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An anatomical study of variations in termination of brachial artery: embryological basis and clinical implication

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Abstract: *A study was done to note the variations in the termination of brachial artery in relation to the level of termination and the terminal branches. A total of 95 upper limbs (51 Right, 44 Left) were studied. The level of termination of brachial artery was classified into five groups based on the distance between the intercondylar line and the point of termination. There was a significant positive correlation (P=0.031) between the arm length and level of termination. Statistically significant association (P=0.022) was observed between the type of terminal branch and different groups of level of termination. Difference in the mean level of termination between brachial artery bifurcation and trifurcation was found to be statistically significant (P < 0.001). Bifurcation of brachial artery occurred at a proximal level when compared to trifurcation which occurred more distally. Due to higher incidence of anatomical variations of arteries of the upper limb, prior anatomical knowledge of anomalies is of great clinical significance to vascular surgeons, orthopaedicians and radiologists performing angiographic studies.*

Keywords: *Arm length, brachial artery, level of termination, terminal branches, variations.*

I. Introduction

A basic law of vascular anatomy is that the only thing which remains constant is its variability. The vascular anatomy is more variable in the living than in the dead and it varies among people living in different countries. Some arteries have more variations than others [1]. The incidence of an abnormality in the arterial anatomy of the upper limb varies from 18.53% to 20% [2].

Brachial artery is the major artery of the arm. A continuation of the axillary artery, it begins at the distal (inferior) border of the tendon of teres major and ends about a centimeter distal to the elbow joint by dividing into radial and ulnar arteries [3]. Frequently, brachial artery divides more proximally than usual into radial, ulnar, and common interosseous arteries. Most often, radial artery arises proximally, leaving a common trunk for ulnar and common interosseous; sometimes the ulnar artery arises proximally, radial and common interosseous forming the other division; the common interosseous may also arise proximally [4].

Because the upper extremity is a frequent site of injury, various surgical and invasive procedures are performed in this region; consequently, it is of utmost importance to be aware of arterial variations. For some medical procedures, there may be an increased risk of complications because of variant vessels; however, for other procedures, they may be beneficial [5] e.g., a variant superficial vessel is easily approachable during catheterization. Even though a number of case reports have been reported, not many studies have been done regarding variations in termination of brachial artery.

Hence the present study was conducted to observe the variations in termination of brachial artery in relation to its level and terminal branches. The authors have also tried to provide an embryological basis for the variations and their clinical implications.

II. Materials and Methods

In total, 95 formalin-preserved cadaveric upper limbs were examined in the Department of Anatomy, Kempegowda Institute of Medical Sciences, Bangalore. They comprised of 51 right side and 44 left side upper limbs, irrespective of sex.

The length of the arm was noted down by measuring the distance between the summit of the acromion of the scapula and the lateral epicondyle of the humerus. The arm and cubital fossa were dissected to expose brachial artery as per Cunningham’s manual of practical Anatomy [6]. Terminal branches of brachial artery and its level of termination were noted down. Level of termination was measured by measuring the distance between the intercondylar line (ICL) of the humerus (line joining the medial and lateral epicondyle of the humerus) and the point of termination using a measuring tape.

Statistical analysis of the data was done to get the percentage, Mean and Standard deviation (SD). Difference in the Mean of two variables was analyzed by doing ‘Z’ Test. ‘Chi Squared Test’ was done to determine the association between two variables. Also correlation between two variables was determined by doing 'Spearman's Rank Correlation'. The results obtained were considered statistically significant when $P < 0.05$.

III. Results

Among the 95 upper limbs studied, the arm length varied between 26 to 36 cms, with a mean arm length of 30.82 cms.

When the level of termination of brachial artery was considered, the most proximal termination was noted at '0'cms i.e., at the ICL in 2 specimens of the right side (Fig.1). Whereas the most distal termination of brachial artery, was found to be at 5.8cms distal to the ICL in 1 specimen of the left side. In 63 of the specimens (66.31%), the termination was observed to occur between 3 to 4.5cms distal to the ICL. The level of termination of brachial artery was classified into 5 groups based on the distance between point of termination and the ICL. No significant association (P=0.230) was observed when the 5 groups based on level of termination were compared on the two sides (Table 1). When all the limbs irrespective of sides were considered, there was a significant positive correlation ($\rho = 0.221$, $P = 0.031$) between the arm length and the level of termination. But no significant correlation ($P>0.05$) was found when the two sides were considered separately (Table 2).

