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Original Research Article

Brachial Artery with Tortuosity, Branching Pattern and Clinical Implications

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Conflict of interest: Nil

Abstract:

Introduction: The variations in the branching patterns of the arteries of the limbs have clinical and surgical importance. Anomalies of the arteries of the upper limb are commonly seen. The arterial development is dependent on a precise sequential pattern of the formation and the regression of some of the arteries during development.

Aims and Objectives: The present work was done to study the branching pattern of brachial artery and its clinical implications.

Materials and Methods: The present study was conducted by dissection of upper limbs of 20 adult human cadavers, all aged between 35 to 65 years, out of which 15 were male and 5 were female cadavers for a period of one year. Right and left upper limbs were dissected and branching pattern of the brachial artery noted. The course, branches and relations of the artery were observed.

Results and Conclusion: Out of 40 upper limbs, 2 limbs had variation in the branching of brachial artery and two limbs were seen with tortuous brachial artery and its terminal branches. Knowledge of variations of brachial artery and its branches is necessary for cardiologists, radiologists, vascular surgeons and orthopaedic surgeons during vascular or reconstructive surgeries of arm and forearm.

Keywords: Brachial Artery; Tortuous; Radial Artery; Ulnar Artery.

Introduction

The brachial artery is a continuation of the axillary artery, begins at the distal (inferior) border of the teres major and ends about a centimeter distal to the elbow joint (at the level of the neck of the radius) by dividing into radial and ulnar arteries [1]. At first it is medial to the humerus, but gradually spirals anterior to it until it lies midway between the humeral epicondyles. Its pulsation can be felt throughout.

The brachial artery is wholly superficial, covered anteriorly only by skin and superficial and deep fasciae [2]. The bicipital aponeurosis crosses it anteriorly at the elbow, separating it from the median cubital vein, the median nerve crosses it later medially near the distal attachment of coracobrachialis. Posteriorly are the long head of triceps, separated by the radial nerve and profunda brachii artery and then successively by the medial head of triceps, the attachment of coracobrachialis and brachialis. Proximally the median nerve and coracobrachialis lie laterally while distally the biceps and the muscles overlap the artery. Proximally the medial cutaneous nerve of the forearm and ulnar nerve lie medially, while distally the median nerve and basilic vein lie medially. With the artery are two venae comitantes, connected by transverse and oblique branches. At the elbow the brachial artery sinks deep into the triangular intermuscular cubital fossa. Occasionally the artery divides proximally into two trunks, which may reunite. Frequently it divides more proximally than usual and this unusually short segment brachial artery may bifurcate as usual or it may trifurcate into radial, ulnar and common interosseous arteries [3]. Variations in the vascular patterns of upper limb in Indian population have been frequently observed [4]. Variations in the arterial supply of the upper limb are relatively usual, with reported frequencies of incidence ranging from 11 to 24.4%. They can be found at different situations along the axillary, brachial, radial or ulnar arteries, as well as in the palmar arches [5].

Aims and Objectives: The present research was done to study the branching pattern of brachial artery and its clinical implications.

Materials and Methods

The present study was conducted by dissection on 20 adult formalin fixed human cadavers all aged between 35 and 65 years, out of which 15 were male and 5 were female cadavers. Dissection was done according to the procedure described in the Cunningham's manual. The Right and left upper limbs were cleanly dissected. The principal neurovascular bundle which is deep to deep fascia and medial to biceps was dissected proximally and distally. The length of the brachial artery was measured from the lower border of teres major to its bifurcation with the non-elastic measuring tape and scale. Three readings were taken, and average was calculated. Its course, branching pattern and relations were observed.

Results

The right and left arms along with the surrounding structures were cleanly dissected in all the 40 specimens. The following findings were noted during dissection.

1. In one specimen (Fig 1& 2) bifurcation of brachial artery (BA) was seen to be in the middle of the arm. Radial (RA) and ulnar arteries (UA) were seen to be originating from the brachial artery about 6 cm above the elbow joint. Ulnar artery was seen to be superficial. The median nerve (MN) was medial to brachial artery till the artery divided into radial and ulnar branches. Median nerve is seen to cross the radial artery from medial to lateral side. The radial and ulnar arteries were seen to be tortuous for about 6 cm. from their origin. Ulnar artery was more tortuous than the radial artery. Branches of the brachial artery in the arm to adjacent muscles and profunda brachii were seen originating before the division of brachial artery.

