PHYSIOTHERAPY INTERVENTION FOR NEUROGENIC THORACIC OUTLET SYNDROME: A CASE STUDY

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ABSTRACT

Background: Thoracic outlet syndrome is a result of compression of nerve and blood vessels in the passage between the clavicle and first rib affects 1-2% of population. Neurogenic thoracic outlet syndrome(NTOS) is common than vascular thoracic outlet syndrome(VTOS) and commonly affects middle aged women. Generally, TOS presents with pain, numbness, weakness and occasionally with loss of movements.

Case description: A 20 year old male field worker came to the clinic with complaints of pain at rest & night, numbness and tingling sensation on left upper extremity along with loss of movement. Other symptoms like weakness, loss of dexterity, muscle spasm, stiffness, fatigue in upper extremity were also present. Daily pain level was of grade 7 according to visual analogue scale. ROM of cervical area was also affected. Tenderness was present over supraclavicular area. No tenderness was present on shoulder and upper extremity.

Intervention: Patient was diagnosed with NTOS on left side with scalene muscle tightness. Rest from aggravating factors, postural correction, strengthening of scalene muscles, neural glide and m/s stimulator was administered. Physiotherapy intervention 5 times a week for 40 minutes over a 3 weeks was planned for these patient in which faradic muscle stimulator was given on left supraclavicular side with 30 repetition followed by strengthening exercises of scalene muscles.

Outcomes

Key words: TOS, NTOS, VAS, m/s stimulator, scalene strengthening exercises.

Introduction

The **Thoracic Outlet syndrome** is an umbrella term which includes variety of conditions. Prevalence rate of TOS is approximately 1-2 in which neurovascular structure gets compressed in interscalene triangle. Thoracic outlet is surrounded by the clavicle above, first rib below and muscles on the sides. If one or more of these vital structures passing through this space are compressed, the symptoms that result are referred to as 'thoracic outlet syndrome' (TOS).[1] In 95% of cases, TOS affects the brachial Plexus which is known as NTOS includes different entrapment sites of the brachial plexus such as interscalene triangle (anterior scalene syndrome), costoclavicular space (costoclavicular syndrome), and the coracopectoral tunnel (pectoralis minor syndrome). NTOS of 2 types 1- true NTOS is compression of brachial plexusf due to bony or soft tissue anomaly and type 2 is symptomatic NTOS occurs due to compression of nerves and blood vessels due to repetitive postural, occupational, or sporting forces. In 4% of cases the venous system is affected, and in less than 1% of cases, the arterial system.[2] If vascular system is compressed it is known as VTOS. When the Brachial Plexus is compressed in the Thoracic Outlet, it restricts the conduction of nerve impulses travelling to and from the arm, hand and fingers. This can result in the sensation of pins and needles, numbness, a feeling of cold and/or pain in the arm, hand or fingers. It may also result in weakness of the hands and arms. Sufferers may also experience pain the neck and/or shoulder.[3]

The most common cause of Thoracic Outlet Syndrome is trauma, such as a whiplash injury or with repetitive strain. This may include changes in postures, such as forward head posture, or rounded shoulders. Slightly common causes for Thoracic Outlet Syndrome are some congenital abnormalities, such as cervical rib, prolonged transverse process, muscular or fibrous connective tissue abnormalities. Rarely, Thoracic Outlet Syndrome may occur as a result of tumours, hyperostosis or osteomyelitis.

Patient information

A 20-year male field worker patient came to me with the complaints of severe pain in the left upper extremity which was associated with constant tingling and numbness in the left palm, and fingers. He was not able to lift his left arm as well as dropping things since 10 days. The patient believed that his symptoms is resulted from continuously lifting heavy weight overhead. He worked in field 7-8 hours during the cutting of grains in the month of June and July continuously but from the last 10 days working in the field with carrying heavy weight on head and in arms was making his pain unbearable. Pain was insidious as it was started suddenly after lifting a heavy weight overhead. After that he was not able to move his left upper extremity. The intensity of pain was so high that he couldn't even tolerate holding a light weight. He had to quit field work as carrying weights on head and in arms was an effort. No relevant family and medical history was found. Continual overhead lifting or motion may contribute in static postures in which the shoulders droop and the head is inclined forward.

