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Anatomical variations of the axillary artery and brachial plexus: Insights from a cadaveric study

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Abstract

Background: Typically, the subclavian artery becomes the axillary artery after crossing the first rib, extending from behind the midpoint of the clavicle up to the level of the inferior border of teres major and continues as the brachial artery beyond teres major. Depending on the relation to pectoralis minor, the axillary artery is divided into three parts, with specific branches arising from each part. This case report describes a significant anatomical variation observed in the axillary artery and neural structures around it during cadaveric dissection on a 65-year-old male of unknown medical history.

Case description: In this case, the right axillary artery bifurcated into two branches with nearly equal diameter. The medial continued as the brachial artery, while the lateral continued as a common trunk. This common trunk then branched into vessels of the third part of the axillary artery before continuing as the profunda brachii artery. Medial and lateral roots of the median nerve embraced this common arterial trunk, instead of cuddling the third part of the axillary artery. The lateral root crossed over the common arterial trunk to join the medial root to form the median nerve lateral to the brachial artery. Furthermore, the median nerve traversed deep to the brachial artery halfway down the arm to reach its medial aspect. On the left side, slight clockwise rotational changes in the orientation of the brachial plexus cords around the axillary artery, accompanied by altered positioning of the median nerve were noted.

Conclusions: These findings underscore the importance of recognizing anatomical variations in interventional and surgical planning involving the axillary artery. Understanding such variations is crucial for minimizing procedural risks such as injury to the brachial plexus and optimising patient outcomes.

Key words: Anatomical variation, Axillary artery, Brachial artery, Profunda brachii artery, Median nerve

Background

In humans, the subclavian artery becomes the axillary artery after crossing the first rib to supply the upper limb and extends from behind the midpoint of the clavicle up to the level of the inferior border of teres major. Based on its relation to the pectoralis minor, the axillary artery is divided into three parts. The superior thoracic artery arises from the first part, while the lateral thoracic artery and thoraco-acromial artery originate from the second part. The three cords of the brachial plexus lie medial, lateral, and posterior to the second part of the axillary artery. The third part of the axillary artery gives rise to the anterior and posterior circumflex humeral arteries and subscapular artery. Beyond the teres major the axillary artery continues as the brachial artery and travels medial to the biceps brachii, and in the upper brachium, lies anterior to the long head of the triceps. At the level of the neck of the radius in

the cubital fossa, the brachial artery divides into radial and ulnar arteries. The median nerve after forming from the lateral and medial cords of brachial plexus, at the third part of axillary artery, descends lateral to the brachial artery. It crosses over the brachial artery half way down the arm and runs medial to the artery. Distal to the teres major, the profunda brachii artery arises from the lateral aspect of the brachial artery and travels down with the radial nerve and ends up in its radial and middle collateral branches. In addition, the superior and inferior ulnar collateral branches arise from the medial aspect of the brachial artery (1)

Case description

During the cadaveric dissection at the Faculty of Medicine, University of Jaffna, we discovered neurovascular abnormalities in the upper limb of a 65-year-old male cadaver, whose previous medical history was unknown. On the right side, the third part of the axillary artery bifurcated 71.28mm distal to the midpoint of the clavicle into two vessels of almost equal diameter. The medial branch continued downwards as the brachial artery (Fig. 1 & 2). The radial artery and ulnar artery originated at 118.40mm proximal to the level of the neck of the radius (Fig 1 & 3) and both arteries followed the normal course in the forearm and hand.

The lateral branch emerged as a common trunk. Roots for the median nerve embraced this common arterial trunk, instead of cuddling the third part of the axillary artery. The lateral root of the median nerve coursed over the common trunk from lateral to medial to join the medial root and the median nerve was formed lateral to the brachial artery (Fig 1 & 2). The median nerve travelled distally and crossed behind the brachial artery halfway down the arm to reach the medial aspect of the brachial artery (Fig 1 & 3).

