# ANATOMICAL FEATURES OF RENAL ARTERY IN A COMMUNITY PEOPLE AND THEIR RELATION TO ATHEROSCLEROSIS MARKERS

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## ABSTRACT

Prediction, therapy, and control of atherosclerotic renal artery stenosis depend on understanding the anatomical characteristics of the renal artery. These characteristics reveal demographic variability, although there were few community-based data available. So, the purpose of this study was to describe the anatomical characteristics of the renal artery in a group of patients. At the Department of Human Anatomy, 305 single renal arteries from 152 adults—103 men and 49 women—with ages ranging from 21 to 80 were dissected and studied. Specimens having macroscopic stenosis and dilatation characteristics were disqualified. Study was done on the branching pattern, length, and implantation angle. These characteristics were connected to luminal diameter and intima-media thickness. In 5 micron slices of Eosin/hematoxylin stained renal artery extracted from the proximal segment, the latter were evaluated using micrometry. The data analysis was carried out using SPSS version 16.0. The Student's t-test was used to determine statistical significance, and a P value of 0.05 or greater was regarded as significant. The mean length of the arteries was 23 +/- 0.3 mm, and 10.5% of them were less than 20 mm. There was a different branching pattern in 30.4% of the instances. Higher implantation angle, shorter arteries, and varied branching were statistically substantially linked with greater intima-media thickness and luminal diameter. These data suggest that geometric risk factors for renal artery atherosclerosis include shorter length, a distinct branching pattern, and a higher implantation angle. Ultrasound screening is suggested for those who exhibit poor geometric characteristics for renal artery atherosclerosis.

**Keywords:** renal artery, atherosclerosis, and anatomical risk factors
**DOI Number: 10.48047/ nq.2021.19.12.NQ21224** **NeuroQuantology2021;19(12): 329-334**



## INTRODUCTION

Atherosclerosis has been linked to geometric characteristics of arteries, including arterial lengths, branching angles, and different branching patterns, in the coronary [1, 2, 3] and carotid [4] arteries. Several parameters exhibit variations in the renal arteries [5,6], but community data were insufficient and there are few reports of their connection to atherosclerosis. Our recent research [7] on the variation in renal artery structure in the community of peoples omitted any mention of the arteries' connection to atherosclerosis. A significant contributing factor to kidney disease is renal artery atherosclerosis [8]. Information on the anatomical risk factors is crucial for managing and predicting atherosclerosis in a community. Therefore, this study investigated the length, distinct branching patterns, mean diameter, and intima-media thickness (IMT) of the renal artery in a group of subjects.

**METHOD AND MATERIALS**

The Department of Human Anatomy conducted a study on 305 renal arteries taken from 152 persons (103 males and 49 females, ages 21 to 80). An prolonged midline abdominal incision was used to access the peritoneal cavity. Incisions in the gastrocolic ligament caused the pancreas and stomach to reflect in a superior and inferior manner, respectively. The aorta, renal artery, and kidneys were made visible by removing the retroperitoneal connective tissue. The arteries that supply the kidneys were referred to as renal arteries. Only renal arteries that originated from the aorta, were bilaterally single, and exhibited no obvious anomalies were considered. The angle between the lateral border of the infra-renal aorta and the lower border of the initial segment of the renal artery was measured using a protractor and recorded to the nearest degree. The kidneys and renal arteries were carefully examined to make sure they hadn't been displaced before calculating the implantation angle.

From the aorta to the first division, the renal artery was measured in millimetres. The right and left renal arteries were also measured. 21 randomly chosen animals' proximal segments served as the basis for the determination of morphometric characteristics. We routinely processed two millimetre samples taken from the proximal renal artery for sectioning and paraffin embedding. Haematoxylin and Eosin was used to stain five micron slices in order to show the basic structure of the artery wall. At x35 magnification, the slides were viewed and captured on camera. Then, using an10 serial sections from each specimen were photographed using an HP scanner and Scion Image TM Multiscan software. The area surrounding the lumen was identified, and its circumference was calculated. The following mathematical formula was used to determine the lumen's diameter: circumference divided by diameter (22/7). The diameter of that artery was calculated using the average of the 10 values. It was determined the medial and intimal thickness. Between the lumen and the internal elastic lamina was considered the intima's extent. Based on the technique developed by Nakashima et al., the average size of four randomly chosen spots (ISa, ISb, ISc, and ISd) was calculated. Before branching and entering the kidney, each of the investigated renal arteries was a single branch of the abdominal aorta.



