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RESEARCH ARTICLE

A CADAVERIC STUDY ON MORPHOMETRY AND HILAR STRUCTURAL PATTERN OF ADULT HUMAN KIDNEYS

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ABSTRACT

Background: Kidneys are bean shaped excretory organs found on either side of the vertebral column in the posterior abdominal wall. Anatomical knowledge regarding renal morphometry and hilar structural pattern are important during urological surgical procedures. They serve as important indicators in the progression of any disease in both nephrology and urology practice. The aim of this study was to analyze the morphometric features of both right and left kidneys and to compare it with the previous studies. The features analyzed were length, breadth, width and weight of both right and left kidneys. Shape of the kidneys, lobulations and variations in the hilar patterns were also noted. ***Materials and Methods:*** The present study was conducted in the department of Anatomy, Yenepoya Medical College, Mangalore. A total of 60 (30 right and 30 left) adult human cadaveric kidneys were studied. Length, breadth, width and weight of all the kidneys were noted. The average valuewas noted for all parameters. Shape of the kidneys, Lobulations and variations in the hilar patterns were also observed. ***Results:*** The length of right kidney varied between 7 and 11cms with an average of 8.72cms whereas the length of left kidney ranged between 7.1and 11.7cms with an average of 9cms. The breadth of right kidney varied between 4 and 6cms with an average of 4.92cms. The breadth of left kidney ranged between 3.7 and 6.4cms with an average of 5cms. The width of right kidney varied between 2.9 and 4.4cms with an average of 3.53cms whereas the width of left kidney ranged between 2.4 and 5cms with an average of 3.76cms. The weight of right kidneys ranged from 60 to 140grams with an average of 88.44 grams. The weight of left kidneys ranged from 56 to 142 grams with an average of 90 grams. Lobulations were seen in both right and left kidneys along with variations in the hilar pattern. The hilar structural pattern arrangement were classified into six types. The antero-posterior arrangement of renal vein, artery and pelvis was the most predominant one. ***Conclusion:*** Knowledge regarding the variations in the morphological features and vascular patterns of kidneys are important in the field of renal transplantation and posterior abdominal wall surgeries. Hence, the detailed knowledge regarding these parameters are of great use for anatomists, surgeons, urologists and radiologists in their field of practice.

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INTRODUCTION

Kidneys are a pair of bean shaped excretory organs present retroperitoneally in the abdomen. Kidneys serve essential regulatory roles in the urinary system, maintain the electrolyte and acid-base balance of the body and also regulate blood pressure. They are present in the posterior abdominal wall on either side of the vertebral column and extend from T12 vertebrae to L3vertebral level (Datta, 2006).[1]According to the standard textbook of Anatomy, each kidney measures approximately 11cms in length, 6cms in breadth and 3cms in width. The average weight of each kidney is given as 150grams. Kidneys have a rounded superior pole, a pointed thin inferior pole, a convex anterior surface and a flat posterior surface. The lateral border of each kidney is convex and the concave medial border presents a hilum that consists of renal vein, renal artery and pelvis of the ureter arranged anteroposteriorly (Standring, 2006). The increase in size of kidney stops by 25 years of age. Many disease conditions like urinary tract diseases, congenital anomalies, neoplasia, arterial hypertension& diabetes mellitus have reported to cause significant difference in the dimensions of kidney (Naveen Kumar, 2013). The development of renal vessels plays a lead role in the complicate development of kidney. The kidneys receive approximately 20% of the cardiac output. Initially, kidneys develop in the pelvic cavity and during further development ascends to the lumbar region. Embryologically, kidney develops from pronephros, mesonephros and metanephros. The pronephros and mesonephros regresses but the arterial network to these segments may remain and it may lead to supernumary renal arteries. Usually, each kidney is supplied by one single renal artery. In approximately 30% of individuals, more than one artery maybe present (Datta, 2005). The knowledge regarding hilar structural pattern is important for urosurgeons during surgical procedures which includes segmental resection of hilar structures as it may cause complications like necrosis of a particular segment. It is also important duringsurgical procedures like nephrectomy andrenal transplantation surgeries where separate clamping of the renal artery, vein and pelvis becomes necessary. It may lead to severe haemorrhage if unnoticed during the surgery.

Arteriovenous fistula has been reported as a late complication in case of En-bloc clamping (Jovanović, 2013). Therefore, the main aim of this study is to assess the morphometric parameters of human adult cadaveric kidneys along with its hilar pattern inorder to avoid possible complications and achieve best operative results.

