ABNORMAL FINDINGS IN THE SHOULDER OF ASYMPTOMATIC ADULTS - A SONOGRAPHIC STUDY

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ABSTRACT

Purpose: To determine the prevalence of abnormal findings at sonography of the shoulder joint in asymptomatic subjects.

Methods: The study group consisted of 70 consecutive subjects, asymptomatic for either shoulder. A musculoskeletal sonographer carried out the ultrasound of a randomly chosen shoulder of the patient in accordance with a specified protocol that comprised imaging of the rotator cuff tendons, tendon of the long head of the biceps brachii muscle, subacromial-subdeltoid bursa, acromioclavicular joint, and posterior labrum. The scans were then retrospectively evaluated by three expert musculoskeletal radiologists in accord, and abnormal findings were documented. Miniscule or equivocal findings of tendinosis, bursal prominence, and osteoarthritis were omitted.

Results: A total of 37 right and 33 left shoulders were imaged in 70 subjects, of which 40 were males, and 30 were females with a male: female ratio of 1:3. The mean age of the subjects was 45 years, with an age range of 30-70 years. Ultrasound revealed subacromial-subdeltoid bursal thickening in 70% (49/70) of the individuals, acromioclavicular joint arthritis in 60% (42/70), supraspinatus tendinosis in 40% (28/70), subscapularis tendinosis in 27.1% (19/70), partial-thickness bursal surface supraspinatus tear in 15.7% (11/70), partial-thickness tear of the subscapularis tendon in 10% (7/70) and posterior glenoid labral abnormality in 10% (7/70). The rest of the findings had a prevalence of less than 10%.

Conclusion: Asymptomatic abnormalities of the shoulder joint were detected in 86% of the subjects, the most prevalent being subacromial-subdeltoid bursal thickening, acromioclavicular joint osteoarthritis, and supraspinatus tendinosis. Our findings in the asymptomatic population advocate that ultrasound findings should be elucidated carefully with clinical information to detect the cause of a patient’s symptoms.

KEYWORDS shoulder, asymptomatic abnormalities, ultrasound, rotator cuff, tear

Introduction

Ultrasound has become the investigation of choice in evaluating shoulder joint pathologies worldwide [1-3]. Amidst all musculoskeletal ultrasound examinations in diagnostic radiology, it is one of the most routinely performed. For evaluating rotator cuff pathologies, many studies have found the sensitivity and specificity of ultrasound equivalent to that of MRI [3-4]. The various advantages of ultrasound over MRI are patient preference, immediate patient feedback and the dynamic nature of the study besides its easy accessibility and cost-effectiveness [5]. Nevertheless, ultrasound is highly operator dependent, thus compromising the sensitivity and specificity in inexperienced hands.

Asymptomatic rotator cuff tears have been incidentally detected on ultrasound [6-12], MRI [13-17], and cadaveric studies [18–21]. A comprehensive standard ultrasound examination of the shoulder comprises evaluation of the rotator cuff tendons and adjoining structures [22]. As per our know-how, there are few peer-reviewed studies of asymptomatic sonographic ab-
normalities of the shoulder, including assessment of adjoining structures and the rotator cuff tendons [23].

Our study intended to determine the prevalence of asymptomatic abnormal findings at ultrasound examination of the shoulder and emphasize the range of asymptomatic abnormalities that may be confronted at sonographic examinations. Knowledge of the spectrum of these asymptomatic shoulder abnormalities is vital to acquire a viewpoint on their clinical relevance in diagnosis and patient care.

**Materials and Methods**

Ours is a prospective study conducted between July-November 2019 with approval from Institutional Ethical Committee (IEC). Prior to each examination, informed consent was obtained from the patients. The study sample consisted of 70 consecutively registered subjects with symptoms unrelated to the shoulder joint. Subjects with a prior history of trauma or systemic inflammatory disease were excluded from the study. A review of previous records, including radiological investigations, was done whenever available.

All the ultrasound scans were carried out with a 12-MHz linear-array high-frequency transducer (LOGIC S8, GE Healthcare, United States) in accordance with the standard shoulder protocol followed in our department. Scans were done by either of the two musculoskeletal sonographers (each with more than 3 years of specialized experience), and static images, as well as cine loops, were saved. A solitary arbitrarily chosen shoulder in each patient was scanned as the sonographer was blinded to the subject's dominant side.

