

MEASUREMENT OF NORMAL KIDNEY LENGTH BY SONOGRAPHY AND ITS RELATION TO AGE, SEX, AND BODY HABITUS

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ABSTRACT

Introduction: Normal kidney length is an important indicator of normal renal function. The length ranges from 9 to 13.5cm. Kidney sizes are roughly related to patient's size. The assessment of renal size is an integral part of evaluation of renal diseases for both diagnostic and prognostic purposes. Normal renal longitudinal length reflects normal renal function, & it can be conveniently measured by ultrasonography.

Materials and Methods: The aim of this study is to evaluate the normal range of kidney length by Ultrasonography and its correlation with Age, Sex, Height, & Weight in normal Indian population. The measurement scale was fixed to the wall to measure height. Weight was measured by a weight machine. The ultrasound image was taken in both lateral decubitus position and the renal length was measured as the maximum bipolar dimension in longitudinal plane.

Observations: The mean length in all Age groups was 94.4±11.8mm of right kidney and 97.4±12mm of left kidney and correlated statistically significantly ($p=0.000$). The mean length of right kidney in male was 94.7±13.8mm, whereas in female it was 94±9.8mm ($p=0.597$) and that of left side was 98.2±14mm in male and 96.6±10mm ($p=0.343$) in female, which was statistically not significant.

Discussion: In the present study, there was sharp increase in measurements of length till the age of 20 years and slight increase upto 30 years and thereafter, it remained stable beyond 30 years upto 50 years. In the present study the kidney length was found to be larger on left side in 63.68%, right side in 34.98% and equal in 1.35%. However the difference of length between Male and Female was not statistically significant in the present study.

Conclusion: The length of kidney were smaller than previously reported, is probably a reflection of the relatively small body size of South East Asians than western population. Left kidney was larger than Right kidney. With increase in Height, Weight there was an increasing trend in the length of measurement in both the kidneys which were statistically significant.

KEY WORDS: Kidney length, Ultrasonography, Age, Sex, Height, Weight.

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INTRODUCTION

The Kidney is part of the Urinary System and plays

an essential role in the regulation of water homeostasis, electrolyte composition, regulation

of extracellular volume and Acid-Base Homeostasis. It filters the plasma of the blood, & excretes metabolic waste products from the body [1]. In adults, each kidney is 11cm long, 2.5cm thick and 5cm wide [2]. The length ranges from 9 to 13.5cm. Kidney sizes are roughly related to patient's size. It is also known that the left kidney is larger than the right kidney [3,4]. The assessment of renal size is an integral part of evaluation of renal diseases for both diagnostic and prognostic purposes [5]. Presently Sonography of the kidney has replaced standard Radiography for evaluation of renal diseases [6,7]. In individuals with normal renal function, an important measurement of renal size is longitudinal length & it can be conveniently measured by ultrasonography[8]. Many studies have shown that the renal size measurements are influenced by many factors such as age, ethnicity, gender, weight and height [9-11].

MATERIALS AND METHODS

The present study is conducted in the Department of Anatomy Kalinga Institute of Medical Sciences, KIIT University, Bhubaneswar, Odisha. Two Hundred (200) Ultrasonography was included of both sex & all age upto 70 years of age. Multiple Renal Cysts, Polycystic Kidney Disease, Unilateral Kidney, Chronic Kidney Disease or Malignancy, previous renal surgery or any congenital anomaly were excluded from this study. To measure height, the measurement scale was fixed to the wall. Height was measured while the subject stood without shoes or hat with heels, buttocks, shoulders and occiput touching the vertical scale & the head held upright. The standing height was measured on a stadiometer in children above 2 years & in children below 2 years the supine lengths were measured on an Infantometer. Height was measured on rounded to the nearest 0.5 cm. weight was taken in a weighing machine. The ultrasound image was taken in both lateral decubitus position and also instructed to hold their breath for a short while. After locating the Kidney, the transducer was rotated slightly to determine the longest renal axis and the renal length was measured as the maximum bipolar dimension in longitudinal plane which was displaying better Central Sinus Echoes, with the

renal parenchyma evenly distributed around the Central Sinus.

Fig. 1: Figure showing measurement of length of kidney.



