Ultrasound in Emergency Medicine

ACUTE HEMATOGENOUS OSTEOMYELITIS OF THE RIB IDENTIFIED ON BEDSIDE ULTRASOUND

Peter J. Emiley, MD,* John L. Kendall, MD, FACEP,*† and Jennifer W. Bellows, MD, MPH*†
*Department of Emergency Medicine, Denver Health Medical Center, Denver, Colorado and †University of Colorado School of Medicine, Aurora, Colorado

Reprint Address: Peter J. Emiley, MD, Department of Emergency Medicine, Denver Health Medical Center, 777 Bannock Street, Mail Code #0108, Denver, CO 80204

Abstract—Background: Osteomyelitis is a challenging and commonly considered diagnosis in the emergency department. Early recognition and treatment with appropriate antibiotic therapy is crucial to prevent complications. Objective: This case reviews relevant literature and typical ultrasound features of osteomyelitis. It highlights a previously undescribed and practical application of emergency department bedside ultrasonography, adding to the diagnostic armamentarium for this disease process. Case Report: A 48-year-old woman presented with fever and left chest wall pain. She had been seen previously for a right axillary abscess requiring incision and drainage. Examination revealed a focal area of chest tenderness without cutaneous changes. Chest x-ray study and laboratory evaluation were nondiagnostic. Bedside ultrasound diagnosed acute hematogenous osteomyelitis of a rib. Conclusions: Bedside ultrasound holds great promise in investigating osteomyelitis when suspicion is high and traditional initial testing is nondiagnostic. Further study is required to quantify this benefit in the emergency department setting and explore utility of negative results. © 2015 Elsevier Inc.

Keywords—osteomyelitis; ultrasound; rib; imaging; infectious diseases

INTRODUCTION

Osteomyelitis is a frequent diagnostic consideration in the emergency department (ED). In the pre-antibiotic era, mortality ranged between 15% and 25% (1). With appropriate antimicrobial therapy and surgical intervention, mortality is < 5% today (1). Early diagnosis of osteomyelitis and administration of antibiotics is of paramount importance to preventing progression of disease and potentially irreversible sequelae.

We present a case of rib osteomyelitis identified during bedside ultrasonography when traditional investigation, including blood work and chest x-ray study, was nondiagnostic. To our knowledge, this is the first case describing the bedside ultrasound identification of osteomyelitis in the ED setting.

CASE REPORT

A 48-year-old female with a remote history of methamphetamine, crack cocaine, and alcohol abuse presented with fever and severe left-sided chest pain, which had been ongoing for a month. Her medical history was significant for a right axillary abscess diagnosed 25 days earlier that required incision and drainage and a 10-day course of trimethoprim/sulfamethoxazole. She represented 6 days later with left chest wall pain. At that visit, her vital signs were normal and electrocardiogram and chest x-ray study were unremarkable. She was discharged home with a diagnosis of chest wall pain.

During the third visit, her physical examination was notable for a blood pressure of 94/69 mm Hg, pulse of 109 beats/min, respirations of 26 breaths/min, oxygen
saturation of 94% on room air, and a temperature of 38.7°C (101.7°F). Examination of the left chest revealed a focal area of tenderness over the left lateral ninth rib without cutaneous erythema or palpable fluctuance. Apart from her tachycardia, the pulmonary and cardiovascular examinations were unremarkable. A chest x-ray study was formally interpreted without acute cardiopulmonary process. Laboratory values included a white blood cell count of 8.9 × 10^3/µL, platelet count of 633 × 10^3/µL, lactate of 1.4 mg/dL, normal basic metabolic panel, an erythrocyte sedimentation rate (ESR) of 34 mm/h, and a C-reactive protein (CRP) of 11 mg/dL. A bedside ultrasound was performed and was notable for anechoic fluid collection in continuity with the surface of the rib, which was highly concerning for osteomyelitis and adjacent abscess formation (Figure 1).

