DOI: 10.53469/jcmp.2025.07(03).06

Clinical Assessment and Rehabilitation Treatment of Shoulder-Hand Syndrome after Stroke

Jing Zhang

School of Traditional Chinese and Western Medicine, Southwest Medical University, Luzhou 646099, Sichuan, China

Abstract: ***Shoulder-Hand Syndrome (SHS), as a common complication of stroke, significantly impacts the rehabilitation efficacy and recovery progress of stroke patients. In clinical practice, there are numerous evaluation methods and treatment approaches for this condition. This article discusses the commonly used assessment techniques and their roles, as well as treatment methods in current clinical practice, aiming to provide insights for targeted evaluation and rehabilitation therapy of this syndrome.***

Keywords: Shoulder-Hand Syndrome, Clinical Assessment, Rehabilitation Therapy**.**

1. Introduction

Shoulder-Hand Syndrome (SHS) is characterized by pain in the shoulder and back, limited shoulder joint mobility, accompanied by pain and swelling in the ipsilateral hand, and occasionally finger contractures [1]. The primary cause of this syndrome is reflex sympathetic dystrophy triggered by underlying diseases, commonly observed after myocardial infarction, cervical spondylosis or degenerative cervical joint changes, trauma, hemiplegia, or other idiopathic conditions [2]. Both men and women can be affected, with a slightly higher prevalence in women, and 90% of patients are over the age of 50 [3].

2. Etiology

The pathogenesis of this syndrome is not entirely clear, but it is generally considered a secondary condition related to reflex neurovascular dysfunction. It is often triggered by trauma or impaired myocardial circulation, which leads to dysfunction of the central nervous system. This dysfunction, mediated through neural reflex pathways, results in sensory nerve impairment, causing pain, trophic disturbances, and functional limitations. Additionally, disuse of the limb, venous stasis, underlying arthritis, and periarthritis are contributing factors. Pathologically, the affected limb exhibits impaired blood circulation, muscular dystrophy and atrophy, osteoporosis, and joint contractures. The shoulder joint tissues show nonspecific inflammatory changes similar to capsulitis and periarthritis. The skin of the fingers may present with edema, reduced fat, and small hemorrhagic foci [4].

3. Clinical Manifestations

SHS primarily manifests as pain in the affected shoulder, elbow, and fingers, accompanied by stiffness, excessive sweating, and changes in skin color and temperature. Joint mobility is also impaired. Clinical presentations vary significantly depending on the underlying cause. Generally, if sympathetic nerve irritation predominates, the main symptom is burning neuropathic pain; if venous stasis in the limb is the primary issue, tissue swelling is more prominent, and significant trophic disturbances may occur. In cases secondary to myocardial infarction, symptoms typically appear 2–16 weeks after the event, with the longest reported onset being 14 months. The left shoulder and hand are slightly more commonly affected than the right or both sides. Symptoms include hyperesthesia, sweating, and changes in skin color. The disease course can be divided into three stages:

Stage I: Acute Phase

Shoulder pain and limited mobility are common, often accompanied by pain in the fingers and wrist joints. The fingers are mostly held in a slightly flexed position with restricted range of motion. Swelling, erythema, and increased skin temperature in the hand indicate vasomotor changes. Pain worsens during wrist movements, particularly flexion. X-rays often reveal focal decalcification in the shoulder and hand bones.

Stage II: Dystrophic Phase

Pain, swelling, and limited mobility in the shoulder and hand persist or diminish. The skin of the hand and upper limb becomes thin, and skin temperature decreases. Significant atrophy of the small hand muscles and thickening of the palmar fascia are observed.

Stage III: Atrophic Phase

Pain in the shoulder and hand subsides or disappears, and vasomotor changes resolve. However, muscle atrophy becomes pronounced, leading to contracture deformities. X-rays show widespread osteoporosis in the affected limb. Atypical forms may present with only one stage or involve specific distal or proximal parts of the limb.

The syndrome is typically preceded by relevant medical history, such as acute myocardial infarction or trauma, combined with characteristic shoulder and hand symptoms. X-ray findings of osteoporosis in some cases facilitate diagnosis, though differentiation from rheumatoid arthritis and periarthritis of the shoulder is necessary. Immediate treatment is crucial upon the appearance of edema, pain, or restricted movement. Once fibrosis occurs, correcting hand contractures becomes challenging. Therefore, early diagnosis and rehabilitation therapy are critical in the management of shoulder-hand syndrome in stroke patients.

