

VARIATIONS IN THE ORIGIN OF PROFUNDA BRACHII ARTERY FROM BRACHIAL ARTERY**K SATHEESH NAIK^{1*}, PRAVEENA KUMARI K², SADHU LOKANADHAM³**¹Department of Anatomy, MNR Medical College and Hospital, Fasalwadi, Sangareddy, Telangana, India. ²Department of Anatomy, Santhiram Medical College, Nandyal, Andhra Pradesh, India. ³Department of Anatomy, Kurnool Medical College, Kurnool, Andhra Pradesh, India.

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ABSTRACT

Objective: The profunda brachii artery (PBA) is a chief artery in anterior compartment of the arm for the nutritional source. Knowledge of variations in the origin and branching is helpful for the surgeon during catheterization and harvesting of lateral flaps.

Methods: During the routine dissection for medical undergraduate students we found variations in the branching pattern of PBA in 72 arms from 36 cadavers in the Department of Anatomy, Viswabharathi Medical College, Penchikalapadu, and Kurnool, over 5 years. We preserved all the variations carefully.

Results: We observed PBA in all the cadavers, patterns of origin, branches, and termination were recorded. In 96.9% of cadavers Profunda Brachii artery arises from the brachial artery, in 1.4% of cadavers Profunda Brachii artery arises from the axillary artery and in 1.7% cadavers Profunda Brachii artery arises from a common stem with the superior ulnar collateral arteries. In 11.1% and 16.7% of the cadavers showed duplication and early branching.

Conclusion: Humeral fractures and BA catheterization the incidence of duplication and early branching make it vulnerable to inadvertent injury and may complicate lateral arm flaps. Pre-operative angiographic evaluation is therefore recommended.

Keywords: Brachial artery, Profunda brachii artery, Vascular surgeries.

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INTRODUCTION

The profunda brachii artery (PBA) arises from the brachial artery (BA) on the posteromedial aspect and is a first and the largest branch. In the radial groove, it joins with the radial nerve and gives rise to deltoid branch, nutrient artery, and terminates by bifurcating into the middle and radial collateral arteries [1,2]. We noticed variations in the origin and branching patterns [3]. These variations are important during BA surgeries and harvesting of the lateral arm flaps [4,5] and may lead to accidental injury during percutaneous arterial catheterization or injection of drugs [6,7]. There are some studies on these variations from many populations, which explain the differences in frequency and branching patterns of the artery. In this study, we are explaining the origin and branching pattern of BA and the origin and termination of PBA, systematically [8-10].

METHODS

We dissected and examined 72 arms from 36 cadavers aged between 35 and 60 years for the origin and termination of PBA in the department of anatomy. Nineteen cadavers were male and 19 were female. Vertical incisions were made on the lateral and medial borders of the arm from the coracoid process and axilla proximally to the mid-arm. These incisions were joined by transverse ones and the skin flaps were removed. The biceps brachii muscle was dissected in the middle, the ends retracted and the fascia split to expose the BA in its entire extent from the axilla to the cubital fossa. The profunda brachii was identified as the first and proximal branch which joined the radial nerve in the radial groove. We observed the origins, and its relationship with the radial nerve and proximal terminal branching patterns carefully, the results are analyzed and presented in Tables 1 and 2.

RESULTS

We included 72 arms in this study, in which PBA arises from the BA. In 98.6% of cadavers Profunda Brachii artery (PBA) arises from the Brachial

artery, in 1.4% of cadavers PBA arises from the axillary artery. In 51 cases (70.8%) the Profunda brachii artery displayed classical pattern entering the radial groove as a single trunk before dividing into its terminal branches (Fig. 1a), in 9 cases (12.5%) we observed single trunk of PBA with immediate bifurcation and in 2% of cases single trunk of PBA with immediate trifurcation from the Brachial artery and the radial nerve passed in between the two trunks (Fig. 1b). In the remaining cadavers, the arteries arise parallel to each other, in which the radial nerve either passed in between the two branches or along the side of one of the branches. In one case, one of the terminal branches of profunda brachii arises from a common trunk with the superior ulnar collateral (Fig. 1c). The double PBA associated with high superior ulnar collateral artery observed in two cases (3.2%), 1 (Fig. 1d). In one case, the origin of the PBA was part of the trifurcation of the BA into PBA, ulnar, and radial arteries (Fig. 1e). One of the PBA arises as a very short trunk that immediately bifurcated into two branches (Fig. 1f).

