

R E V I E W

Ultrasound-guided percutaneous irrigation of calcific tendinopathy: technical developments

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Summary. Rotator cuff calcific tendinopathy (RCCT) is a common and painful shoulder disease characterised by deposition of calcium into the rotator cuff's tendons. Different therapeutic options have been proposed, but the ultrasound-guided percutaneous irrigation (US-PICT) is been proved as an effective and safe first-line treatment. It can be performed with a single- or a double-needle technique, using warm saline solution to improve the dissolution of the calcific deposit. The procedure is ended with an intrabursal injection of local anaesthetics and slow-release steroids to improve the pain relief and to prevent complications. US-PICT leads to significant improvement in the shoulder function and pain relief in the short and long term, with a low complications rate. (www.actabiomedica.it)

Key words: rotator cuff, shoulder, ultrasound-guided procedures, calcific tendinopathy, percutaneous treatments

Introduction

Rotator cuff calcific tendinopathy (RCCT) is a common disease, with a reported prevalence of 2.5% up to 7.5% of asymptomatic adults, and up to 30-40% of painful shoulders, typically seen in women in the 4th or 5th decade and in sedentary workers (1-3).

Aetiology of this condition is still poorly understood, but the most convincing mechanism is that a decrease of intratendinous oxygen concentration may promote tendon fibrocartilaginous metaplasia and cellular necrosis, followed by deposition of calcium, mainly hydroxyapatite (4).

Diagnostic and interventional radiology in the musculoskeletal system are widely used (5-21). Regarding to the US imaging (22-24), three types of calcifications can be found: type I - a hyperechoic focus

with a well defined shadow; type II - a hyperechoic focus with a faint shadow; Type III - a hyperechoic focus without an acoustic shadow (Fig. 1) (25).

In the RCCT's pathogenesis 4 stages are recognizable:

- Precalcific stage with fibrocartilaginous transformation within the tendon.
- Formative stage with calcium deposition
- Resorptive phase.
- Postcalcific phase, in which self-healing and repair of the affected tendon occurs.

The resorptive phase is characterized by hyperemia, edema, increased intratendinous pressure with possible extravasation of calcium crystals in the subacromial bursa. Usually this stage is associated with the development of acute pain, that can be very disabling (pseudoparalytic shoulder) and unresponsive to con-

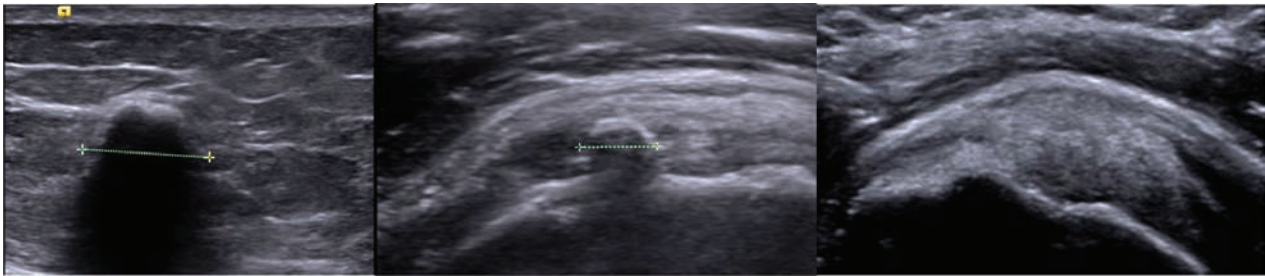


Figure 1. US findings of shoulder calcifications, as described by Farin et al.: (A) a hyperechoic focus with a well defined shadow (B) a hyperechoic focus with a faint shadow (C) a hyperechoic focus without an acoustic shadow

servative treatments such as nonsteroidal anti-inflammatory drugs (NSAIDs) (26).

The most affected tendon of the rotator cuff is the supraspinatus (80%), followed by the lower side of infraspinatus (15%) and the preinsertional area of the subscapularis tendon (5%) (8, 27-31).

Therapeutic options include subacromial steroid injections, arthroscopy, and extracorporeal shockwaves. Currently ultrasound-guided percutaneous irrigation of calcific tendinopathy (US-PICT) is accepted as the first-line safe and effective treatment for RCCT, with significant pain improvement and a very low rate of minor complications (vasovagal reaction, bursitis) (32).

This procedure is also known as “barbotage” and “lavage”, it does not require hospitalization, is performed under local anesthesia and there is no need of post-procedural immobilization. The patient can go home about 30 minutes after the procedure and return the day after the treatment to his daily activities.

Procedure details

- *Pretreatment evaluation:*

US-PICT is always indicated in the resorptive phase, in presence of soft or semi-fluid calcifications (type II or III). In case of hard calcification (type I) or mildly symptomatic patient, elective treatment should be considered. With very small calcifications (<5 mm) or migration into the bursal space the procedure is not indicated (33).

- *Patient positioning and antisepsis:*

The procedure is performed with the patient in

semisupine position, the arm of the affected shoulder should lie completely extended along the body with an internal/external rotation according to the calcification's location.

Ordinary antisepsis is generally sufficient to guarantee a safe procedure for both the patient and the operator.

- *Local anaesthesia:*

A small amount of local anaesthetic (up to 10 ml of lidocaine) is injected along the path of the needles, into the subacromial-subdeltoid bursa (almost two thirds) and around the calcifications. In order to preserve the peripheral calcific rim, no anaesthetic solution should be injected directly within the calcification.

