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AN OVERVIEW OF PATHOPHYSIOLOGY, ASSESSMENT AND MANAGEMENT STRATEGIES OF POST STROKE SHOULDER SUBLUXATION

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ABSTRACT

Shoulder subluxation is a common complication after stroke. It can result in soft tissue damage, stretching of the joint capsule, rotator cuff injury, and in some cases pain. An estimated 17-81 % of stroke patients have shoulder subluxation. It limits the use of affected extremity in addition to the weakness resulting from stroke itself. It can delay the neurological recovery in hemiplegic stroke patients. The etiology is multifactorial and the underlying mechanisms alongwith its association with shoulder pain are not clearly understood. This makes management of post stroke shoulder- subluxation a challenge for stroke management team. This review provides an overview of current concepts about the causes and prevention/management of post stroke shoulder subluxation. It suggests careful and regular assessments particularly the emerging role of musculoskeletal ultrasound in evaluating the prognosis of shoulder subluxation, and the importance of preempting the development of, and prevention of this distressing complication.

Keywords: Shoulder subluxation, hemiplegic shoulder pain, post stroke complication, shoulder slings, electrical stimulation

1. INTRODUCTION

Stroke is the third leading cause of death globally and an important cause of acquired adult impairment. It is a serious and disabling global health-care problem. Stroke and transient ischemic attacks (TIA) are highly prevalent in Pakistan. No large scale, epidemiological studies have been conducted in Pakistan to determine the true incidence of stroke in the country. A community based survey in Karachi urban area estimated the prevalence of stroke and transient ischemic stroke to be 21.8%. Many post stroke complications have been documented in the literature including pain, spasticity, pressure ulcers, urinary tract infections, deep vein thrombosis, aspiration pneumonia and hemiplegic shoulder pain. Shoulder subluxation is an important complication of stroke, which is mostly unrecognized and untreated in Pakistan. Aim of this review article is to raise the awareness of this somewhat preventable complication among allied healthcare professionals and summarize the current literature on the epidemiology and pathophysiology, evaluation and management strategies of post stroke shoulder subluxation.

1.1 Definition:

Glenohumeral subluxation is defined as "increased translation of humeral head relative to the glenoid fossa". The hemiplegic shoulder shows changes in the mechanical integrity of the glenohumeral joint causing a palpable gap between the acromion and humeral head.

1.2. Epidemiology

Shoulder subluxation, is a frequent complication in post stroke patients. It is reported to be present in 17 to 81 % of patients following stroke, most commonly occuring during the flaccid stage. Glenohumeral subluxation (GHS) is associated with development of shoulder pain (SP), delayed motor recovery of upper extremity and should be treated in acute stage of hemiplegia. The reported incidence of shoulder pain varies from 48 to 64%[6], which can result in significant disability. Although it can occur as early as 2 weeks post stroke, an onset time of 2-3 months post stroke is more typical.[6] Although the impact of Glenohumeral subluxation (GHS) on the development of shoulder pain and upper-limb functional recovery has not been completely explained, a number of authors consider GHS an important source of shoulder pain.

1.3. Pathophysiology and risk factors:

The shoulder complex consists of four separate joints, which afford it incredible mobility in all planes of motion, but at the expense of its stability. The glenohumeral joint relies on the integrity of muscular and capsule-ligamentous structures rather than bony conformation for its stability. The shoulder stability depends on static and dynamic stabilizers.The static stabilizers are glenoid labrum, glenohumeral and coracohumeral ligaments. The dynamic stabilizers include the deltoid and rotator cuff muscles which work in a fine balance to elevate the arm and keep the humeral head in glenoid fossa. During the initial phase of post stroke hemiplegia, these muscles becomes flaccid. This low tone makes the surrounding structures more susceptible to damage and results in altered alignment of scapula and humerus. During this phase, dynamic stabilizers are not functioning and reliance is on static stabilizers, which overstretch due to weight of the arm in dependent position. The humeral head displaces inferiorly and anteriorly by a combination of loss of normal shoulder muscle activity and the weight of the upper limb secondary to gravitational pull, which stretches the joint capsule, muscles, tendons and ligaments. Improper positioning in bed, lack of support while the patient is in the upright position or pulling on the hemiplegic arm when transferring the patient can further contribute to glenohumeral subluxation. Significant shoulder pain occurs within 6 months after stroke and there is an increased risk in patients with shoulder subluxation. Huang et al evaluated shoulders of post stroke hemiplegic patients with musculoskeletal ultrasound. They found that acute stroke patients with poor upper limb motor function were more vulnerable to soft-tissue injuries during rehabilitation, and a higher incidence of shoulder subluxation and higher frequency of shoulder pain were found in this group of patients.

