What do you mean it's not foot rot? Managing septic joints in ruminants

Alexis Jennings, DVM

Oklahoma State University

Abstract

Synovial sepsis should be considered in any case of acute, severe lameness with distension, heat or swelling localized around a synovial structure. Trauma, local spread, and hematogenous spread are the most common causes with bacteria such as *Truperella* spp., *Mycoplasma* spp. and other common species prevalent. Treatment consists of systemic, local, and regional antimicrobial therapy in conjunction with drainage and lavage of the synovial structure. Referral is always prudent when athletic potential or a certain level of soundness is required.When referral is not possible, practitioners can manage these cases by following the treatment principles of decreasing bacterial load, mitigating inflammation, and mitigating pain. Prognosis is variable depending on severity of lesions, bony changes, and joints affected.

Keywords: septic arthritis, arthrotomy, arthrocentesis,

Introduction

Synovial sepsis (SS) is one of the more common causes of lameness outside the digit in ruminants. It has many causes and is often missed until the lesions are severe enough treatment is not fruitful. Early recognition is possible and if accomplished, can lead to better outcomes and less production loss by retention of animals in the herd with successful treatment.

Pathophysiology and Etiology

There are several causes of septic joints in ruminants. Direct trauma to a joint (such as a penetrating wound or laceration) almost always results in septic arthritis. Local spread of bacteria is one of the more common causes of synovial sepsis in adult ruminants. Diseases of the digit such as sole ulcers/abscesses, severe white line disease, or

severe interdigital phlegmon (foot rot) can progress to septic arthritis of the distal interphalangeal joint (DIPJ), navicular bursa, digital flexor tendon sheath (DFTS), and less commonly, the proximal interphalangeal joint (PIPJ). Infected wounds or severe cellulitis in close proximity to synovial structures can dissect through soft tissues, leading to degradation and invasion into the joint capsule, and subsequent synovial sepsis (SS). In athletic animals, older animals with high emotional value, or animals of genetic value suffering from severe arthritis, iatrogenic synovial infections may be a concern if articular injections are occurring, although this happens much less frequently than in equine medicine.[7]

In younger ruminants, hematogenous spread of bacteria secondary to umbilical infections, diarrhea, or pneumonia can lead to septic arthritis, especially if the animal had failure of passive transfer of immunity. Due to the increased blood flow associated with growing bones and the high vascularity within the synovium, septic showers of bacteria eventually enter the joint space and are protected from host immune responses. Hematogenous spread does occur in adult ruminants, however significantly less frequently than in juvenile animals. Comorbidities in adults predisposing to septic arthritis include pneumonia, Salmonellosis, septic mastitis, endocarditis, and liver abscessation.[5]

Common Pathogens

Regardless of the inciting cause of the septic joint, there are several bacteria that are commonly isolated. *Truperella pyogenes* is by far the most common pathogen isolated from cattle with septic arthritis. *Mycoplasma* spp. is also a common pathogen, often leading to a primary septic arthritis with minimal recognizable inciting causes. Animals with *Mycoplasma* pneumonia (juvenile and adult) are at risk of developing septic joints, especially following blunt force trauma. Increased blood flow to the injured region allows the bacteria to easily enter the synovium. Other bacteria commonly associated with hematogenous spread or traumatic inoculation into a synovial structure include *Escherichia coli*, *Salmonella* spp., and a variety of other *Enterobacteriaceae*, gram positive aerobes, and anaerobic bacteria. In traumatic cases, environmental pathogens are frequently isolated.[5]

Progression of Disease

Once the bacteria is inoculated into the synovial structure, severe inflammation occurs leading to increased vascular permeability and an influx of cytokines and inflammatory cells. The joint becomes more effusive and the cytokines and cellular products lead to degradation of the articular cartilage, inflammation of the synovium and subchondral bone, and pressure necrosis of the articular structures.[11]

Clinical Presentationand Diagnosis

Physical Examination

Diagnosis of septic arthritis is relatively straight forward in most cases seen in practice. Physical examination with probing of draining tracts, wounds, or sole defects can be highly suggestive. Synovial sepsis should be considered in any animal exhibiting an acute, severe lameness with joint effusion, heat, or pain associated with a synovial structure. If chronic, draining tracts and cellulitis are common findings. If hematogenous spread is the cause, various systemic signs associated with the underlying disease process will be present.

