International Research Journal of Social Sciences and Humanities, Vol.:03, Issue: 01,Jan-June,2024
PP:892-903

OPEN ACCESS
IRJSSH
ISSN (Online): 2959-1392
ISSN (Print): 2959-2887
www. irjssh.com

DIAGNOSTIC ACCURACY OF ULTRASOUND AND MAGNETIC RESONANCE IMAGING IN THE ASSESSMENT OF ROTATOR CUFF TEARS

Muhammad Ahmad Raza
MSDU, University Institute of radiological science & MIT, University of Lahore, Lahore.*
Email: *dr.ahmad663@gmail.com*

Laamia Altuf
Department of radiological science & MIT Superior University ,Lahore.
Email: *laamia.475@gmail.com*

Aqsa
Medical Imaging Technologist at PHQ hospital Gilgit, Pakistan.
Email: *aqsa69926@gmail.com*

Wajiha Sohail Khan
University Institute of radiological science & MIT, University of Lahore, Lahore.
Email: *khan.jia14@gmail.com*

Abstract

Rotator cuff (RTC)pathology is the most prevalent cause of shoulder pain in the general population among the several causes of shoulder discomfort, and there is usually a significant morbidity connected to rotator cuff disease, such as rotator cuff tears (RCT).Shoulder discomfort is frequently caused by tears in the rotator cuff. The cross-sectional observational study was conducted at Sheikh Zayed Hospital Lahore from September 12, 2023, to April 26, 2024. The study aimed to evaluate the diagnostic accuracy of Ultrasound (MSK-USG) compared with Magnetic Resonance Imaging (MRI) in identifying rotator cuff muscles.. The Ultrasound evaluation sequences are with the elbow flexed to a 90-degree angle, the biceps tendon was evaluated first. In order to assess any LHBT dislocation from the bicipital groove, the patient is instructed to rotate their arm both internally and externally. Second, with the arm externally rotated and the elbow at 90 degrees of flexion, the subscapularis was evaluated. The patient was asked to abduct their arm in order to assess impingement, internally rotate their arm so that the dorsum of the hand touched their back to assess supraspinatus and

infraspinatus, and assess the acromioclavicular joint to rule out arthritis. The MRI Shoulder study protocol was applieed. All participants provided informed consent, guaranteeing their voluntary involvement and privacy and followed the Declaration of ethical guidelines. Patients of various age groups are included in this study, which evaluates 50 patients for rotator cuff problems who had both magnetic resonance imaging and ultrasound of their shoulder joint. A total of 50 cases, 32 were males and 18 were females. Age groups 19-34 account for 40% of all cases, while 50–65 account for 23.3% of all cases. These age groups have the greatest number of instances, with a total of 12 cases. A total of 19 cases, or around 63.3% of all cases, had symptoms that had persisted for one to six months. Merely 2.7% of patients had symptoms for over a year in the beginning, which is a very small percentage of cases overall. About 40% cases were Right-handed, and 60% were Left-handed. The rotator cuff tear diagnosis demonstrated a strong negative predictive value (NPV) and good sensitivity.As a result, the ultrasonographer, despite brief expertise with shoulder ultrasonography, demonstrated good sensitivity in identifying tears and certainty in their elimination.
Keywords: *Rotator Cuff tears, Diagnostic Accuracy, Ultrasound, Magnetic Resonance Imaging.*

INTRODUCTION

Rotator cuff (RTC)pathology is the most prevalent cause of shoulder pain in the general population among the several causes of shoulder discomfort, and there is usually a significant morbidity connected to rotator cuff disease, such as rotator cuff tears (RCT)[1,2,3,4,5]. Shoulder discomfort is frequently caused by tears in the rotator cuff. Findings from radiography and clinical examination may indicate the existence of a rotator cuff injury. Impingement and the "arc of pain" sign are the two most sensitive clinical signs. In the acute context, radiographic results are often normal, albeit the "active abduction" view may indicate a reduction in acromiohumeral distance[6].RC tears are also quite common and increase in frequency with age. A history of trauma, limb dominance, contralateral shoulder, smoking, hypercholesterolemia, posture, and occupational inclinations are additional risk factors. Since a large percentage of individuals are asymptomatic, early diagnosis is crucial. A practitioner who is attentive should be alerted by pain and declining shoulder strength and function to rapidly identify the start or exacerbation of pre-existing RC tears[7].A variety of internal, external, and environmental variables contribute to the complex pathophysiology of rotator cuff dysfunction. The development of rotator cuff tendinopathy may be attributed to the specialized morphology of the rotator cuff and the impact of stress shielding. The pathology and accompanying symptoms are closely linked to significant alterations inside the subacromial bursa[8]. A hypoechoic defect of the articular side of the tendon for an

