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Original Research Article

A CADAVERIC STUDY ON DIMENSIONS AND HILAR STRUCTURAL ARRANGEMENT OF KIDNEY

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ABSTRACT

Background: Anatomical knowledge of renal dimensions and arrangement of renal hilar structures is important for urological surgical procedures. The study on renal dimension and detailed information on structural arrangement of hilum is important to distinguish between the pathological kidney from normal sized healthy kidneys and also essential prior to any surgical interventions of kidney.

Materials and Methods: 64 (32 right and 32 left) embalmed kidneys from department of anatomy, MVJ Medical college and Hospital were utilized for the study. The morphometric measurements such as length, weight, width of kidneys at the superior and inferior pole, thickness at superior, middle and inferior pole were measured. Mean and standard deviation of all parameters were noted. Hilar region was dissected and antero posterior arrangement of structures entering and leaving the hilum is noted.

Result: The length of kidney on right and left side is 8.9+/-1.58 cm and 9.01+/-0.88cm respectively. The weight of right kidney is 120.8+/-28 gm and left kidney is 123.45+/-30. 7gm.The mean and standard deviation of thickness and width of each kidney at superior and inferior pole is calculated. The antero posterior arrangement of structures at the renal hilum showed great variations. We classified these variations into 5 types. Typical pattern of hilar arrangement with renal vein, renal artery and pelvis was more predominant seen in 31.24% of specimens followed by Type 4 with renal vein, anterior division of renal artery, pelvis and posterior division of renal artery was seen in21.87% of specimens.

Conclusion: The knowledge of renal dimensions and hilar structure and its variations are important in case of renal transplantation, renal surgeries, radiological interventions, gonadal color Doppler imaging in surgeries of aneurysm of abdominal aorta. Hence the detailed knowledge of renal dimensions and hilar structural arrangement is essential for surgeons and radiologist to avoid any clinical complications in the abdominal region while performing the surgical procedures.

KEY WORDS: Renal hilum, pelvis, renal artery, renal vein, surgical interventions, renal transplantation, aneurysm, abdominal aorta.

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BACKGROUND

Kidneys are pair of essential excretory organs which elaborate urine and eliminates nitrogenous waste products of protein metabolism from the blood and thereby maintains the water and electrolyte balance of the body [1]. Each kidney is

located retroperitoneally in the posterior abdominal wall by the side of vertebral column.It extends from T12 to L3 vertebrae [2]. The standard text book of anatomy described the normal length of kidney as 11cm (11+/-1cm on right side and 11.5+/-1cm on the left side),breadth of 6cms and thickness of 3cms.The average weight of each kidney is 150 gms in males and 135 gms in females.According to some studies it has been noted that the deviation in renal dimensions could be associated with atherosclerotic kidney disease, arterial hypertension, renal vascular disease and diabetes mellitus [3]. Each kidney is bean shaped with convex lateral border and concave medial border with hilum which contain renal vein, renal artery and renal pelvis from before backwards.In some cases posterior division of renal artery and posterior tributary of renal vein might be seen entering the hilum posterior to the pelvis [4].

Precise anatomical knowledge of normal and variant arrangement of hilar structures is of crucial importance for urological surgical procedures where hilar vessel clamping is necessary such as in conventional and laparoscopic nephrectomy, anatrophic nephrolithotomy, renal transplantation.In any surgeries, clamping of individual structures at hilum is considered to be safer than enbloc clamping [5]. Since the literature on the anatomical studies of renal dimensions are scarce, the detailed knowledge on renal morphometry may be useful for surgical and radiological intervention.The knowledge of structural arrangement of renal hilum will be of great help for surgeons performing laparoscopic nephrectomies and renal transplantation. Considering all these factors the study on renal dimensions and hilar structural variations assumes great importance to prevent and avoid possible complication and achieve best operative results as well as diagnostic interventions.

MATERIALS AND METHODS

In the present study 64 (32 right and 32 left) formalin preserved kidneys were collected from the department of anatomy, MVJ Medical College and Research Hospital, Bangalore were used. The kidneys with gross pathological changes such as haematoma, cysts, tumors lobulation were excluded from the study. Kidneys with accessory renal artery also excluded. The kidneys were cleaned by removing the perinephric fat and renal fascia. Hilar region was dissected and structures entering and leaving the hilum of kidney from before backwards were noted.

The morphometric measurements such as length, breadth, thickness of kidneys were measured by using digital vernier caliper. The length of kidney was measured from uppermost edge of superior pole to the lowest edge of inferior pole. The thickness of kidney at superior, middle and inferior pole, width at superior pole and inferior pole were also measured. The weight of kidney is measured in grams using digital weighing machine.

