Primary and secondary limb cellulitis in horses: 44 cases (2000–2006)

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Objective—To determine historical, physical, and microbiologic findings in horses with limb cellulitis and identify factors associated with short- and long-term outcome.

Design—Retrospective case series.

Animals—44 horses with limb cellulitis.

Procedures—Information obtained from medical records included use, history, affected limb, diagnostic procedures, treatment, and short-term outcome. Long-term follow-up information was obtained by means of a telephone survey.

Results—Twenty-four horses had primary cellulitis, and 18 of the 24 (75%) had a hind limb affected. Results of microbiologic culture were positive for all 20 horses with primary cellulitis from which specimens were obtained, with coagulase-positive Staphylococcus spp recovered from 12 of the 20. Short-term survival rate was 67% (18/24) for horses with primary cellulitis; 7 of the 9 horses available for long-term follow-up were being used for their intended use, and 4 had had a recurrence. Results of microbiologic culture were positive for 13 of the 16 (81%) horses with secondary cellulitis from which specimens were obtained. Short-term survival rate for horses with secondary cellulitis was 90% (18/20). Eleven of the 17 horses available for long-term follow-up were being used for their intended use; 2 had had a recurrence.

Conclusions and Clinical Relevance—Results suggested that cellulitis can be a life-threatening condition in horses. Horses that were febrile at admission or that developed laminitis were significantly less likely to survive. The prognosis for return to function was guarded, and recurrence was a potential concern. (J Am Vet Med Assoc 2007;231:1696–1703)

The term cellulitis refers to diffuse infection of the subcutaneous tissues.1 In horses, cellulitis involving the limbs is typically acute in onset and characterized by substantial inflammation. The affected limb typically becomes swollen, indurated, warm, and painful, with the horse often becoming lame or unable to bear weight on the affected limb. Most often in horses with cellulitis, the underlying cause is unknown, although the condition can sometimes be associated with soft tissue trauma and concomitant bacterial inoculation. Regardless of whether it is primary or develops secondary to a penetrating wound of the skin, cellulitis is a serious condition that can cause severe complications such as dermal necrosis, laminitis, vascular thrombosis, and persistent lameness.

To our knowledge, there are few published studies of the causes of limb cellulitis in horses, the risk factors for development of the condition, or the prognosis for affected horses. A previous report2 described 9 racehorses with primary limb cellulitis caused by coagulase-positive Staphylococcus spp that were treated with antimicrobials, NSAIDs, hydrotherapy, and bandaging. Four of the horses were euthanized because of contralateral limb laminitis, and a fifth horse was euthanized because of extensive dermal necrosis. All 9 horses were considered to have primary cellulitis because skin lesions were not identified. Risk factors were not identified, but a comparison was drawn between scalded skin syndrome–like disease in racing Greyhounds and the bathing practices for racehorses. Scalded skin syndrome–like disease in racing Greyhounds is caused by Staphylococcus aureus and is thought to be spread through the use of common water baths and whirlpools.3 Rhodococcus equi has been identified as the etiologic agent of cellulitis in 2 foals,4,5 both of which recovered with treatment.

Predisposing factors for the development of cellulitis in humans include vascular insufficiency, disruption of the venous or lymphatic drainage, diabetes mellitus, previous cellulitis, presence of a foreign body, accidental or surgical trauma, obesity, and poor hygiene.1 The presence of S aureus or β-hemolytic Streptococcus spp on the skin surface of the limb is a risk factor for the development of cellulitis,6 and limb edema and disruption of the skin are associated factors.7 In humans, subclinical dermatomycosis of the foot increases the risk of acute bacterial cellulitis of the legs, which is currently attributed to interruption of the skin barrier.8 Hygiene, the skin bacterial population, and interruption of the skin barrier could all be important factors in the development of limb cellulitis in horses also.

The purposes of the study reported here, therefore, were to determine historical, physical, and micro-

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**abbreviation**

NSAID nonsteroidal anti-inflammatory drug

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biologic findings in horses with limb cellulitis and to identify factors associated with short- and long-term outcome and complications. On the basis of clinical observations and findings in a previous report, we hypothesized that, in horses, primary cellulitis would be more likely to be associated with coagulase-positive \textit{Staphylococcus} spp, to occur in racehorses, and to be associated with a poorer outcome than secondary cellulitis; that results of microbiologic culture for horses with secondary cellulitis would be similar to previously documented results for horses with orthopedic surgical site infections; and that horses that had recovered from primary or secondary cellulitis would be susceptible to recurrences.

