Ultrasound features of rhabdomyolysis

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Keywords: Imaging, ultrasound, musculoskeletal

CASE REPORT

A 24-year-old male presented to the emergency department (ED) complaining of a 1-week history of leg pain and dark colored urine. There was no history of recent trauma, immobilization, recreational drug use, fevers, or neuromuscular disorder. Past medical history was significant for a childhood diagnosis of systemic lupus erythematosus and anxiety. His medications included escitalopram, quetiapine, acetaminophen, and lorazepam.

On physical examination, he was afebrile and his vital signs were within normal limits, including heart rate 69, blood pressure 115/72, respiratory rate 16, and oxygen saturation 99% on room air. His cardiac, respiratory, and abdominal examinations were unremarkable. He had palpable tenderness in his right calf without evidence of weakness or external trauma, and was neurovascularly intact.

Point of care ultrasound (POCUS) of his calf was performed by the emergency ultrasound fellow using a SonoSite Edge 2 (Bothell, WA, USA) with a high frequency linear transducer. Longitudinal images demonstrated hypoechoic areas of muscle, disorganization of the fascicular architecture, irregularity of the muscle fibers, and some hyperechogenicity in the muscle (Figure 1A, Supplemental Video 1).

Bloodwork revealed a normal complete blood count, electrolytes, creatinine, and lactate. Creatine kinase (CK) was markedly elevated at greater than 40,000 IU/L with an aspartate transaminase of 1,136 IU/L and alanine transaminase of 312 IU/L. Alkaline phosphatase, gamma glutamyl transferase, bilirubin, lipase, and C-reactive protein were normal.

He was hospitalized for intravenous fluid hydration and a workup of his lupus and rhabdomyolysis. However, after a 2-day admission, he felt improved, his CK had decreased, and he discharged himself before a final etiology for his rhabdomyolysis could be established.

DISCUSSION

Rhabdomyolysis is a well-known clinical entity of skeletal muscle necrosis typically presenting with a history of muscle pain, weakness, and tea colored urine. It most commonly affects the upper thighs or calf muscles. It can be caused by trauma, strenuous exercise, drug use, medications, prolonged immobilization, or neuromuscular disorder. It can also be idiopathic, as it was presumed to be in our patient.[1]

Rhabdomyolysis has potentially fatal complications, including acute renal failure, hyperkalemia, dysrhythmia, or compartment syndrome. It is, therefore, imperative to establish the diagnosis and initiate treatment promptly. The diagnosis is established with the finding of a CK over 5 times the upper limit of normal, with a higher CK level corresponding to a greater degree of muscle injury but not necessarily correlated with the risk of developing acute kidney injury. Further investigations should include electrolytes, particularly potassium and phosphorus, urea, and creatinine. An electrocardiogram (ECG) should be done promptly to assess for any conduction abnormalities due to hyperkalemia. Treatment consists of rapid high volume fluid resuscitation to prevent further renal injury by promoting renal perfusion and increasing urine flow rates. Dialysis may need to

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 CJEM 2020;22(3):386–388 DOI 10.1017/cem.2020.16

