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"A Study on the Tortuous Brachial Artery and Its Embryological, Genetic and Clinical Significance"

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Abstract
Arteries can be abnormally lengthened causing them to become twisted, forming kinks and loops called as tortuous artery. Tortuous artery can occur in the coronary, axillary, brachial, radial, and ulnar arteries. The most common is the tortuous brachial artery. Arterial knowledge is important for embryogenetic reasons and to know the variations of arteries for the cardiologists and radiologist to do clinical procedures. The main aim of the study is done to find out any anomalous arteries and to categorize its embryological, genetic, and clinical significance. The main objective is to perform the dissection in both the limbs of the 15 cadavers, to analyse the abnormalities in both the sides of the upper limb, to correlate the findings with embryological, genetic and clinical significance and to add the variable to the existing literature. The study was conducted in the Department of Anatomy, Sri Ramachandra Institute of Higher Education and Research in a 15 formalin fixed Cadavers and looked for tortuosity of the arteries, data collected and evaluated. Normal limbs were included for the study and damaged limbs were excluded.

Keywords: Tortuous brachial artery, Brachial artery, Embryological significance, clinical significance, genetical significance, tortuosity of radial artery, ulnar artery.

INTRODUCTION:

Blood is supplied to the arm, hand, and shoulder by primary arteries of upper limb, which initiate from subclavian artery. Primary artery delivering blood to upper limb is subclavian artery. Upon traversing lateral edge of first rib, it transforms into axillary artery. Pectoralis minor muscle segregates axillary artery into 3 segments as it traverses the axilla. It produces several branches, involving lateral thoracic artery, that supplies lateral chest wall, as well as thoracoacromial artery, which nourishes the shoulder and chest. At inferior border of teres major muscle, axillary artery changes into brachial artery. Triceps, biceps, and other upper arm muscles receive blood flow from the arm's main artery. At elbow, brachial artery bifurcates into ulnar as well as radial arteries. Thumb as well as lateral regions of hand are supplied with blood by radial artery, which traverses lateral side of forearm. Ulnar artery offers blood to medial portion of hand as well as fingers by traversing medial side of forearm. All of these arteries work together to ensure that blood reaches the various upper limb structures efficiently.

[1]Brachial artery's tortuosity, which has been observed in a number of arteries throughout the body, is characterized by variation through bending of the arterial wall. Splenic and facial arteries are two examples of the many arteries that are well-known for their convoluted paths. Radiologists, neuroradiologists, as well as surgeons may encounter challenges due to tortuous blood vessels, which can also result in nerve compression. The tortuous arteries present many challenges for radiologists, neuroradiologists, and surgeons during pertinent procedures. To prevent complications, detailed knowledge of the arteries is essential for vascular surgeons, cardiologists, and radiologists when performing clinical procedures. Aim of the research is to examine tortuosity of brachial artery. This research aims to correlate the variations with their genetic, embryological, as well as clinical significance.

AIM AND OBJECTIVE:

Primary goal of the research is to examine tortuosity of the courses of brachial, radial, and ulnar arteries. Correlating variation with its embryological genetics as well as clinical significance is the research's primary goal.

MATERIAL AND METHODS :

Research was conducted at Sri Ramachandra Institute of Higher Education and Research's Department of Anatomy following Institutional Ethical Committee approval. Above 15 formalin-fixed adult cadavers (9 males and 6 females) were used for the study. The 30 normal upper limbs were dissected following the standard procedures, and the tortuous arteries, like brachial arteries, radial ulnar arteries, superficial palmar arch, were looked for and

photographed. Deformed limbs, limbs with fractures, and injured limbs were excluded from the study.

Results:

Of the 30 upper limbs dissected, an elderly male cadaver had a tortuous brachial artery (fig.1), radial and ulnar artery (figs 3 & 4), tortuous superficial palmar arch on right side (fig.5)

Brachial artery was normal in this left side, but ulnar and radial arteries in superficial palmar arch as well as distal third of front forearm were tortuous. Brachial artery was situated close to median nerve. Brachial artery was normal in every other cadaver.

