Section: Radiology

Original Research Article

COMPARATIVE STUDY OF ULTRASONOGRAPHY WITH MAGNETIC RESONANCE IMAGING IN THE DIAGNOSIS OF SHOULDER AILMENTS

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Abstract

Background: Shoulder pain encompasses a diverse array of pathologies and can affect as many as one quarter of the population depending on age and risk factors. It might be brought on by disorders with the rotator cuff, acromioclavicular joint, glenohumeral joint, neck, or other soft tissues around the shoulder. The main aim of the study is to compare the diagnostic accuracy of ultrasound shoulder and Magnetic resonance imaging of the shoulder in the diagnosis of shoulder ailments. **Materials and Methods:** This is a Comparative study done in Department of Radiology, Government Medical College (GMC), Ananthapur. In total 64patients were included for Ultrasonography (USG) and Magnetic Resonance Imaging (MRI) examination of shoulder ailments. The statistical analysis was done using SPSS (Statistical Package for Social Sciences) Version 21.0 statistical analysis Software.**Result:**64 patients with a history of shoulder pain were evaluated using USG and then by MRI. The subscapularis assessment comparison showed a specificity of 92.00% and a sensitivity of just 52.00%. With an accuracy of 92.00%, the negative prediction value (NPV) was measured as 94.65% and the positive predictive value (PPV) as 52.62%. The partial thickness data has a sensitivity of 63.30% and a specificity of 70.82%, according to the correlation results. The NPV value was recorded as 60.73% with an accuracy of 67.00%, while the PPV value that was acquired was 73.18%. Trauma was the etiology in only a few patients. MRI is more sensitive than USG in identifying labral and capsular pathologies. MRI is the most sensitive and specific modality for the establishment of shoulder pain. MRI is useful in cases in which the diagnosis is uncertain on USG. **Conclusion:** MRI is recommended as a secondary method since it provides more information about the extent of tendons and has a lower artifact risk.

INTRODUCTION

Shoulder pain depending on age and risk factors, shoulder discomfort can impact up to 25% of the population and span a wide range of disorders.[1] It might be brought on by disorders with the rotator cuff, acromioclavicular joint, glenohumeral joint, neck, or other soft tissues around the shoulder. Problems with the rotator cuff account for around two thirds of occurrences of shoulder discomfort.[2,3] Rotator cuff abnormalities can be caused by a variety of factors, such as overloading the shoulder, ischemia and aging-related cuff degradation, and musculoskeletal issues in the shoulder joints and muscles.[4,5] When pain, stiffness, or weakness impair shoulder mobility, a person may become severely disabled and unable to carry out everyday tasks (feeding, dressing, and personal hygiene). Self-reported shoulder discomfort accounts for around 1% of adult consultations to general practitioners with new shoulder pain annually.[6] This is the third most prevalent reason for musculoskeletal consultation in primary care. Jobs as varied as construction carry an increased risk of shoulder diseases. A number of physical variables, including lifting large objects, performing repeated motions in uncomfortable postures, and vibrations, can exacerbate symptoms and lead to impairment. Psychosocial elements may also play a role. Recent investigations have shown that chronicity and recurrence are frequent.[7] To differentiate between these conditions, magnetic resonance imaging and shoulder arthroscopy have been the most commonly used imaging modalities. It's possible to obtain a variety of imaging tests, including plain radiographs and magnetic resonance imaging (MRI) using intraarticular contrast and phased array coils. Due to the development of advanced ultrasound (US) capabilities, musculoskeletal ultrasonography is now considered a primary diagnostic imaging test.[8] It is important to note that every modality has its strengths and weaknesses in evaluating shoulder pathology. Radiologists and surgeons agree that ultrasound and MRI are useful for shoulder arthroscopy, but the role of these technologies is still evolving. An understanding of shoulder pathology requires an understanding of the unique anatomy of the shoulder joint.[9] In preoperative planning, the ability to visualize images in axial, sagittal, and coronal planes can be helpful.[10] When performing and interpreting shoulder imaging, it is essential to use equipment with high-resolution transducers, adhere to a strict examination protocol, understand normal anatomy and pathological processes, and be aware of common pitfalls.[11]

This study was undertaken to compare the diagnostic accuracy of ultrasound shoulder with Magnetic resonance imaging as the gold standard in the diagnosis of shoulder ailments.

MATERIALS AND METHODS

Study Design: Comparative Study

Study Population: Data for the study was collected from the patients who present to OPDs with a history of shoulder pain and were referred to the department of diagnostic radiology at Government Medical College (GMC), Ananthapur.

