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Ultrasonographic Evaluation of Painful shoulder Comparison with findings of Physical Examination

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Abstract

Background: *Shoulder pain is typically characterized by symptoms in various joints, muscles, tendons, and bursa involved with shoulder motion. Onset of shoulder pain is variable and can occur with no direct cause, or it can be related to trauma, repetitive movements, inflammatory conditions or a neurological event (i.e., a stroke). Shoulder pain often causes short-term activity limitation and less frequently develops into a chronic condition.* ***Objective:*** *To compare B mode ultrasonography evaluation with physical examination in painful shoulders.* ***Methods:*** *The study was conducted in the Department of Radiology & Imaging, Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders (BIRDEM) General Hospital, Dhaka. Physical examinations were done by researcher and confirmed by a consultant of physical medicine. The ultrasonography of shoulder joint was carried out by Phillips Affinity 50G machine using 12.5 MHz linear transducer in all 120 study patients. Transverse and longitudinal planes from biceps tendon groove, rotator cuff and sub-acromial sub-deltoid bursa and transverse planes from the posterior gleno-humeral recess and glenoid labrum were scanned.* ***Results:*** *Mean age of the 120 patients with shoulder pain was 51.41 ±11.03 years. Male female ratio was 1:1.31. Clinically diagnosed impingement was found in 98(81.7%) patients by Neer sign and 80(66.7%) patients by Hawkins test. Among rotator cuff tendons, supraspinatus lesion was diagnosed in 99(82.5%) patients by Jobe test, infraspinatus & / or teres minor lesion was in 05(4.2%) patients by Patte test, subscapularis lesion was in 10(8.3%) patients by Gerber lift off test. Regarding long head of biceps, tendinosis &/or tenosynovitis was diagnosed in 25(20.8%) patients by Yergason test and in 32(26.7%) patients by Speed's maneuver. By clinical examination 82(68.3%) patients were diagnosed as cases of supraspinatus tendinitis and 17(14.2%) as supraspinatus tear, 04(3.3%) patients of infraspinatus &/or teres minor tendinitis and only 01(0.8%) case of infraspinatus &/or teres minor tear. Ultrasound examination of the study populations diagnosed supraspinatus tendinosis in 59(49.2%) patients, calcification in 17(14.2%), full thickness tear in 04(3.3%) and partial thickness tear in 10(8.3%). Ultrasound examination of the study populations showed infraspinatus tendinosis in 32(26.7%) patients, calcification in 10(8.3%) and partial thickness tear in 7(5.8%) patients. Teres minor tendinosis was found in 04(3.3%) patients and calcification in 02(1.7%) patients. USG also showed Subscapularis tendinosis in 07(5.8%) patients, calcification in 03(2.5%) and partial thickness tear in 03(2.5%) patients. Long head of biceps tenosynovitis was found in 23(19.2%) patients, tendinosis in 06(5.0%), calcification in 03(2.5%) and partial thickness tear in 03(2.5%) patients. Among the miscellaneous causes of shoulder pain, impingement was found in 48(40.0%) patients, osteophyte in 62(51.7%) patients, subdeltoid effusion in 5(4.2%) patients and bursitis was in 11(9.2%), glenohumeral effusion was in 3(2.5%) and acromioclavicular joint effusion 6(5.0%), acromioclavicular joint arthritis in 29(24.2%), adhesive capsulitis in 2(1.7%) and 19(15.8%) patients showed normal findings at USG. There were statistically significant ($p<0.05$) difference between clinical diagnosis & USG findings in case of supraspinatus & infraspinatus tendinitis, infraspinatus tear,*

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shoulder impingement, acromioclavicular joint pathologies and osteophyte. There were no statistically significant (p>0.050) difference in diagnosis of rotator cuff tear, biceps tendon lesions, subacromial bursitis, glenohumeral effusion and adhesive capsulitis. In the present study musculoskeletal ultrasonography findings was considered as the modality of choice for making final diagnosis of painful shoulder. Different clinical tests were done first for a diagnosis and was then compared with ultrasonography. Most of the diagnosis by clinical tests yielded low sensitivity and specificity. ***Conclusion:*** *Physical examination can detect good amount of individual causes of shoulder pain, but it is difficult to distinguish between various articular and periarticular disease by physical examination alone. Therefore musculoskeletal USG can be used as an important diagnostic tool for the evaluation of painful shoulder with excellent results.*

