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Original Research Article

Normative data of liver size in Kashmiri adult population using ultra-sonography, India

Snobar Gul, Mohammad Saleem Itoo, Gousia Nisa*

Department of Anatomy, Government Medical College, Srinagar, Jammu and Kashmir, India

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***Correspondence:**
Dr. Gousia Nisa,
E-mail: dr.gousiamubashir@gmail.com

ABSTRACT

Background: A number of disorders are accompanied by altered size of various abdominal organs like liver including infective, infestation, infiltrative, immunological and malignant conditions. Medical imaging has played an important role in helping physicians for taking normal anatomical dimensions and establishing diagnosis. This study was carried out to determine the normal standards of liver size and its relationship with body weight, height and body mass index.
Methods: A cross sectional study was done in GMC Srinagar, Jammu and Kashmir, India for a period of 18 months. 300 staff members in the age group of 19 to 55 years took part in this study.
Results: The mean craniocaudal length of liver was 13.08±1.04cms. Authors found a significant correlation of liver size with body weight and body mass index.
Conclusions: Body weight and BMI are important determining factors for liver size. Nomograms from this study can be beneficial for diagnosing pathological enlargement or reduction of liver in Kashmiri ethnic population.

Keywords: BMI, Liver, Ultrasonography

INTRODUCTION

Studies have been carried out on dimensions of various abdominal organs, a work done in Germany by Kratzer W et al, demonstrated values for the liver and found that body mass index (BMI) and body height are the most important factors associated with the liver dimensions though age and sex also to a lesser degree influence the size of the liver.[1] Ultrasonography is an established, safe, fast and reliable method for measurement of liver, spleen and kidney sizes.[2-4] It is a relatively inexpensive, fast, non-invasive and radiation-free imaging modality. Nomograms of various abdominal organs are available for Indian population. There is an urge to develop specific ethnic population nomogram to provide a better accuracy of measurements of solid abdominal organs in terms of making a proper medical diagnosis and also during monitoring the disease progress.

In adults the liver weighs 2% of body mass. The liver has an overall wedge shape, which is in part determined by the form of the upper abdominal cavity into which it grows. The contour and shape of the liver vary according to the patient's habitus and lie.[5] Fatty liver is an acquired reversible disorder of metabolism, resulting in accumulation of triglycerides within the hepatocytes. Enlargement of lobe affected by fatty infiltration is evident. Hepatosplenomegaly is present and gallbladder wall is thickened in hepatitis. On sonography cirrhosis presents with hepatomegaly, increased echogenicity and slightly increased attenuation. The disease is associated with hepatic adenomas, focal nodular hyperplasia, and hepatomegaly. The liver is a large, pyramidal shaped organ and liver sectional anatomy may be best described, imaged and defined by using real time ultrasound imaging. Conventional real time ultrasound produces images of thin slices of the liver on the screen, and so it is essential that the operator scans the entire organ

systematically/ritually, in at least two anatomical planes, to be entirely convinced that the entire volume of the liver tissue and structures has been imaged. Many diseases can affect their size, ranging from infective processes to malignant disorders.

Since our currently used nomograms in Kashmir are based on the western database, it might lead to the false positive and false negative diagnosis of condition of these organs. This will be the first of such study to the best of our knowledge amongst the adults of Kashmiri ethnicity. The morphology of visceral organs varies from person to person. During the maturation process from infancy through adolescence, growth of solid visceral organs shows a high correlation with gains in height, weight, and body mass index.

METHODS

This study was conducted in the postgraduate department of anatomy in collaboration with department of radiodiagnosis and imaging of government medical college, Srinagar, Jammu and Kashmir, India for a period of eighteen months. This is an observational cross-sectional type of study which has been conducted on staff members of government medical college Srinagar and its associated hospitals. Informed and written consent was taken from all participants. They were also given right to withdraw from the study. A brief history and physical examination were taken to exclude various pathological conditions affecting the dimensions of liver. The subjects included in this study are all of Kashmiri ethnicity. Height was taken in centimeters (cm) and weight in kilogram (kg), and BMI was calculated. The height and weight of the subjects were recorded and the BMI (body mass index) of each subject was calculated by using following formula:

BMI= (Weight (kg))/(Height (m^2))

