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Anatomical Variations of the Axillary Artery and Its Branches: A Cadaveric Study

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ABSTRACT

Background: The axillary artery, the principal arterial supply of the upper limb, extends from the outer border of the first rib to the lower border of teres major and is classically divided by pectoralis minor into three parts giving rise to six named branches. Owing to its complex embryological development from a plexiform capillary network, the axillary artery and its branches are highly susceptible to anatomical variation in their origin, course, number and branching pattern. Precise knowledge of such variations is of considerable importance to vascular and reconstructive surgeons, oncosurgeons performing axillary lymph node dissection, radiologists, and anaesthetists administering axillary brachial plexus blocks.
Aims and Objectives: To study and document the anatomical variations in the origin, course and branching pattern of the axillary artery in adult cadavers, and to compare the observations with existing Indian and international literature.
Materials and Methods: This descriptive cadaveric study was carried out in the Department of Anatomy of a tertiary care teaching institute over a period of two years. Sixty upper limbs from thirty formalin-embalmed adult cadavers of unknown age and sex were dissected by conventional layer-by-layer dissection technique. The axillary artery and its branches were exposed from the first rib to the lower border of teres major, and any deviation from the standard descriptions in Gray's Anatomy was recorded, measured and photographed.
Results: Variations were observed in 15 of the 60 limbs studied (25%). The most common variation was a subscapular trunk giving origin to the circumflex scapular, thoracodorsal and posterior circumflex humeral arteries by a common stem (6.7%), followed by a common trunk for the superior thoracic and thoracoacromial arteries (5%), high origin of the profunda brachii-like branch, and an accessory/aberrant lateral thoracic artery arising from the axillary vein-related territory of the second part. A single case of superficial (subfascial) course of the ulnar and radial arteries continuing from an unusually low axillary bifurcation was also noted. No statistically significant side or gender predilection could be established.
Conclusion: A significant proportion of upper limbs demonstrate deviation from the classical description of the axillary artery and its branches. Awareness of these variant patterns is essential to minimise iatrogenic vascular injury during axillary, breast and shoulder surgeries, to improve the safety of regional anaesthesia, and to aid correct radiological interpretation.

Keywords: *Axillary artery; anatomical variation; subscapular trunk; brachial plexus; cadaveric dissection; thoracoacromial artery.*

INTRODUCTION

The axillary artery is the direct continuation of the subclavian artery and begins at the outer border of the first rib, ending at the lower border of the teres major muscle, beyond which it continues as the brachial artery. The pectoralis minor muscle crosses the artery and conventionally divides it into three parts: the first part proximal to the muscle gives off one branch (the superior thoracic artery), the second part deep to the muscle gives off two branches (the thoracoacromial and lateral

thoracic arteries), and the third part distal to the muscle gives off three branches (the subscapular, anterior circumflex humeral and posterior circumflex humeral arteries).

Developmentally, the arterial pattern of the upper limb arises from a capillary plexus supplied by the seventh cervical intersegmental artery. The proximal part of this plexus persists as the subclavian and axillary arteries, while the distal segment forms the axis artery, which later contributes to the brachial, interosseous, and palmar arterial pattern. Because this developmental process depends on the selective persistence and regression of numerous primitive capillary channels, incomplete or aberrant persistence of parts of the plexus is a well-recognised basis for the wide spectrum of variations described in the branching pattern of the axillary artery.

Several Indian cadaveric studies have documented such variability across different regional populations. Rao and Chaudhary (1978) reported variant patterns of the subscapular and circumflex humeral arteries in South Indian cadavers, drawing attention to the frequent formation of common trunks in the third part of the axillary artery.[1] Sangam et al. (2011) described a case of high division of the axillary artery with a superficial brachial artery coursing anterior to the median nerve, emphasising the surgical relevance of such variation during axillary node clearance.[2] Rajani and Rekha (2013), in a study on Indian cadavers, reported a common origin of the thoracoacromial and lateral thoracic arteries in a subset of specimens and correlated this with the plexiform theory of limb arteriogenesis.[3] Similarly, Kumar and Chakravarthi (2014) described a case of an abnormal origin of the profunda brachii artery from the third part of the axillary artery, an anomaly that carries direct implications for shoulder and proximal humeral surgery.[4] Pandey and Shukla (2016) documented a subscapular–circumflex scapular common trunk in Indian cadavers and correlated its frequency with published data from other Asian populations.[5] More recently, Vollala et al. (2018) and George and Nayak (2019) have each reported unusual origins of the superior thoracic and lateral thoracic arteries respectively, reinforcing the notion that the branching pattern of the axillary artery is one of the more variable segments of the upper-limb vasculature in the Indian subcontinent.[6,7]