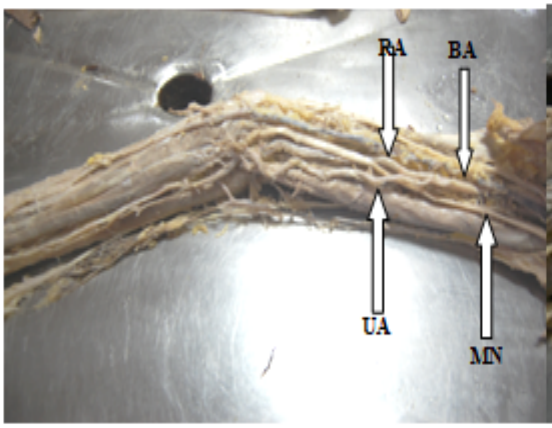

Figure 1:

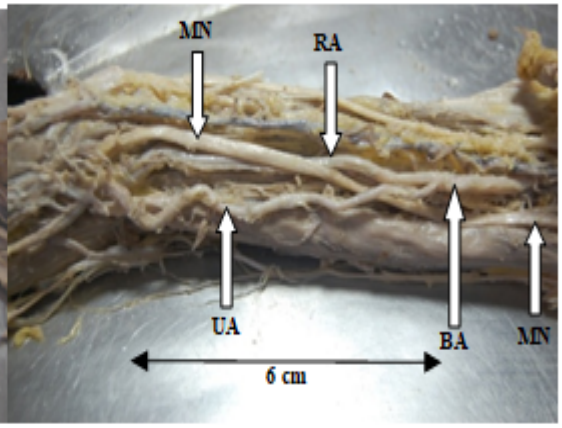

Figure 2:

2. In another specimen (Fig 3 & 4), brachial artery was seen tortuous from its origin but the division into its terminal branches was normal in location.

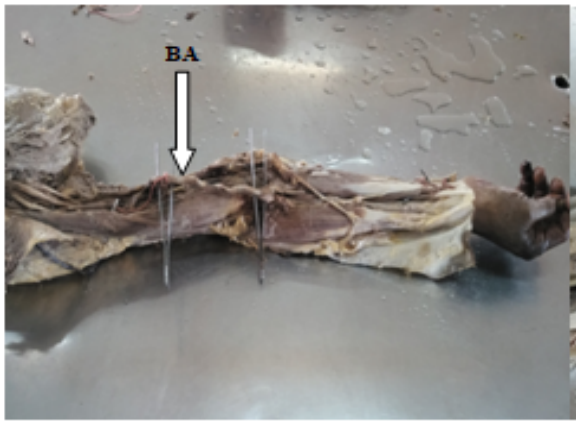

Figure 3:

Figure 4:

3. In two specimens (Fig 5a & 5b1,5b2), brachial artery was seen to be bifurcating into radial and ulnar arteries at the upper end of the arm after a short segment after its continuation from axillary artery.

