very good response to a block of the deep branch of the lateral plantar nerve. Over 500 horses have been operated on by the author to date, and long term follow-up has yielded a long term success rate of 80% returning to normal function. The surgical technique will be described, and approximately 4-5cm of nerve is removed through a 3.5cm incision.

**Figure 2:** Intra-operative view of neurectomy of the deep branch of the lateral plantar nerve, with nerve branch elevated.

Post-operative complications are rare but an appropriate convalescent period must be allowed for more acute injuries. Treatment of other issues that arise during rehabilitation is important.

References


THERAPEUTIC JOINT MANAGEMENT: FROM NUTRACEUTICALS TO STEM CELLS

Andrew P. Bathe MA VetMB DipECVS DEO MRCVS
RCVS & European Specialist in Equine Surgery
Rossdales Equine Hospital
England
andy.bathe@rossdales.com

With joint disease being a common performance-limiting problem in performance horses, there is a great deal of interest in medical management of problems in this area. Successful treatment requires accurate diagnosis. As a rule, targeted treatment is more effective than more generalised medication of the whole horse. Acute injuries will require rest and more severe injuries may require surgical intervention.

There is a huge public demand for oral supplements and this is a massive market but unfortunately the scientific rationale behind this has often failed to keep up with the commercial marketing. There is some rationale for glucosamine, chondroitin sulphate, omega 3 fatty acids and antioxidants, although there are issues with bioavailability. For low-grade conditions and for joint maintenance there may be a role for these products.

Systemic treatment with intramuscular polysulphated glycosaminoglycans and intra-venous hyaluronic acid is popular due to the simplicity of administration and lack of requirement of a specific diagnosis. The clinical benefits are often subtle although they can be useful in mild conditions. They may be used tactically in the run up to competition, and some promote their use for “routine joint maintenance”.

Bisphosphonates such as tiludronate are being used increasingly in the treatment of joint pain. This is generally by systemic administration and increasingly people are using regional perfusion or intra-articular medication even though these routes are not licensed. Some horses do appear to respond well, though the mechanism action is still uncertain and picking which cases are likely to respond can be challenging. In our practice tiludronate has been rather disappointing in its effectiveness for distal tarsal joint pain and for subchondral bone pain in racing thoroughbreds, both areas that intuitively it would likely be beneficial. Conversely, we have not noted any increased incidence of fracture in racehorses treated with this product.

Intra-articular treatment remains the most effective method of treatment of localised joint disease. Intra-articular corticosteroids are the most potent and effective drugs. Appropriate products used in low dosages can be beneficial to the joint rather than detrimental, although less experienced clients are often nervous about the use of steroids. The majority of research work suggests that triamcinolone is more chondroprotective than betamethasone or methylprednisolone acetate (MPA), and is generally considered the drug of choice in our practice. MPA has been shown to have deleterious effects on cartilage and its use is not encouraged. With appropriate aseptic technique for injection the risk of infection is very low in practical terms. I would not normally administer intra-articular antibiotics as a routine, but would inject 100 mg of amikacin along with corticosteroids if the joint had been blocked within the previous week. Steroid medication is often combined with hyaluronic acid. There is no firm evidence that this is beneficial but it may possibly ameliorate some of the deleterious effects of corticosteroids as well as having a beneficial effect in its own right and many clinicians comment that they may get a longer duration of positive effects after medication with steroids if they are combined with hyaluronic acid. Because of the risk of laminitis I would normally use a maximum does of 20 mg of triamcinolone in a sport horse. Racing thoroughbreds seem more resistant to developing laminitis and a dose of up to 40 mg would commonly be used in our practice. A dose of 5-10 mg per joint would be used generally, depending on the number of joints to be treated. Methylprednisolone acetate still tends to be used more in low-motion joints.

More recently there has been an increased interest in the use of biological products. Autologous conditioned serum (Irap) can be a helpful product in the treatment of arthritic conditions and damaged soft tissue structures associated with joints, such as collateral ligament injuries within the distal interphalangeal joint. Platelet-rich plasma (PRP) can also be used intra-articularly and I tend to use this in more severely affected joints where there is more need for an anabolic effect. The benefits of intra-articular stem cell are less well defined currently, although there is some rationale for their use and there may be room for a combined approach using a sequence of biological products. Over the next few years we need to work hard to develop an accurate evidence base to be able to
Thus, during the day when available roughage intake on a free-choice basis is the highest, the mean pH of the gastric contents just inside the lower esophageal sphincter vacillates between 5-7, whereas the contents within the more distal part of the stomach, where the acid is secreted, are consistently within pH 2.0-3.0. When roughage intake is decreased either because it is withheld or because horses eat less during the early morning hours even if it is available, the mean pH in the upper part of the stomach drops markedly to 4.0 or less. When the pH drops below 4.0, the integrity of the non-glandular squamous mucosa in the proximal stomach is challenged.

The EGUS term was coined in 1999 by the Equine Gastric Ulcer Council to refer to “...the disease complex that is associated with ulceration of the esophageal, gastric or duodenal mucosa. Put more succinctly: EGUS is not one disease. Rather, it refers to a number of conditions of differing etiopathogenesis that cause erosive and ulcerative lesions of the non-glandular (squamous) and/or glandular mucosa. Developments in endoscopic technology and procedure have made documentation easier, and observation of both squamous and glandular regions is required for a complete procedure. Various scoring systems of lesion severity within the squamous mucosa, where the problem was first described, have been proposed. These systems have subsequently been applied to lesions within the glandular mucosa without, as yet, due evaluation of their appropriateness.

A high incidence of squamous disease, without any associated glandular disease, has been described in horses in training, irrespective of breed or activity. Typical complaints/clinical signs include failure to finish grain meals, progressive weight loss and underperformance. Early studies found that removing an afflicted horse from the training environment and turning it out to pasture would result in healing, without medication. More recent studies report a notable incidence in pastured animals and epidemiological investigations are needed to truly evaluate the putative value of pasture turnout alone. There is convincing evidence that squamous lesions are induced by mucosal exposure to acidic gastric contents since effective antacid therapy results in lesion reduction/disappearance. This is supported by in vitro studies which indicate that certain volatile fatty acids, derived from intra-gastric fermentation of simple CHO, may exacerbate HCl-induced injury if the pH is <4.0. The role of exercise in the patho-

In most monogastric animals, including the neonatal foal, the gastric contents are quite acidic throughout because of the uniform semi-liquid to liquid consistency of the ingesta. In contrast, the contents of an adult equid on a regular hay/grain diet, where the roughage is available on a free-choice basis, vary in their pH depending upon site within the stomach. The lower density/larger particle size components tend to remain at the top of the mat of ingesta where they are minimally exposed to acid produced in the lower glandular region and maximally exposed to swallowed saliva, which has a pH of approximately 7.4. The greater the dry matter content the food, the greater the amount of saliva secreted due in part to the physical composition of the meal and in part to the time needed for adequate mastication.

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genesis is supported by a study showing a marked reduction in pH within proximal stomach during treadmill exercise, attributed to increased intra-abdominal pressure that pushed gastric acidic contents proximally during the exercise period.

In addition, the studies documenting drop in proximal intragastric pH during extended periods of reduced hay ingestion have implications regarding feeding husbandry. Then there is “stress”. Although classic stress ulcer is described only in glandular mucosa, a number of factors in a training environment might result in excessive exposure of the squamous mucosa to contents of pH < 4.0, including meal feeding, proportionally high concentrate diets, etc. That is, there is an increasing awareness of the potential multifactorial aspects of squamous region-restricted ulcerogenesis and more epidemiological studies may provide better guidance for prophylaxis through husbandry rather than drug therapy. If treatment is needed, however, reduction of gastric acid secretion is the main objective, with the omeprazole-containing oral paste products designed for horses by Merial being the most effective to date. Various neutraceuticals have been touted as effective prophylactic agents but have not been subjected to rigorous evaluation.

Squamous ulceration may also occur secondary to lesions within the distal stomach and/or duodenum that restrict gastric emptying and cause an abnormal reflux of acidic contents into the proximal stomach (see discussion below on glandular mucosal disease).

Finally, squamous disease associated with cribbing: a recent study found that gastric emptying was not disrupted, so does cribbing episodes increase intra-abdominal pressure that pushes acidic contents up into the proximal stomach? Or, is it an unusual response to the ulceration that provides the horse relief from discomfort caused by the lesions?

Ulceration of the Glandular Mucosa

Ulcerogenesis in the glandular region cannot be simply explained as due to prolonged exposure to acidic contents since that is the normal condition. Rather, it must be due to a breakdown of normal mucosal protective mechanisms, the most common cause in humans being Helicobacter pylori which has not been found in horses. Another cause is excessive NSAID use, which has been documented in horses, with lesions occurring within the fundic region. However, the majority of glandular lesions seen to date are within the pyloric region. Limited studies have found varying histopathology, including metaplasia and neutrophilic, eosinophilic and plasmacytic inflammation. In some instances, similar co-incident pathology has been found the proximal duodenum. Character of the lesions can range in severity and chronicity, with some cases progressing to a point where they physically obstruct gastric emptying. Some evidence-based and testimonial information suggests that treatment of the more acute cases with omeprazole may be effective. Would adjunct antibiotic and/or corticosteroid therapy, based upon biopsy findings, be helpful in these cases? There is still much to be learned. Unfortunately, there are those chronic cases that are beyond effective medical intervention.
Studies done to date suggest equine gastric motility is roughly similar to that described in other monogastrics: within the proximal portion it primarily involves changes in tension (compliance) of the gastric wall, whereas within the lower fundic and pyloric (antral) portions it is aborally peristaltic in nature (“antral systole”). During the active ingestion of a meal, the proximal equine stomach relaxes in a biphasic manner, the first phase associated with active meal ingestion and the second accommodating the total meal. The degree of each phase is determined by both amount and composition of the meal. For instance, a grain meal enriched with glucose causes greater relaxation than one enriched with corn oil. In general, ingested liquids empty significantly more rapidly than solids, with solid emptying rate in particular being influenced by meal composition. Increasing the amount of starch in a solid concentrate meal significantly reduces gastric emptying rate.

