POINT-OF-CARE ULTRASOUND IN DIAGNOSING PYOMYSITIS: A REPORT OF THREE CASES

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Abstract—Background: Pyomyositis is a bacterial infection of skeletal muscle that often results in deep intramuscular abscesses. The absence of external dermatologic manifestations in the early stages of pyomyositis makes this a challenging diagnosis. In addition, physical examination findings can be difficult to distinguish from more common processes, such as soft-tissue cellulitis. Clinicians can fail to diagnose this serious disease in a timely manner, resulting in delayed treatment and potential clinical deterioration from sepsis. Although advanced imaging modalities, such as computed tomography (CT) and magnetic resonance imaging (MRI) provide excellent detail, ultrasound (US) can also be used to detect this disease. US can be performed expeditiously at the bedside and is less expensive than CT or MRI. It allows the clinician to examine the deeper tissue planes of muscle, in which purulent fluid collections will develop as pyomyositis advances. Case Report: Three patients presenting with leg pain were evaluated with point-of-care (POC) US and diagnosed with pyomyositis. The early diagnosis of this condition prompted rapid treatment with administration of appropriate antibiotics and involvement of orthopedic surgery. Aspiration of fluid allowed for detailed fluid analysis and bacterial cultures. Additional diagnostic imaging was performed, confirming the initial US diagnosis. Why Should an Emergency Physician Be Aware of This?: POC US can be helpful in identifying and further delineating intramuscular abscesses and can subsequently lead to expedited and appropriate care in patients who present with extremity pain, but lack significant dermatologic changes.

Keywords—pyomyositis; intramuscular abscess; muscle infections; point-of-care ultrasound

INTRODUCTION

Pyomyositis is a rarely encountered deep infection of skeletal muscle. It is believed to be more commonly a result of a transient bacteremia, although contiguous bacterial invasion from a traumatic injury has been reported (1). The overall mortality reported in the literature ranges from 1.5% to 27%, and patients with comorbidities have higher mortality rates (2). Although most common in the tropics and in patients with human immunodeficiency virus (HIV), there are at least 250 documented cases since 1980 in the United States that are not HIV related. Reported underlying medical conditions include diabetes mellitus, malignancy, cirrhosis, rheumatologic conditions, and sickle cell disease (2). Of these conditions, diabetes was the most common predisposing factor (1). The relative immunocompromised state of these patients predisposes them to serious sequelae from pyomyositis.
including joint invasion, sepsis, and even death. The treatment of pyomyositis includes the prompt administration of intravenous antibiotics and definitive surgical drainage.

Although magnetic resonance imagine (MRI) and computed tomography (CT) scans are considered to be the diagnostic gold standards, point-of-care ultrasound (POC US) can also be a useful diagnostic imaging modality. We report three cases of pyomyositis located in the quadriceps, including one case with an additional site in the leg. In all three cases, the use of US prompted rapid diagnosis, expediting appropriate treatment that included i.v. antibiotics and early surgical consultation.

**CASE REPORTS**

**Case 1**

A 61-year-old woman with poorly controlled non-insulin-dependent diabetes mellitus (NIDDM), cirrhosis, and obesity presented to the emergency department (ED) with right thigh pain, redness, and swelling. Of note, there was no history of trauma, i.v. drug abuse, or skin popping. She presented to her primary care physician, who referred her to the ED for evaluation of a presumptive right thigh abscess. She was afebrile and had no clinical evidence of sepsis. Examination revealed faint erythema and induration of the skin on the right proximal lateral thigh, with associated tenderness and edema (Figure 1). She had bilateral lower-extremity edema, which was worse in the right leg. Plain radiographs of the right femur were unremarkable. Laboratory results were significant for a nonreactive HIV test and a complete blood count with white blood cell (WBC) count of 9200/mm³, hemoglobin of 9.6 g/dL, and platelets of 116,000/mm³. C-reactive protein (CRP) was 20.4 mg/L and erythrocyte sedimentation rate (ESR) was 101 mm/h. Her blood glucose was 335 mg/dL. POC US with a Micromaxx (SonoSite Inc, Bothell, WA) 10-MHz linear array probe of the right thigh showed a 2 × 4 cm irregularly bordered, hypoechoic fluid collection with internal echogenicity and posterior acoustic enhancement located 1.5 cm deep to the skin and clearly within the muscle (Figure 2). The overlying soft tissue showed “cobblestoning,” indicating advanced tissue edema (Figure 3). The contralateral thigh had the US appearance of normal muscle (Figure 4).