Our standard ultrasound protocol for the shoulder comprises an assessment of the rotator cuff tendons in conjunction with the tendon of the long head of the biceps brachii muscle in both long and short axes. Evaluation of the posterior labrum, subacromial-subdeltoid bursa and acromioclavicular joint was also done in addition to dynamic evaluation for subacromial impingement and subluxation or dislocation of the long head of the biceps brachii muscle. The pre-recorded static ultrasound images and cine clips were then reviewed retrospectively by any of the three musculoskeletal radiologists, each with more than 5 years of specialized experience. Only unrefuted positive sonographic findings agreed to in consensus were incorporated in the study.

The sonographic criteria for documentation of abnormal findings were as follows:

- **Tendinosis** was described subjectively as thickening of the tendon with associated abnormal echogenicity and loss of the normal fibrillar echotexture. Partial-thickness tear involved a part of the tendon thickness on either the articular or the bursal surface and emerged as a focal hypoechoic or anechoic defect on sonography. Full-thickness tears traversed the whole thickness of the tendon element, extending from the articular to the bursal surface, appearing sonographically as a hypoechoic or anechoic full-thickness defect.

- **Atrophy** was defined as decreased muscle bulk with raised echogenicity. Calcification was described as a well-defined or fluffy hyperechoic deposit within the tendon substance, with or without distal acoustic shadowing.

- **Subluxation** of the long head of biceps brachii was defined as partial displacement of the tendon medial to the bicipital groove in contradistinction to dislocation, where the tendon was displaced in entirety from the bicipital groove. Tear of the biceps brachii long head tendon was defined as interruption and deficient tendon in the bicipital groove. Any hypoechoic or the anechoic fluid collection or hypoechoic soft tissue adjoinig the biceps tendon was termed biceps brachii tendon sheath thickening. Focal or diffuse hypoechoic bursal thickening measuring >2-mm in the transverse dimension with or without accompanying fluid was considered subacromial-subdeltoid bursal thickening [24].

- **Subacromial impingement** was described as a collection of subacromial-subdeltoid bursal content, immediately lateral to the acromion on dynamic evaluation of the shoulder in abduction position [25].

- **Joint space narrowing** with articular surface irregularity and osteophytosis with or without associated capsular thickening or effusion defined acromioclavicular joint osteoarthritis, whereas abnormally decreased echogenicity or anechoic gap in the posterior labrum amounted to posterior glenoid labral abnormality.

**Results**

The study was carried out in the department of radiodiagnosis and imaging, GMC Srinagar and its associated hospitals. The study group comprised of 70 asymptomatic subjects, out of which 40 were males, and 30 were females with an M: F ratio of 1.3. The mean age of the subjects was 45 years with an age range of 30-70 years. Of all these, 37 ultrasound examinations were performed on the right shoulder and 33 on the left. A total of 34 examinations were performed on the dominant side, 32 on the non-dominant side, whereas 4 subjects were ambidextrous. A total of 60 subjects showed abnormal findings on ultrasound, with the prevalence shown in table 1.

**Rotator Cuff**

Asymptomatic abnormalities (tendinosis, tear, calcification and atrophy) of the rotator cuff tendons (supraspinatus, infraspinatus, teres minor and subscapularis) were noted in 70% (49/70) of the examinations.

- **Abnormal supraspinatus tendon** was noted in 42 subjects, with the predominant abnormality being tendinosis (Fig. 1a), seen in 28 subjects. Partial-thickness tears of the supraspinatus tendon were seen in 15 subjects, out of which only 4 were along the articular surface (Fig. 1b), whereas the majority (11) were along the bursal surface (Fig. 1c, 1d). Supraspinatus tendon was completely torn in 8.6% of the subjects (n=6), with most of the full thickness tears being situated at the distal attachment site of the tendon (Fig. 1e), usually involving the frontal fibres. All except three of the supraspinatus tears had concomitant thickening of the subacromial-subdeltoid bursa. 3 subjects showed intrasubstance calcification in the supraspinatus tendon (Fig. 1f).

- A few cases with supraspinatus tendon abnormalities had associated abnormality of the infraspinatus tendon. Six subjects showed evidence of infraspinatus tendinosis with full-thickness tears in three. All full-thickness tears of the infraspinatus tendon had concomitant full-thickness tears of the adjoining supraspinatus tendon.

- **Regarding the subscapularis tendon**, no full-thickness tears were identified. However, 19 subjects had evidence of tendinosis with partial thickness tear in 7. In addition, intrasubstance tendon calcification was seen in 3 subjects.