In three cases (2.4%), the PBA trifurcated immediately after its origin into three terminal branches (Fig. 2a). The PBA divided immediately (within 2 cm of its origin) into its two terminal branches in nine (12.5%) cadavers, with the radial nerve in between the two trunks (Fig. 2b), or the radial nerve running in parallel with one nerve (Fig. 2c).

It was recorded that more variations were observed on the left side than on the right side and this proved to be statistically significant with a $p=0.001$ (Table 2).

DISCUSSION

Our observations support the previous reports in which suggested that, PBA is always present and often arises from the brachial artery [3,11]. PBA may arise from the axillary artery rarely. In 10% of the cases, duplications of the PBA were observed; it is higher than the earlier reports of 0.7–2% seen in other populations [10-13]. This suggests major differences in the bifurcation pattern of this artery.

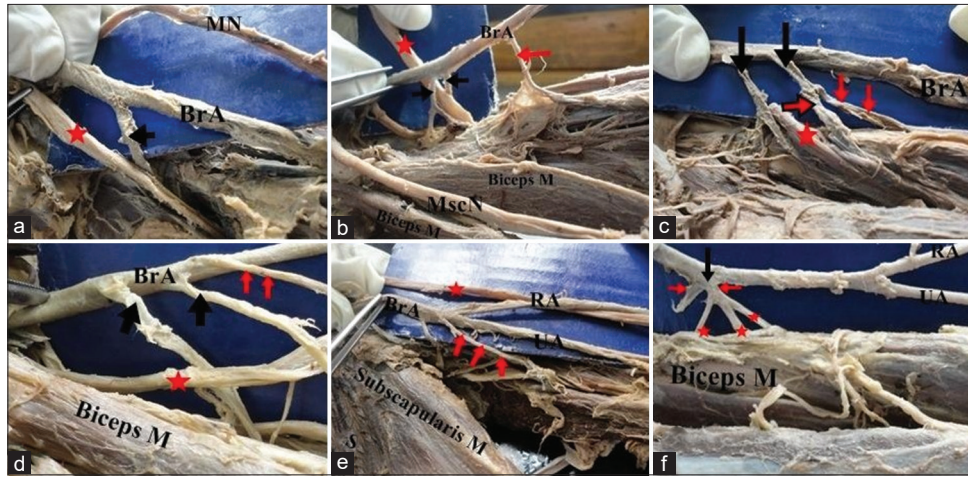


Fig. 1: Pattern of origin of the profunda brachii artery (PBA), (a) single PBA, (black arrow), arises from brachial artery (BA), entering the radial groove with the radial nerve (red star). MN is the median nerve, (b) duplicated PBA (black arrows) with radial nerve RN (star) and passes in between the two trunks. The red arrow points to the superior ulnar collateral artery. MscN is the Musculocutaneous nerve, (c) “double” profunda brachii (arrows) where the second artery (radial collateral) arises in common with the superior ulnar collateral, (d) double PBAs with high ulnar collateral (red arrow), (e) trifurcation of the BA, into PBA (arrow), ulnar (UA), and radial (RA) arteries, (f) very short trunk of PBA (arrow) originating from the BA and immediately bifurcates, one of the arteries further divides into three branches. Note that the BA also divides higher up in the arm into the radial and ulnar arteries

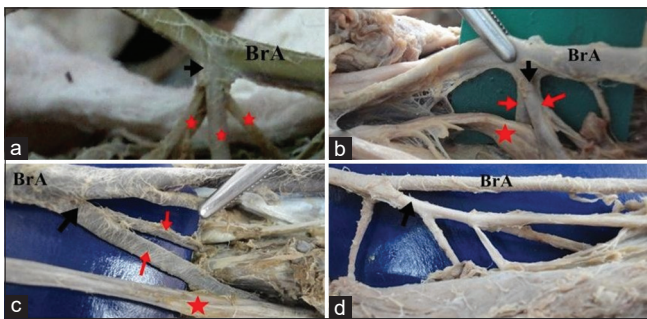


Fig. 2: Branching pattern of the profunda brachii artery (PBA), (a) trifurcation of the PBA (red arrow) from the brachial artery, (b) bifurcation the PBA (vertical black arrow) with the radial nerve (star) in between the two branches (arrow), (c) bifurcation, with radial nerve (star) running with one of the branches, radial ulnar collateral, (d) PBA (black arrow), that is large almost the same size as its mother artery that divides into several branches

