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Review Article

Hemiplegic shoulder pain: Causes and physical therapy management

Moshera H. Darwish[1], Sandra Mohamed Ahmed[2], Esraa Essam Abdelhakim[1]*, Abdelaziz Abdelaziz Elsherif[1,3]

[1] Department of Physical Therapy for Neurology and Neurosurgery. Faculty of Physical Therapy, Cairo University, Egypt.
[2] Department of Neurology, Faculty of Medicine, Cairo University, Egypt.
[3] Department of Physical Therapy and Health Rehabilitation, College of Applied Medical Sciences, Jouf University, Saudi Arabia.
* Esraa Essam Abdelhakim, Department of Physical Therapy for Neurology and Neurosurgery, Faculty of Physical Therapy, Cairo University, Egypt. esraaaessam94@gmail.com.

Abstract:

Background: Shoulder pain is a prevalent complication following stroke that can reduce recovery and reduce quality of life. **Objective:** This review aimed to give a general background of stroke, describe causes of hemiplegic shoulder pain and factors contributing to its development and to illustrate the role of different physical therapy modalities and techniques on shoulder pain after stroke. **Methods**: A comprehensive search of Science Direct, PubMed, and Goggle Scholar was conducted using Keywords such as stroke, hemiplegic shoulder pain, and physical therapy modalities. The authors also reviewed references from pertinent literature, however only the most recent or comprehensive studies from April 2010 to March 2024 were included, and only English-language studies were reviewed due to lack of translation-related sources. Papers such as oral presentations, conference abstracts, unpublished manuscripts and dissertations that were not part of larger scientific studies were excluded. **Conclusions**: A review of the current literature concluded that shoulder pain after stroke is a common impairment, positive results were observed when various physical therapy modalities and techniques were used to treat hemiplegic shoulder pain.

Keywords: Stroke, shoulder pain, management, physical therapy, modalities.

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1. Introduction

Stroke or cerebrovascular accident (CVA) is a medical condition represented by the quick emergence of clinical manifestations of global or focal disturbance in brain function. It persists longer than twenty-four hours. It results in death with no apparent reason other than a vascular –brain-origin [1]. About 15 million people worldwide are estimated to have a stroke yearly, making it among the main causes of death and disability, which places a considerable burden on social health care system [2]. Stroke is regarded the world's second most common cause of death. The annual mortality rate is approximately 5.5 million and the disability rate of about 50% of survivors being chronically impaired [3].

When an artery to the brain is occluded or bursts, the blood supply to the brain is impaired. So, it may result in death of brain tissue caused by the diminution of oxygen [4]. The two main processes that cause stroke-related brain injury are hemorrhage and ischemia. Among all strokes, ischemic stroke accounts for 87%, intracranial hemorrhage for 10%, and subarachnoid hemorrhage for 3% [5].

The results of ischemia are rather quick because glucose, "the primary energy substrate" cannot be stored by the brain and is unable to do anaerobic metabolism. The reduced cerebral blood supply to the brain causes neuronal injury and ultimately neuronal death [6]. More often, hemorrhagic stroke is caused by hypertensive small vessel disease. It results in the development of tiny micro aneurysms (Charcot-Bouchard aneurysms) that burst after causing lipohyalinosis of the small artery wall. Thrombosis, following embolic blockage of arteries of the brain most often originating from the heart or atherosclerotic plaques in the carotid artery and aortic arch, or by hypoperfusion (hemodynamic stroke) can all result in atherothrombotic stroke [7].

Epidemiological risk factors and etiologies of each subtype vary, including those based on modifiable and non-modifiable risk variables (such as age, sex, race/ethnicity). Hyperlipidemia, comorbid cardiac conditions and physical inactivity, diabetes mellitus are correlated to ischemic not to hemorrhagic strokes [8]. After the age of 55, The occurrence of stroke doubles with every decade. However, this has been changing as more risk factors have been developed. This neurological condition is increasingly affecting young people [9].

Shoulder pain after stroke is among the most prevalent cerebrovascular-related impairments [10]. It may have an impact on quality of life [11]. Cerebrovascular accident results in upper motor neuron impairments resulting in a wide range of muscle paralysis around the shoulder joint, subsequent soft tissue changes, alterations in muscle tone [10].

Causes and factors contributing to shoulder pain following stroke:

Among the four most prevalent consequences after cerebrovascular accident is hemiplegic shoulder pain (HSP). Depending on the people studied and the method of assessment used, the incidence of HSP ranged between 30% and 65%. One third of stroke patients experienced shoulder pain within six months following their stroke and 65% of these patients still had this issue months later. A reduction in functional arm usage, difficulties with rehabilitation, increased prevalence of depression and lowering quality of life are all linked to shoulder pain after stroke [12].