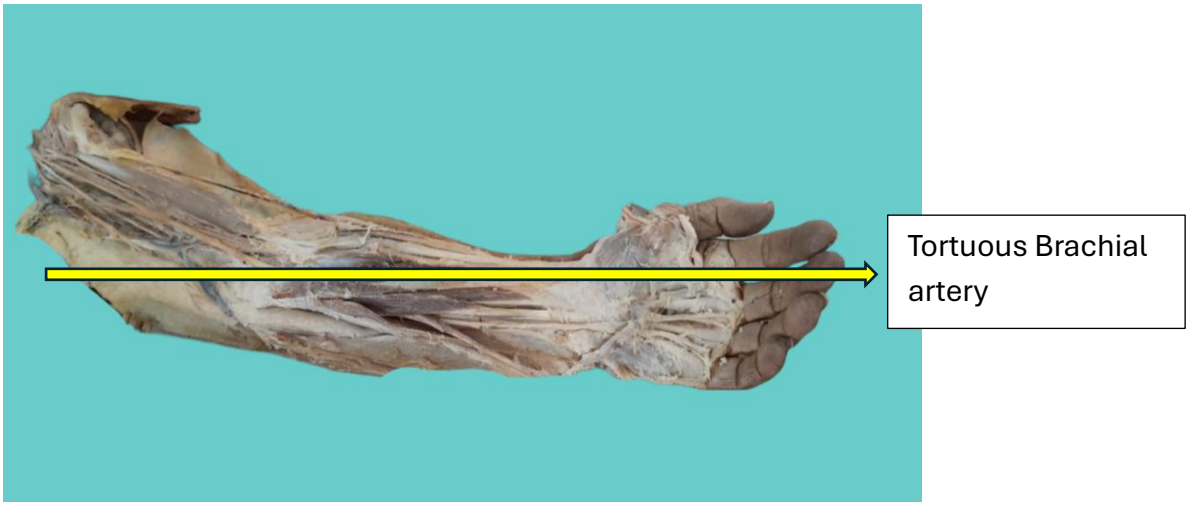

Fig:1 Tortuous brachial artery in the right upper limb

Fig:2 Tortuous brachial artery in the right upper limb (closer look)

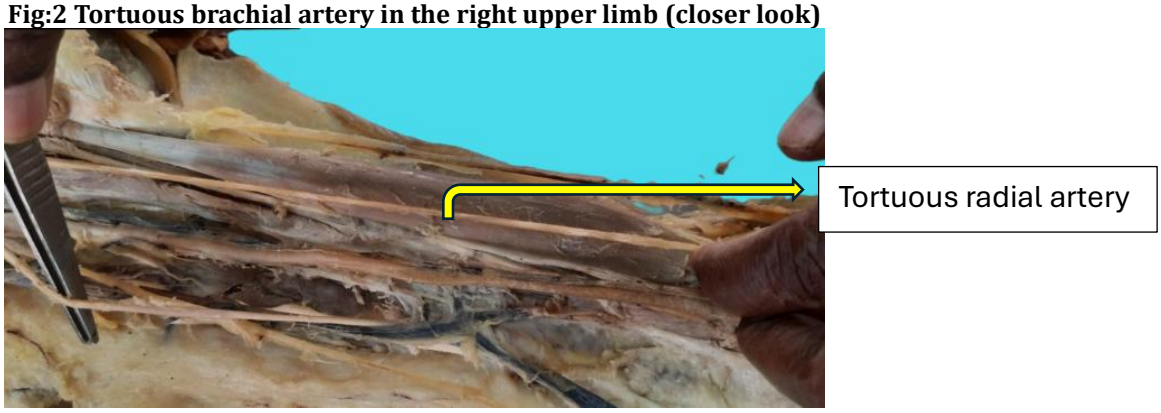

Fig. 3 Tortuous distal end of the radial artery in the right upper limb

Fig. 4 Tortuous distal end of the ulnar artery in the right upper limb

Fig: 5 Tortuous superficial palmar arch in the right upper limb

S.NO	BRACHIAL ARTERY N = 30			RADIAL ARTERY N = 30			ULNAR ARTERY N = 30			SUPERFICIAL PALMAR ARCH N = 30		
1.	RT	LFT	%	RT	LFT	%	RT	LFT	%	RT	LFT	%
	1	0	3.3%	1	1	6.7%	1	1	6.7%	1	1	6.7%

TABLE 1: TORTUOSITY OF THE VARIOUS ARTERIES OF THE UPPER LIMB WITH PRESENT STUDY :

It is observed from the above table that the brachial artery was tortuous in 3.3 % of the upper limbs dissected, and the radial artery, ulnar artery, and superficial palmar arch were tortuous in 6.7 % of the upper limbs dissected. {TABLE:1}

.NO	*AUTHORS*	BRACHIAL ARTERY N = 67	RADIAL ARTERY N = 67	ULNAR ARTERY N = 67	SUPERFICIAL PALMAR ARCH N = 67
1.	Li li et al,	*0*	*23.3%*	*0*	*0*
2.	Yoo bs, et al	*4.2%*	*52.2%*	*0*	*0*
3.	Prakash et al	*30%*	*30%*	*30%*	*30%*
4.	*Present study*	*3.3%*	*6.7%*	*6.7%*	*6.7%*

TABLE 2: TORTUOSITY OF THE VARIOUS ARTERIES OF THE UPPER LIMB WITH VARIOUS AUTHORS AND WITH PRESENT STUDY.

