Equine Science Update

Reports from the world of equine research **Spring 2004**

Crib-biting and colic.

Crib-biting horses are at greater risk than other horses of developing colic due to entrapment of the small intestine in the epiploic foramen, according to research presented at the annual convention of the American Association of Equine Practitioners. A full report of the work has been published recently in the Journal of the American Veterinary Medical Association

Crib-biting (or cribbing) is an abnormal repetitive (stereotypic) behaviour in which the horse grasps an object with its incisor teeth, arches its neck and produces an audible grunt. It is widely thought that the behaviour can lead to colic. However, one study found that in most cases the air is not actually swallowed but merely drawn into the upper oesophagus.

The latest findings tend to confirm the traditional view. The work stemmed from an observation at the University of Illinois. Clinicians noticed that horses were more likely to show cribbing behaviour after surgery for correction of small intestine entrapment in the epiploic foramen than after surgery for any other cause of colic.

The epiploic foramen (sometimes called the foramen of Winslow) is a narrow opening between the liver and pancreas through which the small intestine can occasionally pass and get trapped. The tight borders of the opening restrict the blood supply to the intestines and cause pain. Typically this type of colic is associated with severe pain.Traditionally, this problem is thought to occur more commonly in geldings and in Thoroughbreds.

To investigate whether the observation held true in a larger population of horses, the University of Illinois combined data with data from the University of Liverpool in the UK. The records of horses operated on for colic at the two University hospitals over a ten-year period were reviewed. Only information from those horses with colic that was treated surgically was examined. They looked at all horses in the control group (other forms of colic) and epiploic group to determine what proportion in each had a history of cribbing before surgery.

They found that 68 horses had been treated for entrapment of the small intestine in the epiploic foramen. In the same period 721 horses had surgical treatment for other causes of colic. Of the horses that were treated for epiploic foramen entrapment, over half (54.5%) had a history of crib-biting before they had developed colic.

In contrast, only 10.2% of the horses with colic due to other causes had been seen to crib-bite before getting colic. Crib-biting horses were over ten times more likely to have epiploic foramen entrapment than were horses that did not crib-bite.

The scientists suggest that the negative intra-abdominal pressure that occurs during crib-biting may be responsible for the small intestine becoming entrapped in the epiploic foramen. However, they point out that it could be that similar predisposing factors could cause both the crib-biting and the epiploic entrapment.

They advise clinicians to be aware of the possibility of small intestinal entrapment in the epiploic foramen in crib-biting horses with colic.

References:

*Radiographic and endoscopic study of horses performing an oral based stereotypy.
PD McGreevy, JD Richardson, CJ Nicol, JG Lane. Equine Vet J (1995) 27, 92 - 95.

Cribbing as a risk factor for entrapment of the small intestine in the epiploic foramen.
Aimie J Doyle, David E Freeman, Debra C Archer, Christopher J Proudman, G Barrie Edwards. Proc Am Assoc Equine Pract (2003) 371 - 372.

Association between cribbing and entrapment of the small intestine in the epiploic foramen in horses: 68 cases (1991- 2002)
Debra C Archer, David E Freeman, Aimie J Doyle, Christopher J Proudman, G Barrie Edwards. J Am Vet Med Assoc (2004) 224, 562 - 564

Rasping teeth increases jaw movement.

Routine dental care increases the range of movement of the lower jaw according to research from Canada.

Dental problems in the horse are common. Abnormalities of the teeth may result in damage to the tongue and cheeks and may interfere with chewing. Lack of adequate chewing can lead to loss of condition, increased risk of choke, and intestinal obstruction.

Routine rasping (or floating) the cheek teeth aims to remove sharp points, and reduce any dental overgrowth that might restrict the normal range of movement of the mandibles. During chewing, the main motion of the jaws is from side to side. However, recent video studies have shown that there is also a small amount of front to back motion (rostro-caudal mobility: RCM). A similar movement occurs as the horse raises and lowers its head.

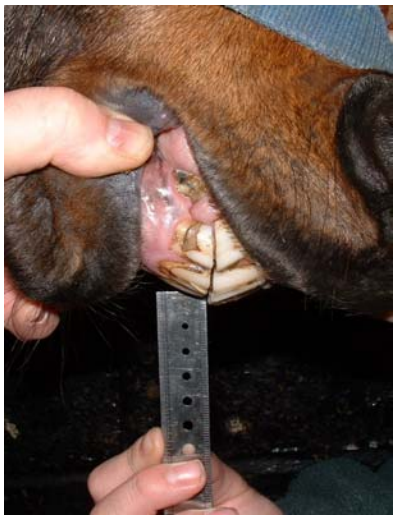
Dr James Carmalt and his colleagues at the Western College of Veterinary Medicine, University of Saskatchewan, have been evaluating the effect of floating the teeth on the range of front to back movement of the lower jaw. To do this they compared the relative positions of the upper and lower jaws when the horse's head and neck was either extended or flexed.

Their study involved fifty-nine horses of various breeds. Each horse was sedated. Then the researchers measured the distance, in the midline, between the front of the lower incisors and the front of the upper incisors.

They recorded this measurement both with the jaw parallel to the ground and with the neck flexed. The difference between the two measurements gave the rostro-caudal mobility of the mandible.

Next, the clinicians carried out a full inspection of the teeth and oral cavity and recorded any dental abnormalities. The horses were then divided at random into two groups. Twenty-six horses were allowed to wake up from the sedation without any treatment.

In the other thirty-three horses, the investigators used a motorised rasp to



remove any sharp points and treat other abnormalities of the teeth.

After they had corrected any dental problems, the researchers repeated the measurement of rostro-caudal mobility of the mandible.

They found that correction of dental abnormalities had a significant effect on the range of front to back movement of the mandibles. The RCM increased in 31 of 33 horses after floating. This difference was greater in heavy horses than in other breeds.

