ORIGINAL ARTICLE

Determination of Normal Renal Size Among Children in Maiduguri, Borno State, North-eastern Nigeria

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ABSTRACT

Background: Measurement of the length and width of the kidneys using ultrasound scan is used to evaluate its rate of growth and the extent of kidney affectation by disease. Renal growth correlates well with somatic growth and is influenced by changes in the age, nutritional status and disease. Knowing renal size in relation to age and body size of a child will help to detect deviation from normal especially in diseased conditions that causes enlargement or reduction in renal size. **Objectives**: To determine the renal size of normal children by ultrasonography and correlation of renal size with age of the children. **Methods**: The data for renal size (renal length), sex and age of 404 children aged 1 month to 14 years were obtained. The (bipolar) lengths of both right and left kidneys were measured with ultrasonography by a sonographer. The age and sex each child was recorded in a preformed proforma. The weight was measured in the Children Outpatient Department (COPD) of State Specialist Hospital Maiduguri, Borno state using a standard weighing scale. **Results**: Four hundred and four (404) normal children aged 1 month to 14 years had abdominal ultrasound scan (USS) done. Their mean age was 7.9 (± 4.2 SD) years. There were 208 (51.5%) females and 196 (48.5%) males with female to male ratio of 1.1: 1. The mean age of females was 7.8 ± 4.2 SD while that of males was 8.0± 4.2 SD. There was no significance difference in their mean ages; p=0.494. There was rapid increase in the renal length in the first year of life and there was no statistically significant difference (p=0.50) in the mean renal length between males and females. There is good correlation between age and right renal length (r = 0.680) but low correlation (r = 0.290) between age and left kidney. **Conclusion**: There was rapid increase in the renal length in the first year of life and there is good correlation between age and renal size.

Key words: renal length, renal width, somatic growth, children

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Introduction

Kidney size (length and width) is considered a good parameter used for the evaluation of renal growth.[1] Organ growth, including renal growth correlates well with somatic growth and is influenced by the changes in the age of a child.[1]

Knowing renal size in relation to age of a child will help detect deviation from the normal especially in disease conditions that causes enlargement or reduction in renal size. Renal ultrasound scan is an important investigative tool in paediatric nephrology. There are numerous advantages of ultrasonographic determination of renal size. They include the lack of exposure to: ionizing radiation, radiographic magnification and Osmotic effect of the iodinated contrast material.[2] The examination is real time, tridimensional, independent of organ function and phase of respiration. Previously the kidney size was accurately measured on intra venous urography which had its own disadvantages of also exposing the patient to ionizing radiation. Renal growth is an index

of somatic growth and knowing its growth in relation to somatic growth is important.[1] A healthy child is the child with normal and good organ and somatic growth. Measurement of somatic parameters like weight, height/ length, body surface area (BSA) and body mass index (BMI) are essential in determining child's somatic growth. Most data on normal renal size are available from western population.[3-6]

Aims and objectives

To determine the renal size in normal children by ultrasonography and determine the correlation of renal size with age of the children

Methodology

Study design and setting

This study was a prospective study carried out on normal siblings of children attending paediatric out-patient department (POPD). The study was conducted at the state specialist hospital Maiduguri Borno state. State Specialist Hospital Maiduguri is one of the busiest referral hospitals located at the centre of Maiduguri metropolitan city with a projected population of 4,171,104 based on 2006 population census.[7]

Study population and sampling

Cases were siblings of children that presented to the POPD with their parents for other illnesses. This study excluded children with any form of renal disease as well as other chronic diseases such as malignancies, HIV and other chronic infections. Cases were recruited consecutively until the desired sample size was attained.

