

Branching Pattern of Axillary Artery: A Morphological Study and It's Embryological Significance

Padmalatha K.¹, Hema N.², Prathap Kumar J.³, Prakash B.S.⁴

Abstract

Background: Axillary artery is a continuation of the Subclavian artery, extending from outer border of first rib to the lower border of Teres Major muscle. The variations in the branching pattern of Axillary artery is not uncommon. Any deviation in the development of the vascular plexus of the limb bud may be responsible for the variations in the branching pattern. The knowledge about such variations in the branching pattern of Axillary artery is important in relation to Coronary bypass and flaps in reconstructive surgeries, treating Axillary artery thrombosis, creating the Axillary-Coronary bypass shunt in high risk patients. Recent progress in vascular surgery has emphasized a need for precise knowledge of frequency of anatomical variations in the branching pattern of Axillary artery. **Aims:** The aim of the present study was to Analyse the variations in the branching pattern of Axillary artery and it's embryological significance. **Materials and Methods:** Forty upperlimb specimens from embalmed cadavers allotted for dissection in the department of Anatomy at ESIC Medical college and PGIMSR, Rajajinagar, Bangalore over a period of five years was used for the study. **Results:** We came across the presence of variation in the branching pattern in one male cadaver bilaterally. On the right side, all the branches of third part of Axillary artery emerged from common trunk, whereas on the left side, all three branches of third part and lateral thoracic artery arised from the common trunk. **Conclusion:** The knowledge of branching pattern of Axillary artery is useful in treating Axillary artery thrombosis, reconstructing Axillary artery post-trauma, microvascular graft for replacing damaged arteries.

Keywords: Axillary Artery; Axillary-Coronary Bypass Shunt; Reconstructive Surgeries; Microvascular Graft.

Introduction

Axillary artery is the continuation of the Subclavian artery. It extends from the outer border of first rib to the lower border of Teres Major muscle. It is divided into three parts by the Pectoralis Minor muscle [1]. The branches of axillary artery are Superior thoracic artery from the first part, Lateral thoracic artery and Thoraco-acromial artery from the second part and Subscapular artery, Anterior circumflex humeral

artery and posterior circumflex humeral artery from the third part.

In tetrapods the subclavian artery traverses the axilla as the Axillary, parallels the humerus as Brachial and divides in the forearm into Ulnar and Radial arteries [2].

Increasing use of invasive, diagnostic and interventional procedures in cardiovascular diseases makes it important that the type and frequency of vascular variations are well documented and understood.

Author's Affiliation: ^{1,2}Associate Professor, Department of Anatomy, ESIC-Medical College & PGIMSR, Rajajinagar, Bangalore, Karnataka 560010, India. ³Assistant Professor, Department of Anatomy, M.S. Ramaiah Medical College, Bangalore, Karnataka 560054, India. ⁴Professor & Head, Department of Anatomy, Hassan Institute of Medical Sciences, Hassan, Karnataka 573201, India.

Corresponding Author: Hema N., Associate Professor, Department of Anatomy, ESIC-Medical College & PGIMSR, Rajajinagar, Bangalore, Karnataka 560010, India
E-mail: hemanesi@gmail.com

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Materials and Methods

The Specimens for this study was obtained from Department of Anatomy at ESIC medical college & PGIMSR, Rajajinagar, Bangalore. Forty upperlimb specimens were obtained from the Twenty embalmed cadavers, which were allotted for first year MBBS Students for the purpose of dissection over a period of five years. Deformed or traumatized upper limbs were excluded from the

study. We came across the presence of variation in the branching pattern in an adult male cadaver bilaterally, that is two out of forty upperlimb specimens showed variations in branching pattern.

Results

We came across the presence of variation in the branching pattern of Axillary artery in two out of forty upper limbs. All the three branches of third part of Axillary artery, Anterior Circumflex Humeral artery, Posterior Circumflex Humeral artery and Subscapular artery arised from a Common trunk [Figure 1].