There is some preliminary epidemiological evidence that housing environment itself may play a role in determining the prevalence of gastric squamous ulcer disease with conditions that keep horse-to-horse contact at a minimum being an important risk factor. Furthermore, in rodents a “stressful” situation, with release of corticotrophin releasing factor (CRF), delays gastric emptying and stimulates colonic motility. This has not been examined specifically in horses, but could be with the instrumentation capabilities that we have today.

Thoughts Concerning “Primary” Gastric Impaction

A.M. Merritt, DVM, MS, DACVIM
Professor Emeritus
Department LACS, University of Florida, Box 100136, Gainesville, FL 32610
USA
merritta@vetmed.ufl.edu

and

A.T. Blikslager, DVM, PhD, DACVS
Professor of Equine Surgery

For this discussion, “primary” gastric impaction is defined as that occurring idiopathically. That is, physical obstruction of gastric outflow by phytobezoars or gastrointestinal lesions, or association with dental problems, poisonous plant exposure, grass sickness, chronic liver disease, chronic enteritis, etc. which may result in impaction secondarily have been ruled out.

Incidence?

In both the USA and Europe, the problem seems to be seen more commonly in Warmbloods and Freisians, although one recent report also included a notable number of Finnhorses. Is this observation concerning Warmbloods and Freisians valid? And what is the prevalence among these breeds?

Etiology?

Is there a genetic pre-disposition? This question is probably more pertinent if incidence data point to Warmbloods and/or Freisians. If the results support the hypothesis, then there are techniques available that can be used to identify horses at risk and, if the commitment is there, attempt to breed away from the problem.

What part do management practices play in induction? There is considerable epidemiological evidence that feeding practices designed to optimize performance of sport horses increase the risk of gastric ulcer disease and intestinal-based colic. Why not gastric impaction as well?

Current Status of Treatment Options and Prognosis

Unless there are clinical findings that suggest rupture is imminent and requires surgical intervention, a conservative medical approach is indicated. It seems that there are some variations of approach depending upon the experience of the clinician involved, but withholding of solid food and assuring maintenance of good hydration are quite universally applied. Attempts at removal of impacted contents by gavage have not proved to be very successful, but repeated intragastric instillation of carbonated beverages (e.g.; Diet Coca-Cola™) and/or isotonic electrolyte solution has been effective. In one report of 20 cases, between 1-5 days of isotonic enteral fluid therapy (up to 80 liters/day) was required before the stomach was cleared of ingesta. 90% survived to hospital discharge and 75% were alive over a year or more later (two of the failures were subsequently found to have lymphoplasmacytic inflammatory bowel disease). Some animals may require NSAID analgesic but it best to avoid this.
if possible. As for pro-kinetic drug indication, erythromycin citrate, bethanechol and mosapride citrate will increase gastric emptying of a small solid meal in normal horses, but whether they would be effective when the stomach is markedly distended is questionable. There is some evidence-based support for the use of slow IV lidocaine infusion but studies have not been done to critically evaluate this observation. Current evidence suggests that, when seen early in the course of the disease, the majority of animals can be effectively treated by repeated intragastric fluid infusion and will not have the problem again. This is particularly interesting given the large size that some of the impacted stomachs can attain.

There are always those few, however, that will require surgical intervention, which may or may not result in a permanent resolution. What is it that determines outcome in these cases? Duration of the problem and/or severity of distention are obvious considerations. One problem is that some horses can have had progressive impaction and gastric dilatation for some time without showing readily noticeable clinical signs of discomfort, so that when they are finally diagnosed, the chance of regaining normal gastric motility after decompression is markedly reduced. Another factor contributing to a poor outcome is concurrent disease not found on initial workup, such as chronic inflammatory bowel disease being one that may only be found only histopathologically. Thus, it would be prudent to collect some small intestinal biopsies during the surgery if there are no obvious attendant lesions. Likewise, for prognostic purposes it is advised to collect small intestinal biopsies via endoscope from those patients that continue to have gastric emptying problems after medical therapy. No matter what, attempts to manage chronic recurring cases with various feeding and other management strategies can be very frustrating, expensive and often discouraging in the long run.

**Prophylaxis?**

Obviously, a better understanding of the pre-disposing conditions that result in what we call “primary” gastric impaction is essential to application of effective prophylactic measures. For purposes of discussion here are some ideas for where to begin:

1) A multi-center multi-factorial prospective epidemiological study with particular focus on breed incidence, and housing, feeding and training methods.

2) An investigation focused on potential genetic pre-disposition and a genetic marker that identifies high-risk horses, so that special attention can be given to them with respect to husbandry and subtle clinical signs of affliction. Definitive indications of a genetic basis could provide guidance for attempts to reduce incidence through selective breeding, recognizing that this is a potentially contentious issue.

**WHAT IF THE COLICKY HORSE HAS NO COLIC?**

Gaby van Galen
DVM, MSc, DES, DiplECEIM
The Netherlands
gaby@equinespecialists.eu

**Introduction**

Colic is a term that is used on a daily basis among equine vets and owners, but what is colic actually? Colic is often used incorrectly as a final diagnosis, while it is only a syndrome. Colic means “abdominal pain” and this can be caused by all kinds of intra-abdominal problems. In the majority of patients examined for colic, the problem is of gastrointestinal origin. In some cases however, a non-gastrointestinal problem is going on, which can be located in- or outside the abdomen. Another thing to keep in mind is that even if you have gastrointestinal findings, they are not necessarily the primary cause. So if these findings do not explain the severity of the displayed clinical signs, you need to consider the fact that digestive problems may be secondary to for example pain and dehydration. Moreover, gastrointestinal colic can also be a part of certain conditions, for example grass disease.

**What if the patient does not suffer from gastrointestinal colic?**

- **Non-gastrointestinal intra-abdominal**
  All intra-abdominal structures other than those of the gastrointestinal tract can lead to abdominal pain. Strictu senso this means that we can still use the term “colic” even though it is not originating from the gastrointestinal tract.
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<table>
<thead>
<tr>
<th>Structure/system</th>
<th>Examples of conditions that may cause colic signs or resemble a gastrointestinal colic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liver</td>
<td>Calculi, Hepatic swelling</td>
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<tr>
<td>Urinary system</td>
<td>Calculi</td>
</tr>
<tr>
<td></td>
<td>Obstruction</td>
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<tr>
<td></td>
<td>Bladder paralysis</td>
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<tr>
<td></td>
<td>Cystitis</td>
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<tr>
<td></td>
<td>Bladder rupture</td>
</tr>
<tr>
<td>Uterus and ovaries</td>
<td>Delivery</td>
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<td></td>
<td>Tumours</td>
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<tr>
<td></td>
<td>Uterine torsion</td>
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<tr>
<td></td>
<td>Hematoma of uterine ligament</td>
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<tr>
<td></td>
<td>Post partum endometritis</td>
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<td></td>
<td>Oxytocin</td>
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<tr>
<td></td>
<td>Trauma</td>
</tr>
<tr>
<td>Spleen</td>
<td>Trauma - hematoma</td>
</tr>
<tr>
<td>Adrenal gland</td>
<td>Pheochromocytoma</td>
</tr>
<tr>
<td>Peritoneum</td>
<td>Peritonitis</td>
</tr>
</tbody>
</table>

**Abdominal cavity**

- Intra-abdominal masses
- Hemoperitoneum
- Intra-abdominal yellow fat disease

**Abdominal wall**

- Trauma
- Rupture of abdominal muscles

**b. Extra-abdominal: no “colic”**

Horses presented for colic can suffer from conditions that are not located in the abdomen. In this case it looks like colic, but it is not colic. In general everything that causes pain, low tissue oxygen delivery, endotoxaemia or dehydration can resemble colic.

**Table 2. Examples of extra-abdominal conditions that may resemble colic.**

<table>
<thead>
<tr>
<th>Structure/system</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thorax</td>
<td>Pleuropneumonia, Acute heart failure: severe arrhythmias, rupture chordate tendinae, etc</td>
</tr>
<tr>
<td>Neuromuscular</td>
<td>Myopathies: atypical myopathy, exercise induced myopathies, etc, Hyperkalemic periodic paralysis, Neurological diseases causing seizures, recumbency, abnormal mental status, Laminitis, Musculoskeletal trauma</td>
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</tbody>
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perform additional complementary exams that will confirm your suspicion.

**Conclusion**

Horses often suffer from gastrointestinal colic, but it is important to keep an open mind to other possibilities. Each patient with the complaint of colic needs to be subjected to a thorough systematic examination to achieve a correct final diagnosis.

**Further reading**

The equine acute abdomen. N. White, J. Moore and T. Mair

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**Complementary exams to add to a systematic approach of a colic patient to differentiate gastrointestinal colic from something else**

Each horse that is presented with the complaint of colic should be examined thoroughly. It is most likely that such a horse actually has a gastrointestinal problem, but other abdominal causes for colic or problems that can be confounded with colic need to be ruled out.

A **complete history and clinical exam** that include all the other body systems are of importance to discover clues or clinical signs that indicate that the patient might have something else. A **rectal examination** should include the examination of the intestines, but also of other palpable organs. In addition, the abdominal cavity should be checked for intra-abdominal masses and fluid accumulations, and the abdominal lining (peritoneum) should be investigated for its smoothness. While performing an **abdominal ultrasound**, all abdominal organs and the abdominal cavity can be examined and it is easy to scan quickly the cranioventral thorax to check for free thoracic fluid or other obvious changes. **Blood analysis** is very useful for a colic workup and haematology, biochemistry, electrolytes and acid-base status can give you a better idea about the general status of the patient. However they also allow differentiation of gastrointestinal from other problems. Intestinal necrosis, but also intra-abdominal inflammation or neoplasia can be diagnosed by the aid of an **abdominocentesis**. Finally, it is always interesting to have a look at the urine: the colour, urine dipstick and density measurement.