- **Atrophy** of the teres minor was seen in 5 subjects and was unrelated to adjoining infraspinatus abnormalities. In addition,
The long head of the biceps brachii muscle (Fig. 2a) demonstrated tendinosis in 3 persons with a full-thickness tear in 2 individuals. Biceps brachii tendon sheath distension (Fig. 2b, 2c, 2d) was seen in 2 subjects. The tendon of the long head of the biceps brachii was medially subluxated (Fig. 3) in 3 cases and medially dislocated with an empty bicpital groove in a single individual. All subjects with medially subluxed brachii tendon had a concomitant partial-thickness subscapularis tendon tear involving the superior fibers.

Subacromial-Subdeltoid Bursa

Synovial thickening of the subacromial-subdeltoid bursa was seen in 49 subjects, with accompanying bursal fluid in 10 cases. In addition, 3 subjects had subacromial impingement, and 19 subjects with subacromial-subdeltoid bursal thickening had associated supraspinatus tendon tears.

Acromioclavicular Joint and Posterior Glenoid Labrum

Forty-two shoulder examinations revealed evidence of acromioclavicular joint osteoarthritis (Fig. 4) in the form of joint space narrowing, articular irregularity, osteophytosis and subchondral cysts. In addition, abnormalities of the posterior labrum were found in 7 subjects.

Discussion

Our study documents the varied incidentally detected abnormal ultrasound findings in the shoulders of asymptomatic adults. Ultrasound examination of the shoulder joint was done in 70 asymptomatic subjects. A variety of incidental abnormalities were found in 85.7% of the subjects, the most common being subacromial-subdeltoid bursal thickening (70%) and acromioclavicular joint osteoarthritis (60%), followed by the tendinosis of supraspinatus (40%) and subscapularis (27%) tendons. Concerning asymptomatic abnormalities of the rotator cuff, the frequency of full-thickness tears of the supraspinatus tendon was 8.6% in our study, a little over 6% reported by Schibany et al. [9] and 7.6% reported by Moosmayer et al. [26] and lesser than 9.8% reported by Girish et al. [23] and 21.7% reported by Reilly et al. [27]

Sher et al. [17] reported a 15% rate of full-thickness tears, probably attributable to the older study population. None of the subjects in our study was older than 70 years, with a mean age of 45 years. All of the full-thickness tears of the supraspinatus tendon in our study were found in subjects older than 50 years, which is in concordance with the findings of Girish et al. and Moosmayer et al. This positive correlation of prevalence of tears with increasing age is in accordance with existing literature [8, 11, 23, 28].

The literature is sparse concerning the presence and quantification of asymptomatic partial-thickness tears of the rotator cuff. A frequency of 17.2% and 24% of partial-thickness supraspinatus tears was cited by Milgrom et al. [6] and Girish et al. [23], respectively. We got a rate of 21.4% of partial-thickness supraspinatus tears in our subjects. Amongst partial-thickness supraspinatus tears, bursal surface involvement was more common than the articular surface, with 73.3% of partial-thickness tears accounting for the former.

We also found that full-thickness tears of the rotator cuff outside the supraspinatus tendon were uncommonly asymptomatic, a finding consistent with other studies [9,10, 23, 26].

All three of our subjects with a full-thickness tear of the infraspinatus tendon had a concomitant tear of the supraspinatus tendon. However, none of our subjects had a tear involving full-thickness of the subscapularis tendon.

Ancillary finding in the rotator cuff was teres minor atrophy, seen in 5 subjects (7.1%), almost similar to the 8% frequency cited by Girish et al. [23]. Friend et al. [29] also reported atrophy of the teres minor muscle in 3% of cases and postulated variations in innervations of teres minor to be responsible for this asymptomatic finding. Two subjects showed a full-thickness tear in our study regarding the tendon of the long head of the biceps brachii muscle. We could not find this type of asymptomatic tear certification in the literature to support our finding. Associated supraspinatus tendon tear was seen in this individual.

Subacromial-subdeltoid bursal thickening was seen in 70% of our subjects, with associated bursal fluid in only 14.3%, suggesting that solitary presence of subacromial-subdeltoid bursal abnormality does not imply symptomatic subacromial impingement. Oshman et al. [8] found that 4% of asymptomatic subjects had the findings of subacromial-subdeltoid bursitis, albeit 36% of overhead-throwing athletes had asymptomatic effusion [7]. We also found that 38.8% of the cases with

