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Diagnostic and therapeutic value of ultrasonography in calcific tendinitis of the rotator cuff: implications for clinical practice

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ABSTRACT

Introduction:

Calcific tendinitis of the rotator cuff is a common musculoskeletal disorder characterized by calcium salt deposits in the tendons of the shoulder's rotator muscles. Initially asymptomatic, it can cause persistent pain, limited mobility, and a reduced quality of life as the condition progresses. Diagnosis is typically made using clinical evaluation and imaging, with ultrasonography being the preferred non-invasive method, while treatment options range from conservative approaches to advanced ultrasound-guided percutaneous interventions.

Aim:

The aim of this article is to explain the pathogenesis of calcific tendinitis of the rotator cuff of the shoulder joint and to discuss the use of ultrasound in the diagnosis and treatment of the condition.

Review methods:

A detailed analysis of recent scientific studies on the treatment and diagnosis of calcific tendinitis of the rotator cuff was conducted. The studies available in PUBMED were analyzed, and the following keywords were used to search for sources: rotator cuff, calcific tendinitis, ultrasonography, percutaneous treatment.

Conclusion:

Owing to its real-time imaging capabilities and clinical accessibility, ultrasonography plays a central role in both the diagnosis and minimally invasive treatment of calcific tendinitis. The procedure contributes to significant pain relief, improved shoulder function, and faster return to daily activities for affected patients.

Keywords:

rotator cuff; calcific tendinitis; ultrasonography; percutaneous treatment

Introduction

Calcific tendinitis of the rotator cuff is a musculoskeletal condition characterized by the deposition of calcium salts within the tendons of the shoulder's rotator muscles. While often asymptomatic in early stages, it may lead to persistent shoulder pain, restricted mobility, and a significant decline in quality of life. The leading etiological theory attributes the condition to microtrauma caused by repetitive mechanical overload, resulting in localized tendon damage and subsequent dystrophic calcification. Diagnosis is based on clinical history, physical examination, and imaging studies. Ultrasonography (US) is considered a first-line diagnostic tool due to its non-invasive nature, wide availability, and lack of ionizing radiation. It allows for the visualization of calcific deposits, assessment of their structure and size, and evaluation of inflammatory changes in surrounding tissues. Management options include conservative treatment (e.g., analgesics, physiotherapy), surgical procedures, and increasingly popular ultrasound-guided percutaneous interventions, particularly in the acute phase. This technique involves inserting one or two needles into the calcific focus to dissolve and aspirate the deposits. High-frequency ultrasound probes enable accurate localization of the lesion, real-time monitoring of the procedure, and minimization of complications.

Materials and methods

A thorough analysis of recent scientific studies on the treatment and diagnosis of calcific tendinitis of the rotator cuff was conducted. The studies available in PUBMED were analyzed, and the following keywords were used to search for sources: rotator cuff, calcific tendinitis, ultrasonography, percutaneous treatment.

Pathogenesis

The presence of calcific deposits in the tendons of the rotator cuff muscles is a common issue in the diagnosis of shoulder disorders, with the deposits most commonly being in the form of hydroxyapatite. These calcifications mainly localize in the supraspinatus tendon (about 80%) and in the infraspinatus tendon (15%) [1, 2]. The condition affects 2% to 7% of adults, with about 70% of cases occurring in women aged 40-50. Calcifications are typically unilateral, although they appear bilaterally in 20% of patients. It is believed that there is no direct correlation between this condition and the level of physical activity [3].

The pathological deposition of calcium in the rotator cuff tendons may be the result of episodes of localized ischemia or chronic reduced blood supply to the tendons, leading to microdamage [4]. Ischemia may result from excessive tendon loading, caused by improper shoulder joint biomechanics and misalignment of its components.

There are four stages in the development of the condition, each presenting different symptoms: the pre-calcification phase, calcification phase, resorption, and repair phase [5]. The pre-calcification phase rarely causes symptoms and is characterized by the development of fibrocartilaginous metaplasia due to microinjuries and tendon ischemia. Subsequent calcification of the metaplastic deposits leads to the formation of calcific foci causing mild, subacute pain, which worsens mainly at night and with sudden movements of the joint. Phagocytic cells active during the resorption phase then cause the gradual dissolution of the calcium deposits. This stage results in increased pressure within the tendons and the most characteristic symptom of the condition, which is sharp, intense pain limiting the range of motion of the entire joint. After the resorption phase, the repair stage follows, during which the inflammatory process subsides, and the tendon gradually returns to its original structure [6].

In some cases, the condition may resolve spontaneously through naturally occurring repair processes. However, in cases of severe pain and advanced disease, appropriate treatment must be initiated. The most commonly used therapeutic method is ultrasound-guided barbotage [7]. The use of ultrasonography not only allows for fast and effective treatment but also precise diagnosis of calcific tendinitis of the rotator cuff [8].

The use of ultrasound in diagnostics

Ultrasonography (US) is a commonly used method for evaluating soft tissues in the body, particularly appreciated for its lack of exposure to ionizing radiation and the ability to avoid the limitations associated with magnetic resonance imaging. In the context of diagnosing calcific tendinitis of the rotator cuff, US allows for a precise assessment of tendon damage, its location, extent, and identification of the accompanying inflammatory process. This method also enables the classification of calcification types within the tendons [9].

