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Research Article

Sonographic Evaluation of the Various Causes of Shoulder Impingement Syndrome

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Abstract

Background: Shoulder impingement syndrome is the most pronounced cause of shoulder pain and disability. It is the entrapment of subacromial content in the shoulder outlet. Howoever, entrapment could be caused by a number of bony and soft tissue defects. However, Ultrasound is the modality of choice for the diagnosis and differentiation of these various causes of shoulder impingement syndrome.

Objective: To evaluate various causes of the shoulder impingement syndrome while uring high-resolution ultrasonography. For this purpose 262 confirmed cases of shoulder impingement syndrome were conveniently selected observed at Gilani Ultrasound Center, Lahore, Pakistan. All the shoulders were evaluated with Toshiba Xario Prime ultrasound Unit with linear transducer 7-14MHz for various causes of shoulder moment restriction. The frequency and percentage of these various causes were calculated to establish the most and least frequent cause of shoulder impingement.

Results: The most common cause of shoulder impingement was supraspinatus tendinosis, while the least common case was supraspinatus tendon full-thickness tear. The right shoulder was more affected as compared to the left one.

Conclusion: Shoulder impingement syndrome could be caused by a variety of bony and soft tissue defects including supraspinatus tendinosis, Supraspinatus tendon articular partial tear, supraspinatus intrasubstance partial tear, supraspinatus tendon atrophy with calcification, supraspinatus tendon Calcarea (calcium deposition), subacromial-subdeltoid bursitis, supraspinatus tendinitis, glenohumeral joint instability, Os-acromial (anatomic variation), supraspinatus bursal partial tear, capsulitis, and supraspinatus tendon full-thickness tear. The most common cause was supraspinatus tendinosis, Supraspinatus tendon articular partial tear while the least common case was supraspinatus tendon full-thickness tear.

Keywords: Shoulder impingement Syndrome; Supraspinatus tendinosis; Glenohumeral joint instability; Subacromial Subdeltoid bursitis; Supraspinatus partial tear

Abbreviations

SIS: Shoulder Impingement Syndrome; US: Ultrasound; IRB: Institutional Review Board; AIUM: American Institute Of Ultrasound In Medicine; SPSS: Statistical Package For The Social Sciences; NY: New York; MRI: Magnetic Resonance Imaging; IBM: International Business Machines; BMI: Body Mass Index

Introduction

Shoulder impingement syndrome is the most frequent cause of shoulder pain and disability among working-class individuals [1]. It involves the entrapment of rotator cuff tendons particularly supraspinatus tendon and subacromial subdeltoid bursa in the shoulder outlet between the acromion and humeral head [2]. Shoulder pain is the second highly prevalent condition after lower back pain within the general population [3]. The one-month prevalence of shoulder pain is between 16% and 30% [4]. It could be caused either by the narrowing of the shoulder outlet (subacromial space) or thickening of the contents of the shoulder outlet (supraspinatus tendon, glenohumeral ligaments and subacromial subdeltoid bursa) [5]. It can be evaluated by multiple imaging and clinical examination techniques. Clinically Neer and Howkins tests are being used since long for the evaluation of shoulder impingement syndrome. But plain x-ray, computed tomography, magnetic resonance imaging and ultrasound are being used for its evaluation [6].

Ultrasound is progressively being used as an expansion to physical examination of the shoulder impingement syndrome [7]. SIS could reliably be diagnosed with dynamic ultrasonography to observe the moment of the supraspinatus and subacromial subdeltoid bursa while passing underneath the acromion during arm abduction in real-time. No other imaging modality has the capability to evaluate structure in real-time during a physiologic moment [8, 9]. Apart from that ultrasound is noninvasive, free of bioeffects and very effective in the observation of superficial structures with high resolution. Patient instructiveness, real-time observation of the changes in the

