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## Case Report

# A unilateral additional right renal artery and vein – A case report

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## ABSTRACT

**Introduction:** Proper knowledge of variations of the vessels of the kidney is essential to radiologist and surgeons.

**Methods:** One such variation was observed during dissection of a 68-year-old male cadaver at Medical College, Kolkata. The cadaver was preserved and dissected by following proper steps.

**Observation:** On right side in addition to normal renal artery, an additional renal artery originated from the abdominal aorta and entered into the kidney through the lower part of its hilum. The additional renal vein emerged from the lowermost point of the hilum, passed medially to end in the posterior part of inferior vena cava below the opening of normal right renal vein.

**Conclusion:** The comprehensive knowledge of different vascular patterns is the key issue in determining the technical feasibility of different surgical interventions.

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## 1. Introduction

The paired renal arteries, taking 20% of the cardiac output arise from the lateral aspect of the aorta just below the origin of the superior mesenteric artery.<sup>1</sup> The right renal artery is longer, often higher than left and passing posterior to right renal vein, inferior vena cava.<sup>1</sup> The left renal artery is a little lower and passes behind the left renal vein and more anteriorly the body of the pancreas and splenic vein.<sup>1</sup>

In 70% of individuals a single renal artery divides into anterior and posterior divisions near the renal hilum and these divide into 4–5 segmental arteries supplying the renal vascular segments. In majority of the cases five arterial segments

namely apical, superior, middle, inferior & posterior are identified, although there can be considerable variations from this pattern.<sup>1</sup> Moreover, different vascular segments of the kidney are supplied by end arteries but larger intrarenal veins have no segmental organization and anastomose freely.<sup>1</sup>

The large renal veins lie anterior to renal arteries and open into the inferior vena cava almost at right angles.<sup>1</sup> The left renal vein runs posterior to splenic vein, body of the pancreas and then crosses the aorta anteriorly just below the origin of superior mesenteric artery. Left gonadal vein enters into it from below and the left suprarenal vein, usually receiving one of the left inferior phrenic veins drains in it from above but nearer the midline. Finally, the left renal vein enters the inferior vena cava a little superior to right vein.<sup>1</sup> Interestingly,

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the longer left renal vein makes the left kidney the preferred side for live donor in transplant surgery.<sup>1</sup>

Most of the variations of renal vessels remain unrecognized until being noticed during any surgical procedure, autopsy or arteriography. So, a rare case where the right kidney was supplied by an additional renal artery and drained by an additional renal vein is reported here.

## 2. Materials and methods

Different vascular abnormalities of right kidney were encountered during routine educational dissection of 68-year-old male cadaver in Medical College, Kolkata in the year 2009. The cadaver was preserved as per standard procedure.

The stomach, intestine and part of peritoneum were removed to get clear access to posterior abdominal wall structures like kidneys, associated blood vessels and nerves.

These structures were dissected out carefully by following proper steps and photographs were taken. Finally left renal vein was cut near its termination to inferior vena cava and the inferior vena cava was reflected to the right side to expose the abdominal aorta & renal arteries of both sides.

## 3. Case report (observation)

Right renal artery originated from the right side of the aorta and then passed horizontally anterior to the right crus of the diaphragm and behind the inferior vena cava to reach the hilum of the right kidney. Deep to inferior vena cava it gave a superior renal polar artery which entered into the upper pole of right kidney. No other segmental artery was found arising from main right renal artery.

Moreover, an additional renal artery aroused from the right side of the abdominal aorta was slightly above the level of the normal renal artery. It then passed downwards and to the right crossing the normal renal artery superficially to reach lower part of the hilum immediately above the additional renal vein (Figs. 1 and 2).

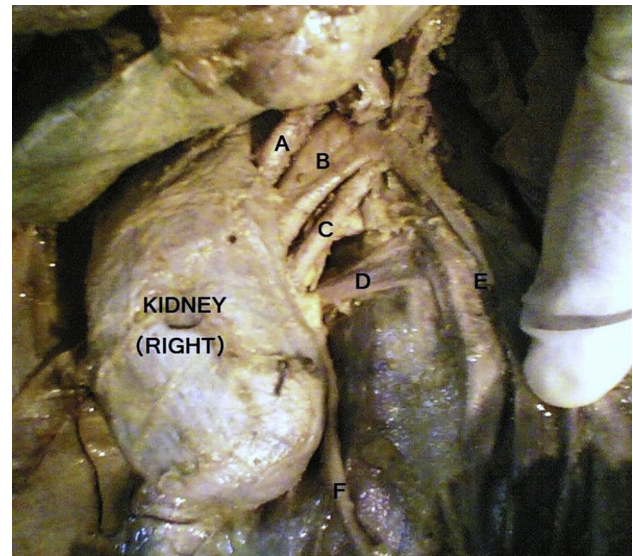
The normal right renal vein emerged from the hilum of the right kidney at a plane in front of both proper & additional renal arteries and drained into inferior vena cava. An additional right renal vein emerged from the lowermost point of the hilum and passed medially anterior to right ureter to drain into posterior aspect of inferior vena cava passing about 3 cm below the normal renal vein (Fig. 3).