Shoulder pain following a cerebrovascular accident has been described as a collection of complicated issues. The source of shoulder pain is used to make a clinical diagnosis. It includes pain sensitivity changes, shoulder-hand syndrome, and misaligned joints or shortened muscles. Since both shoulder pain and central pain post-stroke can develop in stroke patients. Hemiplegic shoulder pain is complicated as it is challenging to distinguish shoulder pain from central pain post-stroke [13].

Hemiplegic shoulder pain is frequently multifactorial. It can be categorized into two types: mechanical and neurological factors. Mechanical causes such as shoulder subluxation, glenohumeral joint disorders, rotator cuff injuries, frozen shoulder, and direct trauma to shoulder joint. On the other hand, spasticity, shoulder hand syndrome, brachial plexus damage, and central sensitization are examples of neurological causes. And may involve both neurologic and mechanical components [14].

During the flaccid stage, the long head of biceps, deltoid, supraspinatus and triceps muscles lose their muscular support for the glenohumeral joint. As a consequence, the humeral head subluxes downward and outward, with the joint capsule serves as the only support. The shoulder capsule is made up of two very tiny tissue layers. As the innermost layer of synovial membrane, which known as "the stratum synovium", is densely vascularized but inadequately innervated; so, pain receptors are susceptible to stretch. In flaccid shoulders, increasing length of the capsule puts the shoulder at risk for pain and permanent injury [15].

Shoulder subluxation and joint instability may result from flaccidity. It can cause serious soft tissue and nerve dysfunction such as traction damage to the brachial plexus, peripheral nerve entrapment, adhesive changes in related tendons [16]. Shoulder subluxation is a common cause of HSP in the early stages of post-stroke. It is characterized by presence of a sulcus sign which "a clinical gap between the acromion and the humeral head". Because of weakness of shoulder muscles in stroke patients in flaccid stage, the shoulder joint is less stable and more vulnerable to traction-induced shoulder damage. It is frequently explained using finger breadths [14]. Although it is obvious that these pathologic changes would result in pain, it is still unknown how exactly shoulder subluxation and hemiplegic shoulder pain (HSP) are related [16].

Increases the tone of the muscles that control scapular mobility. It could lead to irregular scapulohumeral rhythm. As a result, the rotator cuff, especially the tendon of supraspinatus muscle or other structures may impinge in the subacromial space [16]. Upper trapezius muscular activity was higher in patients with shoulder pain, while lower trapezius and serratus anterior muscle activity was lower, and infraspinatus muscle activity was either delayed or limited. The frequent post-stroke muscular imbalance in the scapula area might contribute to develop HSP [17]. In addition, there is

a significant association between HSP and various pain sources, soft tissue injuries to passive structures of shoulder such as tendinitis of supraspinatus and the long head of the biceps [12].

"Frozen shoulder" characterizes a shoulder with reduced range of motion. Its cause may be unknown. Significant restriction in passive and active shoulder mobility in absence of intrinsic shoulder disorder, is a distinguishing characteristic [14]. It may be the cause of HSP and its result. Hemiplegic shoulder pain may precipitate the development of frozen shoulder as a result of contracture, disuse atrophy or immobility of the affected limb. On the other hand HSP can be caused by frozen shoulders since it extremely painful in its acute stage [18]. Structural damage, bad posturing of the hemiplegic shoulder and consequent damage to surrounding tissues lead to reduction in arm function, rehabilitation is challenging, and quality of life is negatively impacted [19].

Another cause of hemiplegic shoulder pain is Complex regional pain syndrome (CRPS). The two types of CRPS are type I which is also called shoulder-hand syndrome, or reflex sympathetic dystrophy, and type II, previously known as "causalgia". Dystrophic changes to a limb following a traumatic injury, peripheral and/or central autonomic dysfunctions, and pain that is excessive for the pathologic condition are characteristics of both types [20].

The role of physical therapy on shoulder pain post stroke:

For the management of HSP, some approaches have been suggested. Hemiplegic shoulder pain can be treated with physiotherapy. Two major approaches to therapy: those that view the issue as a localized mechanical one, and those which view the issue as a neurological one. Local treatments such as heat and cold therapy have been used. Slings and shoulder braces were also used. Bobath, Brunnstrom, and proprioceptive neuromuscular facilitation (PNF) are major approaches for treating HSP [14].

