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RESEARCH ARTICLE

EVALUATING DIAGNOSTIC ACCURACY OF HIGH FREQUENCY ULTRASOUND AND MAGNETIC RESONANCE IMAGING FOR ACUTE SHOULDER JOINT PAIN

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ABSTRACT

One of the most frequent motives of shoulder pain is rotator cuff disease. It is the third most efficacious musculoskeletal malady after low back and neck pain. Shoulder pain is usually due to one of several reasons: subacromial impingement and bursopathy, tendinopathy, a tendon tear, a frozen shoulder, ligamentous instability, and osteoarthritis. Shoulder ultrasonography is approved as the examination of choice for rotator cuff abnormality in many centers around the world since it is an inexpensive and safe tool for investigation of rotator cuff abnormalities. The goal of this study was to determine the ultrasound findings in patients with acute shoulder joint pain, and to compare the ultrasound diagnostic performance to that of MRI.

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INTRODUCTION

General practitioners are frequently consulted by patients with shoulder pain however, shoulder pain is a symptom, not a diagnosis. It has been reported earlier that subacromial disorders are the most common cause of shoulder pain seen by general practitioners. (Winters *et al*., 2008) Shoulder pain is a significant cause of morbidity; the prevalence of self-reported pain is estimated to be between 16 and 26%, and it is the third most common cause of musculoskeletal consultation in primary care. The cause can be difficult to diagnose owing to the complex anatomy of the shoulder and the spectrum of underlying disorders. Most shoulder problems fall into three major categories: soft tissue disorders, articular injury or instability, and arthritis. One of the most commoncause of shoulder pain is rotator cuff disease. It is the third most effectual musculoskeletal problem after low back and neck pain. Shoulder pain is due to several reasons asbursopathysubacromial impingement, a tendon teartendinopathy, a frozen shoulder and osteoarthritis (Teefey, 2012). There are several examination techniques that have been applied to diagnose these disorders, containing sonography, magnetic resonance imaging (MRI), magnetic resonance arthrography, and computed tomographic arthrography. However, ultrasonography is accepted as the examination of choice in many pleacesaround the world as it is inexpensive and safe tool for investigation (Nazarian *et al*., 2013). In daily general practice, combining clinical information with ultrasound diagnosis is potentially helpful to tailor treatment to patients with shoulder pain. Although, ultrasound is greatly operator reliant, and complete education is necessary for full sensitivity and specificity of this diagnostic tool. Accuracy studies showed that diagnostic ultrasound is accurate for evaluating subacromial disorders. (Ottenheijm *et al*., 2010) Ultra-Sonographic findings help the surgeon to determine whether problem can be managed by surgical or nonsurgical means. Further if a nonsurgical way is preferred, sonography can be applied to follow patients for knowing the tear size sequence (Goutallier *et al*., 2003). Sonographyhas a high precision in diagnosing dislocation, rupture, and biceps tendon subluxation, although it cannotdiscriminate a high-grade partial thickness tear from a rupture (Skendzel *et al*., 2011). Shoulder ultrasound has low sensitivity for diagnosing various conditions as, tendinopathyand low-grade partial-thickness tears while on the other hand changes inacromioclavicular jointas effusion, and osteolysis are diagnosed nicely with sonography (Skendzel *et al*., 2005). The aim of the present study was to determine the ultrasound findings in patients with acute shoulder joint pain and to identify predictors of shoulder

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pain and further compare the ultrasound diagnostic performance to MRI.