If following a systematic complete workup of the colic patient another reason than digestive problems is suspected for the observed colic signs, it is recommended to

<table>
<thead>
<tr>
<th>Other</th>
<th>Severe anaemia</th>
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<tbody>
<tr>
<td></td>
<td>Severe electrolyte derangements</td>
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<td></td>
<td>Severe acid base derangements</td>
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<tr>
<td></td>
<td>Important hyperthermia or fever</td>
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<td></td>
<td>Mastitis</td>
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<td>Intoxications</td>
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**THERAPEUTIC STRATEGIES AND TARGETS IN ENDOTOXAEMIA**

A. Werners, DVM, PhD
Professor of Pharmacology at St. George’s University, Grenada, East-Indies
Secretary European Association for Veterinary Pharmacology & Toxicology
ahwerners@gmail.com

Modulation of the immune responses, achieved by targeting cell-surface receptors (pathogen recognition receptors or PRRs) or intra-cellular pathways, is one of the main goals in the development of therapeutic concepts for immune or inflammatory diseases. Since the innate immune system plays a key role in the pathways of microbial recognition, inflammation, microbial clearance and cell death, it offers diverse targets for therapeutic intervention.

**Therapeutic interventions at the receptor complex**

**LPS antibodies**

Clinical trials conducted with different LPS antibodies (against the O-antigen, or the inner core or lipid A moiety) did not demonstrate beneficial effects in human patients with endotoxaemia [1]. In the horse, different studies were conducted to evaluate the use of both lipid A and core LPS antibodies [2-8]. Despite the fact that vaccinations were safe, they did not always elicit an antibody response [2] [5].

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Equine anti-LPS hyperimmune plasma was shown to contain IgG that binds to LPS from a wide range of bacteria [8], and this binding ultimately leads to the initiation of the destruction of Gram-negative bacteria [3]. In horses with clinicopathologic evidence of endotoxic shock, the application of hyperimmune LPS core antigen plasma decreased the mortality rate significantly [7; 9]. Other studies have failed to show any positive effects of the administration of hyperimmune plasma [6; 10]. A more recent study was not able to show beneficial effects on TNF-α production in an in-vivo model of endotoxaemia [11]. Despite these findings, hyperimmune anti core LPS plasma is not widely used in equine endotoxic patients.

Polymyxin B
The possible protective role of the cyclic cationic peptide antibiotic polymyxin B has been studied intensively in different species [12-16]. Polymyxin B forms a stable molecular complex with the lipid A portion of LPS, with one molecule of polymyxin B binding one monomer unit of LPS [17]. In an ex-vivo whole blood model of endotoxaemia, it caused a significant dose- and time-dependent decrease in endotoxin-induced TNF-α activity, NO production [18] and in residual endotoxin activity [19]. MacKay and co-workers [20] studied the effects of a conjugate of polymyxin B-dextran 70 in endotoxin infused horses and showed beneficial effects on both clinical indicators (heart and respiratory rates, rectal temperature and WBC counts) as well as mediator synthesis (cytokines and eicosanoids). More recently Barton and co-workers [16] also reported the beneficial effects of polymyxin B administration to horses infused with endotoxin. Despite the positive reports, the role of polymyxin B in the treatment of endotoxaemia is still limited due to its renal toxicity.

Phospholipid emulsions
High-density lipoproteins neutralise LPS and have been shown to be beneficial in endotoxin models in both pigs and humans and recent evidence showed prevention of LPS induced cytokine production and expression of membrane-associated mediators [21; 22].

Antagonists of Pathogen Recognition Receptors
PRR agonists (for adjuvants) and antagonists are under development for the treatment of many diseases. Some antagonists at other PRRs have been described, but antagonists of TLR4 and TLR2 are likely to be most useful in equine endotoxaemia and sepsis.

Toll-like receptor 4 antagonists
Antagonism at TLR4 is the most obvious therapeutic target for equine endotoxaemia and sepsis, but it is also the most challenging because of the species specificity in lipid A recognition. LPS from Rhodobacter sphaeroides, for example, is a TLR4 antagonist in humans and mice, but it is an agonist in the horse and hamster [23; 24]. E5531, a synthetic compound based on the lipid A structure of Rhodobacter capsulatus, is an antagonist in mice and humans, is an antagonist in equine cell models, but an agonist in an equine whole blood model [25-27]. More recently a second generation compound based on E5531, Eritoran (ES564), has been developed which is a potent antagonist of LPS in humans [28; 29] and in horses [30]. Eritoran has been in phase III clinical trials [31], but it did not meet its primary endpoint in patients with severe sepsis [32]. Several other TLR4 antagonists are currently being investigated for the treatment of different acute and chronic inflammatory diseases [33; 34].

Toll-like receptor 2 antagonists
Antagonistic phospholipids for TLR2 have been synthesised, but currently there is little information available beyond their initial description [35]. TLR2 antibodies protect mice from lethal sepsis shock syndrome [36] and anti-TLR2 antibodies that prevent trafficking of the receptor from the endoplasmic reticulum to the cell surface were shown to inhibit in vitro and ex vivo ligand driven cell activation [37]. Anti-TLR2 antibodies show beneficial effects in arthritis and ischemia-reperfusion injury models [38; 39].

Inhibition of the intracellular signalling pathway
Different pharmacological agents have been described to inhibit NF-κB- or MAPK pathways at one or multiple activation steps. These agents include glucocorticosteroids [40-42], non-steroidal anti-inflammatory drugs (NSAIDs) [43-45], phosphodiesterase inhibitors [46-48], natural compounds and anti-inflammatory cytokines.

Glucocorticosteroids
Glucocorticosteroids have been show to exert their therapeutic effects through the inhibition of gene expression of cytokines, adhesion molecules and other inflammatory mediators [49]. Glucocorticoid administration results in de novo synthesis of I-κB-α [40] and inhibition of NF-κB binding to DNA [50]. Beneficial effects have been shown in the treatment of inflammatory diseases, including endotoxic shock in horses, with glucocorticosteroids [51-55]. However the use of this class of drugs in sepsis is still
under debate [56; 57]. Glucocorticosteroids also interact with the different individual MAPKs [58-61] as is also described for α₂-agonists [62; 63] and phosphodiesterase inhibitors.

**Non-steroidal anti-inflammatory drugs**
The non-COX mechanism by which NSAIDs (carprofen and flunixin meglumine) exert their anti-inflammatory properties is by the interference with the pathway that leads to phosphorylation and degradation of the NF-κB inhibitor IκB [64; 65]. These effects are not shared by all NSAIDs, as indomethacin failed to inhibit NF-κB activation [45].

**Phosphodiesterase inhibitors**
Phosphodiesterase inhibitors control the intracellular degradation of cAMP/cGMP [66]. The increased intracellular cAMP concentrations affect cytokine production through complex mechanisms and involve regulation of NF-κB signal transduction pathways [46]. In models of equine endotoxaemia, the use of pentoxifylline results in inhibition of a variety of inflammatory mediators [67; 68].

α₁-Adrenergic receptor agonists
α₁-Adrenergic receptor agonists regulate NF-κB activation through multiple mechanisms. The increase of cytosolic IκB results from a rise in intracellular AMP concentration and prevents NF-κB activation and translocation [69]. Evidence in mice and rats suggest a positive role for α₁-agonists in sepsis [63; 70; 71]. The anti-inflammatory effects of the α₁-agonist clenbuterol were described in vivo in horses with recurrent airway obstruction and in vitro in an equine macrophage cell line (e-CAS) [72].

**Anti-cytokine therapy**
A meta-analysis of controlled anti-cytokine trials reveals a consistent reduction in mortality but only in patients with the most severe risk of death [73]. The use of antibodies directed against TNF-α showed differential effects in two models of equine endotoxemia [74; 75]. In experimental equine osteoarthritis, beneficial effects were observed after the in-vivo delivery of the equine IL-1ra gene [76]. One article described the use of a TNF-α converting enzyme (TACE) inhibitor in the horse [77]. Continuous venovenous hemofiltration can remove TNF-α and potentially other cytokines from the circulation of critically ill patients, but in an equine endotoxemia model, the efficacy of hemofiltration could not be proven [78]. Experimental studies in the horse revealed that S-phenyl-tert-butylnitrone only decreased both heart rate and respiratory rate but not cytokine production [79].

**Conventional anti-inflammatory therapies**

**Non-steroidal anti-inflammatory drugs**
The conventional therapies comprise of antibiotic therapy, fluid therapy, source control, corticosteroids, NSAIDs and other supportive measurements. Of the NSAIDs used in the horse, the use of small doses of flunixin meglumine has proven to be beneficial in cases of endotoxemia and septicemia [80; 81]. However, when combined with the phosphodiesterase inhibitor pentoxifylline, the effects were more profound compared to the use of flunixin meglumine alone [68]. The use of etenac significantly protected against endotoxin-induced changes in both clinical and haematological and biochemical parameters [82].

**Miscellaneous drugs**
Dimethylsulphoxide has been implicated in the treatment of endotoxemia. Despite its extensive use in equine medicine, it appears that the evidence to support the anti-inflammatory effects is lacking [83; 84]. Pirfenidone is a drug extensively used in inflammatory conditions in humans and has recently been investigated in the horse. Intravenous injection resulted in mild clinical adverse effects, but had no beneficial effects on horses with experimentally induced endotoxemia [85; 86]. The use of ketamine has been described in several models of inflammation in the horse, inhibits TNF-α and IL-6 in vitro [87]; in an in vivo model ketamine infusion had no effects on mediator production [88]. In contrast with ketamine, lidocaine infusion did result in decreased clinical scores and peritoneal fluid TNF-α concentrations [89]; beneficial effects of lidocaine have also been demonstrated in the attenuation of ischaemic injury [90]. In vitro results elucidated the inhibiting effects of ethyl pyruvate on the expression of IL-8, TNF-α and COX-2 in LPS stimulated equine monocytes. The expression of both IL1-α₂ and IL6 was unchanged.

**Conclusions**
Despite the wide variety of drugs currently available for use in the horse and the increased understanding of the pathophysiological processes involved, successfully treating endotoxemia or sepsis remains a challenge to the equine veterinarian.

References are available from the author

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**CASE PRESENTATION: EQUINE COLIC WITH ACCOMPANYING GASTRIC REFUX**
A.M. Merritt, DVM, MS

**Sx:** 16 year old Thoroughbred mare

**Hx:** Acute onset of colic on 16/4 that required xylazine 3X, acepromazine 1X and gastric refluxing 3X during the day to provide comfort. The referring veterinarian thought he might have felt an impaction “somewhere” upon rectal palpation. Previous medical Hx was unavailable. Mare had been bred on 31/3 and 1/4. Was referred to UF VMTH on early AM of 17/4 because of persistent low-grade colic.

