MORPHOMETRY OF RENAL VEINS IN A CADAVER STUDY

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ABSTRACT

Background: Comprehensive surgical workup done preoperatively, has an important role in avoiding unnecessary hazardous outcomes of a surgery related to renal transplantation, radical renal procedures and other urological surgeries. This study was aimed to study the morphometry of normal as well as abnormal anatomic patterns of human renal veins.

Design, setting, and participants: A observational cross-sectional study, carried out at the Anatomy and Forensic departments of King Edward Medical College Lahore, and departments of Anatomy at Allama Iqbal Medical College, Services Institute of Medical Sciences, Postgraduate Medical Institute and Fatima Jinnah Medical College, Lahore on 50 adult male cadavers with well-preserved kidneys, renal vasculature and the inferior vena cava over a period of one year. Cadavers with deformed kidneys, or with congenital anomalies such as horse-shoe kidney, congenital or acquired absence of one kidney, tumors of kidneys or injured renal vessels / inferior vena cava or evidence of surgery i.e., partial nephrectomy, were excluded from the study. After dissection of the cadavers, kidneys, renal veins and the inferior vena cava were exposed.

Results: Mean length and diameter of the right renal vein was 20.88±5.70 mm and 59.90±10.28mm (p value <0.001) respectively, whereas mean length and diameter of left renal vein was 59.90±10.28mm and 11.57±1.78mm (p value <0.01) respectively.

Conclusions: There is a significant variation in the morphometry of normal and variant renal venous system of humans. Adequate awareness and knowledge of these variations must be necessary for surgeons in order to minimize intraoperative as well as postoperative surgical disasters.

Key words: Cadavers, renal veins, morphometry, dissection.

INTRODUCTION

There is an abundance of literature on the anatomical patterns of renal vasculature, but surprisingly, there is a lack of research on the morphometry of renal veins i.e measurement of their length and diameter.[1] Knowledge of the measurements of renal venous patterns and their variations is very important from urological and surgical perspective such as renal transplants and radical renal surgeries as veins of adequate length and caliber can only be used in such procedures. Additionally, with the wide-spread adoption of the laparoscopy for renal surgery, despite its limited field of view, precise planning before operation is needed more than ever to avoid development of catastrophic complications of surgery. As a result of an increased inclination of surgeons towards conservative surgery and availability of new modalities in radiology, there is a renewed interest in detailed study of renal venous architecture.[2]

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A renal vein is formed when the tributaries emerging from kidney (usually three tributaries) merge with each other and it normally ends in inferior vena cava (IVC).[3]The renal vein may not all the times be a singular structure, double renal veins, or additional variants of renal veins are not uncommon. The "additional renal vein" (ARV) is any vessel that arises separately from the kidney and also terminates separately into the inferior vena cava. Compared with the main renal vein, its calibre is usually smaller.[4] Two separate renal veins that have similar calibre and which arise from the same renal hilum but end separately into the inferior vena cave are termed as double renal veins.

The venous patterns in both kidneys do not resemble each other since the right and left renal veins have variable lengths and drain different territories.[5]The right renal vein is usually 25 mm long compared to left which measures around 75 mm according to standard text books.[6] Present study aims to conduct morphometry of renal veins and its variants in cadavers in Pakistani population.

MATERIALS AND METHODS

This observational cross-sectional study was carried out at the Anatomy and Forensic departments of King Edward Medical College Lahore, and departments of Anatomy at Allama Iqbal Medical College, Services Institute of Medical Sciences, Postgraduate Medical Institute and Fatima Jinnah Medical College, Lahore. The study included 50 adult cadavers with well-preserved

kidneys, renal vasculature and the inferior vena cava over a period of one year. Cadavers with deformed kidneys, or with congenital anomalies such as horse-shoe kidney, congenital or acquired absence of one kidney, tumors of kidneys or injured renal vessels / inferior vena cava or evidence of surgery i.e., partial nephrectomy, were excluded from the study.

All 50 cadavers were subjected to dissection, through the anterior abdominal wall. The inferior vena cava, renal veins along with the kidneys were exposed. An injection medium consisting of a mixture of Indian ink and gelatin was injected via IVC to fill renal veins.[7]The mixture was allowed to set and solidify, the renal veins and their variants were outlined for study. The length of renal veins was measured with the help of digital sliding caliper from the point of union of primary tributaries of the respective side to its termination in IVC. The diameter was measured by digital sliding caliper at three points which were hilum, midpoint and termination of variant and normal renal veins.[8] The diameter of renal vein was taken as mean of the three readings. The length and diameter of right and left normal renal veins was compared using independent two-sample t-test. The length and diameter of variant patterns were descriptive only. SPSS, p value<0.05 was considered significant.

RESULTS

Of all cadavers dissected 82% had normal pattern and were included in the analysis.

Normal pattern

The mean length of right renal vein (RRV) was 20.88mm ± 5.70 mm (ranging from 10.95mm to 32.50mm). The diameter was 10.85mm ± 2.37mm. The left renal vein (LRV) on an average measured 59.90mm ± 10.28mm in length (ranging from 38.57mm to 76.37mm). The diameter of LRV was 11.57mm ± 1.78mm.There was statistically significant difference ($p<0.05$) between the morphometry of right and left renal veins (Table 1).

Morphometry of variant patterns

According to the results of morphometry of additional renal veins their average length was 27.12mm ± 15.33mm (ranging from 11.29mm to 47.50mm), and diameter was 5.15mm ± 2.91mm (Table 2). This pattern was found on right side only.

