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Thickening of the Glenohumeral Axillary Recess as an Ultrasound Sign of Adhesive Capsulitis

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Abstract: In the period of the COVID-19 pandemic, we have seen an increase in cases of adhesive capsulitis (AC). Patients presented with shoulder pain associated with limited external rotation and abduction movements. Clinical criteria are considered the standard for diagnosis, with magnetic resonance imaging (MRI) an excellent tool for its imaging diagnosis. Typical findings are thickening and changes in signal intensity of the joint capsule in the axillary recess and in the rotator interval, as well as thickening of the coracohumeral ligament (CHL). Ultrasonographic examination is controversial and only a few studies have attempted to prove its accuracy, based on the evaluation of CHL thickening and increased vascularity in the rotator interval. Recently, the measurement of the capsule of the axillary recess has been proposed as an ultrasound sign of AC, allowing easy analysis and possible during a bilateral comparative examination. A thickness greater than 2.0 mm in the axillary recess capsule measured on ultrasound was correlated with signs of AC on MRI. In all the cases that we evaluated during this period, we observed the same correlation.

Key words: shoulder; adhesive capsulitis; ultrasonography; magnetic resonance imaging

1. Introduction

Adhesive capsulitis (AC) is an inflammatory condition of the shoulder characterized by pain and decreased range of motion, with an incidence ranging from 2% to 5%. [1] It begins with an inflammatory process of the glenohumeral synovial membrane that affects the joint capsule, the coracohumeral ligament (CHL), and the rotator cuff interval (Fig. 1). The main symptoms include persistent pain and gradual joint stiffness, with loss of active and passive mobility, especially with limitation of external rotation of the arm (Fig. 2). The origin is idiopathic, preceded by trauma or associated with diabetes mellitus or conditions such as Dupuytren's disease, among other possibilities. Four clinical stages are recognized in the literature, which begin with shoulder pain and progress to restriction of movement. Patients initially experience pre-freezing pain (pre-adhesive stage), particularly at night, followed by the so-called "freezing," "frozen shoulder," and "thawing" phases, which coincide with the loss and eventual return of mobility.In primary AC, the disease is usually self-limited, lasting 18 to 24 months. However, persistent symptoms and movement restriction beyond three years have been reported in up to 40% of cases, and up to 15% of patients experience permanent disability. [2] Treatment options include physical therapy, intramuscular or intra-articular corticosteroid injections, joint mobilization under anesthesia, and

capsulotomy. [3] Clinical criteria are traditionally considered the standard for diagnosing AC. However, in the early stages, it can be clinically confused with other shoulder conditions, such as glenoid labrum injuries, rotator cuff tears, or secondary to neuropathies; in such cases, imaging modalities are especially useful.

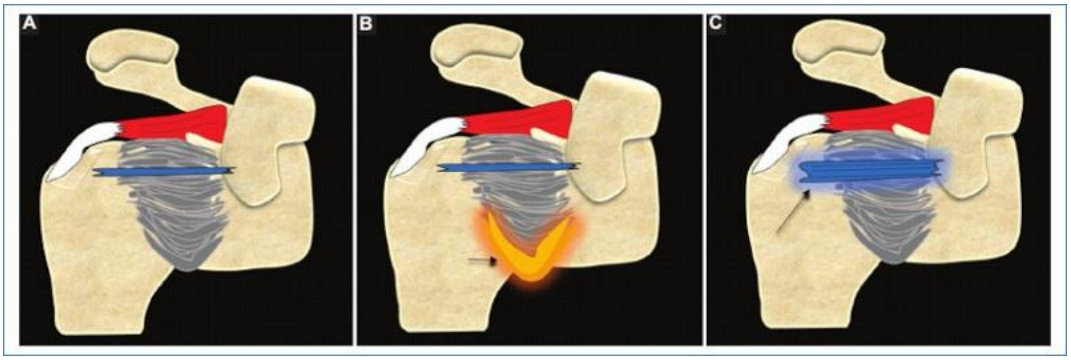

Figure 1. Schematic representation of the main signs of AC in the shoulder. A: Normal.
B: Capsular and inferior glenohumeral ligament thickening with pericapsular edema (arrow).
C: Thickening of the LCH (arrow).

