Bacterial infection of synovial structures, most commonly septic arthritis and septic tenosynovitis, represent potentially devastating musculoskeletal conditions for horses of any type. Bacterial infection of joints and sheathes results in profound inflammation of the synovial membrane and surrounding tissues and may result in rapid, permanent damage to tissues within the joint or sheath.

The cause of infection is most commonly perforating injury, intra-articular injection, or post-operative infection of the joint or surrounding tissues that ultimately accesses the joint. Idiopathic infections occur but are rare. Elucidating the cause of infection is often of use; enteric bacteria are frequently implicated in traumatic injuries, while *Staphylococcus aureus* is the predominant isolate from iatrogenic lesions.

**Clinical Findings and Diagnosis**

As is the case in man, septic arthritis/tenosynovitis constitutes a medical emergency. Clinical experience and most reports indicate that delays in therapy are often associated with progressive tissue destruction and morbidity and a decidedly less favorable prognosis.

Although uncertain, the diagnosis of septic arthritis can often be made on clinical grounds, once fractures or soft tissue infection (subsolary abscess) is eliminated. Indeed, there are few other reasons for profound lameness and effusion in a joint in an adult horse. In addition to pronounced lameness, there is typically demonstrable heat, swelling (both intraarticular and periarticular), and pain on palpation of the affected region. Thus, diagnosis is often relatively simple, however in isolated cases, clinical signs are rather less dramatic than expected. For this reason, if one of the three main predisposing factors (trauma/injection/surgery) is present in a horse with moderate lameness and effusion, further diagnostic investigation is generally warranted. For periarticular wounds, it is advisable to perform a centesis of the nearby joint(s) and tendon sheath(es) using an approach distant from the area of trauma to avoid inadvertent contamination. A sample of synovial fluid may be retrieved for laboratory analysis and the synovial cavity can be injected with a suitable volume of sterile polyionic fluid while the wound is inspected for definite flow of fluid from its depths. This simple maneuver enables one to ascertain with some confidence the violation of a tendon sheath or joint capsule without the need for radiographic equipment that would be required to perform a contrast study. Once completed, the synovial structure is typically injected with an antibiotic (e.g. amikacin sulfate 250-500mg).

Clinical suspicions are usually confirmed by cytologic analysis of synovial fluid. Values may vary among subsequently confirmed cases of sepsis, however a total WBC exceeding 30 x 10⁶ nucleated cells/L (30,000/ul) and/or a total protein concentration exceeding 45 g/L (4.5 gm/dl) are suggestive of infection and values approaching these herald inflammation requiring aggressive treatment regardless of cause. Differential cell counts are extremely valuable: an increase in proportion of polymorphonuclear cells from a modest percentage to values approaching or exceeding 80% strongly supports the diagnosis. Noteworthy is that cytological evidence of moderate synovitis (e.g. WBC 20 x 10⁶ /L and total protein 40 g/L) can accompany periarticular lesions and in isolated cases, occurs in sepsis. Obtaining a positive bacterial culture of synovial fluid or membrane is confirmatory, however negative culture results are disappointingly frequent. The use of blood culture tubes has been reported to improve yields for
a variety of species of bacteria. Conventional culture techniques may eventually be supplanted by the use of polymerase chain reaction (PCR) techniques to detect bacterial DNA. Radiographs of the affected limb are useful to rule out traumatic injury to adjacent bones, or the presence of an infected focus in the bone that could influence the approach to treatment.

Treatment

The profound and frequently irreversible consequences of synovial sepsis dictate early and aggressive antimicrobial therapy, drainage/debridement and supportive care/pain management.

Antimicrobial therapy - Few would argue the wisdom of initial therapy with broad-spectrum antimicrobial coverage, ideally by the intravenous route. A popular combination includes some form of penicillin or cephalosporin with an aminoglycoside. Given a positive culture with a single pathogen, the regimen may be modified accordingly, however, in the presence of open arthrotomies or other conduits for recontamination, many prefer to utilize a broad-spectrum antimicrobial approach throughout much of the treatment period.

While parenteral, typically intravenously, administered antimicrobials have been the time honored method of treatment, a number of strategies for local administration have gained in popularity and may result in superior results, with respect to the elimination of infecting organisms, given current pharmacokinetic and pharmacodynamic tenets. The most popular methods are summarized in Table 1. Adjunctive local antibiotic administration is a practical and very sound method of drug delivery, particularly for the aminoglycosides. These antimicrobials have concentration-dependent killing with a prolonged persistent effects. As such, they are well suited to local administration, where concentrations many times the minimum inhibitory concentration (MIC) for most pathogens are achieved in synovial fluid, soft tissue and bone and still exert an effect after levels have fallen below MIC. In this way, the maximum benefit is realized while lessening the risk of development of antimicrobial resistance or inducing host toxicity. Depending on the specific anatomic structures requiring treatment, comparable levels (4-20 x MIC for common pathogens) are achieved with intraarticular, intravenous and intraosseous perfusion techniques. Currently, intravenous and intraosseous regional perfusion techniques are common and appear to yield comparable drug distribution. A practical technique, developed by Butt and his colleagues, involves the application of a tourniquet, the creation of a 4 mm hole penetrating the medullary canal of a long bone near the involved synovial structure, which accommodates a 30 cm intravenous catheter thorough which an aminoglycoside diluted in 30-50 ml of polyionic fluid is slowly delivered. Resistance to injection is considerable and injection is facilitated with a household-caulking gun. The principal advantages of this method are its ease of application on several occasions, peripheral veins are spared, and damage to intraarticular or intrathecal structures is minimized. While general pharmacodynamic principles would suggest concentration dependent antimicrobials are the logical choice for delivery by local techniques, the use of time-dependent agents has also been reported.