Period of Study: 24 months duration of study (February 2022 to February 2024)

Place of Study: Department of Radiology, Government Medical College (GMC), Ananthapur.

Inclusion Criteria

Using the inclusion criteria, all patients were included in the trial, regardless of their socioeconomic position or gender. Patients with metallic prosthetic implants and those with a history of claustrophobia will not be included in this study. Individuals who have undergone prior surgery were not allowed to participate in the research. After obtaining a thorough clinical history, an MRI and USG examination were performed. Since each patient underwent an MRI examination after a USG, the radiologist was blind to the results of the MRI. The senior radiologist, who has eight years of expertise in musculoskeletal radiology, performed both the MRI and the USG.

Exclusion Criteria

The study's exclusion criteria included having a history of prosthetics, Patients with any electrically, magnetically, or mechanically activated implants (pacemaker, bio stimulators, neurostimulators, and cochlear implants), Patients having claustrophobia, Patients who are unwilling to imaging, Subjects are unable to cooperate due to pain, Patients were not willing to give written informed consent.

Study Procedure: Patient selection: Using the inclusion criteria, all patients were included in the trial, regardless of their socioeconomic position or gender. Patients with metallic prosthetic implants and those with a history of claustrophobia will not be included in this study. Individuals who have undergone prior surgery were not allowed to participate in the research. After obtaining a thorough clinical history, an MRI and USG examination were performed. Since each patient underwent an MRI examination after a USG, the radiologist was blind to the results of the MRI. The senior radiologist, who has eight years of expertise in musculoskeletal radiology, performed both the MRI and the USG.

Ultrasound Examination of the Shoulder

A Mindray DC-70 high-frequency linear transducer operating in the 3.5–16 MHz frequency range was used to examine the damaged shoulder. The patient was sitting on a chair that revolved. Both the axial and sagittal planes reveal both shoulders for comparison. Following structures are routinely evaluated (a) Biceps tendon (b) Subscapularis (c) Supraspinatus (d) Infraspinatus (e) Posterosuperior labrum, spinoglenoid notch (f) Fluid collection in glenohumeral joint (g) Acromioclavicular joint (h) Dynamic maneuvers for biceps tendon to rule out subluxation/dislocation; subscapularis for subcoracoid impingement; supraspinatus for subacromial impingement.

MRI of the Affected Shoulder: A plain MRI was performed using a 1.5T Philips Achieve machine with a shoulder coil. The patient is placed in a supine position and asked to hold the shoulder in a neutral position. A sponge was placed at the elbow and another one supporting the hand and the arm will be strapped in place to prevent movement.

Statistical Analysis: The statistical analysis was done using SPSS (Statistical Package for Social Sciences) Version 21.0 Statistical Analysis Software.

RESULTS

In our study, the age incidence ranged from 18 years to 78 years. The mean age of patients was 54.62 ± 9.45 years. 64 patients with a history of shoulder pain were evaluated using USG and then by MRI. 38 patients (59.37%) were affected on right and 22 (40.63%) patients were affected on the left side. The parameters are shown in [Table 1].

Most patients were between 40-80 years of age. Maximum patients were between 40-49 years (64.07 %), followed by 50-59 years (26.56%) and >60 years (9.37%). The analysis revealed that the number of male patients was comparatively higher than the number of female patients. In the total 64 patients, the gender difference was recorded at around 12.5% with males at 56.25% (36 patients) and females at 43.75% (28 patients).

The data about the duration of symptoms was analyzed. The evaluation showed that around 50% (32 patients) of the patients suffered from the symptoms for up to one month and 40.62% (26 patients) of the patients were found to suffer from the symptoms for 1 to 6 months. Around 9.38 % (6 patients) of the patients were suffering from the symptoms for 6 months to 12 months.

