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Case Report

Collateral Artery from the 1st Part of the Axillary Artery: A Case Report

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Abstract

During radiological studies and surgeries, the branch architecture of the Axillary artery (AA) is crucial. Variations can complicate the interpretation of radiological data and cause unanticipated surgical complications. In the present situation, an uncommon collateral artery arose from the 1st part of the AA and gave rise to the lateral thoracic artery (LTA) and subscapular artery (SSA) before becoming the posterior circumflex humeral artery (PCHA). The SSA additionally gave rise to the thoracodorsal (TDA) and circumflex scapular arteries (CSA). For safe and effective surgical treatments and to prevent technical failures during catheterization and interventional procedures, it is essential to be aware of these anatomical differences.

Keywords: axillary artery, collateral artery, lateral thoracic artery, posterior humeral circumflex artery, subscapular artery, thoracodorsal artery.

INTRODUCTION

The axillary artery (AA) is described as a continuation of the subclavian artery at the outer border of the first rib and the brachial artery at the lower border of the teres major, according to anatomy textbooks. The axillary artery is divided into three parts by the pectoralis minor muscle, whose branches are designated by their numbers. The first section has one branch, the superior thoracic artery (STA), the second has two, the thoracoacromial artery (TAA) and the lateral thoracic artery (LTA), and the third has three, the anterior circumflex humeral artery (ACHA), the posterior circumflex humeral artery (PCHA), and the subscapular artery (SSA). The SSA is subdivided further into the thoracodorsal artery (TDA) and the circumflex scapular artery (CSA) (Standring,2020).

The AA varies in its origin, course, existence of common trunks, and number of branches. SSA and LTA share a common origin in 28.7 percent of instances, while SSA and PCHA share a common origin in 15.2 percent of cases. It is uncommon for SSA, LTA, and PCHA to share a common origin, which accounts for approximately 4.7% of all cases (Xhakaza & Satyapal, 2014). According to Saeed *et al*. (2002), there is a bilateral common subscapular-circumflex humeral trunk (3.8 percent) that branches into the circumflex humeral and TDA, as well as a bilateral thoraco-humeral trunk (1.9 percent) that arises from the second half of the axillary artery (Saeed *et al.*, 2002). According to the Compendium of Human Anatomic Variations, the initial segment of the AA rarely gives rise to the SSA or a branch that supplies the subscapular muscles (Bergman *et al.*, 1988). Due to their possible effect on surgical operations and interventions in the axilla, these variants have major clinical consequences (Naveen *et al.*, 2014). In the vicinity of the scapula, the subclavian and axillary arteries provide significant collateral circulation. The branching pattern of AA becomes therapeutically significant when the AA is severed. We report an instance in which a collateral artery from the first part of the AA gave rise to the LTA and SSA before becoming the PCHA.

CASE REPORT

The routine dissection performed in the Department of Anatomy for educational purposes revealed a variance in the axillary artery's branches. Just proximal to the medial border of the pectoralis minor muscle, the axillary artery is separated into a medial collateral artery and a lateral major trunk of the AA. It was observed that the lateral primary trunk of the AA follows the natural path of the AA, with typical origins of the radial and ulnar arteries. The lateral, medial, and posterior cords of the brachial plexus are lateral to the lateral primary trunk of the AA, medial to it, and posterior to it, respectively, and deep to the pectoralis minor muscle. It was observed that the nerve to latissimus dorsi, which arises from the posterior cord of the brachial plexus, passes between the two trunks of the AA and crosses the medial collateral artery anteriorly in order to supply the latissimus dorsi muscle. The median nerve trunk is formed by the union of the lateral and medial roots of median nerve anterior to the lateral primary trunk.

