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Anatomical variation of high brachial artery bifurcation: A case report

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ABSTRACT

INTRODUCTION: Anatomical variation of high brachial artery bifurcation and these morphological variations of the brachial artery should be considered by surgeons when performing procedures in the brachial artery area.

CASE: The left anterior arm and anterior forearm regions of a thirty-three-year-old cadaver was dissected. The origin, course, and terminal branches of the Brachial artery were traced. It was then observed that the Brachial artery bifurcation was in the upper third of the humerus instead of the cubital fossa.

CONCLUSION: Brachial artery and its terminal branch variations are less common. However Brachial artery could be bifurcated and then reunite. In this case, the brachial artery presented bifurcation one laterally and another one medially with the median nerve running between them. Both branches don't reunite but continue laterally and medially, respectively.

Keywords: Bifurcation, Brachial artery, Ulnar artery, Radial artery

INTRODUCTION

The brachial artery is the main artery of the arm which terminates by bifurcating into radial and ulnar arteries in the cubital fossa [1,2]. This artery is the continuation of the axillary artery as it passes at the inferior border of the teres major muscle [3]. In its course, the brachial artery gives off the nutrient artery of the humerus and muscular branches [4], it also has other branches, including the deep brachial artery, the superior ulnar collateral artery, and the inferior ulnar collateral artery. The deep brachial artery originates from the back of the brachial artery, continuing downward and passing the radial humeral groove along the radial nerve; it supplies blood to the triceps and branches into radial collateral and middle collateral arteries, which are involved in forming the anastomosis around the elbow joint [5]. The superior ulnar collateral artery originates from the middle of the arm and goes to the posterior aspect of the medial epicondyle together with the ulnar nerve, which also anastomoses in the arterial network of the elbow. The inferior ulnar collateral branch begins above the elbow, then goes medially to the medial epicondyle and is part of the arterial anastomosis

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of the elbow joint [6]. The brachial artery is widely applied in many medical interventions, such as approach for coronary, and endovascular procedures, peripheral vascular procedures, and vascular shunt for hemodialysis [7].

The brachial artery is easily accessible as it is covered by skin and superficial and deep fasciae. Anteriorly, the bicipital aponeurosis crosses it at the elbow, separating it from the median antecubital vein. The median nerve crosses in front of the artery from the lateral to the medial side near the middle of the arm at the distal attachment of coracobrachialis [8]. Brachial artery pulse is easily detectable at the middle third of the arm on the brachial artery; therefore, this point allows to perform blood pressure measurement before bifurcating in radial and ulnar arteries [4]. Anatomical variations of the upper extremities' arterial system are quite common; however, the brachial artery and its terminal branch variations are less common [2].

CASE PRESENTATION

This case was identified during a structured dissection course for postgraduate students in the Anatomy laboratory School of Medicine and Pharmacy at the University of Rwanda. An embalmed 33-year-old male cadaver was dissected following the steps outlined in the Grant dissector handbook of Sauerland [14]. The skin was carefully removed at the left anterior arm region, starting with the longitudinal incision from the acromion process downward up to the upper one-third of the anterior forearm. Then the subcutaneous tissues were removed while carefully assessing the nerves, muscles, and blood vessels. The muscles were reflected laterally and medially; then brachial artery was carefully traced for its origin, course, branching, and termination up to the cubital fossa. The brachial artery was observed to have bifurcation in the proximal one-third of the humerus by forming the medial and lateral branches (Figure 1).

The lateral branch continued passing laterally, and its course was lateral to the median nerve up to the cubital fossa, where it continued in the forearm, as shown in Figure 1. On the other hand, the medial branch continued its path on the medial side, medial to the median nerve up to the cubital fossa, and continued in the forearm, as Figure 1 shows.