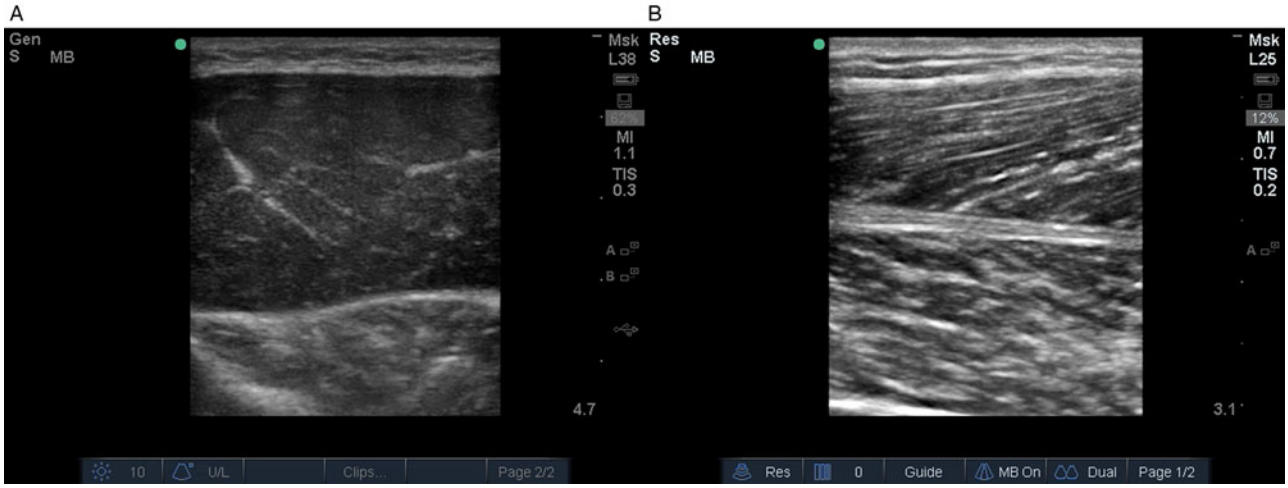

Figure 1. (A) Longitudinal image of calf muscle affected by rhabdomyolysis demonstrates hypoechoic areas of muscle, disorganization of the fascicular architecture, irregularity of the muscle fibers, and some hyperechogenicity. (B) Longitudinal image of normal calf muscle depicts muscle fascicles bundled together in an organized manner to form a muscle belly.

be considered for severe acute kidney injury. Patients should be monitored for signs of volume overload or reperfusion injury, and laboratory testing and ECG should be repeated regularly.[1]

Because the clinical presentation of rhabdomyolysis can vary from patients who are critically unwell to patients with localized muscular pain, POCUS may be useful in suggesting the diagnosis and prompting the clinician to obtain appropriate bloodwork. On ultrasound, rhabdomyolysis has the appearance of disorganization of muscular architecture, increased muscle thickness, hyperechoic areas within the muscle, and decreased echogenicity of the muscle[2,3] (Figure 1A). If the diagnosis is uncertain, it should be compared with the contralateral asymptomatic muscle (Figure 1B).

Loss of the muscle texture is the most characteristic finding and is thought to arise from skeletal muscle necrosis.[2] Hyperechoic areas are thought to be due to hypercontractile muscle fibers in the acute stage of injury.[2,3] Decreased echogenicity is thought to be a result of local inflammation, edema, and hemorrhage.[2]

Lamminen et al. compared different diagnostic imaging modalities in 15 patients with acute rhabdomyolysis, and they found that magnetic resonance imaging had the highest sensitivity (100%) compared with computed tomography (62%) and radiology ultrasound (42%). However, all three imaging modalities were nonspecific and needed to be combined with both the clinical assessment and laboratory results to establish a definitive diagnosis of rhabdomyolysis.[4] There is no literature assessing the diagnostic accuracy of POCUS for rhabdomyolysis. Ultimately, POCUS cannot be used in isolation to rule in or rule out rhabdomyolysis, in much the same way that an ECG should not be used in isolation to rule in or rule out acute coronary syndrome. Instead, clinicians should understand the ultrasound findings associated with rhabdomyolysis, such that when performing POCUS for another indication, such as deep vein thrombosis or abscess, they recognize the abnormality and extend their workup to include CK laboratory testing. This may be helpful in patients presenting with altered mental status who are unable to voice the classic complaints of acute rhabdomyolysis.

When evaluating a patient with musculoskeletal pain using ultrasound, emergency physicians should be aware of the appearance of other common causes and ultrasound mimics. Decreased echogenicity can be seen in other causes of muscle pain, such as abscess, hematoma, or muscle tear. However, these pathologies have other characteristics on ultrasound. Infections, such as cellulitis, will appear as hyperechoic fat lobules separated by anechoic fluid in the subcutaneous tissues, known as cobblestoning. Abscesses appear as well circumscribed anechoic, hypoechoic, or hyperechoic collections with potential loculations and surrounding inflammation or cobblestoning. Hematomas are typically rounded collections that appear hypoechoic in the acute phase and more hyperechoic with age. They do not cause complete disorganization of the muscle fibers. Muscle tears result in the appearance of focal

https://doi.org/10.1017/cem.2020.16 Published online by Cambridge University Press

discontinuity of the muscle fibers as opposed to diffuse disorganization of the muscular architecture seen in rhabdomyolysis. Finally, myositis is commonly associated with muscle atrophy and will have a hypoechoic appearance on ultrasound.[5]

CONCLUSION

POCUS is a useful tool for evaluating musculoskeletal pain. Emergency physicians should be aware of the ultrasound appearance of common causes of musculoskeletal pain along with the ultrasound appearance of rhabdomyolysis, as this may expedite the diagnosis and treatment of rhabdomyolysis, particularly in atypical presentations.

Supplemental material: The supplemental material for this article can be found at https://doi.org/10.1017/cem.2020.16.

Competing interests: P.S.H. and J.S.A. do not report any conflicts of interest. D.J.K. is on the medical advisory board of Clarius Mobile Health.

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