The clinical anatomy of the great veins of the neck

Introduction

Central venous pressure measurement, prolonged intravenous nutrition, massive and rapid fluid replacement, infusion of hypertonic and cytotoxic solutions, and the use of percutaneous pacemakers have all made catheterization of the great veins of the neck and superior mediastinum a common hospital procedure. A detailed knowledge of the internal jugular, subclavian and brachiocephalic veins is therefore of considerable importance – especially their surface markings and the position of adjacent structures which may inadvertently be damaged in these procedures.

The internal jugular vein

The internal jugular vein (*Figure 1*) commences at the jugular foramen of the skull, where it continues the sigmoid sinus, and exits the foramen accompanied by the glossopharyngeal (IX), vagus (X) and accessory (XI) nerves. It terminates behind the sternal end of the clavicle by joining the subclavian vein to form the brachiocephalic vein.

The vein lies lateral, first, to the internal carotid artery, separated by the hypoglossal (XII) nerve, and then the common carotid artery, with the vagus nerve between and rather posterior to the artery and vein. These three structures lie in a common fascial compartment, the carotid sheath, with the cervical sympathetic chain lying posterior to the sheath. These four structures, two vessels and two nerves, form a quartet throughout the neck. The deep cervical chain of lymph nodes lies close against the carotid sheath and, if involved in malignant or inflammatory disease, may become densely adherent to the vein.

Superficially, the internal jugular vein is overlapped above, and then lower down, covered by, the sternocleidomastoid muscle and is crossed above by the posterior belly of the digastric and, lower, by the inferior belly of the omohyoid.

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The superficial veins of the neck

The arrangement of the superficial veins of the head and neck (*Figure 2*) are somewhat variable, but the usual plan is as follows:

The superficial temporal and maxillary veins join to form the retromandibular vein, which traverses the parotid gland. While in the gland, it divides into a posterior division, which continues downwards as the external jugular vein, and an anterior division, which joins the facial vein to form the common facial vein, draining directly into the internal jugular vein.

The external jugular vein lies in the superficial fascia, crosses the sternocleidomastoid superficially, traverses the roof of the posterior triangle of the neck, then dives through the deep (investing) fascia over the posterior triangle about 2.5 cm above the clavicle to drain into the subclavian vein, as its only tributary. The vein is readily visualized when the subject performs a Valsava manoeuvre, or when a singer hits a top note. Not uncommonly the vein may be double.

The subclavian vein

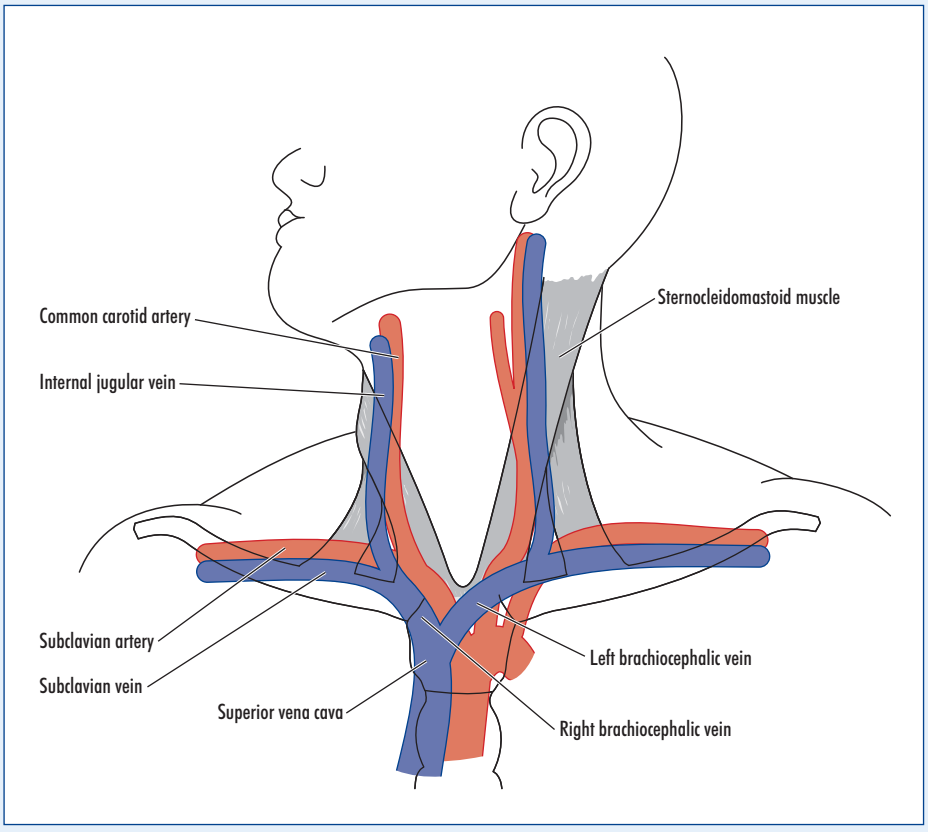
The subclavian veins (*Figures 1* and *3*) are the continuation of the axillary vein and each extends from its commencement at the lateral border of the first rib to the medial border of scalenus anterior, where it joins the internal jugular vein to form the brachiocephalic vein behind the manubrio-sternal joint.