2. ASSESSMENT OF SHOULDER SUBLUXATION:

Shoulder subluxation can be assessed by following three methods

2.1. Clinical assessment

Assessment of shoulder subluxation includes inspection of the shoulder for sulcus sign. (Figure 1) Measurement of subluxation of shoulder can be carried out by following three clinical methods. However these clinical methods are examiner dependent and may lack precision, and may not detect small changes in glenohumeral displacement.

2.1.1. The number of finger breadths that can be inserted between the inferior aspect of the acromion and the superior aspect of the humeral head (Figure 2)

Figure 1 Sulcus Sign

Figure 2 Palpation method to assess the inferior subluxation of glenohumeral joint

2.1.2. The distance between the inferior border of the acromion and the upper border of the humeral head can be measured by calipers or a tape to assess arm length discrepancy.

2.1.3. Use of thermoplastic jig, which is an L-shaped device constructed of thermoplastic material with a tape measure. Landmarks are the same as the anthropometrical evaluation that uses a tape or a caliper.

2.2.Radiological assessment

Radiographic measurements are considered a standard measurement for evaluation and have been used in several studies to assess the effectiveness of therapy or

development of GHS over time. Generally, the X ray approach has been shown to be reliable and valid. Glenohumeral subluxation can be assessed by single antero-posterior radiograph of the affected shoulder. The other methods include plane of the scapula method and the calculation of three-dimensional distances by two X rays (at 0° and at 45° or at 30° to the coronal plane). [13]

2.3 Ultrasonographic assessment:

The assessment of shoulder subluxation by musculoskeletal ultrasound is becoming increasingly popular. Ultrasound can detect minor asymmetry (≤0.5 cm) and has the potential advantage over the fingerbreadth palpation method of identifying patients with minor subluxation. The lateral distance (LD) is measured from the lateral border of the acromion to the greater tuberosity of the humerus. Ultrasonographic measurement of Acromion-Greater tuberosity (AGT) distance demonstrates excellent intra-rater reliability for a novice rater. Inter-rater reliability of ultrasonographic measurement of AGT also demonstrates good reliability between novice and experienced raters.

3 Impairments Associated with shoulder subluxation:

Shoulder subluxation may be associated with several impairments and complications as follows

3.1 Shoulder pain:

It has been suggested that if not corrected, a pattern of traction on the flaccid shoulder will result in pain, decreased range of motion and contracture. However, not all patients with a subluxed hemiplegic shoulder experience shoulder pain and its contribution to the development of HSP is debatable. Paci et al. suggested that pain associated with subluxation is probably present later after stroke since "fibrous changes or injury can occur in connective tissue of the ligaments and joint capsule due to incorrect alignment between the humerus and the scapula".[13] Shoulder subluxation is the second major cause of HSP after adhesive capsulitis.[11] It has been suggested that subluxation causes shoulder pain by overstretching the soft tissues (such as the capsule, ligaments and muscles) surrounding the shoulder. Some studies describe an association between shoulder subluxation and pain[11], while others do not support the role of shoulder subluxation in the development of pain. An arthroscopic study found that the causes of hemiplegic shoulder pain are complex and that shoulder subluxation is one of the major causes.

3.2. Poor upper limb function and Rehabilitation outcomes

Shoulder subluxation is a major challenge in the rehabilitation of stroke patients. It may not only affect the upper limb treatment process, but can also lead to additional complications such as pain, which can further delay the recovery of function. Shoulder pain can negatively affect rehabilitation outcomes,as good shoulder function is a prerequisite for successful transfers, maintaining balance, performing activities of daily living and for effective hand function. GHS can interfere with rehabilitation and has negative effects on motor function recovery . One can predict with 98% accuracy, which are the patients who will develop HSP on the basis of three factors which are strongly associated with shoulder pain including positive Neer test, moderate or greater shoulder pain during the performance of the hand behind the neck maneuver and a reduction in external rotation of shoulder joint greater than 10 degrees.

3.3. Reflex sympathetic dystrophy

There is evidence to suggest that shoulder subluxation is associated with reflex sympathetic dystrophy. Therefore, its prevention should be an important part of upper limb rehabilitation.

3.4. Soft tissue injury

Acute stroke patients with poor upper limb motor function are more vulnerable to soft-tissue injuries during rehabilitation, higher incidence of shoulder subluxation and higher frequency of shoulder pain.[20] There is a higher percentage of tendonitis in hemiplegic shoulders than the unaffected shoulder. The biceps and the supraspinatus tendons are major sites of soft-tissue injury and lesions. Acute stroke patients with poor upper limb motor function, combined with impaired sensation, shoulder spasticity and subluxation, have a higher prevalence of shoulder soft-tissue injuries (85%) and hemiplegic shoulder pain (67%).[20] Once spasticity develops, the severity of shoulder pain and subluxation worsens.

4. Management:

The management of shoulder subluxation after stroke starts with preempting its occurrence especially if the risk factors, mentioned earlier, are present in the hemiplegic patients. Preventing the development of shoulder subluxation is considered an important part of stroke management and rehabilitation.