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body structure during moment, harmlessness, and easy availability distinguish ultrasound from the rest of the imaging modalities [10]. According to a review article the sensitivity and specificity of ultrasound are high enough to be used satisfactorily in the diagnosis SIS [7]. Another study concluded that the static US combined with dynamic study can be a helpful tool in detecting different abnormalities of the painful shoulder especially impingement syndrome and its different causes [11]. In cases of full-thickness tear the sensitivity and specificity of ultrasound is very high 100% and 97% respectively whereas slightly low in partial-thickness tears [12]. The contrast resolution and imaging field of view, and reproducibility (re-opinion by an expert) of computed tomography, magnetic resonance imaging and plain film radiography are better than ultrasound. But these modalities have a high potential for bioeffects [13]. In contrast to other imaging modalities, ultrasound is a non-invasive, inexpensive, readily available, relatively quick procedure, with no special preparation required and safe for the diagnosis of musculoskeletal disorders [14,15].

There are multiple causes of shoulder impingement syndrome; however, these can broadly be divided into two groups; narrowing of the shoulder outlet or thickening of the contents of the shoulder outlet [16]. The narrowing of the shoulder outlet could be caused by glenohumeral joint dislocation, instability and derangement or by os-acromiale (anatomic variation) [17]. However, subacromial content thickening could be either due to the inflammation of the glenohumeral ligaments, supraspinatus tendon, subacromial subdeltoid bursa or coracoacromial ligament, while in other conditions chronic rotator cuff tear give rise to calcium deposits in the tendon (tendinous calcarea) can lead to tendinosis and pain [18]. It is obvious that multiple conditions are responsible for the development of shoulder impingement syndrome and ultrasound is the imaging modality of choice for the evaluation of the shoulder joint. It was therefore intended to evaluate various pathological conditions contributing to the development of shoulder impingement syndrome while using noninvasive imaging modality ultrasound [19,20].

Materials and Methods

It was a cross-sectional observational study conducted in two years as Ph.D. research from 1st April 2018 to 25th March 2020 at Gilani Ultrasound Center, Lahore, Pakistan. A total of 263 symptomatic shoulders were included which were positive on Neer's and Howkins test. The study was aimed to evaluate various causes of shoulder impingement syndrome with the help of high-resolution ultrasonography. Approval was taken from the Institutional Review Board (IRB) and the Ethical Committee of the University of Lahore. A single Ultrasound unit Toshiba Xario with linear transducer frequency ranging from 7-14MHz was used for this study. Patients have been explained the procedure and aim of the research and written informed consent was signed. AIUM guidelines for shoulder ultrasound scanning were followed in this study, which is routinely observed in this department [21]. The privacy of the patient was given priority while scanning the patient and publication. The entire shoulder was evaluated with grayscale sonography and then color Doppler was applied to observe any hemodynamic changes, by a single accredited Sonologist. Various pathological conditions were observed and additional variables like patient age, gender and family history, were also noted. Statistical Package for the Social Sciences (SPSS) version 24 (SPSS 24, IBM, Armonk, NY, United States of America) software was used for the evaluation of data [22]. The results were summarized in the form of graphs, tables. Frequency and percentage of different pathological conditions were giving raise to impingement syndrome were tabulated. Descriptive data is explained in the form of mean and standard deviation and range.

Results

Two hundred and sixty-two shoulder with clinical symptoms and positive sonographic findings of shoulder impingement syndrome. The mean age of the patient was 42.95±17.95 (10-91) years. Among them, 116 (44.3%) were females and 146 (55.7%) males. Hypertensive and non-hypertensive individuals were 124 (47.3%) and 138 (52.7%) respectively, while diabetic and nondiabetic were 89 (34%) and 173 (66%) respectively. Body habitus was categorized as Underweight, Normal, Overweight and Obese, while its frequency and percentage were 24, (9.2%), 176 (67.2%), 40 (15.3%) and 22(8.4%) respectively. The occurrence of impingement in the right and the left side was 142 (54.2%), and 120 (45.8%) respectively. The cortical bone irregularity was found 124 (47.3%) shoulders while 138 (52.7%) shoulders having regular cortical part of the bone. Various causes of the shoulder impingement include, supraspinatus tendinosis, supraspinatus articular partial tear, supraspinatus intrasubstance partial tear were the common causes while supraspinatus full-thickness tear and capsulitis were the least common causes of shoulder impingement syndrome; detailed is given in the Figure 1-5.

