

# Embryological Basis & Clinical Significance of Unilateral High Bifurcation of Brachial Artery: a Case Report

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## ABSTRACT

**Introduction:** the Brachial artery & its branches nourish the upper limb. It is the direct continuation of the axillary artery in the arm. It originates from the distal border of the teres major tendon & terminates 1cm distal to the elbow joint in the cubital fossa, by dividing into two terminal branches, the radial, and the ulnar arteries. Since the brachial artery lies superficially it is vulnerable to trauma or common site for bleeding by accidental venipuncture in the cubital fossa leading to thrombosis and fracture at the surgical neck of the humerus can cause severe hemorrhage, especially in cases of high division of the artery. The brachial artery is used in catheterization procedures for vascular studies. We describe an unusual case of high bifurcation of the brachial artery in the right upper limb & discuss its embryological basis and its clinical implications.

**Case report:** During the routine dissection procedure of the upper limb in a 78year-old male cadaver at the department of Anatomy, JSS Medical College, Mysore, India. We observed an unusually high bifurcation of the brachial artery in the middle one-third of the arm in the right upper limb, 8.2cms above the lateral epicondyle of the humerus. The high origin of the radial & ulnar arteries were noted. The median nerve was seen medial to the radial artery in the middle of the arm. The rest of the radial and ulnar arteries showed a normal distribution pattern following their high origin. The origin and distribution of the brachial artery of the left upper limb were found to be normal. No other vascular variations were found.

**Conclusion:** Anatomical knowledge of such an unusual case of high bifurcation of the brachial artery is helpful for angiographic interpretations by vascular radiologists and surgical intervention procedures like biceps brachii tendon repair and arterial catheterization in the upper limbs.

**Keywords:** High bifurcation; Brachial artery; Anatomic variations; Radial artery.

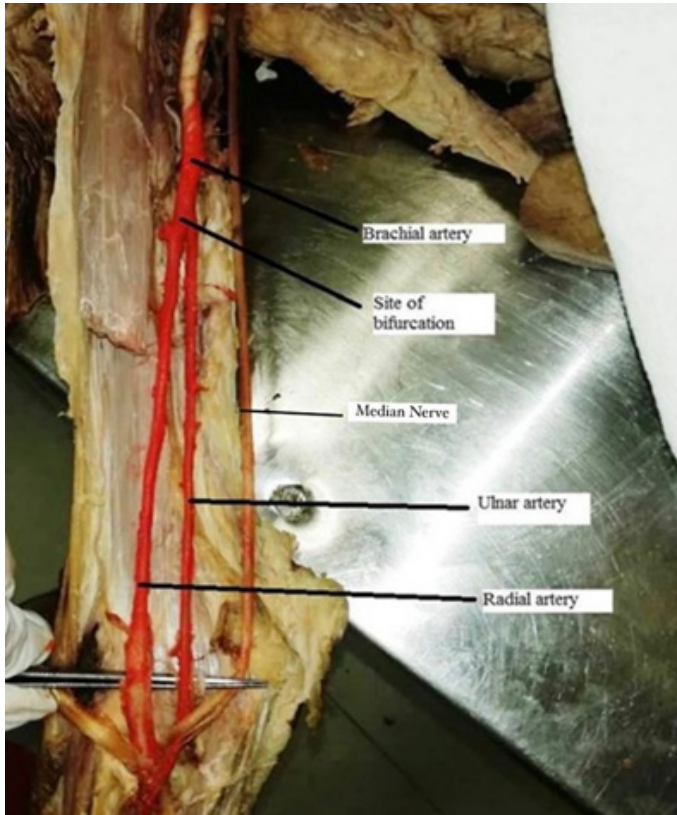
## Introduction

The Brachial artery & its branches nourish the upper limb. It is the direct continuation of the axillary artery in the arm. It originates from the distal border of the teres major tendon & terminates 1cm distal to the elbow joint in the cubital fossa, by dividing into two terminal branches, the radial and the ulnar arteries under cover of the bicipital aponeurosis. Its first branch is the Profunda brachii artery at the surgical neck of the humerus<sup>1</sup>. It lies superficially in the arm and is covered with skin, superficial fascia, and deep fascia, its pulsations can be easily felt<sup>2</sup>. The radial artery traverses distally to supply the lateral aspect of the forearm muscles. The ulnar artery passes deep to pronator teres & flexor digitorum superficialis muscles to supply the ulnar side of the forearm. Both the arteries anastomose in the hand to form the superficial and deep palmar arches<sup>2</sup>. The clinical knowledge of the variations of the vascular anatomy of the upper limb is very essential for both radiologists and surgeons since any occlusions or lacerations of the brachial artery can lead to critical complications like thrombosis gangrene or may even require amputation of the limb, especially in patients who are on dialysis or

