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Assessment of Normal Liver Size among Adults by Ultrasonography in Kathmandu Medical College

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ABSTRACT

Introduction:

Ultrasonography is cheap, non-invasive, reliable, fast method of diagnostic investigation in the measurement of liver size. Normal range of liver size helps to diagnose hepatomegaly sonologically which may be clinically inapparent. Thus warrants further clinical evaluation and other investigations for the prevention of major hepatic comorbidities.

Methods:

A prospective, cross-sectional study was conducted on 400 adults with sonographic findings unrelated to liver pathologies. The liver was measured in right midclavicular line from hepatic dome to lower hepatic margin. The correlation between liver size and age, sex, weight, height, body mass index (BMI), and body surface area(BSA) was calculated. The data were properly analyzed in SPSS version 20 software.

Results:

Out of 400 patients, a male: female ratio of 1:1.25, and the age group was ranging from 20 years to 83 years with a mean age of 48.10±14.86 years were included. The mean liver length in males was 15.05 ± 0.27 cms, females were 14.32 ± 0.29 cms and the total population was 14.73 ±0.46 cms. There was a strong statistically significant correlation between liver size and height, weight whereas the correlation between liver span and BSA was moderate to weak but significant. Similarly, there was a weak but significant correlation between liver size and BMI with no significant association between liver size and age.

Conclusion:

Accurate assessment of liver size is of utmost importance in the evaluation of suspected hepatic pathologies.

Keywords:

Body Mass Index; Hepatomegaly; Reference Values; Ultrasonography

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INTRODUCTION

Adult liver size is clinically evaluated by palpating the lower border of the liver or by percussing the upper and lower edge of the liver. These clinical techniques are less reliable as there are chances of overestimation of liver size in case of pleural effusion, subdiaphragmatic pathologies, and underestimation due to tympanic note over right upper abdomen. A subtle increase in liver size can also be missed clinically. For detailed assessment, the clinician may need the help of radiological diagnostic investigation like ultrasonography. Ultrasonography is a real-time, rapid, noninvasive, inexpensive, convenient, and effective method of determining liver size.[1]

Portable bedside ultrasonography can be performed by the clinician which is presently becoming more and more fascinating as portable ultrasound are smaller in size and is easy to use. Though computed tomography is the most accurate over ultrasonography for the determination of liver size, there are certain merits of sonography like repetitive use as much as needed and it completely lacks radiation. Assessment of liver size helps in the diagnosis of underlying liver disease, its progression and helps in the management and treatment of pathologies. Accurate liver measurement is equally important in surgeries like liver transplantation, monitoring of post-surgical complications, and knowing the efficacy of treatment. Sonographically, the exact length of the liver to interpret as hepatomegaly varies from one radiologist to other. There are many causes of hepatomegaly likely infective pathologies, malignant processes, and anthropometric variations from a population of different ethnic and geographic origins.[2]

Our study aims to determine the adult reference range of normal liver size using readily available sonography.

METHODS

The prospective, cross-sectional study was conducted on 400 adults from January 2021 till April 2021. Sample size (N) was calculated by the formula $4 \times SD^2 / e^2$, where the pre-determined value of standard deviation is 0.89 which was referenced from a study done by researcher Mohamed Abdalla Eltahir[3] based on the frequency of distribution of liver length. Similarly the marginal error (e) was 10% of SD which was 10/100 x 0.89 = 0.089

$$\text{Thus, sample size } (n) = 4 \times SD^2 / e^2 = 4 \times (0.89)^2 / (0.089)^2 = 400$$

The adults who are older than 18 years were included. Similarly, adults who had a history of the hepatobiliary disease, myeloproliferative disease, cardiac disease, or other chronic diseases were excluded. USG evaluation was performed by Aplio 400 and Xario prime ultrasound Toshiba machine ultrasound machine using a real-time scanning system with 5.0 MHz frequency convex transducers. Liver span was measured in the right midclavicular line extending from the hepatic dome to the lower hepatic margin. The sonography was conducted during the breath-holding position at maximum inspiration in the supine and right lateral position with their right arm raised over their head. Detailed assessment of the liver parenchyma including its size, contour, echotexture, and echogenicity was carefully observed by scanning in fan-like motion of the probe at the intercostal and subcostal planes. Age, sex, height, the weight of the study population undergoing ultrasound were taken and then body mass index (BMI), body surface area (BSA) were calculated. We then studied whether liver size was correlated with various anthropometric measurements of the individuals. Mean ± standard deviation was taken for continuous data. Bivariate correlations were performed by using Pearson's correlation coefficient. Data with a value of $p<0.05$ were considered statistically significant. Data analysis was performed using SPSS version 20 software.