When the number of terminal branches of brachial artery was considered, it was observed that, in 69 limbs (72.6%) there was bifurcation of brachial artery, whereas in 25 limbs (26.3%) there was trifurcation of brachial artery. In case of 1 left upper limb, the brachial artery terminated into 5 branches, 5cms distal to the ICL. No significant association (P=0.658) was observed between the number of terminal branches and the two sides (Table 3). Statistically no significant difference (P=0.801) was observed in the mean arm length between the two types of terminal branches (Table 4). Also no significant correlation ($P > 0.05$) was observed between arm length and number of terminal branches (Table 5).

When the types of terminal branches were considered, brachial artery bifurcation was observed in 69 upper limbs (72.6%). Out of these, the classic textbook description of brachial artery bifurcating into radial and ulnar arteries was seen in 62 limbs (34 right & 28 left). Rest of the seven limbs showed one of the following three types of variations in the type of terminal branches. It bifurcated either as ulnar and ulnar recurrent arteries (Fig. 2) or as ulnar and radial recurrent arteries (Fig. 3) or as ulnar artery and communicating branch (Fig. 4).

Brachial artery trifurcation was observed in 25 limbs (26.3%). Out of these, in 24 limbs (96%) the third artery was noted to be radial recurrent artery (Fig. 5). Only in 1 limb brachial artery trifurcated into radial, ulnar and ulnar recurrent branches (Fig. 6). In 1 left side limb, brachial artery terminated by dividing into 5 terminal branches i.e., radial, ulnar, radial recurrent and two muscular branches to pronator teres and brachioradialis (Fig. 7).

No significant association (P=0.620) was observed between the types of terminal branches and the sides (Table 6). But a statistically significant association (P=0.022) was observed between the types of terminal branches and the different groups of level of termination (Table 7). Next the level of termination between two of the commonest types of terminal branches i.e., brachial artery bifurcating into radial and ulnar arteries and brachial artery trifurcating into radial, ulnar and radial recurrent branches were compared. The difference in the mean level of termination (in cms) between the two types of terminal branches was found to be statistically significant ($P<0.001$) with brachial artery bifurcating at a proximal level when compared to trifurcation of brachial artery, which occurred more distally (as measured from ICL) (Table 8). But the classic textbook description of brachial artery bifurcating into radial and ulnar arteries, 1 cm distal to elbow joint (ICL) was observed only in 2 limbs belonging to right side (2.10%).

IV. Discussion

Except for case reports, there are no available data in the literature regarding level of termination of brachial artery and its terminal branches in large sample studies. Hence we could not do a statistical comparison of our data with that of other studies. Also review of literature was not very clear due to use of different terminologies and also due to usage of different criteria for classification and sub classification of variations in arterial pattern of upper limb. Some authors have applied a topographical criterion that names the arteries regionally. Thus, a second artery in the arm was termed the brachialis superficialis, but once it crossed the elbow, it was re-named based on its course; either radial, ulnar, superficial ulnar or interosseous [7]. In 2001 a study was done on 192 cadavers (384 limbs) regarding classification of arterial variations and unifying the terminology of morphological variations [8]. But this study has not reported variations regarding level of termination or terminal branches of brachial artery.

To explain the existence of arterial variations in the upper limb of the adult, several hypotheses have been advanced based on findings from adult corpses, taking into account that these variations represent a transitory embryonic stage [7].

4.1 Embryological background

According to recent embryological anatomical studies, the arteries of the upper limb originate from an initial capillary plexus in a proximal to distal differentiation and this is a result of the maintenance, enlargement and differentiation of certain capillary vessels and the regression of others. This maturation process starts from the aorta at embryonic stage 13 (4-6 mm; 28d), and by embryonic stage 18 (13-17 mm; 44d) it has reached the forearm arteries, except the distal part of the radial artery [9].

On each side the seventh cervical intersegmental artery becomes enlarged to form the axial artery of the upper extremity. The proximal portion of the axial artery, beyond the lateral border of the teres major tendon, can be recognized as the brachial artery while the distal portion, beyond the cubital fossa, is the interosseous artery. Both the radial and ulnar arteries arise comparatively late in development as new vessels off the brachial and interosseous arteries, respectively. As these new vessels arise, the interosseous artery becomes reduced in size. The radial artery originates embryologically as a branch of the brachial artery in the arm. As it crosses the elbow joint, the radial artery establishes a connection with the main trunk of the brachial artery at or near the side of the origin of ulnar artery. Later, the part in the arm disappears to a large extent, resulting in one main artery running along the flexor aspect of the limb [10].