In DIPJ infections, unilateral coronary band swelling, severe toe-touching to non-weight bearing lameness are hallmarks. There may be superficial abscesses at the coronary band or between the digits. The interdigital space can be widened as the disease progresses and cellulitis can be seen up to the carpus/tarsus. In PIPJ infections, there will be focal swelling proximal to the coronary band and distal to the fetlock with or without accompanying cellulitis. In DFTS sepsis, there is palmar/plantar swelling of the limb extending from the dewclaws proximally up the limb. Additionally, the space between the dewclaws is widened and may occur concurrently with coronary band swelling if occurring secondary to DIPJ sepsis.[1,3]

Diagnostic Imaging

Diagnostic imaging is very helpful in the workup of suspected SS. Radiographs are often readily available in practice. Early radiographic changes of SS may include soft tissue or periarticular swelling, gas tracking from a penetrating wound, laceration, or bacterial production, and widening of the joint space. Due to the delay of radiographic changes (10-14 days in most cases), chronic lesions are more apparent on plain film radiographs. In chronic cases, lysis of the subchondral bone is apparent and sometimes severe, periosteal reaction is visible, and spread to neighboring structures/joints is possible. It is important to note, that if there is a draining tract or a wound, aseptically scrub the area and gently place a sterile probe or teat cannula in the tract and repeat radiographs to verify the path and depth of the tract on radiographs.

Ultrasound is by far one of the most helpful tools in practice for the diagnosis of SS.Ultrasound provides visualization into the joint for evaluation of the joint capsule, joint fluid, articular cartilage, and most importantly the presence of fibrin.Most joints are easily scanned and even the DIPJ can be evaluated with ultrasound. It is important to examine the extent of the joint capsule, the amount and echogenicity of synovial fluid, the smoothness and

thickness of articular cartilage, and the presence of fibrin or flocculence within the joint. In acute sepsis, ultrasound is a helpful tool as it can pickup changes earlier that may not be apparent on radiographs. Normal joint fluid should be anechoic (black) and visible in small volumes. Protein rich joint fluid is a mixed echogenicity with possible hyperechoic flecks floating within the fluid. Fibrin appears as hyperechoic floater within the fluid. The presence of fibrin is the primary indicator for whether or not an arthrotomy is indicated. Identification of fibrin within the joint and subsequent arthrotomy lavage can drastically improve the overall prognosis.[4]

Arthrocentesis

Arthrocentesis is crucial for definitive diagnosis of SS. Collection of the sample can be performed under most circumstances as long as aseptic principles are followed and the animal is appropriately restrained. Once obtained, chute side evaluation of the fluid can prove helpful. Synovial fluid that is turbid, flocculent, yellow-white in color, and has a total protein of >4.5g/dL is highly suggestive of SS. Fluid can also be submitted for microscopic and bacteriologic evaluation. Nucleated cell counts >25,000cells/uL with a differential of 80% polymorphonuclear cells or more is diagnostic for SS. Bacterial culture is frequently negative (especially in *Mycoplasma* spp. SS) as the bacteria adhere to the synovium and are not easily collected for culture, however it should still be attempted as if positive it can help guide therapy.[2,9]

Treatment

Treatment of SS is multifactorial as most times, no single treatment option is curative. Overall treatment goals include decreasing bacterial load, mitigating inflammation and articular structure damage, and mitigation of pain and discomfort. In young animals suffering from hematogenous spread due to sepsis, systemic antimicrobials may be enough to decrease bacterial load in very mild, subacute cases however once the joint becomes effusive, often systemics are not sufficient. In adult animals, systemic antibiotics and local/regional antibiotics are insufficient for bacterial clearance and resolution of SS. A well rounded treatment approach often consists of systemic antimicrobials, regional/local antimicrobials, drainage/lavage of the synovial structure, and analgesics. Synovial sepsis is a severe and life-threatening process, especially in production animals. As such, for valuable animals, athletic animals, or breeding animals that need a certain degree of soundness to be productive, referral is always prudent. That said, for most production animals, the cost associated with referral management of these cases is

oftenprohibitive. In those cases where producers refuse referral but still wish to purse treatment, it is appropriate to continue management of those cases as a general practitioner as long as the basic treatment principles are followed.

