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Original Research Article

Correlation of volume of both the kidneys in both the sexes among different age groups of normal North Indian population – An ultrasonographic study

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Abstract

Background: Dimensions of kidney form an extremely important parameter for diagnosis and prognosis of renal pathologies. Dimensions vary according to the geographical locations, racial variations, diet, environment and frequency of pathologies. Renal sizes in Indian population although studied frequently have not been standardized.

Aim: The study was aimed at establishing some preliminary data of normal North Indian population, without a known renal pathology.

Material and methods: Renal measurements i.e., length, width and parenchymal thickness were measured in 164 individuals, both males and females and their renal volume was calculated. The volume was then correlated with the age of the individuals. Analysis was then done for variability due to age, gender and laterality.

Results: It was found that the males showed the maximum volume for both the right and the left kidneys in the fourth decade, where as the females had a maximum volume in the third decade. Volume tended to decrease after the fourth decade. The volume of the left kidney was more as compared to that of right side for both the males and females.

Conclusion: Renal sizes of Indian are invariably lesser as compared to commonly quoted normal values in standard literatures. Inferences about renal sizes need to be made with reference to racial and regional variations rather than basing them on data from other population.

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Key words

Volume of right and left kidney, Age, Sex, North Indian population, Ultrasound.

Introduction

Renal length and volume are synonymous with renal status in routine clinical assessments [1, 2, 3]. Ultrasonography is considered as a dependable, accurate, easy and economic method to evaluate renal size [4, 5]. Renal volumes are commonly calculated from the renal sonographic dimensions [6]. Although more accurate volumetry is possible by computed tomography (CT) and magnetic resonance imaging (MRI), still ultrasonography remains more popular as it is both user and patient friendly [7, 8].

Renal dimensions vary with age, gender, body mass index, ethnicity etc. Since most clinical diagnosis including labeling a patient as of renal failure, treatment, prognosis, biopsy and transplant decisions are made on the basis of ultrasonographic measurements, it is indispensible to have standardized parameters of our own population.

Material and methods

The study was conducted on 164 subjects, both male and female in the age group of 21 to 60 years, who came to Department of Anatomy and the Trauma Centre of hospitals of Uttar Pradesh. Patients had been advised to undergo ultrasonography due to various reasons.

After taking an informed consent from the patient, a detailed history on the basis of questionnaire prepared was taken to rule out any obvious renal pathology. LOGIC TM α 200 installed in the Department of Anatomy and at the Trauma Centre was used to perform ultrasonograpy and the electronic calipers inbuilt in the machine was used to take renal measurements.

Antenatal care (ANC) cases, ascitic patients, subjects with cysts in kidney (even though asymptomatic), mild hydronephrosis etc. were excluded from the study. All images were obtained in the sagittal plane that is the long axis view obtained from a sub costal approach with the patient in the supine position [9]. Length of the kidney was measured in a section visually estimated to represent the largest longitudinal section [10]. The thickness was measured in long axis view, just perpendicular to the longitudinal axis of the kidney [10]. The width was measured in a section perpendicular to the longitudinal axis of the kidney as assessed from the longitudinal image [10]. Finally the volume of each kidney was calculated by using the formula mentioned as below.

Volume (in cm^3) = Length (in mm) x Thickness (in mm) x Width (in mm) x 0.5.

Results

Ultrasonographic examination of the subjects coming to the Trauma Centre and the Department of Anatomy was done. Approximately, 1 out of every 4 subjects observed seemed to fulfill the selection criterion. Hence a total of 164 subjects formed the study group, out of which 84 subjects were males and 80 were females.

Comparison tables were drawn between the mean ± standard deviation of the volume calculated from the kidney dimensions and the age of the subjects separately between males and females and separately for the right and the left kidney. The study group was divided into decades of age groups as per **Table - 1**.

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It was observed that the mean volume of the right and left kidneys in males was 114.59±24.07 cm^3 and 124.17±31.27 cm^3 respectively in the third decade and that in females was 97.35±26.47 cm^3 and 110.02±22.89 cm^3 respectively. In the fourth decade, the values for the right and left kidney were 112.79±28.39 cm^3 and 114.17±19.62 cm^3 respectively in males and 106.29±21.29 cm^3 and 112.01±22.29 cm^3 respectively in females. In the fifth decade, the mean value of the right and left kidneys in the males was 120.84±29.95 cm^3 and 131.15±26.61 cm^3 respectively. In females, the corresponding values were 96.39±26.11 cm^3 and 108.18±24.16 cm^3 respectively. The males of the study group in their sixth decade had a mean volume of 114.94±25.09 cm^3 and 119.02±23.63 cm^3 respectively for the right and left kidney. The females had the corresponding volume as 82.64±23.96 cm^3 and 85.65±27.7 cm^3 respectively as per **Graph-1**.