To observe the courses and observe the sizes of both medial and lateral branches of the Brachial artery in the forearm, the skin of the anterior forearm was removed by making a longitudinal incision up to the distal part of the wrist joint reflected laterally and medially, then all subcutaneous

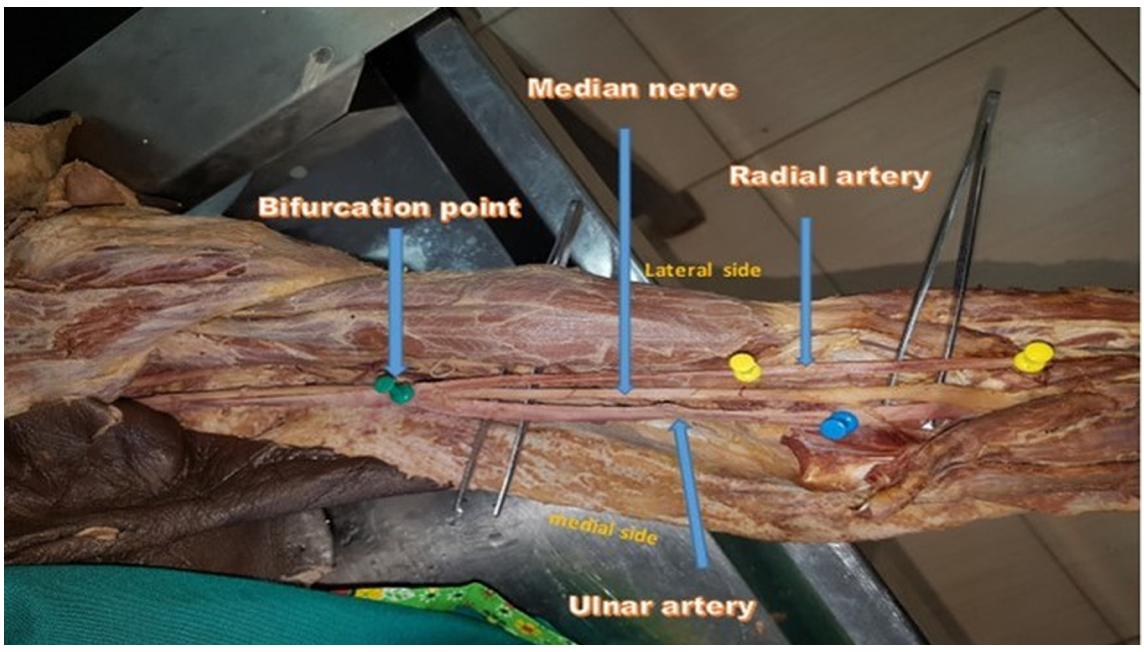

Figure 1: Bifurcation, radial artery, ulnar artery and median nerve positions

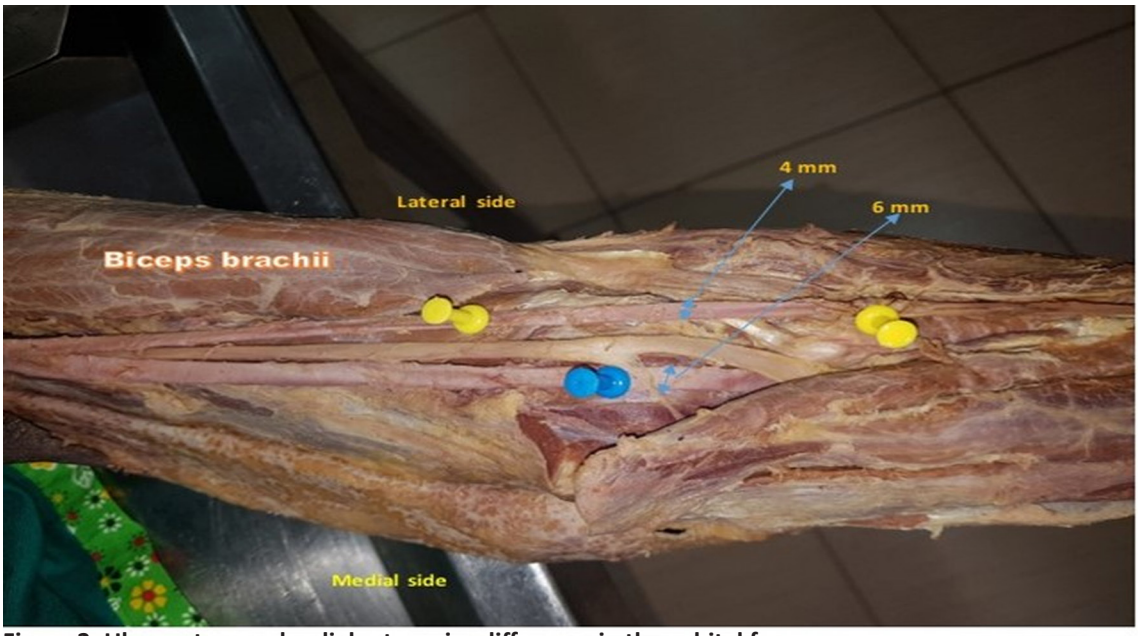

Figure 2: Ulnar artery and radial artery size difference in the cubital fossa

tissues were removed up to the muscles of the anterior (flexors) compartment of the forearm. And then, the superficial layer muscles (pronator teres and palmaris longus) and intermediate layer muscle (flexor digitorum superficialis) of the flexor compartment of the forearm were separated from their origin (medial epicondyle of the humerus) as shown in Figure 2 and reflected laterally to observe the course of the medial branch; it was