Journal of Rare Cardiovascular Diseases
ISSN: 2299-3711 (Print) | e-ISSN: 2300-5505 (Online)
www.jrcd.eu

RESEARCH ARTICLE

Anatomical variation of the renal vessels and its clinical significance: A cadaveric study (Maharashtra)

[1]Dr. Shobha Verma, [2]Dr. Manisha Mishra, [3]Dr. Sunita Bharati and [4]Dr. Haritha KN, [5]Dr. Manisha Nakhate

[1] Associate Professor, Mahatma Gandhi Mission Medical College, Nerul, Navi Mumbai, Maharashtra, India
[2] Tutor, Mahatma Gandhi Mission Medical College, Nerul, Navi Mumbai, Maharashtra, India
[3] Professor and Head, Mahatma Gandhi Mission Medical College, Nerul, Navi Mumbai, Maharashtra, India
[4] Professor, Mahatma Gandhi Mission Medical College, Nerul, Navi Mumbai, Maharashtra, India
[5] Professor and Head , Mahatma Gandhi Mission Medical College, Panvel ,Maharastra ,India

*Corresponding Author
Dr. Sunita Bharati

Article History
Received: 10.09.2025
Revised: 15.092025
Accepted: 06.10.2025
Published: 15.11.2025

Abstract: **Introduction:** Kidney is supplied by a renal artery and a renal vein, which is a branch of abdominal aorta arising from the abdominal aorta and renal veins drain kidney into inferior vena cava. The vascular pattern have number of anatomical variations in terms of their number and origin. **Materials and Methods:** The study on cadavers was carried out by dissecting a total of 15 embalbed cadavers during routine dissection, aged between 50 to 75 years, of which 10 were male (75%) and 5 were female (25%), obtaining a total of 30 kidneys (15 left and 15 right kidneys). **Result:** During routine cadaveric dissection we found following variations Case 1- Two renal vein draining separately in inferior vena cava and artery is entering between both renal veins in right kidney. Case 2- Renal vein emerging from the lower pole and artery entering into the kiney below the hilum of right kidney Case 3 Two Renal vein is emerging one from upper part of the hilum and other from lower pole of the hilum and artery is entering at the level of lower part OF hilum renal vein behind the renal artery in right kidney Case4 - two renal arteries are present both are above the renal vein one artery entering into the hilum whereas other crossing the renal vein anteriorly and entering infront of in the hilum (right kidney) **Conclusion:** Out of 30 kidney we found variation in 4 kidneys in all male that is (13.3% variation of renal vein) cadavers unilaterally mainly on right side is seen. This suggest that renal variation on right side is more common than left side and it is more common in male. Knowledge of variations among renal vessels is Important for radiologists and surgeons

