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Arthroscopic Evaluation of Ultrasonography and Magnetic Resonance Imaging for Diagnosis of Rotator Cuff Tear

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SUMMARY

Background. Rotator cuff tear – diagnosis; comparison of MRI, ultrasonographic and arthroscopic findings

Material and methods. Retrospective study – 20 patients treated for shoulder pain due to rotator cuff tear, initially conservatively and after more than 6 months by arthroscopic shoulder surgery. Comparison of intraoperative findings with preoperative US and MRI images.

Results. Sensitivity of USG – 1.0, specificity 0.9. Sensitivity of MRI – 0.92, specificity 1.0.

Discussion. Clinical examination and physical tests are not fully reliable diagnostic tools in patients with shoulder pain, because symptoms of different conditions overlap. Using ultrasound to visualize the shoulder area has some advantages to other imaging techniques such as CT scan or MRI, and has a very good sensitivity and good specificity. Many authors agree that MRI is one of the most effective methods for the diagnosis of rotator cuff tear

Conclusions. 1. Ultrasound and magnetic resonance imaging are both very sensitive techniques for diagnosis of rotator cuff abnormalities. 2. Ultrasonography can be used as a primary method owing to its fast procedure and affordable cost.

Key words: rotator cuff, MRI, ultrasonography, diagnostics

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BACKGROUND

Rotator cuff tear is a common injury of soft shoulder tissues. Ultrasonography and magnetic resonance imaging (MRI) 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. The aim of this study was to determine the ability of ultrasonography and MRI to correctly diagnose rotator cuff tears. As a reference standard for comparison of both methods we used arthroscopic shoulder surgery.

MATERIAL AND METHODS

We retrospectively selected 20 patients who had been treated for shoulder pain at our department (II. Orthopedic Department, The Motol University Hospital, 2nd Medical School, Charles University) during a two-year period (2004-2006). The average age of our patients (14 men and 6 women) was 56 years. All patients had been conservatively treated for shoulder pain for more than 6 months before they came to our department. Based on the results of clinical tests, all patients were diagnosed with a partial or complete tear of the rotator cuff.

Clinical examination

A history was obtained from each patient and a basic physical exam was performed on the injured shoulder. All patients were subjected to muscle and range of motion tests. We also evaluated x-ray images of the joint taken in anteroposterior (AP) and scapular Y views. At the time of clinical evaluation, all patients in our selected group showed signs and symptoms suggestive of a rotator cuff tear, and were therefore examined using ultrasonography and MRI. This approach is routinely used at our department in such cases [1].

Ultrasonography

Ultrasonography was performed with a Toshiba DSC-V machine using a 9-13 MHz linear probe that allows 0.2-0.4 mm depth resolution. We used standard examinations of sitting patients with the arm adducted without rotation to see the acromioclavicular joint and the caput longum of biceps tendon. This was followed by external rotation to visualize the subscapularis tendon, and internal rotation where the arm was moved behind the patient's back to visualize the tendons of the supraspinatus and infraspinatus muscles. The last test was a dynamic examination of the rotator cuff with lateral elevation and subsequent forward raising of the arm. All parts of the rotator cuff were fully examined. We concluded that the rotator cuff was partially or completely torn if we found a focal heterogeneous hypoechogenic area in the epoechogenic area of the rotator cuff and this hypoechogenic area remained dynamically connected to the surrounding structures while the arm was being moved into different positions [2]. In two cases, it was impossible to visualize the rotator cuff at all and we concluded that there must be major damage to the rotator cuff. Ultrasonography results were assessed by two physicians experienced in shoulder ultrasonography who also performed the initial clinical examination and muscle tests with patients.

MRI

MRI was performed with an E-SCAN XQ machine (Esaote, JANOV, Italy) dedicated to musculoskeletal system examination, with a magnetic field intensity of 0.18 T. Images were made in the axial, oblique coronal (along the line of the supraspinatus) and oblique sagittal (perpendicular to coronal) planes. For all patients, T1-weighted (T1w) sequences were taken in the axial and oblique coronal planes and sequences with fat supression (short inversion-time inversion recovery – STIR) in the oblique coronal and sagittal planes. The technical parameters of sequences were as follows: i) T1w – TR/TE (repetition time/echo time) of 910/26 ms, 384x216 image matrix, 4.0 mm slice thickness with 0.35 mm gap, 18x16cm and field of view (FOV) and ii) STIR – TR/TE of 1640/25 ms, TI (inversion time) 75 ms, 256x 140 matrix image, 4.0 mm slice thickness with 0.4 mm gap, and 20x16 cm FOV. Each MRI was interpreted by five musculoskeletal radiologists experienced in shoulder MRI. Each report contained an evaluation of the following anatomical structures of the shoulder: labrum, biceps tendon, presence of SLAP lesion, articulator cartilage and rotator cuff. If the rotator cuff was damaged, the specific location of the tear was recorded [2,3].

