

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 injury⁷; 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 be-

came 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 sneakers²⁶ 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.

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Contraindications: Hypersensitivity to buspirone.

Warnings: The administration of BuSpar to a patient taking a monoamine oxidase inhibitor (MAOI) may pose a hazard. Since blood pressure has become elevated when BuSpar was administered concomitantly with an MAOI, such concomitant use is not recommended. BuSpar should not be employed in lieu of appropriate antipsychotic treatment.

Precautions: General—Interference with cognitive and motor performance: Although buspirone is less sedating than other anxiolytics and does not produce significant functional impairment, its CNS effects in a given patient may not be predictable; therefore, patients should be cautioned about operating an automobile or using complex machinery until they are reasonably certain that buspirone does not affect them adversely. Although buspirone has not been shown to increase alcohol-induced impairment in motor and mental performance, it is prudent to avoid concomitant use with alcohol.

Potential for withdrawal reactions in sedative/hypnotic/anticholinergic drug dependent patients: Because buspirone will not block the withdrawal syndrome often seen with cessation of therapy with benzodiazepines and other common sedative/hypnotic drugs, before starting buspirone withdrawal patients gradually from their prior treatment, especially those who used a CNS depressant chronically. Rebound or withdrawal symptoms may occur over varying time periods, depending in part on the type of drug and its elimination half-life. The withdrawal syndrome can appear as any combination of irritability, anxiety, agitation, insomnia, tremor, abdominal cramps, muscle cramps, vomiting, sweating, flu-like symptoms without fever, and occasionally, even as seizures.

Possible concerns related to buspirone's binding to dopamine receptors: Because buspirone can bind to central dopamine receptors, a question has been raised about its potential to cause acute and chronic changes in dopamine mediated neurological function (e.g., dystonia, pseudoparkinsonism, akathisia, and tardive dyskinesia). Clinical experience in controlled trials has failed to identify any significant neuroleptic-like activity; however, a syndrome of restlessness, appearing shortly after initiation of treatment, has been reported; the syndrome may be due to increased central noradrenergic activity or may be attributable to dopaminergic effects (ie, represent akathisia).

Information for Patients—Patients should be instructed to inform their physician about any medications, prescription or non-prescription, alcohol or drugs they are now taking or plan to take during treatment with buspirone; to inform their physician if they are pregnant, are planning to become pregnant, or become pregnant while taking buspirone; to inform their physician if they are breast feeding; and not to drive a car or operate potentially dangerous machinery until they experience how this medication affects them.

Drug Interactions—Concomitant use with other CNS active drugs should be approached with caution (see **Warnings**). Concomitant use with trazodone may have caused 3- to 6-fold elevations on SGPT (ALT) in a few patients. Buspirone does not displace tightly bound drugs like phenytoin, propranolol, and warfarin from serum proteins, but may displace less firmly bound drugs like digoxin.

Carcinogenesis, Mutagenesis, Impairment of Fertility—No evidence of carcinogenic potential was observed in rats or mice; buspirone did not induce point mutations, nor was DNA damage observed; chromosomal aberrations or abnormalities did not occur.

Pregnancy: Teratogenic Effects—Pregnancy Category B: Should be used during pregnancy only if clearly needed.

Nursing Mothers—Administration to nursing women should be avoided if clinically possible.

Pediatric Use—The safety and effectiveness have not been determined in individuals below 18 years of age.

Use in the Elderly—No unusual, adverse, age-related phenomena have been identified in elderly patients receiving a total, modal daily dose of 15 mg.

Use in Patients with Impaired Hepatic or Renal Function—Since buspirone is metabolized by the liver and excreted by the kidneys, it is not recommended in severe hepatic or renal impairment.

Adverse Reactions (See also Precautions): Commonly Observed—The more commonly observed untoward events include dizziness, nausea, headache, nervousness, lightheadedness, and excitement.

Associated with Discontinuation of Treatment—The more common events causing discontinuation included: central nervous system disturbances (3.4%), primarily dizziness, insomnia, nervousness, drowsiness, lightheaded feeling, gastrointestinal disturbances (1.2%), primarily nausea; miscellaneous disturbances (1.1%), primarily headache and fatigue. In addition, 3.4% of patients had multiple complaints, none of which could be characterized as primary.

