

Trauma and fracture management in bovine practice

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Abstract

Trauma, including lacerations, blunt trauma, and fractures, are a common presentation to bovine practitioners. Factors that can affect wound healing include duration of time from injury to veterinary intervention, level of contamination, and involvement of pertinent anatomical structures, including blood supply and synovial structures. Proper attention to wound management, fracture immobilization, and pain control can positively influence the outcome of patients suffering from traumatic wounds.

Key words: bovine, trauma, fracture, cast, wound healing

Résumé

Les traumatismes, incluant lacérations, traumatismes contondants et fractures, sont fréquemment rencontrés par les praticiens bovins. Les facteurs qui affectent la guérison des plaies incluent la période de temps entre la blessure et l'intervention vétérinaire, le niveau de contamination et l'implication de structures anatomiques pertinentes comme l'irrigation sanguine et les structures synoviales. L'attention nécessaire au traitement des plaies, l'immobilisation de la fracture et le contrôle de la douleur peuvent avoir un impact positif sur l'issue des patients affligés de plaies traumatiques.

Lacerations/Trauma

Trauma is commonly encountered in bovine practice. From fractures to lacerations to fighting injuries to getting caught up in fences, feeders, and other equipment, cattle provide the veterinary practitioner plenty of opportunities to practice wound management. When examining a traumatic wound it is important to thoroughly assess the situation from an anatomical standpoint, how long the wound has been present, and level of contamination. If a wound is located near a joint or synovial structure it is important to make sure the joint does not communicate with the wound. An open tendon sheath or an open joint can carry a good prognosis if diagnosed very early, is treated aggressively, and there is little contamination present.^{10,16} However, if there is a delay in veterinary attention, severe contamination, and/or compromise to the blood supply the prognosis drops significantly even with aggressive treatment and/or referral.¹⁰

Laceration repair can be achieved in 1 (or a combination) of 3 ways. The first is primary closure. The laceration most amenable to primary closure is clean, acute, and devoid

of tension. Since the inflammatory phase of wound healing begins immediately¹⁴ it is important to close a laceration before extensive swelling develops within the wound bed. Likewise, cleaning the laceration completely, debriding the wound edges and any compromised tissue if necessary, and closing it aseptically contribute to uncomplicated wound healing and a cosmetic outcome.⁵ A second option for wound closure is delayed primary closure. This is a good option when there is extensive inflammation and contamination of a wound, but you believe there is adequate skin available to close the wound once inflammation and infection are controlled. Primary closure of the wound usually follows multiple days of bandaging, wound debridement and lavage, and antibiotic administration. The third option is second-intention healing. Second-intention healing occurs when a wound heals through the process of granulation tissue, contraction, and epithelialization. Cattle are very efficient at second-intention healing and exuberant granulation tissue ('proud flesh') is not as commonly encountered in cattle as it is in horses.⁴ However, even wounds left to heal by second intention should be kept clean and can require frequent attention.

Fractures

Fractures of the long bones of the leg are common.¹⁵ Metatarsal and metacarpal fractures are the most common, and they are more common in calves than adults.⁹ However, fractures of the tibia¹¹ and radius/ulna¹² are also seen with some frequency. Most fractures involving the metatarsal/metacarpal bones in calves are either Salter-Harris configurations or midshaft with an oblique and/or spiral component. As long as the fracture is closed and the blood supply is intact, the prognosis is very good with adequate stabilization.¹⁵ When there is an open wound communicating with the fracture site, however, a poor to grave prognosis is given because of contamination of the fracture site and the resultant negative effects on bone healing.¹⁵ In the instance of a distal limb fracture, special attention should be given to the temperature of the limb distal to the fracture site. This is especially true in cases that were delayed in seeking veterinary attention and in very flighty animals in which the fractured leg was prone to excessive and sudden movements that could damage the vessels to the limb distal to the fracture site. Newborn calves being evaluated for fractures should also be assessed for concurrent disease (ie failure of passive transfer) as the prognosis significantly goes down when concurrent disease is present.¹³

Cattle can make good orthopedic candidates for a number of reasons.¹⁵ Firstly, they have great propensity for healing. They have a natural ability to generate a generous fibrous callous in the fracture gap, leading to replacement with osseous callous, and can, over time, bridge even very large fracture gaps. Secondly, cattle spend a significant time in recumbency and are generally amenable to exercise restriction. Thirdly, because cattle have 2 weight-bearing digits on each foot (and they spend a lot of time laying down naturally), compensatory laminitis as is often seen in horses is not a complication. Similar to other species, factors that affect fracture healing and outcome include the specific bone involved, the fracture configuration, classification of open or closed, duration of time prior to seeking veterinary care, blood supply, and contamination.¹⁵ Radiographs of the fracture can assist the practitioner in determining a prognosis. Useful information to be obtained from a radiograph include involvement of a growth plate or articular surface, fracture configuration (e.g. single fracture line vs comminution), and appearance of the bone density (such as seen in cases of neoplasia or osteomyelitis). Fractures that involve an articular surface carry a worse prognosis because of subsequent arthritis.¹⁵ Fractures that are comminuted or overriding may be more amenable to a transfixation cast instead of a traditional cast.⁸ Other benefits to radiographs include evaluation of fracture healing progress under a cast and identification of sequestrum formation.