Under US-guided needle aspiration, 13 mL cloudy yellow fluid was drained from the visualized intramuscular abscess. Orthopedic surgery was consulted for definitive care. An MRI of the leg showed myositis of the vastus lateralis muscle with a 1.3-cm fluid collection in the proximal and lateral aspect of the muscle, concerning for focal intramuscular abscess (Figure 5). Interestingly, cultures did not isolate a pathogen. However, the Gram stain demonstrated 3 + polymorphonuclear leukocytes. The patient was then managed by orthopedic surgery for definitive therapy of the abscess.

**Case 2**

A 55-year-old man with poorly controlled NIDDM presented to the ED with right thigh and left lower-extremity pain. There was no history of trauma, i.v.

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Figure 1. Picture of right thigh of patient without significant cutaneous evidence of infection. (Abdominal pannus is shown at the upper left of the picture, and thigh is in the center.)

Figure 2. Ultrasound image of right thigh. Large hypoechoic area (*) within muscle (M) with internal echogenic foci suggestive of debris demonstrates posterior acoustic enhancement (bracket), confirming the presence of fluid (or pus in this case).
drug abuse, or skin popping. Examination revealed an afebrile male with right medial thigh swelling, induration, and tenderness without erythema or fluctuance. The patient also had left lateral calf swelling and tenderness, without overlying erythema. Plain radiographs were unremarkable. The patient’s WBC count was 12,700/mm³, hemoglobin was 14.1 g/dL, and platelets were 287,000/mm³. Chemistry panel was significant for high blood glucose of 260 mg/dL. CRP was 229.8 mg/L and ESR was 117 mm/h.

POC US of the left calf performed with a Logiq-e (GE, Fairfield, CT) 10-MHz linear array probe was performed. This revealed a 2 × 2 cm spherical and primarily hypoechoic collection with areas of echogenic debris at a depth of 1.25 cm that was located within the muscle layer (Figure 6).

The skin overlying the fluid collection was noted to be thickened compared with the unaffected side. Twenty milliliters of purulent fluid was aspirated under US guidance. Orthopedic surgery was consulted, and antibiotics were started promptly. MRI of the left leg revealed a 4.1 × 3.1 cm intramuscular abscess involving the extensor digitorum longus muscle (Figure 7). MRI of the right thigh showed myositis of the vastus medialis and gracilis muscles with focal intramuscular abscesses consistent with pyomyositis. Cultures isolated methicillin-sensitive

Staphylococcal aureus. The patient was then admitted to orthopedic surgery for definitive management.

Case 3
A 51-year-old man with a history of gunshot wound to the right thigh 4 years earlier presented to the ED with

Figure 3. Ultrasound image of patient's right thigh. A combination of both phlegmonous and suppurative phases of pyomyositis are noted. In the phlegmonous phase, inflammatory areas distort the superficial layers of muscle, producing the finding of “cobblestoning” (bracket). Deeper layers show large hypoechoic area with internal echoes representing an intramuscular abscess (*).

Figure 4. Ultrasound of patient's left thigh. Normal striations of muscles (M) are seen and show no evidence of abscess. Also demonstrated are subcutaneous tissue (SC) and bone (B).

Figure 5. Magnetic resonance imaging confirms the ultrasonographic findings of intramuscular abscess (arrow) within the vastus lateralis.
1 month of increasing pain to his right thigh. Because of this pain, he had presented to the clinic 6 days earlier. At that time, a bullet extraction was performed. The patient’s pain did not improve after the procedure and continued to worsen during the week. He had no history of i.v. drug abuse or skin popping. At presentation, he was afebrile and nontoxic, but later became febrile to 39.4°C (103°F). The right thigh was tender to palpation, and he had pain with attempts to range his right hip. The skin had a soft-tissue defect correlating with the recent bullet extraction, however, there was no erythema or fluctuance overlying the area of tenderness. His WBC count was 11,900/mm³, hemoglobin was 12.5 g/dL, and platelets were 367,000/mm³. The patient had a CRP of 513.8 mg/L and an ESR of 122 mm/h. The patient’s chemistry panel was significant for an elevated blood sugar of 195 mg/dL.

