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Role of Dynamic Ultrasound of Shoulder in Compare to MRI in Assessment of Rotator Cuff Injury of Shoulder

Dr Kalpesh shah
(Associate Professor, Department of Radiodiagnosis , Banas Medical College & Research Institute, Palanpur),

Dr. Radhika Sanjivkumar Patel
(3rd year resident,Department of Radiodiagnosis, GCS Medical College, Hospital and Research Center, Ahmedabad.)

Dr. Asutosh Dave
(Professor & Head, Department of Radiodiagnosis, GCS Medical College, Hospital and Research Center, Ahmedabad.)
Corresponding author: Dr Kalpesh shah

Abstract
Aims and objectives of study:
In our study we aim to analyze effectiveness of dynamic ultrasound of shoulder compare to MRI in diagnosis of rotator cuff injury.
Shoulder ultrasound is increasingly utilized in hospital now days. It is noninvasive and there is no side effect. Dynamic ultrasound allows visualizing every tendon and giving real time assessment of each tendon. Shoulder ultrasound is operator dependent and long learning curve is its limitation.
Methods and materials:
The study was conducted in tertiary care multispecialty hospital. The study included 50 patients with clinical diagnosis of shoulder pain due to rotator cuff injury from period of Dec 2020 to September2021.Human ethical committee approval was obtained from institutional ethical committee. USG and non-enhanced MRI was done in all patient
by two different radiologists to minimize biases.
Results:
10 patient (20%) showed normal rotator cuff tendons by both ultrasound and MRI but 3 of them (7.5 %) shows evidence of impingement with no tendon's involvement where as two cases out of three showed OA changes of AC joint and one case shows SA bursitis.
35 patient (70 %) showed rotator cuff disease by both modalities as follow.
12 cases (24%) shows tendinitis.
17 cases (34%) shows PTT.
6 cases (12%) shows FTT.
Two cases (4%) were diagnosed as PTT by MRI but were not recognized by ultrasound.
Three cases (6%) were diagnosed as normal on ultrasound shows tendinitis on MRI.
Conclusion:
Ultrasound and MRI can diagnose full-thickness rotator cuff tears with comparable accuracy. In diagnosis of partial thickness tear ultrasound has slightly lower accuracy compare to MRI.
Ultrasound being less expensive, less time-consuming, more dynamic, and less demanding for patients, can be used as the first-line of investigation for rotator cuff tear if appropriate skills are available
Keywords*: MRI, Dynamic Ultrasound, Shoulder, Rotator cuff Tear.*

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I. Introduction:

The rotator cuff is a group of muscle and their tendons that act to stabilize the shoulder. The muscles are the supraspinatus muscle, the infraspinatus muscle, teres minor muscle and subscapularis muscle.
Shoulder pain is common musculoskeletal problem and rotator cuff injury is one of the important underlying cause. Rotator cuff injury account around 13.1 % cause of shoulder pain in India (1).
Trauma is major risk factor for rotator cuff injury.

Role of imaging in such patient is important to detect type and extent of tear and identify the involved muscle. Based on diagnosis surgical or conservative management is decided. Ultrasound and MRI remain main modality to assess rotator cuff injury. MRI is the investigation of
choice for evaluating the rotator cuff tears despite its high cost and
limited availability.
Subsequently technical improvement in linear array broad bandwidth transducer and better penetration of ultrasound beam as well increased experience significantly improved ultrasonographic results and reliability. (2,3)
In our study we aim to analyze effectiveness of dynamic ultrasound of shoulder compare to MRI in diagnosis of rotator cuff injury.
Shoulder ultrasound is increasingly utilized in hospital now days. It is noninvasive and there is no side effect. Dynamic ultrasound allows to visualize every tendon and give real time assessment of each tendons.
Shoulder ultrasound is operator dependent and long learning curve is
its limitation (4).
It has high interobserver variability in diagnosis of partial thickness tear. Patient with severe movement restriction cannot perform shoulder movement which is prerequisite for dynamic ultrasound.
MRI is non invasive and superior imaging technique which allow better visualization of rotator cuff and minimize interobserver variability.
The limitation of MRI is availability, time consuming, cost in addition to absolute contraindication such as intracerebral aneurismal clips, biostimulator cardiac pacemaker, automatic defibrillator, metallic orbital foreign body, cochlear implant, fusion devices (5).