A chest computed tomography (CT) scan (Figure 2) was subsequently obtained and interpreted as showing evidence of developing abscess adjacent to the left ninth rib, which was suggestive of osteomyelitis. The patient was admitted and underwent ultrasound-guided aspiration of the fluid collection by interventional radiology. Cultures grew methicillin-sensitive *Staphylococcus aureus*. Magnetic resonance imaging on hospital day 4 (Figure 3), recommended by the infectious disease service, showed definitive evidence of rib osteomyelitis with surrounding abscess. The patient was offered surgical intervention but elected to undergo 6 weeks of oral antibiotics and re-evaluation. She remained clinically stable with adequate pain control and was discharged with follow-up in the infectious disease clinic.

**DISCUSSION**

Osteomyelitis has multiple classification systems, but the simplest, by Lew and Waldvogel, describes cases as deriving either from hematogenous spread or from contiguous infection (2). Both forms can be defined as acute or chronic (2). In this case, the patient presented with the acute form of the disease, most likely from a hematogenous source.

Diagnosis of osteomyelitis is often challenging and most frequently considered in the setting of chronic foot wounds (3). Laboratory findings, such as leukocytosis or elevated inflammatory markers (eg, ESR and CRP), are nonspecific early in the disease course, but may be more useful to assess response to treatment or progression of disease (4). Plain radiography is traditionally used as an initial diagnostic modality, and can be very helpful in excluding other diagnostic possibilities. Its usefulness in the diagnosis of acute osteomyelitis is limited, however, with sensitivity ranging from 43% to 75% (positive likelihood ratios 1.7–4.4), depending on the degree of disease progression at time of testing (4). Early findings are often subtle and may not be present for 10 to 14 days. When present, however, they are very specific and can be helpful in ruling in the diagnosis (5).

**Figure 1.** Bedside ultrasound utilizing linear array probe to identify periosteal fluid collection concerning for abscess.

**Figure 2.** Chest computed tomography scan redemonstrating periosteal fluid collection concerning for abscess and suggestive of osteomyelitis.

**Figure 3.** Chest magnetic resonance image definitively demonstrating osteomyelitis of left ninth rib.
and bone scintigraphy are both more sensitive than plain radiographs (4). Unfortunately, these studies can be time consuming, are not readily available, and their cost can be prohibitive.

When plain radiography and laboratory evaluation are unrevealing, but clinical suspicion is high, additional testing is indicated. One potential approach is the use of bedside ultrasound, which can augment the initial evaluation and determine the need for more costly and time-intensive investigations (6). Sonographic evidence of osteomyelitis spans a spectrum of findings dependent on degree of disease progression. The primary process occurs within the bone and is poorly visualized by ultrasound. However, recognition of indirect and soft-tissue findings can aide in diagnosis. The earliest changes frequently include juxtacortical tissue swelling with occasional thickening or elevation of the periosteum. This finding can be seen 1 to 2 days after onset of symptoms (6). Worsening subperiostial exudative changes manifest as focal anechoic collections or as an elongated fluid stripe and occur 4–14 days after symptom onset. Abscess formation can be represented by hypo- or hyperechogenic changes in continuity with the surface of the bone and is strongly suggestive of osteomyelitis. The hypoechoic focus seen in our patient led to diagnosis and is a late finding, usually seen 3 to 4 weeks after symptom onset. Finally, cortical erosion occurs in the latest stages of disease progression (7).

To our knowledge, this is the first reported case of osteomyelitis diagnosed using ED bedside ultrasound. Literature supporting this imaging technique in the diagnosis of osteomyelitis consists primarily of small-scale and single-institution studies, with the majority involving the pediatric population. Reported sensitivities range from 55% to 90% (positive likelihood ratios 1.03–14.8) if done for an acute presentation, although variable criteria constituted a positive examination (3,8,9). There is evidence that ultrasound can detect osteomyelitis several days earlier than plain radiographs and some have suggested the use of ultrasound as an adjunct in a multimodality imaging approach to a osteomyelitis (4,5,10,11).

CONCLUSIONS

This case illustrates an otherwise unreported application of ED bedside ultrasonography to elucidate a difficult diagnosis missed on previous patient assessment. There is great promise for the ED provider in using ultrasound to rapidly and inexpensively evaluate for osteomyelitis when plain radiography and laboratory testing are unrevealing and clinical suspicion is high. Further randomized controlled studies are warranted to investigate this technology in the bedside setting and to assess the utility of negative results.

REFERENCES