How to Assess and Treat Acute-Onset Non–Weight-Bearing Lameness in an Ambulatory Emergency Setting

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1. Introduction
Acute-onset non–weight-bearing lameness is a common emergency complaint to the ambulatory practitioner. The initial consultation commonly contains the phrase “he was fine yesterday and today cannot bear any weight on the leg,” or, “he was sound while being ridden and suddenly came up severely lame.” The most common causes of acute non–weight-bearing lameness include subsolar abscessation, penetrating hoof injury, fracture, laminitis, severe soft tissue injury, and cellulitis.1,2 Diagnosis of the lameness can be difficult especially if the initial cause was not witnessed. Using the AAEP lameness scale, these emergency cases would be classified as Grade 4 to 5 of 5. Grade 4 is defined as “obvious lameness with a marked nodding, hitching, or shortened stride”2 and Grade 5 is defined as “lameness produces minimal weight bearing in motion and/or at rest or a complete inability to move.”

This article is intended to assist the ambulatory practitioner in preparation of appropriate diagnostic tools and therapeutic options for an acute-onset non–weight-bearing lameness emergency.

2. History and Physical Examination
A thorough and complete history is important in the examination of horses with non–weight-bearing lameness. Factors such as age, sex, breed, and discipline can predispose a horse to particular injuries. Historical details such as prior lameness or recent farriery can help further narrow the list of differential diagnoses. Horses engaged in different disciplines may sustain discipline-specific injuries, which may help focus the differential diagnosis list and reduce time to diagnosis.

It is important to observe the horse’s attitude, level of distress, and respiratory effort from outside the stall to ascertain the level of pain the horse is experiencing without the added stress of a veterinary examination. A rapid assessment of the natural environment of the patient including number and character of pasture mates, quality of fencing and housing, loose structural materials, and character of the footing can also affect the diagnosis. Once a full history and visual inspection of the environment is complete, a gross examination of the horse in its own environment is very useful.

A brief but thorough physical exam should be completed before focusing on the affected limb.
The patient’s posture and stance can guide the practitioner to the affected limb. A visual assessment of swelling, hemorrhage, or trauma should be performed. In an ambulatory setting, a horse may spend significant time outdoors and can be covered in dirt and mud. Cleaning off all dust or mud and removing all blanketing materials is necessary to complete a thorough examination. Although it may be obvious to the practitioner which limb or limbs are affected, other factors can help to determine severity, secondary complications, or the possibility that multiple lesions need to be addressed. Temperature, heart rate, and respiratory rate can help determine severity, character of a lesion and the presence of systemic disease. An increased body temperature can also help determine if an infectious agent, bacterial or viral, is present, whereas tachycardia and tachypnea can indicate the level of pain the horse is experiencing. This is particularly helpful in our more stoic patients. Mucous membranes can help determine hydration status, an important consideration in horses injured while working. Occasionally, the horse is in such significant pain that a tranquilizer or sedative must be administered immediately, but performing a thorough physical exam before sedation or tranquilization is preferable. If sedation is required, use the minimum amount necessary to ensure proper restraint and safety of the patient and handler without significantly altering the clinical picture.

Once an overall assessment of the horse and a basic physical examination is completed, examine the affected limb or limbs. Each practitioner has his or her own procedure for performing a lameness examination, and it should be the goal of a new practitioner to develop a system that works well for him or her. No one method is superior, provided that all structures are thoroughly examined and palpated and the same procedure is followed with each subsequent case, reducing the possibility of missing a subtle lesion. Diagnosis becomes more challenging when multiple limbs are affected, as with acute-onset laminitis or a front and hind limb concurrently affected. The safety of the practitioner and handler during examination and manipulation of limbs must remain the primary priority. Watching the horse move in the stall or alley, even for a minimal number of steps, is very important. Analyzing the foot placement; engagement of the pastern, fetlock, and proximal joints; and amount of weight being borne on the limb can help determine location of pain.

