# Tropical Myositis (Pyomyositis) in Children in Temperate Climates: A Report of 3 Cases on Long Island, New York, and a Review of the Literature

Jacob Weinberg, MD, Samara Friedman, MD, Sunil Sood, MD, and Russell J. Crider, MD

Pyomyositis is a primary bacterial infection of skeletal muscle with initial clinical features of fever, localized muscle pain and stiffness, swelling, and tenderness.[1] This infection is most commonly seen in tropical climates and thus is also called *tropical myositis*. Four percent of all patients admitted to hospitals in Uganda have this disease.[2] Shepherd[3] reported an incidence of 1 per 1000 population per year in Uganda and New Guinea. Tropical pyomyositis is usually caused by *Staphylococcus aureus*.[4]

**"Whether pyomyositis in temperate zones is becoming more common or is simply recognized more often is not clear"**

Relatively few cases of this disease have been reported in temperate climates. According to a literature review, 100 cases of pyomyositis were reported in North America between 1971 and 1992.[5] More recently, a few additional cases were found in the northeastern United States, at institutions in Boston,[6] Rochester,[7] Philadelphia,[8] and New Jersey.[9] Cases have also been reported in temperate European countries, such as Belgium[10,11] and England.[12-14] Whether pyomyositis in temperate zones is becoming more common or is simply recognized more often is not clear.

As early antibiotic treatment of infectious myositis is usually curative, it is important to entertain this diagnosis even in temperate climates. Delayed diagnosis and late institution of antibiotic treatment can lead to abscess formation, require surgical drainage, and yield poorer results.

In this article, we report 3 cases of pyomyositis in children treated at our institution in Long Island, New York, over a period of 6 months.

## Case Reports

### Case 1

A previously healthy 4-year-old girl presented to our institution with a 2-day history of a right-sided limp and right buttock pain. Her right lower extremity was held externally rotated and moderately abducted. On examination, she demonstrated pain with passive hip abduction and limited range of motion. Her temperature was 37.3°C. Admission laboratory data demonstrated a white blood cell (WBC) count of $12.4 \times 10^9$/L (normal, $3.8\text{-}10 \times 10^9$/L), with 72% neutrophils (normal, 43%-77%); erythrocyte sedimentation rate (ESR) was 68 mm/h (normal, 0-15 mm/h), and C-reactive protein (CRP) was 2.8 mg/dL (normal, 0.0-0.9 mg/dL) (Table I). Hip and pelvis plain films were normal. Magnetic resonance imaging (MRI) of the pelvis showed a swollen and edematous iliacus muscle, without abscess formation or hip joint effusion (Figure 1). The diagnosis

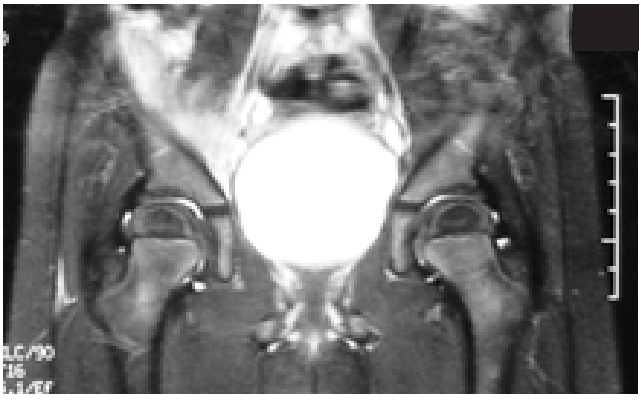

**Figure 1.** Fat-suppressed $T_2$-weighted coronal image of the pelvis shows increased signal in the right iliacus muscle, consistent with an infectious process. No effusion is noted in the right hip joint.

Dr. Weinberg is Assistant Professor, Division of Pediatric Orthopaedics and Scoliosis, Texas Children's Hospital, Baylor College of Medicine, Houston , Texas.
Dr. Friedman is Clinical Fellow, Orthopaedic Surgery, Children's Hospital of Philadelphia, University of Pennsylvania, Philadelphia, Pennsylvania.
Dr. Sood is Chief, Pediatric Infectious Diseases, Schneider Children's Hospital at North Shore University Hospital, Manhasset, New York.
Dr. Crider is Attending Orthopaedic Surgeon, Division of Pediatric Orthopaedic Surgery, Schneider Children's Hospital, New Hyde Park, New York, and Associate Clinical Professor of Orthopaedic Surgery, New York University School of Medicine, New York, New York.

