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Equine Proceedings

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Strangles: Portrait of an Equine Plague
Is there anything new?

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Strangles is a highly contagious disease, primarily of the equine upper respiratory tract, caused by *Streptococcus equi* subsp *equi.* It is categorized as a gram-positive β hemolytic cocci within Lancefield group C and has been the bane of horses for centuries. First reported by Jordanus Ruffus in 1251 it has remained relatively unchanged (genetically) and remains one of the most commonly diagnosed contagious diseases of horses worldwide. There is good evidence that *S.equi* evolved from a common ancestral strain of *S. equi* subsp. *Zooepidemicus.* Recent research has identified key features in the *S.equi* genome, which occurred during its evolution from an ancestral strain of *S.equi* spp *zooepidemicus*, which may enhance its ability to evade host innate immune responses and rapidly multiply in the diffuse tonsillare tissue of horses. The microbe can survive in water sources for over a month but recurrent infections are primarily due to asymptomatic carriers enabling *S. equi* to persist for years and continue to infect naïve horses. The economic impact of strangles on the equine industry is significant due to the high prevalence of the disease with estimates suggesting 30% of upper airway infections in horses worldwide are attributable to *S.equi*.

Natural infection results from direct contact with either an infected or asymptomatic carrier horse that has maintained the organism within chondroids in the guttural pouches. Fomite transmission may also occur when environmental conditions are suitable for maintaining the organism (nasal secretions) on contaminated clothing or cleaning gear. Typical morbidity rates will approach 100% in some cases with reported complications of < 10% of affected individuals. Recovering horses may continue to shed the organism for at least 6 weeks following clinical resolution and this is a major risk factor for disease transmission to naïve horses. Following recovery from disease, approximately 75% of horses develop solid immunity to further *S.equi* infection.

Key Features of *S.equi* Pathogenesis include:

- Shedding is not initiated until 1 or 2 days after the onset of pyrexia. New cases should be isolated immediately.
- Nasal shedding persists for 2 or 3 weeks in most horses. Persistent guttural pouch infection may result in shedding for years.
- Field and experimental data support the conclusion that disease severity is dependent on challenge load and duration.
  (Sweeney C, et al. ACVIM consensus statement. J Vet Intern Med 2005;19:123)

Clinically, *S. equi* infection is most common in horses less than 5 yrs of age as disease is very uncommon in young foals (< 3 months of age) born to mares previously exposed to the bacterium. Adequate passive transfer (colostral antibodies) will confer protection during the first several months of life. Milk from mares that have recovered from *S.equi* contains IgA and the IgG- isotype, IgGb that are likely protective for suckling foals. Strangles is characterized by an abrupt onset of fever (>101.5 F), mucopurulent nasal discharge and abscess formation in the submandibular and retropharyngeal lymph nodes. Pharyngitis will cause dysphagia, and affected horses may become anorexic and have signs of depression and listlessness. Mature abscesses typically rupture externally although retropharyngeal lymph nodes may ultimately rupture and potentially drain into the guttural pouches causing empyema. While generally limited to the lymph nodes of the upper airway, *S. equi* can spread (hematogenous) to distant sites including lungs, mesenteric lnn, and brain. Hematological abnormalities include leukocytosis with a neutrophil count of 25,000 cells/μL and a plasma fibrinogen concentration > 600 mg/dL. Nasal shedding of S equi usually begins 2 to 3 days after onset of fever and persists for 2 to 3 weeks in most animals. Some animals that remain asymptomatic and may have pre- existing immunity never exhibit detectable shedding. In others, shedding may persist much longer should infection persist in the guttural pouch or the sinus.

Systemic and mucosal immune responses are evident 2 to 3 weeks after infection and coincide with mucosal clearance.

Environmental persistence of S equi

S equi remains viable in water for 4 to 6 weeks, but not in feces or soil. Despite older literature claiming extended survival in the laboratory setting, recent studies using real world scenarios showed rapid death (1-3 days) of the bacteria on fencing and soil. S equi is sensitive to bacteriocins from environmental bacteria and does not readily survive in the presence of other soil borne flora.

Diagnostic Testing

Along with clinical signs and hematologic abnormalities, definitive diagnosis is based on aerobic culture of nasal secretions, preferably obtained from the guttural pouch or a pharyngeal wash or cytology brush. Detection of *S.equi* DNA utilizing PCR testing has proven beneficial. However, PCR cannot distinguish between dead or live organisms and a positive result must be considered presumptive until confirmed by bacterial culture. Quantitative PCR or other PCR formats are approximately three times more sensitive than culture. Generally, use of PCR testing of an endoscopically guided guttural pouch lavage for detection of S equi in subclinically infected carrier animals is ideal.

SeM Antibody Titer: Antibody titers to SeM minus its carboxy terminus (currently commercially available in the United States and Europe) peak about 5 weeks after exposure and remain high for at *least* 6 months. Given the possibility that antibodies directed against SzM of S *zooepidemicus* could cross-react with SeM., incubation of sera with heat-killed *S. zooepidemicus* to remove cross-reactive antibodies should be performed to enhance test specificity. SeM specific titers cannot be used to determine carrier status and a single determinate is not a measure of active infection. Titers will wane over time and horses that received antibiotic therapy during an outbreak appear to have a reduced immune response and may remain susceptible to reinfection.

Treatment

Management of horses suffering from strangles can be most challenging as morbidity in a naïve population is very high. Horses with overt clinical signs generally do not present a diagnostic dilemma. However, other horses on the premises should be very closely monitored and strict biosecurity measures implemented. Treatment strategies vary and generally depend on the stage and severity of the disease. Opinion as to whether or not to implement antibiotic therapy is controversial as the majority of cases will require only supportive therapy. If antibiotic treatment is indicated, *S.equi* is consistently sensitive to the B-lactam class (penicillins and cephalosporins). Other classes include the macrolides and trimethoprim-sulfadiazine, keeping in mind that antibiograms may not translate into in vivo efficacy.

I. Horses either exposed or with very early clinical signs (fever spike, anorexia); these horses should be treated with penicillin (22,000U/kg) according to manufacturer's instructions for a minimum of 5 days. If there is no clinical progression, antibiotic therapy may be discontinued.
II. Horses with lymph node abscessation; administration of penicillin in these cases may slow the progression and ultimate resolution of disease. Therapy should be directed toward enhancing maturation and drainage of the abscesses. The administration of NSAID's may improve the horse's demeanor and encourage eating and drinking.
III. Horses with complications; severe cases of *S.equi* infection generally require aggressive supportive therapy such a s IV fluids and penicillin.

Antibiotics may be indicated in some cases, although these are always at the discretion of the attending veterinarian including;

- acutely infected animals with very high fever and malaise prior to abscess formation
- horses with profound lymphadenopathy and respiratory distress
- horses with metastatic abscessation
- cases of purpura hemorrhagica treated with corticosteroids

- guttural pouch infections treated locally and systemically to eliminate the carrier state.
- Antibiotics should NOT be used as a preventative in animals that may have been exposed. Overuse of antibiotics, promotes resistance, provides a false sense of security, and convalescent immune responses may not be induced.

A recent study involving an outbreak on a large Standardbred farm was controlled by the use of CCFA (ceftiofur crystalline free acid). Other than this report of long acting ceftiofur use during a large strangles outbreak improving treatment compliance and resulting in final resolution, there are no data on its efficacy *in vivo*. The interested reader is referred to the 2005 ACVIM consensus statement for *Streptococcus equi* Infections in horses at http://www.acvim.org for a detailed description of treatment options.

Prophylaxis from *S.equi* infection

Management and biosecurity measures are critical for prevention and spread of *S.equi* infections. Segregation of new arrivals along with any history of recent respiratory disease carefully investigated. New arrivals should have a pharyngeal wash or guttural pouch lavage to obtain samples for PCR analysis. In cases where exposure to *S.equi* has possibly occurred it is recommended that serum titers against SeM protein be monitored. A recent study suggests the current recommendation by laboratories that provide SeM ELISA is not to vaccinate when the titer is $\geq$ 1:3,200 and not the previously recommended titer of 1:1,600. (Boyle A. Detection of S.equi in wash samples and SEM titers following strangles outbreaks. Proceeding of ACVIM forum. 2012)

Vaccination is indicated where disease transmission either has or is likely to occur. Subunit and attenuated live vaccines are commercially available for intramuscular and intranasal administration respectively. Recent studies have indicated commercially available attenuated live vaccine may be administered *Per Os*.

References available on request.

Update on Infectious Equine Respiratory Disease

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Brief immunology overview of the equine respiratory system
-Respiratory Immunoglobulins, Alveolar macrophages, Lymphoid Tissues
-General immunological status of the lung
-Introduction of infectious agents and the acute inflammatory response

The overall importance of immunology in respiratory disease cannot be underestimated. It allows for an understanding of both the development of disease and provides a framework by which it may be prevented. Additionally, the clinical manifestations of respiratory disease are not due solely to the invading pathogen or antigenic stimulus but also from0 the host's immunological response to the offending agent. Clearly, prevention is far more effective than any treatment that may be administered following the development of disease.

The equine respiratory system handles about 100,000 liters of air during a 24 hour period. Initial filtering of this air is performed by the nasal passages but many particles (up to 10 microns) will pass through these defenses and impact the upper airway (trachea). Smaller particles (1-5 microns) including bacteria and viruses, will reach the lower airway and contact a host of cellular defense mechanisms. Environmental factors, including transport, housing, hay quality etc. may greatly increase respirable debris and exposure to infectious agents. Thus, the respiratory tract is constantly exposed to potential antigenic material and infectious agents. Under 'normal' conditions the defense mechanisms remove these particles prior to development of infection or an inflammatory response.