Data collection

A total of 404 children were recruited consecutively as they come to the out-patient department until the required sample size was obtained. Ethical approval and informed consent (both verbal and written) were obtained from the Scientific and Ethics Committee of the State Specialist Hospital Maiduguri and from each patient (adolescent) and/or parent/guardian before recruitment into the study. Assent was also obtained from children 8 years and above as suggested by Mangochi*etal*.[8]Basic information such as age, sex, weight, height, BMI and BSA were determined for each child. An abdominal Ultrasound scan was done for each child to determine the renal length of both right and left kidneys. Before performing the Ultrasound scanon any child, the sonographer explained the procedure to the care giver and adolescent child and the respondents was allowed to ask questions regarding the procedure. The Ultra sound machine (GE LOGIC V2) was used to measure the length and width of each kidney with the child placed in a supine oblique position as described by Uchenwa *et al*.[9] The maximal renal length was recorded after re-positioning the probe in several angulations.

All the measurements were made by a trained sonographer. The mean of right and left kidney measurements was used in all calculations. The mean renal length (±2 SD) of the right and left kidneys was calculated separately for different age groups. All information was made confidential. The renal parameters were then plotted against the age of the patient. The findings were recorded in an appropriate section of the study proforma and later interred into statistical software for analysis.

Data analysis

The data obtained was analyzed using IBM SPSS version 23. The results obtained were presented in form of tables. Chi- squared (χ^2) test was used to test for statistical significance between qualitative and quantitative variables. Fisher's exact test were applied where appropriate. A p value of < 0.05 was considered statistically significant.

Results

Four hundred and four (404) normal children had abdominal ultrasound scan (USS) done. Excluded were children with history and/or findings suggestive of renal abnormalities.

They were grouped into 18age groups from 1 month to 14.9 years and the number of children in each age group ranged from 9 to 77 with the mean age of each group shown in table I. The overall mean age of the children was 7.9 ± 4.2 years. There were 208 (51.5%) females and 196 (48.5%) males with female to male ratio of 1.1: 1. The mean age of females was 7.8± 4.2 years while that of males was 8.0± 4.2. There was no significant difference in their mean ages; p=0.49. Sixty (14.9%) children were less than 1 year of age, 222 (55.0%) children were 1 to 5 years of age while the remaining 122 (30.1%) children were 6 to 14 years of age.

There was rapid increase in the renal length in the first year of life though the difference in the increase is not statistically significant (p=0.27). There was no statistically significant difference (p=0.50) in the mean renal length between males and females.

The left kidney is longer than the right kidney with mean renal length of the right and left kidneys being 7.03 ±1.40 and 7.46 ±3.28 respectively ($p<0.01$). Distribution of mean right and left renal lengths across age groups is as stated in Table II.

There is good and positive correlation between age and renal lengths in both right ($r = 0.657$) and left ($r = 0.626$) kidneys. Table III shows the Spearman's correlation coefficient between age and renal size.

Table I: Age and sex distribution of the study population

Age	*N*	*Mean (SD)*	*Female n = 208*	*Male n = 196*
1 – 3mo	12	5.4 (1.5)	8	4
4 – 6mo	14	5.6 (0.4)	6	8
7 – 9mo	25	6.2 (0.7)	12	13
10 – 12mo	9	6.2 (0.5)	5	4
1 – 1.9y	77	6.2 (1.1)	43	34
2 – 2.9y	67	6.7 (1.0)	36	31
3 – 3.9y	33	7.1 (0.7)	15	18
4 – 4.9y	24	7.3 (0.9)	14	10
5 – 5.9y	21	7.0 (1.0)	13	8
6 – 6.9y	11	7.4 (0.9)	5	6
7 – 7.9y	19	7.5 (0.8)	8	11
8 – 8.9y	18	7.7 (1.1)	6	12
9 – 9.9y	11	8.2 (0.7)	3	8
10 – 10.9y	25	8.7 (1.0)	18	7
11 – 11.9y	11	8.5 (0.9)	4	7
12 – 12.9y	14	9.2 (1.4)	6	8
13 – 13.9y	8	6.8 (2.2)	4	4
14 – 14.9y	5	4.1 (1.8)	3	2
Total	**404**	**7.0 (1.4)**	**208**	**196**

