A Case Study of Non-Operative Care of a Patient with Thoracic Outlet Syndrome and Cervical Radiculopathy

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ABSTRACT:

Objective: To discuss the diagnosis and treatment of a patient with neck and upper extremity pain due to thoracic outlet syndrome and nerve root injury secondary to trauma. The conservative treatment in a multidisciplinary center with interventional physiatric procedures and chiropractic rehabilitation protocols was successful.

Clinical Features: A 56-year-old right-handed female employed as a charge nurse who had been involved in 2 motor vehicle accidents (MVAs) reported headaches and neck, bilateral arm and shoulder pain which was much worse on the left than right. MRI demonstrated C3-6 degenerative disc disease with C3-4 protrusion and C4-5 and C5-6 bulging. Nerve conduction studies showed bilateral median nerve conductions through the carpal tunnel and the ulna nerve conductions through the elbow. The patient was then referred to a vascular surgeon who performed arterial volume studies. The studies revealed abnormal arterial blood flow through the bilateral subclavian arteries with hyperabduction of the arms.

Intervention and Outcome: The patient had initially been treated by the center's physiatrist who performed cervical epidural injections and facet injections that improved her complaints of neck pain and arm pain. She was then treated with chiropractic rehabilitation focusing on muscular imbalances including tight muscles with trigger

points and other muscles with weakness. Postural deficits were identified. The abnormal posture and muscular dysfunctions were addresses with muscle stretching, relaxation and therapeutic exercises. The patient responded well to treatment and was released with good long-term outcome.

Conclusion: Conservative chiropractic rehabilitation combined with physiatric interventional procedures in a multidisciplinary approach can provide patients with successful treatment for injuries. Thoracic outlet syndrome combined with cervical spine joint, disc and nerve root injuries offer opportunities for this team approach.

Key Indexing Terms:

Thoracic outlet syndrome, arm pain, neck pain, rehabilitation, brachial plexus, subclavian artery, subclavian vein, neurovascular bundle, costoclavicular space and scalene muscles.

INTRODUCTION:

The thoracic outlet is an opening between the first rib laterally, the vertebral column medially and the clavicle anteriorly.[1] The neurovascular bundle transverses several narrow areas between the neck and the arm where compression is likely. The interscalene triangle between the anterior and medial scalene muscles is the most proximal. The origin of the scalene anticus muscle attaches to the anterior tubercles of the transverse processes of C3, C4, C5, and C6 and it inserts to the scalene tubercle on the anteriolateral portion of the first rib. The scalenus medius originates at the posterior tubercles of the transverse processes of C2, C3, C4, C5, C6 and C7 and inserts at the lateral aspect of the first rib along the outer edge.

Further distally the bundle transverses into the costoclavicular triangle. This triangle is made of the clavicle and subclavius muscle anteriorly, posterolaterally by the scapula and subscapularis muscle and posteroiomedially by the 1st rib. Last, the bundle passes under the coracoid process and the pectoralis minor. The neurovascular bundle and lymphatic trunk are subject to compression at these vulnerable points.[1, 2, 3, 4]

The pectoralis minor attaches distally to the medial aspect of the coracoid process of the scapula. Proximally the muscle attaches to the 3rd, 4th, and 5th ribs near the costochondral junction. The muscle's action is protraction, drawing the glenoid fossa inferior, medial and anterior, winging the scapula at the rear. The pectoralis minor assists with stabilization of the scapula during humeral movements. The muscle also assists in elevating the rib cage during inspiration. Lymphatic vessels from the upper extremity

also transverse the thoracic outlet and other narrow straits on their course to the upper extremity.[2, 3, 4]

