An Isolated Long Thoracic Nerve Injury in a Navy Airman

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A palsy of the long thoracic nerve of Bell is a cause of scapular winging that has been reported after trauma, surgery, infection, electrocution, chiropractic manipulation, exposure to toxins, and various sports-related injuries that include tennis, hockey, bowling, soccer, gymnastics, and weight lifting. Scapular winging can result from repetitive or sudden external biomechanical forces that may either exert compression or place extraordinary traction in the distribution of the long thoracic nerve. We describe an active duty Navy Airman who developed scapular winging secondary to traction to the long thoracic nerve injury while working on the flight line. A thorough history and physical is essential in determining the mechanism of injury. Treatment should initially include retraining from strenuous use of the involved extremity, avoidance of the precipitating activity, and physical therapy to focus on maintaining range of motion and strengthening associated muscles, with most cases resolving within 9 months.

Introduction

Serratus anterior paralysis attributable to injury of the long thoracic nerve was first described in the literature by Velpeau\(^1\) (in 1837 as winging of the scapula known as scapula alata).\(^2\) In serratus anterior palsy, the pain and deformity at rest are minimal, with slight winging of the lower portion of the scapula. The lower part of the medial border of the scapula is closer to the vertebral column due to the action of the rhomboids and levator scapulae. Winging of the scapula becomes more prominent on forward elevation of the arm. The scapula moves upward and laterally during this movement, with the inferior angle displaced farther from the midline than the superior angle.\(^3\)

Etiologies of injury to the long thoracic nerve include entrapment of the fifth and sixth cervical roots as they pass through the scalenus medius muscle, compression of the nerve by the undersurface of the scapula as the nerve crosses over the second rib during traction to the upper extremity, and compression and traction to the nerve by the inferior angle of the scapula during general anesthesia or passive abduction of the arm.\(^4\)–\(^8\) Surgical injury to the long thoracic nerve may occur during mastectomy, radical neck dissection, or thoracotomy.\(^9\) The specific occupational occurrence seen in our patient has not been previously investigated.

Case Report

A 21-year-old right-handed white male Navy Airman presented with chief complaints of right-sided neck pain, right shoulder weakness and discomfort, along with severely diminished upper arm range of motion. There was no radiation of symptoms into the arm, forearm, wrist, or hand. There was no history of recent viral infection, immunization, excessive weight training, sports injury, chiropractic manipulation, shoulder or thorax surgery, or family history of similar complaints. In his job on the flight line, he would run carrying a 60-pound aircraft hydraulic servicing unit on his right shoulder, then swing it behind his back to the ground like swinging a bowling ball. During this maneuver, he felt a pop in his shoulder. After 1 week of pain symptoms, weakness and scapular deformity became apparent. He was well conditioned at 75 inches and weighed 165 pounds.\(^10\) There was no past medical history of right shoulder problems.

Physical examination showed normal neck and shoulder musculature except for atrophy of the right serratus anterior and deltoid muscles. There was protuberation, or winging, of the medial border of the right scapula. This was accentuated by forward flexion of the right arm, increased considerably when he pushed against a wall (Fig. 1). At rest, the right scapula appeared to exhibit a tilt inferomedially, with the inferior tip being prominent. The left scapula appeared to be normal. Range of motion and function of the neck was normal with some mild right-sided paraspinal muscular pain. Passive range of motion of the right shoulder was normal, whereas active range of motion revealed a limitation of abduction to approximately 90° and flexion to 110°. He exhibited a decrease in muscle strength on resisted abduction and forward flexion of the right arm. Stabilization of the right scapula to the thoracic wall enabled him to abduct his arm to 110° and flex to 150°, as well as improved his strength. His C5, C6, and C7 deep tendon reflexes were 2+ bilaterally.

Electromyography performed 8 weeks after the onset of symptoms demonstrated numerous fibrillations and positive sharp waves in the right serratus anterior muscle, confirming a right long thoracic nerve palsy. Maximum patient effort with this muscle was reduced. All other cervical paraspinal and upper extremity muscles were electrically normal. The scapular winging was thought to be primarily due to serratus anterior muscle weakness.

The patient was treated conservatively with enrollment in a physical therapy program focusing on stretching, range of motion, and strengthening of trapezius, rhomboids, and levator scapulae, gradually increasing the amount of weight used. Medication therapy included short-term narcotics, gabapentin and nonsteroidal anti-inflammatory drugs. He has been progressing well with gradual return of shoulder strength, although winging is still apparent.