Thus, brachial artery with its two terminal branches eventually acquires their final form. Therefore, it seems likely that all variant forms of brachial artery can be either attributed to the genetic racial factor or to the derangement in the development of the primordial arterial axis of the upper limb occurring during conception [11]. Causes of arterial variations include local factors, such as the position of the fetus in utero, early movements of the limbs, and unusual muscular development. Because blood vessels develop through hemodynamic selection within a vascular network, anomalies may result from the persistence of channels that normally disappear or from the disappearance of normally persisting vessels. Also, genetic factors at the time of angiogenesis are probable contributory causes. As a consequence of this complex and dynamic process, it is not surprising that vascular anomalies are frequent [12].

4.2 Trifurcation

In the present study, trifurcation of brachial artery was observed in 26.3% of limbs. In 96% of these limbs, brachial artery trifurcated into radial, ulnar and radial recurrent branches whereas in only one limb (4%) it trifurcated into radial, ulnar and ulnar recurrent branches. Ulnar recurrent artery is a rarer terminal branch when compared to radial recurrent artery. It was also noted that trifurcation occurred more distally when compared to bifurcation (Table 8). This could be explained on the following embryological basis. Normally radial artery branches out from the brachial artery in the arm. Later in the cubital fossa it gets reconnected to brachial artery and the proximal segment of radial artery disappears. If this reconnection happens distally, then it can happen in the region where radial artery is giving radial recurrent branch. This results in brachial artery trifurcating into radial, ulnar and radial recurrent branches. Also brachial artery with a low termination can have a higher risk of injury during procedures involving elbow joint.

A study done on 60 upper limbs showed trifurcation of brachial artery in 2 left upper limbs (3.3%). In both the limbs, brachial arteries were terminating in the cubital fossa into radial, ulnar and radial recurrent arteries [13]. Another study reported trifurcation of brachial artery in the right upper limb of 50 years old male cadaver. In this the brachial artery was terminating in the cubital fossa into radial, ulnar and radial recurrent branches [14].

A case of anomalous branching pattern of the brachial artery on the left side of a 42 year male cadaver has been reported. The brachial artery divided into radial, ulnar and superior ulnar collateral arteries at a distance of 6 cm higher than its usual site of division (i.e., 6 cm above the neck of the radius). Also an abnormal communication existed between the radial and the ulnar arteries at the level of the cubital fossa and the tendon of biceps brachii muscle crossed this communication. The reasons for the presence of anastomosis behind the tendon of biceps may be explained by the fact that there may have been an arterial ring network around the bicipital tendon during embryological development [15].

4.3 Bifurcation

In the present study, variation in type of terminal branches in case of bifurcation of brachial artery is noted in 7 out of 69 limbs (10.1%). All these cases are associated with high origin of radial artery. So, in all these cases, radial artery is not one of the terminal branches. This becomes important because, the anatomic variations of the radial artery have great impact while harvesting for coronary bypass graft surgeries, as they are most commonly used. In the present study brachial artery is bifurcating either into ulnar and one of the recurrent branches or into ulnar and a communicating branch. But most of the other studies have reported radial or ulnar and common interosseous arteries. But one has to keep in mind that these are all case reports and not large sample studies.

A unilateral case of superficial ulnar artery (SUA) originating from right axillary artery has been reported in a 75 year old white male cadaver. In this case the brachial artery divided into radial and common interosseous arteries in the cubital fossa. The normal ulnar artery was absent [16].

High origin of ulnar artery was found in the right upper limb of a 50-year-old male cadaver. The brachial artery divided at the elbow level into radial and common interosseous arteries. When an SUA is present, the brachial artery commonly terminates as the radial and common interosseous artery [17].

In another study, it was noted that the ulnar artery was arising from the medial side of the upper one-third of the left brachial artery. The brachial artery divided into radial and common interosseous arteries at the cubital fossa [18].

A very rare case of absence of radial artery in the right upper limb of a south Indian female cadaver has been reported. In the lower part of the arm, brachial artery divided into ulnar and common interosseous artery [4].