Systemic antimicrobials

Antimicrobial selection is crucial in every clinical case, however there are additional considerations when selecting a drug for treatment of SS. A high volume of distribution is critical as even when inflamed, the joint is relatively sequestered and many drugs will not reach therapeutic concentrations within the synovial fluid. Broad spectrum antimicrobials are beneficial. In many cases of SS, polymicrobial infections are common, especially if there has been environmental contamination such as with a wound or digital sepsis. Ease of delivery, cost of medication, and co-morbidities are important to consider. Additionally, any use of antimicrobials for the treatment of SS in ruminants will constitute extra label drug usage and as such all legal considerations also must be taken into account when selecting a course of treatment. Florfenicol and macrolides tend to be great options for SS in ruminants as they have been demonstrated to reach excellent concentrations in the synovial fluid, are often depot formulations for easy infrequent administration, and have minimal labelling restrictions in the United States. In younger animals, intravenous beta lactams are good options as they are bactericidal, and can reach adequate synovial concentrations, however they can be cost and labor prohibitive in larger animals. Additionally, florfenicol, tulathromycin, and ampicillin have been utilized in regional and/or local antimicrobial therapy so multiple levels of drug delivery while still adhering to judicious usage of antibiotics. In the case of SS, early administration of an appropriate systemic antimicrobial can help slow the progression.

Regional and local antimicrobials

Regional and local antimicrobial therapy can quickly increase the amount of drug administered into the synovial structure. Options for regional antimicrobial therapy are typically limited to regional limb perfusions (RLP). When utilizing local anesthesia such as a Bier block, antibiotics can be added to the infusate to provide regional coverage. Additionally, RLPs can be performed to aid in the treatment of SS in most of the distal joints. When treating a hock or carpus, a double tourniquet technique is helpful as it confines the infusate to a smaller area reaching greater concentrations in the affected joint. The same antimicrobials used systemically can be utilized as an RLP. Sodium ampicillin and tulathromycin are easy to administer and can be pushed through a standard 19g butterfly needle. Florfenicol is also a good option, however slight adjustments must be made based on the formulation. This drug tends to be more viscous and precipitates with many compounds. As such, to ensure appropriated delivery of the

drug, a small gauge IV catheter can be placed into the vessel instead of a standard butterfly needle. Ensure that enough florfenicol is drawn enough to allow for a slight overage in drug to flush the catheter as saline or heparin saline will precipitate the drug.[6]

Local antimicrobials also carry an advantage. Antibiotics such as sodium ampicillin can be administered directly into the joint space without significant concern for further irritation of the synovium. Antibiotic impregnated plaster of paris (POP) beads can also be utilized as a prolonged drug delivery system. The use of POP beads is preferred over polymethylmethacrylate beads as some studies show there is a greater elucidation of drug due to the biodegradation to the beads that occurs and if left in place. Additionally, the beads will eventually break down into a bioavailable calcium matrix, therefore, do not need to be removed. Plaster of paris beads are easy to obtain as there are published recipes for POP beads with various antimicrobials that caneasily made in clinic. In addition to bead formulations, POP can be utilized in a paste form. The POP paste has shown some efficacy against biofilm producing bacteria and additionally add a calcium-based bio-scaffolding that is helpful especially in cases of facilitated ankylosis. The paste can be made by hydrating the POP with an antibiotic such as sodium ampicillin and infusing directly into the joint space. Other compounds that have biofilm reduction capacity include manuka honey and bismuth iodoform in petrolatum, however the overall effect on the joint is not yet well known. Both compounds have the capacity for increased synovial irritation and the potential for early ankylosis of the joint which may not be indicated in some cases.

