

A High Origin Subscapular Trunk and its Clinical Implications

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Abstract

Important variations in the arrangement of branches of the axillary artery revolve around the origin of the subscapular artery. The case of a "high origin" subscapular artery as a common trunk to lateral thoracic, common circumflex humeral trunk in the left upper limb of a 72 year-old female cadaver, is discussed. This variant trunk originated posterior to the pectoralis minor muscle about 2-3 cm posteroinferior to that of the thoracoacromial artery. Trunk formations in the axillary artery with four or more branches sharing a common stem of origin are infrequent compared with those with fewer numbers. In certain surgical orthopedic procedures, surgeons sometimes administer a ligature in the 3rd part of the artery, relying on a suprascapular/dorsal scapular-circumflex scapular collateral pathway to dump blood into the artery distal to the ligature. Surgeons engaged in placing such ligature should be aware of proximal origin of the subscapular artery, as in the case of high origin of the artery being presented to guide placements of such ligature. Incorrect ligature placement distal to the origin of the subscapular artery would result in blood being dumped proximal to the clamped site, resulting in possible ischemia, gangrene and limb loss. Pre-operative vascular imaging is advocated during surgical interventions in the shoulder region to assist in the selection of appropriate procedure to help needed in the reduction of iatrogenic complications and in assisting radiologists in the correct interpretation of images.

Keywords: High origin subscapular trunk; Proximal ligature placement; Gangrene of limb; Possible limb loss

Abbreviations: TAA: Thoracoacromial Artery; AA: Axillary Artery; VT: Variant Trunk; MR: Medial Root; LR: Lateral Root; MN: Median Nerve; APCH: Anterior and Posterior Circumflex Humeral Trunk; SSA: Subscapular Artery; CSA: Circumflex Scapular Artery; TDN: Thoracodorsal Nerve; TDA: Thoracodorsal Artery; PmM: Pectoralis minor Muscle; LR: Lateral Root; MR: Medial Root; MN: Median Nerve; UN: Ulnar Nerve

Introduction

Variations in the origin of branches and trunk formations in the axillary artery (AA) have been the subject of many surgical, radiologic and cadaveric anatomic studies. Such variations may result in reduction or an increase in the number of branches arising from the artery. The AA commences from the outer border of the first rib, ending at the inferior border of the teres major muscle to continue as the brachial artery in the arm. The AA is divided into three pectoral parts by the pectoralis minor muscle; superopectoral (1st part), retropectoral (2nd part) and inferopectoral (3rd part) respectively. The 1st part is proximal to the medial border of the pectoralis minor, the 2nd lying posterior to the pectoralis minor muscle while the 3rd part is distal to the lateral thoracic artery or lateral border of the pectoralis minor muscle. The usual branches of the AA include the supreme thoracic from the 1st part, 2 branches namely the thoracoacromial and the lateral thoracic artery from its 2nd part, the subscapular artery (SSA) and the two circumflex humeral arteries are from the third part of the artery. Reduction in the number of branches of the AA are as a result of two or more of its branches sharing a common stem of origin. Keen JA reported a 30% incidence of the anterior circumflex humeral

arising in common with the posterior circumflex humeral artery [1]. An increase in the number of branches may be as a result of other vessels which normally arise elsewhere originating from the AA. Quain reported a variant in which the suprascapular and dorsal scapulae arteries usually of subclavian origin arising from the AA [2].

The SSA is the largest of the six usual branches of the AA, arising most usually in the 3rd part of the artery. The SSA engages in numerous branching variations, and there are reports of the artery originating from all the three regions of the AA. Adachi reported a 91.7% incidence of the SSA, a direct branch of the AA; with an 8.3% absence [3]. A "high origin" SSA occurs when the artery arises much nearer on a level with TAA or from its retropectoral part [1,4]. Huelke reported a 0.6% incidence of the SSA arising from its 1st part [4]. Keen reported a range of incidence from 26.3 % to 31.7% of the SSA arising from the 2nd part of the artery [1]. De Garis and Swartley reported a 94.1% incidence of the SSA from the 3rd part and a 5.1% incidence from its 2nd part [5]. These multiple SSA branching variations do carry diverse clinical implications.

Case Report

An important branching variation of the AA was observed in the left upper limb of a 69 year-old male cadaver. Four of the six standard branches of the AA; the lateral thoracic, SSA and common stem for the anterior and posterior circumflex humeral arteries were observed sharing a common trunk of origin. This variant trunk (VT) arose about same level with the thoracoacromial artery and was placed between the medial and lateral borders of the pectoralis minor muscle, corresponding to the artery's 2nd part (Figure 1).

The main stem of the AA continued distally to become the brachial artery at the inferior border of the teres major muscle. The VT measured about 3.4 mm in diameter at origin, courses obliquely

inferomedially and distal to the main trunk of the AA, (represented by its stump in our Figure 1). About 2 cm distal to its origin of the VT, the lateral thoracic artery originated from the inferomedial surface of the VT. The VT trifurcated into the common stem of origin to the anterior and posterior circumflex humeral arteries, the circumflex scapular and the thoracodorsal arteries about 2-3 cm distal to the origin of the lateral thoracic artery (Figure 1). The VT bifurcated yielding the common trunk to the circumflex humeral arteries superiorly and an inferiorly coursing trunk which also bifurcated yielding the thoracodorsal and the circumflex scapular arteries laterally, which are terminal branches of the SSA (Figure 1). The thoracodorsal nerve, a peripheral branch of the posterior cord of the brachial plexus emerged just medial to the origin of the VT, coursed inferomedially diagonal and distally to join the run the thoracodorsal artery to supply the latissimus dorsi muscle.

