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Neonatal Intensive Care

UF | University of Florida

Message

from the Chief of Staff, Dr. Eleanor Green

Happy New Year. Where did 2006 go? I suppose when we are all busy and trying to make significant, positive changes, the time flies. Already breeding season is right around the corner and foals are already trickling in. The Hofmann Equine Neonatal Unit at the University of Florida, under the direction of Dr. Steeve Giguere, enters another foaling season continuing to provide and constantly upgrade its advanced veterinary services for critically ill foals. It is the only equine NICU in Florida with board certified specialists in 10 separate disciplines, including internal medicine, surgery, theriogenology, anesthesiology, radiology, neurology, cardiology, dermatology, clinical pathology, and pathology. Magnetic resonance imaging (MRI) has been added to the specialized imaging modalities which include videoendoscopy, ultrasonography, digital, computed radiography, computed tomography, fluoroscopy, and scintigraphy. The neonatal research performed here at UF over the last several years has resulted in better ways to monitor cardiovascular and respiratory function in foals, improving the overall monitoring and immediate care of the critical neonate. The clinician scholars performing this research are the same ones who provide and oversee the care of our neonatal patients. They and the staff are proud to be associated with the most advanced neonatal intensive care center in Florida, one which remains among the best in the nation and the world. But we could not do it without our loyal referring veterinarians and their clients. The more foals we see, the better we are. We thank you for your support.

Dr. Maureen Long has provided in this newsletter a summary of the equine herpes outbreak in Florida. This article supplements the information found on the front page of our college website at www.vetmed.ufl.edu. We welcome the use of this website as a portal link to your own website for veterinary continuing education and/or the education of your clients. Dr. Long's informative PowerPoint presentation is readily available. While many were enjoying the holiday festivities, Dr. Jorge Hernandez, Dr. Maureen Long, Dr. Rob MacKay, and Dr. Dana Zimmel were hard at work developing a model for the management of potential EHV-1 outbreaks in a referral hospital setting. These protocols have been implemented in our hospital and will serve as a template for other infectious disease outbreak threats. We are pleased to share them with you through our website. Our protocols were based on the AAEP guidelines, Equine Infectious Disease Outbreak: AAEP Control Guidelines, found on the AAEP website at www.aaep.org. These AAEP guidelines were recently developed by the AAEP task force chaired by Florida's own Dr. Mary Scollay.

The only thing that does not change is change itself. One would have bet that Dr. Rob MacKay would be Chief of the Large Animal Medicine Service into the next century. Effective January 1, 2007, Dr. Dana Zimmel will assume this role and will do an excellent job, as Rob has done. But do not fear, we are not losing Dr. MacKay. He merely wants to spend more time in other activities, like teaching, research, and clinical service. Thank you Dr. MacKay for your excellent leadership and for encouraging new leaders, like Dr. Zimmel.

We at the University of Florida Large Animal Hospital wish each of you success in 2007. As always, we welcome your suggestions for how to serve you better.

Eleanor M. Green, DVM, DACVIM, DABVP
Professor and Chair, Chief of Staff

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NEUROLOGICAL EHV-1 OUTBREAK UPDATE

WITH DR. MAUREEN LONG, DVM, MS, PHD, DACVIM

Veterinarians with suspect cases of EHV-1 must report to FDACS immediately 1-877-815-0034

Equine Herpesvirus 1 (EHV1) has a relatively short incubation period (1-10 days) with a rapid onset of viral shedding that is highest over the first three days of disease (Figure 1). Most shedding is over by 10 days but shedding has been detected in certain horses up to a month. Transmission occurs in several ways and these include: 1) nose to nose contact 2) people through contamination of hands and equipment 3) inanimate objects such as water buckets, bits, clippers, etc, 4) aborted placenta and fetal tissues.

The most important point is that clinically ill horses with neurotropic EHV1 are capable of shedding high amounts of virus and isolation of these horses and personal protection consisting of gowns, boot coverings, head coverings, and gloves to prevent horse-human-horse transmission must be used. In an outbreak, most horses manifest as subclinically infected but these horses still shed virus. The good news is that herpesviruses are easily inactivated with quaternary ammonium compounds or bleach (10%). Hand washing and soap/water washing of equipment will minimize contamination. **However, without this, herpesviruses can persist in the environment for a week and sometimes for up to 30 days.**

EHV-1 Clinical Signs of Disease

Respiratory signs: May be minimal and of short duration and increased rectal temperature may be the only clinical sign. Most horses can have two fever spikes. The initial rise in rectal temperature can be mild-101.5 to 102.5°F and is often missed. After the initial temperature rise, the horse can either be clinically normal, develop nasal discharge, another increased temperature (> 102.5), slight cough, abort, or, in a small number of cases develop neurological signs.

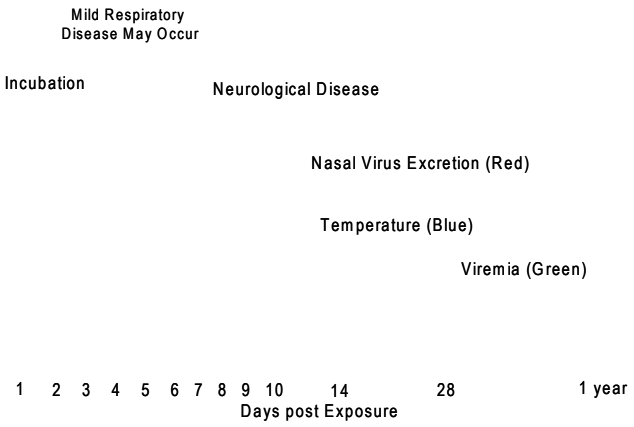

Figure 1. Diagram of clinical signs, nasal virus excretion, and viremia in horses with EHV-1 (E.P. Gibbs 2006)

Neurological signs: Horses become ataxic (incoordination), can be unable to empty its bladder, and may demonstrate weakness of the tail. Some horses will become completely paralyzed; the prognosis for these horses is poor. In a small number of cases, horses can show abnormal mentation and develop cranial nerve signs. Most horses become mildly to moderately neurologic and stabilize rapidly. The neurologic signs can persist but most horses are normal by 3 to 6 months after onset of clinical signs.