Figure 5a

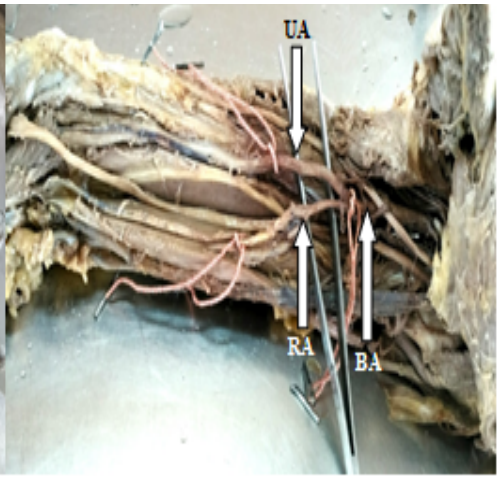

Figure 5b1

Figure 5b2

Figure 6

4. In another specimen (Fig 6) brachial artery was toruous with normal levels of division into radial & ulnar arteries.

5. Further distribution of radial and ulnar arteries was normal in the forearm in all the specimens.

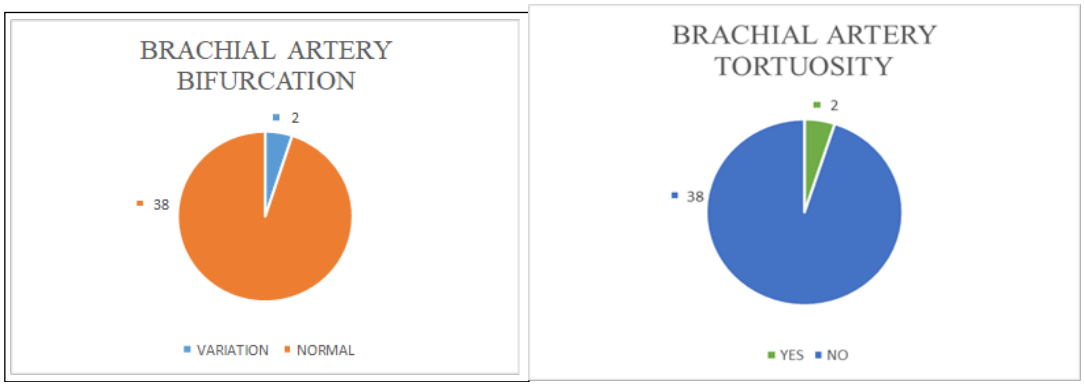

Figure 7: Distribution of results

Discussion

The arteries of the arm can be recognized for the first time in an embryo of 4-7 mm [1]. The early limb bud receives blood via intersegmental arteries, which contribute to a primitive capillary plexus. At the tip of the limb bud there is a terminal plexus that is constantly renewed in a distal direction as the limb grows. Later one main vessel supplies the limb and the terminal plexus; it is termed the axis artery [2]. In the upper limb, the axis artery is derived from the lateral branch of the seventh cervical intersegmental artery that is subclavian artery. The proximal part of the main trunk of axis artery forms axillary and brachial arteries and its distal part continue as anterior interosseous artery and deep palmar arch [3]. Radial and ulnar arteries are last to become evident in the forearm from the axis artery, that is brachial artery [4].

Initially the radial artery arises more proximally than the ulnar artery. Then it establishes a new connection with the main trunk at or near the level of the ulnar artery. The upper portion of its original stalk usually disappears to a large extent [5]. Variations in the arterial pattern in the limbs may be due to persistence of vessels which normally obliterate and disappearance or failure of development of vessels which normally persist. The change in the normal process of vascular development is largely due to altered local hemodynamic environment. High division of brachial artery is the most common variation of the upper limb.

In our case the brachial artery bifurcated into radial and ulnar arteries with tortuosity in both but at a higher level than usual. This resulted in a short segment of brachial artery. Brachial artery may bifurcate as usual or it may trifurcate into radial, ulnar and common interosseous arteries [6]. In a clinical study done on Chinese population with a sample of 3000 cases, they found anatomic variations in arteries of upper limb in 610 cases. Among these 610 cases, tortuous radial artery found in in 150 cases, brachial artery in 27 and tortuous subclavian artery in 57 cases were seen [7]. Tortuosity can be defined as presence of a bend or angulation of more than 45 to 90 degrees [8]. Etiology for the tortuosity of artery has been said to be due to abnormal collagen & elastin synthesis. The upregulation of TGF beta signalling pathway is involved in elastogenesis and is described in arterial tortuosity syndrome [9]. Cheng CH et al in their study have described mutations in the SLC2A10 gene which encodes for GLUT10 causes arterial tortuosity syndrome (ATS) in humans which is an autosomal recessive disorder with typical features of compressing tortuosity and elongation in the major vessels due to disorganization of elastic fibres in the arterial wall [10]. Histopathology of affected vessel walls reveals fragmentation of the internal elastic lamina and elastic laminae of the tunica media of the large arteries. Several connective tissue disorders associated with arterial tortuosity and aneurysm formation show considerable clinical, histological, and pathophysiological overlap with ATS [11]. Clinical and experimental studies have shown that mechanical factors, such as blood pressure, blood flow, axial tension, and wall structural changes, play a significant role in the development of arterial tortuosity [12]. Paucities in the normal ongoing repair of arteries is also said to be a probable cause for tortuosity. This altered mechanism would result in tendency to pool and clot the blood at the bends of the loops of the arterial lane [13].

Conclusion

Altered topographical relationship of vessels in the upper limb will disturb the recording of blood pressure. Tortuous peripheral arteries are usually asymptomatic. Due to altered haemodynamics there is tendency to pool and clot the blood at the bends of the loops of the arteries resulting in arterial occlusion causing ischemia secondary to embolism. Tortuous radial artery, due to its smaller diameter, is considered to cause significant difficulties during trans-radial approach of coronary angiography. Procedural failure is as high as 23.3% in severe radial tortuosity.

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