

# Study of Main Renal Artery Diameter and Its Correlation with Presence of Accessory Renal Artery on Cadaveric Dissection

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## Abstract

**Aim & Objectives:** To evaluate main renal artery dimensions. The main renal artery (MRA) diameter provide indirect evidence of accessory renal arteries (ARA). **Materials and Methods:** 60 well embalmed cadavers from the Department of Anatomy, Stanley Medical College were included in this study. Dissection is through Conventional Dissection Method. **Results:** Of the 60 cadavers 72% had Mean Renal Artery diameter of more than 4mm. 28% had less than 4mm. But in each of the 28% of cadavers the kidneys were supplied with an accessory renal artery arising directly from the abdominal aorta. **Conclusion:** Multiple renal vascular variations are present in screening of normal patients and a sound knowledge of possible variations is very useful for radiologists, urologists and surgeons in general which prompted us to undertake this study.

**Keywords:** Renal artery, Accessory Renal artery, Anatomic variations, Mean Renal Artery Diameter.

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## INTRODUCTION

Kidneys are the paired organs which receive the blood supply through paired renal arteries. They take 20% of cardiac output and supply the kidneys through a number of sub-divisions described sequentially as segmental, lobar, inter lobar and arcuate arteries. These are end arteries with no anastomosis. The arcuate arteries further divide into interlobular arteries which give rise to the afferent arterioles to the glomeruli.

The renal arteries branch laterally from the aorta just below the origin of superior mesenteric artery. Both cross the corresponding crus of diaphragm at right angles to the aorta. The right renal artery is longer and often higher passing posterior to the IVC, right renal vein, head of pancreas and descending part of the duodenum. The left renal artery is a little lower and passes behind the left renal vein, body of the pancreas and splenic vein.

A single renal artery to each kidney is present in 70% of the individuals. The arteries vary in the level of origin, in the caliber, course and relation. In its extra renal course each renal artery gives off one or more inferior suprarenal arteries, a branch to the ureter and branches which supply perinephric tissue, the renal capsule and the pelvis. Near the Hilum each artery is divided into an anterior and a posterior division and this

in turn divides into segmental arteries supplying the renal vascular segments. Accessory renal arteries are common in 30% of the individuals. They arise from the aorta above or below the main renal artery and follow it to the renal Hilum. They are regarded as persistent embryonic lateral splanchnic arteries. The segmental arteries branch successively into lobar, inter lobar, arcuate and interlobular arteries, afferent and efferent glomerular arterioles and cortical inter tubular capillary plexus. The cortical venous radicles drain them and also the vasa recta and associated capillary plexus of the medulla into the renal vein. Renal vascular segmentation was originally recognized by John Hunter in 1794. But the first detailed account of the primary pattern was produced in the year 1954 from casts and radiographs of injected kidneys by F. T. Graves [1]. Whatever the pattern is it must be emphasized that vascular segments are supplied by end arteries. The variations of the renal arteries include origin, length its branching pattern and the presence of accessory renal artery. The awareness of these variations in the origin of the arteries, in this region of Hilum of kidney and para aortic region may be of utmost importance to urologist who perform Nephron preserving surgery, kidney transplantation and the management of renal vascular hypertension. These variations can be demonstrated preoperatively by selective angiography. Knowledge of these variations may also provide safety guidelines for endovascular procedures like therapeutic

embolisation and angioplasties. Multiple renal vascular variations are present in screening of normal patients and a sound knowledge of possible variations is very useful for radiologists, urologists and surgeons in general which prompted us to study the renal artery and its variations.

### Aim

The Aim is to study the diameter of main renal artery and to elucidate the relationship between the Mean Renal Artery diameter and the presence of Accessory Renal Artery

## MATERIALS AND METHODS

### Study Materials

- 60 adult cadavers from 35 Male and 25 Female Cadavers

### Methods of Study

Conventional dissection method.

### Specimen Collection

60 adult embalmed cadavers were selected from the cadavers allotted to the first MBBS students at the institute of anatomy, Stanley medical college,

Chennai and the renal artery diameter was studied in these cadavers.

## OBSERVATION

The renal arteries both right and left in 60 adult human cadavers (35 male & 25 female) embalmed in formalin were studied (Fig-1).

### Origin of the renal artery

In all the 60 adult cadavers the source of origin of renal artery was from abdominal aorta and the percentage of single main renal artery was 72%.

### Diameter of the renal artery

- Diameter was measured near the origin using vernier caliper.
- In 60 cadavers study the diameter of the main renal artery on the left side was 3 to 5 mm.
- The diameter of the main renal artery on the right side was 3 to 6 mm
- The diameter of the accessory renal artery was 2 to 3 mm.
- The average diameter of Right renal artery was 4.64 mm.
- The average diameter of Left renal artery was 4.12 mm.
- The mean diameter of renal artery was 4.38 mm.