PATIENT AND METHODS:

The study was conducted in tertiary care multispecialty hospital. The study included 50 patients with clinical diagnosis of shoulder pain due to rotator cuff injury from period of Dec 2020 to September 2021.Human ethical committee approval was obtained from institutional ethical committee's and non-enhanced MRI was done in all patient by two different radiologists to minimize bias.

TECHNIQUE FOR SHOULDER ULTRASOUND:

Ultrasonography of shoulder was done by 12 Hz linear array transducer with musculoskeletal settings by radiologist having experience in MSK ultrasound who was not aware of MRI results.
Tendons of rotator cuff were evaluated in six standard planes (Anterior, Posterior, Lateral, Transverse and longitudinal).
Tear was identified as hypoechoic area within rotator cuff tendons which persisted in two different planes.
Full thickness tear was defined as continuous hypoechoic defect on tendon which extend from bursal to articular side of tendons.
Partial thickness tear was defined as hypoechoic defect on bursal side or articular side of tendons.
1.Subscapularis tendon assessment.
Elbow is flexed 90*. Then arm is rotated externally so moving tendon away from coracoid process. Internal and external rotation is done for dynamic assessment of subscapularis tendon.
2.Supraspinatus tendon assessment.
The arm is extended posteriorly with hand resting on iliac bone so supraspinatus tendon can be relocated away from acromion bursae.
The elbow is flexed and rotate towards mudline during examination. Abduction of arm with internal rotation is done for dynamic evaluation of supraspinatus tendon.
3.Infraspinatous and teres minor tendon assessment.
Patient is asked to place his hand on opposite shoulder. Probe is then put on scapular spine where infraspinatus and teres minor muscle are visualized deep to deltoid muscle. Infraspinatus tendon is larger and more caudal compare to teres minor tendon which is relatively smaller and more caudal.
Dynamic examination is done by adduction of arm with internal and external rotation.
4.Biceps tendon.
Biceps tendon is also evaluated along with rotator cuff tendons. It is assessed by elbow in 90* flexion position. It is imagined in intertubercular groove in both longitudinal plane and axial plane.

MRI SHOULDER TECHNIQUE:

Multi-planar MR imaging of the shoulder was done using coronal oblique proton density, coronal oblique T1 weighted, sagittal oblique T2-weighted with fat saturation, coronal oblique T2 weighted with fat saturation and axial T2 weighted sequences. All MRIs were reported by a radiologist with specialization in musculoskeletal imaging. The full thickness rotator cuff tear was diagnosed as focal, well-defined area of

increased signal intensity on T1-weighted and T2-weighted images that extended from the bursal to the articular surface. A partialthickness tear was diagnosed when the fluid signals do not traverse the full thickness of the muscle tendon.

II. Results:

Our study included 50 patients. Out of the 33 were females (66%) and 17 males (34%) with their age ranging from 22 to 60 years (Mean age 52 years). 26 patient complained pain in shoulder region,12 patient presented with restriction in movement and 8 patients presented with weakness while 4 patients presented with instability of shoulder joint.

TABLE 1: ULTRASOUND DIAGNOSIS

No tear	Tendinitis	Partial thickness tear	Full thickness tear
15	12	17	6

TABLE 2: MRI DIAGNOSIS

No tear	Tendinitis	Partial thickness tear	Full thickness tear
10	15	19	6

Stastical analysis comparing effectiveness of ultrasound and MRI in diagnosis.