For respiratory disease to occur, 3 criteria necessary:
1. Host
2. An agent (infectious, toxic...)
3. Appropriate environment (including both where the animal lives and local conditions within respiratory tract)

Disease is often the result of interaction of one or more agents (virus, bacteria) in a stressed horse (compromised immune response) in an adverse environment.

Incidence and pathogens of Equine Respiratory Disease
Viral diseases involving the respiratory tract of horses have been identified as one of the most common problems encountered by equine veterinarians. Equine herpesvirus types 1 and 4 (recently EHV-2 and 5), and equine influenza are among the most frequently recognized viral pathogens. Several studies (dependent upon country, age of horses, surveillance methods and diagnostic molecular tools) cite an incidence of 1.5 to 26.4% with EHV-4 as the most common viral pathogen detected in horses with upper respiratory tract disease. Infections with influenza virus and EHV-4 have demonstrated the ability to significantly decrease mucociliary clearance for up to 30 days. Horses typically acquire bacterial pneumonia by aspiration of microorganisms that normally inhabit the upper airway. By far, the most common pathogen isolated from horses with pneumonia is *Streptococcus equi* subspecies *zooepidemicus.*

Regardless of the mechanism predisposing horses to bacterial colonization (virus + stress/compromised immune response) the inflammatory response triggered by microbial invasion results in neutrophilic infiltration and the subsequent release of inflammatory mediators that ultimately damage the airway/capillary epithelium resulting in pneumonia.

Equine Influenza Virus

Clinical relevance

EIV is a common equine respiratory virus, and is responsible for outbreaks in all horse populations. EIV is an orthomyxovirus, and is categorized according to its hemagglutinin (HA) and neuraminidase (NA) proteins. The most common EIV substype is the H3N8 strain. EIV, as with human and other influenza viruses, changes these epitopes according to host immune pressure. The resulting "antigenic drift" can make it difficult for vaccine manufacturers and the horse's natural immunity to keep pace with the virus.

Epidemiology

Although all equine age groups are susceptible to EIV, most foals are protected by maternal antibodies until 5-6 months of age. Older horses have at least partial immunity due to natural exposure or vaccination. Fortunately for the virus, and unfortunately for the host, EIV has an extremely short incubation period and is shed within two days of exposure. This may well precede any clinical recognition of disease. Because EIV can cause protracted coughing in the horse, it is readily spread in aerosols.

Pathogenesis

EIV is frequently designated as a pathogen of the upper respiratory tract, but the most significant pathologic lesions appear in the lower respiratory tract. The virus has a tropism for respiratory epithelium, which it destroys, leading to severe impairment of mucociliary clearance. Necrosis of the epithelium also paves the way for secondary bacterial invaders such as *S. equi* subsp *zooepidemicus*, leading to pneumonia. In managing the convalescent horse, it is important to remember that it takes a minimum of 3 weeks to repair the respiratory epithelium.

Diagnosis

Although the clinician may have strong suspicion of EIV based on history and clinical signs, more rigorous diagnostic methods are necessary to distinguish this disease from other equine viral respiratory infections. The Directigen™ Flu-A test (Becton Dickinson) is a stall-side assay to detect the presence of influenza A virus, but does not characterize the virus further. Similarly, paired serology will confirm an influenza virus infection, but virus isolation is important in helping to determine the epidemic variant, and thus help to formulate future vaccines. Virus isolation is markedly improved if proper viral transport medium is used for sending the sample to the lab. Bacterial overgrowth can otherwise destroy the sample. PCR detection is also available from diagnostic laboratories as a rapid-detection method for identifying EIV H3N8 as well as other EIV subtypes. Clinical samples for PCR assays are obtained from nasopharyngeal swabs and submitted in transport medium, similar to what is done with virus isolation samples. PCR has the advantage of increased sensitivity compared to virus isolation methods.

<u>Diagnostic Testing for Influenza: summary</u>

Virus Isolation, Rapid Cell Culture, Immunofluorescence, Rapid Influenza Diagnostic Test (RIDT), ELISA , RT-PCR, SRH, Hemagglutinin Inhibition (HI)

<u>Rapid Influenza Diagnostic Test</u>

1. Stall side testing
2. Tests for Type A and Type B Influenza
3. Very Sensitive – picks up influenza DNA
4. Uses nasal secretions
5. High rate of false negatives in some tests
6. 15 minutes for results
7. Does not distinguish influenza strain type
8. Does not measure viral load

Reverse transcriptase polymerase chain reaction

1. Tests for viral genetic material
2. Nasal or throat swabs
3. Some false negatives
4. Can distinguish between Type A&B
5. Very fast results <24 hours

Enzyme Linked Immunosorbent Assay (ELISA)

1. Tests for antibodies
2. Usually tests for the Hemagglutinin portion of the influenza virus
3. Can be developed to test for specific portions of influenza virus and not the whole epitope
4. Serologic test
5. Does not quantify viral load
6. Cannot be used for subtyping
7. Correlates well with HI testing

Virus Culture

1. Gold Standard for diagnosing influenza
2. Serologic test
3. 3-10 days for results
4. Identifies which virus and which strains are present
5. Quantifies viral load
6. Used by OIE for genetic influenza chart

Single Radial Hemolysis (SRH)

1. Serologic test
2. Sensitive, specific and reliable
3. Identifies antibodies – usually IgG
4. More commonly used in human influenza testing
5. Indicates seroprotection according to hemolysis ring

Hemagglutinin Inhibition (HI)

1. Serologic test
2. Provides titer levels (1:110, 1:330, etc)
3. Titer levels correlate with level of protection against EIV
4. Detects antibodies to HA
5. Commonly used in correlation with challenge studies

Influenza Challenge Studies

- Cross Reactivity Challenge
- Active Challenge
  - Experimental – controlled
  - Real Life – not controlled

Influenza Cross Reactivity Challenge

1. Used to evaluate/screen efficacy of EIV strains
2. Serologic test performed in the laboratory
3. Can test against multiple EIV strains at one time
4. Cost effective – unlimited number or horses
5. Used by the OIE to determine relevant EIV strains *****
6. Does not carry the risk of introducing the virus to the equine population

7. Provides titer levels against specific strains which can correlate with protection
8. Does not provide clinical signs associated with infection

Influenza Active Challenge

1. Controlled or real life
2. Controlled /experimental usually done with one challenge strain of EIV
3. Used for licensing of EIV vaccines
4. Time consuming and expensive (>250K)
5. Must be performed in BL2 certified facilities
6. Number of challenge horses is limited
7. Severe challenge – not realistic

Treatment

The only available and effective treatment is excellent supportive care and rest for a minimum of 3 weeks.

Vaccination

Unfortunately, EIV vaccines are not able to fully keep pace with the continual changes in antigenic strains (equine-antigenic drift). This differs from human influenza vaccines (antigenic shift), which are updated on an annual basis based on immunosurveillance data. Several EIV vaccines are available, including inactivated parenteral, modified-live intranasal, and a vector-based vaccines. The modified-live and vector-based vaccines appear to be most efficacious. Vaccination should start when maternal antibodies have waned at 5-6 months, with boosters given 3-4 weeks later and again in 3-4 months. Vaccination should be boostered every 6 months *(At a minimum for performance horses)* in horses that are frequently exposed to other horses.

Equine herpesvirus

The common name for equine herpesvirus infection is equine rhinopneumonitis, a designation that, like equine influenza, indicates that the disease is not limited to the upper respiratory tract. Although both EHV-1 and EHV-4 can cause rhinopneumonitis, EHV-4 is more commonly implicated. However, EHV-1 is notorious for its ability to cause abortion and neurologic disease in addition to the respiratory syndrome.

Epidemiology

Epizootics of respiratory disease can be caused by EHV and it is a more ubiquitious equine respiratory pathogen than EIV. However, EHV remains latent in infected horses, residing in the trigeminal ganglia or in T-lymphocytes in the respiratory lymph nodes. Thus, EHV creates an enormous population of carrier animals, ensuring that equine rhinopneumonitis will remain endemic throughout the horse population. Although the majority of adult horses develop a strong immune response to EHV-1 and -4, they continue to spread the virus among naïve populations, especially young horses that travel.

Pathogenesis

Both EHV-1 and EHV-4 are naturally acquired via respiratory transmission. As with EIV, EHV is readily spread in aerosols expressed by persistently coughing horses. EVH can also be easily spread by fomites. The EHV incubation period is 2-5 days, followed by viral shedding for up to two weeks. Respiratory herpesviruses cause destruction of respiratory epithelial cells, enabling secondary bacterial infection to occur. Primary viral pneumonia caused by EHV is also possible. After the virus replicates in the respiratory epithelium, the animal becomes viremic. This is the pathogenesis for EHV neurologic disease or abortion. EHV-4 is restricted to the respiratory epithelium. EHV-1, on the other hand, is endotheliotropic, with a predilection for respiratory, adrenal, thyroid, placental, and CNS vascular endothelium. This explains its ability to cause both abortion and neurologic disease.

Diagnosis

The diagnostic approach is similar to that for EIV, although there is not yet an available EHV stall-side test. A commercial PCR diagnostic test for EHV-1 and EHV-4 (RealPCR™, Iddex) is available for evaluation of samples

submitted as whole blood or nasal swabs. Because presence of EHV in nasal secretions and circulating leukocytes may not overlap, testing of both specimens is recommended to achieve optimum diagnostic sensitivity. The PCR test has acquired new importance in light of the increase in recent years in myeloencephalopathy caused by neuropathic EHV-1. Molecular PCR assays are capable of identifying the EHV-1 D_{752} genotype associated with neurologic cases and distinguishing it from the EHV-1 N_{752} genotype more commonly found in EHV-1 abortions. The commercial PCR test is reportedly capable of identifying the D_{752} mutant strain. It should be noted that a small percentage of myeloencephalopathy cases are caused by EHV-1 strains without the D_{752} neuropathogenic marker. The clinical significance of this new diagnostic technology is arguable, but it may be useful in determining increased risk of EHV neurologic disease and implementing appropriate biosecurity.

