ORIGINAL RESEARCH ARTICLE

Spleen and Kidney Ratio in the Assessment of Mild Splenomegaly

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A B S T R A C T

Introduction:The spleen is a reticuloendothelial organ involved in defense against infection and infestation and thus it is expected that the spleen may be slightly comparatively larger in exposed subjects than to what is obtained in non exposed subjects. Study aimed at Clinical determination of spleen to left kidney ratio according to age and anthropometric parameters among school age children at our local area.

Material and methods: It was a cross sectional study done by random sampling method in 125 patients in 2 years period. USG Scans were done with a curvilinear probe of 3.5 MHz frequency. Measurement was done with each subject in supine or in a slightly right lateral decubitus position. The splenic length was measured on a longitudinal coronal plane between the most superiomedial and the most inferiolateral margins at the level of the hilum. Left kidney longitudinal size measurement (bipolar) was obtained in the coronal plane passing through the renal hilum with the subjects in the supine or slightly right lateral decubitus position.

Results: Mean age, height, weight and BMI ofin subjects are 11.66 ± 3.37 years, 141 ± 18.1 cm, 32.99 ± 13.76 kg and 16.9 ± 3.16 kg/m2. The mean +SD spleen to left kidney ratiois constant around 1.28 +0.067with a range of 1.0 – 1.3(min-max). standard deviations (SD) above the mean as a guide, the upper limit of normal for the spleen to left kidney ratio is 1.3.

Conclusion: A simple method to diagnose mild splenomegaly, is to use spleen/kidney ratio that was found to be constant at any age group. Sonography provides a simple way to assess the renal and splenic growth without any risk of radiation.

Keywords: Spleen, Kidney, Clinical Assessment

INTRODUCTION

The spleen is a part of your lymphatic system. It helps the immune system by storing white blood cells and helping in the creation of antibodies. The size, shape and structure of the spleen are parameters that assist in detecting systemic infections and splenic disorders, inflammatory and malignant pathologies. Splenomegaly can be detected both clinically and sonographically. Ultrasound is frequently used to examine the spleen and to rule out splenomegaly. Ultrasonography is routinely used as it is reliable, easy and non invasive technique also it does not use ionizing radiation, is non-invasive, lacks radiographic magnification and osmotic effect of the iodinated contrast medium.[1] Moreover it is safe, provides real time images and does not require anesthesia.[2,3] Furthermore during the follow-up examination, repeat sonography can be safely done. Ultrasound was adopted as the imaging tool for this study due to its health advantages, accessibility and portability.

The aim of determining the spleen to left kidney ratio in the present study was to provide information in mild splenomegaly during routine abdominal ultrasound in our school age children population as a routineclinical examination.

MATERIAL AND METHODS

It was a cross sectional study done by random sampling method done in 672 patients between June 2017 to May 2019 periodin the department of radiology in school age children aged 6 to 16 years. Some of the children attended hospital for clinical reasons while majority of them attended hospital just as volunteers for the study. Selection done as per inclusion and exclusion criteria.

Inclusion Criteria: Apparently healthy subjects and subjects with normal sonographic appearances of the kidneys.

Exclusion Criteria: Subjects with tropical splenomegaly syndrome (malaria and typhoid fever), lymphadenopathy, sickle cell disease, obesity, splenic parenchymal mass lesions, accessory spleen and cysts, acute or chronic renal failure, renal parenchymal mass lesion, cysts, hydronephrosis or calyectasis. This study was approved by the ethics committee.

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Furthermore informed consent, describing the purpose of the study, was obtained from all parents whose children were involved in the study.

Sex, age, body weight (WT), height (HT), body surface area (BSA) and body mass index (BMI), were determined for each participant. Anthropometric measurements were obtained on the participants wearing light weight street clothes without shoes. Weight was measured on a calibrated portable Salter scaleto the nearest 0.1kg. Height was measured with a metal tape measure to the nearest 0.5cm with the participants standing upright with the head in the Frankfurt position.

USG Scans were done with a curvilinear probe of 3.5 MHz frequency. Two sequential measurements were obtained and the mean calculated; this was to minimize intra-operator variation and ensure greater accuracy and reliability of measurements. Measurements were taken in quiet respiration for the younger children and older children taken in deep inspiration. No sedation or preparation was used.

Measurement was done with each subject in supine or in a slightly right lateral decubitus position. The splenic length was measured on a longitudinal coronal plane between the most superiomedial and the most inferiolateral margins at the level of the hilum Left kidney longitudinal size measurement (bipolar) was obtained in the coronal plane passing through the renal hilum with the subjects in the supine or slightly right lateral decubitus position.

Data analysis was carried out using SPSS version 15.0. Statistical significance was considered at $p < 0.05$. Descriptive statistical methods were used when appropriate.