POC US with a Micromaxx 10-MHz linear array probe of the right thigh was performed, showing a 1.2 cm, irregularly bordered, and hypoechoic area of mixed echogenicity in the vastus intermedius, starting at a depth of 3 cm from the skin (Figure 8). One milliliter of purulent fluid was drained from the thigh. Orthopedic surgery was consulted and antibiotics were started. CT of the right thigh showed a 3.4 x 1.7 x 1.8 cm abscess in the right vastus intermedius muscle, superficial to the right femoral neck and deep to an open soft-tissue defect of the skin at the site of the bullet extraction (Figure 9). Orthopedic surgery subsequently washed out the site of the abscess in the operating room. During his hospital stay, the patient was diagnosed with diabetes mellitus. Cultures isolated Group B streptococcus.

**DISCUSSION**

Because pyomyositis is a rare diagnosis and may not exhibit cutaneous findings, it can easily be confused for alternative entities, or dismissed as another nonsurgical process, such as a “viral syndrome.” A review of cases suggests that most patients with pyomyositis have a predisposing medical condition (1). In the cases reported here, all 3 patients had diabetes and obesity. One patient also had a history of cirrhosis.

Unfortunately, the pathophysiology of the disease makes diagnosis difficult and results in a longer mean
interval to diagnosis of 14 days (1). Pyomyositis typically progresses through 3 discrete stages. In stage 1, the infection is confined by the muscle aponeurosis and deep fascia without any overlying dermatologic extension. Patients might present with nonspecific signs of fever and muscle ache, which can be confused with an alternate diagnosis. In stage 2, pyomyositis might present with cutaneous signs. Affected muscle takes on a firm and “woody” texture, with overlying signs of inflammation (3). This superficial manifestation of pyomyositis can be mistaken for a more superficial infection, such as cellulitis. Stage 3 is the development of sepsis and life-threatening toxicity (4).

In a review of 330 cases in the United States, 80% of patients with pyomyositis were febrile on presentation (1). In obese diabetic patients and edematous cirrhotic patients, the infection lies a greater distance from the skin, resulting in a greater delay in the appearance of the cutaneous manifestations. These patients can progress to sepsis with little to no cutaneous evidence of infection (5). Vital signs and physical examination findings varied among our patients. Only one patient was febrile. In one case, there was mild erythema, while the other cases lacked significant superficial findings. The only common sign was tenderness to palpation of the muscle itself. Pain was present, but was not described as severe.

Locations of primary pyomyositis are variable. In a review of 676 cases, pyomyositis involved the quadriceps muscles in more than a quarter of the cases (3). Other frequent sites were the iliopsoas and gluteus muscles. Less frequent sites included the shoulder, calf, chest wall, and other lower-extremity muscles (3). Upper-extremity muscles were less commonly involved (6). Pyomyositis was unifocal in 81% of cases. Laboratory findings included leukocytosis that was present in 76% of cases. Eighty-one percent of patients had normal creatine kinase (CK) levels. The most common organisms implicated were Staphylococcus aureus (including methicillin-resistant Staphylococcus) and Streptococcus, followed by anaerobes. Only 4% of infections were polymicrobial (4).

In this case series, all 3 patients had abscesses located within the quadriceps muscle, and 1 patient had an additional site located in the calf. Laboratory findings were nonspecific. In 2 patients, the WBC count was elevated, but in the third patient it was normal. Blood glucose, ESR, and CRP were elevated in all 3 patients. Plain radiography was nondiagnostic in all cases, failing to demonstrate the presence of soft-tissue swelling or gas in the tissue planes.