Incidence in Controlled Clinical Trials—Adverse events reported by 1% or more of 477 patients who received buspirone in four-week, controlled trials: **Cardiovascular:** Tachycardia/palpitations 1%. **CNS:** Dizziness 12%, drowsiness 10%, nervousness 5%, insomnia 3%, lightheadedness 3%, decreased concentration 2%, excitement 2%, anger/hostility 2%, confusion 2%, depression 2%. **EENT:** Blurred vision 2%. **Gastrointestinal:** Nausea 8%, dry mouth 3%, abdominal/gastric distress 2%, diarrhea 2%, constipation 1%, vomiting 1%. **Musculoskeletal:** Musculoskeletal aches/pains 1%. **Neurological:** Numbness 2%, paresthesia 1%, incoordination 1%, tremor 1%. **Skin:** Skin rash 1%. **Miscellaneous:** Headache 6%, fatigue 4%, weakness 2%, sweating/clamminess 1%.

Other Events Observed During the Entire Pre-marketing Evaluation—The relative frequency of all other undesirable events reasonably associated with the use of buspirone in approximately 3000 subjects who took multiple doses of the drug under well-controlled, open, and uncontrolled conditions is defined as follows: Frequent are those occurring in at least 1/100 patients; infrequent are those occurring in 1/100 to 1/1000 patients; and rare are those occurring in less than 1/1000 patients. **Cardiovascular—**frequent: non-specific chest pain; infrequent: syncope, hypotension, hypertension; rare: cerebrovascular accident, congestive heart failure, myocardial infarction, cardiomyopathy, bradycardia. **Central Nervous System—**frequent: dream disturbances; infrequent: depersonalization, dysphoria, noise intolerance, euphoria, akathisia, fearfulness, loss of interest, disassociative reaction, hallucinations, suicidal ideation, seizures; rare: feelings of claustrophobia, cold intolerance, stupor, slurred speech, psychosis. **EENT—**frequent: tinnitus, sore throat, nasal congestion; infrequent: redness and itching of the eyes, altered taste, altered smell, conjunctivitis; rare: inner ear abnormality, eye pain, photophobia, pressure on eyes. **Endocrine—**rare: galactorrhea, thyroid abnormality. **Gastrointestinal—**infrequent: flatulence, anorexia, increased appetite, salivation, irritable colon, rectal bleeding; rare: burning of the tongue. **Genitourinary—**infrequent: urinary frequency, urinary hesitancy, menstrual irregularity and spotting, dysuria; rare: amenorrhea, pelvic inflammatory disease, enuresis, nocturia. **Musculoskeletal—**infrequent: muscle cramps, muscle spasms, rigid/stiff muscles, arthralgias. **Neurological—**infrequent: involuntary movements, slowed reaction time; rare: muscle weakness. **Respiratory—**infrequent: hyperventilation, shortness of breath, chest congestion; rare: epistaxis. **Sexual Function—**infrequent: decreased or increased libido; rare: delayed ejaculation, impotence. **Skin—**infrequent: edema, pruritus, flushing, easy bruising, hair loss, dry skin, facial edema, blisters; rare: acne, thinning of nails. **Clinical Laboratory—**infrequent: increases in hepatic aminotransferases (SGOT, SGPT); rare: eosinophilia, leukopenia, thrombocytopenia. **Miscellaneous—**infrequent: weight gain, fever, roaring sensation in the head, weight loss, malaise; rare: alcohol abuse, bleeding disturbance, loss of voice, hiccoughs.

Drug Abuse and Dependence: Controlled Substance Class—Not a controlled substance.

Physical and Psychological Dependence—Buspirone has shown no potential for abuse or diversion and there is no evidence that it causes tolerance, or either physical or psychological dependence. However, since it is difficult to predict from experiments the extent to which a CNS active drug will be misused, diverted, and/or abused once marketed, physicians should carefully evaluate patients for a history of drug abuse and follow such patients closely, observing them for signs of buspirone misuse or abuse (e.g., development of tolerance, incrementation of dose, drug-seeking behavior).

Overdosage: Signs and Symptoms—At doses approaching 375 mg/day the following symptoms were observed: nausea, vomiting, dizziness, drowsiness, miosis, and gastric distress. No deaths have been reported in humans either with deliberate or accidental overdosage.

Recommended Overdose Treatment—General symptomatic and supportive measures should be used along with immediate gastric lavage. No specific antidote is known and dialyzability of buspirone has not been determined.

For complete details, see *Prescribing Information* or consult your Mead Johnson Pharmaceuticals Representative.

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