observed that it continued the same path of the ulnar artery in close anatomic proximity to the ulnar nerve (directly lateral to the nerve) with both structures traveling on the lateral aspect of the flexor carpi ulnaris as shown in Figure 3.

On the other hand, the Brachioradialis muscle was reflected laterally to observe the course of the lateral branch, it was then observed that it followed the normal path of the radial artery in the forearm, as shown in Figure 1.

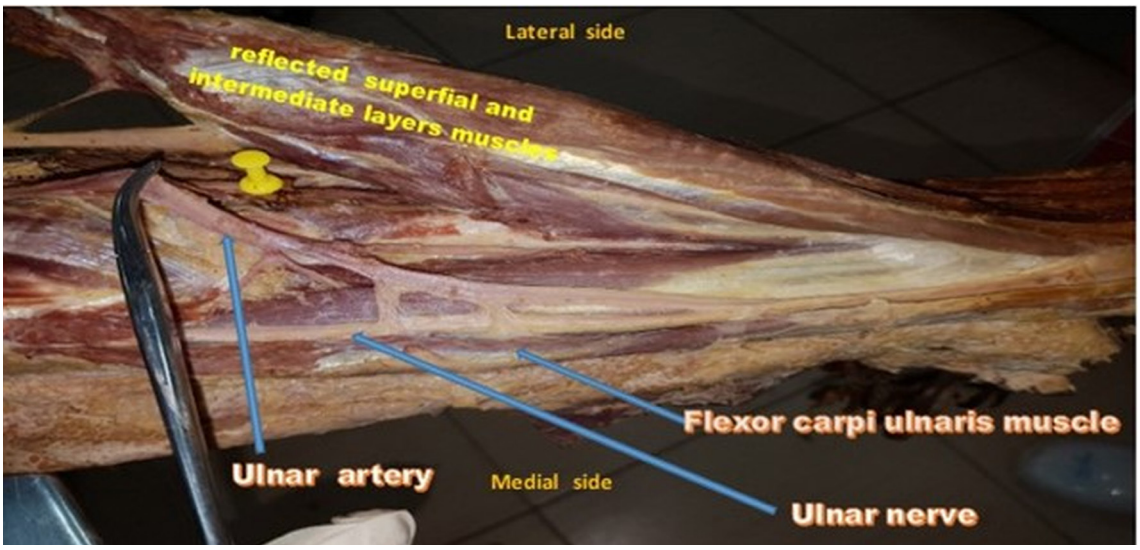

Figure 3: Branches of ulnar artery below the cubital fossa, superficial and intermediate layer mascles of the anteror compartment of the forearm reflected laterally

While assessing the size of both terminal branches of the brachial artery, it was found that the medial branch, which is the Ulnar artery was bigger compared to the lateral branch, which is the radial artery, with 6mm, and 4 mm in diameter respectively. Figure 2 illustrates the comparison clearly.