Patient went to the orthopaedic doctor who gave his medicines which helped to reduce the pain slightly and that too temporarily. On a friend's recommendation he came to Physio clinic. Initiation of movement was aggravating his pain and keeping arm supported on side was relieving the pain.

On observation we had seen shoulder girdle depression or "drooping". Patient was mesomorphic with BMI 24.5 kg/m^2. Patient had normal gait with left arm hanged on side without any swing motion while walking. Patient had cervical spine postural asymmetry with rotation and bending of neck toward the left. Left shoulder girdle was forward dropped and protracted, flat upper back with poking chin posture. No signs of paleness, trophic changes and cyanosis of left upper limb were seen. No wasting of muscles was observed as left extremity was compared to right extremity.

On palpation tenderness was present over scalene muscles in supra-clavicular area. Supraclavicular area palpation with pressure showed the positive tinel sign. Tenderness was also present centrally and left Para medially over C3 to C7 spinal segmental levels. All vital signs found normal.

Sensory examination- The Semmes- Weinstein monofilaments test was performed to assess superficial and deep skin sensation at dermatomal levels from C4 to T2 of left upper extremity which showed impairment of all type of skin sensation at all the dermatomal levels but normal and intact sensation in the right upper extremity. Hyporeflexia of biceps, brachioradialis and supinator reflexes was seen on left but were normal on right side.

AROM/PROM: Symptoms were reproduced with shoulder flexion and abduction. Assessments of cervical spine for joint signs of capsular pattern of movement restriction and non-capsular pattern of movement restrictions caused by internal derangements were carried out. It showed full active range of movement (ROM) of the cervical spine in extension which measured 70°, right and left side flexion measured 20° each and right and left side rotation measured 45°. Cervical spine AROM in flexion measured 80°. Limitation in Side flexion and Side rotation were accompanied with pain. Similar pattern of pain and movement restriction were elicited with passive ROM. Right and left shoulder, elbow and wrist joints PROM were within normal limit but was

difficult to take AROM for left upper limb as patient was not able to lift his extremity actively. AROM and PROM of all joints of right upper extremity was completely normal.

Manual Muscle Testing: Patient had decreased strength in cervical muscles showed the grade 4/5. MMT of left shoulder, elbow, wrist and hand were not taken because of inability of patient to move the left upper extremity, while the muscles in right upper extremity were normal with grade 5/5.

Special test:

Neer and Hawkins test performed for shoulder impingement were negative. Load and shit, anterior and posterior test for joint instability were also negative.

Spurling test for cervical disc prolapse was also negative.

Morley's test to evaluate the scalenes' involvement found positive in which I initially pushed the thumb into the brachial plexus lightly and gradually go hard to see whether symptoms reproduce or not. The test was positive in patient.[8]

The most useful clinical tests for the diagnosis of NTOS are:

1. The "overhead stress test/ roos stress where the patient sits with both arms in the "90-90" position, the upper arms abducted to 90° and the elbows flexed to 90°. The hands are then opened and closed repeatedly. The symptoms of fatiguing and a burning sensation, often with paresthesia in the hand indicating a positive test.[9]
2. The "downward pull test," where the examiner exerts an axial traction force on the arm while holding the wrist of the patient. This may cause and simulate the symptoms of the patient as traction on the brachial plexus is exerted.
3. Elvey's Test/ULTT: This test was positive which involves taking the patient into 90 degrees of abduction/external rotation of the upper limb, wrist in extension, then the head is tilted to the contralateral side. This produce tensions on peripheral nerves which leads to sharp pain if positive.
4. Adson test- This test was also positive in patient which used for scalene syndrome was carried out with the patient seated on a stool and arms held close to the sides. The examiner palpates the patient's radial pulse and also listens for bruits above the clavicle. The right arm was then elevated and the patient was instructed to turn the chin away from the right side. A positive test results was obtained with diminished radial pulse, bruit, and numbness and tingling.
5. Wright test- for pectoralis minor syndrome. was carried out with the examiner taking the radial pulse of the patient in same position as described above. Patient's right arm was then hyperabducted and the radial pulse was measured again. The result was positive with a decrease in the radial pulse.[9]

