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Differential diagnosis of muscle calcification

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ABSTRACT

We report the case of a 36 year old male who demonstrated extensive high attenuation in the muscles of the chest wall and neck on a noncontrast chest CT. The high attenuation in the musculature was due to calcium, sequela from a recent episode of rhabdomyolysis. Although the diagnosis of rhabdomyolysis is made on clinical grounds, the imaging appearance can be confusing given the variability in appearance of rhabdomyolysis depending on the severity and the timeline of disease.

1. Introduction

Although a clinical diagnosis, rhabdomyolysis has a varied imaging appearance depending on the time in the course of the disease when imaging is obtained. In the subacute setting, after muscle enzyme abnormalities have improved, extensive muscle calcification can occur. Without appropriate knowledge of the patient's history, muscle calcifications due to rhabdomyolysis could be incorrectly attributed to another cause. This case report details the hospital course of a young male who developed rhabdomyolysis after methamphetamine use with subsequent muscle calcifications identified on CT.

Patients with rhabdomyolysis may present clinically with complaints of myalgias and dark urine, however in many cases this classic history cannot be obtained due to the severity of the clinical condition. The diagnosis is made when creatine kinase levels are 5 to 10 times above the normal reference valve [1]. Both traumatic and non-traumatic causes have been implicated with prescription medications, over the counter drugs and illicit drugs being the most common non-traumatic causes.

2. Case report

A 36 year old male without known medical history was found unclothed in his driveway. He was noted to be agitated, hypertensive and tachycardic and was given haloperidol. The patient reported recent use of homemade methamphetamine. He became obtunded with a temperature spiking to 107.4o F and required intubation. Treatment for possible neuroleptic malignant syndrome with fluids, cooling, dantrolene, bromocriptine, and benzodiazepines was administered. Labs demonstrated elevation in his liver function tests, creatinine, and a climbing creatine kinase peaking at 300,000 IU/L (normal range being 38–240 IU/L).

On hospital day twenty-three, an MR of the right lower extremity was performed to evaluate for osteomyelitis due to the presence of lower extremity swelling and purulent drainage from a sore near the ankle (Fig. 1). MR findings demonstrated heterogeneously increased signal intensity in the musculature on STIR sequence but no evidence of osteomyelitis. An MR of the abdomen was also performed and demonstrated enhancement in right paraspinal musculature (Fig. 2), a finding which can be seen in the acute setting of rhabdomyolysis. The patient's hospital course was complicated by acute pancreatitis, renal failure requiring renal replacement therapy, liver failure, massive gastrointestinal bleed from ascending colon ulcerations and polymicrobial pneumonia with cultures growing Stenotrophomonas and Citrobacter. Acute renal failure was attributed to rhabdomyolysis occurring in the setting of methamphetamine abuse.

He was discharged to an inpatient rehabilitation facility and one month later underwent unenhanced CT of the chest for follow up of his pulmonary infection. CT revealed striking diffuse high attenuation in multiple muscle groups of the neck and chest wall including the ster-

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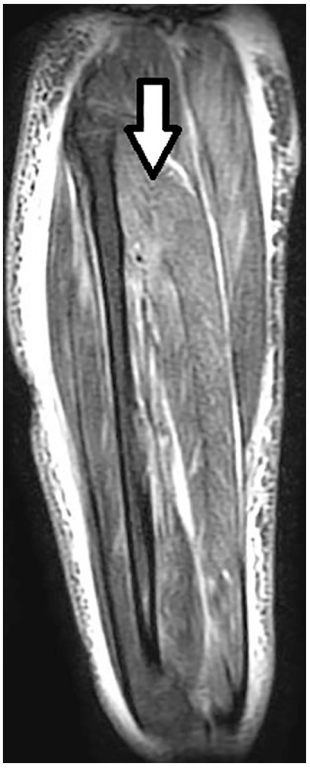

Fig. 1. MR of the right leg for concern for osteomyelitis performed 23 days after admission. Note the heterogeneous hyperintensity of the muscles of the lower extremity (arrow), on this coronal STIR image. Alterations in the signal intensity of the muscles in rhabdomyolysis can be seen including both increased and decreased signal intensity on T1W, T2W and STIR sequences.

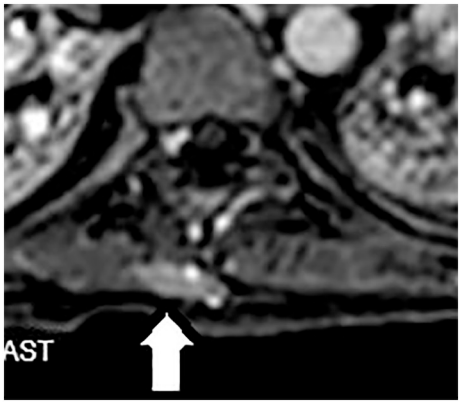

Fig. 2. Contrast enhanced MR of the abdomen demonstrates an areas of homogeneous enhancement in right paraspinal musculature (arrow), a finding which can be seen in the acute setting of rhabdomyolysis.

nocleidomastoid muscles and subscapularis (Fig. 3A–B). This finding was new since the initial CT (Fig. 3C) and significantly more pronounced compared to an interim CT (Fig. 3D), consistent with sequela of rhabdomyolysis.