Keywords: Renal hilum, renal vein, renal arteries

Introduction

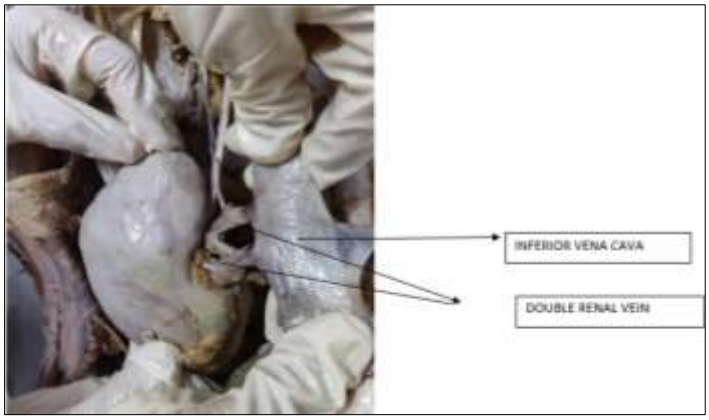
Both the Kidneys are supplied by a renal arteries and a renal veins, a branch arising from the lateral part of abdominal aorta and tributary to the inferior vena cava. However, this vascular pattern presents number of anatomical variations in terms of their number, origin and course. It is considered that variations in the renal arterie are found in about 35% of cases, while alterations in the renal veins, which are less frequent, occur in only 18% of the observed cases. Knowledge of the normal anatomy and variations in the vascular system of the kidney is extremely important for proper medical-surgical care, especially when planning various interventions (renal transplantation, angiography and/or aneurysm repair, among others) and knowing the pathologies associated with these alterations (hydronephrosis, varicocele or orthostatic proteinuria due to venous compression[17]. Embryological development plays a major role in its prevalence, with an association between the presence of accessory renal vessels and evidence of arrested uniform development of the kidney. Kidney migrate during development, may retain vessels from their initial location or incorporate new vessels from the invaded region. Initially, the primordial kidneys are located in the pelvis in close proximity to each other and, as the development occurs, they gradually separate and get relocated in the abdomen, reaching their usual position by the 9th of gestation. During the early stage, the renal arteries originate from the common iliac arteries and as the kidneys ascend they receive new branches from the distal aorta. When the kidneys are located in their adult position they receive most of their arterial branches from the abdominal aorta. Thus, as a rule, the caudal branches from the initial renal vessels involute and disappear, while the cranial branches from the abdominal aorta become the permanent renal arteries. This could explain the cases of accessory renal vessels arising from iliac, sacral or inferior mesenteric arteries, as they could be considered as persistence of primitive renal arteries. . Renal veins usually start at the hilum of the kidneys following union of a variable number of smaller vessels, the primary tributaries, and end at inferior vena cava at a right angle in front of the body of L2 vertebrum [1]. The normal structures Present at renal hilum from anterior to posterior is vein, artery and renal pelvis. [2, 3] Although a single renal vein on either side is the normal pattern, variations such as additional renal veins or double renal veins are not uncommon

Multiple renal veins are more common on right side than left. The major embryonic structures that participate in renal vein formation are the posterior cardinal, the sub-cardinal and the supra cardinal venous systems and their accompanying anastomoses [4]. The posterior cardinal veins appear at about 5th week of development as a pair of two longitudinal veins that ascend upwards. They serve as the veins of mesonephros. These veins disappear along with the mesonephros. [5] This system is later replaced by the

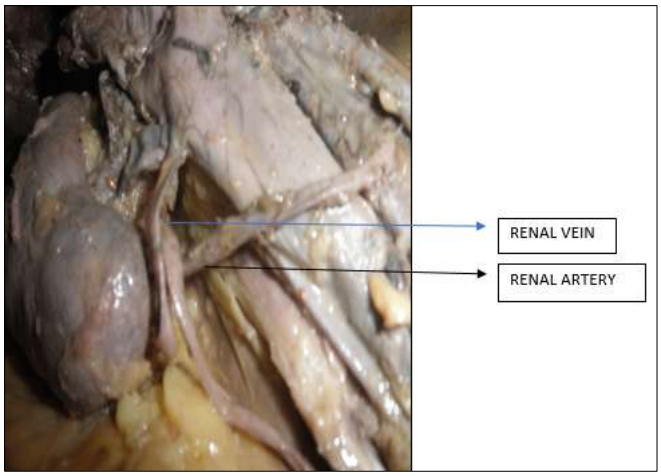
paired supra-cardinal and sub-cardinal veins which develop medial to these veins. Not only they are connected to it at both cranial and caudal ends but also anastomose with each other these veins and anastomoses partly persist to form renal veins and IVC

