

Research Article

Cadaveric study of accessory renal arteries and its surgical correlation

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Received: 8 January 2013

Accepted: 3 February 2013

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ABSTRACT

A thorough knowledge of the accessory renal arteries has grown in importance with the increasing number of renal transplants and other urological procedures. The literature indicates that multiple renal arteries are found in 9-75% cases. Normal anatomy describes each kidney receives irrigation from single renal artery which arises from abdominal aorta at the level L1-L2 vertebrae just below the superior mesenteric artery. Renal artery variations include their origin, number and course. The most common is the presence of additional vessels (accessory arteries) arising above the usual trunk is more frequent than one arising below. The accessory renal arteries are always end arteries. The kidneys may receive a single artery although each organ may equally be supplied by as many as six end arteries. The right and left renal arteries may arise from the aorta by a common stem or arise at lower point than usual in which case the kidneys lie below their usual position. There may be several renal arteries on each side or the renal artery may divide close to its origin into several branches. Current literature reports great variability in renal blood supply, the number of renal arteries mentioned being the most frequently found variation. Normal renal arterial information is useful not only for planning and performing of endovascular, laparoscopic urological procedures and renal transplants. In order to facilitate the clinical approaches, we studied renal arterial pattern in 25 formalin fixed cadavers, on 50 kidneys during the period of one year. The purpose of this present study was to establish the incidence of accessory (aberrant) renal arteries in human cadavers and also discuss its surgical correlation during urological procedures and angiographic interventions.

Keywords: Kidney, Anatomical variations, Accessory renal arteries, Hilar

INTRODUCTION

The kidneys are one of the vital organs in the human body. It receives rich blood supply, nearly 25% of the cardiac output pass through the renal arteries to be filtered by the kidneys. These are end arteries with no anastomosis. Variations in the number and arrangement of the renal vessels are extremely common. The so called aberrant or accessory arteries are in fact, normal segmental arteries. Embryologically development of kidney is very complex, as it develops from pronephros, mesonephros and metanephros. The former two regress but the arterial network to these segments may remain and lead to supernumerary renal arteries (two or more

arteries to a single kidney). Current Literature reports great variability in renal blood supply, the number of renal arteries mentioned being the most frequently found variation.¹ It is most common renovascular anomaly, occurrence ranging from 25%-50% of kidneys. One or two accessory renal arteries are frequently found, especially on the left side.² Instead of entering the kidney at the hilus, they usually pierce the upper or lower part of the organ. Therefore understanding anatomy of the vascular variation of the kidney is essential for the clinicians or surgeons to perform safe procedures and for adequate surgical management. The variations described in the current observation present a unique pattern of congenital renal vascular variants having surgical and radiological importance.

METHODS

During routine abdominal dissections for medical undergraduates, 25 cadavers (50 kidneys) of both sexes, aged 40-70 years, was studied over a period of one year. Dissection of the arteries entering the kidneys was traced for proper visualization of hilar pattern of renal artery and was studied in detail. The kidney specimens obtained from subjects of Indian origin. Comprehensive dissection carried out in the dissection hall of Anatomy department on 25 cadavers over a period of one year, revealed single main renal artery on either side in 22 cadavers (88% of specimens).

RESULTS

The anatomical findings included the presence of multiple renal arteries in 3 cadavers. In the present study group consisting of 25 cadavers i.e. 50 kidneys, the origin of main renal arteries of the aorta was between L1-L2 Vertebrae in 22 cadavers. A single renal artery was present in both kidneys in 88% of cadavers i.e. in 44 kidneys. The presence of accessory (aberrant) renal arteries was seen only in 3 cadavers. Out of 3 cadavers additional renal arteries were seen unilaterally in 1 cadaver, on the left side and on the right side kidney had a single renal artery (Figure 4). Bilaterally accessory renal arteries were seen in two cadavers i.e. in 4 kidneys (Figure 1, Figure 2 & 3). The extra renal arteries the accessory or aberrant arteries were seen in 3 cadavers (12%), and in 5 kidneys around 20% respectively.

Accessory artery= artery arising from abdominal aorta (A.A) or renal artery (RA).

Aberrant artery= artery arising from other than aorta or the renal artery.

Perforating artery= artery piercing the upper or lower poles not entering through the hilum.

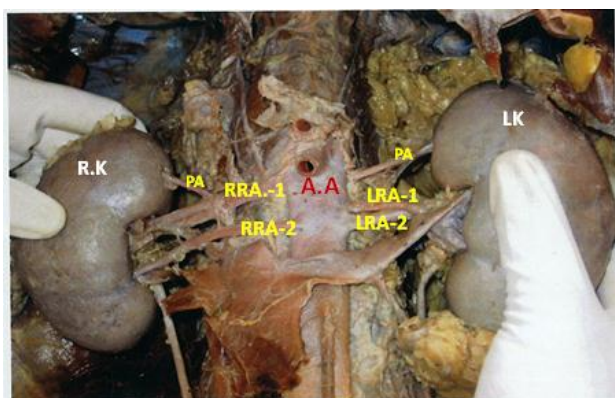


Figure 1: Cadaver 1, bilateral triple renal arteries.