Thoracic outlet syndrome (TOS) is a constellation of symptoms and physical signs that affect the upper extremity, neck, and shoulders. It has also unfortunately been misnamed and should correctly be referred to as thoracic inlet syndrome.[1, 5] The first clinical description of TOS was from Sir Astley Cooper in 1821. In 1910, Thomas Murphy described "cervical rib syndrome" and reported that cervical ribs were removed to treat this condition. In 1927, Adson and Coffey described surgical treatment directed at the anterior scalene muscle for treatment of this upper extremity syndrome. The term "scalenus anticus syndrome" became widely used for a time. Peet, et al. introduced the term TOS in 1956.[6] Various explanations of the mechanical source of the symptoms and corresponding treatment options have been espoused over the years.[6] While there is controversy regarding the syndrome and its causes,[5,7] it is generally accepted to be caused by compression of the neuralgic and/or vascular structures, (collectively referred to as the neurovascular bundle) as they transverse the thoracic outlet or other narrow passages on their way to the upper extremity. This bundle consists of the brachial plexus, the C8 and T1 nerve roots, the subclavian artery and the subclavian vein. The brachial plexus is the group of motor and the sensory nerves that innervate the upper extremity. The compression of the neurovascular bundle typically causes symptoms in the upper extremity—pain, numbness, swelling, coldness, muscle weakness or atrophy. This compression may occur at several sites, as the neurovascular bundle transverses the scalene triangle, costoclavicular space, subcoracoid space or pectoralis minor space.[1, 7]

CASE REPORT:

A 56-year-old right-handed female, employed as a charge nurse, had been involved in 2 motor vehicle accidents (MVAs). In the 1st accident she was a restrained passenger. The impact was to the left front aspect of the vehicle. In the 2nd accident she was the restrained driver and was hit in the rear. After the 1st MVA she developed complaints of neck and back pain. She reported headaches and bilateral arm and shoulder pain, which was much worse on the left than right. After the 1st injury, the patient was treated for left TOS complaints, without symptomatic relief. The 2nd MVA worsened these complaints.

Her past medical history was significant for activity-induced asthma. She was 5 years status-post myocardial infarction, which was successfully treated with angioplasty. She used albuterol for her asthma. She reported that certain vasodilators caused bronchospasms. The patient also reported a smoking habit—1 pack of cigarettes per day.

Prior to the treatment by me, the patient had received extensive treatment at another center that included applying moist heat to the cervical spine and electric stimulation. The treatment produced no long-term symptomatic benefit. Cervical, thoracic, and lumbar spine manipulation was reported as yielding some short-term symptomatic improvement in neck and back pain and an increased range of motion. Her lower back complaints gradually improved and basically resolved with manipulation. The patient's neck and arm complaints continued, however, and she was referred to an orthopedic surgeon. The surgeon ordered electrodiagnostic evaluation and magnetic resonance

imaging. MRI demonstrated C3-6 degenerative disc disease with C3-4 protrusion and C4-5 and C5-6 bulging. Nerve conduction studies showed bilateral median nerve conductions through the carpal tunnel and the ulna nerve conductions through the elbow. The patient was then referred to a vascular surgeon who performed arterial volume studies. The studies revealed abnormal arterial blood flow through the bilateral subclavian arteries with hyperabduction of the arms. The vascular surgeon's assessment was bilateral TOS, for which he offered surgical intervention. The patient rejected the surgical treatment option. She was then referred to a physiatrist who performed cervical epidural injections[8] and facet injection[9] that decreased her neck and arm pain; however, complaints of pain and paraesthesia remained. The physiatrist referred the patient to me for evaluation and rehabilitation.

On presentation, the patient's pain complaints were rated as a 3-4 on a visual analog pain scale[10] of 0 to 10, with 0 being no pain and 10 being the worst pain. She complained of very bothersome upper extremity paraesthesia. The patient denied any increase in pain with coughing, sneezing, or valsalva.

