

SONOGRAPHIC MEASUREMENTS OF THE SPLEEN IN RELATION TO AGE; A PROSPECTIVE STUDY IN NORTH INDIAN ADULTS

N Arora, P.K Sharma*, A. Sahai*, R. Singh**

Department of Anatomy, Rama Medical College, Kanpur.

Department of Anatomy*, Department of Radiodiagnosis**,

CSM Medical University (erstwhile King George Medical University), Lucknow, India.

ABSTRACT

To establish the normal range of the splenic dimensions in North Indian adult population, we used ultrasonography to examine 160 subjects (80 males & 80 females) not known to have any condition likely to be associated with splenic enlargement. Splenic length was measured on longitudinal coronal image from dome to tip through the hilum. On tranverse coronal plane, measurement of the width of the spleen was made at the hilum, followed by thickness measurement taken in the longitudinal coronal plane at a point bisecting the line indicating length. The results show that the splenic length, width & thickness decreased with increase in age in both male and female. All the dimensions were greater in male than in female.

KEY WORDS: Sonography, Measurements, Spleen, Age.

INTRODUCTION

The spleen is an intra abdominal organ that is affected by several diseases. In a variety of clinical conditions the spleen enlarges, most often due to the reactive proliferation of the lymphocyte or reticuloendothelial cells. Splenomegaly is also present in the malignancies of the haematopoietic system such as lymphoma, condition related to the portal hypertension, disseminated tuberculosis, malaria, kala azar, cirrhosis, collagen storage diseases etc.

The estimation of the splenic size in vivo is often important in the diagnosis, treatment and prognosis of a variety of disorders. The precise measurements of the spleen by palpation is not reliable, since in some of the cases a normal sized spleen is palpable where as a non palpable spleen is not always normal sized. Images of the spleen can be obtained by a simple X ray (Schindler et.al.1976)¹ but it exposes the patient to the radiation which could be avoided further if there is a left upper quadrant mass, then it is more often not helpful to differentiate the visible soft tissue arising from the spleen or the adjacent organs. Radionuclide imaging is also used for estimating the splenic size but its accuracy depends upon the vascular integrity of the organ and it unduly exposes the patients to gamma radiations (Frank 1970)². Angiography is another method but it exposes the patients to the radiations and the allergic reactions of the dye and is

also invasive. Sulfur colloid and Scintigraphy (Roberts et.al.1976)³ can also be used for measuring the splenic size but these procedures are time consuming and have the potential hazard of the radiation. C.T. Scan and M.R.I. can also be used but they are very costly. Ultrasound has been found to be both accurate and reliable (Petzoldt et. al.1976)⁴

We measured the splenic length breadth and thickness in different age group of adult population of north India and compared these measurements with those found in other reports.

MATERIALS & METHODS

Before starting study, clearance from the institutional ethical committee was obtained. One hundred and sixty cases were taken for the present study. With the help of ultrasound the length, breadth and the thickness of the spleen were measured. The height of the patient was recorded with the help of the stadometer and weight was measured with the help of the weighing machine. To estimate the dimensions of the spleen, ultrasonography was done with a model LOGIQTM 200 ultrasound machine with a curvilinear 3.5-MHz trasducer.

An age and sex related random sample of 160 patients, including 80 men and 80 women from 20 to 60 years of age living in the eastern part of north India were drawn from the Department of Anatomy and the trauma centre of C S M Medical University, Lucknow. The patients selected for the study being evaluated sonographically for abdominal or pelvic problem unrelated to the spleen, most often because of U.T.I or abdominal pain. 2 cases of pregnancy and 5 cases of splenomegaly were excluded. The dimensions of a

Correspondence

Dr. N. Arora

Deptt. of Anatomy, Rama Medical College, Kanpur

E-mail address: drpksharma_50@yahoo.com

Telephone (landline) : 0522-2258814

(mobile): 09415004139 Fax: 05222258852

number of spleens in which abdominal gas prevented reliable size measurements were excluded. All measured spleen had a normal position, shape and normal texture.

The patients were examined for splenomegaly. After confirming it by physical examination, the patients were taken for study. For ultrasound examination of spleen, first the patients were placed in supine position and coupling gel was applied on abdominal wall in the left hypochondric region in order to assure optimal transmission of energy between the patient and the probe. The subject did not need prior preparation. Now the subject was asked to lie in the right lateral position with the left side elevated. Splenic measurements were taken during deep inspiration, to minimize masking by the lung. Splenic length was measured on longitudinal coronal image from dome to tip through the hilum (Fig I). On tranverse coronal plane, measurement of the width of the spleen was made at the hilum (Fig II), followed by thickness measurement taken in the longitudinal coronal plane at a point bisecting the line indicating length (Fig III). To determine reproducibility, each measurement was repeated at least 3 times and most repeated value was recorded.