4. Assessment Methods

Patients with shoulder-hand syndrome often experience pain in the hand or shoulder, restricted mobility, reduced muscle strength, wrist swelling, and changes in skin color and temperature, all of which contribute to impaired upper limb function. These symptoms negatively impact the patient's ability to perform daily activities and reduce their quality of life. Consequently, in clinical practice, a series of assessment methods and efficacy evaluation criteria have been developed and implemented to address the specific clinical symptoms of SHS patients.

4.1 Observation Indicators

1) The Visual Analogue Scale (VAS) is used to assess the pain level in SHS patients, with scores ranging from 0 to 10. A score of 0 indicates no pain, 1–3 indicates mild pain, 4–6 indicates moderate pain, and 7–10 indicates severe pain.

2) The shoulder joint, characterized by minimal articular contact and high mobility, relies heavily on the restoration of its range of motion for functional recovery. The range of motion is typically measured using a goniometer to assess changes in shoulder flexion, extension, abduction, internal rotation, and external rotation before and after treatment.

3) Some studies employ the water displacement method to evaluate swelling in SHS patients [5]. The affected hand is immersed in a 950 ml beaker filled with water until the water level reaches the distal wrist crease. The volume of water displaced is measured three times, and the average is calculated. Alternatively, the severity of edema is graded according to the Chinese Rehabilitation Medicine Diagnosis and Treatment Guidelines, where 3 points indicate severe edema, 2 points indicate moderate edema (joint swelling level with bony prominences), 1 point indicates mild edema, and 0 points indicate no edema.

4) Sixty percent of shoulder-hand syndrome cases occur in post-stroke hemiplegic patients, many of whom cannot maintain the shoulder joint in a normal position due to muscle weakness. Muscle strength testing of the shoulder-related muscle groups can validate the effectiveness of clinical interventions. Studies have used the IsoMed2000 isokinetic muscle strength testing system (produced by D. & R. Ferstl GmbH, Germany) with a preset angle of 40° to 45° and isokinetic concentric testing modes for shoulder and wrist flexor and extensor muscles [6]. The preset speed is 30°/s, with submaximal flexion and extension performed 10 times, followed by a 60-second rest, and then maximal flexion and extension repeated 10 times. Peak torque (PT) and average power (AP) of the shoulder and wrist flexor and extensor muscles are recorded.

5) CGRP, a bioactive peptide widely present in the central nervous system, plays roles in vasodilation, vascular endothelial protection, and blood flow regulation. NO and ET-1 are critical factors in vascular homeostasis, with NO promoting vasodilation and ET-1 inducing vasoconstriction. BK, a sensitizing agent for sensory neurons, promotes inflammatory responses. Wang et al. used radioimmunoassay to measure serum levels of CGRP, ET-1, and BK, and the nitrate reductase method to measure serum NO levels before and after treatment to assess vascular status, inflammatory responses, and neural functional recovery in SHS patients [7].

6) Post-stroke shoulder-hand syndrome not only causes pain and restricted mobility but also significantly impacts patients' daily lives. Therefore, it is essential to evaluate upper limb function and quality of life in SHS patients to determine clinical treatment efficacy. The Fugl-Meyer Assessment (FMA) is commonly used to assess upper limb function, including hyperreflexia, reflex activity, wrist movement, extensor synergy, and flexor synergy, with 33 items scored on a 0–2 scale (total score: 66) [8]. Higher scores indicate better motor function. The Barthel Index evaluates activities of daily living (ADLs), including eating, grooming, dressing, toileting, and walking, with a total score of 100. Higher scores indicate greater independence [9]. For quality of life, the Quality of Life Scale (QOL) or the General Quality of Life Inventory-74 (GQOLI-74) is used, assessing physical, psychological, social, and material well-being, with scores ranging from 0 to 100 [10]. Higher scores correlate with better quality of life.

4.2 Efficacy Evaluation

The clinical efficacy of interventions is assessed using the Shoulder-Hand Syndrome Scale (SHSS), which evaluates sensory, autonomic, and motor symptoms before and after treatment [11]. The maximum scores for these categories are 5, 3, and 6 points, respectively, with a total maximum score of 14 points. Higher scores indicate more severe symptoms. Additionally, comprehensive efficacy evaluation criteria are based on symptom and sign improvement, shoulder joint functional recovery, pain relief, and edema reduction.