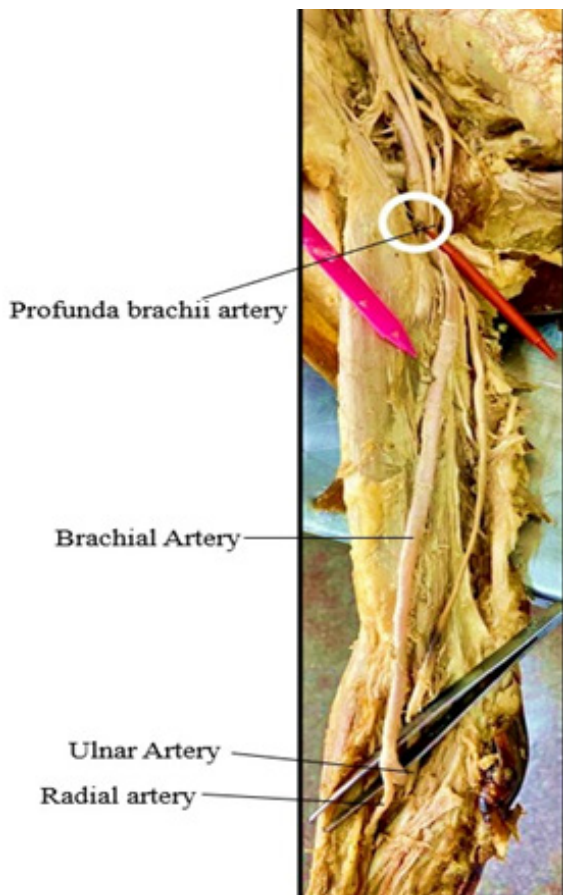
undergoing arteriography<sup>3</sup>. When the femoral artery is not accessible, then the brachial artery is preferred during cardiac ventriculography<sup>4</sup>. This unusual case report aims to elucidate the embryological basis and clinical implications of high bifurcation of the brachial artery taking place in the upper aspect of the middle one-third of the right arm of a male cadaver.

## Case report

During the routine dissection practical for our medical undergraduates at our medical school at the department of Anatomy, JSS Medical College, Mysore, India. We observed in a 78 year-old male cadaver an unusual high bifurcation of the brachial artery in the middle one-third of the arm in the right upper limb, 8.2cms above the lateral epicondyle of the humerus. The high origin of the radial & ulnar arteries were noted (Refer Fig 1). The median nerve was seen running medial to the radial artery in the middle of the right arm. The rest of the radial and ulnar arteries showed a normal distribution pattern following their high origin. The origin and distribution of the brachial artery of the left upper limb were found to be normal (Refer Fig 2). No other vascular variations were found.



**Figure 1.** High bifurcation of brachial artery in the upper aspect of the middle one third of the right arm into radial and ulnar arteries.



**Figure 2.** Normal bifurcation of the brachial artery in the upper aspect of the cubital fossa into radial and ulnar arteries in the left arm.

### Discussion

Variations of the vascular anatomy of the upper limb have been mentioned in previous studies. The high bifurcation of the brachial artery in the arm has the highest percentage of 20%. The bifurcation of the brachial artery as high as the axillary artery level has been noted<sup>5</sup>. It has been observed more frequently in the upper one-third of the arm<sup>5</sup>, unlike in our case where it was found in the middle one-third of the arm. When the radial artery arises first, then it is known as the brachio-radial artery<sup>6,7</sup>. Vascular variations of the upper limb are often encountered in patients undergoing upper limb radiological or surgical procedures, radial artery variations are seen in 15% of cases followed by an ulnar artery in only 2% of the cases<sup>8</sup>.

**Embryological basis:** During the upper limb development, the vascular system is very complex. The axial artery of the arm is in direct continuation of the 6<sup>th</sup> cervical segmental artery<sup>9</sup>. This artery grows anteriorly & distally to terminate in the palmar capillary plexus in the hand. During this process, the axial artery goes to form the axillary artery, the brachial artery, the anterior interosseous artery & the deep palmar arch<sup>6</sup>. Within these developing arteries, the hemodynamic flow seems to be the determinant for the regression or maintenance of the arteries in the upper limb. The determinant factor is the hemodynamic dominance during the involution of the superficial arteries that are situated just proximal to the anastomosis between the superficial & deep arteries<sup>6</sup>. These hemodynamic changes are induced by certain growth factors that lead to the development of such vascular variations<sup>6</sup>, one such variation we are describing in this case.

**Clinical significance:** The unusually high bifurcation of the brachial artery can confuse angiographic procedures making the catheterization process a difficult task<sup>6</sup>. An unusual variation of the brachial artery may complicate surgical procedures like biceps tendon repair<sup>10</sup>. Inappropriate cannulation of the upper limb vessels can lead to complications like thrombosis, gangrene, or even limb loss<sup>6</sup>. Development of brachio-cephalic arteriovenous fistulae has been reported in cases of high bifurcation of the brachial artery<sup>11</sup>. The high origin of the radial artery may cause difficulty in procedures like flap harvesting during reconstructive surgeries<sup>6,12</sup>. Saraswathi P *et al* 2017 described a case of high bifurcation of the brachial artery in the middle one-third of the arm<sup>13</sup>, similar to our case. Lufukuja GJ in 2018 reported two cases of high bifurcation of the brachial artery out of 18 cadavers dissected, one of the divisions was taking place in the upper one-third of the arm & in the second case the division was in the middle third of the arm<sup>14</sup>. Alves FL *et al* in 2020 reported a case of high origin of the radial artery, as high as 18cms above the elbow joint<sup>15</sup>.

## Conclusion

Anatomical knowledge of such an unusual case of high bifurcation of the brachial artery is helpful for angiographic interpretations by vascular radiologists

and surgical intervention procedures like biceps brachii tendon repair and arterial catheterization in the upper limbs.

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