Thoracic outlet syndrome (TOS) is a diagnostic label attached to a collection of clinical presentations thought to be caused by injury to the neurovascular bundle as it travels from the thoracocervical region to the axilla. Common interface sites, linked with the potential for entrapment of the brachial plexus, subclavian artery or subclavian vein, include the interscalene triangle, the costoclavicular space and the sub-coracoid tunnel (Atasoy 2004). Based on the suspected source of symptoms, TOS is commonly categorized as neurogenic or vascular (Hooper et al 2010). It has been estimated that neurogenic TOS accounts for over 90% of TOS cases (Sanders et al 2007, Brantigan & Roos 2004). In the medical field neurogenic TOS remains a controversial topic. Much of the controversy centers on the finding that a large proportion of patients have symptoms suggestive of TOS, without having abnormal radiological or electrophysiological test findings (Watson & Pizzari 2010). The label of disputed or non specific TOS is commonly attached to this patient group. It is suggested that diagnosis of TOS is clinical, requiring a detailed history and physical examination (Hooper et al 2010).

To assist the clinical examination process a number of provocation tests have been proposed, some of which date back as far as the 1940’s (Adson 1947, Wright 1945). In a recent review Adson’s test, Wright’s hyperabduction test, Roos elevated arm stress test (EAST) and the costoclavicular maneuver were considered to be the most commonly described provocation tests in the literature (Watson & Pizzari 2010). Two recent reviews on this topic have alluded to the evidence within the literature questioning the validity of this group of tests (Hooper et al 2010, Watson & Pizzari 2010). Despite this evidence, both reviews suggest that provocation tests continue to have merit in the examination process. This essay aims to outline from the literature the symptoms associated with different forms of TOS. It also aims to present some of the key evidence surrounding the validity of TOS provocation tests and how this affects the weighting given to TOS provocation tests.

Neurogenic TOS symptomology is commonly presented in the literature according to whether symptoms are suggestive of an upper plexus (C5, C6, C7) or a lower plexus (C8, T1) presentation. In the spine, pain in the anterior/lateral neck, potentially radiating up into the ear, face and head, has been suggested as part of an upper plexus presentation (Brantigan & Roos 2004, Watson & Pizzari 2010). In the upper extremity common pain patterns include the shoulder, anterior chest, lateral upper arm and lateral forearm. Potential upper plexus paresthesias include numbness or tingling in the cheek, earlobe, back of the shoulder and outer arm. Watson and Pizzari (2010) also suggest that less commonly, occipital headaches, dizziness, vertigo and blurred vision may be present with upper plexus presentations.

Pain patterns suggestive of a lower plexus presentation include the shoulder, medial arm and the ulnar side of the hand. Potential areas of paresthesia include the medial aspect of the arm and the ulnar distribution of the hand (Brantigan & Roos 2004, Watson & Pizzari 2010). The literature also reflects that neurological TOS symptomology can be more generalized in nature and location and include reports of numbness, fatigue and weakness affecting the whole arm and hand (Watson & Pizzari 2010). In addition some experts suggest that symptoms of coldness of the hand and color changes can be present in cases of neurogenic TOS without any vascular involvement (Brantigan & Roos 2004, Sanders et al 2007). Sanders et al (2007) proposes that symptoms of coldness in the arm may reflect a sympathetic nervous system response as a result of lower plexus irritation.
Vascular TOS is typically subdivided into arterial TOS and venous TOS. In the literature symptoms associated with arterial TOS include ischemic responses such as hand pallor, coldness and paraesthesia (Sanders et al 2007, Nichols 2009). More generalized symptoms such as stiffness, heaviness, fatigue and cramp may also be present (Watson & Pizzari 2010). It is reported that in contrast to neurogenic TOS, pain in the shoulder and neck are uncommon in arterial TOS (Sanders et al 1997, Nichols 2009). Key symptoms suggestive of venous TOS include upper extremity edema, cyanosis, pain, heaviness and hand paresthesia (Sanders et al 2007, Watson & Pizzari 2010). It is proposed by Sanders et al (2007) that the arm swelling seen in venous TOS is not a typical feature of arterial or neurogenic TOS. In addition it has been contended that symptoms in the neck are not common in this form of TOS (Nichols 2009).

