

Original research article

Anatomical Study of Variations in Branching Pattern of Third Part of Axillary Artery

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Abstract

Axillary Artery is a continuation of subclavian artery, extending from outer border of first rib to lower border of teres major muscle where it continues as brachial artery. The axillary artery is conventionally described as giving off six branches but the number arising independently from it, is subject to considerable variations. The aim of the study is to note for variations in origin and course of third part of axillary artery and to study the branching pattern of third part of axillary artery in relation to brachial plexus.

Keywords: Axillary artery; Subscapular artery; Anterior circumflex humeral Artery; Posterior circumflex humeral artery

Introduction

Axillary artery is a continuation of subclavian artery, extending from outer border of first rib to lower border of teres major muscle where it continues as brachial artery. The pectoralis minor muscle is related anteriorly to axillary artery and it divides the axillary artery into three parts. The first part gives superior thoracic artery. The second part gives lateral thoracic and thoraco acromial artery. The third part gives subscapular artery, anterior circumflex humeral, posterior circumflex humeral artery.

MATERIALS & METHODS

Bilateral dissection of axilla was conducted on 50 upper limbs of 25 embalmed cadavers which included 38 males and 12 females during routine dissection for undergraduate medical students in Bangalore Medical College and Research Institute, during the period from 2017 and 2019. The embalmed cadaver's upper limbs were labelled from 1 to 50, right and left respectively. The limbs were dissected retaining its continuity with the trunk.

RESULTS

The following variations were noted in the present study in the third part of axillary artery and the findings in the present study are summarized as follows. In the present study variations in axillary artery was 14%, predominantly on right side. The variations in anterior circumflex humeral artery were 6%, posterior circumflex humeral artery was 8% [Table 1]. In all the specimen unilateral variations were observed. The common trunk gave origin to several branches of axillary artery. In one case, third part of axillary artery bifurcated into superficial and deep artery. Posterior circumflex humeral artery in one case was from medial aspect.

TABLE 1: Variations in anterior circumflex humeral artery and posterior circumflex humeral artery

| Number of Specimens | Sides Observed | Origin of | Right | Left | Total | Percentage |
|---------------------|----------------|-------------------------------------|-------|------|-------|------------|
| 25 | 50 | Anterior circumflex humeral artery | 3 | 0 | 3 | 6% |
| | | Posterior circumflex humeral artery | 3 | 1 | 4 | 8% |

DISCUSSION**VARIATION 1: Origin of posterior circumflex humeral artery from medial aspect of axillary artery**

As in Figure 1, posterior circumflex humeral artery instead of usual origin from lateral side of third part of axillary artery, originated from medial side of third part of axillary artery at a higher level than the origin of anterior circumflex humeral artery [Table 4]. This particular variation in the side of origin of posterior circumflex humeral artery (i.e.) from the medial side of third part of axillary artery is considered as a rare variation because, as of now no literature had encountered such variation in the side of origin of artery. The posterior circumflex humeral artery after its origin from the medial aspect of third part of axillary artery, winded posterior to third part of axillary artery below teres major instead of passing through quadrangular space [Table 3]. Also, posterior circumflex humeral artery did not anastomose with anterior circumflex humeral artery in the present case. Due to variation in the course of posterior circumflex humeral artery, the artery had variant relation with the axillary nerve.

VARIATION 2: Origin of subscapular artery at the level of ACHA and posterior circumflex humeral artery

As in Figure 2, the subscapular artery which is the first branch of third part of axillary artery usually originates at a higher level than circumflex arteries. The variation observed in Figure 2, was origin of subscapular artery was from the lower level (i.e.) at the site of origin of anterior circumflex humeral artery and posterior circumflex humeral artery. The subscapular artery was subsequently divided into circumflex scapular artery and thoracodorsal artery and both the branches of subscapular artery had normal course and its relation with branches of brachial plexus were normal.