articular-side partial-thickness tear, tendon nonvisualization for a complete tear, and flattening of the bursal surface of the tendon for a bursal-side partial-thickness tear are the main US signs for rotator cuff supraspinatus tendon tears. When linked with the primary indications, secondary US signals include joint and subacromial-subdeltoid bursal fluid, as well as cortical irregularity of the larger tuberosity, are useful. There is evidence of intrinsic heterogeneity in tendinopathy, tendinopathy, and intrasubstance tear[9].Adhesive capsulitis, tendonitis, arthritis, fractures, and bursitis of the subacromial and subdeltoid bursts are among the various reasons of shoulder discomfort.Plain radiographs are the primary imaging modality of choice for working up shoulder pain since they may rule out soft tissue calcifications and any abnormalities in the bone. However, even in situations when there is underlying disease, simple radiographs typically show normal values. When identifying and treating rotator cuff injuries (RCT), magnetic resonance imaging (MRI) is a useful tool[10,11]. The sensitivity of ultrasonography (SN) in evaluating and diagnosing rotator cuff tears in radiocardiography (RCT-SIST) has improved significantly and is now almost as high as magnetic resonance imaging (MRI). This is due to the rapid development and advancement of ultrasonography technology, including the use of 7.5–18 MHz (Megahertz) linear array broad-bandwidth probes, good penetration of ultrasonography beams, and improved image resolution[12]. The ultrasound operator's proficiency in conducting the scan is the most crucial component. Many of the earlier investigations that were documented and made available in the literature, showing great (SN) sensitivity and (SP), used ultrasonographers with a large amount of experience virtually many years in doing shoulder ultrasounds[13]. There is a plethora of information available on the ultrasonographer doing the shoulder ultrasonography who experienced limited evaluation and diagnosis of rotator cuff tears and rotator cuff diseases (RCT). An published study showed that the expertise of the ultrasonographer during the study improved the good (SN) sensitivity and (SP) specificity in assessing and diagnosing rotator cuff injuries[14].This research relied on an ultrasonographer with little expertise doing shoulder ultrasounds to accurately evaluate and diagnose (RCT) rotator cuff tears and rotator cuff disorders using magnetic resonance imaging[15]. For rotator cuff abnormalities, shoulder ultrasound is widely acknowledged as the preferred examination in many global centers.With regard to all diagnostic musculoskeletal ultrasonography exams, it is also one of the most often carried out investigations[16].Ultrasound has completely changed the diagnostic landscape, but magnetic resonance imaging is still the gold standard for rotator cuff injuries. While all-arthroscopic repair of rotator cuff tear is currently

quickly taking the place of mini-open rotator cuff repair as the standard of treatment, the latter technique is still often used with comparable results. Good to exceptional results have resulted from postcuff repair due to appropriate knowledge of pathophysiology and healing pattern of the cuff, strong and biological repair procedures, improved suture anchors, and progressive rehabilitation. The significance of biological agents like stem cells and platelet-rich plasma for postcuff repair augmentation is currently being investigated since the healing process of degenerative cuff tears is still unknown[17].When evaluating the rotator cuff after surgery, MRI and US are helpful in identifying hardware issues and other causes of shoulder discomfort in addition to assessing the rotator cuff tears[18].

MATERIAL AND METHODS

The cross-sectional observational study was conducted at Sheikh Zayed Hospital Lahore from September 12, 2023, to April 26, 2024. The study aimed to evaluate the diagnostic accuracy of Ultrasound (MSK-USG) compared with Magnetic Resonance Imaging (MRI) in identifying rotator cuff muscles. Acute and chronic shoulder pain patients are included in this study. Individuals presenting with restricted mobility at the joint, Patients experiencing tight shoulders patients having a background of shoulder injuries. The Ultrasound evaluation sequences are with the elbow flexed to a 90-degree angle, the biceps tendon was evaluated first. In order to assess any LHBT dislocation from the bicipital groove, the patient is instructed to rotate their arm both internally and externally.

