



REVIEW / *Neuroradiology*

Ultrasonography of the brachial plexus, normal appearance and practical applications



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Abstract Ultrasound examination of the brachial plexus, although at first sight difficult, is perfectly feasible with fairly rapid practical and theoretical training. The roots are accurately identified due to the shape (a single tubercle) of the transverse process of C7 in the paravertebral space, and the superficial position of C5 in the interscalene groove. The *téléphérique* technique allows the roots, trunks and cords to be followed easily into the supraclavicular fossa. In just a few years, ultrasound imaging of the plexus has become a routine anesthesia examination for guiding nerve blocks. In trained hands, it also provides information in thoracic outlet syndromes, traumatic conditions (particularly for postganglionic lesions) and tumoral diseases. Even if MRI remains the standard examination in these indications, ultrasound, with its higher definition and dynamic character, is an excellent additional method which is still under-exploited.

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In the last 10 years, ultrasonography has become an extremely effective examination for exploring the nerves of the upper limb.

The brachial plexus is still one of the few areas dreaded by musculoskeletal ultrasonographers because of its complex anatomy and its bony relations (the clavicle) hindering exploration.

Ultrasound examination of this difficult region becomes less daunting with knowledge of some reference slices and a few anatomical landmarks.

It is no longer a research application since it is commonly used in anesthesia to perform ultrasound-guided nerve block. Because of its definition and dynamic character, it is also proving to be very useful for studying thoracic outlet syndrome, tumor disease and traumatic lesions.

Anatomy of the brachial plexus

Anatomical description

The brachial plexus is formed from the ventral nerve roots of C5 to T1 (Fig. 1). A contribution from C4 or more rarely T2 roots may be found in certain cases. The size of the roots increases from C5 to C7 then decreases from C8 to T1.

These ventral roots unite to form the trunks:

- C5 and C6 give rise to the upper trunk;
- C7 to the middle trunk;
- C8 and T1 to the lower trunk.

The suprascapular nerve arises from the upper trunk. Each of these trunks separates into an anterior and posterior division, these divisions in their turn reuniting to form 3 cords. The anterior divisions of the upper and middle trunks give rise to the lateral cord, the anterior division of the

lower trunk gives rise to the medial cord, and the three posterior divisions of the trunks anastomose to form the posterior cord.

The following terminal nerve branches arise from these cords:

- the musculocutaneous nerve (lateral cord, roots C5-C6-C7);
- the median nerve (lateral and medial cords, roots C5-C6-C7-C8-T1);
- the ulnar nerve (medial cord, roots C7-C8-T1);
- the radial nerve (posterior cord, roots C5 to T1);
- the axillary nerve (posterior cord, roots C5-C6).

This complex intermixing of the nerve fibers is subject to very many interindividual variations and the classic description given above is only found in 50 to 70% of cases [1,2].

Topographic anatomy

The brachial plexus is roughly shaped like an hourglass with the long axis represented by the 7th pair of cervical nerves.

The proximal base of the hourglass is formed by the cervical vertebral foramina from which the ventral roots emerge.

A little further distally the roots enter the interscalene groove (between the anterior and middle scalene muscles), where they are superjacent to the subclavian artery, before regrouping into trunks.

The narrowest area of the hourglass is the narrow costoclavicular gap where the trunks are redistributed into cords. In the sagittal plane, the cords are superior and posterior to the subclavian artery forming a 'Phrygian cap' over it.

In the axial plane, the cords are lateral to the subclavian artery, which is itself lateral to the subclavian vein.

Distal to the costoclavicular gap the plexus expands again.

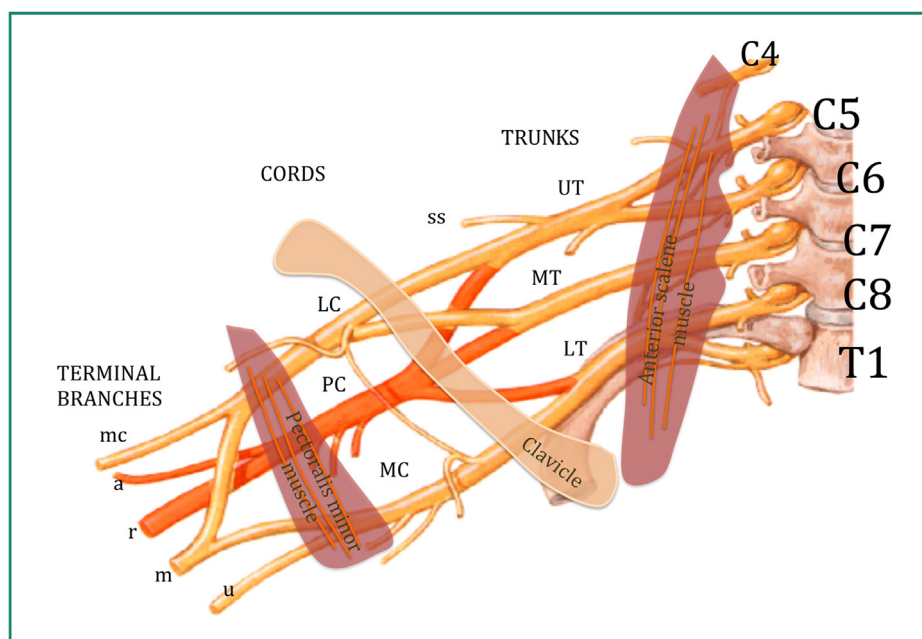


Figure 1. Diagrammatic representation of the brachial plexus according to Netter, and anatomical relations with the scalenes, clavicle and pectoralis minor. UT: upper trunk; MT: middle trunk; LT: lower trunk; LC: lateral cord; PC: posterior cord; MC: medial cord; ss: suprascapular nerve; mc: musculocutaneous nerve; a: axillary nerve; r: radial nerve; m: median nerve; u: ulnar nerve.

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