MATERIAL AND METHODS

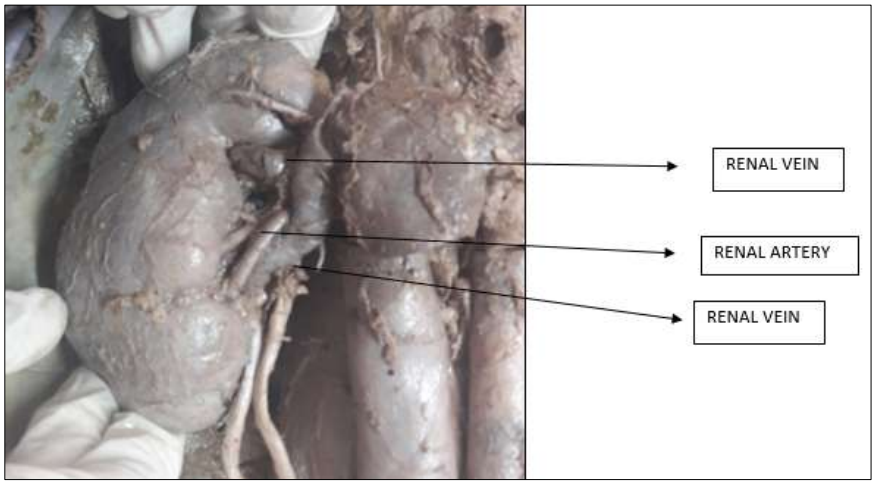
An observational study of renal vessles was carried out during routine cadaveric dissection, in the Department of Anatomy at Dy Patil Medical College and at MGMMC Nerul navi Mumbai. The study was carried out by dissecting total fifteen cadavers, aged between 50 to 75 years, of which 10 were males (75%) and 5 were females (25%), obtaining total 30 kidneys (15 left and 15 right).



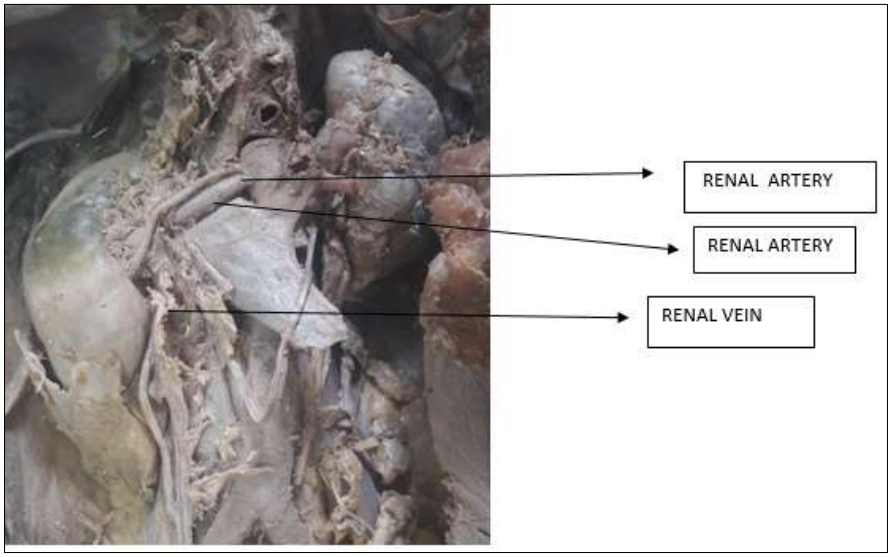
Case 1: Double renal vein (RT kidney)



Case 2: Renal vein is at lower pole of the kidney (RT kidney)



Case 3: Renal vein is behind the artery (RT kidney)



Case 4: Two renal arteries are arising from aorta and renal vein is emerging between the two arteries

Results

During routine cadaveric dissection of 15 cadavers (30 kidneys) we found variation in four cadavers and all the variation was unilateral.

- **Case 1:** Two renal vein draining separately into the inferior vena cava and artery is entering between both renal veins in the hilum of right kidney.
- **Case 2:** Renal vein emerging from the lower pole and artery entering into the kindey belo the hilum of right kidney
- **Case 3:** Two Renal vein is emerging one from upper part of the hilum and other from lower pole of the hilum and artery is entering at the level of lower part of hilum renal vein behind the renal artery in right kidney
- **Case 4:** two renal arteries are present both are above the renal vein one artery entering into the hilum whereas other crossing the renal vein anteriorly and entering infront of in the hilum (right kidney)

All the variation we found was unilateral and on right side and is present in male cadavers only.

