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Case Report

A rare combination of variations in renal vascular anatomy: embryological perspective and clinical importance

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Abstract

Renal vascular variations are frequent but they are usually asymptomatic and diagnosed accidently during angiography or surgery leading into severe complications. Thus knowledge of renal angioarchitecture, whether usual or variant, is considered prerequisite for successful and uncomplicated surgeries and interventional radiology.

This case report describes one of such varying branching pattern of in which right kidney was supplied by three renal arteries and drained by a pair of tributaries of renal vein. An inferior polar renal artery and an accessory renal artery were encountered along with main renal artery on the right side. Variant hilar branching pattern of left renal artery as triplicate variety was also found on left side in the same case.

Awareness of such variations would certainly be helpful in various renal surgeries and radiological procedures.

Key words [kidney] [accessory renal artery] [inferior polar artery] [hilar branching pattern]

Introduction

Vascular variations are frequent in abdomen but they are usually asymptomatic and diagnosed accidently during diagnostic angiography, surgery or dissection. Despite refinement in various abdominal surgical techniques, vascular complications still account for considerable morbidity and mortality. The variant renal angioarchitecture is also not uncommon and variation in the number, source and branching pattern of renal arteries (RA) can be found in approximately 30% of population [1].

Usually the RA arises from lateral aspect of abdominal aorta below the origin of superior mesenteric artery at the upper lumbar level and divides into anterior and posterior divisions close to hilum of kidney, which give rise to number of end arteries known as segmental arteries supplying the respective segments of kidney. While an accessory RA is the one that is accessory to the main RA, running towards renal hilum, aberrant RA supplies the kidney without entering its hilum.

Existence of variation in renal arterial anatomy is accountable in renal pathologies, radiological interventions, renal transplants and other procedures involving the kidneys because altered state of hemodynamics is obvious in such cases. Interestingly, few recent researchers have suggested thorough investigations for presence of any renal vascular variant in the patients of galactosemia [2].

A detailed knowledge of renal angioarchitecture, whether usual or variant, is thus considered a prerequisite for successful, uncomplicated renal surgeries, transplants and interventional radiological procedures; and risk of graft loss and iatrogenic vascular injuries can greatly be reduced by their identification.

One of such case involving a rarely reported combination of varying branching pattern of RA is reported here.

Case Report

During routine dissection of a well-embalmed 76-year-old male cadaver in the Department of Anatomy, MLNMC, Allahabad, India on 11 May 2012, the kidneys and their hilar structures were explored and following variations were observed:

- The right kidney was found lobulated, measured 12 x 5.5 x 3.5 cm and received three RAs. It was drained by two veins as superior and inferior tributaries, which were united to form single right renal vein 3 cm distal to right renal hilum.

- The main right RA was found arising from right lateral surface of abdominal aorta at the level of L2 vertebra (diameter: 4.4 mm) which followed its usual course and relations; and divided into anterior and posterior divisions behind the right renal vein, which intern gave off several segmental branches close to the hilum (Figures 1, 2).
- An accessory right RA (diameter: 3.0 mm) was originated from main right RA, 2 cm distal to its origin, and entered into right renal hilum posterior to it (Figure 1).
- An inferior polar RA (diameter: 4.2 mm) originated from right lateral surface of abdominal aorta at the level of upper border of L4 vertebra, below the origin of inferior mesenteric artery. It followed long and straight course, behind the right gonadal vessels and ureter, towards the right kidney and entered through posterior surface of its capsule to supply the lower pole (Figures 1, 2).
- The left kidney was also lobulated, measuring 12.5 x 6.5 x 4.5 cm. It was drained by single left renal vein and supplied by left RA (diameter: 5.4 mm), arising from left lateral surface of abdominal aorta at the level of L2 vertebra 1.5 cm below the origin of right RA (Figure 2).
- No additional blood vessel was seen but variation in hilar branching pattern was well appreciated on left side in the form resembling "triplicate pattern". Left RA was divided into two superior (anterior and posterior) and an inferior divisions 3.5 cm proximal to hilum (diameters of each division: 2.8–3.2 mm) which approached the upper and lower ends of left renal hilum and divided into several segmental branches to supply respective segments of left kidney (Figure 3).