They found that neither the age of the horse nor the number of abnormalities of the teeth had a significant effect on the RCM. It was not possible to predict, by measuring the rosto-casual movement, which dental abnormalities would be present

Although this study gave an artificial measure of RCM, the researchers believe that it gives a good representation of the range of movement that occurs in the natural feeding action.

Reference

James L Carmalt, Hugh GG Townsend, Andrew L Allen
Effect of floating on the rostro-caudal mobility of the mandible of horses.
J Am Vet Med Assoc (2003) 223, 666 - 669

Ivermectin resistant worms?

Researchers in Canada have found foals infected with *Parascaris equorum* apparently resistant to ivermectin.

Parascaris equorum is the large roundworm of horses. It is found throughout the world. It affects young horses, particularly foals under six months. Adult horses tend to develop immunity to it and so it is unusual to find large numbers of the worms present except in foals.

P. equorum are large white worms. The adults live in the small intestine and feed on the gut contents. Adult females may reach up to 50cm in length and males half that size. The females produce large numbers of eggs. The eggs are not able to infect horses immediately after they are passed in the faeces, but take 2-3 weeks to become infective. Their outer coat is sticky and they often stick to the mare's coat, which is an important source of infection. Eggs can survive for several years outside the body.

Foals become infected by eating the infective larvae, which migrate through the liver and lungs, before being coughed up and swallowed. It takes three months for larvae to develop into egg-laying adults in the gut. However, infection may also occur through the blood stream before the foal is born.

It is unusual to see obvious clinical signs of infection. A whitish nasal discharge is sometimes attributed to the lung migration phase of the larvae. Large numbers of adult worms may cause obstruction of the small intestine. This is particularly a problem of foals of up to 3-4 months old.

Since the development of modern anthelmintics these worms rarely cause clinical problems because all wormers that are commonly used are effective against them.

A recent report in the Journal of the American Veterinary Medical Association suggests that this may not always be the case. Drs Hearn and Peregrine working Ontario, Canada have identified signs of ivermectin resistance in *Parascaris equorum.*

Preventing disruptive oestrus behaviour.

A simple treatment for suppressing unwanted oestrus cycles in competition mares has been described by scientists in Cambridge.

Ivermectin resistant worms. Continued.

They found *P. equorum* eggs in routine faeces samples taken from a group of Thoroughbred foals. Seven days after treatment with ivermectin at the recommended dose, nearly half of the foals had more eggs in the faeces than before treatment. Looking at a larger group of foals, they found that foals that had been routinely treated with ivermectin since birth were more likely to have significant numbers of *P. equorum* eggs in their faeces than were foals that had been treated with different anthelmintics.

This work serves to remind us of the ever-present risk of resistance developing to the commonly used anthelmintics. The correct approach to management of parasitic problems must include pasture management (because of the long time required for the larvae to become infective, collecting droppings at least every two weeks is likely to be effective against this particular parasite.)

Modern anthelmintics are effective against the adult stages of the parasite and the larval stages within the gut lumen. However they are not generally effective against the migrating larval stages. It is not usually necessary to institute special control measures for these parasites. Measures that are effective against strongyles are also likely to be effective against this species.

Reference:

Hearn FPD , Peregrine AS
Identification of foals infected with *Parascaris equorum* apparently resistant to ivermectin.
JAVMA (2003) 223, 482 - 485

Some fillies are disruptive and behave badly when they are in season. They may be so unruly that they are impossible to train, and they may be unable to follow their intended competitive careers.

The cyclic events of oestrus are associated with the development of follicles in the ovary. In the normal cycle, one of these follicles will develop, releasing the oestrogen that is responsible for the oestrus behaviour. Once ovulation has occurred, the function of the follicle changes. The remaining follicular tissue is transformed to become the corpus luteum (CL), which produces progesterone, the hormone responsible for maintaining pregnancy.

In the non-pregnant mare, hormones known as prostaglandins are released from the uterine wall. They break down the CL, removing the source of progesterone, and the mare comes back into season. If the mare is pregnant, the embryo reaches the uterus about 6 or 7 days after ovulation. It then spends over a week migrating around the uterus, releasing molecular signals that prevent the uterus releasing prostaglandin. This ensures that the corpus luteum continues to produce progesterone, preventing a return to oestrus, and allowing the pregnancy to proceed.

Various methods have been suggested to control the problem of inappropriate or excessive oestrus behaviour.

Hormone treatment, using the progestagen allyl-trenbolone (a synthetic progesterone-like drug), is commonly used. It suppresses activity within the ovaries and prevents the mare coming in season. However, it is expensive and is banned for use in many competitions.

Pregnancy itself will prevent cyclic oestrus behaviour. However, the demands of the growing foal will eventually interfere with the mare's athletic ability. Indeed, the use of pregnant mares is banned in many competitions. For example, mares over five months pregnant are not allowed to race in the UK.

A 35 mm sterile glass ball inserted into the uterus a day after ovulation has been used to suppress oestrus behaviour. But in tests it was successful in preventing oestrus in only about 40% of mares.

Research at the Equine Fertility Unit of the University of Cambridge has demonstrated an effective way of preventing oestrus behaviour, without using drugs.

Professor Twink Allen and Dr A-C Lefranc, described the work in a report published in the Equine Veterinary Journal. They used eleven Welsh Pony or Welsh Cob-type mares in the study. When the mares came in season, they were monitored by ultrasound and managed routinely for artificial insemination.

The researchers confirmed the mares were pregnant by ultrasound scan at about 12 - 14 days after ovulation. Then, at 16 - 22 days after ovulation, they sedated the mares and terminated the pregnancy by manually compressing the embryonic vesicle per rectum. (This is a procedure that is commonly used on stud farms for managing twin pregnancies.) A couple of days later they checked that they had been successful in removing the pregnancy and that the corpus luteum was still present in the ovary.