Figure 1: Long-axis ultrasound images of supraspinatus tendon showing varied asymptomatic abnormalities in our study. (a) Thick and hypoechoic supraspinatus tendon with loss of normal fibrillar structure, consistent with tendinosis. (b) A partial-thickness articular surface tear appears as the hypoechoic area along the articular surface with intact bursal fibres. (c, d) Partial-thickness tear along the bursal surface appears as a small hypoechoic defect along the bursal surface with intact articular fibres. (e) Full-thickness defect in supraspinatus tendon near insertion site with accompanying fluid in subacromial-subdeltoid bursa. (f) Ill-defined echogenic foci without posterior acoustic shadowing in the supraspinatus tendon of a 70-year-old asymptomatic male.
Table 1: Abnormal ultrasound findings in shoulders of asymptomatic individuals.

| Finding                              | Number of Patients (n) |
|--------------------------------------|------------------------|
| **Supraspinatus**                    |                        |
| Tendinosis                           | 28                     |
| Partial thickness tear, articular    | 4                      |
| surface                              |                        |
| Partial thickness tear, bursal       | 11                     |
| surface                              |                        |
| Full thickness tear                   | 6                      |
| Calcification                         | 3                      |
| **Infraspinatus**                    |                        |
| Tendinosis                           | 6                      |
| Full thickness tear                   | 3                      |
| **Subscapularis**                    |                        |
| Tendinosis                           | 19                     |
| Partial thickness tear               | 7                      |
| Calcification                         | 3                      |
| **Teres minor atrophy**              | 5                      |
| **Biceps brachii**                   |                        |
| Tendinosis                           | 3                      |
| Distension of sheath                 | 2                      |
| Full thickness tear                   | 2                      |
| Subluxation                          | 3                      |
| Dislocation                          | 1                      |
| **Subacromial-subdeltoid bursal      |                        |
| thickening                           | 49                     |
| **Subacromial impingement**          | 3                      |
| **Acromioclavicular osteoarthritis** | 42                     |
| **Posterior labral abnormality**     | 7                      |

Figure 2: Short-axis and long-axis ultrasound images of the long head of biceps brachii tendon in asymptomatic subjects. (a, c) Short-axis ultrasound images showing normal and fluid distended synovial sheath of the long head of biceps brachii tendon, respectively. (b, d) Long-axis ultrasound images of the tendon of the long head of biceps brachii muscle showing fluid distension of the synovial sheath.

Figure 3: Short-axis and long-axis ultrasound images of the long head of biceps brachii tendon showing the normal anatomical position of the tendon in the upper row (a, b) with medial subluxation of the biceps tendon from the bicipital groove in the lower row (c, d).

Subacromial-subdeltoid bursal thickening or effusion had associated supraspinatus tears. In a similar study population,
Figure 4: Long-axis ultrasound image of the acromioclavicular joint in a 50-year-old asymptomatic male with mild osteophyte formation, capsular thickening and joint effusion, consistent with acromioclavicular osteoarthritis. The clavicle is on the right side of the image, and the acromion on left.

Moosmayer et al. [26] and Needell et al. [15] cited the presence of bursal thickening or fluid accumulation in 34.3% and 100% of the individuals, respectively.

We also came across three cases of subacromial impingement in our study, all being asymptomatic. The high prevalence of acromioclavicular joint osteoarthritis (60%) in our study is in keeping with the age of our subjects. In a study by Fialka et al. [28], degenerative changes in the acromioclavicular joint were found by the 3rd decade of life. Furthermore, ultrasound being sensitive to cortical irregularity, asymptomatic degenerative change is likely to be detected early.

There are several possible limitations to our study. First, the sample did not represent the general population because all the subjects were inducted from orthopaedics OPD with problems unrelated to the shoulder after a thorough history and clinical examination of both the shoulders by an orthopaedic surgeon. Any subject with shoulder symptoms was excluded from the study. As the cases were asymptomatic, no follow-up was obtained. To recompense this shortcoming, only abnormal ultrasound findings agreed to in unison by all the interpreting radiologists were documented. Another possible limitation of our study might be recall bias with respect to the absence of former symptoms. Moreover, lack of symptoms does not rule out the subsequent development of symptoms. Finally, the radiographic correlation was not done in all cases because of lack of availability.

Conclusion

Asymptomatic abnormalities of the shoulder joint were detected in 85.7% of the subjects, the most prevalent being subacromial-subdeltoid bursal thickening, acromioclavicular joint osteoarthritis, and supraspinatus tendinosis. Our findings in the asymptomatic population advocate that ultrasound findings should be elucidated carefully with clinical information to detect the cause of a patient’s symptoms.

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Conflict of interest

There are no conflicts of interest to declare by any of the authors of this study.

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