Each of the classic TOS provocation tests proposes to stress one or more of the interfaces in the thoracic outlet space (Descriptions of each test can be found in Watson & Pizzari’s article). Adson’s test is thought to stress the scalene triangle while the costoclavicular maneuver, as its name suggests, is thought to stress the region between the clavicle and first rib. The 2 parts of Wright’s test are thought to stress the subcoracoid tunnel and the costoclavicular space. Roos EAST test is proposed to stress all three interface sites. Interpretation of the EAST test is based on either symptom provocation or the inability to maintain the test position for the allotted test time. In all of the other tests a positive response is based on either symptom provocation or the obliteration of the radial pulse.

For over a decade evidence from multiple studies has demonstrated that a high number of normal subjects test positive for pulse obliteration, in response to the classic provocation tests (Rayan & Jenson 1995, Plewa & Delinger 1998, Nord et al 2008). Rayan & Jensen (1995) demonstrated a positive test response for Adson’s test, the costoclavicular maneuver and the hyperabduction test of 13.5%, 47% and 57% respectively, in an asymptomatic group (n=200). The range of false positives response in a more recent study for this group of tests was 9-47% (n=86) (Nord et al 2008). Evidence such as this has lead to a number of different perspectives on the continued clinical use of the classic provocation tests. Some experts have suggested that Adson’s test should be consigned to the history books (Brantigan & Roos 2004). Others suggest that the EAST test is the most accurate and clinically useful provocation test (Sanders et al 2007, Brantigan & Roos 2004). It has also been suggested that clusters of positive responses and a greater emphasis on test interpretation based on symptom provocation, may improve the accuracy of the tests (Hooper et al 2010, Watson & Pizzari 2010).

The position that the EAST test is more accurate than the other provocation test does not appear to be supported in the literature. Research suggests that this test, just like the other provocation tests, has poor specificity. Nord et al (2008) reported a false positive rate of 77% in a group of subjects (n=62) with electrodiagnostically confirmed carpal tunnel syndrome. Positive responses were also seen in 58 out of 100 women with confirmed carpel tunnel syndrome in a study by Seror (2005). The results of an older study suggest that this figure may be higher, with Costigan & Wilbourn (1985) demonstrating that 92% of their CTS subject group (n=65) had a positive test response.
Investigation of the EAST test in asymptomatic subject groups further supports the position that this test suffers from poor specificity. Nord et al (2008) reported a positive test response in 27% of the studies control group (n=86). Older studies again suggest that this figure may be higher. Costigan & Wilbourn (1985) reported a positive test response in 74% of its asymptomatic control group (n=24). Barsotti and Chiaroni’s (1984) study, involving 150 subjects, reported the test to be positive in nearly all of the subjects after 2 minutes, based on pain provocation in the forearm and interscapular region.

Hopper et al’s (2010) review cites a study by Gillard et al (2001) as support for the notion that clusters of positive tests may improve diagnostic accuracy. In this study certain pairs of tests, most noticeably Adson’s test and any one of the other provocation tests, was significant correlated with the final diagnosis of TOS. However, the data from this study can also be used to present a conflicting argument. While the specificity of having 5 positive tests was 84%, specificity for 4 positive tests dropped to 38%. Overall the mean specificity for the 5 tests was 53%. It is also worth noting that the study’s data analysis is impacted by one of the tests not being completed in 17 of the subject group.

Nord et al’s (2008) study furthers the argument that specificity remains problematic even when combinations of positive response are considered. The data from this research demonstrates that 73% of the CTS group had positive responses to 2 provocation tests and 55% had positive responses to 3 provocation tests. In the normal group this figure was 34% and 19% respectively. The authors also provide separate data for the response to each test based on pulse obliteration, pain provocation and paresthesia. The data for the CTS groups showed a high false positive rate for paresthesia (ranging from 34% to 55%). In the normal subject group this figure ranged from 9% to 31%, and supports the findings of Plewa & Delinger (1998) who reported a similar range of positive test responses (11% to 36%) in a group of 53 subjects.

The literature on this topic clearly demonstrates that TOS is not a single entity but a collection of syndromes. Its clinical presentation can be diverse and many of the cardinal signs and symptoms overlap with those seen in other spinal and upper extremity neuromusculoskeletal disorders. The evidence to date demonstrates that a low diagnostic weighting should be given to the provocation tests and that even when tests are combined the potential for a false positive response can not be adequately ruled out. As TOS is largely a diagnosis of exclusion this weighting needs to be considered in the ranking of evidence gathered from a careful and comprehensive subjective and physical examination.

**Recommended Reading**


References