The males showed the maximum volume for both the kidneys in the fourth decade whereas females had a maximum volume in the third decade. The values were minimum in the sixth decade for both the males and females.

Discussion

The ultrasonography is a diagnostic technique not only evolving but which is becoming more and more sophisticated through its application in modern medicine. The present high level of image resolution allows us to evaluate many anatomical and physiological variables and to detect a number of pathological derangements at an early stage. Compared to excretory urography, sonographic measurements are not subject to magnification, to the diuretic effects of contrast agents or to foreshortening caused by obliquity of the renal axis or the phase of respiration and they can be obtained without exposing the patient to the ionizing radiation.

This study revealed that the volume did not relate well with age. In males, the volume was maximum for both the kidneys in the fourth decade where as in females it was maximum in the third decade as per **Graph - 2**. This was different from the findings of Emamian, et al. (1992) [10] who reported a decrease in the volume with age, although they noted a very slight difference among different age groups up to 60 years of age. They reported a median renal volume of 134 cm^3 and 146 cm^3 respectively for the right and left kidney in the European population. We found the mean volume of the right and left kidney as 105.6 cm^3 and 112.8 cm^3 respectively for the Indian population. When the mean renal volume of right and left kidney was observed only in males, it was 117.8 cm^3 and 121.2 cm^3 respectively. In females, the corresponding values were 92.81 cm^3 and 104.0 cm^3. These values were slightly lower than the values reported by Venkat Raman, et al. (1998) [11] who reported the mean volume of the right and left kidney as 133 cm^3 and 134 cm^3 respectively in males, 115 cm^3 and 112 cm^3 in females in for the population of London.

So again the observation was that the volume of kidney of the Indian population is slightly less than their western counterparts. Determination of renal volume is an important measurement for evaluating renal allografts, or assessing patients after unilateral nephrectomy [12].

Conclusion

Ultrasonographic measurement of renal dimensions and volume is a simple and reliable method that can be applied clinically [13]. Unilateral or bilateral reduction or increase in the renal size is an important parameter of many renal diseases. It was concluded that the mean volume of the right and left kidney in males is 117.8 cm^3 and 121.2 cm^3 respectively. The mean volume of the right and left kidney in

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females is 92.81 cm^3 and 104.0 cm^3. The volume for individual right and left kidney was maximum in the fourth decade in males and in the third decade in females. The volume did not show a steady decline with age although it was minimum in the sixth decade for both the right and left kidney in both the males and females.

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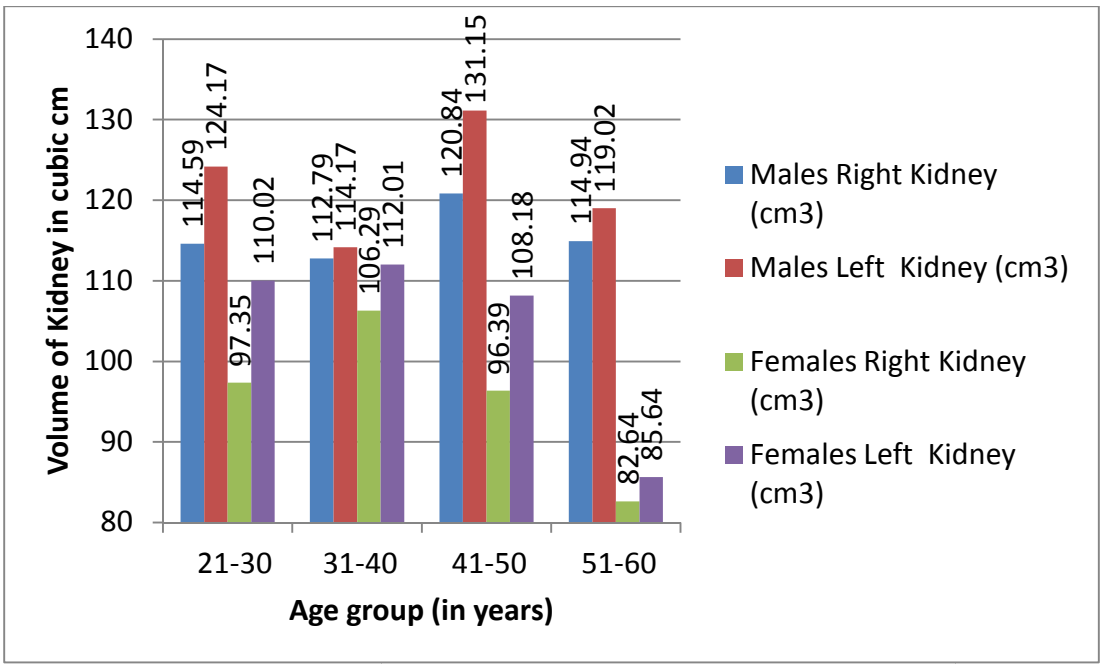
Graph - 1: Bar graph showing the volume of both the kidneys in both the sexes among different age groups.