Second, with the arm externally rotated and the elbow at 90 degrees of flexion, the subscapularis was evaluated. The patient was asked to abduct their arm in order to assess impingement, internally rotate their arm so that the dorsum of the hand touched their back to assess supraspinatus and infraspinatus, and assess the acromioclavicular joint to rule out arthritis. The MRI Shoulder study protocol includes the following: PD FS AXIAL, PD FS SAGITTAL, PD FS CORONAL, T2W CORONAL, T1W CORONAL, T2W AXIAL, and AXIAL GRE. All participants provided informed consent, guaranteeing their voluntary involvement and privacy and followed the Declaration of ethical guidelines. Face-to-face interviews were conducted to gather clinical and demographic information from the participants, such as age, gender, and symptoms.

RESULTS

Patients of various age groups are included in this study, which evaluates 50 patients for rotator cuff problems who had both magnetic resonance imaging and ultrasound of their shoulder joint. A total of 50 cases, 32 were males and 18 were females.

Age groups 19-34 account for 40% of all cases, while 50–65 account for 23.3% of all cases. These age groups have the greatest number of instances, with a

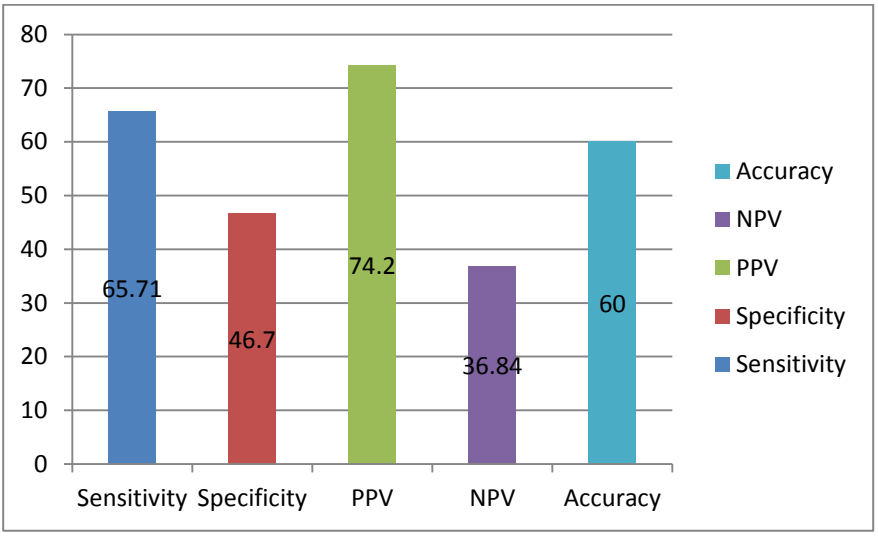
total of 12 cases. A total of 19 cases, or around 63.3% of all cases, had symptoms that had persisted for one to six months. Merely 2.7% of patients had symptoms for over a year in the beginning, which is a very small percentage of cases overall. About 40% cases were Right-handed, and 60% were Left-handed.

Ultrasound showed sensitivity (SN) of 65.71%, specificity (SP) of 46.7%, positive predictive value (PPV) of 74.2%%, and negative predictive value (NPV) of 36.84%, and with a diagnostic accuracy of 60.0%

Table 1: Accuracy of ultrasound with MRI-Supraspinatus tears

		MRI		***total***
		Positive	*Negative*	
Ultrasound	*Positive*	*23*	*8*	*1*
	Negative	*12*	*7*	*9*
Total		*35*	*15*	***0***

Sensitivity:65.71%
Specificity:46.7%
Positivepredictivevalue:74.2%
Negativepredictivevalue:36.84%
Accuracy:60.0%