She appeared as a normal female of her stated age, appropriate in her behavior. Her height was 5'7 1/2" and weight was 225 lbs. Her gait was unremarkable. She appeared to be in distress, however. Her left arm, shoulder and the cervical spine were splinted. Range of motion of the cervical spine was grossly intact with right lateral flexion at 25 degrees compared with 30 degrees on the right. Provocative compression of the cervical spine with rotation did not reproduce pain. There was bilateral scalene and pectoralis

minor tightness and tenderness, more left than right. The left pectoralis major and left scalenus anticus muscles were significantly shortened as demonstrated by muscle length testing.[11] Left arm hyperabduction was limited by the tight pectoralis muscles and caused tingling into the C7-T1 nerve distribution in the arm and hand. Provocative compression of the clavicle was painful and sustained pressure caused tingling into the C7-T1 nerve distribution of the left hand. Upper-extremity deep-tendon reflexes, sensation to light touch, and gross motor strength were intact. Postural examination revealed an anterior shift in head posture. The sternocleidomastoid (SCM) muscle was tight and tender. The shoulders protracted and the upper trapezius muscles were tight. Neck flexion in the supine position demonstrated mild overactivation of the SCM muscles.[11] Excessive upper cervical spine extension during neck flexion was noted with SCM overactivation. Paradoxical breathing was noted—the diaphragm was less active than the chest on inspiration.[3] Paradoxical breathing is defined by Travell as overactivation of the rib elevators and under-utilization of the diaphragm during inspiration. On deep inspiration, the patient had very tight scalene and SCM muscles. The suboccipital muscles were mildly tight. She excessively elevated the shoulder with abduction of the left arm, along with levator scapulae muscles being tight. Muscle strength testing revealed weakness of the lower trapezius and rhomboids muscles. Left shoulder ROM was impaired—she was unable to retract or depress the shoulder herself, but could briefly do it with assistance.

The patient presented with extensive diagnostic testing with reports and films. MRI revealed degenerative disc disease at C3-4, C4-5, and C5-6 with bulges seen at C3-4 and C5-6. Electromyography performed by a physiatrist was normal. Nerve conduction

studies showed bilateral median nerve conductions through the carpal tunnel and the ulna nerve conductions through the elbow. Arterial pulse volume studies revealed abnormal arterial blood flow through the bilateral subclavian arteries with hyperabduction of the arms, which was interpreted by the surgeon as bilateral arterial and neurogenic thoracic outlet syndrome.

My assessment of the patient was bilateral trauma-induced TOS, which was worse on the left. Cervical degenerative disc disease with cervical facet pain and mild radiculitis were improved with epidural steroid injection and cervical facet joint injections.

After the initial evaluation and informed consent, medical clearance was obtained from the patient's internist and treatment was started. Initially relaxation and lengthening of the short, tight scalene and pectoralis muscles were addressed.[12] Stretch and spray technique [3] and post-isometric relaxation (PIR) [12] were performed to the bilateral pectoralis and scalene muscles. Stretch and spray technique is a treatment of myofascial trigger points, myofascial pain and tight muscles. Passive stretch was used in combination with vapocoolant spray to allow stretching tight muscles to their full length. Post-isometric relaxation is a technique of manually resisted isometric muscle contraction followed by a slow, gentle stretch and relaxation. The purpose of the technique is to relieve musculoskeletal pain and myofascial trigger points.[3, 12]

The patient was then recommended a series of therapeutic exercises with an initial focus on scapular stabilization and postural re-education.[13] She was taught cervical retraction

exercises to correct the forward head and protracted shoulder posture.[11,13] The patient was unable to assume the required positions for the exercises for the 1st few visits. The doctor's assistance was required initially and the patient's original passive movements transitioned to independent, active performance of the exercises. Exercises were performed in sitting and supine positions and with the patient on her hands and knees. Scapular retraction and depression exercises, stimulating the serratus posterior and lower trapezius muscles, were used to improve neck and shoulder posture and help retract the scapulae. The patient was instructed in home stretching exercises directed 1st at the tight pectoralis muscles and the scalene muscles. Upper limb tension exercises[14] were started to mobilize the upper extremity nerves. Nerve gliding exercises are movements designed to allow improved movement of nerve tissue in the moving extremity, thereby reducing tension on the nerve and ultimately improving function-limiting symptoms. The patient was taught to progress with these exercises independently at home. She used the upper body ergometer—an exercise machine that uses the upper extremities in a bicycle-like fashion to provide ROM activity with measured resistance to improve strength and coordination. She was instructed to focus on the pulling part of the cycle to strengthen the shoulder retractors and encourage improved shoulder position. Myofascial release1[15] of the pectoralis major and minor was performed. The patient also stared resistance exercises at home with surgical tubing for improving strength. The exercises included rows—the horizontal arm pulling against resistance to encourage scapular retraction and strengthen the rhomboid muscles. Diaphragm breathing[3] was explained and the patient instructed to perform it at home daily to reduce the use of the scalene and SCM muscles by increasing the use of the diaphragm during inspiration. Ultrasound and stretch and