RESULTS

There were 223 males and 177 females out of 400 total individuals with a male: female ratio of 1:1.25. The age group was ranging from 20 years to 83 years with a mean age of 48.10±14.86 years. Age group distribution according to gender is illustrated in Figure 1.

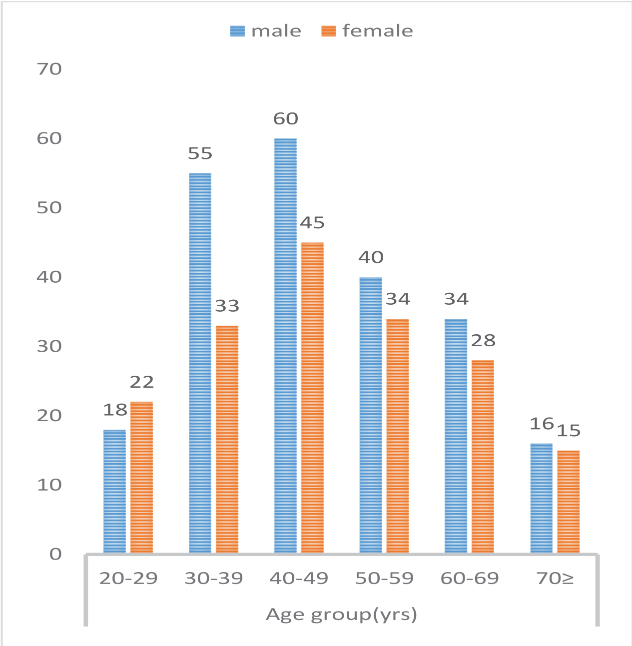

Figure 1: Distribution of age group

The mean liver length in males was 15.05 ± 0.27 cm, in females was 14.32 ± 0.29 cm and in the total population was 14.73 ±0.46 cm. The mean weight was 70± 3.6 kgs in the case of males and 59.15± 4.47 kgs in the case of females. Similarly, mean height was 168.18 ± 2.09 cms in males and 155.46 ± 11.95 cms in females.

313 individuals had normal weight (BMI between 18.5-24.9), 85 individuals who were overweight (BMI between 25 - 29.9), and obese(BMI above 30) which is better delineated in figure no 2. Mean BMI was 24.51 ± 1.57 and mean BSA was 1.70 ± 0.15 m^2 respectively.

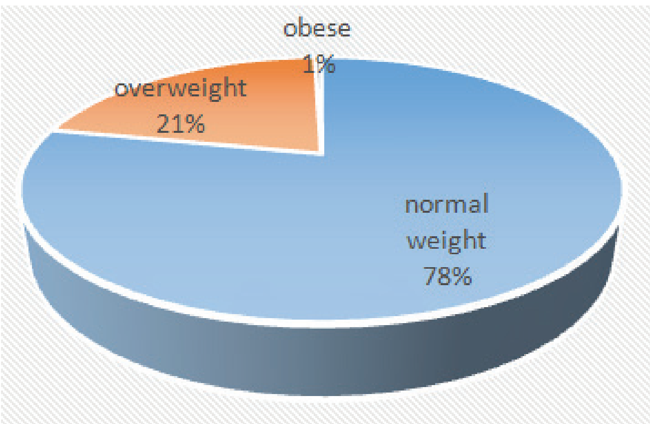

Figure 2: Pie diagram of weight status between individuals

In our study, there was no significant association between liver span and age in cases of the total study group and males (total study group: r= 0.032, p= 0.52, males: r= 0.071, p=0.29). Though the association between liver span and age was weak among females but significant (females, r=0.210, p=0.004). The correlation of liver span with various anthropometric variables was calculated as shown in Table 1.

Table 1: Bivariate correlation coefficient of variables with liver span

Variables	Liver span (all individuals)	Male	Female
Age			
r	0.032	0.071	0.210
p	0.52	0.291	0.004
Weight (kg)			
r	0.824	0.577	0.458
P	0.001	0.001	0.001
Height (cm)			
r	0.837	0.519	0.368
p	0.001	0.001	0.001
BMI			
r	0.316	0.280	0.281
p	0.001	0.001	0.001
BSA			
r	0.638	0.415	0.282
p	0.001	0.001	0.001

There was a significant correlation between liver span and weight in cases of the total study group(r=0.824, p=0.001) and moderate along with statistically significant correlation in cases of males and females (males: r=0.577, p=0.001, females: r=0.458, p=0.001). The correlation between liver span and height was strong and statistically significant in the total study group (r=0.837, p=0.001), moderate but significant correlation in cases of males and females (males: r=0.519, p=0.001, females: r=0.368, p=0.001). There was a weak but significant correlation between liver span and BMI in all three groups. (total study group: r=0.316, p=0.001, males: r=0.280,p=0.001, females: r=0.281, p=0.001). The correlation between liver span and BSA was moderate in total study groups and males whereas weak in cases of females but significant in all three groups. (total: r=0.638, p=0.001, males: r=0.415, p=0.001, females: r=0.282, p=0.001). Thus, we concluded that the statistically significant positive correlation was between liver span weight and height.

