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CASE REPORT

UNIQUE BILATERAL SYMMETRICAL ACCESSORY RENAL ARTERY – A CASE REPORT

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ABSTRACT

Renal arteries normally arise from the abdominal aorta at the level L1 vertebra. During routine dissection of abdomen by the undergraduate medical students we noted, two additional renal arteries were observed on both sides arising from abdominal aorta. It is not associated with any other anomaly of kidneys or other vascular anomaly. Both arteries were caudal to the normal renal artery, entering the hilum of kidney anterior to the renal vein. Accessory renal arteries usually arise from aorta below the normal renal artery. Variations in renal arteries are common due its complicated development, ascent and rotation. These variations of arteries are common at the inferior pole rather than the superior pole of kidneys. Additional renal arteries may or may not be associated with the congenital malformations of the kidneys. The variations of renal arteries are considered critical that surgeons should have thorough knowledge. Renal artery variations such as their number, source and course are very common. Most of the variations of human renal vessels can be explained on the basis of phylogeny as many conditions which are anomalous in human are normally present in some animals. The most common variation of renal artery is the presence of an accessory renal artery, occurring in approximately 30% of cases. Accessory renal arteries usually arise from aorta commonly on left side and enter the hilum of kidney below the normal renal arteries. Knowledge of the presence of such additional renal arteries is necessary while performing the surgical and radiological procedures related to kidney. Variations in the renal vessels and supernumerary renal arteries have been observed frequently, either in routine dissections or in clinical practice. Knowledge of these variations of renal vascular anatomy has importance in exploration and treatment of renal trauma, renal transplantation, renal artery embolization, surgery for abdominal aortic aneurysm and conservative or radical renal surgery, laparoscopic surgeries and retroperitoneal operations.

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INTRODUCTION

During a Routine dissection of abdomen by the undergraduate medical students at AFMC, 88 years old female cadaver revealed an anatomical variation of the renal vessels. A formalin-fixed female cadaver aged 88 years whose case history and cause of death was known (acute Myocardial Infarction) was dissected. Exposure of the kidney was done following classical incision and dissection procedures after taking out the stomach and whole of the small intestine (Romanes, 1986). The procedures followed were in accordance with ethical standards of handling of cadaver for learning, teaching and research purpose. The right kidney measured 12 x 6.5 x 4 cm and left kidney measured 10.5 x 6 x 4 cm. Two additional renal arteries were observed on both sides arising from abdominal aorta (Fig 1). The origin of both arteries were caudal to the normal renal arteries, entered the hilum of kidney anterior to the renal vein instead of entering between renal vein and pelvis of kidney. The right artery entered as a single artery into the hilum of kidney without dividing but the left entered after dividing into 3 branches (Fig 2). These right and left arteries were not accompanied by corresponding renal veins. The right accessory renal artery originated 1 cm above the inferior mesenteric artery and traversed, in front of IVC behind the right gonadal vessels and then ascended upwards in front of right ureter, renal pelvis to enter into the hilum anterior to the renal vein as a single artery without dividing (Fig 3). The accessory left renal artery originated 3 cm above the inferior mesenteric artery from left side of the abdominal aorta to lie behind the left gonadal vessels, to ascend up slightly to enter into hilum of left kidney dividing into 3 branches (Fig 2). The accessory right renal artery has a tortuous course compared to the left accessory renal artery. Coexistence of additional renal arteries arising bilaterally symmetrical from abdominal aorta and supplying the kidney is a rare finding and on both sides the ureters were lying posteriorly.