Abortion: Pregnant horses can experience spontaneous abortion between 7 days and several months after exposure. The mare will exhibit limited initial signs.

The take home message is that outbreaks of neurologic EHV1 can occur in populations of horses with a higher frequency of affect horses (30-50%) and a higher incidence of mortality (30-50%) in affected horses. This is the basis for concern and the need to quarantine when these outbreaks manifest. In populations of horses that break, usually 28 days is required in which no horses leave the herd or are added to the herd to allow for activity to minimize. In the individual horse that is affect and isolated, a 21 day period should be observed until testing and release.

Testing: UPON onset of clinical signs (temperature), a **nasal swab** and a blood sample **(purple top tube)** should be performed. Nasal shedding can be of short duration and the samples should be taken the first day there is an increase in body temperature.

Vaccination: No vaccine is marketed with efficacy against neurological signs associated with EHV1. In an outbreak situation, vaccination must be weighed against the need for accurate diagnostic information. Vaccination in general will decrease post exposure nasal shedding of virus; both killed and modified live vaccines have demonstrated have this affect. Currently killed vaccines offer protection against EHV4 which is still important in certain populations of horses. However a modified live vaccine would be expected to provide a faster onset of immunity especially in naïve populations of horses. Owners and veterinarians must decide which vaccine program best fits the needs of a particular situation.

Medicine

with Dr. Rob MacKay BVSc, PhD, DACVIM

As always at this time of the year, the Large Animal Medicine Service looks forward to the upcoming foal season. Although this is our busiest time of the year, it is also the most rewarding. We believe that our infrastructure of equipment and support staff combined with the collective expertise of our faculty clinicians and residents really does work well – many critical foals are saved that several years ago would have had little or no chance of survival. We like to think that the first equine neonatal intensive care unit in the world (ours) is still the best.

The service is undergoing some rearrangements this spring. After ten years as service chief, I'm handing over the reins to Dana Zimmel. Dr. Zimmel is known to most of you from her previous roles as a private practitioner in Ocala, equine extension specialist here at the University of Florida, College of Veterinary Medicine, and an active participant in the leadership of FAEP and AAEP. I am sure that Dana's varied background will bring a new and fresh perspective to our work and redound to the great benefit of our service and clients. Steeve Giguère remains head of the ENICU; Chris Sanchez and I will continue our roles as resident and beer coordinators, respectively.

This season we also have reorganized technical staff so that Heather Wells is exclusively attached to the Large Animal Medicine service. Through Heather, we have instituted a system of clinician notification and follow-up phone calls that should improve our efficiency and follow-through with clients.

This should be an excellent spring. We welcome back those of you who have used us before and to the rest we say – Happy New Year and give us a try!

Diagnosis of Failure of passive transfer of immunoglobulins in foals

with Dr. Steeve Giguère, DVM, PhD, DACVIM

Failure of passive transfer of immunoglobulins (FPT) is the most common immunodeficiency disorder of foals. There has been some controversy regarding the definition of FPT, but the most widely recognized classification defines FPT as serum IgG concentrations of less than 400 mg/dl after 24 h of age.

Partial FPT is often defined as serum IgG concentrations between 400 and 800 mg/dl whereas foals with adequate transfer of IgG have serum concentrations greater than 800 mg/dl. The incidence of FPT (IgG < 400 mg/dl) in foals has ranged between 3 and 20 %. Several studies have documented a positive correlation between FPT and bacterial sepsis.

Assessment of colostrum quality

The three potential causes of FPT are production failure, ingestion failure and absorption failure.

Insufficient production of colostrum can occur with a premature birth where the mare has not yet produced colostrum at the time of foaling. Serious illness in the mare during gestation or ingestion of endophyte-infected fescue during the third trimester of gestation can also contribute to a lack of colostrum production. Twinning, placentitis and premature placental separation can cause premature lactation in the mare. Mares with premature lactation prior to foaling often leak colostrum, leading to low IgG concentrations at the time of foaling. Finally, the mare may produce an ample volume of colostrum that is of poor quality with inadequate IgG concentrations.

Colostral immunoglobulin concentration can vary widely between mares. Good quality colostrum has IgG concentrations in excess of 3000 mg/dl. Immunoglobulin concentration in colostrum can be directly measured by single radial immunodiffusion. Alternatively, fairly accurate stall-side estimation of colostral immunoglobulin concentrations can be achieved by refractometry, specific gravity or glutaraldehyde coagulation.

The equine colostrometer (Jorgensen Laboratories, Loveland CO) is a modified hydrometer that measures the specific gravity of colostrum. A specific gravity of >1.060 corresponds to an IgG concentration of >3000 mg/dl.

A hand held refractometer (Bellingham & Stanley Inc. Lawrenceville, GA) used to measure alcohol and sugar content of wine can also be used. A reading of greater than 23% on the sugar scale or greater than 16º on the alcohol scale corresponds to IgG concentrations > 6000 mg/dl.

