Anatomical Variations of Radial Artery-Its morphology and Clinical Implications.

Short Communication

Muhammad Tariq[1], Saeed Ahmad[2], Jamshed Khan[3], Salman Hakim[4], Usmanullah[5], Shehla Aman[6]

1. Assistant Professor Pathology, Jinnah Medical College, Peshawar.
2. Principal, Loralai Medical College, Loralai.
3. Assistant Professor Anatomy, Loralai Medical College, Loralai.
4. Demonstrator, Nowshera Medical College Nowshera.
5. Assistant Professor Anatomy, Gajo Khan Medical College, Swabi.
6. Assistant Professor Anatomy Gomal Medical College, Dera Ismail Khan.

CORRESPONDING AUTHOR

Dr Muhammad Tariq,
Assistant Professor Pathology,
Jinnah Medical College,
Peshawar, Pakistan.

Author Email:
drtariq857@gmail.com

doi:
10.5281/zenodo.3595105

Submission: Dec 19, 2019
Acceptance: Jan 29, 2020
Publication: Feb 1, 2020

ABSTRACT

Background: The radial artery is the smaller terminal branch of the brachial artery. It is one of the most commonly used arteries for various interventions. Anatomical variations exist and can predispose patients to iatrogenic injury if the operator is unaware of normal radial artery morphology. The present study focuses on giving detailed information about radial artery measurements in our local population.

Methods: This was a cross-sectional observational study, conducted in the anatomy department of Jinnah Medical College Peshawar from 2017 to 2018. This study was conducted on 42 formalin-fixed cadavers, yielding 84 upper limbs. The radial artery was dissected and studied; length, external and internal diameters were measured. Data was entered in SPSS v20 and analyzed. Results: The mean age of the study population was 36 ± 11.25. Male to female ratio was 1:1. The most common site of origin of the radial artery was distal to head of the radius. The right radial artery was longer than the left. The right radial artery was broader in males as compared to females with a p-value of <0.05. The external and internal diameters of the radial artery decreased gradually from start to the endpoint for both the genders. The external diameters of the left radial artery were greater than those on the right side. The right radial artery had a larger internal diameter than the left side.

Conclusion: The anatomy and morphology of radial artery have many documented variations. Radiologist and surgeons should have a good understanding of normal morphological variations of radial artery.

Keywords: Radial diameter, wrist, Radial artery, morphological variations.

INTRODUCTION

The blood supply to the arm is from the brachial artery, which is a direct continuation of the axillary artery. It arises underneath the teres major muscle. The artery travels on the ventral aspect of the arm till it reaches the cubital fossa, beneath the bicipital aponeurosis. In the inferior part of the cubital fossa, the brachial artery bifurcates into radial and ulnar arteries.[1] The radial artery (RA) is the smaller terminal branch of the brachial artery. It arises at the level of the neck of radius and runs on the lateral aspect of the forearm, beneath the brachioradialis muscle, lateral to the flexor carpi radialis. For some part of its course, it is in direct contact with the radius bone, then it passes on the floor of the anatomical snuffbox, passing on the dorsal aspect of scaphoid and trapezium and terminates by forming the deep palmar arch of the hand.[2,3] In the lateral part of the forearm, during its course, the RA lies close to the radial nerve. Throughout its course, the artery is accompanied by radial vein.[4] The RA may be absent, hypoplastic or there may be trifurcation of the brachial artery in the cubital fossa, leading to significant anatomical variations.[5] These morphological variations of RA predispose it to iatrogenic injury during vascular surgeries, arterial cannulation, cardiology interventions and interventional radiological procedures. It is because of this reason that it is of utmost importance to study radial artery, in cadavers so that we can have a better knowledge about the standard external and internal diameters, thicknesses and variable origins of the artery that is most commonly used for recording pulse, invasive blood pressure monitoring, cardiac catheterization, and forms 50% of blood supply of hand.[6]

The focus of the present study is to give extensive details

to the physicians on the features of the radial artery, such as its origin level, wall thickness, external and internal diameters in our local population.