Drainage and lavage

The most crucial component of the management of SS is achieving adequate drainage and lavage to significantly decrease the concentration of inflammatory mediators and fibrin within the joint. Through and through needle lavage is simple to perform and can be performed in most sedated animals as long as adequate restraint and aseptic principles are followed. This technique is more fruitful in very acute cases or juvenile animals where a large amount of fibrin has not yetformed. Fibrin can occlude the needles and prevent complete ingress and egress of the lavage resulting in an incomplete flush of the joint.

In adult ruminants, chronic cases, or cases with significant fibrin deposition, arthrotomy lavage is a more appropriate treatment. Depending on the affected joint, arthrotomy lavage with the addition of arthrodesis may provide better long-term outcomes for soundness. General anesthesia is required for this treatment due to the pain associated with the incisions and large volume flush into the joint. By creating larger incisions into the joint, better drainage and

fibrin removal can occur, necrotic articular cartilage and synovium can be debrided, and a more thorough lavage can be performed. If the equipment is available, the addition of arthroscopy to the management of SS can also improve outcome by allowing for visualization of the joint.

Once initiated, lavage of the joint should happen frequently. Daily lavages are often not feasible in ruminants so the aggressiveness of therapy is dictated by the patient and financial constraints of the owner. Following resolution of the septic process, the arthrotomy sites are allowed to heal by second intention with sterile bandaging. If facilitated ankylosis is performed, casting following resolution of SS is indicated. [8,10]

References

1. Constant C., Nichols S., Desrochers A., Babkine M., Fecteau G., Lardé H., Fairbrother JH., Francoz D. Clinical findings and diagnostic test results for calves with septic arthritis: 64 cases (2009-2014). *J Am Vet Med Assoc*. 2018; 252:995-1005.
2. Desrochers A., Francoz D. Clinical Management of Septic Arthritis in Cattle. *Vet Clin North Am FoodAnimPract* 2014; 30: 177-203.
3. Desrochers, A., Steiner A., Surgery of the Bovine Musculoskeletal System. In: *Farm Animal Surgery*. 2nd ed. St. Louis: Elsevier, 2017; 352-366.
4. Heppelmann, M., Rehage, J., Kofler, J. and Starke, A., 2009. Ultrasonographic diagnosis of septic arthritis of the distal interphalangeal joint in cattle. *The Veterinary Journal*, 2009; 179:407-416.
5. Maunsell, F., Woolums, A.R., Francoz, D., Rosenbusch, R.F., Step, D.L., Wilson, D.J. and Janzen, E.D. Mycoplasma bovis infections in cattle. *Jour Vet Int Med*, 2011; 25:772-783.
6. Merkatoris, P., Schleining, J., Krull, A., Borts, D. and Fajt, V. In vitro elution of penicillin, ampicillin, tetracycline, tulathromycin, and florfenicol from plaster of Paris beads. Frontiers in Veterinary Science, 2020; 7:585423.
7. Mulon, P.Y., Desrochers, A. Francoz, D. Surgical management of septic arthritis. *Vet Clin North Am Food AnimPract*, 2016: 32:777-795.
8. Richardson DW., Stewart S. Synovial and Osseus Infection. In: *Equine Surgery*. 5th ed. St Louis: Elsevier, 2019; 1458-1470.
9. Rohde, C., Anderson, D.E., Desrochers, A., St-Jean, G., Hull, B.L. and Rings, D.M. Synovial fluid analysis in cattle: a review of 130 cases. *Vet Surg*, 2000; *29*:341-346.

10. van Weeren PR. Septic Arthritis. In: *Joint Disease in the Horse*. 2nd ed. St Louis: Elsevier, 2016; 91-104.
11. van Weeren PR. General Anatomy and Physiology of Joints. In: *Joint Disease in the Horse*. 2nd ed. St Louis: Elsevier, 2016; 1-24.