Correlation of USG findings with MRI findings

The subscapularis assessment comparison showed a specificity of 92.00% and a sensitivity of just 52.00%. With an accuracy of 92.00%, the negative prediction value (NPV) was measured as 94.65% and the positive predictive value (PPV) as 52.62%. The correlation's importance is confirmed by the p-value of 0.002. On the other hand, in the supraspinatus assessment, accuracy was 83.00%, sensitivity was greater (84.86%) than specificity (52%) and PPV was higher (91.00%) than NPV (38.42%). The correlation's importance is indicated by the p-value of 0.028. For the findings of the other tendon (Infraspinatus, Teres Minor, and Biceps tendon), no association data were found. The data correlation for the Bursal PBT (Biceps tendon) showed a sensitivity of 46.50% and a specificity range of 82.00%. With a 54.00% accuracy range, the NPV was recorded as 28.10% and the PPV as 90.90%. The correlation's significance was confirmed by the p-value of 0.09, which is less than 0.05. The Subacromial Subdeltiod Bursitis data association showed a sensitivity of 31.70% and a specificity of 84.60%. Additionally, the NPV value was recorded as 28.20% with an accuracy of 44.00%, and the PPV was reported as 86.7%. Since the p-value was greater than 0.05, it may be concluded that there was no statistically significant link. There was no sensitivity found in the instance of Bursal SCA (Subcoracoid Bursitis), while 92% specificity was reported. In the same way, no PPV value was found, but an accuracy range of 43.00% was found for the NPV value, which came out to be 44.20%. The p-value of 0.121 which is >0.05 confirms the insignificance of the correlation. The correlation of USG findings with MRI findings was shown in [Table 2].

The correlation between USG and MRI findings regarding thickness was displayed in [Table 3]. The partial thickness data has a sensitivity of 63.30% and a specificity of 70.82%, according to the correlation results. The NPV value was recorded as 60.73% with an accuracy of 67.00%, while the PPV value that was acquired was 73.18%. The correlation's significance was confirmed by the p-value of less than 0.05. The correlation of full-thickness data showed a similar pattern. With a specificity range of 91.86%, the sensitivity was found to be 80%. While the accuracy range was reported as 91.00%, the PPV value was slightly lower (50.23%) than the NPV value (97.89%). The correlation's importance is confirmed by the p-value of 0.0001, which is less than 0.05.

USG showing a partial thickness tear on the bursal aspect. USG of supraspinatus tendon showing tendinopathy [Figure 1]. Secondary signs of full-thickness rotator cuff tears include fluid in the SASD bursa and muscle atrophy [Figure 2]. [Figure 3] shows MRI images in coronal (A &B), axial (C), and sagittal (D) planes showing full thickness tear of the supraspinatus.

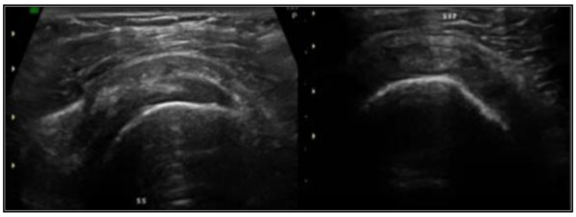

Figure 1: USG of supraspinatus (SS) tendon showing signs of partial thickness tear in the bursal aspect. USG of supraspinatus tendon showing tendinopathy.

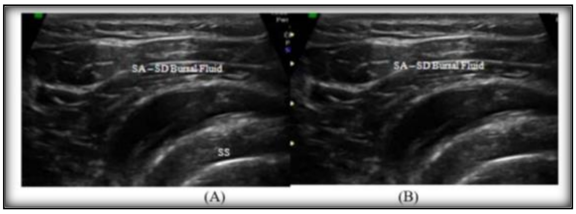

Figure 2: USG showing SA-SD bursal fluid (A, B)

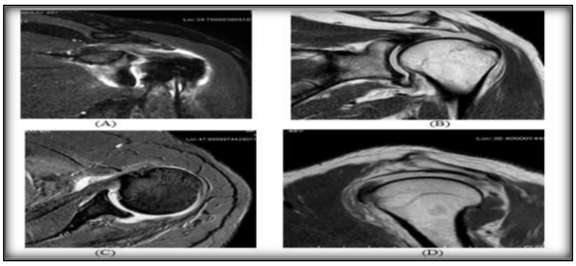

Figure 3: MRI images in coronal (A &B), axial (C), and sagittal (D), show a full-thickness tear of the supraspinatus.

Table 1: Demographic parameters

Parameters	
Age (Range)	54.62 ± 9.45 (18-78)
Age Distribution	
40-49 Years	41 (64.07 %)
50-59 Years	17 (26.56 %)
>60 Years	6 (9.37 %)
Sex Distribution	
Male	36 (56.25 %)
Female	28 (43.75 %)

Duration of symptoms	
< one month	32 (50%)
1-6 months	26 (40.62 %)
6-12 months	6 (9.38 %)

Table 2: Correlation of USG findings with MRI findings

Findings	Sensitivity	Specificity	PPV	NPV	Accuracy	P Value
Subscapularis	52.00%	92.00%	52.62%	94.65%	92.00%	0.002
Supraspinatus	84.86%	52.00%	91.00%	38.42%	83.00%	0.028
Infraspinatus	0	0	0	0	0	NA
Teres Minor	0	0	0	0	0	NA
BicepsTendon	0	0	0	0	0	NA
Bursal PBT	46.50%	82%	91%	28.10%	54.00%	0.09
Bursal SA-SD	31.70%	84.60%	86.70%	28.20%	44.00%	0.252
Bursal SCA	0	92.00%	0.0	44.20%	43.00%	0.121