Start the examination with the most distal structures and move proximally in a methodical manner. Palpate the hoof capsule and coronary band for increased temperature or defects, and palpate the digital arteries at the level of the fetlock for an increased or “bounding” digital pulse to determine if the hoof is affected. Typically, an increased digital pulse indicates inflammation or pain originating from an area distal to the point of palpation and should prompt the practitioner to give the distal structures a more thorough inspection. Given the prevalence of subsolar abscessation, this is a good location to begin the examination of the limb. Elevate the limb, if possible, and remove debris from the sole and frog, allowing a thorough exam of the foot for foreign bodies, penetrating wounds, or drainage. Apply the hoof testers to all areas of the sole, frog, and across the heels searching for a pain response such as an increase in muscular tension, jerking the foot away, or behavioral changes such as attempting to bite the handler or pinning of the ears. Once the examination of the foot is complete, begin moving proximally on the limb analyzing each structure in careful detail. Examine the limb thoroughly while the horse is weight bearing and also with the limb elevated, as lesions in deeper structures such as the suspensory ligament may not be easily accessible without flexion of the limb. Each joint should be carefully flexed and extended and evaluated for lateromedial motion as well. The clinician should pay close attention to the response of the horse as this can help guide the isolation of the source of pain. Some common responses indicating local discomfort include reluctance to allow full flexion or extension and jerking the limb away from the practitioner. A noticeable reduction or unexpected increase in the range of motion indicates possible pathology of the joint or periarticular structures, such as collateral ligaments, requiring closer attention. While performing flexion and extension motions, it is important to remember that multiple ongoing conditions may be present and a positive test may not indicate the cause of the acute non-weight-bearing lameness. Perform a careful evaluation of the limb, noting any abnormalities such as obvious trauma, heat, swelling, discharge, pain on palpation, and change in the size or character of tendons, ligaments, or muscles. Once a thorough exam is complete, the practitioner should be able to narrow down the list of differentials and formulate a diagnostic plan to confirm a diagnosis.

Many diagnostic tools are available to the ambulatory practitioner to aid in diagnosis. Radiography remains one of the most important tools available. Portable digital radiography has significantly increased the accuracy and speed of diagnosis with the ability to image the affected limb on site and assess the severity immediately. Radiography should be used when a bony abnormality is suspected given the history of the lesion and the clinical exam findings. Perineural analgesia is a very important diagnostic tool and can be used to locate a source of lameness, especially if the clinical exam findings are not conclusive, such as with subsolar abscessation or severe soft tissue trauma at the level of the distal phalanx. However, radiography may be required to first rule out the possibility of a bony fracture before performing local anesthesia so that excess weight is not borne on the injured limb, further complicating the problem. Other diagnostic
modalities that are useful to the ambulatory practitioner include ultrasonography and thermography, which confirm or rule out diagnoses once the exam has finished.

3. Subsolar Abscessation

One of the most common causes of acute-onset non-weight-bearing lameness in an ambulatory setting is subsolar abscessation. Horses affected with subsolar abscessation will typically present with an increased digital pulse at the level of the fetlock and will respond to repeated hoof tester application. Horses will occasionally respond to a small localized area with hoof tester application but more frequently will be painful over a larger area of the sole. If the horse has been shod recently, particular attention should be paid to the nail locations in the sole of the hoof. Frequently, distal limb swelling occurs starting at the level of the coronary band and progressing proximally if the abscess has not commenced draining. In the author’s experience, some of the common causes of abscessation include penetrating wounds, tight horseshoe nail placement, and previous laminar trauma such as laminitis or subsolar bruising. Once a lesion has been accurately localized, the sole is pared with a hoof knife to identify a solar crack or tract of debris. Establishing drainage is the most important therapeutic option and can rapidly improve comfort and soundness. Once a tract has been located, establish drainage with a small hook hoof knife or bone curette. Continue paring through the tract until the abscess begins to drain or the tract nears the level of the sensitive solar corium, at which time paring should be discontinued. The pared solar opening must be just large enough to ensure proper drainage without being sealed by edematous tissue. Another option is to notch the distal wall of the hoof to establish drainage, thereby preserving the integrity of the sole. This may be beneficial if the suspected abscess covers a large surface area of the sole. If the abscess drains, the resultant fluid is typically light grey to black in color and ranges from profuse watery discharge to a thick tar-like consistency and is often malodorous.