Key words: *Painful shoulder, physical examination, musculoskeletal ultrasonography.*

Introduction:

Shoulder pain is one of the most common complaints encountered in clinical practice and often leads to considerable disability. Common conditions that can result in shoulder pain include rotator cuff disorders, adhesive capsulitis, shoulder instability, and shoulder arthritis.[1] The onset of shoulder pain has a strong correlation with adult age, possibly due to the fact that aging is associated with degenerative processes and changes of the shoulder and rotator cuff tendon, which may explain the increase in symptom. With age, repetitive shoulder pain episodes may lead to the accumulation of symptoms and therefore the development of chronic pain.[2] Many clinical diagnostic tests have been developed for the physical examination of shoulder girdle, but their diagnostic values are often controversial, and many tests suffer from lack of accuracy.[3] Provocative tests provide a more focused evaluation for specific problems and are typically performed after the history and general examination have been completed. Some tests are Neer's sign for subacromial impingement, Hawkins' test for supraspinatus tendon impingement, Jobe's test for Supraspinatus, Patte's test for Subscapularis & teres minor, Yergason's test & speed's maneuver for long head of biceps tendon etc.[4] Imaging studies include plain radiographs, Ultrasonography (USG), magnetic resonance imaging (MRI), and computed tomography scans (CT scan).[1] Plain radiographs is common and rapid investigation technique, may help diagnose massive rotator cuff tears, shoulder instability, and shoulder arthritis. MRI with or without intra-articular contrast is the most accurate imaging modality for evaluating shoulder pathology allowing visualization of the soft tissues that are often the source of pain. However USG of shoulder is simple, cheap, fast and non-invasive imaging technology for detection of rotator cuff and non- rotator cuff abnormalities.[5] Among various imaging modalities, Ultrasonography is emerging as a cost-effective alternative, with advantages over CT & MRI that includes better patient tolerance, dynamic assessment and improved resolution in the face of previous surgery. CT & MRI are costly, technician-dependent and not available at all level of health care center. Ultrasonographic (US) evaluation is useful for diagnosing a variety of regional pain syndrome and soft tissue pathology and has been increasingly employed in the clinical practice also in primary health care settings. Given the great improvement in resolution achieved by high frequency ultrasound, it is expected to serve as an important tool for accurate evaluation of shoulder pain.

This study was conducted to describe the utilization of ultrasonography in the evaluation of shoulder pain and assess the feasibility with clinical diagnosis at our setting.

Materials and methods:

This cross sectional study was performed in the department of Radiology and Imaging, BIRDEM, Dhaka within the period of February 2018 to July 2019. A total of 120 patients with shoulder pain were included in this study. Adult patients with unilateral painful shoulder referred to the Department of Radiology and Imaging for musculoskeletal ultrasonography were enrolled in this study. Whereas, history of trauma, infection of shoulder joint and debilitated patients not suitable for clinical examination were excluded from the study. Subjects were briefed about the objectives of the study, risk and benefits, freedom

for participating in the study and confidentiality. Detailed history taking & physical examinations were done. All subjects who were included in the study signed on informed consent after careful explanation of the study procedures. Physical examinations were done by researcher and confirmed by a consultant of physical medicine. Within a day of the physical examination, ultrasonography of shoulder was performed by the investigator and confirmed by consultant radiologist who did not know the findings of physical examination. Physical examination of each patient was performed meticulously and assessed the active and passive range of motion. Neer's, Hawkin's test were used to detect shoulder impingement syndrome. Several maneuvers for determining the location of the tendon lesion such as, Jobe's test for supraspinatus, Patte's test for infraspinatus and teres minor, Gerber's lift off test for subscapularis and Yergason's test & Speed's maneuver for the long head of the biceps brachii were also performed. Within a day of the physical examination, ultrasonographic examination was carried out by Philips affinity 50G USG machine using a 12.5 MHz linear transducer with musculoskeletal settings. Patient sits on a rotating stool and the arm was examined in both neutral and externally rotated positions. Transverse and longitudinal planes from the biceps tendon groove, rotator cuff, and subacromial-subdeltoid bursa and transverse planes from the posterior glenohumeral recess and glenoid labrum was scanned. In all patients, comparable images of the opposite non painful shoulder were obtained in order to compare USG findings. USG examination of the opposite side was routinely performed to facilitate detection of subtle abnormalities. Final diagnosis of ultrasonography was compared with physical examination findings. All information was collected in Case Record Form (CRF). Data processing work consisted of registration schedules, editing, and preparation of dummy table and analysis of data. Statistical analyses of the results were carried out by using the Statistical Package for Social Sciences version 23.0 for Windows (SPSS Inc., Chicago, Illinois, USA). Chi square test was used for categorical variables. For the validity test sensitivity, specificity, accuracy, positive predictive value and negative predictive values of the clinical tests were calculated for the evaluation of shoulder pain. For all statistical tests, P –value less than 0.05 was considered as statistically significant.