MATERIALS AND METHODS

The present study was conducted in the department of radio diagnosis and imaging, Bone & Joints hospital& SMHS hospital, Government Medical College, Srinagar, Jammu and Kashmir, India. Patients admitted or attending Out Patient Department (OPD) in Bone & Joints hospital with a complaint of shoulder pain or who were known case of shoulder pain were included in the study. An written informed consent was acquired from the patients. Ethical clearance was given by the local ethics committee. A total of 65 (aged 21 to 60 years) who attended the OPD for acute shoulder pain in the area of the study were examined using sonograpy. A single examiner performed shoulder sonography procedure for all patients who were selected for a period of six months between October 2015 and February 2017in this prospective study. Only male subjects were selected in the study to reduce any confounding factors affecting the female population. All patients were above the age of 20 years without any systemic disease. Data were collected on age, medical history, and clinical symptoms. The patients were treated correspondingly to history, physical investigation, and shoulder ultrasonography. MRI for the shoulder joint was performed in all cases following ultrasound to confirm the results. The MRI examinations were blindly evaluated by the same radologist in order to avoid bias and effect on the interpretation of findings. Shoulder ultrasound scans were done using brightness mode with high frequency and color Doppler were performed in patients using a linear array transducer (10 – 15 MHz) connected to Siemenx X300 premium machine. Initial examination was executed under high gain (80 dB to 90 dB) sensitivity for more detailed examination. The inspection was done as per the criteria used previously by Teefeyetal. (Teefey, 2012) This orientation increases the visualization of the joint space and its bony margins (Teefey, 2012; KimKim *et al*., 2008). The integrity of the rotator cuff was recorded, as being the tendons involved, presence of partial or full thickness tears, and the size of any tear. It was kept in mind that tears was approximately at 15 mm posteriorly to the intra-articular portion of the biceps tendon (Kim *et al*., 2010).

All MRI examinations for each shoulder joint were done using 1.5-T& 3 T high field power MRI system (MagnetomSkyra); Siemens. The conventional MRI shoulder procedure was undertaken for inspection as per the previous studies done using similar criteria (Lenza *et al*., 2013). The findings were summarized as mean with standard deviation in a form of tables. The data were analyzed using a prescription as a unit. The primary analysis included all prescription who satisfied the inclusion criteria. Data were entered into an Excel Sheet database (MS Office Excel 2000; Microsoft Corporation, Redmond, WA, USA). The Data was analyzed using Minitab 16.1.1 version of statistical software.

RESULTS

In the present study a total of 65 patients who came to the department of radio diagnosis and imaging, in Bone & joints and SMHS hospital, Government Medical College, Srinagar, Jammu and Kashmir, India and presented acute shoulder joint pain were investigated using ultrasound. Mean age of the patients was 28 ± 1.2 years. Results about clinical presentations are detailed in Table 1. In 37 patientsright shoulder joint was examined sonographically while the left joint was examined in the 28. Ultrasound correctly detected the causes ofpain in 98% patients and the findings were confirmed by using MRI(Table 2). According to ultrasound findings, tendon abnormalities where 15.3% of tendinosis, 10.6% of partial thickness tear while 3% were affected by full thickness tear. Least abnormality detected was atrophy of teres minor tendon with prevalence of 6.4% as compared to 10.8%. tendinosis of the tendon. These findings are detailed in Table 2. Musculoskeletal ultrasound showed that biceps tendons was affected in 4.6% patient by tendinosis while full thickness tear abnormality of the tendon was found in 3%. Osteoarthritis changes were seen in 16.8% and 21% of acromioclavicular and glenohumeral joints respectively. Subluxation and or dislocation were seen in less than 9.1% and 6.1% for both joints. MRI was used to confirm the ultrasound findings regarding the diagnosis causes of pain. MRI showed that ultrasound diagnosed correctly the causes in 98% patients. The performance values for musculoskeletal ultrasound in diagnosing the above mentioned abnormalities was 100% for sensitivity. Accuracy was 98.4%, 100%, 96%, and 100% respectively for the mentioned disorders. Positive predictive value (PPV) is detailed in Table 3.

Table 1. Clinical presentation in patients with acute shoulder joint pain

Clinical presentation	Frequency (n)	Percentage (%)
Pain/tenderness	65	100%
Swelling	13	20%
Numbness	7	10.8%
Bruising/redness	16	24.6%
Joint weakness	24	36.9%
Joint stiffness	4	6.2%
Clunking sound	9	13.9%