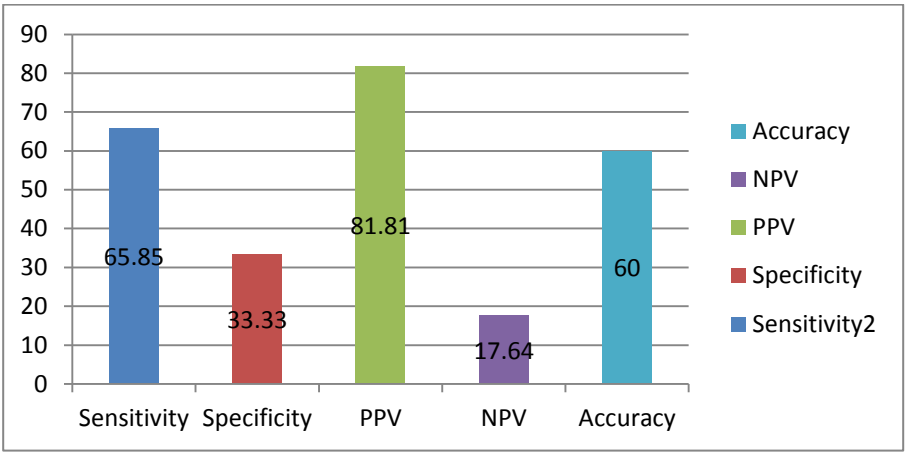


Ultrasound showed a specificity (SP) of 65.85%, sensitivity (SN) of 33.33%, positive predictive value(PPV) of 81.81%, negative predictive value (NPV) of 17.64%, and with diagnostic accuracy of 60.0%

Table 2: Accuracy of ultrasound with MRI-Infraspinatus tear

		MRI		total
		Positive	Negative	
Ultrasound	Positive	27	6	3
	Negative	14	3	7
Total		41	9	**0**

Sensitivity:65.85%
Specificity:33.33%
Positivepredictivevalue:81.81%
Negativepredictivevalue:17.64%
Accuracy: 60.0%



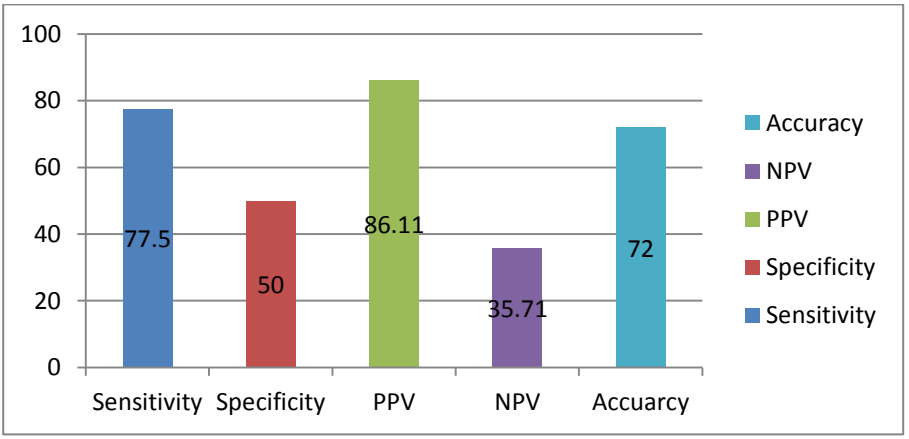
Ultrasound showed a specificity (SP) of 77.5%, sensitivity (SN) of 50.0%, positive predictive value (PPV) of 86.11%, negative predictive value (NPV) of 35.71%%, and with diagnostic accuracy of 72.0%.

Table 3:Accuracy of ultrasound with MRI- Subscapularis tear

		MRI		total
		Positive	Negative	
Ultrasound	Positive	31	5	6
	Negative	9	5	4
Total		40	10	**0**

