Clinical Case Report

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Musculoskeletal ultrasound-guided physical therapy in hemiplegic shoulder pain

A CARE-compliant case report

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Abstract

Rationale: The use of musculoskeletal ultrasound (MU) method in the diagnosis of shoulder pain and injury and guidance of injection and pain blocking has been established. However, the treatment of posthemiplegic shoulder pain (HSP) with MU-guided precise physical therapy has not been reported.

Patient concerns: Here, we present the first case report of a 64-year-old man with a right basal ganglia hemorrhage. Left side shoulder pain remained unbearable, which seriously affected sleep and shoulder-related activities.

Interventions: The patient received MU-guided precise drug administration, laser, and other physical therapy in addition to exercise training for 2 months.

Outcomes: The pain was significantly relieved and shoulder function was improved. Effusion extent and tendon thickness were reduced.

Lessons: MU-guided precise physical therapy can effectively reduce symptoms of HSP and improve inflammation and effusion absorption of lesioned tissue.

Abbreviations: HSP = hemiplegic shoulder pain, MBI = modified Barthel index, MRI = magnetic resonance imaging, MU = musculoskeletal ultrasound, SA-SD = subacromial-subdortoid, VAS = visual analogue scale.

Keywords: musculoskeletal ultrasound, physical therapy, posthemiplegic shoulder pain, stroke

1. Introduction

Shoulder pain is one of the most frequent complaints in hemiplegic patients. Such pain negatively impacts patient quality of life and causes significant social and economic burden.[1] Hemiplegic shoulder pain (HSP) usually occurs 2 weeks to 2 months after stroke, with an incidence rate of 16% to 84%,[2] and research suggests that soft tissue injury is a primary contributor to HSP.[3,4] Musculoskeletal ultrasound (MU) utilizes high-frequency probes (3–17 Hz) to diagnose human soft tissue and bone lesions and perform real-time treatment under guidance.[5] MU can be effective at high-resolution imaging of muscle, tendon, ligament, bursa, and peripheral nerves and other structures to identify and evaluate damage while also serving to help provide clear diagnosis via easy operation.[6] In the rehabilitation field, MU has become a promising approach for the diagnosis and treatment of patients with HSP.

Shoulder pain is typically diagnosed based on patient history and clinical signs found in routine physical examination,[7] such as Neer sign, shoulder impact test, pain arc, suprachoroid muscle strength test, and the falling arm test. Because of low sensitivity and specificity, it has been difficult to precisely localize and determine the extent of the lesion causing the pain.[8] In addition, decreased muscle strength, limited joint mobility, and sensory dysfunction in patients with hemiplegia influences accuracy of the results.[9] Accurate diagnosis is essential to ensure that patients receive appropriate treatment and prognosis. Previous studies have suggested that joint radiography and magnetic resonance imaging (MRI) of the shoulder is the criterion standard for diagnosing soft tissue damage in the shoulder.[10,11] Joint radiography can verify rotator cuff integrity and the severity and location of the rotator cuff tear, but may increase shoulder pain symptoms. Other disadvantages of this approach are the high cost, it is time-consuming, and examination can be traumatic.[12] Shoulder MRI is highly specific and sensitive for diagnosing shoulder soft tissue injury, but it is inappropriate for patients with a cardiac pacemaker, fracture implants, and artificial joints. As such, MRI is not always practical for the diagnosis of shoulder joint soft tissue disease,[13] and developing a new shoulder imaging examination, such as MU, is necessary.

Many studies have shown the reliability of shoulder ultrasound, as this method can accurately diagnose several

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shoulder diseases. It has up to 92% sensitivity and 94% specificity in detecting complete rotator cuff tear,[14] and prior studies have established and validated application of high-frequency probe MU in the diagnosis of rotator cuff tear and rotator cuff injury.[15] El-Kouba et al[16] confirmed the accuracy and sensitivity of MU in diagnosing abnormal rotator cuffs. Research into the ultrasonographic characteristics of the shoulder in stroke patients revealed that ultrasonography was helpful in detecting soft tissue lesions in these patients.[17] The United States considers MU as the preferred method of diagnosis for patients with HSP .[18] Ultrasound assessment of inflammation and noninflammatory tissue changes has been shown to be more sensitive and specific than the clinical examination,[19] and therefore can be used as a reference for clinical drug administration.

