

Variation in the Branching Pattern of Superior Thoracic Artery- A Rare Case

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ABSTRACT

Superior thoracic artery is usually a branch from the first part of axillary artery. It descends down up to the 2nd intercostal space and anastomose with internal thoracic and intercostal arteries. However, during routine dissection for medical students it was observed that the superior thoracic artery on the right side showed unusual branching pattern, dividing into medial and lateral branches. The lateral branch coursed around the medial wall of axilla horizontally superficial to the long thoracic nerve of bell which divided into medial and lateral branch. This variation is of radiological, surgical and morphogenic importance as no such branching pattern have been described in the literature previously.

Keywords: Axillary artery, 1st part, Morphogenesis, Variation

CASE REPORT

Among ten cadavers that were dissected during routine dissection in the axilla region for medical students at Madha Medical College and Research Institute, one cadaver (male with age approximately around 50 years) had a unilateral variation in the course of the Superior Thoracic Artery (STA) on the right side limb alone [Table/Fig-1] and the left side had no such variations [Table/Fig-2]. The rest of its 5 branches of axillary artery did not show any variation. The present case has a rare variation where the STA divides into medial and lateral branches and in turn the lateral branch again divides into two terminal medial and lateral branch [Table/Fig-2,3]. STA raised from 1st part of axillary artery and at the level of 2nd rib the artery divided into two prominent branches in an inverted 'T' shaped manner unusually.

The medial branch followed the usual course of axillary artery and supplied the 1st intercostal space. The lateral branch had a variant course towards the medial wall of axilla. The STA divided into a medial branch and a lateral branch which again divided into 'Y' shaped branch-upper and lower running deep towards subscapularis muscle. This lateral branch was found superficial to long thoracic nerve of Bell and coursed laterally along the medial wall of axilla [Table/Fig-3]. No such variation has been reported in the literature. Since this variation was noted during routine dissection, no ethical approval was needed.

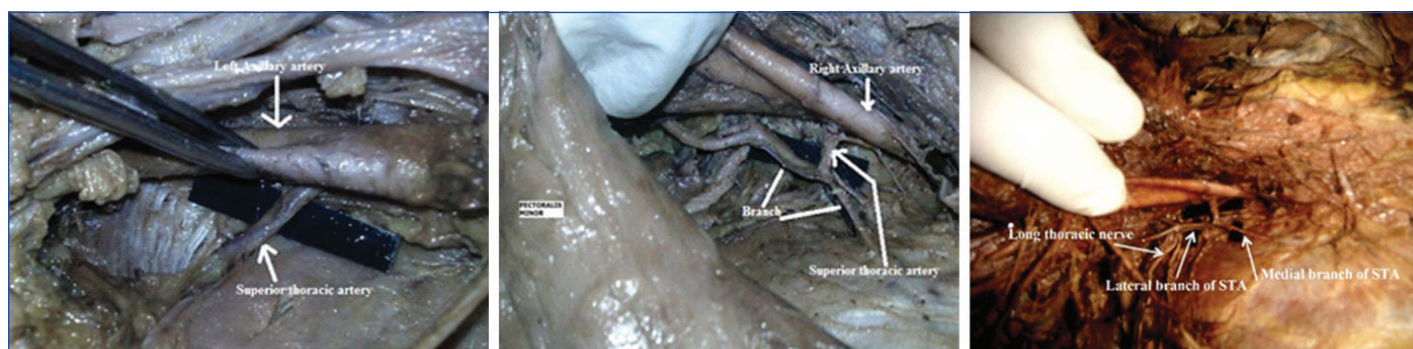
DISCUSSION

Axillary artery is a continuation of subclavian artery and a number of variations have been noted thus far [1-3]. Variations in course, branches, double axillary artery have all been described [4,5].