METHODOLOGY

The study was a cross-sectional observational study, conducted in the anatomy department of Jinnah Medical College Peshawar, from January 2018 to January 2019 on 84 upper limbs specimens (42 right, 42 left). All the cadavers were formalin-fixed. Only those cadavers were included in this study who had intact upper limbs and torso. The data was obtained by dissections of 42 cadavers with equal gender distribution (male to female ratio of 1:1). To minimize bias, each limb dissection was done by the same team, following predefined protocols in the same environment. After appropriate exposure, the dissection was started in a strictly controlled environment. The skin and fasciae of the arms and forearms of formalin-fixed cadavers were removed. The axillary artery was exposed in the axilla by opening up the axillary sheath and was followed until the lower border of teres major muscle. The brachial artery was followed in the anterior compartment of the arm, until its bifurcation in cubital fossa into ulnar and radial arteries. The radial artery was followed carefully throughout its course in the forearm until its termination in the deep palmar arch of the hand. The external diameters were measured at 1 cm distal to the origin, 4cm from cubital fossa and in anatomical snuffbox. The widest portion of the artery at these points was measured using a standard set of vernier callipers (0-150 mm). The internal diameters of the radial artery were measured at cubital fossa and wrist, at the widest point of the artery. The length of the radial artery, from its origin to the terminal point, was measured using a standard measuring tape. The diameters were recorded in millimetres (mm) and the length was recorded in centimetres (cm).The origin, termination of the radial artery and any anatomic variation were carefully noted in each upper limb. All the data was entered in SPSS v20. Mean and standard deviations of the variables were calculated. Student t-test was applied to variables to compare the variation in external and internal arterial diameters in the right and left upper limbs in both genders.

RESULTS

A total of 42 cadavers (84 upper limbs) were included in this study. It took us one week to thoroughly study the RA in both limbs of each cadaver. Age was ascertained from the record of anatomy department. The mean age for male cadavers was 34 ± 8.2 years, whereas the mean age for female cadavers was 38 ±15.1 years. The overall mean age for the present study was 36 ± 11.25 years with a range of 24 to 48 years. In total, 84 upper limbs from 42 cadavers were dissected to examine the origin of RA along with its wall thickness, length, internal and external diameters. In our study, RA originated proximally to head of radius on the left side in 2 male subjects (2.38%), whereas, in 82 of the subjects (from both genders), RA originated distal to the head of the radius on the left (97.61%). We noticed that right radial artery was broader in males as compared to females with a p-value of <0.05. The thickness of the radial artery was more at its origin and at its termination points. The difference of external diameter (thickness) was 1.5±0.25mm in right arm and 1.25±0.5mm in the left arm at the point of origin of radial arteries.

The external and internal diameters of the radial artery decreased gradually from start to the endpoint for both the genders[Table 2]. The internal and external diameters of RA was greater on the right side when compared to left. The mean external diameter of RA at the origin in our study was 3.533±0.86 at its origin on the right, whereas the mean external diameter of the left radial artery was 3.46±0.79. The mean internal diameter of RA at its origin on the left was 3.23±0.81, and on the right, it was 3.28±0.76 [Table 2]. The left radial artery had a greater external diameter than the right one at the point of origin in all the dissected limbs of male subjects.. Interestingly, at the wrist, the thickness and the external diameters of the left radial artery were bigger than that on the right side. However, the right radial artery had larger internal diameter than left side In our study, the males had thick radial arteries at their origins as compared to females, and the results were statistically significant (p<0.05) [Table 2].

DISCUSSION

The vascular variations in embryonic growth of limbs depend exclusively on the growth of buds plexus. The classic 'sprouting' theory of vascular bud development postulated that the arteries of the upper limb originated from a single trunk of the axial artery in a predefined manner.[7] Several variations in arterial origins and course can occur due to any flaws in embryonic evolution of the buds plexus. The variations in the vasculature of the upper limb are seen 9% to 18.5% of the cases.[8] The radial artery is commonly variable in origin and route; this variation may affect the diagnosis, surgery and post-operative management of the patient. These medical implications are associated with anatomical vascular variations of the radial artery. Accordingly, for clinicians it is vital to understand the diameter, thickness and the radial artery variability because the radial artery is one of

Radial artery	Side	Mean (mm)	Standard dev (mm)
Males	Left	215.7	25.7
	Right	229.8	27.9
Females	Left	211.5	22.5
	Right	217.3.45	24.9
Total	Left	213.6	24.1
	Right	223.65	26.4

Table 1: Mean size of Radial Artery in our subjects.

