Section: Anatomy

Original Research Article

STUDY OF THE VARIATIONS OF AXILLARY ARTERY BRANCHING PATTERN AND ITS CLINICAL IMPORTANCE

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Abstract

Background: Variations in the axillary artery is crucial in the context of vascular surgeries. The axillary artery is susceptible to injury in situations such as penetrating wounds and traumatic shoulder dislocations. In upper limb amputation procedures, it serves as the designated artery for ligation. In cases of profuse bleeding, compression of the third part of the axillary artery against the humerus may be required. The branches of the axillary artery find application in coronary artery bypass and other cardiovascular surgical procedures. **Materials and Methods:** Bilateral dissection of the axilla was performed on 30 embalmed cadavers, involving a total of 60 upper limbs, as part of routine dissection for first-year MBBS undergraduate medical students. The exposure of the axillary artery and its branches followed classical incisions and dissection procedures outlined in Cunningham's manual of practical anatomy. Variations were carefully observed, documented, and photographed during the study. **Result:** The findings of the present study revealed variations in the branching pattern of the axillary artery in certain cases. Specifically: 1. Variations in the first part The first part of the axillary artery displayed a normal branching pattern in all cases. 2. Variations in the second part i) High origin of subscapular artery: Subscapular artery originated from the second part of the axillary artery in 2 cases. A common trunk gave rise to both the subscapular artery and the lateral thoracic artery. In 2 cases, alar branches and superficial branches were present. In 2 cases, deltoid, pectoral, acromial, clavicular branches of the thoracoacromial artery arose directly from the second part of the artery. Total in 6 cases variation in second part was observed. 3. Variations in the third part: i) Subscapular artery, lateral thoracic artery, and circumflex scapular artery arising as a common trunk in 5 cases. In 2 cases, the circumflex scapular artery arose directly from the third part of the axillary artery. ii) In 2 cases, the posterior circumflex humeral artery originated from the subscapular artery. **Conclusion:** When the ETT cuff inflation medium was alkalinized lignocaine rather than plain lignocaine or air, the incidence of tracheal intubation side effects such as hemodynamic abnormalities, restlessness, dysphonia, and hoarseness was reduced.

INTRODUCTION

The axillary artery is an extension of the subclavian artery, spanning from the outer edge of the first rib to the lower border of the teres major muscle. Beyond the teres major, it transitions into the brachial artery. The division caused by the pectoralis minor muscle results in three segments: the first part situated above the muscle, the second part positioned behind the muscle, and the third part located beneath the muscle. Typically, the first part yields the superior thoracic artery, the second part provides the thoraco-acromial and lateral thoracic arteries, while the third part contributes to the subscapular artery, as well as the anterior and posterior circumflex humeral arteries.[1] The quantity of branches originating from the axillary artery varies, lacking a consistent pattern. These branches might emerge individually from the axillary artery, and in some cases, two or more of the typically named branches may arise from a shared trunk. The alar thoracic artery (ATA), a variable branch, frequently originates from the second part of the axillary artery and can potentially provide blood to adipose tissue and lymph nodes in the axilla. The presence of the lateral thoracic artery may be absent, being substituted by lateral perforating branches of the intercostal arteries.[2] In about 30% of instances,

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the subscapular artery may emerge from a shared trunk with the posterior circumflex humeral artery.[3] Understanding variations in the axillary artery is crucial in the context of vascular surgeries. The axillary artery is susceptible to injury in situations such as penetrating wounds and traumatic shoulder dislocations. In upper limb amputation procedures, it serves as the designated artery for ligation. In cases of profuse bleeding, compression of the third part of the axillary artery against the humerus may be required. The branches of the axillary artery find application in coronary artery bypass and other cardiovascular surgical procedures. Additionally, these branches are employed in addressing old dislocations, particularly when the artery is adherent to the articular capsule.[4] Given the pivotal role of the axillary artery and its branches in the significant procedures, the investigation of the axillary artery, its branching pattern, and variations has been chosen for the current study.[5-12]

MATERIALS AND METHODS

A bilateral dissection of the axilla was performed on 30 embalmed cadavers, involving a total of 60 upper limbs, as part of routine dissection for first-year MBBS undergraduate medical students. The exposure of the axillary artery and its branches followed classical incisions and dissection procedures outlined in Cunningham's manual of practical anatomy. Variations were carefully observed, documented, and photographed during the study.

RESULTS

The findings of the present study revealed variations in the branching pattern of the axillary artery in certain cases. Specifically: Variations in the first part of the axillary artery:

The first part of the axillary artery displayed a normal branching pattern in all cases.

Variations in the second part of the axillary artery:

i) High origin of subscapular artery:

Subscapular artery originated from the second part of the axillary artery in 2 cases.

A common trunk gave rise to both the subscapular artery and the lateral thoracic artery.

