

# Variation in Branching Pattern and Length of Brachial Artery among Black African Population

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## Abstract:-

**Background:** As the main arterial supply of the upper limb, the normal documented branching pattern of brachial artery is by bifurcation of its terminal branches into radial and ulnar arteries, but due to variations in studies done, two patterns have been identified i.e., bifurcation and trifurcation though there is paucity data in black African population. The length of brachial artery also varies in majority of studies done.

**Objective:** The purpose of this study was to evaluate the branching pattern and length of brachial artery as brachial artery is of clinical importance in majority of clinical procedures of the upper arm like blood pressure monitoring and various surgical therapeutic procedures.

**Methodology:** The study was carried out in Maseno, Uzima and Masinde muliro universities human anatomy laboratories where 154 upper limb specimens of 77 cadavers were used. A Cross sectional descriptive study design with stratified sampling method were adopted in the study. Data was recorded in data entry form and later analyzed using SPSS version 26.0.

**Results:** Out of 154 upper limbs 93.5% had normal bifurcation into radial and ulnar arteries, 4(2.4%) showed high bifurcation of brachial artery into ulnar and radial arteries, 6(4.1%) had trifurcation into radial ulnar and common interosseous arteries. Mean length of brachial artery was 26.0cm. There was no statistically significant difference in variation ( $p=0.333$  and  $0.564$ ) when correlated with the normal branching pattern.

**Conclusion:** Knowledge regarding the known normal anatomy and variant arterial anatomy of the upper limb, has significant importance, it can guide vascular radiologist, surgeons, and clinicians for accurate diagnostic interpretation as well as in the conduct of interventional and surgical procedures of upper limb. Thus, knowledge on variant anatomy in branching pattern and length of brachial artery is important for clinicians when performing invasive and other clinical procedures to avoid misdiagnosis and surgical related complications, thus each patient should be treated uniquely due to such anatomical variations.

**Keywords:-** Brachial Artery, Ulnar Artery, Radial Artery, Trifurcation, Bifurcation

## I. INTRODUCTION

The normal documented branching pattern of brachial artery (BA) is by bifurcation of its terminal branches into radial and ulnar arteries, but due to variations in studies done two patterns have been identified i.e. bifurcation and trifurcation (1). As the main arterial supply of the upper limb, There was insufficient knowledge of variations in the anatomy of branching pattern and length of brachial artery especially among black African population and due to these variations clinicians may find it difficult to locate BA pulse or blood pressure monitoring. BA is of great significance due to the clinical procedures performed in the upper arm. Locally brachium is the most commonly used part up to the peripheral facility, in blood pressure monitoring, blood sample collection for investigations and cannulation to administer intravenous drugs. Brachial blood pressure and pulse results can differ during monitoring of patients due to these variations. This can lead to misdiagnosis of patients due to either absent, abnormal pulse or inability to locate the brachial artery.

Studies have shown most common site for embolism is at bifurcation of brachial artery and higher bifurcation may lead to large ischemic area thus being fatal (2). Study conducted on 15 cadavers found out in one case (3.3%) trifurcation of brachial artery into radial, ulnar and common interosseous at the level of the neck of radius (3). To understand variations in brachial artery many authors divide it into three phases, upper 1/3, and middle 1/3 and lower 1/3. Study conducted 45 upper limb cadavers found out bifurcation of BA into ulnar and radial arteries both of equal caliber at the junction between middle 1/3 and lower 1/3 of the arm (4) Because of its clinical importance, knowledge on BA variation is important to health care professionals, specifically surgeons, and radiologists including anatomists as the brachial artery is used in various diagnostic procedures. Thus, the study sought to evaluate variations in branching pattern and length of brachial artery among black African population.

## II. MATERIALS AND METHODS

The study was carried out in three human anatomy laboratories in western Kenya namely, Maseno, Masinde Muliro and Uzima universities used by undergraduate and postgraduate medical students during their routine dissection. A Cross-sectional descriptive study design and stratified sampling method was used to allocate cadavers from the three universities. Sample size of 77 cadavers (39 males and 38 females) were used in the study. Only cadavers with bilateral intact upper limbs with no deformities were picked while those of non-African origin, missing or deformed limbs were excluded. To expose the brachial artery, an incision was made along the brachium region as set in Cunninghams manual for dissection, skin and superficial fasciae were reflected and deep fasciae dissected, biceps brachii identified, brachial artery was exposed from point of origin to the point of termination and cleaned, its branches and lengths were identified and evaluated,

Photomicrographs were taken for any variation noted. Data entry forms were used to collect data, data was entered into SPSS version 26.0 for analysis. Variation in branching patterns and length of brachial artery, were studied and analyzed. Ethical approval was sought from Maseno university ethical and research committee (MSU/DRPI/MUSERC/01140/22) and National commission of science technology and innovations (NACOSTI/P/23/22873).