The ulnar nerve coursed superiorly to the branches of the VT, was placed anterior to the common circumflex humeral trunks before the latter travelled with the axillary nerve to run in the quadrangular space in the left upper limb. The brachial and the basilic veins in the left limb as well as the neurovascular branching pattern in the right upper limb were found normal.

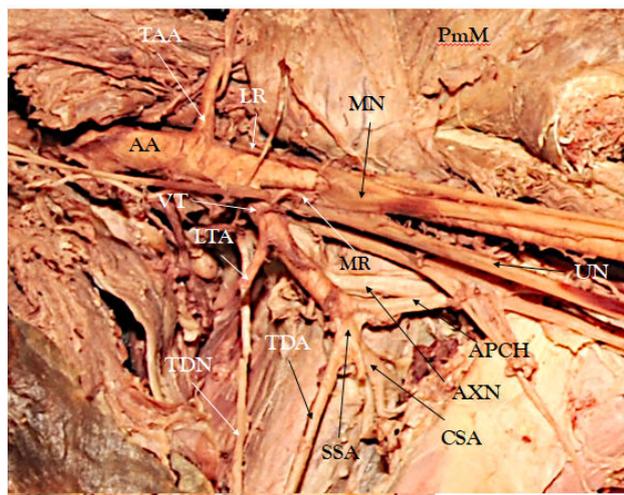


Figure 1: The image shows a variant trunk originating from the axillary artery, at a level just 2-3 cm posteroinferiorly and distal to the origin of the thoracoacromial artery. About 1 cm distal to its origin, the variant trunk gave origin to the lateral thoracic medially (represented by a short stump in our specimen). Other branches arising more distal and inferiorly from the trunk included a common trunk to the anterior and posterior humeral arteries (which would divide later into the anterior and posterior arteries). The common trunk is found coursing with the axillary nerve. A short trunk of the subscapular artery bifurcated yielding the thoracodorsal and circumflex scapular arteries respectively.

Discussion

Branching variations in AA have been extensively reported by authors of large sample studies [2-5] and as casual findings by others [6]. George BM reported the case of an AA which gave a large abnormal arterial trunk which divided into a common circumflex

humeral-subscapular trunk and profunda brachii arteries [6]. Our reported trunk unlike the one George BM reported did not have a profunda brachii.

Vascular malformations are frequently straightforward to detect; anomalies result from deviations from typical vascular development. Development of the arterial pattern in the upper limb occurs between stages 12 through 23 of the developmental process and unrelated to any stage of development [2]. The sprouting theory of vascular development are obsolete [7]. Rodriguez-Niedenfuhr et al. suggest that the variations arise through the persistence, enlargement and differentiation of parts of the initial network which would normally remain as capillaries or even regress [8].

Rodriquez-Niedenfuhr et al. suggest that arterial patterns develop from an initial capillary plexus and its proximo-distal maintenance, enlargement and differentiation of some capillaries and the regression of others [9].

Important variations in the arrangements of the branches of the AA revolve around the point of origin of the SSA [1]. Numerous authors have reported on the various morphological origins of the SSA from the three parts of the AA. [1,4,5]. Ramesh Rao et al. reported an incidental finding of an unusual variation in the branching pattern of axillary artery observed on the left side of a 72 year-old female cadáver [10]. This was comprised of an unusual origin of subscapular, anterior and posterior circumflex humeral, profunda brachii artery and ulnar collateral arteries from a common trunk arising from the third part of the axillary artery and at its commencement was found passing between the two roots of the median nerve [10]. Our MN was formed properly by the union of its lateral and medial roots, and arising posterior to the medial root unlike the one Ramesh Rao et al. reported.

The usual terminal branches of the SSA are the thoracodorsal artery and the circumflex scapular artery. The circumflex scapular artery plays a very vital role as one of the several vessels forming the scapular anastomosis.

The principal arteries of the upper limb can be ligated at any point without impeding blood flow to the distal part of the extremity, because potential anastomoses exist between practically all branches of the subclavian-axillary continuance; the hub of such a grid is the scapular anastomosis, bringing blood from the subclavian artery via the dorsal scapular or suprascapular linking up with the circumflex scapular-subscapular arteries, which dumps blood into the 3rd part of the AA with blood flowing thereafter distally to supply the arm and distal forearm structures and hand respectively. Reliance on this continuum assumes an AA with its usual branching pattern; an anatomical landmark that requires clamping in the 3rd part. Such a reliance on the usual anatomical landmark would pose a risk when the SSA is high arising. The grid of the subscapular anastomosis in a high origin SSA would dump blood into its 1st or 2nd part, depending on where the SSA took origin, a point proximal to the clamping site. A similar result would occur in instances of avulsion occurring in the 3rd part with a high origin SSA. Hemorrhaging from such an avulsion can threaten the health of extremity structures, with possible attending gangrene and limb loss. In addition, brachial plexopathy can also result from hematoma compression of some nerves, resulting possibly in attendant sensory loss in the skin areas of such compressed nerves.

Pre-operative studies including angiography, duplex scanning or Doppler MRA are advocated when surgical interventions may likely cause iatrogenic complications to branches of the AA and in assisting radiologists in the correct interpretation of images.

Conflict of Interest

None.

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