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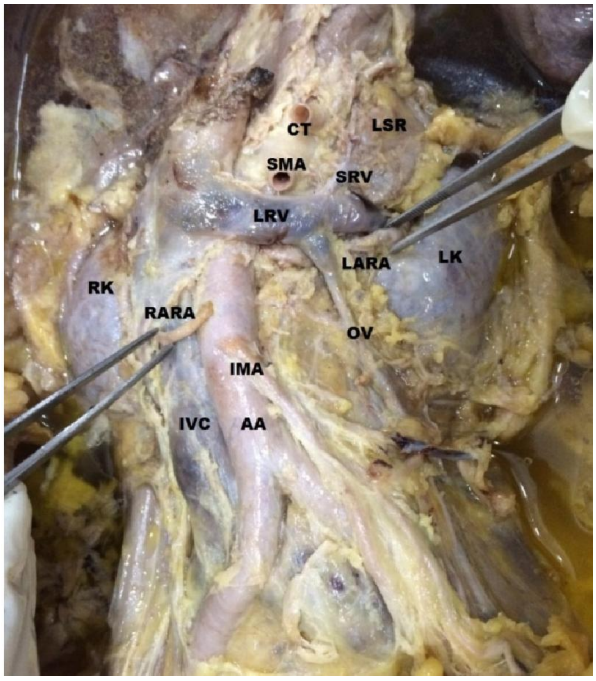

Fig. 1.

RK – Right Kidney.
LK – Left Kidney.
RSR – Right Suprarenal Gland.
Ct – Coeliac Trunk.
LSR – Left Suprarenal Gland.
SMA – Superior Mesenteric Artery.
RRV – Right Renal Vein.
LRV – Left Renal Vein.
SRV – Suprarenal Vein.
RARA – Right Accessory Renal Artery.
LARA – Left Accessory Renal Artery.
OV – Ovarian Vein.
IMA – Inferior Mesenteric Artery.
IVC – Inferior Vena Cava.
AA – Abdominal Aorta.
RCI – Right Common Iliac.
LCI – Left Common Iliac.
PM – Psoas Major Muscle.
RU – Right Ureter.
LOA – Left Ovarian Artery.

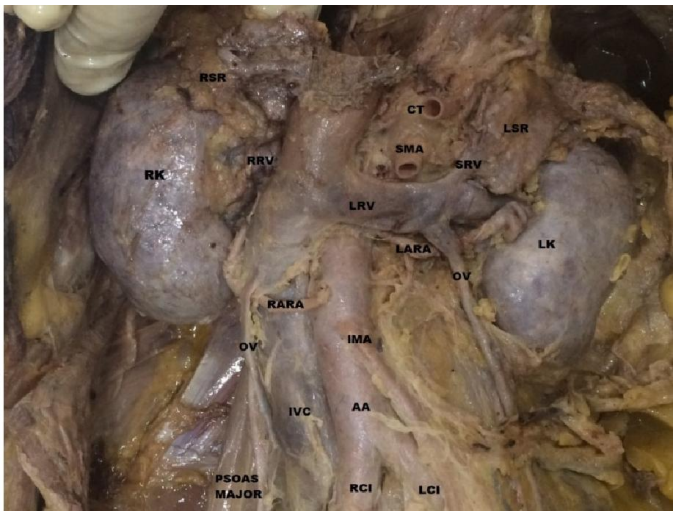

Fig. 2.

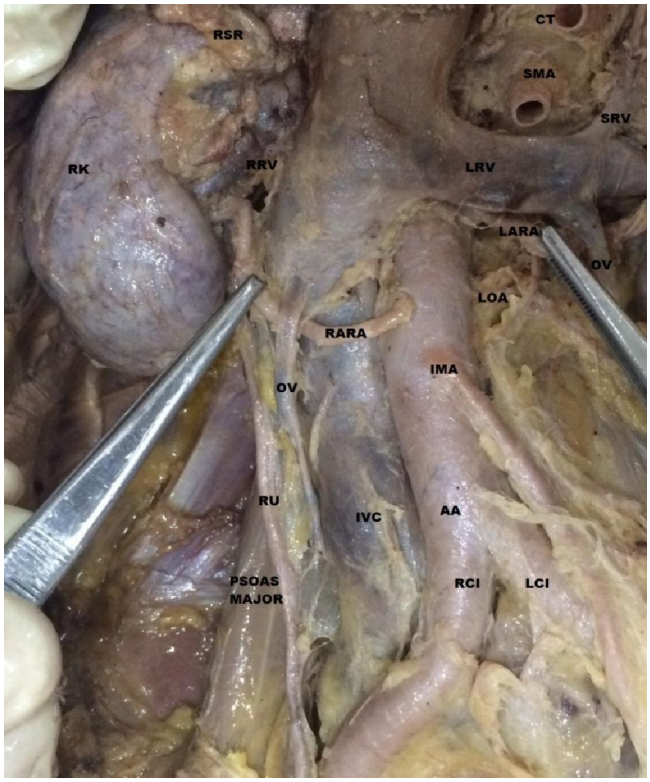

Fig. 3.