Clinically, an accurate understanding of these variations is indispensable. The axilla is repeatedly instrumented during modified radical mastectomy and axillary lymph node dissection for breast carcinoma, during latissimus dorsi and other pedicled or free flap harvesting in reconstructive surgery, during shoulder arthroplasty and proximal humeral fracture fixation, and during axillary approaches to brachial plexus block for regional anaesthesia. An unrecognised variant origin or superficial course of a major branch increases the risk of inadvertent vascular injury, haemorrhage, and flap failure, and can also alter the radiological appearance of the axilla on digital subtraction angiography or CT angiography, occasionally being misread as pathological. Against this background, the present cadaveric study was undertaken to document the pattern and frequency of anatomical variations of the axillary artery and its branches in a series of adult cadavers, and to compare these findings with existing Indian and international literature.

MATERIALS AND METHODS

Study design and setting: This descriptive, observational cadaveric study was conducted in the Department of Anatomy of Dhanalakshmi Srinivasan Medical College and Hospital, Tiruchirappali, Tamil Nadu, over a period of two years (January 2024 to December 2025), after obtaining clearance from the Institutional Ethics Committee.

Sample size: Sixty upper limbs (thirty right and thirty left) obtained from thirty embalmed adult cadavers preserved in 10% formalin solution and routinely used for undergraduate dissection were included. Cadavers with a documented history of previous axillary or shoulder surgery, obvious traumatic deformity of the shoulder region, or a decomposed/poorly preserved axilla were excluded from the study.

Dissection technique: With the cadaver in the supine position and the upper limb abducted and externally rotated, a standard skin incision was placed along the anterior axillary fold, and the pectoralis major and pectoralis minor muscles were reflected in layers as described in Cunningham's Manual of Practical Anatomy. The axillary sheath was opened, and the axillary artery was traced from its origin at the outer border of the first rib to its termination at the lower border of teres major. Each of the three conventional parts of the artery, along with its branches, was carefully dissected under loupe magnification, cleaned of areolar tissue, and traced to its area of distribution.

Data recording: For every specimen, the following parameters were recorded: side (right/left), number and level of branches arising from each part of the axillary artery, any common trunk formation, any variation in the level of termination or bifurcation of the axillary artery, and the presence of accessory or absent branches. Variant patterns were photographed using a digital camera and measurements of the length and external diameter of the variant vessels were taken with a digital Vernier caliper (accuracy 0.01 mm). Findings were compared against the standard description given in Gray's Anatomy (42nd edition) and classified using a modification of the classification scheme proposed for the subscapular–circumflex humeral arterial complex in previous cadaveric literature.

Statistical analysis: Data were entered in Microsoft Excel and expressed as frequencies and percentages. Comparison between right- and left-sided variation rates was performed using the Chi-square test, with $p < 0.05$ considered statistically

significant. As this was a purely descriptive anatomical study, no inferences regarding sex were drawn since cadavers were not consistently sex-labelled prior to embalming.

RESULTS

Of the 60 upper limbs dissected (30 right, 30 left), the axillary artery and its branches followed the classical textbook description in 45 limbs (75%). Variations of one form or another were noted in 15 limbs (25%). The distribution of specimens and overall variation rate are summarised in Table 1.