RESULTS

The mean and standard deviation of length, width and thickness, weight of kidneys were calculated on both sides. On the right side, the length of kidney is 8.9+/-1.58 cm, width at the superior pole is 3.5+/-0.7cm and inferior pole is 3.06+/-0.72cm, thickness at the superior pole 2.92+/-0.52cm, middle 4+/-0. +/-49cm and inferior pole is 2.06+/-0.49cm. The weight of right kidney is 120+/-28gm.

On the left side, the length is 9.01+/-0.88cm, width at the superior pole is 3.55+/-0.62cm, inferior pole is 3.09+/-0.53cm. Thickness of kidney in the superior, middle and inferior pole is 2.13+/-0.51cm, 3.73+/-0.90cm and 2.39+/-0.79cm respectively. The weight of left kidney is 123.45+/-30.7gm.

The antero posterior arrangement of renal vein, renal artery and pelvis at the hilum showed great variations. Accordingly, it is classified into 5 types.

TYPE1: Renal vein, renal artery, pelvis

TYPE 2: anterior division of renal artery, Renal vein, posterior division of renal artery and pelvis.

TYPE3: Anterior tributary of Renal vein, anterior division of renal artery, posterior tributary of Renal vein, pelvis, posterior division of renal artery

TYPE 4: Renal vein, anterior division of renal artery, pelvis, posterior division of renal artery

TYPE5: Anterior division of renal artery, Renal vein, pelvis, posterior division of renal artery.

Table 1: Showing the arrangement of structures at the renal hilum.

Type	No.of kidneys (right side)	No.of kidneys (left side)	Total	Percentage
Type1	11	9	20	31.24
Type2	4	7	11	17.18
Type3	5	1	6	9.37
Type4	7	7	14	21.87
Type5	5	8	13	20.31

Fig. 1: TYPE1: Renal vein(V), Renal artery(A), Pelvis(P).

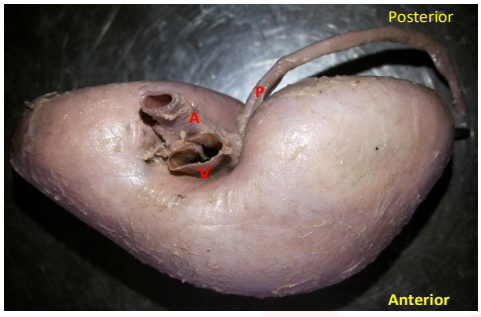


Fig. 2: TYPE2: Anterior division of Renal artery(A-A), Renal vein(V), Posterior division of renal artery(P-A), Pelvis(P).

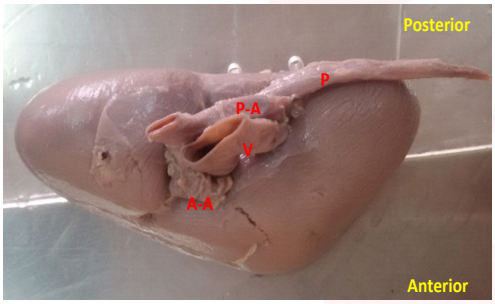


Fig. 3: Anterior tributary of Renal vein(A-V), Anterior division of Renal artery(A-A), Posterior tributary of Renal vein(P-V), Pelvis(P), Posterior division of renal artery(P-A).

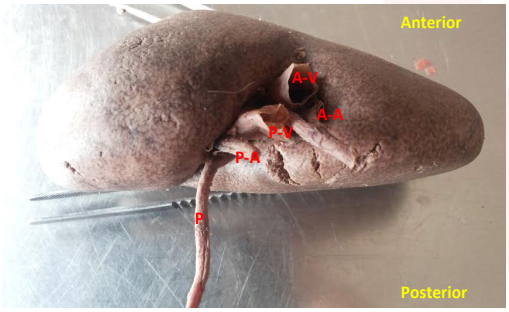


Fig. 4: TYPE4: Renal vein(V), Anterior division of Renal artery(A-A), Pelvis(P), Posterior division of renal artery(P-A).

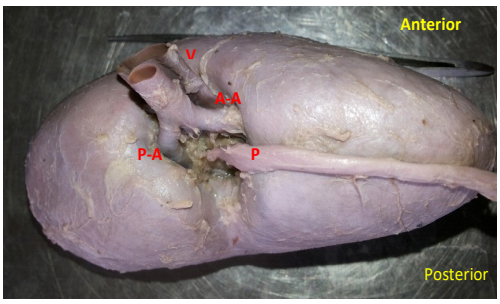
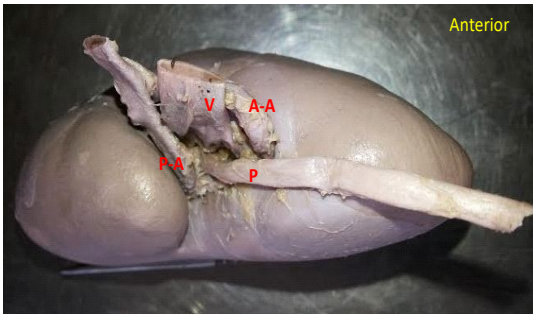


Fig. 5: TYPE5: Anterior division of Renal artery(A-A), Renal vein(V), Pelvis(P), Posterior division of renal artery(P-A).