RESULTS

The spleen to left kidney ratio according to age, height, weight, BMI and BSA were studied. Mean age of subjects was 11.66 ± 3.37 years. The mean +SD spleen to left kidney

Age in years	Number of subjects	Minimum	Maximum	Mean	Standard deviation
6	56	1.0	1.2	1.12	0.05
7	39	1.0	1.2	1.12	0.06
8	71	1.0	1.3	1.13	0.07
9	82	1.0	1.3	1.13	0.06
10	50	1.0	1.3	1.13	0.08
11	52	1.0	1.3	1.13	0.07
12	49	1.0	1.3	1.13	0.08
13	68	1.0	1.3	1.13	0.07
14	37	1.0	1.3	1.13	0.06
15	73	1.0	1.3	1.13	0.08
16	95	1.0	1.3	1.13	0.06
Total	672	1.0	1.3	1.128	0.067

Table-1: Spleen to Left Kidney Ratio According to Age in present study

Height in cms	Number of subjects	Minimum	Maximum	Mean	Standard deviation
100-110	60	1.0	1.2	1.12	0.05
111-120	94	1.0	1.2	1.12	0.06
121-130	81	1.0	1.3	1.14	0.07
131-140	82	1.0	1.3	1.13	0.06
141-150	85	1.0	1.3	1.12	0.08
151-160	92	1.0	1.3	1.13	0.07
161-170	95	1.0	1.3	1.13	0.08
171-180	83	1.0	1.3	1.14	0.07
Total	672	1.0	1.3	1.128	0.067

Table-2: Spleen to Left Kidney Ratio According to Height in present study

Weight in kgs	Number of subjects	Minimum	Maximum	Mean	Standard deviation
15-20	97	1.0	1.2	1.12	0.06
21-25	84	1.0	1.2	1.12	0.06
26-30	103	1.0	1.3	1.14	0.06
31-35	107	1.0	1.3	1.13	0.07
36-40	91	1.0	1.3	1.12	0.06
41-45	66	1.0	1.3	1.13	0.06
46-50	83	1.0	1.3	1.13	0.07
>50	41	1.0	1.3	1.14	0.06
Total	672	1.0	1.3	1.128	0.067

Table-3: Spleen to Left Kidney Ratio According to weight in present study

BMI in kg/m2	Number of subjects	Minimum	Maximum	Mean	Standard deviation
12-14.9	89	1.0	1.2	1.12	0.06
15-16.9	95	1.0	1.2	1.12	0.06
17-18.9	113	1.0	1.3	1.14	0.06
19-20.9	109	1.0	1.3	1.13	0.07
21-22.9	96	1.0	1.3	1.12	0.06
23-24.9	84	1.0	1.3	1.13	0.06
25-26.9	86	1.0	1.3	1.13	0.07
>27	0	1.0	1.3	1.14	0.06
Total	672	1.0	1.3	1.128	0.067

Table-4: Spleen to Left Kidney Ratio According to Body mass index in present study

ratio was constant around 1.128 +0.067 with a range of 1.0 – 1.3(min-max). Standard deviations (SD) above the mean as a guide, the upper limit of normal for the spleen to left kidney ratio was 1.3 (table 1).

Mean height ofin subjects was 141 ± 18.1 cm;. The mean +SD spleen to left kidney ratio was constant around 1.128 +0.067with a range of 1.0 – 1.3(min-max). Standard deviations (SD) above the mean as a guide, the upper limit of normal for the spleen to left kidney ratio was 1.3.(Table 2)

Mean height of subjects was 32.99 ± 13.76 kg. The mean +SD spleen to left kidney ratio was constant around 1.128 +0.067 with a range of 1.0 – 1.3 (min-max). Standard deviations (SD) above the mean as a guide, the upper limit of normal for the spleen to left kidney ratio was 1.3.(Table 3)

Mean BMI of subjects was 16.9 ± 3.16 kg/m^2. The mean +SD spleen to left kidney ratio was constant around 1.128 +0.067 with a range of 1.0 – 1.3(min-max). Standard deviations (SD) above the mean as a guide, the upper limit of normal for the spleen to left kidney ratio was 1.3.(Table 4)

DISCUSSION

The accurate diagnosis of splenic enlargement is a matter of considerable importance for athletes of unusual size and height. Although splenic enlargement can be the result of a number of disorders (including infectious, infiltrative, immunologic, and malignant conditions), viral illnesses are by far the most common cause in the young population.