Requests for reprints: Russell J. Crider, MD, 225 Community Dr, Suite 120, Great Neck, NY 11021 (tel, 516-466-3131; fax, 516-466-0246; e-mail, rjcridermdpc@msn.com).

*Am J Orthop.* 2007;36(5):E71-E75. 

**Table I. Summary of Cases**

| Case | Age (y) | Sex | Location | Temperature (°C) | WBC* (x10$^9$/L) | ESR† (mm/h) | Blood Cultures |
|---|---|---|---|---|---|---|---|
| 1 | 4 | F | Hip | 37.3 | 12.4 | 68 | No growth |
| 2 | 19 | F | Shoulder | 38.4 | 12.1 | 57 | No growth |
| 3 | 15 | M | Hip | 37.9 | 8.5 | 68 | α-Hemolytic streptococcus |

*White blood cell count normal range, 3.8-10.0x10$^9$/L.
†Erythrocyte sedimentation rate normal range, 0-15 mm/h.

**Table II. Incidence of Infectious Myositis Throughout the World**

4% of surgical admissions in East Africa[17]
1 to 2 cases per 4000 admissions per year in San Antonio, Texas[19]
1 case per 3875 emergency department admissions in Sydney, Australia[15]
1 case per 3218 pediatric admissions in Long Island, New York (current report)

of infectious pyomyositis of the iliacus was made, and the patient was started on intravenous (IV) nafcillin 150 mg/kg/d dosed every 6 hours. Admission blood cultures were sterile after 5 days. After a 7-day course of parenteral antibiotics, physical examination findings were significantly improved. The patient was discharged home on IV cefazolin 100 mg/kg/d dosed every 8 hours for a total of 4 weeks. She continued to improve clinically and at the most recent visit had normal laboratory blood values. She was asymptomatic at 11-month follow-up.

## Case 2

A healthy 19-year-old female adolescent presented with worsening pain in the left shoulder. In Mexico 2 weeks earlier, she had had a gastrointestinal infection treated with ciprofloxacin. A week later, she developed left shoulder pain. At the time, she was involved in a regular cardiopulmonary aerobic exercise program but could not recall any history of trauma to the shoulder. An orthopedic surgeon used a steroid injection to treat her for bursitis. The injection relieved her symptoms temporarily. She denied IV drug use and unprotected sex.

On presentation, shoulder motion was limited to 90° flexion and 90° abduction. Temperature was 38.4°C; WBC count was 12.1x10$^9$/L, with 83% neutrophils; and ESR was 57 mm/h. Plain films of the involved joint were normal. MRI of the shoulder showed soft-tissue edema in the subscapularis and pectoralis muscles. Edema was also visualized superior and inferior to the clavicle (Figure 2). The patient was admitted to the hospital and treated for pyomyositis with IV cefazolin 2 g every 8 hours. Admission blood cultures were negative.

The patient completed 2 weeks of IV antibiotics and 2 weeks of oral cefazolin. At 7-month follow-up, she was asymptomatic and had normalized laboratory results.

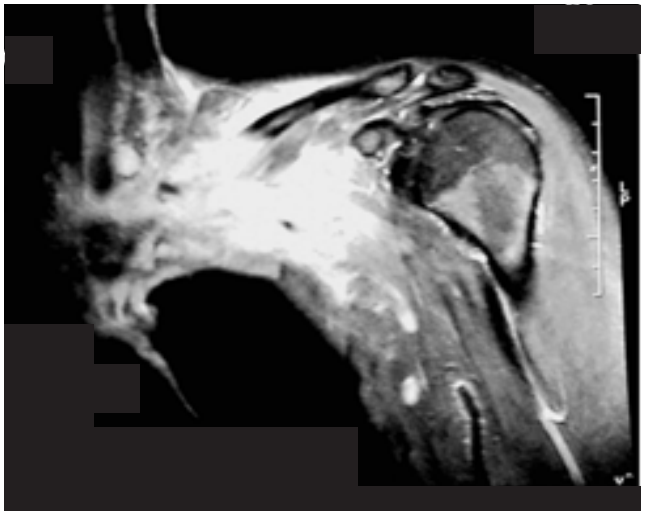

**Figure 2.** Fat-suppressed $T_2$-weighted coronal image of the left shoulder shows high signal intensity in the muscles of the shoulder girdle. There is no effusion in the glenohumeral joint.

## Case 3

A healthy 15-year-old boy was transferred to our institution with a 2-day history of left buttock and thigh pain without a history of injury. These symptoms were accompanied by severe sweats and chills. The patient was unable to ambulate. Temperature was 37.9°C. He had severe pain with

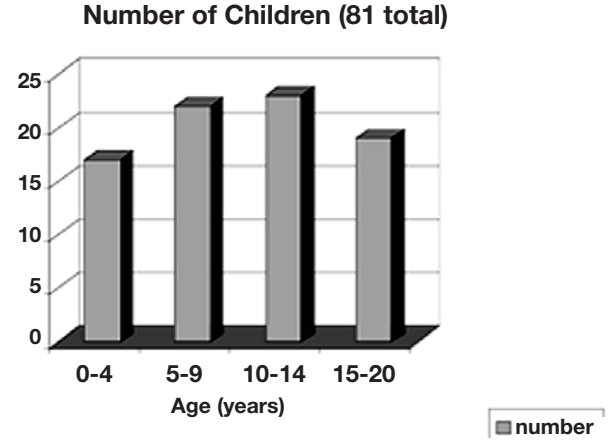


**Figure 3.** Literature review: Age distribution in children presenting with pyomyositis in temperate climates.

**Table III. Literature Review: Distribution of Anatomical Locations Affected by Pyomyositis in Children in Temperate Climates**

| Location | Children | |
|---|---|---|
| | n | % |
| Pelvis/hip | 29 | 35.8 |
| Thigh | 18 | 22.2 |
| Multiple sites | 10 | 12.3 |
| Leg | 8 | 9.9 |
| Spine | 5 | 6.2 |
| Arm | 4 | 4.9 |
| Neck | 2 | 2.5 |
| Shoulder | 2 | 2.5 |
| Torso | 2 | 2.5 |
| Forearm | 1 | 1.2 |

straight-leg raising and other hip motion. Hip and pelvis plain films were unremarkable. WBC count was $8.5x10^9$/L, with 77% neutrophils; ESR was 68 mm/h; and CRP was 18.4 mg/dL. MRI of the pelvis showed inflammatory changes in the left iliacus, iliopsoas, and gluteus maximus. At the outside institution, the patient was treated with IV cefotetan. Admission blood cultures were positive for an α-hemolytic streptococcus. Treatment was completed with piperacillin-tazobactam at our hospital. Examination findings were improved after 8 days of IV antibiotics.

The patient completed 6 weeks of treatment. At 7-month follow-up, acute-phase reactants were negative, but the patient still had a slight limp and minor pain.

## Discussion

Pyomyositis is traditionally viewed as a tropical disease, seen primarily in East Africa and the South Pacific,[4,15] but it is not limited to the tropics. In temperate climates, however, the entity is usually not considered in the differential diagnosis of patients presenting with musculoskeletal pain.[16] In these regions, physicians' lack of familiarity with the disease may be a factor in its being overlooked.[17] Yet, multiple authors have documented this disease in the United States.[2,5,8-10,16-21] In East Africa, the disease represents 4% of surgical admissions,[17] but even in San Antonio, Texas, there are as many as 1 or 2 cases per 4000 admissions per year.[19] Among the 9655 pediatric admissions to our hospital over 6 months were 3 cases, or 1 case per 3218 admissions. This incidence is similar to what has been previously reported (Table II).

We reviewed the cases of 81 children (64 boys, 17 girls) presenting with pyomyositis in temperate climates since 1971.[5,7-14,21-28] All subjects were younger than 21 years; mean age was 10 years (Figure 3). The most frequent locations of isolated infection were in the pelvis/hip (36%) and in the thigh (22%) (Table III). Ten children presented with multifocal disease. The most common isolated organism was *S aureus* (64%). An organism could not be isolated in 11% of patients (Table IV). In this series, 63% required surgical incision and drainage.

Pyomyositis is most common in the first and second decades of life. Mean age at presentation is 28.1 years. The youngest reported patient was 2 months old.[4] In children, malignancy and HIV infection are predisposing factors.[5,7] Associated comorbidities in adults include diabetes mellitus, malnutrition, HIV infection, tumors, and IV drug use.[4,6,7] Approximately half of all pyomyositis patients older than 30 years have an underlying medical condition.[3] Occasionally, a history of vigorous exercise or trauma to the muscle is reported.[4,8] A traumatic event, however, is not required for infection, as illustrated in our series.

**Table IV. Literature Review: Isolated Organisms in Children Presenting With Pyomyositis in Temperate Climates**

| Organism | % |
|---|---|
| *Staphylococcus aureus* | 64 |
| *Streptococcus* species | 14 |
| **Polymicrobial** | 8 |
| *Neisseria gonorrhoeae* | 1 |
| *Haemophilus influenzae* | 1 |
| *Bacteroides melaninogenicus* | 1 |
| **No isolated organism** | 11 |

### Presentation

A single muscle is commonly affected, though 11% to 43% of patients may have multiple sites involved.[4] The thigh muscles and muscles around the hip are the most common muscle groups infected.[5] Involvement of the deltoid, triceps, chest wall, gastrocsoleus, paraspinals, and forearm muscles has also been reported.[8,19,29] Abdominal muscle involvement can mimic an acute abdomen.[1,22] Infection in the iliopsoas may elicit pain with hip extension or internal rotation.[4] Furthermore, infection of the hip muscles can present like septic arthritis. One author thought that infection outside the joint is suspected when pain is elicited by active motion of the hip, but not by passive motion.[10] In addition, posterior buttock pain can be the overriding symptom—not the typical anterior or inguinal pain that occurs in other primary hip disorders.

**The 3 Stages of Bacterial Pyomyositis.** Bacterial pyomyositis typically presents in 3 stages. In the first, invasive stage, the patient may have fever, local swelling, mild pain, and minimal tenderness. The muscle itself may have a wooden consistency. These symptoms are often ignored by the patient. Because the infection is contained by the overlying fascia, local erythema or heat may be minimal until the infection extends to the subcutaneous tissues. The second stage develops 10 to 21 days later, when the patient experiences distinct muscle tenderness and swelling. This stage is defined by muscle abscess formation. The skin is warm but usually not erythematous. The patient is typically febrile. Pus can sometimes be aspirated from the muscle at this point. North American patients typically present to the hospital at this stage, a mean of 24 days after symptom onset.[5] Lymphatic channels and lymph nodes are seldom involved.[3] The third and last stage of pyomyositis is marked by systemic signs of sepsis and local erythema, extreme tenderness, and

fluctuance. The untreated patient may develop metastatic abscesses, shock, and renal failure.[1] Leg compartment syndrome has also been reported at this stage.[12] The clinical features that present at each stage of the disease in tropical and temperate climates are identical.[17] On the basis of these clinical findings, septic arthritis, cellulitis, osteomyelitis, thrombophlebitis, hematoma, contusion, muscle rupture, and tumor should be ruled out.[8] The clinical differential diagnosis can be somewhat difficult, especially during the first stage of pyomyositis.

**Lab Results.** In pyomyositis, laboratory blood testing typically demonstrates leukocytosis. Leukocytosis was found in two thirds of patients in one series.[16] Eosinophilia is indicative of a parasitic infection.[15] ESR and CRP are usually elevated, as seen in the patients in our series. Muscle destruction can be detected by elevations in serum muscle enzymes. Rhabdomyolysis with myoglobinuria can occur in later stages.[1]

*S aureus* is involved in 95% of skeletal muscle infections.[2] Other bacterial species include *Streptococcus pyogenes, Streptococcus pneumoniae,* and gram-negative organisms such as *Haemophilus influenzae* and *Escherichia coli*.[1] Adenoviruses, parainfluenza viruses, and coxsackievirus have also been isolated in muscle infection. Viral myositis, usually preceded by an upper respiratory tract infection, primarily affects the calf muscles, preventing normal ambulation, and is often associated with markedly elevated serum creatinine phosphokinase without myoglobinuria. The viral illness resolves spontaneously, typically within several days.[30] Other muscle infections may be caused by *Candida* species, toxoplasmosis, trichinosis, and cysticercosis.[19]

Blood cultures from initial presentation are positive in only 5% to 35% of cases.[1] In our series, only 1 of 3 patients had positive blood cultures. Nevertheless, elevated ESR, neutrophil counts, and clinical response to antibiotic treatment over an extended period pointed toward a bacterial infection in each case.

**Imaging.** In pyomyositis diagnosis, MRI is the imaging modality of choice.[4] $T_1$-weighted images show enlargement of involved muscle, with an increase in signal intensity in the involved area.[1] High signal intensity is seen on $T_2$-weighted sequences in the affected muscles. This signal can be separated from the low signal intensity of normal muscle.[30] In contrast, MRI of necrotizing fasciitis caused by *S pyogenes* shows thickening and tracking of abnormal high signal intensity along deep fascial planes on $T_2$-weighted sequences.[31] MRI may also be useful in ruling out osteomyelitis of the proximal femur or the pelvis, hematoma, soft-tissue tumor, and septic arthritis.[4]

Plain films can show soft-tissue swelling or a widened fascial plane.[19] Computed tomography (CT) of affected areas can show loss of muscle planes, central fluid collection, and a surrounding rim of enhancement with contrast. Ultrasound can demonstrate a hypoechoic collection and an increase in muscle mass. CT and ultrasound are useful in guiding percutaneous aspirations.

### Treatment

In the early stage of pyogenic disease, antibiotics alone are usually successful.[4] In one series, 8 of 16 children were successfully treated with antibiotics alone.[20] Similarly, none of our patients required surgical intervention. Surgical incision and drainage are required for the large abscesses of the third stage. Histologic examination of resected tissue demonstrates necrosis, hemorrhage, and acute and chronic inflammatory changes within the skeletal muscle.[30] Percutaneous aspiration may be attempted, and it is often successful.[8] After drainage, systemic antibiotics should be administered to prevent further abscess formation. Because *S aureus* is almost always resistant to penicillin,[15] the preferred antibiotic is a penicillinase-resistant penicillin such as nafcillin or oxacillin. Clindamycin can be used for patients with penicillin allergies. The patient is started on IV antibiotics until there is evidence of clinical improvement, and then oral or parenteral antibiotics are used for 2 to 6 weeks.[8,19]

Prompt diagnosis and early antibiotic treatment may be successful in treating infection without surgical drainage, as seen in our series. Pyomyositis should be carefully considered when diagnosing patients with musculoskeletal pain accompanied by symptoms of infection, even in temperate regions.

### Infectious Hip Myositis Versus Septic Hip Arthritis

A caution: as the most common site of infectious myositis in children is in the hip, septic arthritis of the hip can easily be confused with this entity. Differentiation of these entities is vital, as infectious myositis is usually successfully treated with antibiotics whereas septic arthritis of the hip requires surgical drainage. We speculate that attempted aspiration or arthrotomy of a hip through an area of infectious myositis could easily introduce the infectious agent into the previously sterile hip joint, thus producing iatrogenic septic arthritis.

## Author's Disclosure Statement and Acknowledgement

The authors report no actual or potential conflict of interest in relation to this article. This study was conducted in the Division of Pediatric Orthopaedic Surgery, Schneider Children's Hospital, New Hyde Park, New York.

A version of this article was presented to the Section on Orthopaedics at the National Conference of the American Academy of Pediatrics; October 2004; San Francisco, California.

## References

1. Swartz MN. Myositis. In: Mandell GL, Bennett JE, Dolin R, eds. *Principles and Practices of Infectious Diseases*. 5th ed. Philadelphia, Pa: Churchill Livingstone; 2000:1058-1066.
2. Brown JD. Pyomyositis. In: Strickland GT, ed. Hunter's Tropical Medicine and Emerging Infectious Diseases. 8th ed. Philadelphia, Pa: Saunders; 2000:390-391.
3. Shepherd JJ. Tropical myositis: is it an entity and what is its cause? *Lancet*. 1983;2:1240-1242.
4. Bickels J, Ben-Sira L, Kessler A, Wientroub S. Primary pyomyositis. *J Bone Joint Surg Am*. 2002;84:2277-2286.
5. Christin L, Sarosi GA. Pyomyositis in North America: case reports and

review. *Clin Infect Dis.* 1992;15:668-677.
6. Rodgers WB, Yodlowski ML, Mintzer CM. Pyomyositis in patients who have the human immunodeficiency virus. *J Bone Joint Surg Am.* 1993;75:588-592.
7. Corden TE, Morgan ER. Pyomyositis during induction chemotherapy for acute lymphocytic leukemia. *J Pediatr Hematol Oncol.* 1996;18:323-326.
8. Spiegel DA, Meyer JS, Dormans JP, Flynn JM, Drummond DS. Pyomyositis in children and adolescents: report of 12 cases and review of the literature. *J Pediatr Orthop.* 1999;19:143-150.
9. Bibbo C, Patel DV, Mackessy RP, Lin SS, Barricella RL. Pyomyositis of the leg with early neurologic compromise. *Pediatr Emerg Care.* 2000;16:352-354.
10. DeBoeck H, Noppen L, Desprechins B. Pyomyositis of the adductor muscles mimicking an infection of the hip. *J Bone Joint Surg Am.* 1994;76:747-750.
11. Godfroid N, Stalen JP. Thigh pain due to obturator internus phlegmon: a diagnostic challenge. *Eur J Pediatr.* 1995;154:273-274.
12. Harrington P, Scott B, Chetcuti P. Multifocal streptococcal pyomyositis complicated by acute compartment syndrome: case report. *J Pediatr Orthop B.* 2001;10:120-122.
13. Peckett WRC, Butler-Manuel A, Apthorp LA. Pyomyositis of the iliacus muscle in a child. *J Bone Joint Surg Br.* 2001;83:103-105.
14. Thomas S, Tytherleigh-Strong G, Dodds R. Adductor myositis as a cause of childhood hip pain. *J Pediatr Orthop B.* 2002;11:117-120.
15. Canoso JJ, Barza M. Soft tissue infections. *Rheum Dis Clin North Am.* 1993;19:293-305.
16. Hall RL, Callaghan JJ, Moloney E, Martinez S, Harrelson JM. Pyomyositis in a temperate climate: presentation, diagnosis, and treatment. *J Bone Joint Surg Am.* 1990;72:1240-1244.
17. Schlech WF, Moulton P, Kaiser AB. Pyomyositis: tropical disease in a temperate climate. *Am J Med.* 1981;71:900-902.
18. Echeverria P, Vaughn MC. "Tropical pyomyositis." A diagnostic problem in temperate climates. *Am J Dis Child.* 1975;129:856-857.
19. Grose C. Bacterial myositis and pyomyositis. In: Feigin RD, Cherry JD, eds. *Textbook of Pediatric Infectious Diseases.* 4th ed. Philadelphia, Pa: Saunders; 1998:704-708.
20. Gubbay AJ, Isaacs D. Pyomyositis in children. *Pediatr Infect Dis J.* 2000;19:1009-1019.
21. Brook I. Pyomyositis in children, caused by anaerobic bacteria. *J Pediatr Surg.* 1996;31:394-396.
22. Wheeler DS, Vazquez WD, Vaux KK, Poss WB. Streptococcal pyomyositis: case report and review. *Pediatr Emerg Care.* 1998;14:411-412.
23. Akman I, Ostrov B, Varma BK, Keenan G. Pyomyositis: report of three patients and review of the literature. *Clin Pediatr.* 1996;35:397-401.
24. Birkbeck D, Watson JT. Obturator internus pyomyositis. *Clin Orthop.* 1995;316:221-226.
25. Hernandez RJ, Strouse PJ, Craig CL, Farley FA. Focal pyomyositis of the perisciatic muscles in children. *AJR Am J Roentgenol.* 2002;179;1267-1271.
26. Meehan J, Grose C, Soper RT, Kimura K. Pyomyositis in an adolescent female athlete. *J Pediatr Surg*. 1995;30:127-128.
27. Papadopoulos M, Chugh S, Fiztgerald R, Thomas RJ. Obturator internus pyomyositis. *Orthopaedics.* 2000;23:383-384.
28. Renwick SE, Ritterbusch JF. Pyomyositis in children. *J Pediatr Orthop.* 1993;13:769-772.
29. Pretorius ES, Hruban RH, Fishman EK. Tropical pyomyositis: imaging findings and a review of the literature. *Skeletal Radiol.* 1996;25:576-579.
30. Wiedermann BL. Miscellaneous causes of myositis. In: Fiegin RD, Cherry JD, eds. *Textbook of Pediatric Infectious Diseases.* 4th ed. Philadelphia, Pa: Saunders; 1998:709-711.
31. Struk DW, Munk PL, Lee MJ, Ho SG, Worsley DF. Imaging of soft tissue infections. *Radiol Clin North Am.* 2001;39:277-303.