MED-PHOENIX: JOURNAL OF NATIONAL MEDICAL COLLEGE

ORIGINAL ARTICLE

MEASUREMENT OF NORMAL PORTAL VEIN DIAMETER BY ULTRASOUND

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Date of Submission : March 16, 2023
Date of Acceptance : July 11, 2023
Date of Publication : July 28, 2023

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Citation:
Jha AK, Shah SSP, Akhtar MK, Sah D, Mahato RK, Chaurasiya C, et al.Measurement 0f Normal Portal Vein Diameter by Ultrasound. Medphoenix. 2023;8(1):17-20

DOI:https://doi.org/10.3126/medphoenix.v8i1.53187

Conflict of interest: None, ***Funding:*** None

Publisher: *National Medical College Pvt. Ltd.*
MedPhoenix - Journal of National Medical College (JNMC); 2023,8(1), available at www.jnmc.com.np

ISSN:2631-1992 (Online); ISSN:2392-425X (Print)

ABSTRACT

Introduction: *Measurement of the diameter of the portal vein may be particularly important in detecting and evaluating patients with portal hypertension as well as some other clinical disorders.This study is aimed at determining the mean portal vein diameter based on age, gender and anthropometric variables.*

Materials and Methods: *A cross-sectional study was performed on a total of 195 apparently healthy individuals with overnight fasting and normal ultrasonographic findings of the liver. Portal vein diameter was measured and correlated with age, height, weight and BMI of the participants.*

Results: *The mean portal vein diameter was 9.57 ± 0.66mm for both sexes. The mean value for males was9.71 ± 0.67mm, and9.46±0.64mm among females. There was a positive correlation between the PV diameter and age, height, weight and body mass index (P≤ 0.05).*

Conclusion: *The measurement of the portal vein diameter using sonography is an important cornerstone for diagnosing patients with portal hypertension and also has a reasonable degree of accuracy.*

Keywords: *Portal Hypertension, Portal Vein Diameter, Ultrasonography*

INTRODUCTION

Liver's dual blood supply is formed by portal vein (PV) and hepatic artery. The portal vein contributes the majority of hepatic blood flow (75%), while the hepatic artery contributes the remainder. A portal vein (PV) is formed at the level of the second lumbar vertebra at the point where the superior mesenteric vein and the splenic vein meet.[1]The measurement of the portal vein diameter using sonography is an important cornerstone for diagnosing patients with portal hypertension and also has a reasonable degree of accuracy.[2]A major abnormality of the portal venous system is portal hypertension, which is caused by an increase in resistance to portal blood flow that is caused by alterations in liver architecture that cause an enlargement of extrahepatic and intrahepatic portal vessels and the formation of portosystemic collaterals.[3]The formation of portosystemic collaterals may lead to splenomegaly, ascites, encephalopathy among others.[4]To evaluate patients suspected of having portal thrombosis, diagnostic imaging methods such as portal venography, splenoportography, and arteriography have been used. These methods are invasive, expensive, time-consuming, and dangerous. Although computed tomography and magnetic resonance imaging offer better cross-sectional images, they are both expensive, and the former exposes patients to high levels of radiation.[5,6]

MATERIALS AND METHODS

This was a cross-sectional prospective study carried outamong apparently healthy adult subjects at National Medical College and Teaching Hospital, Birgunj, Nepal for a period of six months from September 2022 to February 2023. Ethical clearance was obtained fromthe ethical committeeand informed consent was obtainedfrom all the participants, prior to the study.A total of 195 apparently healthy participants with normal ultrasonographic findings of liver were recruited.

Personal information including age and gender were

taken. Height and weight of each participant were measured to calculate the BMI.

Apparently healthyindividuals with normal ultrasound findings of the liverformed the inclusion criteria while ill individuals, pregnant women, subjects on hepatotoxic drugs such as anti- tuberculous and antiretroviral drugs were excludedfrom the study.

After thorough clinical history and examination all the participants were examined with ultrasonography. Following an overnight fast, the subjects wereexamined by ultrasound in supine and in the right anterior oblique position. Subjects were exposed from the xiphisternum to the pelvic brim. After applying ultrasound gel the transducer was placed in the epigastrium in both the transverse and longitudinal planes to assess the main portal vein during quiet respiration. when the visualization of the portal vein was optimal, measurements were made at a point where the portal vein crosses anterior to the inferior vena cava (IVC) with the calipers placed between the inner margins of the echogenic walls of the vessel. Demographic data such as age, sex, weight, and height were recorded and the body mass index (BMI) was calculated using Quetelets' formula: BMI= weight (Kg)/ height (m^2).

Data capture sheet was used to record all the measurements obtained. Data analysis was done using StatisticalPackage for Social Science (SPSS) version 25.0.Descriptive statistics (mean, standard deviation, frequency, and percentages) and Pearsonproduct moment correlation were used for the analysis.Statistical significance was considered at P<0.05.

Fig. 1- Ultrasonographic image showing measurement of portal vein diameter.

RESULTS

This study enrolled 195 apparently healthy adults, consisting of 92 (47.18%) males and 103 (52.82%) females, with a mean age of 41.88±14.59 years. The age range of participants was between 18-70 years. The highest frequency of participants was in the age group of 51-60 years with 42 individuals (21.54%), while the lowest frequency was in the age group of less than or equal to 20 years with 14 individuals (7.18%)as shown in table 1.