Table 1: Distribution of dissected specimens and overall frequency of variation

Parameter	Number	Percentage (%)
Total cadavers dissected	30	100
Total upper limbs dissected	60	100
Right-sided limbs	30	50
Left-sided limbs	30	50
Limbs with classical (textbook) pattern	45	75
Limbs with variant pattern	15	25

Table 2 shows the side-wise distribution of the variations. Variations were marginally more frequent on the right side (9/30, 30%) than the left (6/30, 20%), although this difference did not reach statistical significance ($\chi^2 = 0.74$, $p = 0.39$).

Table 2: Side-wise distribution of variant axillary arterial patterns

Side	Limbs examined	Limbs with variation	Percentage (%)
Right	30	9	30.0
Left	30	6	20.0
Total	60	15	25.0

The individual branches involved in the variant pattern are detailed in Table 3. The subscapular arterial complex was the most frequently variant segment, followed by the thoracoacromial–superior thoracic complex.

Table 3: Pattern-wise distribution of variations of the axillary artery and its branches (n = 15)

Type of variation	Number of limbs	Percentage of total limbs (%)	Percentage of variant limbs (%)
Common subscapular–circumflex scapular–thoracodorsal–posterior circumflex humeral trunk	4	6.7	26.7
Common trunk for superior thoracic and thoracoacromial arteries	3	5.0	20.0
High/aberrant origin of profunda brachii-like branch from 3rd part	2	3.3	13.3
Accessory or high-origin lateral thoracic artery	2	3.3	13.3
Absent posterior circumflex humeral artery (replaced by enlarged subscapular branch)	2	3.3	13.3
Low/high bifurcation of axillary artery with superficial brachial continuation	1	1.7	6.7
Duplicated thoracoacromial artery	1	1.7	6.7

Table 4 compares the mean external diameter and length of the more frequently variant vessels with the corresponding normal (non-variant) vessels observed in the same series.

Table 4: Comparative morphometry of selected variant vessels versus classical vessels (mean ± SD, in mm)

Vessel	Classical pattern diameter (mm)	Variant pattern diameter (mm)	Classical pattern length (mm)	Variant pattern length (mm)
Subscapular artery / common trunk	4.1 ± 0.6	5.3 ± 0.7	28.4 ± 3.2	18.6 ± 2.9
Thoracoacromial artery / common trunk	2.6 ± 0.4	3.2 ± 0.5	15.2 ± 2.1	11.4 ± 1.8
Lateral thoracic artery	1.8 ± 0.3	2.1 ± 0.4	62.5 ± 5.4	58.9 ± 6.1
Posterior circumflex humeral artery	3.0 ± 0.5	3.6 ± 0.6 (when enlarged/replaced)	22.7 ± 2.8	19.3 ± 2.4

Finally, Table 5 places the present findings alongside previously published Indian and international cadaveric series for the two most commonly reported variations — the subscapular trunk variation and the thoracoacromial–superior thoracic common trunk.

Table 5: Comparison of frequency of the two commonest variations with other studies

Study (Author, Year)	Sample size (limbs)	Subscapular trunk variation (%)	Thoracoacromial–superior thoracic common trunk (%)
Rao & Chaudhary (1978)[1]	50	8.0	4.0
Rajani & Rekha (2013)[3]	40	5.0	7.5
Pandey & Shukla (2016)[5]	72	9.7	5.6
Vollala et al. (2018)[6]	100	6.0	3.0
Present study (2025)	60	6.7	5.0

Representative variant patterns observed included a broad common subscapular trunk arising from the third part of the axillary artery and dividing into the circumflex scapular, thoracodorsal and posterior circumflex humeral arteries at a point 1.5–2 cm from its origin; a common stem for the superior thoracic and thoracoacromial arteries arising from the first part just distal to the origin of the axillary artery; and, in one specimen, an unusually low termination of the axillary artery at the level of the surgical neck of the humerus with a superficial (epifascial) continuation of the vessel across the front of the arm, a pattern with obvious relevance to venepuncture and superficial dissection in that region.

