

Original Research Article

Diagnostic accuracy in rotator cuff tears: clinical tests vs MRI

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ABSTRACT

Background: Till date there is a lack of consensus regarding validity of clinical tests in identifying the rotator cuff injuries and also the predictive value of noninvasive investigations done to confirm such shoulder pathology.

Methods: We included 48 patients with shoulder complaints in our study who underwent blinded clinical examination and MRI of shoulder, whose findings were compared with arthroscopic findings and were statistically analyzed.

Results: In the study group mean age was 47 years and 71% were males. When compared with arthroscopy, clinical examination for supraspinatus had better sensitivity (90) but low specificity and negative predictive value (NPV) (37.5). MRI evaluation of supraspinatus had specificity of 85 and NPV of 60. Infraspinatus had almost similar statistical values. MRI was found to have better specificity (89.5) in comparison with clinical examination (52.6) in subscapularis evaluation along with higher positive (67 vs. 30) and negative predictive value (94 vs. 90).

Conclusions: Clinical examination is good in identifying lesion or tear of supraspinatus and subscapularis but may also have false positives, where usage of noninvasive MRI will reduce these false positive in comparison with gold standard arthroscopy. Although clinical examination is very useful for diagnosis of rotator cuff injuries, MRI could be used to improve specificity and predictive values in patients who are planned for surgical management of rotator cuff injury.

Keywords: Arthroscopy, Rotator cuff, Shoulder

INTRODUCTION

Shoulder pain and restriction of movements are common and a major health concern especially in elderly and post traumatic injuries. It is second most frequent acute musculoskeletal complaint in primary care and third most common cause of regional pain syndrome in the population.¹⁻⁴ Of all the causes for shoulder pain in patients aged 40 years or above, rotator cuff musculotendinous unit injuries accounts for up to 85%.^{2,5} These symptoms results in significant morbidity including sleep disturbances and psychological distress resulting in increased health care utilization or reaching to chiropractors and undergoing investigations.^{2,6,7}

Neither clinical nor radiological assessment of shoulder complaints have a validated methods of evaluation. This mandates a review into diagnosis of a shoulder pain in order to develop a standardized approach to shoulder examination and investigation to guide into a better management decisions.⁸⁻¹⁰ Due to this lack of standardization, the current approach to assessment of the rotator cuff remains as a complex combination of clinical tests, imaging modalities and direct observation through arthroscopy.¹¹⁻¹³

At present there is no universally recognized method for evaluation of the rotator cuff with over 25 clinical tests recommended for the evaluation of rotator cuff with unclear sensitivity specificity and validity of these tests.¹⁴

Lack of an ideal clinical method of evaluation of rotator cuff is the likely to be one significant reason for the paucity of management approaches in the treatment of cuff lesions.¹⁵

An ideal clinical test is one that is sensitive, specific and repeatable. Validation of specific clinical tests requires an easily accessible standard of reference. Although direct observation at surgery is likely to remain gold standard, the noninvasive and most feasible optimal standard of reference may be imaging in the form of MRI.¹¹⁻¹³ After its introduction, MRI has made a significant impact upon the evaluation of the rotator cuff and has been demonstrated to significantly influence clinician's diagnosis and intervention.¹⁶ The accuracy of diagnosing full-thickness tears using MRI is reported to be up to 89% in studies using surgical inspection as the gold standard with the accuracy of the diagnosis of partial-thickness lesions and tendinitis/tendinosis also being high.^{8,12} The need to validate clinical tests and imaging has been stressed for arriving at a diagnostic approach and establishing investigative criteria for rotator cuff tendinopathy.

This study was done to establish sensitivity, specificity, positive predictive value and negative predictive value of individual clinical tests and the MRI diagnosis of disorders of rotator cuff against a standard of reference of findings at arthroscopy.