Treatments of choice for abscesses vary widely by practitioner. The goal of any treatment is to induce drainage of the abscess material and to allow the surrounding structures of the foot to heal the defect. A common therapy is to soak the foot once to twice daily in an Epsom salts and warm water solution for 15 to 20 minutes. Care must be taken as this type of treatment can dehydrate the hoof capsule reducing its overall strength and predisposing the hoof to further damage. Another option is to poultice the foot, which promotes softening of the hoof capsule making it more malleable to pressure. During weight bearing, the hoof capsule deforms, which promotes further drainage. Common poulticing methods include coating a baby diaper or cotton in a compound such as ichthammol, an Epsom salts mixture, or a medicated poultice pad. The diaper or cotton is applied to the solar surface, wrapped with an elastic cohesive bandage material, and coated with a protective layer such as duct tape. Another treatment option includes flushing the tract with water and an iodine solution to aid in disinfection of the underlying tissue. Soaking or poulticing is continued until drainage has ceased and the patient is comfortable bearing weight on the limb. The use of antibiotics is controversial in the treatment of subsolar abscessation. Unless it is suspected that the infection includes deeper structures, antibiotics are widely considered to delay the progression of abscess drainage. Nonsteroidal anti-inflammatory drugs (NSAIDs) may be used to provide analgesia in a distressed animal. Controlled exercise, such as hand-walking or limited turnout, can be beneficial to promote drainage using the weight-bearing cycle of the horse’s gait. Tetanus prophylaxis is highly recommended for any injury or infection in a patient with an unknown or unclear vaccination history.

4. Penetrating Solar Injuries

Penetrating wounds to the solar surface of the hoof capsule are common in any farm situation. The most common offending foreign bodies in our practice include malpositioned horseshoe nails, construction nails, screws, wire, and other metallic pieces from farm implements. These injuries should be considered serious due to the many sensitive structures within the hoof capsule. Common injuries in our practice include puncture to the distal phalanx creating a sequestrum, puncture to the deep digital flexor tendon, damage to the collateral cartilages of the caudal heel, and penetration into synovial structures such as the distal interphalangeal joint, the distal flexor tendon sheath, or the navicular bursa. Progression from puncture wound to non-weight-bearing lameness occurs when swelling commences due to injury, and, combined with the rigidity of the hoof capsule, significant pressure builds within the hoof capsule, causing severe discomfort. Horse owners or barn managers will frequently attempt to remove the offending object before the veterinary visit; this must be avoided if possible because it can then be difficult to find the site of puncture. The ability to radiograph the object in place can greatly assist in developing a treatment program or in the decision to refer for further debridement. Keeping the horse immobile to prevent further advancement of the foreign body is crucial. If the foreign body was removed or if came out on its own, you may see a small dark spot or hemorrhage resulting from puncture to the solar corium. Locating a puncture to the soft tissue of the frog can be difficult because the tissue may close over the tract, obscuring the site of entry.

If the foreign body is present upon the practitioner’s arrival, radiographs are necessary to ascertain the location, vector, and structures involved. If the
foreign body is not present, thorough cleaning and disinfection of the hoof is done to identify the entry wound and then a malleable radiopaque probe or radiopaque contrast material can be passed into the tract and radiographs taken. It is important to take multiple radiographic views of the foot because it may be difficult to ascertain the involved structures with only a lateral view. Once a diagnosis of the structures involved is made, a treatment plan can be formulated.

Once the penetration site is located, it is crucial to open the tract with a hoof knife or bone curette and remove all necrotic debris. The hoof should be considered at risk to develop a subsolar abscess and treated accordingly as discussed in the previous section. Thorough irrigation of the tract with a teat cannula using sterile saline and an iodine solution is an effective method for disinfection. If synovial distension is noted in the distal interphalangeal joint or distal flexor tendon sheath during the exam, a synovial fluid sample should be taken for cytology, culture, and sensitivity. The synovial structure should be thoroughly irrigated with a sterile saline solution and infused with an antibiotic such as amikacin. If it is likely that the deeper structures such as the deep digital flexor tendon (DDFT), distal phalanx, or synovial structures sustained damage or were penetrated, referral for aggressive treatment and surgical debridement of the affected tissue should be considered. Advanced diagnostic procedures, such as MRI and CT, can be very helpful to diagnose the amount of damage sustained.