Sensitivity:77.5%
Specificity:50.0%
Positivepredictivevalue:86.11%

Negativepredictivevalue:35.71%
Accuracy:72.0%

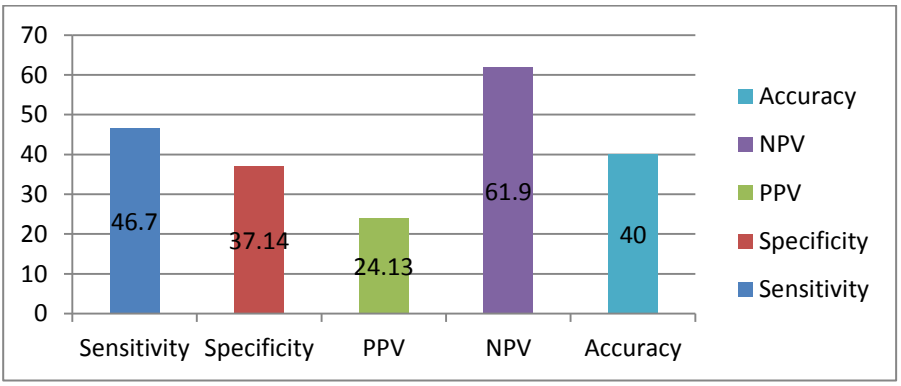


Ultrasound showed a specificity (SP) of 46.7%, sensitivity (SN) of 37.14%, positive predictive value (PPV) of 24.13%, negative predictive value (NPV) of 61.90%, and with diagnostic accuracy of 40.0%.

Table 4:Accuracy of ultrasound with MRI- Subacromial-Subdeltoid tear

		MRI		***total***
		Positive	*Negative*	
Ultrasound	*Positive*	*7*	*22*	*9*
	Negative	*8*	*13*	*1*
Total		*15*	*35*	***0***

Sensitivity:46.7%
Specificity:37.14%
Positivepredictivevalue:24.13%
Negativepredictivevalue:61.90%
Accuracy: 40.0%

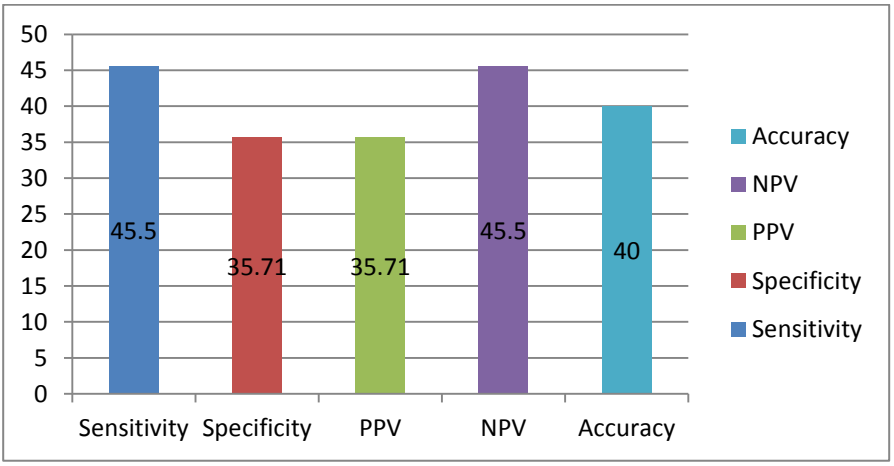


Ultrasound showed a specificity (SP) of 45.5%, sensitivity (SN) of 35.71%, positive predictive value (PPV) of 35.71%, negative predictive value (NPV) of 45.5%, and with diagnostic accuracy of 40.0%.

Table 5:Accuracy of ultrasound with MRI – Joint effusion

		MRI		***total***
		Positive	*Negative*	
Ultrasound	*Positive*	*10*	*18*	*8*
	Negative	*12*	*10*	*2*
Total		*22*	*28*	***0***

Sensitivity:45.5%
Specificity:35.71%
Positivepredictivevalue:35.71%
Negativepredictivevalue:45.5%
Accuracy:40.0%