So, here right kidney was supplied by two arteries and drained by two veins. At the hilum the vascular relation was normal renal artery, normal renal vein, additional renal artery & additional renal vein from above downwards (Fig. 1).

Vascular supply of left kidney was according to normal anatomy. Here the left renal artery divided into five segmental arteries near the hilum before entering into it (Fig. 4).

## 4. Discussion

It is widely accepted that renal vessels, specially the renal arteries exhibit a high degree of variations and the knowledge

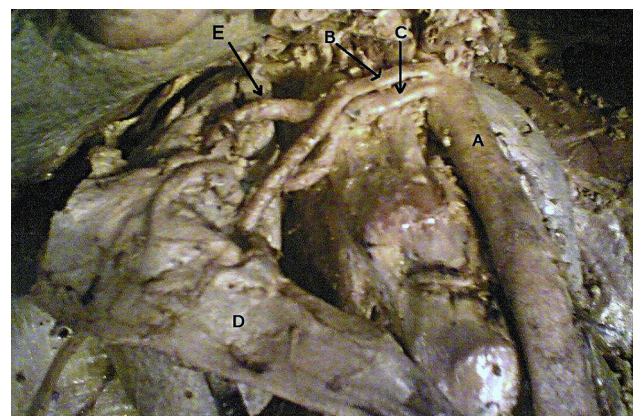


**Fig. 1 – Additional and normal renal vessels at the hilum of right kidney. A = Normal right renal artery, B = Normal right renal vein, C = Additional right renal artery, D = Additional right renal vein, E = Inferior vena cava, F = Right ureter.**

of accessory renal arteries and their variable origins have profound clinical significance in renal surgery.<sup>1</sup>

Accessory renal arteries are found in 30% of individuals and usually arise from the aorta above or below (most commonly below) the main renal artery and follow it to the renal hilum. They are regarded as persistent embryonic lateral splanchnic arteries.<sup>1</sup> In this case it is above the main renal artery.

Loukas et al (2005) reported an accessory renal artery originating from a common trunk with inferior mesenteric artery.<sup>2</sup> Rarely additional renal arteries may arise from the coeliac trunk, superior mesenteric artery, near the aortic bifurcation or from the common iliac arteries.<sup>3</sup> Accessory renal vessels to inferior pole of kidney cross anterior to the



**Fig. 2 – Inferior vena cava was reflected to the right to expose the normal and additional right renal arteries. A = Abdominal aorta, B = Additional right renal artery, C = Normal right renal artery, D = Inferior vena cava, E = Right superior renal polar artery.**





**Fig. 3 – Drainage of both renal veins into inferior vena cava. A = Inferior vena cava, B = Additional right renal vein, C = Normal right renal vein, D = Additional right renal artery, E = Normal right renal artery, F = Abdominal aorta, G = Right testicular artery, H = Right testicular vein.**

ureter and may cause hydronephrosis by obstructing the ureter.<sup>3</sup> Kaneko et al (2008) reported the cases of additional renal artery emerging from the lateral aspect of the aorta, below the level of inferior mesenteric artery in 2.4% of cadavers on the right side and 1.8% on the left.<sup>4</sup> An angiographic evaluation of 855 cases by Ozkan et al (2006) demonstrated several variations of renal artery namely multiple arteries in 24%, bilateral multiple arteries in 5% and early division in 8% of the cases.<sup>5</sup> Moreover, additional renal arteries were found in 16% of the cases on the right side and in 13% of the cases on the left side.<sup>5</sup> In the year 2003, Satyapal et al analyzed 1244 pairs of kidneys and reported additional renal arteries on the right side in 18.6% and on the left side in 27.6% of the cases.<sup>6</sup> Thereafter in the year 2005, dissection of 40 cadavers was carried out and examined by Dhar et al. Finally, the study revealed a single main renal artery on either side in 80% of the specimens and multiple renal arteries in 20% of the specimens where the unilateral cases (15%) were more commonly encountered than the bilateral cases.<sup>7</sup> A case of bilateral triple renal arteries was also reported by Pestemalci et al in the year 2009.<sup>8</sup> Similarly, many cases of bilateral double renal arteries and unilateral multiple right renal arteries originating from lateral side of abdominal aorta were also reported in subsequent years.<sup>9–12</sup>

Tanyeli et al (2006) reported an interesting case of double renal artery where the superior renal artery crossed the inferior renal artery as they passed towards the kidney. In the present case similar type of crossing was also found.<sup>13</sup>

The variations among the renal veins are not as common as arteries. According to Satyapal et al (2001) the frequency of additional renal vein was 3.3% on the right side and 2.6% on the left.<sup>14</sup> The left renal vein may be double where one vein passes posterior and the other passes anterior to the aorta before joining the inferior vena cava. This is sometimes referred to as persistence of the 'renal collar'.<sup>1</sup> The anterior vein may be absent so that there is a single retroaortic left renal vein.<sup>1</sup>