VARIATION 3: Common trunk of origin for both anterior circumflex humeral artery and posterior circumflex humeral artery from third part of axillary artery

As in Figure 3, it was noted that both anterior circumflex humeral artery and posterior circumflex humeral artery were not arising independently from third part of axillary artery, rather it was seen as a common trunk arising from third part of axillary artery [Table 5]. The common trunk was from posterolateral aspect of third part of axillary artery and the common trunk immediately divided into two branches, with one of the branches was smaller in diameter passed anteriorly and was identified as anterior circumflex humeral artery and the artery gave branch to shoulder joint [Table 2]. The other branch from the common trunk was larger in diameter and it continued postero-laterally to enter into quadrangular space along with axillary nerve and emerged out on the posterior aspect around the surgical neck of humerus [Table 3].

The variation noted in anterior circumflex humeral artery and posterior circumflex humeral artery was in its origin from third part of axillary artery. There was no variation in relation with branches of brachial plexus [Table 4].

VARIATION 4: Origin of anterior circumflex humeral artery and posterior circumflex humeral artery from second part of axillary artery

As in Figure 4, anterior circumflex humeral artery and posterior circumflex humeral artery was not found in its usual site [Table 4]. While tracing for the circumflex humeral arteries proximally, beneath the pectoralis muscle area which is the second part of axillary artery, two branches having a circumflex course over humerus was noted. Both the branches were slender in appearance. The anterior branch was named as anterior circumflex humeral artery [Table 2] and posterior branch was named as posterior circumflex humeral artery. Both circumflex humeral arteries immediately formed a loop to anastomose with each other. They had variation in the branching pattern. After the formation of loop both the arteries pierced long head of biceps and gave an articular branch to shoulder joint. The posterior circumflex humeral artery did not enter through quadrangular space and did not accompany axillary nerve.

VARIATION 5: Bifurcation of axillary artery into superficial and deep artery. Bifurcation of axillary artery between two roots of median nerve into superficial artery and deep artery. The superficial artery continued as brachial artery and the deep artery gave rise to all the branches of third part of axillary artery.

As in Figure 5, it was observed that the third part of axillary artery showed anomalous branching pattern immediately below the pectoralis minor muscle bifurcated into superficial brachial part and deep brachial part. The two arterial trunks were of similar diameter. The bifurcation of the artery was at the level of formation of median nerve (i.e.) between the two roots of median nerve. The superficial part ran in front of median nerve and axillary vein and continued as brachial artery. The deep brachial artery trunk was posterior to median nerve and anterior to radial nerve and the deep trunk gave off anterior circumflex humeral artery, posterior circumflex humeral artery and subscapular artery [Table 3]. The posterior circumflex humeral artery was larger in diameter and accompanied the axillary nerve. The smallest branch was anterior circumflex humeral artery which coursed deep to coracobrachialis and biceps brachii towards surgical neck of humerus [Table 2]. The subscapular artery coursed on costal surface of subscapularis muscle. There was clumping of nerves of brachial plexus anterosuperior to deep part of axillary artery. The importance of this particular variation is that, the branches of axillary artery coursed between cords of brachial plexus are likely to be compressed between two roots leading to lowered blood supply to concerned area. In case of brachial plexus injury which requires exploration and repair, might lead to damage to the artery. Disturbed relationship with brachial plexus may lead to partial failure of brachial plexus block. The particular variation has got additional importance as the superficial course of the artery is more prone for injury leading to haemorrhage and pseudo aneurysm, also superficial course of superficial brachial artery makes the arterial grafting and cardiac catheterization easier.

Variant relationship of nerves of brachial plexus to axillary artery was observed in the present study. All cords and their branches were anterosuperior to axillary artery in abducted position of arm. These variations have important clinical implications while performing subclavian vein puncture for central venous line and brachial plexus blocks. Knowledge of such variations is also important in interpreting images and in carrying our procedures involving axillary artery.

Literature study shows that the incidence of such superficial brachial artery is around 0.1% to 3.2%.