Ultrasonographic assessment of liver of all normal adult employees of both sexes were taken. The employees with skin infection at scanning area, any history of surgery around upper abdomen, known diabetics, people taking alcohol, any past history of abdominal trauma were excluded from the study. Subjects with focal lesion, nonuniform parenchyma, lympho-proliferative disorders such as lymphomas, leukemias, etc. were also excluded. Any employee with past history of malaria, typhoid fever, malnutrition, sickle cell disease, obesity and abnormal clinical examination of abdomen particularly presence of clinical signs of liver disease were excluded from study. Any employee with body weight more than 95 kg or less than 50kg has been excluded as she/he can have different orientation of the liver necessitating a report of further parameters for the determination of liver size. Pregnant employees were excluded from the study. The height and weight of all eligible subjects were recorded. The subjects were counselled about the abdominal ultrasonographic examination and results. The procedure was explained to all subjects in detail and written consent was taken from each subject. The ultrasonography scan of subjects was performed in ultrasonographic laboratory in the department of radiodiagonosis, government medical college, Srinagar, Jammu and Kashmir, India. Same radiologist performed USG scan every time to avoid any inter-observer variation. The Siemens Acusonx 300 ultrasonic diagnostic imaging systems with convex array 3.5MHz transducer was used for scanning. The liver was scanned in five views, four of the views were done with the patient lying on right lateral side and these views are the diaphragm-lung interface, the left liver lobe, sagittal plane and the transverse plane. The fifth view of the right lobe of the liver is from the left lateral side of the lying patient. The transducer was placed on the anterior abdominal wall after applying a lubricating gel at the right upper quadrant and the epigastric area. The liver was visualized as a homogeneous collection of echoes of moderate echogenicity. Longitudinal scan of the liver in the midclavicular line was obtained after asking the subject to take a deep breath and the craniocaudal (CCL) measured.

A total of 300 subjects were scanned and all the parameters recorded in excel sheet of Microsoft office. Descriptive statistics were applied on the available data. Mean±SD was presented for age, height, weight, BMI, craniocaudal length and transverse diameter of spleen. Data analysis was carried out using SPSS 20. Data comparison (statistical test of significance) was done with t-test and ANNOVA test. At 95% interval, two-tailed P-values less than or equal to 0.05 were considered to be statistically significant.

RESULTS

A total of 300 eligible subjects were included in the study, among them 168 were female subjects and 132 male subjects. The average age of the subjects was 34.4 years with range from 19-55 years with 41% between 19 to 30 years, 35.3% between 31 and 40 years and 23.7% between 41 and 55 years of age. The mean weight of present study group was 59.55kgs. The mean height was 161.15cms. The mean BMI was 22.96kg/m^2. Mean weight and mean height were more in males than females, but mean BMI was more in females. The average size was more in males than females, but the difference was not found to be significant (p valve >0.05). The mean craniocaudal length of liver was 13.08±1.04cms.

Table 1: Results of analysis comparing liver size with weight in males and females.

Correlation with body weight	Craniocaudal length of liver in males	Craniocaudal length of liver in females
r valve	0.403	0.393
p valve	<0.001	<0.001

The mean craniocaudal length of liver was 13.13±1.32cms in males and 13.22±1.34cms in females. The average size was more in females than males, but the difference was not significant (p valve=0.562). There was a significant correlation of craniocaudal length of liver with body weight (Table 1) and body mass index (BMI) (Table 2) in both males and females.

Table 2: Results of analysis comparing liver size with BMI in males and females.

Correlation with BMI	Craniocaudal length of liver in males	Craniocaudal length of liver in females
r valve	0.344	0.303
p valve	<0.001	<0.001

There was no significant correlation of craniocaudal length of liver with body height (Table 3).

Table 3: Results of analysis comparing liver size with body height in males and females.