RESULTS

The splenic length, width and thickness were measured with respect to the sex and age with the help of ultrasound. The following observations were recorded.

It was observed that the mean splenic length in male in the first age group i.e. 21-30 yrs was 107.24 ± 13.18 mm, in the second age group i.e. 31-40 yrs was 103.50 ± 10.12 mm, in the third age group i.e. 41-50 yrs was 100.23 ± 14.11mm and in the fourth age group i.e. 51-60 yrs was observed to be 87.85 ± 12.15 mm.

(Table -1)

In female, the mean splenic length in the first age group i.e. 21-30 yrs was 97.09 ± 16.16 mm, in the second age group i.e. 31-40 yrs was 94.69 ± 13.67 mm, in the third age group i.e. 41-50 yrs was 92.88 ± 12.77 mm and in the fourth age group i.e. 51-60 yrs was observed to be 85.06 ± 10.09 mm. (Table-2)

Our result shows that in both male and female, the splenic length decreased at a slow rate up to the age of 50 years after which it decreased rapidly. The splenic length was greater in males than in females in the each age group.

It was observed that the mean splenic thickness in male in the first age group i.e. 21-30 yrs was 39.60 ± 7.51 mm, in the second age group i.e. 31-40 yrs was 38.79 ± 5.30 mm, in the third age group i.e. 41-50 yrs was 38.93 ± 5.50 mm and in the fourth age group i.e. 51-60 yrs was observed to be 34.41 ± 6.47 mm. (Table -3)

In female, the mean splenic thickness in the first age group i.e. 21-30 yrs was 35.45 ± 7.50 mm, in the second age group i.e. 31-40 yrs was 34.37 ± 6.77 mm, in the third age group i.e. 41-50 yrs was 34.87 ± 5.60 mm, and in the fourth age group i.e. 51-60 yrs was

Age	N	Mean(mm)+S.D	Range (mm)	F Ratio
21-30 yrs	20	107.24 ± 13.18	85.6-132	F=9.096 P=3.23X 10 ⁻⁵ (p<0.001)
31-40 yrs	20	103.50 ± 10.12	87-128	
41-50 yrs	20	100.23 ± 14.11	74.8-121	
51-60 yrs	20	87.85 ± 12.15	70-120	

Table 1 Splenic length in different age groups in males

Age	N	Mean (mm) +S.D	Range (mm)	F Ratio
21-30 yrs	20	97.09 ± 16.16	73.80-123.3	F=3.042 P=0.034(p<0.05)
31-40 yrs	20	94.69 ± 13.67	73.20-122.0	
41-50 yrs	20	92.88 ± 12.77	74.80-121.0	
51-60 yrs	20	85.06 ± 10.09	65.40-108.60	

Table 2 - Splenic length in different age groups in females

Age	N	Mean (mm) +S.D	Range (mm)	F Ratio
21-30 yrs	20	39.60 ± 7.51	31-62	F=2.88 P<0.05
31-40 yrs	20	38.79 ± 5.30	32-53	
41-50 yrs	20	38.93 ± 5.50	29-49	
51-60 yrs	20	34.41 ± 6.47	27-58	

Table 3 - Splenic thickness in different age groups in males

Age	N	Mean (mm) +S.D	Range (mm)	F Ratio
21-30 yrs	20	35.45 ± 7.50	22.3-51.80	F=2.74 P<0.05
31-40 yrs	20	34.37 ± 6.77	24.70-51.30	
41-50 yrs	20	34.87 ± 5.60	27.50-52.30	
51-60 yrs	20	30.90 ± 5.58	23.0-48.40	

Table 4 - Splenic thickness in different age groups in females

Age	N	Mean(mm)+S.D	Range(mm)	F Ratio
21-30 yrs	20	55.07 ± 10.97	42.2-74.8	F=7.33 P=2.21x10 ⁻⁴ (P<0.001)
31-40 yrs	20	46.53 ± 6.77	34.0-59.9	
41-50 yrs	20	49.00 ± 18.80	53-68.2	
51-60 yrs	20	42.64 ± 7.26	31.3-62.3	

Table 5 - Splenic width in different age groups in males

Age	N	Mean(mm) +S.D	Range (mm)	F Ratio
21-30 yrs	20	47.27 ± 13.05	34.20-83.80	F=2.70 P<0.05
31-40 yrs	20	43.09 ± 8.33	32.30-59.0	
41-50 yrs	20	44.54 ± 11.46	31.40-69.80	
51-60 yrs	20	38.65 ± 6.90	31.0-54.70	