In case of double right renal veins, one vein emerged from anterior aspect of hilum. It measured 25.76mm in length, 8.44mm in diameter. The second vein that emerged from mid hilum crossed the first one posteriorly and joined IVC 4mm inferior to it. Its length was 19.81mm and diameter was 9.72mm. In case of double left renal vein, two renal veins were present independently, one passing anterior and other posterior to aorta. Length and diameter of the anterior renal vein was 60.80mm and 6.76mm respectively. The posterior vein joined IVC 25.89mm below the anterior component at the level of L3. Length of the posterior component was 60.50mm while diameter was 6.78mm.

The circumaortic renal collar having an anterior and a posterior component Length of anterior vein was 64.31mm while diameter was 12mm. The posterior component was 102.67mm in length while its diameter was 11.23mm (Table 2). Retroaortic left renal vein passed posterior to aorta to join IVC at the level of L3. Its length was 49.91mm and diameter was 8.58mm (Table 2).

Table 1: Mean value (±SD) of morphometry of both sides (n=50).

	Right side (mm)	Left side (mm)	p value
Length	20.88±5.70	59.90±10.28	<0.001
Diameter	10.85±2.37	11.57±1.78	<0.01

Table 2: Mean values of morphometry of different patterns of renal vein of both sides

Patterns	Right		Left	
	Length(mm)	Diameter (mm)	Length(mm)	Diameter (mm)
Normal	12.88	10.85	59.90	11.57
Additional RV	27.12	5.15	--	--
Proximally Double RV(single part)	19.82	7.95	40.58	13.03
Retroaortic LRV	--	--	49.91	8.58
Circumaortic LRV				
Anterior component	--	--	62.55	9.38
Posterior component	--	--	81.58	9.00

In case of proximally double right renal vein, two veins emerged from anterior aspect of hilum. The two veins converged and joined to form single renal vein. The average length of double part was 10.00mm in first and 13.20mm in second case. The mean length of single part of proximally double right renal vein was 19.82mm ± 3.69mm, and its mean diameter was 7.95mm ± 2.55mm (Table 2).

On left side in case of proximally double renal vein, two veins emerged from anterior aspect of mid hilum which later united to form a single renal vein which in turn joined IVC at the normal position. The average length of double part was 27.64mm to 36.84mm. Mean length of single part of proximally double left renal vein was 40.58mm ± 3.38mm diameters was 13.03mm ± 2.86mm (Table 2).

DISCUSSION

Renal veins have gained increasing importance in context with the procurement of donor kidneys and renal transplantation surgeries. The length of renal vessels plays a crucial role in transplantations procedures and only vessels of adequate length could be anastomosed to the vessels of recipients without undue difficulty[9].

In the present study, the mean length of renal vein was recorded to be 20.88mm ±5.70mm on right and 59.90mm ±10.28mm on left side respectively; the length of LRV being 2.8 times the length of RRV. Sarkar et al[9] observed the lengths of right and left RV as 18mm and 36mm respectively in a study carried out on 32 pairs of kidney specimens. Dharet al[2], in their study, reported the length of RRV as 28mm and that of LRV as 80mm. The length of LRV was two times that of RRV in the former and three times in the later study. Satyapalet al[10] reported that the length of LRV is two and a half times that of RRV. They noted the length of RRV and LRV to be 59mm ±15mm and 24mm ±7.8mm respectively. The length of the LRV has been reported to be 3 times the length of RRV by standard book of anatomy, measuring 75mm and 25mm respectively[6]. Janschek *et al*[11] recorded the length of right renal vein only. The reported length was from 21mm to 71mm.

On the basis of the earlier reports and the observations of the present study, it can be said that LRV generally exceeds two to three times in length than that of RRV. Nevertheless, the variation in lengths of renal veins as per earlier reports and the present observations could be explained on racial basis as present work was carried out in subjects of Pakistani origin, whereas, the earlier studies were carried out in population of other origins.

In the present study, the gross diameter of renal veins was noted to be 10.85mm ±2.37mm and 11.57mm ±1.78mm on the right and left side respectively. Earlier Satyapal *et al*[10] in their study on 100 pairs of kidneys recorded same values for gross diameter of renal veins on both sides (12mm ±2mm). In another study by Sarkar et al[9] the diameter of renal vein was noted to be 8.6mm and 9.2mm, while Ballesteros *et al*[12]recorded it to be 10.9±1.5mm and 12.3±1-41mm on right and left side respectively. They mentioned that Anson *et al* in their study on 215 bodies reported the diameter of renal veins as 14mm and 19mm on right and left side respectively.

Despite reports of additional renal veins, scant records of their lengths as well as diameters are available in literature. In the present study, the mean length and gross diameter were 27.12mm ± 15.33mm and 5.15mm ± 2.91 mm for the first ARV and 36.28mm and 2.66mm for the second ARV. In a report by Satyapal and colleagues, the mean length and diameter was reported to be 25mm ±11mm and 7mm ± 2mm and 24mm ± 9mm and 7mm ± 2mm for the first and second additional renal veins respectively.[1]Ballesteros et al12 recorded the length of first and second additional veins to be 30.7 ±10.19mm and 31.2 ±7.93mm respectively.

The difference in values of present study and that of the published data could be due to variation in average body built of different racial groups.

CONCLUSIONS

There is a significant variation in the morphometry of normal and variant renal venous system of humans. Adequate awareness and knowledge of the morphological expression allows surgeon to make better pre operative as well as intra operative planning and decisions.

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