Overall, MU has many key advantages: the ultrasonic high-frequency probe exhibits high resolution on soft tissue. Minor lesions can be detected by MU dynamic scanning, and dynamic imaging of superficial tissue can effectively detect soft tissue lesions; it is convenient for patients for short-term review in assessing treatment effects, and It has minimal impact on metal implants, and is portable, rapid, economical, and nonradioactive, enhancing its utility as a routine screening tool for shoulder pain.[20] Because of its unique advantages, ultrasound has attracted attention from orthopedics, pain and rehabilitation specialties and has been widely used in these fields.

1.1. Ethics statement

Study participants voluntarily agreed to participate in the study and provided written informed consent before enrollment. The study was approved by the Ethics Committee of Shanghai Jiaotong University School of Medicine Affiliated Tongren Hospital and Nanjing Medical University. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

1.2. Case presentation

A male patient, 64 years old, presented with sudden left limb weakness and head computed tomography indicated a right basal ganglia hemorrhage. Conservative treatment was administered until the condition stabilized followed by 4 months of rehabilitation. Currently, the patient can walk independently and perform the majority of daily living activities without assistance; however, he still suffers from left shoulder pain.

No subluxation in the left shoulder was observed. Muscle tension in the left shoulder joint abduction and adductor muscles and elbow flexors increased, improving to Ashworth score level 1. Concerning the active range of motion, shoulder flexion was 80°, extension 15°, extroverted 80°, external rotation 5°, and internal rotation 30°. Pain occurred when left shoulder joint flexion was in the 50° to 80° range. Visual analogue scale (VAS) was 8 and the patient experienced restlessness without pain. The left shoulder joint exhibited Neer score of 54/100 points, left upper limb Fugl-Meyer score of 47/66 points, and Modified Barthel Index (MBI) score of 85 points. After onset, the patient did not receive corticosteroids, botulinum toxin injections, or acupuncture therapy. During this study period, the patient underwent no other rehabilitation outside the scope of the study. The patient signed the informed consent form.

1.3. Musculoskeletal ultrasonography

Musculoskeletal ultrasonography was performed using a Philips IE ELITE color Doppler ultrasound diagnostic apparatus with a 5 to 17 MHz high-frequency linear array probe. Patients assumed a sitting position with full exposure of bilateral shoulders. First, the side without clinical symptoms was examined followed by examination of the lesion side. Structures examined included the biceps brachialis tendon, subscapularis tendon, and muscle belly, the supraspinous muscle tendon and muscle belly, infraspinous muscle tendon and muscle belly, teres minor muscle tendon and muscle belly, musculus acromiodeltoideus bursa, circumferential cartilage, and joint capsule. The use of multisection observation, dynamic scanning, and contrast scanning methods helped avoid anisotropic artifacts.

1.4. Ultrasound-guided physical therapy

Using ultrasound guidance on the effusion site, tendon lesions were accurately positioned and marked. According to the body surface position labeling, a precise physical therapy approach was taken. Using ultrasound-guided drug delivery, topical anti-inflammatory diclofenac diethylammonium (Voltaren) ointment was administered, with reciprocating movement of the ultrasound probe around the labeled position for 10 minutes, 2 times/day. For laser treatment, the irradiation distance was 2 cm with a continuous output power 500 mW and irradiation time of 12 minutes, 2 times/day. Two weeks after therapy, patients experienced shoulder pain relief (VAS 3 points). Under guidance by physical therapists, patients began passive shoulder joint mobility activities.

For these activities, the shoulder was moved forward and backward and left and right (Codman bell movement), and the upper arm was lifted. One month later, the patient received ultrasonography of the shoulder and function was evaluated. The rehabilitation program was adjusted as needed based on evaluation results. If appropriate, shoulder joint stretch and exercise control/strength training were added. Two months later, the patient was subjected to shoulder ultrasonography and shoulder function was re-evaluated.

1.5. Evaluation of efficacy

Evaluation criteria for efficacy of therapy was as follows: shoulder pain: VAS pain assessment on the patients' affected

Table 1

Pain relief and shoulder function improvement.

