

# The Anatomical Variation of the left Renal vein and the Right Gonadal Vein—A Case Report

Geeta Anasuya Daliparthi<sup>1</sup>; Sobana M<sup>2</sup>, Vijaijanand M<sup>3</sup>

<sup>1</sup>Professor, Department of Anatomy, KMCH Institute of Health Sciences and Research, Coimbatore, Tamil Nadu, India. <sup>2</sup>Tutor, Department of Anatomy, KMCH Institute of Health Sciences and Research, Coimbatore, Tamil Nadu, India. <sup>3</sup>Professor & Head, Department of Anatomy, KMCH Institute of Health Sciences and Research, Coimbatore, Tamil Nadu, India.

## Abstract

The developmental abnormalities of the inferior vena cava and its tributaries are the basis for the complications associated with the kidney. Two renal veins were found on the left side of an adult female cadaver during regular dissection for the first MBBS students in 2024–2025. A ring known as the circum-aortic renal collar is formed around the aorta by two veins: one is the pre-aortic channel, and the other is the post-aortic renal channel. On the right side a single right renal vein was found draining into the inferior vena cava. Furthermore, the right ovarian vein was found draining at the junction of the inferior vena cava and the right renal vein. Any injury to the post-aortic venous channel during surgeries may cause severe hemorrhage. The presence of a double renal vein and the variation in the drainage area of the right gonadal vein are rare developmental anomalies. So, a thorough knowledge about these embryological variations is necessary for the treating surgeons and radiologists.

**Keywords:** Double left renal vein, renal collar, right gonadal vein.

Received: 15 September 2025

Revised: 12 October 2025

Accepted: 10 November 2025

Published: 20 November 2025

## INTRODUCTION

The renal veins open into the inferior vena cava at a straight angle and are located in front of the renal arteries. Compared to the right renal vein (2.5 cm), the left renal vein (7.5 cm) is longer.<sup>[1]</sup> The primary venous drainage system during embryonic life is made up of the cardinal veins. The subcardinal and supracardinal veins, two longitudinal venous channels, emerge beside the posterior cardinal veins in weeks five and seven. Subsequently, a plexiform venous collar forms around the dorsal aorta and facilitates drainage from the permanent kidney. The post-aortic anastomosis of the two subcentral veins, the pre-aortic anastomosis between the subcardinal veins, the anastomosis between the supracardinal and subcardinal veins, the anastomosis between the supracardinal and azygos venous line, and the anastomosis between the azygos venous lines and the subcentral veins all contribute to the formation of this circum-aortic renal collar. The left renal vein, which travels in front of the aorta and the renal arteries and opens into the inferior vena cava, is typically formed by the venous channels behind the aorta atrophy and pre-aortic anastomosis. If pre-aortic anastomosis regresses, the left renal vein lies behind the aorta. The right subcardinal vein is directly incorporated into the IVC, forming its renal segment.<sup>[2]</sup> [Figures: 1, 2] Abnormal connections may arise from complex venous development sequences. Both the pre-aortic and post-aortic left renal veins flow into the IVC as a result of the maintenance of the "renal collar."

The rare structures associated with the anatomy of the left renal vein consist of several left renal veins, a single

retroaortic left renal vein, and a circum-aortic left renal vein. The circum-aortic left renal vein creates a vascular ring encircling the abdominal aorta. Typically, they are identified unexpectedly during imaging studies, autopsies, and occasionally prior to surgery. The compression of the retro-aortic left renal vein can result in renal venous hypertension, potentially leading to hematuria and, in males, varicocele.<sup>[3-5]</sup>

There are three types of circum-aortic left renal vein [Table 1].<sup>[5]</sup>

S.no	Type	Definition
1	I	Pre-aortic and a retro-aortic vein joining together at renal hilum
2	II	Pre-aortic and Retro-aortic veins have parallel separate course till renal hilum without forming common trunk
3	III	Multiple anastomoses between pre- and retro-aortic veins or multiple veins.

