Pulse Oximetry Measurements in the Evaluation of Patients With Possible Thoracic Outlet Syndrome

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Purpose We present our experience in using pulse oximetry as an aid in the diagnosis of thoracic outlet syndrome (TOS). Our attention was given to those symptomatic patients without objective confirmatory data on imaging or electrodiagnostic evaluation.

Methods Using a pulse oximeter, we measured the oxygen saturation and the pulse rate during a provocative extremity abduction stress test exercise maneuver in 18 patients with symptoms and signs consistent with a diagnosis of nonspecific neurogenic TOS. The oxygen saturation and pulse rates in 18 asymptomatic subjects were used as a control.

Results Resting oxygen saturation above 97% was present in both groups initially. After the provocative exercise maneuver, there was a significant reduction in the oxygen saturation levels, which dropped to 86% in the symptomatic TOS group compared with 94% in the control group. There was a significant increase in pulse rate in those subjects suspected of having TOS compared with a minimal increase in pulse rate in control subjects.

Conclusions Pulse oximetry produced objective confirmatory measurements, which support a hypothesis that hypoperfusion in the upper limb during provocative activities or exercise may cause disabling symptoms associated with nonspecific neurogenic TOS. This method may be a useful, noninvasive, rapid, and inexpensive clinical tool in the diagnosis of TOS, a condition frequently lacking in objective, confirmatory diagnostic data. *(J Hand Surg 2012;37A:2564–2569.*

Type of study/level of evidence Diagnostic III.

Key words Thoracic outlet syndrome, diagnosis, hypoperfusion, pulse oximetry, oxygen saturation.

NEUROVASCULAR COMPRESSION BETWEEN the clavicle, the scalene muscles, and the first rib results in thoracic outlet syndrome (TOS) associated with fatigue, pain, and paresthesias in the upper extremity.[1–6] Symptoms may be associated with upper extremity work, activities of daily living performed above shoulder level, or with the arms extended in front of the torso when reaching or driving. Associated complaints involving intractable headache or symptoms suggesting cardiac angina have been reported.[7,8] Absent objective data, diffuse suprascapular tenderness may obscure a specific regional diagnosis and contribute to a delay in treatment.[9,10]

Evidence of vascular or neurological compromise may identify TOS. The Adson test,[11] pulse loss with shoulder abduction,[2] or pallor after repetitive gripping with the arm elevated (Fig. 1) may suggest TOS. These findings may lack confirmatory objective data.

Reduced endurance capacity during overhead exercise has been used to diagnosis TOS.[12] Variable abduction stress test results may occur with inconsistent arm positioning or individual differences in pain tolerance.

A cervical rib or previous clavicle fracture may create a nexus between usual morphology and disabling TOS symptoms.

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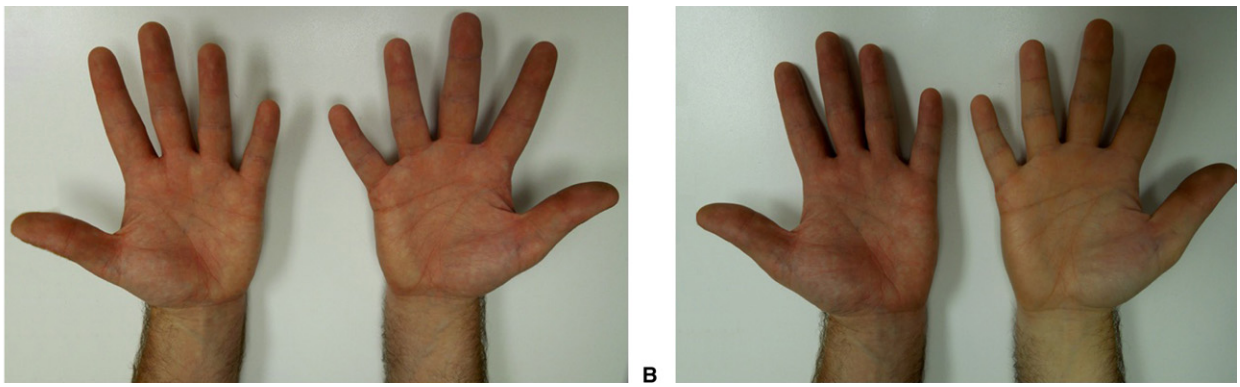

FIGURE 1: A The patient's hands are at rest and similar color is noted in both palms. **B** The right hand performed the elevated arm stress test for 1 minute. It was then placed next to the left hand, which remained at rest and served as a control. Pallor is noted in the right palm.

Angiography may demonstrate space reduction and vascular compromise that require decompression; nevertheless, pulse loss with arm elevation is not always symptomatic.[13]

A periclavicular Doppler evaluation may localize the region of arterial compromise[14]; however, Doppler studies do not usually address impairment during arm exercise.

Electrical studies are not often diagnostic. Abnormal conduction in the medial antebrachial cutaneous nerve, originating in the medial cord of the brachial plexus, has been reported in TOS patients.[15]

Nonspecific neurogenic TOS is identified as a symptomatic and disabling condition that is not associated with specific objective evidence for neurovascular compromise in the upper limb.[9] Our study was directed toward nonspecific neurogenic TOS. There is no pathognomonic sign for this cohort. These patients may present with symptoms of neurovascular compromise, usually associated with work activities or the use of the arms in an overhead position.

The absence of a single reference standard has been addressed by several authors who have reported patterns of symptoms that allow them to diagnose TOS and then successfully treat these patients.[16–19] Guillard et al[20] applied multiple tests, sequentially performed and then selectively combined. Because of the lack of a reference standard for diagnosing TOS, reliance on nonspecific symptoms associated with low specificity may adversely affect timely diagnosis and surgical results.[9]

We attempted to design a study that would clarify the clinical diagnosis of TOS. We attempted to differentiate patients with diffuse musculoskeletal pain from those with a neurovascular compression syndrome. We focused on patients who could not be clearly identified with definitive clinical signs, imaging, or electrodiagnostic abnormalities. We obtained contributory physiological measurements during functional activity. This helped us to segregate patients with symptoms suggesting nonspecific neurogenic TOS into a new specific cohort. We used Doppler pulse oximetry measurements to monitor tissue perfusion in the limb while the symptomatic patient performed provocative exercises that duplicated disabling symptoms experienced at work or while performing provocative activities of daily living.

MATERIALS AND METHODS

Eighteen patients with a mean age of 40 years (± 8 y) presenting symptoms suggesting nonspecific neurogenic TOS were selected for the symptomatic group. All patients had experienced disabling symptoms for over 1 year and were in good general health with no history of cardiovascular disease. None of these patients took medications for blood pressure problems or heart conditions. There were 15 women and 3 men. Out of the 18 patients, 3 reported symptoms in both their upper limbs, 5 on their left limb, and 10 on their right limb. Out of the 15 patients that reported unilateral symptoms, 4 reported symptoms in their nondominant limb, whereas 11 reported symptoms in their dominant limb. All of these 18 patients complained of disabling pain in the upper limb when performing repetitive gripping, lifting, pushing, or pulling activities. Symptoms usually increased when the patient worked in an overhead position or extended the arms when driving or placing objects on shelves. All patients in this group had tenderness in the supraclavicular area and tenderness in the