Graph – 2: Line diagram to show the variation of the volume of both the kidneys according to age in both the sexes.

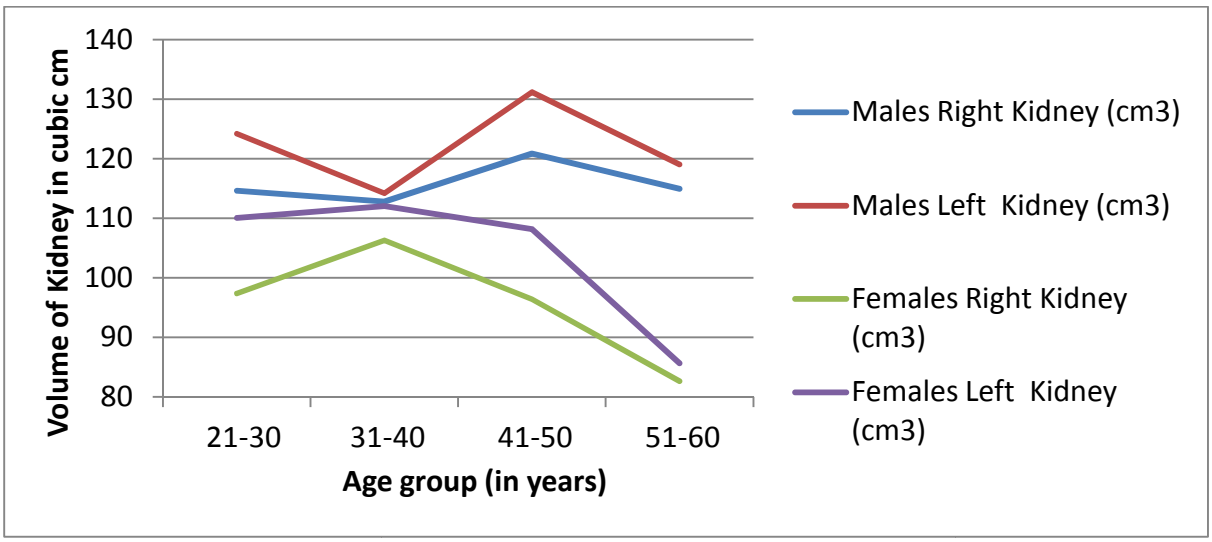


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Table - 1: Comparison of the volume of both the kidneys in both the sexes among different age groups.

Age groups (years)	Males			Females		
	Age (Mean±SD)	Right Kidney (cm^3) (Mean±SD)	Left Kidney (cm^3) (Mean±SD)	Age (Mean±SD)	Right Kidney (cm^3) (Mean±SD)	Left Kidney (cm^3) (Mean±SD)
21-30	22.71±3.41	114.59±24.07	124.17±31.27	25.55±3.05	97.35±26.47	110.02±22.89
31-40	36.55±3.09	112.79±28.39	114.17±19.62	36.2±2.81	106.29±21.29	112.01±22.29
41-50	45.0±2.73	120.84±29.95	131.15±26.61	46.0±3.09	96.39±26.11	108.18±24.16
51-60	56.6±2.95	114.94±25.09	119.02±23.63	56.25±3.10	82.64±23.96	85.64±27.7