The common arterial trunk gave off both circumflex humeral arteries and muscular branches 14.42mm distal to its origin and the subscapular artery originated 11.34mm distal to the above branches (Fig 1). After giving off these branches (which usually originate from the third part of the axillary artery), the common trunk continued as the profunda brachii artery (Fig 1)

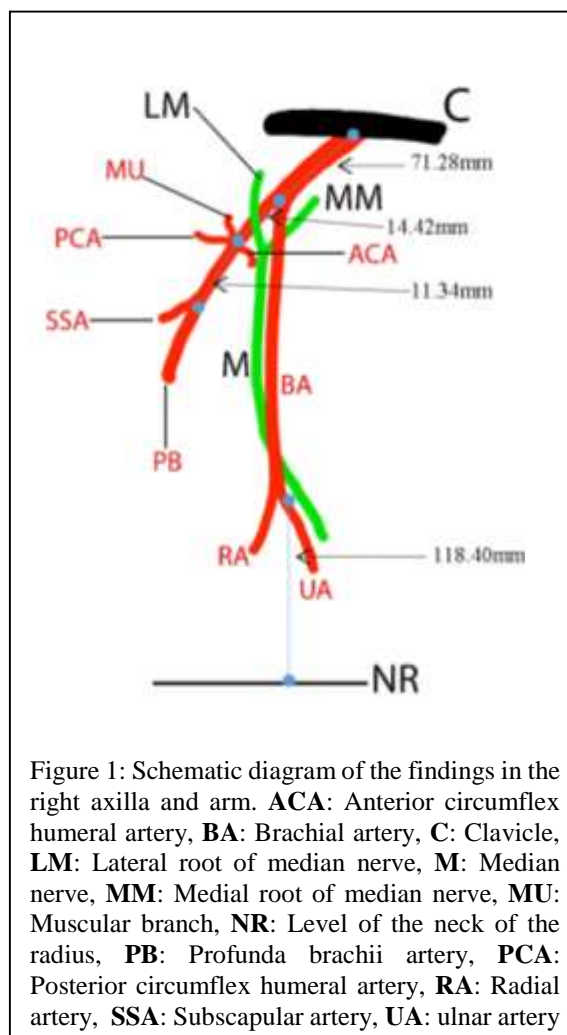


Figure 1: Schematic diagram of the findings in the right axilla and arm. **ACA**: Anterior circumflex humeral artery, **BA**: Brachial artery, **C**: Clavicle, **LM**: Lateral root of median nerve, **M**: Median nerve, **MM**: Medial root of median nerve, **MU**: Muscular branch, **NR**: Level of the neck of the radius, **PB**: Profunda brachii artery, **PCA**: Posterior circumflex humeral artery, **RA**: Radial artery, **SSA**: Subscapular artery, **UA**: ulnar artery

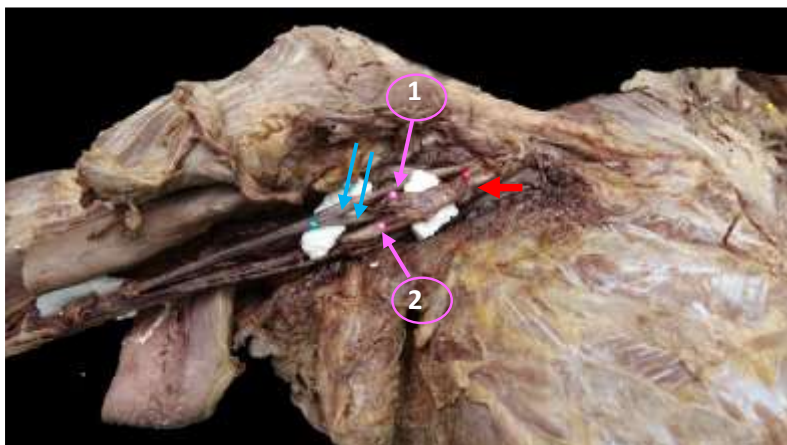


Figure 2: The emerging right axillary artery (Red pointer) divides into two branches (purple pointers); one continues as the brachial artery (purple-2) and the other branch continues as a common trunk (purple-1) which is embraced by the lateral and medial roots of the median nerve (Blue pointers)