## III. RESULTS

### A. Branching patterns of brachial artery

A total of 154 cases were included in the study. The most common branching pattern observed was bifurcation into radial and ulnar arteries seen in 144 upper limbs (93.5%). High bifurcation of the radial and ulnar arteries was seen in 4 cases (2.4%). Trifurcation into radial, ulnar, and interosseous artery was seen in 6 cases (4.1%) (Table1).

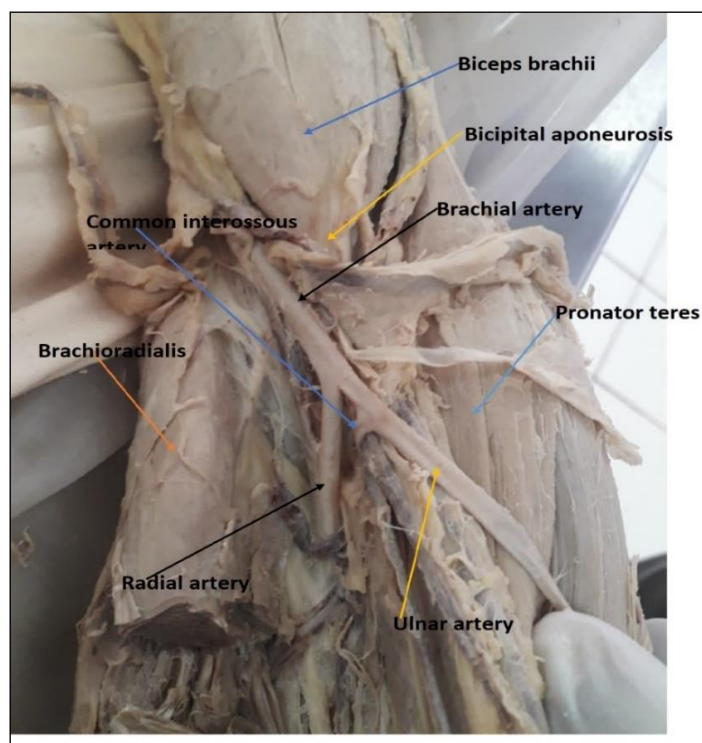


Fig 1 Bifurcation of brachial artery into radial and ulnar artery, Common interosseous originating from ulnar artery.

**Table:1. Branching patterns of brachial artery**

Branching patterns of upper limbs	n	%	Valid Percent
Bifurcation into radial and ulnar arteries.	144	93.5	93.5
High bifurcation- radial and ulnar arteries	4	2.4	2.4
Trifurcation into radial, ulnar and interosseous artery.	6	4.1	4.1
Total	154	100.0	100.0

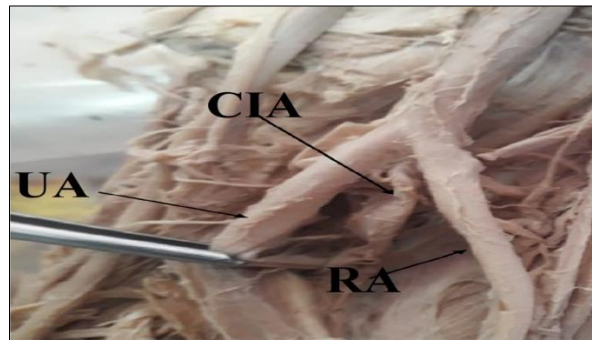


Fig 2 Trifurcation of BA into ulnar, radial and common interosseous artery  
**KEY:BA-Brachial artery; A- Ulnar artery; RA-Radial artery; CIA-Common interosseous artery.**

*B. Relations between normal and variant branching pattern*

Data from 154 upper limbs of 77 cadavers, found no statistically significant difference variation ( $p > 0.333$  and  $0.564$ ) in the branches of brachial artery when correlated with the normal branching patterns

**Table 2: Relations between the normal branching and variations in the branching patterns of brachial artery**

Pearson Chi-Square Tests		
BRANCHING RIGHT	Chi-square	SEX. 6.875
	df	6
	P value	0.333
BRANCHING LEFT	Chi-square	1.145
	df	2
	P value	0.564

Cross tabulation of variation in branching pattern left and right.

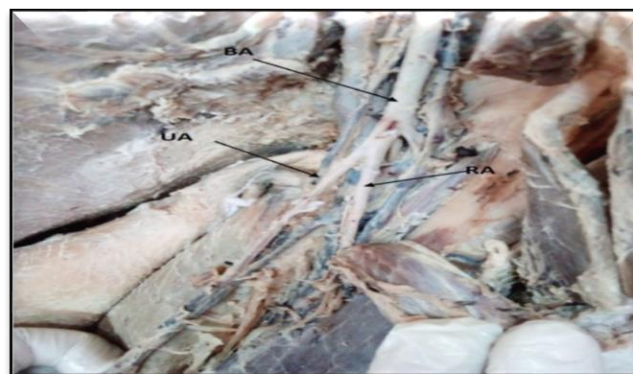


Fig 3 High bifurcation of brachial artery.

