To determine the role of ultrasonography as a primary imaging modality as compared to MRI in patients with shoulder pain

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ABSTRACT

Context: Prevalence of shoulder pain in general population worldwide ranges from 16 -26%. It is necessary to evaluate different causative factors in shoulder pain and explore the utility of ultrasonography in rotator cuff and non-rotator cuff diseases as a primary imaging modality and reserve MRI for unequivocal cases. Aims: To evaluate patients with shoulder pain using ultrasound as first line of imaging modality compared to MRI. Methods and Material: A Prospective Cross-sectional Descriptive and Analytical study was done in patients with shoulder pain referred to radiology department for USG and MRI. Statistical Analysis Used: Analysis was performed using STATA (14.2). Descriptive statistics was used to portray baseline profile of study population. Sensitivity, specificity, PPV, NPV and Kappa value used. Results: In the resent study the maximum patients were between 40-59 years with Male: Female ratio of 3.5:1. Trauma was the most common etiological factor and restricted range of motion was seen in 47 (94%). Supraspinatus tendon was the most common tendon to show abnormality followed by Subscapularis. For Supraspinatus tendon and Subscapularis tendon partial thickness tear- USG had a sensitivity of 90.62% and 100%, specificity of 88.88% and 95.74%, PPV of 93.5% and 60.00% and NPV of 84.21% and 100% respectively. Conclusion: Ultrasound although being operator dependent and not as accurate as MRI, provides rapid real time non-invasive cross-sectional imaging of joint and thus can be considered as primary modality for imaging rotator cuff pathologies, as it is readily available and cost effective.

Keywords: Full thickness tear, partial thickness tear, subscapularis, supraspinatus, rotator cuff

Introduction

The prevalence of shoulder pain in general population worldwide ranges from 16% to 26%.¹ Its annual incidence has been quoted upto 14.7 per 1000 patients per year.² It is the third most common cause of musculoskeletal symptom encountered in orthopedic practice following back pain and knee pain.³ In India, the prevalence of shoulder pain is reported to be 2% in urban population and 7.4% in rural areas.⁴ Both MRI and ultrasonography of shoulder have shown promising results in diagnosing rotator cuff disease with their own limitations in different conditions.⁵ Ultrasound being cost effective is used as a primary screening tool but is highly operator dependent. Many studies have shown high sensitivity and specificity of Ultrasonography mainly for rotator cuff disease,⁶ however there is limited data on diseases other than rotator cuff.⁷

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The common diagnosis made in few studies on patients with shoulder pain included in decreasing order as periarthritis shoulder, subacromial impingement, rotator cuff injury Glenohumeral arthritis and Acromioclavicular arthritis with causative risk factors being excessive overhead lifting and trauma.[10]

We intend to evaluate the different causative factors in acute and chronic shoulder pain and explore the utility of ultrasonography in rotator cuff and non-rotator cuff diseases and compare its sensitivity and specificity with MRI. Though MRI is considered a highly efficient tool in diagnosing the shoulder diseases, it is time consuming and a costly modality with its inherent limitations imaging patients with ferromagnetic implants and various non MR compatible cardiac devices. Thus optimum utilization of an easily available and economically effective modality like ultrasound in majority of cases as a primary imaging tool would be worthwhile.

Materials and Methods

Source of data
Outdoor and indoor patients with shoulder pain referred to radiology department of Shree Krishna Hospital, Karamsad for USG and MRI were included in this study. Approval from ethics committee was obtained on date 09-06-2020. IEC/ HMPCMCE/109/Faculty/12.

Methodology
This was a prospective observational study including a total of 50 patients. After taking informed consent from each patient, detailed demographic data, clinical history was reviewed and collated along with USG and MRI findings. Descriptive statistics was used to explore USG and MRI findings and to assess the association between USG and MRI findings.

The USG scan was performed with patient in sitting position, arm in neutral position and elbow flexed 90° with various dynamic maneuver to improve the field of view. The MRI scan was performed with T1 axial, STIR coronal, PDFS sagittal and T2 axial and sagittal sequences.

Inclusion criteria
Adult patients of age 18 or above presenting with shoulder pain and undergoing USG and MRI in our institute.

Exclusion criteria
Patients who had a recent surgery within 6 weeks of MRI, patients who were not MR compatible for example those with pacemakers, MR incompatible implants in situ and clostrophobia were excluded.

Result
In the present study the age incidence ranged from 20 years to 76 years with a mean age of 51.2 years. Maximum patients were between 40-59 years (16%). The gender distribution in our study showed Male: Female ratio to be 3.54:1.

Trauma was the most common etiological factor observed in 32 (64%) patients for shoulder pain in our study and on clinical examination restricted range of motion was seen in 47 patients (94%).

In the present study, among the tendons of rotator cuff, Supraspinatus tendon was the most common tendon to show abnormality both on ultrasound (n = 43) and on MRI (n = 48). Subscapularis was the next common tendon to show abnormality on ultrasound (n = 14) and on MRI (n = 14). Infraspinatus tendon showed abnormality on MRI in 7 patients while no abnormality was detected on USG in infraspinatus muscle. Teres minor was normal in all the patients.

For Supraspinatus tendon [Figure 1] Partial thickness tear, USG had a sensitivity of 90.62%, specificity of 88.88%, PPV of 93.5% and NPV of 84.21%. For Tendinosis, USG had a sensitivity of 96% and specificity of 100%, PPV of 100% and NPV of 90.47%. The strength of agreement is considered to be good as Kappa value is 0.7467.