Table 1: Variations in the branching pattern of the profunda brachii artery

Variations	Left	Right	Total	
			No	%
Normal branching pattern	22	29	51	70.8
Single trunk with immediate bifurcation	6	3	9	12.5
Single trunk with immediate trifurcation	1	1	2	2.8
Double profunda brachii	6	3	9	12.5
Common trunk of origin with the superior ulnar collateral	1	0	1	1.4
Total	36	36	72	100

Humerus fracture may cause damage to PBA and lead to excessive hemorrhage [7] in cases of 23 double arteries from PBA important for the surgical anatomy. The high frequency of double PBA suggests that the artery is more amenable to accidental damage and excessive bleeding consequent to fracture of the Humerus. When operating on the BA (BA surgeons and interventional radiologists should exercise extra diligence). Early division of PBA into two or three branches will

Table 2: Side-to-side comparison of the branching pattern of the profunda brachii artery

Side	Classical (usual branching pattern)	Variant branching pattern
Right	14	4
Left	11	7
Total	25	11

enter the radial groove separately. These arterial variations have not been described in literature before even though they affect the length of the branches which in turn influences the length and the depth of the musculocutaneous lateral arm flap [6]. High origin of PBA from the BA with the origin of the superior ulnar collateral artery as in the case of the common trunk predisposes the latter to inadvertent injury during flap harvesting or other procedures of the arm [14]. There is a high incidence of duplication and early branching of the PBA in this population. These make it vulnerable to inadvertent injury during fractures of the Humerus, BA catheterization and may complicate lateral arm flaps. Pre-operative angiographic evaluation is recommended.

CONCLUSION

Knowledge about the branching pattern and origin of upper limb arteries is very useful for different surgical approaches.

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CONFLICT OF INTEREST

Nil.

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REFERENCES

1. Standring S, Johnson D, Ellis H, Collins P. Gray’s Anatomy. 39th ed. London: Churchill Livingstone; 2005. p. 356.

2. Bidarkotimath S, Avadhani R, Kumar A. Primary pattern of arteries of upper limb with relevance to their variations. *Int J Morphol* 2011;29:1422-8. doi: 10.4067/S0717-95022011000400059
3. Charles CM, Penn L, Holden HF, Miller RA, Elvis EB. The origin of the deep brachial artery in American white and American Negro males. *Anat Rec* 1931;50:299-302. doi: 10.1002/ar.1090500307
4. Katsaros J, Schusterman M, Beppu M, Banis JC Jr., Acland RD. The lateral upper arm flap: Anatomy and clinical applications. *Ann Plast Surg* 1984;12:489-500. doi: 10.1097/0000637-198406000-00001, PMID 6465806
5. Antohi N, Stingu C, Stan V. The use of free flap transfer in upper extremity reconstruction. *Tim Med J* 2005;1:27-35.
6. Evans JM, Latto IP, Ng WS. Accidental intra-arterial injection of drugs: A hazard of arterial cannulation. 3 Case reports. *Br J Anaesth* 1974;46:463-6. doi: 10.1093/bja/46.6.463, PMID 4458766
7. Das S, Singh S, Paul S. Double profunda brachii and abnormal branching pattern of the brachial artery. *Tim Med J* 2005;2:159-61.
8. Shewale SN, Sukre SB, Diwan CV. Bifurcation of brachial artery at its commencement-a case report. *Biomed Res* 2012;23:453-6.
9. Celik HH, Aldur MM, Tunali SS, Ozdemir MB, Aktekin M. Multiple variations of the deep artery of arm: Double deep artery of arm and deep artery of arm with the superior ulnar collateral artery. A case report. *Morphologie* 2004;88:188-90.
10. Madhyastha S, Nayak SR, Krishnamurthy A, D'Costa S, Bhat KM, Jose A. Case report of high origin of radial, ulnar and profunda brachii arteries, its clinical implications and review of literature. *J Vasc Bras* 2009;8:374-8.
11. Keen JA. A study of the arterial variations in the limbs, with special reference to symmetry of vascular patterns. *Am J Anat* 1961;108:245-61. doi: 10.1002/aja.1001080303, PMID 14454801
12. Patnaik WG, Kalsey G, Singla RK. Branching pattern of brachial artery-a morphological study. *J Anat Soc India* 2002;51:176-86.
13. Mane UV, Pandhare SR. Unusual arterial variation of upper limb-case report. *Int J Res Trends Sci Technol* 2011;1:61-4.
14. Anson BJ. Morris' human anatomy. In: *The Cardiovascular System-arteries and Veins*. New York: McGraw Hill Book Co., The Blackiston Division; 1966. p. 708-24.