The ability of glutaraldehyde to form a solid clot in the presence of gammaglobulins can also be used to estimate IgG content of colostrum (Gammacheck C, Plasvacc USA, Templeton CA). Formation of a solid clot in 10 min or less corresponds to IgG concentrations > 3800 mg/dl.

Finally, a stall side immunoassay for colostrum evaluation has recently been marketed (Midland Bioproducts Corp. Boone, IA).

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Diagnosis of FPT

Assessment of passive transfer is important to accomplish within the first 24 hours. This is the period of time when the foal is most vulnerable to infectious organisms if transfer of immunoglobulins has not been achieved. Serum immunoglobulin status can be determined as early as 6 hours after birth if the foal has nursed sufficiently. Generally, immunoglobulin concentration is measured at 18-24 hours at which time serum IgG concentration has reached its peak. However, if there is concern or uncertainty regarding adequate ingestion of colostrum, the foal should be evaluated before 12 hours such that oral supplementation of colostrum or an oral immunoglobulin preparation can be given. Foals that develop clinical signs of illness should have their immunoglobulin concentration assessed to determine the need for therapeutic intervention even if IgG was adequate during an earlier routine check.

Single radial immunodiffusion has historically been considered the most quantitatively accurate test available but requires an 18-24 hour incubation period. This long delay before test results are available is the major disadvantage of this test as rapid identification of FPT is imperative for timely therapeutic intervention.More recently, turbidimetric immunoassays run on routine chemistry analyzer have also been shown to be accurate.

Several stall-side tests or kits are available to estimate immunoglobulin concentration in whole blood, serum or plasma. Criteria for selection of a screening kit for FPT in foals include overall accuracy, time necessary to perform the assay, and cost (see table). Zinc sulfate turbidity (Equi Z, VMRD, Pullman, WA), and glutaraldehyde coagulation (Gamma-Check-E, Plasvacc USA, Templeton CA) tests are good initial screening tests because they are relatively inexpensive and results can be obtained in 5 min (glutaraldehyde coagulation) to 1 h (zinc sulfate turbidity). These tests are fairly sensitive for the diagnosis of FPT but they lack specificity. As a result, the predictive value of a negative test is very good, indicating that the foal likely has adequate transfer of maternal immunoglobulin. In contrast, a positive test does not necessarily indicate that the foal has FPT and additional testing is warranted.

Many practitioners prefer the convenience and ease of use of immunoassays. Both quantitative (DVM Stat, CAA, WestBand, WI) and semiquantitative (Snap, Idexx Laboratories, Westbrooke, ME; Foal IgG Midland Quick Test, Midland Bioproducts Corp. Boone, IA) immunoassays are commercially available.

If you have questions about any of the information in this article please call (352) 392-4700 ext. 4000.

Comparison of sample type, sample volume required, time necessary to perform the assay and approximate cost for commercially available assays.

Test	Principle	Sample type	Sample amount (mL)	Time	Tests per kit	Cost per kit ($)	Cost per test ($)
VMRD RID	RID	S	0.003	18-24 h	30	85.00	2.83*
					60	150.00	2.50*
Triple J Farm	RID	S, P	0.005	5-18 h	24	68.40	2.84*
DVM Stat†	Immunoassay	S, P	0.005	20 min	10	120.00	12.00
					20	200.00	10.00
Equi Z	Zinc sulfate	S	0.1	1 h	10	50.00	5.00
					24	95.00	3.96
Midland	Immunoassay	S, P, WB	0.2	20 min	3	22.50	7.50
					6	36.00	6.00
					12	69.00	5.75
					24	132.00	5.50
Snap	Immunoassay	S, P, WB	unspecified	7 min	10	136.50	13.65
Gammacheck E	Glutaraldehyde coagulation	S, WB	1.5	5 min	10	27.50	2.75
					25	50.00	2.00

S: serum; P: plasma; WB: whole blood; h: hour; min: minutes; RID: radial immunodiffusion; *price per test will be higher if only a few samples are run at a time because standards must be run each time. †The price of the analyzer is $695.00

Equine Neonatal Basic Care Guidelines

with Dr. Dana Zimmel, DVM, DACVIM, DABVP

Physical exam: All neonates should receive a physical examination within the first 8-24 hours of age. See the following table for each specific parameter that should be examined including the normal values and possible reasons for abnormal observations.