Broad-spectrum antibiotics for 10 to 14 days, NSAIDs, and tetanus prophylaxis are recommended in treating a penetrating solar wound. After initial treatment is complete, bandaging the foot is necessary to prevent continued contamination. A hospital treatment plate can be applied and ensures good protection and support for the affected foot while allowing easy access for continued treatment. A treatment that is commonly used and very effective is a distal regional limb perfusion with antibiotics. A tourniquet is placed just proximal to or at the level of the fetlock; a catheter or butterfly cannula is aseptically placed in the digital vein, and an antibiotic/saline mixture is infused. The most common antibiotic used in our practice is amikacin. An effective combination is using 20 mL of sterile saline and 500 to 1000 mg of amikacin sulfate injected into the digital vein with the tourniquet removed after 30 minutes. Studies have shown that 125 mg of amikacin in a regional limb perfusion causes intra-articular concentrations to reach 25 to 50 times the minimum inhibitory concentration of most pathogens. Few data exist to determine the amount of antibiotic required to reach adequate minimum inhibitory concentrations in extrasynovial tissues when performing this technique; therefore, using a higher dosage of antibiotics (the aforementioned 500 to 1000 mg of amikacin) may be needed.

5. Fractures

Traumatic fractures can occur in any environment. A diagnosis of fracture should be ruled out with any occurrence of an acute non-weight-bearing lameness. When a fracture occurs, the bone loses its structural function in varying degrees depending on the location, type, and character of the fracture. Severity of lameness is dictated by the degree of loss of structural function and the specific bone affected. Fracture of the major load supporting bones typically results in severe lameness. Fractures of the long bones, scapula, and pelvis can occur due to severe trauma such as kick injury or the result of a fall. Fractures of the distal limb can occur due to stress torsion, hyperextension, or hyperflexion. Fractures of the distal phalanx typically occur with heavy concussion on an uneven object, such as a rock or uneven frozen ground, or can be a pathologic fracture secondary to pre-existing disease. If the fracture is open, the prognosis is significantly worse, proportional to the amount of contamination and length of time exposed to the environment. Body weight of the horse can also have an effect on overall prognosis. As body weight increases, the prognosis for full recovery decreases due to the load placed on the implant or on external coaptation.

A fracture of the major load supporting bones will often present with acute swelling, pain, and occasionally crepitation on palpation and manipulation of the limb in the region of the fracture. If a fracture is suspected, radiography is an invaluable tool to assess the character of the fracture, whether the fracture is simple or compound, and the location of the fracture. In certain circumstances, radiography may not be essential to determine the presence of a fracture such as open fractures where bone fragments are visible. These factors will dictate the type of coaptation needed. A diagnosis of fracture in the limb that is able to be stabilized surgically should prompt an ambulatory veterinarian to recommend referral. Some fractures may not require or are unable to receive surgical intervention such as a pelvic fracture or depression fracture of the scapula. If surgery is not an option, long-term coaptation is possible but likely to carry a guarded to poor prognosis. Therefore, due to the severity of the injury, euthanasia must be considered as a humane alternative.

A number of resources exist for coaptation of a fracture in preparation for transport to a referral facility and for adequate stabilization for the level of injury within the limb. At minimum, a Robert Jones bandage consisting of multiple layers of cotton and tension bandaging can be used to provide support to the affected limb. The overall size of the bandage should be least 3 times the diameter of the limb. Apply each layer of cotton and firmly secure with rolled gauze. With each successive layer, the amount of tension placed on the gauze should increase to create a stable support wrap. The outer
Good references exist for splinting a fracture,\(^8,9\) and other will provide the most effective stabilization. The goal of splinting is to ensure immobilization of the joint proximal and distal to the fracture site. If possible, two splints applied at a 90° angle to each other will provide the most effective stabilization. Good references exist for splinting a fracture,\(^8,9\) and keeping a copy in the ambulatory vehicle can be very helpful. If the fracture is located in the distal limb, a Kimsey splint can be used to align the bony column and relieve the fulcrum at fetlock and pastern joints. Depending on the level of distress of the patient, sedation may be needed. Care must be taken to not use an excessive amount of sedative, reducing the patient’s ability to maintain a solid stance. Appropriate analgesia is crucial to maintaining comfort of the patient and reducing stress. NSAIDs and opioids such as butorphanol can be used to reduce pain at appropriate dosages. If contamination of the fracture is suspected, broad-spectrum intravenous antibiotics should be started immediately. Once the bandage and splint are applied, load the horse as soon as possible for transportation to a referral hospital for further workup and treatment. Horses should ideally be positioned straight, forward to rear, with the fractured limb pointing to the rear of the trailer. This allows the horse to brace for the braking inertia of the trailer. When adequate fracture stabilization is not possible, as with some proximal limb fractures, transport should not be attempted. In these cases, an on-farm supportive care program can be considered, utilizing methods such as highline or cross-tie restraint, distal limb support, and environmental and behavioral management. Euthanasia should also be considered a viable and humane option in fractures in which adequate stabilization by external coaptation or surgery is not possible or supportive care is not feasible. These fractures may include but are not limited to open contaminated fractures with comminution, catastrophic compound fractures of load-supporting bones, or severe fractures with difficult or impossible access such as acetabular fractures, in which external stabilization also not an option.

