JOURNAL-BASED CME ARTICLE

Ultrasound-Guided Lateral Approach for Needle Insertion into the Subscapularis for Treatment of Spasticity

Dong-wook Rha, MD, PhD, Seung-Ho Han, MD, PhD, Hee-Jin Kim, DDS, PhD, Sung-Yoon Won, OT, PhD, Sang Chul Lee, MD, PhD

Statement of Need

Spasticity of the subscapularis muscle resulting from upper motor neuron lesions may overwhelm the other rotator cuff muscles that are relatively weak. As a result, internal rotation and adduction contracture of the shoulder joint with associated pain occur frequently. This can lead to reduced external rotation and insufficient acromial elevation, provoking rotator cuff tendon impingement.

Treating upper-limb spasticity with focal neuronal or neuromuscular blockade can relieve the pain and improve the range of motion. The general method for localizing the site of injection is palpation of the muscle belly, but this is not possible for the subscapularis muscle because of its location. Previous studies have investigated several approaches, but all of them are associated with problems, such as the possibility of injection into the wrong muscle or damage to neurovascular structures.

This activity evaluated the safety and accuracy of ultrasound (US)-guided needle insertion into the subscapularis targeting the motor points of the subscapularis.

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1. Describe Ultrasound-guided lateral approach for needle insertion into the subscapularis muscle from the treatment of spasticity
2. Apply the calculations described to locate the points of injection using sonographic examination.
3. Compare and Contrast using ultrasound guided needle insertion with other methods for determining localized sites for botulinum toxin injections into the subscapularis muscle.

Planning Committee

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Estimated Time to Complete This Activity: . . . . . **2.0 hours**

ABSTRACT. Rha D-w, Han S-H, Kim H-J, Won S-Y, Lee SC. Ultrasound-guided lateral approach for needle insertion into the subscapularis for treatment of spasticity. Arch Phys Med Rehabil 2012;93:1147-52.

Objective: To evaluate the safety and accuracy of ultrasound (US)-guided needle insertion into the subscapularis using fresh cadavers.

Design: A needle was inserted into the subscapularis of adult human cadavers under US guidance using a lateral approach from the posterior axillary fold. An anatomist dissected the cadavers to evaluate the effectiveness of this injection method.

Setting: University dissecting room.

Participants: Fresh cadavers (N=5).

Interventions: US-guided dye injections targeting the motor points of the subscapularis.

Main Outcome Measure: Accuracy of the injections and prevalence of complications. The presence of dye within 1.0cm of the motor points was defined as reaching the target. The injection procedure was considered a success if two-thirds of the injected dye reached the target.

Results: We did not identify any neurovascular structures at risk of injury in the injection route. All subscapularis muscles were injected successfully using the US-guided lateral approach.

Conclusions: US-guided needle insertion into the subscapularis using this lateral approach was accurate and had the minimal risk of neurovascular or lung injuries.

Key Words: Cadaver; Rehabilitation; Ultrasonography.

THE SUBSCAPULARIS MUSCLE acts as a shoulder internal rotator and helps to prevent anterior dislocation of the humeral head. This muscle is innervated by the upper and lower subscapular nerves that come off the posterior cord of the brachial plexus.[1] The subscapularis muscle originates from the entire subscapular fossa and inserts onto the lesser tuberosity of the humerus. Spasticity of the subscapularis muscle resulting from upper motor neuron lesions may overwhelm the other rotator cuff muscles that are relatively weak. As a result, internal rotation and adduction contracture of the shoulder joint with associated pain occur frequently.[2,3] This can lead to reduced external rotation and insufficient acromial elevation, provoking rotator cuff tendon impingement.[4] Treating upper-limb spasticity with focal neuronal or neuromuscular blockade can relieve the pain and improve the range of motion.[2] Botulinum toxin injection is currently used most often for this purpose.

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In-press corrected proof published online on Apr 13, 2012, at www.archives-pmr.org.

0003-9993/12/9307-00017$36.00/0
doi:10.1016/j.apmr.2012.02.017

The general method for localizing the site to inject botulinum toxin is palpation of the muscle belly, but this is not possible for the subscapularis muscle because of its location. Previous studies have investigated several approaches,[5-7] but all of them are associated with problems, such as the possibility of injection into the wrong muscle or damage to neurovascular structures. Some studies evaluating the effects of intramuscular botulinum toxin injection on upper-limb spasticity did not even attempt to inject botulinum toxin into the subscapularis.[8-11] Electric nerve stimulation and electromyography have been used for more precise localization of the muscle, motor points, or motor endplates, but these techniques also have limitations. To identify endplate potentials with electromyography, the patient must be able to relax their muscles during the procedure.[2] Electric nerve stimulation still carries a risk of unintended tissue injuries such as pneumothorax. Moreover, both guiding techniques are painful and usually require sedation or general anesthesia.

The efficacy of botulinum toxin can be maximized by injecting the toxin as close as possible to its effector site, the motor endplates,[12,13] which cluster around the motor points (macroscopic entry point of a nerve into a muscle).[14-16] Harrison et al[2] reported that the motor points lie across the muscle as a continuous band based on their cadaveric findings. They suggested that botulinum toxin should be injected from the lateral border of the scapula to maximize coverage of these motor points. In their study, data from 20 subscapularis dissections were plotted as proportions relative to the distance between the inferior angle and the acromial tip. The calculated line of best fit bisects a hypothetical line between the inferior angle of the scapula and its acromial tip, revealing the optimal path along which botulinum toxin is injected into the subscapularis. The angle of injection relative to the line is 56°, which can be achieved by directing the needle to a point approximately halfway along the spine of the scapula through a lateral (posterior axillary) approach.

Ultrasound (US) allows real-time scanning of the targeted muscle, adjacent structures, and needle advancement into the tissue, thus facilitating accurate depth control of needle placement even for the small, atrophic muscles in the paretic limbs of children.[17,18] Furthermore, US-guided botulinum toxin injection into the muscles of the upper and lower extremities is reported to be accurate, safe, and efficient.[17] However, there is currently no evidence-based recommendation regarding US-guided needle insertion into the subscapularis muscle.

Based on the study of Harrison et al,[2] and knowledge of the subscapularis anatomy, we hypothesized that US-guided needle insertion into the subscapularis would be accurate and would have a minimal risk of neurovascular or lung injury, especially when a lateral approach is used. Therefore, the present study evaluated the safety and accuracy of US-guided injection into the motor points of the subscapularis in a fresh cadaver model using a lateral (posterior axillary) approach.

METHODS

Bilateral subscapularis muscle injections were performed using 5 fresh cadavers without embalming preparation (3 women and 2 men). The average age at death ± SD was 72.2±6.7 years (range, 64–81y). Injection and dissection were performed within 2 days of death. There was no evidence of

List of Abbreviations

US	ultrasound