Physical Exam	Normal	Abnormal
Attitude, Behavior	Bright, alert, responsive	Depressed, sleepy, hyperexcitable, seizures
Temperature	99.0 - 102.0 °F	Hypothermia- sepsis, prematurity, asphyxia; Fever- indicates infection
Heart rate	70-110 bpm, normal rhythm	Tachycardia- dehydration, sepsis, asphyxia, pain, shock, fever; Bradycardia- septic shock, hypothermia, hypoglycemia
Capillary refill time	< 2 seconds	Prolonged CRT- dehydration, shock
Mucous membranes	Pink and moist	Red/ injected-sepsis, endotoxemia; Pale pink- anemia; Brown/orange- hemolysis, liver disease, sepsis; White/grey- shock
Pulse quality - distal extremities	Strong, warm extremities	Poor quality, cool limbs- hypotension, hypovolemia,
Respiratory rate	30-40 breaths/min	Tachypnea-stress, pain, pneumonia, shock, fever, acidosis; Slow or irregular-asphyxia, shock, hypothermia, prematurity
Auscultation of lungs	Easily heard over the entire thorax	Crackles, wheezes, absent lung sounds-pneumonia, atelectasis
Gastrointestinal motility	Borborygmi present bilaterally	Absent or increased borborygmi / abdominal distension- Enteritis, ileus, hypoxic damage to gi tract, meconium impaction, uroabdomen
Feces, quantity, color, consistency	Pasty yellow or tan in color, 2-4 times a day	Constipation-meconium impactions; Diarrhea- viral, bacterial, parasite induced; Bloody diarrhea- *Clostridium* or *Salmonella* enterocolitis
Suckle reflex	30 minutes after birth	Absent or weak -sepsis, asphyxia, immaturity
Urine	Clear, urinates frequently, USG < 1.008	Decreased volume with dehydration, renal failure, uroabdomen
Umbilicus	Dry and small	Swelling or purulent discharge-umbilical infection; wet (urine)-patent urachus
Eyes, eyelids	Clear cornea	Tearing, miosis, blepharospasm can indicate corneal ulceration which can occur with recumbency or entropion
Joints	No evidence of lameness or distension	Pain, heat, joint swelling or lameness can be caused by septic arthritis/physitis
Palpation of ribs	smooth, non-painful	If broken there may be increased RR rate, edema or crepitus over thorax

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Foal Meconium Impaction

Foal Straining

Administration of Enemas: Meconium is digested amniotic fluid and cell debris. Most foals should pass meconium within 4 hours of birth. It is very common to administer an enema to prevent straining soon after the foal is born. Over the counter enemas such as phosphate-based Fleet® enemas are acceptable for this purpose. They are very simple to use and require proper restraint of the foal while inserting the soft applicator into the rectum. As an alternative a stallion catheter can be used to administer a soapy water enema using a few drops of Ivory soap in 200-500 mls of warm water. The rectum is check by digital palpation first to remove hard feces. The tube is lubricated and inserted approximately 6-8 inches and the enema is given by gravity. If the foal displays signs of constipation or straining without passage of meconium after 2-3 enemas veterinary examination is prudent.

Dip Umbilicus

Sunken eye due to dehydration

Umbilical Care: If the umbilical stalk is bleeding after foaling a temporary clamp should be applied. Avoid using suture that can serve as a nidus for infection. The use of strong solutions of iodine or tincture of iodine on the umbilical stalk is contraindicated because it can cause severe scalding and necrosis of the skin. Dilute iodine (2%) or 1 part 2% chlorhexidine and 3 parts sterile water are recommended. Fill a 6 or 12 cc syringe case with the solution and hold it over the umbilical stalk for 30 seconds. Dipping the umbilicus 1-4 times a day for 1- 2 days is adequate in a healthy foal. A spray bottle could be used as an alternative to dipping. Inspection of the umbilicus for purulent debris, sudden enlargement, bleeding or urine should be part of the daily routine by the farm manager for the first 3 weeks of life.

Practical use of antibiotics in the neonatal foal

Chris Sanchez, DVM, PhD, DACVIM

The main indications for antimicrobial use in the neonatal foal include the prevention or treatment of sepsis and the treatment of clostridial diarrhea.

Prevention of sepsis

Some of the most important strategies for sepsis prevention include maintaining a clean environment, reducing the potential bacterial load introduced during udder seeking, ensuring rapid gastrointestinal intake and passive transfer of immunoglobulins, and appropriate umbilical care. But, if foaling is unattended or some of the above factors either cannot be ensured or have been documented as inadequate, a 3-5 day course of antimicrobial therapy is often recommended. If the foal remains healthy and afebrile, 3 days is typically adequate, with a longer duration recommended for those foals in which multiple risk factors have been identified. Broad-spectrum antibiotics (ie. penicillin and an aminoglycoside) are typically recommended.

Treatment of sepsis

Antibiotics provide the basis of therapy for foals in which bacterial sepsis is either highly suspected or confirmed by culture. Initially a broad-spectrum bactericidal approach must be used based on previous experiences and costs. Antimicrobial therapy should begin immediately in any foal in which sepsis is suspected. A minimum therapeutic course of two weeks is recommended for bacteremic foals without localizing clinical signs. If localizing signs, such as pneumonia or septic arthritis, are present, a minimum course of 4 weeks is recommended.

Agent	Preparation	Route	Interval (h)	Dosage (/kg)
Amikacin	sulfate	IV, IM	24	25 mg
Ampicillin	sodium	IV, IM	6	22-25 mg
Cefotaxime	sodium	IV	6	40 mg
Cefpodoxime	proxetil	PO	8-12	10 mg
Ceftiofur	sodium	IV, IM	12	5 mg
Chloramphenicol	palmitate	PO	6-8	50 mg
Gentamicin	sulfate	IV, IM	24	6.6 mg (10-16 mg/kg if <7days of age)
Metronidazole		IV, PO	8-12	10-15 mg
Penicillin G	sodium or potassium	IV	6	22,000-40,000 IU
Penicillin G	procaine	IM	12-24	22,000 IU

Few published veterinary reports discuss antimicrobial sensitivity of organisms isolated from septic neonatal foals. A common theme is that a lower percentage of gram-negative isolates are sensitive to gentamicin relative to amikacin. Paradis reported that 95% and 91% of gram-negative isolates were sensitive to amikacin and cefotaxime, respectively, while sensitivity to gentamicin and trimethoprim-sulfa was much lower.