Results:

Out of 120 patients with shoulder pain, more than 50.0% of the patients belonged to 51-68 years. The mean age was found 51.41 ± 11.03 years with age range from 18 to 68 years. Majority 68(56.7%) patients were female and 52(43.3%) were male. Male female ratio was 1:1.3. The mean duration of shoulder pain was 5.6 ± 3.2 months which ranged from 1 to 20 months. Majority 100(83.3%) patients had involvement of right side and 20(16.7%) had left sided involvement (Table-1). Clinically diagnosed impingement was found in 98(81.7%) patients by Neer sign and 80(66.7%) patients by Hawkins test. Among rotator cuff tendons supraspinatus lesion was diagnosed in 99(82.5%) patients by Jobe test, infraspinatus &/or teres minor lesion in 5(4.2%) patients by Patte test, subscapularis lesion in 10(8.3%) patients by Gerber lift off test. Regarding long head of biceps, tendinosis &/or tenosynovitis was diagnosed in 25(20.8%) patients by Yergason test and in 32(26.7%) patients by Speed's maneuver (Table-2). There were statistically significant ($p<0.05$) difference between clinical diagnosis & USG findings in case of supraspinatus & infraspinatus tendinitis, infraspinatus tear, shoulder impingement, acromioclavicular joint pathologies and osteophyte. There were no statistically significant ($p>0.050$) difference in diagnosis of rotator cuff tear, biceps tendon lesions, subacromial bursitis, glenohumeral effusion and adhesive capsulitis (Table-3). The sensitivity, specificity, accuracy, positive and negative predictive values of clinical tests in the diagnosis of painful shoulder was calculated by considering Ultrasonography to be the optimal diagnostic test. Neer sign showed sensitivity 87.5%, specificity 22.5%, accuracy 48.3%, positive predictive value

42.9% and negative predictive value 72.7%. Hawkins test showed sensitivity 85.4%, specificity 45.8%, accuracy 61.7%, positive predictive value 51.3% and negative predictive value 82.5%. Jobe test showed sensitivity 78.9%, specificity 6.7%, accuracy 60.8%, positive predictive value 71.7% and negative predictive value 9.5%. Patte test showed sensitivity 9.1%, specificity 100%, accuracy 58.3%, positive predictive value 100% and negative predictive value 56.5%. Gerber lift off test showed sensitivity 69.2%, specificity 99.1%, accuracy 95.8%, positive predictive value 90% and negative predictive value 96.4%. Yergason test showed sensitivity 65.7%, specificity 97.6%, accuracy 88.3%, positive predictive value 92% and negative predictive value 87.4%. Speed's maneuver showed sensitivity 80%, specificity 95.3%, accuracy 90.8%, positive predictive value 87.5% and negative predictive value 92% (Table-IV).

Table I

Baseline characteristics of the study patients (n=120)

Baseline characteristics	Frequency	Percentage
Age (years)		
18-20	02	1.7
21-30	02	1.7
31-40	19	15.8
41-50	35	29.2
51-60	31	25.8
61-68	31	25.8
Mean ± SD	51.41 ± 11.03	
Range (min-max)	18 - 68	
Sex		
Male	52	43.3
Female	68	56.7
Duration of shoulder pain (in month)	5.6±3.2	
Range (min-max)	1.0-20.0	
Side of involvement		
Right	100	83.3
Left	20	16.7

Table-II

Distribution of patients by physical examination findings of shoulder pathologies (n=120)