For Subscapularis tendon [Figure 2] Partial thickness tear, USG had a sensitivity of 100%, specificity of 95.74%, PPV of 60.00% and NPV of 100%. For Tendinosis- USG had a sensitivity of 70.00% and specificity of 97.50%, PPV of 87.5% and NPV of 92.85%. The strength of agreement is considered to be good as Kappa value is 0.7292.

For Infraspinatus tendon no findings were found in USG where has 4 patients had partial tear and 3 patients had tendinosis. This suggest MRI is better modality in detecting infraspinatus tendon pathology.

Discussion
In developing countries like India with a predominant rural population the ease of availability of advanced imaging modality is a challenge. Ultrasonography as compared to MRI is a readily
available cost effective first line imaging modality. The findings on ultrasonography and MRI of 50 patients who presented with clinical signs and symptoms of rotator cuff injuries were compared.

The age incidence ranged from 20 years to 76 years and mean age of patients was 51.2 years. Maximum patients were between 40-59 years (54%), followed by >/=60 years (30%) and 40-59 years (16%).

Though the gender distribution in our study showed a Male: Female ratio of 3.54:1, most of the studies have reported that, there is no marked difference in gender prevalence. This could be due to the patriarchal social norms, still prevalent in rural communities, which makes it difficult for the under-privileged to access the health care system.

Rotator cuff tendon degeneration and accidental falls are both known to increase in incidence with increasing age. In the present study, 32 (64%) patients had a history of trauma to the affected shoulder. Matthew P. Lungren et al. reported that tears of the rotator cuff tendons may occur as a result of tendon degeneration or from a single traumatic event but commonly a combination of these factors are in play and nearly always it occurred on the same side as the fall. The findings highlight that falls are the leading cause of injury in the rotator cuff tear which was also observed in other studies.

On clinical examination restricted range of motion was seen in 47 patients (94%). The rotator cuff pathologies included partial thickness tears, full thickness tears and tendinosis. Associated pathologies included bursal fluid, ACJ arthrosis and bicipital tendinosis.

Supraspinatus tendon followed by subscapularis were the most frequent tendons of rotator cuff showing tears both on USG and MRI whereas infraspinatus was least frequently involved, however in the present study there was no case with injury to the teres minor.

Similar observations were also made by Iagnocco et al. and Naredo et al. who observed supraspinatus to be the most commonly involved tendon and teres minor the least involved. However, in our study subscapularis was more frequently involved as compared to infraspinatus which is in contrast to the studies of Iagnocco et al. and Naredo et al. were infraspinatus was more frequently involved. This variability could be due to vast difference in sample size (350 patients) [Figure 3].

The frequent involvement of supraspinatus tendon could be because of its characteristic anatomical location between two bones (head of humerus and acromion), where it gets compressed during forward flexion of shoulder joint, thus making it vulnerable for ischemia and later degeneration of the tendon.

Partial thickness tears were more common than full thickness tears in the present study. Brenneke SL et al. and Hawkins et al. studies also showed partial thickness tears to be the commonest [Figure 4].

On MRI 32 patients detected supraspinatus partial thickness tear, US correctly identified the presence of partial supraspinatus tendon tears in 29 of 32 cases, and was false negative in 3 of 32 cases that proved to be normal. There were also 2 false-positive interpretations which were cases of tendinosis which were diagnosed as partial-thickness tear of the supraspinatus tendon on USG.

On MRI 3 patients detected subscapularis partial thickness tear, US correctly identified the presence of partial thickness subscapularis tendon tears in all 3 cases. There were also 2 false-positive interpretations: in 1 case of tendinosis and 1 case of complete tear were diagnosed as partial-thickness tear of the subscapularis tendon on USG.

For Supraspinatus tendon partial thickness tear, USG had a sensitivity of 90.62%, specificity of 88.88%, PPV of 93.5% and NPV of 84.21%. For tendinosis, USG had a sensitivity of 96% and specificity of 100%, PPV of 100% and NPV of 90.47%. The strength of agreement is considered to be good as Kappa value is 0.7467.
For Subscapularis tendon Partial thickness tear, USG had a sensitivity of 100%, specificity of 95.74%, PPV of 60.00% and NPV of 100%. For tendinosis, USG had a sensitivity of 70.00% and specificity of 97.50%, PPV of 87.5% and NPV of 92.85%. The strength of agreement is considered to be good as Kappa value is 0.7292.

For Infraspinatus tendon USG was unable to identify the tears however 4 patients had partial tear and 3 patients had tendinosis on MRI. This suggest MRI is a better modality in detecting infraspinatus tendon pathology due to limited field of view on Ultrasonography.

None of the 50 cases had teres minor tendon involvement evident on both MRI and ultrasonography.

MRI additionally picked up labral tears, IGHL thickening and muscle atrophy suggesting its superior role in imaging structures in addition to rotator cuff abnormalities.

MRI, in particularly the PDFS and T2WI sequences are informative in detecting cuff tears. While MRI is better in delineating labral and ligamentous pathologies, bony abnormalities, glenohumeral joint arthritis and muscle atrophy, USG has its advantage being a primary non-invasive, real-time, multiplanar imaging modality which can be done rapidly without any patient preparation to evaluate rotator cuff abnormalities.

**Conclusion**

MRI however a costly investigation, is the gold standard in evaluation of rotator cuff pathologies. Ultrasound although being operator dependent and not as accurate as MRI, provides a rapid real time non-invasive cross sectional imaging of the joint. Moreover it is widely available and has a low cost burden at the same time in experienced hands provides adequate information to the treating orthopaedician as a primary imaging tool, keeping MRI reserved for unequivocal cases.

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**Conflicts of interest**

There are no conflicts of interest.

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