spray technique were used on the pectoralis and scalene muscles to reduce palpable and tender trigger points. Slow, long duration stretching was performed to gently lengthen muscles, as the muscles became less tender and tight. Home exercises were increased to include strengthening exercise for the serratus anterior. These exercises were modified push-ups with the patient on her hands and knees. PIR technique was used to the SCM and suboccipital muscles to address overactivation of these muscles that was found during head and neck flexion. During treatment, the patient's radicular complaints were exacerbated. This episode was successfully addressed with several sessions of mechanical traction and manipulation of the cervical joints.

The patient was treated 3 visits per week for 4 weeks. She was discharged from care after the 12 visits. During treatment there was gradual decrease in arm pain and paresthesia. She reported that her headaches became less bothersome and less frequent. By the 12th visit, she reported almost complete resolution of her presenting complaints. At the end of her treatment program, she returned to work after an absence of 5 months. During the 6-month follow-up via telephone, she reported no recrudesce of her presenting complaints and was performing all of her normal activities of daily living including working full-time.

DISCUSSION:

Pain, numbness, swelling, weakness, muscle atrophy or coldness are common subjective complaints of TOS.[5] The history of the illness and physical examination are important for

proper identification of these conditions. Neck trauma is another frequent TOS causative factor.[16]

There are several diagnostic tools to evaluate the patient with these complaints and examination findings. Electromyography, ultrasonagraphy, nerve conduction studies and imaging of the cervical spine and thorax can help the clinician arrive at a differential diagnosis.[1,17,18] Sensory test has also been suggested as a more sensitive test for evaluation of thoracic outlet patients.[19,20]

Surgical treatment has yielded mixed results.[21,22] Scalene resection, removal of the first rib or pectoralis resection are common surgical treatment options with varied outcomes.[1, 21,22] and surgically treated patients were found to be 3 to 4 times more likely to remain unable to work than non-surgically treated patients. Surgery has also doubled medical costs.[21] The key to good surgical outcomes, as with many other conditions, seems to be careful patient selection.[22]

Trigger point injections, spray and stretch techniques, myofascial release techniques, and nerve mobilization are some of the non-surgical treatment options.[3, 12,15,23,24]
TOS is frequently addressed with surgical intervention. Non-surgical, conservative rehabilitation protocols using cervicothoracic stabilization therapeutic exercise programs, nerve mobilization techniques, and muscle relaxation and stretching were used successfully to treat this patient. Many chiropractors are trained in rehabilitation and can successfully treat patients that have exhausted manipulation and passive physical

modalities. Restoration of muscular balance can be achieved with PIR and other stretching and relaxing of techniques to tight, overactive muscles combined with strengthening of weak muscles. Home exercises to compliment these techniques to facilitate this restoration of balance and to maintain functional gains will improve success and long-term benefit. These rehabilitation procedures combined with physiatric treatment in a team approach can yield the patient significant and lasting benefit.

CONCLUSION:

Similar types of conservative care protocols may be appropriate treatment alternatives to surgical intervention for the treatment of TOS. Case study results such as this one can be helpful to the chiropractic community to highlight the benefits of a team approach and the importance of transitioning patients to active care, especially after passive treatment approaches are exhausted.

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