\textbf{Criteria for Selection of Cases}

Medical records from the University of Pennsylvania Teaching Hospital were reviewed for horses admitted with acute limb swelling between January 2000 and October 2006. Cases were selected for inclusion in the study if the horse was 6 months old and had clinical signs of limb cellulitis. Limb cellulitis was defined as a firm, swollen limb that was warm to the touch, with signs of pain on palpation. Cellulitis was defined as primary if there was no history of a penetrating skin lesion and as secondary if it developed within 1 month after, in the same limb as, and in association with a penetrating skin lesion, surgical incision, or intra-articular injection.

\textbf{Procedures}

\textbf{Medical records review—}Information obtained from the medical records of cases included in the study consisted of age, breed, sex, use of the horse (ie, racehorse or nonracehorse), and duration of clinical signs. Information regarding any history of trauma, penetrating wound, surgery, or intra-articular injection associated with the affected limb was also recorded, along with any medications that were administered prior to admission.

Results of the initial physical examination, including the focus and extent of swelling and, when indicated, the area of most extensive swelling, were recorded, along with the affected limb, degree of lameness at a walk, and whether there was any evidence of a break in the skin. Swelling of the entire limb was defined as swelling to the level of the elbow or stifle joint.

For horses with primary cellulitis, the term broken skin was defined as full-thickness dermal necrosis that was present at the time of admission but had developed after the onset of limb swelling or that developed any time after admission. For horses with secondary cellulitis, the term broken skin was defined as a full-thickness skin lesion associated with a documented surgery or injection site or traumatic wound that was present at the time of admission. Dermal necrosis in horses with secondary cellulitis was defined as a full-thickness ulcerative skin lesion that developed in an area distant to the inciting lesion.

Additional information obtained from the medical records included whether the horse had a fever (rectal temperature \(>38.6\,^\circ\text{C} \left[101.5\,^\circ\text{F}\right]\)) at the time of admission, results of diagnostic imaging (ie, ultrasonography, radiography, and scintigraphy), and results of hemato logic testing. Leukocytosis was defined as a WBC count \(>12,500 \,\text{cells/\muL}\), and leukopenia was defined as a WBC count \(<4,500 \,\text{cells/\muL}\). A left shift was defined as a band neutrophil fraction \(>1\%\). Azotemia was defined as a serum creatinine concentration \(>2 \,\text{mg/dL}\).

Finally, results of microbiologic culture were recorded. Samples submitted for microbiologic culture consisted of subcutaneous fluid aspirates and deep wound swab specimens. All samples were submitted to the University of Pennsylvania Microbiology Laboratory for aerobic culture; some were also submitted for anaerobic culture. Standard microbiologic techniques were used. Briefly, samples for aerobic culture were plated on trypticase-soy blood agar, MacConkey agar, and Columbia-nalidixic acid agar plates. Trypticase-soy blood agar plates were incubated in 3% to 5% CO\(_2\), and other plates were incubated in ambient air. Samples for anaerobic culture were plated on prerduced agar plates, and plates were incubated under standard anaerobic conditions. Plates were checked daily for 3 days, and all colony types were identified with a commercial kit. Infections were classified as polymicrobial if \(>1\) species of microorganism were isolated from a single sample.

Results of arthrocentesis were recorded when performed. Results of synovial fluid examination were considered normal if nucleated cell count was \(<300 \,\text{cells/\muL}\) with \(<20\%\) neutrophils and protein concentration was \(\leq3 \,\text{g/dL}\). Results were considered to be consistent with a diagnosis of septic arthritis when the total protein concentration was \(>3 \,\text{g/dL}\) and the nucleated cell count was \(>30,000 \,\text{cells/\muL}\) with \(>80\%\) of the nucleated cells being neutrophils. Synovial fluid samples with nucleated cell counts \(>300 \,\text{cells/\muL}\) but \(<30,000 \,\text{cells/\muL}\) were classified as sympathetic effusions.

