

# A rare case of combined abnormalities of renal and testicular vessels

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## Research Article

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# Abstract

In clinical practice, pre-operative radiological assessment of gonadal and renal vessels is important in planning alternative surgical procedures related to the urogenital structures and/or the great vessels of the abdomen. Failure to identify critical vascular variations may be considered a technical error, resulting in inadvertent surgical injuries that may result in ethical and medico-legal litigation. One such variation was encountered in a male plastinated cadaver during routine undergraduate teaching that showed an abnormal origin, course and relation of the left testicular artery from an accessory renal artery on the same side, and a duplicated right testicular artery with a retrocaval course. The purpose of this report is to discuss the possible embryological reasons for the combined vascular variants that were found as well as any possible clinical implications

## Introduction

Kidneys and the gonads are classically supplied by direct lateral branches of the abdominal aorta; the renal artery on either side arises from the first lumbar vertebral level, and the gonadal artery arises below that [1, 5]. However, variations in the renal and gonadal arteries are not uncommon because their developmental process *in utero* is interwoven [5, 9]. In this report, we document a male cadaver (plastinated specimen used for medical teaching) which displayed multiple rare and clinically relevant venous variations of the genitourinary organs. We also discuss the possible embryological origin of the variations and any potential clinical complications related to these [7].

## Case Report

During routine teaching of the urogenital system to undergraduate medical students using a plastinated male cadaver specimen, at least three of the following vascular variations were encountered in the origin and course of the renal and testicular arteries (Figs 1, 2).

1. Duplicated right testicular arteries (Fig 1, 2a) arising separately from the abdominal aorta below the origin of the renal arteries (at L2) and running posterior to the inferior vena cava (IVC). Exiting laterally from behind the IVC, both arteries followed a normal course, accompanying the right testicular vein to the inguinal ring. The course of the right testicular vein was normal, running anterior to the ureter and draining acutely into the IVC (Fig 1).

2. Accessory left renal artery arising from the abdominal aorta at L2 level, 4 cm distal to the origin of superior mesenteric artery (Fig 1, 2b). Coursing laterally and upwards behind the left testicular vein, it entered the left renal hilum below the left inferior segmental renal vein. There were no obvious variations in the origin, course or distribution of the main renal arteries (or veins) on either side.

3. The left testicular artery arising from the proximal part of the accessory left renal artery described above, 2 cm lateral to the abdominal aorta (Fig 2b). Distally, it followed a normal course accompanying the left testicular vein to the inguinal ring, reaching the left testis. However, the left testicular vein was

seen to run anterior to the accessory left renal artery before draining into the left inferior segmental renal vein instead of main left renal vein.

Any further detail on the age, ethnicity, and medical history of this donor is not available to the authors.

## Discussion

The normal arterial supply to the kidney and testis is through a single vessel arising from either side of the abdominal aorta at the level of L1-L2. The renal veins drain into the IVC and so does the right testicular vein; however, the left testicular vein enters the left renal vein. Due to the overlapping development of the urogenital systems, anatomical variations in the origin, course and distribution of the renal and gonadal arteries are not uncommon [9].

Embryologically, both the kidneys and gonads develop from the intermediate mesoderm which later differentiates into the urogenital ridge during the second month of intrauterine development. About 9–11 mesonephric arteries exist on either side of the embryonic abdominal aorta to supply the urogenital ridge. As the kidney ascends the caudal ones usually disappear. However, some persist as the phrenic, suprarenal, main and accessory renal and gonadal vessels. The lowest of the mesonephric artery usually becomes the testicular artery; the rest are obliterated, or one or two would persist as the accessory testicular artery. The mesonephric and the later formed metanephric arteries are interconnected towards the renal sinus; this plexus is responsible for the variability in the origin, side and numbers of the metanephric arteries [4].

Bergman's compendium reports that accessory renal arteries are found in 25–30% of the individuals. In fact, these are the widely published variants of the lateral branches of the abdominal aorta in terms of their number, course and level of origin [1, 2]. The accessory renal arteries are noticed more on the left side (28%) and also frequently arise above main artery [11]; in contrast, the one identified in our specimen was below the main artery. The accessory renal arteries that enter the inferior aspect of the kidney (polar arteries) are often considered a potential risk to the ureteric compression, leading to hydronephrosis [3]. However, in our finding, as the artery enters the renal sinus directly, it might not compress the ureter leading to a hydronephrosis. Additionally, the left accessory renal artery in this case is peculiar in that it does not fit into any of the five variation types described by Cases et al. [1].

The testicular arteries are reported to arise directly from the abdominal aorta only in less than 80% of the population (right- 76.3%, left- 78.9%). Other possible origins include a common trunk with middle suprarenal artery on the right side [8]. Rarely, a triple or quadruple occurrence is also noted [6]. Double testicular arteries (up to 17%) or those with retrocaval course (up to 13%) are reported as separate entities [10]; a double artery with retrocaval course in the same individual as identified in our specimen has not been reported earlier, to the best of authors knowledge. The retrocaval path of the gonadal artery can be traced back to the embryological position of the right splanchnic artery, which continues as the right testicular artery. Normally, the artery travels ventral to the supracardinal veins, but it assumes the retrocaval position when it crosses dorsal to the supracardinal anastomosis [5]. Unlike earlier report that

state that double testicular arteries with a retrocaval course frequently arch over the ipsilateral renal vein [2], our findings indicate that double testicular arteries with a retrocaval course do not exhibit this arching pattern.