No other anatomical variation was evident in the region and suprarenal as well as gonadal vessels followed their usual courses. Diameter of all arteries was measured 1 cm distal to their origin, with the help of vernier caliper and scale.

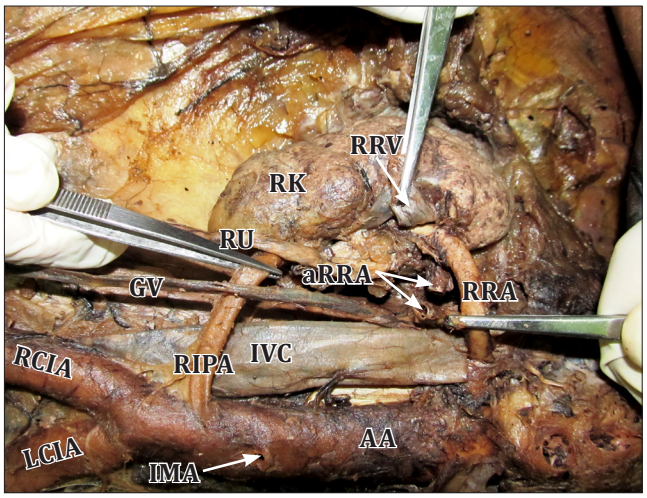

Figure 1. Photograph showing right kidney with hilar structures and supernumerary vessels. *(**RK**: right kidney; **RRV**: right renal vein; **RU**: right ureter; **RRA**: right renal artery; **aRRA**: accessory right renal artery; **IVC**: inferior vena cava; **AA**: abdominal aorta; **IMA**: inferior mesenteric artery; **RIPA**: right inferior polar artery; **GV**: gonadal vessels; **RCIA**: right common iliac artery; **LCIA**: left common iliac artery)*

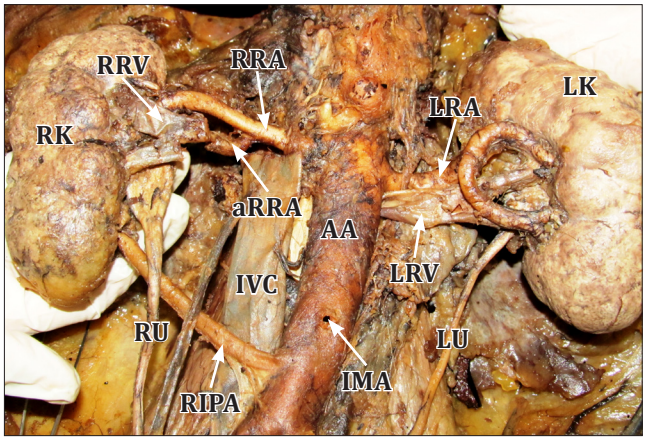

Figure 2. Photograph showing both kidneys with their angioarchitecture. *(**RK**: right kidney; **RRV**: right renal vein; **RU**: right ureter; **RRA**: right renal artery; **aRRA**: accessory right renal artery; **IVC**: inferior vena cava; **AA**: abdominal aorta; **IMA**: inferior mesenteric artery; **RIPA**: right inferior polar artery; **LK**: left kidney; **LRA**: left renal artery; **LRV**: left renal vein; **LU**: left ureter)*

Discussion

In recent times, trend in surgical branches is to move towards minimal invasive surgery to decreased morbidity, if the patient is selected carefully and investigated properly. Despite refinement in surgical techniques in the field of urology like laparoscopic procedures and renal transplantation, vascular complications still accounted for considerable morbidity and mortality till recent past when anatomy of renal area was revisited and detailed knowledge of renal angioarchitecture, whether usual or variant, was thus considered a prerequisite for successful and uncomplicated procedures [3].

Anatomical variations of RA are frequent in the literature including their number, source, course and allocation in renal parenchyma; and various reports have claimed their occurrence in about 30–35% of population, most common being an additional or accessory RA arising above or below the main RA which were reported in 20% of cases [4].