\textbf{Treatment—}Antimicrobial treatment, including type of antimicrobials and route and duration of administration, during and after hospitalization was recorded. Use of a combination of a \(\beta\)-lactam antimicrobial and an aminoglycoside was specifically noted, along with systemic administration of \(>2\) antimicrobials (eg, a combination of cefotiofur, penicillin G procaine, and metronidazole or a combination of enrofloxacin, gentamicin, and metronidazole). Antimicrobials used for regional limb perfusion were considered separately. For horses treated with NSAIDs, the type of drugs and duration of administration were recorded. Other treatments, such as IV fluid administration, administration of lidocaine or butorphanol as a continuous-rate infusion, regional limb perfusion, hand walking, and hydrotherapy were also recorded. Finally, duration of hospitalization and any complications, such as laminitis, dermal necrosis, jugular vein thrombosis, and colic, were recorded.

\textbf{Outcome—}Short-term survival was defined as survival to discharge. The contour of the affected limb at the time of discharge was noted. Long-term follow-up information was obtained by telephone surveys of owners or trainers. Information obtained included whether the horse had returned to its original use or was being used for its intended purpose, whether the horse was...
sound on the affected limb, whether the limb had regained its normal contour, whether it took > 3 months for the limb to return to normal, whether cellulitis recurred, and whether there were any residual problems with the limb, such as occasional edema or abnormalities of hoof capsule growth.

**Statistical analysis**—Categoric data were summarized as percentages, and continuous data were summarized as mean, median, and range. Categoric data were analyzed by use of the Fisher exact test, and continuous data were analyzed by use of 1-way ANOVA. Standard statistical software was used for all analyses. Values of \( P < 0.05 \) were considered significant.

The Fisher exact test was used to determine whether type of cellulitis (primary vs secondary) was associated with isolation of coagulase-positive *Staphylococcus* spp (yes vs no), horse use (racehorse vs nonracehorse), or outcome (survived vs died or euthanatized). Microbiologic culture results for horses with secondary cellulitis were compared descriptively with previously documented results for horses with orthopedic surgical site infections.

The Fisher exact test was also used for associations between outcome and affected limb, presence or development of dermal necrosis, presence of fever at the time of initial examination, bacterial isolates, use of a bandage (poultice or support), use of hydrotherapy, hand walking, and development of laminitis; between cause of cellulitis (primary vs secondary) and affected limb, bacterial isolates, and whether the horse was bearing weight on the limb at the time of initial examination; between the presence of dermal necrosis and bacterial isolates; between pyrexia and changes in CBC results and bacterial isolates; between administration of a \( β \)-lactam antimicrobial in combination with an aminoglycoside prior to initial examination and bacterial isolates and outcome; between administration of multiple antimicrobials prior to initial examination and bacterial isolates and outcome; between administration of a \( β \)-lactam antimicrobial in combination with an aminoglycoside during hospitalization and bacterial isolates and outcome; between administration of multiple antimicrobials during hospitalization and bacterial isolates and outcome; between horse use and bacterial isolates; and between affected limb and bacterial isolates. One-way ANOVA was used to test for associations between duration of clinical signs prior to initial examination and outcome; between duration of hospitalization and treatment with multiple antimicrobials; and between duration of hospitalization and type of cellulitis (primary vs secondary).

**Results**

**Signalment and history**—Forty-four horses, including 24 horses that were classified as having primary cellulitis and 20 that were classified as having secondary cellulitis, met the criteria for inclusion in the study (Table 1). There were 29 (66%) females, 9 (20%) geldings, and 6 (14%) stallions. Mean age was 5 years (range, 7 months to 17 years), with 26 (39%) horses (16 with primary cellulitis and 10 with secondary cellulitis) being < 5 years old. Most of the horses were Thoroughbreds (35 [79%]) and racehorses (23 [52%]). There was no significant \( P = 0.47 \) association between type of cellulitis (primary vs secondary) and horse use (racehorse vs nonracehorse).