Fractures in foals tend to carry a better prognosis than in adult horses. Some of the reasons for a more favorable prognosis include lower body weight, potential for growth, ability to repair more rapidly, the ability to restrain the foal, the ability to remain recumbent for longer periods, and reduced strain on the repair by less-developed muscle/tendon units. Certain types of fractures, uncommon in adult horses, are more common in foals. These include Salter-Harris type fractures, which warrant a closer inspection of the physis and epiphysis on radiographs. A similar diagnostic approach is used in foals as in adults to identify a fracture and develop a treatment protocol. Due to less body weight, bandaging and splinting methods may be more successful in treating a simple fracture than in adult horses but referral to a surgical facility should be offered. As in adult horses, certain types of fractures may warrant the inclusion of euthanasia as a humane option due to a poor prognosis.

6. Laminitis

Laminitis remains one of the most common and most difficult conditions to treat in equine medicine. There is a vast amount of data published on laminitis and research will continue as equine practitioners struggle to understand and control this debilitating disease. Laminitis can result from a multitude of conditions including “grass” founder, carbohydrate overdose, endotoxemia, retained placent, gastrointestinal disease, respiratory disease, metabolic disease, and iatrogenic treatment. Laminitis can occur unilaterally, bilaterally, or involve all four limbs. The disease can be broken down into three general phases. The developmental phase is the time between the initial insult and the onset of clinical signs. The acute phase is the time from the onset of clinical signs but before the displacement of the distal phalanx, typically lasting the first 72 hours. The chronic phase is the time after the displacement of the distal phalanx has occurred.\(^9\) From an ambulatory emergency perspective, patients requiring treatment will be in the acute laminitic and/or chronic active laminitic categories. Clinical signs emerge after enzymatic lysis has occurred in the lamina of the hoof due to the metabolic processes that occurred during the developmental stage. Once the lamellar bonds begin to break down, the combination of weight-bearing forces on the bony column and the pull of the deep digital flexor tendon causes the distal phalanx to rotate or descend inside the hoof capsule.

Horses with laminitis typically present with severe discomfort on one or two limbs, most commonly in the forelimbs. Unilateral laminitis is usually associated with excessive weight bearing secondary to contralateral limb lameness. Clinical signs of acute laminitis include an increased digital pulse, increased heat of the hoof capsule, swelling or depression of the coronary band, shifting weight between affected limbs, and a “rocked back” or “camped under” stance. Tachycardia, tachypnea, and pyrexia are common findings and are attributable to significant pain. Horses with laminitis will often be acutely sensitive to hoof tester application. However, it may be difficult to evaluate a limb when the contralateral limb is also involved due to the
reluctance of the horse to bear weight. Perineural analgesia can be used to improve short-term comfort or for performing minor procedures but is not always successful in extreme pain situations. If perineural analgesia is needed for application of therapeutic implements, the horse should be reevaluated once the analgesia has worn off. Radiography of the distal phalanges of horses with laminitis is desirable, especially when rotation or distal displacement is suspected. A minimum of a lateromedial view and a horizontal dorsopalmar/plantar view are needed to assess the degree of rotation and/or descent of the distal phalanx. The lateromedial view alone cannot assess the amount of medial or lateral asymmetric descent of the distal phalanx. Once radiographs are taken, measurements can be used to determine the degree of rotation, the solar thickness at the apex of the distal phalanx, the amount of descent of the coffin bone, and the separation of the lamina from the hoof capsule. Even if no radiographic changes have taken place, this baseline set of radiographs can prove invaluable later in the course of treatment.