Further Circumflex Scapular artery and Thoracodorsal artery emerged from Subscapular artery. The Posterior Circumflex Humeral artery accompanying the Axillary nerve is seen. The branches from second part Lateral Thoracic artery and Thoracoacromial artery was normal [Figure 2].

In the same cadaver, on the left side, the Common trunk gave rise to Anterior Circumflex Humeral artery, Posterior Circumflex Humeral artery, Subscapular artery and Lateral Thoracic artery [Figure 3].

Futher, on the left side Circumflex Scapular artery and Thoracodorsal artery emerged from Subscapular artery. The Axillary nerve accompanying the Posterior Circumflex artery is seen [Figure 4].

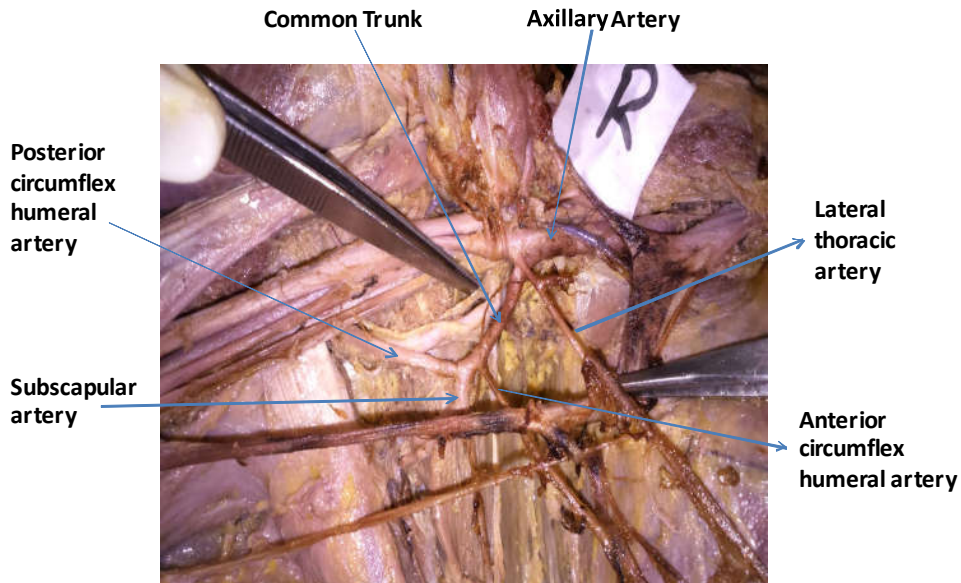


Fig. 1: Common trunk from third part of axillary artery on right side giving rise to posterior circumflex humeral artery, anterior circumflex humeral artery and subscapular artery

