The diagnosis of thoracic outlet syndrome (TOS) is intrinsically difficult, and the literature about it is full of confusing terminology. Symptoms may arise due to compression of neural and/or vascular elements in one or more of three different locations. A number of tests were developed during the early part of this century, and a variety of syndromes have been described that relate to these tests, all of which are now considered to be subtypes of the thoracic outlet syndrome. Yet anatomists and clinicians fail to agree on even the definition of the thoracic outlet. It is proposed that anatomists not use the term thoracic inlet as a synonym for the superior thoracic aperture, nor thoracic outlet for the inferior thoracic aperture. What many clinicians call the thoracic outlet should be called the scalene triangle by both anatomists and clinicians, divisible into a lower portion to be called the thoracic outlet (for subclavian vessels and nerve roots C.8 and T.1) and an upper portion, the cervical outlet (for nerve roots C.5, C.6, and normally C.7). What is currently called thoracic outlet syndrome should be renamed the cervico-axillary syndrome (CAS), divisible into three subtypes: thoracic outlet, costoclavicular, and pectoralis minor syndromes. Compression of the upper roots of the brachial plexus between the anterior and middle scalene muscles should be recognized as cervical outlet syndrome, and all terms containing the word scalenus should be discarded.

Key words: brachial neuritis, cervical outlet, definition, scalene triangle, scalenus

Thoracic outlet syndrome (TOS) is a controversial subject with regard to both diagnosis and management (Lederman, 1987; Cuettter and Bartoszek, 1989). The situation is further confused by the lack of a generally accepted anatomical definition of the thoracic outlet. Standard anatomical textbooks (e.g., Moore, 1992) use the term thoracic outlet as a synonym for the inferior thoracic aperture, the opening into the abdominal area that is bounded by the lower costal elements. This is not at all what clinicians have in mind when they talk about the subclavian artery's exit from the thorax by passing over the first rib between the anterior and middle scalene muscles. Anatomists might think of such an area as a part of the thoracic inlet.

The superior thoracic aperture is the space bounded by the left and right first rib together with the first thoracic vertebra and manubrium of the sternum. Sometimes anatomists refer to this opening as the thoracic inlet and call the inferior thoracic aperture the thoracic outlet. Yet several structures pass out of the inlet or into the outlet, as thus defined. It seems reasonable, therefore, to standardize the terminology of these anatomical apertures, and to develop a definition of the thoracic outlet that would be agreed upon by all. This, in turn, would allow the various compression syndromes to be defined, or redefined, with a greater degree of anatomical precision.

Travell and Simons (1983) have defined the thoracic outlet as the thin triangular space between the anterior and middle scalene muscles, whose base is the first rib. Others (Mosely et al., 1991) have accepted this definition. But there are problems with this definition, both semantic and practical, which add unnecessary confusion to the diagnosis and management of thoracic outlet syndrome. Other authors (Berger and Kleinert, 1991; Press and Young, 1994) call this space between

Received for publication November 15, 1994; revised April 11, 1995.
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the anterior and middle scalene muscles the scalene triangle. This is not a new term, but its use by all may help reduce diagnostic confusion.

THORACIC OUTLET SYNDROME

The constellation of symptoms now attributed to this condition was described by Sir Astley Cooper in 1818, but it was Peet et al. (1956) who first published and apparently coined the term that is in current use. However, thoracic outlet syndrome is not a single clinical entity, and the nerve compression may be at one of three locations. Mackinnon and Dellon (1988) have suggested there may be compression at more than one site. The clinical presentation is that of pain, tingling, and possibly numbness along the post-axial border of the upper limb, with or without vascular symptoms. The precise symptomatology varies according to the extent of arterial, venous, or nerve compression. Physical signs vary according to site.

Three sites of compression are possible.

1. The subclavian artery and lower roots of the brachial plexus may be compressed where they cross the first rib (or a cervical rib) between the anterior and middle scalene muscles. About this level the two lowest roots usually combine to form the lower trunk.

2. The subclavian artery and vein and/or lower trunk of the brachial plexus may be compressed behind the clavicle in the costoclavicular space.

3. The axillary artery and/or vein and/or one of the cords of the brachial plexus may be trapped in the angle between the pectoralis minor tendon and the coracoid process on which it inserts. This is apt to occur with hyperabduction of the arm and has been called the hyperabduction syndrome or pectoralis minor syndrome (see Fig. 1).

At all three sites the nerves and vessels are enclosed within a fascial tube, the cervicoaxillary canal (Anson, 1966). Hence, the term cervicoaxillary syndrome (CAS) would be a better diagnostic term than thoracic outlet syndrome, to be applied in clinical situations until further investigation could identify the precise location of the compression site.

Cuettet and Bartoszek (1989) have stated: "The confusions and contradictions in the literature emphasize the poor understanding of the syndrome and the urgent need for a more efficient nomenclature describing the etiologic factors and clinical features of all subsets of TOCS" (thoracic outlet compression syndrome). This paper has been written to help meet that need.

REDEFINING THE THORACIC OUTLET

The terms thoracic inlet and thoracic outlet as they appear in current anatomy texts are not of any great functional significance. The terms superior thoracic aperture and inferior thoracic aperture are preferable anatomical terms. The space most clinicians call the thoracic outlet is in fact the scalene triangle. We may consider this divisible into a lower part, the thoracic outlet, and an upper part, the cervical outlet. The upper roots of the brachial plexus were never in the thorax and by definition therefore cannot pass into the arm through a thoracic outlet. They arise in the neck and, passing from the neck into the upper limb, must pass out through a cervical outlet. But inferior to these upper roots the subclavian artery does pass out of the thorax, changing its name to axillary as it crosses the lower border of the

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1Rob and Standeren (1958) quickly accepted it. Lord and Rosati (1958) initially rejected it. But when, in a revision of the same monograph, they did accept the term, they erroneously credited it to Rob and Standeren (Lord and Rosati, 1971).

2The entire scalene triangle is, of course, in the neck. The division of this triangle into cervical and thoracic components is with reference to its contents, and hence its clinical significance.
first rib. With it normally pass the eighth cervical and first thoracic nerve roots and/or the inferior trunk of the brachial plexus that these form (generally at the lateral border of the anterior scalene muscle). When there is a cervical rib or band, their exit from the thorax is at a higher level and the seventh cervical nerve root, while not actually passing out of the thorax, may be deemed to have done so.

Terminology used in clinical diagnoses should also be amended. The constellation of symptoms now called thoracic outlet syndrome should be renamed cervico-axillary syndrome (CAS). When the specific site of compression has been determined, a more precise term—thoracic outlet, costoclavicular or pectoralis minor—can be applied as appropriate. Clearly distinguished from any of these would be compression of the upper roots of the brachial plexus, with pre-axial border sensory disturbance and nothing to suggest vascular compression. This would be a newly named condition, cervical outlet syndrome. In the past this may have been called by some scalenus syndrome or scalenus anticus syndrome. But the terms scalenus syndrome and scalenus anticus syndrome are better left in the history books.

REFERENCES