Treatment

The only practical treatment for EHV clinical disease is supportive care and excellent nursing. As with EIV, horses must be allowed at least 3 weeks of rest before returning to work.

Prevention and Treatment Strategies

Vaccination against EHV-1 and 4, and equine influenza virus infection remain a cornerstone for the control of equine viral respiratory disease. Inactivated vaccines are the most common type of vaccine in use although modified live and recombinant vaccines are available. The value of inactivated vaccines critically depends on the quality and quantity of viral antigen and the adjuvant utilized. Treatment modalities for equine respiratory disease may involve multiple strategies.

The Application of Acupuncture in Equine Internal Medicine Disorders

Mark V. Crisman, DVM, MS, CVA, Dip ACVIM

Over the past several decades, the demands on equine athletes and performance (racing, eventing, endurance riding) have greatly increased. Therefore, most equine acupuncturists have responded by focusing their practice of TCM on musculoskeletal and gait abnormalities. However, the observance and practice of basic TCM principles has a wide range of applications in many equine internal medical disorders. Overall, western medicine takes a very linear, controlled, problem oriented approach to medical cases carefully dissecting the signalment, history, diagnostic exercise and therapeutic decision making process. Traditional Chinese medicine takes a more 'circular' approach and, like western medicine, seeks to identify the underlying cause of the problem but the exercise is focused on restoring the flow and balance of energy within the body. As my medical practice is based in a Veterinary Teaching Hospital, I have access to all the latest technologies western medicine has to offer (from CT scans and MRI to a complete array of diagnostic and clinicopathological testing services). This "Western" information, along with a basic understanding of TCM practices and principles has allowed me to develop a more "integrative" approach to the practice of veterinary medicine and I truly believe this to be the ideal solution to helping our patients. Integrative medicine is broadly defined as "practicing medicine in a way that selectively incorporates elements of complementary medicine into comprehensive treatment plans alongside solidly orthodox methods of diagnosis and treatment" (Rees, 2001). Regardless of your approach, it is important to maintain/observe the perspective of *seeing the relationship of the symptom(s) to the whole body*.

My overall approach and application of TCM to equine medical cases is derived from textbooks, journals and discussions with colleagues. Generally, a practitioner can get good results using empirical points for various internal medicine problems. The use of these points should not be undervalued as their description and evolution has occurred over thousands of years of careful observation. Additionally, empirical points serve as a good foundation or basis while the practitioner develops knowledge and experience with TCM.

Gastrointestinal Condition Acupuncture has been widely used to treat various gastrointestinal (GI) disorders in horses. Numerous studies in several species including humans, dogs, horses and pigs have documented the effect of acupuncture on the general physiology and function of the GI tract. Studies have objectively evaluated acid secretion, neurohormonal alterations and gastrointestinal motility. However, we must keep in mind the extreme variation in the structure and function of the GI tract among species and any extrapolations must be made with caution. Additionally, successful and reliable models for the induction of colic in conscious horses have been problematic. Several recent studies by Merritt &Xie and Skarda have evaluated a colic-model in horses whereby the duodenum, large intestine or rectum are distended by a balloon inserted through an indwelling cannula. The method results in a reproducible and controllable means for inducing colic (abdominal pain) in conscious horses. The objective of these studies was to evaluate the analgesic potential of various acupuncture treatments following controlled balloon distention. While the results of some of these studies were equivocal, progress is being made to objectively evaluate the effects of acupuncture in horses with colic. Another study by East evaluated the effects of acupuncture on 76 colic cases presented to a referral clinic over a 3 year period (1999- 2001).4 Chronic colic, acute colic, post-operative ileus and enterocolitis cases were included in the study group. A variety of breeds and ages ranging from 2 to 25 years were represented. Clinical success of the acupuncture treatment was determined by return of ausculatable borborygmi, cessation of reflux, cessation of colic, return of appetite, ultrasonographic evidence of motility and defecation. Negative outcomes comprised 25/76 horses and included strictures, neoplasia, torsions, intestinal adhesions and endotoxic shock. Positive outcomes included 51/76 horses and involved spasmodic colics, tympany, post-operative ileus, small intestinal dilation and enterocolitis. Initial findings of this retrospective study are supportive of including acupuncture for the treatment of intestinal ileus and chronic colic.

Numerous studies have demonstrated the effectiveness of acupuncture in the treatment of emesis and nausea in humans. One particularly well designed and controlled study by Shen et al was published in *JAMA* in 2000. The

study was a randomized controlled trial with 104 women with high-risk breast cancer. The objective of the study was to compare the effectiveness of electroacupuncture vs. minimal needling and mock electrical stimulation or antiemetic medications alone in controlling emesis among patients undergoing a highly emetogenic chemotherapy regimen. The study clearly demonstrated that electroacupuncture was the most effective method of controlling emesis in these patients.

Acupuncture point prescriptions are indicated for the following disorders:

Large Bowel Impaction (pattern-dry); Dry needle BL 20, 21, 25, ST 36, SP 6, Guan Yuan Shu (BL 26), Bai-hui, GV-1
Esophageal disorders including choke: PC 6, BL 17, ST 36, LI 4, CV 17, 12, 22, ST 41, BL 13 to 16 and BL 23.
Diarrhea (acute): SP 6 &9, LI 11, BL 20, and GV 1 & 14 (never Moxa).
Diarrhea (chronic): BL 20, 21, Bai Hui, SP 6, GV 1, 3 & 14, ST 36, *Jian-wei* (located on right side of neck, 1 cm dorsal to the jugular vein at the junction of the upper and middle 1/3 of the jugular groove). Chapter 23 – The Application of Acupuncture in Equine Internal Medical Disorders 443
Post-operative ileus: BL 21, 25, 27; Outer BL points-2cun lateral to BL 21 (BL 50)BL 25 & 27; Huatuojiaji points-1 cun lateral to dorsal midline at same level as BL 21, 25 & 27, *Baihui*, GV 1, ST 36. Occasionally, I will use EA at BL 21 – BL 21.
Abdominal pain (nonsurgical)- Spasmodic colic (pattern, LI cold): BL 20, 21, 25, SP 4, ST 36, 2, GV 1, *Baihui*.
*NB- caution must always be exercised in using acupuncture to treat colic in horses as it may cause symptomatic relief of clinical signs and delay the decision for surgery in critical cases.

Immunomodulation
Several studies in humans have demonstrated that acupuncture modulates immune responses both by increasing the concentrations of endogenous opioid peptides and enhancing lymphocyte proliferation.1 Current evidence suggests that acupuncture stimulates an increased release of the neuropeptide beta-endorphine. Endorphins will interact with some cytokines (interleukin-10) which will down regulate the inflammatory component while other cytokines may amplify the interaction between neuropeptides, cytokines and acupuncture.2 Other studies have reported that acupuncture activates both cell proliferation and leukocyte production and enhances microbicidal activity via increased antibody, globulin, complement and interferon production.3 Another study by Hahm et al examined the effect of electroacupuncture (EA) at ST 36 on natural killer (NK) cell activity in rats with anterior hypothalamic lesions.4 The study concluded that EA enhances or restores the NK cell activity previously suppressed by an anterior hypothalamic lesion. These studies suggest that acupuncture may exert its actions on both pain and immune processes.

Overall, when considering the goal of balancing *Yin* and *Yang*, there exists an overlap between points which will stimulate or upregulate the immune response and those which will downregulate-sedate or suppress immune function. Conditions indicated for immunostimulation include recurrent infections, any infectious diseases (including EPM, Lyme disease, and viral infections) and immunodeficiency diseases. Many of these conditions may actually reflect a disturbance in the balance of immune function rather than a deficiency of all functions. Appropriate antimicrobial therapy should be used in conjunction with acupuncture.

General immunostimulatory points include: GV 14, LI 4, 11, ST 36, SP 6, BL 23, GB 39, BL 11, 17, 20, and GV 4.

Suppression of the immune system would be indicated in allergic and autoimmune diseases. The most common applications involve allergic skin diseases and respiratory dysfunction (RAO). The most common points for immunosuppression are: BL 23, 47, LI 11, LIV 3, SP 10, CV 6 and GB 20.

Ophthalmic Diseases
Inflammation of the eye is viewed in TCM theory as invasion of exogenous wind heat and upward disturbance of

heat in the liver. Stagnation of *Qi* and Blood occurs in the affected meridian. Conditions with ocular inflammation include keratitis, conjunctivitis and recurrent uveitis- all of which are treated similarly.
Local points: (most commonly used) ST 2, BL 1, BL 2, TH 23, GB 1, *San Jiang*.
Distal points: LI 11 (clears heat, dispel wind), BL 18 (liver association pt), GB 20 (dispels wind), LIV 3 (source point, Shu stream pt), LI 4 (master point for face, clears heat).
Ting points: TH 1, SI 1, BL 67, GB 44.

The following points and anatomical descriptions are referenced in *Handbook on Chinese Veterinary Acupuncture and Moxibustion.*

Recurrent Uveitis (Liver fire); GB-20, BL 1, 2, San Jiang, GB 1 TH 23, LIV 3 *Da-Mai*: on angular v. 1.5 cun ventral to the medial canthus. Bleed 1 cm deep.
San-Jiang: On the angular vein about 1 cun ventral to the medial canthus. Bleed 1 cm deep.
Chui-Jing: In the temporal fossa 1 cun above the zygomatic process of the frontal bone, caudo-ventral insertion 2-6 cm deep.

