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Anatomical Variations of Tributaries Emerging from Hilum to Form Renal Vein

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Abstract

The hila and the adjacent pre-hilar area of seventy-two (35 right and 37 left) kidneys isolated from formalin fixed cadavers were examined. Subsequently, the total number of tributaries emerging from renal hilum to form main renal vein were studied and the variations in them were observed. Thereafter, we calculate and compare our results with similar studies conducted in the past. This information is of importance for surgeons performing nephron sparing surgeries and performing renal transplant operations.

Keywords: Renal Vein; Renal Artery; Renal Transplant Surgery; Hilum.

Introduction

The anatomical knowledge of renal veins and its variations are of extreme importance for surgeons approaching the retroperitoneal region especially with the recent increase in the frequency of renal transplant surgeries [1].

The large renal veins lie anterior to the renal arteries and open into inferior venacava at almost right angles [2].

At the hilum, renal vein is anterior to the renal artery, which is anterior to renal pelvis [3].

Veins from renal segments communicate with one another unlike the arteries and eventually form five or six vessels that unite at the hilum to form single renal vein [4].

The left renal vein is three times longer than the right renal vein. As a result, the left kidney is the preferred side for live donor nephrectomy. The left renal vein may be double, one vein passing posterior and the other anterior to aorta before joining the inferior venacava [2].

In the kidney transplantation operation, accessory veins may be ligated as there is generous venovenous anastomosis throughout the kidneys [5].

Knowledge of anatomy and anomalies of renal veins is necessary for retroperitoneal surgery and venographic procedures in addition to providing safety guidelines for endovascular procedures [6].

Advanced imaging techniques have resulted in increasing use of minimally invasive approaches for nephron sparing surgeries of the kidney. Need for precise knowledge of normal and variant anatomy of vascular pedicle of kidney is therefore justified [7].

Materials and Methods

The hila and the adjacent pre-hilar area of 72 (35 right and 37 left) kidneys isolated from formalin fixed cadavers were examined. The hilum and pre-hilar area of each kidney was dissected carefully. The total number of tributaries emerging from renal hilum to form main renal vein were documented. The arrangements of the structures in the renal hilum and pre-hilar area were analysed to find the most anterior structure entering the hilum.

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Observations and Results

Venous tributaries emerging from hilum to form main renal vein and their percentage incidences are recorded in Table 1.

The presence of single renal vein at hilum was found in 51 kidneys with the incidence of 70.8%. In 27 right kidneys, incidence of single renal vein was observed and calculated as 27/35= 77.14%. Comparatively, the incidence of single renal vein in the left kidneys was observed to be less, i.e. 24/37 = 64.8%

Further, we observed the presence of two tributaries of the renal vein that emerge from the hilum separately and subsequently unite to form a single renal vein outside of the hilum. An incidence of 18.91% (7/37) was detected in the left kidneys as compared to the incidence of 11.42% (4/35) in right kidneys. The total incidence is calculated as 11/72 = 15.27%.

However, a maximum of four tributaries of a renal vein were also observed with an incidence of 2.7% in the total number of kidneys (72). Furthermore, the incidence of four tributaries in right and left kidneys was calculated to 2.8% and 2.1% respectively.

Renal vein or its tributaries are not found as anterior most structures at hilum in 7/35 right kidneys with an incidence of 20% and in 11/37 left kidneys with incidence of 29.7%. In total, 18/72 kidneys with an incidence of 25% did not have renal vein or its tributaries as the anterior most structure. However, in these cases, renal artery or its branches were observed to be the anterior most structure.

Table 1: Number of venous tributaries emerging from hilum to form main renal vein and their percentage incidences

No of tributaries of vein	No of right kidneys	Incidence in %	No of left kidneys	Incidence in %	No of total kidneys	Incidence in %
2	4	11.42	7	18.91	11	15.27
3	3	8.5	5	13.51	08	11.11
4	1	2.8	1	2.1	2	2.7

Table 2: Incidence of single vein at hilum

No of right kidneys	Incidence	No of left kidneys	Incidence	No of total kidneys	Incidence
27	77.14%	24	64.8%	51	70.8%

Table 3: Incidence of renal vein or its tributaries not as most anterior structures

No of right kidneys	Incidence	No of left kidneys	Incidence	No of total kidneys	Incidence
7	20 %	11	29.7 %	18	25%

