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Original Research Article

Anatomical study of renal vein in cadavers by dissection method

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ABSTRACT

Background: The renal veins present a broad spectrum of variability in their length, tributaries. Such aspects are important when considering a surgical approach, trauma, interpreting diagnostic images and teaching renal veins.
Although imaging techniques have good resolution, they have failed to reduce the incidence of complications of renal surgery. Objectives of the study are to measure length of renal vein and to study the variations in renal vasculature.
Materials and Method: The dissection was carried out in 75 cadavers which were embalmed using formalin. Length of the renal vein was measured using Vernier caliper. Values were reported as in percentage, mean and standard deviation.
Result: 66.7% specimens didn't have extrahilar primary tributaries. We found additional renal veins were less on left side i.e. 3 than on right side 10. One specimen of retro aortic left renal vein was found.
Conclusion: This knowledge will be of immense help to radiologists and oncologists who are dealing with this region. Also a detailed knowledge and understanding of major congenital anomalies of the renal veins variations will provides safety guidelines for endovascular procedures.

1. Introduction

The fact of the conservative methods in surgeries performed on kidney has necessitated detailed knowledge of the renal vascularization. The kidneys are important to the life, so many researchers have tried to investigate this organ. The renal veins have variability in tributaries and in their length. Such aspects are important when performing surgeries, in trauma, interpreting diagnostic images and giving information about renal veins.

Length of the right renal vein (2.5cm) is three times shorter than left renal vein (7.5cm).[1] The left side anomalies of the renal vein may represent problems in the interpretation of CT scan, magnetic resonance of abdomen, stated by Senecail et al.[2]

Although imaging techniques have good resolution and they have contributed substantially in recognizing the pattern of renal vasculature of a patient, they have failed to reduce the incidence of complications of renal surgery. Anatomical studies through dissection directly lead to recognizing anatomical vascularization patterns in greater details.

Aim of the study was to study variability in morphology of the renal vein. Objectives of the study are to measure length of renal vein and to observe the variations in renal vein.

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2. Materials and Methods

The dissection was done in 75 embalmed cadavers. They included 55 male and 20 female cadavers. This was cross-sectional study. They were collected from the dissection hall of department of Human Anatomy of various medical colleges in Maharashtra. Institutional ethical committee approval was taken.

Presence of abnormal abdominal growth or mass, evidence of renal surgical scar or trauma on the abdomen were included in exclusion criteria.

Each cadaver was kept in supine position. Cadavers were dissected according to guidelines of 'Cunningham's Manual of Practical Anatomy.[3]

1. A midline skin incision from the xiphi sternum to the pubic symphysis, encircling the umbilicus was made. The incision from xiphoid process along costal margin to point on the mid axillary line was made. A skin incision from pubic symphysis to anterior superior iliac spine was made. This was extended posteriorly to a point on the mid axillary line.
2. The skin was reflected from the medial to the lateral aspect in four quadrants towards mid axillary line. Anterior abdominal wall was dissected sequentially. Muscles of the anterior abdominal wall were incised and reflected laterally.
3. Peritoneal cavity was opened and various organs of the abdomen were removed and simultaneously renal vessels and their tributaries and branches were identified. Search was made for any variation. The renal vessels were studied by using simple blunt dissection.
4. All measurements were obtained using a Vernier caliper. Photographed records were made. With the dissection, we liberated the kidney from the fat shell and separated the blood vessels from it towards the large blood vessels.
5. Presence of primary tributaries were noted. These tributaries emerged from kidney and join renal vein.[4]
6. Length of renal vein was measured using Vernier caliper between:
   (a) Point at renal hilum or when extra hilar primary tributaries were present, the point where it joined with renal vein
   (b) Point of entry of renal vein into the inferior vena cava
7. Also any variation in relation to renal vein was looked upon.

2.1. Statistical analysis

The collected data regarding length was entered into the Microsoft excel sheet and analyzed statistically by Epo info 7.2.5. Values were reported as in percentage, mean and standard deviation. Statistical analysis of right and left side specimen was carried out by using Fisher Exact Test, T Test, P Value.