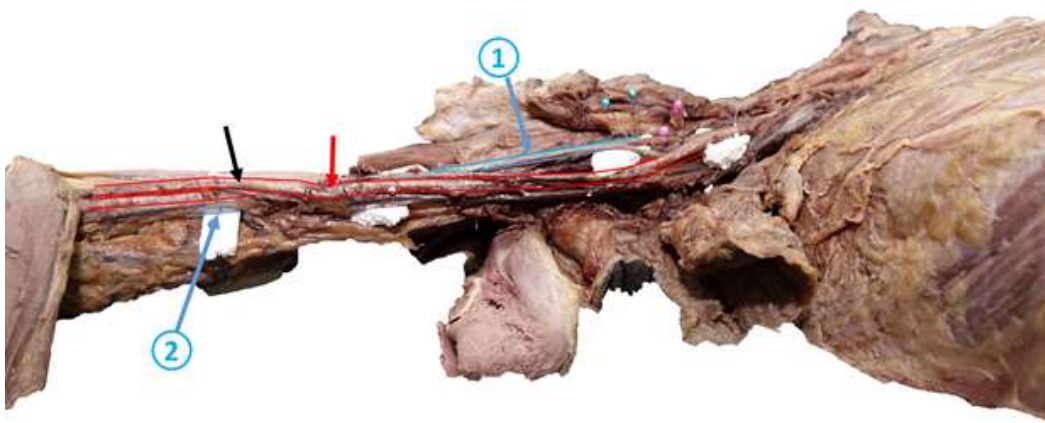


Figure 3: The median nerve forms on the right side lateral to the brachial artery (Blue arrow 1). It then travels distally, crossing deep beneath the brachial artery (Black arrow) before shifting medially in relation to it (Blue arrow 2). The bifurcation of the brachial artery is indicated by the red arrow.

Discussion

The axillary artery customarily gives off six branches: a single branch from the first part, two branches from the second part and three branches from the third part (1). Considerable variations in the independent origin of the branches of the axillary artery, and in the course and branching pattern of the axillary artery were documented (2–6). The present case showed a variant where a common trunk arising from the third part of the axillary artery gave off branches that usually originate independently from the third part of the axillary artery before continuing as the profunda brachii artery. Ramesh Rao et al. reported a case with similar findings, where the profunda brachii artery additionally gave off superior and inferior ulnar collateral arteries, which usually originate from the brachial artery (2). A case report by Naveen et al further support our findings, although the common trunk was larger in diameter than the brachial artery and equal in size to the axillary artery (7). Venieratos et al encountered a similar variant in the third part of the axillary artery, where the common trunk gave off the ulnar collateral artery in addition to the branches of the third part of the axillary artery before continuing as the profunda brachii artery (3). A similar variant of the branching of the third part of the axillary artery was reported by Cavdar et al, but the abnormal trunk was smaller in diameter compared to the axillary artery and superficial brachial artery (8). Our observation is

accompanying the radial nerve. The profunda artery ran its normal course in the right arm. On the left upper side, the brachial plexus cords were slightly rotated in a clockwise manner, resulting in changes in the orientation of the cords in relation to the axillary artery. The median nerve was identified deep to the brachial artery on the left side as well.

supported by the finding of George et al. where the common trunk bifurcated into a common circumflex humeral-subscapular trunk and the profunda brachii artery (4) Another case reported by Vijaya et al. showed similar origin of an abnormal common trunk from the third part of the axillary artery where the profunda brachii artery was absent and the common trunk gave off the radial collateral and middle collateral branches in addition to the branches of the third part of the axillary artery (5).

The present case showed division of the brachial artery into radial and ulnar arteries at a higher level. Sawant et al. described a case where the first part of the axillary artery divided into superficial and deep branches and all the branches of the axillary artery and profunda brachii artery arose from the deep branch. The superficial branch descended as the brachial artery following the normal course and ended at the neck of the radius by dividing into radial and ulnar arteries (6). Yoshinaga et al. reported a unilateral variation of the course of the brachial artery which travelled superficial to the ulnar and median nerves from posterior aspect to anterior in the right arm. However, contrary to our case, this superficial brachial artery gave rise to the profunda brachii artery where it became the inferior ulnar collateral artery (9). Satyanarayana et al. reported an abnormal high bifurcation of the brachial artery in to radial and ulnar arteries at the level of the coracobrachialis insertion in the right arm (10). They further stated that the brachial artery gave off its branches prior to bifurcation. A similar case was reported by Jayasabarinathan et al. where unusual bifurcation was observed in the left arm at the level of the lower border of teres major and the ulnar artery was found medial to the median nerve in the cubital fossa (11). In both cases, similar to our case, the course of the radial and ulnar arteries was normal in the forearm.

The medial root of median nerve, arising from the medial cord of brachial plexus, usually crosses in front of the third part of the axillary artery and joins the lateral root to form the median nerve lateral to the brachial artery (1) We found that the common trunk was embraced by the two roots of the brachial plexus which has been documented by previous researchers (2,4,7).

Conclusions

This case report adds to the literature on anatomical variations in major arteries of the upper limb. Knowledge of neurovascular variations would explain unexpected signs and symptoms and help to plan interventional or surgical procedures. As the axillary artery is often used for arterial cannulation and in other surgical procedures, recognising the anatomical deviations would help to prevent complications.

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Conflict of interest

None of the authors have any conflicts of interest to declare.

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