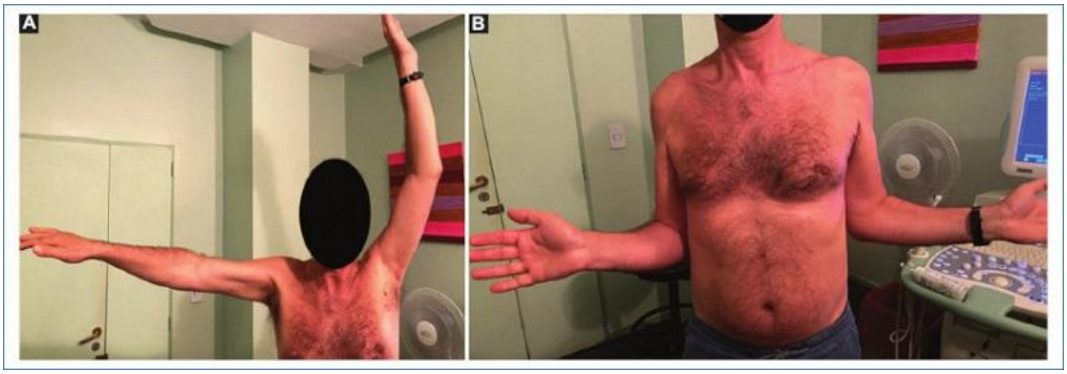

Figure 2. Patient with right shoulder pain and limited arm abduction (A) and external rotation (B).

2. Diagnostic Techniques

Magnetic resonance imaging (MRI) is a commonly used imaging technique to evaluate shoulder pain. Numerous publications have described the evaluation of MR images of the rotator cuff, glenoid labrum, capsule, and biceps tendon, and abnormalities of these structures are frequently described in radiology reports. The diagnosis of frozen shoulder is probably less common, but recognition of this abnormality has an important impact on therapeutic decisions. Typical MRI findings of AC described by Mengiardi et al. [4] are thickening and abnormal signal intensity of the joint capsule in the axillary recess and rotator interval, as well as thickening of the CHL and glenohumeral axillary recess [5] (Figs. 3, 4, and 5). Although several MRI findings have been reported for AC, the role of ultrasound has not been established, and only a few studies have attempted to test its accuracy, based on the assessment of CHL thickening and increased vascularity in the rotator interval. Homsi et al. [6] evaluated CHL accessibility and thickness in asymptomatic patients and in patients with AC, and demonstrated that a thickened CHL is suggestive of AC. However, such assessment is often limited, as it can be difficult to obtain a reliable measurement of the CHL due to its complex anatomy, without clearly definable margins. Other authors evaluated the rotator interval with color Doppler and found that patients diagnosed with acute AC presented increased vascularity in the rotator interval. However, such vascularity can also be altered by biceps or subscapularis tendinopathy, presenting an appearance similar to that of inflammatory fibrous tissue associated with AC. Sernik et al. [7] observed that a thickness greater than 2.0 mm in the axillary recess capsule measured on ultrasound correlated with signs of AC on MRI.

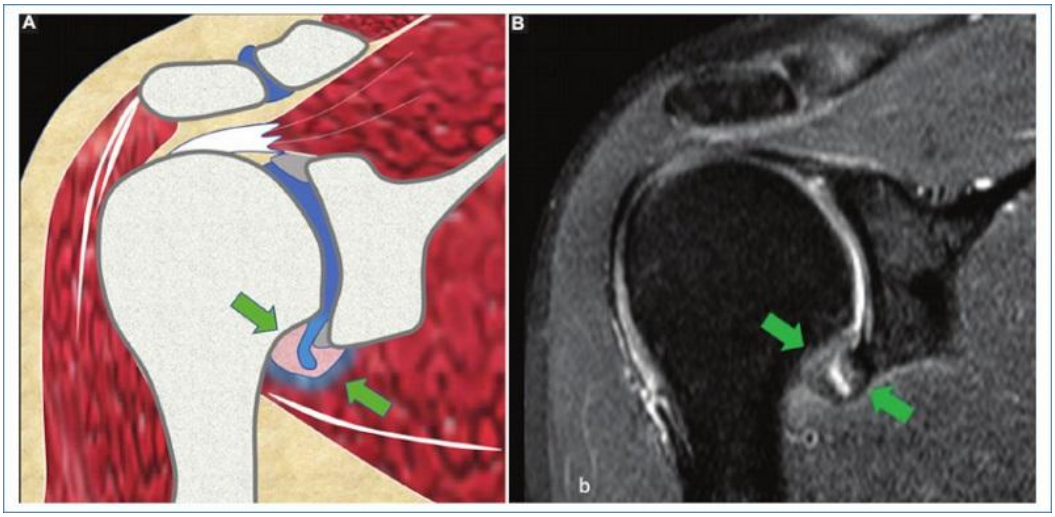

Figure 3. Schematic representation of AC with capsular thickening and inferior glenohumeral ligament thickening with pericapsular edema (A) and STIR MRI in the coronal plane (B).