Table II: Mean right and left renal lengths in different age groups of the study population

		Mean renal length (±2)	
Age (Years)	N (404)	Right(cm)	Left(cm)
1 – 3mo	12	3.2	3.9
4 – 6mo	14	5.2	5.8
7 – 9mo	25	6.4	6.7
10 -12mo	9	7.5	7.9
1 – 1.9y	77	7.8	7.9
2 – 2.9y	67	7.8	8.0
3 – 3.9y	33	7.8	8.2
4 – 4.9y	24	7.9	8.5
5 – 5.9y	21	8.3	9.2
6 – 6.9y	11	8.5	9.7
7 – 7.9y	19	9.2	9.9
8 – 8.9y	18	9.7	10.2
9 -9.9y	11	9.9	10.4
10 – 10.9y	25	10.1	10.4
11 – 11.9y	11	10.7	11.0
12 – 12.9y	14	11.0	11.3
13 – 13.9y	8	10.7	11.1
14 -14.9y	5	12.3	12.7

Table III: Correlation between age and renal length

Age group	Spearman's Correlation (r)	p-Value
Right renal length	+0.657	<0.001
Left renal length	+0.626	<0.001

Discussion

Ultrasonographic determination of normal renal size, especially the renal length, is very important in children as renal length changes with child's age. Before the advent of ultrasonography, excretory urography was the method of measuring renal size since 1062 [10,11]with a lot of challenges. The excretory urographic technique yields differences in the apparent size of the kidneys due to technical challenges like differences in positioning of the tube and its distance from the patient, phase of respiration and osmotic effect of iodinated contrast material which are found with ultrasonography. [12,13]Evaluating normal renal size in normal children can help determine baseline renal size as well as the normal reference range of renal size in our locality. Knowing the normal renal size in children can help detect any renal abnormality such as abnormally enlarged or shrunken kidneys, renal cysts, hydronephrosis, congenital abnormalities, reflux nephropathy, other glomerulopathies, among others. This is the first study, to the best of our knowledge, that determines children's renal size in North-eastern Nigeria.

The mean right and left renal lengths documented in this study was similar to that reported by Umeh *et*

al.[14]but higher than that reported by Ravikumar *et al*.[15]The higher mean renal sizes observed in this study as compared with that of Ravikumar *et al*[15]
may be due to larger sample size and inclusion of teenagers of up to 14 years in this study.

This study demonstrated that, the left kidney is longer than the right kidney a finding similar to that reported by others elsewhere. [16,17,18] Other studies however reported no significant difference between the right and left renal sizes.[19,20,21,22] The reason for an apparently larger left kidney could be due to the availability of enough space for the left kidney to expand as the spleen is smaller than the liver. [23] Also, rapid growth of a child in the first year of life may be directly proportional to the rapid organ growth including the kidneys. The left renal artery is shorter than the right renal artery thereby increasing the renal blood flow to the left kidney as compared to the right kidney leading to relatively increased left renal size. [24]Our study demonstrated that there was an increase in the renal size in the first year of life as compared to subsequent years. Other studies reported similar trend but their studies demonstrated rapid growth in renal size in the first 2 years of life. [2,25]

There is a good correlation in renal size with age a finding similar to that reported elsewhere by other researchers.[11,26] Our study demonstrated no sex difference in the mean renal size indicating that sex is not a determining factor for renal size. This finding was in agreement with findings observed elsewhere. [26,27,28,29,30,31]

Conclusion

Measurement of renal size ultrasonographically can be an initial screening technique for children in order to establish the baseline renal size as well as detect renal diseases. There was rapid increase in the renal length in the first year of life and there is positive correlation between age and renal size. The left kidney is significantly longer than the right kidney. We did not find sexual differences in the mean renal sizes indicating that sex is not a determining factor for renal size.

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