

Research Article: Human Anatomy Case Report

## Variations in branching pattern of renal artery and arrangement of hilar structures in the left kidney: clinical correlations, a case report

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### Abstract

Traditionally, anatomy textbooks describe each kidney to receive irrigation from a single renal artery. However, current literature reports great variability in renal blood supply, the number of renal arteries and the arrangement of hilar structures on the left side. Here a case is described where, on the right side, the renal artery had its origin from the abdominal aorta, as normally occurs, and followed a normal course and relations in the hilum. There were three renal arteries on the left side. The left main renal artery took origin from the anterior aspect of the abdominal aorta. The other two arteries took their origin from a common trunk coming out of the lateral aspect of abdominal aorta inferior to the main left renal artery. The renal vein at the hilum was found between the main renal artery and the ventral branch of the common trunk, anteriorly, and the dorsal branch of the common trunk, posteriorly. Such variation has great implications when surgery is indicated, as in renal transplants, urological and radiological procedures, renovascular hypertension, renal trauma and hydronephrosis. As the number of renal surgical and radiological interventions increase, a better understanding of the anatomy of renal arteries and their branches gain importance. To plan the adequate surgical procedure and to avoid any vascular complication, Multi Detector Computer Tomography (MDCT), angiography and arteriography should be performed prior to surgery (nephrectomy).

### Key words

Pelvis; renal artery; transplantation; variation.

### Introduction

Conventional textbooks of anatomy define the order of hilar structures from above downwards and from anterior to posterior as renal vein, renal artery and pelvis (Standring, 2005). Renal arteries are a pair of lateral branches from the abdominal aorta. Normally, each kidney receives one renal artery. The venous drainage of each kidney is through one renal vein, which drains the blood from the kidney into the inferior vena cava. The left renal vein also receives left suprarenal and left gonadal veins, in addition to the vein coming out from the kidney (Nayak *et al.*, 2008). Variations in number, source and course of the renal arteries are common. The renal artery may give rise to branches normally derived from other vessels such as the inferior phrenic, hepatic, suprarenal, gonadal, pancreatic and lumbar arteries (Bergman *et al.*,

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1992). Renal artery variations are common in the general population and the frequency of variations shows social, ethnic, and racial differences (Özkan *et al.*, 2006).

Knowledge of the 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 (Gupta *et al.*, 2010).

### **Case report**

In the present case report, during routine abdominal dissection conducted in an adult male cadaver while teaching medical undergraduates, we observed an anomalous arrangement of renal hilar structures with variation in the number and branching pattern of a renal artery. The variation was detected unilaterally in the left kidney. The hilar region was dissected carefully and the structures and their relations were clearly defined. Appropriate photographs were taken (Fig. 1).

### **Results**

#### **On the left side**

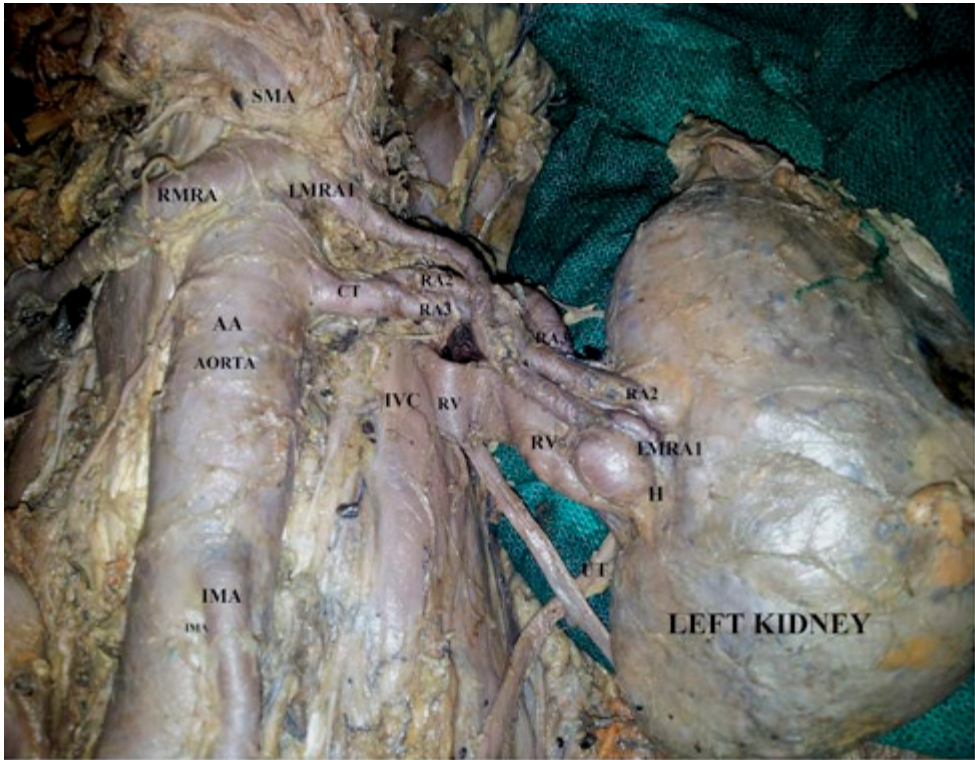
The size of the left kidney was 12x6x5 cm. It received three renal arteries. The left main renal artery took origin from the anterior aspect of the abdominal aorta at the level of L1 vertebra (corresponding to the right renal artery) just inferior to superior mesenteric artery. The other two arteries took their origin from a common trunk coming out of the lateral aspect of abdominal aorta inferior to the main left renal artery at the level of L2 vertebra (Fig. 1). Among all the renal arteries, the common trunk was the thickest and even its two branches were of greater caliber than the left main renal artery; indeed, the left main renal artery and the two branches of the common trunk were almost of same caliber. The arrangement of the structures in the hilum antero-posteriorly was left main renal artery, one branch of the common trunk, renal vein, and ureter. Superoinferiorly, the order at the hilum was: more ventral branch of the common trunk, left main renal artery, renal vein, more dorsal branch of the common trunk and ureter. The renal vein at the hilum was found to be lying between the main renal artery and the ventral branch of the common trunk, anteriorly, and the dorsal branch of the common trunk, posteriorly.