Cadaver 1 (Figure 1): Bilateral triple renal arteries including with perforating arteries. On the right side two renal from the aorta entering the hilum and one

perforating artery (accessory) to the upper pole was from the upper R.A. On the left side two renal arteries from the aorta entering the hilum and the perforating artery (accessory) to the upper pole was from the aorta.

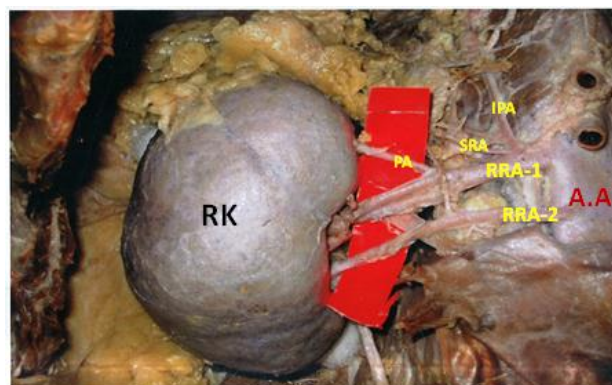


Figure 2: Cadaver 2, Right kidney, triple renal arteries.

Cadaver 2 (Figure 2): Right triple renal arteries- The double renal arteries arising from the aorta, entering the hilum and with perforating artery (accessory) to the upper pole arising from the upper R.A.

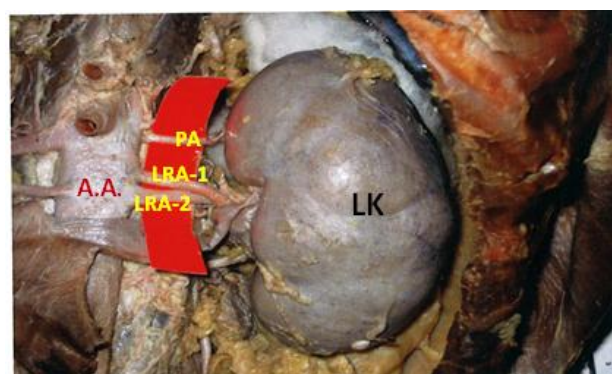


Figure 3: Cadaver 2, Left kidney, triple renal arteries.

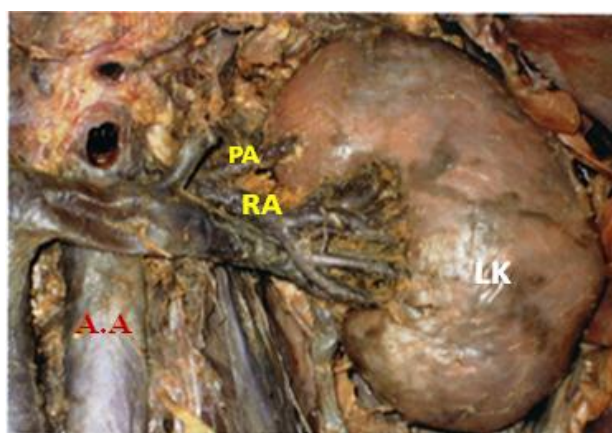


Figure 4: Cadaver 3, Left kidney, Prehilar multiple branching of left renal artery with perforating artery to the upper pole.

Cadaver 2 (Figure 3): Left triple renal arteries- The double renal arteries arising from the aorta entering the hilum and with perforating artery (accessory) from the aorta to the upper pole.

Cadaver 3 (Figure 4): Prehilar multiple branches of the left renal artery entering the hilum and a perforating artery (accessory) to the upper pole arising from the left renal artery.

DISCUSSION

The variations in the renal arteries are considered critical issues that surgeons or radiologists should have a thorough envision and evaluation of the condition. Clinically accessory or aberrant renal arteries constitute most common vascular variant. Multiple renal arteries are when any kidney is supplied by more than one artery. The accessory artery denotes the artery arising from aorta and supplying the same renal segment, on the other hand term anomalous or aberrant vessel should be reserved for arteries that originate from other than aorta or main renal artery (e.g. Inferior phrenic A, Suprarenal A, Ureteric A, Iliac A, Mesenteric A etc.).

Accessory renal arteries varying in size are generally derived from the Aorta (9-76%) and may enter the kidney at any point. The right and left renal arteries arise at the same level in about 30% of cases, and the right was higher in some and left was higher in some cases. A single renal artery on one side and multiple renal arteries on the other is not uncommon. There was no reported sex or racial differences.¹ The present study of 25 cadavers, out of which 3 cadavers had multiple renal arteries. Bilaterally in 2 cadavers, which is a rare finding, and 1 cadaver had prehilar multiple renal arteries on the left side and the right side had single renal artery which is also rare finding. It also included perforating arteries arising from Aorta or from Main renal arteries and there were no aberrant renal vessels.