**RESULTS**

Angle of the aorta is between 81 and 1000. 15.6 split off at a thousand or more. With a range of 58 to 25, the mean angle on the left was 85 1.4, and on the right, it was 83 1.0. (range 65 – 1200). There were no statistically significant side differences. Higher IMT and diameter were related to wider implantation angles (Table 1)

**Table 1:**IMT variation due to renal artery implantation angle

| Angle Spline | SE IMT Mean | Dimension Mean SE |
|---|---|---|
| <61 | 0.29±0.005 | 2.4±0.04 |
| 62 – 71 | 0.32±0.024 | 2.41±0.02 |
| 72 – 81 | 0.32±0.012 | 2.42±0.06 |

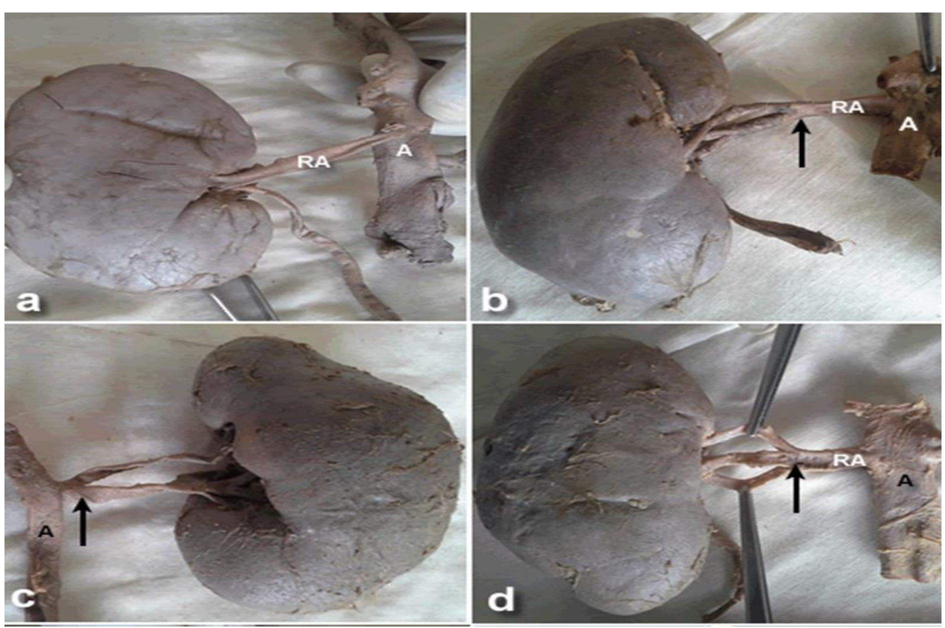
| | | |
|---|---|---|
| 82 – 91 | 0.35±0.007 | 2.50±0.02 |
| 92 – 101 | 0.41±0.005 | 2.6±0.01 |
| 102 – 111 | 0.44±0.020 | 2.7±0.04 |
| >111 | 0.49±0.015 | 2.7 ±0.02 |

The mean for those with an angle >1000 was 0.46 0.007 mm, while it was 0.35 0.006 mm for those with an angle 1000. The diameter varied depending on the implantation angle. The mean luminal diameter was 2.7 0.01 mm for those with angle 1000 and 2.46 0.07 mm for those with angle 100. Statistics did not support the difference. Length: The renal artery's average length was 23 mm (range 12 – 67 mm). There were statistically significant side length variations (P 0.001). IMT and diameter were higher in shorter arteries. In 10.5% of instances, early branching 20 mm occurred. In comparison to arteries with hilar branching (0.24 0.006 mm), the mean IMT for early branching arteries was 0.41 0.005 mm. (p = 0.002) The difference was statistically significant. 2.5 0.08 mm was the average luminal diameter. It was higher in prehilar than in hilar ones, and it had an inverse relationship to length (Table 2). Pre-hilar branching arteries had a mean diameter of 2.64 mm by 0.14 mm, while hilar branching arteries had a mean diameter of 2.21 mm by 0.006 mm. (p = 0.056) Statistics did not support the difference.