Wilson reported cumulative sensitivity of all isolates from 33 foals to be >90% for imepenim, ciprofloxacin, ceftriaxone, and ceftazidime, 80-89% for amikacin and ceftizoxime, and only 70-79% for gentamicin and ceftiofur. Some organisms, such as Enterobacter, Acinetobacter, Enterococcus, and coagulase-positive Staphylococcus spp. have demonstrated substantial resistance.

At UF, antimicrobial sensitivity of organisms isolated from foal blood cultures has varied somewhat by decade. In those recovered from 2000-2004, approximately 65% were sensitive to trimethoprim-sulfa, 80% to ceftiofur, 80% to a combination of penicillin and gentamicin, and 92-94% to a combination of penicillin and amikacin or ampicillin with either amikacin or gentamicin.

Thus, based on available data, a recommended initial therapeutic approach involves combining amikacin or a third-generation cephalosporin with penicillin or ampicillin. The use of aminoglycosides should be tempered in light of the foal's cardiovascular and renal status. If a foal is severely hypovolemic and azotemic, a safer initial choice would likely involve a cephalosporin. If animoglycosides are used, serial monitoring of creatinine every 2-3 days is recommended in order to monitor for potential renal side-effects. A trend of increasing serum creatinine concentration can be an early indicator for nephrotoxicity, even without an overt increase above the normal range.

Unfortunately, the range of effective oral antibiotics is limited. Due to significant resistance, trimethoprim/sulfa combinations should not be used in septic foals without documented sensitivity, and then only as a long-term option following initial parenteral therapy. Cefpodoxime proxetil, a third-generation cephalosporin available for oral administration, was recently evaluated by Drs. Natalie Carrillo and Steeve Giguère.

Antibiotic Use in Foals from Page 9...

This drug was shown to be effective against 90% of Klebsiella spp., Pasteurella spp. and β-hemolytic streptococci.

Unfortunately, it was less effective for other bacteria commonly associated with neonatal sepsis. Fluoroquinolones, such as enrofloxacin, have an excellent spectrum of activity against gram-negative and some gram-positive organisms but have been associated with arthropathy in foals. Thus, use of this agent should be reserved for those cases with documented resistance to other antimicrobial agents, such as with Salmonellosis and associated osteomyelitis, and informed owner consent.

Treatment of clostridial diarrhea

Clostridial diarrhea can occur sporadically or in outbreaks. A complete review of clostridiosis in foals is beyond the scope of this article, but C. difficile-associated diarrhea can range from mild to highly fatal, hemorrhagic or necrotizing diarrhea to lactose intolerance in foals. C. perfringens (type C)-associated diarrhea is typically associated with watery to hemorrhagic diarrhea, often with signs of abdominal pain. If clostridial diarrhea is suspected, therapy with metronidazole should be instituted as early as possible and continued for at least 7-10 days. In outbreaks of C. perfringens, therapy with metronidazole should be instituted for at least 3-5 days in any suspect foal, as rapid deterioration and death can occur prior to the onset of diarrhea. Some cases of metronidazole-resistant C. difficile have been documented. But, these cases are rare in the Southeastern United States, and use of vancomycin should be limited to severely ill, isolated foals in which resistance is either highly suspected or documented.

Managing the Llama and Alpaca Neonate

with

Dr. Michael Porter, DVM, MS, DACVIM

More and more Floridians are venturing into the business of raising llamas and/or alpacas for the harvesting of their wool. There are some important concepts to remember regarding pregnancy and parturition of these neonates, also known as 'crias'. The length of gestation for alpacas and llamas is 330 days and 345 days, respectively. It is recommended that the dams receive routine medical care (vaccination, deworming, and foot trims) no later than 60 days prior to the expected deliver date to reduce the stress on the dam. As the time of parturition nears, most dams will begin to develop an udder within 1-3 days of delivery.

Once the fetal membranes have ruptured the cria is typically expelled between 30 and 120 minutes. In addition, the complete fetal membranes are expected to pass within 4-6 hours after the cria has been delivered. Any delays in the delivery and/or expulsion of the placenta should be considered a medical emergency and the dam should be evaluated by a veterinarian immediately. It is normal for the dam to have mucopurulent discharge (lochia) exiting from her vulva for 3-4 days after birthing.

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Septic Arthritis in the Neonate

with Dr. Troy Trumble, DVM, PhD, DACVS

Due to its immature immune system, neonates are more likely to be susceptible to infection (sepsis). Systemically septic foals have the tendency to infect other tissues, such as the joints, via spread of bacteria through the bloodstream. Sepsis should be considered in any lame foal < 1 month of age, but identification of septic arthritis can be difficult. Thorough daily musculoskeletal examinations are important because many are weak and recumbent. Clinical signs include: joint distention and/or heat, swelling around the joint, pain from and/or restriction to passive movement, as well as focal pain on palpation. Any joint or combination of joints can be involved, but usually larger joints such as the stifle, hock, carpus and fetlocks are most often affected.

When clinical signs suggest joint infection, it is important to obtain radiographs of the joints of interest because infection of the joint and growth plate region are closely related. If the foal does not respond to therapy or regresses during treatment, more radiographs should be taken and compared to baseline. In addition, other more advanced diagnostic imaging techniques such as ultrasound, nuclear scintigraphy (bone scan), or magnetic resonance imaging (MRI) could be used to identify infection prior to radiographic changes.

Examination of joint fluid helps confirm the diagnosis, monitor effectiveness of therapy, as well as potentially identify the causative agent. The presence of inflammation leads to an increase in both total protein as well as white blood cells (WBC) within the joint fluid. Usually joint fluid total protein > 4 g/dl is indicative of severe inflammation that can be associated with infection. When this is combined with a joint fluid WBC count of > 30,000 ul, infection should be suspected. Joint fluid should also be collected for bacterial culture to help select the appropriate antibiotic.