Corneal Ulcers Regardless of the initiating insult (trauma, bacterial, viral), an ulcer can be treated by "surrounding the dragon" or needling the points directly around the eye; BL 1, TH 23, GB 1,

Respiratory
Several theories have been proposed as to why acupuncture may affect lung function in horses. Acupuncture has been demonstrated to cause a significant increase in sympathetic nerve activity, along with the release of endogenous opioids and catecholamines, all of which may have beneficial effects on airway function. Opioids and catecholamines can inhibit the release of acetylcholine from airway parasympathetic nerves along with relaxation of bronchial smooth muscle.

Infectious respiratory diseases (viral, bacterial) generally result in disturbances in the Lung *Zang Fu* organ system with exogenous pathogenic cold, heat and wind invading through the nasal cavity. Acupoints indicated for general immunostimulation are generally indicated for treatment. Additional points for specific conditions include:

Pharyngitis: LU 5, 7, 11, LI 1, 11, 18, ST 10, PC 6

Laryngeal Hemiplegia; E-stim ST 9…ST 9, LI 18…LI 18, dry needle ST-4

Pneumonia: LI 4, 11, LU 10, GV 14, GB 20, BL 12,13, LU 6, 7 combined with western therapy including antibiotics, NSAIDs and supportive care

Recurrent Airway Obstruction- Equine Asthma can be the result of either an Excess or Deficiency. Similar to asthma in humans- airway hyperresponsiveness (observed both in humans and horses with RAO) may be the result initially of an upregulated immune response but the immunological profile may alter as the condition progresses and becomes more chronic. A recent study investigated the effects of a single acupuncture treatment in horses with severe recurrent airway obstruction.4 They evaluated (pulmonary function measurements) a single acupuncture treatment by an experienced acupuncturist, and a single acupuncture treatment using predetermined points by a veterinarian with no acupuncture training. The authors concluded that acupuncture resulted in no improvement in lung function parameters and that acupuncture should not replace conventional medical treatments. Keep in mind that this was a single acupuncture treatment and lung function was measured at 20 mins and 1, 2, 4 and 24 hours after treatment. Additionally, environmental adjustments (removing dusty hay and straw) were not made. Points to consider when treating RAO include:
Bai hui, BL 13, 23, 26, LU 1& 7, KI 6, ST 36, 40, GV 14, PC 6

Exercise Induced Pulmonary Hemorrhage (EIPH); From a TCM standpoint, this may be due to EITHER excess

Heat in the Lung and/or Stomach (meridian begins on the nares) seen in racehorses in a 'hypermetabolic state' OR a *Yin* Deficiency (primarily kidney) observed in horses that are chronically dry and hot.
BL 13-15, 17, 20, 25, 42-48, LI 4, 20, LU 11, KI 3, 6, GV 5, 7, 9, 14.

Laminitis Laminitis is a vascular disorder in the equine foot that occurs as a result of diseases such as retained placenta, carbohydrate overload, intestinal inflammation and ischemia. Additionally, laminitis may be induced by excessive corticosteroid administration and concussion ('road founder'). Once the blood supply to the laminar corium is disrupted by any mechanism (vasoconstriction, arteriovenous shunting, perivascular edema, microthrombosis) the laminae begin to degenerate and the hoof wall separates from the laminar corium resulting in displacement or rotation of the third phalanx. While there appears to be no unifying mechanism for laminitis from a Western standpoint, we can address meridian imbalances from an Eastern perspective. So, for example, a racehorse that is laminitic from excessive corticosteroid administration may have an excess in the Liver Channel. An aged pony with pituitary dysfunction and chronic laminitis may have Kidney Deficiency.

Ting points are important from both a diagnostic and therapeutic standpoint when addressing laminitis. In acute laminitis, I have found hemoacupuncture (18-20g needle) very helpful. Local points to be needled include ting points TH 1, SI 1, LI 1, PC 9(dry needle). If the rear feet are involved use GB 44, LIV 1, ST 45, and KI 1. Follow-up treatments in acute cases and initial treatment in chronic cases are dry needled. Additional points that may be useful include SI 3, LI 2, 3, 4, LU 7, 9, TH 2 and 3. Depending on palpation findings, back *Shu* may be used including BL 13, 18, 19 and 23. It is critical to follow up the acupuncture treatment with western approaches including ice water, NSAID's and pentoxifylline.

Behavior and Training Problems
Generally, pain is the underlying cause of many behavioral issues with horses. These 'attitudinal' demonstrations include; pinning ears, turning hindquarters toward people, herd bully or outcast, rejects grooming, bucking or rearing when mounted or being saddled, shying or bucking when asked to perform and refusing jumps - just to name a few. Many of these problems are a result of the performance requirements placed on horses by owners and the unnatural conditions the horses are forced to live in. A thorough history, acupuncture examination and meridian balancing with attention to tings points will help determine if a problem or imbalance exists. From a TCM standpoint, emotions are specifically related to *Zang-fu* organs in that an imbalance in the organ meridian system may create issues with its particular emotion. For example, Anger is related to the Liver, which controls the ascending qualities of *Qi*.

Anxiety is a disturbance of consciousness or *Shen* which is housed in the Heart. A sudden shock may create disharmony in Heart *Qi* and result in hyperexcitability or anxiety. This problem is often observed in performance mares, especially during estrous. Dr. Allen Schoen describes a technique that I have successfully used on several mares. A stainless steel surgical staple is placed on the inside of each ear. The staple is placed in the center of ear, midway from the tip to the base of the ear and midway between the rostral and caudal edges of the ear. *NB- Do Not place the staple through the ear veins! Horses will generally require a twitch and/or sedation. The staple instruments often make a 'clicking' sound so cotton placed in the ear may be helpful. Some mares will become 'ear shy' after this procedure so warn the clients accordingly. If the staples result in the desired effect, leave them in place. Result often occur within a few days to a week and may last for months or a lifetime. This procedure is generally less effective with 'anxious' geldings or mares where the problem is not associated with estrous.

Additional acupoints that may be helpful for anxiety include:
BL 1, 2, 15, 20 & 21, PC 6, 9, TH 17, HT 7, GV 26 and GB 34

Headshaking is a condition in horses in which the horse shakes or jerks its head uncontrollably without any apparent stimulus. Headshaking ranges in severity from a mild annoyance to a devastating affliction that renders the horse unusable and unsafe. While causes for this condition are rarely determined, several causes have been suggested including middle ear disorders, ear mites, guttural pouch mycosis, allergic disorders, EPM and allergic

rhinitis. Radiographs of the skull may be diagnostic in cases that are associated with otitis media/interna and bone changes of the petrous temporal and stylohyoid bones. Western treatments include bilateral infra-orbital neurectomy, cyproheptadine (H1 blocker and serotonin antagonist)

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Selected Topics in Rational Antimicrobial Usage

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Dr. Alexander Fleming (1928) initiated the 'modern age of medicine' with the discovery of penicillin.

Drs. Fleming, Florey & Chain (1945) were awarded the Nobel Prize in medicine. They received no money for their amazing discovery.

Therapeutic Decision Making:

- Often a difficult and complex process
- Often confusing and contradictory information
  (Researchers, horse owners, websites & list serve's)
- Frequently our decisions are based on:
  * Our last successful case
  * Our last failure
  * Our last case

Pharmacological Considerations:

- Target
- Mechanism of action
- Route of delivery
- Disposition
- Metabolism/ elimination
- Potential for toxicity

Pharmacokinetics
What the body does to the drug
Describes the movement of drugs in the body
Absorption
Distribution
Metabolism
Elimination
Clinical pharmacokinetics is important for formulating dosage regimens in animals with disease

Pharmacodynamics
What the drug does to the body
Describes the action of the drug on the body- typically related to:
-Plasma/serum concentrations (window into the body)
-Exceptions: Macrolides for respiratory disease & other compounds that are 'tissue-loving'
Values poorly defined in horses- we extrapolate desired 'dose' from human or small animal literature.
Identify the agent;
1. Gram stain (+) (-)
2. disk diffusion test; susceptible,
   intermediate, resistant.
   (based on human serum concentrations)
3. MIC - more expensive but more info.
   resistance often a concentration phenom.
   (minimum concentration of an AB that inhibits
   growth of a pathogen in vitro)

Antibiotic Selection:

Spectrum of Activity (Gram + or Gram -)
Microbial Effect (Cidal or Static)
Bacterial Killing (concentration vs. time dependent)
Post-Antibiotic Effect (aminoglycosides and fluoroquinolones)

Time Dependent drugs

Concentrations need to be above MIC in the body for prolonged period…
Beta-lactams
Sulfonamides

Concentration dependent drugs

High peak concentrations associated with > clinical efficacy
Aminoglycosides
Tetracyclines
Fluoroquinolones

Interval Considerations

- Optimum dose interval = sum of "time required for most effective kill" + "duration of PAE's"
- No method for calculating optimum interval
- Duration of therapy
- Too short = therapeutic failure
- Too long = increase risk of adverse drug events and increase resistance in bacterial population
- "Treat 3 days past the end of clinical signs"
- Clinician experience & accepted practice

"Getting the drug into the horse??"

- Oral administration- many challenges…
- Absorption & tissue distribution determined by drug & species factors (most information defined in humans).
- Generally not ideal in horses
- Drug solubility; gastric pH, particle size, fluid volumes, feed in the stomach etc…

Reasons for Therapeutic Failure

- Wrong diagnosis
- Wrong drug for infection
- Mixed infection
- Resistant strain of bacteria
- Incorrect dosage
- Noncompliance w/ prescribed regimen
- Drug-Drug interaction
- Concurrent underlying disease
- Drug toxicity or adverse effect
- Immune suppression
- Inadequate duration of therapy

Beta-lactam antibiotics

- Penicillin- Procaine penicillin G, Na or K penicillin
- Synthetic penicillins- ampicillin, amoxicillin, ticarcillin
- Cephalosporins-
  - First generation- cefazolin, cephalexin

- Third generation- ceftiofur, ceftazidime
- Fourth generation- cefepime
  - o all have extended gm (-) activity
  - o increased resistance to B-lactamase org.