Two branches were observed emanating from the AA's lateral major trunk. The TAA originated close to the medial edge of the pectoralis minor muscle, just next to the bifurcation of the axillary artery into two branches. The TAA was observed to divide into four branches following its origin: the pectoral, acromial, clavicular, and deltoid branches. ACHA was the other branch that originated from the lateral major stem of AA. At the distal border of the subscapularis muscle, the ACHA originated from the lateral primary trunk of AA. After its genesis, the ACHA ran horizontally, anterior to the surgical neck of the humerus, behind the coracobrachialis and the short head of the biceps brachii muscle. The ACHA terminated at the shoulder joint and the humeral head. No anastomoses were seen between the ACHA and PCHA. From the lower border of the teres major muscle, the lateral primary trunk of AA continued as the brachial artery after giving rise to the ACHA.

The LTA arised from the medial collateral artery deep to the pectoralis minor muscle. It was observed that the LTA passes between the subscapularis and serratus anterior muscles and supplies both. The medial collateral artery then travelled horizontally over the subscapularis muscle medial to the medial cord of the brachial plexus. At the subscapularis distal boundary, the medial collateral artery gave origin to the SSA. Approximately 2 cm after its inception, the SSA was observed to split into the CSA and the TDA. The TDA finished by feeding the serratus anterior and latissimus dorsi muscles as it descended down the lateral border of the scapula. The neurovascular pedicle supplying the latissimus dorsi muscle was formed by the nerve to latissimus dorsi and the branch from TDA supplying the latissimus dorsi muscle. The CSA, the largest of the terminal branches, curved around the lateral edge of the scapula to enter the upper triangular region defined by the subscapularis above, the teres major below, and the long head of the triceps brachii laterally. The medial collateral artery then continued as the PCHA and travelled posteriorly to enter the quadrangular region defined by the teres minor, teres major, long head of triceps brachii, and surgical neck of humerus. The PCHA terminated at the humeral head, triceps brachii, and deltoid muscles. There were no anastomoses between the ACHA and PCHA or between the PCHA and profunda brachii artery. Figures 1 and 2 depict the origin and branching of the medial collateral artery from the AA.

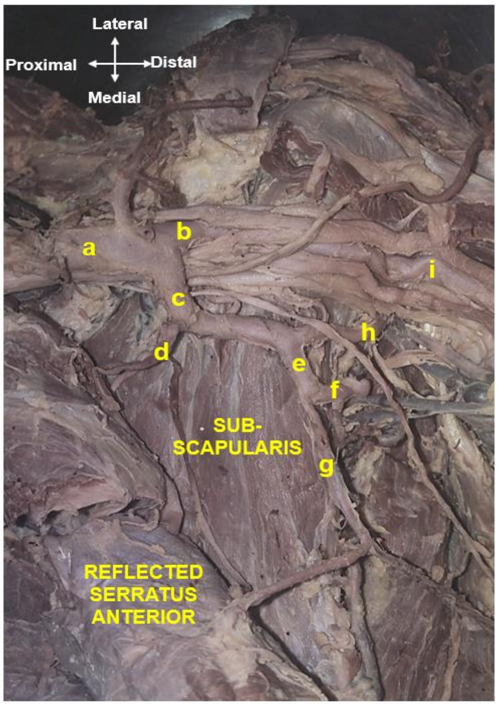

Figure 1: Photograph showing medial collateral artery from axillary artery.
a: Axillary artery, b: Lateral primary trunk of axillary artery, c: Medial collateral artery from axillary artery, d: Lateral thoracic artery, e: Subscapular artery, f: Circumflex scapular artery, g: Thoracodorsal artery, h: Medial, collateral branch of axillary artery continuing as posterior circumflex humeral artery, i: Lateral, primary trunk of axillary artery continuing as brachial artery