3. Results

Tributaries that emerge from the kidney and join to form renal vein are called primary tributaries. These were present in 21% right and 29% left specimens. 66.7% specimens didn't have extra hilar primary tributaries. Statistically significant association was not found between presence of primary tributary of renal vein and side.

Statistically significant difference found between length of renal vein of right and left side. Average length was more on left side (61.42mm) than that of right side (25.98mm).

Additional renal veins were less on left side 3 (4%) than on right side 10 (13.3%).

In present study, only in one cadaver, the left renal vein was present dorsal to the aorta and draining into the inferior vena cava. It also received the left supra renal vein and left gonadal vein. That was normal finding.

4. Discussion

The renal vein having primary tributaries which emerged from the renal hilum separately and 2 or more join to form a single renal vein outside the renal hilum, was noted in 39% specimens by Satyapal.[5] The highest incidence of primary tributaries was 40.6% specimens, according to Kumar N et al.[6] In the present study**,** primary tributaries were observed in 33.3% specimens.

The posterior primary tributary is easily found by an anatomical dissection of abdomen than radiological analysis. It is due to the difficulty of distinguishing anterior from posterior branches from AP view.

Results of all studies showed that mean length of left renal vein (LRV) was three times more than that of right renal vein (RRV).[5,7,8] In the present study, the length of LRV exceeded the length of RRV by three times: the average length of the RRV being 25.9 mm (11.15 - 45.01 mm) and that of the LRV being 61.4 mm (43.14 - 78.64 mm). (Figure 1)

The common anatomical variations of the renal veins like circum-aortic left renal vein, additional renal veins, retro-aortic, and plexiform left renal vein were observed. The presence of additional renal veins was most common finding.

The wide discrepancies of incidence of variations of renal veins were seen in previous studies.

Additional veins are observed less commonly on left side than on right side.[5] Reason behind this is different development of right and left sub-supra cardinal anastomosis. On the right side sub-supra cardinal anastomosis is incorporated into inferior vena cava. This may be explanation for the persistence of both right

Table 1: Number of renal veins having extra hilar primary tributaries

Primary tributaries	Right Renal Vein		Left Renal Vein		Total	
	Specimens	%	Specimens	%	Specimens	%
Present	21	28	29	38.7	50	33.3
Absent	54	72	46	61.3	100	66.7

P= 0.2252, not significant [P>0.05], Fisher exact test

Table 2: Measurement of length of renal vein in millimeter

Renal Vein	Maximum Length	Minimum Length	Mean Length	S.D.	P value
Right	45.01	11.15	25.98	2.19	<0.001
Left	78.64	43.14	61.42	2.41	

t = 94.2509 DF=148 standard error of difference = 0.376

Table 3: Average measurement of range of length of renal vein in millimeter

Average length of right renal vein	25.98
Average length of left renal vein	61.42
Average obsolete difference between two	35.44
Average difference as expressed in %	58.32

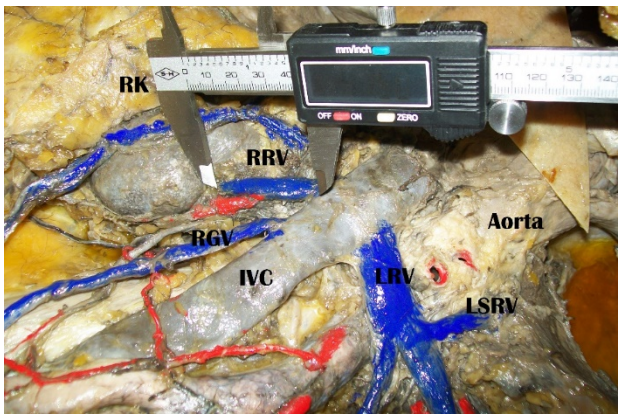

Fig. 1: An anterior view of an abdomen illustrating measurement of the right renal vein using a vernier caliper (RK- right kidney), RRV- right renal vein, RGV- right gonadal vein, IVC- inferior vena cava, LSRV- left suprarenal vein, LRV- left renal vein)