Treatment of acute or chronic active laminitis is highly variable and dependent on the client, patient, and attending practitioner. The goal of treatment is to reduce the discomfort of the horse and to aid in stabilization of the distal phalanx within the hoof capsule either during descent or immediately after termination of the acute phase. In the author’s practice, cryotherapy is very beneficial in reducing discomfort of horses with laminitis. It is important to apply the cryotherapy from the metacarpal bones to the distal phalanx. This will aid in cooling the blood flow before arrival at the distal limb. Constant cryotherapy in the form of ice boots has shown to be more beneficial than episodic treatment. It is important to treat as frequently as possible when using episodic cryotherapy. The patient should be housed in a stall or confined area with deep, soft bedding such as shavings or sand. Solar hoof support can help support the bony column and distribute the weight of the horse over a larger surface area thereby reducing focal pressure on the central toe region of the sole. Using Styrofoam, closed cell foam material, frog support pads, or moldable impression material formed to the frog and sulci can provide effective support. When using moldable materials, it is important to remember that they can be easily compressed and should be changed frequently. The initial compressed portion that has molded to the structure of the sole can be reused and fresh material applied in combination. The support material of choice is held in place with an elastic cohesive bandage material or duct tape wrapped around the hoof and heel bulbs, taking care not to compress the coronary band.

Systemic analgesia with NSAIDs such as phenylbutazone, flunixin meglumine, ketoprofen, or firocoxib should be administered immediately. Use of NSAIDs such as phenylbutazone and flunixin con-currently is beneficial with careful monitoring of secondary complications of their use. Butorphanol administered episodically or diluted in a polyionic solution as a constant rate infusion provides effective analgesia. Combining butorphanol with sedative compounds such as xylazine or detomidine, which also have analgesic effects, can be very effective if the patient is in distress. While little supporting scientific evidence exists, dimethylsulfoxide (DMSO) administered intravenously is widely used by veterinarians as an anti-inflammatory by way of scavenging free radicals. DMSO is diluted in polyionic saline solutions and administered as a constant rate infusion. Acepromazine can have a beneficial effect by providing peripheral vasodilation. While treating the effects of laminitis, it is important to treat the primary causative condition.

Antibiotic treatment, anti-endotoxic therapy, and intravenous fluids should be considered as adjunctive treatment if the ongoing laminitis is secondary to an identifiable primary insult. The horse owner should be made aware of the potential treatment options once the horse progresses to the chronic phase of laminitis such as corrective shoeing, analgesics, and rehabilitation programs.

7. Severe Soft Tissue Injury

Severe injury to the soft tissue supporting structures of the limb can cause significant lameness, particularly in the pre-acute stages. Horses will typically present with tachycardia, tachypnea, and pyrexia consistent with significant pain. Injuries to the suspensory ligament, flexor tendons, collateral ligaments, and major muscle groups may all be a diagnosis of exclusion. The environment can play a role in the diagnosis of the injury. In conditions of deep mud, snow, or ice, soft tissue injuries to muscle groups and periarticular structures are more common. Injuries incurred in performance disciplines such as jumping, barrel racing, or endurance should prompt close examination of the flexor tendons, suspensory ligaments, and periarticular structures. In the absence of significant swelling or heat, it is crucial to rule out other causes of severe lameness such as fracture or pathology of the hoof. If significant swelling and pain are present, ruling out bony fracture is also important. Careful palpation and manipulation of the involved structures is critical to diagnosing a soft tissue lesion. Muscle injuries are typically painful on direct palpation and extension or flexion of the limb. In performance situations, exertional rhabdomyolysis must be considered. Horses with a muscle condition often will be painful over the psoas and gluteal muscle groups. Supporting soft tissue structures such as the superficial and deep digital flexor tendons and suspensory ligament are likely to be painful on direct palpation and tend to form localized swelling. Injuries to the
periarticular structures may present with significant joint effusion and pain elicited on joint stress manipulation. Radiography of the affected limb should be considered to rule out bony lesions such as fracture. If the instrumentation is readily available, a complete blood cell count can be helpful in ruling out differential diagnoses such as cellulitis or intra-articular sepsis. Serum chemistry panels containing muscle-specific enzymes such as creatine kinase, lactate dehydrogenase (LDH), and aspartate aminotransferase (AST) can help determine the extent of muscle damage and aid in the diagnosis of rhabdomyolysis. Urinalysis can also be very useful in determining if muscle damage has occurred, as the urine will typically be discolored from red to brown.

For soft tissue lesions, ultrasonography is one of the most important diagnostic tools available to the ambulatory practitioner. Diagnosis of a significant lesion in structures such as the suspensory ligament or collateral ligaments can alter treatment in the acute stages. Once the lameness has been localized to a region of the limb, targeted ultrasonography can help determine the structures involved, the extent to which the tissues have been damaged, and the treatment plan required.