Treatment can be difficult because many have multisystemic disease. No one treatment is better than another, and a combination of some or all probably leads to the best chance for a successful outcome. Systemic antibiotics should be started as soon as possible after the diagnosis is confirmed, or even presumed. Since culture results generally take 48 hours to obtain, initial antibiotic selection will need to be chosen prior to having knowledge of the infecting organism. Broad-spectrum antibiotics (usually penicillins combined with one of the following: cefazolin, ceftiofur, gentamicin or amikacin) should be chosen.

Joint lavage can enhance the effectiveness of systemic antibiotic therapy by decreasing the number of organisms present within the joint fluid so the antibiotic has the potential to be more effective against the decreased numbers. In general, joint lavage will need to be repeated within 48 hours if there is no significant improvement in the amount of effusion or degree of lameness. Once significant inflammation is present, fibrin accumulates within the joint. Bacteria will congregate around fibrin making it difficult to decrease the number of organisms until fibrin is removed. At this stage, treatment needs to become more aggressive by debridement via an arthrotomy or arthroscopically.

An additional approach is delivery of a high concentration of antibiotics directly to the infected site since alterations in tissue blood supply can limit the activity of the systemically administered antibiotic in the actual infected tissue. To combat the most common type of bacteria present in septic joints aminoglycosides such as amikacin and gentamicin are routinely used for intravenous or intraosseous regional perfusion. The ideal number of regional perfusions that should be performed is unknown, but repeat administration is often performed within 48 hours. Additional local therapies that are of some benefit in septic joints include intra-articular antibiotic administration, antibiotic impregnated beads, as well as indwelling drains.

The prognosis for septic joints in foals is poor to unfavorable for survival. Early diagnosis and treatment via lavage and debridement has been shown to be the most important aspect of a successful outcome. In other words, early and aggressive treatment is paramount for success. One study demonstrated that 71% of foals treated within 2 days of the onset of clinical signs survived whereas only 4% survived when treated after 2 days. However, the potential for future athletic function may not be very good for those that survive, as only 30-48% of Thoroughbred foals that had septic arthritis as a neonate started > 1 race. Other factors that affect the prognosis include the systemic status of the foal, number of joints involved, as well as the extent of corresponding bony lesions.

Overall, the prognosis for survival and successful athletic performance in foals with septic joints is guarded, but has the best chance for success if treated early and aggressively using any combination of the methods described above.

Reproductive Management of Mares That Are Hospitalized After Foaling

Mats H.T. Troedsson, DVM, PhD, DACT, DECAR
Margo L. Macpherson, DVM, MS, DACT

Maintaining yearly foal production is important to broodmare operations. Since income is generated from selling offspring, maximal foal production ensures optimal economic performance for broodmares. Income generated from annual foal production also offsets maintenance and breeding expenses incurred by the mare owner. Furthermore, many breed associations impose a January 1 birth date. Breeding for foal production early in the year allows the offspring to command superior sales prices as yearlings or even two-year-olds, and to remain competitive with its peers, again enhancing economic returns (figure 1).

In order to maintain an annual production rate after foaling, mares need to be bred soon after parturition. Mares typically have an average gestational length of 333 to 342 days (range 320-360). Therefore, a mare must become pregnant within one month post partum in order to continue to produce one foal each year. Estrus generally begins 5-12 days after foaling; hence, the terminology foal-heat or "9 day heat" is often used.

FIGURE 1
USED WITH PERMISSION FROM DAN SHARP, PHD
UNIVERSITY OF FLORIDA
DEPARTMENT OF ANIMAL SCIENCES

The foal-heat usually results in ovulation, with most mares ovulating within 20 days post partum. The average interval from parturition to first ovulation approximates 10 days. Mares that foal early during the season and do not become pregnant on foal-heat, may enter seasonal anestrus (ovarian inactivity). Pregnant mares exposed to artificial lighting (approximately 60 days) are less likely to show ovarian inactivity after foaling.

Given the short postpartum to conception interval required to maintain yearly offspring, breeding mares in the foal-heat period appears to be an attractive strategy to enhance reproductive efficiency. Although pregnancy rates from mares bred on foal-heat have been reported to be lower than for mares first bred on subsequent estrous periods, it appears that there is little impact on the overall pregnancy rates in those mares that do not get pregnant on foal-heat and must be bred again. Therefore, breeding on foal-heat offers the advantages of maintaining a yearly production rate and reducing the possibility of seasonal anestrous in early-foaling mares not bred on foal heat.

However, components such as uterine health must be considered for successfully breeding mares on the first estrus after foaling. In addition, mares that are hospitalized with a sick neonatal foal on her side may be difficult to manage for optimal reproductive efficiency.

Hospitalization may disrupt original breeding plans for the mare, and visits to the breeding shed or ordering of transported semen may be difficult to schedule. A sick neonatal foal is of great concern to the owner, and breeding management of the mare may seem less important at the time. However, if the mare fails to become pregnant, or even if she is successfully bred later during the season, the goal to produce one foal per year has failed.

From a strict financial standpoint, this will almost be as costly for the owner as loosing the foal that currently is treated in the neonatal unit. It is therefore, important to not only care for the foal, but also provide optimal care and closely monitor the mares' reproductive health during the critical post-partum period.

