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Original Article

Management of rotator cuff calcific tendinosis guided by ultrasound elastography

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Abstract

Background: Ultrasound (US) elastography can provide information about the hardness of calcification and might help decide treatment strategy. The purpose of this study was to evaluate the hardness of the calcific area within rotator cuffs by US elastography as an aid for the selection of aspiration or fine-needle repeated puncture for the treatment of rotator cuff calcific tendinosis.
Methods: This prospective study included 39 patients (32 males, 7 females; mean age, 52.9 years) who received US elastography and gray-scale ultrasonography before US-guided treatment for rotator cuff calcific tendinosis. The morphology of the calcifications was classified as arc, fragmented, nodular, and cystic types. US elastography using virtual touch imaging (acoustic radiation force impulse) technique was performed to examine the calcified region to obtain an elastogram that was graded dark, intermediate, or bright. The hardness of the calcifications were recorded, and graded as hard, sand-like, or fluid-like tactile patterns during the US-guided treatment, and the tactile patterns were compared with the results of US elastography and gray-scale ultrasonography.
Results: Though the morphologies of the calcifications were significantly related to the tactile pattern of the needle punctures ($p < 0.001$), gray-scale US could not accurately demonstrate the hardness of the calcifications. With the aid of elastography, the fluid-like tactile pattern could be predicted well as a nondark pattern by elastography ($p < 0.001$).
Conclusion: Ultrasound elastography is a useful modality for evaluation of rotator cuff calcific tendinosis, and as an aid to guide management. If elastography shows the calcified area as a non-dark pattern, then fine-needle aspiration should be performed.

Keywords: calcific tendinosis; fine-needle repeated-puncture treatment; rotator cuff; ultrasound elastography

1. Introduction

Rotator cuff calcific tendinosis is one of the common tendon degenerative conditions, occurs more commonly on the supraspinatous tendon,[1] and usually causes inflammation and pain over the shoulder region. It has been reported that chronic or acute calcific tendinitis is predominantly caused by the deposition of hypdroxyapatite in the periarticular tendon.[2] Calcific tendinosis can be diagnosed by plain radiography, gray-scale ultrasonography (US), computed tomography (CT), or magnetic resonance imaging (MRI). On gray-scale US, calcific tendinosis may be categorized as arc, fragmented, nodular, and cystic types.[3] On the basis of hemodynamic changes, there is also a good correlation between color Doppler US (CDUS) and clinical symptoms of pain, and the

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prognosis of calcification can be predicted from CDUS findings.[3,4] The management of rotator cuff calcific tendinosis is varied, and treatments include physical therapy with a short course of oral nonsteroid anti-inflammatory drugs,[1] lithotripsy by arthroscopy[5,6] or an imaging-guided fluoroscopic procedure,[7,8] extracorporeal shockwave therapy,[9,10] and US-guided techniques.[3,4,11–16] In order to perform a single- or double-lavage technique, more needles or larger needles should be inserted, which can result in tendon injury. In our previous study, US-guided fine-needle aspiration or repeated puncture resulted in marked clinical improvement and marked decreases in the size of calcifications or complete disappearance in 80% of patients.[4] However, some patients with rotator cuff calcific tendinosis had liquefied calcium deposition, which could be aspired for relief of symptoms, and US-guided fine-needle repeated puncture was not necessary.[4]

Ultrasound elastography was introduced in 1991,[17] and started to be used clinically in 1997, especially for breast lesions.[18] Most applications have used free-hand external compression of the tissue through an imaging transducer or vascular balloon.[19] With free-hand manual techniques, some US equipment can provide relatively high-energy sound waves for tissue compression, such as those achieved with acoustic radiation force impulse (ARFI) equipment from the Siemens company, Mountain View, CA, USA. Such equipment is associated with the advantage of less operator dependency because of the consistent pressure. After reviewing the literature, we found no previous study of elastography applied to the evaluation of rotator cuff calcific tendinosis.

Ultrasound elastography could provide information about hardness of the calcification and might help decide the treatment strategy. The purpose of this study was to evaluate the hardness of calcifications within the rotator cuff by US elastography using the ARFI technique, and examine its utility as an aid for the selection of aspiration or fine-needle repeated-puncture treatment.

2. Methods

2.1. Patients

This was a prospective study involving patients who were referred from the outpatient departments of orthopedics or rehabilitation due to shoulder pain for more than 6 months. The primary inclusion criterion was the presence of calcifications within the rotator cuff confirmed by gray-scale ultrasonography. The exclusion criteria were previous invasive treatment for calcifications within the rotator cuff including lithotripsy by arthroscopy or other imaging-guided procedure and extracorporeal shockwave therapy. Patients with concomitant rotator cuff tears were also excluded. A total of 39 patients (32 males, 7 females; mean age, 52.9 years) receiving US elastography and an US-guided procedure for rotator cuff calcific tendinosis were enrolled from October 2010 to December 2011. All patients received US elastography and gray-scale ultrasonography immediately before the US-guided treatment for rotator cuff tendinosis was performed. The hardness of calcifications was recorded as three tactile patterns by the operator during the US-guided treatment, and the tactile patterns were compared with the US elastography and gray-scale ultrasonography results. All patients provided written consent for the US-guided procedure for treatment of rotator cuff calcific tendinosis. Investigative and interventional procedures were performed according to the guidelines of the Declaration of Helsinki, and were approved by the Institutional Review Board in Taipei Veterans General Hospital.

2.2. Ultrasound elastography

US elastography using the ARFI Virtual Touch Imaging system (ACUSON S2000; Siemens, Mountain View, CA, USA) was performed with the 9L4 linear transducer, and applied to the calcified region to obtain a colored static elastogram. All patients received gray-scale ultrasonography and US elastography before the US-guided procedure. The morphology of calcifications on high-resolution ultrasonography (HRUS) was classified into four types: arc shaped (an echogenic arc with clear shadowing); fragmented (at least 2 separate echogenic spots with or without shadowing); nodular (an echogenic nodule without shadowing); and cystic (a bold echogenic wall with an anechoic area, weak internal echoes, or layering content).[3] An oval circle was manually drawn by the operator within the calcification in the gray-scale image, which then was reflected to the same area in the elastogram just beside the gray-scale image. The encircled area was no larger than the calcification. All of the images were stored in the Picture Archiving and Communication System (PACS) system. The hardness of calcifications were represented by the brightness of the encircled area in the elastography, and the brightness was calculated and recorded as a histogram from zero (darkest region) to 255 (brightest region) using Image J software version 1.44 (National Institutes of Health, Bethesda, MD, USA). The histogram values were graded as dark (0–85), intermediate (86–170), and bright (171–255). The darker the elastography image, the greater the hardness of the calcification. All US examinations were performed and elastograms interpreted by the author (HJC), who had more than 20 years' experience of ultrasonography and 15 years' experience in musculoskeletal ultrasonography.

2.3. The hardness of calcifications determined by US-guided treatment for rotator cuff calcific tendinosis

All patients received repeated puncture or aspiration with a 3.8-cm #21 needle attached to a 10-mL syringe. An US-guided free-hand method was used to place the needle tip above the calcified lesion, which was then punctured repeatedly by moving the needle back and forth. No large-needle lavage was performed in this study. Before the procedure, the skin of the puncture site was sterilized with povidone-iodine, and the transducer was covered with a sterilized plastic bag. Less than 2 mL of 2% xylocaine was injected in the subcutaneous and muscle layer. When the US-guided aspiration was performed,