Another study reported variations in the upper limb of a male cadaver of 55 years of age. On the left side there was a high origin of radial artery from the 2nd part of axillary artery, which had bifurcated into radial and brachio-ulnar trunk in the axilla it self. In cubital fossa the brachio-ulnar artery gave common interosseous branch and ulnar artery at the level of neck of radius [19].

4.4 Anastomotic Artery

An anastomotic vessel may exist in the region of the cubital fossa, connecting the radial artery with the brachial artery or more rarely with the median artery. The incidence of this variation ranges from 18.67% to 50% [2].

In the present study, anastomotic artery (communicating branch) as one of the terminal branches of brachial artery was noted in 3 out of 95 limbs (3.15%). All these cases had an associated high origin of radial artery and the anastomotic artery joined this radial artery. Embryological basis of this could be explained as follows - non disappearance of proximal segment of radial artery i.e., the initial part of radial artery arising from the brachial artery in the arm, and also, retention of communication between the radial and brachial arteries in the cubital fossa.

Another study has reported an anastomosis joining the brachial and brachioradial artery at the elbow in 3 of the 21 cases (14±3%) which is a higher incidence when compared to the present study [20].

4.5 Muscular branch

In the present study, muscular branches were noted in one left upper limb where brachial artery terminated into 5 branches i.e., radial, ulnar, radial recurrent and 2 muscular branches, one to pronator teres and the other to brachioradialis. Another study reported trifurcation of the right side brachial artery in a 70 year old Turkish female cadaver. It was noted that brachial artery terminated into radial, ulnar and a muscular branch at the proximal $1/3^{rd}$ of the humerus. Muscular branch supplied brachialis and biceps brachii muscles [21]. The muscular branches vary in the two studies because of variation in the level of termination.

4.6 Clinical Significance

Even though angiographic studies can easily diagnose arterial variations, every patient admitted for emergency upper limb surgeries in the region of brachial artery cannot be subjected to CT angiography.

Secondly, it is not a cost effective procedure to be applied to all patients especially in the developing countries. Also availability of angiography facilities itself is questionable in the rural areas. So surgeons involved in vascular or reconstructive surgeries should be aware of the arterial variations in the region before embarking on the procedure. Hence the authors opine that the findings of the present study have a great clinical relevance.

V. Conclusion

Since ischemia of the upper extremity accounts for approximately 4% of all vascular procedures, knowledge regarding any type of arterial variations is crucial [22]. Hence the findings reported in the present study become highly relevant in adding to the literature. Also, the authors faced a lot of terminology problem while reviewing the literature because a number of studies have used different terms while referring to same variations. Hence it is very important for all anatomists and clinicians to use universally accepted terminology while reporting cases or studies.

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References

[1] Ahmet Uzun, Leonard L Seelig Jr. The anastomotic artery connecting the axillary or brachial artery to one of the forearm arteries. *Folia Morphol. 59(3).* 2000. 217-220.

[2] Konstantinos Natsis, Anastásia L. Papadopoulou, Efthymia Papathanasiou, George Noussios, George Paraskevas, Nikolaos Lazaridis. Study of two cases of high-origin radial artery in humans. *Eur J Anat. 13 (2)*. 2009. 97-103.

[3] Susan Standring. *Gray's Anatomy* (London, Elsevier Churchill Livingstone Publishers, 2008) 856.

[4] Suganthy J., Koshy S., Indrasingh I., and Vettivel S. A Very Rare Absence of Radial Artery : A Case Report. *J Anat. Soc. India. 51(1)*. 2002. 61-64.

[5] Jasna Malcic-Gu¨rbu¨Z, Raffi Gu¨ru¨Nlu¨Og˘lu, O¨mer O¨zdog˘Mus , and Aymelek Yalin. Unique Case of Trifurcation of the Brachial Artery: Its Clinical Significance. *Clinical Anatomy. 15*. 2002. 224–227.

[6] G J Romanes. *Cunningham's manual of practical Anatomy* (New York, Oxford University Press, 2005) 67-71

[7] M. Rodríguez-Niedenführ, T. Vázquez, I.G. Parkin and J.R. Sañudo. Arterial patterns of the human upper limb: update of anatomical variations and embryological development. *Eur J Anat. 7(1)*. 2003. 21-28.