Table 6 - Splenic width in different age groups in females

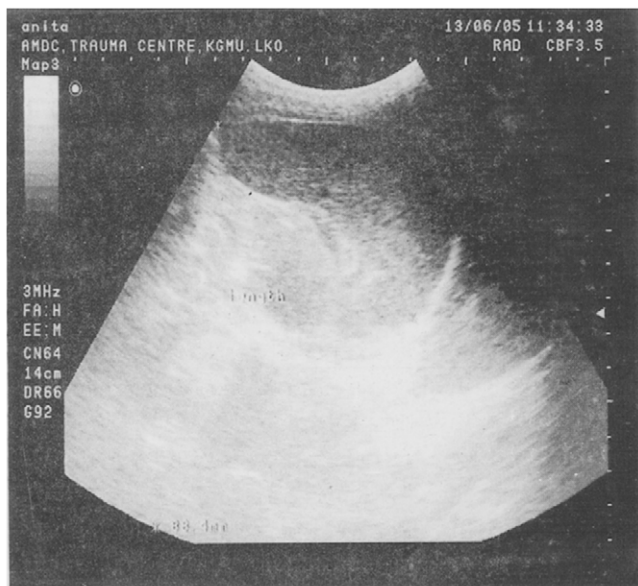


Fig I: showing measurement of length of spleen

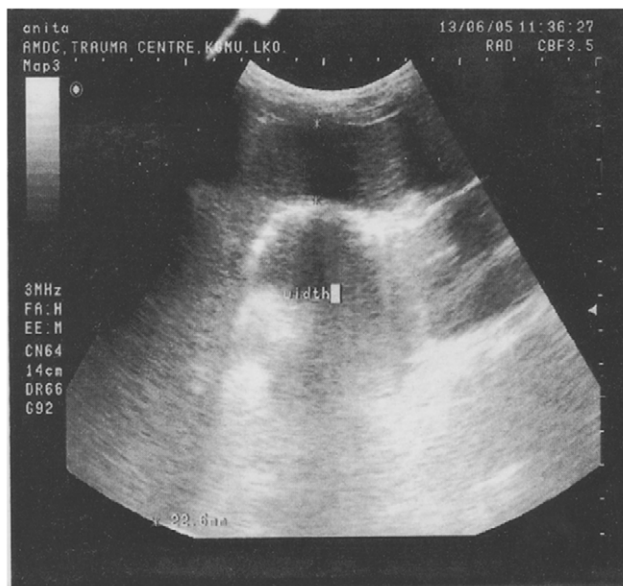


Fig II: showing measurement of width of spleen

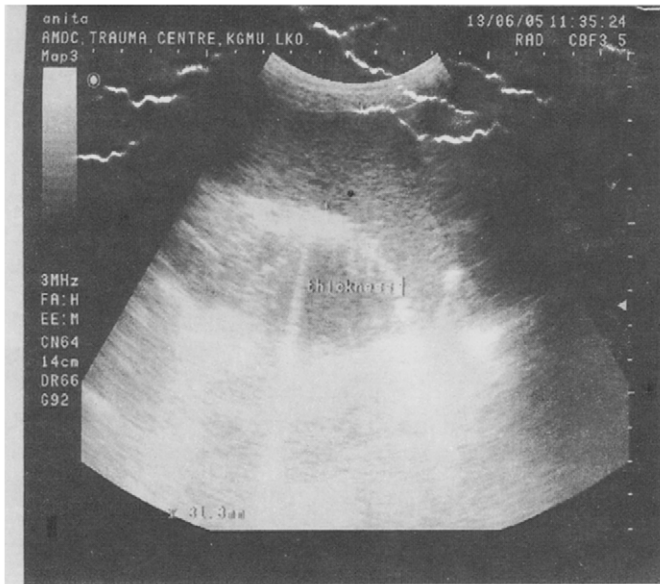


Fig III: showing measurement of thickness of spleen

observed to be 30.90 ± 5.58 mm. (Table -4)
 Our results show that in both male and female splenic thickness was constant up to the age of 50 yrs, after which there was a fall in the splenic thickness. The splenic thickness in the males was greater than the females at each age group.

In case of the mean splenic width in male in the first age group i.e. 21-30 yrs was 55.07 ± 10.97 mm, in the second age group i.e. 31-40 yrs was 46.53 ± 6.77 mm, in the third age group i.e. 41-50 yrs was 49.0 ± 18.80 mm, and in the fourth age group i.e. 51-60 yrs was observed to be 42.64 ± 7.26 mm. (Table -5)

In females the mean splenic width in the age group 21-30 yrs was 47.27 ± 13.05 mm, in the age group 31-40 yrs was 43.09 ± 8.33 , in the age group 41-50 yrs was 44.54 ± 11.46 mm, and in the age group 51-60 yrs was observed to be 38.65 ± 6.90 mm. (Table -6)

Our results show that in both males and females, the splenic width decreases with age up to 30 yrs, after 30 yrs it remained relatively constant up to the age of 50 yrs and after that the splenic width decreased. The splenic width in males was greater than females at each age group.

