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Original Research Article

Assessing Morphological and Clinical Significance of Variations in Branching Pattern of Axillary Artery in Cadavers

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Abstract

Aim: The aim of the present study was to contribute to the existing knowledge of the variations in the branching pattern of the Axillary artery, explaining its embryological basis and also its morphological and clinical significance.

Methods: 20 cadavers (40 upper limbs) - 15 male and 5 female embalmed with 10% formalin were dissected for this study. The study was conducted at Department of Anatomy, Nalanda Medical College, Patna, Bihar, India from March 2022 to Jan 2023. Variations in the origin and branching pattern of axillary artery were noted.

Results: Variable branching pattern was observed in 7% of the cases on right side and 8% of the cases on left side in first part of Axillary artery, 43% of the cases on right side and 52% of the cases on left side in second part and 50% of the cases on right side and 25% of the cases on left side in third part.

Conclusion: Accurate and detailed knowledge of the normal and variant anatomy of the axillary artery is of importance for anatomists, surgeons, radiologists and clinicians during various interventional, diagnostic, therapeutic and surgical procedures on pectoral and axillary regions.

Keywords: Axillary artery, Branching pattern, Cadavers, Upper limbs

Introduction

The axillary artery, which is a continuation of the subclavian artery is divided into three parts by the pectoralis minor muscle. First part, superior to the muscle, gives one branch viz., superior thoracic artery. Second part, behind the muscle, gives rise to two arteries viz., acromion thoracic and lateral thoracic arteries. Three arteries arise from the third part (inferior to pectoralis minor) viz., subscapular, anterior circumflex humoral and posterior circumflex humoral. The subscapular artery continues as the lateral thoracic artery. However, various authors have reported branching patterns different from the one that is normally seen. Nearly, 62.5% of population may have a variated pattern of axillary artery which means that one has to be careful in dealing with this artery. [1-5]

The axillary artery is a continuation of the subclavian one from outer border of the first rib to lower border of teres major muscle that continues further distally as brachial artery. It is classically divided into three parts by the pectoralis minor muscle. It is conventionally described as giving of six branches. The branches vary considerably, in up to 30% of the cases, the subscapular artery can arise from a common trunk with the posterior circumflex humeral artery. Occasionally, the subscapular, anterior circumflex humeral, posterior circumflex humeral, and profunda brachii arteries arise in common. The posterior circumflex humeral artery may arise from the profunda brachii artery, and pass back below the teres major to enter the quadrangular space. [6]

The number of branches that arose from the axillary artery showed considerable variations: two or more of usual branches may arise by a common trunk or named artery viz. deltoid, acromial, clavicular or pectoral branch may arise directly from axillary artery. [7]

Axillary artery has the second highest rate of puncture and damage in traumatic injuries, surgeries, clinical and imaging procedures after the popliteal artery. The knowledge of variable branching pattern of Axillary artery is important for vascular surgeons, onco surgeons, anesthesiologists, orthopedic surgeons and radiologists due to increased use of invasive diagnostic, interventional procedures. The aim of the present study was to

contribute to the existing knowledge of the variations in the branching pattern of the Axillary artery, explaining its embryological basis and also its morphological and clinical significance.

Materials and Methods

20 cadavers (40 upper limbs) - 15 male and 5 female embalmed with 10% formalin were dissected for this study. The study was conducted at Department of Anatomy, Nalanda Medical College, Patna, Bihar, India from March 2022 to Jan 2023. Variations in the origin and branching pattern of axillary artery were noted.

The branching pattern of the axillary artery was studied under the following headings: origin of all branches, their courses and variations if present, and photographs were taken for recording.

Statistical comparisons between percentages were performed by the $\chi 2$ test; $p<0.05$ was regarded as statistically significant. For the dissection of the cadavers, investigations and materials were used in the study, the required permissions were taken from appropriate firms within the institute, and all the methods were followed in-line with international ethics and values.

Results

Table 1: Variations in Axillary Artery

Parts	Variations in Axillary Artery	
	Right	Left
First part	7%	8%
Second part	43%	52%
Third part	50	25%

Variable branching pattern was observed in 7% of the cases on right side and 8% of the cases on left side in first part of Axillary artery, 43% of the cases on right side and 52% of the cases on left side in second part and 50% of the cases on right side and 25% of the cases on left side in third part.

We found variant branching pattern of the axillary artery in 13 out of 20 limbs (65% limbs) in males and 10 limbs out of 20 limbs (50% limbs) in females. The variant branching pattern was found in 10 male cadavers, unilaterally in 3 cases and bilaterally in 2. It was found in four female cadavers, with one unilateral case on the right side and three bilateral.

We found the origin of lateral thoracic artery from subscapular artery in six male cadavers , unilaterally in two cases on the right side and bilaterally in four. Lateral thoracic artery arose from subscapular artery in one female cadaver bilaterally. The $\chi 2$ test did not show any statistically.

Some of the important variations observed are as follows:

1. A common trunk of lateral thoracic artery (LTA) and acromion - thoracic artery (ATA), suprascapular artery(SSA) and pectoral branches (PB) arising independently from 2nd part of left axillary artery.