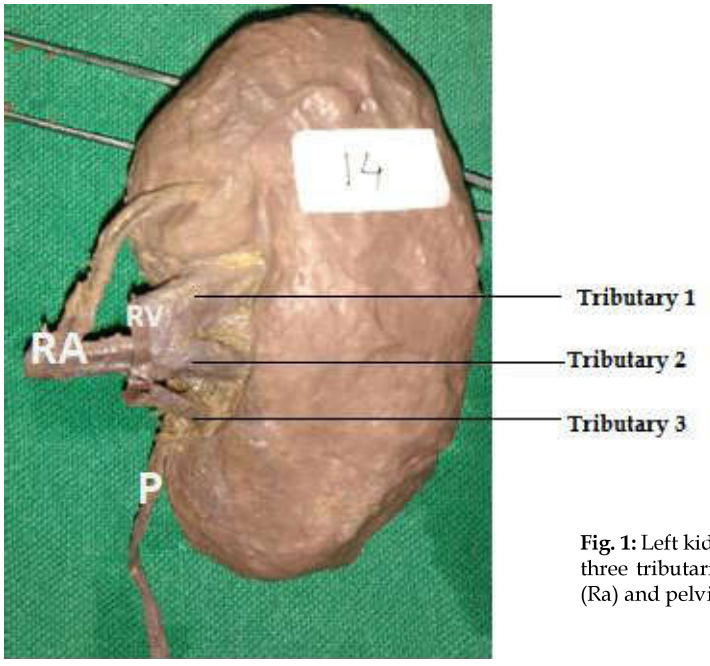

Fig. 1: Left kidney showing renal vein (Rv) formed by three tributaries emerging from hilum, Renal artery (Ra) and pelvis (P) of ureter

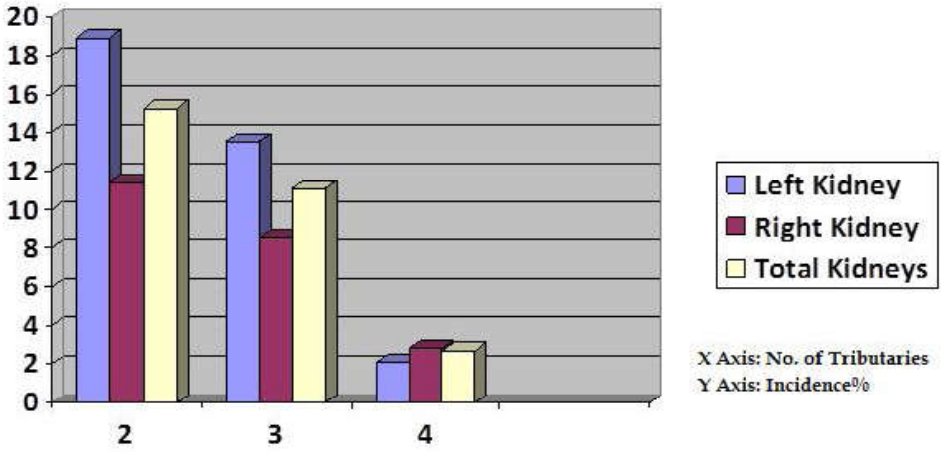

Fig. 2: Comparison of incidences in number of tributaries

Discussion

In this study, incidence of two or more tributaries emerging from hilum to form renal vein was (72-51)/72 =29.1%. Incidence in right kidneys is calculated as (35-27)/35 = 22.8%. Conversely, the incidence of the left kidneys is derived as (37-24)/37 = 35.1%.

The development of the renal veins is a complex process with multiple possible alternative patterns of formation. This is particularly true for the left side because of the communication of the left renal vein with the adrenal, gonadal, phrenic and hemiazygos veins. The anatomical features of the left renal vein (its longer course and complex embryogenesis) add to its complexity and results in sizeable number of clinically significant variations. A familiarity with such venous variations is the first step towards avoiding vascular injury during retroperitoneal procedures [8].

In the study by Satyapal on 306 kidneys, the classification of the drainage pattern of renal veins was done on the basis of the drainage pattern of primary tributaries of the renal vein on both sides (Classified as type IA). This group consisted of two primary tributaries only— an upper and a lower, and occurred in 118 (38.6%) of the 306 kidneys

The existence of more than two tributaries, i.e. upper, middle and lower is classified as type IIA. A maximum of five primary tributaries were identified. Type IIA was noted in 36 (11.8%) cases [9].

In this study, as per the classification type IA by Satyapal, the incidence of the presence of two divisions of the renal vein, which emerged from the hilum separately and united to form a single renal vein outside the hilum, was highest and noted in 15.27% kidneys. This incidence is much less compared to the incidence observedin the study by Satyapal.

Moreover, a maximum of four tributaries of renal vein emerging from the hilum and uniting to form a single renal vein were observed in our study, as compared to maximum five tributaries of renal veinnoted by Satyapal.

The classification type IIA was observed in (8+2/72=10/72=13.88% of kidneys. The incidence of more than two tributaries of main renal vein in our study is slightly more than that found in the study by Satyapal.

In another study, in 31% of the cases, anterior trunk of renal artery is the most anteriorly placed structure at the renal hilum [10].

In our study, in 25% of kidneys instead of renal vein or its tributary, renal artery or its branch was the anterior most structure in hilum.

Conclusion

Nephron sparing surgeries like partial nephrectomy by laparoscopic approach have become the treatment of choice. Such surgical interventions require hilar dissections which are technically more challenging in laparoscopic approach as compared to open surgeries [10].

The study of renal vasculature has become critically important in surgical planning of partial laparoscopic nephrectomies and in renal transplant [11].

Anatomical knowledge of distribution of structures in the renal hilum is important for various urological surgical procedures.

Surgical intervention which requires hilar dissection needs separate clamping of the vessels and renal pelvis which is preferred over en bloc mass stapling of renal hilum. A difficult hilar dissection may result in conversion of laparoscopic operation to an open procedure.

Consequently, the understanding of the anatomical variations in the number of tributaries emerging from hilum to form renal vein is crucial to improvise and successfully perform various renal surgeries.

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