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Case Report

A Rare Bifurcation of the Axillary Artery into Deep and Superficial Branches: A Clinically Relevant Anatomical Variation: A Case Report

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Abstract

The Axillary artery is the primary arterial supply to the upper limb and is classically divided into three parts based on its relationship with pectoralis minor muscle. Variations in its branching pattern are not uncommon and may have significant clinical implications in surgical operative procedures, orthopaedics, anaesthesia, and radiologic practices. ***Objective:*** To report a rare anatomical variation in the branching pattern of the third part of the Axillary artery observed during routine cadaveric dissection. ***Case Discussion:*** During the routine dissection of an embalmed adult female cadaver, an unusual branching pattern of the third part of Axillary artery was observed in the right upper limb just proximal to the convergence of lateral and medial roots of the median nerve. The third part of the Axillary artery divided into a superficial and deep branch. The deep branch gave rise to subscapular artery, anterior circumflex humeral artery, and posterior circumflex humeral artery and then continued as profunda brachii artery. The superficial branch followed the course of brachial artery; entered the cubital fossa and divided into radial and ulnar artery. The left upper limb showed a normal arterial pattern ***Conclusion:*** The variations may not have affected the functioning of the upper limb in this female, but this rare variation highlights the need for awareness and knowledge of arterial anomalies in surgical planning, regional anesthesia, trauma management and imaging interpretation. Hence detailed anatomical knowledge can help to avoid iatrogenic injuries and improve outcomes.

Keywords: Axillary artery, Variations, Alar thoracic.

INTRODUCTION

The Axillary artery, a continuation of the subclavian artery, begins at the outer border of the first rib, and ends at the inferior border of teres major muscle and continues as the brachial artery. The axillary artery is the primary arterial supply to the upper limb and is classically divided into three parts based on its relationship with pectoralis minor muscle. According to the classic description, axillary artery gives off six branches; first part giving rise to superior thoracic artery, second part to thoracoacromial artery and lateral thoracic artery and the third part to subscapular artery, anterior circumflex humeral and posterior circumflex humeral arteries [1].

Variations in its branching pattern are not uncommon and may have significant clinical implications in surgical operative procedures, orthopedics, anesthesia, and radiologic practices.

CASE REPORT

The study was done in the Department of Anatomy, St John's medical college, Bangalore. The variations were observed in a female cadaver during routine undergraduate dissection in 2022. After the incision and dissection of pectoral region was done, the axilla was approached. Skin, loose connective tissue, fascia, and fat were removed to expose the contents of axilla. The pectoralis minor muscle was identified and cut from its origin and retracted to expose the three parts of the Axillary artery and their branches.

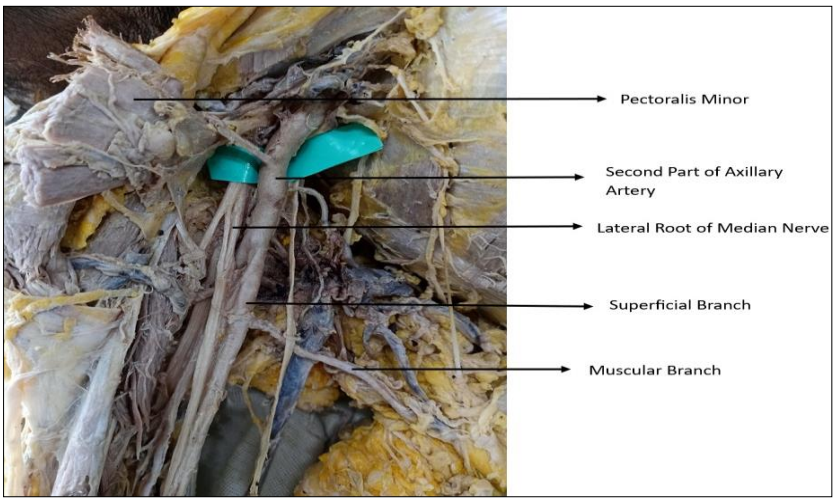

Fig-1: Shows 2nd and 3rd part of right sided Axillary artery. Pectoralis Minor can be seen. At the convergence of Lateral and Median root of Median Nerve the 3rd part of Axillary Artery is seen to split into superficial and deep branches with an Alar branch arising from the Superficial Branch