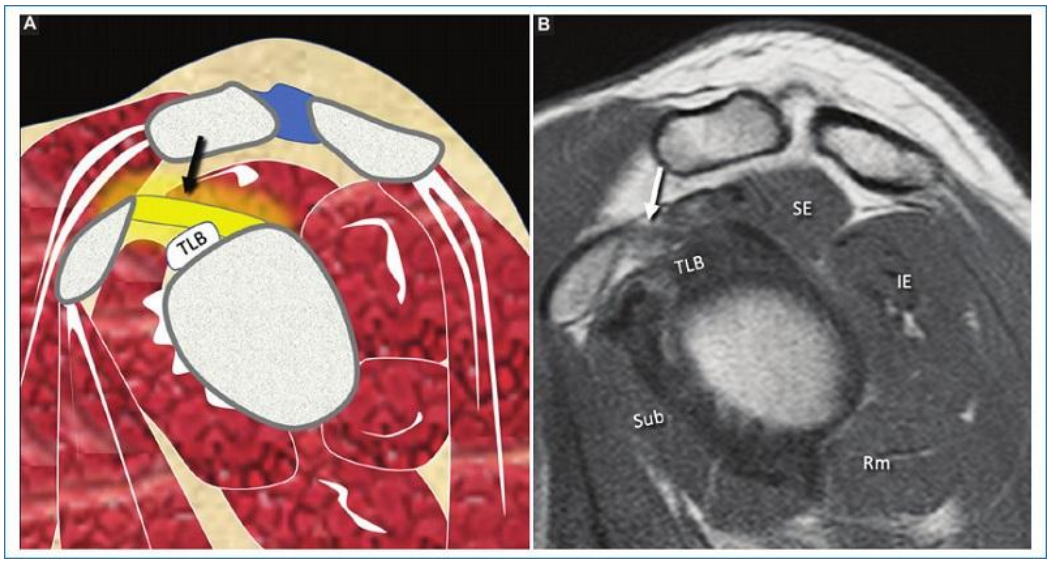

Figure 4. Thickening of the CHL (arrows).
A: Schematic representation. B: MRI, proton density sequence in the sagittal plane. IE: infraspinatus muscle; Rm: teres minor muscle; SE: supraspinatus muscle; Sub: subscapularis muscle; TLB: long head of the biceps tendon.

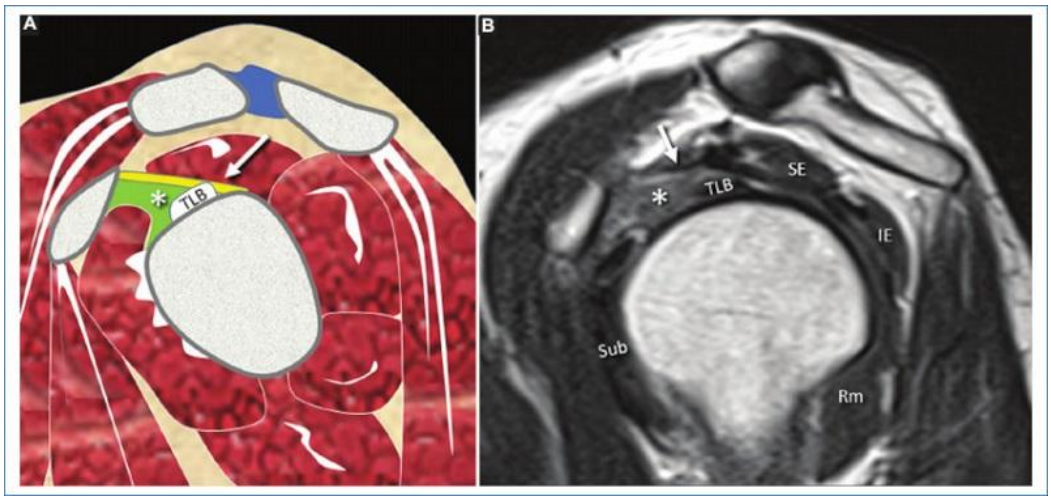

Figure 5. Obliteration of the rotator interval fat pads: asterisk in the schematic representation (A) and in the sagittal T2-weighted MRI sequence (B). Note the normal LCH (arrows).

