Ultrasound-Guided Hydraulic Release Associated With Corticosteroids in Radial Tunnel Syndrome

Description of Technique and Preliminary Clinical Results

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The aim of this study was to describe a perineural ultrasound-guided infiltration technique for management of radial tunnel syndrome and to report its preliminary results in 54 patients. A mixture of a saline solution, a local anesthetic, and a corticosteroid solution was infiltrated in the perineural region at the arcade of Frohse. Pain was reported in 100% of patients before the procedure versus 1.9% after the procedure. Scratch collapse and Cozen test results were positive in 98.1% and 66.7% of patients before infiltration, respectively, versus 5.6% and 9.2% after infiltration. All variables had statistically significant differences between preprocedure and postprocedure evaluations ($P < .01$).

Key Words—interventional radiology; musculoskeletal ultrasound; posterior interosseus nerve; ultrasound-guided infiltration

Radial tunnel syndrome (RTS) is an uncommon misdiagnosed source of pain to the elbow and forearm. Intermittent compression of the radial nerve or the deep branch in the forearm, the posterior interosseous nerve (PIN), is thought to be the pathologic basis for RTS. The supinator fascia (arcade of Frohse) is the most common cause of compression of the radial nerve. Other causes of compression of the radial nerve include prominent recurrent radial vessels, a thickened/fibrous edge of the extensor carpi radialis brevis, and schwannoma-like swelling of the radial nerve.[1]

Radial tunnel syndrome presents with lateral elbow and forearm pain without weakness and is distinguished from PIN palsy by the absence of motor loss. Diagnosis is based primarily on the patient's history and physical examination, as nerve conduction test and radiologic study results are typically negative.[1,2] Patients with RTS have characteristic pain at the area of entrapment, which, typically, is located at the lateral forearm 5 cm distal to the lateral epicondyle. Occasionally, vague wrist pain also may be present.[3]

The diagnosis of RTS and even the existence of the phenomenon have been subjects of controversy for many years.[4] The differential diagnosis for RTS includes lateral epicondylitis, an extensor carpi radialis brevis tear, osteoarthritis or synovitis of the radiocapitellar joint, and posterior plica impingement. Some surgeons

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Abbreviations

PIN, posterior interosseous nerve; RTS, radial tunnel syndrome; US, ultrasound

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believe that radial nerve compression in patients with RTS is not severe enough to cause radial sensory or motor dysfunction, but, instead, radial nerve irritation is perceived as pain.[5]

Many nonsurgical options in the management of RTS have been described, including immobilization of the wrist with splinting or casting, anti-inflammatory medication, ultrasound (US) massage, and physical therapy, with minimal efficacy in relieving symptoms.[6,7] Otherwise, surgical approaches to decompress the radial nerve have been reported, with variable success in limited case series.[8]

Only a few studies described the use of corticosteroid and/or local anesthetic injections in the treatment of RTS, with variable outcomes.[9–11] The objective of these infiltrations was to reach the tender region with medications to achieve an enhanced therapeutic effect. The aim of this study was to describe a US-guided perineural infiltration technique for injecting a mixture of a saline solution, a local anesthetic, and a corticosteroid solution to cause release of the radial nerve in the forearm and to report the preliminary clinical results from a case series.

Materials and Methods

Patients

Fifty-four patients who were referred to the Clinica Meds Department of Musculoskeletal Interventional Radiology between January 2016 and December 2018 from the Clinica Meds Department of Orthopedics and had a diagnosis of RTS with an indication for perineural infiltration treatment were retrospectively evaluated. The following parameters were recorded before and after the procedure (evaluated 4 weeks after infiltration): pain (as a dichotomic variable: yes or no), scratch collapse test (positive or negative results),[12,13] and Cozen test (positive or negative result).[14] The McNemar statistical test was used to determine differences between preprocedure and postprocedure variables, using $P < .01$ and the 95% confidence interval. All patients had a US evaluation of the elbow, with special emphasis on a PIN evaluation. The patients were provided detailed information about the procedure, and informed written consent was obtained. The local Ethics Committee approved the study.