**Ex:** (17/4, 0400 hrs)

**T** - 36.5°C; **P** - 68 bpm; **R** - 16 bpm

- Pain: intermittent, low-grade, relieved by gastric decompression; generally
- depressed attitude
- Paunch: Thin horse; no abdominal distention
- Pulse: Normal rate; weak character
- Perfusion: Membranes dark pink; CRT 2-3 seconds
- Peristalsis: Gut sounds depressed, but not absent
- Pings: None
- Palpation: Anal tone poor; rectum ballooned; no abnormalities palpated
- Pass a Tube: Spontaneous reflux of copious amounts of fluid (>20 liters)
- PCV / TP: 45% / 87g/l
- Peritoneal Fluid: Dark yellow and cloudy; WBC - 1000/µl; RBC - <1000/µl;
- TP - 25g/l (subsequent cytology revealed many clumped and lysed cells, suggesting a WBC count more like 70,000/µl; many neutrophils contained rod shaped bacteria)

Serum Chemistry: (17/4, 0400 hrs)

- Na - 133 mMol/l
- K - 3.1 mMol/l
- Ca - 4.9 mMol/l
- Creat - 460 µMol/l
- Gluc - 26.6 mMol/l

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**CASE PRESENTATIONS**
A.M. Merritt, A.T. Blikslager
DVM
Florida State University, North Carolina State University
USA
Anthony_Blikslager@ncsu.edu

**Colic with accompanying gastric reflux**

**16 year old Thoroughbred mare**

**Hx:** Acute onset of colic on 16/4/90 that required xylazine treatment 3 times, acepromazine treatment once, and gastric refluxing 3 times during the day to provide comfort. The RDVM thought he might have felt an impaction “some-where” upon rectal palpation. Previous medical Hx was unavailable. Mare had been bred on 31/3 and 1/4. Was referred to UF VMTH on early AM of 17/4 because of persistent low-grade colic.

**Ex:** (17/4, 0400 hrs)

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- Pulse: Normal rate; weak character
- Perfusion: Membranes dark pink; CRT 2-3 seconds
- Peristalsis: Gut sounds depressed, but not absent
- Pings: None
- Palpation: Anal tone poor; rectum ballooned; no abnormalities palpated
- Pass a Tube: Spontaneous reflux of “copious amounts” of fluid (volume not recorded)
- PCV / TP: 45% / 87g/l
- Peritoneal Fluid: Dark yellow and cloudy; WBC - 1000/µl; RBC - <1000/µl;
- TP - 25g/l (subsequent cytology revealed many clumped and lysed cells, suggesting a WBC count more like 70,000/µl; many neutrophils contained rod shaped bacteria)

Serum Chemistry

- Na - 133 mMol/l
- K - 3.1 mMol/l

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Colic following elective surgery

3 year old Hanovarian Gelding

Hx: Admitted for elective arthroscopic surgery of a condy-
lar cyst of the left stifle. The surgery was uneventful,
but the horse did not defecate following surgery and
became mildly painful

Ex:

T – 37.00°C; P - 52 bpm; R - 14 bpm

• Pain: Mild colic, including pawing and looking at
the flanks
• Pulse: Slightly elevated rate, normal character
• Perfusion: Pink; CRT <2 seconds
• Peristalsis: Gut sounds reduced but present in all 4
quadrants
• Pings: None
• Palpation: Impaction detected on the midline of
the abdomen extending toward the right side of
the abdomen
• Pass a Tube: No reflux
• PCV / TP: 42% / 69g/l
• Peritoneal Fluid: Normal

Mild persistent colic

11 year old Dutch Warmblood Gelding

Hx: Was reluctant to come in from the field to the stable,
and had a poor appetite.

Ex:

T – not done; P - 52 bpm; R - 24 bpm

• Pain: Depression and abnormal behavioral signs
progressing to moderate colic
• Pulse: Slightly elevated rate, normal character
• Perfusion: Pale pink; CRT <2 seconds
• Peristalsis: Gut sounds increased, and short and
sharp in nature
• Pings: None
• Palpation: No abnormalities
• Pass a Tube: No reflux
• PCV / TP: 42% / 78g/l
• Peritoneal Fluid: Normal

Colic with pain as the principal finding

5 year old Thoroughbred mare

Hx: 1 hour duration of severe colic

Ex:

T – not done; P - 54 bpm; R - 18 bpm

• Pain: severe pain in which the horse repeatedly
roles, and is difficult to examine
• Pulse: Elevated rate, normal character
• Perfusion: Pale pink; CRT 2 seconds
• Peristalsis: Gut sounds absent
• Pings: None
• Palpation: Distended colon
• Pass a Tube: 3L Reflux following passage of a stom-
ach tube
• PCV / TP: 42% / 72g/l
• Peritoneal Fluid: No fluid obtained

Ca - 4.9 mMol/l
Creat - 460 µMol/l
Gluc - 26.6 mMol/l
Is there any new news on epiploic foramen entrapment?
Prior studies have shown that crib-biting is associated with development of this prevalent cause of colic, although the cause of this association is unknown. A recent study has shown that although short-term survival is good, long-term survival is markedly reduced. Risk factors for non-survival include the length of intestine affected and the development of post-operative ileus.

Preoperative treatments
Currently, horses may be treated for pain with non-steroidal anti-inflammatory drugs (NSAIDs), alpha-agonists (xylazine, detomidine, and romifidine), opiates (butorphanol), and the spasmolytic drug Buscopan®. Recently, a number of selective NSAIDs have been tested in pre-clinical trials, including the COX-2 preferential drug meloxicam and the COX-2 selective drug firocoxib. In the EU, both are labeled for use in horses, although off-label use may be required because of how these medications are labeled. Clinical trials will be required to determine if these medications offer any advantages over non-selective NSAIDs such as flunixin meglumine or phenylbutazone. Buscopan compositum is generally recommended for treatment of mild or spasmotic colic, but studies indicated it should not be given repeatedly within a short time period. As far as the elevation in heart rate associated with this medication, studies have assessed co-administration with alpha-2 agonists, studies indicate that caution should be used because of elevations in blood pressure associated with both drugs.

Intraoperative Treatments
There has been a lot of attention on lidocaine, and whether or not it alters anesthetic parameters and reduces postoperative. Firstly, recent studies have shown that Intraoperative administration of lidocaine reduces the MAC for isoflurane, suggesting its analgesic effects help reduce the amount of anesthetic gas required. This reduces cost, and also allows for administration of lidocaine in at risk cases prior to development of postoperative complications. For example, administration of lidocaine during surgery increased smooth muscle contractility in a preclinical trial on horses with ischemia/reperfusion injury.

Postoperative Treatments
Lidocaine continues to be the most used treatment for postoperative ileus, and there is growing evidence that it is efficacious. For example, it reduces inflammation and increase intestinal motility. The mechanisms for these
Equine Programme

CHAPTER 7

EQUINE RESCUE
Jim Green¹ and Josh Slater²
Animal Rescue Specialist¹ and Professor of Equine Clinical Studies²
Hampshire Fire and Rescue Service¹ and Royal Veterinary College, University of London²
United Kingdom
jim.green@hantsfire.gov.uk¹ jslater@rvc.ac.uk²

Outside demonstration in cooperation with
Harco Kwakernaat, Amsterdam Fire Department, www.rhft.nl
Tom Van Esbroeck, Ghent Fire Department, Belgium
Prof. Dr. Frank Gasthuys, Dean Ghent University Faculty of Veterinary Medicine

Key points
- Safe horse rescues require an effective working partnership between the emergency services and the equine veterinary profession
- Veterinarians are an essential part of the rescue team
- The vet’s key roles are scene safety and animal welfare
- Knowledge and confidence with a range of chemical restraint (sedation and field anaesthesia) techniques are absolute requirements for attending vets
- Adequate training and a strict incident command system are vital
- During the rescue always have head control, never release a horse unless you have a safe place for it to go and always maintain a safe egress for all personnel

What is equine rescue?
Safe equine rescue is the removal of a horse from a place of danger to a place of safety by the most humane method but with an over-riding regard for human safety (the ani-
mal rescue team, other emergency responders and members of the public). Rescue techniques are based on knowledge of anatomy and horse behaviour. Rescues carried out by properly trained and equipped teams have better safety, better equine welfare and more horses successfully saved.

Emergency responders at equine rescues
Rescues can be complicated environments with several different agencies present at the scene (Fig. 1). In the UK the FRS attends equine rescues because if they do not members of the public will ‘have a go’ themselves. Since 2008, the UK FRS and the equine veterinary profession (through the British Equine Veterinary Association) have been working together to provide joint training in rescue techniques. The key messages in training for vets are:

- Understand the Incident Command System
- The vet is part of the rescue team but does not run the rescue
- The vet’s roles are firefighter safety, equine welfare, triage, euthanasia and first aid
- Providing appropriate sedation or anaesthesia is highly important in risk management
- Wearing appropriate personal protective equipment (helmet, high visibility vest and steel toe capped boots) is mandatory
- A knowledge of rescue techniques is important to choose appropriate sedation or anaesthesia

Incident command system
The Incident Command System (ICS) is a method of organizing and controlling the rescue scene (Fig 2). All work is carried out under the direction of the Incident Commander and a Safety Officer who are not directly involved with the rescue effort itself. The scene is divided into an inner cordon (the danger zone and immediate working area) around the horse and an outer cordon which marks the point beyond which the public may not enter. The rescue equipment dump is set up at the edge of the outer cordon and is managed by the support crew.

Rescue techniques and equipment
Most rescues can be accomplished with a selection of basic and relatively cheap equipment. The basic rescue kit consists of 5m and 10 m strops, general purpose ropes, a strop guide, heavy duty shepherd’s crooks, a drag mat, a rescue glide, mud lance and a lifting harness (Fig. 3). The majority of rescues can be carried out by manual skidding techniques alone using strops, ropes and people. There are three basic skidding techniques: the forward skid (Fig 4), the backwards skid (Fig 5) and the sideways skid (Fig 6). Lifting should be carried out with a harness fitted with quick release catches.
How long is control required for (rescue duration)?