OBSERVATIONS

Data analysis was done by using software SPSS 13 version. The analysis of the age parameters by ten years age group was conducted through an ANOVA. The mean length in all age groups of right kidney was 94.4 ± 11.8 mm and correlated statistically significantly ($p=0.000$). The mean length in d"10 year age group was 75.2 ± 11.7 mm with a sharp increase to 98.2 ± 9.2 mm upto 21-30 years of age. Thereafter, the mean length remained almost constant upto 41-50 years i.e. 99 ± 8.6 mm. There was a declining trend after 50 years of age upto 70 years of age (95.5 ± 9.4 mm). The mean length in all age groups of left kidney was 97.4 ± 12 mm and correlated statistically significantly ($p=0.000$). The mean length in d"10 year age group was 76.6 ± 9.8 mm, increased upto 41-50 years age group (103.2 ± 10.1 mm). After that there was a declining trend upto 70 years (Table 1).

It was found (of't' test) that male kidney were larger than female kidney in both sides. The mean length of right kidney in male was 94.7 ± 13.8 mm, whereas in female it was 94 ± 9.8 mm ($p=0.597$) and that of left side was 98.2 ± 14 mm in male and 96.6 ± 10 mm ($p=0.343$) in female, which was statistically not significant (Table 2).

There was significant difference ($p=0.000$) of the length of both right and left kidneys among the Weight groups. The analysis revealed that, as the weight increases the length of kidney also increases (Table 3).

The subjects were classified into four groups on

Table 1: Descriptive Statistics and ANOVA for Parameters of Right and Left Kidney by Age Group by USG.

	Age Group (years)	N	Mean	Std. Deviation	95% Confidence Interval for Mean		Min	Max	f & p Value
					Lower Bound	Upper Bound			
Length Right Kidney (mm)	≤10	26	75.208	11.679	70.491	79.925	55.3	97.7	21.27
	11-20	36	94.048	9.25	91.165	96.93	72.7	109.4	
	21 - 30	35	98.152	9.201	95.48	100.824	80.4	119.5	
	31 - 40	38	97.926	10.167	94.758	101.094	78.7	120.1	
	41- 50	28	99.043	8.6	95.708	102.378	84.4	122.7	0
	51 - 60	18	96.439	6.333	93.29	99.588	80.7	110.5	
	61 - 70	19	95.542	9.493	90.967	100.117	78.9	113.5	
	Total	200	94.413	11.801	92.855	95.97	55.3	122.7	
Length Left Kidney (mm)	≤10	26	76.623	9.812	72.66	80.586	56.6	95.3	26.141
	Nov-20	36	96.864	9.901	93.779	99.95	69.5	121	
	21 - 30	35	101.719	8.642	99.209	104.228	82.2	120.7	
	31 - 40	38	100.783	9.815	97.725	103.842	78.1	121.9	
	41- 50	28	103.236	10.147	99.301	107.17	87.1	136.8	0
	51 - 60	18	99.494	5.312	96.853	102.136	89.2	111.1	
	61 - 70	19	97.458	9.556	92.852	102.064	81.4	118.5	
	Total	200	97.35	12.087	95.755	98.945	56.6	136.8	

Table 2: Comparison of Parameters of Right and Left Kidney by Sex by USG.

Group Statistics	Sex	N	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval for Mean		t Value	p Value
						Lower Bound	Upper Bound		
Length Right Kidney (mm)	M	105	94.866	13.777	1.345	92.23	97.501	0.53	0.597
	F	95	94.009	9.757	0.898	92.249	95.77		
Length Left Kidney (mm)	M	105	98.181	14.052	1.371	95.493	100.869	0.95	0.343
	F	95	96.611	10.026	0.923	94.802	98.42		

Table 3: Descriptive Statistics and ANOVA for Parameters of Right and Left Kidney by eight(kg) by USG.

	Weight Groups	Mean	Std. Deviation	95% Confidence Interval for Mean		f value	p value
				Lower Bound	Upper Bound		
Length Right Kidney (mm)	≤30	75.663	11.186	71.486	79.84	47.462	0
	31 - 40	89.944	7.878	86.828	93.061		
	41 - 50	95.732	5.683	94.063	97.401		
	51 - 60	96.401	8.647	94.308	98.495		
	61 - 70	103.021	7.304	100.472	105.569		
	>70	105.776	8.909	101.196	110.357		
	Total	94.413	11.801	92.855	95.97		
Length Left Kidney (mm)	≤30	77.883	10.458	73.978	81.788	42.406	0
	31 - 40	95.552	8.187	92.313	98.79		
	41 - 50	97.557	8.448	95.077	100.038		
	51 - 60	99.919	8.358	97.896	101.942		
	61 - 70	104.794	7.791	102.076	107.513		
	>70	108.824	9.759	103.806	113.841		
	Total	97.35	12.087	95.755	98.945		