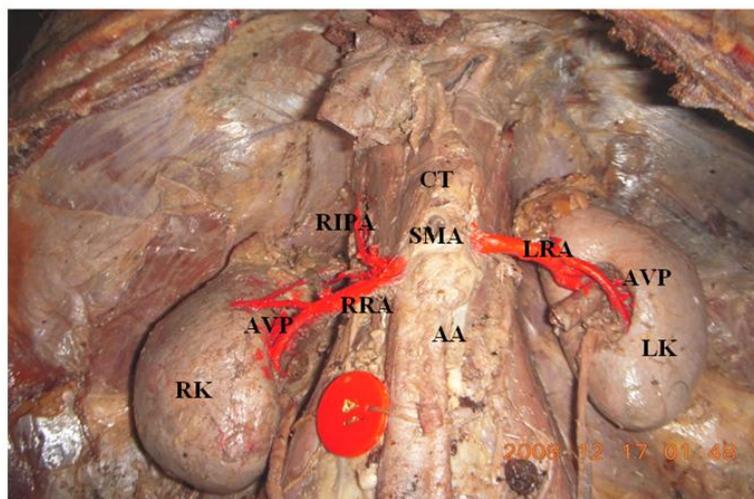


Fig-1: Main renal arteries (right and left) arising from abdominal aorta

### Accessory Renal artery

Henry Gray [2], Merklin & R. J Michels [3], Lockhart R D *et al.*, [4] said that accessory renal arteries are common in 30% of individuals and arises from the aorta above or below the main renal artery. Boijesen [5] found multiple renal arteries 20.7% in 369 patients examined by angiography. Necdet Kocabiyik *et al.*, [6] said that the incidence of additional renal arteries are in the range of 8.7 to 75.7%.

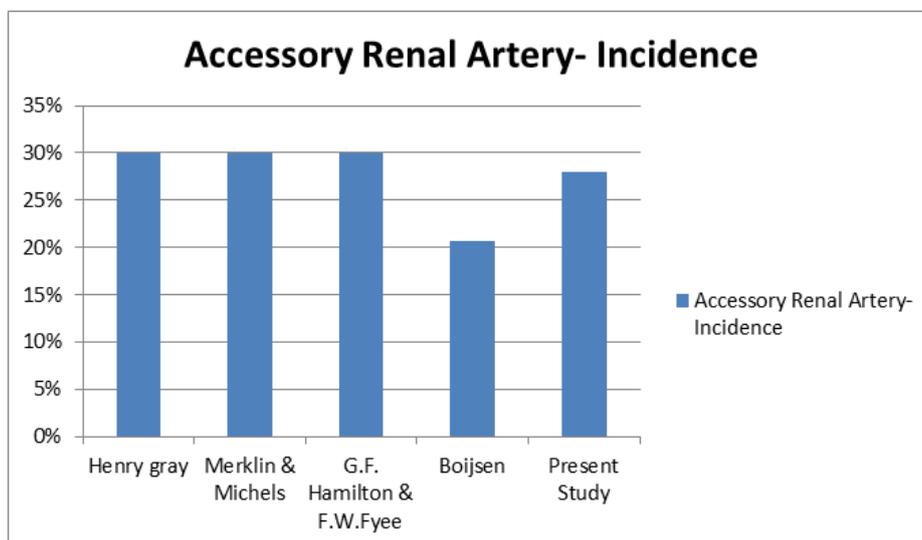
In the present study accessory renal artery was present in 17 specimens (28%) and all had their origin

from aorta. 7 accessory renal arteries arising above the main stem of renal artery and 10 arising below the main stem of renal artery from abdominal aorta. The percentage is high compared to Boijesen [5] but coincides with Henry Gray [2], Merklin & Michels [3], R. D. Lockhart, G. F. Hamilton & F. W. Fyee [4], Necdet Kocabiyik *et al.*, [6] (Table-1 & Chart-1).

In the present study the incidence of accessory renal artery is 28%.