[8] M. Rodriguez-Niedenfuhr, T. Vazquez, L. Nearn B. Ferreira, I. Parkin and J. R. Sanudo. Variations in the arterial pattern in the upper limb revisited- a morphological and statistical study, with a review of the literature. *J. Anat. 199*. 2001. 547-566.

[9] Konstantinos Natsis, Anastásia L. Papadopoulou, Efthymia Papathanasiou, George Noussios, George Paraskevas, Nikolaos Lazaridis. Study of two cases of high-origin radial artery in humans. *Eur J Anat. 13 (2)*. 2009. 97-103.

[10] Ahmet Uzun, Leonard L Seelig Jr. The anastomotic artery connecting the axillary or brachial artery to one of the forearm arteries. *Folia Morphol. 59 (3)*. 2000. 217-220.

[11] Adib A. Aughsteen, Hasan M. Hawamdeh, Muzahim Al-Khayat. Bilateral variations in the branching pattern of brachial artery. *International Journal of Anatomical Variations. 4*. 2011. 167–170.

[12] Jasna Malcic-Gu¨ Rbu¨ Z, Raffi Gu¨ Ru¨ Nlu¨Og˘ Lu, O ¨ Mer O ¨ Zdog˘ Mus¸ and Aymelek Yalin. Unique Case of Trifurcation of the Brachial Artery: Its Clinical Significance. *Clinical Anatomy. 15*. 2002. 224–227.

[13] Vandana R, N M Suresh, Lakshmi Prabha R, Veena Pai. Variation in course and branching pattern of brachial artery. *Anatomica Karnataka. 6 (3)*. 2012. 42-48.

[14] Patnaik V V G, Kalse G, Sigla R K. Trifurcation of brachial artery – a case report. *Journal of Anatomical Society of India. 50 (2)*. 2001. 163-165.

[15] Srijit Das, Shashi Singh, Shipra Paul. Double Profunda Brachii and abnormal branching pattern of Brachial artery. *TMJ. 55(2)*. 2005. 159-161.

[16] K. Natsis, A.L. Papadopoulou, G. Paraskevas, T. Totlis, P. Tsikaras. High origin of a superficial ulnar artery arising from the axillary artery: anatomy, embryology, clinical significance and a review of the literature. *Folia Morphol. 65 (4)*. 2006. 400–405.

[17] Venkata Ramana Vollala, Raghu Jetti, Simmi Soni. High Origin of An Ulnar Artery–Development and Surgical Significance. *Chang Gung Med J. 34 (6)*. 2011. 39-42.

[18] Kithsiri J Senanayake, Sujatha Salgado, Manjula J Rathnayake, Ranil Fernando and Kosala Somarathne. A rare variant of the superficial ulnar artery, and its clinical implications: a case report. *Journal of Medical Case Reports. 1*. 2007. 128.

[19] J E Waghmare, A M Tarnekar, B R Sonatakke, P Bokariya and I V Ingole. A high origin of radial artery with asymmetrical vasculature of upper limbs: a case report. *Nepal Med Coll J. 11 (4)*. 2009. 284-286.

[20] M. Rodriguez-Niedenfuhr, G. J. Burton, J. Deu and J. R. Sannudo. Development of the arterial pattern in the upper limb of staged human embryos: normal development and anatomic variations. *J. Anat. 199*. 2001. 407- 417.

[21] Bulent Yalcin, Necdet Kocabiyik, Fatih Yazar, Yalcin Kirci and Hasan Ozan. Arterial variations of the upper extremities. *Anatomical Science International. 81*. 2006. 62-64.

[22] Salvatore Docimo Jr, Dellene E Kornitsky, Robert V Hill and David E Elkowitz. Arterio-arterial malformation between a high origin radial artery and brachial artery within the cubital fossa – its clinical and embryological significance: a case report. *Cases Journal. 2*. 2009. 6836.