DISCUSSION

Variations of renal veins are usually clinically silent and remain unnoticed until discover during venography, operation or autopsy. To transplant surgeon, morphology acquires special significance, since variations influence technical feasibility of operation. Variations restrict availability of vein for mobilization procedures [6]. The occurrence of congenital variations of renal vein can be explained on the basis of its embryological development. The development of the renal veins is a part of the complex developmental process of inferior vena cava. The process starts from the forth week of conception and ends at about the eight week. There is vast network of three pair of parallel veins in communication. These are in the order of appearance; the posterior cardinal veins, the subcardinal veins and the supracardinal veins. The renal veins are formed by anastomoses of the subcardinal veins and supracardinal veins. Two renal veins form as ventral and dorsal; the dorsal vein usually degenerates, the ventral vein forms the renal vein [7].

It is known that renal vessels, shows high degree of variations. Many studies have been done and cases are reported about these variations .Satyapal conducted a study to determine the site of entry of renal veins into the IVC. He has reported that left vein entered IVC higher than right in 54%, lower in 36% and opposite each other in about 10% of cases [8]. In the present study we found variation of renal vein in 4 kidneys out of 30 kidneys which is 13.33% in one case we found that two renal vein separately draining into the inferior vena cava in second case renal vein is present at the lower pole of the kidney.in third case we found that renal vein is present behind the renal artery and in the forth case we found renal vein is present below the artery. Some other renal vein variations reported are the retroaortic left renal vein opening in to the left common iliac vein, a circumaortic venous ring and a retro-aortic bifid left renal vein [9, 10].

In fact it is even suggested that the incidents of additional renal veins are much less, that is about 0.4% than what is mentioned in standard text books which is about 0.8 to 6%. From above literature review it is evident that renal vein variation is more common then arteries. Fernandes *et al* reported a case of triple right renal veins arising from ventral aspect of hilum and terminating independent of each other into the inferior

vena cava. Double right side renal veins have been reported elsewhere too. [9] These authors did report cases of multiple right renal [11].

According to Shaheen *et al* multiple right renal veins have also been reported in literature. Th ere was only one case of double renal vein (2% of cases) on right side our study. The two renal vein [12]. In another study, the renal arterial supply was analyzed in 266 kidneys dissected from 133 fixed adult subjects. The anatomical findings were 1 hilar artery in 53.3%, 1 hilar artery with 1 superior pole extra-hilar branch in 14.3%, 2 hilar arteries in 7.9%, 3 hilar arteries in 1.9%, superior polar artery in 6.8%, and inferior polar artery in 5.3% and other variations in 8.5% of cases [13]. In fact it is even suggested that the incidents of additional renal veins are much less, that is about 0.4% than what is mentioned in standard text books which is about 0.8 to 6% (14) A meta-analysis on the renal veins established a 13.8% prevalence for the double RRVs and a 1.7% prevalence for the triple RRVs [15]

According to Sebastia *et al* Left renal vein anomalies are generally classified into four types Type I the ventral preaortic limb of the left renal vein is obliterated, but the dorsal retroaortic limb persists and joins the IVC in the normal positionType IIresults from the obliteration of the ventral preaortic limb of the left renal vein and the remaining dorsal limb turns into a retroaortic left renal vein (RLRV)left renal vein lies at the level of L4 to L5 and joins the gonadal and ascending lumbar veins before joining the IVC Type III is the circumaortic left renal vein or venous collar - due to the persistence of subsupra cardinal and inter supracardial anastomoses and the dorsal limb of the left renal vein .if all small retroaortic veins that empty into the IVC are considered, the incidence of a circumaortic left renal vein could be as high as 16% Type IV the ventral preaortic limb of the left renal vein is obliterated, and the remaining dorsal limb becomes the RLRV which courses obliquely and inferiorly to join left common iliac vein. Other (non-classified): can involve either kidney supernumerary renal veins late venous confluence [16]