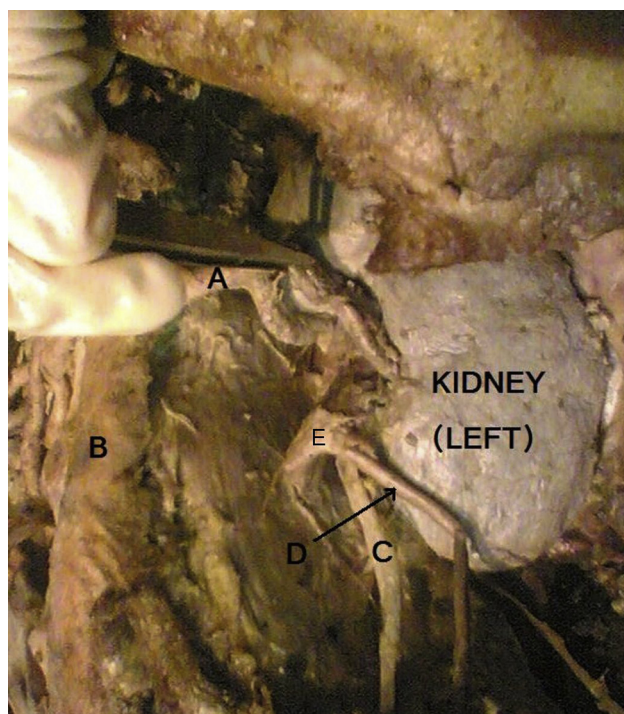
The left renal vein may have to be ligated during operation for aortic aneurism due to its close proximity with abdominal aorta.<sup>1</sup> Ligation of left renal vein at the right side of gonadal or suprarenal vein can provide adequate collateral venous drainage.<sup>1</sup> But the right renal vein cannot be ligated safely due to absence of significant collateral drainage.<sup>1</sup> But in case of double renal veins (like our case) it can be possible on the right side also due to presence of an extra renal vein.

Satyapal (1999) conducted a study to determine the site of entry of renal veins into the IVC. He reported that left vein entered IVC higher than right in 54%, lower in 36% and opposite each other in about 10% of cases.<sup>15</sup> It can be recalled that in the present case the normal right renal vein opened into IVC opposite the left renal vein and the accessory right renal vein about 3 cm below the normal. Some other renal vein variations were also reported earlier like a retroaortic left renal vein opening in to the left common iliac vein, a circumaortic venous ring & a retroaortic bifid left renal vein.<sup>16,17</sup> In fact it is even suggested that the frequency of additional renal veins are much less, that is about 0.4% than what is mentioned in standard text books which is about 0.8%–6%.<sup>16</sup>

From above literature review it is evident that though the cases of accessory renal arteries are common, the incidents of accessory renal veins are rare. Moreover, only a single case was reported so far by Krishnamay et al (2010) with both the variations occurring together on the right side.<sup>18</sup>

## 5. Conclusion

Knowledge of the variations of the renal vessels has grown in importance with increasing numbers of renal transplants, vascular reconstructions and various surgical and radiological techniques being performed in the recent years.<sup>4</sup> It also facilitates a safe approach to the kidneys in trauma management.<sup>4</sup> A significant surgical difficulty may be encountered in the presence of undiagnosed variations of the renal arteries preoperatively.<sup>5,6</sup> In selected cases, a conventional arteriography or CT angiography can be of great help in reducing unexpected problems and improving the outcome.<sup>5</sup> In the majority of such situations, it is the comprehensive knowledge of the renal arterial pattern that remains the key issue in determining the technical feasibility of surgical interventions as well as the post-operative management.<sup>6</sup> The likelihood of the additional renal vessels should be kept in mind when a noninvasive diagnostic search is performed for renal artery stenosis or when renal surgery related to renal arteries is performed.<sup>5,19</sup> In addition to the surgical importance, some of these variations might have some clinical implications as in the present case where the sharp kink formed by the additional artery might affect the renal blood flow.<sup>5,19</sup> As far as



**Fig. 4 – Normal left renal artery with its segmental branches. Here left renal vein was cut near inferior vena cava to expose the artery. A = Normal left renal artery, B = Abdominal aorta, C = Left ureter, D = Left testicular vein, E = Left renal vein (cut end).**

renal vein variations are concerned, most of them remain unnoticed until discovered during venography, operation or autopsy as they are clinically silent.<sup>1,5,6</sup> However, to a transplant surgeon, morphology acquires special significance, since variations influence technical feasibility of the operation. In addition to other variations, the level of entry of renal veins into the IVC is also important as these findings are clinically important for angiography, catheter design, and planning porto-renal shunt procedures.<sup>20</sup> During such procedures cases similar to the one reported here (double renal veins and both opening into IVC at different points) also must be kept in mind.

So, our findings of the present case will add to the long list of diversity of variations among the renal vessels which is essential for radiologists and surgeons and encourage all anatomists to detect other possible variations in future.

### Conflicts of interest

All authors have none to declare.

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