The researchers monitored the ovarian activity by regular ultrasound scanning and blood tests. They also teased the mares with a stallion twice weekly.

The mares did not come in season for between 64 and 109 days (average 82 days). (One mare remained "pseudopregnant" for over 223 days and was excluded from the statistical analysis).

The researchers conclude that physically disrupting the pregnancy after the 16th day provides a simple, non-pharmacological method of suppressing unwanted oestrus activity in competition mares.

Reference.

Non-pharmacological suppression of oestrus in the mare.
A-C Lefranc, WR Allen.
Equine Vet Journal (2004) 36, 183 - 185

Hair analysis for drug detection.

Analysis of hair may provide a new way of detecting past drug administration.

Two reports in the Equine Veterinary Journal describe preliminary studies into hair analysis, which may prove a useful technique both for therapeutic monitoring and for identifying the use of banned substances.

In a pilot study at the Royal Veterinary College, Dr Dunnett and Prof Lees looked at hair samples that had been collected from four horses a known time after the last administration of certain drugs. They detected the antibacterial combination trimethoprim / sulphadiazine in a sample taken 5 months after the horse had last been treated. They add that in other unpublished work they have detected the same drug combination in horse hair three years after therapeutic dosing.

In another horse they found the anti-biotic metronidazole three months after it had last been given. Interestingly, they also found low levels of trimethoprim and sulphadiazine although there was no record of the horse having been treated with the combination. They suggest possible explanations are inadequate records or contamination of the horse's food with antibiotic.

Analysis of mane and tail hair may provide a new way of detecting past drug administration.

Three months after administration of procaine benzyl penicillin, the procaine molecule was still detectable. In contrast, omeprazole, which is used to treat gastric ulcers, was not detected 23 days after the end of the treatment period. This is probably because it is not absorbed from the intestine in significant quantities.

Meanwhile, researchers in Germany reported that they could detect clenbuterol in the mane and tail hair up to a year after it had been administered. Dr Schlupp of the Institute for Animal Science at Neustadt carried out the work with colleagues in the Institute of Doping Analysis and Sports Biochemistry and the Munich Technical University's Institute of Physiology.

Clenbuterol (Ventipulmin ™) is commonly used for treating respiratory disease in horses. It dilates the airways and promotes the removal of mucus. However, it also has anabolic (muscle building) activity, and is sometimes used illegally as a growth promoter. Its use as an anabolic agent is banned in competitions. But it can prove difficult to detect illegal use as the drug can only be found in blood or urine samples for a few days after administration.

Firstly, the researchers established that the mane and tail hair grew at a relatively constant rate of just over 2cm a month. By dividing the hair into 2-cm sections they were able to correlate the change in concentration along the hair with the time lag since the drug was administered.

The scientists treated four geldings with clenbuterol (0.8microgams / kg body-weight twice daily) in the food for ten days. Four more geldings were left untreated as controls.

They first detected clenbuterol five days after end of the treatment period. As expected it was found in the first 20mm section of hair close to the root. It was still detectable in the hair nearly a year later. By then the peak concentration of the drug was present in the segment between 24cm and 26 cm from the root. As the hair grows, the clenbuterol was carried down the hair. The researchers point out that the system could potentially be used for detecting clenbuterol administration up to two years previously.

In contrast, clenbuterol was only found in the blood or urine up to 30 days after treatment finished.

The research team found a marked difference in clenbuterol concentration in different coloured hairs. Dark coloured hairs had higher concentrations than lighter hairs. This difference can be explained by the fact that clenbuterol is thought to be bound to melanin pigment

The use of hair analysis for monitoring past drug administration has several advantages compared with analysis of blood samples. Unlike blood samples, it is non-invasive. The hair gives a relatively permanent picture of the pattern of drug administration. A sample can be repeated at a later date, unlike the situation with blood samples in which the drug or its breakdown products are only present for a limited time. If necessary, the identity of the sample could be confirmed by DNA profiling.

In the future, it may be possible to use hair analysis to estimate the dose of drug given some time previously. It may also be possible to estimate the date of administration.

However it is likely that the technique will become less accurate as the time between administration and analysis increases. This is because there is more opportunity for variation in growth rate. There may, for example, be seasonal variations in growth rate of the hair, although recent work suggests that this might not be the case.

Before the technique can be used a practical tool for monitoring drug administration more work needs to be done to establish how much of each drug is taken up by the hair, and how factors such as hair colour affect the process.

References:

Hair analysis as a novel investigative tool for the detection of historical drug use/misuse in the horse: a pilot study.
M Dunnett, P Lees
Equine Vet Journal (2004) 36, 113 - 117.

The beta -agonist clenbuterol in mane and tail hair of horses.
A Schlupp, P Anielski, RK Muller, H Meyer, F Ellendorf
Equine Veterinary Journal (2004) 36, 122 - 118

Maximising water intake after exercise

.Recent research suggests ways to increase the voluntary water intake of horses after prolonged exercise.

During exercise, horses lose both water and electrolytes in sweat. After strenuous or prolonged exercise, they can become dehydrated and the reservoir of electrolytes can become depleted. They may suffer medical problems as a result.

The salt concentration in the body plays an important role in the control of thirst. Loss of salt through prolonged sweating may decrease the sensation thirst, leading to an inadequate water intake. This is known as voluntary (or sometimes involuntary) dehydration.

In a series of studies, scientists at the Michigan State University's Veterinary Medical Center have been investigating the various factors that influence the voluntary water intake of horses after prolonged exercise.