• How much stimulation is the horse likely to receive during the rescue?

• Is the horse fit to be sedated/what is its medical status?

• Is it in pain?

• Which drug or drug combinations, and which doses, should be used?

• Which route of administration?

The IV route is preferred because it provides rapid, dose-dependent but the IM route (SC or oral routes are also possible) and can be used as an alternative followed up by IV top-ups. Higher doses (at least twice ‘normal’ doses, depending on level of stress and excitement) than in routine equine practice are required. The alpha-2 agonists xylazine (0.25-1.1 mg/kg; 1.25 – 5.5ml/100kg IV), detomidine (0.005-0.04 mg/kg; 0.25-2.0ml/100kg IV) and romifidine (0.025-0.1 mg/kg; 1.25-5ml/500kg IV) are the basis for all sedative regimes and provide (fairly) reliable dose-dependent sedation of varying durations. Opioids (butorphanol 0.02 mg/kg; 1ml/500kg IV or buprenorphine 1.7-3.4 ml/100kg IV) provide synergistic chemical restraint in combination with alpha-2 agonists. For IM administration a suitable cocktail (‘Magimix’) is acepromazine, detomidine and butorphanol (onset of maximum effect approx 30 min).

**Intramuscular injection sedative cocktail (‘Magimix’)**

- Acepromazine 10% solution 0.3ml/100kg (1.5ml/500kg)
- Detomidine 0.2ml/100kg (1.0ml/500kg) or Romifidine 1.0ml/100kg (5ml/500kg)
- Butorphanol 0.5ml/100kg (2.5ml/500kg)

Where safe access is not possible, a proprietary or home-made (Fig. 7) remote injection pole should be used to administer an initial IM injection which can then be topped up by IV injection. In prolonged rescues continuous rate infusion provides a more even plane of sedation:

- Sedate with 6μg/kg Detomidine (0.3mls /500kg). Wait for 5mins to achieve full potential
- Give a sedative dose of Butorphanol 0.02mg/kg (1.0ml /500kg)
- Add 12mg of Detomidine (1.2ml) to 500ml of saline
- For a 500Kg horse start drip rate @ 4 drops per sec (approx 0.1μg/kg/min)
Equine piroplasmosis: clinical symptoms, clinical pathology, immunity and treatment

Youssef Tamzali
DVM, European Specialist in Equine Internal Medicine
Toulouse University, INP-Ecole Vétérinaire de Toulouse
France
y.tamzali@envt.fr

Introduction

Equine piroplasmosis (EP) is a tick-borne protozoal disease reportable to the World Organization for Animal Health (OIE) (1). The causative agents are Babesia caballi and Babesia (Theileria) equi. Horses infected with B. equi remain carriers for life, and serve as reservoirs for transmission to naïve horses (2-4). It is estimated that 90% of the world’s horses are exposed to EP (2-4). In these endemic regions exposure occurs within the first year of life with case fatality rates of 5-10% in naïve horses while this rate can exceed 50% when naïve horses are introduced in endemic regions (3).

Transmission (3,5)
Both EP agents can be transmitted by same tick vectors leading to frequent co-infection. For B. caballi, ticks serve as reservoirs for transmission to naïve horses (2-4). It is estimated that 90% of the world’s horses are exposed to EP (2-4). In these endemic regions exposure occurs within the first year of life with case fatality rates of 5-10% in naïve horses while this rate can exceed 50% when naïve horses are introduced in endemic regions (3).

Clinical signs and differential diagnoses (3,4)
Clinical signs of EP are similar for both agents infection. Typical clinical signs of acute EP can include fever, anorexia, anemia, icterus, congested mucous membranes, tachypnea and tachycardia, sweating, limb and supraorbital edema. In severe cases hemoglobinuria and bilirubinuria are present as well as a variety of atypical presentations due to organ damage and dysfunction. Death may occur in severe cases. The clinical signs of EP are consistent with other diseases including equine infectious anemia (EIA), purpura hemorrhagica, idiopathic immune mediated anemia, and intoxications.

Clinical pathology (3,4)
While not specific of EP, infected horses usually show reduced red blood cell count, platelet count and hemo-
globin concentration as well as elevated bilirubin concentration and prolonged clotting time. Variations of the white blood cells lines can also occur at varying degrees. In chronic forms only mild anemia is present with no change in serum bilirubin concentration.

**Diagnosis**

**Blood smears:**
Blood smears can reveal the presence of intraerythrocytic parasites in typical clinical forms while it may be not rewarding in chronic forms because of low parasitemia. B. caballi appears pyriform shaped and occurs in pairs while B. equi appears as four pyriform parasites in a Maltese cross formation.

**Serologic tests:**
The Complement Fixation Test (CFT) is very specific and was the previous official test for EP. The antibody titers can be detected from day 8 after infection and decline after 2-3 months. Its disadvantages are the occurrence of false negative results, cross-reactivity between B. caballi and B. equi and low sensitivity in chronic cases.

The Indirect Immunofluorescent Antibody Test (IFAT) is more sensitive than CFT and has been used as supplementary test when CFT was un conclusive. Antibody response can be detected 3 to 20 days after infection and remain during the latent period of infection. The IFAT is difficult to standardize due to the subjectivity in the interpretation of fluorescence.

The Competitive Inhibition Enzyme-Linked Immunosorbent Assay (cELISA) has been approved by OIE for international horse trading in 2004. It is more performant in case of latent infection while CFT is more sensitive in acute infection. Thus, within an outbreak, multiple tests may be necessary to accurately determine a horse’s infection status.

**Polymerase Chain Reaction (PCR) tests** have been developed and are used for research purposes. The PCR tests are more sensitive than blood smears for the diagnosis of inapparent infections.

**Immunity**
Continuous stimulation of immunity by persistent Babesia infection results in protective immunity in endemic regions. The exact mechanism of this protective immunity is unknown to date. There is no cross-immunity between B. caballi and B. equi. At present there is no effective vaccine.

**Treatment**
In the endemic regions the goal of treatment is not to clear infection but to reduce clinical disease because EP prevalence is high and premunition plays a role in the protection of horses. In non-endemic regions the goal of treatment is generally to eliminate the risk of transmission by clearing infection.

In endemic region EP it is usually considered effective and sufficient to treat EP infections with two treatments of imidocarb (2.2 mg/kg BW IM at 24-48 h interval). The clearing (or sterilizing) protocol consists of four treatments (4 mg/kg BW IM at 72 h intervals). It has been experimentally tested recently with success in both species with subsequent removal of transmission risk especially for B. caballi.

Adverse anticholinesterase effects (spasmodic colic, diarrhea, inappetence) are common and can be minimized by atropine sulfate, N-butylscopolammonium bromide or NSAIDs pretreatment. Local injection site reactions can also occur.

**Prevention**
Some countries like USA, Canada, Australia, Japan, Mexico and Brazil restrict the movement of EP-positive horses. In USA these procedures are monitored by the federal authorities.

The control of infected ticks is a difficult or impossible undertaking especially if neighboring countries are EP-endemic. Quarantine of horses imported from these regions (or having travelled to) with administration of pyrethrinoids may help minimizing the risks.

**References**
3. C.M. Rothschild et al., in Equine Infectious Diseases (2007).
Equine Programme

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“WHAT CAN BE DONE 24H BEFORE COMPETITION?” (15H15-16.00H)
Marcus Swail BVMS MRCVS, Irish Showjumping Team Vet marcusswail@gmail.com

Veterinarians with high level competition horses under their care are often faced with musculoskeletal problems just prior to a competition, or a particular phase of competition in the case of three day eventing. This often results in having to establish a diagnosis under stressful and difficult circumstances. A logical, reasoned approach is critical to the process at this time. It is important to recognise and accept when a horse is unable to continue to compete or should not compete. Where the horse has an issue that is compatible with continued competition, treatment within the relevant rules is possible.

EQUINE REHABILITATION: KEEP THE HORSE IN MOTION.
Stefan Cokelaere, DVM, Dipl. ECVS
Department of Equine Sciences, Faculty of Veterinary Medicine, Utrecht University

Rehabilitation is an integral part of human medicine and is being performed by mainly physiotherapist. In horses, box rest for prolonged periods of time are contraindicated if possible and rehabilitation has become a very important part in veterinary medicine. Techniques used in the equine field are mainly based on human medicine and are applicable in horses with equine spinal-related problems, prevention or treatment of musculoskeletal injuries, support and treatment of postsurgical problems and also in the support of performance levels enhancement. The goal of rehabilitation is to help horses to return to its original or higher functional level.

Many important factors determine the efficiency and outcome of a rehabilitation process. Specific rehabilitation programmes are dependent upon type of musculoskeletal injury and the type or level of sports activity. Cooperation between different partners, especially between physiotherapists – veterinarians – horse owner, is crucial in this process, in which good communication and knowledge are essential.

Thorough clinical assessment and evaluation, by mainly using your hands and eyes, are essential and the rehabilitation programme should be implemented around specific goals. Knowledge of biomechanics and normal movement in specific horses is essential to effectively influence the horse’s return to full function. Constant re-evaluation at different time points by using static assessments, gait analysis, specific palpation and supplementary diagnostics are important to determine the evolution of the deficit.

Numerous physiotherapeutic (massage, aquatherapy, electro- and magnetic field therapy) and manual therapeutic techniques are applied in combination with conventional veterinary medicine alongside the rehabilitation programme to restore the horse’s function, based on the result of the clinical assessments. Another important part of the rehabilitation process is training of the equine spinal column to stimulate the whole function and to develop strength, function and coordination of the horse. Active training can be started after pain cessation and improvement of flexibility, by using exercises at rest or in motion (unridden / ridden). In this process of training, it is essential to be surrounded by very skilled professionals who can help the horse and rider to obtain the desired goals.