A therapeutic exercise technique called proprioceptive neuromuscular facilitation (PNF) uses neuromuscular facilitation techniques in conjunction with functionally based diagonal movement patterns in order to enhance neuromuscular control and function and elicit motor responses. According to research by Joshi et al. [21] Scapular PNF can improve range of motion ROM and shoulder pain after a stroke. It also strengthens the proximal muscles of upper extremity (UE) and increases stroke patient's UE function by readjusting scapular alignment. Exercises performed in PNF patterns have been shown to have a favorable effect on both function and pain, as demonstrated by Lee et al. [22]. Proprioceptive neuromuscular facilitation techniques can improve blood circulation and normalize tone.

Kinesio taping is one of the most common utilized non-invasive therapeutic treatments for people with musculoskeletal disorders [23]. It has various uses, it is used to control spasticity, stabilize joints, promote muscle function by stimulating more cutaneous mechanoreceptors. And reducing inflammation and pain by enhancing blood and lymphatic circulation [24].

Electrical stimulation has been shown in a few recent studies to be effective for patients with HSP. Bilateral arm training combined with electromyography- triggered electrical were found to have a role in lowering pain in both subacute and chronic stroke patients [25]. Similar findings were documented by another study, which showed that after applying electrical stimulation to stroke patients, their upper limb function, daily living activities and range of motion (ROM) have not changed but their pain is improved [26].

Transcutaneous electrical stimulation (TENS) gives an external electrical stimulus to the affected limb. Its effectiveness is relying on the gate control hypothesis. At high intensity, electrical impulses can also stimulate the muscles to preserve muscular mass. Transcutaneous electrical nerve stimulation can be applied at low intensity stimulation which is sufficient to be felt on the skin or at high intensity which can cause visible muscular contraction and almost painful skin sensation [14]. It stimulates the sensory nerves and is frequently used specially as an analgesic physical therapy modality for masking the pain by stimulating cutaneous peripheral nerves at a higher frequency, with less intensity without producing muscular contraction [27].

Recently, using extracorporeal shock wave therapy (ESWT) has emerged as a safe and simple intervention, with notable benefits in the management of pain. The ESWT is defined "a group of mechanical pulsed waves usually at a frequency from 16 to 20 MHz, characterized by a high peak pressure (approximately from 50 to 80 MPa, sometimes >100

MPa), rapid pressure build-up (<10 ns), and short pulse period (10μs)" [28]. Previous research has demonstrated the beneficial impact of rESWT on pain relief. This is explained by the direct inhibition of nociceptors by shock wave, the reduction of substance P levels in the target tissue, and the hyper- stimulation process that inhibits the gate control process [29].

Research by Khalifa et al. [30] demonstrated that rESWT significantly reduced shoulder structural dysfunction and as a result, pain and impairment in subacute stroke patients when combined with designed physical therapy program.

The noninvasive and painless laser therapy is used to treat a variety of clinical conditions. Carpal tunnel syndrome, rheumatoid arthritis, chronic osteoarthritis, fibromyalgia, shoulder pain, knee injuries and post-operative pain are among the acute and chronic pain conditions that reduced by using laser therapy [31]. It has been found that there is an association between the effect of laser on pain to its effect on inflammation, tissue repair, nerves guidance and secretion of endorphine [32].

Many studies suggested that High intensity laser therapy (HILT) can be used in the treatment of shoulder pain. It is highly beneficial for a number of shoulder joint conditions, such as frozen shoulder, rotator cuff tendinopathy and sub-acromial impingement syndrome. This is due to its photochemical, thermal, electrical, and bio-stimulation impacts on deep tissues. It can increase microcirculation, accelerate tissue repair, decrease edema, pain, and inflammation [33].

There are studies that have supported that HILT has an effect on improving pain and enhancing function in patients with musculoskeletal disorders, particularly those with shoulder pain problems such as subacromial impingement syndrome (SAIS) and adhesive capsulitis. Nevertheless, studies demonstrating the effectiveness of HILT on hemiplegic shoulder pain (HSP) remains limited. The significant effect of HILT usage was shown in research by Abdelhakiemet et al. [33] particularly in stroke patients. Another study by Korkmaz et al. [34] indicated that using HILT in conjunction with designed physical therapy exercises were more advantageous than using therapeutic exercises alone in the short term in terms of enhancing pain, function and quality of life for hemiplegic patients with shoulder pain and partial thickness tear of rotator cuff.

2. Conclusions:

Hemiplegic shoulder pain (HSP) is among the most prevalent problems after stroke. It can affect patients in a negative way as it can result in withdrawal from rehabilitation programs, longer hospital stays and impaired quality of life. Using different physical therapy modalities has a positive effect on improving it.

Conflicts of Interest:

No conflicts of interest exist.

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