The objective of the present case report and review of literature is to bring awareness to clinicians about the variations in the blood supply of the kidney especially those who are performing invasive procedures and vascular surgeries on kidney.

The kidneys are retroperitoneal and they are located in the lumbar region, with the upper pole of the left kidney at the level of the T11vertebra, whereas the upper pole of the right kidney lies at a lower level, at the level of the T12 vertebra. Normally, renal arteries arise as lateral branches of abdominal aorta at the level of 2nd lumbar vertebra. Just below the origin of superior mesenteric artery. They run laterally towards the kidney to enter the hilum between renal vein and renal pelvis. Right renal artery is longer and higher than the left. It passes behind the inferior vena cava (IVC), right renal vein, head of pancreas and second part of duodenum. Left renal artery passes behind left renal vein, body of pancreas and splenic vein. It is crossed anteriorly by inferior mesenteric vein. Usually one renal artery supplies each kidney by dividing in to four or five branches/segmental artery, which enter the hilum between renal vein and pelvis of ureter. At the hilum each artery divides in to a posterior division that supplies the posterior segment and an anterior division that further branches and supplies apical, upper, middle and lower segments (Standring, 2005). This standard pattern is sometimes modified due to the difference in the branching pattern. However five segments are always present and there is no collateral circulation between these segments. An artery arising from Aorta in addition to main renal artery is called as accessory renal artery. An artery arising from sources other than aorta is called as aberrant renal artery (Graves, 1956).

Through the pronephric, mesonephric stages, definitive kidney develops from metanephros. During this period kidney ascends from pelvic cavity to sub diaphragmatic position. The hilum rotates from anterior to medial direction as it reach lumbar region. The foetal lobulations finally disappear (Moore and Persaud, 2003). According to the observations which were made by Felix, there are nine pairs of arteries which supply the mesonephros, metanephros, gonads and the adrenal glands. These nine pairs have been divided into the cranial (the 1st and the 2nd pair), middle (the 3rd to the 5th pair) and the caudal (the 6th to the 9th pair) groups. The renal arteries develop from a single pair, from the middle group. The remaining arteries of the middle group, if they persist; give rise to the accessory or the aberrant renal arteries. These persistent arteries may be associated with non-ascent, incomplete ascent, an ectopic kidney, persistence of fetal lobulations or other congenital malformations (Felix, 1912).

Multiple renal arteries are unilateral in approximately 30% of patients and bilateral in approximately 10%. Accessory renal arteries usually arise from the aorta or iliac arteries anywhere from the level of T11 to the level of L4 vertebra. In rare cases, they can arise from the lower thoracic aorta or from lumbar or mesenteric arteries. Usually the accessory artery courses into the renal hilum to perfuse the upper or lower renal poles. Accessory vessels to the polar region are usually smaller than accessory hilar renal arteries, which are typically equal in size to a single renal artery (Kadir, 1986).

Vascular anomalies related to renal artery or vein is not uncommon and their incidence varies between 9-76% (Gray, 1906). A meta-analysis has shown the incidence of accessory renal artery to be 30% (Merklin and Michels, 1958). An incidence of 30% certainly warrants proper understanding of its anatomy and clinical significance as the success of the renal transplant depends on immunological acceptance and perfect vascularization of the grafted kidney. Knowledge about these possible variations and anomalies of renal arteries are necessary for good surgical management during renal transplantation, repair of abdominal aortic aneurysms, urological procedures and angiographic interventions related to kidney (Nathan and Glezer, 1984; Olsson and Wholey, 1964)

DISCUSSION

Most of the abnormalities of renal artery are due to changing position of kidney as a part of its normal development and ascent. The kidney begins their development in pelvic cavity, during further development they ascend to lumber region which is their final position. When they are in pelvic cavity they are supplied by internal iliac artery or common iliac artery. While the kidney ascends to lumber region their arterial supply also shifts from common iliac to abdominal aorta (Kiebel and Mall, 1912). Thus knowledge of embryology of renal vasculature and its development is essential in order to understand the possibilities of multiple anomalies and variations in renal arteries.