MATERIALS AND METHODS

In this study, 60 (30 right and 30 left) formalin preserved adult human cadaveric kidneys were collected from the department of Anatomy, Yenepoya medical college, Mangalore. The perinephric fat and renal fascia was removed from all the specimens. Specimens with gross pathological defects such as cysts or tumours were excluded from the study. The morphometric features of allkidneys were measured using vernier calipers and the weight was taken using an electronic weighing machine. Maximum distance between the two poles of the kidneys was taken as its length, the maximum distance between two points at the same level between medial and lateral borders as the breadth of the kidney and the maximum width of kidneys was noted down as the width. The shape, patterns of lobulations and the variation in the hilar patterns of all kidneys were noted down. The obtained values were tabulated and statistically analyzed.

RESULTS

60 specimens of kidneys were studied of which 30 were right sided and 30 were left sided kidneys. All the 60 kidneys were bean shaped. Among the 30 right kidneys studied, length ranged from 7 to 11cms with an average of 8.72cms. The breadth of right kidney varied between 4 to 6cms with an average of 4.92cms. The width of right kidney ranged between 2.9 to 4.4cms with an average of 3.53cms.Among the 30 right kidneys, weight ranged from 60 to 140grams with an average of 88.44 grams (Table 1). Among the 30 left sided kidneys studied, length ranged from 7.1 to 11.7cms with an average of 9cms. The breadth of left kidneys varied between 3.7 to 6.4cms with an average of 5cms. The width of the left kidney ranged between 2.4 to 5cms with an average of 3.76cms. Among the 30 left kidneys, weight ranged from 56 to 142 grams with an average of 90 grams (Table 1).

Table 1. Comparison between morphometric parameters of right and left kidney

Parameter	Right kidney (Average)	Left kidney (Average)
Length	8.72cms	9cms
Breadth	4.92cms	5cms
Width	3.53cms	3.76cms
Weight	88.44 grams	90 grams

In the 30 right kidney specimens studied, 5(16.7%) showed lobulations. Among 30 left kidney specimens, 6(20 %) showed lobulations (Figure 1). The arrangement of structures at the renal hilum showed great variations. Accordingly, it has been classified into 4 types anteroposteriorly (Table 2).

- Type 1- renal vein, renal artery and renal pelvis (Figure 2)
- Type 2- renal artery, renal vein and renal pelvis (Figure 3)
- Type 3- anterior division of renal artery, renal vein, posterior division of renal artery, renal pelvis (Figure-4)
- Type 4- renal vein, anterior division of renal artery, renal pelvis, posterior division of renal artery (Figure-5)
- Type 5- anterior tributary of renal vein, posterior tributary of renal vein, renal pelvis, renal artery
- (Figure-6)
- Type 6- anterior division of renal artery, anterior tributary of renal vein, posterior division of renal artery, posterior tributary of renal vein, renal pelvis (Figure-7)

Table 2. Arrangement of structures at the renal hilum

Type	No of kidneys (right side)	No of kidneys (left side)	Total	Percentage
Type 1	13	12	25	41.67%
Type 2	8	7	15	25%
Type 3	4	6	10	16.67%
Type 4	2	3	5	8.33%
Type 5	2	1	3	5%
Type 6	1	1	2	3.33%

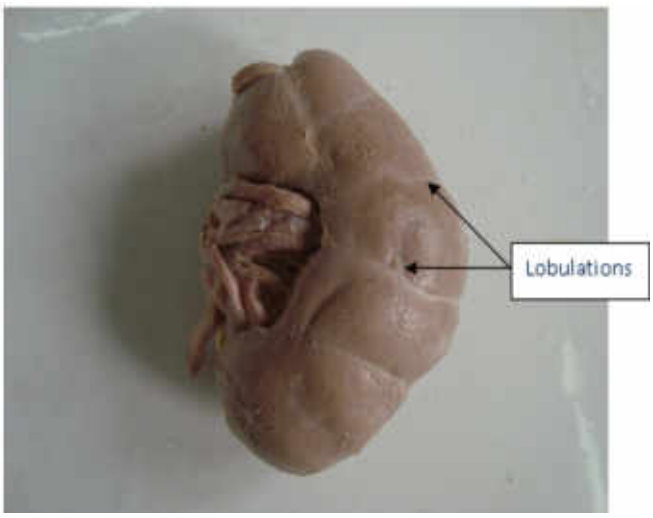

Figure 1. Showing the lobulations of kidney

Figure 2. Showing renal vein (V), renal artery(A) and renal pelvis(P)antero-posteriorly