Treatmcnt of severe soft tissue lesions varies, depending on the diagnosis. Strict stall rest should be instituted to limit further damage to the affected structures until a detailed treatment plan has been made. If severe muscle damage is present due to a pre-existing muscle condition or trauma, intravenous fluid therapy with balanced electrolyte solutions is important to prevent renal damage from circulating myoglobin. If intravenous therapy is not readily available, oral rehydration should be instituted. Rehydration is important before administering NSAIDs due to the possibility of renal damage. In the absence of laboratory values such as packed cell volume, total protein, or urinalysis, fluid therapy can be estimated based on findings of a thorough physical exam including capillary refill time, skin tent assessment, and urine production. Electrolytes may be added to replace losses or correct metabolic alkalosis or acidosis but should be used only after serum chemistry has been performed.

Once hydration status has been assessed and fluid therapy instituted if necessary, pain control should be administered. NSAIDs are typically used initially for controlling inflammation and pain. If the patient continues to show severe distress or pain, administration of sedatives such as detomidine and xylazine combined with butorphanol may be indicated. Corticosteroids can be a very effective anti-inflammatory therapy when indicated. Muscle relaxants such as methocarbamol intravenously or orally can significantly reduce muscle spasm and provide rapid comfort for the patient. For lesions of the upper and lower limb, frequent use of cryotherapy can be a very useful tool in controlling ongoing inflammation, swelling, and pain. Placing a firm wrap of cotton padding, rolled gauze, and an elastic cohesive bandage material is important to provide support to the limb and limit ongoing swelling and edema. If the injury has occurred to the proximal region of the limb, a stacked bandage or Robert Jones bandage may be necessary. It is important to replace or reset the bandage once to twice daily to limit secondary pressure injury. In addition to providing support to control swelling and edema, certain severe soft tissue injuries require bandaging for stabilization purposes. These include flexor tendon ruptures and collateral ligament ruptures. The placement of a firm support wrap is indicated in these instances; a splint in the appropriate location may be necessary to achieve adequate stabilization. If referral to a hospital is indicated, further support such as a Robert Jones bandage and a splint should be considered to limit damage during transportation. Topical products, such as DMSO and nitrofurazone, alcohol, or commercially available poultice products have been used successfully to reduce inflammation and edema. Care must be taken to avoid a dermatological reaction in an already compromised tissue and to avoid further exacerbating the pain and irritation of the horse.

8. Cellulitis
Cellulitis is a difficult and frustrating condition to diagnose and treat. In the practice region of the author, cellulitis occurs rapidly, with little warning, and frequently results in partial to full limb swelling, increased heat, significant pain on palpation, and variability in the grade of lameness from sound at a walk to non-weight-bearing lameness. The hind limb tends to be more frequently affected than the forelimb, and the condition tends to be unilateral.11 The prevalence of hind limb cellulitis over forelimb cellulitis is not fully understood but could relate to the higher likelihood of trauma from kicking or less frequent care due to safety concerns. Cellulitis of the limb can be initiated by many factors including puncture trauma, blunt trauma, or skin barrier disruption but is commonly idiopathic. The most common infectious agents isolated from cellulitis cases are Staphylococcus sp. and Streptococcus sp.11,12 These infectious agents are normal dermal flora of the horse thereby leading to the prevalence of their isolation. Other pathogens such as Escherichia coli have been found, and polymicrobial infections are not uncommon.12 As with severe soft tissue injuries, other causes of significant swelling, pain, and lameness should be ruled out before a diagnosis of cellulitis is made. Intra-articular or intrasynovial infections should not be overlooked, but frequently these structures are obscured by periarticular swelling and distension. A thorough history must be documented, especially if intra-articular therapeutic products have been administered in the recent past.
Clinical signs of cellulitis include pyrexia, tachycardia, tachypnea, significant heat, swelling, and pain. Due to the anatomical location of major blood and lymphatic vessels, swelling and pain is usually more pronounced on the medial aspect of the limb. If available, a complete blood cell count is very useful in determining the systemic impact of infection. Typically, leukocytosis and neutrophilia are seen along with an increased fibrinogen. Ultrasonography of the limb can be helpful if a traumatic lesion is found. If the lesion can be adequately visualized, drainage and treatment of the infected region can decrease the progression of the condition. A culture and sensitivity of the infected site should be obtained if possible. Ultrasonography can be of little assistance in the absence of a gross visible lesion, as the inciting cause of the swelling may be very small in a large, swollen limb and therefore very difficult to find and treat accordingly. Another diagnostic option occasionally used is thermography.

