

# Stable feet before a night out: Bovine arthrodesis

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## Introduction

Lameness in cattle is one of the top causes of lost production in the United States. It affects milk production, feed and water intake, reproduction, daily gain, and animal wellbeing. While there is increasing information available in the literature describing lameness in dairy cattle, comparatively very little is published on lameness in beef cattle. One of the most potentially debilitating causes of lameness is a septic distal interphalangeal joint. When this occurs, an arthrodesis is a useful procedure to maintain the welfare and production of the bovine.

## Lameness assessment and evaluation

A physical examination should not only include a visual assessment of the patient at a walk in its normal environment (if possible), but it should also include a thorough examination while restrained in a chute or tied (in the case of dairy and/or show cattle). Swelling above the coronary band should lead the practitioner to include conditions such as sole ulcers, toe ulcers, heel lesions, foot rot, distal limb traumatic injury, as well as septic coffin joints, in the list of differential diagnoses. When considering pathology of the sole, even without soft tissue swelling, heat will be palpable at the region of the heel. If there is joint swelling, is the swelling confined to the joint space or is it more generalized, such as a cellulitis? Swelling associated with a fracture is typically profound and the patient is often non-weight bearing on the leg. Swelling from a septic joint can range in severity, but ambulation on the limb, albeit in a limited fashion, is usually possible.

## Examination of the foot

Thorough examination of the feet requires a hoof tester and a sharp hoof knife. Sensitivity to the testers should be determined at the toe, along the lateral wall, the cranial and caudal sole, and across the heel bulbs of each individual claw. When diagnosing sensitivity, the response to the hoof testers should be repeatable and may consist of only a subtle withdrawal of the leg rather than the more exaggerated response noted with deeper lesions of the hoof. The interdigital space should be cleaned and examined with a light source for signs of foot rot or digital dermatitis. Manure and debris on the hoof wall should be removed to allow for assessment of the integrity of the entire hoof wall. It can be surprising at how well a hoof wall crack can be hidden by what was just a small amount of dried manure on a foot. Take a bare hand and palpate the heel and coronary band for heat. Claw lesions will make the affected claw warmer than the opposite claw due to inflammation. While a thorough foot exam is easy on a tilt table or in a tilt chute, it can be challenging in ambulatory conditions. In the field, creative measures must be sometimes taken to facilitate a good foot examination. Various rope configurations, pulley systems, and restraint mechanisms have been described. If all else fails and the farm facilities don't offer a safe way to perform a thorough lameness examination, maybe the exam is best done at your clinic.

## Approaches to the septic joint

In the bovine more so than other large animals, it is common for lesions that originate in the foot (sole ulcers, toe ulcers, white line disease, etc.) to invade tissues deep to the claw rather, as opposed to breaking out the bottom of the sole or at the coronary band. This can manifest as sepsis involving the distal interphalangeal joint, the navicular bone and/or bursae, the flexor tendon sheath and/or the deep digital flexor tendon, and/or surrounding soft tissues. The most important prognostic indicator is how many structures are involved, the presence of lytic bone, and how soon appropriate treatment is instituted. The use of diagnostic imaging, in particular serial radiographs are useful in initial assessment, diagnosing and following the healing process if correction is chosen.

It is important to note that appropriate treatment of a septic foot is multifaceted beyond solely administering antibiotics. The goal of treatment of septic synovial structures (mainly tendon sheath and DIP) is to eliminate bacterial infection from the joint while preserving the integrity of the joint. Joint lavage is the best method for this. Consider the old adage "dilution is the solution to pollution", it is true for this instance as well. Cattle are notorious for their ability to produce and deposit fibrin. This is especially true for septic joints. The presence of fibrin within the joint is problematic for the veterinarian trying to lavage the joint especially in cases that are chronic in nature. Fibrin and edematous synovial membrane can obstruct large (12- or 14-gauge) needles, rendering a through-and-through lavage unsuccessful in some instances. If this occurs, open lavage and debridement (using sterile technique) is essential. An arthroto-my can accomplish this, with the use of sterile hemostatic forceps or arthroscopic forceps to remove fibrin deposits from the joint. Extensive joint lavage should follow with 1 to 3 liters of sterile isotonic fluids. The limb should then be bandaged with a sterile wrap and the patient kept in a dry environment with limited activity. Joint lavage is usually indicated daily or every other day as the patient's condition dictates.