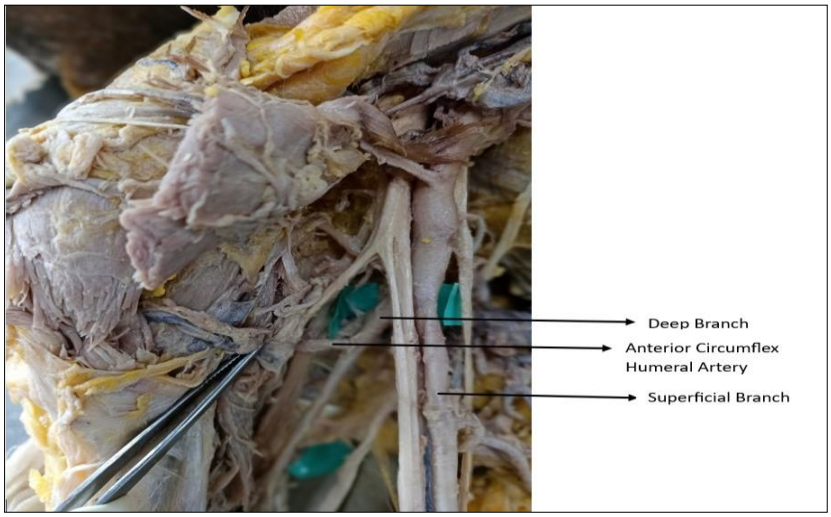

Fig-2: Shows the Superficial and Deep branch and the Anterior Circumflex Humeral Circumflex Artery branching off from Deep Branch

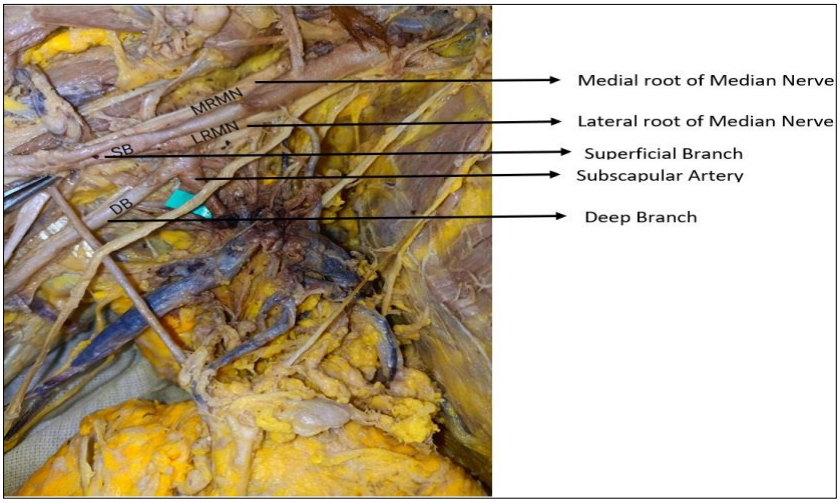

Fig-3: Shows MRMN-Medial Root of Median Nerve, LRMN -Lateral Root of Median Nerve, SB- Superficial Branch and DB- Deep Branch and Subscapular artery arising from the Deep Branch

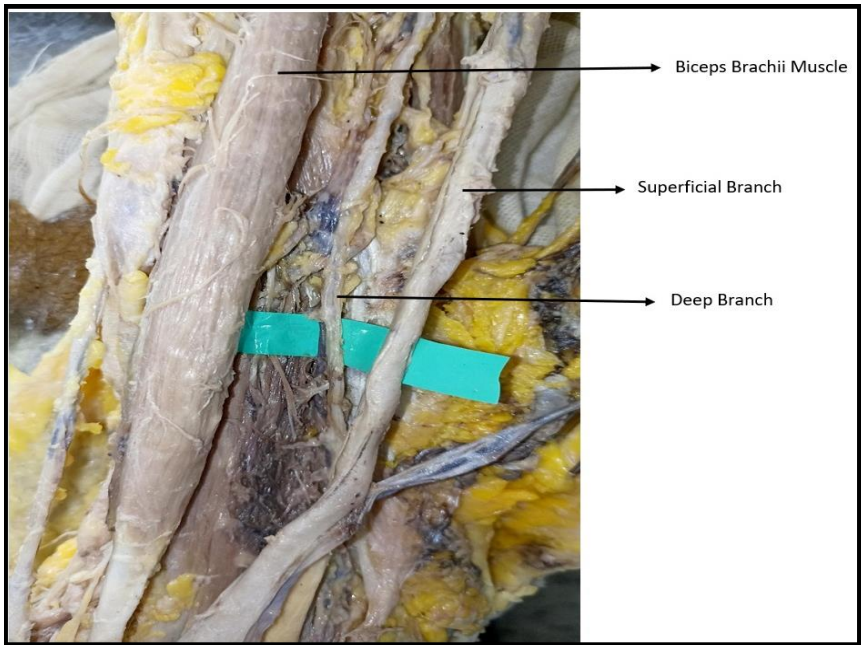

Fig-4: **Deep Branch continuing as Profunda brachii and Superficial Branch continues to traverse into the cubital fossa**