DISCUSSION

The splenic size may give information about the diagnosis and course of the gastrointestinal and hematologic disease (Niederlau.et.al.1983)⁵

In one study the splenic size was evaluated in patients with sarcoidosis and thrombocytosis, the splenomegaly was present in 57% of the patients (using sonographic criteria to evaluate the size), but only clinically palpable in 8% of the cases

(Kataoka.et.al.1990)⁶. Therefore the imaging has become essential for the accurate measurement of the splenic size, the serial monitoring of the splenic size over the course of the patient's illness and development of the guidelines for return to play. Several prior studies have sought to develop the standards for the splenic size such as C.T. Scan, Scintigraphy, M.R.I and Sonography. The conventional sonography was found to be a well established, widely used and relatively inexpensive means of assessing the splenic size without ionizing radiation. In the present study, it was observed that the splenic length decreased with age in both males and females. The splenic length decreased at a slow rate up to the age of 50 years after which it decreased rapidly. This was similar to the findings of Loftus and Metreweli 1997⁷. They observed rapid growth in the splenic length up to the age of 20 years followed by a mild decrease up to the age of 50 years and then rapid fall after the age of 50 years.

In the present study, it was revealed that the splenic length of males was found to be 0.2 cm longer than the splenic length of the females. This was different to the findings of the Loftus and Metreweli 1997⁷. They observed that the splenic length of the males was 0.5 cm longer than the splenic length of the females. Perhaps this may be due to the difference in height, weight, surface area and the genetic factors. In the present study, it was observed that the splenic length was found to be less than 11 cm in most of the subjects. This was similar to the findings of Frank et.al.1986⁹.

Rosenberg et. al. 1991⁸ demonstrated that the upper normal limit of the splenic length was observed to be 12 cm for girls of 15 years or more and 13 cm for boys of 15 years or older. These findings were slightly different from the findings of the present study. This difference may be due to the genetic factors, nutritional factors or the environmental factors.

Niederlau et. al. 1983⁵ demonstrated that the mean longitudinal diameter of the spleen was found to be $5.8 + 1.8$ cm and transverse diameter $5.5 + 1.4$ cm. These dimensions were much smaller than those of present study because the authors did not measure the maximum length of the spleen.

In the present study the splenic width and thickness were observed to be less than 6 cm and 4 cm respectively in most of the subjects. This was different from the findings of Frank et.al.1986⁹, who observed the splenic width below 7 cm and thickness below 5 cm in most of the subjects.

CONCLUSION

In the present study an attempt has been made to determine the normal range of the length, width and thickness of the spleen and to correlate these dimensions with the age in male and female subjects. The dimensions of the spleen measured with the help of the ultrasound in eighty(80) males and eighty (80) female subjects.

On the basis of the above study, the following conclusions were drawn.

- The splenic length decreased with increase in age in both male and female.
- The splenic width decreased with increase in age in both male and female.
- The splenic thickness decreased with increase in age in both male and female.
- All dimensions were greater in male than in female.

REFERENCES

1. Schindler G, Longin F, Helmschrott M. The individual limit of normal spleen size in routine x-ray film. *Radiologe* 1976; 16 (4):166-71.
2. Frank H, Deland. Normal Spleen Size. *Radiology* 1970; 589-2.
3. Roberts JG, Wisbey ML, Newcombe RG, Leach KG, Baum M. Prediction of human spleen size by computer analysis of splenic scintigrams. *Br J radio* 1976; 49 (578): 151-5.
4. Petzoldt R, Lutz H, Ehler R, Neidhardt B. Determination of splenic size by ultrasonic scanning *Med Klin.* 1976; 26.71 (48): 2113-6.
5. Niederau C, Sonnenberg A, Muller JE, Erckenbrecht JF, Scholten T, Fritsch WP. Sonographic measurements of the normal liver, spleen, pancreas and portal vein. *Radiology* 1983; 149(2): 537-40.
6. Kataoka M, Nataka Y, Maeda T et. al. Ultrasonographic analysis of splenomegaly in patients with sarcoidosis (in japanese). *Nihon Kyobu Shikkan Gakkai Zasshi* 1990; 28: 750-5.
7. Loftus WK, Metreweli C, Normal splenic size in a Chinese population *J Ultrasound Med .* 1997; 16(5): 345-7.
8. Rosenberg HK, Markowitz RI, Kolberg H, Park C, Hubbard A, Bellah RD. Normal splenic size in infants and children: sonographic measurements. *Am J roentgenol* 1991; 157 (1): 119-21.
9. Frank K, Linhart P, Kortsik C, Wohlenberg H. Sonographic determination of the spleen size: normal dimensions in adults with a healthy spleen. *Ultraschall Med.* 1986; 7(3): 134-7.