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Ultrasound in Emergency Medicine

STERNAL FRACTURE COMPLICATED BY A SUBCUTANEOUS ABSCESS IN A 5-YEAR-OLD BOY AND DIAGNOSED USING POINT-OF-CARE ULTRASOUND

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☐ **Abstract—Background: Although fractures of the sternum are rare in young children, owing to the compliance of the chest wall, these fractures are still possible and require thorough examination. We present a case that emphasizes the usefulness of point-of-care ultrasound in the diagnosis of a pediatric sternal fracture complicated by a subcutaneous abscess. Case Report: A 5-year-old boy presented with tenderness of the sternum, with diffuse swelling extending bilaterally to the anterior chest wall. Ultrasound imaging identified irregular alignment of the sternum with a subcutaneous abscess and swirling of purulent material within the abscess in the fracture area. These findings were confirmed on enhanced chest computed tomography and had not been visible at the time of the first evaluation 6 days prior. Why Should an Emergency Physician Be Aware of This?: Our case demonstrates the usefulness of point-of-care ultrasound for the diagnosis and appropriate management of a sternal fracture complicated by a subcutaneous abscess in a young child. As ultrasound imaging is easy to perform at the bedside, it is useful for examining pediatric patients with swelling of the anterior chest and local tenderness of the sternum to rule out a sternal fracture, even if these fractures are deemed to be uncommon in children.** © **2018 Elsevier Inc. All rights reserved.**

☐ **Keywords—sternal fracture; point-of-care ultrasound; abscess; child**

INTRODUCTION

Although sternal fractures are uncommon in children, owing to the marked compliance of the chest wall, their occurrence is possible and, thus, thorough examination is necessary (1,2). Plain radiography may be unsuitable in these cases, with the potential for missed diagnosis of a fracture and subcutaneous abscess (3). Ultrasound examination can improve the diagnosis, with demonstrated usefulness for diagnosis of fractures, including those of the sternum, in adults and children (4–8). However, use of ultrasound to diagnose and guide the clinical management of sternal fracture complicated by a subcutaneous abscess has not been reported on previously. In this case report, we describe the usefulness of ultrasound for the identification of a fracture of the sternum, complicated by a subcutaneous abscess, in a 5-year-old child. These findings had not been observed on previous chest computed tomography (CT) obtained 6 days prior.

CASE REPORT

Written informed consent was obtained from the parents for publication of this case report.

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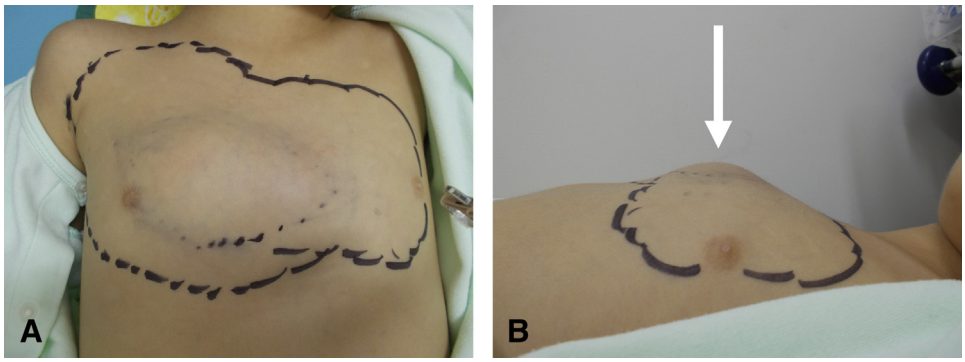

Figure 1. (A) Photograph of the patient's chest (anterior view), obtained before surgery, showing the swelling (indicated by the lines drawn on the image) without redness. (B) Lateral view photograph of the patient's chest (obtained from the left side, before surgery), showing the swelling on the right side of the anterior chest.

A 5-year-old boy presented to our emergency department (ED) complaining of an exacerbation of precordial pain. The pain was associated with mild swelling over the sternum, due to an injury sustained 6 days prior, when he was hit by a door. A chest CT performed at the time of the injury did not reveal a fracture and the patient was discharged from the ED. However, the pain and mild swelling remained constant over the next few days and then progressed, with the swelling extending to the anterior chest, bilaterally, and the patient developing a low-grade fever. This exacerbation prompted his parents to seek further medical consultation.

On arrival to the ED, the patient was alert and cooperative, with a temperature of 37.6°C, a heart rate of 105 beats/min, and oxygen saturation of 98% at room air. He was in mild distress. On physical examination, breathing sounds were heard bilaterally, with no acute cardiopulmonary issues identified. The abdominal examination was unremarkable. Swelling was observed over the sternum, extending to the anterior chest bilaterally (Figures 1A and 1B). There was no observed redness in the region. The anterior chest was tender on palpation. However, direct palpation of the sternum was not possible due to the swelling. Laboratory analysis revealed an elevation in the serum white blood cell count ($12.5 \times 10^3/\mu L$) and C-reactive protein level (6.54 mg/dL).