4.1. Prevention:

During the initial flaccid stage of hemiplegia, the involved extremity should be adequately supported or

the weight of the arm might result in shoulder subluxation. Education and training for the patient, family/caregiver and clinical staff on how to correctly handle and position the affected upper limb is mandatory.[29]

4.2. Positioning

Low tone shoulder should be managed by proper positioning using pillows, slings, lap trays. Slings should be worn during transfers or ambulation only. They should be removed during sitting or in bed. In sitting, shoulder must be positioned in slight flexion, abduction and external rotation; and hand in open weight bearing position. Particular attention should be paid to proper positioning of pelvis and trunk alignment as Proximal stability of the trunk is a pre-requisite for distal limb mobility. Since lap trays are not widely available in Pakistan so authors recommend use of pillow placed under the forearm to prevent and manage shoulder subluxation. (Figures 3 and 4)

Figure 3. Shoulder without support while sitting

Figure 4. Shoulder with support under forearm

4.3. Strapping/ Slings

There is insufficient evidence to conclude whether slings and wheelchair attachments prevent subluxation, decrease pain, increase function, or adversely increase contracture in the shoulder after stroke. There is some evidence that strapping the affected shoulder delays the onset of pain but does not decrease it. There is also some evidence that strapping does not increase function nor adversely increase contracture. Slings are generally simpler for caregivers to use than functional electrical stimulation (FES) or strapping, and they can be combined with the other treatments. Although formal shoulder sling prescription is low (28%) but it is commonly used by patients with post stroke subluxation (81%). Shoulder Supports have various purposes i.e., realigning scapular symmetry, supporting the forearm in a flexed arm position, improving anatomic alignment with an auxiliary support, or supporting the shoulder with a cuff. The use of slings has been considered a contraindication by some authors because slings can facilitate an increase in flexor tone and synergistic patterns, cause reflex sympathetic dystrophy, restrain functional recovery, obstruct arm swing during walking, and for some, impair body image.[34] When prescribing shoulder slings to a post stroke hemiplegic patients following should be considered

- Ensure a Proper fit that promotes proper glenohumeral alignment since poor alignment can contribute to increased flexion synergy.
- The sling should not interfere with patient function and should be relatively easy to don and doff.
- It should not create new problems (e.g., edema in the dependent hand), contribute to synergy patterns, or cause scapulohumeralmalalignment.

There is conflicting evidence regarding strapping the shoulder to prevent or manage subluxation with most of the research articles and systematic reviews do not favor the use of slings.

4.4. Kinesiotaping.

Kinesiological taping (KT)can be used to prevent GHS or improve symptoms associated with shoulder pain. The use of taping method in conjunction with an established rehabilitation program may play an important role in the reduction of post stroke shoulder pain, soft tissue inflammation, muscle weakness, and postural malalignment. Kinesiotape may improve the

position of the glenohumeral joint and may provide the proprioceptive feedback to achieve proper body alignment. These factors are fundamental when exercises to restore the upper extremity functions are performed. The use and the position of the upper extremity following a stroke affect not only the patients' ability to reach, hold, and manipulate an object, but also their ability to stand up and walk.

4.5. Neuromuscular electrical stimulation

Neuromuscular electrical stimulation (NMES) has been shown to be effective in treating and preventing GHS and pain associated with it.[29] A recent meta-analysis of 15 randomized controlled trials concluded that FES can be used to prevent or reduce shoulder subluxation early after stroke, however it did not support the efficacy of use of FES for pain reduction, improvement in arm strength, movement, functional use, daily function, or quality of life after stroke. NMES can be applied both in form of surface functional electrical stimulation (FES) or intra-muscular stimulation.[46,47] The muscles targeted should include supraspinatus, long head of biceps and the posterior deltoid muscle. The NMES should be applied as early as possible because early application is associated with better outcomes and late application might not be as much effective.[48] Since FES is not widely available in most of the developing countries including Pakistan, so the authors recommend early and regular use of surface electrical muscle stimulations in post stroke patients to promote motor recovery and prevent muscle wasting.

4.6. Robotic Devices

The role of robotic technology in the neurological rehabilitation has expanded in the last decade. Many devices have been developed and tested in post stroke patients. In small trial of 18 patients, the robotic protocol effectively treated the shoulder subluxation. This robotic treatment additionally can lead to decreased spasticity, which may further increase use of the affected extremity and possibly help prevent complications such as adhesive capsulitis[50].

5. CONCLUSION:

Shoulder subluxation is an important complication in post stroke patients, which can adversely affect the rehabilitation outcome and lead to shoulder pain. It should be preempted and appropriate preventive measures must be taken to avoid it. These include proper positioning, family and caregiver education, provision of adequate shoulder support and early introduction of neuromuscular approaches. Since the low tone in early recovery phase makes the surrounding muscles, tendons and ligaments more susceptible to damage. Thus, it is important to prevent subluxation in the early stages of recovery.

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