They made the horses dehydrated in the first study by giving them exercise on a treadmill equivalent to a 45-km endurance ride. In the other two studies they gave frusemide as well to increase the degree of dehydration. Frusemide (also known as furosemide) is a potent diuretic. It acts on the kidneys to cause the loss of water and sodium ions in the urine. Exercise alone produced about a 3% body weight loss. When they were given frusemide as well, horses lost about 5% of their body weight.

Firstly the researchers investigated whether restricting the water intake immediately after exercise affected total water intake. Six two-year-old Arabian horses were used in the study. The horses received 4l, 8litres or unrestricted access to water in the first five minutes after exercise. They were then cooled off and allowed free access to water from 20 -60 minutes after the end of exercise, and their total water intake was measured.

Traditional advice has been to limit the intake of water immediately after exercise. This was because of the perceived risk of causing colic or laminitis. However, the researchers found that this fear was unfounded. Horses given free access to fluid immediately after exercise had no greater incidence of such problems. And in fact horses tended to limit the fluid intake to the size of the stomach (about 10 litres) On the other hand, restricting the amount of water in the first five minutes after exercise did not adversely affect the overall recovery from dehydration.

In the second part of the study, the researchers compared the effect of giving either plain water or two different concentrations of salt solution as the initial rehydration fluid. This was followed by free access plain water from twenty minutes after the end of the exercise period. Again, they recorded the total fluid intake in the first hour after exercise. They found that using water as the initial rehydration fluid was less effective than either of the salt-water solutions. They suggest that this may be because the water dilutes the salt concentration in the blood, reducing the stimulus for thirst.

Finally, they assessed whether the temperature of the rehydration fluid affected the total fluid intake.

The total fluid intake was greatest when the fluid was given at room temperature (20^{o} C) rather than cooled (10^{o} C) or at near body temperature (30^{o} C).

As a result of their findings, they recommend:

- allow free access to fluids straight after exercise
- offer salt water at concentrations up to 0.9%salt as the initial rehydration liquid, after that change to plain water
- give fluids at ambient temperature. There is no benefit using cold fluids or those at body temperature.

They also point out that body fluid and electrolyte depletion can persist for several days after prolonged exercise. Several meals may be required to fully replenish electrolytes lost in sweat after prolonged exercise.

Reference.

Strategies to increase voluntary drinking after exercise. Harold Schott II, Prawit Butudom, Brian D Nielsen, Susan W Eberhart.
Proc Am Assoc Equine Pract (2003) 49, 132-136

Epidural catheterisation for pain relief.

Epidural catheterisation can be used successfully for prolonged pain control in horses in a variety of clinical conditions according to a report from Canada.

It can be difficult to provide horses with adequate long-term pain relief. Non steroidal anti-inflammatory drugs (NSAIDs), such as phenylbutazome or flunixin, may be effective but carry the risk of gastro-intestinal or kidney damage. Morphine and related drugs can affect gut motility and cause central nervous system excitation when given intravenously or into the muscle.

One way of limiting the adverse effects is to administer the analgesic agent by epidural injection. The epidural space lies within the vertebral canal and surrounds the spinal cord. Often only small amounts of analgesic (pain-killing) drugs need to be given into the epidural space to be effective. The small doses that are used make systemic adverse effects less likely.

The site for injection lies in the gap between the first and second coccygeal vertebrae, the first moveable joint of the tail.

The area of skin that is desensitised depends on the choice of anaesthetic agent and the amount used. The further forward along the spine that the anaesthetic spreads, the larger the area that is desensitised. Local anaesthetics, such as lignocaine, also affect the motor nerves that control muscle activity. If they are allowed to spread too far forward they will cause muscle weakness and make the horse unsteady on its hind legs. Other agents, such as morphine and alpha-2 agonists like detomidine, do not have the same effect on the motor nerves. When given into the epidural space they give a prolonged period of analgesia, without the sedation that occurs when they are given into the vein.

For longer-term pain relief a catheter can be left in place in the epidural space. Repeated doses of the chosen anaesthetic agent can then be given as required.

Clinicians at the Ontario Vet College in Guelph have been assessing the value of epidural catheters for long-term pain relief in horses. In a retrospective study, the researchers reviewed the medical records of horses that had been treated between 1998 and 2001.

During that period 43 horses had been treated using epidural catheters. Some horses were treated more than once, and so a total of 50 records of the use of epidural catheters were available.

The researchers found that most common reason for using an epidural catheter was the management of pain (86%). Prevention of straining accounted for 12% of cases. The longest a catheter was left in place was twenty days, but the average time was four days.

Morphine was the most common drug used, either on its own or in combination with detomidine. Morphine was used as the sole analgesic agent to provide relief from pain resulting from forelimb injuries, in which case it was usually given in up to 100ml of a 0.9% saline solution. To treat pain in the hind limbs or pelvis, a combination of morphine and detomidine was usually used.

According to the records, the response was good in 34 of the 43 horses. All horses with rectal damage, in which the epidural was used to prevent straining, responded well. Twenty of twenty-six horses with hind limb or pelvis injury responded well, as did six of the seven horses with forelimb pain.

Adverse effects were only reported in only 4 horses. In each of those the problem was only temporary. Three horses developed inflammation or increased sensitivity at the site where the catheter was inserted. This was despite rigorous attention to cleanliness and sterility when the catheters were placed.

The researchers conclude that epidural catheterisation provides a useful way of managing pain in the horse. In the cases they reviewed the technique was usually effective and adverse effects were few and temporary.

Reference:

CA Martin, CL Kerr, SG Pearce, JL Lansdown, LP Boure.
Outcome of epidural catheterization for delivery of analgesic in horses: 43 cases (1998- 2001)
J Am Vet Med Assoc (2003) 222, 1394 - 1398

EHV abortion: more tests needed.

Current procedures may not be sufficient to detect all cases of herpes virus abortion in horses, warn scientists at the Animal Health Trust.