Table 4: Descriptive Statistics and ANOVA for Parameters of Right and Left Kidney by Height (cms) by USG

	Height Groups	Mean	Std. Deviation	95% Confidence Interval for Mean		F & P Value
				Lower Bound	Upper Bound	
Length Right Kidney (mm)	≤130	75.104	11.558	70.333	79.875	48.671
	131 - 150	93.917	8.609	91.521	96.314	
	151 - 170	96.743	9.195	95.108	98.377	
	>170	105.076	7.479	101.672	108.481	
	Total	94.432	11.824	92.868	95.996	0
Length Left Kidney (mm)	≤130	76.12	9.718	72.109	80.131	55.924
	131 - 150	96.729	8.665	94.316	99.141	
	151 - 170	100.406	8.957	98.813	101.998	
	>170	106.233	10.863	101.289	111.178	
	Total	97.361	12.113	95.759	98.963	0

the basis of their Height. The groups were ≤ 130cm, 131-150cm, 151-170cm and >170cm. The mean of length of right and left kidney along with ANOVA results according to Height has been furnished in Table 4. There is an increasing trend of the length of kidney with the Height, which was statistically significant (p=0.000).

DISCUSSION

Ultrasound is the preferred method of diagnosis in most clinical practice. Ultrasonographic renal size is one of the easily reproducible parameter and provides a rough indication of the renal function. The minimal size of a fully functional kidney is 9 cm in length[12]. A difference in length of 2 cm or more between the right & left kidneys may raise the possibility of unilateral kidney disease. Many congenital and acquired diseases directly or indirectly affect renal dimensions in all age groups[3]. Decrease in size and function are seen with chronic renal failure[13], renal arterial occlusion[14] and late stage renal venous thrombosis[15]. Autopsy findings of renal biometry in Indian population

yielded comparable results with kidney length ranging between 9.1-9.9cm [16, 18]. However, reported lengths obtained during dedicated renal ultrasound examinations were both more accurate and more precise than those reported in general abdominal ultrasound examinations.

In the present study the mean kidney length correlated with the previous studies of Adeela Arooj et al (2011)[17], Zeb Saeed et al (2012)[18], Mujahid Raza et al (2011)[19], J.O. Carrasco et al (2009)[3], Buchholz NP et al (2000)[20]. The smaller length of kidney, probably due to reflection of the relatively small body size of South East Asians[18, 20].

In the present study the kidney length was found to be larger on left side in 63.68%, right side in 34.98% and equal in 1.35%. E. Dinkel et al (1985), in their study observed that Left kidney in children were slightly greater in median length (0.9 mm) and median volume (2.5 ml) than Right kidney. The kidney was found to be longer on the Left in 51.7%, on the Right in 34.1% and of equal size in 14.2%[21].

Table 5: Kidney length in different studies.

	Parameter	Present Study	Adeela Arooj (2011)	Zeb Saeed (2012)	Mujahid Raza (2011)	J.O. Carrasco (2009)	Buchholz NP (2000)
Right kidney	Length (mm)	94.4± 11.8	97±7.9	98.5	101.6±8.9	104.3± 6.4	104±9
Left kidney	Length (mm)	97.3± 12.0	99±9.6	100	102.7±9.2	105.8±7	105±9

Table 6: Percentage Distribution Of Kidney Length.

	PRESENT STUDY	E. DINKEL (1985)
Left length larger	63.68%	51.70%
Right length larger	34.98%	34.10%
Equal length	1.35%	14.20%

In the present study, there was sharp increase in measurements of length till the age of 20 years and slight increase upto 30 years and thereafter, it remained stable beyond 30 years upto 50 years. A. Hekmatnia, M. Yaraghi (2004) got significant decrease in absolute and relative renal length in the age group 60-69 years old. They showed gradual decrease in renal length with increase in age and the decrease accelerates after the age of sixty years[22]. However the difference of length between male and female was not statistically significant in the present study. In this present study all the length of kidney correlates well with Height, Weight and statistically significantly ($p=0.000$). Higher body weight and height requires a bigger kidney[17] E. Dinkel et al (1985) found better correlation between kidney length to body height than to age or body weight[21].

CONCLUSION

The length of kidney in this study were smaller than previously reported, is probably a reflection of the relatively small body size of South East Asians than western population. Left kidney was larger than Right kidney. With increase in Height, Weight there was an increasing trend in the length of measurement in both the kidneys which were statistically significant.

Conflicts of Interests: None

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