Discussion

Subacromial impingement refers to the pain, weakness and loss of movement at the shoulder due to irritation of the subacromial structures i.e. supraspinatus tendon, and bursa as they pass through the subacromial space due to the inflammation of tendons, bursa, and joint capsule [5,23]. This irritation of structures worsens at the mid-range shoulder abduction, that's why it is also called mid-range impingement syndrome [6]. Patient clinical history and physical examination of the shoulder are the early diagnostic criteria of impingement syndrome, which is then followed by plain x-rays to

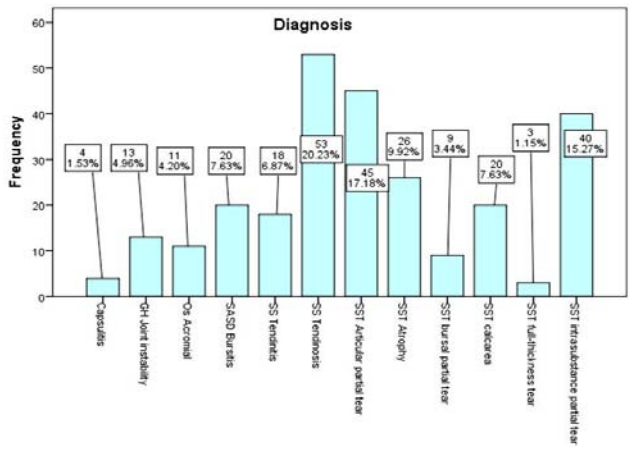

Figure 1: Frequency and percentage of various bony and soft tissue defects accounts for the development of Shoulder impingement syndrome. SST in the image stands for supraspinatus Tendon.

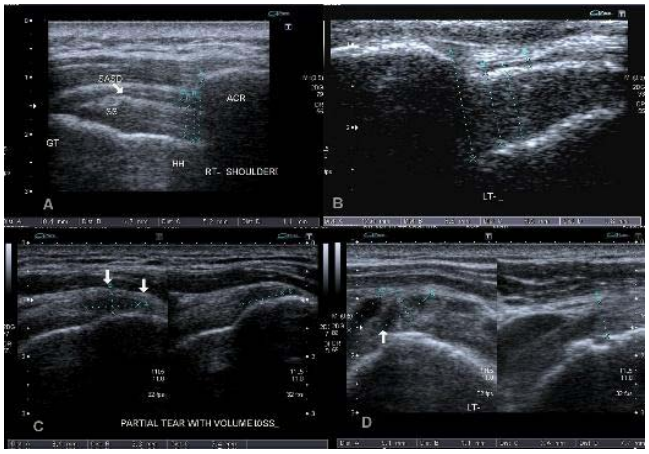

Figure 2: A) Normal right shoulder outlet containing supraspinatus tendon (SS) and subacromial subdeltoid bursa (SASD). ACR represent acromion, HH humeral head, and GT Greater Tuberosity. B) Left shoulder outlet containing diffusely thickened supraspinatus tendon with undifferentiable tendon fibers. C) Bursal type of partial tear at the enthesis of the right supraspinatus tendon. D) Multiple tears in the supraspinatus tendon including Intrasubstance and bursal type of partial tear. Irregularity of the cortical part of the bone with spurs.