The clinical efficacy is evaluated according to the Four-Level Weighted Scoring Method for Clinical Diagnosis and Efficacy Judgment [12]. The efficacy index (n) is calculated as: n = (pre-treatment score - post-treatment score) / pre-treatment score × 100%. The outcomes are categorized as follows: Cure: $n \geq 90\%$; Significant improvement: $70\% \leq n < 90\%$; Effective: $30\% \leq n < 70\%$; Ineffective: $n < 30\%$. The total effective rate is the sum of the cure rate, significant improvement rate, and effective rate. Alternatively, efficacy standards are established based on the Rehabilitation Assessment and Treatment of Stroke. Specific evaluation criteria include: Cure: No joint pain, active and passive joint movements within normal range, and no edema; Significant improvement**: Reduced joint pain, mild limitation in joint mobility, and residual edema; Ineffective: No improvement in joint pain, shoulder mobility, or edema. The total clinical effective rate is calculated as: (Cure + Significant improvement + Effective) / Total number of cases × 100%.

5. Treatment Methods

The treatment principle for post-stroke SHS focuses on prevention in the early stages, while the primary goals in the later stages are pain relief, edema reduction, and improvement of upper limb motor function. The treatment plan typically combines Western medicine with rehabilitation therapy. Rehabilitation therapy includes both traditional and modern approaches. Traditional rehabilitation methods, such as herbal medicine, acupuncture, moxibustion, herbal fumigation, and

acupoint application, are used to alleviate symptoms based on traditional Chinese medicine principles. Modern rehabilitation therapy primarily involves physical factor therapy, exercise therapy, and other next-generation treatment methods.

5.1 Pharmacological Treatment

The primary approaches for treating SHS abroad involve the use of hormones and symptomatic management. Davis SW et al. conducted a study involving 540 hospitalized patients, of whom 68 (12.5%) were diagnosed with shoulder-hand syndrome [13]. These patients were administered low-dose oral steroids over three weeks, resulting in pain relief and increased passive range of motion without significant side effects or complications. Other studies have explored the use of specific medications for SHS. For instance, C. Gobelet et al. investigated the efficacy of intranasal salmon calcitonin in treating central reflex sympathetic dystrophy, demonstrating improvements in pain and joint mobility in the treatment group [14]. De Santis A et al. conducted a clinical trial using phenobarbital, reporting that 27.6% of the 30 treated patients developed SHS [15].

In China, pharmacological treatment for SHS often involves intravenous or localized administration of herbal extracts combined with hormones and neuro-edema-reducing agents to promote blood circulation, remove stasis, and reduce swelling. For example, Yang Yongmin et al. [19] achieved a clinical cure rate of 75% by injecting 2 ml of Salvia miltiorrhiza injection and 2 ml of 2% procaine at acupoints [16].

5.2 Traditional Rehabilitation Therapy

5.2.1 Acupuncture Treatment

SHS falls under the categories of “Bi Syndrome” and “Wei Syndrome” in traditional Chinese medicine (TCM). According to TCM theory, qi deficiency leads to impaired blood circulation, resulting in blood stasis and meridian blockage, which causes pain [17]. Additionally, qi and blood deficiency deprive the meridians of nourishment, leading to joint contractures. Acupuncture can regulate blood flow in the affected limb, unblock the meridians and qi-blood circulation in the shoulder and hand, and alleviate pain. Acupuncture stimulation helps maintain normal excitation and inhibition of the central and peripheral nervous systems, blocks sensory nerve conduction, reduces peripheral nerve excitability, raises the pain threshold, promotes blood circulation, relieves limb pain, and eliminates edema [18].Liu Yingjiao et al. used acupuncture combined with rehabilitation training to treat SHS, selecting acupoints such as Jianyu (LI15), Quchi (LI11), Waiguan (TE5), Hegu (LI4), Houxi (SI3), and Zhongzhu (TE3) on the affected side, employing the reinforcing-reducing method [19]. Post-treatment, patients showed significant reductions in VAS scores and swelling in the affected hand. The specific needle techniques may vary based on the practitioner’s experience.