After joint lavage, antibiotics should be administered. While, in a perfect world, a culture and susceptibility would be available for each case. Clinicians should consider that only about 50% or less of cultures taken from septic synovial structures result in identification of bacteria. Also, it is prudent to begin the bovine be on an antibiotic regimen prior to receiving susceptibility results. The choice of antibiotic should be driven by the most likely suspected bacterial pathogen(s), labeled indications, frequency and route of administration, and cost. The most common bacteria isolated from a septic distal interphalangeal joint are those that are commonly found on the foot and ground - namely *E. coli* and *T. pyogenes*, and those found on the skin (i.e. *Staph* and *Strep* species). Regional limb perfusion of antibiotics is commonly performed in our hospital when the use of florfenicol is not restricted by the patient (i.e. lactating dairy cows). Several pharmacokinetic studies have been performed in cattle assessing regional delivery of antibiotics.<sup>1-3</sup> While these studies support the use of regional limb perfusion, ceftiofur is now

unable to be used in an extralabel route or dose<sup>4</sup> resulting in the inability for regional limb delivery of this antibiotic for treatment of septic conditions. However, florfenicol remains a viable option, although caution is necessary to avoid administration in a perivascular manner. Ampicillin sulbactam presents a cheap, broad-spectrum option that is not extremely irritating to tissues in the event of perivascular leakage.<sup>3</sup>

An additional adjunctive therapy in the treatment of sepsis is that of control of pain control and inflammation. Repeated doses of intravenous flunixin meglumine in an already stressed animal may result in the likelihood of development of abomasal lesions. For this reason, it may be prudent to not use flunixin meglumine for more than 3 consecutive days. In the event abomasal ulcers are suspected from flunixin administration, pantoprazole could be administered as a gastroprotectant.<sup>5,6</sup> Alternatively, oral meloxicam administered at 0.25 to 0.5 mg/lb (0.5 to 1.0 mg/kg) once a day or every other day as dictated by response to treatment and comfort level of the patient.

Therapy of septic synovial structures is more likely to be successful with multimodal therapy comprised of synovial lavage, antibiotic therapy, and anti-inflammatory administration, in a timely manner. With treatment failures or if the septic process is advanced, additional options include facilitated ankylosis by way of joint arthrodesis and digit amputation. However, treatment of synovial sepsis can result in great expense to the owner with a resulting guarded prognosis and the client should be informed on the investment and expected outcomes prior to instituting therapy.

## Bier block (distal limb anesthesia)

Manipulation of the distal limb, such as debridement of foot lesions, joint lavage and surgical procedures are aided by the Bier block, or distal limb lidocaine block.<sup>7</sup> Easily performed with the patient restrained on a tilt table or heavily sedated/anesthetized if in the field. It can also be employed if a foot is tied up and restrained appropriately in a chute. A mid-cannon bone placed tourniquet is applied tightly. Tourniquet selection is important. Simplex tubing or other hose will not get tight enough for the required pressure to be obtained. A 3" or 4" es-march (blue or green elastic plastic) tourniquet is inexpensive, reusable and provides a superior method of occluding arterial and venous blood flow to the digit. Ideally a tourniquet is kept in place no longer than 45 minutes to limit soft tissue damage at the site of the tourniquet. The lateral or medial digital vein or common digital vein are clipped and briefly scrubbed. A 19-gauge butterfly catheter is inserted into the vein and 25 to 30 ml of lidocaine is infused into the vein. The distal limb will effectively be desensitized within several minutes.

## DIP joint arthrodesis procedures

The approach for the best arthrodesis technique, as stated before, is determined by the articular structures affected within the hoof as well as any draining tracts from the present lesion. Two arthrodesis procedures for the distal interphalangeal (DIP) joint will be discussed: 1) the dorsal approach, and 2) the solar approach.<sup>8</sup> For both approaches the arthrodesis procedure is performed with restrain, sedation and local anesthesia as stated above.