During its short course it crosses, and lightly grooves, the superior surface of the first rib. Postero-superiorly lies the subclavian artery, separated by scalenus anterior, with the phrenic nerve running down on this muscle. Anteriorly lies the clavicle, with the subclavius muscle on its under aspect. This no doubt protects the vein, which is rarely torn in fractures of the clavicle.

On the left side the vein receives the termination of the thoracic duct, while the right lymph duct empties into the right vein. Its only constant tributary is the external jugular vein.

Quite commonly the subclavian vein is crossed anteriorly by the accessory phrenic

Figure 1. The great vessels of the neck and their relationship to the thoracic inlet and sternocleidomastoid.



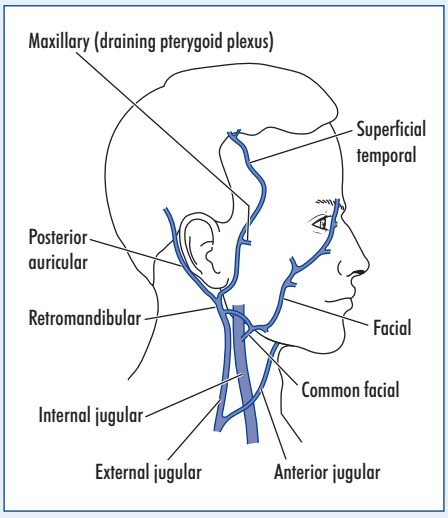


Figure 2. The usual arrangement of the superficial veins of the neck.

nerve, which arises from the fifth cervical nerve root and joins the main phrenic nerve more distally.

The brachiocephalic veins

These form on either side by the junction of the subclavian and internal jugular veins behind the right and left sternoclavicular joint (*Figure 1*). Each lies lateral to its corresponding common carotid artery and in front of scalenus anterior.

