



## DUPLICATION OF RENAL ARTERIES : ANATOMICAL, MEDICAL AND SURGICAL PERSPECTIVE

### Anatomy

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### ABSTRACT

A sound knowledge of variations of blood vessels is important during operative, diagnostic and endovascular procedures in the abdomen. Knowledge of the variations in the renal arteries is important for urologists, radiologists and surgeons in general. The objective of the current Study is to bring awareness to clinicians about the variations in the blood supply of the kidney. This report may also be useful to clinicians performing invasive techniques and vascular surgeries and in cases of trauma.

### KEYWORDS

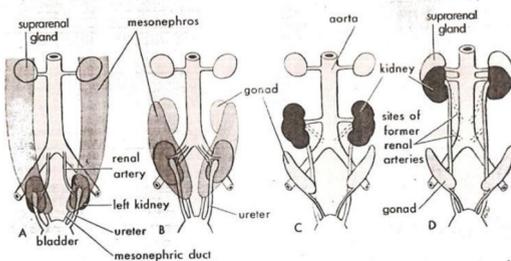
Renal Arteries, Renal Veins, Inferior Vena Cava, Abdominal Aorta, Nut Cracker Phenomenon, Duplication, Splanchnic, Mesonephric, Pseudo Coarctation, Doppler, Nephrectomy.

### INTRODUCTION

Renal arteries are a pair of lateral branches from abdominal aorta. Normally each kidney receives one renal artery. However, accessory renal arteries can also exist. The normal renal arteries enter the kidney through its hilum where as the accessory renal arteries might enter the renal artery through the hilum or through the surfaces of the kidney.

#### A,B,C :- Development and Ascent of Kidney

#### D :- Sites of Aberrant Renal Arteries



During the gross anatomy dissection of the abdomen of cadavers, we observed variations in the renal arteries (Figs 1, 2 and 3). The renal arteries were double in many cadaveric dissections. The normal relation of renal vein lying in front of the renal artery was preserved. Both the renal arteries were seen arising from the abdominal aorta.



FIGURE 1



FIGURE 2



FIGURE 3

seen arising from the abdominal aorta. Both the Renal veins were seen draining into the inferior vena cava. The Kidneys were situated posteriorly on each side of the vertebral column. Superiorly, they were at the level with the upper border of T12 vertebral level and inferiorly with the L3 level. The right kidney as usual was slightly inferior. The normal relationship of renal vessels and ureter was preserved as vessels in front of renal pelvis. The suprarenal and gonadal veins drain into left renal vein on the left side.

### DISCUSSION

Renal arteries are a pair of lateral branches from abdominal aorta. Normally each kidney receives one renal artery. However, accessory renal arteries can also exist. The normal renal arteries enter the kidney through its hilum where as the accessory renal arteries might enter the renal artery through the hilum or through the surfaces of the kidney. Knowledge of the variations in the renal arteries is important for urologists, radiologists and surgeons in general. The objective of the case report is to bring awareness to clinicians about the variations in the blood supply of the kidney. This report may also be useful to clinicians performing invasive techniques and vascular surgeries

The kidneys begin their development in the pelvic cavity. During further development, they ascend to their final position in the lumbar region. When the kidneys are located in the pelvis, they are supplied by the branches of internal iliac or common iliac arteries. While the kidneys ascend to lumbar region, their arterial supply also shifts from common iliac artery to the abdominal aorta. Accessory renal arteries originate from the abdominal aorta either above or below the main renal artery and reach the hilum. It is important to be aware that accessory renal arteries are end arteries; therefore, if an accessory artery is ligated or damaged, the part of kidney supplied by it is likely to become ischemic.

According to David Sykes<sup>(1)</sup>, when there were many accessory renal arteries, the superior accessory artery is a separate segmental artery and the inferior accessory artery is a separate lower segmental artery. Multiple renal arteries are a common finding in renal angiograms and

are more common in the aorta and renal vessels in the donor population subjected to angiography but do not pose any serious risk or contraindication to renal donation

Accessory renal arteries are common in 20-30% of individuals, usually arising from the aorta above or below the main renal artery. The variation in the number of arteries is because of persistence of lateral splanchnic arteries<sup>(2)</sup> or due to the persistence of blood supply from lower level than normal<sup>(3)</sup>.