Anatomically axillary artery is divided into 3 parts by pectoralis minor muscle, the proximal being the first part and the distal being the 3rd part. The 1st part gives one branch –STA, the 2nd part gives two branches – thoraco-acromial and lateral thoracic artery, the 3rd part gives three branches – anterior and posterior circumflex artery, subscapular artery. Apart from the usually named 6 branches, other branches such as superior subscapular artery and alar thoracic artery were described by Huelke, (1959) [6]. The abnormal branching pattern of axillary artery is less common in male than in females [1].

The axillary artery develops from the seventh cervical segmental artery and any morphological variation in its branching pattern is linked to its development [7]. De Garis CF and Swartley WB (1928) described 23 different types of axillary artery which showed greater tendency of variation amongst the African race than in Caucasians [4]. There is also found to be a sex difference in the branching pattern with female showing more variation than males [8]. Astik R and Dave U reported incidence of variation in axillary artery can be as high as upto 62.5% [9]. The most common variations in STA that were reported in the literature usually are; a) arising from 3rd part of subclavian artery; b) in few cases STA was absent [6]; c) could arise from thoraco-acromial trunk [1]; d) arising as second branch of 1st part of axillary artery – the first branch being an aberrant one supplying serratus anterior [10].

Usually STA is small branch in case of males and it courses down beneath subclavius muscle and anastomose with internal thoracic artery and intercostal arteries [11]. There can be numerous reasons of the variation in normal branching pattern of axillary artery and it could be due to the defects of neighbouring tissue and also defects



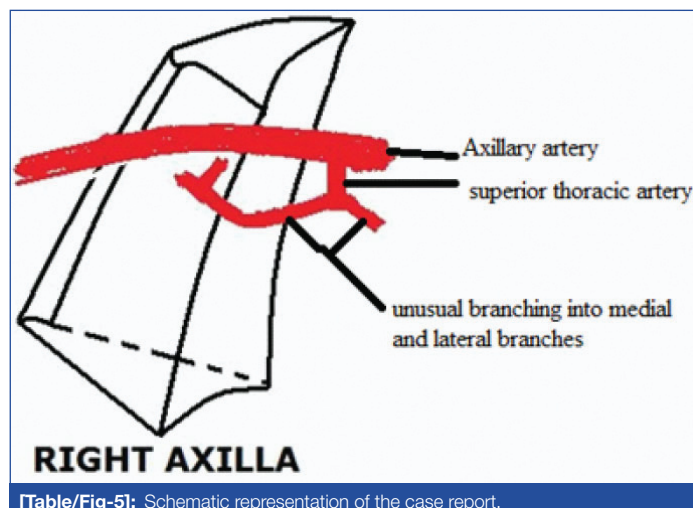
[Table/Fig-1]: Shows the normal left side axillary artery (White arrow shows axillary artery- top, superior thoracic artery- bottom). **[Table/Fig-2] and [Table/Fig-3]** shows the right side axillary artery. Note the variation in the branching pattern of STA when compared to its usual course on the right side (In Table/ Fig. 2 White arrow points the axillary artery- top, bend arrow points superior thoracic artery and the bottom arrow points the variant medial and lateral branches of STA. In Table/ Fig. 3 the white arrow in the left points on the long thoracic nerve, the middle and right arrow points the variant medial and lateral branches of STA)

in embryonic vascular network development. Variations in axillary artery are not unusual [Table/Fig-4] [12-23].