#### **On the right side**

The right renal artery had its origin from the abdominal aorta, as normal, followed a normal course and had normal topographical relationships in the hilum.

### **Discussion**

The abnormalities in the renal arteries are mainly due to the various developmental positions of the kidney (Moore *et al.*, 2002). Different origin of renal arteries and



**Figure 1** – Anterior view of retroperitoneal upper left region showing details of hilar renal region. AA: abdominal aorta; MRA1: main renal artery; RA1 and RA2: upper and lower branches from the common trunk (CT) respectively; RV: renal vein; UT: ureter; H: hilum of kidney; RV: renal vein; IVC: inferior vena cava; SMA: superior mesenteric artery; IMA: inferior mesenteric artery, RMRA: right main renal artery.

their frequent variations are explained by the development of mesonephric arteries. Deficiency in the development of mesonephric arteries results in more than one renal artery (Felix, 1911; Boijesen, 1997). During development, when the kidneys are situated in the pelvis, they are supplied by the branches of common iliac arteries but later, when they ascend to the lumbar region, their arterial supply also shifts from the common iliac artery to the abdominal aorta. Accessory renal arteries arise from the abdominal aorta, either above or below the main renal artery, and follow the latter to the hilum. Although extra renal arteries are common (24%) in Turkish population, the probability of finding bilateral extra renal arteries, i.e. the probability of having more than one renal artery in both kidneys of a kidney donor during renal transplantation is low (5%) (Özkan *et al.*, 2006). According to Soni *et al.* (2010), double renal arteries were seen on the left side and triple renal arteries were seen on the right side. These authors reported incidence of triple renal arteries to be 1-2%. Shoja *et al.* (2008) studied the perihilar branching pattern of renal artery. They observed fork pattern in 92.6% kidneys, duplication in 80.2%, triplication in 12.4% and presence of ladder

pattern in 7.4% kidneys. Prehilar multiple branching of renal arteries were reported by Rao *et al.* (2006). Budhiraja *et al.* (2010) in their study observed prehilar multiple branching of renal arteries in 11.66% of cases. These branches were directed towards apical, superior, middle, inferior and posterior vascular segment of kidney. Rusu *et al.* (2006) 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. All these renal arteries emerged from the abdominal aorta, as in our case. Bayramoglu *et al.* (2003) 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 on the right side. Bulic *et al.* (1996) reported that the right kidney received two renal arteries from the aorta which 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. It is important to be aware that accessory renal arteries are terminal arteries; therefore, if an accessory artery is damaged, the part of the kidney which is supplied by it is likely to become ischaemic (Soni *et al.*, 2010). In transplantation of kidneys with one renal artery, post-surgical rates of complication are lower than in transplantation of kidneys with more than one renal artery. (Özkan *et al.*, 2006). This might depend on the fact that the transplantation of kidneys having one renal artery is technically easier than when there is more than one renal artery (Sanson *et al.*, 1978).

Accessory renal arteries may constitute a danger in nephrectomy and in the partial resection of the kidney. The presence of triple renal arteries is infrequent. The objective of this case report is to bring awareness to clinicians about the variations in the renal vascular region and their hilar relation. This report may also be useful to clinicians performing invasive techniques and to surgeons performing nephrectomy and renal transplantation.

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