



Measurement of normal hepatic veins among Sudanese population using ultrasonography related to gender and BMI

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The diameter of hepatic veins (HV) is one of the important parameters to aid in diagnosis of most liver diseases, which are increasing worldwide. Cross-sectional study was conducted at East Nile hospital in Khartoum state, Sudan during the period of January to April 2021. 100 adult patients (52 males and 48 females) presented for abdominal ultrasound for other purpose rather than liver diseases were enrolled in the study. Measurement of HV was performed using Mindray ultrasound machine- 3.5 MHz transducer, where any patients with liver disease or a medical condition affecting HV diameters were excluded. Ethical approval was gained from the research committee of University of Medical Sciences and Technology (UMST), the faculty of radiological science, the Ministry of Health Institutional Review Board in Sudan, in addition to the study participants. The study showed that the mean diameter of right hepatic vein (RHV), middle hepatic vein (MHV) and left hepatic vein (LHV) were, (7.30 ±1.3 mm), (7.20 ±1.3 mm) and (6.7 ±1.1 mm) respectively, significant differences in mean measurement in both genders, p value less than 0.01. The HV diameter in males was greater than females. There was no significant correlation between age and diameter, as the Body Mass Index (BMI) increased, the HV (hepatic veins) diameter decreased. A significant difference was found in HV diameter in normal, overweight and obese patients.

Keywords: Right hepatic vein diameter, Left hepatic vein, middle hepatic vein, IVC, BMI

INTRODUCTION

The hepatic veins (HV) are the only draining vessels in the liver, which has two supplying vessels that connect to the inferior vena cava (IVC). Under ultrasonography, the thin-walled veins are anechoic, lack valves, and can be distinguished from the portal vein (Zhang et al. 2011). HV can be divided into three large veins (right, middle, left) and many tributary veins. The three large hepatic veins are 6-15 mm in diameter; do not course outside the liver. The right hepatic vein (RHV) is the longest, located in the right portal fissure and divides the right lobe of the liver into anterior and posterior sections. The left hepatic vein (LHV) is located in the left portal fissure. It is very close to the course of the venous ligaments and separates the left lobe of the liver into medial and lateral sectors. The middle hepatic vein (MHV) is located in the middle portal fissure and separates the anterior aspect of the right lobe from the medial part of the left lobe of the liver (Sharma, Somani and Rameshbabu,

2018). Under normal conditions, the IVC and HV contract during inspiration or Valsalva maneuver. In the presence of right heart failure, the normal fluctuations in venous diameter associated with respiratory movement may be reduced or absent. (Wells and Venkatesh, 2018).

Many pathological conditions affect vena hepatica and cause its dilation or compression e.g. hepatic venous congestion and cirrhosis. The study aimed to measure the HV diameter by real time sonography in the Sudanese population of patients with normal liver size and normal IVC diameter. This is to estimate reference values for normal HV and correlate this with age, gender and BMI.

MATERIALS AND METHODS

A cross-sectional study was designed with a sample size of 100 cases referred to the radiology department of East Nile hospital, Khartoum state, Sudan, from January to April 2021. The abdominal ultrasound scans were for other purposes rather than liver disease. After assessing

the abdominal organ scans, HV measurements were performed using Mindray DP10 transabdominal (TA) convex probe 3.5 MHZ. Measurement of HV were performed in the right lateral intercostals approach during quiet respiration, from outer to outer in the area before entering the IVC as appears in figures 1A and B. The study included participants with a normal liver and any patient with liver disease was excluded. Ethical approval was gained from the research committee of University of Medical Sciences and Technology (UMST), the faculty of radiological science, the Ministry of Health Institutional Review Board in Sudan. Informed consent was gained from all participants prior to completing the data sheet. The results were reported anonymously and confidentiality was respected in each step of the research.

The data of this study was analyzed using Statistical Package for Social Sciences software, version 23.0 (IBM SPSS Inc., Chicago, IL). All information gathered via data collection was then coded into variables. Both descriptive and inferential statistics involving Independent T-test, One Way ANOVA (Analysis of variance) and Pearson correlation tests were used to present the results. A P-value of less than 0.05 was considered statistically significant.

RESULTS

Measurement of Hepatic Vein using Ultrasonography

In A total number of 100 cases include 52 males and 48 females (Table 1),

Table 1: Frequency distribution of gender in the study

Gender	Number	Percent
Male	52	52%
Female	48	48%
Total	100	100%

The overall mean diameter of HV in 100 cases was 7.3 mm for RHV, 7.20 mm for MHV and 6.7 mm for LHV. The mean diameter of IVC was 15.4 mm and 13.8 cm for the liver (Table 2).

The study found there was strong correlation between HV diameter and gender. The HV diameter was larger in males than females. The diameter of MHV, LHV and RHV were 7.78 mm, 7.16 mm and 7.99 mm respectively for males, 6.64 mm, 6.11 mm and 6.64 mm for females respectively (P-value < 0.001). (Table 3 & 4)

In participants with a normal BMI, the mean diameter of LHV, RHV and MHV were 6.84 mm, 7.52 mm and 7.37 mm respectively. However, in overweight participants the mean diameter were 6.52 mm, 7.31 mm and 7.01 mm respectively.

Table 2: Illustrates values of statistical parameters of all participants.