Author	Year	Finding
Cavdar S et al., [12]	2000	Third part of axillary artery gave 2 branches- superficial and deep brachial arteries which gave rise to various branches. The superficial brachial artery divided into radial and ulnar artery
Jacquemin G et al., [13]	2001	Bilateral origin of superficial ulnar artery from the axillary artery with different courses in two limbs
Saeed M et al., [14]	2002	Variations in branching pattern in subclavian and axillary systems.
Natsis K et al., [15]	2006	High origin of superficial ulnar artery on the right side with a looped course
Venieratos D and Lolis ED, [16]	2001	Common trunk from the third part of axillary artery dividing into various branches
Panagouli E et al., [17]	2009	Superficial ulnar artery from the second part of axillary artery on the right side. On the left side, a single common trunk from the second part dividing into two branches.
Daimi SR et al., [18]	2010	First part giving rise to thoracoacromial trunk and two posterior circumflex humeral arteries and high origin of radial arteries
Sawant SP et al., [19]	2012	Superior thoracic, lateral thoracic, thoraco-acromial arteries raised from deep part of axillary artery which was found have two parts- superficial and deep axillary artery
Gaur S et al., [20]	2012	Variation in the branches of axillary artery is more common on the second part.
Naveen K et al., [21]	2014	Profundabrachii artery originated from the 3 rd part of axillary artery
Aastha AJ and Kumar MS, [22]	2015	Superior thoracic artery passes between two divisions of lateral cord and third part gave a single common trunk.
Ezzati M et al., [23]	2018	Common trunk in the second part of axillary artery, which divided into Lateral Thoracic, Subscapular arteries and then muscular branches.

Table/Fig-4: Shows the variations in the branching pattern of axillary artery.

Many of the branches may arise as a common trunk or constant branches may arise separately in different part of the axillary artery [24]. Previous literatures have shown that variations in the first part is very rare [12] and more common on the second part of axillary artery (Gaur S et al., 2012) [20]. Among the usually named 6 branches, lateral thoracic, subscapular artery (87%) and Posterior Circumflex-humeral Artery (PCA) (86.5%) are most common branches of variable origin. When PCA arises from deep brachial artery it passes through the lower triangular space along with radial nerve rather than in the quadrangular space with axillary nerve [25]. In the present case, the lateral branch of STA is in close proximity with the long thoracic nerve [Table/Fig-3,5]. It can also be noted that, this lateral branch bifurcates over the surface of the nerve. The places of arterial bifurcation are sites where aneurysms are more prone to happen due to higher haemodynamic stress at such sites. Such an aneurysm may compress long thoracic nerve there by leading to deficits in the function of serratus anterior muscle [26].



Table/Fig-5: Schematic representation of the case report.

Formation of vascular system involves vasculogenesis and vascular remodelling. Genetic regulation may be a vital factor in the formation of blood vessels during the early stages of development, however in later stages blood flow plays a pivotal role in the formation of blood vessels. The plasticity of blood vessels is determined by various genes such as ephrin B2 (for arteries) and neuropilin- 2 (for veins) which is one of the factor playing a role in branching morphogenesis [27,28]. Studies have shown apart from the normal genetic expression which controls branching points, haemodynamics (hypoxia) and cardiac output regulation also determines the branching morphogenesis [29]. The present case is unique because of its variation in branching pattern where there might have been an area of tissue hypoxia during embryogenesis along the axilla, which would have probably upregulated hypoxia induced factor-1 gene to trigger sprouting from primitive vascular capillaries to that region. Failure of such anomalous branch to regress might have caused this sort of a distinctive changes in branching morphology of STA even though genetic and other factors cannot be ruled out.

Deep seated axillary abscess is usually drained along the medial wall of axilla as the other 3 walls of axilla contains important neurovascular structures namely lateral thoracic, axillary and subscapular arteries along the anterior, lateral and posterior walls respectively [30]. Sound knowledge of the vascular variations is important for surgeons during mastectomy with axillary clearance for CA-breast, to anaesthesiologist and orthopaedic surgeons considering the frequency of procedures done in this region for instance on the humerus. Since this variant branch is in close proximity with shoulder joint, utmost care should be taken during any interventional procedure to not injure such variant branch of STA.

CONCLUSION(S)

Variations in axillary artery are very common but a variation in the branching pattern of STA is very rare. During coronary bypass grafting as well as other reconstructive surgeries of the axillary artery after trauma, vascular grafts from branches of upper extremities arteries are used. For accurate diagnosis of underlying pathology in the axillary region, a thorough knowledge of variant and normal anatomy is vital for vascular radiologist, clinical anatomist and surgeons.

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