

## Double Accessory Right Renal Arteries.

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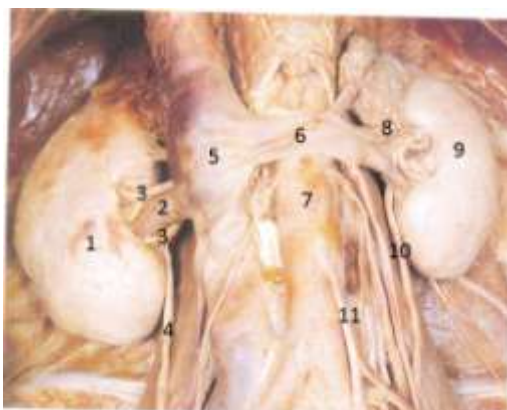
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**Abstract:** Renal arteries normally arise from the abdominal aorta at the level L1 vertebra. During routine dissection of abdomen by the undergraduate medical students two additional renal arteries were observed on the right side arising from abdominal aorta. The artery cranial to the normal renal artery entered the anterior aspect of the kidney 4cm below the upper pole. The second artery was caudal to the normal renal artery. This artery entered the lower pole of kidney. Accessory renal arteries usually arise from aorta below the normal renal artery. These are more common on left side and enter the hilum of kidney below the normal renal arteries. They are also seen more commonly at the lower pole than at the upper pole of kidney. Knowledge of presence of such additional renal arteries is necessary while performing all the surgical and radiological procedures related to kidney.

**Key words:** Accessory renal artery, Polar arteries, Renal artery, Renal angiography, Renal transplant.

### I. Introduction

The left and right renal arteries usually arise from the lateral aspect of abdominal aorta just below the origin of superior mesenteric artery at the level of L1 vertebra. They cross the corresponding crus of diaphragm anteriorly. Right renal artery is longer and higher than the left. It passes behind the inferior vena cava, 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 which enter the hilum between renal vein and pelvis of ureter<sup>1</sup>. Based on the arterial supply each kidney is divided in to five segments. 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. 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<sup>2</sup>. 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<sup>3</sup>. The presence of an accessory/aberrant/ abnormal renal artery at the lower pole is in fact a segmental vessel that is a persisted foetal vessel with an abnormal origin<sup>2</sup>. Vascular anomalies related to renal artery or vein is not uncommon and their incidence varies between 9-76%<sup>4</sup>. A meta-analysis has shown its median incidence of accessory renal artery to be 30%<sup>5</sup>. 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 vascularisation of the grafted kidney. Knowledge and awareness of these possible variations and anomalies of renal arteries are necessary for sufficient surgical management during renal transplantation, repair of abdominal aorta aneurysm, urological procedures and angiographic interventions<sup>6,7</sup>.



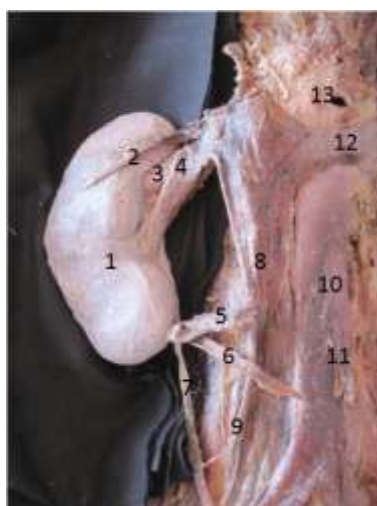
**Figure 1<sup>8</sup>**

1. Right Kidney
2. Right Renal vein
3. Right Renal artery
4. Ureter
5. Inferior Vena Cava
6. Left renal cava
7. Aorta
8. Left renal vein
9. Left Kidney
10. Left Ureter
11. Inferior Mesenteric artery

## II. A Case Report

During routine dissection of a male cadaver in department of Anatomy at Dr. D. Y. Patil Medical College, Pimpri, Pune Accessory renal arteries were observed. There were two additional renal arteries supplying the right kidney in addition to normal renal artery in an approximately 55yrs old male cadaver.

Abdomen was dissected as follows – A vertical incision on the anterior abdominal wall was given extending from xiphisternum to the pubic symphysis. The musculocutaneous flaps were reflected and the abdominal cavity was opened. After opening the abdominal cavity, both large and small intestines were removed and the structures close to posterior abdominal wall were dissected<sup>9</sup>. All the paired and unpaired branches of the abdominal aorta were studied. In addition to normal branches two additional renal arteries were observed on the right side supplying the right kidney. The cranial artery along with the accompanying vein was a small vessel arising just above the normal renal artery. It entered the anterior surface of kidney 4 cm below the upper pole. It was in the same plane as that of the normal renal artery which was entering the hilum of the right kidney. The caudal accessory renal artery was present below the inferior mesenteric artery. It was arising from the lateral aspect of aorta and it entered the lower pole of the kidney. This artery on its way to kidney crossed the right testicular vein. The caudal accessory renal artery was accompanied by a vein which drained into the Inferior vena cava. The accessory vein did not cross the testicular vein. The ureter was passing posterior to these vessels. These above mentioned vessels were present in addition to the normal renal artery and vein. Similar additional vessels were not seen on the left side. No other variation was found. Coexistence of additional renal arteries supplying the lower pole and region near the hilum is a rare finding.