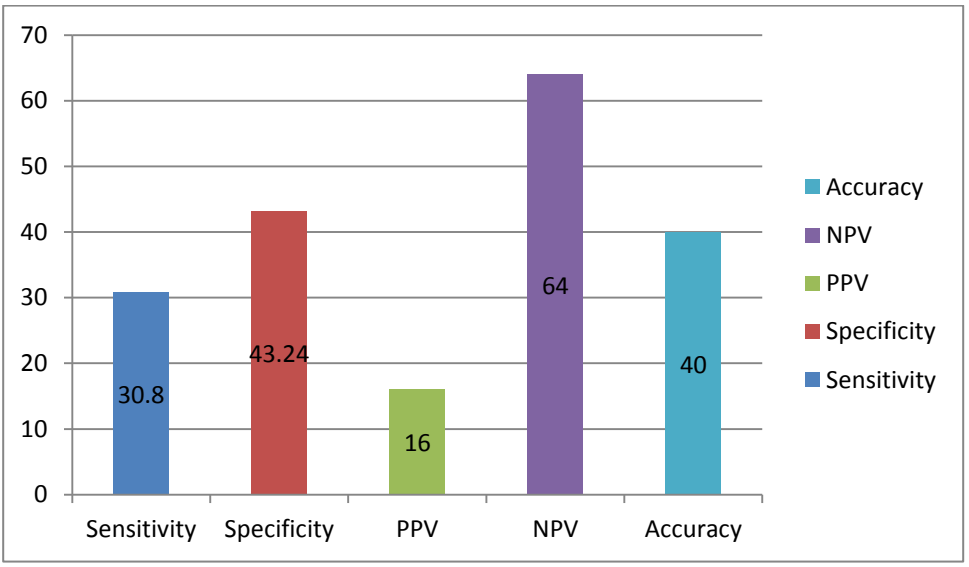


Ultrasound showed a specificity (SP) of 30.8%, sensitivity (SN) of 43.24%, positive predictive value (PPV) of 16.0%, negative predictive value (NPV) of 64.0%%, and with diagnostic accuracy of 40%.

Table 6:Accuracy of ultrasound with MRI-Any tear

		MRI		***total***
		Positive	*Negative*	
Ultrasound	*Positive*	*4*	*21*	*5*
	Negative	*9*	*16*	*5*
Total		*13*	*37*	***0***

Sensitivity:30.8%
Specificity:43.24%
Positivepredictivevalue:16.0%
Negativepredictivevalue:64.0%
Accuracy:40.0%



DISCUSSION

As of right now, there is limited information available on the total number of ultrasound scans required for an ultrasonographer to thoroughly assess and diagnose a rotator cuff tear (RCT) with absolute certainty.

According to research that involved the evaluation of two ultrasound operators, operators of ultrasound need do at least one hundred shoulder joint ultrasound scans before they reach a plateau in their ability to confidently identify and assess rips of the supraspinatus tendon[19]. In this study, the ultrasonographer who performed the ultrasound on the shoulder joints (2 normal subjects, 4 shoulders, and 20 patients, 40 shoulders) had a brief experience, but he was still able to evaluate and diagnose any rotator cuff tear with 30.8% sensitivity, 43.24% specificity, 16.0% positive predictive value, 64.0% negative predictive value, and 40.0% diagnostic accuracy.

Tendinosis and subscapularis tendon injuries were frequently overlooked. This could be caused by the anisotropy artifact, which appears when the transducer is not positioned correctly, parallel to the tendon's axis, and the subscapularis tendon's typical striated pattern[20]. It is possible to misinterpret the intra-tendinous hypoechoic pattern that results from a pathological tendinosis or tendon tear. Because of this, an inexperienced ultrasonographer would overestimate or underestimate actual pathology. (SN) A rotator cuff tear might be diagnosed with strong sensitivity and a better negative predictive value (NPV). This means that an ultrasonographer, even with limited expertise doing shoulder ultrasonography, may more confidently rule out a rotator cuff tear than they can evaluate and diagnose it. Case selection was a complicating factor in this investigation. A substantial pretest risk for rotator cuff tendon tears was present in every research participant in this study (a confounding

factor that is nearly always present in the bulk of research in hospital setups). This might cause the estimations of the sensitivity and positive predictive values (PPV) of the signal to climb artificially. If shoulder ultrasonography was done by the same operator on a large population with a lower pretest probability, the test's sensitivity may be lowered. However, in this case, the negative predictive values (NPV) would be greater than what was determined in this study.

CONCLUSION

The rotator cuff tear diagnosis demonstrated a strong negative predictive value (NPV) and good sensitivity.As a result, the ultrasonographer, despite brief expertise with shoulder ultrasonography, demonstrated good sensitivity in identifying tears and certainty in their elimination.

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