Original Article

ULTRASONIC MEASUREMENT OF NORMAL SPLENIC SIZE IN INFANTS AND CHILDREN IN PAEDIATRIC INDIAN POPULATION

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ABSTRACT

Background: No two individuals are alike in this world, not even identical twins. In children, knowledge of normal splenic size (splenic length) in relation to age and other biometric parameters (height and weight) of physical growth is of paramount importance for the determination of mild splenomegaly.

Objectives: The purpose of this study is to measure normal splenic size in infants & children in Indian population by ultrasonography; to establish correlation of splenic size with age, height and weight.

Methods: The present study was conducted in the departments of Anatomy, Radiology and Paediatrics at a General Public Charitable Hospital, Mumbai. The study group consisted of 80 children of both sexes, who were referred to the Radiology department for ultrasonography for abdominal and/or pelvic problems unrelated to the spleen. The splenic length was measured by a radiologist using a commercially available real time ultrasound system with a TOSHIBA ECOCEE USG SYSTEM particularly by using the convex probe.

Results: In the present study, p value is less than 0.001 for all - age with splenic size, splenic size with height, splenic size with weight indicate significant correlation of slenic size with age, height and weight.

Conclusion: I believe this study shall stand as a good reference to Radiologists and Paediatricians in early diagnosis as well as undiagnosed and complicated disorders involving the spleen.

Key words: Splenomegaly, splenic size, Ultrasonography, Paediatric population.

INTRODUCTION

The spleen, a large encapsulated mass of vascular and lymphoid tissue is the organum plenum mysterium (Latin) = organ full of mystery (Galen)[1]. In humans, the spleen has two main functions[2]: First is production of immunological responses against blood borne antigens and second is removal of particulate

matter and aged or defective blood cells, particularly erythrocytes, from the circulation. In the human foetus, the spleen is an important site of haemopoiesis and this function may be resumed in adulthood in certain disease states.

Under a variety of conditions, including surgical misadventure, the spleen may be removed. It is common for a person to live successfully without a spleen. However, particularly in childhood, the immune response may be impaired, particularly to encapsulated bacteria. Recently, the surgical trend is toward splenic preservation whenever possible[3].

A large number of pathologic entities can affect splenic size, and the clinical examination is far from accurate to detect small increases in size[4]. The spleen may be palpable in 15 -17% of healthy neonates and 10% of healthy children; however, in most individuals it must be two to three times the normal size before it is palpable[5,6].

In children, knowledge of normal splenic size (splenic length) in relation to age and other biometric parameters (height and weight) of physical growth is of paramount importance for the determination of mild splenomegaly[7].

Splenomegaly in paediatric age group is commonly associated with typhoid, malaria, portal hypertension, thalassemia major, haemolytic anaemia, leukemia, lymphoma, etc[6].

The splenic length at the hilum is considered the most reproducible linear measurement. Ultrasonography is an established safe, quick, and reliable method for the assessment of splenic dimensions[7].

The surge of enthusiasm for preserving the damaged spleen came about because of the fear of overwhelming post-splenectomy infection and has highlighted the immunological role of the spleen[8]. The splenic macrophages are the most active of the body's macrophages in phagocytosing living and inert particles. Ultrasonography is very useful for determination of mild splenomegaly, as clinical examination is far from accurate to detect small increases in size. So the purpose of this study is to measure normal splenic size in infants & children in Indian population by ultrasonography; to establish correlation of splenic size with age, height and weight.

MATERIALS AND METHODS

The study was approved by the ethical committee of TNMC, Mumbai. The study included 80 children who were referred to Radiology Department for Ultrasonography for abdominal and/or pelvic problems unrelated to the spleen from January' 2004 to December'2005 at B.Y. L. Nair Hospital, Mumbai.

The relevant information of the child like age, sex, height, weight, immunization history and general medical history was noted and due consent of the parent was taken. The height in children was measured in centimeters by using a measuring tape. In infants, height (length) was taken with the help of an infantometer. The weight was taken by electronic weighing scale.

All examinations were performed by a radiologist using a commercially available linear array real time ultrasound system with a TOSHIBA ECOCEE USG SYSTEM OR SIEMENS USG SYSTEM particularly by using the convex format.