Mean time from the onset of limb swelling to admission was 5.5 days (median, 4 days; range, 0.5 to 28 days) for horses with primary cellulitis and 8 days (median, 5 days; range, 1 to 56 days) for horses with secondary cellulitis. For horses with secondary cellulitis, mean time between the penetrating skin lesion, surgical incision, or intra-articular injection and the onset of cellulitis was 13 days (median, 9 days; range, 1 to 56 days).

Twelve of the 24 (50%) horses with primary cellulitis did not have any history of recent trauma, and 7 (29%) had a history of blunt trauma. Information on history was not available for the remaining 5 (21%) horses. Three (12.5%) of the horses with primary cellulitis reportedly had dermatitis of unknown cause involving the neck and girth region (2 racehorses) or pastern region (1 broodmare).

Eleven of the 20 (55%) horses with secondary cellulitis had sustained a penetrating skin wound, 6 (30%) had undergone surgery, and 3 (15%) had received an intra-articular injection. Of the 6 horses that had undergone surgery on the affected limb, 4 had undergone unilateral stifle arthroscopy, 1 had undergone unilateral metacarpophalangeal arthroscopy, and 1 had undergone bilateral desmotomy of the superficial digital flexor muscle accessory ligament.

Prior to examination at the veterinary teaching hospital, 25 of the 44 (57%) horses (17 with primary cellulitis and 8 with secondary cellulitis) had received \( ≥ 1 \) doses of phenylbutazone or flunixin meglumine. Twenty-three (52%) horses (15 with primary cellulitis and 8 with secondary cellulitis) had received antimicrobials. Thirteen (30%) horses (7 with primary cellulitis and 6 with secondary cellulitis) had received a combination of a \( β \)-lactam antimicrobial and an aminoglycoside. Six (14%) horses (3 with primary cellulitis and 3 with secondary cellulitis) had been given multiple antimicrobials (eg, penicillin, gentamicin, and metronidazole). Seventeen (39%) horses (8 with primary cellulitis and 9

<table>
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<th>Variable</th>
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<th>Secondary cellulitis</th>
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<td>13 (65)</td>
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<td></td>
<td>Sexually intact</td>
<td>6 (25)</td>
</tr>
<tr>
<td></td>
<td>Gelding</td>
<td>2 (8)</td>
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</tr>
<tr>
<td></td>
<td>Nonracehorse</td>
<td>11 (55)</td>
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</table>

*Data are given as number (%) or as mean (range).*
with secondary cellulitis) had not received antimicrobials prior to admission to the veterinary teaching hospital, and in the remaining 4 (9%) horses (1 with primary cellulitis and 3 with secondary cellulitis), medication history was unknown.

**Physical examination findings**—In all horses, a single limb was affected (Table 2). Twenty-six of the 44 (59%) horses (8 with primary cellulitis and 18 with secondary cellulitis) had broken skin. Twenty-eight (64%) horses (16 with primary cellulitis and 12 with secondary cellulitis) had a fever at the time of initial examination. Twelve (27%) horses (7 with primary cellulitis and 5 with secondary cellulitis) without a fever had received NSAIDs within 12 hours prior to initial examination. Rectal temperature at the time of admission was not recorded for 2 horses.

Ultrasoundography of the affected limb was performed in 31 (71%) horses (19 with primary cellulitis and 12 with secondary cellulitis). In all 31, the diagnosis of cellulitis was supported by the ultrasonographic findings (Table 3). One horse with necrotizing tenosynovitis developed cellulitis 4 days after receiving an intratendinous injection of lyophilized porcine small intestine submucosa.

Radiography of the affected limb was performed in 34 (77%) horses (18 with primary cellulitis and 16 with secondary cellulitis). In 3 of these horses, a bony lesion was found. One horse was found to have an injection-related metacarpal sequestrum, 1 horse was found to have fracture fragments displaced from the proximal end of the tibia secondary to a kick wound, and 1 horse was found to have lytic changes of the talus in association with wound-related sepsis of the tibiotarsal joint. Nuclear scintigraphy was performed in 1 horse with primary cellulitis after 12 days of hospitalization. Flow-phase images confirmed ischemia of the distal portion of the limb (Figure 1).