According to Michal's & Merklin 1956²- The renal arteries divide into segmental arteries before entering the hilum giving an appearance of multiple renal arteries. There are two types of division: 1. Distributed type: RA breaks up into terminal branches early after the origin from aorta with RA short stem about 3 cms. 2. Magistral type: RA breaks up into terminal branches at the hilum, i.e. RA with long stem about 5 cms. The present study one cadaver (cadaver- 3 & figure 4) had pre hilar multiple branching of left renal artery with a perforating artery to the upper pole. This cadaver shows the Magistral type. This type is considered as hazardous and not suitable for donor nephrectomy as anastomosis with multiple renal arteries is very difficult. Multiple renal arteries are usually unilateral in 30% and bilateral in approximately 10%. Accessory renal arteries usually arise from the Aorta or Iliac arteries anywhere from the level of T11-L4 vertebra. In rare case they can arise from the lower thoracic or mesenteric arteries. Accessory renal arteries

course into the renal hilum and then perfuse the upper or lower poles. Accessory renal vessels (perforating artery) to the polar are usually smaller than accessory hilar renal vessels, which are typically equal in size to single renal artery.³ In the present study the 2 cadavers had bilaterally double renal arteries, large of equal caliber entering the hilum and one perforating (accessory) renal artery entering to the upper pole was smaller to the arteries entering the hilum (figure 1-3).

Most of the variations of human renal vessels can be explained on the basis of phylogeny. An anomalous in human, is normally present in some animals. The most common variation of renal artery is an accessory renal artery arising from aorta or main renal artery about 30%.⁴ The present study had accessory renal arteries in 3 cadavers, bilateral in case of 2 cadavers. All these accessory renal arteries were arising from the Aorta or from upper renal artery (figure 1-3). One cadaver had unilateral prehilar multiple branching left renal artery with perforating branch to upper pole and opposite side had single renal artery (i.e. right). Therefore it make up 20% of kidneys (5 kidneys) had accessory arteries and no anomalous artery. The simplest vascular pedicle namely single artery and vein bilaterally is seen in half the patients. The incidence of anatomical variations in the renal vascular pedicle is not uncommon. Anomalies determine the choice of kidney in renal allografting and may disqualify a potential donor. Routine arteriography should be considered in evaluation of living related renal donors.⁵ The present study includes 25 cadavers and 22 cadavers (88%) had simple vascular pedicle with single renal artery and vein bilaterally.

The most common variation of an accessory renal artery may enter through the hilum or through the surfaces of the kidney. Graves (1956) accordingly described an artery arising from aorta or main renal artery should be accessory and other sources should be called aberrant artery.⁶ According to Graves an accessory renal artery studies showed different incidences ranging from 11-61%. The present study showed accessory renal arteries in 3 cadavers that is in 5 kidneys (1 unilateral and two bilateral, i.e. the incidence being 20%).

Classification of renal arterial anomalies was done by Irena Vilhova et al in 2001.⁷ According to them:

1. Triple renal arteries are three vessels originating from the Aorta with different diameters entering the kidney through hilum (Seldom found).
2. Double renal arteries are two vessels originating from the Aorta, with similar diameter also entering through the hilum of the kidney.
3. Accessory renal arteries arising from the Aorta with diameter of segmental arteries supplying one segment only, enter the kidney through upper pole or lower pole or the hilum.

4. Perforating renal arteries arising from Aorta or one of its major branches, diameter being sub-segmental supplying one segment and entering the kidney outside the hilum i.e. via upper or lower pole.

The present study includes bilateral triple renal arteries entering the kidney, two entering via the hilum with similar diameter, one perforating artery of smaller diameter entering the upper pole, in all the two cadavers, which is very rare and seldom seen (2 cadavers in 25 cadaveric study i.e. 8 %.). Standard text books mentioned accessory renal arteries to upper or lower poles are linked to developmental defects.^{8,9}

The accessory or aberrant renal arteries have been encountered with increasing frequency over past decade. This is due to wide spread use of renal angiography and other imaging modalities, in recent years. We as anatomist believe that anatomical knowledge of accessory or aberrant renal arteries is important for all surgical and radiological interventions involving the kidneys or it may lead to erroneous interpretation.

CONCLUSION

Accessory or aberrant renal arteries are end arteries. Knowledge of the unrecognized presence of aberrant or accessory arteries is important because they may be damaged during renal surgery and their presence must be considered in evaluating a donor kidney for possible renal transplantation, renovascular reconstruction and other uroradiological procedures. It is mandatory for the surgeon to understand the abnormality in renal vasculature; otherwise renal transplant may be jeopardized by the presence of aberrant vessels. A cadaveric study on accessory renal arteries with surgical correlation was undertaken in the department of Anatomy

is humble effort to throw light on already existing knowledge.

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DOI: 10.5455/2320-6012.ijrms20130205

Cite this article as: Saritha S, Jyothi N, Praveen Kumar M, Supriya G. Cadaveric study of accessory renal arteries and its surgical correlation. *Int J Res Med Sci* 2013;1:19-22.