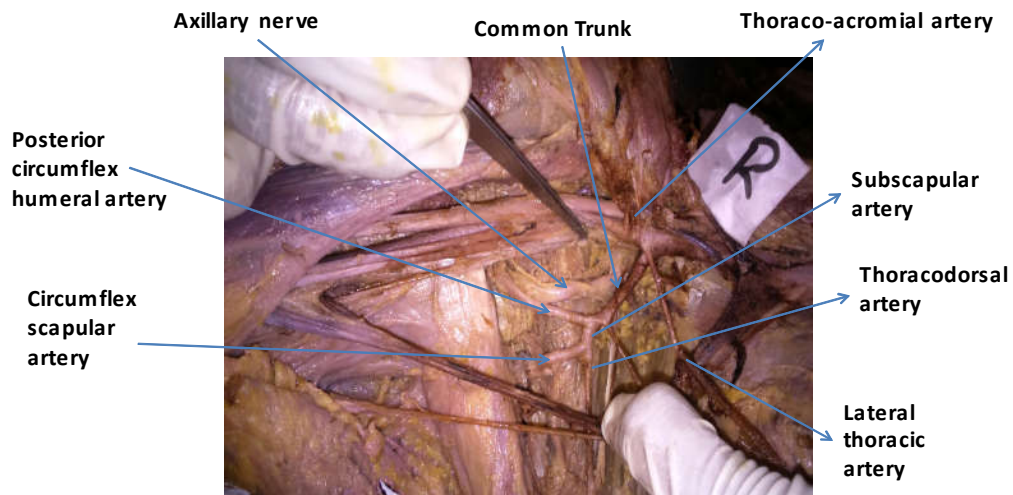


Fig. 2: Subscapular artery giving rise to circumflex scapular artery and thoracodorsal artery on the right side. Posterior circumflex humeral artery accompanying axillary nerve is also seen

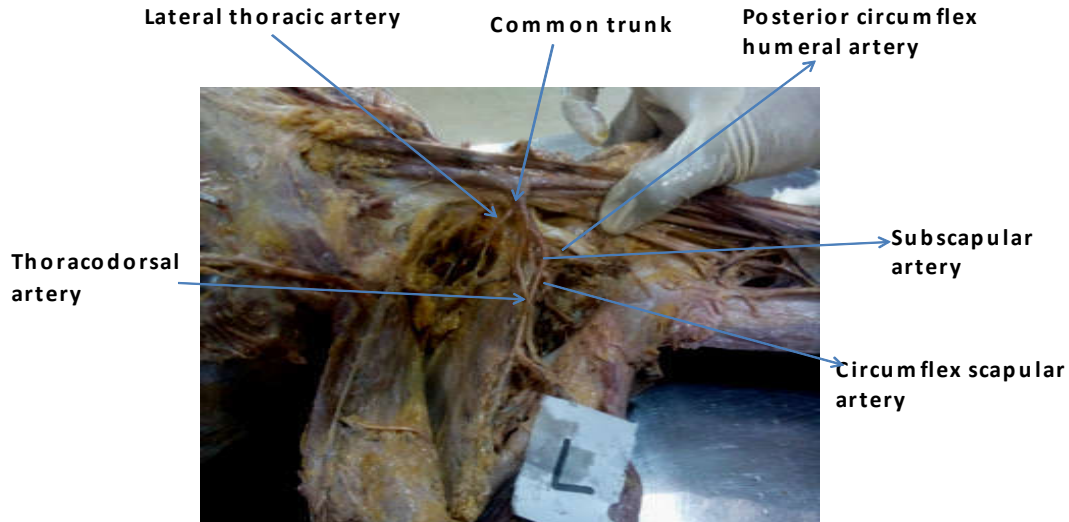


Fig. 3: Common trunk from third part of axillary artery on left side giving rise to posterior circumflex humeral artery, anterior circumflex humeral artery, subscapular artery and lateral thoracic artery

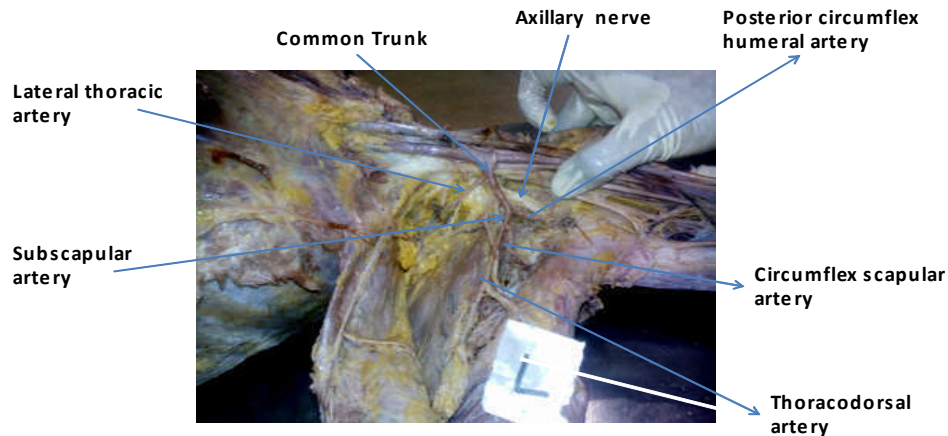


Fig. 4: Subscapular artery giving rise to circumflex scapular artery and thoracodorsal artery on the left side. Posterior circumflex humeral artery accompanying axillary nerve is also seen.

