Morphologic and functional anatomy of the subclavian veins

S Calen, X Pommereau, AM Gbikpi-Benissan and J Videau
Laboratoire d’Anatomie Médico-Chirurgicale et de Technique Chirurgicale, UER de Sciences Médicales III,
Université de Bordeaux-II, 146, rue Léo-Saignat, 33076 Bordeaux Cedex, France

Summary. 50 jugulo-subclavian venous junctions were removed to study the endovenous structures of the subclavian vein and of this junction. The diameter of the subclavian vein is always less than that of the internal jugular vein. Valvules were constantly found, whereas endovenous structures such as those found in the ilio-caval junctions were very rare. In view of these findings, these structures may be regarded as of embryologic origin.

Anatomie morphologique et fonctionnelle des veines sub-clavières

Résumé. 50 carrefours veineux jugulo-sub-claviers ont été prélevés pour étudier les formations endoveineuses de la veine sub-clavière et de ce carrefour. Le diamètre de la veine sub-clavière est toujours inférieur à celui de la veine jugulaire interne. Des valvules ont été trouvées de façon constante, alors que des formations endoveineuses, telles que celles que l’on trouve dans les carrefours ilio-cavés, sont très rares. Ces résultats permettent de considérer ces formations comme d’origine embryologique.

Key words: Subclavian veins – Valvules – Endovenous structures

An anatomic and functional entity, the jugulo-subclavian junction or confluence of Pirogoff (CP) is formed by the convergence of the subclavian veins (SCV) (vena subclavia) and internal jugular veins (IJV) (vena jugularis interna) which drain almost the whole of the venous blood of the upper limb and the head and neck region. This confluence and its subclavian afferent present direct anterior relations, bony and articular, the costo-clavicular vice and the sterno-clavicular joint (articulatio sternoclavicularis), and posterior arterial relations. Thus there exists a parallel between the jugulo-subclavian confluence and the left ilio-caval confluence, caught between the promontory (promontorium) and the right common iliac artery (arteria iliaca communis dextra). These two junctions are the site of extrinsic compression and often of endovenous structures which have long been known (Houzé de l’Aulnoit, 1854 [9]).

Numerous publications have been devoted to the study of the endovenous anomalies of the ilio-caval junction; the debate between partisans of an acquired origin and those of a congenital origin is still unsettled.

We studied the morphology of the jugulo-subclavian venous junctions on the basis of 50 anatomic specimens. The object of this work was to seek a resemblance between the endovenous lesions encountered in the jugulo-subclavian region and those described at the ilio-caval region and to attempt to define their etiology.

Review of the classic anatomic data

The subclavian vein (vena subclavia) originates at the level of the costo-coraco-clavicular space, under the middle portion of the clavicle, from which it is separated by the subclavius muscle (musculus subclavius). It is the continuation of the axillary vein (vena axillaris). It collects the venous circulation of the upper limb, the axilla, part of the neck, the thoracic wall and the scapular region. It passes transversely from without
inwards, describing a curve with inferior concavity, straddling the first rib and on the anterior aspect of the dome of the pleura. Always lower in its ascent than the homonymous artery, consequently it is always shorter than the latter. It is interposed between the pleural dome and the medial portion of the clavicle, which conceals it in great part. It terminates at the base of the neck, where, sometimes at the level of the superior apature of the thorax, behind the medial end of the clavicle, or behind the first costal cartilage, it joins with the homolateral internal jugular vein to constitute the brachio-cephalic venous trunk (vena brachio-cephalica).

These findings are very variable, so it is well to recall briefly the features noted by certain classic authors.

Poirier (1903) [18] gave an average caliber of 12 mm and noted the presence of two ostial valvules. He described an adhesion of the muscular sheath of the SCV to the clavicle. From the aponeurosis of the subclavius there spreads a wide and strong fibrous expansion which embraces the neurovascular bundle and is attached to the upper part of the first rib. Thus, the vein dilates due to the action of this aponeurosis in inspiratory movements or in the effort of elevating the arm and clavicle.

Testut (1948) [20] also noted the presence, at the level of the termination of the SCV, of two valvules, usually efficient. Paturet (1958) [17] also described an adhesion to the sheath of the subclavius muscle situated in front of and internal to it.

**Dynamic concept of the thoraco-brachial outlet**

The classic anatomic data do not allow consideration of the phenomena of vascular compression; only a dynamic concept of the thoraco-brachial outlet enables one to stress the modifications in caliber of the subclavian vein during movements of the shoulder. These compression phenomena are responsible for the clinical manifestations of the thoracic outlet syndrome, and it is now established that these are related to mechanical processes compressing the subclavian vascular structures and the nerve trunks of the brachial plexus (plexus brachialis).

By the term “thoracic outlet” is meant the totality of the spaces crossed by the neurovascular structures mentioned above, from the medial border of the scalene passage (m. scaleni) to the inferior border of the pectoralis minor muscle. Thus the thoracic outlet successively involves the intercosto-scalene passage, the costo-clavicular canal and the subpectoral tunnel. The subclavian vein, our sole interest here, traverses only the first two spaces in the inverse order to that described.

The costo-clavicular passage is a very narrow true osteo-muscular tunnel. This canal [8] is situated between the inferior aspect of the medial half of the clavicle and the superior aspect of the middle and anterior segments of the first rib.

The crossed direction of these two bony elements [4] has caused them to be compared with the two blades of a pair of scissors. Barring this passage at its inner end, the tendon of the scalenus anterior separates the artery from the vein, the latter being therefore lodged in a narrow canal. In this passage the space available for the vessels is restricted by the subclavius muscle which lines the inferior aspect of the clavicle and whose tendon crosses over the subclavian vein. Finally, the subclavius muscle itself is added to at its inferior border by the costocoracoid ligament.

The amplitude of the movements of the sternoclavicular joint confers great mobility on the clavicle. Measured at the outer end of the clavicle, the excursion is in a horizontal plane from 10 cm forward (anteposition) to 3 cm backward (retroposition). It is limited by the anterior sternoclavicular ligament (ligamentum sterno-claviculare anterius) and the costo-clavicular ligament (ligamentum costo-claviculare). In the frontal plane the excursion is from 10 cm above (movement of elevation), limited by tension of the costo-clavicular ligament [14], to 3 cm below (movement of lowering of the point of the shoulder), limited by the tension of the sternoclavicular ligament.

Thus, the movements of the shoulder considerably modify the costo-subclavious angle. When the arm is in neutral position, this angle is of the order of 25° [8] and the vein is then in no way compressed. It is situated outside the costo-subclavious angle, which is filled and thereby rounded off by the existence of thick fibrous tracts stretching from the venous adventitia to the neighboring aponeurotic structures, notably the subclavicular and middle cervical aponeuroses, thus keeping the venous lumen patent.

In adduction, the costo-subclavious space tends to close. Maximal closure of the angle gives figures reaching 14° [14], notably when this phenomenon is accentuated by retropulsion, which tightens the tendon of the subclavius muscle [11]. In this case the vein may suffer a certain degree of compression between the fibrous border of the subclavius muscle and the first rib.

In abduction a diminution of the costo-clavicular space is noted, but only in its outer part, by axial rotation of the clavicle (about 30°). This movement carries the superior face of the clavicle backward and its inferior face forward. The curvature of the medial segment of the clavicle then fits perfectly with the lateral contours of the neck and acts as a truly protective curve [8], resisting any costo-clavicular neuro-arterial crushing. As for the costo-subclavious angle, this tends to open out in the movement of abduction. During the second state of shoulder abduction (i.e., from 90°