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## Case Report

Rectus abdominus tear in a collegiate cheerleader<sup>☆</sup>Hassan Haider, BS<sup>a</sup>, Justin R. Montgomery, MD<sup>b</sup>, Paul J. Spicer, MD<sup>b,\*</sup><sup>a</sup> University of Kentucky School of Medicine, 800 Rose Street, Lexington, KY 40536, USA<sup>b</sup> University of Kentucky Medical Center, Department of Radiology, 800 Rose Street, HX 315, Lexington, KY 40536, USA

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## ABSTRACT

Acute muscle injuries can occur at all skill levels across multiple different sports. Imaging is often used for diagnosis and is necessary for recognizing the extent of injury, complications, and overall prognosis. Ultrasound can be used in diagnosing muscle tears. However, there are less than a dozen documented cases that use ultrasound in the evaluation and diagnosis of a rectus abdominus tear, though the actual number of cases are most likely underreported in the literature. This case discusses an 18-year-old college athlete that suffered a distal rectus abdominus tear after performing a stunt as a cheerleader and her subsequent treatment.

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## Introduction

Approximately 30% of sports injuries are muscle injuries [1]. Although rectus abdominus tears make up only a small portion of those injuries, they are often seen in both the professional and amateur levels. A rectus abdominus muscle tear can present with pain like pathologies associated with visceral organs, such as liver or spleen injury and appendicitis. To help with diagnosing these types of injuries it can be helpful to assess pain level during muscle contraction compared to pain level when the muscle is relaxed. One way this is often done in the clinical setting is to assess for Carnett's sign. This physical exam technique is done by performing deep palpation at the point of maximum pain, the patient is then asked to contract their abdominal muscles while pressure is relieved and then reapplied to examiner's hand. If both parts of the exam are painful the pain is likely due to an etiology involving the

abdominal wall musculature. However, if only the first part of the exam is painful, then the source of the pain is likely the visceral abdominal organs [2]. However, for more definitive diagnosis, imaging either with ultrasound (US) or magnetic resonance imaging (MRI) may be required.

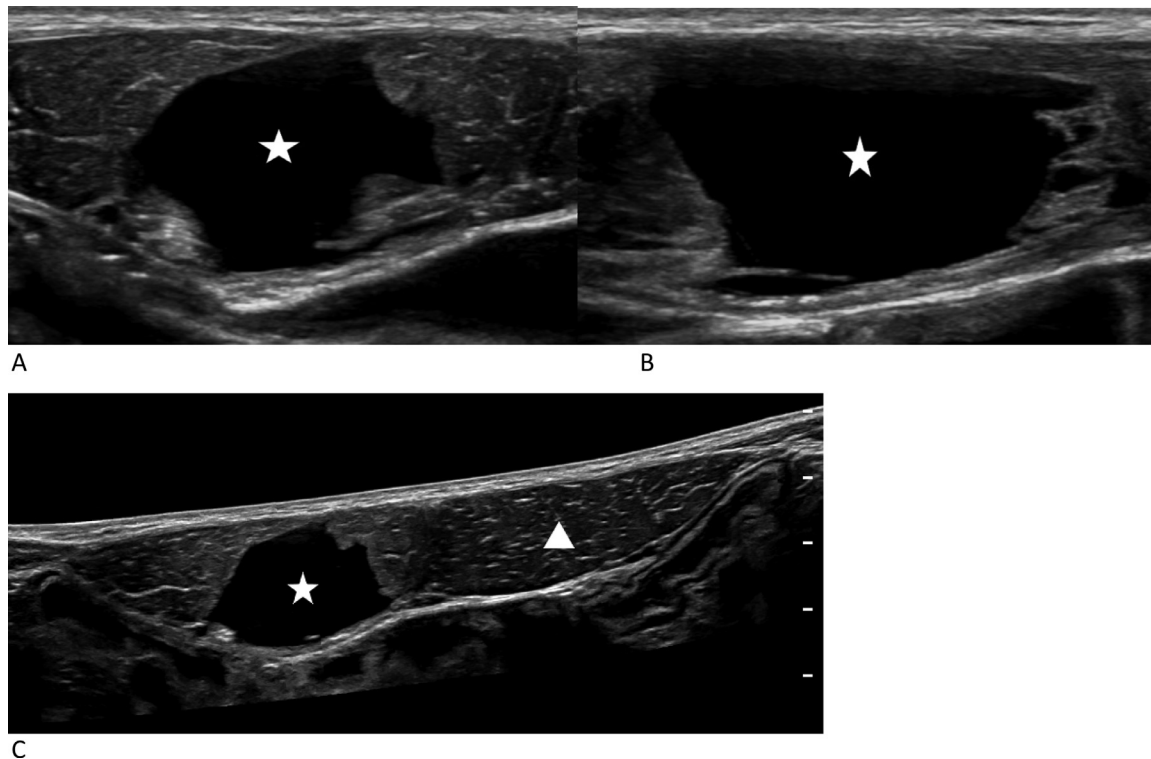
## Case report

An 18-year-old female with no significant past medical history presented with a 3-week history of abdominal pain. The patient was a collegiate cheerleader and the pain started suddenly when performing a stunt at cheerleading practice. Immediately after the injury, she was treated conservatively with Meloxicam and rehabilitation with her team's athletic trainer. After the initial assessment and treatment, she was referred to a formal physical therapist to work on her core and hip

