

Comparison of Sonography and MRI in Diagnosis of Rotator Cuff Injuries

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Abstract: Background and Objectives: Rotator cuff injuries are problems commonly encountered in athletic and non-athletic patients. Its definite diagnosis is also important. Accordingly, this study was performed to determine the diagnostic accuracy of ultra-sonography (US) compared with magnetic resonance imaging (MRI) in cases with suspicion of rotator cuff injuries. Methods and materials: In this prospective comparative study, 130 patients who had undergone shoulder arthroscopy and open rotator cuff repairing and confirm rotator cuff tears have been enrolled and evaluated with both ultrasonography and MRI methods. Results: The overall sensitivity (95% confidence interval[CI]) of US was 87.64% (78.55-93.37), the specificity (95%CI) was 89.02% (61.24-95.45). The overall sensitivity (95% confidence interval) of MRI was 91.31% (75.47-94.4) and the specificity (95%CI) of MRI was 83.02% (61.23-91.45). There was no statistical significance between sensitivity of two methods (p-value: 0.092). Conclusions: Totally, according to our findings and comparison with other similar studies, it could be concluded that ultrasonography has a good diagnostic modality in patients suspicious to rotator cuff tearing compared with MRI as a more diagnostic imaging test. Accordingly, its use is recommended in patients suspicious to have rotator cuff tearing.

Keywords: Rotator Cuff Tearing, Ultrasonography, MRI

1. Introduction

Rotator cuff injuries are problems commonly encountered in athletic and nonathletic patients. Those symptoms include pain, weakness, and limitation of motion. Early diagnosis is important for identifying causes, implementing effective treatment, and preventing further injury.¹

Shoulder sonography is a valuable method of evaluating the rotator cuff.² In experienced hands, it is as sensitive as arthrography and magnetic resonance imaging for detecting rotator cuff tears and abnormalities of the biceps tendon.^{3,4} Because sonography is rapid, noninvasive, relatively inexpensive, and capable of performing bilateral examinations in one sitting, it should be used as the initial imaging test when the primary question is one of rotator cuff abnormalities.^{2,5,6} Accordingly, this study was performed to determine the diagnostic accuracy of sonography compared with MRI in cases with suspicion of rotator cuff injuries.

2. Methods & Materials

The current study was performed as a comparative cross-sectional study. In this study, 130 patients suspicious to rotator cuff tears have been evaluated with both ultrasonography and MRI methods. The study was performed in Shahid Sadoughi hospital of Shahid Sadoughi university of Medical sciences in Yazd during winter-spring of 2011.

MRI was performed with 1.5 Tesla Siemens machine and Sonography with 10-13 transducers (Siemens) with two separate radiologists.

All the rotator cuff muscles were determined with MRI and Sonography for full-thickness and partial tearing. Finally, we performed data analysis by SPSS-13 statistical software. The sensitivity and specificity of US compared with MRI were calculated. Comparison between two methods was done by McNemar Chi-Square test.

3. Results

Totally 130 patients suspicious with rotator cuff tears have been studied. The mean age of patients was 43.2 ± 7.1 years old. Most of the patients (59.23%) were women. Eighty nine patients (68.5%) had positive US results. All the cases with full-thickness tearing, according to MRI were determined in the US. Among the nine patients with full-thickness supraspinatus tearing, eight cases had partial-thickness subscapularis tearing and seven cases had partial-thickness infraspinatus tearing. No case of tearing was observed in Teres minor muscle. About 72.3% had positive MRI results that among these 94 patients, 85 subjects had partial-thickness supraspinatus tearing and nine had full-thickness supraspinatus tearing. These nine patients with full-thickness supraspinatus tearing had partial-thickness subscapularis tearing and nine had partial-thickness infraspinatus tearing. No case of tearing has been observed in Teres minor muscle.

The overall sensitivity (95% confidence interval) of US was 87.64% (78.55-93.37), the specificity (95%CI) was 89.02% (61.24-95.45). The overall sensitivity (95% confidence interval) of MRI was 91.31% (75.47-94.4) and the specificity (95%CI) of MRI was 83.02% (61.23-91.45). There was no statistical significance between sensitivity of two methods (p-value: 0.092).

Table 1. Comparison of US and MRI results among patients.

	Positive MRI	Negative MRI	Total
Positive US	86(66.1%)	3(2.3%)	89(68%)
Negative US	8(6.1%)	33(25.39%)	41(31.53%)
	94 (72.3%)	36 (27.7%)	130 (100%)

All patients with full-thickness supraspinatus in MRI were detectable by the US. The sensitivity of US was 100%, the specificity was 100%, Among 85 patients with partial-thickness supraspinatus tearing in MRI 77 patient determined by US. The sensitivity of US was 90.6%, the specificity was 100%, the positive predictive value was 100%, and the negative predictive value was 53%. Among the nine patients with partial-thickness subscapularis tearing in MRI, eight were diagnosed by US. The sensitivity of US was 88.9%, the specificity was 100%, the positive predictive value was 100%, and the negative predictive value was 98.7%. Among the nine patients with partial-thickness infraspinatus tearing in MRI, seven were diagnosed by US. The sensitivity of US was 77.8%, the specificity was 100%, the positive predictive value was 100%, and the negative predictive value was 97.5%.