Correlation of with body height	Craniocaudal length of liver in males	Craniocaudal length of liver in females
r valve	0.154	0.088
p valve	0.077	0.255

DISCUSSION

Ultrasound imaging also known as ultrasound scanning or sonography is based on the principle of piezoelectric effect. It is a relatively inexpensive, fast, non-invasive and radiation-free imaging modality. Its portability and simplicity are the characteristics that made it become indispensable modality over other modalities. Sonography can be repeated safely during the examination. The variations in the anthropometric features of various populations, races and regions are an established and proved fact. Several studies have sought to develop standards for size of solid visceral organs like liver, kidney, and spleen utilizing a variety of imaging techniques such as computed tomography, scintigraphy, magnetic resonance imaging, and sonography. Nevertheless, routine computed tomography for the diagnosis and serial follow-up of patients for suspected enlargement of these organs is difficult to justify in view of the radiation exposure (especially in a pediatric or adolescent population) and the expense in our environment. The use of magnetic resonance imaging is similarly hampered by expense and limited availability in many areas of the world, particularly in developing countries. Ultrasonography is an established, safe, fast and reliable method for measurement of liver, spleen and kidney sizes.[2-4]

Previous studies showed that the longitudinal measurements of the liver were best correlated with body parameters.[6-16] In many studies, the lengths of the liver in the midclavicular and midsagittal planes were both measured, but they found better correlation between the measurement of the midclavicular plane and the body parameters.[17-20,8] In present study only midclavicular measurements of the liver were used, and strong correlations were found with the body parameters. This result indicates that midclavicular measurement of the liver is practical and yields reliable information. The average craniocaudal length was more in females than males in present study which is contrary to many studies (Kratzer W et al, Mittal R et al, Tarawneh ES et al,) but the difference was not significant (p valve=0.562).[1,21,22] The larger size in females than males may be due to the fact that the mean BMI was more in females (23.42±3.46) as compared to males (22.39±3.10) in present study. As craniocaudal length of liver is strongly correlated to BMI, this may be the reason of higher craniocaudal length of liver in females than males. Kratzer W et al, also found that in qualitative variables gender was found to have no effect on the liver span.[1] Kratzer W et al, found the mean craniocaudal length in Germans equal to 14±1.7cms which is larger than our population.[1] It may due to racial and genetic factors. Mittal R et al, did a study in Rajasthani population and found that the mean craniocaudal length of liver was 12.99±0.76cms in males and 12.66±1.07cms in females which is lower than in our population, it may be due to differences in mean height and weight, genetic and environmental factors.[21] Udeako AI et al, did a study in Nigerian population and found the craniocaudal length of liver in the males with mean of 13.42±1.43cm and 13.0±0.88cm in the females which was almost similar to present study.[23] In present study craniocaudal length of liver correlated well with body weight (p valve <0.001, r valve=0.372) in both males and females. Same was found by Tarawneh ES et al, in his study on Jordanian adults with r valve =0.38 which was more in females (r valve=0.49) than males (r valve= 0.11).[22] Morabe F et al, also found the highest correlation (r=0.65) of liver AP diameter with weight.[24] Authors found a weak correlation (r valve <0.3) between body height and craniocaudal length of liver which was consistent with studies done by Udoeko AI et al, and Niederau C et al, Tarawneh ES et al, found a weak correlation between height and craniocaudal length of liver (p valve <0.3).[22,23,25] While strong correlation was found by Kratzer W et al, who have shown height to be a significant influence parameter affecting liver size in the midclavicular line (P<0.001).[1] Body mass index was found to be a strong significant influence parameter affecting the liver size in midclavicular line with p valve <0.01 in both males and females. Similar observations were made by Kratzer W et al, and Tarawneh ES et al.[1,22]

CONCLUSION

In conclusion authors found that craniocaudal length in midclavicular line is an important parameter to be measured during a sonographic examination. Present study found that liver dimensions showed best correlation

with body weight and BMI. Nomograms from this study can be utilized for Kashmiri ethnic population for better diagnosis of pathological enlargement or reduction of liver in clinical practice.