Positive clinical test	Shoulder pathologies	n (%)
Neer sign	Subacromial impingement	98 (81.7)
Hawkins test	Subacromial impingement	80 (66.7)
Jobe test	Supraspinatus lesion	99 (82.5)
Patte test	Infraspinatus &/or Teres minor lesion	05 (4.2)
Gerber lift off test	Subscapularis lesion	10 (8.3)
Yergason test	Long head of biceps tendinosis &/or tenosynovitis	25 (20.8)
Speed's maneuver	Long head of biceps tendinosis &/or tenosynovitis	32 (26.7)

*Multiple responses were considered

Table-III

Comparison of study patients by findings of ultrasonography and physical examination

	Clinical findings		USG findings		P
	N	%	N	%	value
Supraspinatus pathologies					
Tendinitis	82	68.3	59	49.2	0.002^{s}
Tear	17	14.2	14	11.6	0.563^{ns}
Infraspinatus &/or Teres minor pathologies					
Tendinitis	04	3.3	36	30	0.001^{s}
Tear	01	0.8	07	5.8	0.031^{s}
Subscapularis pathologies					
Tendinitis	08	6.7	07	5.8	0.789^{ns}
Tear	02	1.7	03	2.5	0.651^{ns}

Table-III (Cont'd)

	Clinical findings		USG findings		P
	N	%	N	%	value
Long head of biceps pathologies					
Tendinitis &/or Tenosynovitis	29	24.2	36	30	0.309^{ns}
Tear	02	1.7	03	2.5	0.651^{ns}
Subluxation or dislocation	02	1.7	00	00	0.155^{ns}
Miscellaneous pathologies					
Impingement	101	84.2	48	40	0.001^{s}
Subdeltoid bursitis	08	6.7	11	9.2	0.473^{ns}
Glenohumeral effusion	00	00	03	2.5	0.081^{ns}
Osteophyte	00	00	62	51.7	0.001^{s}
Acromioclaricular joint involvement	06	5.0	35	29.2	0.001^{s}
Adhesive capsulitis	07	5.8	02	1.7	0.089^{ns}

*Multiple responses were considered; s=significant; ns=not significant; P value reached from Chi square test

Table-V

Sensitivity, specificity, accuracy, positive and negative predictive values of clinical tests in the diagnosis of painful shoulder

Validity test	Neer sign	Hawkins test	Jobe test	Patte test	Gerber lift off test	Yergason test	Speed's maneuver
Sensitivity	87.5	85.4	97.3	9.1	69.2	65.7	80.0
Specificity	22.5	45.8	40.4	100	99.1	97.6	95.3
Accuracy	48.3	61.7	75.0	58.3	95.8	88.3	90.8
PPV	42.9	51.3	71.7	100	90.0	92.0	87.5
NPV	72.7	82.5	90.5	56.5	96.4	87.4	92.0

PPV= positive predictive value; NPV= negative predictive value

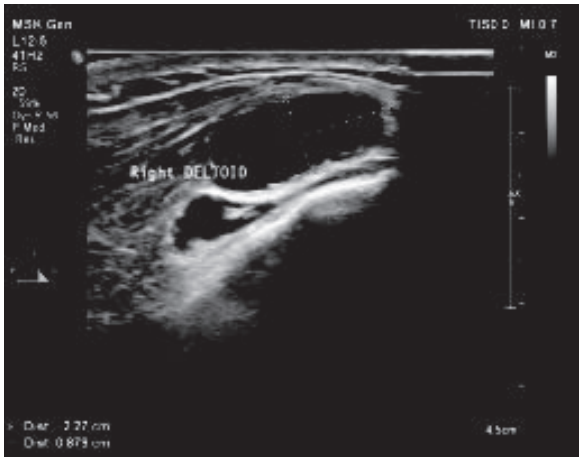

Fig. 1: *Shows fluid collection and synovial proliferation in the subacromial bursa (Sub-acromial bursitis)*

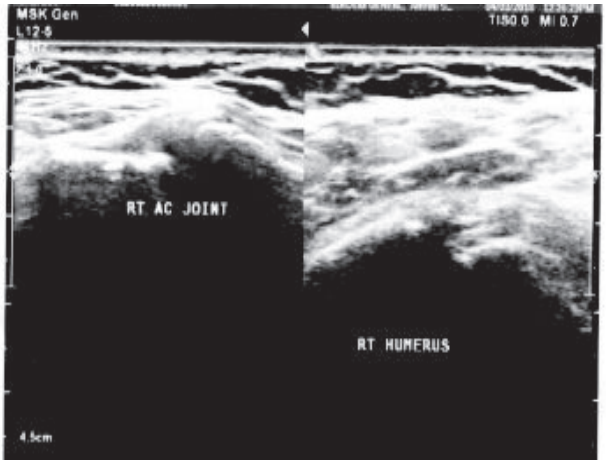

Fig. 2: *Shows osteophyte in the articular margins of glenohumeral and acromioclavicular joints.*

