Septic arthritis is a common problem in horses that often occurs following contamination of joints with bacteria from wounds, intra-articular injections, and surgical procedures. In foals the most common source of bacteria is hematogenous transfer of bacteria to joints from the lungs, intestines or umbilical structures. Septic arthritis is a serious condition that may result in chronic lameness from loss of joint function, contralateral limb laminitis in mature horses, or death. Recent reports have shown similar survival rates for adult horses with septic arthritis, ranging from 90 to 94%. Survival in foals ranges from 78 to 89%. The lower survival rate in foals is due in part to multiple joint involvement and sepsis in other body systems. Return to performance in horses that survive treatment for joint sepsis ranges from 73 to 81%. However, the prognosis for foals with septic arthritis to race is still guarded, with 37 to 48% of foals treated for septic arthritis starting in a race. Smith et al reports that the odds ratio for foals treated for septic arthritis starting a race as compared to foals without septic arthritis is .28 with a confidence interval of 0.12-0.62, P=0.001. Septic arthritis with adjacent osteomyelitis of subchondral bone may be difficult to treat successfully.

Prevention of septic arthritis should be emphasized. Management practices to reduce neonatal sepsis have been described by Knottenbelt and others and should be employed in newborn foals. Endoscopic surgery for evaluation and treatment of open wounds and punctures into synovial cavities is necessary to remove foreign debris and joint pannus. Wright et al identified foreign debris in 43% of synovial cavities following injury. Endoscopic surgery should be done immediately after injury whenever possible to prevent contaminated joints from becoming infected joints. Septic arthritis following intra-articular injections and arthroscopic surgery has a low prevalence but is not uncommon due to the large number of these procedures being performed. All joint injections and arthroscopic procedures should be done with strict adherence to aseptic procedures. Perioperative antimicrobial prophylaxis may be indicated for joints at higher risk for infection following arthroscopy, such as the tarsocrural joint in draft horses. However, routine use of perioperative antibiotics for elective arthroscopic surgery has not proven to reduce infections in horses or humans. A recent study by the author showed a high percentage of joints were likely contaminated with hair and tissue debris following needle insertion. Reuse of needles for injections (as may occur when the joint is not entered on the first try), clipping or shaving the hair and the use of spinal needles increased the risk of hair contamination of the joint compared to first time needle insertion of sharp disposable needles through unclipped hair.

Diagnosis of septic arthritis is based on history, physical examination, synovial fluid analysis, culture of synovial fluid and membrane, and imaging. Standard radiographs and ultrasonography help define osseous and soft tissue abnormalities. MRI and CT imaging have been used recently on selected cases and may offer some advantage in early detection and characterization of subchondral bone lesions. A representative culture and antibiogram is

Figure 1: Subchondral cyst in condyle from septic fetlock joint. Seen with CT but not standard radiographs
extremely helpful in selecting effective antimicrobial drugs. However, bacteria are not always isolated from septic joints, particularly in mature horses following joint injections, and treatment with antimicrobial drugs should begin immediately upon diagnosis before results of the culture are known. It is useful to have an idea of the common bacterial organisms present in joint sepsis for selection of the initial antimicrobial therapy. Review of the records of 192 horses with septic arthritis/tenosynovitis by Schneider et al revealed that *Staphylococcus* is cultured from most horses following surgery or joint injection. Infection secondary to wounds often had more than one bacterium with *Enterobacteriaceae* and anaerobes frequently isolated. *Enterobacteriaceae* were most frequently isolated from foals with *E. coli* being identified in 27% of foals. Other bacteria commonly isolated include *Streptococcus* spp., *Pseudomonas* spp. and *Actinobacillus*. The objectives for treating septic arthritis are to eradicate the infecting bacteria; remove foreign material, fibrin, pannus and necrotic subchondral bone; remove inflammatory mediators, free radicals and damaging cytokines; reduce pain; and protect cartilage. The methods to accomplish these objectives are systemic antimicrobial administration, local antimicrobial delivery, lavage and drainage of the infected joint, and arthroscopic surgical debridement of debris and necrotic tissues.