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REFERENCES

1. Kratzer W, Fritz V, Mason RA, Haenle MM, Kaechele V, Roemerstein study group. Factors affecting liver size: a sonographic survey of 2080 subjects. J Ultrasound Med. 2003;22(11):1155-61.
2. Wee LK, Supriyanto E. Automatic detection of fetal nasal bone in 2 dimensional ultrasound image using map matching. 12th WSEAS International conference on automatic control, modeling and simulation. World Scientif Eng Acad Soc. 2010:305-9.
3. Supriyanto E, Wee LK, Min TY. Ultrasonic marker pattern recognition and measurement using artificial neural network. In proceedings of the 9th WSEAS international conference on signal processing. World Scient Eng Acad Soc. 2010;29:35-40
4. Wee LK, Arooj A, Supriyanto E. Computerized automatic nasal bone detection based on ultrasound fetal images using cross correlation techniques. WSEAS Transact Informat Sci Appl. 2010;7(8):1068-77.
5. Sandra L Ansert H, eds. Textbook of diagnostic sonography. Chapter 10 the liver. 1:20.
6. Rosenberg HK, Markowitz RI, Kolberg H, Park C, Hubbard A, Bellah RD. Normal splenic size in infants and children: sonographic measurements. AJR Am J Roentgenol. 1991;157:119-21.
7. Carpentieri U, Gustavson LP, Leach TM, Bunce H. Liver size in normal infants and children. South Med J. 1977;70:1096-7.
8. Konus OL, Ozdemir A, Akkaya A, Erbas G, Celik H, Isik S. Normal liver, spleen and kidney dimensions in neonates, infants and children: evaluation with sonography. Am J Roentgenol. 1998;171:1693-8.
9. Soyupak SK, Narli N, Yapicioglu H, Satar M, Sungur EH. Sonographic measurements of the liver, spleen and kidney dimensions in the healthy term and preterm newborns. Eur J Radiol. 2002;43:73-8.
10. Zerin JM, Blane CE. Sonographic assessment of renal length in children: a reappraisal. Pediatr Radiol. 1994;24:101-6.
11. Dinkel E, Ertel M, Dittrich M, Peters H, Berres M, Schulte-Wissermann H. Kidney size in childhood: sonographical growth charts for kidney length and volume. Pediatr Radiol. 1985;15:38-43.
12. Han BK, Babcock DS. Sonographic measurements and appearance of normal kidneys in children. Am J Roentgenol. 1985;145:611.
13. Dremsek PA, Kritscher H, Böhm G, Hochberger O. Kidney dimensions in ultrasound compared to somatometric parameters in normal children. Pediatr Radiol. 1987;17:285-90.
14. Carrico CW, Zerin JM. Sonographic measurement of renal length in children: does the position of the patient matter? Pediatr Radiol. 1996;26:553.
15. Mathur S, Chandra J, Mittal KP, Mittal SK, Khurana A. Sonographic renal length in Indian children. Indian J Pediatr. 1996;63:553-7.
16. Christophe C, Cantraine F, Bogaert C, Coussement C, Hanquinet S, Spehl M, et al. Ultrasound: a method for kidney size monitoring in children. Europ J Pediatr. 1986;145(6):532-8.
17. Carpentieri U, Gustavson LP, Leach TM, Bunce H. Liver size in normal infants and children. South Med J. 1977;70:1096-7.
18. Soyupak SK, Narli N, Yapicioglu H, Satar M, Sungur EH. Sonographic measurements of the liver, spleen and kidney dimensions in the healthy term and preterm newborns. Eur J Radiol. 2002;43:73-8.
19. Holder L, Strife J, Padikal TN, Perkins PJ, Kerelakes J G. Liver size determination in pediatrics using sonographic and scintigraphic techniques. Radiol. 1975;117:349-53.
20. Dittrich M, Milde S, Dinkel E, Baumann W, Weitzel D. Sonographic biometry of liver and spleen size in childhood. Pediatr Radiol. 1983;13:206-11.
21. Mittal R, Chowdary DS. A pilot study of the normal measurements of the liver and spleen by ultrasonography in the Rajasthani population. J Clinic Diag Res. 2010;(4):2733-6.
22. Tarawneh ES, Hadidy AM, Haroun AA, Mahafza WS, Samara OA, Arafeh FM, et al. Ultrasound Measurement of Liver Span in Jordanian Adults: a preliminary experience. J Med J. 2009;43(3):197-204.
23. Udoaka AI, Enyi C and Agi CE. Sonological evaluation of the liver, spleen and the kidneys in an adult southern Nigerian population. Asian J Med Sci. 2013;5(2):33-6.
24. Morabe F, Domondon MT, Ramos D, Caguete F, Que E. Establishing the normal sonographic measurements of the liver, spleen and portal vein among Filipino adults. Philippine J Int Med. 1995;33:97-101.
25. Niederau C, Sonnenberg A, Müller JE, Erckenbrecht JF, Scholten T, Fritsch WP. Sonographic measurements of the normal liver, spleen, pancreas, and portal vein. Radiol. 1983;149(2):537-40.

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