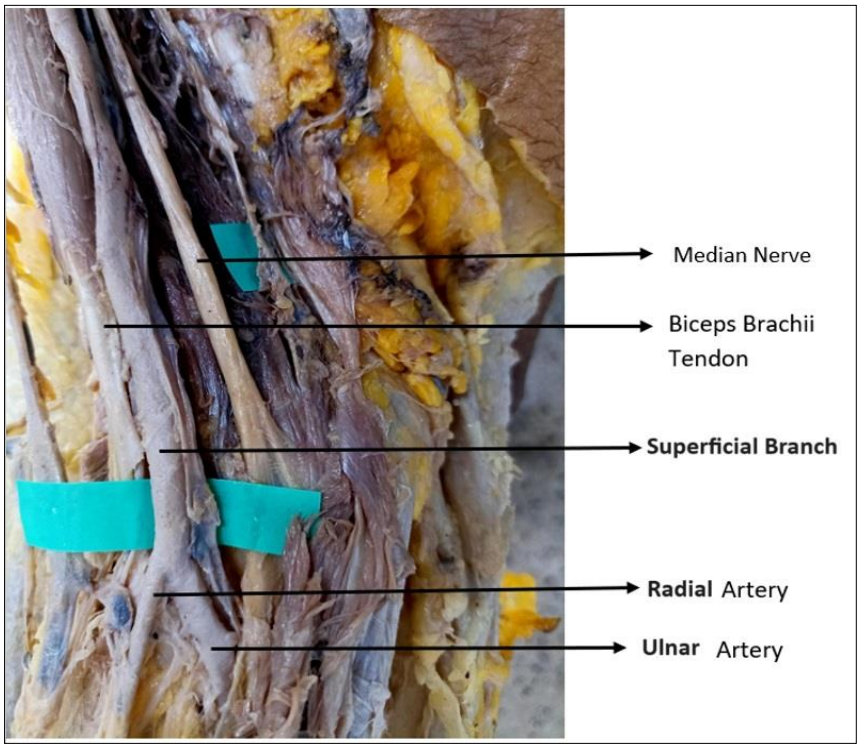

Fig-5: Shows Superficial Branch split into Radial and Ulnar artery at the cubital fossa. The Biceps brachii tendon and Median nerve can also be seen

The branches of first and second part of the axillary artery were anatomically normal. The first part gave rise to superior thoracic artery and from the second part the lateral thoracic and thoraco-acromial artery on both the sides.

On the right side, the third part bifurcated into

- A deep branch which passed between the roots of medial nerve, gave rise to subscapular, anterior circumflex humeral, and posterior circumflex humeral arteries, and continued as the profunda brachii artery.
- The superficial branch which was medial to lateral root and then medial to median nerve gave a branch (Alar thoracic) going towards the axilla. It then followed the course of brachial artery, entered the cubital fossa, and bifurcated into the radial and ulnar arteries.

The left side showed normal Axillary artery branching pattern.

DISCUSSION

The axillary artery is the primary arterial supply to the upper limb and is classically divided into three parts based on its relationship with pectoralis minor muscle. According to the classic description, axillary artery gives off six branches; first part giving rise to superior thoracic artery, second part to thoracoacromial artery and lateral thoracic artery and the third part to subscapular artery, anterior circumflex humeral and posterior circumflex humeral arteries [1].

However, several studies have demonstrated that variations in the Axillary artery's branching pattern are not uncommon, especially in the second and third part of the artery

Huelke was among the first to classify axillary artery variations, identifying a wide range of branching patterns in cadaveric studies [2]. De Garis and Swartley later reported that the number of direct branches could vary from five to eleven, while Kanaka *et al.,* noted a range of five to eight branches [3, 4].

