



Original Article

Evaluation of Normal Spleen Volume using Ultrasonography

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ABSTRACT

The largest organ in the abdomen is the spleen, also called the lymphoid organ. Its major function is to purify the blood and provide immunity. **Objective:** To evaluate and measure normal splenic volume on ultrasound. **Methods:** A cross-sectional study was conducted at the radiology department of Gujranwala, Pakistan. A sample size of 150 participants was taken from previously published articles from January 2022 to March 2022. The sample size was taken with the inclusion of normal healthy adults and exclusion of splenomegaly after informed consent. TOSHIBA ultrasound equipment was used with a convex transducer having a frequency of 3.5MHz. The data was entered and analyzed using SPSS version 22. **Results:** The results show that most participants were between the age of 30 to 39years 55(36.7%). The female participants 94(62.7%) were more than the males 56(37.3%). The length, width, and thickness of the spleen are shown in the tables respectively. The splenic volume seems to be 174cm³ in most participants. **Conclusion:** Ultrasound is the most accurate, cheap, portable, and easily available modality for measuring spleen volume, which can be measured by using different approaches.

INTRODUCTION

One of the largest organs in the abdomen is the spleen, also called the lymphoid organ [1, 2]. It is located in the left hypochondriac region, between the left kidney and hemidiaphragm. It is a soft, purple, triangular/circular, and friable organ with very smooth surfaces. Spleen varies in size from person to person. Normally, its length is 12cm, width is 7cm and thickness is about 5cm. The weight of the spleen is approximately 150grams [3, 4]. About 100% population has a length of kidney below 12cm which ranges 7-11cm. The size of the spleen decreases as age increases while there is no effect of the weight and gender on spleen size [5, 6]. Spleen is an important organ in the human body that protects against bacteria, fungi, and some other blood-borne pathogens. Spleen is generally composed of two parts, the white pulp includes three areas named per

arteriolar lymphoid sheaths, lymph follicles, and marginal zone which contribute 25% of the spleen. On the other hand, red pulp helps to form cords and sinus of the spleen with help of lymphocytes, contributing 75% to the spleen. Two major functions of the spleen are providing immunity and purifying blood [7, 8]. Spleen filters almost 150ml of blood/minute. Spleen is supplied by surrounding collaterals of different organs and the splenic artery [9, 10]. Some variations are also common in the spleen. These variations are named as, poly-splenia, hyposplenia, lobulated spleen, accessory spleen, accessory nodules of the spleen, etc [11]. Accessory spleen also called the supra-numerary spleen or splenule is a condition in which a splenic tissue, separated from the spleen is noted outside the normal The accessory spleen is noted in 10%-40% of the total

population [12, 13]. In polysplenia, multiple, small parts of accessory spleens are attached with a normal, full-sized spleen [14]. Some other conditions including trauma, splenomegaly, focal lesions in the spleen, infarction, tumors, and congenital abnormalities are also common pathologies of the spleen in the human body [15, 16]. The volume of the spleen can be measured by using many techniques including radiography, CT, MRI, scintigraphy, and ultrasonography [17]. Ultrasound is one of the most common modalities used to measure splenic index. Ultrasound use sound waves that are non-ionizing radiations and a convex probe of 3.5MHz. It is a safe, noninvasive, cheap, easily available, and fast modality for diagnosing spleen pathologies. The volume of the spleen can be measured by using a formula, written as (length × width × depth × 0.523), called splenic index. The volume of the spleen can be measured in two ways. One is by length which is taken in the longitudinal plane and the other is width taken in the transverse plane [18, 19]. Moreover, in emergency conditions, ultrasound is the first-line tool to assess splenic rupture and other conditions [20, 21]. One unique modality of ultrasound called Color Doppler can also be used to assess vasculature abnormalities of the spleen [22,23]. One technique used to visualize crescent shape spleen is to use the left kidney as a window. The probe is placed on the left midline of the patient and the left kidney is detected, appearing oval. An anechoic area seen on greyscale ultrasonography shows the vessels of the spleen having an echoic thin capsule [24,25]. Ultrasound is the most accurate, cheap, portable, and easily available modality for measuring spleen volume which can be measured by using different approaches. People can undergo this easily as it is not expensive.

METHODS

A cross-sectional study was conducted at the radiology department of Gujranwala, Pakistan. A sample size of 150 participants for 3 months from January 2022 to March 2022 was taken from previously published article with the inclusion of normal healthy adults and exclusion of splenomegaly. Data were collected from the participants after informed consent. TOSHIBA was used with a convex transducer having a frequency of 3.5MHz. The data were analyzed using SPSS version 22.0. Data were entered and analyzed using SPSS version 7 via tables and bar charts.