- Most infections in horses caused by B-hemolytic *streptococcus* spp. (uniformly susceptible to penicillins).
- Primary cephalosporin administered to horses is ceftiofur.
- Advantages include broad spectrum of activity and good safety profile.
- Several studies have evaluated concentrations (lungs, plasma) and safety of ceftiofur over wide range (1.1mg/kg to 11mg/kg) IM and IV.

Ceftiofur

- Approved for use in horses for respiratory tract infections (2.2 to 4.4 mg/kg Q24 IM).
- Higher doses recommended for treating gram - pathogens (Klebsiella,Salmonella,Enterobacter).
- Important to maintain concentrations above MIC with gm (-).
- Unlike other cephlosporins- it is extensively metabolized (desfuroylcetiofur DFC)- primarily excreted in urine
- Protein bound DFC is reservoir for active drug at site of infection (reduced dosing interval)
- Protein binding extends effective half-life (t ½)
- Pharmacokinetic profile; IV vs. IM vs. SQ
- 99% protein bound (clinically significant)
- Binds to acute phase proteins (α1-anti-trypsin) which carries bound drug to sites of inflammation
- Time dependent antimicrobial
- Label dose is 2.2 to 4.4 mg/kg q 24h IM.
- Higher doses (5-10 mg/kg) q 12h IV or IM clinically successful in treating septicemic neonates.
- The IM route of administration + lack of "penicillin rxn's" + broad spectrum of activity = excellent utility in treating polymicrobic infections (pleuropneumonia)

Excede

- Recent FDA approval (ceftiofur crystalline free acid)- sustained-release formulation of ceftiofur in United States
- Indicated for treatment of LRT disease caused by *Streptococcus zooepidemicus.*
- Produces 10 days of therapeutic ceftiofur blood concentrations with 2 IM injections (6.6mg/kg)
- Helps overcome irregular compliance increasing the likelihood of treatment success

Oral B-lactams?

- Very poor absorption and bioavailability
- 2 recent studies in foals; cephalexin and cephadroxil dosed at 30mg/kg PO q 12 hrs was effective

Trimethoprim-Sulfonamide (TMS)

- Considered bactericidal at high concentrations.
- Lipophylic and penetrates tissues well (including central nervous system).
- Broad-spectrum coverage (gm (+), (-) and some anaerobes.
- Interfere with synthesis of folic acid from PABA with sulfonamides competitively inhibiting PABA.
- Purulent fluids rich in protein and PABA, this will decrease TMS activity.
- Good activity against many *Streptococcus* organisms although some resistance noted despite susceptibility results.
- Potentiated sulfas Not recommended for initial treatment of Streptococcus equi infections; [Verheyen K, Newton J et al Equine Vet J. 2000; 32. 527-532].

- Excellent GI absorption although reduced substantially by feeding….(delay feeding).
- Lack of clinical activity against anaerobes.

Trimethoprim-Sulfonamide
- Oral formulation containing TMP with sulfadiazine in a 1:5 ratio commonly dosed at 20 to 30mg/kg BID.
- In horses- rapid elimination of TMP leads to >persistence of sulfonamide and changes optimal ratio. Therefore, potentiated sulfonamides should be dosed BID.
- t½ =sulfamethoxazole 3.5-5 hrs.
- t½ =sulfadiazine 3-4 hrs.
- t½ =trimethoprim 2-3 hrs.
- BID *per os* dosing is necessary to attain therapeutic plasma concentrations of trimethoprim (Dowling in Bertone,2004)

Macrolides

Erythromycin
- Macrolide; bacteriostatic except at high dosages they are -cidal.; good tissue distribution.
- Good activity Strep. Staph. Bacteroides, & Rhodococcus.
- Poor activity E.coli, Pseudomonas, Klebsiella & Salmonella.
- R. equi pneumonia- 25mg/kg q 6-8 hrs will achieve plasma conc. which exceed MIC.

Azithromycin
- Pharmacokinetic advance in macrolide arena.
- High oral bioavailability, large Vd (18.6L/kg) and peritoneal = synovial = serum conc., T1/2 = 20hrs, conc. in bronchoalveolar cells 15- 170x [serum].
- Impression; fewer GI issues.
- Dose;10 mg/kg QD for 5 days then q 48hrs per os.
- Significant advantage over erythromycin.
- Bioavailability =56% in 6 healthy foals
- 10mg/kg QD PO for 5 days then reduced to every other day

Clarithromycin
- Oral bioavailability =57.3% +/- 12.0%
- 7.5 mg/kg BID PO provides serum, pulmonary epithelial lining and bronchalveolar cells of foals above MIC for R. equi isolates during entire 12 hr period
- Determined in 6 healthy foals
- (Womble, 2006)

Rifampin
- Bioavailability is 40 – 70%, lower bioavailability if fed with feed
- t½ =17 hrs. in foals, 6-8 hrs. in adults
- Dose 5mg/kg BID PO
- Emerging resistance especially if used as a monotherapy (Takai, 1997)

Tetracyclines
- Broad-spectrum bacteriostatic activity.
- Excellent tissue penetration (including CNS).
- High GI conc. which may cause diarrhea.
- Effective against several organisms (N.risticii) & Borrelia; oxytetracycline; 5-10mg/kg q 12-24 hrs iv

Doxycycline
- Semi-synthetic tetracycline.

- Very limited bioavailability (+/- 5%), t1/2 = 10-12 hrs.
- CNS penetration and good gm(+) activity.
- Dose; 10 mg/kg BID *per os*

Minocycline
- Semi-synthetic tetracycline.
- Good bioavailability (+/- 25%), t1/2 = 13 hrs.
- CNS penetration and good gm(+) activity.
- Dose; 4 mg/kg BID *per os*

Chloramphenicol
Bacteriostatic (-cidal at high conc.)
- Broad spectrum activity; gm(-), (+) & anaerobes.
- Good intracellular penetration.
- Rapidly metabolized by the liver (short t1/2).
- Oral administration (very bitter).
- Minimize human exposure (animal toxicity rare).
- Dosage25-50mg/kgq4to6hrs*per*

Fluoroquinolones
- Very active against enteric gm(-) and many aerobic gm(+). No anaerobic activity.
- Enrofloxacin- good bioavailability and tissue penetration (higher conc. in resp. tract than serum).
- Arthropathies are concern in foals-not substantiated in adult horses.
- Injectable- 2.5 to 5mg/kg Q24, *per os*- 7.5 to 10mg/kg Q24 is recommended.

Aminoglycosides (General)
- Widely used for treatment of gram (-) infections
- Concentration dependent antibiotics
- If a q24 h approach to dosing is employed, it should be augmented with another AB with gm(+) activity (ampicillin, ceftiofur).
- Serum aminoglycoside assays available at human & vet hospitals.
- Due to individual variability & alterations from disease states, therapeutic monitoring should be employed to optimize dose & interval.

Amikacin
- Concentration dependent aminoglycoside
- Once daily dosing is safer than more frequent administration while being as effective
- Dose 10mg/kg Q24 in adult horses
- Dose 25mg/kg in foals (Papich, 2005)

Gentamicin sulfate
- Rapid, bactericidal action indicated for acute gram (-) infection
- May be administered IM, SQ and IV.
- Synergistic with Beta lactam antibiotics (ampicillin, ceftiofur).
- Do Not administer to horses with compromised renal function
- Dose 6 to 8 mg/kg IM or IV Q24 in adult horses.

Metronidazole
- Nitroimidazole anti-infective- selectively taken up by anaerobes
- Effective vs. anaerobic (Clostridium spp) bacteria and protozoa (Giardia and Trichomonas spp.)

- Vd= 1-2 l/kg
- t½= 3-4 hrs.
- Concentration dependent antimicrobial
- Dose 15-20 mg/kg TID PO
- Widely used for colitis
- Resistance reported (rare) for C.difficile isolates
- Less information available for C.perfringens
- Neonates- 10mg/kg PO q 8-12 hours
- PK profile- Per Os > IV
- Pleuropneumonia PK; 15mg/kg initially followed by 7.5mg/kg PO q6h

Polymyxin B

- Cationic detergent AB (gram -) binds to cell membrane making it more permeable
- PMB was found to decrease in vivo endotoxin-induced TNF activity
- Compared with baseline values 5,000 U of PBM/kg should inhibit 75% of endotoxin induced TNF activity for 12 hours (Parviainen, 2001)

Vitamin E and Selenium in Horses

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What causes deficiency?
Low dietary intake is the main cause of deficiency for both of these nutrients. Other factors, such as increased oxidative stress due to fat supplementation of rations, exercise and poor gastrointestinal absorption can also contribute and exacerbate the low dietary supply.

Selenium – Deficiency can vary between regions and is related to soil type used to grow the hay with lower availability of selenium from soils of volcanic origin and acidic pH. Plants take up inorganic selenium via active transport and incorporate it into organic forms. Therefore, the plant species as well as rate and season of growth will also affect selenium availability from a specific forage. Selenium concentration is often higher in younger leaves and in slower growing plants.

