Ultrasound Evaluation Of Normal Liver Size And Factors Affecting It Among Adults In Northeastern Nigeria

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ABSTRACT

Background: A large number of pathologic entities can affect the sizes of the liver, and clinical examination is far from accurate to detect small increases in size. A previous study had observed that the liver size is lower in Zimbabweans compared to Germans due to endemic tropical diseases. This study was carried out in adults to find out if the 'smaller size' would also be documented among a Nigerian population.

Methodology: The size of the liver was measured using ultrasound scanning machine fitted with 3.5MHz transducer in adults aged between 18 and 66 years. This prospective study was conducted in 106 females and 92 males with normal liver sonographic findings. The sagittal and transverse diameters were measured and related to age, sex, weight and height of the subjects.

Results: The overall mean and standard deviation (SD) of the liver size in sagittal and transverse planes were 9.35 cm (± 1.66) and 13.73 cm (± 0.19) respectively. The sagittal liver span in the mid-clavicular line was smaller among Nigerians when compared with the previous studies among Caucasians and Turkish indigenes. A significant statistical difference ($p<0.05$) was observed in the transverse liver span between male and female subjects, however, no significant statistical difference was observed in the sagittal dimension. The age, body weight and height showed a weak positive correlation with the sagittal and transverse liver dimensions. Among these factors, age showed the strongest correlation with the sagittal liver dimension and weight with the transverse liver dimensions.

Conclusion: The sagittal liver span in the mid-clavicular line from this study was smaller than values documented from the previous studies on Caucasians and Turkish indigenes. Subject age showed the strongest positive correlation with the sagittal liver sizes and weight with the transverse liver size.

INTRODUCTION

A large number of pathologic entities especially tropical diseases that are endemic in our society can affect the liver size. These tropical diseases include Schistosomiasis, amaebiasis, tuberculosis, hydatid liver disease, malaria, etc. The chronic form of these diseases especially Schistosomiasis has been known to cause periportal fibrosis leading to reduction in liver size[1]. A previous study had observed that the liver size is lower in Zimbabweans compared to Germans and Schistosomiasis was implicated[2]. Nigeria is a Schistosoma endemic region, more so, the northeastern zone[3].

The bedside physical examination of the liver is far from accurate to detect small increases in size and does not provide accurate any information regarding the actual size of the organ[4]. Its major role remains to define the characteristic of the lower edge, mainly consistency, which may help in clinical diagnosis. Liver size has been proved to predict prognosis, but its measurement needs quantitative, reproducible methods, which can be obtained only by imaging techniques[4]. It is very important to have a set of standard normal measurements of the size of the liver showing the upper and the lower limits[5]. This information would serve as a source of valuable reference to clinicians managing patients with liver or liver related diseases. It will enormously assist in avoiding diagnosis of small liver or hepatomegaly by using Caucasians reference points, as currently there is no previous study in the sub region on this aspect of the liver. The sizes can also be related to other parameters such as age, sex, height and weight.

Ultrasound is an extremely important imaging method in the evaluation of liver size due to the fact that; it is easy to use, provides real time images, does not require anaesthesia and does not utilize ionizing radiation[5]. The cheaper cost of imaging of this organ with ultrasonography compared with Computed Tomography (CT) and Magnetic Resonance Images (MRI) makes it the preferred modality of imaging[6]. Additionally, Bartoon et al, recommended the use of real-time ultrasound for teaching physical examination of the liver and it improves medical student's accuracy in measuring liver size clinically[7].

Ultrasound determination of the liver size is commonly done in sagittal and transverse planes using a transducer. The normal size of the liver obtained using this method in most studies is 9.4-21.3cm in sagittal mid-clavicular plane[9,10,11] and 13cm in transverse plane[9]. Alternatively the volume of the liver may be measured, but our machine has no software for volumetric assessment of the liver size.

This study was conducted to establish normal liver size among adults in northeastern, Nigeria a Schistosomiasis endemic area, compare it with previous studies and relate it to sex, age, height, and weight.

MATERIALS AND METHODS

This was a prospective study undertaken at the Department of Radiology, University of Maiduguri Teaching Hospital between August, 2004 and September, 2005. One hundred and ninety eight subjects who had normal liver scan in the aforementioned period were included in this study. All ultrasound scans that show liver abnormality were excluded from the study.

The biodata including the name, age, sex, height and weight of all the subjects were recorded after obtaining informed consent from them.

Sonographic measurement of the liver size was carried out using Pie Medical 250 ultrasound machine with 3.5MHz sector transducer. The patients were placed in supine position on an examination couch and ultrasound gel was applied to the right upper quadrant of the abdomen for the examination of the liver. Ultrasound estimation of size was made by measuring the sagittal diameter (length) of the right lobe of the liver in the mid-clavicular line. The measurement was done using an electronic digital caliper from the diaphragm to the most inferior border of the liver (line AB in Fig.1). Taking oblique measurements were avoided. The maximum transverse dimension of the liver was measured on transverse scan (line CD in Fig.2).

The data was collected and collated. It was entered into a computer and analyzed using SPSS for windows (Chicago Illinois) and presented in form of tables.

RESULTS

From this study, both the males and females have age range from 18- 66 years with a mean (±SD) of 32.21± 11.73 years. Their height and weight ranged from 1.42 1.85m and 42 - 120kg with total means of 1.66 ± 0.08m and 65.94± 14.35kg, respectively (table 1).