In 2 cases, alar branches and superficial branches were present. In 2 cases, deltoid, pectoral, acromial, clavicular branches of the thoracoacromial artery arose directly from the second part of the artery.

Total in 6 cases variation in second part was observed

Variations in the third part of the axillary artery:

i) Subscapular artery, lateral thoracic artery, and circumflex scapular artery arising as a common trunk in 5 cases. In 2 cases, the circumflex scapular artery arose directly from the third part of the axillary artery. ii) In 2 cases, the posterior circumflex humeral artery originated from the subscapular artery. In one case, two anterior circumflex humeral artery was present.

Statistical Analysis: The collected data was summarized by using frequency, percentage, mean & S.D. To compare the qualitative outcome measures Chi-square test or Fisher's exact test was used. To compare the quantitative outcome measures independent t test was used. If data was not following normal distribution, Mann Whitney U test was used. SPSS version 22 software was used to analyse the collected data. p value of <0.05 was significant.

Figure 1: Showing Origin of Alar Branches from 2nd Part of AA

Figure 2: Showing Origin of PCHA from 3rd Part of AA

Figure 3: Showing High Origin of SSA from 2nd Part of AA Subscapular Artery Originated from the Second Part of the Axillary Artery Showing High Origin of IT

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Figure 4: Showing Origin of LTA as A Common Trunk from 3rd Part of Aa Subscapular Artery, Lateral Thoracic Artery, And Circumflex Scapular Artery Arising as A Common Trunk

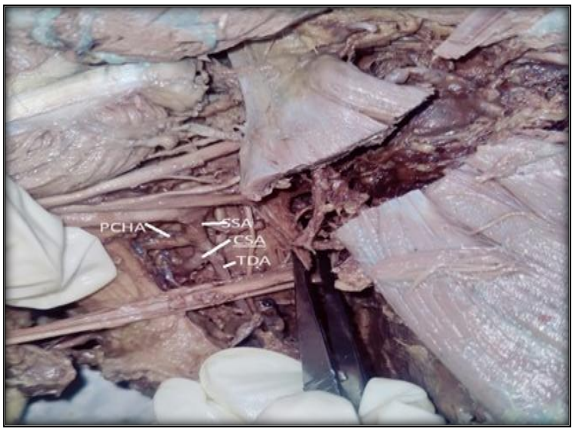

Figure 5: Showing Origin of LTA as A Common Trunk from 3rd Part of Aa Subscapular Artery, Lateral Thoracic Artery, And Circumflex Scapular Artery Arising as A Common Trunk

Table 1: Variation in Branching Pattern of Axillary Artery.

Variation Present	No of Cases	% Variation
Origin		
First Part	2(sup thoracic artery was absent)	3.3%
Second Part	6	10.00%
Third Part	9	13.33%
Total	14	23.33%

Table 2: Variation in Branching Pattern of the Second Part of Axillary Artery.

Name of abnormal origin of branches	No of cases	% variation
Alar Branches	1	1.666%
Subscapular Artery	2	3.333%
Superficial Branch	1	1.666%
Direct origin of Deltoid,acromial, pectoral clavicular braches	2	3.333%
Total	6	10%

Table 3: Variation in Branching Pattern of the Third Part of Axillary Artery.

Name of abnormal origin	No of cases	% variation
Subscapular Artery	7(2 high origin)	11.66%
Circumflex Scapular Artery	7(5 along with SCA &2 separate)	11.66%
Posterior Circumflex Humeral Artery	2	3.33%
Anterior Circumflex Humeral Artery	1	1.6%
Total	17	28.33%

Table 4: Frequency Distribution of Variation in Origin of Axillary Artery Branches.

Axillary Artery Branches	Origin		
	Normal n (%)	Variation n (%)	Comment
Superior Thoracic Artery	58	2	STA was absent in 2 limbs
Thoracoacromial Artery	58	2	-
Lateral Thoracic Artery	55	5	Arising as common trunk with SSA from 2nd part (2cases). And from third part in 3 cases
Subscapular Artery CSA arising as separate branch from 3rd part (2cases)		7 2	Arising from 2nd part as common trunk with LTA(2cases) from third part in common trunk in 3 cases As common trunk with PCHA (2cases) CSA arising as separate branch from 3rd part (2cases)
Posterior Circumflex Humeral Artery		2	Arising as common trunk with subscapular artery (2 cases)

Abbreviations

TDA – Thoraco Dorsal Artery
CSA – Circumflex Scapular Artery
SSA – Sub Scapular Artery
PCHA – Posterior Circumflex Humoral Artery
ACHA – Anterior Circumflex Humoral Artery
LTA – Lateral Thoracic Artery
AA – Axillary Artery
PM – Pectoralis Minor

