

ULTRASONIC MEASUREMENT OF DIAMETERS OF LIVERAvnish Dave¹, Vilas Khandare², Divyesh Vadasmiya³**HOW TO CITE THIS ARTICLE:**

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ABSTRACT: To find out the correlation between liver size and anthropometric measurements a study was carried out in 103 subjects (52 females and 51 males). The study was carried out at Department of Physiology, GMERS Medical College, Valsad, Gujarat. The longitudinal and antero-posterior diameter of liver was noted in centimeters and diameter of portal vein and common bile duct at porta hepatis were noted in millimetres. Thereafter height in meters and weight in kilograms was documented. The anthropometric parameters selected were height, BSA¹ and weight. The mean height and weight was 160.02 cm and 51.70 kg respectively. The statistical analysis revealed a very highly significant correlation between the mean height (160.02 cm), mean weight (51.70 kg), mean BSA and mean Longitudinal (12.44cm) and antero-posterior (10.12 cm) diameter of liver. The results obtained were very highly significant ($p < 0.001$).

KEYWORDS: BSA diameters of liver hepatomegaly Ultrasound.

INTRODUCTION : Ultrasonic measurement of diameters of liver are important to assess the size of the liver even then there is a paucity of data in this regard in India as well as in the world. Sherlock S 1993² identifies liver as the one of the most commonly affected organs in various disease conditions such as cirrhosis, amoebic liver abscess, hydatid cyst, and carcinoma of liver. Clouse M E 1989³ advocates modern equipment and available technology for the accurate measurement of liver size for correct diagnosis. Being inexpensive, non-invasive and no biological side effects Ultrasound becomes the first line of investigation in hepato-biliary disorders. Maurer HJ 1986⁴ prefers ultrasound to computed tomography and magnetic resonance imaging because of its reasonable cost and its ability to scan in any axis and most importantly it is without any radiation hazards.

Neiderau C 1983⁵ has found definite relationship between parameters like sex, height, weight and body surface area and the size of liver.

Indian literature is deficient in studies correlating liver measurements and body parameters.

AIMS AND OBJECTIVES: To evaluate the measurements of normal liver size in midclavicular plane, longitudinal and anteroposterior diameter by ultrasound. These findings were correlated with age, gender, height, weight and body surface area.

MATERIAL AND METHODS: Study was carried out at Department of Physiology, GMERS, Valsad in 103 subjects. Out of which 52 were females and 51 were males. The age varied from 18 to 80 yrs. The average age, height and weight were 49.16 years, 160.02 cm, 51.70 kg respectively.

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After ethical clearance and explaining the aim of the study to subjects their consent was obtained.

Selection of Cases: Patients were referred to radiology department by various departments such as surgery, medicine, urology and gynaecology to examine the abdomen of patient ultrasonically to establish or to rule out any pathology. Subjects with normal hepato-biliary architecture were included in study.

Exclusion Criteria: Patient with GI disorder, alcoholic, smokers, with history of malaria, typhoid, jaundice in last 6 months.

Patient on medication known to be hepatotoxic.

Measurement of Liver Size: The measurements of liver in midclavicular plane i.e. the longitudinal and anteroposterior diameter were noted in centimeters, and diameter of portal vein and common bile duct at porta hepatis were noted in millimeters.

Thereafter height in meters and weight in kilograms was documented.

The body surface area is calculated by the formula:

$$A = W^{0.425} \times H^{0.725} \times 71.84 \text{ (Constant) Sq.m.}$$

A is body surface area in square meter, W is weight in Kilogram, H is height in meters.¹

This study includes 103 cases out of which fifty-one are males and fifty-two are females for evaluation and correlation with various parameters.

Preparation of Patients: The patients were advised to fast a minimum of eight hours before the examination so that bowel gas get limited and gall bladder was not contracted. Patients were given laxative on the night before ultrasound examination. The examination of abdomen was done in supine and in oblique position with the transducer of 3.5 MHz. coupling agent is applied liberally on the probe.

Scanning Technique : Ultrasound examination was carried out by the expert sonographers in the morning and on an empty stomach, this helps to prevent aerophagia and also helps examination of whole abdomen accurately. We carried out the study by using the machine ESOATE MyLab -40. Depending on the age and built of patient, transducer is chosen for scanning. As higher frequencies are more readily absorbed and scattered than lower frequencies, transducer of higher frequencies (5 MHz) or higher gives more details of superficial organs and used for scanning thin adults and children and 3.5 MHz is used for scanning adults.