RESULTS

A total number of 150 participants with the inclusion of normal healthy adults and exclusion of splenomegaly were taken in the study. Table 1 shows the age of participants categorized into subgroup as 20-29 41(27.3%), 30-39 55(36.7%), 40-49 33(22%) and lastly 50-59 21(14%). The highest frequency of age groups was between 30 to

39years 55(36.7%).

| Age Of Participants | | | | |
|---------------------|-----------|---------|---------------|--------------------|
| | Frequency | Percent | Valid Percent | Cumulative Percent |
| 20-29 | 41 | 27.3 | 27.3 | 27.3 |
| 30-39 | 55 | 36.7 | 36.7 | 64.0 |
| 40-49 | 33 | 22.0 | 22.0 | 86.0 |
| 50-59 | 21 | 14.0 | 14.0 | 100.0 |
| Total | 150 | 100.0 | 100.0 | |

Table 1: Age of Participants

Table 2 shows the gender of participants in which 56 (37.3%) are male and 94 (62.7%) are female.

| Gender of Patients | | | | |
|--------------------|-----------|---------|---------------|--------------------|
| | Frequency | Percent | Valid Percent | Cumulative Percent |
| Female | 94 | 62.7 | 62.7 | 62.7 |
| Male | 56 | 37.3 | 37.3 | 100.0 |
| Total | 150 | 100.0 | 100.0 | |

Table 2: Gender of Participants

Table 3 shows the length of the spleen in all participants ranging from 7cm to 12cm. Most of the participants were having spleen length of 12cm 62(41.3%), followed by 11cm 48(32%), 9cm 22(14.7%), and 8cm 18(12%). Most common spleen width was noted to be 7cm 72(48%), followed by 6.4cm 56(37.3%), and 6.9cm 22 (14.7%). The highest thickness was 5cm 100(66.7%). Out of 150 participants, 64(42.7%) were having a splenic volume of 174cm³, Table 3.

| Gender of Patients | | | |
|---------------------|-----------|---------|-------|
| Parameter | Frequency | Percent | |
| Length of Spleen | 12cm | 62 | 41.3 |
| | 11cm | 48 | 32.0 |
| | 8cm | 18 | 12.0 |
| | 9cm | 22 | 14.7 |
| | Total | 150 | 100.0 |
| Width Of Spleen | 7cm | 72 | 48.0 |
| | 6.4cm | 56 | 37.3 |
| | 6.9cm | 22 | 14.7 |
| | Total | 150 | 100.0 |
| Thickness Of Spleen | 5cm | 100 | 66.7 |
| | 3cm | 18 | 12.0 |
| | 3.9cm | 32 | 21.3 |
| | Total | 150 | 100.0 |
| Volume Of Spleen | 155 | 27 | 18.0 |
| | 153 | 32 | 21.3 |
| | 147 | 27 | 18.0 |
| | 174 | 64 | 42.7 |
| | Total | 150 | 100.0 |

Table 3: Parameters of Spleen among participants

DISCUSSION

Ultrasound is one of the most common modalities used to measure splenic index. Ultrasound use sound waves that are non-ionizing radiations and a convex probe of 3.5MHz. It is a safe, noninvasive, cheap, easily available, and fast modality for diagnosing spleen pathologies. A sample size of 150 participants was taken. One of the most common, cheap, easily available tools for measuring splenic volume is ultrasound. Ultrasound contains non-ionizing radiations that are not harmful to the patients. It is a noninvasive,

portable, less expensive, and easily affordable modality [21]. The current study proves that the splenic index is an accurate method for measuring splenic volume. Splenic index (SI) is the product of transverse width and the longitudinal length of the spleen which is measured in the cross sectional view of the image on ultrasound. Even with normal measurement, splenomegaly, abnormal vasculature, etc. can also be detected on ultrasonography. A study was done by Hiromi Ishibashi also has similar findings in which length, and width of the spleen was used to take the volume of the spleen [23]. In the current study, the splenic volume of all participants is calculated using the formula length x width x thickness x 0.524. This formula is best for calculating splenic volume accurately. Similar results were found by Çeliktas, M. in 2015. A study conducted by Stylianos D. Megremis in 2004 also concluded that ultrasound is useful tool for measuring splenic length, width, a thickness that can be calculated using the formula from which splenic volume can be measured accurately. In a previous study, one hundred and fifty participants with normal spleen were taken to rule out the accuracy of the formula [6].

CONCLUSION

Ultrasound is the most accurate, cheap, portable, and easily available modality for measuring spleen volume which can be measured by using different approaches. People can undergo this easily as it is not expensive.

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