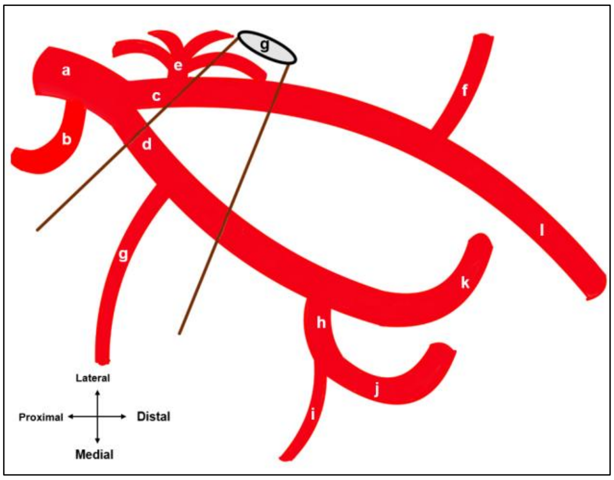

Figure 2: showing the schematic picture of the variation in the axillary artery branches.
a: Axillary artery, b: Superior thoracic artery, c: Lateral primary trunk of axillary artery
d: Medial, collateral artery, e: Thoracoacromial artery, f: Anterior circumflex humeral artery, g: Lateral thoracic artery, h: Subscapular artery, i: Thoracodorsal artery, j: Circumflex scapular artery, k: Collateral artery continuing as posterior

circumflex humeral artery, l: Axillary artery continuing as brachial artery, g: Pectoralis minor

DISCUSSION

Embryology

In the present case, a medial collateral artery was observed to arise from the first part of the AA, supplying about half of the AA's branches. These vascular anomalies may have embryological causes, such as aberrant growth and development of the seventh intersegmental artery or failure of absorption during limb creation. In 11-mm-long embryos, the seventh cervical intersegmental artery normally enlarges and becomes the major artery of axilla. The segmental arteries at C6, C7, and T1 and the majority of the longitudinal anastomoses connecting the intersegmental arteries deteriorate slowly. An stoppage at any point of embryogenesis showing as retention, reappearance, or regression can lead to aberrant arterial branching. Abnormal arterial branching patterns in the upper limb appear to be the result of an abundance of potential alternatives during arterial development (Woolard, H., 1922, Tan, C. B., & Tan, C. K., 1994). In our situation, a medial collateral artery arose from the first part of the axillary artery, giving rise to the LTA and SSA before continuing as the PCHA. The SSA is subdivided into the TDA and the CSA.

The number of branches arising from AA varies from 4 -7. The most common variation in the present study was observed in the origin of SSA (15%), followed by PCHA (10%), ACHA and LTA (7.5% each) and STA (2.5%) (Suman Tiwari & Khizer Hussain Afroze, 2020). Further, the TDA, CSA, PCHA originating from the SSA whereas the ACHA only originating from the third part of the AA was also reported (Esakkiammal *et al.,* 2022). Aguez *et al.* also reported that the SSA have been found to be among the most common variations in the AA and its branches (Ã-guez *et al*., 2022). It was reported that the CSA, TDA, PCHA, TCA and LTA arise form SSA (Vasuki *et al.*, 2015). According to a report by Venieratos & Lolis, that the CSA, TDA, ACHA, PCHA, Profunda brachii artery and ulnar collateral artery originated from a common SSA (Venieratos & Lolis, 2001).

In a report, the SSA identified the origins of LTA and PCHA in addition to its typical branches. Also reported was the right SSA originating from the initial portion of the AA and branching into the LTA, TDA, and PCHA (Tverskoi *et al.,* 2018). In 30% of instances, the SSA and PCHA share a common trunk (Muraleedhar & Kuppi, 2018). Samuel *et al.* (2006) found no profunda brachii artery, although the third segment of the AA branches off into a single arterial trunk, from which the ACHA and PCHA, SSA, radial collateral, middle collateral, and superior ulnar collateral arteries branch off (Vollala *et al.,* 2006).