In conclusion, rehabilitation has to become integral part of veterinary medicine and specific knowledge about this matter is essential for every player in this process.
Equine Programme

CHAPTER 7

Clinical Pathology of Liver Disease in Horses

Specific indicators of liver disease are increases in serum sorbitol dehydrogenase (SDH), gamma-glutamyltransferase (GGT), bile acids concentration, ammonia, arginase, glutamate dehydrogenase, direct bilirubin (>25% of total), BSP half-life, urine bilirubine and decreased branched chain:aromatic amino acid ratio. Nonspecific parameters of liver disease are increased total bilirubin, indirect bilirubin, lactate dehydrogenase-5 (LDH-5), aspartate aminotransferase (AST), alanine aminotransferase (ALT) and globulins. Decreased blood urea nitrogen (BUN), albumine, glucose, prolonged prothrombin time (PT) and activated partial thromboplasin time (APTT), increase triglycerides. The white blood cell count increases with infection or inflammation and decreases with endotoxaemia.

Faecal Analysis

Parascaris equorum, Strongylus edentatus and S. equinus can migrate through the liver. S. vulgaris can cause thrombotic emboli in the liver. Rare cases of liver fluke (Fasciola hepatica) are reported in horses and donkeys, with the treatment of choice being triclabendazole (12 mg/kg po). Eggs of Fasciola will be only seldom be detected in the faeces.

Diagnostic Imaging

The normal liver has a relatively hypoechogenic homogeneity interrupted by anechogenic blood vessels. In most horses, examination from the right hemithorax allows imaging of a larger volume of liver than from the left. The normal hepatic image from the right side is approximately triangular in shape with a convex surface adjacent to the diaphragm laterally and a concave surface against the hyperechoic colonic image medially. The left lateral lobe projects caudoventrally to the left lung for approximately 2 or 3 intercostal spaces caudal to the palpable cardiac apex beat.

Liver Biopsy

Biopsy is the most useful tool in characterising liver disease. The results will influence treatment and prognosis.

Technique

1. Sedate the horse (optional twitch, stocks to restrain the horse) and administer systemic analgesia.
2. Identify, with ultrasound, a site on the right cranial side of the abdomen, where there is preferably 3 cm of liver visible, or where a lesion is present and there are no large vessels.

PRACTICAL MANAGEMENT OF EQUINE LIVER PATHOLOGY. HOW TO RECOGNIZE, DIAGNOSE AND TREAT?

DVM, Dipl. ECEIM
Dierenkliniek De Bosdreef, Moerbeke-Waas
Belgium
tresemiek.picavet@bosdreef.be

There are many potential causes of equine liver pathology. Some of the more common can be identified by detailed consideration of the history, physical examination, haematology, blood biochemistry. In most cases further examinations (ultrasound, liver biopsy) are required. Hepatic failure or insufficiency refers to the inability of the liver to perform its normal functions. Because the liver is involved in so many physiological activities, any pathological process may hinder one or several functions without interfering with others. Furthermore, most hepatic functions are not impaired until greater than 80% of the hepatic mass is lost. The liver has the capability to regenerate under certain conditions. If hepatocyte loss is gradual and regeneration parallels destruction, then hepatic failure does not necessarily follows: hepatic disease may be present without hepatic failure and hepatic disease does not always manifest clinically.

Clinical Approach

The clinical approach has to start with an extensive anamnesis, followed by a thorough physical examination, haematology, blood biochemistry and faecal analysis. Complementary exams are ultrasonographic examination, liver biopsy, peritoneal fluid analysis, radionucleotide imaging, operative mesenteric portography and exploratory laparascopy or laparotomy.

Physical Examination

Common clinical signs of liver disease are: depression, anorexia, colic, hepatic encephalopathy (HE), weight loss and icterus. Less common signs are: photosensitization, diarrhea, bilateral laryngeal paralysis, bleeding, ascites and dependent oedema. Rare signs of liver disease are: steatorrhea, tenesmus, generalized seborrhoea, pruritus, endotoxaemic shock, polydipsia and pigmenturia (yellow-brown with bilirubinaemia; red-brown with haemoglobinuria).
Equine Programme

3. If no ultrasound is available, choose a site in the right 13th intercostal space, midway between two lines drawn between the point of the shoulder and the tuber coxae and the point of the elbow (olecranon) and the tuber coxae.

4. Clip, scrub, desinfect, local anaesthetic.

5. Desinfect, make stab incision, check blood is clotting.

6. Ultrasound -sterile sleeve placed over the probe. Biopsy guides, which fix the biopsy needle in the plane of the ultrasonographic image facilitate the procedure.

7. Use a sping-loaded biopsy needle 14G 9 (foals) or 15 cm Vet-Core biopsy needle, Surgivet, Smith Medical. (www.surgivet.com).

8. Insert needle, orientated cranially and slightly ventrally directed to the left olecranon.

9. Take 4-6 samples for histological examination (10% neutral buffered formaline) - take tissue for bacteriological examination. Use a small-gauge needle to tease the sample off the needle into the sample container. Do not damage the sample. After collection an antiseptic spray can be used on the skin, with or without closing the stab incision with a staple.

Possible problems: unrepresentative biopsy, haemorrhage, colic, peritonitis, pleuritis, pneumothorax. These problems are rare, and the requirement for prebiopsy coagulation assessment via blood examination is questionable.

Exploratory laparascopy-laparotomy allows visualisation and palpation but is invasive and expensive.

Treatment, management

Horses with HI may present with hypovolaemia. Most, despite occasionally hypoglycaemic, are normo- to hyperglycaemic (glucose- or dextose containing fluids are usually unnecessary or contra-indicated). Maintenance fluids often should be supplemented with potassium. Colloid therapy can be indicated in hypoalbuminaemic horses (especially if without hyperglobulinaemia). In subjects with clinical or subclinical coagulopathy, plasma is preferred. Hepatic lipidosis should be treated with enteral or parenteral lipid-free nutrition and insulin. Sedation is usually required in horses with moderate signs of HE (xylazine 0.5 mg/kg iv, detomidine 10 microgram/kg iv, acepromazine 25 microg/kg iv). Diazepam is best avoided. Lactulose 0.3 ml/kg po every 6 hours gradually reduced to once or twice daily treatments is suitable for long term administration. As antifibrotic therapy corticosteroids or pentoxyphilline can be used. In mature horses with suppurative hepatitis broad spectrunm antibotics are essential. Prolonged therapy is required (6-8 weeks) so enteral administration is preferred: potentiated sulphonamides (30 mg/kg combined product q12-24h), enrofloxacine (7.5 mg/kg po sid), doxycycline (10 mg/g po bid) and metronidazole 15 mg/kg loading dose followed by 7.5 mg/kg q 6h). Phlebotomy should be considered in horses with severe haemosiderosis in liver biopsy. The failing liver needs supportive nutritional strategies: free access to fresh grass or grass hay, 4-6 meals/day supplementary feed. Zinc, vitamin E and B supplementation.

Back pain in the high level equine athlete is relatively common and can often cause insidious or overt loss of performance. Back pain can be both occupational - simply a result of the high level of exercise the horse is being asked to do - or a result of underlying pathology such as, for example, spinous process impingement. In either instance there are a number of possible treatment options to address the back pain and allow a return to normal function and level of performance.

“EQUINE BACK, SPINE AND SOFT TISSUE WORK UP AND OPTIONS FOR MANAGING PERFORMANCE LIMITING BACK PAIN” (14H15-15.00H)

Marcus Swail BVMS MRCVS, Irish Showjumping Team Vet

Synovial Sepsis

Sepsis of a joint, tendon sheath or bursa represents an immediate orthopaedic emergency. Microorganisms elicit an inflammatory response in synovium and articular cartilage and released inflammatory mediators promote cartilage degeneration chronic
changes in soft tissues. In some situations, increased synovial effusion cannot be identified due to overlying tissues or the small size of the cavity. Horses with open lacerations extending into synovial cavities are commonly not as lame as horses with closed infections.

The diagnostic gold standard for synovial sepsis consists of cytological and microbiological analysis of synovial fluid obtained via an aseptically performed centesis. Normal synovial fluid has less than 500 cells per µl (less than 10% of neutrophils) and less than 2.5 g/dl of total protein. Bacteria can be directly identified on cytology smears in approximately 24% of cases. Radiographs of the area should be obtained in subacute cases. Infection of the subchondral bone complicates treatment and decreases the prognosis. Contrast radiography studies should be performed in lacerations or puncture wounds in the proximity of synovial structures. Ultrasonography is very useful in identifying synovial inflammation, fibrin deposits and adhesions. Although, not routinely performed, Computed Tomography is excellent for delineating osteomyelitis with bone destruction and sequestration but lacks soft tissue contrast resolution. In people, Magnetic Resonance Imaging (MRI) is the gold standard for the diagnosis of human septic arthritis, acute osteomyelitis, and soft tissue infection. With the wider availability of MRI in horses, this modality has become very popular to identify occult synovial sepsis in horses.

Treatment of synovial sepsis is usually initiated before culture results are available. The most likely infecting organism should be targeted with systemic antibiotics. Iatrogenic infections commonly contain gram-positive microorganism such as Staphylococcus, whereas isolates from traumatically infected joints are mixed and can also contain gram-positive and anaerobe bacteria. Lavage of the infected synovial cavity can be performed with needles or endoscopically. Endoscopic techniques provide greater volumes of lavage fluids in a shorter period of time and allow direct visualisation of the infected structure. Intrasynovial injection of antimicrobial drugs achieves high intrasynovial concentrations. Regional limb perfusion additionally provides high antimicrobial concentrations in the periphery of the synovial cavity. Surgically, antibiotic-impregnated beads or biomaterials can be deposited in or near the synovial cavity. Reasonably high success rates have also been reported with continuous intraarticular antibiotic delivery via a balloon constant rate infusion.

Fractures

Horses can sustain considerable secondary trauma after a fracture has occurred. Correct immobilisation must be performed immediately.

Deviation of a limb in an abnormal axial/abaxial position may allow identification of bone(s) involved. If hyperextension of a limb is present, the pivot point of the deviation may help determining which tendons, ligaments, or joints may be involved in the breakdown. Thorough physical examination should provide sufficient information to apply the proper immobilisation technique to an unstable limb. For effective neutralisation of forces acting on a fracture site limbs are divided into four functional divisions.

