



## Anatomy of the Retroaortic Left Renal Vein: A Study on a Human Cadaver

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### Abstract

The variations of the renal veins in their syntopy with the abdominal part of the aorta artery are described in the literature as retroaortic and circumaortic, with a frequency between 0.3% and 0.5% of cases and they are of significant importance in the clinical picture of hematuria, dysuria, varicocele and thrombosis, in addition to surgical procedures associated with the aorta and kidney. The present work describes the retroaortic left renal vein, a variation of the Type II, in an adult male cadaver, using the classic methods of preparation and dissection of anatomical specimens. The dissected left renal vein was submitted to morphometry, obtaining measurements of the length and diameter of the vessel. These rare and generally unreferenced variations represent an atypical morphology that should be considered when establishing models of abdominal and renal vascular anatomy, imaging diagnosis, preoperative planning for aneurysmectomy, abdominal aortic reconstruction, nephrectomy and transplantation.

**Keywords:** Renal Veins; Abnormalities; Diagnostic Imaging; Kidney; Anatomy

### Abbreviations

IVC: Inferior Vena Cava; RLRV: Retroaortic Left Renal Vein

### Introduction

The renal veins are large caliber vessels distributed laterally to the inferior vena cava, originating in the right and left renal hilum, receiving the denomination of right and left. They are tributaries of the inferior vena cava (IVC) at the level of the first lumbar vertebra, passing in most cases anterior to the aorta artery and inferior to the superior mesenteric artery in the retroperitoneal space [1].

Despite a wide range of variations in the distribution of renal arteries, the same is not observed with venous vessels.

Several patterns of variations are described: the retroaortic left renal vein (RLRV), the circumaortic renal vein (collar venous), the

IVC duplication, the IVC transposition and the pre-aortic iliac confluence [2].

Left renal vein abnormalities were categorized into four types: Type I, II, III, and IV. In these types, the RLRV join the IVC in the orthotopic position, at level L4 - L5, at the circumaortic or collar left renal vein, or join the left common iliac vein, respectively [3].

The renal veins occupy the renal pedicle in a plane anterior to the arteries, the left one crossing the aorta anteriorly below the aortomesenteric angle, its posterior course being exceptional [4]. Bergman RA [5] cite the incidence of about 2% of renal veins with atypical courses; Satyapal KS [6], describe retroaortic or circum-aortic variations between 0.3% and 0.5%. Some authors report a higher frequency, in 0.75% of dissected cadavers [7] and 1.7% of dissected cadavers [8].

Variations in vessel topography and position are directly associated with the morphogenesis of venous vessels from changes in the pattern of division of cardinal vessels [9].

In the individual adult, the posterior course of the left renal vein results in important clinical manifestations such as hematuria, dysuria, varicocele, left aortic-renal fistula, abdominal aortic aneurysm and thrombosis resulting from vascular compression [10].

The anatomical description of the retroaortic variation for the course of the left renal vein contributes to an important reference for clinical investigation and diagnostic imaging, in the same way that it supports the planning of vascular and renal surgical interventions.

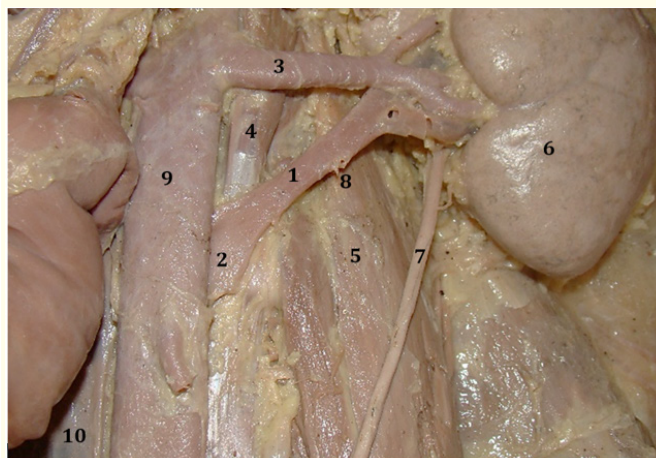
### Materials and Methods

The cadaver of an adult male, approximately 50 years old, belonging to the collection of anatomical parts of the Laboratory of Human Anatomy of the Unilago School of Medicine, São José do Rio Preto, São Paulo, Brazil, underwent dissection according to the classic methods [11] with access to the retroperitoneal space and the left renal vein (CEP Unilago No.12/14).

The anatomical and morphometric description of the left renal vein with retroaortic course was performed, considering the measurements of the length and diameter of the vessel, its syntopy with the left kidney, pancreas, left renal artery, left ureter, abdominal aorta artery, inferior vena cava, psoas major muscle and diaphragm muscle, left pillar.

### Results and Discussion

During dissection, it was observed that the left renal vein emerged posterior to the branches of the renal artery at the renal hilum, formed from the convergence of three smaller vessels, posterior to the middle third of the pancreas and anterior to the left ureter, with an oblique and horizontal path. The first segment of the left renal vein, the oblique, assumed a descending path at a 40-degree angle, anterior to the belly of the psoas major muscle, with a length of 5.3 cm and a diameter of 0.9 cm in the proximal end, 0.7 cm in the middle third, and 1.8 cm in the distal third, establishing syntopy with the pancreas. The left testicular vein draining into the lower margin of the middle third of this segment (Figure 1).