Technique

The procedure was performed by a radiologist who specializes in US-guided musculoskeletal injections. An Aplio 500 US system (Toshiba America Medical Systems, Inc, Tustin, CA) equipped with a multifrequency linear transducer was used. A frequency of 18 MHz was chosen.

The patient was placed in the supine position on a flat table, with the forearm lying on the table in a midprone position (Figure 1). Then, US was used to locate the arcade of Frohse and PIN. First, the main trunk of the radial nerve was observed in the hyperechoic space between the brachialis and brachioradialis muscles, superficial to the humeral capitellum. Subsequently, the nerve was followed distally until the PIN appeared at the level of supinator muscle, between the superficial and deep bellies. Once the nerve was located, the injection site was marked on the skin.

The infiltrating solution was prepared. The solution consisted of 1 mL of a corticosteroid solution (5 mg of betamethasone dipropionate acetate and 2 mg of betamethasone sodium phosphate; Cronolevel; MSD,

Figure 1. Patient position on the table, transducer, and needle insertion site in a lateral-to-medial approach.

Santiago, Chile) diluted in 2 mL of a local anesthetic (2% lidocaine; Euro-Med Laboratories, Manila, Philippines) and 1 to 2 mL of a saline solution. Then, under strict aseptic conditions, the transducer was inserted into a sterile transducer cover after application of US gel. Infiltration was performed at the anatomic plane between the PIN and the arcade of Frohse with a 23-gauge needle. The insertion was done with a needle inclination of 45° to lateral or in an oblique plane in a lateral-to-medial approach, taking into account the multiple venous superficial branches in the cubital fossa (Figure 2). The prepared solution was then infiltrated, which caused debridement of the PIN (Figure 3). It is important to reach the exact anatomic plane adjacent to the PIN, so the injection volume could have been less than 5 mL. A freehand technique was used for injection. With this method, the transducer is held in one hand while the free hand pushes the needle toward the arcade of Frohse, as perpendicularly as possible to the US beam to identify the route of the needle.

Results

The 54 patients included 38 women and 16 men with a mean age of 45.1 (SD, 11.5) years. In the preprocedure US evaluations, 52% of patients had nerve swelling. Two patients (4%) had moderate epicondylitis but also had PIN alterations. Both of them had previously failed conservative treatment for this condition, so they were clinically reevaluated, and RTS was diagnosed concomitantly. The procedure was performed in all patients without any incidents. No adverse effects were observed. The time taken for the procedure was approximately 20 minutes.

Pain was reported in 100% of patients before the procedure. Scratch collapse and Cozen test results were positive in 98.1 and 66.7% of patients, respectively, before infiltration. After the procedure, only 1.9% of the sample reported pain, whereas 5.6% and 9.2% had positive Scratch collapse and Cozen test results. All variables evaluated had statistically significant differences between preprocedure and postprocedure evaluations ($P < .01$).

Discussion

Only a few studies evaluated corticoids and/or anesthetic injections in RTS. Ritts et al[9] demonstrated a good prognostic effect of radial nerve blocks in concomitant surgical treatment. Sarhadi et al[10] reported on 25 patients with RTS who were treated with a single injection of 40 mg of triamcinolone in 1 mL of a carrier and 2 mL of 1% lidocaine and found that 18 patients (72%) improved at 6 weeks, whereas 16 patients (62%) continued to be pain free for 2 years. Surgical decompression was performed in 9 patients (36%) because of failed nonsurgical treatment.

Another experience[11] used a single corticosteroid injection (0.25 mL of 1% lidocaine and 0.75 mL of betamethasone [Celestone; Merck & Co, Kenilworth, NJ] at 6 mg/mL) administered in the area of maximal

Figure 2. Transverse plane at the PIN (red arrowhead) in the arcade of Frohse, with the needle (red arrow) in a lateral-to-medial approach, going through the supinator muscle (asterisk). White arrowhead indicates brachialis muscle.