Uterine Involution

Uterine involution after parturition is a complex set of events that dictates the readiness of the uterus for re-establishing pregnancy. Involution occurs rapidly after a normal parturition. Factors such as tissue remodeling, uterine contractility and reduction in uterine size and fluid content are linked to successful uterine involution. Rapid reduction in uterine length and diameter occurs in the early postpartum period of the mare. There is a positive influence of exercise on involution of the uterus. Ultrasonographic measurements taken on days 6, 11 and 16 post partum (with the day of foaling designated as day 1) revealed the mean diameter of the previously gravid uterine horn reduced more rapidly in mares maintained on pasture compared to mares confined to stalls. For mares that are hospitalized with an unhealthy foal on their side, exercise is limited with the mare confined to stall rest. In addition, she is often not nursed by the foal. This is important, since nursing may be another component in normal uterine involution. When the foal is nursing, oxytocin is released from the pituitary gland of the mare. In addition to being important for milk let-down, oxytocin has an effect on uterine contractility. A failure of the uterus to contract during the post-partum period will delay involution.

Luminal contents (lochia) are discharged from the uterus via the cervix during uterine involution. Lochial discharge is typically seen as a vulvar exudate between days 3 and 6 post partum. Color of lochia varies from red to reddish brown, but sometimes can be yellowish when mucopurulent. Normal lochia is not malodorous and is easily distinguished from the fetid uterine discharge of mares with an acute uterine inflammation. Ultrasonographically, luminal fluid is frequently seen in the first few days after foaling, but should not be present at the time of breeding. We have observed that mares that are confined to stall rest during the post partum period retain intraluminal fluid longer than exercised mares.


photo by: Dale Eurenius

Treatment Effects on Uterine Involution

Several treatments have been tried to hasten uterine involution and/or improve postpartum pregnancy rates. These treatments have included stimulating uterine contractions, removing uterine fluid contents, and hormonal therapy.

Uterine lavage has been used in postpartum mares with questionable benefit in hastening uterine involution or postpartum pregnancy rates in normal mares. This is not surprising, since the normal foaling mare has an efficient mechanism for involution. Routine uterine lavage for normal foaling mares is therefore, not be recommended. However, if uterine involution is delayed or if intrauterine fluid accumulation is present at the time of breeding, uterine lavage should be beneficial.

Oxytocin or a prostaglandin analogue (prostalene) have been used to speed up involution in attempts to improve postpartum pregnancy rates, but the effect in normal mares has not been consistent. Therefore, treatment of the normal foaling mare may not alter postpartum events because natural mechanisms are already contributing to rapid repair of the uterine environment. The effect in mares that experience abnormal parturient events, mares that are confined to stalls because of health problems to the mare or foal, or aged mares with compromised uterine clearance, might be more profound. Mares with foals that are too weak to nurse, are routinely treated with oxytocin at UFVMC.

Factors that will decide if a mare can be bred on foal-heat:

Parturient Conditions

Periparturient problems, including dystocia or retained placenta, have been shown to slow the uterine involution rate and delay the first postpartum ovulation. In addition, mares experiencing a dystocia frequently suffer trauma to the genital tract that will impair reproductive soundness. This category of mares would not be suitable for breeding during foal-heat.

Day of Ovulation Post partum

The day of first postpartum ovulation has long been the benchmark for determining if a mare is ready to breed in the foal-heat period. Historically, pregnancy rates have been higher in mares that have ovulated after day 10 postpartum. Recent data from Texas A&M indicate that the day of first postpartum ovulation may not be a definitive factor for success in foal-heat breeding. Other factors, such as inherent fertility of the mare, uterine health, and exercise may be as important as the day of ovulation for mares bred on foal-heat.

Presence of Intrauterine Fluid

The presence of intrauterine fluid at the time of foal-heat breeding will significantly interfere with a mare's ability to become pregnant.

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Strategies for Breeding Mares on the First Estrus Post Partum:

- Treat each mare individually, and pay extra attention to the uterine health of mares at risk of delayeduterin involution (e.g. hospitalized mares).
- Examine the mare beginning day 5-8 post partum
- Breed only mares that do not have intrauterine fluid accumulations.
- Practice good breeding management protocols with postpartum mares.
- Consider post-breeding treatment in at-risk mares.

Uterine therapy should not be necessary in the normal, post-foaling mare with unlimited access to exercise and a suckling foal. Mares that show abnormal retention of uterine fluid in the postpartum period may benefit from post-breeding treatment with oxytocin and/or uterine lavage.

An Alternative Postpartum Breeding Strategy

Many mares that are hospitalized during the immediate post-partum period, experience delayed uterine involution and are not suitable to be bred during foal heat. For these mares, an alternative breeding strategy can be implemented in order to maintain an optimal foaling interval.

- Examine the mare daily, beginning day 5-8 post partum
- Determine the day of ovulation.
- Administer prostaglandin (PGF2%) 5-6 days after ovulation for luteolysis.
- Monitor the mare for signs of estrus and breed.

It is thought that a short-cycling protocol allows the uterine environment more time for involution. This protocol provides a shorter interval to breeding than breeding on the second naturally occurring postpartum estrus (typically around day 30). The success of this breeding strategy is still dependent on the reproductive management of the mare during the first 7-10 days after foaling.

In conclusion, with a target on a breeding interval of one foal per year, special attention must be directed towards the reproductive health of mares that are hospitalized with a sick foal during the immediate post-foaling period. Close monitoring of uterine involution and follicular development in combination with sound breeding decisions will optimize the mares' reproductive performance. Considering criteria such as parturient events (dystocia, retained placenta, reproductive tract trauma), uterine involution, physical examination findings and good breeding management, breeding during foal heat, or short-cycling of the mare after foal heat can result in favorable pregnancy rates in a highly efficient manner.