Equine herpes virus-1 (EHV-1) is a common virus that is found in horses throughout the world and causes respiratory disease, abortion and paralysis. Abortion storms may occur, with multiple abortions in a group of mares. The closely related herpes virus EHV-4 causes respiratory disease and sporadic abortion.

Typically, abortion due to EHV occurs in the last third of pregnancy, and often happens without warning. The aborted foetus is usually expelled quickly, still wrapped in its placental membranes.

Diagnosis is based on finding evidence of the virus in the aborted foetus. Tissues such as liver, lung, thymus and spleen are examined using a variety of techniques. Microscopic examination may reveal characteristic changes in the cells, and specialist techniques using virus-specific antibodies (e.g. Immuno-peroxidase analysis) can be used to demonstrate the presence of the virus in the tissues. It may also be possible to grow the virus-infected cells in tissue culture. Polymerase chain reaction (PCR) analysis is a rapid and highly sensitivee technique that may be used to detect small amounts of viral DNA.

Experimental work ten years ago showed that some mares abort so quickly after being infected that there is no time for characteristic signs to become apparent in the foetus. It seems that the virus caused localised damage to blood vessels in the uterine lining in these mares, which precipitated the abortion.

If a similar situation occurs in real life, it raises the possibility that standard diagnostic procedures may fail to detect some cases of herpes virus abortion. Because of these fears, scientists at the Animal Health Trust, Newmarket have

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been examining samples of the placenta from aborted foetuses that have shown no characteristic signs of EHV. They reported their findings in a recent edition of the Equine Veterinary Journal.

Over the past three breeding seasons, they have investigated 241 abortions. Of those, nine were found to be typical herpes virus abortions, with signs of virus infection in the sborted foetus. However, in five cases the scientists found no evidence that the foetus was infected. In the sixth case the virus was restricted to the lung. All of these atypical cases had signs of EHV-1 infection in the placenta. Most of the mares involved were Thoroughbreds, and all had been vaccinated.

As a result of this work, and studies on the placenta in more typical cases of EHV-1 abortion, changes have been made to the Code of Practice. It is now recommended that the placenta be submitted along with the foetus for post mortem examination. It is also recommended that the placenta be submitted for examination even if the foetus is not available to the laboratory (for example if it has been taken by foxes).

It may be that these atypical abortions, in which the foetus is not infected, are caused only by the more virulent strains of the virus. Members of the research team are now investigating that possibility.

Reference

Equine herpesvirus-1 abortion: atypical cases with lesions largely or wholly restricted to the placenta.
KC Smith, KE Whitwell, AS Blunden, ME Bestbier, TJ Scase, RJ Geraghty, J Nugent, NJ Davis-Poynter, JM Cardwell.
Equine Veterinary Journal (2004) 36, 79-82.

Combined wormer safe in pregnancy.

A recent study carried out in Brazil shows that a combined ivermectin / praziquantel paste* is safe to use in pregnant mares.

Brood mares commonly return to the stallion shortly after foaling, and so there is only a short period when they are not pregnant. It is, therefore, important to have anthelmintics available that are safe for use during pregnancy so that a year-round worming plan can be established.

Ivermectin has been used for twenty years in horses and has proved to be an effective and safe anthelmintic. It is effective against a wide range of roundworms in the horse including the small redworms, or cyathostomes, currently the most significant parastitic worms of the horse. It also acts against bot larvae.

Anoplocephala perfoliata, the common tapeworm, is known to increase the risk of spasmodic colic and ileal impaction. It is commonly found in abattoir surveys. Indeed it may have become more common in recent years with the widespread use of wormers containing ivermectin, which has no effect on the parasite.

Horses become infected by ingesting oribatid mites, which are the intermediate host. Control centres on removing the adult tapeworms from the gut before they can contaminate the pasture. Praziquantel has become available for use in horses relatively recently and is very effective against tapeworms.

Dr Patrick Mercier, based with the pharmaceutical company Virbac in France, worked with colleagues in Brazil to assess the safety of a combined ivermectin / praziquantel paste in pregnant mares. They reported their findings in a recent issue of the American Journal of Veterinary Research.

Twenty mares were given three times the recommended dose of ivermectin and praziquantel every two weeks throughout pregnancy. A further twenty mares received a placebo.

Clinicians, who were unaware of which treatment each mare had received, monitored their health during pregnancy and collected blood samples every month. They monitored blood cell numbers and carried out routine biochemistry tests on the samples. After the mares had foaled they carried out monthly examinations on both the mares and their foals to check for signs of any adverse effects of the drug combination.

All forty mares in the study produced healthy foals with no sign of developmental defects. On average, the foals from the treated group were nearly 5kg heavier than the others.

The researchers found no difference between the treated and untreated groups. The blood analysis revealed only minor alterations, which were not biologically important. Despite the frequent high dose of ivermectin and praziquantel that was used, they found no sign of interference with reproductive function. Although the period of administration of the drugs had included the critical period when the organs of the foetus are developing, there was no sign of developmental defects.

The researchers conclude that the combined ivermectin-praziquantel paste appears to be safe for use in pregnant mares.

* Equimax™

Reference:

Patrick Mercier, Francisco Alves-Branco, Maria de Fatima Sapper, Christopher Roger White
Evaluation of the safety of ivermectin-praziquantel administered orally to pregnant mares.
Am J Vet Res (2003) 1221 - 1224

Isoflurane or halothane safer?

General anaesthesia in horses presents a much greater risk than in other species. One in every hundred horses that are anaesthetised die unexpectedly within seven days of the anaesthetic. In comparison, the unexpected death rate from anaesthetic-related causes is about 1/1000 in dogs and cats and about 1/10,000 in humans.