Investigation

Cervical spine X-ray report revealed normal cervical curvature without any abnormal changes. No cervical rib was noticed. Patient didn't go for MRI so findings from MRI were not involved in the case study so it was clear that pain in neck and upper extremity was not because of neural compression in cervical vertebral level. Shoulder girdle x-ray were also taken but no abnormal changes were seen.

Analysis of findings from the assessments

- Neck and left upper extremity pain and paresis possibly caused by neurovascular compression in supraclavicular area due to tightness of scalene muscle. Asymmetrical neck and upper back posture and heavy weight carrying overhead lead to poor body mechanics that may cause or contributed to neurovascular compression and irritation at the thoracic outlet. The forward head and poking chin posture could have also induced excessive tension in the scalene muscles. Limitation of right side flexion and rotation at the cervical spinal segment levels due to pain and muscle tightness. Weakness of the muscles in the left upper extremity, impaired sensation at C4, C5, C6, C7, C8, T1 and T2 dermatomal levels possibly due to impaired conduction of sensorimotor nerve roots due to neurovascular compression at the left thoracic outlet. Impaired functional use of the left hand (lifting and driving) possibly due to compression of brachial plexus and muscle weakness. Patient also rated constant tingling and numbness in the left palm and fingers as a major problem.
- Clinical impression: Impaired functional use of the left upper extremity associated with cervical spine movement limitation and neck pain radiating to the left upper extremity secondary to left thoracic outlet syndrome. Special test results indicated a presentation of neurogenic thoracic outlet syndrome.

Treatment procedure: The subject goal was to reduce the pain and improve his ability to lift his left upper extremity as before so he can go back to work. He also wants to reduce that feeling of hanging of lifeless limb while walking. Treatment protocol began with an initial postural assessment followed by 15 forty minutes' sessions over a 3 weeks period. Pain and postural assessment was taken as outcome measures. Treatment included postural correction, scalene muscle strengthening exercise and NMS. The following tools were used during assessment and treatment

- Treatment table
- Goniometer
- Pillow
- Muscle stimulator
- Plumb bob
- Monofilament
- Hammer

Postural corrections: session was focused on correcting any type of postural distortion that may contribute to occlusion of thoracic outlet. Patient was instructed on postural awareness and how to identify the proper posture by using postural overcorrection exercise [10]. Patient was in a seated position before a mirror. He was initially asked to hyperflex 'slouch' the upper back. While in this position, patient was instructed to think about and feel the tension in the neck, upper back and shoulders and to maintain this position for10 seconds. This was followed by hyperextension 'chest-out' posture. Patient was instructed to think about and feel the tension in the neck, upper-back and shoulders and to maintain this position for10 seconds for another 10 seconds. From the chest out position patient was instructed to slowly reverse to adopting the initial slouch posture but to stop at the point he noticed a drop in the tension (relaxation) in his neck, upper-back and shoulders muscles.

Muscle stimulator was given to the patients with specific parameters (20 Hz, 50ms, 1:3 duty cycle). Inactive pad electrode with application of conductive gel over the surface of electrodes to improve transmission of the current was applied to the back of the neck (C3, C4 level) for 20 minutes. Active pen electrode was applied to supraclavicular area to stimulate the brachial plexus that concentrated the current densities, allowed focal concentration of current with less chance of stimulation crossover into nearby muscles.