If a traumatic lesion is present, the wound should be treated aggressively. Debridement of damaged or necrotic tissue and frequent irrigation with an antiseptic solution, such as a diluted iodine solution, is indicated. Arthrocentesis for culture and sensitivity is indicated if intra-articular or intrasynovial sepsis is suspected. Case selection is critical when deciding if arthrocentesis is appropriate due to the risks of introducing infectious agents into a sterile synovial structure. After arthrocentesis is performed, a thorough lavage with a sterile saline solution and administration of a suitable antimicrobial product is necessary.

Systemic antimicrobial therapy should be commenced as quickly as possible if cellulitis is suspected. Broad-spectrum treatment with two or more antibiotics is recommended until a culture and sensitivity is received or if initiating cause is unknown and a culture is unavailable. Common antimicrobials used include potassium penicillin, gentamicin, oxytetracycline, cefiofur, enrofloxacin, and metronidazole. Regional limb perfusion is a very effective method to introduce high concentrations of antimicrobials to the intravascular and extravascular structures of the distal limb. This is a technique that is relatively easy for the ambulatory practitioner to perform. This method should be considered if adequate visualization of a superficial vein is possible. Ultrasound guidance can be helpful in locating a suitable site at which to perform this procedure. If adequate visualization of a site is not possible, as in severe full limb swelling and tissue distension, this procedure should not be attempted due to potential complications of introducing infectious agents to synovial structures if the vascular system is missed.

NSAID therapy is indicated to provide analgesia and to control inflammation. If the patient is normothermic, corticosteroids can be used to reduce inflammation and resulting edema. Intravascular administration of DMSO has been used for anti-inflammatory effects and free radical scavenging. As in other instances, if distress is present due to pain or inability to bear weight, sedation can be given on an as needed basis. Butorphanol can be administered either alone or in combination with a sedative to provide additional analgesia. Frequent cryotherapy in the form of cold-water hosing or ice packing can provide immediate relief to the patient and aid in the reduction of swelling. Cooling the entire limb proximal to distal is ideal. Topical products to reduce inflammation may be used but can occasionally cause additional irritation and inflammation and thus should be chosen carefully. DMSO, nitrofurazone, and menthol-based products all may be useful but may lead to additional dermatological reaction. Clay poultices, especially on the distal limb, are effective at drawing heat without the likelihood of irritation. Support bandaging can limit additional swelling, thereby reducing discomfort, and should be applied with firm tension but not overly tight. If traumatic wounds exist, they should be bandaged accordingly. Applying a wet-to-dry bandage can aid in drawing exudate from infected wounds away from the surrounding tissue. A support wrap can then be applied over the wound bandage.

Once the patient is able to bear weight, inducing motion through the use of controlled exercise can greatly aid in the dispersal of dependent fluid from the lower limb and reduce the severity of lameness. In the lower limb, the mechanical motion of the joints combined with the stretch and release of the muscle-tendon unit will apply pressure to the vascular and lymphatic system circulating the fluid proximally into the central circulatory system. The owner should be made aware of the potential of contralateral limb laminitis as a possible consequence of the excessive weight bearing. Frequent cryotherapy, use of anti-inflammatories, and appropriate exercise can reduce the incidence of laminitis.

9. Conclusion
Acute-onset non-weight-bearing lameness is and will continue to be one of the most common emergencies faced by the ambulatory practitioner. The key to approaching horses in this condition is to be well prepared with the basic equipment and ever-evolving knowledge to provide clients and patients with the best possible care. The basic principles of patient care should apply to all emergency lameness scenarios including taking a thorough and complete history, performing a complete physical exam, not solely examining the affected limb but the entire patient, creating a differential diagnosis list, using the diagnostic tools available to you to form a diagnosis, starting the appropriate treatment, developing and implementing a treatment protocol going forward, and referring when necessary.

References and Footnotes
1. Dyson SJ. Assessment of acute-onset, severe lameness. In: Ross MW, Dyson SJ, editors. Diagnosis and Man-

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cVetrap™, 3M™, St. Paul, MN 55144–1000.
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