The ultrasound examination technique is performed with the patient in the supine position, with shoulder abduction at 90° and external rotation of the arm to elongate the axillary recess and the anteroinferior capsulosynovial complex. The transducer is placed in the mid-distal third of the arm along the longitudinal axis, following the bone cortex of the humeral shaft, and is lowered caudally in the axillary projection to achieve correct visualization of the transition between the surgical neck and the humeral head (Fig. 6). Measurements are taken between the tip of the humeral head and the surgical neck. Furthermore, patients with normal capsule thickness on ultrasound have been reported to show no signs of AC on MRI. These findings are in agreement with MRI studies that have shown that capsular thickening and edema in the axillary recess are highly accurate for diagnosing AC and for staging it. Kim et al. [8] compared the axillary recess capsule thickness on ultrasound and MRI in patients with clinically established AC and showed that these measurements correlate. [8, 9] They also found that the axillary recess thickness was significantly greater in the affected shoulder compared with the unaffected shoulder. In their study, asymptomatic patients had a capsule thickness less than 2.0 mm at maximum shoulder abduction, and all patients with AC had an axillary recess thickness of 2.2 mm or greater.

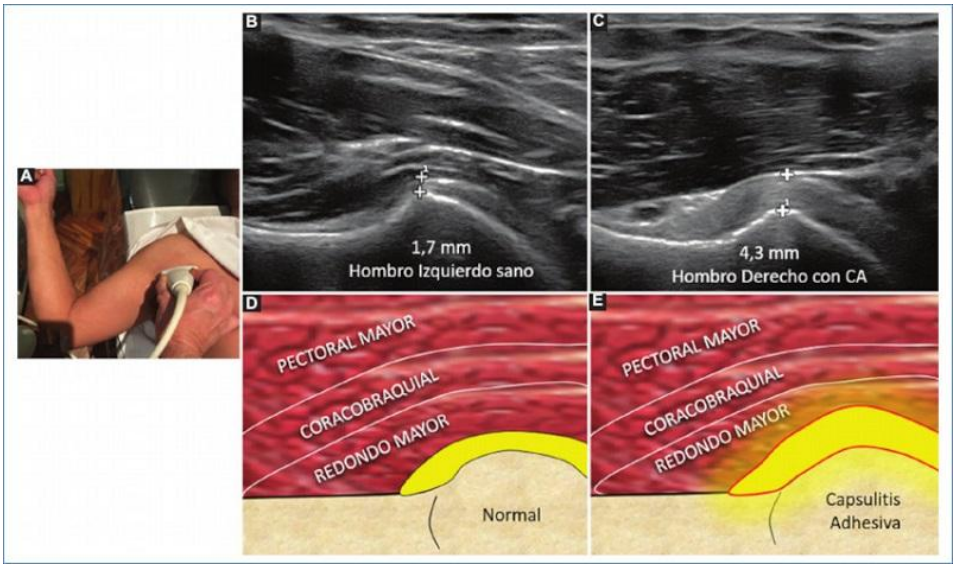

Figure 6. Ultrasound examination technique of the axillary recess. A: Ultrasound image and schematic representation in the normal left shoulder. B and D: The thickness of the inferior glenohumeral ligament is 1.7 mm, and in the right shoulder with AC. C and E: The thickness of the inferior glenohumeral ligament is 4.3 mm.

Ultrasound evaluation of the axillary recess capsule offers the advantage of easy analysis and bilateral comparative examination. The most important clinical relevance is the identification of a valid correlation between the axillary recess capsule thickness measured on ultrasound and MRI findings considered highly suggestive of AC, allowing sonographers to consider this condition in patients with shoulder pain and a thickened axilla. These data can avoid unnecessary MRI examinations, which are often required in patients with shoulder pain. Furthermore, the maneuver suggested for axillary recess measurements is easily reproducible and includes recognizable anatomical landmarks.

3. Conclusion

During the COVID-19 pandemic, we have seen an exponential increase in AC cases in our outpatient clinics. All patients evaluated by ultrasound with suspected AC during that period and who were able to complete MRI showed the same correlation described regarding thickening of the glenohumeral axillary recess. Of all the AC characteristics that can be assessed by ultrasound, measuring the capsule thickness in the axillary recess is the simplest and easiest to perform, for both general and musculoskeletal sonographers. This maneuver should be added to the ultrasound protocol for shoulder assessment, especially in patients with acute pain, limited range of motion, and clinical suspicion of AC.

Ethical Responsibilities

Protection of Humans and Animals. The authors declare that no experiments were performed on humans or animals for this research.

Data Confidentiality. The authors declare that they have followed their workplace's protocols regarding the publication of patient data.

Right to Privacy and Informed Consent. The authors have obtained informed consent from the patients and/or subjects mentioned in the article. This document is in the possession of the corresponding author.

Use of Artificial Intelligence to Generate Texts. The authors declare that they have not used any type of generative artificial intelligence in the writing of this manuscript or for the creation of figures, graphs, tables, or their corresponding captions or legends.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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