To successfully heal a fracture and quickly return the animal to comfort, adequate stabilization must be achieved. The rule of thumb for fracture stabilization is **Immobilize the joint above and the joint below the fracture**. If the metatarsus/carpus is fractured, you **MUST** immobilize the fetlock and the tarsus/carpus. If the radius is fractured, you **MUST** immobilize the carpus and elbow. If the tibia is fractured, you **MUST** immobilize the tarsus and stifle. The elbow and stifle are difficult, if not impossible, to immobilize in adult cattle. Youngstock, before they develop a lot of body condition, can be amenable to immobilization of these proximal joints.

Cast Placement

Correct cast placement is facilitated by a cooperative patient, attention to detail, and having the right equipment. Our goal at the end of the procedure should be to have a comfortable patient with a straight limb. You will need sedation and likely, lidocaine, to make this happen. Even with heavy sedation though, traction on the fractured limb will cause patient resistance as the fracture is reduced. A regional limb block, such as the Bier block, can be useful in this situation. Additionally, a brachial plexus block or ring block could be useful. A bolus of ketamine or other general anesthetic in the sedated patient just prior to fracture reduction could also be indicated. In hind limb fractures, an epidural at the lumbosacral space is very useful in making a patient comfortable, facilitating pain-free fracture

reduction, and placing a cast without complications from patient movement.⁶ This is accomplished with the calf in sternal recumbency, the lumbosacral space clipped and aseptically prepared, and advancement of an 18 or 20 gauge spinal needle of appropriate length for the patient into the epidural space. Two percent lidocaine should be dosed at 0.91 to 1.14 mg/lb (2.0 to 2.5 mg/kg) and slowly injected. This will equal roughly 6 mL for a 100 lb (45.5 kg) calf. This will effectively desensitize the entire hind end. After an epidural, fracture reduction can be aided by suspending the limb from a sturdy rafter or overhead pole. A disposable nylon dog leash can be used around the coronary band to suspend the leg while having an assistant hold the leash taut, placing tension on the leg to maintain alignment. Depending on the fracture configuration, manual external reduction may first be needed to achieve alignment.

A cast should have at least 3 layers – stockinette, cast padding, and fiberglass cast material. Stockinette can be purchased in a large range of sizes, and calves will generally take 3" (7.6 cm) while adult cattle may require 5" or 6" (12.7 or 15.2 cm). The stockinette should be cut to a length twice the length of what is needed. After cutting, find the center of the length of stockinette and mark it. Start rolling the stockinette from 1 end outwardly like a tube sock ending at the center. From the other end, roll the stockinette inwardly onto itself until you reach the center. Then place the foot into the lumen of the stockinette, unrolling the stockinette up the leg. With the unrolled half of the stockinette, give it a few twists to encase the foot and then also unroll it up the limb. The stockinette should be tight enough that there are few wrinkles, and the top of the stockinette should extend at least 3" (7.6 cm) above the proposed top of the cast. Next, cut a 1" (2.5 cm) wide strip of thick felt to line the top of the cast and place it circumferentially around the leg where the top of the cast will be. Hold it in place with white tape. Depending on circumstances, you may choose to make felt 'donuts' for the accessory carpal bone and/or dewclaws as well. Next, take cast padding and place it on the leg, overlapping each layer by ~50% as you go up the limb. Make sure you are using cast-specific padding and not roll cotton or cotton combi-rolls. You want some padding in your cast, but too much padding will cause movement at the fracture site. This will result in a painful patient, healing complications, and in worst-case scenario, a cast that falls off. Finally, apply fiberglass cast material. Calves will usually take 3" or 4" (7.6 or 10.2 cm) cast material and adult cattle will necessarily need 5" and/or 6" (12.7 and/or 15.2 cm) material. Place enough layers of the cast material to effectively eliminate motion of the leg under the cast. You want to place the layers snugly, but not tight. There should be no wrinkles in the cast material. The warmer the water that you dip your cast material in, the faster it will set up. If you are placing a large cast, you may choose to use cool water to allow for more time to get all of the cast material on the leg before it starts hardening. In calves, you will likely use 4 or 5 rolls, depending on the length of the cast. In adults,

it will likely take 10 to 15 rolls, again depending on size of the cast. Prior to the last roll of cast material being placed, the stockinette should be rolled down and incorporated into the cast. All layers of cast material should be in place before the material starts 'weeping'. This is a sign that the chemical reaction that bonds the layers of the cast material together is starting. Failure to have your cast completed by this time will result in an 'onion peel' effect and the layers will not bond effectively, decreasing the strength of your cast. When the cast is dried, elastic tape should be used to seal the top of the cast to prevent debris or shavings from entering the cast. During the healing period, the cast should remain dry. The addition of methylmethacrylate or rubber from a tire to the bottom of a cast can also improve its longevity.