About 2 cm below the left renal vein, on the anterolateral side of the inferior vena cava, the right gonadal vein enters the cava directly in healthy individuals. Sometimes, like the left gonadal vein, it drains into the right renal vein and ends at a right angle. The chance of developing venous incompetence is increased in

**Address for correspondence:** Dr. Geeta Anasuya Daliparthi, Professor, Department of Anatomy, KMCH Institute of Health Sciences and Research, Coimbatore, Tamil Nadu, India. E-mail: [geetagee1@gmail.com](mailto:geetagee1@gmail.com)

**DOI:**

10.21276/amit.2025.v12.i3.192

**How to cite this article:** Daliparthi GA, Sobana M, Vijaijanand M. The Anatomical Variation of the left Renal vein and the Right Gonadal Vein—A Case Report. Acta Med Int. 2025;12(3):863-866.

certain situations.<sup>[6]</sup> About 30% are due to anatomical variances, which can be seen in the origin level, caliber, obliquity, and their connections to neighboring structures.<sup>[1]</sup>

### MATERIALS AND METHODS

During the routine dissection of the posterior abdominal wall for the phase I MBBS students during the year 2024-25, the abdominal cavity was opened according to Cunningham's Manual of Practical Anatomy. Connective tissue surrounding the renal veins, gonadal veins, and their tributaries was removed to provide a clear field of vision. During dissection, observed a rare variation with two left renal veins draining into the IVC. The gonadal vein on the right side was emptying at the intersection of the inferior vena cava and the right renal vein.

### RESULTS

An adult female cadaver presented two renal veins on the left side draining into the inferior vena cava. As a shared trunk, both veins were located in front of the renal pelvis and the left renal artery. There were an inferior vein and a superior vein close to the drainage. The vein lying above was pre-aortic, and the other renal vein lying below was post-aortic. The inferior renal vein was lying slightly above the level of the right renal vein. Thus, a circum-aortic ring of the left renal vein was formed surrounding the abdominal aorta. The two veins together formed a common trunk 2.5 cm away from the hilum of the left kidney. The left gonadal vein joined the post-aortic renal vein, while the left suprarenal vein joined the pre-aortic renal vein [Figures: 3, 3a, 4].

The length of the left superior renal vein was 4.5 cm, with the breadth being 1.8 cm close to the inferior vena cava and 1.3 cm close to the common trunk. The length of the inferior renal vein was 4 cm, with the breadth being 0.5 cm near the inferior vena cava and 1 cm near the common trunk. The inferior vena cava's breadth was 3.5 cm close to the superior renal vein's entrance and 2.7 cm close to the inferior renal vein's opening. The distance between the superior and inferior renal veins is 2 cm. The distance between the opening of the superior renal vein and the caval opening of the diaphragm was 10 cm. The distance between the opening of the inferior renal vein and the caval opening of the diaphragm was 12 cm.

The right suprarenal vein drained into the inferior vena cava, and the renal vein on the right side was seen to be normal as it passed superficially to the renal artery. An additional variation was noted. At the intersection of the inferior vena cava and right renal vein, the right gonadal vein was draining. The renal artery provided blood to each kidney. On the left side, the left renal artery took origin from the abdominal aorta and, 1.5 cm away from it, divided into two segmental arteries. The inferior segmental artery travelled behind the renal vein to reach the hilum 2.4 cm from the hilum, while the superior segmental artery passed anterior to the common trunk of the left renal vein to reach the hilum. The superior segmental artery further split into three arteries, two of which reached the upper and lower parts of the hilum, and one of which reached the middle part of the hilum. The inferior segmental

artery arrived at the left kidney's hilum. Two centimeters from the abdominal aorta, the right renal artery split into two segmental arteries.