Table 2. Ultrasound findings in selected population

Shoulder joint ultrasound finding	Frequency	Percentage (%)
Biceps tendon abnormalities		
Tendinosis	3	4.6%
Full-thickness tear	2	3.1%
Subscapularis tendon abnormalities		
Tendinosis	10	15.4%
Partial thickness tear	7	10.8%
Full thickness tear	2	3.1%
Supraspinatus tendon abnormalities		
Tendinosis	15	23.1%
Partial thickness tear	1	1.5%
Full thickness tear	3	4.6%
Infraspinatus tendon abnormalities		
Tendinosis	9	13.9%
Partial thickness tear	3	4.6%
Teres minor tendon abnormalities		
Tendinosis	7	10.8%
Atrophy	4	6.2%
Acromioclavicular joint abnormalities		
Osteoarthritis	11	16.9%
Subluxation/dislocation	6	9.2%
Posterior labrum abnormality	8	12.3%
Glenohumeral joint/bony margins abnormalities		
Osteoarthritis	13	20%
Subluxation/dislocation	4	6.2%

DISCUSSION

As per the findings of the present study and many previous syudies the most widespread abnormality that leads to the start

Table 3. Performance of ultrasound in diagnosing various abnormalities related to shoulder joint pain

Disorders location	True +, n	True -, n	False+, n	False-, n	Sensitivity, %	Accuracy, %	*PPV, %
Rotator cuff	60	0	0	1	100%	100%	100%
Biceps tendon	5	0	0	0	100%	100%	100%
Acromioclavkuar Joint	24	0	0	1	100%	96%	96%
Glenohumeral Joint	17	0	0	0	100%	100%	100%

**PPV, positive predictive value.*

of the acute shoulder joint pain istendinosis of supraspinatus tendon. The results of the present study areare similar to as have ben reported by many previous studies., where tendinopathieshave been highly prevalent problem (Bedi *et al*., 2012). Women were excluded to avoid the effects of post menopause whgich might increased incidence of osteoarthritis. Osteoarthritis was seen to affect both glenohumeral and acromioclavicular joints and the results of the present study were confirmed by previous findings using a dedicated MRI procedure, where these joints were often present degenerative changes start from the third decade of life. In present study incidence of teres minor tendon atrophy was noted in more than 6% of patients within the study (Table 3), while in previous study of teres minor innervation in the perspective of isolated muscle atrophy (Sofka *et al*., 2004). Such incidence can be becaus of the previous study population had a mean age of more than 72 years which may lead to minimize atrophy. The incidence of rotator cuff full thickness tear was more than 7% (Table 2). This rate was a higher than the rate reported by in previous sudies. (Moosmayer *et al*., 2009) However lesser rates have been reported upto6%, which is lower than the obtained rate (14). similarly many previous authors have reported rates of 9% to 21% for full thickness tear, which were higher than the present reported rate (Karthikeyan *et al*., 2014; Tashjian, 2012). In the present study an incidence for partial thickness tear of the rotator cuff was approximately 16% (Table 2). This parameter can be compared to the results of many previous studies where it has been reported that an incidence was of around 18% (Karthikeyan *et al*., 2014; Milgrom *et al*., 1995). The present study results showed that, shoulder ultrasound found was100% accurate in the diagnosis of abnormalities which effect biceps tendon and glenohumeral joint. An accuracy of above 98% were reported for the detection of both rotator cuff and acromioclavicular joint disorders (Table 3). though the literature for accessing accuracy, sensitivity, and PPV of shoulder ultrasound in recognition the causes of acute shoulder joint pain is limited, but a previous study has reported an accuracy of 94% for the effectiveness of diagnostic tests for the evaluation of shoulder pain due to soft tissue problems (Kumagai *et al*., 1994). Within the limitations of this study was a small sample size that was, however the amount of patients which came to the hospital for the treatment of such disorders was also limited. We believe that measuring disability, pain in acute shoulder pain patients gives the best prognostic data. The use of complex radiological investigations as MRI may be higher than is clinically necessary.

Conclusion

The results of the present study shows that ultrasound for the shoulder joint presented high accuracy and sensitivity in diagnosis, with a diagnostic performance value almost near to MRI. Furthermore, Ultrasound manages to determine the causes of acute shoulder joint pain in 98% of the patients. Fitted achievement values for shoulder ultrasound in the diagnosis the causes of shoulder joint pain were 100% sensitivity and a range of 96% to 100% of accuracy. Ultrasound presents a high sensitivity and accuracy in diagnosis a wide spectrum of shoulder joint lesions, with a diagnostic performance near to that of MRI.

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