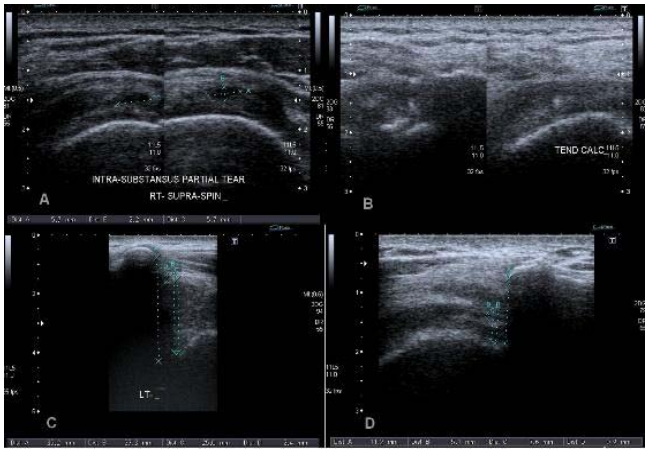

Figure 3: A) Intrasubstance type of partial tear with calcification. B) Calcification in the supraspinatus tendon (tendinous calcarea). C) Increased subacromial space with thickened supraspinatus tendon (shoulder joint instability. D) Reduced supraspinatus tendon thickness with calcification (atrophy).

rule out bone-related deformities i.e. bone degeneration, fractures or spurs which could be the cause of soft tissue injury [24]. Plain x-ray is unable to diagnose soft tissue related abnormalities; however, ultrasound is the modality of choice to observe cortical part of the bone as well as soft tissue related abnormalities. The addition of dynamic ultrasound examination for diagnosis of the painful shoulder showed the highest sensitivity in the assessment of impingement syndrome. However, 85.7% sensitivity for rotator cuff partial-thickness tear and 90% for rotator cuff full-thickness tear [11]. Shoulder impingement or shoulder pain syndrome is more clinical and it is not the expertise of ultrasound to merely label either impingement syndrome present or absent. Rather it is important to explore the underlying cause of this syndrome for proper management and treatment plane. It was

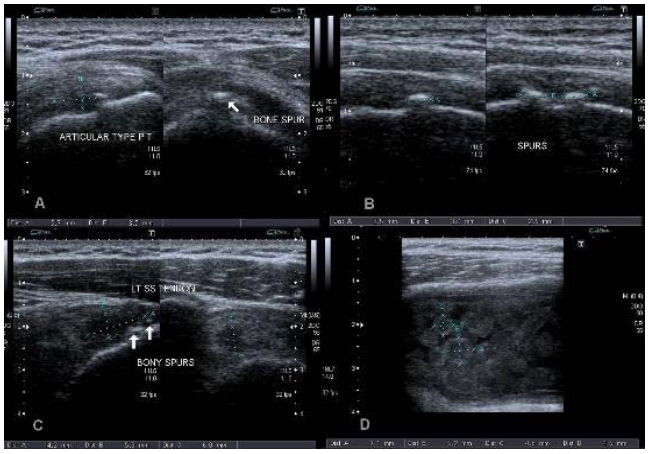

Figure 4: (A) Articular type of partial tear with bony spurs. B) Cortical bone irregularity and bony spurs. C) Articular type of tendon tear with spurs. D) Chronic subacromial subdeltoid bursitis with calcified bodies in the bursa (rice bodies).

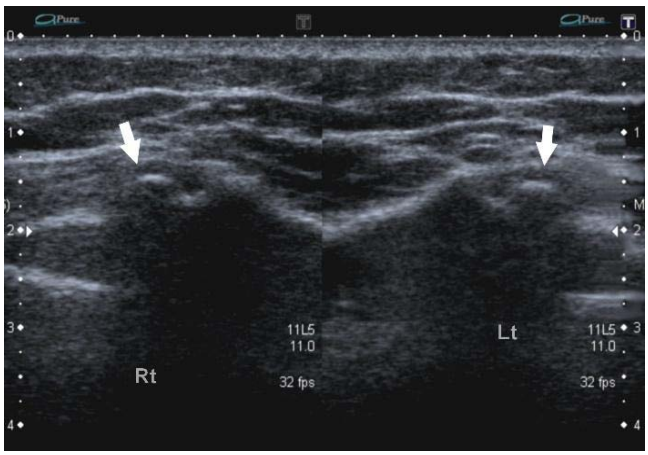

Figure 5: Bilateral osseous fragment at the ending of the acromion giving raise to the shoulder impingement syndrome pointed with white arrows (Os-acromiale).

therefore tried in this article to explore various causes of shoulder impingent syndrome with the help of noninvasive imaging modality Ultrasound [25].