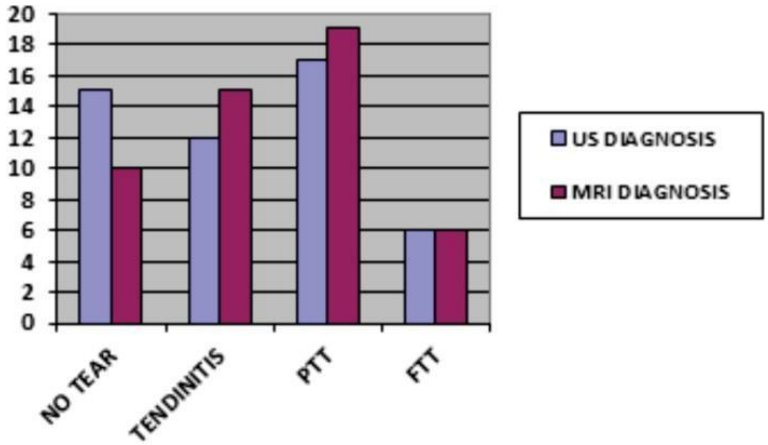

IMAGE 1A: IMAGE 1B:

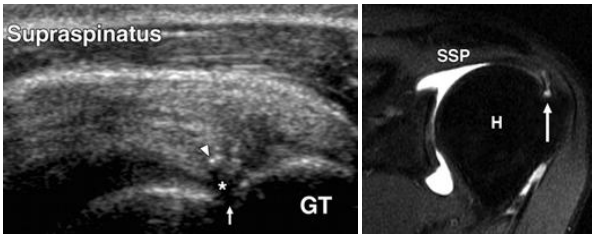

IMAGE 1A: 46-year-old man with pain and disability of left shoulder. Long- axis ultrasound of supraspinatus tendon shows hypoechoic area in insertion (i.e., at footprint) (asterisks), which was diagnosed by radiologists as partial- thickness rotator cuff tear. GT = greater tuberosity

IMAGE 1B: 46-year-old man with pain and disability of left shoulder. Coronal T1-weighted, fast spin- echo image with fat saturation of MR arthrogram (1.5 T) (TR/TE, 700/16; field of view (FOV): 160–160 mm, slice: 3 mm, flip angle: 90°, matrix: 512 × 512) confirmed ultrasound findings by showing leakage of contrast media insertion of supraspinatus tendon (SSP) (arrow). H = humerus.

IMAGE 2A: IMAGE 2B:

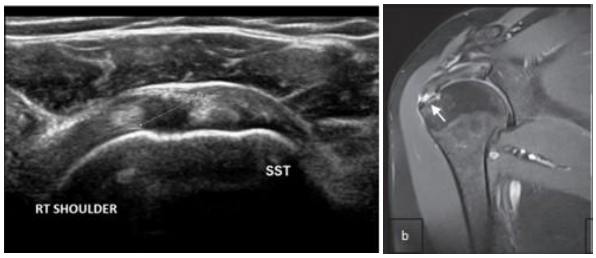

IMAGE 2A: US of the right supraspinatus tendon showing a hypoechoic area within involving its whole thickness denoting full thickness tear with a gap measuring 7 mm.

IMAGE 2B: MRI coronal PD with fat suppression revealed a full thickness tear of the supraspinatus tendon near its humeral attachment with fluid signal seen in the gapping area which measures about 6 mm (comparable to the US)

III. Discussion:

10 patient (20%) showed normal rotator cuff tendons by both ultrasound and MRI but 3 of them (7.5 %) shows evidence of impingement with no tendon's involvement where as two cases out of three showed OA changes of AC joint and one case shows SA bursitis.
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IV. Conclusion:

Ultrasound and MRI can diagnose full-thickness rotator cuff tears with comparable accuracy. In diagnosis of partial thickness tear ultrasound has slightly lower accuracy compare to MRI. Ultrasound being less expensive, less time-consuming, more dynamic, and less demanding for patients, can be used as the first-line of investigation for rotator cuff tear if appropriate skills are available.

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