DISCUSSION

It was reported in São Paulo that the brachial artery was found bifurcating in the proximal portion of the middle third of the arm, forming a lateral and another medial branch; the only difference with the present case referred to in figure 1 is that the bifurcation was found to be in the proximal one third [9]. In India, 30 specimens were dissected, then it was reported that the brachial artery in the third middle part gives a branch. The accessory brachial artery was in one case (3.3%) among the 30 limbs, then trifurcation of the brachial artery was also seen in 1 case (3.3%) into Radial Artery, Ulnar Artery, Common interosseous Artery [10], which is different from the current case where the Brachial artery bifurcated in the proximal third of the arm.

Jacomo et al. in 2014 in São Paulo and Eyni in 2016 reported similar cases in which the Brachial artery bifurcation was observed in the proximal portion of the middle third of the arm, forming lateral and medial branches. The medial branch passed posterior to the median nerve, then headed medially and turned towards the lateral side in the distal third of the arm and crossed the median nerve to become the radial artery in the forearm. On the other hand, its lateral branch continued medially toward the brachial biceps muscle and, in the distal third of the arm, crossed posterior to the medial branch so that it headed toward the cubital fossa, where it formed the common interosseous artery and then continued as ulnar artery [11]. This is different from the present case, whereby the medial and lateral branches continued infero-medially and infero-laterally, respectively, as shown in Figures 1 and 3. In addition to that, in the current case, the median nerve runs merely in the middle of two brachial branches from the bifurcation point up to the cubital fossa.

According to Ashraf et al. [12], the diameter of the ulnar artery is larger than that of the radial artery, as it was reported in their study that the mean diameter of the left radial artery was 2.2 ± 0.4mm while the mean diameter the left ulnar artery was 2.3 ± 0.3mm, this is similar to the current report in terms of size comparison as the Ulnar artery is bigger than radial with 6mm and 4 mm respectively. On the other hand, the sizes of the ulnar and radial arteries are far larger than in the Tariq Ashraf et al. study.

We normally know that the two main branches of the Brachial artery in the cubital fossa are the Radial and Ulnar arteries. On the other hand, Jayasabarinathan et al., in 2013, stated that if those two branches originate in the arm should be named according to that area, then bear the name 'brachio' which corresponds to it. Therefore, radial and ulnar arteries originating in the arm should be named brachioradial and brachioulnar arteries, respectively. In that regard, the two branches observed in the present case as they originate from the arm position (Figure 1), the medial and lateral branches should bear the names brachioulnar and brachioradial arteries, respectively. Tsoucalas et al. [1] in 2020 reported that the brachial artery could be divided proximally into two trunks, which then reunite. However, in the current case, the Brachial artery divided but did not reunite distally, as shown in Figure 2 and 3.

CONCLUSION

Blood pressure is usually estimated by conventional measurements of brachial artery blood pressure [13]; in that regard, because of the Brachial artery variation; there will be errors in blood pressure results.

Also because of the unexpected position of radial and ulnar arteries, the clinicians may be confused during surgery or cannulation procedures. Brachial pulse may be weak or absent when checked, where it is usually palpated along the medial border of the Biceps Brachii.

When the brachial artery bifurcates higher, both its branches run more superficial and therefore get more vulnerable to injury and more likely to be mistaken for a vein. Therefore, intra-vascular injection into it can accidentally occur and cause gangrene, thrombosis, and even result in amputation of the fingers or the arm when it is very severe.

There are also some benefits to having superficial arteries because they can provide nourishment for skin grafts. The superficial radial artery is easily accessible for taking grafts which are largely used

for bypass graft surgery of the coronary artery. In that regard, clinicians should be aware of the variations to avoid any confusion during medical interventions.

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