The emergency physician performed point-of-care ultrasound (POCUS) using an Aplio 100 system (Toshiba Medical Systems, Tokyo, Japan) with a high-frequency linear transducer. Ultrasound imaging revealed a sternal fracture accompanied by a discontinuity of the sternal alignment and fluid retention around the fracture site (Figures 2 and 3). Swirling of purulent material inside the abscess was observed by movement of the point of high echogenicity (Videos 1 and 2). The swelling over the anterior chest was diagnosed as subcutaneous fluid retention. A contrast chest CT examination was performed, revealing a sternal fracture with a subcutaneous abscess (Figure 4).

The patient was admitted to the hospital and was treated with surgical drainage of the abscess and i.v. cefazolin therapy. The blood culture examination was negative, but culture of the fluid drained from the abscess was positive for *Staphylococcus aureus*, sensitive to cefazolin.

DISCUSSION

Cellulitis is an infection of the skin and underling soft tissue that is normally characterized by pain, erythema, edema, and warmth to the touch. Surface redness may not be observable for infections localized in deeper tissues. Cellulitis is relatively common in children, being complicated by the formation of subcutaneous abscesses in some cases. An abscess is a cavity filled with purulent matter that results from a bacterial infection, which can present with or without surrounding cellulitis. To our knowledge, a sternal fracture complicated by a subcutaneous abscess, with diffuse swelling of the anterior

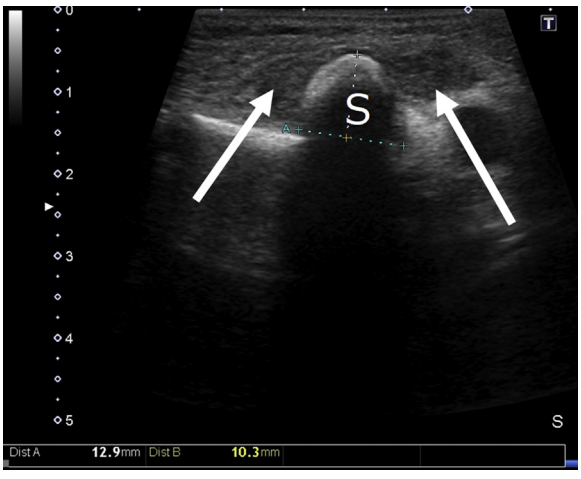

Figure 2. Midline sagittal sonogram of the sternum showing disruption in the surface of the sternum, with purulent material (indicating by arrow) around the area of fracture of the sternum (S).

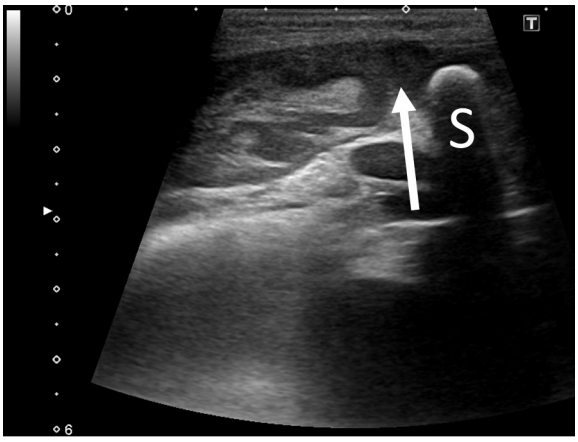

Figure 3. Midline transverse sonogram of the sternum showing disruption in the surface of the sternum, with purulent material (indicating by arrow) around the area of fracture of the sternum (S).

chest, and diagnosed using POCUS has not been reported previously.

The cause of the subcutaneous abscess was not specifically obvious. We did identify one previous case report describing the presence of subcutaneous abscess with a sternal fracture in an immunocompetent patient (9). In our case, local pain developed after precordial trauma, with local swelling developing after. In the absence of any local signs of skin infection, a cause for the abscess, other than the sternal fracture, was not obvious. Therefore, it is conceivable that the sternal fracture was the cause of the subcutaneous abscess.

Diagnosis

Physical examination and laboratory studies. Tenderness or swelling of the anterior chest after trauma is indicative of a possible fracture. However, it is difficult to discriminate between bruises and fractures, and to distinguish between cellulitis and a subcutaneous abscess, based on the physical examination alone. The appearance and distribution of the swelling is not always helpful to differentiate between an abscess and cellulitis, or to determine the extent of a potential infection. Moreover, the presence of swelling can make it difficult to palpate an underlying abscess. Soft-tissue swelling associated with cellulitis may obscure the findings of an abscess. Moreover, as both cellulitis and a subcutaneous abscess are soft-tissue infections, both are accompanied by an increase in white blood cell count and C-reactive protein level on laboratory tests.