### Medical treatment for septic arthritis

*Systemic antimicrobial drugs*: Systemic antimicrobials are indicated for treatment of all septic joints. The combination of a cephalosporin and amikacin gives the best general coverage for most of the bacteria that commonly infect joints and should be considered for first line treatment prior to bacterial isolation. Metronidazole may be administered when anaerobic bacteria are isolated although in animals many anaerobes are susceptible to penicillin. Trimethoprim-sulphonamide combinations have a broad spectrum of activity against many Gram-positive and Gram-negative aerobes but *Pseudomonas* and many anaerobes are resistant. Bacterial resistance to the potentiated sulfonamides limits their usefulness as a first line drug. Enrofloxacin has good penetration of bone and combined with a beta-lactam will provide broad spectrum coverage. Initial treatment of septic arthritis should be done with intravenous administration of antimicrobials. For prolonged treatment after initial therapy, oral formulations of the potentiated sulfonamides, enrofloxacin, or doxycycline may be used when appropriate based upon culture and sensitivity. All horses confirmed with septic arthritis should be treated a minimum of 2 weeks after cessation of clinical signs. My preference is to treat a minimum of 30 days from the time the most effective antimicrobial has been selected based upon culture and sensitivity.

### Table 1: Commonly used antimicrobial drugs and doses.

<table>
<thead>
<tr>
<th>Antimicrobial</th>
<th>Dose and Interval</th>
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<tbody>
<tr>
<td>Na or K salts of penicillin</td>
<td>22,000-44,000 IU/kg IV q 4-6 h</td>
</tr>
<tr>
<td>Ceftiofur</td>
<td>2.2 mg/kg IV, IM q 12 h (Neonates 5-10 mg/kg q 8-12 h)</td>
</tr>
<tr>
<td>Trimethoprim-sulphonamide</td>
<td>30 mg/kg PO q 12 h</td>
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<tr>
<td>Gentamicin</td>
<td>6.6 mg/kg IV q 24 h</td>
</tr>
<tr>
<td>Amikacin</td>
<td>21 mg/kg IV q 24 h</td>
</tr>
<tr>
<td>Enrofloxacin</td>
<td>5 mg/kg IV q 24 h (Oral dose up to 7.5 mg/kg q 24 h)</td>
</tr>
<tr>
<td>Metronidazole</td>
<td>20 mg/kg IV or PO q 8 h</td>
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</table>
Local Antimicrobial Therapy: Antimicrobial drug concentrations in synovial tissues following systemic administration are often not effective. The septic environment may inactivate the antimicrobial drug and the presence of necrotic tissue, ischemia, fibrin, and pannus can shield the bacteria from antimicrobial action. Local antimicrobial therapy delivers high concentrations of drug to the site of the infection while reducing systemic concentrations that can cause toxicity and reducing drug costs. Local antimicrobial therapy (LAT) is most suited to concentration dependent drugs, such as the aminoglycosides, though other antimicrobials have also been used clinically. Local antimicrobial therapy has gained much support by veterinarians for treatment of septic arthritis. Four methods of LAT have been evaluated in experimental studies and clinical trials in the horse. The methods are direct intraarticular injection, intravenous regional perfusion or intraosseous regional perfusion, antimicrobial impregnated polymethylmethacrylate (PMMA) beads and continuous intraarticular infusion.

Intraarticular injections - Direct intraarticular injection is the simplest and most common method of local antimicrobial delivery. Amikacin at 500 mg maintains drug levels above the minimum inhibitory concentration of most pathogens for 48 hours. Injection of 150 mg of gentamicin into the radiocarpal joint resulted in peak concentrations of 4,750 micrograms/ml. Antimicrobial concentrations in adjacent bone greatly exceed those obtained by systemic antimicrobial injections and are similar to those achieved by regional perfusion. Dose interval is 24-48 hours.

Regional limb perfusion - This method of LAT can be done via intravenous or intraosseous routes. The region to be perfused is isolated with a pneumatic or Esmarch bandage placed proximal to the affected joint. A tourniquet may also be placed distal to the carpus or tarsus to contain the perfused drug to the immediate area of the joint. Delivery of diluted antimicrobial is done via a superficial vein or by canulating the medullary cavity of an adjacent bone. The volume of the perfusate forces the drug into infected tissues even in the presence of ischemia or necrosis. Commonly 250 to 1000 mg of amikacin or gentamicin is diluted in 60 ml of sterile balanced electrolyte solution for the distal limb and 120 ml for perfusion of the carpal and tarsal regions. The perfusate is instilled into the vein or bone and the tourniquet is left in place for 30 minutes. Other drugs that have been used for regional limb perfusion are potassium penicillin, timentin, and ceftiofur. Treatments can be performed on the standing horse at 24-48 hour intervals until resolution of the infection.

