

A morphometric study of human adult cadaveric kidneys

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Abstract

Aim: The morphometric study of human cadaveric kidney specimens was done and the findings were compared with the previous studies. **Materials and Methods:** Eighty human adult cadaveric kidneys (40 right and 40 left) were included in this study. Morphology of the kidneys was studied with the features like length, breadth, thickness, and weight. The arrangements of renal hilar structures were also observed. **Results:** The length varied from 7.7 to 14 cm with an average of 11.5 cm for right kidney and for left kidney, the length ranged from 8 to 14.5 cm with an average of 12.71cm. The breadth varied from 3 to 8 cm with an average of 5.325 cm for right kidney and for left kidney, the breadth ranged from 3.5 to 8 cm with an average of 6.07 cm. The thickness varied from 2 to 4.8 cm with an average of 3.32 cm for right kidney and for left kidney, the thickness ranged from 2 to 5 cm with an average of 3.64 cm. The weight ranged from 59.2 to 197.1 gms with an average of 102.48 gms for right kidney and for left kidney, the weight ranged from 60 to 200 gms with an average of 122.15 gms. Variations in renal hilar structures were found in 17.5 % of right kidney and 37.5 % of left kidney specimens. **Conclusion:** As morphological findings help to determine anatomical variations of kidney, such studies will help to strengthen the current literature. This also can help to improve the knowledge of the anatomist, radiologist and surgeons.

Keywords: Cadaveric Kidney, Morphometry, Hilum

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INTRODUCTION

Kidneys are a pair of chief excretory organs which maintain the electrolyte and water balance and also serve as endocrine organs.¹ They are retroperitoneal organs, situated in the posterior abdominal wall beside the vertebral column and extend from T12 to L3 vertebra.² Each kidney is bean shaped and has a length of 11 cms, breadth of 6 cms and width of 3 cms. The left kidney is 1.5 cm longer than the right. The average weight of a kidney is 150 grams.^{1, 2} in males and 135 grams in females. Kidneys have a broad, thick upper pole and a

pointed, thin lower pole.² The anterior surface is convex and posterior surface is flat.² The lateral border is convex, medial border is concave with a hilum that consists of renal vein, renal artery and renal pelvis, antero-posteriorly.² Morphometric studies have gained much research attention as they are believed to possess significant clinical importance. Conditions like systemic diseases, urinary tract diseases, congenital anomalies, neoplasia, micro and macrovascular diseases were reported to significantly influence kidney sizes.³ So renal dimensions could possess significant clinical value. It is necessary to distinguish a pathological kidney from a normal sized healthy kidney.⁴ Structural arrangements or alterations at the hilum also possess medical significance, as per the available case reports.⁴⁻⁸ But, studies related to morphometric determination of renal dimensions and hilum structures still appear limited and need to be strengthened with the additional findings. Therefore, the main objective of this study was to carry out morphometric study of human adult cadaveric kidney specimens and compare the findings with the previous studies. Determination of renal anatomical variants should be greatly encouraged to strengthen the current

literature and improve the knowledge needed for surgical and radiological intervention.

MATERIALS AND METHODS

Eighty human adult cadaveric kidneys (40 right and 40 left) over a period of 2 years from the department of Anatomy, J.N.Medical College, Belgavi, were included in

this study. Kidneys were observed and studied with the help of-

- 1) Digital Vernier caliper (mm)
- 2) Weighing machine (gms)

Morphology of the kidneys was studied with the features like length, breadth, thickness, and weight. The arrangement of renal hilar structures were also observed. Photographs were taken.

OBSERVATION AND RESULTS



Figure 1



Figure 2



Figure 3

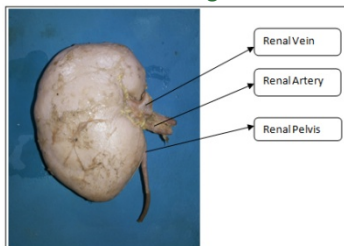


Figure 4

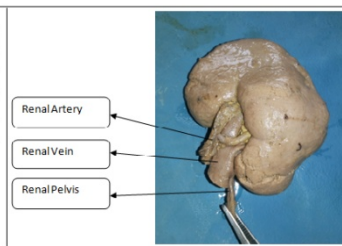


Figure 5

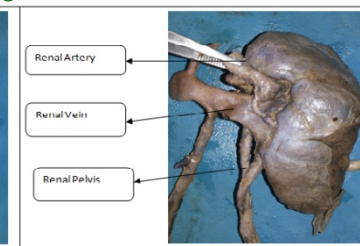


Figure 6

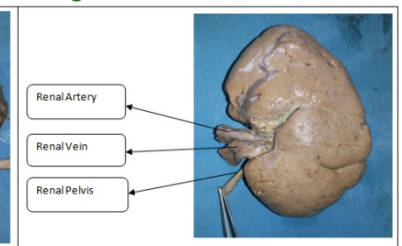


Figure 7

Legend

Figure 1: Showing length of kidney

Figure 2: Showing breadth of kidney

Figure 3: Showing thickness of kidney

Figure 4: Showing normal VAP arrangement at hilum of Right kidney

Figure 5, Figure 6 and Figure 7: Showing AVP arrangement at hilum of Left kidney

All the 80 kidney specimens were bean shaped. The data obtained was tabulated, analysed and compared with the previous studies. The length of right kidney varied from 7.7 to 14 cm with an average of 11.5 cm and the length of left kidney ranged from 8 to 14.5 cm with an average of 12.71cm. (Table-1) The breadth of right kidney varied from 3 to 8 cm with an average of 5.325 cm and the breadth of left kidney ranged from 3.5 to 8 cm with an average of 6.07 cm. (Table-1). The thickness of right kidney varied from 2 to 4.8 cm with an average of 3.32 cm and the thickness of left kidney ranged from 2 to 5 cm with an average of 3.64 cm. (Table-3). The weight of right kidney from 59.2 to 197.1 gms with an average of