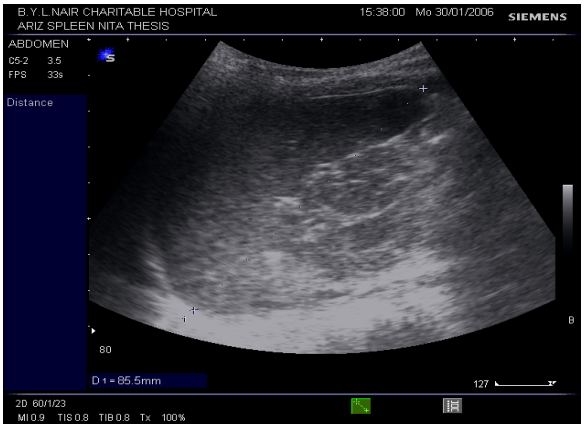

Figure 1: Gray Scale, B mode sonogram of the spleen showing normal dimensions of the spleen (splenic length) in a 9 yrs child.

The splenic size (splenic length) was measured sonographically by obtaining an oblique coronal view which included the hilum, during quiet breathing; in the older children, measurements were made while they were holding their breath. The patient was lying in a supine or in a slightly right lateral decubitus position during ultrasonography. The 5 MHZ curvilinear transducer was placed posteriorly along the long axis of lower left intercostal spaces. The spleen was seen as a uniform homogenous echo pattern.

The statistical analysis was done by using the 't' test.

RESULTS

The results of the study are shown in table one. Age wise distribution of splenic size, height and weight is shown in the table.

Pearson correlation of age with splenic size, height with splenic size and weight with splenic size was shown positive correlation. P values for all three group are less than 0.001 which indicate that size of the spleen increases with age, height and weight..

Table 1: Age group wise splenic size, height and weight in normal Spleen Group (n=80)

Age Group (Years)	Splenic Size (cm)		Height (cm)		Weight (kg)	
	Mean	SD	Mean	SD	Mean	SD
0-1	6.13	0.13	70.25	6.65	8.68	1.81
1-2	6.45	0.17	81.25	5.56	11.45	1.33
2-3	6.30	0.21	92.23	5.51	13.67	1.53
3-4	7.24	0.08	102.29	4.35	16.34	1.27
4-5	7.46	0.16	105.14	4.71	18.21	2.96
5-6	7.66	0.27	107.67	4.06	18.90	3.11
6-7	8.18	0.17	116.50	7.18	20.42	2.87
7-8	7.46	1.16	124.14	2.41	24.36	1.55
8-9	9.00	0.25	128.38	2.77	27.44	1.99
9-10	9.17	0.10	132.14	2.34	30.36	1.95
10-11	9.41	0.11	138.00	2.39	33.19	1.91
11-12	9.70	0.15	140.50	5.13	35.44	3.61

Table 2: Pearson Correlation Coefficient in normal spleen group

Variables	Correlation Coefficient(r)	P value
Age with splenic size	0.9	<0.001
Splenic size with height	0.8	<0.001
Splenic size with weight	0.6	<0.001

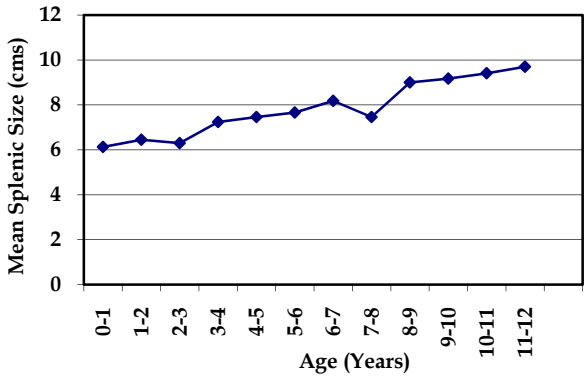

Figure 2: Mean of splenic size by age of normal spleen group

Figure 2 shows that as the age increases the splenic size increases in normal spleen group. So there is a strong positive relationship between the two variables. The correlation analysis also revealed that as the height increases the splenic size increases in normal spleen group. So there is a strong positive relationship between the two variables. Similarly the weight increases, the splenic size increases in normal spleen group which indicate a positive relationship between the two variables.

DISCUSSION

In the present study, p value is less than 0.001 for all - age with splenic size, splenic size with height, splenic size with weight. So it is significant. Although the spleen in general has common anatomical features, they widely differ in their measurement (according to age) in paediatric age group. Ultrasonography provides probably the most dependable information for assessing the splenic length because of its relatively established safe, quick and reliable method[7].

Very few studies have been done in the past including performance of a normogram analysis of the splenic size in childhood. They were either exclusively concerned with spleen or included more parenchymal organs[7].

While reviewing the past literature, as I have not come across any such study in Indian population, the present study entitled: "Ultrasonic measurement of normal splenic size in infants and children in Paediatric Indian Population" was aimed to evaluate splenic length with ultrasonography as a reliable and reproducible measurement.