Ronald et al (2006)¹², Rodriguez-Baeza et al (1995)¹³ and Tountas et al (1993)¹⁴ all have reported variations in the branching patterns of the axillary artery.

Standing et al (2008) reported that the branches of axillary artery showed numerous variations in number, origin and distribution¹⁵.

Johnson & Ellis (2005) noted a similar variation in the branching pattern of posterior circumflex humeral artery, in which the artery after emerging from profunda brachii artery passed backward below teres major muscle without passing through quadrangular space¹⁶

Drushti et al (2017) reported origin of profunda brachii artery from anterior division of deep brachial artery along with anterior circumflex humeral artery and posterior circumflex humeral artery¹⁷.

Patil et al (2016) noted a unique variation of a common trunk from first part of axillary artery which gave origin to all the branches of the third part of axillary artery¹⁸.

Chakravarthi (2012) reported an unusual branching pattern of axillary artery in which second part of axillary artery gave a common trunk which gave off posterior circumflex humeral artery and subscapular artery along with other branches of first and second part. While anterior circumflex humeral artery originated from usual site of third part of axillary artery¹⁹.

Bagoji et al (2013) noted third part of axillary artery terminated by trifurcating into three large branches: (i.e.) Superficial brachial artery, deep brachial artery and subscapular artery trunk. Subscapular arterial trunk gave rise to circumflex scapular artery, thoracodorsal artery, posterior circumflex humeral artery. Superior brachial artery which later fused with deep brachial artery in cubital fossa. Deep brachial artery, which terminated into radial and ulnar artery respectively²⁰.

TABLE 2: Variations in anterior circumflex humeral artery.

| Number of Specimens | Sides Observed | Variations in anterior circumflex humeral artery | Right | Left | Total | Percentage |
|---------------------|----------------|--|-------|------|-------|------------|
| 25 | 50 | From common trunk | 1 | - | 1 | 2% |
| | | From second part | 1 | - | 1 | 2% |
| | | From deep brachial artery | 1 | - | 1 | 2% |

TABLE 3: Types of variations in posterior circumflex humeral artery.

| Number of Specimens | Sides Observed | Variations in Posterior circumflex humeral artery | Right | Left | Total | Percentage |
|---------------------|----------------|---|-------|------|-------|------------|
| 25 | 50 | From common trunk | 1 | - | 1 | 2% |
| | | From second part | 1 | - | 1 | 2% |
| | | From unusual site | - | 1 | 1 | 2% |
| | | From deep brachial artery | 1 | - | 1 | 2% |

TABLE 4: Types of variations.

| No | Types of Variations | Name of the Artery | Percentage |
|----|-------------------------|--|------------|
| 1 | Common trunk | Anterior circumflex humeral artery – Posterior circumflex humeral artery | 4% |
| | | Anterior circumflex humeral artery - Posterior circumflex humeral artery -Subscapular artery | 2% |
| 2 | Absence | Anterior circumflex humeral artery - Posterior circumflex humeral artery | 2% |
| 3 | Abnormal site of origin | Posterior circumflex humeral artery | 2% |

TABLE 5: Comparative study on common trunk.