Managing Llama and Alpaca Neonates continued from page 10...

Evaluation of the cria shortly after birthing is important. The cria should be evaluated for birth defects such as contracted tendons, chloanal atresia, and wry face, Chloanal atresia is a common birth defect that affects the nasal passages of llamas and results in severe difficulty in breathing. Hence, respiratory rate and effort should be closely monitored. Equally important, cardiac abnormalities are relatively common in crias and may result in exercise intolerance and/or respiratory distress. Any cria that is having difficulty breathing (open-mouth breathing) or appears weak should be evaluated by a veterinarian immediately.

Some important post-birthing events that should be documented:

1- Standing within 2 hours of delivery
2- Nursing within 4 hours of delivery
3- Rectal temperature: 37.7-39º C
4- Pulse rate: 60-90 beats per minute (bpm)
5- Respiratory rate: 10-30 bpm
6- Muconium (first feces)passed within 2-4 hours of delivery

Finally, it is very important to ensure that the cria receives adequate immunoglobins from the dam's colostrum and appropriate measures are taken to treat the umbilical stump. Failure of passive transfer in newborn crias is a complication that can result in critical illness and sometimes death. Crias should consume more than 10 percent of their body weight during the first 24 hours of life. For a 10kg llama, 1kg or 1 liter of colostrum is required. If there is any question regarding the status of passive transfer, a veterinarian should collect blood from the cria to verify the levels of immunoglobins in the cria's serum. The umbilical stump should be treated three times during the first 24 hours postpartum with a dilute (0.5%) clorhexidine, followed by two times per day for the next 7 days. Failure to properly treat the umbilical stump may result in a localized infection that can become systemic.

It's blue skies and clear eyes for Lulu these days

by Sarah Carey

The 3-month old Miniature Jersey cow, owned by Peter Petres of Bradenton was born with cataracts but now has the gift of sight, thanks to the UF Veterinary Medical Center's ophthalmology team.

"She came in on Tuesday, Oct.,10th, had surgery the next day and went home the following Monday so that we could keep her confined and give her intravenous medications," said Dr. Caryn Plummer, assistant professor of ophthalmology, who served as the attending veterinarian on the case along with Dr. Maria Kallberg.

Lulu, a 4-month-old Miniature Jersey cow, on Oct. 11 prior to her release from the UFVMC. Lulu had successful surgery to remove cataracts in both eyes Oct. 10 and continues to recuperate well at home.

"We did cataract extraction by way of a procedure called phacoemulsification -- the same procedure that we use to remove cataracts in dogs and that human ophthalmologists use to remove cataracts in humans," Plummer said. "The cow's lens is much larger, though."

Plummer said Lulu was "doing great" and had returned to the VMC two weeks after surgery for a recheck. "She's healing beautifully," Plummer said. "Her vision will never be normal, because we do not have an intraocular lens available for use in cows, since there is no commercial market for such things. Even so, her vision will certainly be better than before the cataract removal." Congenital cataracts are rare in large animals, Plummer said. "But it's even more rare to have a situation in which we are able to treat them, since most cows would be culled because of them."

For Petres, the latter was never an option. In fact, he and his wife, Tracy, had been looking for a Miniature Jersey cow because they thought the breed would be perfect for their five-acre ranchette near Sarasota. "Over the years, I kept tabs on breeders, availability, prices and general information," Petres said. "This past June, I saw that a breeder had a heifer cow born with congenital cataracts. It tugged at my heartstrings, what the outlook might be for this calf, so before I even spoke to the breeder, I contacted UF's VMC to see what might be done."

Told that cataract removal was indeed possible and would give Lulu a better quality of life, Petres contacted the breeder and arranged to pick Lulu up. "She stayed at a friend's place along with four horses while I finished a new barn and introduced Lulu's companion, Sammy, to his new surroundings," Petres said. "With the cataracts, Lulu had a limited routine on her own, so I made it a point to walk her as often as possible with a halter. There was no problem giving her attention where she was staying, as she is so cute and everyone loved her. She was brushed and handled often and seemed to thrive."

A few weeks before Lulu's operation, the Petreses moved her to her new home and introduced her to Sammy. "The two hit it off right away," Petres said. After he dropped Lulu off at UF's VMC, everyone was "compassionate and professional," but that didn't keep Petres from being anxious.

"Dr. Blackwood called daily with Lulu's progress and the next week I brought her home," he said. "Our first insight into her new-found sense was when we arrived home after dark. Sammy would have nothing to do with the alien sporting the satellite dish (Elizabeth collar) around her neck! He was snorting, kicking and running around."

Lulu, however, seemed quite content to be home.

"I guess in her previously dark world, everything seemed normal," Petres said, adding that Sammy sniffed Lulu through the stall slats her first night home and finally calmed down. "The next morning when I brought Lulu out of the stall into the pasture, it was her turn to kick and run," Petres said. "She ran around in circles, stopped to sniff poles, sniff me, and then went back to running while Sammy was looking and wondering what all the fuss was. Apparently, things looked different to Lulu in daylight."

He added that on the morning of Nov. 2, he took Lulu's collar off for good. "I tried to sneak up on her this afternoon, but she saw me halfway across the field, got up, stretched her back and trotted over to me," Petres said. "I got big, sticky cow licks. Life is good at the Petres Ranch."

UFVMC on the Scene

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