METHODS

This study was carried out in Kasturba Medical College hospital and allied institutions from January 2016 to December 2016. Institution Ethical committee clearance was taken for this study. Patients with traumatic or degenerative shoulder pain positive for clinical examination for rotator cuff lesions between the age of 25-60 years with symptom duration of 6 months or longer who required surgical management were included in this study which was conducted in accordance with the declaration of Helsinki and good clinical practice. Patients who were beyond the specified age limits and had suffered fractures around the shoulder or shoulder dislocation earlier, symptom period of <6 months, inability to undergo MRI and arthroscopy were excluded from the study.

Written informed consent was taken from all the participants. All patients were clinically evaluated by single shoulder surgeon and filled the proforma. Participants underwent MRI, which was reported by single musculoskeletal radiologist who was blinded for clinical assessment findings.

Clinical examination

The examination protocol included inspection for atrophy of the deltoid, supraspinatus, infraspinatus muscles and palpation for eliciting tenderness of the sternoclavicular,

acromioclavicular, subacromial and biceps regions. Range of movement of the shoulder was assessed including abduction, internal rotation and external rotation by visual estimation. Specific tests performed included 'lift off test' (Gerber's), 'empty can test' (Jobe's), 'resisted external rotation test', 'drop arm test', 'Hawkins-Kennedy test' and 'horn blower sign'.^{17,18}

Imaging

MRI (1.5T) was performed according to standard radiological protocols.¹⁹ This comprised a coronal oblique fat-saturated T2 and proton density-weighted series aligned along the line of the supraspinatus tendon to visualize the supraspinatus and infraspinatus tendons together with an axially acquired T1 and fat-saturated T2-weighted sequence to visualize subscapularis and teres minor. Thickness of the slice was 3 mm.

The MRI definitions of rotator cuff disease are as follows:

Full-thickness tear: a continuous band of fluid traversing the full thickness of the cuff on the fluid sensitive sequences, retraction of the tendon and high signal intensity in the cuff on both T2-weighted and proton density images.

Partial-thickness tear: a continuous band of fluid that does not traverse the full thickness of the cuff on the fluid sensitive sequences and high signal intensity in the cuff on T2 and proton density images.

Arthroscopy

All patients included in study underwent a standard diagnostic arthroscopy before proceeding to therapeutic procedure. Initially, the gleno humeral joint was assessed using standard viewing and instrumentation portals. The articular surfaces of subscapularis, supraspinatus, and infraspinatus were then examined. Fraying with exposure of more than 2 mm of the cuff bony footprint was considered to represent an articular sided partial thickness tear. A full-thickness tear occurred where a tear in a tendon insertion communicated through to the sub acromial space. Avulsion of an entire tendon insertion was considered a complete tendon rupture. The sub acromial space was also assessed to look for of a bursal-sided partial tear and for confirmation of a full-thickness tear or a complete tendon rupture. Results were documented in a standard proforma.

Then the clinical and MRI diagnosis are compared with arthroscopic diagnosis. In this study arthroscopy is considered as gold standard for the diagnosis of pathological changes in the rotator cuff tendons. A finding is considered true positive if clinical diagnosis or MRI diagnosis is confirmed by arthroscopy. A finding is considered true negative if a tendon is found to be intact by clinical examination or MRI, is normal during

arthroscopy. A finding is false positive if clinical examination or MRI diagnosis cuff injury but is found to be normal during arthroscopy. And a finding is considered false negative if cuff pathology is missed during clinical examination or MRI is picked by arthroscopy.

Statistical analysis

The sensitivity and specificity of clinical examination and MRI were assessed against arthroscopy and was calculated with 95% confidence interval. The PPV and NPV were also estimated with 95% confidence intervals. SPSS software was utilized for statistical analysis.

RESULTS

Our study included 48 participants, of whom 34(71%) were males and 14 (29%) were females with mean age of 47 years. There were 36 (62.5%) right sided shoulder pathology and 12 (37.5%) left shoulder, traumatic injury being major cause of rotator cuff pathology.

Table 1: Patient demographics.

	Percentage (%)
Male	71
Female	29
Right shoulder	62.5
Left shoulder	37.5

Table 2: Clinical tests vs. arthroscopy.