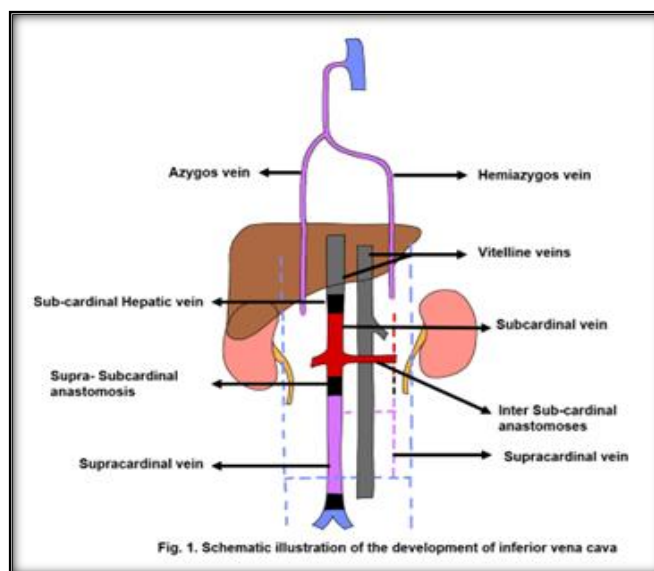


Fig. 1. Schematic illustration of the development of inferior vena cava

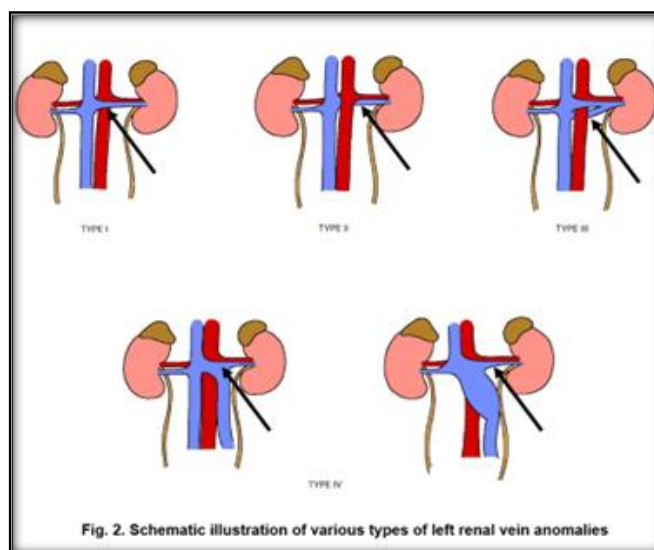


Fig. 2. Schematic illustration of various types of left renal vein anomalies

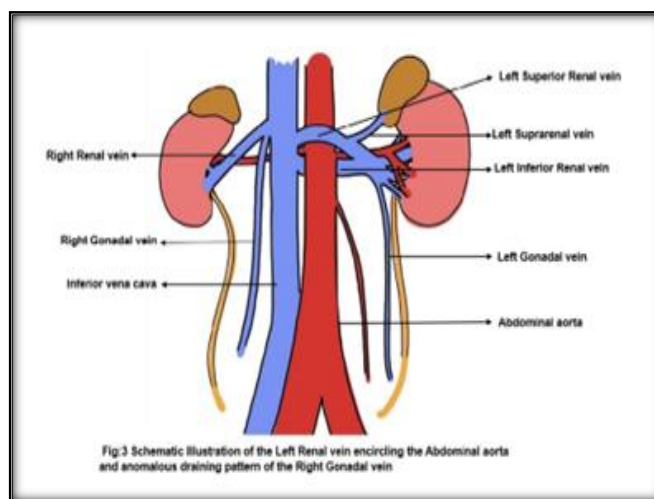


Fig.3 Schematic illustration of the Left Renal vein encircling the Abdominal aorta and anomalous draining pattern of the Right Gonadal vein



Figure 3a: Showing the double left renal veins and anomalous draining pattern of right gonadal vein.



Figure 4: A white arrow indicating the Right gonadal vein, and a red arrow indicating the left inferior renal vein

## DISCUSSION

The inferior vena cava frequently has a close relationship with the development of the gonadal and renal veins. Only 6.4% of the 342 individuals in the study had changes in the renal vein, primarily on the right side, according to Baptista Silva et al., Only one of these cases was found to be a tributary of the gonadal vein, and about one-third of them

involved a duplicate renal vein. Rarely (9.7%) did they observe three or more renal veins.<sup>[6]</sup> Cicek et al. conducted a retrospective review of 1,859 voluntary donors over an 11-year follow-up period and found slightly higher rates of numerous right-sided renal veins, 28.2%.<sup>[7]</sup> Four instances had a circum-aortic left renal vein. Additionally, in each of the four cases, there was a left testicular vein duplication, with one testicular vein draining into the left renal vein and the other into the circum-aortic renal vein.<sup>[8]</sup>