Vitamin E - Vitamin E is produced by photosynthesis in plants and plant concentrations are influenced by stem-to-leaf ratio, plant species, stage of plant maturity and climate conditions. At early stages of growth, grasses often contain higher concentrations of vitamin E compared to legumes. However, as the legumes mature and produce more leaf, which has higher vitamin E content than the stems, the differences between legumes and grasses become less significant. Wet, mild climate conditions favor higher concentrations of vitamin E in forage independent of growth cycle and plant type. Vitamin E content in hay is decreased by storage and drying which increases oxidative damage. Rapid dehydration and ensiling of hay causes smaller losses, however, fresh grass remains the best source of vitamin E for grazing animals.

What are the clinical conditions associated with deficiency?
Both vitamin E and selenium function as anti-oxidants preventing excessive damage to tissues under high oxidative stress. Deficiency leads to damage of cellular membranes with the tissues most commonly affected including muscles and peripheral nerves.

Equine Motor Neuron Disease (EMND) – A neurodegenerative disorder affecting motor nerves with secondary muscle wasting. It is associated with low plasma concentrations and a dietary deficiency of α-tocopherol. These horses are typically on restricted pasture access.

Vitamin E Deficient Myopathy – A disease of α-tocopherol deficiency with clinical signs related to muscle atrophy and weakness without evidence of damage to motor nerves. These horses may or may not have restricted pasture access and may or may not have low vitamin E serum concentrations. This may indicate an impaired mechanism of vitamin E uptake into the myocytes, not strictly due to deficient dietary intake.

Nutritional Myodegeneration – Disease of cardiac and skeletal muscle caused by a dietary deficiency of selenium and to a lesser extent vitamin E. Severe deficiency can result in heart failure and profound muscle damage.

Equine Degenerative Myeloencephalopathy/Equine Neuroaxonal Dystrophy – These are two closely related disorders associated with low dietary vitamin E early in life (under 1 year of age). There is a possible hereditary component, although the exact mechanism and manner of inheritance has not been described. Both are largely diseases of rule out as definitive diagnosis is currently only achieved by histopathologic evaluation of the spinal cord and brainstem tissue. Spontaneous recovery has not been described and vitamin E supplementation after the onset of signs has minimal impact.

Reaching a diagnosis
Best strategies include obtaining a complete history (particularly diet and progression of clinical signs) and physical examination. Common clinical signs of advanced disease include weakness, generalized muscle atrophy affecting the hind end most prominently, muscle fasciculations, recumbency and an "elephant on a ball" stance. Horses with selenium deficiency may have signs of chewing difficulty related to masseter atrophy and signs of cardiac failure. More subtle signs may include poor performance, mild neurologic deficits and decreased immune function. Both deficiencies can result in elevations of muscle enzymes (CK and AST) on serum chemistry. Measurement of vitamin E in plasma or serum, and selenium in whole blood or liver tissue supports diagnosis of deficiency.

Blood Sample collection:
Vitamin E: The sample should be chilled, protected from light and the serum or plasma separated as soon as possible after collection. Hemolysis will significantly reduce measured vitamin E concentration. Contact with the rubber stopper should also be minimized (keep blood tubes upright).

- Significant deficiency which is often related to clinical disease is indicated by values below 1 ug/mL
- Subclinical deficiency is possible with values between 1-2 ug/mL
- Adequate vitamin E status is indicated by values over 2 ug/mL

Selenium: Whole blood analysis is more accurate compared to serum, however, tissue samples such as liver may also be submitted. Artefact from sample handling is much less likely than for vitamin E analysis

- Severe deficiency which is often related to clinical disease is possible with values below 80 ng/ml
- Mild to subclinical deficiency is possible with values between 80-160 ng/ml
- Adequate selenium values are over 160 ng/ml but below 300 ng/ml

Biopsy of Sacrocaudalis dorsalis muscle: The muscle is located dorsal-lateral to the spinous processes of the coccygeal vertebra. Surgical incision or punch biopsy provides diagnostic specimens. Biopsy of this muscle will help differentiate between EMND and Vitamin E responsive myopathy.

Other diseases to potentially consider and rule out include musculoskeletal disorders leading to primary lameness, neurologic conditions such as cervical vertebral myelopathy (CVM) and to a lesser extent in this region EPM, as well as muscle disorders such as polysaccharide storage myopathy (PSSM) among others.

Treatment strategies
Vitamin E Supplementation: Water soluble, natural vitamin E products (d-α-tocopherol) are preferred to synthetic sources (dl-α-tocopherol) since synthetic vitamin E is not as bioavailable (less potent), values take longer to increase, and it potentially does not transfer as well into nervous tissue. When treating animals with deficiency it may take several weeks (2-4) before clinical signs improve, particularly in EMND. If using a synthetic product, consider increasing the amount of units provided by 30-50%.

- When treating low vitamin E, supplement with 5,000 – 10,000 IU/day PO
- In apparently healthy animals with normal vitamin E concentrations, 1-2 IU/kg PO (500-1000IU/day for an average 450kg horse) is adequate

Some options for natural, water soluble vitamin E supplements include Nano•E (Kentucky Equine Research, Versailles, KY), Elevate WS (Kentucky Performance Products LLC, Versailles, K) and Emcelle tocopherol (Stuart Products, Bedford TX).

Labeling: Many product labels vary in how they describe vitamin E. For the synthetic form 'dl' or 'all-rac' precede tocopherol, and for the natural form 'd' or 'RRR' precede tocopherol. Some supplements listed as natural will often contain a combination of natural and synthetic forms and others do not specify either one directly and usually can be assumed to be largely synthetic ('vitamin E supplement' or sometimes 'alpha-tocopherol-acetate' on labels).

Selenium Supplementation: Selenium enriched yeast is more readily absorbed compared to sodium selenite, although the difference between the two sources is relatively small and adequate blood selenium concentrations can be achieved with both supplements.

- Daily supplementation with 1-3mg total PO for an average 450kg horse

Injectable Selenium and Vitamin E: Combination products often have inadequate levels of vitamin E to treat vitamin E deficiency and solitary products become necessary.

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The Role of Head Computed Tomography in Equine Patients

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Introduction

Diseases of the head of horses occur frequently and are often categorized by their location into dental, sinonasal or neurological origin. Additionally, lesions of the soft tissues including the tongue, alivary glands, the temporomandibular joints as well as the hyoid apparatus may be present. The most common reasons why equine radiography of the head is performed is due to dental or sinonasal disease or for evaluation of injuries due to a traumatic event. Head radiographs provide a good spatial resolution; however, due to the superimposition of anatomic structures, localization of lesions can be quite challenging. In cases were radiography and endoscopy do not provide sufficient information or when there is incomplete or no response to treatment, additional diagnostic imaging modalities are often considered. The equine head is an anatomically very complex structure, making it therefore most suitable for exploration using cross sectional imaging techniques such as computed tomography (CT) or magnetic resonance tomography (MRI), where the superimposition of anatomic structures is eliminated. CT is commonly the method of choice for evaluation of osseous or air-filled structures and MRI is usually the preferred method for evaluation of the brain, spinal cord and soft tissue structures. It is important to remember, that CT is for neuroimaging by many only considered the diagnostic imaging test of choice, if magnetic resonance imaging (MRI) is not available. The only exception is within the first 24 hours post-acute head trauma, were CT is often the go to technique for the detection of acute or subacute hemorrhage, especially in cases, where an early diagnosis for case management and treatment is necessary, as it is a fast, often more readily available and more cost effective modality compared to MRI. However, controversy about the use of CT for brain imaging exists also in human patients, especially children, where in acute or febrile seizuring patients, the yield of positive results using computed tomography is often low. MRI of the head in horses has demonstrated a beneficial diagnostic information, however, the need for anesthesia, cost and the lack of MRI facilities accessible to horses currently often limits the use of this technique.

Clinical computed tomography of the equine head has over the last few years rapidly advanced and in some places, the ability to utilize CT for standing sedated horses, has made this technique more readily available. Multidetector computed tomography (MDCT) units provide an excellent resolution and allow scanning of the head in submillimeter slices (currently as low as 0.5mm), providing outstanding detail of the osseous structures of the skull; however require the horse to be fully anesthetized and recumbent during the CT scan. Despite the excitement of utilizing standing CT units in horses, these units are still in its infancy and several limitations still remain including the size of the patient, motion of the standing sedated horse and high exposure settings to penetrate the high density osseous structures of the head. These high exposure setting can pose a high safety risk for personnel restraining the sedated horses during the exam. Additionally, the images of these standing CT units have a reduced image quality when compared with MDCT images. However, the benefit of being able to scan horses without the requirement of general anesthesia is clinically important and future technical developments will likely make this technique more readily available.

The next few paragraphs focus on disease of the head were CT can provide additional benefits in the evaluation of the disease process. Not all disease processes occurring in the head will be discussed, but information is added for disease were additional CT imaging may add value to the diagnostic workup of equine patients.

Imaging of dental disease

Young horses have 24 teeth (paired I3/3, C0/0, P0/0 and M3/3). On radiographic or CT imaging deciduous teeth are more radiolucent, have shorter reserve crowns and roots, and a shorter cross-sectional area than permanent teeth. Additionally, it is important to remember, that in normal teeth of young horses radiolucent eruption cysts can be present adjacent to the immature apices of the teeth, leaving the impression of an apical infection.
The mature horse has 40 to 42 teeth (paired I3/3, C1/1 in the male or C 0/0 in the female, P3 or 4/3 and M3/3). All

permanent teeth in horses are hypsodont, meaning that they continue to erupt throughout life compensating for the grinding wear, which is usually 2-3 mm/year in the adult horse. Due to this continues growth, the appearance of the teeth, and especially their apices, varies considerably throughout the life of a horse. Furthermore, due the variable eruption times of horse teeth, the length of the reserve crowns of the cheek teeth are variable with the first molars (09s) consistently being the shortest, as they are the first permanent cheek teeth to erupt. Additionally, the second premolar teeth (06s) are shorter than the adjacent cheek teeth. Additionally, the apices of some of the check teeth tend to extend into the paranasal sinuses with the caudal aspect of the fourth maxillary premolar (08s) and the first maxillary molar (09s) extending into the rostral maxillary sinus and the second (10s) and third maxillary molar (11s) extending into the caudal maxillary sinus.