		Shoulder joint activity					Upper limb		
	VAS	Flexion	Extension	Abduction	Intorsion	Extorsion	Fugl-Meyer	Neer shoulder function score	MBI
Before therapy	8	80°	15°	80°	30°	5°	47	54	85
1 Mo after therapy	2	100°	45°	100°	50°	30°	55	71	90
2 Mo after therapy	0	110°	45°	110°	70°	45°	60	82	95

MBI = modified Barthel index, VAS = visual analogue scale.

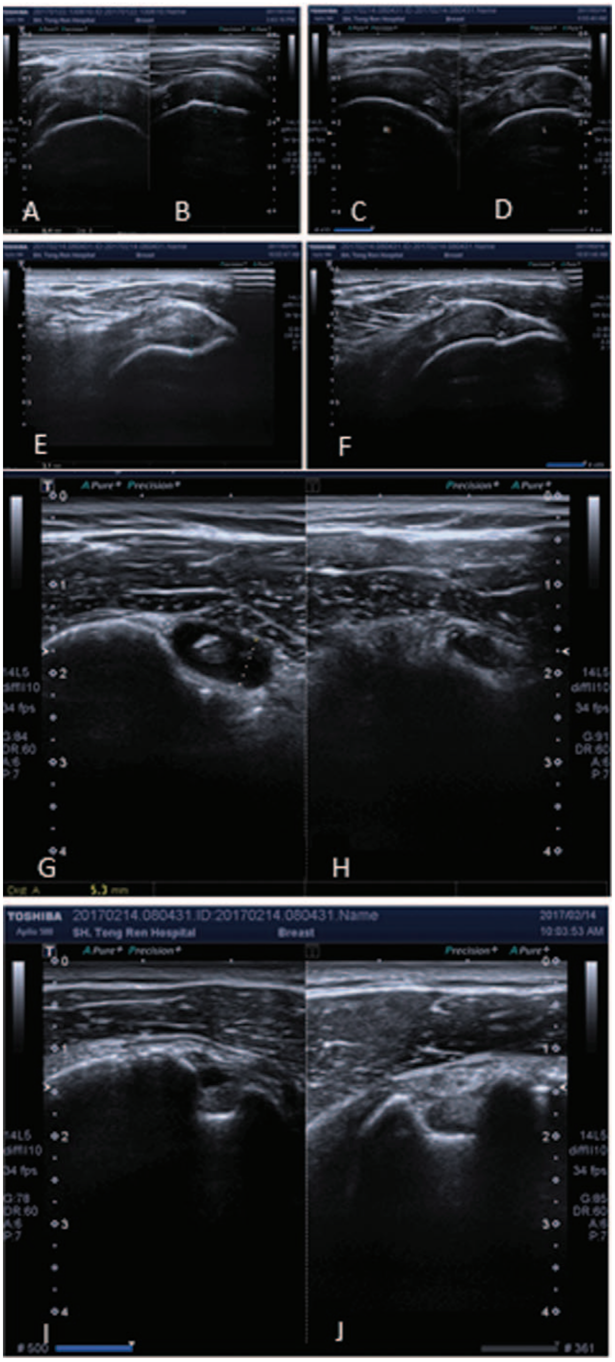

Figure 1. Comparison of the supraspinatus, subscapularis, and long head of biceps tendons before and after treatment. The tendon of affected supraspinatus before therapy (A) was thicker than the unaffected side (B). The thickness of the tendon of affected supraspinatus after therapy (C) was significantly reduced than that before therapy (A) and no different from that of the unaffected side (D). The diameter of the subscapularis tendon was significantly smaller after therapy (F) than before therapy (E). The diameter of long head tendon of affected biceps (G) was significantly larger than that of the unaffected side (H). The diameter of the long head tendon of affected biceps was significantly smaller after therapy (I) than before (G) and no different from that of the unaffected side (J).

shoulder joint; motor function assessment of the upper limb via a simplified Fugl-Meyer motor function score (Fugl-Meyer assessment), and activities of daily living assessment using a MBI score. All evaluations were performed at different time points by the same rehabilitation physician and 2 therapists.