Diameter of Variables	Std. Error of Mean	Mean	95% CI Mean z=1.96		99% CI Mean z=2.58	
			Lower	Upper	Lower	Upper
LHV (mm)	0.1056	6.7	6.5	6.9	6.4	6.9
MHV (mm)	0.1291	7.2	6.9	7.4	6.8	7.5
RHV (mm)	0.1318	7.3	7.1	7.6	7.0	7.7
IVC (mm)	0.1867	15.4	15.0	15.7	14.9	15.8
Liver (cm)	0.1127	13.8	13.6	14.1	13.5	14.1

Table 3: The range of measurements of HV in both genders

Gender		Age (year)	BMI	RHV diameter (mm)	LHV diameter (mm)	MHV diameter (mm)
Male	Minimum	16	17.28	6.0	5.6	6.0
	Maximum	74	32.71	9.8	9.0	9.5
Female	Minimum	15	19.47	4.1	4.2	4.0
	Maximum	75	33.46	9.2	8.0	8.7

Table 4: Comparison of mean HV measurements in both genders using Independent T-test

Diameter Variables (mm)	Gender	Number	Mean	Std. Deviation	Std. Error of Mean	P-value
LHV	Male	52	7.162	0.8707	0.1207	0.000**
	Female	48	6.117	0.972	0.1403	
MHV	Male	52	7.788	0.9534	0.1322	
	Female	48	6.469	1.2656	0.1827	
RHV	Male	52	7.998	0.9847	0.1366	
	Female	48	6.644	1.2786	0.1846	

In obese participants, the mean diameter were 5.5 mm, 6.02 mm and 5.74 mm respectively. There were

great differences in HV diameter with varying participant BMI, with p-value < 0.001. Overall, as BMI increased the measurement of HV decreased. (Table 4)

Table 5: One Way ANOVA-Test to assess the relation between measurement of hepatic veins and BMI for all participants.

One Way ANOVA-Test						
Variables	Weight groups	Number	Mean	Std. Deviation	Std. Error	P value
Left hepatic vein diameter (mm)	Normal	71	6.846	0.9648	0.1145	0.001**
	Overweight	20	6.52	1.1519	0.2576	
	Obese	9	5.5	0.789	0.263	
Middle hepatic vein diameter (mm)	Normal	71	7.373	1.1925	0.1415	0.001**
	Overweight	20	7.015	1.3838	0.3094	
	Obese	9	5.744	0.9684	0.3228	
Right hepatic vein diameter (mm)	Normal	71	7.525	1.2414	0.1473	0.005**
	Overweight	20	7.315	1.3892	0.3106	
	Obese	9	6.022	1.0872	0.3624	



Figure1: A. Measurement of MHV and LHV for 25-year-old male patient, B. outer to outer measurement of hepatic veins before entering the IVC for female 30 years old

DISCUSSION

This study aimed to assess the HV diameter of normal patients at Khartoum state and the relationship between HV with gender and BMI. The overall mean diameter was 7.3 mm for RHV, 7.20 mm for MHV and 6.7 mm for LHV. The mean diameter of IVC was 15.4 mm and 13.8 cm for the liver. The mean diameter was slightly larger than that of the Korean population when compared with the study by (Bang et al.2015). They found the mean diameter of MHV was 0.60±0.15 mm at rest versus 0.38±0.20 mm during valsalva maneuver (Bang et al. 2015; Morales et al. 2020). (Henriksson L et al. 1982), found that the normal

diameter of HV was 5.6 to 6.2 mm, this increased to 8.8 mm with heart failure and 13.3 mm with heart failure with pleural effusion(Henriksson et al. 1982,Morales et al. 2020). The present study found that there were great differences in HV diameter in male and female participants, with an increased diameter in males more than females. (C.DINA et al.2013) found that the caliber of the MHV in male participants is larger than females, ranged from 6.8 to 8.1 mm, compared with 5.0 to 7.6 mm in females. In this study the MHV in male participants ranged from 6.0 to 9.5 mm, compared with 4.0 to 8.7 mm in females (Biasutto. 2013).

The study found that as the BMI increased the

diameter of HV decreased. In the participants with a normal BMI the mean diameter of LHV, RHV and MHV were 6.84 mm, 7.52 mm and 7.37 mm respectively. However, in overweight participants the mean diameter was 6.52 mm, 7.31 mm and 7.01 mm respectively. In obese participants the mean diameter was 5.5 mm, 6.02 mm and 5.74 mm respectively. A significant correlation was found between HV diameter and BMI of participants with p-value < 0.002.

Ultrasonography (US) is a good modality for assessing the morphology of HV. Increased HV diameter is a diagnostic feature of liver and cardiac diseases.

CONCLUSION

The study concludes there was a significant difference between HV diameter and gender, with male diameter larger than females. Significant differences were also found between HV diameter and BMI. Obese participants have smaller diameter than individuals with a normal BMI. There are few studies found in literature assessing HV diameter measurements in adults using ultrasonography, therefore, further studies are recommended for more accurate results.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

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AUTHOR CONTRIBUTIONS

RBA with MOHO designed the data collection sheet then RBA wrote the manuscript, AWG analyzed the data and revised the manuscript ,MOHO,SH.MW and MOHA collected the data finally RAN, MIR and JIN checked plagiarism and revised the final manuscript.

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