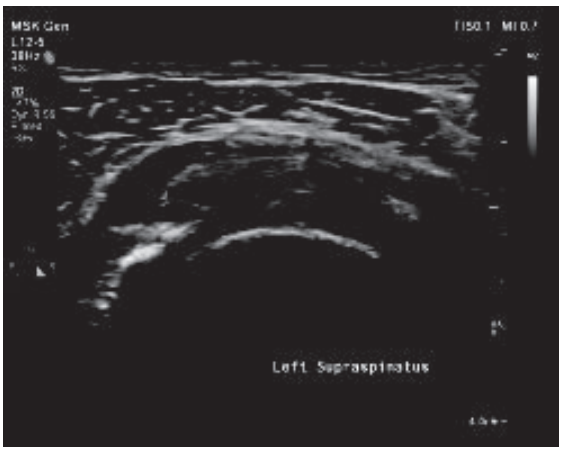

Fig. 3: *Shows complete disruption of the fibers of supraspinatus tendon & fluid collection within (complete tear)*

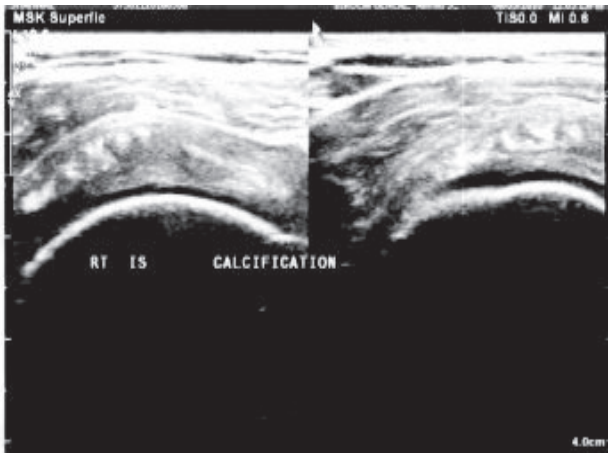

Fig. 4: *Shows increased fluid within synovial sheath of biceps tendon and tendon become hypoechogenic and thickened (Biceps tendinitis)*

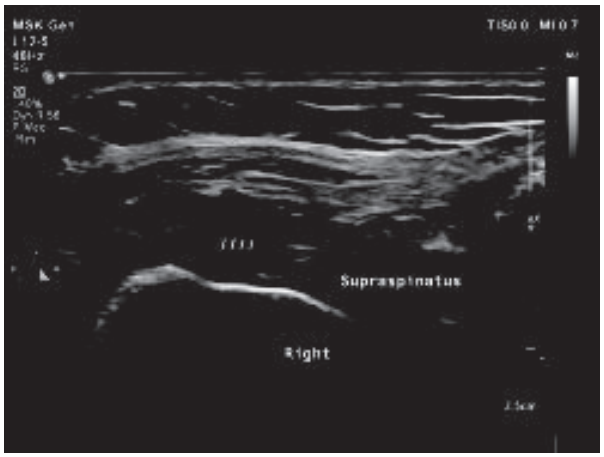

Fig. 5: *Shows a defect in distal supraspinatus tendon (Partial tear of right supraspinatus tendon).*

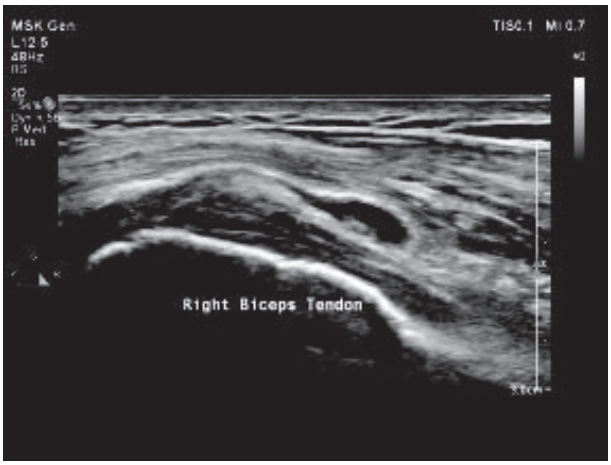

Fig. 6: *Shows thickening and inhomogeneity of right infraspinatus tendon with flecks of calcification (Calcific tendinitis).*