DISCUSSION

The branches of the axillary artery exhibit various variations in terms of their number, origin, and distribution. Consequently, only cases relevant to the present study, sharing similarities, are discussed herein. G.J. Romanes, Hollinshead, Susan Standring, and Chummy S. Sinnatamby have noted that the

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thoracoacromial artery typically arises from the second part of the axillary artery, penetrating the clavipectoral fascia and subsequently branching into clavicular, pectoral, acromial, and deltoid branches. Rajesh Astik observed that in 10% of cases, the thoracoacromial artery was absent, and in such instances, all four classical terminal branches of the thoracoacromial artery originated directly from the second part of the artery.[13,14]

In the current investigation, we identified two cases where the thoracoacromial artery was absent, and all four branches originated directly from the trunk. Previous studies have documented variations in the origin and branching pattern of the subscapular artery. According to Huelke's study, the subscapular artery arises from the first part of the axillary artery in 0.6% of cases, from the second part in 15.7% of cases, and from the third part in 79.2% of cases. Samta et al. noted that the subscapular artery arises from the second part of the axillary artery in 4% of cases, and in up to 30% of cases, it originates from a common trunk with the posterior circumflex humeral artery.[15,16]

Venieratos D., Lolis E.D detailed various common subscapular trunks, which served as the point of origin for different branches such as the circumflex scapular, thoracodorsal, anterior and posterior circumflex humeral, profunda brachii, and ulnar collateral arteries. Ven Kanaka S et al. documented that a common trunk originating from the second part of the axillary artery was observed in 15% of cases, connecting the subscapular and thoracoacromial arteries. In our current investigation, we identified 3 cases where a common trunk, giving rise to the subscapular, circumflex scapular, and lateral thoracic arteries, originated from the third part of the axillary artery.[17,18]

Table 5: Mode of origin of Superior thoracic, Lateral thoracic, Subscapular & Posterior Circumflex Humeral arteries.

Branch	Site of Origin	Author			
		Degaris & swartley		Mohammad	Present Study
Superior Thoracic Artery	Directly from 1st part of AA	96.9%	86.6%	82%	96.66%
	2nd part of AA		2.2%	-	-
Lateral Thoracic Artery	With SSA	1.2%	15%	6%	8.33%
Subscapular Artery	From 2nd part	5.1%	15.7%	16%	3.33%
Posterior Circumflex Humeral Artery	In common with SSA	1.4%	15.2%	22%	3.33%
	In common with ACHA	15.8%	11.2%	16%	-

In previous studies, the lateral thoracic artery was reported to originate from the subscapular artery in 14.6%, 1%, 23.4%, and 26.4% of cases. In our present study, we have documented the 8.33percentage of cases as well.

Table 6: Incidence of origin of lateral thoracic artery from subscapular artery

Author's Name	% of variation
Huelke DF	14.6%
Pellegrini	1.00%
Trotter M et al	23.40%
P' An MT	26.40%
Present Study	8.33%

Huelke observed that a common trunk originated the subscapular artery with the posterior circumflex humeral artery in 15.2% of specimens. Johnson & Ellis (2005) reported that the subscapular artery arises from a common trunk with the posterior circumflex humeral artery in 30% of specimens. In Mohammad.A. Abdalla's study, it was noted that the subscapular and posterior circumflex humeral arteries arise from a common trunk originating from the third part of the axillary artery in 18% of specimens. Sudeshna Majumdar et al. observed a common trunk origin of the subscapular artery with the posterior circumflex humeral artery in 1.43% of specimens. In the present study, we have found a percentage of cases with similar findings.

Table 7: Incidence of common truck origin of subscapular and posterior circumflex humeral arteries

Name of study	% (Percentage)
Heulke (1959)	15.20%
Johnson & Ellis (2005)	30.00%
Mohammad Abdalla (2007)	18.00%
Sudeshna Majumdar (2013)	1.43%
Present study	3.3%

Table 8: Incidence of two anterior circumflex humeral arteries from third part of axillary artery

Name of study	% (Percentage)
Samta Gaur (2012)	4.00%
Present Study	1.6%

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CONCLUSION

The axillary artery serves as a crucial site for arterial cannulation in cardiac surgery, especially in cases of aortic aneurysmal dissection and the replacement of the ascending and arch of the aorta. The lateral mammary branches derived from the axillary artery are employed in coronary bypass graft procedures. In plastic surgery, these branches play a key role in preparing pedicle the grafts for various reconstructive interventions. Understanding potential variations in the branching pattern becomes paramount to mitigate risks such as bleeding during surgical procedures, aiding in the prevention of diagnostic errors in interventional procedures and interpretation of angiograms. Consequently, a comprehensive knowledge of both the normal anatomy and variations of the axillary artery holds great significance for anatomists, surgeons, anesthetists, radiologists, cardiologists, and plastic surgeons, ensuring accurate diagnostic and therapeutic interventions.

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