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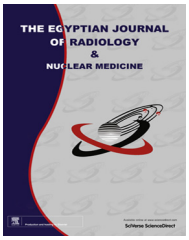

ORIGINAL ARTICLE

Evaluation of supraspinatus muscle tears by ultrasonography and magnetic resonance imaging in comparison with surgical findings

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KEYWORDS

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Abstract *Objective:* To evaluate the sensitivity, specificity and diagnostic accuracy of ultrasonography (US) and magnetic resonance imaging (MRI) in evaluating suspected supraspinatus muscle injury compared with surgery.
Subjects and methods: One hundred patients underwent both US and MRI for their shoulders due to shoulder pain. Forty patients with non-improved symptoms underwent surgical exploration. We compared the sensitivity, specificity and accuracy of US and MRI for detection of supraspinatus pathology, using surgical findings as 'gold standard'.
Results: Study included 40 patients (27 men and 13 women, age range from 20 to 68 years). US had sensitivity, specificity and accuracy of 92.3%, 92.6% and 92.5%, respectively in diagnosing partial thickness tears (PTT); 92.6%, 94% and 95%, respectively in diagnosing full thickness tears (FTT). MRI had sensitivity, specificity and accuracy of 84.6%, 92.6% and 90%, respectively in diagnosing partial thickness tears (PTT); 100%, 88.2% and 95%, respectively in diagnosing full thickness tears (FTT). There was no statistically significant difference between the two techniques on one hand and surgery on the other hand in detecting both PTT and FTT.
Conclusion: US and MRI yield high sensitivity, diagnostic accuracy in detecting FTT. Regarding PTT rotator cuff tears both tests were less sensitive.

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1. Introduction

Rotator cuff tear is a common condition affecting the shoulder and its incidence increases with advancing age (1,2). The supraspinatus tendon is the structure most frequently involved. Any tears of the rotator cuff most often begin in the supraspinatus.

The diagnosis of tears is often difficult because the intensity of clinical findings does not correspond to the severity of the lesion (3,4).

One of the most common imaging modalities for assessing the rotator cuff tendon is magnetic resonance imaging (MRI). It can reliably identify and characterize the rotator cuff tendon tear (5).

Ultrasound imaging has become a popular modality for evaluating rotator cuff pathology because of its low cost and noninvasive nature. It has proven to be quite reliable in identifying the presence of a tear, even during the postoperative period (6–9).

Although many investigators have evaluated the accuracy of US or MRI separately for the detection of partial thickness (PTT) and full-thickness (FTT) rotator cuff tears, some have directly compared the two tests for the detection of full-thickness tears (10,11), partial-thickness tears or partial-thickness and full-thickness tears (12,13), but most with a relatively small number of patients (14,15). In a systematic review of the diagnostic accuracy of clinical examinations with US and MRI in the detection of full-thickness and partial-thickness rotator cuff tears, Dinnes et al. at 2003 showed that US and MRI have comparably high accuracy for the detection of full thickness tears (16).

In patients unresponsive to non-operative measures, surgical treatment of supraspinatus tears provides satisfactory functional and anatomical outcomes (17–20). Surgical repair of rotator cuff defects focuses on recreating the anatomy of the intact rotator cuff with tension-free reinsertion of the torn tendons to achieve tendon healing and painless recovery of shoulder function (21–23).

The purpose of this study was first to evaluate the need for additional MRI following US of the shoulder and secondly to evaluate and compare the accuracy of US and MRI for the detection of partial-thickness and full thickness supraspinatus tears with surgery as the reference standard in a selected group of patients.

2. Patients and methods

In the time period between February 2009 and October 2012, one hundred patients with shoulder pain were examined with US and conventional MRI. The indications to perform MRI following US were non improving clinical symptoms and suspicion for having intraarticular pathology.

Because we used surgery as a gold standard for our study, we carried our study only on the 40 patients who underwent surgery due to non improvement of their symptoms or due to suspicious or definitive findings in the ultrasound or MRI. We did not include those patients who did not undergo surgery due to disappearance of symptoms.

The study included 27 men and 13 women whose ages ranged from 20 to 68 years (mean age 54.6 years); none of our patients had previously undergone shoulder surgery.

All MRI examinations were performed and evaluated by the same radiologist; all dynamic US were performed and evaluated by another radiologist. The reports were made by each reader without knowledge of the results of the other imaging method.

Ultrasound examinations were done using ultrasound machines (General Electric Logiq 5, linear probe 12.0 MHZ). During examination, patients were seated on a stool and ultrasound of the shoulder started with a transverse and longitudinal image of the bicep tendon within the bicipital groove. Next, longitudinal and transverse scans of the subscapularis tendon are made with the patient's arm externally rotated.

Images of the supraspinatus tendon are made with the arm in internal rotation in order to expose as much of the supraspinatus tendon as possible from beneath the acromion. This position is best achieved by placing the patient's arm behind his back. The supraspinatus tendon scanned perpendicular and parallel to its fibers.

The thickness and echogenicity of the tendon, the segmental or complete loss of rotator cuff substance, the presence and amount of joint and bursal fluid, the loss of convex contour of tendon on the bursal side, and greater tuberosity changes are observed.

In addition MRI examinations were performed with a 1T MR Imaging unit (Intera, Philips Medical Systems, Neberland B.V) and one surface coil was used. Examinations were done with the shoulder in external rotation, because this anatomic position optimally orients the supraspinatus tendon parallel and perpendicular to the oblique coronal and oblique sagittal imaging planes.

The conventional MRI shoulder protocol consisted of oblique coronal T2-weighted with fat suppression (2.48 min) and T1-weighted turbo spin echo images (5.58 min), oblique sagittal T2-weighted turbo spin echo images with fat suppression (2.36 min) and transverse T1-weighted turbo spin echo images (4.52 min), coronal PD with fat suppression. A field of view of 16 cm was used, the slice thickness was 3 mm, the imaging matrix was 320×224, and three signals were averaged for each pulse sequence. Established criteria were used for the diagnosis of a partial-thickness or full-thickness rotator cuff tear (24).

3. Surgical technique

Surgery was indicated whenever there was pain or loss of function after conservative treatment for 6 months, the presence of a partial- or full-thickness tear by MRI and US, and no cuff arthropathy. All patients were operated under general anesthesia.

The surgical procedure is performed through open arthrotomy. The patient is placed in a semi-sitting posture and the shoulder and arm are prepared in the usual sterile manner. The deltoid muscle fibers are split from the anterolateral acromion several centimeters distal, and the deltoid is dissected off. The anterior acromion is beveled with an osteotome, power burr, and hand rasp. The inferior portion of the acromioclavicular joint is smoothed to remove prominent inferior osteophytes. Thickened or fibrotic bursal tissue is removed to visualize the superior portion of the rotator cuff. Debridement of the necrotic rotator cuff tissue is performed and inspection of intact tissue follows. The greatest dimension of each rotator cuff tear was intraoperatively measured. Torn tendons were