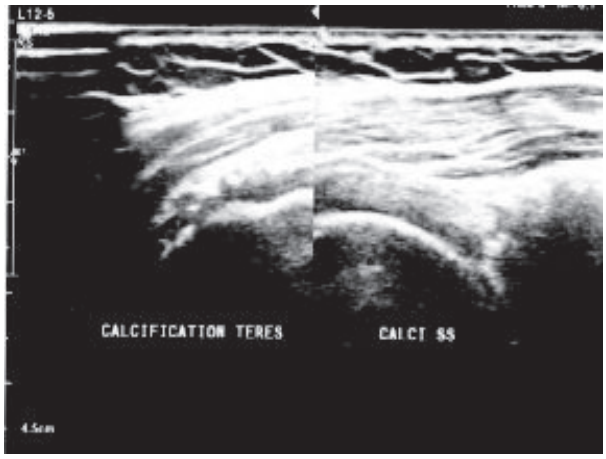

Fig. 7: *Shows calcification and thickening of supraspinatus and teres minor (Calcific tendinitis).*

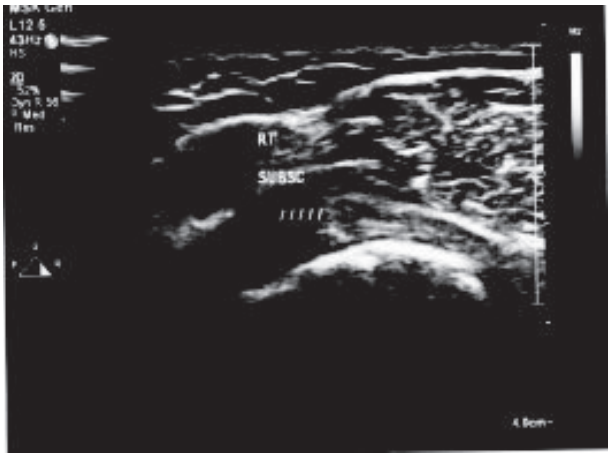

Fig. 8: *Shows partial loss of fibers of subscapularis tendon (Partial tear).*

Discussion:

Shoulder pain is one of the most common musculoskeletal symptoms that needs prompt medical evaluation and can result in disability and substantial health care costs.[6] Shoulder pain can originate in various structures of the shoulder joint or in affected periarticular structures. Comprehensive history taking and clinical examination is therefore of great importance. However, with clinical examination alone, often an exact diagnosis cannot be made. The high resolution ultrasonography (HRUS) provides a non-painful, noninvasive, cost-efficient and fast imaging technique which is increasingly used to evaluate patients with musculoskeletal disorders.[7]

In the present study majority 35(29.2%) patients belonged to age 41-50 years. The mean age was found 51.41±11.03 years ranged from 18 to 68 years. In Mohamed et al. study the age of the studied patients ranged from 35 to 75 years with a mean of 62.29 ±8.93 years.[8] Patidar et al. found that the mean age of the patients was 50.62 years (ranges from 31-70 years).[9] Carlos et al. observed average age of patients assessed was 59±17 years old.[10] The reason for the difference of age at presentation in various regions of the world may be due to geographic/ ethnic influence.

We found that female patients were predominant 68(56.7%) whereas male patients 52(43.3%) were male with male-female ratio was 1:1˙3. In Mohamed et al. study most of them were males (56.25%), while 43.75% were females.[8] Carlos et al. observed that proportion of females was 67%.[10] Patidar et al. reported male female ratio was 1.94: 1 (male 33, female 17).[9]

In the present study 52(43.3%) patients had pain in shoulder for the duration of 1-3 month, 39(32.5%) for 4-6 months, 21(17.5%) for 7- 12 months and 8(6.7%) for 13-20 months. The mean duration of shoulder pain was 5.6 ± 3.2 months with ranged from 1 to 20 months. Sharma and Ranjan study observed mean symptoms duration 2.4 months.[11] Naredo et al. study found mean duration of shoulder pain was 12.5 months.[12]

We found that majority 100(83.3%) of patients had involvement of right side and 20(16.7%) had involvement of left side. None of our cases had bilateral involvement at clinical examination. Mohamed et al.[8] observed 78.75% abnormalities in right side and 21.25% in left side.