Radial artery	Side	Mean (SD)		
Female	Left	External	Internal	Thickness
	Origin	3.21 (.67)	2.91 (.55)	.16 (.07) **
	Wrist	2.98 (.59)	2.77 (.41)	.13 (.08)
	Right	External	Internal	Thickness
	Origin	3.26 (.68)	2.88 (.68)	.18 (.02)
	Wrist	3.05 (.65)	2.81 (.55)	.13 (.06)
Male	Left	External	Internal	Thickness
	Origin	3.64 (.85)	3.45 (.89) *	.08 (.03) *
	Wrist	3.63 (.83) *	3.26 (.51) *	.19 (.17)
	Right	External	Internal	Thickness
	Origin	3.26 (.68)	2.88 (.68)	.18 (.02)
	Wrist	3.05 (.65)	2.81 (.55)	.13 (.06)
Total	Left	External	Internal	Thickness
	Origin	3.46 (.78)	3.23 (.81)	.13 (.00)
	Wrist	3.37 (.77)	3.06 (.53)	.17 (.14)
	Right	External	Internal	Thickness
	Origin	3.53 (.86)	3.28 (.76)	.12 (.06)
	Wrist	3.37 (.79)	3.07 (.59)	.16 (.11)

Table 2: Internal diameters, external diameters and thickness of radial artery at wrist and origin.
*Significant (P<0.05) value**Significant (P<0.05) value

the primary access points for interventional procedures like aneurysm coiling and cardiac catheterizations. The iatrogenic mistake may be reduced these precautions.[9] In the majority of cases, the radial artery originates distal to the upper margin of the radial head.[10] The high origin radial artery is referred to as the artery beginning from the brachial or axillary artery.[11] In our study, about 80% of the radial artery arose from brachial bifurcation near the head of the radius, just distal to its superior margin. We noted that in 8.33% (n=7) of our cases, it had high origin. Nasr et al. showed that the radial artery had an external diameter of 3.3mm at its starting point, and 3.1mm at the styloid process, which is same as our study. It is interesting to note that the left external diameter was found to be smaller than the right one in all samples. For males, the external diameters were larger as compared to females. Yoo et al. report that the external diameter of the radial artery narrowed from its origin point to termination.[4] Previous research has shown that the internal diameter of the radial artery is large in male than female.[13] The present study shows that the internal diameter of the radial artery is larger in male than females, which is following published literature. This study is in accordance with the previous research works that the right side of the radial artery is more dominant than the left. There is more variation in the radial artery at origin than at termination. Radial artery is wider at origin than termination and gradually narrows along its course.[14]

CONCLUSION

Any kind of anatomical variations that are encountered during cadaveric dissections alongside surgical or clinical procedures are to be reported and taken into account. As noted, RA is one of the most commonly used arterial vessels for monitoring, interventions and a wide variety of procedures. To avoid iatrogenic injuries radiologists and surgeons should have good understanding of normal morphological variations of RA. This changeable morphology of the RA may cause vascular injury during surgeries and interventional procedures. Hence, it is imperative to note the various possible arrangements of the arterial pattern of the upper limb. Numerous anatomical variations of the radial arteries and the vascular territory in the hand are of concern for surgical methods. Therefore, it is clinically significant to recognize the external and internal diameters, thickness and changeable origin level of the radial artery in our local Pakistani population. Interventional cardiologists, interventional neurologists, hand, orthopedic, vascular, and plastic surgeons require further awareness of the anatomic variations of the origin, course, and distribution of the radial artery while planning and conducting surgeries of the upper limb.

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CONFLICT OF INTEREST

The Authors declared no conflicts of interest.

HOW TO CITE

Tariq M, Ahmad S, Khan J, Hakim S, Ullah U, Aman S. Anatomical Variations of Radial Artery-Its morphology and Clinical Implications. Pak J Surg Med. 2020;1(1):86-90. doi: 10.5281/zenodo.3595105.

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