Figure 3. Showing renal artery(A), renal vein(V) and renal pelvis(P)antero-posteriorly

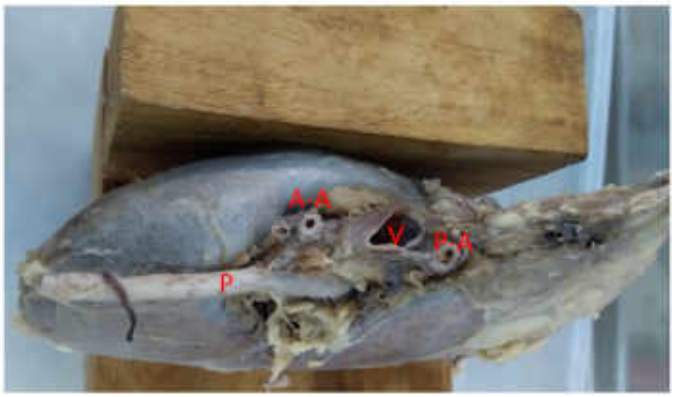

Figure 4. Showing anterior division of renal artery (A-A), renal vein(V), posterior division of renal artery(P-A) and renal pelvis(P) anteroposteriorly

Figure 5. Showing renal vein(V), anterior division of renal artery (A-A), renal pelvis(P), posterior division of renal artery (P-A)

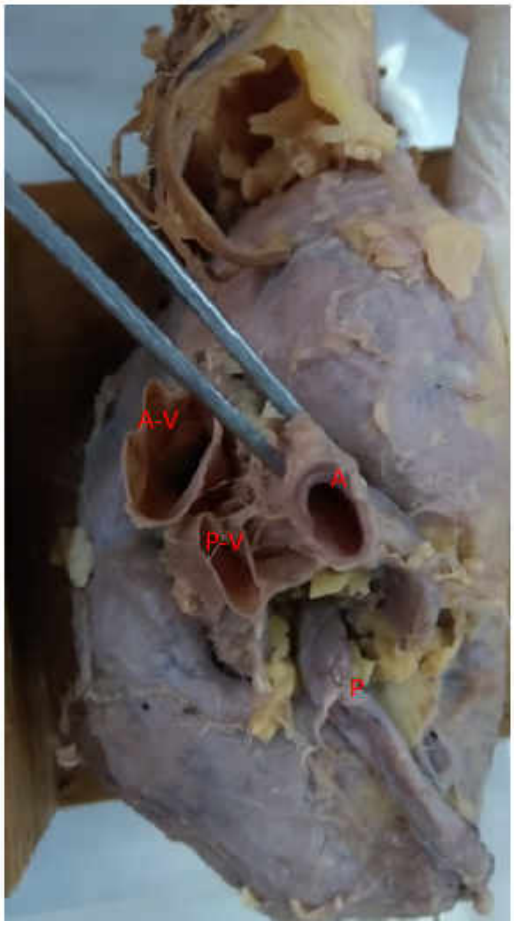

Figure 6. Showing antetior tributary of renal vein(A-V), posterior tributary of renal vein(P-V), renal pelvis(P), renal artery(A)

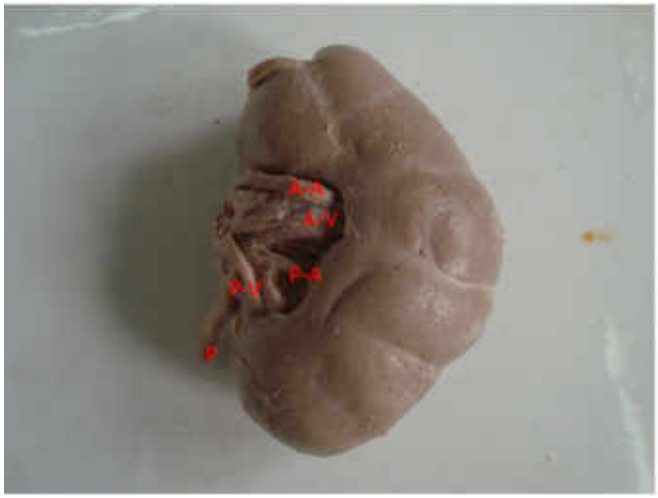

Figure 7. Showing anterior division of renal artery (A-A), anterior tributary of renal vein (A-V), posterior division of renal artery (P-A), posterior tributary of renal vein (P-V), renal pelvis (P)