**Table-1:**

Study	Incidence of accessory renal artery
Henry Gray [2]	30%
Merklin & Michels [3]	30%
G. F. Hamilton & F. W. Fyee [4]	30%
Boijesen [5]	20.7%
Present Study	28%

**Chart-1: Showing the incidence of accessory renal artery****Diameter**

Olsson and Wholey [7] said that the renal artery diameter vary from 2 to 8 mm. Julia Lewis and Barbara Greco [8] said the diameter of renal artery ranges from 3 to 7 mm. In the present study of 60 adult specimens the diameter of main renal artery was in the range of 3 to 6 mm. Proximal to the bifurcation which is similar to the report of Julia Lewis and Barbara Greco [8]. It slightly varies from Olsson and Wholey [7]. Aytac *et al.*, [9] said that the mean diameter of

renal artery was 5.87 mm. Adam D. Talenfeld [10] said that the mean diameter of left and right renal arteries proximal to bifurcation was  $6.4 \pm 1.3$  mm. Saldarriaga B. Pinto S. A., Ballesteros L. E [11] said that the mean diameter of renal artery was 4.87 mm. The mean diameter of renal artery in the present study was 4.38 mm which coincides with Saldarriaga, B. Pinto S. A., Ballesteros L. E [11] and is less than Aytac *et al.*, [9] and Adam D. Talenfeld [10] Table-2 & Chart-2).

**Table-2:**

Study	Mean renal artery diameter
Aytac <i>et al.</i> , [9]	5.8 mm
Adam D <i>et al.</i> , [10]	$6.4 \pm 1.3$ mm
Saldarriaga <i>et al.</i> , [11]	4.87mm
Present Study	4.38mm

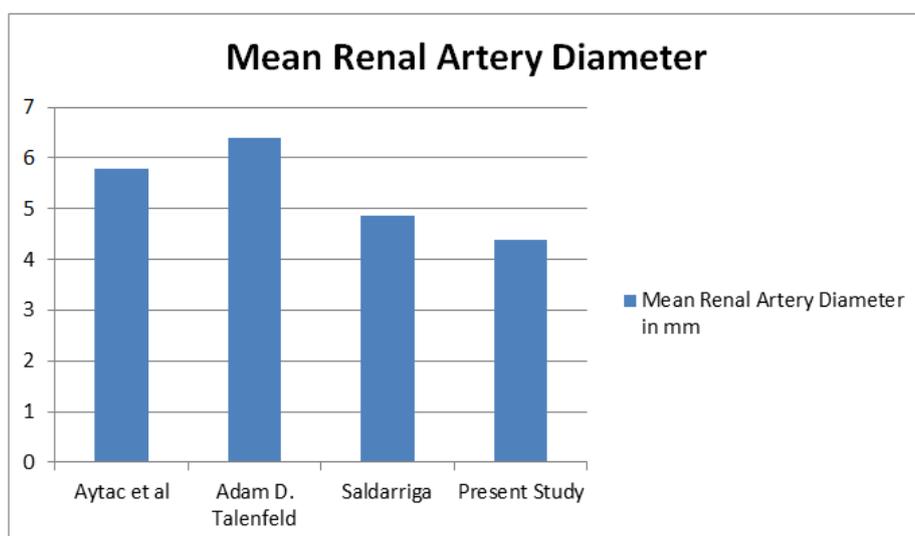


Chart-2: Showing mean renal artery diameter

### Dissection method

The adult cadaver was placed in the supine position. A midline skin incision was made from the xiphi sternum to the pubic symphysis encircling the umbilicus. From the xiphi sternum incision was extended laterally up to the lower border of the 10<sup>th</sup> costal cartilage in the mid-axillary line above and below the incision was extended from the pubic symphysis to iliac crest. After removing the organs like Stomach, duodenum, intestines (both small and large) liver and spleen the retroperitoneal cavity was exposed. Kidney was visualized and the renal arteries were traced from their origin from aorta up to the hilum of the kidney and the relations at the hilum were noted. Presence of any accessory renal artery from the Aorta above or below the main renal artery was noted. Its source of origin, level of origin, length and variations in position were noted. The Mean renal artery diameter of the Main Renal artery as well as the Accessory Renal Artery were measured using vernier calipers. Photographs were taken and anatomical markers added using photo editor software

### CONCLUSION

The renal artery was studied in detail by conventional dissection. The observation of the study have been correlated with the findings of already existing studies. The following conclusions were derived:

- Source of origin of renal artery in all the 60 specimens was from abdominal aorta. Single renal artery was present in 72% specimens.
- The accessory renal arteries were present in 17 specimens (28%) of which 7(8%) were upper polar and 10 (16%) were lower polar.
- The mean diameter of the main renal artery on the left and right was 4.12 mm and 4.64 mm respectively. The diameter of accessory renal artery was in the range of 2 – 3 mm.

The comprehensive study of the origin, presence of accessory renal artery and diameter under a common umbrella was to increase the awareness of the presence of such anatomical arrangements and allow a proper evaluation of the renal vascular anatomy. In selected cases a conventional arteriography / CT angiography can be of great help in reducing unexpected problems and improving the outcome. The knowledge of renal vascular anatomy and its variations are very much essential in case of renal transplantation, renal surgeries, uro-radiology, gonadal colour Doppler imaging and in surgeries of abdominal aorta and gonadal surgeries.

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