DISCUSSION

Liver span measurement in the right midclavicular line extending from the hepatic dome to the lower hepatic margin is the most frequently performed convenient measure of assessment of liver size in routine practice. Gosink and Leymaster documented a good correlation between longitudinal hepatic length (as measured by right MCL) and the actual liver size reported through an autopsy in one of their studies.[4] We also followed the same method while assessing liver size in our study.

The left lobe of the liver differs in size and extension in between a person and with age but measurement of the right lobe seems more consistent.[5] There was a significant correlation between the liver measurement at the midclavicular line with the body parameters rather than the liver measurement at the midsaggital plane which was proved by many studies.[6]

The mean liver size was 15.1 ± 1.5 cm in males, 14.9 ± 1.6 cm in females, and 15.0 ± 1.5 cm in the total population as reported by Patzak et al[7] whereas Kratzer et al[8] conducted a study in which the mean liver size was 130.9 ± 1.7 mm. Ozmen et al. reported the mean liver size among males was 150.04 ± 14.84 mm, 147.57 ± 18.32 mm among females, and 149.8 ± 16.73 mm in the whole study group.[9] In our study, the mean liver length was 15.05 ± 0.27 cm in males which was similar to Patzak et al. and Ozmen et al. whereas in the female the liver span was 14.32 ± 0.29 cm and of the total population was 14.73 ±0.46 cm which was litter lesser than Patzak et al.[7,9]

Our study reported that the liver span in the mid-clavicular line was less in the case of females than in males. Similar findings were compatible with the study conducted by Niederau C et al., Singh et al., and Emad et al.[6,10,11] On the contrary there was not any significant difference in organ sizes between the two sexes which was revealed by a study done by Christophe.[12]

In our study, there was no significant association between liver span and age in cases of the total study group and males(total study group: r= 0.032, p= 0.52, males: r= 0.071, p=0.29) but significant and weak association between liver span and age among females (females, r=0.210, p=0.004). Although, the association between liver size and age has controversial results in different studies. Patzak et al. documented that age has no association with liver size.[7] On the contrary, a positive correlation between ultrasonic liver span with the age of the adults was reported by Singh et al. and Kratzer et al.[8,10]

There was a significant correlation between liver span and weight in cases of the total study group(r=0.824, p=0.001) and moderate along with statistically significant correlation in cases of males and females (males: r=0.577, p=0.001, females: r=0.458, p=0.001) in our study. Similarly, a statistically significant correlation between liver size and weight was reported by Safak et al.[13] The weight was a major factor in the assessment of liver size was reported by Toukan and Al-Adli.[14]

In our study, the correlation between liver span and height was strong and statistically significant in the total study group(r=0.837, p=0.001), moderate but significant correlation in cases of males and females (males: r=0.519, p=0.001, females: r=0.368, p=0.001). Similarly, a statistically significant positive correlation was found between liver span and height in the studies done by Singh et al. in 1985, Niederau et al., Kratzer et al., and Emad et al.[6,8,10,11]

There was a weak but significant correlation between liver span and BMI in all three groups. (total study group: r=0.316, p=0.001, males: r=0.280,p=0.001, females: r=0.281, p=0.001) in our study. In a study by Singla et al, there was a negative correlation (r=-

0.226; p>0.025) of BMI with the ultrasonographic liver span.[15] On the contrary, Niederau et al. and Emad et al. conducted a study in which BMI was the most strongly correlated with liver size.[6,11]

Our study revealed that the correlation between liver span and BSA was moderate in total study groups and males whereas weak in cases of females but significant in all three groups (Total: r=0.638, p=0.001, males: r=0.415, p=0.001, females: r=0.282, p=0.001). There was an association between liver size and BSA in the studies done by Niederau et al. and Emad et al.[6,11]

Thus from our study, we concluded that various anthropometrical measurements affect the liver size, out of which weight and height were strongly correlated with liver span.

CONCLUSION

Liver span measurement differs from one study to other as liver span is affected by various factors. Thus our study can be a reference for the normal range of liver size, although our study group was selected from one particular geographical and ethnic origin. Exact assessment of liver size is of great value in the evaluation of suspected hepatic pathologies and follow-up sonography is relevant for detection of gradual change in liver size, liver echotexture, and finding individuals who may develop liver pathologies in the future. In our study, there was a statistically significant positive correlation between liver span with weight, height and a moderate to weak correlation with BSA and BMI. A higher level of studies is recommended for the inclusion of a larger group of the population from different geographical distributions.

CONFLICT OF INTEREST

None

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None

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