Astik R *et al.,* reported a common trunk from the third part of the left axillary artery, which gave origin to subscapular, anterior circumflex humeral, posterior circumflex humeral, profunda, brachial, and ulnar collateral arteries[9]. Singh D *et al.,* reported a common trunk from the third part of the axillary artery, which gave origin to anterior circumflex humeral, posterior circumflex humeral, subscapular, radial collateral, middle collateral, and superior ulnar collateral arteries with absent profunda brachiac artery[7]. Cavdar *et al.,* reported, the third part of Axillary artery variation as its division into superficial and deep brachial arteries: The superficial brachial artery was divided into radial and ulnar arteries in cubital fossa; and deep brachial artery divided into anterior circumflex humeral, posterior circumflex humeral, subscapular, and profunda brachial arteries [5].

In the present study, five branches were observed arising from the axillary artery. The branching patterns of the first and second parts were typical on both sides. However, a significant variation was noted in the third part on the right side, where the axillary artery bifurcated into deep and superficial branches. The deep branch followed an atypical course, passing between the roots of the median nerve and descending medial to the radial nerve. It gave rise to the subscapular artery, anterior and posterior circumflex humeral arteries, and continued as the profunda brachii artery. The superficial branch continued as the brachial artery, entering the cubital fossa and dividing into the radial and ulnar arteries.

This branching pattern closely resembles the variation described by Cavdar et al., who reported a division of the third part of the axillary artery into superficial and deep brachial arteries. In their case, the superficial brachial artery continued as the radial and ulnar arteries, while the deep brachial artery gave rise to the anterior circumflex humeral, posterior circumflex humeral, subscapular, and profunda brachii arteries [5]. The configuration observed in the present study may be considered a comparable variant.

Additionally, in the present study, an alar thoracic artery was identified arising from the superficial branch. The alar thoracic artery, though not consistently present, has been described to originate from the second or third part of the axillary artery [6,7]. It typically supplies axillary lymph nodes, fat and the skin of the axilla. Gaur *et al.,* reported extra branches (alar arteries) arising from the second part of the axillary artery [6], and Mugurel reported bilateral asymmetry in alar thoracic artery origin, including cases where it arose from the third part or directly from a high-origin radial artery [8].

Variations appear due to persistence of vessels that normally regress leading to variant trunks or branching patterns instead of standard arrangement.

Various developmental theories explain the same: Remodeling of primitive vascular plexus leads to unusual vascular paths. Sprouting theory: Aberrant sprouting from central artery Proximodistal differentiation of initial capillary plexus, with shifting polarity, leads to alternate vessel regression.

The left side of the axillary artery in the present study displayed a normal branching pattern.

Clinical Correlation:

Understanding variations in the axillary artery's branching pattern is crucial for surgical, orthopedic, and radiologic procedures involving the axillary region. Variations, particularly those involving bifurcation or the presence of common trunks, can complicate surgeries such as axillary lymph node dissection, vascular repair, or trauma management.

Failure to recognize such variations may result in inadvertent arterial injury, inadequate regional anesthesia, or misinterpretation during angiographic studies. The presence of a superficial brachial artery is particularly significant as it may be mistaken for a normal brachial artery during vascular access procedures, potentially leading to complications.

Preoperative imaging, such as CT angiography, can assist in identifying such anomalies, enabling surgeons and interventional radiologists to modify their approach appropriately. Moreover, the recognition of the alar thoracic artery is essential in procedures involving

axillary lymph node clearance or flap harvesting, to avoid unintentional ligation or bleeding.

Review of Literature

Huelke (1959) identified 23 branching patterns of the axillary artery. Kanaka *et al.,* (2015) reported common trunks in 30% of cadavers. Tiwari and Afroze (2020) found subscapular variation in 15% of specimens. Yang *et al.,* (2021) documented multiple trunk formations and branching irregularities in 59 upper limbs. Cavdar *et al.,* (2000) described a similar bifurcation of the axillary artery into superficial and deep brachial arteries. Astik and Dave (2012) highlighted that axillary artery variations involving common trunks and variant origins are frequently encountered. These findings support the clinical relevance of detailed preoperative vascular mapping.

CONCLUSION

This case is a rare anatomical variant highlights an unusual bifurcation and such variations are rarely reported and have important surgical relevance.

No explicit frequency is quoted in Bergman's Compendium of Anatomical variation. This case emphasizes the need for awareness of vascular anomalies. Surgeons, anaesthetists and radiologists must be vigilant about possible variations in the arteries, clinicians to be aware of arterial variations in the axillary region. Preoperative imaging before invasive procedures and anatomical knowledge are crucial for avoiding complications. Further documentation and study of such anomalies are encouraged.

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