DISCUSSION

Kidneys are important organs that maintain the urinary system of the body. Changes in the morphometric parameters of kidney could be indicative of arterial hypertension, renal vascular disease, diabetes mellitus or atherosclerotic kidney disease (Verma, 2012). Glodny etal had reported in his study that changes in the renal dimensions maybe indicative of many systemic disorders. Unilateral nephrectomy may lead to

increase in size of the remaining kidney inorder to compensate the functions of the removed kidney. A decrease in kidney size may be indicative of chronic renal failure or renal arterial occlusion. The knowledge regarding renal dimensions is also useful in managing patients with vesico ureteric reflex which alters the morphometric parameters of kidney (Glodny, 2009).
Renal artery arises as a direct branch from abdominal aorta at the level of intervertebral disc between L1 and L2. It supplies the respective kidneys on each side. Each renal artery branches into segmental arteries which further divides into interlobar arteries. Each interlobar artery penetrates the renal capsule and extends between the renal pyramids. The interlobar arteries supply the arcuate arteries that reaches the cortico-medullary junction. Each arcuate artery in turn supplies several interlobular arteries. The interlobular arterioles feed into the afferent arterioles that supplies the glomeruli. After filtration, the blood moves through venules that converge into interlobular veins. The interlobular veins provide blood to the arcuate veins and then into interlobar veins, which forms renal veins that ultimately drains into inferior venacava. A study done by Manisha More etal showed renal length of right kidney varied from 7.7cm to 14cm whereas left kidney varied from 8cm to 14.5cm (Manisha, 2015). A study by Emamian etal reported that the average length of right and left side kidneys were 10.9cm and 11.2cm respectively (Emamian, 1993). Muralimanju etal noted that the mean renal length of right kidney was 8.9+/-0.9cm and left kidney was 9.01+/-0.9cm (Muralimanju, 2014).

Sivanageswara Rao Sundara Setty et al (2013) had conducted a study on morphometric parameters of 50 human adult cadaveric kidneys. Right kidney measured an average of 10.92cms in length, 6.2cms in breadth and 3.34cms in width. Left kidney measured an average of 11.32cms in length, 6.62cms in breadth and 3.54cms in width. Lobulation was present in 8% of right kidney and 16% of left kidney specimens.Variations in hilar structures were present in 8% of right kidney and 24% of left kidney specimens (Setty, 2013). Satheesh Naik K. et al (2014) had conducted a study on morphometric parameters of 36 human adult cadaveric kidneys. The right kidney showed an average of 8.02cms in length, 4.56 cms breadth and 2.51cms in width. Left kidney measured an average of 8.56 cms in length, 4.52cms in breadth and 2.54cms in width (Naik, 2014). In a study done by Varalakshmi etal the mean length of right kidney was 8.9+/-1.58 cm, and left was 9.01+/-0.88cm (Varalakshmi, 2017). In the present study, all 60 kidneys were bean shaped and right kidney size measurements revealed an average length of 8.72cms, an average breadth of 4.92cms and an average width of 3.53cms. Left kidneys showed an average length of 9cms, an average breadth of 5cms and an average width of 3.76cms.Right kidney weighed an average of 88.44grams and left kidney weighed an average of 90grams. These results were close to the findings of previous studies but differed in some measurements. The morphometric parameters of left kidneys showed higher values compared to right kidneysin this study which is compatible with all the previous studies. Moorthy etal reported that this maybe because the spleen on the left side allows more space for the growth of the kidney compared to the liver on the right side. Another explanation given was that left renal artery is short and straight which may result in increased blood flow to the left kidney causing its increase in size compared to the right kidney (Moorthy, 2011). Lobulations were seen both in right and left kidneys.During the process of development, the foetal kidneys are subdivided into lobules. Normally it disappears during infancy. In some individuals, the lobulations persist and maybe associated with certain structural variations (Saritha, 2013). Hilar pattern variations were seen more on the left side compared to right side.In majority (58.33%), the hilar structural arrangement varied from the normal standard textbook patterns which is given as renal vein, renal artery and pelvis in an anteroposterior order. This may be attributed to the developmental defects of renal vein. Right renal vein develops from one channel whereas left renal vein develops from several anastomotic channels. Any defect during these channel development may alter the arrangement of renal hilar structures (Singh, 2016 and Trivedi, 2011). In this era of advanced imaging technologies, partial nephrectomies have gained importance over radical nephrectomies. Though field of vision is limited, laproscopic partial nephrectomies are done commonly these days. Proper knowledge regarding variations in hilar structures are required for clamping the individual structures at the hilum. Renal morphometrical variations maybe observed in population of different geological origins as well. Further studies need to be done on these aspects.