Apical infection/inflammation
Common CT findings in horses with inflammatory dental disease are similar to radiography and include widening of the diastema, sclerosis of the alveolar bone without or with osteolysis, blunting of the tooth root, gas within or adjacent to the tooth root and fragmentation of the teeth. As a reminder, the fourth maxillary to second molar tooth roots are closely associated with the maxillary sinus and can, when dental disease is present, result in sinusitis. Most tooth root fractures are idiopathic and occur less commonly secondary to external or iatrogenic trauma such as due to a dental procedure. Tooth root fractures can be challenging to diagnose radiographically, but can easily be identified using CT.

In a study comparing the CT and radiographic findings in 32 horses with dental disease, CT had a reported sensitivity of 100%, specificity of 96.7% and a positive predictive value of 88.9%, compared to radiography, which had a sensitivity of 72.5%, specificity of 89.5% and a positive predictive value 64.4%. CT showed more teeth affected and in only about 50% of the horses CT and radiography agreed on the tooth affected. Additionally, only approximately a third of the tooth fractures were diagnosed using radiography when compared to CT. Furthermore, CT also identified more teeth as being abnormal than clinically suspected.[1] In another study were dental sinusitis was present, only in 57% of the horses dental disease was diagnosed on the initial radiographs.[2] Whereas the diagnosis of sinus in combination with dental abnormalities using CT is relatively easy and straightforward as there is no summation of surrounding anatomic structures. As a reminder, rostral maxillary tooth root infections are usually easily diagnosed on radiographs, but CT should be considered in cases of suspected dental sinusitis, especially when no response to treatment is noted.

Inflammatory/infection –infundibular caries, pulpitis
CT is an excellent technique to evaluate the individual teeth for the presence of cemental or enamel hypoplasia, infundibular caries and pulpitis, which might be missed on conventional radiographs of the head. Hyperattenuating infundibular lesions were noted in approximately 57% of the horses imaged using CT in one study, but affected teeth were only identified in about 8% of the horses using radiography in this study. Intraoral radiographs of the individual teeth, might provide similar information compared to CT; however, no comparative studies of intraoral radiography and CT are currently available.

Dental (odontogenic) tumors
Dental tumors occur infrequently; however, in equine species, they are reported more frequently than in other species. Common odontogenic tumors include ameloblastoma, cementoma and odontoma. Ameloblastoma occur more frequently in mandibular than maxillary teeth, tend to be locally destructive, are round to multilobulated in shape and are often expansile in their growth pattern. Radiographs often help to identify the lesion. However, the extent of these tumors is frequently better evaluated using CT than radiography, especially when additional information for surgical pre-planning, or radiation treatment is considered.

Oligodontia, polydontia or dysplastic teeth
The lack or presence of additional teeth are often first noted on a clinical examination. Oligodontia, the lack of a tooth, can cause abnormal occlusion and therefore abnormal wear of the teeth. In polydontia, which is the presence of extra or supernumerary teeth, the teeth may have a normal anatomic shape or could be malformed.

When teeth are dysplastic, which is not uncommon in horses, the teeth can be so mal-shaped, that it can be difficult to decide, if an apical infection is present or not. In these cases, performing a CT examination may allow to differentiate between mal-shaped teeth without or with apical inflammation.

Other dental head imaging findings

Dentigerous cyst (ectopic tooth, ear tooth, temporal teratoma, heterotopic polydontia)

Usually, this is a benign developmental abnormality resulting from an incomplete closure of the first branchial cleft, resulting in the development of a cystic structure surrounding a tooth, often close or even attached to the temporal bone. Frequently, these cystic structures are associated with a draining tract by the pinna of the ear and/or they can pose a cosmetic problem. They can be present unilateral or bilateral in the horse. On radiographs, the abnormally positioned tooth-like structure may be identified; however, often the additional temporal bone abnormality is not visualized on radiographs, and requires additional cross-sectional imaging such as CT or MRI to further evaluate the extent of the lesion.

Imaging of sinonasal disease

The equine paranasal system is a complex system and consists of paired rostral and caudal maxillary, frontal, ventral and dorsal conchal, ethmoid and sphenopalatine sinuses. The frontal and dorsal conchal sinus are often called the conchofrontal sinus. The conchofrontal, caudal maxillary, ethmoidal and sphenopalatine sinuses communicate with each other and the rostral maxillary and the ventral conchal sinuses interconnect with each other as well.[3]

The most common sinonasal disease in horses include primary sinusitis, dental sinusitis secondary to tooth root infection, sinus cysts, ethmoid hematomas or neoplasia. If mass lesions in the sinus system are present, they are more frequently secondary to sinus cysts, ethmoid hematoma and inflammatory nasal polyps than due to neoplasia. Neoplasia of the sinus system in horses are quite rare and it is even rarer, that the tumor originates from the sinuses itself. More commonly these tumors originate from the oral cavity, adjacent osseous or dental structures extending into the sinuses.[4]

Sinusitis

In primary or dental sinusitis, usually an increased amount of soft tissue attenuating material and reduced amount of air filling is noted in the sinus. In a standing position, horizontal fluid lines within the sinus may be noted on radiographs. Another form of sinusitis is caused by fungal organisms. Sinus mycosis occurs relatively infrequent in horses, however, geographic differences in the prevalence of fungal disease are present. Fungal agents noted in the nasal cavity and paranasal sinuses include *cryptococcus neoformans, blastomyces dermatides, aspergillus spp*., etc. Sinus mycosis can be associated with an increase in fluid in addition to turbinate and conchal destruction, and remodeling of the surrounding bones; however, sinus mycosis can also be associated with only a minimal increase in soft tissue attenuating material in the nasal cavity and paranasal sinuses and can therefore easily be missed on radiographs. Usually sinus mycosis has a classical appearance using endoscopy; however if osseous involvement is suspected, CT is providing a better overview of the extent of the lesion. On CT, small soft tissue attenuation plaques may be noted in the nasal cavity and paranasal sinuses, in addition to mucosal thickening, fluid within the nasal cavity and sinuses and remodeling of osseous structures.

Radiographs should always be carefully evaluated, to see if more than one sinus is involved. On radiographic studies, sinus involvement is diagnosed more likely when an involvement of the maxillary or frontal sinuses is present; however, sphenopalatine or ventral conchal sinus involvement are challenging to diagnose (Manso-Diaz reported a sensitivity ranging from 8.7 to 54.1%).[1] Radiography and CT had a good agreement in diagnosing sinusitis, when the mucosa of the sinuses measured more than 1 cm in thickness and fluid was present within the sinus or when a complete sinus obstruction was present. In cases were no fluid was present in the sinus and the mucosa was not greatly thickened, radiography only allowed to diagnose sinusitis in a limited number of cases. Furthermore, radiography is a great technique diagnosing sinusitis when fluid is present, but is often an inadequate technique diagnosing the cause of sinusitis. In horses, secondary sinusitis due to dental disease occurs

commonly, and as on radiographs the visualization of the reserve crown of the teeth may be hindered by the presence of fluid in the sinuses and therefore other imaging modalities such as CT should be considered.

Sinus cysts (maxillary follicular cysts)
Sinus cysts are radiographically often noted as a rounded, soft tissue attenuating mass within the nasal cavity or paranasal sinuses. Frequently a thin mineralized capsule-like structure may be noted. If large cysts are present distortion of adjacent frontal and maxillary bones may be noted in addition to deviation of the nasal septum. CT findings are similar in appearance; however, allow to better evaluate the extent of the lesion with respect to adjacent bones, the nasal septum and paranasal sinuses.

Ethmoid hematoma
Ethmoid hematomas may be noted radiographically as a well-defined, round to ovoid, soft tissue attenuating mass in the area of the ethmoid labyrinth and/or sphenopalatine sinus. However, when the lesion is small or when fluid is present in the sinus system, ethmoid hematomas may not be identified radiographically or using endoscopy. In difference, CT allows to differentiate between fluid and a mass lesion and therefore, allows to diagnose lesions of the ethmoid or sphenopalatine sinuses, even if they are small. However, it is important to remember, that radiographic and CT findings are nonspecific and can appear similar to neoplasia.

Sinonasal neoplasia
Sinonasal neoplasia is rare in horses. Several tumors of the nasal cavity and/or paranasal sinuses have been described and include neuroendocrine tumors, carcinoma, myxosarcoma, adenocarcinoma, hemangiosarcoma, etc. This tumors are often aggressive in nature and can lead to a moderate to marked osteolysis of adjacent osseous structures including the cribriform plate. Radiographs were inadequate to identify masses involving the sphenopalatine sinus and demonstrating extension into the cranium. Again, CT can overcome these limitations and provide more accurate information in regards to extent, location and features of malignancy.[5]

Osseous and joint disease
Head trauma occurs frequently in horses, especially in young horses. Asymmetry to the skull or nasal bleeding can be present. A good agreement between radiographic and CT findings in fractures of external osseous structures is expected; however, if fractures extending towards the retrobulbar space and calvarium are present and when fractures are very comminuted, CT allows to identify more fractures, fracture fragments and provides more detailed information about fracture location.

Standard radiographs of the head only allow a limited evaluation of the temporomandibular joints, and if no oblique views, centered on the temporomandibular joint, are available, CT allows complete evaluation of the temporomandibular joints. Additionally, ultrasound of the central and lateral aspects of the temporomandibular joints can easily be performed due to its superficial location; however, the medial aspect of the temporomandibular joint is generally not accessible using ultrasound.