3. Discussion

When myocytes are injured, intra-cellular calcium increases leading to a cascade of events that compromise cell membrane integrity. Cellular components including proteins, metabolites and electrolytes are then free to leave the myocytes. Laboratory assessment can readily demonstrate the presence of these now extra-cellular myocyte components in the blood stream and urine including creatine kinase, myoglobin and potassium. Creatine kinase values that are five times the normal value are 100% sensitive in diagnosing rhabdomyolysis [2]. Other laboratory tests are performed for the identification of complications including acute kidney injury, electrolyte imbalance predisposing to cardiac arrhythmia and disseminated intravascular coagulopathy.

Rhabdomyolysis may be evident in the acute phase and after recovery on imaging. Acutely, skeletal muscle may appear enlarged and edematous. Ultrasound findings include altered echogenicity of the muscles and surrounding fluid [3]. On CT the muscle may be low to normal in attenuation and if contrast is administered, enhancement maybe present [4]. On MR imaging, various patterns have been described including a less severe form where muscle is hyper or isointense on T1W, T2W and STIR imaging (Fig. 1) with homogeneous enhancement (Fig. 2) and a more severe form where muscle is heterogeneous on T1W, T2W and STIR imaging with rim enhancement [5]. The stippled sign (streaky enhancement surrounded by rim enhancement within a muscle) has also been described in more severe cases of rhabdomyolysis [6]. Bone scintigraphy may also be abnormal in patients with rhabdomyolysis with diffuse muscle uptake seen in patients with drug induced rhabdomyolysis while a more focal form of uptake in the muscle is seen in cases induced by physical activity [7]. Overall, MR is reportedly the most sensitive cross sectional modality for this entity [6].

Later on, at approximately 3–4 weeks after the initial diagnosis of rhabdomyolysis, diffuse calcification of the muscles may occur as seen in this case [8]. Without prior knowledge of the patient medical history, this finding could be confused for other causes of muscular calcification.

The differential considerations for diffuse high attenuation of skeletal muscle include myositis ossificans (which typically leads to peripheral and centripetal ossification (Fig. 4)) and inflammatory myopathies (e.g. polymyositis and dermatomyositis) which cause dystrophic calcification most commonly involving the thigh musculature. The calcification in these cases involves not only the muscles but also subcutaneous tissue (Fig. 5). Infectious myositis may cause alternations in muscle density/signal intensity however does not usually cause high density to the extent seen in this case. Additional findings of infection such as abscess formation may also be present aiding in diagnosis. Other considerations for abnormalities in muscle density/intensity include tumors and hemorrhage, though the diffuse nature in this case is atypical for these pathologic processes.

4. Conclusion

Although not required for the diagnosis or treatment of rhabdomyolysis, imagers may incidentally observe findings of this condition including muscle enlargement and edema, alterations in attenuation/signal intensity, contrast enhancement and high attenuation during recovery. Proper correlation between imaging findings and patient history is important to prevent confusion and additional, unnecessary testing.