Discussion:

Any kinks or loops in the arteries is known as tortuous brachial artery. It's less common than other upper limb arteries. [9]The incidence of tortuosity of the brachial artery ranges from Brachial artery: 0.33 %, Radial artery: 0.73 %, and Ulnar artery: 0.7 % to 7 %. The causes of the tortuous brachial artery can be due to advance aging, hypertension, and mechanical factors. There are several types of loops in the tortuosity of the brachial artery. They are curves, spiral twists, loops, and angulations.

[7]Li Li et al. claim that in cases of severe radial tortuosity, the rate of procedural failure can reach 23.3 percent. (Table 2.2). Females are more likely than males to experience procedure failure, according to Li et al. and Yazdankhah et al.

[11]According to Yoo BS et al., tortuosity is more prevalent in distal region. Toruosity of brachial arteries has been found in sixty seven of fifty cases (4.2 percent). The proximal third of the radial artery (52.2 percent of 67 cases).(Table:2) than the distal one-third. Before radial artery, left ulnar artery had six bends. Dive beneath palmar carpal ligament and proceed into Guyon's canal, also known as ulnar tunnel. Ulnar artery ended in the superficial palmar arch when the hand was further dissected.

[8]According to Prakash et al., in 30 percent of cases out of 15, tortuosity is frequently observed in all arteries in distal 1/3rd.(Table:2)

- Only right upper limb showed tortuosity throughout the brachial artery's entire course in current research, with an incidence of 3.3%; however, **distal 1/3 of radial and ulnar arteries showed tortuosity of 6.7%**. (Table 1)

Results: 8 female cadavers (11.43 percent) exhibited an accessory brachial artery. 3 cadavers (4.29 percent) out of 8 had an uncommon bilateral accessory brachial artery that started in axillary artery and extended into forearm as superficial accessory ulnar artery. A uncommon variation of a unilateral accessory brachial artery was seen in 5 cadavers (7.14 percent). This artery rejoined primary brachial artery in cubital fossa as well as showed a variable course associated with musculocutaneous and median nerves.

EMBRYOLOGICAL CORRELATION AND GENETIC CORRELATION:

According to [3]Chukwuyem Ekhator et.al, endothelial cells contain vegetative endothelial growth factor and angiopoietin 2 factors that upregulate the genes and it helps in the formation of straight arteries and fixed arteries. when there is any hypoxia to the cells, vegetative endothelial growth factors and angiopoietin factors are deficient. When these factors are deficient, there is also an deficient of upregulation of genes which is helpful for the formation of the straight arteries, which results in elongation and lengthening of arteries, which leads to tortuosity of the arteries.

[3]Chukwuyem Ekhatoret. al, also elucidated the genetic causes that the Slc2a10 gene creates a protein called glut 10. This results in the formation of collagen, and it strengthens and straightens the arteries. When there is any deficiency of slc2a10 gene, there is a deficiency of glut 10 gene, which finally loses its elasticity and becomes tortuous arteries.

CLINICAL SIGNIFICANCE

[1]Brachial artery is frequently used to measure blood pressure and pulsed doppler ultrasonography (Alka Bhingardeo et al., 2020). [9]A convoluted radial artery is a contributing factor for access failure in trans radial technique for coronary interventions. Therefore, in order to prevent further complications, it is crucial to understand the tortuosity of vessels, especially when performing cardiac interventions involving upper limb vessels. When it comes to diagnostic and therapeutic interventions, radiologists should be aware of this tortuosity. Clinically, abnormal tortuosity in the venous and arterial systems has been linked to nerve compressions. During imaging, interventional procedures, and surgery, tortuous vessels can cause issues. Sometimes, when tortuous vessels appear on imaging, a solid mass could be mistaken for a solid tumor. Additionally, during surgery, the tortuous artery and winding are more likely to sustain a laceration. These vessels' numerous bends put them at risk of puncturing during different procedures.

Conclusion:

A thorough arterial knowledge of the tortuous arteries becomes clinically very important for the vascular surgeons, radiologists and cardiologists to prevent unnecessary complications like perforations and hemorrhages while performing surgical procedures in the arteries.

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