Sonographic Measurement of Spleen to Left Kidney Ratio among Saudi Children

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ABSTRACT

Objective: Spleen length varying according to many factors such as individual height, age, and weight, determination of mild splenomegaly might be extremely inaccurate. The goal of this study was to determine the spleen to left kidney ratio in different age group among school age children in Saudi Arabia.

Methods: A cross sectional study was conducted on 150 healthy subjects (66 boys and 84 girls) their age ranged from 7 to 15 years. The study was conducted at the Taawon clinic in Kharj city, Saudi Arabia. The sonographic examination was performed using Siemens (Acuson X300) machine with convex probe (3.5 – 5 MHz). Spleen and left kidney lengths were measured as well as weight and height of the subjects.

Results: The result of the study showed that there is no significant different between boys and girls regarding spleen and left kidney lengths (p > 0.05). The spleen to left kidney ratio was found to be about 1.1 with 1.3 as the normal upper limit in the study sample.

Conclusion: Spleen to left kidney length ratio becomes a promising method to detect non palpable splenic enlargement. Mild splenomegaly is considered if the spleen to left kidney ratio is greater than 1.3 in the absence of kidney disorders.

Keywords: Spleen, Left Kidney, Ultrasound.

I. INTRODUCTION

Assessment of the spleen morphologically is one of the factors that can aid in detecting splenic disorders as well as systemic Disorders [1]. Occasionally, morphological evaluation of anatomical structures and laboratory reports are needed for a full characterization of the disease process. However, in some cases, such as splenomegaly in malaria, an enlargement can be the only feature on ultrasonography. On the other hand, clinically palpable spleen may not be a pathological condition. Palpable spleen without clinical significance includes lying down spleen due to subdiaphragmatic pathology, visceraloptosis, and palpable spleen found in 10% to 15% of normal children [2]. Clinical assessment of changes in visceral organ size is difficult and undependable. Ultrasonography was used as an appropriate tool because it is a non-invasive, safe and quick method for measurement of spleen and kidney sizes [3].

To establish an internal reference point against which the spleen size can be standardized, the length of the spleen compared to the length of the left kidney. This method has been used by Loftus and Metreweli as well as Al Imam et al who found that the spleen to left kidney ratio among children was constant for all age groups with a mean value of 1 and proposed a ratio of 1.25 as the upper limit of normal [4], [5]. In a similar study in adult population, spleen length was correlated with left kidney length in women, but not in men and they found the spleen to left kidney ratio to be an unpredictable index for spleen size in adults [6]. It has been shown that racial variations in the standard length and width of the spleen exist [7]. There is inadequate data in the tropics on the spleen to left kidney ratio with reference to age and body habitus among school age children which will serve as an internal reference standard against which the spleen size can be standardized [8]. The aim of this research was to determine spleen to left kidney ratio among Saudi school aged children in order to establish specific charts to compensate for demographic variations in spleen dimensions.

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II. Method

This cross-sectional study was carried out in a convenient sample of 150 (66 boys and 84 girls) Saudi children who were enrolled in the study, their age ranged (7-15) years which obtained from hospital birth certificate. Children less than 7 and more that 17 years, thick patient, and patient with known pathology were exclude from the study. Ethical approval was obtained from the Ethical Committee board of the Private Medical Centers. The informed consent was obtained from each participant’s parent for the purpose of research.

The sonographic examinations were carried out using (Siemens ultrasound machine (Acuson X300–10566144 from Siemens medical solutions – USA) manufactured in 2012 with 3.5MHz and 5 MHz convex transducers. All sonographic measurements were made with curvilinear probes. Demographic data were taken from each participant which included age, sex, height, and body weight.

Ultrasound transmission gel (hypoallergic-water soluble) (Figure 1) was first applied to the area being scanned to ensure good transmission of the ultrasound beam into the subjects. Right lateral decubitus position in the coronal plane was used for the spleen length measurement. Longitudinal size measurement was performed between the most superomedial and the most inferolateral points of the spleen. These techniques were used because the longest dimension of the spleen and left kidney could be obtained easily. Spleen and left kidney lengths were measured three times, and the mean values were recorded (Fig. 1 and Fig. 2).

Data analysis was carried out using (SPSS Version 20). Descriptive statistics were applied on the available data. Mean ± SD was presented for age, height, weight, S/K ratio. Difference of mean between two independent groups was assessed with the Student’s t-test, statistical significance was considered at p < 0.05.

III. Results

Table I shows the mean of the spleen and left kidney lengths in the study sample. They were found to be 9.72±1.79 cm and 8.90±1.72 cm, respectively. The variables include: age = 10.38±2.9 years; height = 131.66±14.12 cm; weight = 30.72±15.54 kg.