PPV= Positive predictive values; NPV =Negative prediction value

Table 3: Correlation of USG findings with MRI findings regarding thickness

Findings	Sensitivity	Specificity	PPV	NPV	Accuracy	P-Value
PartialThickness	63.30%	70.82%	73.18%	60.73%	67.00%	0.013
FullThickness	80.25%	91.86%	50.23%	97.89%	91.00%	0.0001

PPV= Positive predictive values; NPV =Negative prediction value

DISCUSSION

Many techniques are utilised to assess the pathologies of patients with shoulder discomfort, including clinical examination, X-rays, arthrography, USG, CT, and MRI. MRI is among the most accurate techniques in terms of accuracy. MRI machines cannot be utilised as the primary method of examination to determine whether a problem exists due to their restricted availability. Conversely, USG is a non-invasive, low-cost technique that may be used to identify a range of pathological disorders.[12] A study including sixty-four individuals with shoulder discomfort was carried out.[13] In order to fully comprehend all of the shoulder's issues, we first conducted a thorough clinical examination and history. This was followed by a USG examination to compare the afflicted shoulder to the unaffected shoulder. The results of a CT scan supported the findings of the MRI.[14] The prevalence estimates of shoulder discomfort in the general population above the age of 60–65 are effectively declining due to rising rotator cuff pathology and declining prevalence estimates in the older population.[15] In this age bracket, researchers hypothesized that this might be related to people retiring, changing occupations, or not exposing themselves to as many shoulder-demanding activities as in the younger age bracket. Focal discontinuities of the tendon at the bursal or articular surfaces were the USG criteria for partial thickness tears. The USG standard for determining full-thickness tears is the lack of a whole tendon. Related symptoms may include fluid tracking from the AC joint to the subcutaneous site (Geyser phenomenon) and free fluid in the Subacromial Subdeltoid Bursa. Tendon thickness (more than 6 mm in craniocaudal dimension) and heterogeneous echotexture were the USG's findings of tendinosis.[16]

In MRI, partial thickness tears were detected by focal fiber discontinuities that are filled with fluid in acute tears, a subtle increased signal at the site of tear on fluid sensitive sequences. A focal tendon defect was also observed, along with surface fraying or changes in the caliber of the tendon. In MRI, tendon discontinuity is characterized by full-thickness tears associated with tendon retraction and atrophy of residual muscle. Another indirect indicator of a full-thickness tear is fluid in the subacromial-subdeltoid bursa.[17,18]

The correlation data between USG findings and MRI findings showed that the partial thickness data has a sensitivity of 63.30% and a specificity of 70.82%, according to the correlation results. The NPV value was recorded as 60.73% with an accuracy of 67.00%, while the PPV value that was acquired was 73.18%. The correlation's significance was confirmed by the p-value of less than 0.05. The correlation of full-thickness data showed a similar pattern. With a specificity range of 91.86%, the sensitivity was found to be 80%. While the accuracy range was reported as 91.00%, the PPV value was slightly lower (50.23%) than the NPV value (97.89%). The correlation's importance is confirmed by the p-value of 0.0001, which is less than 0.05. Rotator cuffs reflect the ultrasound beam maximally when they are insonated 90° to the long axis of the tendon fibers.[19] Consequently, the transducer will detect fewer reflected sound waves as the angle deviates. Tendons become isoechoic to the muscle between 2° and 7° and hypoechoic at greater angles. Because of their curved course, tendon insertions are most susceptible to anisotropic artifacts. Less skilled radiologists could misinterpret this as tendinosis or partial thickness rotator cuff tears if this artefact is absent. The rotator cuff anatomy is distorted by anatomical anomalies of the humeral head, such as fractures. In order to assess denervation damage, USG cannot be the primary modality. USG has a steep learning curve and significant inter-observer variance for radiologists.[20,21]

CONCLUSION

MRI provides the most exact and reliable diagnosis for the pathology responsible for shoulder discomfort. MRI can be useful when USG results are unclear. Experienced radiologists may assess rotator cuff injuries using USG as a first-line imaging modality with outcomes similar to MRI. Regardless of the operator's dependency, a well-performed USG can screen all uncomfortable shoulder joints because it is a quick and affordable primary diagnostic technique.

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