## **Conclusion**

These variations have direct implications on clinical procedures such as renal transplantation or endopyelotomy in the vicinity of pelviureteric junction; failure to identify these variations prior to or during surgery would have a detrimental effect on surgical outcomes.

## **Declarations**

### **Conflict of interest**

The authors declare that they have no conflicts of interest pertinent to the content of this article.

### **Contributions**

Vivek Perumal designed the illustrations and as well as revised the manuscript; Ranganath Vallabhajosyula reviewed manuscript critically and provided advice; Sreenivasulu Reddy Mogali discovered the variation, drafted the manuscript and is the corresponding author.

### **Acknowledgement**

“The authors sincerely thank those who donated their bodies to science so that anatomical research could be performed. Results from such research can potentially increase mankind's overall knowledge that can then improve patient care. Therefore, these donors and their families deserve our highest gratitude.”

### **Ethics approval and consent to participate**

No studies involving human participants or animals were conducted by any of the authors in this paper. The plastinated specimen is the property of the Lee Kong Chian School of Medicine, Nanyang Technological University Singapore. The plastinated specimen was obtained from the from Gubener Plastinate GmbH (Guben, Germany) which preserves donated bodies through plastination.

### **Consent for publication**

Not applicable.

### **Availability of data and materials**

For data requests, please contact authors (Sreenivasulu Reddy Mogali – email: [sreenivasulu.reddy@ntu.edu.sg](mailto:sreenivasulu.reddy@ntu.edu.sg)).

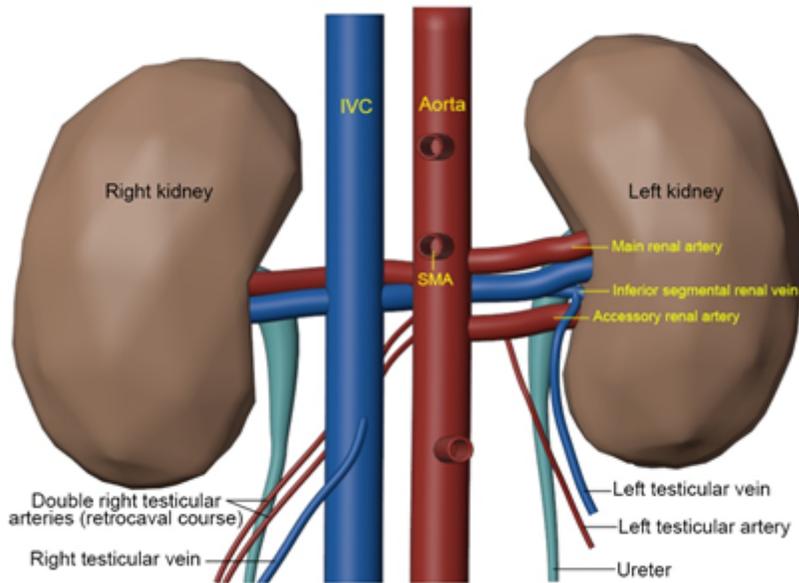
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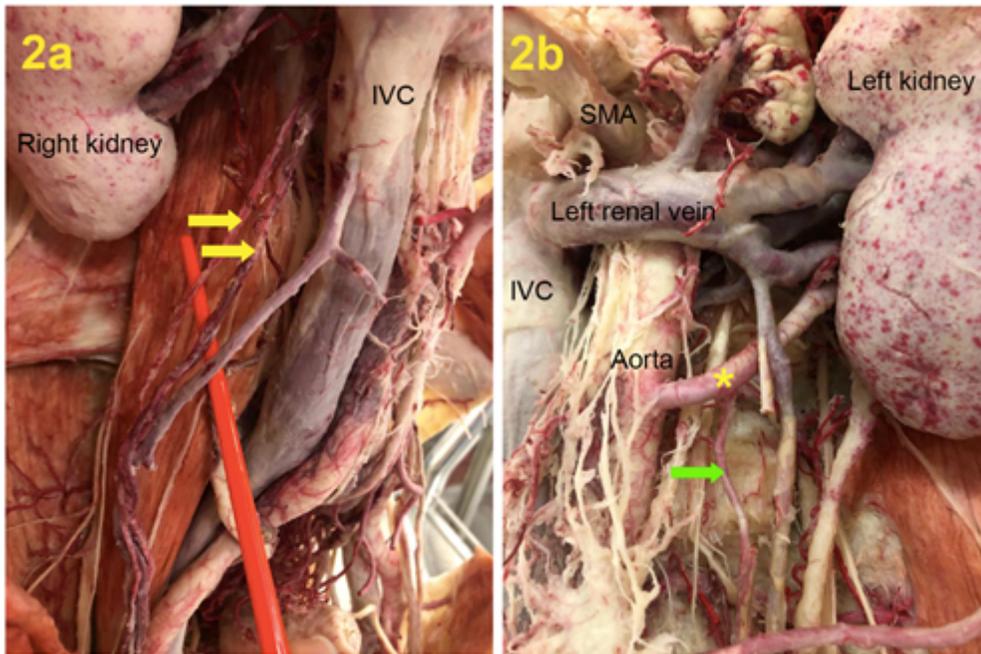
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## Figures



**Figure 1**

Illustration of the combined anatomical variations.



**Figure 2**

(a) Duplicated right testicular arteries with a retrocaval course (yellow arrows). (b) accessory left renal artery (\*) giving rise to a left testicular artery (green arrow).