	Supraspinatus	Infraspinatus	Subscapularis
Sensitivity	90	75	80
specificity	75	75	52.63
PPV	93.75	60	30.77
NPV	37.5	85.71	90.91

Clinical tests for supraspinatus showed high sensitivity but low specificity. However clinical tests were not very specific or sensitive for infraspinatus pathologies. Clinical tests showed least specificity for subscapularis pathologies.

Table 3: MRI vs. arthroscopy.

	Supraspinatus	Infraspinatus	Subscapularis
Sensitivity	90	75	80
Specificity	85	75	89.47
PPV	94.74	60	66.67
NPV	60	85.71	94.4

MRI showed higher specificity for supraspinatus compared to clinical tests. Sensitivity and specificity of MRI for infraspinatus were not high but comparable to

clinical tests. MRI evaluation greatly increased specificity for subscapularis when compared to clinical tests.

DISCUSSION

There is lack of validated methods in diagnosing shoulder pathology particularly rotator cuff tear, even though it is one of major health care concerns. Hence our study attempted to assess the sensitivity and specificity of clinical examination and MRI with gold standard of direct visualization under arthroscope for rotator cuff injury.

Some of the studies have shown that only clinical examination of impingement and instability strongly correlated with the arthroscopic findings but not the rotator cuff injury.¹⁶ The diagnostic accuracy of isolated standard shoulder tests in recreational athletes was poor when compared with arthroscopy.²⁰ Inter-observer agreement of commonly used tests for the diagnosis of rotator cuff injury were found to be poor. If clinical assessment is poor at determining the underlying pathology, then perhaps an alternative assessment approach is required to prevent missing out of rotator cuff injury.¹⁰

Bryant et al. found that imaging techniques (ultrasound and MRI) were not able to estimate the size of a partial-thickness tear but performed well when estimating the size of full thickness rotator cuff tears and these have weakest correlation with clinical examination.¹¹ A study by Teefey et al comparing these imaging modalities revealed an overall accuracy for detecting and quantifying rotator cuff tears of 87% when compared with arthroscopy.¹⁵ Numerous other studies have assessed the validity of imaging to diagnose shoulder pathology. Most of these have documented benefits of MRI and ultrasound at detecting full-thickness tears but less so for partial-thickness tears. These studies do not address the critical issue of true validity and number of imaging studies showing a significant proportion of false positives.²¹

Our results suggest that clinical examination for supraspinatus has high sensitivity but significantly low specificity which is increased by addition of an MRI thus reducing the possibilities of false positives.

For the infraspinatus tendon which is less commonly involved than supraspinatus, the sensitivity and specificity in both clinical examination and MRI were low but they were comparable suggesting that MRI does not have any added benefits over good clinical examination.

For subscapularis tears clinical tests have low specificity and PPV and MRI seems to have better sensitivity, specificity and PPV than clinical examination. Therefore it is better to rely on MRI than clinical examination alone

for diagnosing subscapularis tears. Teres minor injury in RC injury cannot be independently diagnosed in MRI, hence was not included in the study.

Most the clinical test used are termed positive on pain, but several other shoulder pathologies can also provoke pain and thus causes difficulty in determining specific diagnosis. This situation is complicated further in that many patients have more than one lesion defined clinically.² Hence it has been suggested that combinations of tests may be more predictive of the presence or absence of a rotator cuff tear.^{11,22}

Our study has limitations of potential selection bias as all patients with rotator cuff injury severe enough to undergo arthroscopy were included in the study, missing out the people who could not undergo MRI in view of claustrophobia or metallic and pacemaker implants and patients who could not undergo arthroscopy in view of co morbidities.

CONCLUSION

Clinical examination depends on expertise and experience of the surgeon and hence may pose limitations. In our study although clinical examination has better sensitivity it lacks specificity. It is good in identifying lesion or tear of supraspinatus and subscapularis but may also have false positives, where as usage of noninvasive MRI will reduce these false positive in comparison with gold standard arthroscopy. Hence thorough clinical examination along with judicious use of MRI will help in identifying rotator cuff injury.

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