Several investigations have demonstrated that the PCHA is a division of the SSA. Olinger *et al.*, studied the branching patterns of the SSA and PCHA; they also reported that the SSA produced the LTA (4.2% of the time) and the PCHA (12%) (Olinger and Benninger, 2010). Ramesh *et al.* reported an instance in which a single trunk gave rise to numerous branches, including the TAA, LTA, PCHA, and SSA, while the ACHA was discovered to originate from the third section of the AA (Ramesh Rao *et al.,* 2008). Also reported is a variant origin of the SSA from a shared trunk with the PCHA (Astik & Dave, 2012). (Chakraborty & Sarkar, 2019). A study reported that the common subscapular stem and its branches constitute the collateral artery (Saralaya V *et al.,* 2008). Astik *et al.* (Astik & Dave, 2012), Alicea *et al.* (Alice *et al.*, 2022), and Fatima *et al.* (2016) reported the PCHA resulting from SSA (Fatima *et al.*, 2021).

In a study, it was discovered that, on the left side, the SSA, which typically develops from the third portion of the AA, originated from the second portion together with the LTA and TAA arteries, and the ACHA and PCHA formed, as expected, from the third portion. On the right side, the CSA and TDA emerged from the third segment as a single trunk, which is not the typical pattern (Alicea *et al.,* 2022). According to Huelka, 15.2% and 14.6% of PCHA and LTA cases, respectively, originated from SSA (Huelke, 1959).

Clinical implications

Surgeons must be aware of these variations in order to avoid difficulties during treatments involving the axilla. Knowledge of these variations is crucial for effective interpretation of radiological images and diagnostic procedures in clinical assessments. Clinical repercussions of the LTA and PCHA resulting from the SSA include the potential for surgical complications and the significance of correct identification and interpretation in clinical assessments. In angiography or computed tomography angiography (CTA) studies, for instance, the identification and proper labelling of arteries emanating from the SSA, such as the LTA and PCHA, might aid in accurate diagnosis and treatment planning (Esakkiammal *et al.,* 2022; Vasuki *et al.,* 2015). These changes in the second and third portion of AA can present difficulties in surgical treatments, such as breast reconstruction and shoulder surgery, where the identification and preservation of arteries is critical (Olinger and Benninger, 2010).

The peripheral arterial pulse of the upper limb may be weak due to collateral artery from AA, making blood pressure monitoring more difficult. Vascular surgeons and radiologists interpreting angiographic scans of the upper limb must take into account the altered vascular pattern in this case. In clinical practise, it is advantageous to be familiar with the AA branch variants and their brachial plexus interactions. Due to the region's high volume of surgical procedures, surgeons must be aware of these distinctions. If the AA is interrupted beyond the first half, collateral circulation between the first and third subclavian branches could be affected. These aberrant branches should be explored even during axilla and pectoral surgery. To treat cardiovascular disorders with increasingly invasive diagnostic and interventional approaches, we must know vascular variability. In bypass and flap surgery, upper-limb arterial branches are utilised. Understanding the vascular pattern of the upper extremity is beneficial for reconstructive surgery and angiography. To avoid difficulties resulting from a lack of clinical anatomical knowledge, radiologists and operating surgeons must nonetheless be made aware of vascular differences (Yotova & Novakov, 2004).

For safe and effective surgical treatments, as well as to avoid technical failures during catheterization and interventional procedures, it is necessary to be aware of these anatomical variances. In addition, imaging techniques such as computed tomography angiography and magnetic resonance angiography benefit significantly from the proper detection of anatomical changes in the AA.

CONCLUSION

In the present instance, an atypical medial collateral artery arose from the 1st part of the AA, giving rise to the LTA and SSA before becoming the PCHA. In addition, the SSA spawned the TDA and CSA. These variations may be the result of seventh intersegmental artery anomalies. The differences between AA branches may be relevant to radiologists and surgeons performing treatments on the axilla and breast. Therefore, healthcare professionals and students should be aware of the variety of AA branching patterns to ensure they may take a tailored approach with each patient and adapt to their unique anatomy.

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