**Laboratory findings**—Leukocytosis was identified in 15 (34%) horses (11 with primary cellulitis and 4 with secondary cellulitis), leukopenia was identified in 1 (2.2%) horse with secondary cellulitis, and a left shift was identified in 5 (11.3%) horses with primary cellulitis. Hypoproteinemia was identified in 1 horse with primary cellulitis. Thirty-three (75%) horses (17 with primary cellulitis and 16 with secondary cellulitis) had hyperfibrinogenemia. Azotemia was identified in 3 horses with primary cellulitis.

In 36 (82%) horses (20 with primary cellulitis and 16 with secondary cellulitis), a subcutaneous fluid aspirate or deep wound swab specimen was submitted for microbiologic culture. Sampling technique and site were dependent on clinician preference, although ultrasonographic findings were used to choose the sampling site in some instances. In 8 of the 10 horses with primary cellulitis and ultrasonographic evidence of subcutaneous fluid accumulation, a fluid sample was obtained from this site. In 5 horses with secondary cellulitis that developed following arthroscopic surgery, a synovial fluid sample was also submitted for microbiologic culture. In all 20 horses with primary cellulitis from which a subcutaneous fluid aspirate (n = 12) was obtained or in which skin necrosis had occurred (8), results of microbiologic culture were positive (Table 4). For 1 horse with primary cellulitis from which coagulase-positive *Staphylococcus* spp were isolated...
Other treatments while horses were hospitalized included IV administration of polyionic isotonic fluids (n = 6), IV administration of butorphanol (4), IV administration of lidocaine (4), implantation of antimicrobial-impregnated polymethyl methacrylate beads (2), IV administration of dimethyl sulfoxide (1), TM administration of heparin sulfate (1), IV administration of polymyxin B (1), and epidural administration of morphine (1). Regional limb perfusion with amikacin sulfate was performed in 11 horses. In 1 horse with secondary cellulitis associated with sepsis of the stifle joint, an intra-articular infusion catheter was used for antimicrobial delivery. A skin graft was applied in 1 horse with secondary cellulitis, and surgical debridement was performed in 1 horse with an injection-related sequestrum.

In 35 of the 42 (83%) horses that were treated (20 with primary cellulitis and 13 with secondary cellulitis), a bandage was applied to the affected limb. A poultice bandage containing nitrofurazone and dimethyl sulfoxide with or without methyl salicylate and magnesium sulfate was used in 13 (37%) horses (9 with primary cellulitis and 4 with secondary cellulitis), and a padded compression bandage was used in 6 (2 with primary cellulitis and 4 with secondary cellulitis). Type of bandage used was not recorded for 16 horses (9 with primary cellulitis and 7 with secondary cellulitis). Hand walking was performed on 28 of the 42 (67%) horses (17 with primary cellulitis and 11 with secondary cellulitis), and hydrotherapy was performed on 26 (62%) horses (17 with primary cellulitis and 9 with secondary cellulitis).

Mean duration of hospitalization was 12 days (median, 10 days; range, 1 to 65 days). This included the 2 horses that were euthanatized the day after admission.

Ten (23%) horses (8 with primary cellulitis and 2 with secondary cellulitis) developed laminitis, and 9 of the 10 were subsequently euthanatized. Laminitis developed in the contralateral limb in 9 horses and in the affected limb in 1. Full-thickness dermal necrosis developed in 25 (57%) horses (18 with primary cellulitis and 7 with secondary cellulitis). Other complications that developed during hospitalization included azotemia (2 horses), salmonellosis (1), jugular vein thrombosis (1), and colic (2). Both horses with colic were treated medically and recovered.

Outcome—Thirty-four of the 44 (77%) horses were discharged from the hospital, including 16 of the 24 (67%) with primary cellulitis and 18 of the 20 (90%) with secondary cellulitis. The remaining 10 (23%) horses were euthanatized while hospitalized. Nine of these horses were euthanatized because of severe laminitis, and 1 was euthanatized because of uncontrollable pain and a lack of response to treatment.

At the time of discharge, the limb had returned to its normal size in only 4 of the 34 (12%) horses, all of which had had secondary cellulitis. Thirty-one (91%) horses were sound at a walk at the time of discharge, and 3 horses with secondary cellulitis were lame on the affected limb at the time of discharge.