Discussion

Anterior and Posterior Circumflex Humeral branches of the third part of Axillary artery are subject to great variations [3].

The common arterial trunk from third part of Axillary artery gave rise to Anterior and Posterior Circumflex Humeral, Subscapular, Radial collateral, Middle collateral and Superior Ulnar collateral arteries with absence of Profunda brachii artery [4].

Arterial variations in the upperlimb are due to defects in embryonic development of the vascular plexus of upperlimb bud. This may be due to arrest at any stage of development of vessels followed by regression, retention or reappearance, thus leading to variations in the arterial origin and course of major upperlimb vessels [5].

The seventh cervical intersegmental artery forms the axis artery of upperlimb and persists in the adult to form the Axillary, Brachial and Interosseous arteries. The number of upperlimb arterial variations arise through the persistence, enlargement and differentiation of parts of the initial network which would normally remain as capillaries or even regress [6].

Anomalous branching pattern of Axillary artery represents persisting branches of the capillary plexus of the developing limb buds and their unusual course, it may be a cause for concern to radiologists and vascular surgeons and may lead to complications in surgeries that involve the axilla and pectoral regions [7].

Accurate knowledge of the normal and variant arterial anatomy of Axillary artery is important for clinical procedures in this region. Branches of

Axillary artery are used for Coronary bypass and flaps in reconstructive surgeries [8].

According to Arey, unusual blood vessels may be due to choice of unusual paths in the primitive vascular plexuses, persistence of vessels normally obliterated, disappearance of vessels normally retained, incomplete development, fusions and absorption of parts usually distinct [9].

De Garis and Swartley described 23 different types of axillary artery. They said that there is a greater tendency in the Negro than there is in white persons towards clumping of the branches, with two or more arising in common. Trotter and her associates found a sex difference, common origin of two or more vessels being more frequent in females but no significant difference between races in males [10].

Seventh cervical intersegmental arteries grow into the limb buds to form axis arteries of the developing upper limbs. Axis artery gives rise to Subclavian, Axillary and to the Deep Palmar arch. Other arteries of the upper extremity develop as sprouts of axis artery [11].

The branches of upper limb arteries have been used for Coronary bypass and flaps in reconstructive surgeries, antegrade cerebral perfusion in Aortic surgery, treating Axillary artery thrombosis, reconstructing Axillary artery after trauma using the artery for microvascular graft to replace damaged arteries, creating Axillary Coronary bypass shunt in high risk patients, surgical procedures of fractured upper end of Humerus. Aneurysm of Axillary artery may enlarge and compress the trunks of Brachial plexus, causing pain and anesthesia in the areas of skin supplied by affected nerves. Aneurysm of Axillary artery may occur in baseball pitchers because of their rapid and forceful arm movements [12].

Based on Muller's model, the disappearance of the superior, middle and inferior superficial brachial arteries and the superficial antebrachial artery, and the distal parts of the median and interosseous arteries cause the normal arterial system to be constructed [Figure 5] [13].