Retro-aortic left vein was observed in 1.8%, and circum-aortic renal collar in 1.5% was reported by Davis and Lundbery in their study.<sup>[9]</sup> Riichiro Toda reported a double renal vein associated with abdominal aortic aneurysm.<sup>[10]</sup> M. Jafarpour discovered a 6.5% twin left renal vein in 32 male cadavers.<sup>[11]</sup> In recent decades, a limited number of studies have indicated a median prevalence ranging from 5% to 7%. The prevalence has been observed to be greater in studies involving cadavers. It is crucial to recognize this anomaly from a surgical perspective, particularly concerning endovascular procedures performed retroperitoneally or any renal surgeries. Failing to identify this surgical variation may result in hematuria or lead to unsuccessful endovascular procedures. A comprehensive understanding of these anomalies will help prevent complications or oversights.

In the event of EHPVO, balloon-occluded retrograde transverse obliteration of varices presents a viable treatment alternative. This procedure necessitates the cannulation of the left renal vein; however, if a circum-aortic left renal vein is present, it will be essential to cannulate both the pre-aortic and post-aortic veins to accurately define the shunt and prevent treatment failure.

There are important clinical implications for the anatomical differences of the left renal vein. Imaging techniques like CECT and MRI can offer insights regarding their existence, and having preprocedural awareness of these variations is crucial to prevent therapeutic failures.

In a study with 5,089 cases, Hoeltl et al. found that the overall percentage of renal collar was 0.2%.<sup>[12]</sup> One incidence was reported by Schindo et al., out of 166 patients (0.6%) who had aortic surgery.<sup>[13]</sup>

The latter is of great importance in retroperitoneal surgical procedures such as lumbar sympathectomy, adrenalectomy, nephrectomy, abdominal aorta repair, and retro-aortic renal vein management. A pre-aortic vein must be seen during retroperitoneal surgery, but the surgeon may not be aware of any other retro-aortic components or post-primary tributaries and could rip it while clamping the aorta or mobilizing the kidney.<sup>[12,13]</sup> This complication following abdominal aortic aneurysm surgery was reported by Toda et al.<sup>[10]</sup> When blood samples are needed for suprarenal hormonal testing, the anterior portion of the CLRV should be used because the suprarenal vein always empties into it.<sup>[14]</sup>

The left gonadal vein empties into the posterior portion of the circum-aortic left renal vein, according to our research and that of Haladaj et al. Furthermore, the anterior part of the circum-aortic left renal vein receives the drainage from the left inferior phrenic vein. No variations regarding the arterial structure were noted in this case.<sup>[15]</sup> Imaging methods should be used to evaluate the venous pattern before surgery. However, as contrasted with surgical, dissection, and autopsy investigations, imaging methods do not fully capture all variances.<sup>[9]</sup>

Anterior and posterior veins may overlap in venographies. In CECT and MRI, the posterior vein can be misinterpreted or completely overlooked. Surgeons must therefore exercise caution during surgery to reduce the possibility of harming the portal vein, even in cases when imaging methods show no differences. In this instance, the inferior vena cava and right renal vein met at the point where the right gonadal vein empties. In order to make an appropriate diagnosis during abdominal procedures, clinicians and surgeons should be knowledgeable about anatomical variations.

Nephrectomy is challenging since the right renal vein is small, measuring less than 10 cm. The left renal vein is the preferable side for a living donor nephrectomy since it is three times longer than the right.<sup>[5]</sup> In this instance, the right gonadal vein opened inferiorly on the right side at the precise point where the inferior vena cava and right renal vein converge. There was no duplication of the right renal vein. Multiple renal vein anomalies are incompatible with donor nephrectomy because they are linked to an increased risk of graft thrombosis. vein of the kidney.<sup>[14]</sup> Krishna Gopal et al. observed the right gonadal vein draining at the junction of the right renal vein and inferior vena cava in one cadaver, similar to the present study.<sup>[16]</sup>

## CONCLUSION

Despite the relatively small number of cases examined, a new anatomical classification system for the RLRV was created in order to assist future RLRV reporting when novel morphological characteristics of the left renal vein were discovered. Rare variations such as numerous RLRVs or LLRVs with multiple cava end trunks may raise the risk of several treatments if they go unreported. It is necessary to document the LRV anatomic variances on an individual basis.