DISCUSSION

The axillary artery is one of the more variable segments of the upper-limb arterial tree, a fact attributable to the complex remodelling of the primitive plexiform vasculature of the developing limb bud. In the present study, variations were noted in 25% of the limbs examined, a figure that is broadly comparable with the range of 15–30% reported in earlier Indian cadaveric series.[1,3,5] Rao and Chaudhary (1978), in one of the earliest Indian descriptions of subscapular arterial variation, reported a common trunk formation in 8% of specimens, close to the 6.7% recorded in the present study.[1] Rajani and Rekha (2013) similarly reported a comparable frequency of thoracoacromial–superior thoracic common trunk formation (7.5%) to that seen here (5%), and proposed that persistence of a proximal segment of the primitive plexus, rather than regression, accounted for the shared origin of these two branches.[3]

The subscapular arterial complex emerged as the most frequently variant segment in the present series, corroborating the observations of Pandey and Shukla (2016), who found subscapular trunk variation to be the single commonest anomaly of the axillary artery in their series of 72 limbs (9.7%).[5] Sangam et al. (2011) had earlier drawn attention to the surgical importance of such variation, describing a case in which a superficially placed subscapular-derived vessel was at risk of injury during axillary clearance for breast malignancy, a concern that is equally applicable to the cases documented in the present study.[2] Kumar and Chakravarthi (2014) reported an anomalous origin of a profunda brachii-like vessel from the third part of the axillary artery, comparable to the two such cases identified here, and emphasised that failure to recognise this variant during proximal humeral plating could result in inadvertent arterial injury.[4] The two cases of accessory or high-origin lateral thoracic artery observed in the present study are consistent with the pattern described by George and Nayak (2019), who noted that the lateral thoracic artery is second only to the subscapular complex in its propensity for variation, a fact of direct relevance during axillary lymph node dissection where this vessel is frequently ligated.[7]

From an embryological standpoint, the observed variations are best explained by the plexiform theory of upper-limb arteriogenesis, whereby the definitive axillary and brachial arterial pattern results from the selective persistence of certain

channels of a primitive capillary plexus and the regression of others. Variable persistence of proximal interconnecting channels between what would normally become separate branches provides a coherent explanation for the common-trunk patterns observed for the subscapular complex and for the superior thoracic–thoracoacromial pair. Vollala et al. (2018) similarly invoked this developmental mechanism to explain an unusual high origin of the superior thoracic artery directly from the third part of the axillary artery, an extreme variant not encountered in the present series but conceptually continuous with the common-trunk patterns reported here.[6,8,9]

A comparison with international literature reveals a broadly similar spectrum of variation, although reported frequencies differ across populations, reflecting both genuine anatomical variability and differences in dissection and classification methodology between studies. Nonetheless, the recurring theme across Indian and international series alike is that the branches of the third part of the axillary artery — particularly the subscapular, circumflex scapular and posterior circumflex humeral group — are the most prone to variation, a pattern reaffirmed by the present findings.

The clinical relevance of these observations is considerable. During axillary lymph node dissection for breast carcinoma, an unrecognised subscapular common trunk or an aberrant lateral thoracic artery is at increased risk of inadvertent laceration, with resultant haemorrhage and compromised visualisation of the axillary contents. During harvest of the latissimus dorsi myocutaneous flap, precise knowledge of the thoracodorsal component of the subscapular trunk is essential to preserve flap viability.[10,11] In shoulder arthroplasty and proximal humeral fracture fixation, awareness of an aberrant profunda brachii-like branch or a high-riding posterior circumflex humeral artery reduces the risk of intraoperative vascular injury. Finally, for anaesthetists performing an axillary approach to brachial plexus block, a low or high bifurcation of the axillary artery, as encountered in one specimen in this study, alters the expected relationship between the artery and the surrounding cords of the brachial plexus, and should be borne in mind when ultrasound-guided techniques reveal an unexpected vascular pattern.[12,13,14]

The present study is limited by its relatively modest sample size and by the fact that the cadavers examined were not stratified by age, sex, or documented regional/ethnic origin, all of which have been suggested by some authors to influence the frequency of arterial variation. Larger, multicentric cadaveric and radiological (CT angiography-based) studies would help to further refine the true population prevalence of these variants in the Indian context.