Phases of respiration can be affect the images of abdominal organs so patient is asked to hold the breath in full inspiration thereby displacing the bowel loops downwards and stabilizing the organ to be imaged.^{1,4}

In scanning the liver, homogenous parenchyma interrupted by the portal vein and its branches are seen as linear tubular structures with reflective valves. Hepatic veins are readily identifiable and course along the boundaries of hepatic lobes and are intersegmental. The confluence of three hepatic veins, right, middle and left hepatic veins can be seen in subcostal

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oblique view dividing the liver parenchyma in lobes and segments. Middle hepatic vein courses within main lobar fissure and divides the liver into right and left lobes.

Right hepatic vein in the right lobe divides it into anterior segment anteriorly and posterior segment posteriorly. Hypertrophy of caudate lobe occurs in cirrhosis of liver. The major branches of right and left portal veins run centrally within the segments (intra-segmental) with the exception of the ascending portion of the left portal vein which runs in left intersegmental fissure. Heger et al 1990⁶ and Igdibashin et al 1989⁷ guidelines helps to locate hepatic veins according to it left hepatic vein forms the boundary of the cranial third, the ascending branch of the left portal vein represents the middle third and the fissure for ligament teres acts as the most caudal division of the left lobe.

In longitudinal scan, the probe is kept in the midclavicular plane on the right costal margin and the diameter from the right dome of diaphragm to the tip of the liver is measured as longitudinal diameter and similarly by moving the probe in transverse axis, perpendicular to longitudinal diameter, the anteroposterior diameter is measured.

RESULT & OBSERVATIONS:

SI. No.	VARIABLE	Mean	SD
1	Age	49.16 years	12.96 years
2	Height	160.02 cm	11.88 cm
3	Weight	51.70 kg	11.39 kg
4	Longitudinal Diameter	12.44 cm	1.20 cm
5	Antero-Posterior Diameter	10.12 cm	1.21 cm
6	Body surface area	1.5 Sq. m	0.39 Sq. m

Table No. 1: Mean values and standard deviation of variables

Table 1 shows mean values with SD of age, weight, height, BSA, and diameters of liver. The mean age was 49.16 years with a standard deviation 12.96 years 95% confidence limit of age is 36.2-62.12yrs.

SI. No.	Group	No. of cases	%	LD cm	AP cm
1	18-30	48	46.60	12.4	10.0
2	31-40	25	24.27	12.4	10.2
3	41-50	15	14.56	12.4	9.9
4	51- 60	11	10.67	13.2	10.8
5	61-70	2	1.94	11.6	9.4
6	71 -80	2	1.94	11.6	9.5

Table No. 1: Mean values and standard deviation of variables

SI. No.	Variable Pair	Correlation of Co-efficient
1	Height & Longitudinal Diameter of Liver	0.34166***
2	Height & Anteroposterior Diameter of Liver	0.23408***
3	Weight & Longitudinal Diameter of Liver	0.49558***

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4	Weight & Anteroposterior Diameter of Liver	0.48952***
5	BSA & Longitudinal Diameter of Liver	0.5624***
6	BSA & Anteroposterior Diameter of Liver	0.454***

Table No. 3: Statistical significance of Height, Weight, & BSA with diameters of Liver

*** = $P < 0.01$ - very highly significant.

Height: Height and longitudinal diameter of liver.

The correlation coefficient was 0.34166 which at 99 degrees of freedom is very highly significant ($p < 0.001$). Thus there is very highly significant positive relationship between height and longitudinal diameter. As one variable i.e. height increases other variable i.e. longitudinal diameter will also show very highly significant increase.

Height & Anteroposterior Diameter of Liver

The correlation coefficient was 0.23408 which at 99 degrees of freedom is very highly significant ($p < 0.001$).

Weight: Weight & Longitudinal Diameter of Liver.

The correlation coefficient was 0.49558 which at 99 degrees of freedom is very highly significant ($p < 0.001$).

Weight & Anteroposterior Diameter of Liver.

The correlation coefficient was 0.48952 which at 99 degrees of freedom is very highly significant ($p < 0.001$).

Body Surface Area (BSA): BSA & Longitudinal Diameter of Liver.

The correlation coefficient was 0.5624 which at 99 degrees of freedom is very highly significant ($p < 0.001$)

BSA & Anteroposterior Diameter of Liver.

The correlation coefficient was 0.454 which at 99 degrees of freedom is very highly significant ($p < 0.001$).

Gender Difference: Mean values of all the parameters in females were found lesser than in the males.