Studies have identified some of the risk factors involved. One study* found that procedures in which inhaled anaesthetics were used were more likely to be associated with unexpected deaths than were procedures in which the anaesthesia was induced and maintained by anaesthetics administered into the vein ("total intravenous anaesthesia"). Unexplained deaths were also more likely to occur in operations performed at night or weekends.

Inhaled anaesthetics are commonly used to maintain anaesthesia after the horse has first been anaesthetised with injectable drugs. Halothane has been widely used in Europe. It is a potent anaesthetic, but does depress heart function, causing reduced cardiac output and lower blood pressure. It also sensitises the heart to rhythm disturbances caused by adrenaline.

Laboratory tests suggested that a newer, related drug, isoflurane, might be safer than halothane. Isoflurane has been used for long time in USA and has recently become available in the UK. It gives a more rapid onset of anaesthesia compared with halothane. Isoflurane also has benefits for the clinicians using it. Inevitably some of the anaesthetic gases will escape to the atmosphere and be inhaled by surgeons, anaesthetists and nursing staff. Almost all isoflurane inhaled is breathed out unchanged. In contrast about 20% of inhaled halothane is broken down in the liver. Some of the breakdown products may be harmful.

To investigate whether one anaesthetic is safer than the other, a large multi-centre trial was carried out involving thirty-five clinics in seven countries. Each time a horse was anaesthetised, the anaesthetic agent was chosen at random. The researchers thought that they would need to follow 12,000 anaesthetics to have sufficient anaesthetic-related deaths to be able to tell whether there was a significant difference in safety between the two drugs. As it happened, the death rate was higher than expected and only 8242 horse anaesthesias were needed.

Inhaled anaesthetics are commonly used to maintain anaesthesia.

One hundred and thirty four deaths occurred in the 8242 horse anaesthetics included in the study. Cardiac arrest was the main cause of death, accounting for nearly a third of the deaths. Fractures occurring during recovery from the anaesthetic were the second most common cause of death.

Overall the researchers found no advantage to either drug. But they did find that isoflurane had benefits over halothane in certain circumstances. The death rate was significantly lower in young horses (2-5 year old) anaesthetised with isoflurane. Statistical analysis of the results suggested that for every 208 horses in the 2-5 year age group that were anaesthetised, one less would die if isoflurane were used as the anaesthetic agent instead of halothane.

Horses were less likely to die from cardiac arrest if they were anaesthetised with isoflurane than if they were anaesthetised with halothane.

So although there is no overall benefit to using isoflurane, its use could be considered in young horses, or in high risk cases.

*GM Johnston, JK Eastment, PM Taylor, JLN Wood.
The confidential enquiry into perioperative equine fatalities (CEPEF): mortality results of phases 1 and 2. Vet. Anaesth. Analg. (2002) 29, 159 - 170

Reference.

Is isoflurane safer than halothane in equine anaesthesia? Results from a prospective multicentre randomised controlled trial.
GM Johnston, JK Eastment, PM Taylor, JLN Wood.
Equine Veterinary Journal (2004) 36, 64 - 71.

Effects of atropine eye drops.

Atropine eye drops should be used only when necessary and not on a regular basis, to reduce the risk of side effects, according to recent research.

The pupil is the hole in the iris through which light passes into the eye. In horses it is a horizontal slit, unlike the round pupil of humans and dogs. Its function is to control the amount of light entering the eye. In bright conditions the pupil constricts (closes) to prevent excessive light entering and damaging the retina, the light sensitive cells at the back of the eye. Conversely, in dull conditions the pupil dilates (opens) to allow as much light as possible into the eye.

The size of the pupil is controlled by muscles in the iris that either constrict or dilate the pupil. Dilation (opening) of the pupil is achieved by contracting the iris dilator muscles. These muscles are stimulated by sympathetic (alpha-1 adrenergic) nerves. The sympathetic nervous system is responsible for the animal's fight or flight preservation responses. The pupil constricts when the iris sphincter muscles contract. These muscles are stimulated by para-sympathetic nerves.

It may be necessary to dilate the pupil to allow a full examination of the eye, or as part of the treatment for certain eye diseases. Inflammation of the iris causes constriction of the pupil. As well as being painful, it may cause further damage within the eye. The inflamed iris becomes sticky and may adhere to itself or to the lens. This can lead to permanent damage - a common consequence of recurrent uveitis (or periodic ophthalmia).

Drugs that mimic the action of the sympathetic nerves are known as sympatho-mimetics. One such drug is phenylephrine, which is used in other species to dilate the pupil, but unfortunately it is not very effective in horses. The only real option in horses is to use atropine, which blocks the parasympathetic nerves. However there are worries that, even when applied topically to the eye, atropine can have more generalised effects on the horse. Most significant is the risk that it may affect gut motility and cause colic.

Atropine is used to dilate the pupil to allow a full examination of the eye, or as part of a treatment regime.

Dr Brian Gilger and his colleagues at North Carolina State University have been investigating the duration of effect of a single dose of atropine on the eye of normal horses.

They used thirty-two horses of a range of ages and breeds for the study. A preliminary examination determined that all horses had normal eyes. The scientists used electronic callipers to measure the vertical diameter of the pupils (VPD) at their widest part. Then they gave a single dose of atropine (2mg in a 1% solution) into the right eye of each horse. This concentration of atropine is one commonly used for treatment of eye disease. They monitored the VPD in both treated an untreated eyes daily for two weeks.

The research team found that, in normal horses, even a single application of atropine affects the pupil diameter for at least two weeks. They also noticed that females and Arabians tended to be more sensitive to the effects of atropine. On several occasions during the trial the average VPD was greater in the treated eye in Arabians than in other breeds, and in females in geldings.

The scientists advise that when atropine is used as part of the treatment regime for eye problems the frequency of treatment should be determined according to its effect, rather than being given as a regular dose once or twice a day.