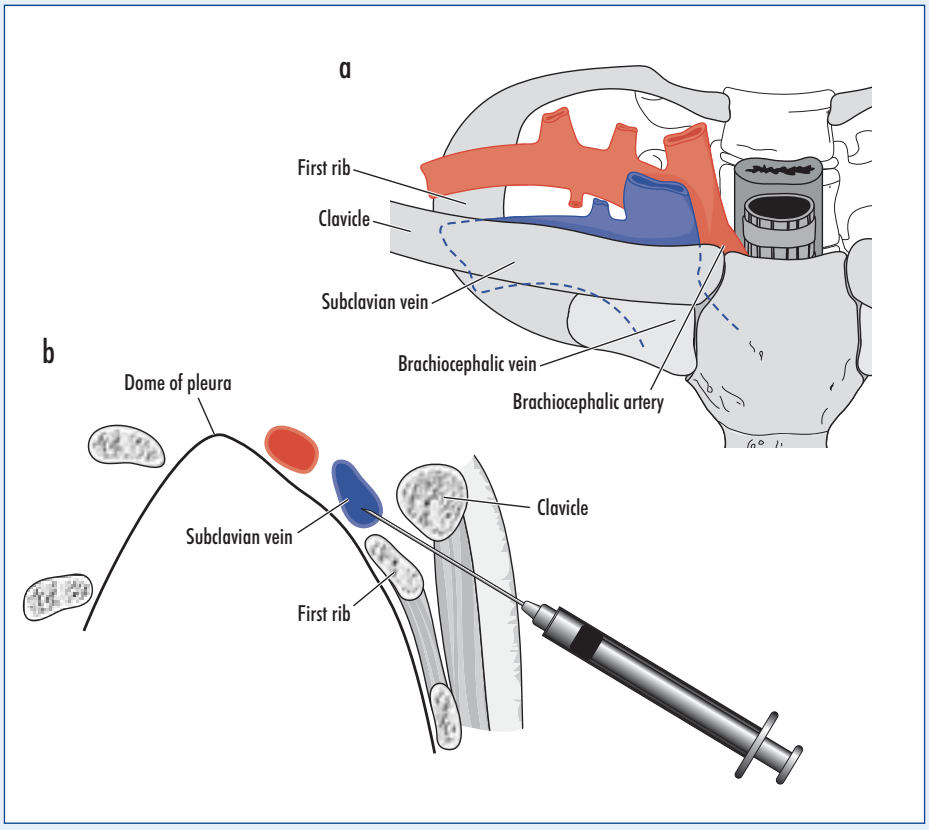
The right brachiocephalic vein is about 3 cm in length and descends vertically behind the right border of the manubrium. It lies anterolateral to the brachiocephalic artery and the right vagus nerve. The right pleura, phrenic nerve and internal thoracic artery are first posterior to it, then inferiorly become lateral to the vein.

The left brachiocephalic vein is about 6 cm in length and descends obliquely behind the manubrium, separated by the thymus gland, to join the right vein at the lower border of the first costal cartilage to become the superior vena cava.

The vein crosses above the arch of the aorta in front of the left subclavian artery, the left common carotid, together with the left vagus and phrenic nerves, the trachea and the brachiocephalic artery.

Note that the dome of the pleura covered by the suprapleural membrane (Sibson's fascia) projects above the medial third of the clavicle for a distance of 2.5 cm. Both the internal jugular and brachiocephalic veins lie in close proximity to the pleura posteriorly, and the risk of pleural puncture, with consequent pneumothorax, must constantly be borne in mind when needles and cannulae are passed into this area.

Figure 3. The anatomy of the infraclavicular approach to the subclavian vein: (a) anterior view (b) in sagittal section.



Anatomical landmarks for central venous cannulation

The internal jugular vein

The patient is tipped head down (to dilate the vein) with the head turned to the opposite side. The surface marking of the vein is the groove between the tendinous sternal head of the sternocleidomastoid and its fleshy clavicular head immediately above the clavicle.

The subclavian vein

The patient is placed head down with the head turned to the opposite side. The needle is inserted just below the clavicle at the junction of its middle and medial thirds (*Figure 3*), although the medial and outer thirds, marked by the delto-pectoral groove, may be used. The needle is aimed towards the sternoclavicular joint and advanced until blood is aspirated into the syringe.

Anatomical complications of cannulation

Apart from such complications as thrombosis, sepsis and air embolism, a number of serious anatomical complications may occur from injury to adjacent or contiguous structures. These include: haematoma, haemothorax, pneumothorax, cannulation of the internal jugular vein, the subclavian or carotid artery, cannulation of the right ventricle, haemopericardium with cardiac tamponade and transient phrenic nerve paralysis. BJHM

Figures 1–3 *are reproduced from Ellis et al (2004) by kind permission of Blackwell Publishing.*
Conflict of interest: none.

Ellis H, Feldman S, Harrup-Griffiths W (2004) *Anatomy for Anaesthetists.* 8th edn. Blackwell Publishing, Oxford

KEY POINT

- Cannulations of the subclavian and internal jugular veins are common hospital procedures which depend on a detailed knowledge of anatomy for their safe execution.