Antimicrobial impregnated PMMA beads - The non-resorbable beads can be loaded with many different antimicrobial drugs although the most common ones are the aminoglycosides. The beads are hard and rough and may cause significant irritation to the joint but they may be used in joints for which fusion or ankylosis is desired and have been used successfully to treat sepsis of the tarsometatarsal joint.

Continuous intrasynovial antimicrobial infusion - Several commercial balloon pumps and catheter systems are available for this technique which enables controlled infusion of antimicrobial drugs directly into joint. The author selects this method of LAT for septic joints that have not responded to previous treatment, are chronic, or have subchondral bone involvement. Antimicrobial drugs delivered by this system include gentamicin, amikacin, ceftazidime, and ceftriaxone. A local anesthetic may also be added to the pump fluid to provide pain relief. Review of cases treated by continuous intrasynovial antimicrobial infusion by Lescun et al and Meagher et al support this technique as being a useful adjunct treatment.

Analgesia: Breaking the pain/inflammation cycle during synovial sepsis is achieved through the use of various drugs and physical treatments. NSAID’s are the most commonly used
analgesics in horses, though increasing use of opioids and various drug delivery methods such as continuous intrasynovial infusion of lidocaine, epidural administration of analgesics (typically alpha-agonists and opioids) and systemic constant rate infusion of analgesics have all been used to reduce reliance on NSAID’s in horses with septic arthritis. Contralateral limb laminitis is not uncommon in horses with severe long standing pain from septic arthritis.

**Chondroprotective drugs:** The value of chondroprotectants in the face of sepsis is not known. However, by reason, any method to reduce inflammation and normalize the synovial environment would be helpful. Systemic administration of the chondroprotective drugs is recommended if they are used.

**Surgical procedures to remove bacteria, inflammatory mediators, foreign debris and fibrin**

*Needle Lavage:* Technically simple and can be done on standing horse. Needle lavage is most effective in early disease before fibrin formation occurs which will plug needles. Large 14 or 16 gauge needles should be inserted in the joint from several locations so both ingress and egress needles are place. Lavage with 2-3 liters of balanced electrolyte solution is performed with intermittent pressure distention of the joint by occluding outflow needles. The procedure can be repeated every 24 hours as needed. If no improvement by second treatment more aggressive drainage and debridement recommended.

*Closed suction drainage:* Jackson Pratt or other suitable drains are placed within the joint and attached to vacuum. Best done after arthroscopic flush and debridement but drains can be placed as primary procedure.

*Arthrotomy:* Open drainage of septic synovial cavities has been reported by Schneider et al and others as a practical and effective method of treatment. This procedure can be done as the primary surgical procedure following local anesthesia in the standing horse. When possible the best approach is to assess, flush, debride and drain the joint arthroscopically and then enlarge the arthroscopic portals to approximately 3 cm in length. The arthrotomy incisions provide joint decompression via continuous drainage of the synovial cavity as well as access for regular lavage and direct antimicrobial delivery. Arthrotomy incisions often heal by granulation or they can be closed primarily following resolution of infection.

*Arthroscopy:* Arthroscopy is the best surgical method for treating septic joints. Direct visualization of the joint facilitates directed lavage, effective removal of fibrin and pannus, evaluation of the cartilage, debridement of subchondral bone lesions from concurrent osteomyelitis and removal of foreign bodies. This procedure facilitates quick return to a more normal synovial environment, in which medical treatments are more likely to be successful. Arthroscopic evaluation is recommended immediately for all joints with open wounds or punctures to remove foreign debris and prevent contaminated joints from becoming septic.

*Surgical arthrodesis:* Some joints irreversible damaged by sepsis may be salvaged by surgical arthrodesis.
Selection of the methods to remove debris from the joint is guided by the duration and severity of the disease, economics of the case and personal preference. Early onset post-injection joint sepsis may respond quickly and completely with systemic antimicrobials, LAT and needle lavage. Chronic sepsis +/- adjacent osteomyelitis will require arthroscopic surgery and may not respond satisfactorily to any treatment. Arthrotomy is a practical and inexpensive means of joint drainage but requires post operative bandaging and in some horses closure of the arthrotomy incisions. Comparisons of these surgical methods within a single study have not been made and all are effective when properly selected. The improvement in success for treatment of septic joints in horses over the last 20 years is likely due to a combination of advances in both surgical and medical procedures.

Selected references
Smith LJ, Marr CM, Payne RJ et al. What is the likelihood that Thoroughbred foals treated for septic arthritis will race? Equine Vet J 36:452-456, 2004