Positioning of the needles and irrigation procedure:

The procedure can be done with a single or double needle technique (Figg. 2, 3).

The size of the needle should be chosen in order to maximize calcium retrieval and avoid obstruction, in other published studies for RCCT treatment varies between 16 and 18 G. Every approach is done under continuous US monitoring, with a free-hand technique or with needle guidance kit, but the first one is faster and allows a more flexible approach. In the double-needle technique the needles are inserted depending on the location and accessibility to the calcification. Both needles should be as perpendicular as possible to the US beam so anisotropy artifacts are minimized and needles can be seen thoroughly (Fig. 4). The deeper needle is first inserted, taking care to preserve the integrity of the calcific shell, than the second needle is inserted su-



Figure 2. (A) US probe and needle positioning with the one-needle technique. (B) Ultrasound image of a soft-fluid calcification (type III). After the puncture and the washing, a leakage of toothpaste-like material is seen from the needle



Figure 3. Image shows the needles positioning in the double-needle technique. The deeper needle (1) inserted first, than the second needle is inserted superficial to the first one. Is important to position the needles as much perpendicular as possible to the US beam to achieve optimal visualization under US guidance

perficially. The correct angulation of the needles's tips should be 25-30°, with both bevels facing each other, to allow a continuous flow of water that is injected from one needle and drained by the other (Fig. 5) (34). Saline solution is normally injected using 20/40-ml syringe in one needle, the plunger pushed repeatedly and when the calcification starts to dissolve, water and calcium debris are drained from the second needle.

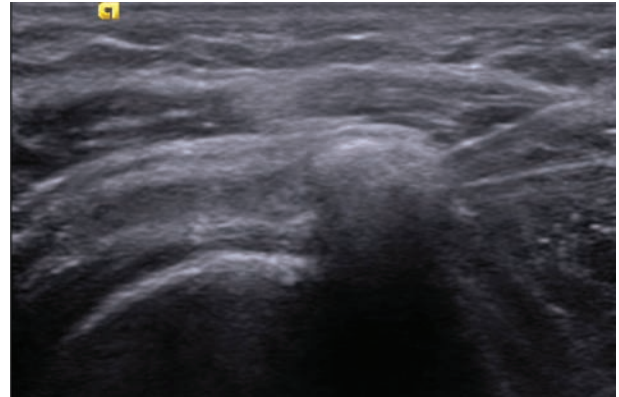


Figure 4. Ultrasound image of the double-needle technique. Both needles lay on the same coronal plane, with a correct angulation (25-30°) and both bevels facing each other

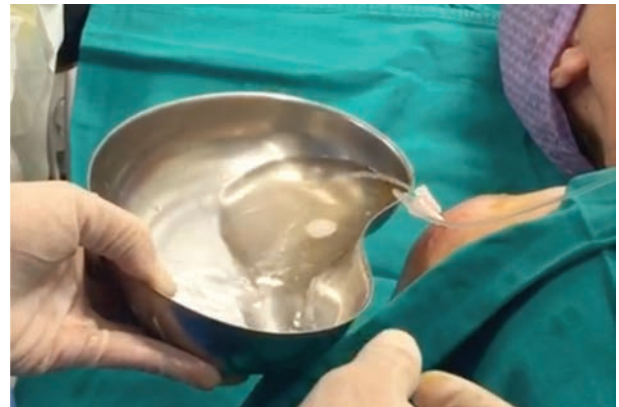


Figure 5. The flow of saline water, injected from one needle and drained by the other, using the double-needle technique.

During the irrigation procedure needles can be rotated and displaced to increase calcium disaggregation and fragmentation. The use of warm saline solution may shorten the procedure and improve calcification dissolution (Fig. 6) (2).

Postprocedural treatment

At the end of the procedure, to reduce the risk of postprocedural bursitis, US-guided intrabursal injection of local anaesthetics and slow-release steroids is indicated (35).

After the treatment a short course of nonsteroidal anti-inflammatory drugs (NSAIDs), a period of relative rest (~15 days), and physiokinetic therapy are recommended.



Figure 6. (A) Out-flow of calcium deposit with toothpaste-like consistency. (B) After few minutes the calcium tends to form aggregates.

Clinical outcome and complications

In the short-term period the worsening of symptoms is frequent, but normally followed by a quick resolution (~48 h). In the middle and long-term period many authors reported a greater reduction of pain, compared to patients who refused the treatment, and a significant improvement of shoulder function.

A recent systematic review reported a 10% complication rate: bursitis was the most frequent, that occurred in 7% of all procedures. Other complications included vasovagal reactions (2%), frozen shoulder (0,2%), seizures (0,2%), tenosynovitis of the bicipital long head (0,1%) (2) (36).

Conclusions

Magnetic Resonance Imaging (MRI), thanks to its excellent soft tissue contrast and multiplanar capability, is the primary imaging tool for a variety of conditions and diseases both for diagnostic and interventional purposes (37-48) but US-PICT has been demonstrated to be a quick, minimally invasive, low cost and effective procedure for treating RCCT, regardless of the use of a single- or double- needle technique. It lead to significant long term improvement in the shoulder function and is very effective in the short term with regard to pain relief.

Ethical approval: This article does not contain any studies with human participants performed by any of the authors.

Conflict of interest: None to declare

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