Calcifications can occur in three types, differing in calcium salt content. Type I is characterized by hyperechoic, homogeneous foci with a clear acoustic shadow, indicating a high calcium content. In Type II, a reduced amount of calcium salts results in a weaker acoustic shadow. Types I and II calcifications are solid in nature. Type III consists of nearly isoechoic calcifications that often do not produce an acoustic shadow and are difficult to

detect; they have a semi-fluid form and occur during the resorption phase of the disease [10]. High-frequency sonograms are particularly useful in diagnosing this condition, allowing for the detection of even microscopic calcium deposits and precise localization within the tendons. US also provides information about the size, shape of the calcifications, and the condition of the tendons [11]. Another advantage of ultrasonography is the ability to compare results with the contralateral limb and to dynamically assess the presence of subacromial impingement or subacromial crowding. Furthermore, this technique enables precise monitoring of drug administration or performing percutaneous treatment at the designated site [12].

Despite its numerous advantages, US has certain diagnostic limitations. The detection of calcifications may be hindered by their location, particularly in the region of the acromion process of the scapula [13]. Moreover, ultrasonography does not provide complete information about the consistency of the calcifications, which is important when selecting the appropriate treatment method [14]. Nevertheless, US remains an indispensable diagnostic tool, providing detailed data necessary for developing an effective treatment plan for the patient.

Treatment with ultrasound

Percutaneous removal of calcifications is an effective non-surgical treatment method for calcific tendinitis of the rotator cuff. The procedure involves aspiration and dissolution of calcium using a needle (or needles) under ultrasound guidance. It is particularly indicated in the acute stages of the disease, especially when type II or III calcifications are visible on ultrasound imaging. For type I calcifications, the decision to perform the procedure depends on the size of the deposits. Percutaneous treatment is not recommended for small deposits (<5 mm) or when the deposits migrate to the bursa or erode toward the humeral bone [15].

Currently, percutaneous removal of calcifications is the preferred treatment method due to its low invasiveness, quick execution, low cost, and minimal risk of complications. A heated saline solution is injected into the calcification [16]. To reduce patient discomfort, local anesthesia is applied before aspiration. Depending on the physician's preference, the procedure may be performed with one or two needles [17].

In the single-needle technique, saline is slowly introduced into the calcification while simultaneously aspirating the calcium from inside. The needle is positioned with the cutting edge facing upward, which allows for effective flushing and aspiration. The entire process is performed under ultrasound guidance, ensuring precise execution of the procedure. The procedure continues until the calcification is completely cleared, after which a steroid is injected into the bursa to prevent inflammation [18, 19].

In the double-needle technique, after local anesthesia is applied, two needles are inserted, one to introduce saline solution and the other to flush out the calcium deposits. This technique allows for continuous flow of the solution, which increases the effectiveness of the procedure [20]. As with the single-needle method, ultrasound guidance is crucial for proper needle placement. Although some researchers point to the potential risk of tendon damage when using the double-needle technique [21], previous studies have not confirmed this association.
Regardless of the technique used, ultrasonography plays a key role in ensuring precise execution of the procedure, monitoring progress, and accurately administering medications. Due to its minimal invasiveness, this procedure allows for a rapid return of the patient to full functionality [22].

Other therapeutic options

Asymptomatic calcific tendinitis of the rotator cuff usually does not require therapeutic intervention, as the condition often resolves spontaneously. For mild symptoms, conservative management and appropriately chosen physiotherapy are recommended [23]. Conservative treatment for calcific tendinitis of the rotator cuff is effective in up to 80% of cases [24] and is the primary therapeutic strategy. This includes pharmacotherapy, physiotherapy, and temporary restriction of activity. Oral nonsteroidal anti-inflammatory drugs (NSAIDs) are commonly used to alleviate pain related to shoulder joint movement. In the acute pain phase, typical of the resorption stage of calcifications, a local steroid injection into the subacromial space can be an effective intervention. Stabilizing orthopedic braces are also used to reduce the load on the affected shoulder, but regular and targeted rehabilitation, enabling the restoration of full joint range of motion, plays a crucial role in recovery [25].
An alternative supporting treatment method is shockwave therapy, which has shown high effectiveness in pain reduction and improving shoulder function [26]. The use of high-energy shockwaves can result in improvement for over 80% of patients, although some experience only partial resolution of calcifications or no clear response to the therapy [27]. It has been observed that prior ineffective shockwave treatment for patients with calcific shoulder tendinopathy does not affect the outcome of percutaneous treatment under ultrasound guidance [28].
In cases resistant to conservative treatment and physiotherapy, surgical intervention may be necessary. The preferred surgical technique, due to its lower risk of complications and comparable effectiveness to traditional open surgeries, is arthroscopy [29]. However, this method requires access to specialized equipment and hospital settings, and recovery after the

procedure may involve a longer period of work disability. Despite these limitations, surgical treatment remains an important part of the therapeutic algorithm for patients who do not respond to other forms of therapy [30].

Conclusions

Calcific tendinitis of the rotator cuff is a condition with a complex pathogenesis, often affecting middle-aged women, with symptoms ranging from an asymptomatic course to severe, acute shoulder pain. Ultrasonography plays a key role in both diagnosis and treatment, as its high resolution allows for the detection and classification of calcium deposits and precise monitoring of the treatment process. US also enables dynamic evaluation of periarticular structures, which supports accurate diagnosis and selection of the appropriate therapeutic approach. In non-surgical treatment, percutaneous removal of calcifications under ultrasound guidance is increasingly used due to its low invasiveness, effectiveness, and rapid return to functionality. Alternative methods, such as shockwave therapy, pharmacotherapy, or physiotherapy, remain valuable components of therapy, particularly in milder cases. An interdisciplinary approach, combining medicine, physiotherapy, and modern imaging diagnostics, is the foundation of effective treatment for this condition.

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