Discussion

The long thoracic nerve is a purely motor nerve originating from the ventral rami of the fifth, sixth, and seventh cervical roots. It, alone, innervates the serratus anterior muscle. The
fifth and sixth cervical roots pass through the body of the scalenus medius muscle along with the dorsal scapular nerve. The seventh cervical root passes anterior to the scalenus medius. The nerve then courses beneath the brachial plexus and clavicle where it passes over the first rib and descends along the lateral aspect of the thorax, where it innervates the serratus anterior. The nerve extends as far inferior as the eighth or ninth rib. This long, relatively superficial course makes it susceptible to injury.5,6,8,11

The main function of the serratus anterior is to protract and upwardly rotate the scapula.6,12-14 As one of the major scapular stabilizers, normal function of the serratus anterior is critical in maintaining the proper scapulohumeral position during glenohumeral movement, particularly arm elevation.13 The serratus anterior is more active in forward flexion than pure abduction, as abduction requires some retraction of the scapula.15 Without upward rotation and protraction of the scapula by the serratus anterior, full glenohumeral elevation is not possible, resulting in scapular winging. Scapular winging is an uncommon but potentially disabling condition. Dysfunction of the serratus anterior muscle from the long thoracic nerve is the most common cause of scapular winging.16

The pathophysiology of long thoracic nerve palsy may be caused by direct pressure, stretching, or ischemia of the nerve. In most cases, acute nerve lesions are caused by excess force on the shoulder generating direct pressure on the nerve. In chronic overexertion ischemia is the cause of damage to the nerve.2

Long thoracic nerve palsy resulting from a single, violent force has been described following sudden stretching of the arm, work with arms extended above the head, cervical chiropractic manipulation, lifting a heavy weight, involvement in an automobile accident, and following an electrical shock.17-22 Cases described demonstrating a sustained compression of the long thoracic nerve include soldiers carrying a rucksack and during sleep or when lying in bed with abducted arms, such as while reading a book.17,23,24 Recurrent traction force on the long thoracic nerve may cause a palsy in occupations such as carpentry, operation of certain machines, and in sports.12 Nontraumatic insult of the long thoracic nerve include: viral illness, immunizations, Parsonage-Turner syndrome, and isolated long thoracic neuritis.1,25-27 Compression of the C7 nerve root at the neural foramen can lead to weakness of the serratus anterior and scapular winging.28 A tight fascial band of tissue found to arise from the inferior aspect of the brachial plexus was proposed to cause a bow-stringing injury to the long thoracic nerve with abduction and external rotation of the upper extremity.29 Compression of the long thoracic nerve by a cervical rib was reported.30

A thorough history is important and patients should be questioned regarding their hand dominance, occupation, hobbies, family history, past surgeries, current and previous levels of function, recent illnesses, and immunizations. The exact mechanism of injury should be clearly defined.5

Typically the patient’s history includes shoulder pain after an acute injury or after repetitive activity. The pain is described as radiating from the neck and down the affected arm. The pain is usually not severe enough to cause the patient to discontinue the activity. After several weeks, weakness of the shoulder and scapular winging become apparent.12,31-33 The pain and limitation of shoulder elevation are caused by loss of scapular stabilization and can be alleviated by manual stabilization by the examiner.34 Electromyography and nerve conduction studies confirm the diagnosis of long thoracic nerve injury and exclude other causes of scapular winging.4,32

The extent of disability will influence whether to treat the patient nonoperatively or surgically. Treatment involves the cessation of the instigating activity and physical therapy.33,35 The patient should undergo range of motion exercises immediately to prevent contracture of the periscapular muscles to maintain shoulder function.36 As recovery proceeds, a more vigorous exercise program for strengthening is recommended.12 Various orthotic devices have had equivocal results.4,7,14,16 Gregg et al.12 reported good results in 10 young athletes with acute isolated and complete serratus anterior paralysis. All of their patients modified their activities and underwent range of motion and periscapular muscle-strengthening exercises. Nerve function returned in an average of 9 months but as late as 2 years after their injury. Approximately 25% of patients with serratus anterior paralysis will experience persistence of scapular winging and will not respond to conservative treatment.4,12,37 Surgical treatment was recommended only after 2 years had elapsed without evidence of nerve recovery. Surgical options include: scapulothoracic fusions, static stabilization procedures, and dynamic muscle transfers.4,12

The mechanism of injury in our patient was severe traction of the right arm and, subsequently, the right long thoracic nerve sustained injury while swinging a 60-pound hydraulic servicing unit from his shoulder in a “bowling ball-like” fashion. Turning the flexed head away from one shoulder and raising the ipsilateral arm doubles the length of the segment of the long thoracic nerve between its points of fixation, the scalenus medius proximally and the superior digitsation of the serratus anterior distally. This is the presumed mechanism of injury in tennis players, golfers, and other athletes.12,19 A nerve may tolerate 20% increase in its resting length but further stretching results in intrafunicular damage.38

Fig. 1. Patient soon after presentation. Notice the scapular winging on the right exaggerated by pushing against a wall.
Conclusion

Patients who present with shoulder pain and scapular winging should have a careful examination of the shoulder, including scapulothoracic motion and a functional assessment to rule out long thoracic nerve injury.

Although no cases of a long thoracic palsy have been documented in a Navy Airman while on duty, it must be considered that it has occurred. It is our hope that a better understanding and awareness of these injuries in this unique community and in this setting will lead to better education, prevention, diagnosis, and subsequent treatment.

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References

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