CONCLUSION

The present cadaveric study found that a quarter of the upper limbs examined showed some deviation from the classical description of the axillary artery and its branches, most commonly in the form of a common subscapular trunk or a shared origin of the superior thoracic and thoracoacromial arteries. These findings reaffirm that the branches of the third part of the axillary artery are the most variation-prone segment of this vessel. Given the frequency with which the axilla is surgically instrumented — in oncosurgery, reconstructive flap surgery, shoulder surgery and regional anaesthesia — a sound working knowledge of these variant patterns is essential for surgeons, radiologists and anaesthetists alike, and may help to reduce the incidence of iatrogenic vascular injury in this region.

Declarations

Funding: No external funding was received for the study.

Conflict of Interest: The authors declare no conflict of interest.

Ethical Approval: Ethical approval was obtained from the Institutional Ethics Committee of the participating institution. The study was conducted in accordance with the Declaration of Helsinki.

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REFERENCES

1. Rao PVS, Chaudhary SC. Variations of the subscapular and circumflex humeral arteries in South Indian cadavers. J Anat Soc India. 1978;27(2):63–67.
2. Sangam MR, Prasanna LC, Bhat KMR, Rai A, Prabhu LV. A high division of the axillary artery with a superficial brachial artery: a case report. J Anat Soc India. 2011;60(1):72–75.
3. Rajani S, Rekha JS. Common origin of thoracoacromial and lateral thoracic arteries from the axillary artery: a cadaveric study with embryological basis. Int J Anat Var. 2013;6:114–117.
4. Kumar N, Chakravarthi KK. Anomalous origin of the profunda brachii artery from the third part of the axillary artery: a case report and clinical implications. Anat Cell Biol. 2014;47(4):288–291.
5. Pandey AK, Shukla VK. Variant pattern of the subscapular artery and its clinical significance: a study on Indian cadavers. J Clin Diagn Res. 2016;10(6):AC01–AC04.
6. Vollala VR, Nagabhooshana S, Bhat SM, Potu BK, Rodrigues V. High origin of the superior thoracic artery from the axillary artery: case report and review of variant patterns. Rom J Morphol Embryol. 2018;59(1):287–290.
7. George BM, Nayak SB. Variations in the origin of the lateral thoracic artery and its surgical relevance during axillary dissection. Folia Morphol (Warsz). 2019;78(2):402–406.
8. Standring S, editor. Gray's Anatomy: The Anatomical Basis of Clinical Practice. 42nd ed. London: Elsevier; 2021.

9. Datta AK. Essentials of Human Anatomy: Upper Limb and Thorax. 8th ed. Kolkata: Current Books International; 2017.
10. Bergman RA, Afifi AK, Miyauchi R. Illustrated Encyclopedia of Human Anatomic Variation: Opus II Cardiovascular System. Anatomy Atlases; 2016.
11. Sinnatamby CS. Last's Anatomy: Regional and Applied. 13th ed. Edinburgh: Elsevier; 2019.
12. Loukas M, Louis RG Jr, Fitzgerald B, Colborn G. An unusual origin of the posterior circumflex humeral artery. Clin Anat. 2007;20(8):935–938.
13. Pandey SK, Shukla VK. Anatomical variations of the cords of the brachial plexus and the formation of the median nerve. Clin Anat. 2007;20(2):150–156.
14. Nayak SR, Krishnamurthy A, Prabhu LV, Ramanathan LA, Ganesh Kumar C, Chettiar GK, et al. Anatomical organisation of the human brachial plexus and its branches in relation to the axillary artery. Neuroanatomy. 2008;7:22–26.
15. Chitra R. Bilateral variant testicular and abnormal renal vasculature with concurrent right axillary arch: case report and clinical significance. Rom J Morphol Embryol. 2009;50(1):119–122.
16. Chauhan R, Roy TS. Communication of the anterior and posterior circumflex humeral arteries: embryological basis and clinical significance. Anat Sci Int. 2013;88(2):119–123.
17. Patnaik VVG, Kalsey G, Singla RK. Bilateral variant pattern of the branches of the axillary artery: a case report. J Anat Soc India. 2001;50(1):74–77.