In the present study positive Neer sign was found in 98(81.7%) patients, Hawkins test in 80(66.7%), Jobe test in 99(82.5%), Patte test in 5(4.2%), Gerber lift off test in 10(8.3%), Yergason test in 25(20.8%), speed‘s maneuver in 32(26.7%). For the physical examination of individual muscles, positive Jobe‘s test, indicating supraspinatus lesion, was the most common, followed by Yegarson‘s test (biceps) and Patte’s (infraspinatus) test. For impingement syndrome, only Neer sign was positive in 21(17.5%) patients, Hawkins test in 3(2.5%) patients and both tests were in positive in 77(64.2%) patients. Clinical examination for long head biceps tendon showed Yergason test was positive in 2(1.7%) patients, speed‘s maneuver in 7(5.8%) patients and both tests were positive in 21(17.5%) patients. Sharma and Ranjan reported that the Speed‘s test was positive in 9 (18%) painful shoulders, Jobe test in 13 (26%) painful shoulders, resisted external rotation in 2 (4%) painful shoulders, resisted internal rotation in 2 (4%) painful shoulders and adduction stress test in 10 (20%) painful shoulders. Adduction stress test was positive in 1 asymptomatic shoulder.[11] Patidar et al. consisted that Neer and Hawkins tests were found 10 cases.[9] Kim et al. observed that impingement sign tested by Neer‘s or Hawkins‘s tests was positive in 50% the shoulders, with both tests positive in 41 (23.3%), only Neer‘s test positive in 40 (22.7%), and only Hawkin‘s test positive in 6 (3.4%) shoulders.[3]

In our study there were statistically significant ($p<0.05$) difference between clinical diagnosis & USG findings in case of supraspinatus & infraspinatus tendinitis, infraspinatus tear, shoulder impingement, acromioclavicular joint pathologies and osteophyte. There were no statistically significant ($p>0.05$) difference in diagnosis of rotator cuff tear, biceps tendon lesions, subacromial bursitis, glenohumeral effusion and adhesive capsulitis. Maeda et al. study showed that the clinical testing for the supraspinatus tendon (Neer, Hawkins, Yocum and Jobe) were statistically associated ($P<0.05$), when compared with painful symptoms. However, a larger sample is needed to test this maneuver. There was no statistical association between pain, semiological and ultrasound tests for the long head of the biceps tendon.[13]

In the present study musculoskeletal ultrasonography findings was considered as the

modality of choice for making final diagnosis of painful shoulder and clinical tests were compared with ultrasonography using standard formulae to arrive at the test characteristics. Neer sign showed a sensitivity of 87.5%, specificity of 22.5%, accuracy of 48.3%, positive predictive value of 42.9% and negative predictive value of 72.7%. Hawkins test showed sensitivity of 85.4%, specificity of 45.8%, accuracy of 61.7%, positive predictive value of 51.3% and negative predictive value of 82.5%. Jobe test showed sensitivity of 78.9%, specificity of 6.7%, accuracy of 60.8%, positive predictive value of 71.7% and negative predictive value of 9.5%. Patte test showed sensitivity of 9.1%, specificity of 100%, accuracy of 58.3%, positive predictive value of 100% and negative predictive value of 56.5%. Gerber lift off test showed sensitivity of 69.2%, specificity of 99.1%, accuracy of 95.8%, positive predictive value of 90% and negative predictive value of 96.4%. Yergason test showed sensitivity of 65.7%, specificity of 97.6%, accuracy of 88.3%, positive predictive value of 92% and negative predictive value of 87.4%. Speed's maneuver showed sensitivity of 80%, specificity of 95.3%, accuracy of 90.8%, positive predictive value of 87.5% and negative predictive value of 92%. Hegedus et al.[14] observed the sensitivity of Neer test varied from 64% to 81% and the specificity from 10% to 95%, for Hawkins test sensitivity ranged from 46% to 87% and specificity from 26% to 89%, Jobe test sensitivity varied from 71% to 74% and specificity from 30% to 74%, Sensitivity of the Patte test varied from 36% to 71% and specificity from 60% to 95%, the sensitivity of Gerber lift off test was 6% - 68% and the specificity 23% - 90%. Kim et al. observed sensitivity and specificity of physical examination for the detection of tendon tears. The sensitivity of Jobe test was 30.8% and specificity 51.60%, sensitivity of the Patte test was not done but specificity 86.4%, the sensitivity of Gerber lift off test was 6.25% and the specificity 22.5%, Yeargason test showed sensitivity 75% and specificity 81.4%.[3]