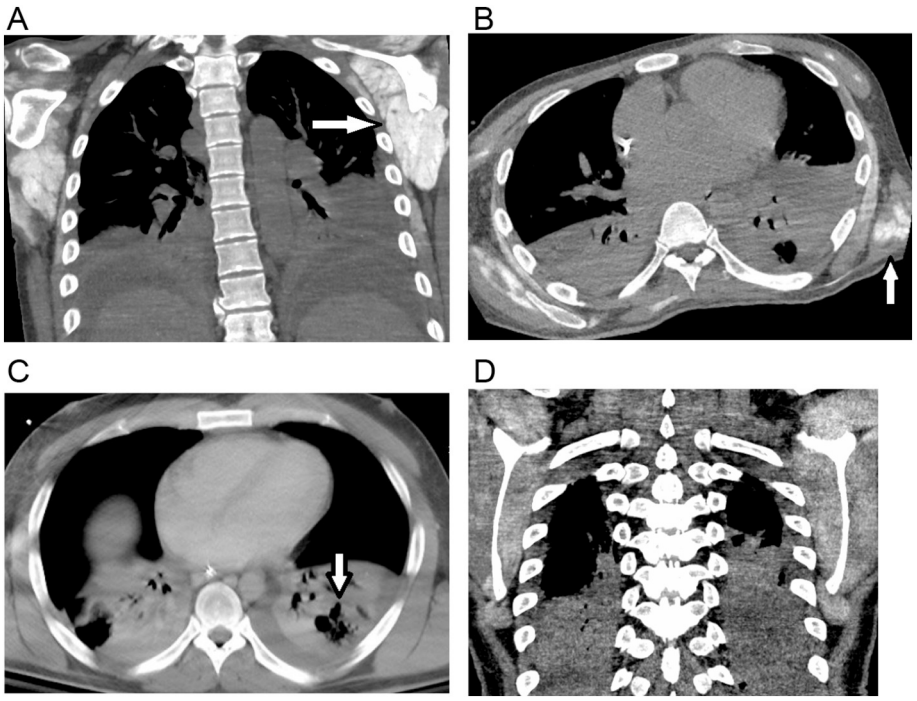

Fig. 3. Coronal (A) and axial (B) unenhanced chest CT images demonstrating significant calcification of the rotator cuff musculature (arrow image A and B). Multiple additional muscle groups are affected in a symmetric fashion. This finding is new when compared to the initial axial contrast enhanced chest CT performed on hospital day 9 for persistent fevers (C) which demonstrates bilateral lower lobe consolidation with areas of necrosis (arrow) and small pleural effusions. Another CT was performed in between the initial chest CT and post-discharge CT (panel D). Note the heterogeneity and developing calcifications in the shoulder girdle muscles on this unenhanced coronal CT image (D).

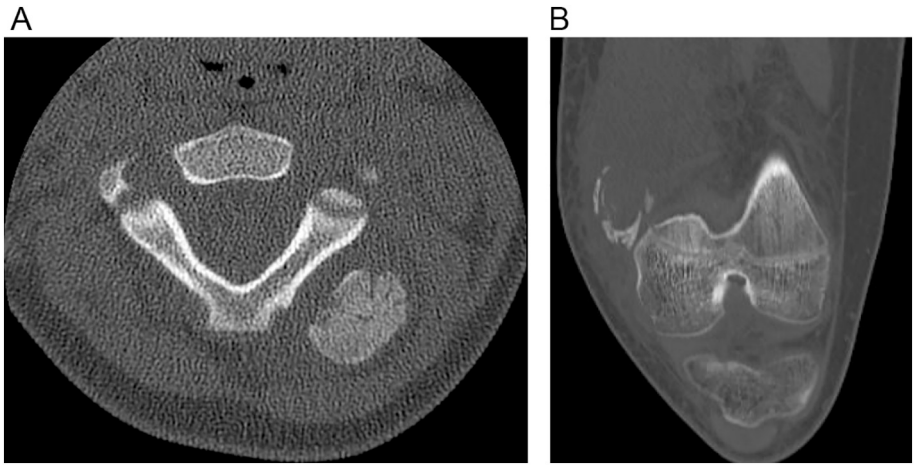

Fig. 4. Axial CT of the cervical spine and coronal CT of the knees both performed without contrast highlighting the typical imaging appearance of myositis ossificans in two separate patients. Ossifications are usually peripheral and centripetal. Hence, the margins are dense with decreased (A) or absent ossification centrally (B).

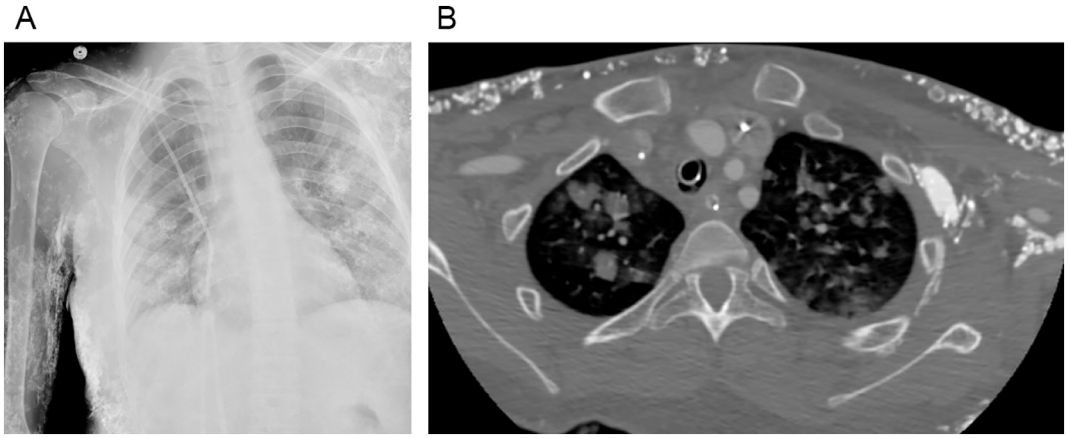

Fig. 5. Extensive muscular and soft tissue calcifications in a patient with dermatomyositis on radiograph of the chest (A) and contrast enhanced CT (B). Calcifications in this condition are more extensive and can also be seen in the subcutaneous fat and other soft tissue in contrast to rhabdomyolysis.

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