US findings of pyomyositis can be categorized as stage 1 (phlegmonous) or stage 2 (suppurative). The phlegmonous phase shows localized muscle edema and distortion of the linear planes, with hypoechoic (darker) areas in the muscle. This stage can be harder to detect on US imaging. The later suppurative phase demonstrates a more variable echogenicity within the muscle, with evidence of liquefaction associated with abscess formation (7). Abscesses
tend to be hyperechoic, but can also have areas of complex echogenicity, with lighter and darker areas seen within the abscess cavity. Abscesses often exhibit posterior acoustic enhancement, which confirms the presence of fluid in the muscle. This is a useful artifact to observe, particularly when differentiating solid tissue masses from fluid-filled abscesses, as the former tend not to have this finding (6). In addition, compression with the probe can be helpful in making the diagnosis, as fluid or pus might be seen moving within the cavity with this maneuver (8).

Although pyomyositis shares sonographic features of cutaneous abscesses, the location differs in these two disease processes. Pyomyositis is located deeper and within the muscle layer, rather than in the more superficial skin and subcutaneous fat. Therefore, the clinician must closely inspect the deeper muscle layer to diagnose this disease. On US examination, muscle has a classic striated structure that is enclosed in a sheath, which might be seen as an outer linear line. Muscular tissue is relatively hyperechoic to both the superficial fascia and the underlying bone. On more detailed view, hyperechoic, fibroadipose septa, or perimysium separate the muscle bundles. In contrast, fascia lacks the striated organization of muscle, is located more superficially and generally appears more hyperechoic (brighter) (9).

When sonographic features suggestive of pyomyositis are seen, advanced imaging with CT or preferably MRI should generally be pursued. Facilitated treatment with antibiotics and consultation with orthopedic surgery for operative debridement is indicated for a pyomyositis abscess. Direct needle aspiration of pus can also be pursued, usually in consultation with orthopedic surgery, to obtain material for culture and sensitivity before surgery.

Although CT and MRI are the diagnostic gold standards for deep tissue infections, in each of our cases, POC US rapidly established the diagnosis and allowed for early initiation of appropriate therapy. Advanced imaging was performed for confirmation and surgical planning. These cases demonstrate the ability of POC US to exclude a superficial infection, such as cellulitis or cutaneous abscess, and second, to diagnose a deep muscle infection like pyomyositis. Pyomyositis can easily be missed on clinical evaluation and US provides a relatively sensitive means for the detection of this rare infection. Finally, there are significant advantages to US in areas of the world where it is extremely difficult to obtain advanced imaging and where the prevalence of pyomyositis is higher.

There are several limitations of bedside US in the evaluation of pyomyositis. First, this is an advanced application for emergency physicians and the ability to exclude pyomyositis with US has not been studied. In this series, the measurements of fluid collections on US were smaller than those obtained by MRI. Therefore, US can underestimate the size of an abscess. The power of POC US, however, lies not in obtaining specific dimensions of an infection, but rather in the ability to detect a deep space abscess that might not be accurately diagnosed by physical examination alone. Finally, US lacks the ability to accurately identify the contents of a fluid collection. A purulent fluid collection can be difficult to distinguish sonographically from hematoma or other fluid. Therefore, needle aspiration can be performed using US guidance to obtain fluid for analysis. In each of these cases, needle aspiration was used diagnostically and was not considered therapeutic. Simple aspiration would not generally be considered sufficient for the treatment of a pyomyositis abscess, as most cases will require operative management by orthopedic surgery.

WHY SHOULD AN EMERGENCY PHYSICIAN BE AWARE OF THIS?

POC US can be a valuable bedside tool in the diagnosis of pyomyositis. Early utilization of US should be considered in patients with suspected soft-tissue and muscle infections. This modality can better discern the more common soft tissue infections such as cellulitis and cutaneous abscess from the more rare and complicated deep intramuscular abscesses of pyomyositis. By allowing for the detailed imaging of deeper body structures, earlier diagnosis of this disease can be made with more timely initiation of appropriate treatment and involvement of subspecialty consultation. Use of POC US to examine for pyomyositis might, therefore, prevent delayed diagnosis and the potential for increased complications in patients with this less common, but serious infection. In addition, in international practice, US represents an effective diagnostic strategy for this disease, especially in situations where advanced imaging with CT or MRI will not be accessible.

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REFERENCES