Tables

Table 1: Classification of level of termination across each side

Classification of level of termination	Left Side		Right Side		Total	χ^2	P-Value
	n	%	n	%			
At 0 cms	0	0%	2	100%	2	5.615	0.230
≤2.4 cms	2	25%	6	75%	8		
2.5 to 3.4 cms	17	59%	12	41%	29		
3.5 to 4.4 cms	20	48%	22	52%	42		
≥4.5 cms	5	36%	9	64%	14		

Table 2: Correlation between arm length and level of termination (Spearman's Rank Correlation)

Side	ρ	P-Value
Both Sides	0.221	0.031*
Left Side	0.276	0.070
Right Side	0.211	0.137

*denotes significant correlation

Table 3: Number of terminal branches on the two sides

Side	Bifurcation		Trifurcation		Total	χ^2	P-Value
	n	%	n	%			
Left	31	70%	13	30%	44	0.195	0.658
Right	38	75%	13	25%	51		

Table 4: Comparison of arm length between the no. of terminal branches

No. of Terminal Branches	n	Mean	Std dev	SE of Mean	Mean difference	Z	P-Value
Bifurcation	69	30.87	2.08	0.25	0.104	-0.252	0.801
Trifurcation	26	30.77	2.14	0.42			

Table 5: Correlation between arm length and No. of terminal branches (Spearman's Rank Correlation)

Side	ρ	P-Value
Both Sides	-0.026	0.802
Left Side	0.048	0.759
Right Side	-0.060	0.675

Table 6: Distribution of type of terminal branches on each side

Type of branch	Left Side		Right Side		Total	χ^2	P-Value
	N	%	n	%			
R+U	28	45%	34	55%	62	4.422	0.620
U+UR	0	0%	2	100%	2		
U+RR	1	50%	1	50%	2		
U+C	2	67%	1	33%	3		
R+U+RR	12	50%	12	50%	24		
R+U+UR	0	0%	1	100%	1		
Five Branch Termination	1	100%	0	0%	1		

Abbreviations: R – Radial, U – Ulnar, UR – Ulnar Recurrent, RR – Radial Recurrent and C – Communicating Branch

Table 7: Type of terminal branches across classification of level of termination

Type of branch	At 0 cms		≤2.4 cms		2.5 to 3.4 cms		3.5 to 4.4 cms		≥4.5 cms		Total	χ^2	P-Value
	n	%	n	%	n	%	n	%	n	%			
R+U	2	3%	7	11%	24	39%	26	42%	3	5%	62	39.974	0.022*
U+UR	0	0%	0	0%	0	0%	0	0%	2	100%	2		
U+RR	0	0%	0	0%	1	50%	1	50%	0	0%	2		
U+C	0	0%	1	33%	1	33%	1	33%	0	0%	3		
R+U+RR	0	0%	0	0%	3	13%	13	54%	8	33%	24		
R+U+UR	0	0%	0	0%	0	0%	1	100%	0	0%	1		
Five Branch Termination	0	0%	0	0%	0	0%	0	0%	1	100%	1		

*denotes significant difference

Abbreviations: R – Radial, U – Ulnar, UR – Ulnar Recurrent, RR – Radial Recurrent and C – Communicating Branch

Table 8: Comparison of level of termination (cms) between two types of terminal branches

Type of Branch	n	Mean	Std dev	SE of Mean	Mean difference	Z	P-Value
R+U	62	3.21	0.99	0.13	-0.959	-4.118	<0.001*
R+U+RR	24	4.17	0.72	0.15			

*denotes significant difference
Abbreviations: R – Radial, U – Ulnar and RR – Radial Recurrent

Figures

Figure 1: Brachial artery (BA) bifurcating into radial (RA) and ulnar (UA) arteries at the intercondylar line (0cms).

Figure 2: Brachial artery (BA) bifurcating into ulnar (UA) and ulnar recurrent (UR) arteries.
HORA – high origin of radial artery, RR- radial recurrent artery

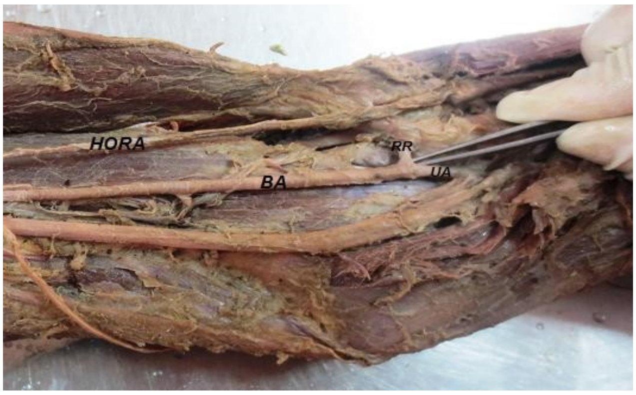

Figure 3: Brachial artery (BA) bifurcating into ulnar (UA) and radial recurrent (RR) arteries.
HORA – high origin of radial artery