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**Fig. 1 – Short axis (A) and long axis (B) sonographic images of the right rectus abdominus muscle demonstrates a 2.7 × 1.7 × 3.6 cm full-thickness, grade 3 tear of the muscle. The gap between the tendon fibers is filled with fluid (star). Panoramic image (C) demonstrates the right rectus abdominus muscle tear (star) with a normal, contralateral left rectus abdominus muscle (triangle) for comparison.**

strength. A rectus abdominus muscle tear was suspected, and an abdominal musculature ultrasound was performed demonstrating a 2.7 × 1.7 × 3.6 cm full-thickness, grade 3 tear of her distal right rectus abdominus muscle (Fig. 1). Up to the time of the ultrasound, the patient continued to practice with the team, however, she had been removed from some stunts that were becoming too difficult for her to perform. After the diagnosis of the tear by ultrasound, the patient decided the pain was too severe to allow her to continue competing as a division 1 athlete and was causing her significant distress. She was counseled that this injury could take several weeks to months to fully resolve and that her pain was to be expected at that time. She ultimately decided to end her cheerleading career because of the injury to focus on her education.

## Discussion

The use of US is an excellent first line imaging modality in diagnosing rectus abdominus wall tears. This imaging modality has the advantage of having a dynamic component that is useful to assess muscle contraction as well as having excellent spatial resolution [3,4]. These 2 benefits are helpful for evaluating muscle structure and texture. When compared to MRI, US has the added benefit of comparing with contralateral normal anatomy for comparison that may be out of the field-of-view on MRI. It is important to note that there are limitations with US. First, US has a limited field of view. Secondly,

because sound waves cannot pass through cortical bone, bone marrow and intra-articular ligaments cannot be evaluated [5].

If a tear is identified in the abdominal wall musculature, the injury will be qualified based on severity. Tears are usually accompanied by hematomas which require a longer rest period. The grading system used to categorize muscular injuries is from grades 0 to 3. Grade 0 means no injury was identified on US. Grade 1 may have a normal appearance but will have minimal muscle fiber elongation, with less than 5% of the muscle fibers affected. Grade 2 injuries may present with pain and loss of function and demonstrates a partial rupture with greater than 5% of the muscle fibers involved. A Grade 2 tear will often reveal a hypoechoic gap of the muscle fibers. Grade 3 injuries represent a complete rupture of the muscle with fiber retraction, as in our case [6].

On average it takes approximately 3-6 weeks to completely recover from a muscle tear, although recovery time is dependent upon the extent of the injury [7]. Larger tears have a greater volume of scar tissue accumulation and require longer recovery times. US findings of healing muscular tissue may differ depending on the severity of the injury. A grade 1 injury will show increased echogenicity during the healing process and will often undergo a decrease in size. Eventually, echogenicity may subside after completion of healing. Grade 2 injuries, however, may appear more hypoechoic than grade 1 injuries due to fluid accumulation near the muscle tissue. This accumulation is expected to resolve after the healing process is completed. Grade 3 muscle tears present with findings similar to grade 2 tears but will have increased fluid accumulation

and a wider hypoechoic gap, as in our case [3]. With healing, scar tissue will form. Scar tissue formation is echogenic on ultrasound.

There are several complications of rectus abdominus muscle tears that can arise depending on the severity of the injury. The most common complication is myositis ossificans. This occurs when ossification forms inside the muscle tissue. Another complication is muscle herniation, which is focal penetration of muscle tissue through a defect in its fascial sheath. Muscle cysts can also occur after injury. They are formed by crushing and shearing strains, and usually occur where the subcutaneous fat and deep fascia intersect. They form as the result of muscle tissue being filled with serosanguinous fluid and they are lined with fibrous tissue [8].

Treatment options vary depending on the severity of the muscle tear. For grade 1 tears conservative management is the initial treatment option, which includes rest, immobilization, and nonsteroidal anti-inflammatory medications. The immobilization period allows time for scar tissue to form and should be followed by a gradual return to normal activity. Pain levels should be used by the patient to determine what movements or actions are safe to perform. Early return to activity can be expected in most cases. Additionally, early return to activity has been shown to aid in rehabilitation of the affected muscle and improve the injured muscle's strength and flexibility. Surgical repair of a muscle tear is difficult to perform and has a high likelihood of failure. For this reason, surgical repair is usually reserved for grade 3 tears, or tears that have persistent pain or weakness despite conservative management. A patient can return to more vigorous sports-related exercise when they have no pain with the movements required for their training [9].

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### Patient consent

Written, informed consent for publication of the patient's case was obtained from the patient.

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