For the dorsal DIP joint arthrodesis approach, 2 arthrotomies must be performed. The first arthrotomy site is on the dorsal aspect of the digit and directed into the infected DIP joint. This

arthrotomy site should be approximately 0.5 cm to the coronary band and axial or abaxial to the digital extensor muscles. The second arthrotomy site is located approximately 0.5 cm proximal to the coronary band and caudal to the abaxial ligament of the DIP joint.<sup>8</sup> Cartilage and necrotic bone are removed by curettage and lavage with copious amounts of isotonic fluids through a teat cannula, instead of needles, as described above for the joint lavage. Continued curettage and lavage should occur daily for up to 5 to 7 days depending on necrotic tissue declaration and healthy vital bone.<sup>8</sup> Between daily lavage treatments, bandages should be placed around the hoof to protect the open arthrotomy sites. The dorsal DIP joint arthrodesis approach should be selected if the regional sesamoid bone and accompanying ligaments are not affected. At the time of the first arthrotomy procedure, a wooden hoof block should be placed on the contralateral claw to offload weightbearing forces of that limb to promote healing and reduce pain.

For the solar approach to DIP joint arthrodesis, paring away the hoof sole and hoof tissue of the heel of the affected claw should be trimmed away until soft tissue of the sole and/or the draining tract of the infected joint can be visualized. In severely infected DIP joint cases, these lesions and draining tracts may already be visible. Once the hoof tissue is pared away, removal of the distal sesamoid joint is needed. The approach to infected sesamoid removal through an incision performed 2 cm proximal to the coronary band on the palmar or plantar surface of the heel. The tendinous structures of the deep digital flexor should be incised and resected to aid in removal of the distal sesamoid. If the sesamoid is necrotic removal can be achieved by way of a rongeurs. When the sesamoid is not severely infected resection of the collateral and distal ligaments is required for removal. Once the sesamoid is removed, debridement of the DIP joint can occur. Further debridement of the DIP joint can occur by accessing the joint from the dorsal hoof wall 1 cm distal to the coronary band with a half inch drill bit.<sup>8</sup> Affected cartilage and the necrotic bone can then be removed by a rongeurs, curettage and lavaged with copious amounts of fluids. Curettage and lavage should occur every other day for at least a week until necrotic bone and tissue has been removed. Bandage placement between treatments should occur as well to protect these sites. A Penrose drain may also be used to provide adequate drainage of the lesion. As stated before, a wooden block should be placed on the contralateral claw to remove weightbearing of the infected claw.

## Postoperative care

On the final day of curettage and lavage, application of a foot cast should occur to aid in stabilizing the joints above and below to allow for healing and ankylosis of the DIP joint. To reinforce the foot cast, which should include the wooden block on the contralateral claw, a layer of polymethyl methacrylate (PMMA) should be applied judiciously to the floor contact surface of the cast for reinforcement. Daily evaluation of comfort after cast application should be performed. Cattle should be 100% weightbearing after the second day of cast placement. Housing these cattle in a small stall for 8 or more weeks in a clean and dry area with good footing is highly recommended. Continual assessment of the cast should occur until joint stabilization and ankylosis has occurred. This may take up to three months depending on the initial extent of joint damage. The foot cast should be changed on regular frequencies for at least every 3 weeks in younger animals and every 6 weeks for adults. For better understanding of the healing process at the ankylosing joint, it is recommended that repeat radiographs be taken at times of cast change.

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## Withdrawal recommendations

For this procedure, when considering these options for postoperative pain and inflammation management, as well as reducing infection, it should be noted that no drugs are currently labeled in North America for these purposes with respect to ankyloses in cattle. As such, use for these applications would be considered extralabel and clinicians should consult FARAD ([www.farad.org](http://www.farad.org); US) or CgFARAD (<https://cgfarad.usask.ca/language.php>; CAN) for extralabel drug withdrawal recommendations for these patients.

The arthrodesis procedures explained here are quite involved procedures that can provide a longer more productive life for the animals that need such procedures over a claw amputation which is considered a salvage procedure. Arthrodesis can be technically demanding, have intense aftercare/rechecks, and may cause a fair amount of pain initially which can be mitigated by anti-inflammatory/pain medications. As mentioned, procedures can become quite costly but when successful they can provide productive outcomes to cattle over those that do not receive this procedure. It is important that the advantages and disadvantages of the arthrodesis procedures be discussed with cattle owners prior to electing this procedure. The prognosis of these procedures depends on the duration of disease, the intended purpose of the animal, and the financial dedication/time commitment the owner has to this approach.

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