Reference:

The effect of topical administration of atropine sulfate on the normal equine pupil: influence of age, breed and gender.
JL Davis, T Stewart, E Brazik, BC Gilger.
Veterinary Ophthalmology (2003) 6, 329-332

Do microchips migrate?

Microchips do not migrate if implanted into the middle of the nuchal ligament in horses, according to research carried out in Texas.

It is important to be able to confirm a horse's identity, to prevent substitution of horses in competitions, to reduce the risk of theft and to be able to prove ownership. Various methods are used. Standardised diagrammatic sketches have been developed, which describe the permanent features of the horse such as white marks, whorls and scars. Visible identification marks include freeze brands, and hoof brands. In certain breeds hot iron brands are used. Microchips are becoming popular means of identifying various animals including horses. They have been adopted as the preferred means of confirming the identity of racing Thoroughbred horses in the UK.

The microchip is a small device, the size of a grain of rice. Each one consists of an integrated circuit, programmed with a unique number, and sealed in glass. The glass is covered with special coating that allows cells to attach to it. This may help hold the microchip in place.

The unique number can be read using a scanner. This emits low frequency radio waves, which activate the integrated circuit, causing it to transmit the number, which is picked up and read by the scanner. Each chip can be read over 1 million times before wearing out.

In 1999 it became a condition of entry to the general studbook for Thoroughbreds in the UK that they have a microchip implanted. Since then, an average of 14,000 - 15,000 foals has been registered each year. According to a spokesman for Weatherbys, who coordinate the microchipping scheme, problems with the chips have been infrequent. Problems occur in less than 0.1% of cases - usually due to the chip being lost during implantation. Any chips found in abnormal positions are usually attributed to the difficulty of implanting chips into foals that are difficult to restrain.

Nevertheless, concerns have been raised about the possibility that chips might migrate. If the chip moves from the site of implantation it is more difficult to detect. It may even not be found when the animal is scanned, thus reducing its value as a means of identification.

In horses, the microchip is usually implanted midway between the poll and the withers, into the middle of the nuchal ligament. The nuchal ligament is the tough fibrous band that runs in the upper third of the crest from the head to the withers and helps support the weight of the head. It is generally recommended that the chip be placed from the left-hand side.

Researchers at the Texas A&M University College of Veterinary Medicine have been conducting a study to assess whether microchips migrate after being implanted into horses, donkeys and mules.

Firstly they scanned a group of twenty horses that had microchips implanted in the middle of the nuchal ligament up to four years previously. Using a microchip scanner they located the chip and noted its position. Then, in a second group of horses, donkeys and mules, they implanted a microchip in the middle of the nuchal ligament on the left side of the neck. They reassessed the position of the microchips between 42 and 67 days later.

In all cases the researchers found that the microchips had not moved from their original site.

The researchers explained that when chips were first used in the USA many owners and vets preferred to insert them into the triangle area at the side of the neck commonly used for injections. This might explain why some chips had appeared to move.

The researchers conclude that microchips, implanted midway between the poll and withers, may provide a useful way of identifying horses.

Reference:

Evaluation of microchip migration in horses, donkeys, and mules.
FJ Stein, SC Geller, JC Carter.
J Am Vet Med Assoc. (2003) 223, 1316 - 1319

Dehydration affects hoof keratin.

Water plays an important role in maintaining the structure and characteristics of keratin, the major protein of hoof horn, according to research carried out in Cambridge, England.

Melinda Duer and Nicky McDougal at Cambridge University`s Department of Chemistry, have been working with Rachel Murray at the Animal Health Trust in Newmarket. The work has revealed new information about the molecular characteristics of keratin, which has important implications for the material properties of the horse's hoof.

The investigation used nuclear magnetic resonance (NMR) - a technique that can provide information on molecular structure. The substance under investigation, in this case hoof horn keratin, is placed in a strong magnetic field. Short bursts of radio waves are sent through it, which stimulate the molecules and cause a release of tiny but detectable electromagnetic signals. The signals emitted by the sample are recorded. Different molecules and groups of atoms have characteristic patterns of emitted radiation.

Keratin in hoof horn occurs in two basic forms: a well organised structure (an “alpha-helix”) in the microfibrils, and an amorphous matrix that surrounds the microfibrils.

The scientists took horn from an apparently normal hind foot of a Caspian horse. They used the outer layer of the horn, the “stratum externum”, from the toe region. The horn was ground to a fine powder before recording its NMR characteristics. Samples were examined before and after being dried in a vacuum dessicator for 28 days.

By analysing the NMR spectra recorded from the normal hoof the research team found evidence for disulphide links between cysteine residues. (Cysteine is a sulphur-containing amino acid, one of the

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building blocks that make up the much larger keratin molecule.) This was interesting because previous work has suggested that such links contribute to the stability of the amorphous matrix component of equine hoof keratin.

There were differences in the NMR spectra recorded from the desiccated and normal samples of hoof horn. The researchers interpret the changes as indicating that a significant number of the disulphide bonds between the cysteine molecules had been broken down by dehydration. There was more evidence for this as the recorded pattern suggested less of the keratin was in the tight alpha-helix form in the dehydrated sample.

In a further study, they showed that the side chains of the keratin molecule were less mobile when dehydrated. The hoof itself appears to become more rigid as it becomes drier. This may be due to the loss of mobility of the side chains. The researchers suggest that the mobility of the keratin side chains may play an important role in dissipating the stresses placed on the hoof.

Another part of the research demonstrated at least three types of site within the keratin molecule where water could attach.

So, the structure and properties of the hoof horn are highly influenced by the moisture content. Dehydration is associated with disruption of disulphide bonds between cysteine residues in the keratin causing a breakdown of the helical structure of the keratin. The side chains of the keratin molecule become less mobile, which may make the hoof more rigid and less able to absorb stresses.