Forelimb:

Fractures of the Phalanges and Distal Metacarpus
Unstable fractures and luxations are stabilised by aligning the dorsal cortices of the phalanges and the cannon in a straight line with a splint. Alternatively, a Kimzey® splint can be used. Fractures of the distal condyle of the metacarpus are not as unstable in bending (flexion or extension of the fetlock) as fractures of P1 and P2, but do require medial-to-lateral support. Simple condylar fractures can initially be managed in a distal limb bandage whereas displaced fractures should be casted with the limb in neutral position or stabilised in a commercial splint that provides circumferential support (Fetlock Stabilizing Brace®, Equine Bracing Solutions).

Fractures of the Mid-Forelimb

This division involves the area from the distal Mc III to the distal radius. Immobilisation consists of a Robert Jones Bandage with a caudal and lateral splint from the ground to the elbow.

Fractures of the Radius

With a fracture, muscles originating proximally become abductors of the limb rather than effectors of extension or flexion. The skin over the medial aspect of the radius can easily be penetrated by fracture fragments. Immobilisation is provided with a Robert Jones Bandage identical to the bandage used for mid-forelimb fractures but the lateral splint is extended to the level of the withers.

Fractures proximal to the Elbow

These fractures disable the triceps apparatus and make it impossible for the horse to fix the elbow for weight bearing. The horse will present with a characteristically “dropped elbow”. By splinting the carpus in an extended...
Equine Programme

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Position the horse can use the limb for balance and is more amenable for ambulating.

Hind Limb:

Fractures of the Phalanges and Distal Metatarsus
Fractures in this area can be treated similarly to the forelimb but it is easier to place a splint on the plantar surface of bones. Alternatively, a Kimzey® splint can be used. Condylar fractures of the distal metatarsus should be managed like in the forelimb.

Fractures of the Mid- and Proximal Metatarsus
The tuber calcaneus can be used as functional extension of the metatarsus. Splints from the ground to the tuber calcaneus placed laterally and caudally over a Robert Jones Bandage.

Fractures of the Tarsus and Tibia
A lateral splint over the Robert Jones Bandage must be extended proximally up to the hip to prevent abduction of the limb over the fracture site and penetration of fracture fragments through the skin.

Fractures of the Femur
It is impossible to stabilise fractures of the femur by external means.

Tendon and Ligament Damage
The above mentioned immobilisation Techniques for the distal limb can also be applied in case of instability. Damaged flexor tendons or suspensory ligaments are best immobilised with the fetlock on flexion. Casting techniques should be employed in case of lateromedial instability associated with rupture of the collateral ligaments in joints.

Recommended Reading

Diagnostic Imaging of the Equine Foot
David M. Bolt
Dr. med. vet., MS, FHEA, DACVS, DECVS, MRCVS
The Royal Veterinary College, University of London
United Kingdom
dbolt@rvc.ac.uk

The equine foot represents a challenge for diagnostic imaging. The hoof capsule contains all structural components of the musculoskeletal system, as well as the laminae, vasculature, and nerves. The clinical importance of many soft tissue structures has been underestimated until advanced imaging modalities such as MRI and CT have become widely available in equine orthopaedics. Historically, once the clinical suspicion of "navicular disease" had been confirmed with a PD nerve block, radiographs had been obtained and some form of treatment initiated. Advanced imaging techniques have increased our understanding of "heel pain" and provided a more accurate diagnosis. However, advanced modalities are not "lameness finders": They only provide valuable additional information that should always be critically evaluated in conjunction with clinical findings and results from traditional modalities (e.g. radiology, ultrasound, and nuclear scintigraphy). To complicate matters, many diagnostic blocks in the foot lack the specificity that had previously been assumed.

Radiography
Radiography remains the first-line modality for horses with foot pain. Although limited in its ability to demon-
Upright pedal projections
These alternative views to the 60° and 45° DP projections combine the positions in a Hickman block with a horizontal X-ray beam. They produce less distortion of the distal borders of the navicular bone, but require more patient restraint than the high coronary projections.

Ultrasonography
While radiographs do not image soft tissues well, ultrasound cannot penetrate tissues with high acoustic impedance such as bone and hoof wall. However, ultrasound can be used to evaluate parts of the foot through several acoustic windows: The distal palmar pastern, the transcuneal (frog) window, and dorsally over the DIP joint. Visible structures include: Dorsal aspect of the DIP joint including periarticular bone margins, proximal portions of the collateral ligaments of the DIP joint, the distal DDFT, navicular bursa, collateral sesamoidean ligaments, and distal sesamoidean impar ligament. Considerations include operator skills and experience, patient preparation, equipment, and knowledge of topographical anatomy.

Skin should be clipped and thoroughly cleaned with soap and water or alcohol. Coupling gel should be worked into the skin surface to remove any trapped gas. For the transcuneal approach, the foot needs to be prepared in advance trimming and soaking water.

Computed Tomography
Conventional radiographs depict a three dimensional object in a two dimensional image which creates the problem of superimposition. Computed tomography overcomes this by scanning thin slices of the body with a narrow X-ray beam that rotates around the body, thereby producing an image of each slice as a cross section of the body. X-ray slice data are generated using an X-ray source...
that rotates around and sensors positioned on the opposite side of the circle from the X-ray source.

Computed tomography is considerably more expensive than conventional radiography and the radiation dose is larger than for conventional radiography. The modality requires general anaesthesia with the associated risks in most cases. Recently, CT systems allowing for examination of the head and foot in standing sedated horses have been introduced.

CT is the method of choice for the evaluation of subchondral bone disease, e.g. occult subchondral osseous cyst-like lesions or osteochondritis dissecans-like lesions of the proximal phalanx. It has been useful in cases of navicular syndrome, osteoarthritis and osteomyelitis. The modality enables assessment of complex fractures due to the availability of multiplanar reconstruction. CT contrast angiography allows mapping of blood vessels in three dimensions and provides additional information with soft tissue injuries.

**Magnetic Resonance Imaging (MRI)**

Nuclear magnetic resonance describes the physical phenomenon that atoms containing odd numbers of nucleons have an intrinsic magnetic moment. The most common molecule in the body is hydrogen with a nucleus of an unpaired proton. The direction of the magnetic moment of these protons is randomly distributed in nature. If the protons are put in the field of a strong magnet, the spins of the hydrogen atoms align themselves with the magnetic field. If a perturbing radiofrequency signal is introduced, the aligned spins are aligned afresh. When the disturbance field is turned off, the spins wobble before gradually realigning themselves to their original vector in the magnetic field. This induces a current in a detector coil that is processed into an image. The realigning of the spins is called relaxation occurs in two different ways: T1 and T2 relaxation. Depending on application and tissue of interest, emphasis is put on one or the other and results in “T1 or T2 weighted” images.

Currently, the major indication for MR imaging in the horse is the evaluation of foot related problems. MRI is an excellent diagnostic tool in the diagnosis of soft tissue problems (especially ligaments and tendons) in the foot. It has also been used for to assess fractures and subchondral bone pathology, but appears inferior to CT for the visualisation of bone pathology. High-field magnets allow detection of cartilage damage in clinical circumstances.

**Nuclear Scintigraphy**

Scintigraphy is an imaging modality which detects and depicts gamma radiation emitted by the patient. It is a dynamic modality that portrays the metabolism of the system being studied, rather than the anatomy (the anatomic resolution of scintigraphy is, in fact, rather poor). The patient is injected with a consisting of a radioisotope (usually technetium m99Tc) plus a label which is taken up by the system under investigation. The main nuclear medicine technique in veterinary medicine is bone scintigraphy. Most equine clinics use a gamma camera, which utilises an array of photomultiplier tubes and a computer to produce an image of the region being imaged, with areas of higher radioactive activity being shaded more densely.

Diphosphonates are taken up by exposed hydroxyapatite crystals in bone. Where bone is remodelling at a greater rate, more radiopharmaceutical is deposited and the area will be detected as more radioactive. The horse can be imaged immediately to give some idea of soft tissue activity, and again 2-3 hours later, when the bone image will be at its best. Most studies are performed in the standing sedated horse.

Similar to other imaging modalities, it is easier to detect a dramatic acute lesion (fracture) on scintigraphy than a low-grade chronic one (e.g. degenerative joint disease). Scintigraphy is very sensitive but fairly non-specific. That is, pedal osteitis may look like a fracture on a bone scan and other modalities are usually necessary to make a final diagnosis once scintigraphy has localised to the foot an abnormality. In a recent study, good correlation between positive intraosseous analgesia in the foot and increased radiopharmaceutical uptake in the navicular bone has been demonstrated, but there was a large incidence of false positive results related to the region of insertion of the DDFT.

**Recommended Reading**

* Mair TS & Kinns J. Deep digital flexor tendonitis in the equine foot diagnosed by low-field magnetic reso-
Castration is probably the most commonly performed surgical procedure in equine and is associated with a fairly low percentage of complications. Nevertheless, complications following castration are the number one reason for lawsuits against equine practitioners. Some of the complications are inherent to the surgery and difficult to rule out. However a part of the intra- and postoperative complications can be avoided by a good preparation, good knowledge of the male anatomy and an adequate technique.

A thorough clinical exam should precede every surgical intervention. Febrile horses, horses that cough or have diarrhea or horses with purulent wounds are not good candidates for elective surgery. The presence of two testicles in the scrotum should be verified. Horses with only one testicle should be sedated and the scrotum and inguinal area should be palpated. When deep palpation does not reveal the missing testicle, a rectal exam and/or transabdominal ultrasound should be performed. Transabdominal ultrasound has been shown to be a sensitive and specific technique for localizing undescended testes \(^{(1)}\). In cryptorchid horses, failure of right and left testicular descent occur with nearly equal frequency \(^{(2,3)}\). However, in one study the left, undescended testes were more frequently located in the abdomen compared to the right undescended testes \(^{(3)}\). Inguinally located testes can be removed by routine castration under general anesthesia whereas abdominal cryptorchids are better referred to a clinic. When the presence of testicular tissue cannot be ruled out, hormonal assays or laparoscopy may help in the definitive diagnosis.
Horses can be castrated standing under sedation and local anaesthesia or in lateral or dorsal recumbency under general anaesthesia. The approach can be scrotal by two parallel incisions on either side of the raphe or by scrotal ablation, or inguinal by incision directly over the superficial inguinal ring. Regardless of whether the horse is castrated while standing or recumbent, or whether the approach is inguinal or scrotal the techniques used for castration are the open, closed and half-closed techniques depending on whether the common vaginal tunic is opened or not. It is important to know that the closed technique has no advantage over the open technique in preventing evisceration if a ligature is not applied to the cord proximal to the site of transection.