5.2.2 Moxibustion Therapy

Moxibustion, as a form of heat therapy, has shown significant efficacy in treating Bi Syndrome. Chen Xiaobo et al. prepared a medicinal paste by grinding white mustard seeds, asarum, cinnamon twigs, and safflower into powder and mixing it with ginger juice [20]. This paste was applied to acupoints such as Jianjing (GB21), Naoshu (SI10), Jianyu (LI15), Quchi (LI11), Shousanli (LI10), and Hegu (LI4) for celestial moxibustion [20]. Studies have also demonstrated that celestial moxibustion combines the therapeutic effects of herbal medicine with the thermal stimulation of acupoints provided by moxibustion [21].

5.2.3 Herbal Medicine Treatment

1) Oral Herbal Medicine

The treatment of post-stroke SHS with TCM primarily focuses on dispelling wind, activating blood circulation, warming yang, resolving phlegm, unblocking meridians, relieving pain, and nourishing kidney yang. Classical formulas, empirical prescriptions, or customized herbal formulas are often used. Zhao Yunxia administered a modified Juanbi Decoction in addition to conventional and rehabilitation therapies [22]. The study compared pre- and post-treatment scores for symptoms, neurological deficits, sensory, autonomic, and motor functions, demonstrating that the modified Juanbi Decoction alleviated clinical symptoms of post-stroke SHS and promoted the recovery of sensory and motor functions. Cui Huimin et al. divided 76 post-stroke SHS patients into a control group and an observation group. The control group received basic treatment, rehabilitation education, and electroacupuncture, while the observation group received additional herbal therapy to nourish kidney yang. The results showed significant improvements in joint swelling, pain, and mobility in the observation group, indicating that nourishing kidney yang enhanced the effects of electroacupuncture and improved shoulder and hand symptoms [23].

2) External Herbal Medicine

External herbal treatments often utilize herbs with properties that relax tendons, activate blood circulation, unblock meridians, and relieve pain. These herbs are prepared as powders, medicinal cakes, or decoctions and applied to the affected limb through methods such as compresses, fumigation, soaking, rubbing, or hot ironing. Alternatively, instruments that enhance drug penetration may be used. External herbal applications allow direct action on the affected area, delivering high local concentrations of active ingredients, which significantly alleviate pain, swelling, and other symptoms, promote upper limb functional recovery, and improve patients’ quality of life. These methods are simple, safe, economical, and well-accepted by patients. Common external herbal methods include compresses, fumigation, rubbing, and hot ironing. Zhang Yin et al. developed a self-made Kuanjin San herbal pack, which relaxes tendons, unblocks meridians, promotes diuresis, reduces swelling, and activates blood circulation [24]. The pack was boiled, wrapped in a towel, and applied to the Dazhui (GV14) acupoint while acupuncture was administered to the affected limb to unblock meridians and promote qi and blood circulation. The results showed that the combination of Kuanjin San compress and acupuncture (effective rate:

77.50%) was significantly more effective than conventional rehabilitation alone (effective rate: 55.00%). Duan Xihong divided 100 post-stroke SHS patients into two groups of 50 each [25]. The control group received acupuncture, while the observation group received additional fumigation with Honghua Huayu Decoction. After three treatment courses, the study demonstrated that the combination of Honghua Huayu Decoction fumigation and acupuncture better alleviated shoulder pain and promoted upper limb motor function recovery compared to acupuncture alone.

Liang Fangfang applied Honghua Huayu Decoction rubbing combined with Baihu Yaotou acupuncture to treat post-stroke SHS [26]. The decoction was concentrated, applied with sterile cotton balls to the affected limb 3–5 times daily, and heated to an appropriate temperature before each application to enhance penetration. Combined with Baihu Yaotou acupuncture, this treatment significantly reduced limb pain and swelling, improved upper limb motor function, and enhanced daily living abilities. Zhou Haifang et al. used herbal hot ironing combined with rehabilitation training to treat post-stroke SHS [27]. A self-made herbal pack (containing mugwort, evodia seeds, cowherb seeds, abutilon seeds, mint, etc.) was placed in a constant-temperature box at around 60°C and applied to acupoints such as Jianzhen (SI9), Quchi (LI11), Waiguan (TE5), and Hegu (LI4) twice daily. After four weeks, patients showed significant improvements in pain scores, motor function scores, and daily living activity scores.