DISCUSSION

The deviation in the renal dimensions from the standard normal established values is of great significance as it is associated with many diseases. A study by Glodny et al reported that changes in the renal morphometry may be indicative of many systemic disorders [6]. In the present study the mean length of right kidney was **8.9+/-1.58 cm,** and left was **9.01+/-0.88cm**. In a study by Manisha More et al showed renal length of right kidney varied from 7.7cm to 14cm whereas left kidney was 8cm to 14.5cm [3]. A study by Emamian et al reported that the average length of right and left side kidneys were 10.9cm and 11.2cm respectively [7].

Muralimanju et al done a detailed morphometric study and noted that the mean renal length of right kidney was 8.9+/-0.9cm and left kidney was 9.01+/-0.9cm which is closely correlating with the values of present study [8]. In the same study by Muralimanju et al reported width of right kidney on the superior and inferior pole was 4.9+/-0.6 cm and 4.8+/-0.6 cm and on the left side was 0.7 cm and 4.5+/0.7 cm respectively. Thickness of right kidney on the superior and inferior pole was 3+/-0.4cm and 3.1+/-0.4cm and on the left side is 3+/-0.5mm and 3.2 +/-0.5mm respectively. These findings were compared with the present study which showed slight variations and these variations in the morphometry of kidney may be due to many factors such as age, ethnicity, gender, height and weight of an individual. Moorthy et al reported that volume of right kidney is significantly smaller than that of left kidney and possible explanation given for this was that the spleen on the left side is smaller than the liver on the right providing the space for the growth of the left kidney [9].

Another explanation for the variation in the weight of kidney was given based on its blood supply .According to this the left renal artery is short and straight ,the increased blood flow in the left renal artery might result in increased size of left kidney [7]. As vesicoureteric reflux disorders alters the renal dimensions these morphometric values will be helpful for clinicians while managing these cases [10].

The renal hilum is a vertical slit on the medial border of the kidney, which is bound by the thick lips of the renal substance [11]. Classically the arrangement of the hilar structures in the antero posterior direction is vein-artery –pelvis [12]. The knowledge of arrangement of hilar structures is important in surgical procedures involving the clamping of hilar structures .In the present study 5 different type of arrangement of structures at the renal hilar regions were observed. The classic type of hilar arrangement with renal vein, renal artery and renal pelvis (Type 1) pattern was more predominant showing 32.24%. In a study by Surekha Dilip Jadhav et al observed 10 different types whereas Naveen et al observed 5 different types of hilar structural arrangements in antero posterior direction. It has been noted that in majority of cases branches and tributaries of renal vessels occupies the hilar and prehilar region than the main trunk of renal vessels and the variation in their branching pattern is mainly responsible for such arrangements [13].

The knowledge on hilar arrangement of kidney is important for urosurgeons during nephrectomy surgeries. In such surgeries clamping of separate hilar structures is preferred than the enbloc mass clamping. Enbloc mass clamping of structures at the hilum during nephrectomy surgeries may end up in complications like arterio venous fistula [14]. The knowledge of variant hilar structural arrangement is also useful in case of procedures requiring pyelic incision for removal of calculi, such as conventional laparoscopic pyelolithotomy [15]. In a study by Bayramoglu et al showed variation in the number of renal arteries in the hilar region. In the present study such variations were not observed. The number of renal artery was constant except their branching pattern [16]. The variation in the branching pattern of renal vessels is important for radiologists who interpret renal angiograms and also for surgeons performing laparoscopies [17]. The rotational defect of kidney also lead to variant hilar arrangement which in turn may lead to ureteropelvic obstruction [18]. Considering these hilar structural variation ,the previous studies have emphasized on the lateral deep incisions along the ureteropelvic junction in case of endopyelotomies rather than the anterior or posterior incisions [19].

CONCLUSION

A detailed search of literature revealed that there are only few anatomical studies available on the renal dimensions. Hence the results of present study could be used as a reference by surgeons and radiologists. Knowledge of structural pattern at renal hilum is useful for operating surgeons to identify and clamp the hilar structures individually instead of enbloc clamping to prevent complications.

Conflicts of Interests: None

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