**Key; BA-Brachial artery; UA-Ulnar artery; RA-Radial artery.**

*C. Variation in the length of the brachial artery*

The data includes measurements from 154 upper limbs of 77 cadavers, with a mean length of 26cm, median length of 26cm, and a standard deviation of 1.0 The minimum observed length was 16cm, while the maximum observed length was 30cm. These statistics suggest that the length of the brachial artery in upper limbs is relatively consistent, with little variability between measurements.

**Table 3: Length of brachial artery in all upper limbs.**

Total upper limbs	Mean	Median	Standard deviation	Minimum	Maximum
Length	26	26	1	16	30

#### IV. DISCUSSION

##### A. Branching pattern of brachial artery

The standard documented branching pattern of brachial artery in anatomy text books is its bifurcation into radial and ulnar arteries(5). The current study established two varying branching patterns i.e., High bifurcation into radial and ulnar artery at 2.4%, and trifurcation into radial, ulnar and common interosseous arteries at 4.1% (Table 4.1). This concurs with (6)study conducted on 50 upper limb specimens in India, which observed 2% of high bifurcation of brachial artery in the proximal<sup>1/3</sup> of the arm. In another study involving 50 upper limb specimens, high bifurcation of brachial artery into ulnar and radial artery was reported (7). The incidence of variations in branching patterns observed in the present study is in line with findings from several authors from the previous literature (8–12).

The current study, observed 6 (4.1%) incidences of trifurcation of brachial artery into ulnar, radial and common interosseous arteries. This was at the usual neck of radius in the total sampled upper limbs. This finding agrees with (13)who reported the incidence of 4.0% in the total 50 upper limbs. However, (14)reported a higher incidence trifurcation of brachial artery(26.3%) among 95 upper limbs in Indian population. This high incidence might have been possible because he included unique branching patterns such trifurcation of brachial artery into radial, ulnar and radial recurrent arteries and radial, ulnar and ulnar recurrent arteries. Another study by (15)reported trifurcation of brachial artery into radial, ulnar and common interosseous artery concurring with the current study in terms of pattern of trifurcation. However(16) case report observed trifurcation of brachial artery into radial ulnar and radial recurrent arteries, unlike the current study where brachial artery trifurcated into radial, ulnar and common interosseous arteries.

A case report by (17)observed a unique and rare case of trifurcation of brachial artery into radial, ulnar and superior ulnar collateral arteries, case which was not observed in the current study. In another study by (18) reported trifurcation of superficial brachial artery into radial common interosseous and ulnar artery which concurs with the current study. However,(6) observed trifurcation of brachial artery(10%) into radial, ulnar and radial recurrent artery higher than the current study which had brachial artery trifurcating into radial, ulnar and common interosseous arteries, branching pattern of arteries vary, these variations are thought to be as a result of aberrant developmental events, it may be due to incomplete development of the vessels, abnormal persistence or disappearance of vessels, fusion and absorption of the usually distinct parts and unusual paths formation in the primitive plexus, best explained by choice of unusual paths in the development of primitive vascular plexus(19)

##### B. Mean length of brachial artery

In the current study, out of the 154 cadaveric upper limb specimens, the mean length of brachial artery was 26.0cm,(Table 4.8).These concurs with a study done in India on 50 upper limbs by (20)who reported the mean length of brachial artery to be 26.29cm. However, study done on 50 upper limb specimens by (21)in Kuwait observed lower mean length of brachial artery (22.5cm) in comparison to the current study.

Other authors who reported lower mean length than the current study include(22–24),the mean length of brachial artery in their studies were 22.65cm, 24.56cm and 21.5cm respectively. A higher mean length was noted by (14)reported mean length of brachial artery be 30.82cm, the difference the in mean length may be attributed to geographical location, genetic and racial factors of an individual.

#### V. CONCLUSION AND RECOMMENDATION

There were considerable variations in mean length and branching pattern of brachial artery among the study population, however, the variation from the normal morphology was not statistically significant. Knowledge about variations in brachial artery and its branching pattern is important to Anatomist, surgeons, radiologists, cardiothoracic and vascular surgeons, due to variant patterns observed thus each individual should be treated as a special case to avert complications and mismanagement of patients.

Further population specific studies should be carried out especially on racial differences among Caucasians, blacks and Asians to guide in the developmental variations.

#### DECLARATIONS

**Source of funding:** The study did not receive any source of funding from any organization.

**Conflict of interest:** The authors of this study declare no conflict of interest.

**Consent:** for publications: All authors of this study declare no conflict of interest

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