**Table 2:**variations in IMT and renal artery diameter with respect to length

| Length (mm) | IMT Mean± SE | Diameter Mean± SE |
|---|---|---|
| 0 – 10 | 0.47±0.020 | 2.8±0.01 |
| 11 – 20 | 0.38±0.008 | 2.6±0.008 |
| 21 – 30 | 0.28±0.010 | 2.4±0.10 |
| 31 – 40 | 0.26±0.003 | 2.4±0.12 |
| 41 – 50 | 0.25±0.010 | 2.3±0.14 |
| 51 – 60 | 0.22±0.008 | 2.1±0.11 |
| >60 | 0.21±0.001 | 2.1±0.07 |



Intraparenchymal branching is seen in Figure 1A. B: The kidney and aorta are connected by the renal artery, which splits in two (see arrow). C: Renal artery prehilar branching. When the stem (arrow) leaves the aorta, it divides very quickly (A). D: The renal artery (RA), which emerges from the aorta, trifurcates (arrow).
65.3% of the renal arteries displayed hilar, 10.5% prehilar, and 1.9% parenchymal branching (Fig 1A). Bifurcation was the most prevalent branching pattern (48.5%). Either the hilar (Fig. 1B) or prehilar bifurcation occurred. Some of the latter had stems that were under 10 mm long (Fig 1C). In 22% of cases, there was a trifurcation. 14.4% of the trifurcations were unilateral (Fig. 1D). Compared to bifurcation (0.31 0.007 mm), IMT was higher in quadrifurcation cases (0.50 0.024 mm) [Table 3]. (p = 0.002) The difference was statistically significant.

**Table 3:** Variations of IMT and diameter of renal artery with its branching pattern

| Forming Branches | IMT | Diameter |
|---|---|---|
| | Mean± SE | Mean± SE |
| Bifurcation | 0.31±0.007 | 2.3±0.08 |
| Trifurcation | 0.42±0.005 | 2.7±0.01 |
| Quadrifurcation | 0.50±0.013 | 3.2±0.03 |



**DISCUSSION**

The renal artery's implantation angle may have an effect on its length and histomorphometric measurements. These characteristics have been linked together, indicating that the geometry of this artery affects how susceptible its proximal portion is to atherosclerosis.

**Angle of implantation**

When assessing heterogeneity in renal vascular anatomy and predicting renal artery morphometry, implantation angle is crucial [9]. Due to the wider angles' increased turbulence and reduced shear stress, which promote atherogenesis, eccentric thickening is encouraged and predisposes to lipid buildup and atherosclerosis [11]. An major biophysical factor in influencing atherosclerosis susceptibility and plaque formation is the bifurcation angle [10]. 15.6% of the implantation angles were higher than 1000, with a mean of 83149. According to the current study, arteries with implantation angles greater than 1000 have higher IMTs. It is advised that those who are at risk undergo ultrasound screening.

**Length**

The remarkable conclusion of the current study is that 10.5% of the renal arteries were shorter than 20 mm and may be considered to have early branching. Short stem arteries are one of the geometric risk factors for atherosclerosis ([13] b). This suggests that more than 20% of the research population might be more vulnerable to renal artery atherosclerosis. This supports the finding of the present study that early branching is associated with greater intima media thickness. 10.5% of cases have early branching, which is more than the bulk of cases that have been recorded. This might point to a greater propensity for atherosclerosis.

**illumination size**

Luminal diameter is regarded as a marker of atherosclerosis together with IMT and atherosclerotic plaque [14]. The renal artery has a diameter of 2.5 mm, which is smaller than that of populations from Asia and Europe, according to the results of the current study [15] [16].

An important finding of the present study is that the diameter was larger in arteries with early branching and those with higher implantation angles, which have similarly been associated with higher IMT. This demonstrates that the renal artery is more prone to atherosclerosis in this population due to the larger diameter, which is connected to IMT, a proxy for atherosclerosis. In actuality, atherosclerosis was the root cause of 2.4% of cases of hypertensive renal disease. Complex geometries produce disturbed or oscillatory flows near the ostia of arterial bifurcations and many branches that impact velocity profiles and shear stresses [17]. These flows are characterised by turbulence and boundary separation. The high frequency of variant branching pattern observation in the current investigation shows that uncommon branching patterns disrupt flow patterns and change hemodynamics. This idea is supported by the observation that, like the common carotid artery, the number of branches was positively linked with an increase in intima media thickness [18].

**CONCLUSION**

The thickness and width of the intima media of renal arteries are all influenced by their length, branching structure, and implantation angle, suggesting that these parameters are geometric risk factors for renal artery atherosclerosis. It is suggested that patients with poor geometrical features undergo ultrasonography screening for atherosclerosis.

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