CONCLUSION

In our study which is carried out during cadaveric dissection out of 30 kideys we got vein variation in 4 kidneys unilaterally that shows the prevalence of renal vein variation is 13.3%. Clinical significance Knowledge of possible variations among renal vessels is essential for radiologists and surgeons. Regarding patients who receive a kidney transplant, the surgeon must know how this variant. However, prior knowledge could help the surgery to be done with all these considerations, and these changes could improve the probability of surgical success in these patients

REFERENCES

1. Satyapal KS, Kalideen JM, Haffejee AA, Singh B, Robbs JV. Left renal vein variations. Surg Radiol Anat. 1999;21(1):77-81.
2. Standring S, Ellis H, Healy JC, Johnson D, Williams A, Collins P, *et al* . Gray's Anatomy. 39th ed. Edinburgh: Churchill Livingstone; 2005.
3. Sinnatamby CS. Last's Anatomy: Regional and Applied. 10th ed. Edinburgh: Churchill Livingstone; 1999.
4. Verma R, Kalra S, Rana K. Malformation of renal and testicular veins: A case report. J Anat Soc India. 2005;54(1):29-31.
5. Satyapal KS, Kalideen JM, Haffejee AA, Singh B, Robbs JV. Left renal vein variations. Surg Radiol Anat. 1999;21(1):77-81.
6. Tatar I, Tore HG, Hamidi Celik H, Karcaaltincaba M. Retroaortic and circumaortic left renal veins with their findings: A review of the literature. Anatomy. 2008;2:72-76.
7. Moore KL, Persaud TVN. The Developing Human: Clinically Oriented Embryology. 7th ed. Philadelphia: WB Saunders; 2003.
8. Satyapal KS. Infra-renal angles, entry into inferior vena cava, and vertebral levels of renal veins. Anat Rec. 1999;256:202-207.
9. Rotti R, Jevoor P, Vollala VR, Potu BK, Ravishankar M, Virupaxi R. Multiple variations of the urogenital vascular system in a single cadaver: A case report. Cases J. 2008;1:344-348.
10. Senecail B, Bobeuf J, Forlodou P, Nonent M. Two rare anomalies of the left renal vein. Surg Radiol Anat. 2003;25:465-467.
11. Nayak BS. Multiple variations of right renal vessels. Singapore Med J. 2008;49(6):e153-e155.
12. Shaheen R, Jamil MN, Farooq U. Anatomic patterns of the right renal vein. J Ayub Med Coll Abbottabad. 2019;31(1):55-59.
13. Sampaio FJ, Passos MA. Renal arteries: An anatomic study for surgical and radiological practice. Surg Radiol Anat. 1992;14:113-117.
14. Satyapal KS, Kalideen JM, Haffejee AA, Singh B, Robbs JV. Left renal vein variations. Surg Radiol Anat. 1999;21:77-81.
15. Hostiuc S, Rusu MC, Negoi I, Dorobanțu B, Grigoriu M. Anatomical variants of renal veins: A meta-analysis of prevalence. Sci Rep. 2019;9:10802.
16. Sebastià C, Peri L, Salvador R, *et al* . Multidetector CT of living renal donors: Lessons learned from surgeons. Radiographics. 2010;30(7):1875-1890.
17. Buffoli B, Franceschetti L, Belotti F, Ferrari M, Hirtler L, Tschabitscher M, Rodella LF: Multiple anatomical variations of the renal vessels associated with malrotated and unrotated kidneys: a case report. Surg Radiol Anat. 2015, 37:1133-6. 10.1007/s00276-015-1446-3