1.6. Therapeutic effect

After treatment, pain was significantly relieved and shoulder function significantly improved based on assessment scoring and indices (Table 1). Musculoskeletal echocardiography also showed a reduction or disappearance of multiple sites of effusion and the thickness of involved tendons decreased (Fig. 1). Before therapy, effusion of the long head of the bursa, the long head of the biceps tendon, and the acromioclavicular joint was 5.4×5.2, 3.2×8.8, and $2.0 \times 1.0\,cm^2$, respectively. After therapy, these values were reduced to 3.7×3.2, $2.1 \times 3.8\,cm^2$, and 0, respectively. The thickness of the supraspinatus muscle tendon was reduced from 6.0 to 4.6 mm, and the subscapularis muscle tendon thickness was reduced from 4.5 to 3.8 mm.

2. Discussion

HSP is one of the most common complications of stroke[1] and is often associated with soft tissue injury, dyskinesia, and peripheral or central nervous system dysfunctions.[21–23] The subacromial-subdortoid (SA-SD) bursa, located between the musculus acromiodeltoideus and musculus supraspinatus, is one of the most important bursas in the shoulder region. It prevents direct contact of rotator cuffs with the acromion and reduces rotator cuff injury. Studies have shown that MU examination is sensitive in detecting SA-SD bursal effusion or inflammation in patients with HSP.[24] Furthermore, hemiplegic patients primarily suffer from adduction and intorsion of the upper limbs. Under external traction, uncoordinated muscle movements can cause uneven stress on the intertubercular sulcus. Friction of the tendon of the long head of biceps is increased, resulting in chronic strain and inflammatory effusion.[1] Posthemiplegia posture abnormalities, weak muscle strength, and muscle imbalance caused by spasms also increase the risk of shoulder trauma and injury. Asuman et al[25] found that when MU was used in patients with HSP, incidence of traumatic tendon lesions, and acromioclavicular degeneration was 54.5% and 26.5%, respectively.

Physical therapy is a critical clinical treatment for HSP. Pain is often used to identify target sites for therapy; however, due to associated sensory loss and cognitive disorders, patients exhibit difficulty in accurately localizing the site of pain for accurate treatment. In these cases, patients with HSP received 2 months of staged precision treatment involving a combination of MU-guided drug penetration therapy and laser irradiation at the sites of pain and exercise therapy relieved shoulder effusion and tendon swelling. The patient's ipsilateral shoulder function greatly improved, which is attributed to the precise identification and treatment of the lesion site by physiotherapists with assistance from MU.

For selecting physical therapeutic approaches, options included ultrasound, laser therapy, low-frequency electrotherapy, intermediate frequency electrotherapy, and other methods. According to the MU ultrasound results, the patient selected ultrasound and laser therapy. Ultrasonography has anti-inflammatory and analgesic effects and improves microcirculation. Ultrasound can also directly inhibit sympathetic excitability of the ipsilateral shoulder and upper limb, relieve spasm, and dilate the blood vessels, preventing a vicious cycle of vascular dysplasia.[26] Simultaneously with ultrasonic treatment, diclofenac diethylammonium ointment was administered. Through skin absorption, diclofenac diethylammonium exhibits anti-inflammatory and analgesic effects.[27] Laser irradiation can improve microcirculation, as well as decrease smooth muscle tension, increase tissue permeability, and reduce edema and hematoma. In addition, it can increase cell energy, transfer high-energy ATP into ADP, and improve muscle energy metabolism. A combination of these effects can increase the pain threshold, relax muscles, and efficiently achieve rapid antispasmodic and analgesic effects. Photochemical effects of laser therapy can also activate endorphins and decrease local serotonin concentration, thereby reducing neural excitability.[28]

From a physical therapy perspective, exercise is used to improve shoulder joint movement and induce benign reactions of affected joints, muscles, ligaments, nerves, and vessels resulting in enhanced muscle strength, reduced spasms, and pain relief, which further improves joint movement and patient quality of life.[29]

3. Conclusion

MU has many advantages in identifying soft tissue lesions of the shoulder, which provides excellent imaging evidence for patients with shoulder pain to design a rehabilitation plan and perform precise rehabilitation therapy.

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