Exercise Restriction

Fracture management does not end with cast placement. Cattle with casts MUST be confined. I find this is the hardest part for owners to comply with. The more an animal moves around, the greater the chance of cast sore development under the cast, cast breakage, or delayed fracture healing. This is especially important in the case of calves that are still on the cow. If the pair is turned out, the calf will have difficulty keeping up with the dam and even good casts will have a higher incidence of failure in this situation. In addition, the calf will likely not nurse as often, leading to ill thrift. Limiting exercise to a small paddock or inside the barn is an important part of fracture repair. This will also make it easier for the owner to quickly recognize complications or indications for follow-up exam. Fast-growing calves may need a cast replacement after 2 weeks, as they outgrow the cast.

Pain Management

Another important part of fracture repair and patient management is to adequately address pain. Possible analgesics are NSAIDs (flunixin meglumine, phenylbutazone, meloxicam, carprofen, and ketoprofen), local anesthetics, opioids, $\alpha 2$ agonists, ketamine, and gabapentin.¹ Of the NSAIDs, flunixin meglumine and meloxicam are the most frequently used. Phenylbutazone (bute) is prohibited in female dairy cattle over the age of 20 months, and there is a zero tolerance for bute in all meat and milk products, so it is not commonly used. Aspirin has a very low volume of distribution, and is not a good option for analgesia in ruminants.² Meloxicam is a COX-2 selective inhibitor which results in fewer side effects when used long term vs a non-COX selective NSAID. It is used at an oral dose of 0.23 to 0.45 mg/lb (0.5 to 1.0 mg/kg) once per day to every other day as needed.² Gabapentin, when used concurrently with meloxicam at an oral dose of 6.8 mg/lb (15 mg/kg), appears to have a synergistic effect for pain relief, especially when an animal is experiencing hyperalgesia.³ Flunixin, a non-COX selective inhibitor, can cause gastrointestinal ulceration (abomasal ulcers) and renal

complications when used long term, but is a good option for short-term analgesia.

Recently, topical flunixin meglumine was approved for use in cattle specifically for the relief of pain from foot rot.^a The topical preparation is rapidly absorbed and has a longer half-life than intravenously administered flunixin.⁷ This is the first FDA-approved pain relieving medication for cattle in the United States. Previously, flunixin meglumine^b was the only non-steroidal anti-inflammatory labeled for use in cattle, but was labeled for the treatment of pyrexia associated with respiratory disease and metritis and inflammation and pyrexia in cases of endotoxemia. Extralabel drug use in ruminants is allowed only by or under the supervision of a veterinarian, allowed only for FDA-approved animal and human drugs, only permitted when the health of the animal is threatened (not for production purposes), not permitted in feed, and not permitted if it results in a drug residue in food intended for human consumption. (Animal Medicinal Drug Use Clarification Act of 1994 (AMDUCA)). Research of the pharmacokinetics and pharmacodynamics of analgesics in the ruminant is an evolving science that has seen increased activity recently. Along with these options, the practitioner should be aware of the mechanism of action of these medications and the current science so that the best analgesic can be prescribed for a specific patient's needs. Appropriate withdrawal times should also be honored so as to prevent a violative residue in meat and/or milk. When questions arise as to what an appropriate withdrawal time should be, the Food Animal Residue Avoidance Databank (FARAD) should be consulted. Most questions are answered within 24 hours, and this is a very good resource for food animal veterinarians. www.farad.org.

In summary, lacerations and fractures that are attended to promptly have the best prognosis when there is the least amount of contamination and inflammation. Closed, acute, non-articular long bone fractures in calves have a good prognosis. Success increases when casts are placed utilizing the rule of immobilization of the joint above and the joint below the fracture, in an appropriately restrained patient, on an appropriately reduced fracture. Success is further influenced by owner compliance with strict exercise restriction and attention to pain management.

Endnotes

^aBanamine Transdermal, Merck Animal Health

^bBanamine, Merck Animal Health

Conflict of Interest Statement

The author declares no conflict of interest.

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