Conclusion

- Morphometric parameters of the kidney and renal hilar pattern are of great clinical significance.
- The present study was done to explore the morphometric variations of bothright and left kidneys.
- Pathological conditions affecting the kidney may result in alteration of the kidney size.
- Any hilar structural anomaly may risk the life of the patient during surgeries.
- Therefore, it is mandatory for a surgeon to understand the variations in the hilar structural pattern before any surgery.
- Therefore the present study might be used as a reference for clinicians in diagnosing any change in the kidney size.

REFERENCES

Datta AK. Essentials of Human Anatomy (Thorax and Abdomen) part I, 7th ed., Calcutta: Current books international, 2006; 301-320.

Datta AK. Essentials of Human Embryology part, 5th ed., Calcutta: Current books international, 2005; 220-224.

Emamian SA, Nielsen MB, Pedersen JF, Ytte L. Kidneydimensions at sonography: correlation with age,sex, and habitus in 665 adult volunteers. *AJR Am Journal of Roentgenology*. 1993;160(1);83-6.

Glodny B, Unterholzner V, Taferner B, Hofmann K J, Rehder P, Strasak A, Petersen J et al. Normal kidney size and its influencing factors - a 64-slice MDCT study of 1.040 asymptomatic patients. *BMC Urology*. 2009;9 (19);6.1471

Jovanović D, Gasic B, Pavlovic S, NaumovicR.Correlation of kidney size with kidney function and anthropometric parameters in healthy subjects and patients with chronic kidney diseases. *Renal Failure* 2013;35(6): 896-900

Manisha S M, Toggale MD, Dixit D, Desai SP. Morphometricstudy of human adult cadaveric kidneys. *Med Plus-International Medical Journal*. 2015;2(6);355-358.

Moorthy HK, Venugopal P. Measurement of renal dimensionsin vivo: A critical appraisal. *Indian Journalof Urology*. 2011;27(2);169-75.

Muralimanju BV et al. Morphometric parameters ofthe human adult kidney: An anatomical study. *International Journal of Morphology*. 2014;32(2);656-659.

Naik KS, Gurushanthaiah M, Sharmila T. Human cadaveric kidneys Morphometry-research article. *Int J Med Pharm Sci,* July 2014 ; 04 (11): 14-19

Naveen Kumar et al., Evaluation of the Variant Anatomical Disposition of the Renal Hilar Structures. *Journal of Clinical and Diagnostic Research*. 2013;7(8):1543-1546.

Saritha S, Jyothi NM, Kumar MP, Supriya G. Cadaveric study of accessory renal arteries and its surgical correlation *Int J Res Med Sci*. 2013 Feb;1(1):19-22

Setty SRS, Katikireddi RS. Morphometric study of human adult cadaveric kidneys- research article. *Int J Cur Res Rev,* Oct 2013 ; 05 (20): 109-115

Singh K, Parmar P, Rohilla A, Katoch N, Kaur K, et al. (2016) Renal Hilum Study for Anomalous Vasculature. *Anat Physiol* 6: 230.

Standring S: Gray's Anatomy: The Anatomical Basis of the Clinical Practice, 39th edition. Edinburg: *Elsevier Churchill Livingstone,* 2006; 1269-84.

Structures and its Clinical Significance. *Int. J. Morphol,* 2011; 29(4):1379-1383.

Trivedi, S.; Athavale, S. & Kotgiriwar, S.Normal and Variant Anatomy of Renal Hilar

Varalakshmi KL, Sangeeta M. A cadaveric study on dimensions and hilar structural arrangement of kidney. *IntJ anat res* 2017;5(3.1):4124-4128.

Verma P, Arora AK, Sharma P, Mahajan A. Variations in branching pattern of renal artery and arrangement of hilar structures in the left kidney: clinical correlations, a case report. *Ital J Anat Embryol*. 2012; 117(2):118-22.

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