For the purpose to diagnose various causes of shoulder impingement syndrome, 262 confirmed cases were selected. It was observed that males were more affected by shoulder impingement syndrome as compared to females. Hypertensive and non-hypertensive were equally affected by shoulder impingement syndrome. It is therefore confirmed that hypertension has no relation with shoulder impingement syndrome. In study 137 symptomatic shoulders were evaluated with MRI to evaluate the prevalence of partial and complete tears of the rotator cuff. It was observed that 44% women and 56% of men were affected by shoulder impingement syndrome in the symptomatic group of patients [26]. In a narrative review to analyze the epidemiology shoulder syndrome, it was summarized that the ratio of male to female prevalence rates for the 25–44 year age groups were 23% and 13% respectively [27].

It was also observed that most of the individuals suffering from shoulder impingement syndrome were of normal BMI. However, it was also confirmed that body habitus has an impact on shoulder impingement syndrome. In a study, while including 49 individuals while conducted to determine if obesity affects neuropathic pain, usually considered unrelated to the weight-load on the musculoskeletal system. It was observed that overweight negatively affects musculoskeletal health; hence obesity is considered a risk factor for osteoarthritis and chronic low back pain but no shoulder disorders were related to obesity [28]. However, a significant association was found between increasing body mass index and rotator cuff tendinitis, in a study while recruiting 311 cases and 933 controls from 53 to 77 years of individuals [29].

According to a study, there was an association between obesity and shoulder pain. Six-thousand two-hundred and thirty-seven individuals were included in this cross-sectional study [29].

The right side was slightly more effected in shoulder impingement syndrome as compared to the left side. It could be justified with the vast majority of right-side dominant individuals. In such individuals, the right side is most commonly used in different types of occupations and physical activities. In a study, it was observed that heavy lifting or repetitive movements, especially above shoulder level in some occupations lead to shoulder pain syndrome. This way the dominant arm of the workers was associated with the rotator cuff pathologies [30]. Another case-control study was conducted to observe variation in the scapular position with shoulder impingement. For this purpose, 66 individuals were included and observed that almost all the individuals suffering from shoulder impingement syndrome were affected dominant side [31].

The most common cause of shoulder impingement was supraspinatus tendinosis (Figure 2B), followed by Supraspinatus tendon articular partial tear (Figure 2D), which is then followed by supraspinatus intrasubstance partial tear (Figure 2C & D), then Supraspinatus tendon atrophy with calcification then supraspinatus tendon Calcarea (calcium deposition) (Figure 3A, B and D) and subacromial-subdeltoid bursitis (Figure 4D), then supraspinatus tendinitis, then glenohumeral joint instability (Figure 3C), then Os-acromial (anatomic variation) (Figure 5), then supraspinatus bursal partial tear, then capsulitis and the least common case was supraspinatus tendon full-thickness tear as shown in the Figure # 2-5. Various causes of rotator cuff pathologies are summarized in a study that ultimately gives rise to shoulder impingement syndrome. Rotator cuff tear in young ones is strongly related to trauma while in elderly people attrition from bony spurs on the undersurface of the acromion or intrinsic degeneration of the rotator cuff tendons. Partial tears, tendinopathy, tendon atrophy or calcium deposition in tendon resist the movement of the shoulder joint. Several conditions of the rotator cuff may lead to an inability of the rotate cuff beyond 20° [30].

Conclusion

Shoulder impingement syndrome could be caused by a variety of bony and soft tissue defects including supraspinatus tendinosis, Supraspinatus tendon articular partial tear, supraspinatus intrasubstance partial tear, supraspinatus tendon atrophy with calcification, supraspinatus tendon Calcarea (calcium deposition), subacromial-subdeltoid bursitis, supraspinatus tendinitis, glenohumeral joint instability, Os-acromial (anatomic variation), supraspinatus bursal partial tear, capsulitis, and supraspinatus tendon full-thickness tear. The most common cause was supraspinatus tendinosis, Supraspinatus tendon articular partial tear while the least common case was supraspinatus tendon full-thickness tear.

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