Table II spleen length, kidney length and spleen to Lt kidney ratio in male and female; the spleen and left kidney lengths as well as spleen to left kidney ratio were not statistically different in boys and girls.

Table III shows the Spleen to Left Kidney Ratio in different age group. The ratio is constant around 1.1 ranged from 1.0 to 1.3; the normal upper limit for the spleen to left kidney ratio is 1.3.

IV. Discussion

This cross-sectional study conducted on school age children; their age ranged from 7-15 years which was compatible with school-age in Saudi Arabia. The results showed that there is no significant difference in the measurements of spleen and left kidney lengths regarding gender; the result was in line with other previous studies [4], [5]. Therefore, gender could not be used as a factor for spleen and left kidney lengths in school-age children in Saudi Population. This could lead to additional method of measurement for the left kidney and spleen, which is Sonography. In addition to that the absence of gender difference suggests a non–involvement of sex hormones in the development of these organs until the age of 15 years.

As the spleen length found to be affected by age, height and weight, the most common method to detect mild

![Fig. 1. Method of measurement of spleen length.](image1)

![Fig. 2. Method of measurement of Kidney length.](image2)

| TABLE I: DESCRIPTIVE STATISTICS OF STUDY VARIABLES |
|-----------------------------------------------|
| Minimum | Maximum | Mean | SD  |
|--------|---------|------|-----|
| Age    | 7       | 15   | 10.38 | 2.9 |
| Height | 102     | 158  | 131.66 | 14.12 |
| Weight | 14      | 71   | 30.72 | 15.54 |
| Spleen Length | 7.28 | 13.00 | 9.72 | 1.79 |
| Lt Kidney Length | 6.70 | 12.40 | 8.90 | 1.72 |
| S/K Ratio | 0.9 | 1.3 | 1.1 | 0.076 |

| TABLE II: MEAN OF THE SPLEEN LENGTH, KIDNEY LENGTH AND SPLEEN TO LT KIDNEY RATIO IN MALE AND FEMALE |
|--------------------------------------------------------|
| Gender | Spleen Length | Mean | SD | Std. Error |
|--------|----------------|------|----|-----------|
| Male   | 9.69           | 1.82 | 0.39 |
| Female | 9.74           | 1.79 | 0.34 |
| Spleen Length | Male | 8.91 | 1.81 | 0.39 |
| Lt Kidney Length | Female | 8.89 | 1.69 | 0.32 |
| S/K Ratio | Male | 1.09 | 0.071 | 0.01 |
| Female | 1.10           | 0.079 | 0.01 |

| TABLE III: SPLEEN TO LEFT KIDNEY RATIO IN DIFFERENT AGE GROUP |
|---------------------------------------------------------------|
| Age Groups | Mean | SD | Std. Error |
|------------|------|----|------------|
| 7 - 9      | 1.12 | 0.08 | .0170 |
| 9 - 11     | 1.04 | 0.08 | .0297 |
| 11 - 13    | 1.08 | 0.05 | .0164 |
| 13 - 15    | 1.09 | 0.05 | .0163 |
| Total      | 1.10 | 0.08 | .0107 |
spleenomegaly is to use the spleen to left kidney ratio. Some investigators establish an internal reference for spleen size. This method adopted by [9] and [10] who found that the spleen to left kidney ratio was constant for all children age groups with a mean value of 1 and proposed a ratio of 1.3 as the upper limit for normal pediatric population. In our study the spleen to left kidney ratio is constant at around 1.1 for all ages, using 0.2 standard deviations above the mean as a guide, the upper limit of normal for the spleen to left kidney ratio is 1.3. Therefore, spleenomegaly is confirmed in this school age children population if the spleen to left kidney ratio is more than 1.3 in the absence of renal diseases, the result was similar to studies conducted in adult population, it stated that the spleen length was correlated with left kidney length in women, but not in men [6]; their results also showed that the spleen to left kidney ratio was not a reliable index for spleen size in adults and suggest the use of Look-up tables instead.

The findings of this study could be applied to the rest of the other international community, where each country, particularly in tropical regions which affected by malaria and typhoid fever, needs to develop its own unique spleen-to-left-kidney-size ratios in school-aged children, as differences in these ratios could be due to ethnic and racial differences. A study in other regions of Saudi Arabia could improve the estimation of the spleen to left kidney ratio. Furthermore, the socio economic status should be also considered.

V. CONCLUSION

Ultrasound is the best imaging modalities to detect mild spleenomegaly. In Saudi school age children, the spleenomegaly is confirmed if the spleen to left kidney ratio is more than 1.3 in the absence of renal diseases.

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