In the anatomy books the variations in the origin of the renal artery were divided into two groups. They were: (1) The early division and (2) The extra renal arteries. The early division consisted of the branching of the main renal arteries into segmental branches, which lay more proximal in terms of their origins. Extra Renal Arteries (ERA) Were Divided into 2 Groups: the hilar (also called as accessory) and the polar (also called as aberrant) arteries. The hilar arteries entered the kidneys from the hilus with the main renal artery, whereas the polar arteries entered the kidneys directly from the capsule outside the hilus (Ozkan *et al*., 2006) There is no confirmed word in the literature regarding the nomenclature of renal arteries other than the main renal artery. They have been variously described as “accessory”, “aberrant”, “supernumerary”, “supplementary”, “multiple”, “accessory aortic hilar”, “aorticsuperior polar”, “aortic inferior polar” and“anomalous” (Satyapal *et al*., 2001). Felix 1912 has divided 9 pair of lateral mesonephric arteries in an 18 mm fetus in to cranial, middle and caudal groups. Middle group constitutes 3rd, 4th and 5th pair. This middle group later on remains as renal arteries and that persistence of more than one artery from middle group leads to occurrence of accessory renal artery. A capillary network known as “rete arteriosum urogenitale” has been described to give rise to all definitive renal arteries. Rete arteriosum urogenitale is derived from the segmental lateral splanchnic arteries which branch from aorta and form the proximal portion of this network. These arteries usually regress but their persistence or enlargement may give rise to variations in renal arteries (Felix, 1912). F J B Sampaio 1992 dissected 266 kidneys. 53.3% had single renal artery. Two hilar arteries in 7.3% and three hilar arteries in 1.9% .One hilar and one superior polar artery together in 14.3%, superior polar artery in 6.8%, inferior polar artery in 5.3% and other variations in 8.5%.we have found bilateral accessory renal artery which is a rare vascular anomaly in kidney (Sampaio *et al*., 1992). Kaneko *et al*. from their study of 170 cases, found that 36 of 170 subjects (21.2%) had multiple arterial origins on the left or right side, and 8 subjects (4.7%) had bilateral multiple arterial origins. Multiple renal veins were present in 22 cadavers (12.9%), and bilateral multiple veins were observed in 1 cadaver (0.6%) (Kaneko *et al*., 2008).

K S Satyapal 2001 found that out of 130 renal angiograms and 32 cadavers, kidneys showed presence of one additional renal artery in 23.2% and two additional renal arteries in 4.5%. They were seen more commonly on left side 32% as compared to 23.3 % on right side. Presence of one additional renal artery was seen bilaterally in 10. 2%. We have found bilateral accessory renal artery which is a rare vascular anomaly of kidney as stated by this author (Satyapal *et al*., 2001). Albolhassan B Shakeri 2007 reported the presence of accessory renal artery bilaterally on digital subtraction angiography (DSA) performed on a renal transplant donor. Two renal arteries originated from aorta on Right side. One was a normal hilar artery and second was lower polar artery. Left accessory renal artery simultaneously supplied upper and lower pole by replacing the upper / apical and lower segmental artery. Main renal artery divided in to anterior and posterior segmental arteries (Abolhassan *et al*., 2007). Dissection of 40 cadavers studied by Dhar andLalhas revealed a single main renal artery oneither side in 80% of the specimens. Multiple(accessory) renal arteries in 20% of thespecimens with unilateral anomaly (15%) beingmore ommonly encountered than bilateralanomaly (5%) (Dhar and Lal, 2005).

BeataPatasi 2009 reports single accessory right renal artery from abdominal aorta entering lower pole at the same point of exit of renal vein (BeataPatasi and Andrew Boozary, 2009). In a study conducted on 267 Thai cadavers, following observations regarding renal artery were made: a single hilar artery in 82% of cases; double renal arteries in 17% of cases; and triplerenal arteries occurred in 1% (Khamanarong *et al*., 2004).