| No | Common Trunk Third part of axillary artery | Author | Percentage |
|----|--|-----------------------------------|------------|
| 1 | Subscapular artery / Anterior circumflex humeral artery /Posterior circumflex humeral artery | Saeed et al ² | 3.80% |
| 2 | Subscapular artery + Anterior circumflex humeral artery + Posterior circumflex humeral artery + Profunda brachii + Ulnar collateral arteries | Ramesh et al ³ | - |
| 3 | Anterior circumflex humeral artery + Posterior circumflex humeral artery + Subscapular artery + Radial collateral + middle collateral + superior ulnar collateral arteries | Vijaya et al ⁴ | - |
| 4 | Posterior circumflex humeral artery + Anterior circumflex humeral artery | Majumdar et al ⁵ | 0.70% |
| 5 | Anterior circumflex humeral artery + Posterior circumflex humeral artery + Subscapular artery + profunda brachii artery | Astik et al ⁶ | 10% |
| 6 | Anterior circumflex humeral artery + Posterior circumflex humeral artery + Lateral thoracic artery | Satyanarayana et al ⁷ | - |
| 7 | Anterior circumflex humeral artery + Posterior circumflex humeral artery | Pellegrini ⁸ | 22 % |
| | | Hitzrot ⁹ | 16 % |
| | | Poynter ¹⁰ | 20 % |
| | | Dubreuil-Chambardel ¹¹ | 17 % |
| 8 | Anterior circumflex humeral artery + Posterior circumflex humeral artery | Present Study | 6% |
| | Anterior circumflex humeral artery + Posterior circumflex humeral artery + Subscapular artery | | |

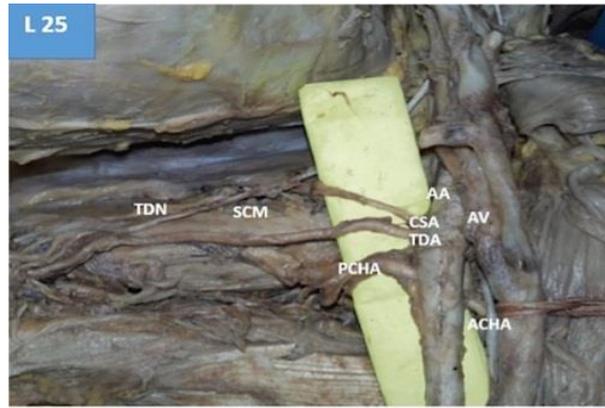


Figure 1 : Variation 1

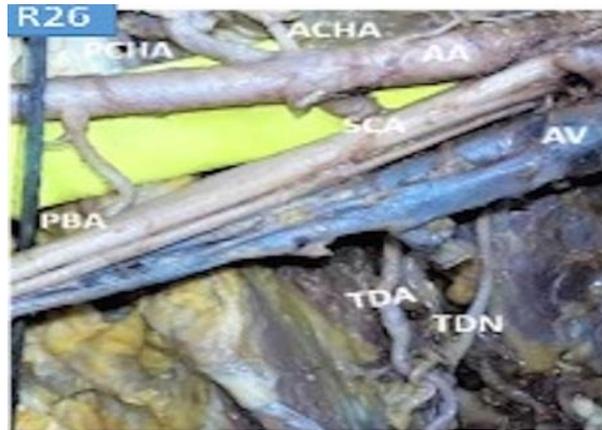


Figure 2 : Variation 2



Figure 3 : Variation 3



Figure 4 : Variation 4



Figure 5 : Variation 5

CONCLUSION

A profound knowledge of normal and variation of third part of axillary artery in its origin and branching pattern along with its relations with brachial plexuses is of indispensable value for a safe attempt in performing procedures in the axillary region. Iatrogenic injury can be avoided, and unusual situations can be handled by having awareness about the variations in the axillary artery. The study is significant because of its increasing interventional procedures done in axilla. Axillary artery is now-a-days used as the access vessel for invasive diagnostic and interventional cardiovascular procedures, during bypass surgery between axillary and subclavian artery. Next to the popliteal artery, axillary artery is more frequently lacerated by violence than any other injury. Axillary artery is important for plastic surgeons performing a musculocutaneous flap for wound or defect reconstruction or during harvesting the axillary artery for microvascular graft repair of damaged arteries²¹. Axillary artery has emerged as feasible and safe alternative access for delivering large bore interventional procedures, in peripheral arterial disease and coronary artery diseases, due to low incidence of atherosclerosis involving the vessel. Abnormal division of artery may have clinical application in haemorrhagic emergencies where accurate diagnosis and surgical repair on ligation of vessel is crucial.

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CONFLICT OF INTEREST

There are no conflicts of interest.

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