5.3 Modern Rehabilitation Therapy

5.3.1 Exercise Therapy

Zhang Ning demonstrated through experiments that rehabilitation nursing is superior to conventional nursing, with significantly higher treatment effectiveness and patient satisfaction compared to the control group [28]. Li Xiangyang confirmed that early rehabilitation intervention training for acute stroke patients with hemiplegic SHS yields better outcomes than conventional training [29]. Early rehabilitation intervention can alleviate muscle tension, improve the range of motion in the shoulder, elbow, wrist, and hand joints, and prevent tissue adhesion. Zhang Yuexi et al. emphasized that shoulder functional reconstruction plays a critical role in alleviating SHS symptoms [30]. Their treatment approach focuses on passive rotational movements of the scapula, including stretching and massaging the anterior and posterior neck muscles, strengthening weaker shoulder muscle groups, and performing passive movements such as scapular elevation and depression. Pain-free active and passive movements of the affected limb facilitate muscle contraction and relaxation, enhancing the muscle pump effect, promoting venous and lymphatic return, reducing local edema, and improving muscle and joint mobility.

5.3.2 Physical Agent Therapy

Jiang Liyun utilized helium-neon laser irradiation combined with medium-frequency electrotherapy in addition to general rehabilitation training to treat this condition [31]. Laser irradiation points were selected based on the pain points of the affected side, administered once daily for 20 minutes over two weeks. Simultaneously, modulated medium-frequency electrotherapy was applied to the anterior and posterior shoulder joints, the flexion and extension sides of the wrist, and the dorsum of the hand on the affected side. Deng Xueli combined neuromuscular electrical stimulation with general rehabilitation training to alleviate pain and improve limb motor function in patients [31]. Wang Xiaoming employed extracorporeal shockwave therapy (ESWT) alongside conventional rehabilitation methods [31]. The shockwave applicator was placed on the patient's pain points. Post-treatment, patients showed significant improvements in upper limb motor function and quality of life, along with a notable reduction in joint pain. ESWT stimulates the production of pain-inhibiting chemicals in muscles, thereby alleviating pain, promoting blood circulation, and reducing edema.

5.3.3 Adjunctive Rehabilitation Therapies

Wu Min et al. employed kinesiology taping in addition to conventional drug therapy to treat stage I SHS patients [32]. A four-claw dispersion tape was used to promote wrist extension and prevent or reduce edema, while an I-shaped tape was applied to prevent excessive wrist flexion. Kinesiology taping, a non-invasive technique, promotes wrist extension, enhances lymphatic drainage, prevents excessive wrist flexion, and reduces edema. It significantly improves upper limb motor function, as measured by the FMA score and BI index. Weng Dihua et al. used novel paraffin wax therapy combined with rehabilitation training [33]. Paraffin wax was cooled to 45–50°C and applied to the affected side. The thermal and pressure effects of paraffin wax accelerate blood circulation, promote edema absorption, increase sweat gland secretion, eliminate pain-inducing substances, and alleviate pain.

Pneumatic compression therapy uses airbags to apply uniform pressure from the distal to the proximal limb, promoting blood and tissue fluid return, improving microcirculation, preventing thrombosis and limb edema, and reducing muscle atrophy [34]. Wu Shenghua combined pneumatic compression therapy with rehabilitation training for stage I SHS patients, resulting in significant reductions in edema and muscle atrophy, as well as higher MBI and Fugl-Meyer scores compared to the rehabilitation-only group [35].

6. Summary

In summary, there are various treatment approaches for post-stroke SHS. Commonly used Western medications, such as corticosteroids and nonsteroidal anti-inflammatory drugs, primarily provide symptomatic relief and analgesia but do not address the root cause of neural repair. While oral herbal medicine allows for individualized treatment, its poor taste and potential side effects limit its use. External TCM methods, such as acupuncture, moxibustion, herbal fumigation, and acupoint hot compresses, are effective, have fewer side effects, and are convenient, but they may not be suitable for patients with chronic conditions. Modern rehabilitation therapies, including physical agent therapy and exercise therapy, play a significant role in treating post-stroke SHS. However, while physical agent therapy effectively alleviates symptoms, it does not provide a complete cure, and exercise therapy requires careful joint protection to avoid injury. Therefore, in

clinical practice, rehabilitation physicians and therapists must tailor treatment plans to individual patients and conditions to achieve optimal outcomes.

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