Follow-up information was available for 26 horses (9 with primary cellulitis and 17 with secondary cellulitis). Mean follow-up time was 38.2 months (range,
for their intended or original use, and recurrence was a potential concern, with 6 horses having at least 1 recurrent episode.

For most horses with primary cellulitis in the present study, the underlying cause was not determined, although 7 (29%) horses did have a history of blunt trauma. In humans, blunt trauma has been found to be a risk factor for cellulitis, and although the present study did not allow us to identify risk factors, the possibility that blunt trauma could lead to severe enough cutaneous damage to cause inoculation of subcutaneous tissues with bacteria warrants consideration. Alternatively, traumatic alterations in local blood supply could increase the susceptibility of the region to localization of bacteria from hematogenous spread. It is also possible that a small penetrating wound occurred with the traumatic event but that physical evidence of the inciting lesion was lacking at the time of initial examination.

For 15 of the 24 (63%) horses with primary cellulitis in the present study, a hind limb was affected. Similarly, 7 of 9 horses in a previous report had hind limb cellulitis. If blunt trauma were indeed a predisposing factor for limb cellulitis and kicking were the most common cause of blunt trauma, then a predominance of unilateral hind limb involvement would be expected.

In the present study, 14 of 24 (58%) horses with primary cellulitis were racehorses; however, we did not find any significant association between type of cellulitis (primary vs secondary) and horse use (racehorse vs nonracehorse). Because of limitations of the hospital record system, we were not able to determine whether racehorses were overrepresented in our study population, compared with the hospital population during the study period. However, in the previous report of 9 horses with coagulase-positive Staphylococcus cellulitis, all 9 were racehorses. Thus, it is still unclear whether racehorses are predisposed to developing cellulitis.

Although a few horses in the present study had dermatitis of unknown cause prior to the onset of cellulitis, such lesions are common in horses, particularly racehorses. Thus, our findings do not provide support for an association between dermatitis and the development of cellulitis. Nevertheless, loss of skin integrity is an important risk factor for human patients with limb cellulitis. Scalded skin syndrome–like disease has been associated with bathing practices in racing Greyhounds and has been suggested as a possible cause of cellulitis in racehorses. Bathing equipment may act as a fomite for the causative bacteria, or the act of bathing may predispose the skin to drying and chapping. Additionally, in horses, the hind limbs may be more difficult to adequately wash and dry after exercise because horses are often hosed down by the same individual who is holding them, making access to the plantar aspect of the hind limbs difficult. Thus, the authors recommend hygienic handling of bathing equipment and careful drying of limbs after bathing.

The short-term survival rate for horses with primary cellulitis (16/24 [67%]) in the present study was not significantly different from the rate for horses with secondary cellulitis (18/20 [90%]). The most important factor associated with a poor outcome was development of laminitis, as 9 of the 10 horses that did not survive to

Discussion

Results of the present study suggested that cellulitis can be a life-threatening condition in horses, with only 34 of 44 (77%) horses in the present study surviving to discharge. Horses that were febrile at admission and horses that developed laminitis were significantly less likely to survive, as were horses with polymicrobial infection and horses from which Escherichia coli was isolated. We did not find any significant association between type of cellulitis (primary vs secondary) and outcome or between type of cellulitis and horse use (racehorse vs nonracehorse). The prognosis for return to function was guarded, with only 18 of the 26 (69%) horses that were discharged from the hospital and for which long-term follow-up information was available being used
discharge were euthanatized because of laminitis. Of the 10 horses that developed laminitis, 9 developed laminitis of the contralateral limb, emphasizing the need for adequate analgesic protocols in horses with cellulitis. Anecdotally, administration of lidocaine or butorphanol appeared to provide some relief for horses in the present study. However, these drugs were generally used after laminitis had already developed. We believe that these analgesic protocols should be used more often in horses with severe cellulitis, with IV administration of ketamine considered for horses in which pain control cannot be achieved.14

Full-thickness dermal necrosis developed in 25 (57%) horses in the present study and has been reported2,15 to contribute to morbidity and mortality rates in horses with limb cellulitis. Dermal necrosis may develop as a result of compromise of the cutaneous vasculature secondary to severe swelling, as a direct result of toxin production, or as a result of a combination of these factors.