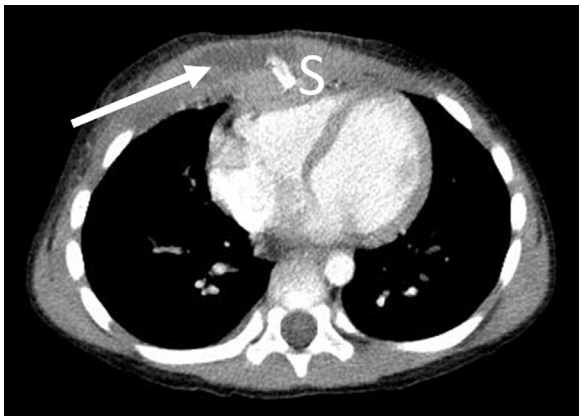

Figure 4. Transverse enhanced computed tomography image showing the sternal fracture (S) and subcutaneous abscess (arrow).

Imaging. Plain radiography study of the sternum is usually used to confirm the clinical diagnosis of a sternal fracture. However, interpretation of findings is more difficult in children due to the number of ossification centers and the large variation in their pattern of appearance and fusion (10). In addition, the evaluation of a subcutaneous abscess is also difficult using radiography. Ultrasound imaging offers a useful alternative to plain radiography for the diagnosis of fractures in both adults and children (11–14). Disruption of the echogenic cortical line on ultrasound images is indicative of a fracture. For the sternum, a fracture is identified as a discontinuity of the surface of the bone on images obtained by placing the transducer over the area of maximal tenderness and recording both longitudinal and transverse images. Identification of such discontinuities, however, is challenging in young children, in whom the sternum is formed of four ossification centers, with synostosis connections between these centers beginning to develop at the age of 7 years. Therefore, in young children, displacement of these centers of ossification is indicative of a possible sternal fracture.

Ultrasound examination is also a useful modality for the diagnosis of subcutaneous swelling, and POCUS is effective to distinguish between cellulitis and an abscess (15,16). In this regard, ultrasound imaging is useful to avoid unnecessary drainage procedures and allow appropriate treatment (17). The application of ultrasound imaging for the diagnosis and management of skin and soft-tissue infections is similar in children and in adults.

The echogenicity of an abscess, relative to surrounding structures, can also range from being anechoic to being hyperechoic. Occasionally, the contents of the abscess are hyperechoic or isoechoic compared to the adjacent inflamed tissues, with the abscess being distinguished from cellulitis by the presence of liquefaction. In our case, the abscess presented as a hypoechoic area compared to surrounding tissues, with poorly defined irregular borders and the presence of liquefaction, which distinguished it from cellulitis. Swirling of purulent

material in the cavity of the abscess was also visualized by the movement of the point of high echogenicity.

Differential diagnosis. The differential diagnosis of a sternal fracture is local bruising. The differential diagnosis for a subcutaneous abscess includes cellulitis, tumor, and other fluid collection, such as a cyst.

Treatment. For sternal fractures associated with a local infection, a foreign body, such as wires, should not be inserted. Drainage or aspiration is mandatory to treat the subcutaneous abscess. Intravenous cephazolin therapy should be initiated at a dose of 100 mg/kg/d. Because of the increase in methicillin-resistant *S. aureus* (MRSA) in recent years, vancomycin therapy is also recommended when there is a risk of MRSA, when the culture result is positive for MRSA, or when local findings do not improve. There is no definite guideline regarding the duration of antibiotic therapy for the treatment of a subcutaneous abscess. In our case, as there was a possibility of osteomyelitis based on CT images, antibiotic therapy was maintained for a period of 6 weeks.

WHY SHOULD AN EMERGENCY PHYSICIAN BE AWARE OF THIS?

POCUS is a valuable tool for emergency physicians. In this case, we demonstrate its usefulness for the diagnosis and appropriate management of a sternal fracture complicated by a subcutaneous abscess in a young child, which was not previously detectable on chest CT. As POCUS can be performed easily at the bedside, its use would be warranted to rule out a sternal fracture in pediatric patients presenting with swelling of the anterior chest and local tenderness of the sternum, even if these fractures are deemed to be uncommon in children. Our case further demonstrates that POCUS can be useful for detecting a subcutaneous abscess complicating the sternal fracture, allowing us to provide appropriate treatment. Cases of pediatric ultrasound examination using POCUS should be accumulated to clarify the usefulness of POCUS for diagnosis in the ED.

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SUPPLEMENTARY DATA

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jemermed.2018.12.040.

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