Conclusion:

From the findings of present study it can be concluded that there were significant differences between the findings of USG & physical examinations in the diagnosis of supraspinatus & infraspinatus tendinitis, infraspinatus tear, shoulder impingement, acromioclavicular joint pathologies and osteophyte. But no significant difference was found in diagnosis of rotator cuff tear, biceps tendon lesions, subacromial bursitis, glenohumeral effusion and adhesive capsulitis. Many clinical diagnostic tests are used for evaluation of painful shoulder but for more accurate diagnosis imaging modalities are applied. Now a days, musculoskeletal ultrasound is using for this purpose because it is less costly, radiation free and can be applied repeatedly for follow up. Further studies can be undertaken by including larger number of patients with MRI comparison.

References

1. Burbank KM, Stevenson JH, Czarnecki GR, Dorfman J. Chronic Shoulder Pain Part I: Evaluation and Diagnosis. *American family physician* 2008; 77(4):453-60.
2. Pribicevic M. The epidemiology of shoulder pain: A narrative review of the literature. In Pain in perspective 2012 Oct 24. Intech Open
3. Kim HA, Kim SH, Seo YI. Ultrasonographic findings of painful shoulders and correlation between physical examination and ultrasonographic rotator cuff tear. *Modern Rheumatology* 2007; 17(3):213-9.
4. Woodward TW, Best TM. The Painful Shoulder: Part I. Clinical Evaluation. *American family physician* 2000;61(10):3079-88.
5. Singh A, Thukral CL, Gupta K, Singh MI, Lata S, Arora RK. Role and correlation of high resolution ultrasound and magnetic resonance imaging in evaluation of patients with shoulder pain. *Polish Journal of Radiology* 2017; 82:410
6. Lee MH, Sheehan SE, Orwin JF, Lee KS. Comprehensive shoulder US examination: a standardized approach with multimodality correlation for common shoulder disease. *Radiographics* 2016;36(6):1606-27.
7. Micheroli R, Kyburz D, Ciurea A, Dubs B, Toniolo M, Bisig SP, Tamborrini G. Porównanie badania przedmiotowego i badania ultrasonograficznego u pacjentów z bólem stawu [3]opatkowo-ramiennego. *Journal of Ultrasonography*. 2015;15(60):29-44.

8. Mohamed RE, Amin MA, Aboelsafa AA. Ultrasonographic and clinical study of post-stroke painful hemiplegic shoulder. *The Egyptian Journal of Radiology and Nuclear Medicine* 2014;45(4):1163-70.

9. Patidar M, Patil A, Verma V, Kaushal L. Evaluation of painful shoulder with high frequency sonography and their comparison with the clinical diagnosis made by physical examination. *Nepalese Journal of Radiology* 2012;2(2):43-50.

10. Carlos GA, María BV, Blazquez-Canamero BA, Angeles M. Prevalence of Ultrasonographic Findings in Patients with Shoulder Pain: from the Chronic to the Hyperacute. *Archives of medicine* 2015; 7(6:2), pp. 1-6.

11. Sharma P, Ranjan R. Accuracy of High Resolution Sonographic Evaluation of Painful Shoulder. *Journal of Scientific Research and Reports* 2015: 19:1-6.

12. Naredo E, Aguado P, De Miguel E, Uson J, Mayordomo L, Gijon-Banos J, Martin-Mola E. Painful shoulder: comparison of physical examination and ultrasonographic findings. *Annals of the rheumatic diseases* 2002; 61(2):132-6.

13. Maeda EY, Helfenstein Jr M, Ascencio JE, Feldman D. The shoulder in a production line: clinical and ultrasound study. *Revista Brasileira de Reumatologia* 2009;49(4):375-86.

14. Hegedus EJ, Goode AP, Cook CE, Michener L, Myer CA, Myer DM, Wright AA. Which physical examination tests provide clinicians with the most value when examining the shoulder? Update of a systematic review with meta-analysis of individual tests. *British journal of sports medicine* 2012; 46(14):964-78.