Arthroscopic evaluation

Each patient from the study group was subjected to an arthroscopic examination of the shoulder [4]. Arthroscopy was performed by four surgeons with the patient in a lateral decubitus position with the affected limb up. The arm was then connected to a traction apparatus with traction homolateral to the joint. The rotator cuff was approached from the posterior portal and the following anatomical structures were examined: the intra-articular part of the caput longum of the biceps tendon, subscapularis tendon,

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superior glenohumeral ligament and humeral head of the glenohumeral joint, and finally the integrity of the labrum and rotator cuff. The choice of arthroscopic or non-endoscopic treatment was based on the size of the rotator cuff tear [5,6]. Standard post surgery treatment and rehabilitation were administered to all patients.

Statistical analysis

Each set of ultrasound and MRI images was compared with the results of the arthroscopic examination to assess the specificity and sensitivity of the individual examinations [7].

RESULTS

A rotator cuff tear was diagnosed in 16 patients using ultrasonography and it was confirmed by arthroscopy in only 14 patients, with the ultrasound diagnosis thus falsely positive in two patients. The sensitivity of ultrasonography was 1.0 (100% agreement with arthroscopic evaluation), and the specificity was 0.9. Ultrasound was able to precisely visualize pathological symptoms of complete rotator cuff tears in the study group. However, this method was less sensitive for diagnosis of partial rotator cuff tears. MRI revealed rotator cuff tears in 13 patients, with a sensitivity of 0.92 (92% agreement with arthroscopic evaluation), and specificity of 1.0. Both methods provided high specificity, with better diagnostic sensitivity of MRI.

DISCUSSION

Acute or chronic shoulder pain of intra- or extra-articular origin caused by a trauma or degenerative processes leads to disabilities, and limits patients' everyday lives. However, if a precise diagnosis is normally available and is followed by effective treatment, the number of patients with chronic shoulder pain is reduced. Additionally, patients with acute pain caused by injury will recover sooner.

The clinical examination and physical tests are not fully reliable diagnostic tools in patients with shoulder pain, because symptoms of different conditions overlap [8]. However, additional non-invasive diagnostic techniques can help to avoid incorrect treatment and improve pre-operative preparation of patients.

Currently, additional examinations utilise imaging techniques, where the x-ray is still the most routine technique, although its diagnostic potential is very limited in soft tissue injuries. Therefore, if available, it is preferable to use ultrasonography and MRI to specify the diagnosis. Other alternative imaging techniques such as CT scans, arthrography, scintigraphy, and thermography are not commonly used for visualization of soft tissues. Arthroscopy is not commonly used for solely diagnostic purposes.

Many studies have reported that ultrasonography and MRI significantly improve diagnosis of soft tissue injuries. However, the comparative reliability or specificity of these two techniques for individual diagnoses is not well documented. Therefore, the choice between these techniques depends mostly on the personal preference of the physician [9,10].

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 [11,12]. 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 [2]. In the literature, ultrasound examination of rotator cuff tears has generally shown very high sensitivity (75-100%) and specificity (0.85-0.98). However, sensitivity has often been lower for partial tears or damage in the infraspinatus area. 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).

MRI can be used to verify all types of damage to soft tissues, even tissues in less accessible locations or tissues that already have degenerative or post-injury deformations. MRI owes its ability to adequately visualize a range of different tissues to a broad flexibility of approaches in obtaining images using many different settings (induction coil, position of examined body parts, contrast enhancement, weighting, sequences with fat suppression or 3D reconstruction). The disadvantages of MRI include its very high price, the long duration of an exam, and possible artifacts on images obtained from patients with metal implants.

In the literature, non-weighted MRI of shoulders has shown high variability in diagnostic accuracy. Hoand and Torstensen evaluated the accuracy of MRI for labral lesions in their practice and found very low sensitivity (62%), concluding that MRI is a non-effective diagnostic technique for shoulder pathology [13]. On the other hand, Gusmer et al. found 95% accuracy in detecting labrum tears on

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non-weighted MR slides [14]. However, the patient group in their study included a high percentage of patients with acute shoulder dislocation, where the presence of exudate in the joint produced a special effect similar to arthrograms [3]. MRI sensitivity currently reaches 90-100% and specificity is almost 1.0. Many authors agree that MRI is one of the most effective methods for the diagnosis of rotator cuff tear.

CONCLUSIONS

1. Ultrasound and magnetic resonance imaging are both very sensitive techniques for diagnosis of rotator cuff abnormalities.
2. Ultrasonography can be used as a primary method owing to its fast procedure and affordable cost.
3. MRI can be used as an additional method providing clarification and more detailed information on joint deformations with the possibility of 3D reconstruction and description of structural changes of connected areas.

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