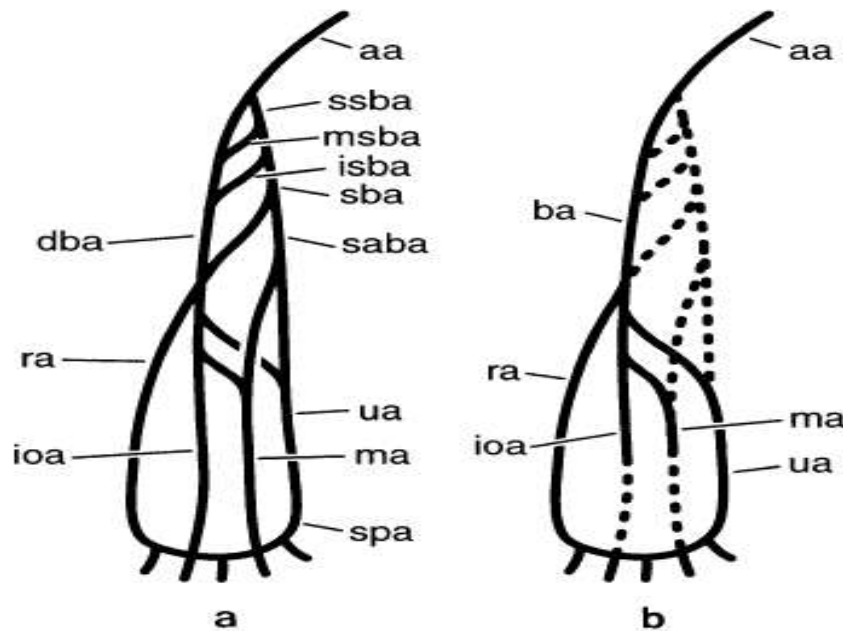


Fig. 5a: Modified reconstruction of the arterial system of the arm in a human embryo 11.7 mm long from Muller (1903)

b: Normal arteries in the arm are shown as solid lines.

Full forms of Abbreviations used in Figure 5

- aa-axillary artery
- dba-deep brachial artery
- ioa-interosseous artery
- ra-radial artery
- ua-ulnar artery
- ma-median artery
- sba-superficial brachial artery
- saba-antebrachial artery
- ssba-superior superficial brachial artery

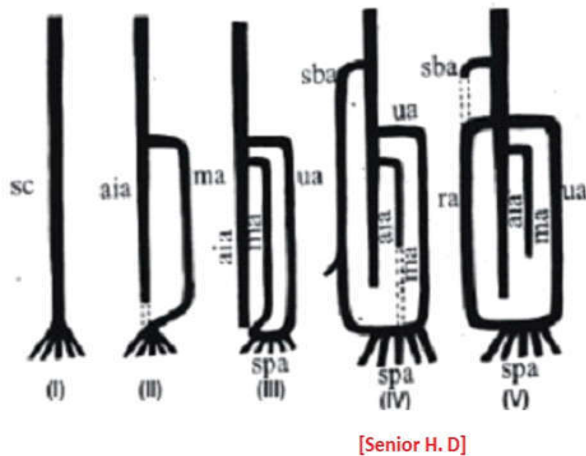


Fig. 6: Development of arteries of upper limb in 5 stages [15]

The current understanding regarding development and variations of upperlimb arteries is derived from early descriptive studies on human or laboratory animal embryos, and several theories have been proposed (Von Baer,1828; Baadar 1866, Hochstetter 1890, 1891; Gosppert 1904, 1910; Sabin 1905,1917; Rabl 1907; Elze 1908, 1913,1919; Evans1908, 1909). In Humans, De Vriese (1902) described the arteries as originating from an initial capillary network associated witheach of the principal nerves, whereas Musller (1903) considered they were formed by the union of superficial and deep pathways [14].

Conclusion

Any surgical procedures in pectoral and axillary regions require accurate knowledge of normal and variant arterial anatomy of Axillary artery. The knowledge regarding normal and variant arterial anatomy is a must for surgeons in avoiding iatrogenic injuries and radiologists for interpreting of angiograms. Branches of upperlimb arteries have been used for Coronary bypass and flaps in reconstructive surgeries. The knowledge of branching pattern of Axillary artery is useful during antegrade cerebral perfusion in Aortic surgery, treating Axillary artery thrombosis, reconstructing Axillary artery after trauma, using artery for microvascular graft to replace damaged arteries. The increasing use of invasive diagnostic and interventional procedures in cardiovascular diseases makes it important that the type and frequency of vascular variations are well documented and understood.

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