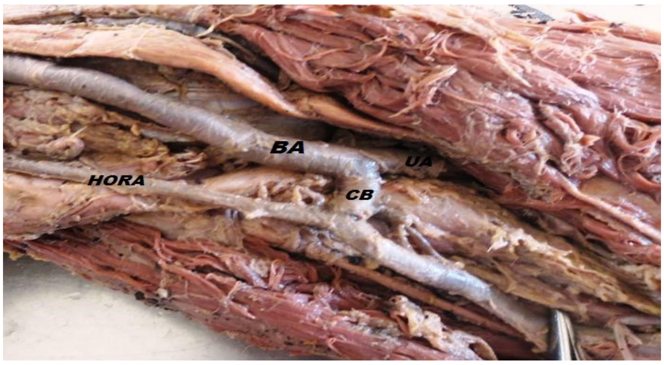

Figure 4: Brachial artery (BA) bifurcating into ulnar artery (UA) and communicating branch (CB)
HORA – high origin of radial artery

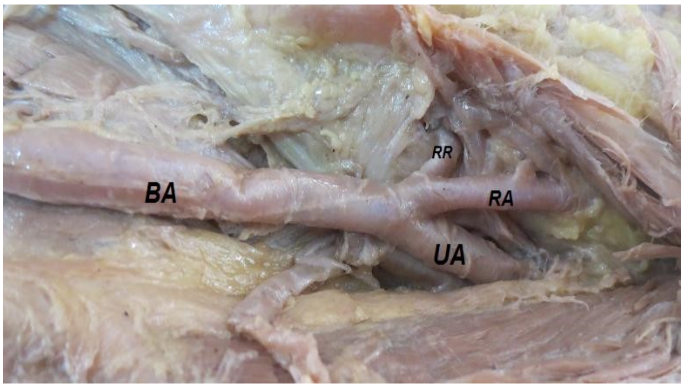

Figure 5: Brachial artery (BA) trifurcating into radial (RA), ulnar (UA) and radial recurrent (RR) arteries.

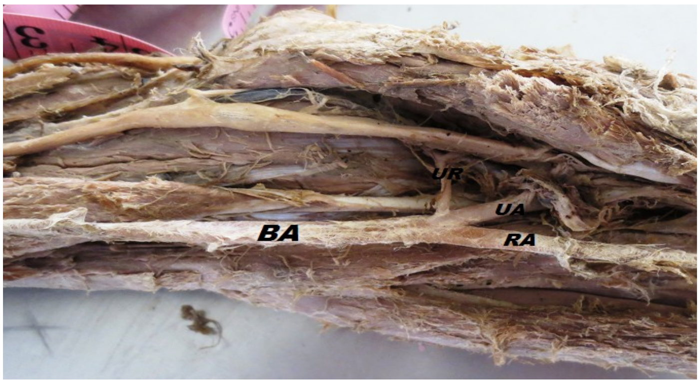

Figure 6: Brachial artery (BA) trifurcating into radial (RA), ulnar (UA) and ulnar recurrent (UR) arteries.

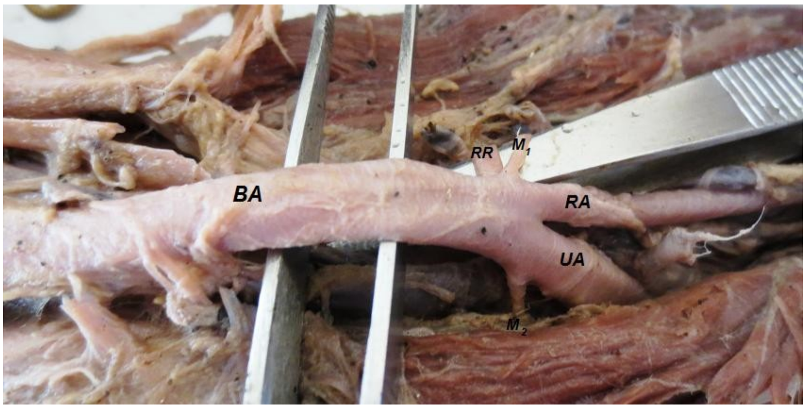

Figure 7: Brachial artery (BA) terminating into 5 branches – ulnar (UA), radial (RA) and radial recurrent (RR) arteries and two muscular branches (M_1, M_2).