In splenomegaly, the anterior border, anterior diaphragmatic surface and notched superior border may become clearly palpable below the left costal margin; the notches are often exaggerated and may be clearly palpable. The transverse colon and splenic flexure are displaced downward[3].

In individuals suffering chronic breakdown of erythrocytes, for example in malaria and other haemolytic diseases, the splenic tissues may be permanently hypertrophied and the spleen greatly enlarged (splenomegaly). These changes involve the distension of the reticular spaces of the red pulp with macrophages loaded with damaged red cells or their breakdown products, the proliferation of reticular cells, increase in macrophage numbers and hypertrophy of the fibrous framework[3].

In thalassemia major, there is extramedullary haemopoiesis, which leads to splenomegaly[6]. When there is venous congestion, for example in portal hypertension and other congestive diseases, there also occurs splenomegaly[6].

In the present study, the splenic length was measured ultrasonographically in 80 children of both sexes in 0-12 years in which the spleen was not affected.

Rosenberg Henrietta Kotlus et al 1991[12] used data from 230 healthy children of all ages and suggested upper limit guidelines for splenic length in 11 definite age groups without mention of somatometric factors. A roughly logarithmic correlation between the splenic length and age (r=0.7) was found. A good correlation was found between the splenic length and patient's height (r=0.73) and weight (r=0.78).

Stylianos D. Megremis et al 2004[7] used data from 512 healthy children (274 girls) with ages ranging from 1 day to 17 years. In their study, they have calculated mean and standard deviation in different age groups. They observed that the splenic length was highly correlated with age and all body parameters (height, weight and body surface area).

In the above study[7], the mean and standard deviation (SD) in different age groups are as follows:

In 0-1 year age group: Mean was 6.4 cm with SD 0.78 cm; In 1-2 year age group: Mean was 6.8 cm with SD 0.72 cm; In 2-4 year age group: Mean was 7.6 cm with SD 1.70 cm; In 4-6 year age group: Mean was 8.1 cm with SD 1.10 cm; In 6-8 year age group: Mean was 8.9 cm with SD 0.91 cm; In 8-10 year age group: Mean was 9 cm with SD 1.02 cm; In 10-12 year age group: Mean was 9.80 cm with SD 1.05 cm; So the results of both the studies are almost similar.

William K. Loftus et al 1998[14] sonographically measured both the splenic length and the kidney length in 256 healthy Chinese children and they compared the splenic lengths with the results of the study of Rosenberg Henrietta Kotlus et al 1991[12]. They have found that the splenic length in Chinese children upto the age of 15 years was similar to that of Western children. They have also suggested that splenomegaly should be suspected in children if the spleen is 1.25 times longer than the adjacent kidney. For this, they have calculated the median of splenic size in different age groups which is as follows:

In 0-1 year age group: 6.10 cm; In 1-2 years age group: 6.20 cm; In 2-4 years age group: 6.70 cm; In 4-6 years age group: 7.20 cm; In 6-8 years age group: 7.70 cm; In 8-10 years age group: 8.00 cm; In 10-12 years age group: 8.40 cm

Both the values i.e. mean and standard deviation are measures of central values. In the present study, the mean is used as a central value and the standard deviation is also calculated. By comparing the median values of the above study[14] with mean and standard deviation of the present study, there is not much difference in these values as such. So both the results are almost similar.

Oznur L. Konus et al 1998[13] sonographically evaluated normal liver, spleen and kidney dimensions in 307 paediatric patients (169 girls and 138 boys). The relationships of the dimensions of these organs with sex, age, body height, weight, and body surface area were assessed. They have proposed that body height should be considered the best criteria to correlate with longitudinal dimensions of these organs.

In the present study, it is observed that it is the age which is the best criterion to correlate with

the splenic length (r=0.9) and not the body height.

In the present study, there is a strong correlation between the splenic size and age and other body parameters like height and weight i.e. as the age, height and weight of the child increases, the splenic size increases.

CONCLUSIONS

In the present study, there is a strong correlation between age and the splenic size i.e. as the age increases, the splenic size increases. There is also a strong correlation between height and the splenic size i.e. as the height increases, the splenic size increases. There is a partial correlation between weight and the splenic size i.e as the weight increases the splenic size increases.

P value is less than 0.001 for all - age with splenic size, splenic size with height, splenic size with weight. So it is significant.

In many disease conditions with splenomegaly, this study by sonographic measurement will help to diagnose the size of spleen in early phases. It will also help to differentiate the complicated disease conditions, where other investigations are not supportive. Particularly in children this ultrasonic measurement would be a blessing.

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