SONOGRAPHIC MEASUREMENT OF RENAL SIZE IN NORMAL BANGLADESHI CHILDREN

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SUMMARY

To assess the renal length and volume in Bangladeshi children, we prospectively studied 217 healthy children aged between 1 to 12 years using ultrasonography. The mean kidney length was 7.23 ± 0.89 cm and mean kidney volume was 47.67 ±15.23 cm3. No significant difference in kidney length and volume was noted between boys and girls. The length and volume of left kidney was significantly larger than the right. There was a good correlation between renal volume and variables like age, body height, body weight and body surface area. The best values were found in the correlations to body surface area.

Key Words: Renal length; Renal volume; Children; Ultrasonography.

INTRODUCTION

Sonography is now playing a significant role in the evaluation of urinary tract diseases in children. Knowledge of normal renal parameters is essential for accurate evaluation of abnormal kidneys. Sonography appears to be an accurate method for measuring renal dimensions without known magnification caused by factors of chemical and photographic nature seen by excretory urography.[1,2] There are several western sonographic evaluations of renal dimensions in normal children,[3,4,5] but no such studies have been undertaken in this region. The aim of this study was to determine the normal renal length and volume as correlated with age, body height, body weight and body surface area in Bangladeshi children by ultrasonography and to establish a normal reference kidney size of children in this region of Asia.

MATERIALS AND METHODS

We performed this study at the Centre for Nuclear Medicine & Ultrasound, Khulna, Bangladesh between July 2000 to June 2001. Renal sonogram was done in 217 healthy children without apparent urinary tract disease who were refereed from Pediatric Unit, Khulna Medical College Hospital, Bangladesh for abdominal sonography for symptoms unrelated to urinary tract. Age ranged from 1 to 12 years; children less than 1 year old were not included

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because of the more rapid change in kidney size during the first year of life. Patients with abnormal sonographic findings were excluded. The variables like age, body height, body weight and body surface area were recorded at the time of the examination. The body surface area (BSA) was calculated by

$$BSA\ (m^2) = \frac{4 \times weight\ (kg) + 7}{90 + weight\ (kg)}$$

Sonographic evaluation was done with Siemens Sonoline SL-2 real time ultrasonogram using 3.5 MHz linear transducer. All the children were examined in a prone position without any special preparations and both longitudinal and transverse scanning were performed. Length, width and thickness of both kidneys were measured. Renal volume was calculated by volume (cm3) = Length x width x thickness x 0.523. We attempted to find relationship between renal dimensions such as renal length and volume and variables like age, height, weight and body surface area. The results were processed and analyzed using SPSS 7.0 program.

RESULTS

The length and volume of 434 kidneys was measured in 217 healthy children ranged in age from 1 to 12 years. Of them 110 were boys and 107 were girls. The mean kidney length was 7.23 ?0.89 cm and mean kidney volume was 47.67 ?15.23 cm.^{3} There was no significant difference in kidney length and volume between boys and girls. The length and volume of left kidney was larger than the right and this difference is statistically significant (Table-I).

TABLE I Measurement of renal length and volume in right and left kidney separately

Parameters	Renal length (cm) (Mean ±SD) n=217	Renal volume (cm^3) (Mean ±SD) n=217
Right kidney	7.16±0.92	46.80 ±15.07
Left kidney	7.31±0.92	48.55 ±16.17
P value	<0.001	<0.001

The mean renal length and volume in different groups of age, body height, body weight and body surface area is shown in Table-II. P values are <0.001 in all those variables. So mean renal length and volume increases with rise of age, height, weight and body surface area are highly significant.

The correlation coefficient between kidney volume and body variable is shown in Table-III. There was a positive correlation found between kidney volume and age, height, weight and BSA in the total population and in each sex. The best values were found in the correlations to body surface area.

TABLE II Renal length and volume in different groups of age, height, weight and BSA

Variable	Renal length (cm) (Mean ±SD)	Renal volume (cm^3) (Mean ±SD)
Age (years)		
1-3 (n=25)	5.92±0.77	27.03±12.03
4-6 (n=46)	6.74 ±0.52	38.69±7.89
7-9(n=69)	7.39 ±0.59	49.89 ±9.98
10-12 (n=77)	7.82 ±0.70	57.76±13.83
Height (cm)		
<100 (n=54)	6.35±0.80	32.82±11.64
100-119 (n=55)	7.20±0.66	47.73±12.97
120-139 (n=97)	7.62±0.63	53.93±11.74
≤140 (n=11)	8.37±0.59	65.14±12.38
Weight (kg)		
≤10 (n=19)	5.78±0.73	23.86±9.42
11-15 (n=43)	6.68±0.63	37.70±10.29
16-20 (n=56)	7.14±0.54	45.75±8.74
21-25 (n=55)	7.58±0.60	53.75±11.44
26-30 (n=34)	8.08±0.53	60.74±11.38
>30 (n=10)	8.13±0.79	68.70±10.50
BSA (m2)		
≤0.600 (n=43)	6.25±0.80	30.66±11.22
0.601-0.800(n=75)	7.05±0.58	44.24±9.65
0.801-1.00(n=75)	7.74±0.63	55.65±11.63
>1.00(n=24)	8.03±0.67	63.95±12.25

TABLE III Kidney volume in children correlated to age, height, weight and BSA

Variable	r value	p value
Age (years) Vs renal volume (cm^3)		
Total population (n=217)	0.700	<0.001
Boys (n=110)	0.701	<0.001
Girls (n=107)	0.691	<0.001
Height (cm) Vs renal volume (cm^3)		
Total population (n=217)	0.648	<0.001
Boys (n=110)	0.697	<0.001
Girls (n=107)	0.587	<0.001
Weight (kg) Vs renal volume (cm^3)		
Total population (n=217)	0.727	<0.001
Boys (n=110)	0.741	<0.001
Girls (n=107)	0.700	<0.001
Body surface area (m^2) Vs renal volume (cm^3)		
Total population (n=217)	0.741	<0.001
Boys (n=110)	0.764	<0.001
Girls (n=107)	0.705	<0.001

DISCUSSION

Hodson et al, in 1962 first described the measurement of renal size in children based on excretory urography.[6] Measurement of kidney size by ultrasonography is superior to radiological measurement and presently ultrasonography is popularly used for renal dimensions. Radiographic technique yields some variability in the apparent size of the kidney due to magnification and diuretic effects of contrast material. Sonographic measurements are not influenced by the above mentioned factors. Ultrasonography is non-invasive and relatively inexpensive when compared to radiographic method. There is no radiation exposure and therefore it can be safely used in children.

In this study we found no difference in kidney length and volume between boys and girls. This finding is in good agreement with other studies.[7,8] Several authors found no significant difference in renal length or volume between right and left kidneys.[3,7,9] As with other study, our results showed that the length and volume of left kidney is significantly larger than the right.[10]

We observed that mean renal length or volume in children increases with age, height, weight and body surface area. In our series, we found significant correlation between kidney volume and variables like age, height, weight and body surface area. This finding is consistent with other studies.[7,10] The best values were obtained in the correlations to body surface area is in agreement with the result of other study.[10]

CONCLUSION

Ultrasonography is a simple and convenient method of measuring kidney size in children. This study provides sonographic measurement of normal kidney length and volume in Bangladeshi children and the result was found to be consistent with other studies elsewhere in the world.

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