Table 1. Comparison of local antimicrobial delivery methods

<table>
<thead>
<tr>
<th></th>
<th>Intra-articular injection</th>
<th>Antibiotic-impregnated substances</th>
<th>Regional intravenous perfusion</th>
<th>Regional intraosseous perfusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pharmacokinetic</td>
<td>Good</td>
<td>Medium</td>
<td>Good</td>
<td>Good</td>
</tr>
</tbody>
</table>

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### “soundness”

<table>
<thead>
<tr>
<th>Bone penetration</th>
<th>Good</th>
<th>Medium</th>
<th>Good</th>
<th>Good</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morbidity</td>
<td>Cartilage damage/recontamination</td>
<td>Cartilage damage/pain if mal-positioned</td>
<td>Vein damage with repeated use</td>
<td>Negligible</td>
</tr>
<tr>
<td>Ease of delivery</td>
<td>Very easy</td>
<td>Moderately involved</td>
<td>Easy initially</td>
<td>Very easy</td>
</tr>
<tr>
<td>Additional procedure(s)</td>
<td>None</td>
<td>Removal +/- necessary</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Expense</td>
<td>Minimal</td>
<td>Moderate</td>
<td>Minimal</td>
<td>Minimal</td>
</tr>
</tbody>
</table>

**Drainage and Debridement** - Joint lavage and drainage are vital for the effective management of synovial sepsis. Depending on existing facilities, equipment and economic considerations, there exists a number of options to accomplish this treatment goal. While in some cases a conservative approach may be required by economic pressures, the results following treatment without thorough drainage are frequently disappointing. Through-and-through lavage using needles or cannulae represents an improvement over medical management and produces satisfactory results in selected cases. Ideal candidates are horses that are diagnosed promptly, lack bone lesions, intraarticular fragments or foreign bodies and have negligible quantities of organized fibrin in the synovial space. In animals with more tenacious debris, or those with a lesion that serves as a nidus for recontamination, this method is often less effective. Where available, the use of arthroscopic debridement and lavage has become the mainstay for treatment of these horses and, accompanied by appropriate supportive care, has resulted in substantial improvements in success rates (both survival and return to active use) for a diverse array of joints, sheathes and bursae. Benefits of arthroscopic evaluation are intuitively clear; improved inspection of a greater proportion of the synovial space and its contents, directed lavage, and physical removal of tenacious debris, necrotic bone or foreign material, and the establishment of effective postoperative drainage, all of which contributing to a more rapid resolution of the infection and attendant synovitis. In clinics where arthroscopic equipment is not available, the use of thoughtfully placed incisions into dependent areas of an affected joint or tendon sheath is an alternative that has been used to good effect.

Aftercare for open arthrotomy/arthroscopy incisions is important; strict attention to detail during dressing changes is paramount to reduce the risk of recontamination with a nosocomial organism. The necessity for repeating lavage is based on the clinical response and by cytological evaluation of the joint/tendon sheath fluid. In our practice, this is typically evaluated at 48-72 hour intervals. Failure of lameness to improve or persistently elevated nucleated cell counts are indications for additional lavage or drainage. Radiographs should be obtained for joints that show incomplete improvement; on occasion previously unrecognized bone lesions are evident on follow-up films and provide an indication for a second look procedure. Unexpectedly poor responses should prompt follow-up microbial and fungal cultures.

Pain management is frequently an important component of the care of affected horses. Non-steroidal anti-inflammatory drugs provide adequate pain relief in many cases and have the added benefit of reducing prostaglandin-mediated deleterious effects in the synovial environment. In some cases, NSAIDs alone are inadequate and other measures are required to provide for improved patient comfort and limb use to avoid the catastrophic consequences of support limb laminitis. Unfortunately, there exists no universally satisfactory means of addressing pain in these horses. Epidural administration of α2-agonists and opioids is useful in...
lesions of the hind limbs and in other circumstances the intravenous infusion of lidocaine appears to be helpful. Adjunctive measures including parenteral administration of α2-agonists and opioids or the transcutaneous use of fentanyl has been attempted in our clinic with varying success. An aggressive approach to pain management in the early phases of treatment is prudent; if the “pain cycle” can be broken initially; subsequent pain management appears to be facilitated.

Interested readers are encouraged to consult recently published reviews on the topics of septic arthritis/tenosynovitis and regional delivery of antimicrobials.7-9

References: