Pseudomonas Osteomyelitis Secondary to Puncture Wound of the Foot

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Pseudomonas osteomyelitis as a complication of puncture wound of the foot has not been emphasized in the family practice literature, and, indeed, has only recently received any attention as a clinical entity. Major texts and reviews give cursory attention to the topic if it is mentioned at all.[1–5] Certainly the puncture wound of the foot, most often caused by a nail, is commonly treated in the offices of family physicians and pediatricians. The patient, most often a child, is brought to the office for a tetanus shot, and the injury is frequently overlooked. More widespread awareness of Pseudomonas osteomyelitis as a complication of puncture wounds, however, with its characteristic clinical features, should facilitate early recognition and minimize morbidity.

It is estimated that 8 to 15 percent of puncture wounds of the foot become infected, resulting in cellulitis, abscess, deep soft tissue infection, or osteomyelitis.[6–9] Staphylococcus is commonly isolated in cases of osteomyelitis in children,[10,11] although other organisms are associated with specific situations, such as Salmonella osteomyelitis in patients with hemoglobinopathies.[12] Pseudomonas aeruginosa isolated in cases of osteomyelitis secondary to puncture wound of the foot was first described in 1968 by Johanson.[13]

Subsequent reports have implicated the child's sneakers as contributing to the emergence of this organism,[14,15] even dubbing the complication "sneaker osteomyelitis" to emphasize the sneaker as a frequent concomitant of the injury[7]; however, Pseudomonas osteomyelitis can occur following a puncture wound in bare feet as well.[16]

CASE REPORT

The patient, a healthy 11-year-old boy, stepped on a nail while wearing sneakers. The puncture wound in the ball of the right foot was treated at home with soaks and antibacterial ointment for one week. The puncture site became red and swollen, and the patient was unable to put weight on the right foot. He presented to the emergency room, where a diagnosis of cellulitis was made. The patient was given a tetanus shot and was sent home on oral penicillin. He returned several days later, and because the puncture site was still tender and erythematous, the antibiotic was changed to oral cephalexin. Findings on an x-ray examination of the foot were normal. The infection at the puncture site did not respond to the new antibiotic, and the boy was admitted to the hospital for parenteral therapy of presumed cellulitis.

At admission to the hospital, approximately 16 days after the initial injury, the puncture site was erythematous and swollen, and the medial aspect of the foot began to show signs of an erythematous streak. Lymphadenopathy was absent. The patient was afebrile and had a normal white cell count. Intravenous oxacillin and cefazolin was instituted for treatment of cellulitis. The lesion markedly improved, but six days later began again to develop signs of infection. Osteomyelitis was revealed by repeat x-ray films, showing bony erosion in the head of the first metatarsal of the right foot, as well as by an elevated erythrocyte sedimentation rate of 52 mm/h. The diagnosis of osteomyelitis was confirmed by bone scan.

The metatarsal lesion was explored and debrided in surgery. The antibiotic regimen was changed to ticarcillin and gentamicin to cover Pseudomonas. Gram stain of purulent material from the lesion revealed sheets of white cells, but no organisms. Pure Pseudomonas subsequently grew from culture.

The patient was treated for six weeks with parenteral ticarcillin and gentamicin. The pain, swelling, erythema, and tenderness resolved, and the erythrocyte sedimentation rate at discharge was 23 mm/h. Throughout the hospitalization the patient remained afebrile with a normal white cell count. Two years after his initial injury, the patient is well.

DISCUSSION

This case illustrates the characteristic clinical features of Pseudomonas osteomyelitis, including the lack of signs of

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systemic illness (such as fever and leukocytosis), treatment for cellulitis with multiple antibiotics (resulting in apparent recovery), and a puncture wound of the foot from a nail while wearing sneakers.

Although Pseudomonas osteomyelitis occurs in some unusual circumstances (for example, as a result of heroin abuse,[17]) in most cases there is an antecedent puncture wound of the foot.[18–20] The clinical course is characteristic.[7,8,13–16,18–25] The patient who has stepped on a nail presents some days later with infection at the site of the injury and is treated with an antibiotic. The infection initially seems to resolve, but the patient returns with an apparent cellulitis and is frequently treated with another antibiotic. Fever, lymphadenopathy, and leukocytosis are absent. The diagnosis finally comes to light many weeks after the initial injury, when an x-ray examination of the foot reveals osteomyelitic changes and the erythrocyte sedimentation rate is elevated. Gram stain of material from the affected bone may not reveal any organisms.[13,23]

Some investigators have been able to culture Pseudomonas from the inner sole of the sneakers worn at the time of the injury.[14,15] It has been hypothesized that the spongy inner layer becomes wet with use and acts as a medium for bacterial growth; the foot then is inoculated when the nail punctures the sneaker.[15] Others have suggested that the sneaker is merely contaminated by drainage from the puncture wound.[19] Pseudomonas is not usually cultured from the surface of the sneakers[26] or the interdigital skin.[25,26] In any case, children are certainly likely to be wearing sneakers in play situations in which a child would be at risk for stepping on a nail.

Puncture wounds should be cleaned with an iodophor and explored thoroughly.[8,27,28] Foreign bodies, such as bits of the sock within the wound, should be sought and removed.[8,25,29] Patients given antibiotics on the day of the injury (which may promote the growth of gram-negative bacteria) fare no better than those simply instructed to return should signs of infection appear.[8,15,25] If the patient returns with infection, antibiotics may be prescribed, directed against the gram-positive skin bacteria, Staphylococcus and Streptococcus.[15] If the infection fails to resolve after several days, however, osteomyelitis should be considered even in the face of a dearth of systemic symptoms and a normal white cell count. It may be possible to recover Pseudomonas by injecting nonbacteriostatic saline into the puncture site, aspirating the fluid, and sending the aspirated material for culture.[15,25]

Once the diagnosis of Pseudomonas osteomyelitis is established, extended parenteral anti-Pseudomonas therapy would seem warranted, although a shorter (two-week) course of antibiotics has been reported.[20] Newer oral and parenteral agents active against Pseudomonas may be effective in the treatment of osteomyelitis, but there is less experience using these drugs.[30–35]

The sequelae of Pseudomonas osteomyelitis are not insignificant, and include premature closure of growth plates, destruction of joints, and chronically draining sinus tracts.[6,13,16,23] Thus, Pseudomonas osteomyelitis should be considered early in the differential diagnosis when "cellulitis" following a puncture wound of the foot does not promptly resolve. The puncture wound of the foot needs to be treated with respect. Careful follow-up of this common and seemingly innocuous wound is imperative.

References

1. Behrman RE, Vaughan VC, Nelson WE (eds.): Nelson Textbook of Pediatrics, ed 13. Philadelphia, WB Saunders, 1987
2. Taylor RB (ed): Family Medicine: Principles and Practice, ed 2. New York, Springer-Verlag, 1983
3. Aronoff SC, Scoles PV: Treatment of childhood skeletal infections. Pediatr Clin North Am 1983; 30:271–280
4. Mandell GL, Douglas RG, Bennett JE (eds): Principles and Practice of Infectious Diseases. New York, John Wiley & Sons, 1979
5. Waldvogel FA: Osteomyelitis: The past decade. New Engl J Med 1980; 303:360–370
6. Riley HD: Puncture wounds of the foot: Their importance and potential for complications. J Okla State Med Assoc 1984; 77:3–6
7. Higham M: Infection in a puncture wound after it "healed." Hosp Pract 1983; 18:47–50
8. Fitzgerald RH, Cowan JDE: Puncture wounds of the foot. Orthop Clin North Am 1975; 6:965–972
9. Houston AN, Roy WA, Faust RA, et al: Tetanus prophylaxis in the treatment of puncture wounds of patients in the Deep South. J Trauma 1962; 2:439–450
10. Dich V, Nelson JD, Haltalin KC: Osteomyelitis in infants and children: A review of 163 cases. Am J Dis Child 1975; 129:1273–1278
11. Nade S: Acute hematogenous osteomyelitis in infancy and childhood. J Bone Joint Surg 1983; 65-B:109–119
12. Givner LB, Luddy RE, Schwartz AD: Etiology of osteomyelitis in patients with major sickle hemoglobinopathies. J Pediatr 1981; 99:411–413
13. Johanson PH: Pseudomonas infections of the foot following puncture wounds. JAMA 1968; 204:170–172
14. Jacobs NM, Rice TW: Puncture wound osteomyelitis, letter. J Pediatr 1985; 107:645
15. Fisher MC, Goldsmith JF, Gilligan PH: Sneakers as a source of Pseudomonas aeruginosa in children with osteomyelitis following puncture wounds. J Pediatr 1985; 106:607–609
16. Riegler HF, Routson GW: Complications of deep puncture wounds of the foot. J Trauma 1979; 19:18–22
17. Holzman RS, Bishko F: Osteomyelitis in heroin addicts. Ann Intern Med 1971; 75:693–696
18. Brand RA, Black H: Pseudomonas osteomyelitis following puncture wounds in children. J Bone Joint Surg 1974; 56-A:1637–1642
19. Elliott SJ, Aronoff SC: Clinical presentation and management of Pseudomonas osteomyelitis. Clin Pediatr 1985; 24:566–570
20. Jacobs RF, Adelman L, Sack CM, et al: Management of Pseudomonas osteochondritis complicating puncture wounds of the foot. Pediatrics 1982; 69:432–435
21. Minnefor AB, Olson MI, Carver DH: Pseudomonas osteomyelitis following puncture wounds of the foot. Pediatrics 1971; 47:598–601
22. Hagler DJ: Pseudomonas osteomyelitis: Puncture wounds of the feet, letter. Pediatrics 1971; 48:672–673
23. Chusid MJ, Jacobs WM, Sty JR: Pseudomonas arthritis following puncture wounds of the foot. J Pediatr 1979; 94:429–431

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24. Levinsky RJ: Two children with Pseudomonas osteomyelitis: The paucity of systemic symptoms may lead to delay in diagnosis. Clin Pediatr 1975; 14:288–291
25. Miller EH, Semian DW: Gram-negative osteomyelitis following puncture wounds of the foot. J Bone Joint Surg 1975; 57-A:535–537
26. Fritz RH, Crosson FJ: Concerning the source of Pseudomonas osteomyelitis of the foot, letter. J Pediatr 1977; 91:161–162
27. Mahan KT, Kalish SR: Complications following puncture wounds of the foot. J Am Podiatry Assoc 1982; 72:497–504
28. Graham BS, Gregory DW: Pseudomonas aeruginosa causing osteomyelitis after puncture wounds of the foot. South Med J 1984; 77:1228–1230
29. Green NE, Bruno J: Pseudomonas infections of the foot after puncture wounds. South Med J 1980; 73:146–149
30. Smith DW, Wilson RD: Treatment of Pseudomonas aeruginosa osteomyelitis with aztreonam, letter. Med J Aust 1987; 147:152
31. Scully BE, Neu HC: Use of aztreonam in the treatment of serious infections due to multiresistant gram-negative organisms, including Pseudomonas aeruginosa. Am J Med 1985; 78:251–261
32. Eron LJ, Park CH, Hixon DL, et al: Ceftriaxone therapy of bone and soft tissue infections in hospital and outpatient settings. Antimicrob Agents Chemother 1983; 23:731–737
33. Gentry LO: Treatment of skin, skin structure, bone, and joint infections with ceftazidime. Am J Med 1985; 79(suppl 2A):67–74
34. MacGregor RR, Gentry LO: Imipenem/cilastatin in the treatment of osteomyelitis. Am J Med 1985; 78:100–103
35. Gilbert DN, Tice AD, Marsh PK, et al: Oral ciprofloxacin therapy for chronic contiguous osteomyelitis caused by aerobic gram-negative bacilli. Am J Med 1987; 82:254–258