In present study, school age children ranging from 6 – 16 years were studied. In the present study the spleen to left kidney ratio was strikingly constant at around 1.13 for all ages as well as other biometric parameters such as height, weight andBMI studied. Using 2 standard deviations above the mean as a guide, the upper limit of normal for the spleen to left kidney ratio is 1.3. Thus splenomegaly should be suspected in this school age children population if the spleen is more than 1.3 times longer than the adjacent left kidney in the absence of renal disease. The age, height and weight of the child showed the best correlation with renal length and splenic parameters.

Some investigators have sought to establish an internal reference standard against which the spleen size can be calibrated. The most common of such strategy is to compare the length of the spleen to the length of the left kidney. Loftus and Metreweli[4] as well as Al Imam et al[5] found that the spleen to left kidney ratio 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 in a pediatric population. Because of racial differences in spleen size, knowledge of the spleen to left kidney ratio in the population being examined is a prerequisite.[6]

Splenic lengths in 184 normal Jordanian children were measured through the hilum by ultrasound and compared with data from Hong Kong and the United States of America. The spleen to left kidney ratio was calculated to determine whether it was constant and to establish a ratio above which splenomegaly can be diagnosed. Up to age 15 years, little variation in splenic length was observed, but over 15 years splenic length was slightly lower in Jordanian males. Spleen to left kidney ratio was constant at around 1; splenomegaly is highly probable in ratios > or = 1.25.[5]

Audrey L. Spielmann et al study showed Sonographic measurements of spleen size and left renal length, which were performed on 129 college athletes (82 men, 47 women). Length, width, and thickness of the spleen and left renal length were obtained. Concluded Spleen size correlates with height in tall healthy athletes. Nomograms from this data can be used to gauge the risk of returning to play after episodes of acute splenomegaly, as with infectious mononucleosis.[7]

Some investigators have sought to establish an internal reference standard against which spleen size can be calibrated. The most common such strategy is to compare the length of the spleen to the length of the left kidney. Loftus and Metreweli[4] proposed a spleen-kidney ratio of 1.25, as measured on sonography, as the upper limit of normal in a pediatric population. In our study, spleen length was correlated with kidney length in women, but not in men. Dittrich et al[8] established a nomogram for determining the splenic size in children sonographically, however these techniques are time consuming. Rosenberg et al[9] found that measurement of splenic length was an easier technique and he suggested upper limit guidlinees for assessing the spleen length. Several prior studies have sought to develop standards for spleen size, using a variety of imaging techniques, such as CT, scintigraphy, MRI, and sonography One study used four measurements from two imaging planes in the volume formula for an ellipsoid to estimate splenic volume.[4] The spleen, however, has a variable 3D configuration, and its shape does not easily conform to the simple geometry of

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an ellipsoid. Therefore, volumetric measurement is obtained most accurately on CT or MRI.[5] Nevertheless, routine CT for the diagnosis and serial follow-up of patients for suspected splenic enlargement is difficult to justify in view of the radiation exposure (especially in a pediatric or young adult population) and the expense. As an alternative, MRI is hampered by expense and limited availability in many areas of the world. One group estimated the normal splenic volume using 3D sonography in 52 normal volunteers.[7] The 3D technique was believed to provide a more accurate measurement of the spleen volume than conventional sonographic techniques but was cumbersome and time-consuming and therefore not practical for a busy sonographic practice.

Splenic length in our study correlated very well with all the body size indicators. This is in agreement with the observation of the rapid increases of organs during the early years of life.[6] In our study, BSA gave the best correlation with splenic length. This is in agreement with the study by Safaketal.[10] but contrary to reports by Konusetal.[11] and Dhingra etal.[12] where HT was reported to give the best correlation, followed by BSA. Other studies[3,13] have reported WT to give the best correlation. Other studies on spleen length in adults have also compared body habitus with spleen sizes. Two of these studies in Nigeria[3,14] noted WT as the best correlate. Although sex, age and body habitus alongside ethnicity are considered very important in the estimation of the spleen length in children, Hoseyetal.[6] in their study of the spleen size of collegiate athletes emphasized strongly the role of sex and race above others, in reliable prediction of the spleen size of adults.

Spleen to kidney ratio is another easy and reliable way to exclude splenic enlargement. splenomegaly is highly probable if the spleen to kidney ratio is >1.3 in the absence of renal disease.

CONCLUSION

The spleen to left kidney ratio can be used to exclude non palpable splenic enlargement objectively among school age children. The spleen to left kidney ratio is strikingly constant around 1.13 with a range of 1 – 3 with respect to age and somatometric parameters among school age children. Ultrasound can be used to diagnose mild splenomegaly if the spleen is about 1.3 times longer than the adjacent left kidney in the absence of renal disease among school age children.

These values are expected to enhance medical and health care practice particularly in centers that may not afford or have easy access to ultrasound machines, rural areas where electric power generation is still a challenge and also in urban areas where it can speed up health response.

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