4. Discussion

Rotator cuff tear is a common injury of soft shoulder tissues. Ultrasonography and magnetic resonance imaging are often used to confirm an initial clinical diagnosis. Although a number of studies have focused on the sensitivity of ultrasonography and MRI to detect the presence or absence of partial or complete rotator cuff tears, only a few

studies have directly compared these diagnostic methods.⁷

Several different imaging techniques are available for evaluating the rotator cuff and biceps tendon. The most common disorders of impingement, rotator cuff tears and biceps tendonitis are discussed along with the role which the various imaging modalities can play in establishing their diagnosis. Plain radiographs can be helpful, particularly with a history of trauma but give limited information on the soft tissues. Ultrasound is a useful and inexpensive method of assessing the rotator cuff and biceps tendon, but there are some limitations and various reports on its accuracy. Computed tomography (CT) is most helpful in evaluation of shoulder trauma, but gives limited information on the soft tissues. Magnetic resonance imaging (MRI) is an accurate imaging modality for evaluating the rotator cuff and biceps tendon, allowing visualization of the soft tissues and the adjacent bony structures.⁵ Dynamic shoulder ultrasonography is a noninvasive, accurate method used to assess the rotator cuff tendons. It can be incorporated into the in-office physical examination of patients at risk for rotator cuff problems. The low cost, convenience, and lack of risk turn dynamic ultrasonography into an excellent imaging tool for evaluating the biceps, subscapularis, infraspinatus, teres minor, and supraspinatus tendons. In-office ultrasound, also provides an opportunity for patient education and explanation of management options.⁸

In this study, 72.3% had positive MRI results that among these 94 patients, 85 subjects had partial-thickness supraspinatus tearing and nine had full-thickness supraspinatus tearing. These nine patients with full-thickness supraspinatus tearing had partial-thickness subscapularis tearing and nine had partial-thickness infraspinatus tearing. No case of tearing has been observed in Teres minor muscle. 68.5% had positive US results. All patients with full-thickness supraspinatus in MRI have been determined by the US. Among 85 patients with partial-thickness supraspinatus tearing in MRI 77 patient have been determined by the US. Among the nine patients with partial-thickness subscapularis tearing in MRI, eight cases have been diagnosed by US. Among the nine patients with partial-thickness infraspinatus tearing in MRI, seven cases have been diagnosed by US.

In a study has been carried out by Schibany *et al.*,⁹ sonographic examinations of the shoulder of 212 asymptomatic individuals between 18 and 85 years old were performed by a single experienced operator. The prevalence and location of complete rotator cuff tears were evaluated. Ultrasound showed a complete rupture of the supraspinatus tendon in 6% of 212 patients from 56 to 83 years of age. MRI confirmed a complete rupture of the supraspinatus tendon in 90% that is near to 91.66% obtained in our study. All patients reported no functional deficits, although strength was significantly lower in the patient group with complete supraspinatus tendon tear.

The study, has been fulfilled by Teefey *et al.*,¹⁰ demonstrated that US correctly identified all sixty-five full-thickness rotator cuff tears (a sensitivity of 100 percent). There were seventeen true-negative and three false-positive

ultra-sonograms showing a specificity of 85 percent that is lower than our study.

Innaotti et al⁶ have demonstrated that office-based ultrasonography led to the correct diagnosis for thirty-seven (88%) of forty-two shoulders with a full-thickness rotator cuff tears or both full and partial-thickness tears, twenty-six (70%) of thirty-seven shoulders with a partial-thickness rotator cuff tear only, and sixteen (80%) of twenty shoulders with normal tendons. However the sensitivity and specificity were higher in our study. In their study, there were no significant differences between magnetic resonance imaging and ultrasonography with regard to the correct identification of a full-thickness tear that is similar to our findings. Using ultrasound to visualize the shoulder area has advantages to other imaging techniques such as CT scans or MRI as it allows spatial examination during the motion of individual structures in the shoulder, and this technique is also relatively cheap and readily available.⁶ On the other hand, the ability of ultrasound waves to penetrate tissues is limited, and this technique requires very experienced examiners. Due to these limitations, the diagnosis of some conditions, such as labrum or capsular defects or damage to articular cartilage, is problematic.¹¹ In the literature, ultrasound examination of rotator cuff tears has generally shown very high sensitivity (75-100%) and specificity (85-98%) that this matter is in congruence with our findings showing a sensitivity of 91.84% and specificity of 91.66%. However, sensitivity has often been lower for partial tears or damage in the infraspinatus area.^{6,12-15}

Another positive aspect of ultrasonography is the relatively small discomfort experienced by patients during the examination when compared with other techniques (level of discomfort was estimated based on patients' reports of pain intensity, duration and willingness to undergo a repeat examination).

5. Conclusions

Totally, according to our findings and comparison with other similar studies, it may be concluded that ultrasonography has a good diagnostic modality in patients suspicious to rotator cuff tears compared with MRI as a more diagnostic imaging test. Accordingly, using sonography is recommended in patients suspicious to rotator cuff tears.

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