102.48 gms and the weight of left kidney ranged from 60 to 200 gms with an average of 122.15 gms.(Table-1)

Table 1: Comparison of Measurements of Right and Left Kidneys

	Right kidney		Left kidney	
	Range	Average	Range	Average
Length (cms)	7.7 to 14	11.5	8 to 14.5	12.71
Breadth (cms)	3 to 8	5.325	3.5 to 8	6.07
Thickness (cms)	2 to 4.8	3.32	2 to 5	3.64
Weight (gms)	59.2 to 197.1	102.48	60 to 200	122.15

The hilum of the right kidney showed an arrangement of renal vein, renal artery and renal pelvis antero-posteriorly in 33 (82.5%) specimens. In contrast, 7

(17.5%) specimens showed renal artery, renal vein and renal pelvis antero-posteriorly at hilum (Table 4). The hilum of the left kidney showed an arrangement of renal vein, renal artery and renal pelvis antero-posteriorly in 25 (62.5%) specimens. In contrast, 15 (37.5%) specimens showed renal artery, renal vein and renal pelvis antero-posteriorly at hilum (Table 2). Thus variations in renal hilar structures were found in 17.5 % of right kidney and 37.5 % of left kidney specimens. The normal and variational renal hilar structures are shown in figures 4 - 7.

Table 2: Variations in Renal hilar structures

	Percentage of Normal renal hilar structure arrangement (Antero-Posteriorly VAP) (%)	Percentage of Variation in renal hilar structure arrangement (Antero-Posteriorly AVP) (%)
Right kidney	82.5	17.5
Left kidney	62.5	37.5

V- Renal vein, A- Renal artery, P- Renal pelvis

DISCUSSION

Kidneys are the important retroperitoneal organs which maintain the homeostatic function of the body and act as endocrine organs.¹ The present study was done to find out morphological variations of right and left kidneys and describe their significance. In the present study, all the 80 (100%) kidneys were bean shaped as mentioned in the standard text books of Anatomy.^{1,2} At birth, both kidneys weigh between 20 and 35 g. The average adult kidney weight is 10 to 14 times greater than the newborn kidney weight.⁹ The average weight of right kidneys was 102.48 gms and the average weight of the left kidneys was 122.15 gms. This is not coinciding with the earlier studies that described the average weight to be 108.7 +/- 22.6 g and 111.8 +/- 23.3 g for right and left kidneys, respectively.¹⁰ This is also not in agreement with some studies where the average weight was taken into consideration commonly for both kidneys.^{1, 11} This could indicate that our present study showed a variation in the weight of kidneys when compared with the earlier findings. Kidney size is considered as an important indication for many clinical signs and hence it is worth studying. Previous studies showed that aging leads to a progressive decrease in kidney size, especially after middle age.^{12,13} Other influencing factors are many factors such as age, ethnicity, gender, weight and height.²⁻⁴ Recently, a significant correlation between kidney size and kidney function was observed in patients with

chronic kidney disease (CKD).¹⁴ So, this indicated variations in the renal dimensions and could generate considerable medical interest. It could be possible that the renal dimensions might also vary among population of different geographical origin. However, as not much data is available, renal variations need further exploration. In the present study, right kidney size measurements showed an average length of 11.5 cms, average breadth of 5.235 cms and the average width of 3.32cms. These are closer to earlier findings^{14, 15} but varied with some other^{15, 11} Left kidney size measurements showed an average length of 12.71 cms, breadth of 6.07 cms and the width of 3.64 cms which are closer to the previous findings^{14,15} but differed from some other studies.^{5,11} We observed variations in the renal hilar structures both in the right and left kidneys, but more at the left kidney (24%). Generally, renal hilum variant patterns were reported to be frequent on the left kidney.⁵ This could be attributed to the developmental defects of the renal veins. From the embryological view point, right renal vein develops from one channel whereas left renal vein develops from several anastomotic channels. Any abnormality during these channel developments could alter the arrangement of renal hilar structures with regard to the renal vein.⁵ So, our findings related to renal hilar structural variation is supported by the previous studies.⁵⁻⁸ Overall, weight, dimensions and hilar structural variations of left kidney were larger than the right kidney (Table 1 and 2). This could indicate that left kidney is more susceptible to anatomical variations than the right kidney, which correlates with previous studies.

CONCLUSION

As morphological findings help to determine anatomical variations of kidney, such studies will help to strengthen the current literature. Renal dimensions and hilar structural arrangements could possess significant clinical value. This could help to distinguish a pathological kidney from a normal sized healthy kidney. This also can help to improve the knowledge of the anatomist, radiologist and surgeons.

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