To strengthen scalene muscle patient was sit in a comfortable chair. We placed the palm on the right side of patient's head. This hand acted as a stabilizer in the exercise. Asked the patient to begin to move his right ear toward his right shoulder while maintaining the resistance provided by my hand. Repeated 8 to 12 times on each side. By strengthening the scalene muscle, we increased the ability to stabilize patient cervical spine.

After 1 week of treatment protocol few exercises were introduced in the protocol. These exercise were pectoralis stretch, scapular squeeze and thoracic extension. Hold for 15 seconds and repeat 10 times.

Ergonomics advice was also given to patient which included

- DO NOT sit or stand with slumped posture. Be sure to keep the head and shoulders back.
- REMAIN ACTIVE, but avoid aggravating activities.
- RECEIVE physiotherapy care to get your joints, ligaments and muscles de-loaded and moving freely with no restrictions.

Outcome measures

After 3 weeks of treatment protocol the assessment of the patient was taken to examine the significant improvement in the condition of the patient.

a) sensory examination shown significant improvement in superficial and deep sensation which returned to normal (grade 3).
b) Patient was able to lift his left upper extremity which was totally impossible for the patient before the commencement of treatment.
c) There was significant change in cervical ROM as well. Initially ROM of lateral flexion and rotation of cervical was 20 degrees and 45 degrees which was improved to 35 and 70 degrees respectively.
d) Gradual improvement in pain and symptoms intensity was also during the course with decline in pain from 7 to 2 on VAS scale.
e) Improvement in strength of scalene and pectoral muscle was also seen.
f) Posture was also improved which was measured through the plumb line.

Discussion

There are very less studies are present related to physiotherapy role in TOS. Most of these studies has concluded that exercise therapy has a good effect on TOS but none of these studies explained the role of strengthening of scalene and neuromuscular stimulation of brachial plexus. This case study shows that strengthening of scalene helps in reducing the tightness of muscle. These strengthening have proven to be able to reduce the tightness which further increase the ROM of lateral flexion and rotation of cervical region. In VAS scale, there was significant difference between pre and post treatment readings. We gave strengthening exercise to scalene muscle because according to Garrick and Webb[1] in their excellent book, Sports Injuries: Diagnosis and Management, state that a weak muscle is a tight muscle. Whenever a weak muscle is forced to work beyond its capacity, it will tighten and, therefore, be more subject to stress and strain. We gave strengthening exercise to scalene muscle because according to Garrick and Webb[1] in their excellent book, Sports Injuries: Diagnosis and Management, state that a weak muscle is a tight muscle. Whenever a weak muscle is forced to work beyond its capacity, it will tighten and, therefore, be more subject to stress and strain.

Due to scalene muscle tightness nerve conduction was blocked at supraclavicular level which was maintained by electrical nerve stimulator which helps in contraction of muscles and prevents the muscle wasting. As the main aim of electrical stimulation is to maintain blood supply and maintain some metabolic pathway to prevent the atrophy of muscles.

Patient with NTOS due to compression of brachial plexus between the tight scalene can benefit from the nerve stimulator for pain reduction and range improvement. Scalene muscle strengthening with other muscles like pectoralis, serratus anterior, levator scapulae etc strengthening have a beneficial effect on NTOS.

A study done by Nicholas and Brandon stated that TOS is the result of improper positioning and muscle weakness which further affects the other tissues of the body. According to their study exercises are the conservative and effective approach in TOS treatment.[4]

A review study with title the effectiveness of physical treatments on thoracic outlet syndrome in reducing clinical symptoms concluded that major no. of studies adopted exercises as one of the interventions. Researchers should consider exercises as a major part of conservative treatments.[5]

A study was done to see the effect of neuromuscular electrical stimulation(NMES) effect on neonatal brachial plexus concluded that NMES is more effective in improving ROM and some evidence of muscle strength were also present.[7]

Conclusion

Future research should be conducted to determine the effectiveness of neuromuscular stimulation and scalene strengthening in the treatment of thoracic outlet syndrome.

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