**Figure 1:** Topography of RLRV: oblique segment.

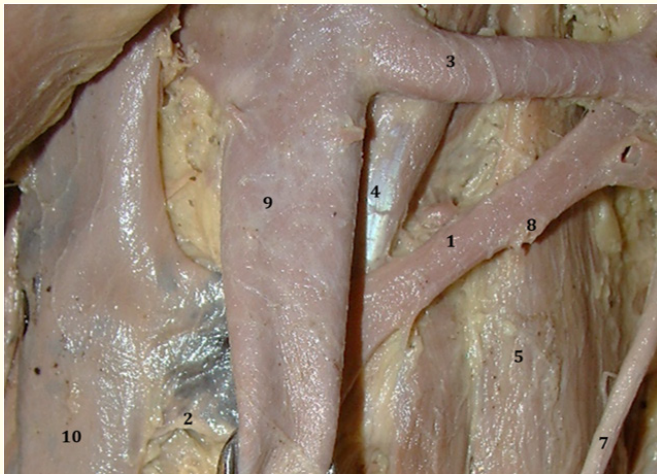
**Subtitles:** 1. Retroaortic left renal vein, oblique segment. 2. Retroaortic left renal vein, horizontal segment. 3. Left renal artery. 4. Left pillar of the diaphragm. 5. Psoas major muscle. 6. Left kidney. 7. Left ureter. 8. Left testicular vein (Sectioned). 9. Abdominal aorta. 10 Inferior vena cava.

The second segment, the horizontal path, at a 90-degree angle to the IVC, assumed a retroaortic path along the lower margin and anterior of the left pillar of the diaphragm, in the plan of the L2 - L3, with a dimension of 2.0 cm in length and diameters of 1.8 cm in the proximal end, 2.0 cm in the middle third and 2.1 cm in diameter at the distal end, draining into the IVC (Figures 2 and 3).

The development of renal veins is an important and extremely complex process that presents variations in topography. The renal vein is derived from intersubcardinal anastomosis, which passes anterior to the aorta. When there is regression of the anterior subcardinal anastomosis and persistence of the posterior anastomosis, there is the formation of the RLRV [12].

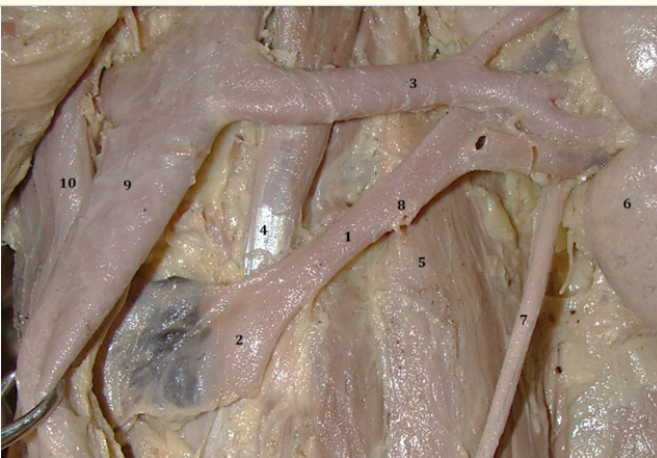
The variation described in our study also represents the atypical formation of the RLRV draining into the IVC at a 90-degree angle, in the plan of the L2 - L3, a variation of the Type II.

Variations of the RLRV in male and female individuals, present clinical manifestations associated with diffuse abdominal pain,



**Figure 2:** Topography of RLRV: exposure of the horizontal segment.

**Subtitles:** 1. Retroaortic left renal vein, oblique segment. 2. Retroaortic left renal vein, horizontal segment. 3. Left renal artery. 4. Left pillar of the diaphragm. 5. Psoas major muscle. 6. Left kidney. 7. Left ureter. 8. Left testicular vein (Sectioned). 9. Abdominal aorta. 10. Inferior vena cava.



**Figure 3:** Topography of RLRV: exposure of the horizontal segment.

**Subtitles:** 1. Retroaortic left renal vein, oblique segment. 2. Retroaortic left renal vein, horizontal segment. 3. Left renal artery. 4. Left pillar of the diaphragm. 5. Psoas major muscle. 6. Left kidney. 7. Left ureter. 8. Left testicular vein (Sectioned). 9. Abdominal aorta. 10. Inferior vena cava.

thrombosis resulting from vascular compression, renal vein hypertension, left testicular vein reflux and varicocele, the latter being observed in 77% of male patients with the variation [13,14] and the posterior nutcracker phenomenon [15]. In females, the incidence of pelvic varicose veins associated with the left retroaortic renal vein is higher if compared to patients without such anatomic occurrences [16], such as the *Pelvic Congestion Syndrome* [14].

The VRLR - Type II represents a significative frequency of urological symptoms compared to the other types [17].

The retroaortic course of the renal vein significantly interferes in abdominal aortic reconstruction surgeries with aneurysm formations and in the aneurysmectomy procedure itself, and represents an obstacle in surgical approaches to the retroperitoneum [6].

When describing the retroaortic vessel in the topography of the left renal vein, models are also established for surgical procedures associated with the aorta and kidney, in the same way that it constitutes an important element for preoperative planning in nephrectomy and transplantation, mainly for the left kidney [18], ensuring the integrity of the structures and preventing iatrogenic injuries.

## Conclusion

The topographic and morphometric description of the retroaortic course of the left renal vein provides an important support for the correct interpretation in imaging, contributing to a better understanding of renal venous return circulation models and their implications for routine or more complex surgical interventions, such as kidney transplants.

## Conflict of Interest

None.

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