The generally accepted and precise terminology for these arteries has not been unified in majority of authors and the terms accessory or aberrant are not seem to adequately represent the arteries which are exclusive source of provision of blood to certain part of kidney without any significant anastomosis with main RA. They should be better termed as supernumerary renal arteries (sRA), which can be upper, polar, hilar and lower polar sRA. Polar arteries perforate the substance of the kidney rather than entering the hilum to supply a definite segment of renal parenchyma [5].

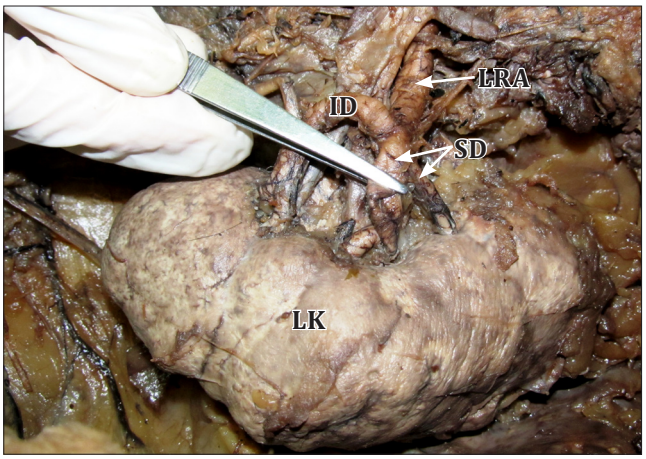

Figure 3. Photograph showing left kidney with triplicate hilar branching pattern of left renal artery. *(**LK**: left kidney; **LRA**: left renal artery; **SD**: superior division of renal artery; **ID**: inferior division of renal artery)*

The variations in RA anatomy can be explained on the basis of embryological development of mesonephric arteries which extends from C6 to L3 level. Most cranial vessels disappear while caudal arteries supply the future metanephric kidney, developed in pelvic cavity deriving its blood supply from branches of neighboring iliac artery. As embryo grows, kidneys ascend to reach the lumbar region and consequently their blood supply also shift from the iliac arteries to abdominal aorta. The sRAs are due to persistence of either cranial mesonephric vessels or embryonic arteries formed during renal ascend [6].

Various reports have appeared in literature describing variations in renal vascular anatomy. Kaneko et al. observed unilateral variations in 21.2% and bilateral variations in 4.7% cases. Talovic et al. (2007) found 28.2% cases with sRA originating from aorta, most common being lower polar RA, as described in present case, which was in concordance to other researches available in the literature as 25% to 30% [1, 4].

Few authors suggested that the presence of sRA is very probable when main RA has a diameter less than 4.15 mm and kidneys may not have any sRA if their main RA diameter is greater than 5.5 mm. So the RA diameter may be a predicting factor for presence of sRA [7].

Lower polar RAs are the most common type of sRA and extremely important clinically [5]. In some cases they are direct and surgically correctable cause of the hydronephrosis due to compression of ureter; and may also provide blood supply to the proximal portion of ureter, making it liable to necrosis in case of injury to these arteries.

Near the hilum of kidney each RA divides into anterior and posterior divisions, which intern divide into segmental branches prior to their entrance through the hilum. Reports of unusual hilar branching pattern can also be found in literature and knowledge of such an unusual branching pattern of the segmental arteries could be helpful to surgeons; because according to Weld et al., selective segmental vascular control may offer more benefits over total hilar control, reducing overall renal ischemic injury [8].

Interest in medical and surgical aspects of sRA has been high in the recent years due to advancement and refinement in the treatment modalities for renal diseases, and the fact that presence of sRA may be associated with other renal pathological conditions and postoperative complications involving renal surgeries. Renal transplant with single RA is technically easier as compared to the kidneys with sRA which may result in postoperative morbidity, decreased graft function, rejection episodes and acute tubular necrosis following the injury or ligation of sRA. Also each RA is a terminal branch and its injury causes segmental ischemia with delayed hypertension, leads to a direct link between essential hypertension and the presence of sRA, without evidence of other pathological changes [9].

The aim of this case report describing variation of renal arterial anatomy is to aid further the awareness to surgeons and clinicians the possibility of sRA and knowledge of such variant angioarchitecture with their embryological basis would certainly be helpful to achieve successful and uncomplicated management of renal diseases; and would enable interventional radiologists in planning and executing safe and successful procedures.

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