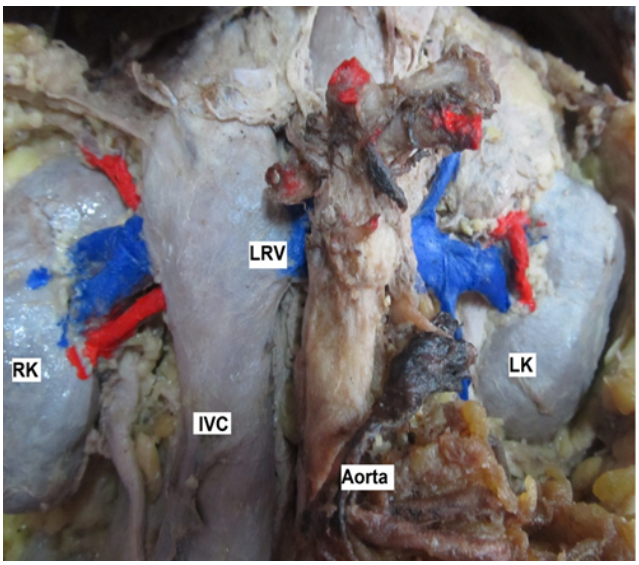

Fig. 2: Anterior view of abdomen showing retroaortic left renal vein (Aorta: abdominal aorta; LRV: left renal vein; RK: right kidney; IVC: inferior vena cava; LK: left kidney)

primitive renal veins, on the left side, the sub-supracardinal anastomosis regresses completely.[9]

In one literature, significant prevalence of anatomical variations on the left renal vein (about 92%) was found and the presence of multiple right renal veins (more than 2 vessels) was found in about 8 to 9.7% of cases.[10] Bergman et al. pointed that, the renal veins show less variation than renal arteries and multiple renal veins common on the right side (28%) and rare on the left side (1%) and.[11]

A congenital anomaly may restrict the mobilization procedures (e.g. spleno-renal shunts) of left renal vein for and nullify better result which normally occur from greater length of left renal vein (e.g. left renal transplant).[7]

Retro aortic left renal vein was seen in 1.3% cadavers of the present study.(Figure 2)

It had been reported from 0.5% to 17% in various studies. An occurrences of the retro-aortic renal vein shows ethnic, social, and racial differences. Eg. Satyapal et al did study in South African population based on cadaveric study using resins, retrospective clinical study using renal venogram.[12]

In embryo, a plexiform collar encircled aorta and drains the blood from permanent kidney. This collar connects with 2 sets of paired longitudinal channels, sub cardinal and supra cardinal veins. Normally, only anterior part persists and gives renal veins present anterior to aorta and renal arteries. We can say that development of retro-aortic left renal vein is due to persistence of posterior limb of renal

collar and absence of its anterior limb.[12]

Singla et al (2010) stated that the retro aortic left renal vein may be compressed between the lumbar spine and the aorta leading to left renal venous hypertension.[13]

This is known as Posterior Nutcracker Syndrome. Compression of the retro-aortic left renal vein may result in left renal-gonadal vein reflux resulting in lower limb varices. This varicocele may produce difficulties in spermatogenesis and result in infertility. Patient may complain left flank and abdominal pain and hematuria.

Pelvic Congestion Syndrome in females is associated with retro-aortic left renal vein located between vertebra and aorta. It may be compressed by retroperitoneal growths and lead to congestion of kidney. It causes chronic interstitial nephritis.

The surgical significance of such variants may affect use the long left renal vein for venous reconstruction in hepato pancreatic surgery and mobilization procedures gets restricted.[14]

5. Conclusion

Detailed knowledge of variations of these vessels will definitely improve outcome of various urological, renal transplantation and laparoscopic surgeries. This knowledge will be of immense help to radiologists and oncologists who are dealing with this region. Also, a detailed knowledge and understanding of major congenital anomalies of the renal veins variations will provides safety guidelines for endovascular procedures.

6. Limitation of the Study

The study could have been supplemented with CT and MRI findings. Also, the renal veins get collapsed in cadavers, diameters become difficult to measure.

7. Source of Funding

None.

8. Conflict of Interest

None.

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