Sterile and laparoscopic castrations are routinely performed in referral centers. Here, standing laparoscopic castration may be an alternative for castration under general anaesthesia. However, a specific complication of laparoscopic castration of normally descended or inguinal testes is incomplete castration.

The most commonly encountered complications after equine castration are swelling and oedema, seroma formation, bleeding, septic funiculitis, evisceration and omentum prolapse, hydrocoele and incomplete castration and continued masculine behavior. Each of these complications will be discussed together with the appropriate treatment.

References:

AN OVERVIEW OF CONFORMATIONAL DEFORMITIES IN YOUNG HORSES. HOW TO RECOGNIZE AND HOW TO DEAL WITH IT IN DAILY PRACTICE?
F. Pille, DVM, PhD, DECVS
Ghent University, Dept. of Surgery and Anaesthesiology of Domestic Animals
Belgium
frederik.pille@ugent.be

Angular limb deformities
Common angular limb deformities in foals include valgus deformities of the carpus and the tarsus and varus deformities of the fetlock. Either type of deformity is usually associated with some degree of axial rotation. Typically, a toed-out posture is noticed with valgus deformities whereas varus deformities tend to be accompanied by a toed-in posture.

The treatment of angular limb deformities in foals depends on the underlying cause. Traditionally, 3 different situations are distinguished.

1. Incomplete cuboidal bone ossification
Incompletely ossification of carpal and tarsal bones is routinely seen with premature birth and in twin foals. If going unnoticed, (uneven) loading may result in compression of the precursor cartilage with development of a limb deformity (carpal valgus and/or sickle hock with some ‘curby’ appearance). Ideally, foals at risk for having incompletely ossified cuboidal bones are radiographically examined before limb deformities develop. From the moment incomplete ossification is diagnosed, stall rest is mandatory and radiographs should be repeated at 2-week intervals to evaluate the progression of ossification. In order to maintain the affected limbs in proper alignment, the application of splints is usually indicated.

2. Laxity of periarticular structures
Laxity of periarticular structures most of the times involves several joints resulting in a combination of valgus- and varus deformities in one and the same foal (so-called ‘windswept’ foals). Usually, the limbs can be manually straightened. Spontaneous correction of the condition within a few weeks is routine. Awaiting correction of the deformity, foals should be given only...
limited access to the field in order to prevent as far as possible uneven loading of the skeleton. Cast or splint immobilisation is contra-indicated with this condition.

3. Asynchronous physeal growth

Asynchronous physeal growth is the most common cause of angular limb deformities. Deformities are usually congenital in origin but they may also result from physeal damage after trauma or local inflammation / infection. With congenital deformities, most foals auto correct because the bone grows faster on the more intensely loaded concave side compared to the convex side (Wolff’s law). However, with severe deformities or overactivity of the foal, there is risk for overload of the physis at the concave side and the deformity may worsen.

Awaiting auto correction of congenital deformities, treatment may consist of restricting the foal’s exercise (stall + small pasture) and corrective trimming with or without shoeing. With varus deformities, the hooves wear more on the lateral side compared to the medial side and break-over occurs too lateral (off-centre). Trimming of the medial side of the hoof is indicated to make the foot balanced. Glue-on shoes can protect the hoof from continued asymmetric wear. In combination with a lateral extension it is claimed that the limb is pulled outward which should minimize asymmetrical loading of the physis. The inverse is true with valgus deformities. Balancing of the hoof occurs through trimming of its lateral half and shoes with a medial extension should force a less base-wide posture.

Conservative treatment is usually not successful with severe deformities. Surgical intervention is indicated and is directed toward accelerating growth on the concave side of the limb and / or slowing growth on the convex side. Hemicircumferential transsection of the periosteum and periosteal stripping (HCTP+PS) is used to stimulate growth and various forms of transphyseal bridging (TPB) are used to retard growth.

HCTP+PS is the preferred technique for correction of mild deformities that failed to respond to conservative therapy, provided that there is still maximal growth potential at the physis (distal metacarpus or metatarsus: until 2 months of age; distal tibia: until 4 months of age; distal radius: until 6 months of age). The true benefit of HCTP+PS is controversial but compared to TPB, the technique has minimal complications, is less expensive and there is no risk for overcorrection.

TPB is used for correction of severe deformities and / or in older foals where the growth potential of the physis has started to reduce. Depending on the location, bridging of the physis is achieved by a combination of screws and wires or by a transphyseal screw. The upper age limit for using TPB varies through literature and, in order to ensure correction, depends largely on the severity of the deformity. Overall, it appears nowadays that TPB can be used successfully in foals and weanlings older than what has been previously thought. Disadvantages of TPB include wound healing complications, the need for a second procedure to remove the implants and the risk for overcorrection if the owners fail to monitor closely correction of the deformity.

Flexural limb deformities

Flexural deformities involve most commonly the distal interphalangeal (DIP) joint, the metacarpophalangeal (MCP) and metatarsophalangeal (MTP) joint and the carpus. They may present at birth (congenital deformities) or develop during the remainder of life (acquired deformities).

1. Congenital flexural deformities

a) Digital hyperextension

Newborn foals may present flexor muscle flaccidity resulting in digital hyperextension. The condition is more common in the hindlimbs than in the front limbs. Affected foals are unable to maintain their toes on the ground and their MTP (and sometimes MCP) joints are angled more acutely than normal. Most foals auto correct over a few days or weeks as a result of increased muscle tone and longitudinal growth of the skeleton. In more severe cases, protective bandages are needed to prevent the skin on the plantar / palmar aspect of the digit from getting wounded and shoes with heel extension may help the foal maintaining the toes on the ground. Immobilisation is contra-indicated since inactivity will further accentuate flexor muscle flaccidity.

b) Contractural deformities

Congenital contractural deformities present in various degrees of severity and in several locations (DIP joint, MCP joint and carpus). Occasionally, rupture of the common digital extensor tendon may occur secondarily to flexor tendon contracture.
As long as foals are able to ambulate (mild deformities), auto correction is very likely. When the DIP joint is involved, a glue-on shoe with raised heels may increase the foal’s comfort and promote ambulation. As the deformity corrects, the heels can be gradually lowered. In more severe cases, cast or splint immobilisation together with oxytetracycline infusions are indicated. Refractory cases or cases that do not allow sufficient manual correction for immobilisation have a guarded prognosis and surgical correction is often the only option. Flexor tendon tenotomies, inferior and superior check ligament desmotomies, and tenotomies of the ulnaris lateralis and flexor carpi ulnaris are performed with varying success-rates.

2. Acquired flexural deformities

a) Contractural deformities of the DIP joint

Acquired contractural deformities of the DIP joint are typically seen in young foals and results in the development of a clubfoot. As a unilateral condition, it is associated with handedness during grazing and results from unloading systematically the same limb. In its bilateral form, the condition is associated with an episode of rapid longitudinal growth of the skeleton. When pain develops (taut digital flexor tendon, worn toe), a flexor withdrawal reflex that causes deep digital flexor muscle spasms is initiated and the deformity usually get worse quickly.

Moderate deformities usually respond favourable to conservative treatment consisting of gradual trimming of the heels and temporary treatment with NSAIDs. Foals that present with extensive wear at the toe benefit from glue-on shoes (if necessary in combination with some toe-extension) or application of a 2-component resin.

Severe deformities or refractory cases require surgical correction. Usually there is a favourable response to an inferior check ligament desmotomy, provided the procedure is performed before the development of ‘contracted heels’. Exceptionally, a contractural deformity of the DIP joint can only be corrected by a ‘salvage’ deep digital flexor tenotomy.

b) Contractural deformities of the MCP (and MTP) joint

Acquired contractural deformities of the fetlock joint are typically observed in the front limbs of yearling horses. The condition usually develops quickly and has been associated with a growth spurt at the level of the distal physis of the radius, pain and lack of exercise. Traditionally, the condition has been referred to as superficial digital flexor tendon contracture. However, also the deep digital flexor tendon and the suspensory ligament (chronic cases) may be involved.

Conservative treatment is only successful when installed early. This is at the stage where the fetlock and pastern appear to become more upright and thus before the fetlock starts to knuckle forward with every step. Most cases respond best to a shoe with raised heels and a small toe extension in combination with temporary administration of NSAIDs.

Severe deformities or refractory cases have a guarded prognosis and require surgical correction. In the standing horse, digital palpation of the tendons while forcing the fetlock in an extended position may help to determine which of the structures is more involved. Ideally, correction of MCP deformities is achieved after desmotomy of the superior and/or inferior check ligament. However, correction of more severe deformities may require a superficial flexor tendon tenotomy (if necessary combined with an inferior check ligament desmotomy). Chronic cases have a poor prognosis since they may only correct after additional tenotomy of the deep digital flexor tendon and -occasionally- also a desmotomy of the suspensory ligament.

REPRODUCTION PROBLEMS IN THE MARE

Peter Daels & Tom Stout
Peter Daels, DVM, PhD, veterinarian at Keros

Insemination and embryo transfer center

Interactive key voting session.
Practical cases will be presented to you and discussed
HOW TO RECOGNIZE AND WORK UP ORTHOPAEDIC PROBLEMS IN YOUNG GROWING HORSES?
INTERACTIVE SESSION YOUNG HORSES: FIND OUT WHAT YOU ACTUALLY KNOW!
Prof Dr. Frederik Pille
Dr Denis Verwilghen

By use of different media including pictures, videos and medical imaging material surgical and orthopaedic issues encountered in young growing horses will be discussed. In this interactive session participation of the delegates will be mandatory. The delegates approach to the presented case will be assessed by use of a voting system followed by comments made by the duo of presenters. A variety of cases will be discussed, intensively illustrated with lots of imaging material and lab work. Don't miss this great session where you will be able to test and update your actual knowledge on sometimes very challenging cases.