DISCUSSION: Liver size may give information about the diagnosis and course of gastrointestinal and haematological diseases. Hepatomegaly may occur in many diseases such as amoebiasis, typhoid, malaria, tuberculosis or congestive cardiac failure and few inborn errors metabolism. Haematological diseases include Hodgkin's disease and leukemias. Ultrasound is the first line of investigation in studying the pathology of liver and biliary tree.⁴

Naftalis J 1963⁸ and Peternel WW 1966⁹, found measurement of liver size based on percussion and palpation as inaccurate and unreliable, and while radiography and radionuclide studies expose the patients to gamma radiations.

Neiderau et al⁵ measured the liver size in a longitudinal and anteroposterior diameter in midclavicular and correlated these findings with gender, age, height, weight, and body surface area.

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We employed only simple commonplace method of measurements. Determination of midclavicular longitudinal diameter is still the predominant method. Since the liver may vary widely even in healthy subjects. The anteroposterior diameter was also measured and correlated with the parameters.

We found that the measurements of the diameters of liver are usually smaller in females than the males. The midclavicular longitudinal and anteroposterior diameters of liver in females were found to be 12.18 cm and 9.90 cm. respectively whereas in males these diameters were 12.74 cm and 10.35 cm.¹⁰ Thus it is obvious that in female the size of the liver smaller than that in males. This is in accord with the previous study by Niederauet al.⁵

In our study we found that mean midclavicular longitudinal and anteroposterior diameter to be 12.44±1.20 cm and 10.12±1.21 cm whereas in previous study Niederau et al.⁵ shows slightly lesser values which are 10.5±1.5 cm and anteroposterior diameter 8.1±1.19 cm. But it corroborates with the statement that midclavicular longitudinal diameter of liver is usually less than 14 cm with considerable variation.

Midclavicular longitudinal and antero-posterior diameters of liver in our study shows positive correlation with the height, weight and body surface area which means liver size increases with the increase in the height, weight and body surface. These findings matches with that of DeLand FH et al. 1968,¹⁰ Castell Do et al. 1969¹¹ and Sapira JD 1979.¹² Within these parameters, midclavicular longitudinal diameter of liver has stronger positive correlation more consistently with height than body weight and body surface area. Whereas in case of anteroposterior diameter increases more consistently with body weight and body surface area which corroborates with the Niederau et al 1983.⁵ They stated that in thin person, the longitudinal diameter was large and anteroposterior diameter small whereas in heavy subjects the reverse was true.

The liver size decreases with age. In our study we did not find any correlation with the age. This might be because of the less number of subjects were included from the fourth to eight decade.

CONCLUSION: Measurement of the liver size in midclavicular, longitudinal and anteroposterior diameters by ultrasound give the following data:

1. Liver size increases with various parameters such as height, weight, and body surface area.
2. Diameters of liver, diameters of portal vein and common bile duct are generally lesser in females than males.
3. Midclavicular longitudinal diameter of liver has stronger positive correlation more consistently with height than body weight and body surface area.
4. Anteroposterior diameter increases more consistently with body weight and body surface area.

REFERENCES:

1. Taylor NB. The physiological basis of medical Practice, MEEH and Modified by DuBois and duBois. 8th Edition, 1967: 237-238.

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2. Sherlock S, Dooley J, Diseases of Liver and Biliary System. Blackwell Scientific Publications Oxford, 9th Edition 1993: 17-26, 146-147.
3. Clouse ME: Current diagnostic imaging modalities of the liver. Surg-Clin North Am. 1989 Apr; 69(2): 193-234.
4. Maurer HJ et al; Size determination of abdominal and retroperitoneal organs by means of Ultrasound. Rontgenblatter 1986 Dec; 39(2): 354-6.
5. Neiderau C et al: Sonographic measurements of normal liver, spleen, Pancrease and portal vein. Radiology 1983; 149: 537-540.
6. Heger et al. Ultrasound anatomy of the liver. CSK-Radiol Mar 1990; 44(2): 72-82.
7. Igdibashin et al. Hepatic ultrasound. Semin-Liver- Dis 1989; 9 (1): 16-31.
8. Naftalis J, Leevy CM. Clinical estimation of liver size. American Journal Diagnostic Disease 1963; 8: 236 -243.
9. Peternel WW, Schaefer JW L. Clinical evaluation of Liver size and hepatic scintiscan. Am J Dig Dis. 1966; 11: 346-350.
10. DeL and FH et al. Relationship between liver size and body size. Radiology 1968; 91: 1195-98.
11. Castell Do et al. estimation of liver size by permission in normal individual. Ann Intern Med 1969; 70: 1183; 1969.
12. Sapira JD, Williamson DL. How big will be normal liver? Arch Intern Med. 1979; 971-973.

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