The hyoid apparatus can be evaluated using radiography; but, the degree of summation of the individual parts of the hyoid apparatus in combination with the location of the temporohyoid articulation, often limits the diagnostic information gained using radiographs. Additional information can be obtained using CT for the presence of new bone formation, fractures and displacement of the hyoid apparatus.

Neuroimaging
As mentioned earlier, CT is often the method of choice in acute trauma patient as it allows to evaluate for the presence of fractures in combination with evaluation of the brain for signs of hemorrhage. However, other disease processes of the brain are difficult to evaluate using CT. Radiographs are usually insufficient evaluating intracalvarial structures.

Brain trauma
Initially, post-acute trauma, hypoattenuating areas of the brain parenchyma suggestive of edema and areas of hyperattenuation relative to normal brain parenchyma, suggestive of hemorrhage, can be noted. It is also possible, that the hemorrhage occurs sub- or epidural and in these cases, localized areas of hyperattenuation adjacent to the brain parenchyma with often displacement of the brain parenchyma are noted. Not in all cases, an osseous lesion of the skull will be present.

Brain abscess
On CT, a mass effect with a central hypoattenuating area and a peripheral, hyperattenuating rim may be noted. Post intravenous contrast agent injection, a ring enhancement may be noted.

Encephalitis
On CT examination, no abnormality may be noted or mixed areas of hypo- and hyperattenuation can be present. Post intravenous contrast agent injection, heterogeneous contrast enhancement may be present.

Pituitary adenoma and neoplasia
The pituitary gland can easily be seen on CT images, especially post intravenous iodinated contrast agent injection. The pituitary gland is surrounded by a thin rim of fat and cerebrospinal fluid allowing to differentiate the from adjacent brain parenchyma. The normal height of the pituitary gland height is reported to range between 10-12mm, width 19-21mm and length 21-24mm.[6] An enlarged pituitary gland is often present secondary to Cushing's disease; however, in cases of adenomatous enlargement, the pituitary gland, may measure normal.

Hydrocephalus
Hydrocephalus is a developmental disorder with an increase of cerebrospinal fluid in the ventricle system. Hydrocephalus can be noted in foals born prematurely, in stillbirth fetuses or dystocia foals. Some horse breeds such as the Friesian horse an autosomal recessive trait is reported. Foals born with a hydrocephalus have often severe neurological signs. On CT, a marked dilation of the ventricle system with fluid attenuating material is noted. Additionally, the cortex of the brain is thin.

Cerebellar abiotrophy or cerebella cortical abiotrophy
Cerebellar abiotrophy is a genetic, neurologic condition of the cerebellum with a recessive mode of inheritance, which is nearly exclusively only identified in Arabian horses and Arabian-cross breeds. On CT a small cerebellum can be noted.

Cholesterinic granulomas
Cholesterinic granulomas are benign growth involving the choroid plexus and occur in 15-20% of older horses. The lesion can associated with clinical signs or no clinical may be present. On CT, these lesions often occur bilateral and can be of variable density and contain small mineralized areas.[7]

Other head imaging findings
Mucocele
CT allows to evaluate the salivary glands and can provide information about the presence of fluid-filled structures within or adjacent to the salivary gland and may identify the presence of dilated salivary ducts.

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Today's Equine Prepurchase Examination

H. W. Werner VMD

Introduction:

- Why perform prepurchase examinations.
- Today = pleasure & performance horses
- NOT today = racing, breeding soundness, auction sales
- Remember: Though some of the approaches we discuss today may not fit your practice needs at present, please consider the logic behind the approaches and how you might adapt them now (or in the future) to meet your particular needs.

History of the Prepurchase Examination

- ***"And first, I must caution all purchasers against a very common fault – that of wanting and expecting to find perfection in any horse; there is no such thing either in man or horse."*** George Armatage MRCVS, 1893

Practitioner Challenges:

- Client expectations
- Examiner confidence
- Conflicts of interest
- Liability exposure
- Timely, proactive communications
- Effective/efficient delivery of services & perceived value
- Comprehensive, inter-operable medical records

AVMA PLIT: Buyer Complaints:

- Prepurchase examinations represent greater than 20% of all equine claims
- Of these, 80% are from post-sale lameness events or radiography errors

Prepurchase Examination Goals:

- Timely/accurate gathering, sharing and recording of case-related information
- Competent, professional physical examination
- Timely, accurate report to Prospective Buyer
- Positive perception of value by all parties
- Minimal risk exposure
- Comprehensive/accurate/inter-operational records
- Repeat client contact

Strategies: Standards of Patient Care:

- Customize
- Intended use
- History
- General Observations
- Physical Examination
- Ancillary Services

Client Touch Points:

- All possible interactions between the practice and the client-related parties involved in a veterinary service.

- Opportunities to communicate before, during and after a veterinary service is performed.
- Opportunities to observe, listen, learn, share, document and deliver value.

Prepurchase Examination Tasks:

- Veterinarian
- Support staff

Part 1: Pre-Examination:

- Informational handouts
- Incoming contact
- Review of services
- Veterinary Care Plan
- Prospective buyer agreement
- Intended use
- Conflicts of Interest
- Seller agreement

Part 2: Physical Examination:

- Worksheet
- Liability release
- Physical examination
- Ancillary services
- Verbal reporting

Part 3: Post-Examination:

- Written report(s)
- Invoice
- Invitation to discuss

Legal Landmines:

- Failure to communicate accurately, understandably & in a timely way
- Failure to context intended use
- Failure to request/review/report history
- Failure to identify and report surgical scars
- Improper image acquisition/interpretation

"Maintenance" Procedures:

- definition of "maintenance" in equine veterinary context?
- can you defend at sale time in support of medical history of "no lameness"?
- are you comfortable with full disclosure to buyer's veterinarian?
- are you comfortable with full disclosure to insurance company?

Melanoma

- Always a potential metastatic malignancy that will behave unpredictably.
- Avoid predicting its future or taking it for granted.
- Although there may be a tendency to dismiss one or a few small melanomas at the time of the prepurchase examination as of minimal or no long-term significance, especially in an otherwise excellent prospect, such an approach is both risky and medically untrue.

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Perform and Leverage the Physical Examination for the Health of Your Patients and Practice

H. W. Werner VMD

Introduction: ***Why this matters to you!***

- Essential for horses' health
- Important for practice recognition and growth
- A "door opener" procedure
- Minimizes professional liability

VCPR:

- Definition
- implications

Equipment*:*

- Cost: minimal
- Senses: sight, smell, sound, feel
- Thermometer, stethoscope, penlight/flashlight
- Have available: AliveCor, ophthalmoscope, hoof tester and hoof pick

AAEP *TOUCH* PROGRAM*:*

Pre-visit:

- Signalment: name, age, color, breed gender
- Intended use
- Chronic condition(s)
- Recent problem(s)
- Current medications
- Hoof status
- Regulatory needs (Coggins test, health certificate, insurance examination, FEI Passport, vaccination certificate)
- Upcoming competition(s): "Do" and "Don't do"

Visit:

Communicate!

- ASK!
- LISTEN > TALK!
- Chronic condition(s)?
- Recent problem(s)?
- Current medications?
- Hoof status
- Regulatory needs (Coggins test, health certificate, insurance examination, FEI Passport, vaccination certificate)?
- Upcoming competition(s): "Do" and "Don't do"

Record:

- On-site
- Photos – identification (brand, scar, markings), BCS, abnormalities
- Fillable pdf

Report:

- "secured" pdf via email

Wellness PE findings - Werner Equine LLC over 12 months (2014):

WELLNESS PE = 5 minutes

METABOLIC

- PPID
- insulin resistance
- BCS extremes
- equine metabolic syndrome
- PSSM

OCULAR

- nuclear sclerosis
- cataract
- recurrent uveitis
- nasolacrimal duct occlusion

BEHAVIOR

- >>> EGUS
- >>> granulosa cell tumor

CARDIOVASCULAR

- atrial fibrillation
- VSD murmur
- 2 degree AV block (problem at PPE)

RESPIRATORY

- upper respiratory infection
- small airway inflammation

INFECTIOUS

- dermatophilosis
- "scratches"
- dermatophytosis

NEOPLASTIC

- sarcoid
- melanoma
- SCC - ocular & penile
- papilloma – penile & aural
- pulmonary adenocarcinoma (FUO, poor BCS, exercise intolerance)

ORTHOPEDIC

- poor farriery
- angular limb deformities
- laminitis
- DSLD

NEUROLOGIC
- Horner's syndrome
- hindquarters ataxia

MISCELLANEOUS
- pinworm tail rub
- fever of unknown origin
- Culicoides hypersensitivity
- plant photosensitization (St. John's wort)
- umbilical hernia

Resources:

- https://touch.aaep.org/
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Videoendoscopy in Ambulatory Practice

H. W. Werner VMD

Introduction: ***Why this matters to you!***

- Important for horses' health
- Important for practice recognition and growth
- Very adaptable to ambulatory practice
- A "door opener" procedure

Equipment*:* ***options.***

- Cost range
- Length
- Diameter
- Accessories
- Image viewing
- Image capture
- Image archive

Equipment: ***care & maintenance.***

- Transport
- Cleaning
- Sterilization

Clinical Applications:

- Upper respiratory
- Guttural pouch
- Bronchoalveolar
- Upper gastrointestinal
- Lower urinary
- Uterine

Archiving: ***options.***

- Hard drive
- Cloud
- CD
- Thumb drive

Reporting: ***conveyance of value!!!***

- Templates
- CD
- Thumb drive

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