**Figure 2**

1. Right Kidney
2. Cranial accessory renal artery along with the accompanying vein on the upper pole
3. Normal right renal artery entering the hilum.
4. Right renal vein
5. Caudal right accessory renal vein
6. Caudal right accessory renal artery.
7. Ureter
8. Inferior vena cava
9. Right testicular vein
10. Abdominal aorta
11. Inferior mesenteric artery
12. Left renal vein
13. Superior mesenteric artery

## III. Discussion

Most of the abnormalities of renal artery are due to changing position of kidney as a part of its normal development and ascent<sup>10</sup>. The kidney begins their development in pelvic cavity. During further development they ascend to lumbar 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 lumbar region their arterial supply also shifts from common iliac to abdominal aorta<sup>11</sup>

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<sup>10</sup>. Felix 1912 has divided 9 pair of lateral mesonephric arteries in an 18 mm fetus into cranial, middle and caudal groups. Middle group constitutes 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> 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<sup>12</sup>. 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<sup>13,14</sup>.

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%<sup>15</sup>. We have found one accessory renal artery entering anterior surface and one inferior polar artery in addition to normal hilar artery on right side.

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%<sup>16</sup>. We have found two additional renal arteries on right side.

K Khamanarong 2004 found single hilar artery in 82%, double in 17 %, (this includes 7% of upper polar arteries and 3% of lower polar arteries.) & three renal arteries in 1%<sup>17</sup>.

Albolhassan B Shakeri 2007 reported the presence of accessory renal artery bilaterally on digital subtraction angiography 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 into anterior and posterior segmental arteries<sup>14</sup>.

Satheesha Nayak 2008 found an extra inferior polar artery on left side. Abdominal aorta also showed a kink at the level of origin of renal arteries<sup>18</sup>.

Beata Patasi 2009 reports single accessory right renal artery from abdominal aorta entering lower pole at the same point of exit of renal vein<sup>19</sup>.

Like Ali Gurses 2009 reports occurrence of double hilar renal arteries bilaterally. On right side, upper renal artery gave two suprarenal branches and lower renal artery gave a testicular branch in addition to a testicular artery that arose from aorta just proximal to inferior mesenteric artery. Superior left renal artery gave segmental branches and lower renal artery gave testicular branch. The authors have not discussed about the origin of normal testicular artery on the left side<sup>20</sup>. Cranial and caudal accessory renal arteries seen in our case did not give any branches.

S Bindu 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<sup>21</sup>. Other associated vascular anomalies were not seen in our case.

Anupama Gupta 2011 states that presence of 5 to 6 pairs of renal arteries from dorsal aorta in frog, 3 pairs in domestic 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<sup>22</sup>. Our case shows presence of two accessory renal arteries on right side.

Hemanth kammuru in 2012 studied 182 kidneys. 34 kidneys showed presence of one additional artery, where as 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<sup>23</sup>. 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 foetal renal vessels<sup>24</sup>. When these vessels enter the upper or lower pole of kidney they are termed as "polar arteries"<sup>17</sup>, However the nomenclature of these arteries is still not clear as different authors describe them as additional, abnormal or accessory renal arteries<sup>10</sup>.

Availability of huge amount of data about the presence of multiple renal arteries, categorised as accessory, aberrant or additional, presence of extra renal arteries unilaterally or bilaterally, superior and inferior polar arteries, necessarily warrants the importance of a uniform and internationally acceptable nomenclature and classification of renal arteries. Other factors like genetic background, oxygenation and haemodynamic changes may also account for presence of accessory renal artery. Recent reports have also associated galactosemia with renal vascular anomalies<sup>25</sup>.

The knowledge of this potential anomaly is important for surgical procedures related to posterior abdominal wall such as renal transplantation, abdominal aorta aneurysm, ureter surgery and angiographic interventions. Caudal accessory renal artery in our case passed superficial to ureter and testicular vein on right side and hence can lead to partial obstruction of ureter leading to hydronephrosis, or testicular vein predisposing to varicocele. Surgeons should exclude the possibility of presence of such accessory renal arteries obstructing ureter or testicular vein prior to the surgical treatment of hydronephrosis and varicocele. Although it is very rare, fibromuscular dysplasia of accessory renal artery can be responsible for renovascular hypertension. Selective renal angiography should be performed as gold standard test when renovascular hypertension is considered. Every multiple renal artery is likened to segmental artery so the risk of bleeding during urological surgery or renal transplantation, segmental ischemia and post operative hypertension increases, if the urologist is unaware of its existence<sup>19</sup>. Surgeons performing renal transplant need 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<sup>26</sup>. The present case highlighted presence of accessory renal arteries entering and supplying the anterior surface and lower pole 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 transplantation, successful graft with multiple arteries may become a routine procedure. Variation in the course and origin of renal arteries occur frequently and are of special interest to urologist with respect to diseases associated with it.

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