**Acknowledgement:** I would like to acknowledge Vandita Agila S, a student from Phase III, Part-2 MBBS, KMCH Institute of Health Sciences and Research, for the outstanding diagrams created with precision that truly brought the concept to life, making much clearer the normal embryology of renal veins and the observational findings of the present study.

## Financial support and sponsorship

Nil.

## Conflicts of interest

There are no conflicts of interest.

## REFERENCES

1. Gray Henry. The anatomical basis of clinical practice, 39th edition. Susan Standring, Elsevier Livingstone; 2005
2. Moore KL, Persaud TVN. The Developing Human: Clinically Oriented Embryology. 7th ed. Philadelphia: WB Saunders, 2002
3. Provenza CG, Boutrous M, Amankwah KS. Incidental finding of circumaortic left renal vein aneurysm on imaging. *Journal of Vascular Surgery Cases, Innovations and Techniques*. 2022 Dec 1;8(4):711-4
4. Damen NS, Hostiu S, Jianu AM, Manta BA, Rusu MC, Dobra MA. Anatomical variants of the retroaortic left renal vein. *Annals of Anatomy-Anatomischer Anzeiger*. 2024 Jan; 251:152170.
5. Ismailoglu P, Tanyeli E, Uzel M, Soyluoglu AI, Yildirim GK. Double left renal vein encircling the aorta (renal collar). *Cerrahpasa Medical Journal*. 2020 Apr 29;44(2):112-4.
6. Singh AK. Circumaortic left renal vein: An uncommon variation. *J Anat Soc India* 2024; 73:287-9.
6. Baptista-Silva JC, Verissimo MJ, Castro MJ, Camara AL, Pestana JO. Anatomical study of the renal veins observed during 342 living-donor nephrectomies. *Sao Paulo Medical Journal*. 1997; 115:1456-9.
7. Cicek cibai AE, Salbacak A, Peker M, et al. The origin of gonadal arteries in human fetuses: Anatomical variations. *Annals of Anatomy* 2002; 184(3): 275–79
8. Preeti Sonje, Neelesh Kanasker, P. Vatsalawamy. Variations in the Origin and Draining Pattern of Gonadal Vessels with Their Surgical Significance and Developmental Correlations. *Indian J Anat*. 2020;9(1):39-43
9. Davis Jr CJ, Lundberg GD. Retroaortic left renal vein: a relatively frequent anomaly. *American journal of clinical pathology*. 1968 Dec 1;50(6):700-3
10. Toda R, Iguro Y, Moriyama Y, Hisashi Y, Masuda H, Sakata R. Double left renal vein associated with abdominal aortic aneurysm. *Annals of thoracic and cardiovascular surgery*. 2001 Apr 1;7(2):113-5.
11. Jafarpour M, Mofidpour H. Left renal vein variations: a cadaveric study. (2002): 25-27.
12. Hoeltl W, Hrubby W, Aharinejad S. Renal vein anatomy and its implications for retroperitoneal surgery. *J. Urol*. 1990; 143:1108–1114.
13. Shindo S, et al. Anomalies of inferior vena cava and left renal vein: risks in aortic surgery. *Ann Vasc Surg*. 2000; 14:393–396.
14. Satyapal KS, Kalideen JM, Haffejee AA, Singh B, Robbs JV. Left renal vein variations. *Surg Radiol Anat* 1999; 21:77-81
15. Haladaj R, Polguy M, Wysiadecki G, Żytkowski A, Topol M. Circumaortic left renal vein (circumaortic renal collar) associated with the presence of vascular anomalies: a case series and review of literature. *Folia Morphol (Warsz)*. 2019;78(2):437-443. Epub 2018 Oct 3
16. Krishna Gopal, Onkar Singh, Anurag. Abnormal Pattern of Renal and Gonadal Veins and Its Developmental Correlation. *Int J Anat Res* 2017;5(3.2):4295-4298.