Dehydration is associated with disruption of disulphide bonds between cysteine residues in the keratin causing a breakdown of the helical structure of the keratin. The side chains of the keratin molecule become less mobile, which may make the hoof more rigid and less able to absorb stresses.

Reference:

A solid-state NMR study of the structure and molecular mobility of alpha-keratin. Melinda J Duer, Nicky McDougal, Rachel C Murray.
Phys Chem Chem Phys (2003) 5, 2894 - 2899

Laminitis: nutritional aspects.

Dr Pat Harris, a leading authority on equine nutrition, discussed the nutritional aspects of laminitis at a recent meeting of the British Equine Veterinary Association.

She explained that the horse is designed for a forage-based diet. Today for our convenience, horses tend to be kept inside and given high-energy food because of the requirements for work. They are often fed on pasture that is not ideally suited to them. Horses are often greedy and will eat sweet feed if you offer it to them.

Depending on the size of the meal, especially if you feed your horse cereal based meals, some of the starch may escape digestion in the small intestine and pass unchanged to the large intestine where it can be rapidly fermented. This is particularly the case if you feed large infrequent meals resulting in cyclic changes in the microbial population of the hindgut.

Dr Harris pointed out that the starch in oats, the grain traditionally used to feed horses, is also the most efficiently digested in the small intestine, without further processing of the cereal. About 85% can be digested before the hindgut, if not fed in excessive amounts. In contrast, only around 20% of the starch in barley is digested in the small intestine.

Cooking and processing can however affect the digestibility of the grain starch. For example whilst only about 30%of maize (corn) starch fed as the whole grain may be digested in the small intestine, if it is cooked before feeding, up to around 90% may be now digested before the hindgut.

Does obesity play a role in laminitis? Certainly, increased weight bearing may add to the problem. Dr Harris also explained that she had been working with colleagues at the Virginia Tech. in the USA. They have been looking at the animal`s ability to cope with a load of glucose and the effect when you give it insulin. They found that obese horses tend to be more resistant to the effects of insulin, (and some believe ponies in general are more resistant). Feeding diets rich in sugar and starch also appeared to increase the insulin resistance. (Insulin resistance is thought to increase the risk of developing laminitis.)

So what can we do to help reduce the risk of laminitis? Dr Harris recommended that owners should monitor the condition score and weight of their animals regularly. Avoid obesity, especially in ponies. But it is important not to suddenly reduce the weight because of the risk of hyper-lipaemia. A fibre-based diet should be considered for obese animals and those prone to laminitis. A lot of horses can manage very well on a diet based on meadow hay, provided the overall intake of mineral and vitamin is adequate. (This often means that a vitamin and mineral supplement is required.) Avoiding grain-based diets rich in starch and sugar may help to reduce the risk of developing insulin resistance.

She emphasised the importance of feeding small grain meals - even to race horses. No more than 0.5kg/100kg body weight of oats or processed grain should be fed in each meal. If more energy is required in the diet it is better to increase the number of daily feeds and not their size.

Currently there is much interest in fructans as a cause of laminitis, but high levels of other water soluble carbo-hydrates, including simple sugars, are also likely to be involved. Dr Harris explained that fructans are storage carbohydrates composed of one molecule of glucose with more than one fructose molecule. They are found particularly in temperate pasture grasses but also in other plants such as dandelions. Horses do not appear to have the enzymes needed to digest fructans in the small intestine. So the fructans pass into the hindgut unchanged.

Fructans, as with starch that reaches the hind gut, undergoes relatively rapid fermentation. Marked changes to the environment within the hindgut can

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therefore result. Lactic acid levels rise, making the gut contents more acidic and disturbing the balance of bacteria and micro-organisms.

This change in the environment within the large intestine leads to the accumulation of various factors, which may be responsible for triggering laminitis. As the hind gut contents become more acidic, bacteria that can survive under those conditions increase dramatically in number; those that cannot, die. The overgrowth of organisms such as *Streptococcus bovis,* it has been suggested, leads to the release of MMP activators (MMPs are now thought to be involved in certain changes in the hoof that may lead to laminitis); while those bacteria that cannot survive the acidic conditions release factors such as endotoxins.

The increased acidity alters the permeability of the intestine, making it easier for these factors to be absorbed - which may have further effects, in particular within the feet (not necessarily directly), triggering the development of laminitis.

Dr Harris explained that the fructan content of the pasture is affected by a number of factors, including light intensity, ambient temperature, stage of growth, residual fructan accumulation from the previous day and past plus present management regimens.

Fructans are found in significantly greater amounts in the stem than in the leaves, hence the importance of pasture management. They are present in highest concentration at times of restricted growth but continued photosynthesis, such as during a drought. The amount of fructan present in the grass also varies during the day. Generally there is less at night and early in the morning.

Certain grasses, such as timothy tend to have larger fructan molecules. These may be broken down more slowly in the hindgut and may therefore be safer than other grasses that contain smaller molecules. Levels of 14-20% fructan in fresh grass are not uncommon.

Measures that could be taken to reduce the risk of fructan-induced laminitis include:

- Choose pasture that is regularly grazed or cut (the grass stems tend to have high fructan content) and contains species such as timothy that produce low levels of fructans.
- Turn horses onto pasture late at night and bring them in before mid-morning, so they are grazing when the fructan content is likely to be lowest.
- Restrict grazing in spring and autumn when the fructan and water soluble carbohydrate levels are high.
- Don't use stubble grazing (i.e. after it has been cut for hay) - because the stems are likely to have a high fructan content.
- Don't turn horses onto pasture that has been exposed to frost and bright sunlight. (The sunlight produces energy, which the grass cannot use for growth because of the cold, and so it is stored as fructan).
- Consider zero grazing (whilst providing the horse with suitable forage and vitamin / mineral supplementation) if it is essential that the horse ingests minimal levels of fructans.

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