Bindhu 2010 reported right accessory inferior polar renal artery coexisting with multiple vascular variations. Right Testicular artery was a branch of accessory renal artery. Right Obturator artery was a branch of posterior division of internal iliac artery. Other associated vascular anomalies were not seen in our case (Bindhu *et al*., 2010). Anupama Gupta 2011 states that presence of 5 to 6 pairs of renal arteries from dorsal aorta in frog, 3 pairs indomestic fowl and 3 or more in lizard is a normal phenomenon. Cranial pairs arise from abdominal aorta while the caudal ones from distal branches of aorta. 17 cadavers out of 60 showed the presence of accessory renal artery. In one of the cadavers three accessory renal arteries were seen on left side and two on right side. Our case shows presence of two accessory renal arteries one each on both sides (Anupma Gupta *et al*., 2011). Rusu reported bilateral doubled renal arteries on the right side as superior hilar and inferior hilar renal arteries and on the left side as superior hilar and inferior polar renal arteries (Rusu, 2006). All these renal arteries emerged from the abdominal aorta, as in our case Hemanth kommuru in 2012 studied 182 kidneys. 34 kidneys showed presence of one additional artery, whereas two additional arteries were seen in 18 kidneys, extra artery was present unilaterally in 6 cadavers and bilaterally in 20 cadavers. 23 showed presence of superior polar artery and 29 showed inferior polar artery. They also mentioned that in one of the cases the aberrant (accessory) renal artery was a branch of superior mesenteric artery. The abnormal or accessory renal arteries to any of the poles of the kidney can be considered as segmental vessels. They are due to persistence of fo *et al* renal vessels .When these vessels enter the upper or lower pole of kidney they are termed as "polar arteries, however the nomenclature of these arteries is still not clear as different authors describe them as additional, abnormal or accessory renal arteries (Hemmanth Kommuru *et al*., 2012).

Bulic *et al*. reported that the right kidney received two renal arteries from the aorta that were similar in diameter, both entering through the hilum. The left kidney had three arteries originating from the aorta, one at its usual hilar position and two entering the renal cortex at its upper and lower poles. The upper pole of the left kidney also gave rise to an additional tributary of the renal vein (Bulic *et al*., 1996). Bayramoglu *et al*. reported a variant which consisted of bilateral additional renal arteries originating from the abdominal aorta and an additional right renal vein accompanying the additional right renal artery. These anomalies were associated with unrotated kidneys with extrarenal calices and pelvis. All the additional vessels were located posterior to the ureter with a close relationship to the ureteropelvic junction on the right side (Bayramoglu *et al*., 2003). The variations of renal arteries described in the presentcaseare a unique pattern of renal vascular variants having surgical and radiological importance.

Conclusion

The knowledge of this potential anomaly is important for surgical procedures related to renal transplantation, abdominal aortic aneurysm, ureteric surgery, angiographic interventions, renal artery embolization, renal trauma and conservative or radical renal surgery. Bilateral symmetrical accessory renal artery in our case passed superficial to ureter and behind the ovarian vein on both side and hence can lead to partial obstruction of ureter may lead to hydronephrosis. Surgeons should exclude the possibility of presence of such accessory renal arteries obstructing ureter prior to the surgical treatment of hydronephrosis and also while performing renal transplant one needs to have prior anatomical knowledge of normal renal vasculature and also accessory renal arteries in order to perform successful graft. It has been described that failure to restore circulation in accessory renal artery after surgery may cause unnecessary ischemia or necrosis of renal tissue. In recent years, interest in the surgical and medical aspects of accessory renal arteries has been high. One has to keep in mind that transplanting a kidney with accessory renal arteries has several theoretical disadvantages – acute tubular necrosis, rejection episodes, decreased graft function, and prolonged hospitalization. The present case highlighted the presence of bilateral symmetrical accessory renal arteries entering at the hilum of kidney. The awareness about the presence of such variation is important from the academic, surgical and radiological point of view. With increase in number of cases of renal transplantations, successful graft with multiple arteries may become a routine procedure.

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