For the sagittal liver span, the range in males was 7.0 - 14.2cm and 4.9cm - 13.6cm for females. The mean was 9.61± 1.70cm and 9.20 ± 1.63cm for males and females respectively. There is no statistical significant difference ($p>0.05$) in the sagittal diameter between males and females (table 2).

The range of the transverse liver span in males was 9.6 -20.3 cm compared to that of females which was 10.2 - 17.7cm. The mean was 14.37 ±2.20 for males while that of females was 13.36±1.71cm. There was a statistical significant difference ($p<0.05$) in transverse liver span between males and females (table 2).

The sagittal liver span showed very weak positive correlation with age ($r=0.27$), weight ($r=0.23$), and height ($r=0.20$). Similarly, the transverse liver span showed very weak positive correlation with age ($r=0.31$), weight ($r=0.33$), and height ($r=0.29$) (table 3). A statistical significant difference ($p<0.05$) was found between the transverse and sagittal liver dimensions.

Fig.1 Sagittal ultrasound image of the liver through the mid-clavicular line showing the sagittal length of the right lobe of the liver (AB).

Fig.2 Ultrasound image of the widest transverse diameter of the liver (CD).

Table 1: The mean and range of the age, weight, height, sagittal liver span and transverse liver span in all the patients studied.

PARAMETERS	FREQUENCY	RANGE	MEAN(±SD)
Age (years)	198	18-65	32.21±11.73
Weight (Kg)	198	42-120	65.94±14.35
Height (m)	198	1.42-1.85	1.66±0.08
Sagittal liver span (cm)	198	4.9-14.2	9.35±1.66
Transverse liver span (cm)	198	9.96-20.3	13.73±1.94

Table 2: The sagittal and transverse liver spans in male and female patients studied.

SEX	FREQUENCY	LIVER DIMENSION(cm)	MEAN (cm)	STANDARD DEVIATION	STANDARD ERROR	RANGE
		Sagittal	9.20	1.63	0.20	4.9-13.6
Female	106	Transverse	13.36	1.71	0.21	10.2-17.7
		Sagittal	9.61	1.70	0.28	7.0-14.2
Male	92	Transverse	14.37	2.20	0.37	9.6-20.3
		Sagittal	9.35	1.66	0.17	4.9-14.2
Total	198	Transverse	13.73	0.19	0.20	9.6-20.3

Table 3. The correlation between the sagittal and transverse liver spans with age, weight and height.

LIVER DIMENSIONS	AGE (Years)	WEIGHT (Kg)	HEIGHT (m)
Sagittal liver span	0.27	0.23	0.20
Transverse liver span	0.31	0.33	0.29

DISCUSSION

The liver begins to develop early in the fourth week of fetal life and fills most of the abdomen by the 9th week. It accounts for; 10% of the fetal weight, 5% of the total weight at term and 2.5% of the total weight in the adult. Despite this, the liver is the largest single organ in the body[10].

The normal adult liver volume is 1500cc in males and 1300cc in females[8]. This is best measured using CT or MRI. Liver volume measurement using ultrasound is technically difficult[8]. The most practicable and easy method for routine use in the sonographic measurement of sagittal liver size is taking the measurement at the mid-clavicular line[11]. This was the method adopted in our study. Most of the previous studies have shown the sagittal liver span range between 9.4cm-21.3cm in adults with a mean of 11cm-15cm[8,9,10]. The range of sagittal liver span in our study is 7.0 - 14.2cm and 4.9cm - 13.6cm and a mean of 9.61± 1.70cm and 9.20 ± 1.63cm in males and females respectively. Our values are on the lower side compared with the above studies. A previous study[2] showed that German children had larger liver sizes than Zimbabwean childre n. Many tropical diseases, especially Schistosomiasis has been shown to affect the liver size in endemic areas[1,2,12,13,14]. Maiduguri, the Capital of Borno state where this study was carried out has a Schistosomiasis prevalence of 37.92 %[3].

In a study carried out to determine the normal range of liver dimensions in adults in Turkey, the dimensions showed no statistically significant difference between liver sizes in males and females[5]. In our study, statistical significant differences ($p<0.05$) were observed in the transverse liver span sizes in males and females, however, no statistical significant difference was observed in the sagittal dimensions. In another study carried out in 144 Zimbabweans no statistical significant difference was observed in the liver sizes between males and females[2]. Our findings therefore are similar to these studies for the sagittal dimensions, but differ in the transverse dimensions. The liver is oriented longitudinally in slender people and transversely in heavy people; thus both sagittal and transverse diameters as done in our study need to be measured for liver size assessment, since the sagittal diameter alone will give too high or too low a value[15].

In the Turkey study, sagittal dimension of the liver showed the best correlation with age, body weight, and height, height being the strongest correlation of all[2]. Therefore, their study considered body height being the best parameter in relating with sagittal dimension of the liver[5,11]. A very weak positive correlation was observed in this study and the strongest correlation for sagittal liver size was age and for transverse liver size was weight. The strong positive correlation of the sagittal liver span with age, body weight and height observed in the Turkish study was low in the present study.

CONCLUSION

The liver is smaller in size among Nigerians resident in the Northeast when compared with previous studies among Caucasians and Turkish indigenes. The age, body weight and height show very weak positive correlation with the sagittal and transverse liver dimensions. Among these factors, the strongest correlation for sagittal liver size was age and for transverse liver size was weight.

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