In the present study, horses that were afebrile at admission were significantly more likely to survive than were horses that had a fever at admission. Fever, most likely, was a reflection of the severity and duration of disease in these horses, the pathogenicity of the infective organism, or the inoculating dose of the organism. The poorer survival rate for horses that were febrile at admission emphasizes the importance of systemic responses with regard to complications, including death.

For horses with secondary cellulitis in the present study, result of microbiologic culture were similar to previously reported8 results for horses with surgical site infections. This information can guide initial therapy prior to the availability of microbiologic culture results being available. In terms of secondary cellulitis, it suggests that similar opportunistic organisms colonize wounds as were found associated with orthopedic surgical site infection.

In the present study, only 18 of the 26 (69%); 9 with primary cellulitis and 17 with secondary cellulitis) horses for which long-term follow-up information was available returned to their original or intended use. Of this number, horses with primary cellulitis were underrepresented. This finding underscores the severity of this disease.

Our clinical impression that the limb often does not return to its normal contour in horses with cellulitis was borne out by findings of the present study in that only 12 of the 26 (46%) horses for which long-term follow-up information was available were reported to have a normal contour to the previously affected limb. Permanent damage to the limb is common. However, it is not possible, from these data, to determine whether the cause of the disease or the degree or duration of the swelling influences the likelihood of permanent damage.

Six of 26 (23%) horses in the present study for which long-term follow-up information was available reportedly had a recurrence of cellulitis. Determining the true incidence of recurrence in horses with cellulitis would require a much larger study. Nevertheless, owners of affected horses should be advised of the possibility of recurrence.

Samples were obtained for microbiologic culture from only 36 of the 44 (82%) horses in the present study. In informal discussions with attending clinicians, we identified 2 possible reasons why samples may not have been obtained. Some clinicians were concerned about the possibility of inadvertently inoculating another structure with bacteria while collecting a sample. In addition, there were concerns that needle penetration would lead to dermal necrosis and rupture of the skin. However, neither of these complications occurred in horses from which samples were obtained.

In all 20 horses with primary cellulitis in the present study from which a specimen was obtained, results of microbiologic culture were positive. This was higher than the percentage of positive culture results reported for people with cellulitis,16,17 for which positive culture rates of 15% to 23% have been reported for needle aspirates from individuals with cellulitis. It is possible that culture results were falsely positive in some horses in the present study. Nevertheless, on the basis of our results, we recommend that for horses with cellulitis, samples of fluid identified sonographically be submitted for microbiologic culture.

Blood samples were submitted for microbiologic culture in only 1 horse with primary cellulitis in the present study. Coagulase-positive Staphylococcus spp were isolated from both blood and limb samples, and the horse was euthanatized. In contrast, blood samples are frequently submitted for microbiologic culture in humans with cellulitis,18 with positive culture results obtained in 18.5% of cases. We advise that blood samples be submitted for microbiologic culture in horses with signs of systemic illness, as results could have therapeutic and prognostic implications.

Use of broad-spectrum antimicrobials has been previously recommended for the treatment of horses with cellulitis,2 and in humans with necrotizing fasciitis, IV administration of penicillin in combination with an aminoglycoside has been recommended.19,20 In the present study, 35 horses were treated with a combination of a β-lactam antimicrobial and an aminoglycoside and an additional 3 horses received a combination of 3 or more antimicrobials. The use of enrofloxacin in dogs with streptococcal cellulitis has recently come into question, as it had been reported that dogs appeared to do worse when treated with this drug.20 Recent research20 has suggested that this may be due to the induction of a phage that can act as a superantigen, thereby exacerbating the disease process.

a. CDC anaerobic blood agar plates with kanamycin and vancomycin, Krackeler Scientific Inc, Albany, NY.
b. Sensititre GNID and GPID, TREK Diagnostic Systems, Cleveland, Ohio.
c. SAS, version 9.1, SAS Institute Inc, Cary, NC.
d. ACell, ACell Inc, Jessup, Md.

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3. Love DN, Davis PE. Isolation of Staphylococcus aureus from a condition in Greyhounds histologically resembling “staphy-