2. A suprascapular artery arising from 1st part of right axillary artery.

3. 2 acromion thoracic arteries arising independently from 2nd part of left axillary artery.

4. A subscapular artery (SSA) and thoracodorsal artery arising independently from 2nd part of right axillary artery.

5. A superior thoracic artery, 2 lateral thoracic arteries, subscapular artery, 2 accessory muscular branches arising from 2nd part of left axillary artery and a common trunk of lateral thoracic artery (LTA) and acromion - thoracic artery (ATA).

6. A common trunk of lateral thoracic artery and subscapular artery arising from 2nd part of left axillary artery.

7. Accessory muscular branches arising from 2nd part of left axillary artery.

9. A common trunk of anterior circumflex humeral artery (ACHA) and posterior circumflex humeral artery (PCHA) arising from 3rd part of right axillary artery.

10. 2 anterior circumflex humeral arteries and posterior circumflex humeral artery arising from 3rd part of left axillary artery.

11. A common trunk of posterior circumflex humeral artery and subscapular artery arising from 3rd part of left axillary artery.

12. A common trunk of anterior circumflex humeral artery, posterior circumflex humeral artery and subscapular artery and an accessory muscular branch arising from 3rd part of left axillary artery.

Discussion

Due to clinical importance of axillary artery and its branches, a more definitive study seemed appropriate and necessary to provide additional data to coeval anatomical literature. Axillary artery extends from the outer border of the 1st rib to the lower border of Teres major. It is a direct continuation of the subclavian artery and continues as the brachial artery.[10] The Pectoralis minor passes

over to divide the artery into 3 parts. Conventionally, six branches arise from the axillary artery. Superior thoracic artery from the 1st part, thoracic acromial and lateral thoracic arteries from the 2nd part and subscapular, anterior circumflex humeral and posterior circumflex humeral arteries from the 3rd part. [8] Twenty three different types of axillary artery on the basis of origin of branches have been described. Literature suggests 5-11 branches arising from the axillary artery. [10] A study by Huelke DF documents 2-7 direct branches of the axillary artery while Kanaka S et al., reported 5-8 branches originating from axillary artery. [11,12] Occasionally, the branches may take origin from a common stem or the sub-branches may arise directly from the main branch. [7]

Rajesh Astik et al. (2012) found variant branching pattern of the axillary artery in 43 out of 68 limbs (63% limbs) in males and 7 limbs out of 12 limbs (58% limbs) in females. The variant branching pattern was found in 26 male cadavers (76.4%), unilaterally in 9 cases (five right, four left) and bilaterally in 17. It was found in four female cadavers (66.7%), with one unilateral case on the right side and three bilateral. In their study, the total incidence of variant branching pattern of the axillary artery was 30 out of 40 cadavers (75%) or 50 out of 80 upper limbs (62.5%).[1]

But in present study, a variable branching pattern was observed in 7% of the cases on right side and 8% of the cases on left side in first part of Axillary artery, 43% of the cases on right side and 52% of the cases on left side in second part and 50% of the cases on right side and 25% of the cases on left side in third part.

Samuel et al. (2006) documented a variation of an abnormal trunk of anterior and posterior circumflex humeral, subscapular, radial collateral, middle collateral and superior ulnar collateral arteries (third part) on left side in 50 years old male cadaver. [13] Ramesh Rao et al. (2008) found a rare case of origin of subscapular, anterior and posterior circumflex humeral, profunda brachii artery and ulnar collateral arteries from a common trunk (third part- left side). [14]

In present study a common trunk of anterior circumflex humeral artery, posterior circumflex humeral artery and subscapular artery and an accessory muscular branch were found to be arising from 3rd part of left axillary artery. Also 2 anterior circumflex humeral arteries and posterior circumflex humeral artery are seen to be arising from 3rd part of left axillary artery (Figure 10). A common trunk of lateral thoracic artery (LTA) and acromion – thoracic artery (ATA), suprascapular artery (SSA) and pectoral branches (PB) were seen to be arising independently from 2nd part of left axillary artery. Baral et al (2009) recorded a variable pattern of a common trunk of lateral thoracic, thoracodorsal, subscapular, posterior circumflex scapular which continued as posterior circumflex humeral artery (second part). [15] T. Srimathi et al (2011) found a common trunk of lateral thoracic artery, thoracic acromial artery, subscapular artery and posterior circumflex humeral artery (third part). [16]

Knowledge of branching pattern of axillary artery is useful during antegrade cerebral perfusion in aortic surgery [17], while 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 [18] and during surgical procedures of fractured upper end of humerus. Thus we see that accurate knowledge of the normal and variant arterial pattern of the human upper extremities is important both for reparative surgery and for angiography. [19]

Conclusion

Accurate and detailed knowledge of the normal and variant anatomy of the axillary artery is of importance for anatomists, surgeons, radiologists and clinicians during various interventional, diagnostic, therapeutic and surgical procedures on pectoral and axillary regions. Variations in branching pattern of axillary artery are found frequently. Most of the variations are noticed in III part of axillary artery. No variation is reported in 1st part of the artery. Knowledge of variations is important for orthopedic and vascular surgeons to avoid complications during various surgical procedures in axillary regions and during angiographies respectively.

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