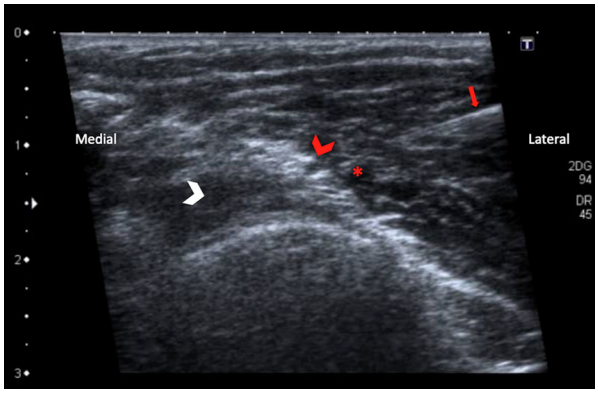
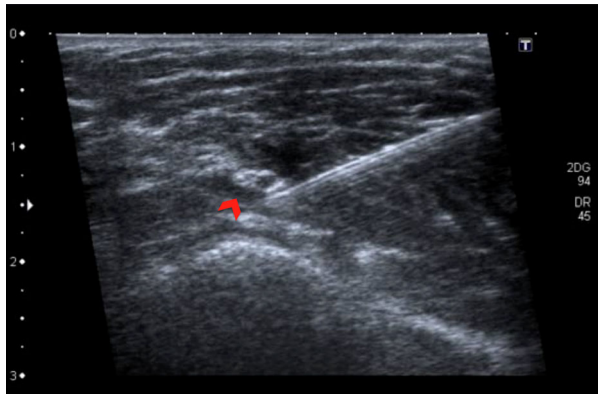


Figure 3. Debridement of the PIN after infiltration in the perineural space (red arrowhead).



tenderness in the forearm in 35 patients. They described a discernable effect in 57% of patients at 1 year of follow-up; 23% of patients failed to improve after injection and went to radial tunnel decompressive surgery.

Almost all of these techniques emphasize infiltration of a local corticosteroid and/or anesthetic solution. Although there is little knowledge about physiopathologic mechanism of RTS, it seems that an inflammatory process is only a secondary feature of the problem. It seems that repetitive pronation and supination of the forearm may cause symptoms in RTS secondary to compression-induced neuronal swelling (endoneural inflammation, edema, fibrosis, demyelination, and remyelination).[15] The infiltration technique we describe, which uses higher volumes of a local anesthetic, corticosteroid, and saline solution delivered to the arcade of Frohse, is based on the need to liberate the radial nerve from any anatomic structure in the forearm, dealing with what seems to be the main culprit of this syndrome.

This feature could explain the better outcome in our case series in comparison to the other data published. Another fact that could favor these results is the use of US. The effectiveness of US guidance in musculoskeletal injections involving small structures is well documented.[16–18] In the particular case of RTS injections, US plays an essential role because it helps make sure that the solution delivered is well located. To our knowledge, this is the first experience of injection therapy under US guidance in RTS. Another advantage of using US guidance is to minimize the risk of adverse effects, particularly nerve injury. This technique could also serve as diagnostic test, similarly to the lidocaine test in hip arthrography.

Some weaknesses of the study should be recognized. Only limited patient data were included, and there was a lack of long-term follow-up. There was no control cohort, so it remains unknown what proportion of pain relief might have been attributed to a placebo effect of injection.

In conclusion, US-guided perineural injection using a mixture of a saline solution, a local anesthetic, and a corticosteroid solution in patients with RTS was a safe procedure that gave very good preliminary results for symptom relief. The procedure could be a diagnostic and therapeutic test, as an alternative for management of the disease before surgery.

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