Double renal arteries may coexist with other uro-vascular variations, such as: double renal veins on the same side or on the opposite side, double ureter on the same side or on the opposite side, persistence of the fetal renal lobulation on the adult kidney, genital artery originating from the supplementary.<sup>(5)</sup>

### Clinical implications

The use of kidneys with multiple renal arteries from live donors has been discouraged, because of increased risk to the donor while obtaining a common aortic cuff, technical difficulty of completing multiple arterial anastomosis, prolonged ischemia time, and poorly controlled hypertension from segmental infarctions of the allograft<sup>(6)</sup>

The disadvantages of a multiple vessel graft include technical difficulty to anastomose, with inability to use a Carrel patch from live donors. A longer warm ischemia time, increased incidence of ATN, rejection episodes, and decreased graft function have also been cited. Besides, the failure to properly anastomose all arteries can lead to graft necrosis, graft rupture, segmental renal infarction, and postoperative hypertension and calyceal fistula formation.<sup>(7)</sup>

Multiple renal arteries occurred bilaterally in 10.2% of donors and unilaterally in 20.8%, a total incidence of 31%. There was a higher incidence of vascular-related complications following transplantation of kidneys with multiple renal arteries. Attention is drawn to the need for careful technique in identification of multiple renal vessels, especially aberrant vessels, at the time of donor nephrectomy and also to the different techniques available for anastomosis of multiple renal arteries in kidney transplant recipients.<sup>(15)</sup>

Knowledge of the varied anatomy of the renal vessels facilitates a safe approach to the kidneys in trauma management. The varied and unpredictable anatomy of the renal vasculature requires prompt change when the normal approach fails to provide access to the vessels. In such cases, the colon should be mobilized promptly. Operative exposure and control of the renal vessels through a transabdominal retroperitoneal (TARP) approach has been advocated for emergency management of renal trauma. The pertinent anatomic variations of the renal vasculature have not been well described

Detailed knowledge of the anatomy and anomalies of renal veins is necessary for retroperitoneal surgery and venographic procedures. According to Thomas (1970, Arch. Surg. 100:738-740), the anomalies of renal veins are more frequent than estimated. The number of surgical procedures and radiologic examinations related to the retroperitoneum are increasing

Double retroaortic left renal veins as a possible cause of pelvic congestion syndrome. Pelvic congestion syndrome is characterized by chronic pelvic pain and varicose veins around the uterus and ovaries. Cases of double left renal vein, associated with left-sided pelvic congestion syndrome, diagnosed by CT and confirmed by clinical findings and colour Doppler ultrasound. Double retroaortic left renal veins may be a contributing factor for the development of left pelvic congestion.<sup>(8)</sup>

### Pelviureteric junction obstruction

It is an extramural cause of unilateral hydronephrosis. These are usually seen at the junction of pelvis and ureter. It is often a lower polar artery which supplies the inferior segment of the kidney. Such artery may not arise from renal artery but from aorta, common iliac artery. Such aberrant renal vessel may cause of hydronephrosis in children and may be considered as congenital hydronephrosis. The treatment of this condition is to do a plastic operation in front of such artery without disturbing it as it may be the sole artery supplying the lower pole of kidney and division of such artery will cause infarction of that segment of that kidney.

*Kinking of the aorta is also known as pseudocoarctation, or buckling of the aorta.* It is an uncommon anomaly. A case of kinking of the abdominal aorta at the level of the renal arteries has been reported in the past<sup>(9)</sup>. The kinking was probably due to the origin of the renal arteries from the anterior aspect of aorta. The origin of the left renal artery was more nearer to the anterior midline of the aorta and the artery passed to the left in front of the aorta to enter the kidney. This factor would have resulted in the kinking of the aorta above the level of renal artery due to the pull on aorta by the weight of the left kidney. The aortic kinking might decrease the blood flow to the kidneys and other pelvic organs and lower limbs. It might lead to pathological or true coarctation of aorta.

The left renal vein is normally located between the abdominal aorta and the superior mesenteric artery (SMA). *In the nutcracker phenomenon*, there is an abnormal branching of the SMA from the abdominal aorta. Subsequently; the left renal vein is compressed between these arteries. This compression causes elevated pressure in the left renal vein and this high pressure then result in rupture of the thin-walled veins of the renal collecting system. Permanent left renal vein hypertension may affect collateral veins causing dilatation of the gonadal vein and varicocele.<sup>(11,12,13)</sup>

Direct venous extension of renal cell carcinoma via the renal vein is of normal occurrence and the presence of extra renal veins might prove an extra route for spread of metastasis. This can enhance the spread of primary renal cell carcinoma to multiple sites in the body.

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