Table 1: Frequency distribution based on age and sex of participants

Age Group (Years)	Male	Female	Total
≤ 20	7	7	14
21-30	19	19	38
31-40	20	21	41
41-50	18	20	38
51-60	19	23	42
61-70	9	13	32
Total	92	103	195

This study reported a mean weight of 62.17 ± 7.96 kg and a mean height of 1.65 ± 0.06m, as well as a mean portal vein diameter of 9.57 ± 0.66mm and mean BMI of 23.01 ± 3.31 as shown in table 2.

Table 2: Mean height, weight, BMI and PVD according to age group

Age Group (Years)	Height (m) (Mean±SD)	Weight (kg) (Mean±SD)	BMI (kg/m^2) (Mean±SD)	PVD (mm) (Mean±SD)
≤ 20	1.66±0.04	49.14±4.84	17.90±1.64	8.55±0.93
21-30	1.67±0.06	59.26±4.28	21.43±2.11	9.53±0.55
31-40	1.64±0.07	61.54±6.22	22.99±2.91	9.50±0.56
41-50	1.63±0.07	65.92±7.91	24.76±3.02	9.74±0.65
51-60	1.64±0.05	65.50±7.90	24.38±2.99	9.78±0.54
61-70	1.66±0.56	63.86±7.25	23.37±3.29	9.78±0.44
Total	1.65±0.06	62.17±7.96	23.01±3.31	9.57±0.66

Participants within the age group of 51-60 years hadthe highest mean portal vein diameter of 9.78 ± 0.54mm and those withinthe age group below or equal to 20 years had the least value of 8.55 ±0.93mm as shown in table 2 and 3.The mean values of portal vein diameter in males and females were 9.71 ± 0.67mm and 9.46 ± 0.64respectively,as shown in table 3.

Table 3: Mean portal vein diameter (in mm) according to age group and gender

Age Group (Years)	Male(Mean±SD)	Female(Mean±SD)	Total(Mean±SD)
≤ 20	8.40±0.89	8.70±1.01	8.55±0.93
21-30	9.80±0.31	9.25±0.59	9.53±0.55
31-40	9.66±0.53	9.35±0.55	9.50±0.56
41-50	10.02±0.65	9.48±0.54	9.74±0.65
51-60	9.76±0.59	9.79±0.52	9.78±0.54
61-70	9.84±0.38	9.73±0.48	9.78±0.44
Total	9.71±0.67	9.46±0.64	9.57±0.66

There was a positivecorrelation between theaverage portal vein diameter andage, weight, height and BMI for both sexes with correlation coefficientsofr=0.354 and P ≤0.05, r=0.437 and P ≤ 0.05,r=0.267 and P ≤ 0.05 and r=0.246 and P ≤ 0.05respectively as shown in table 4.

Table 4: Correlation between PVD and different variables according to sex

Variables	Male	Female	Total
Age	R=0.312 P<0.05	R=0.423 P<0.05	R=0.354 P<0.05
Height	R=0.290 P<0.05	R=0.213 P<0.05	R=0.267 P<0.05
Weight	R=0.537 P<0.05	R=0.352 P<0.05	R=0.437 P<0.05
BMI	R=0.342 P<0.05	R=0.198 P<0.05	R=0.246 P<0.05

DISCUSSION

Ultrasound is a valuable tool for the diagnosis and management of liver disease, providing accurate and reliable information that can help guide treatment decisions and improve patient outcomes.[7]The mean portal diameter in this study was 9.57 ± 0.66mm. Similar findings were reported by other studies in Nepal; Bhattarai et al[8],found 10.80±1.14mm and Neupane et al[9], found 10.41±1.18mm.The consistency in the reported portal vein diameter across different studies and populations may be attributed to the similarity in the methods adopted, such as the use of the trans-abdominal approach and similar probe frequencies. Studies conducted in other countries have also reported similar findings regarding the mean portal vein diameter measured by ultrasound.Hawaz et al.[2]and Geleto et al[13]reported a mean value of 10.0±1.8mm and 10.6 ± 1.8mm respectively among Ethiopians, while Rokni-Yazdi et al.[10] reported a mean value of 9.36±1.65mm among Iranians. Similarly, Bhattacharya et al.[1] in West Bengal, India reported a mean value of 10.02±0.89mm.

Numerous studies have been conducted on the measurement of the portal vein diameter using ultrasound, and the reported values have been found to be consistent across different countries, ethnic groups, and races, with minimal variations. This suggests that the technique is reliable and can be used in a consistent manner across different populations.

In this study, the mean portal vein diameter was found to be slightly higher in males than females, but the difference was not statistically significant at p<0.05 level. This finding is consistent with the results of other studies, such as Hawaz et al[2] and Ghosh et al[3], who also found no significant influence of gender on portal vein diameter.

Various studies have investigated the influence of age on portal vein diameter, with mixed results. In this study, a positive correlation was found between age and portal vein diameter, with a statistically significant p-value of less than 0.05.This finding is consistent with the results of other studies, such as Bhattacharya et al[1], Hawaz et al[2], and Ghosh et al[3], which also found a positive correlation between age and portal vein diameter. These findings suggest that portal vein diameter increases with age, likely due to changes in liver function and metabolism that occur with aging.

This study also showed a positive correlation betweenBody Mass Index (BMI) and portal vein diameter(p<0.01). Studies examining the relationship between portal vein diameter and BMI have reported mixed findings. Bhattacharya et al.[1] found a positive correlation between BMI and portal vein diameter in individuals with chronic liver disease. Similarly, studies by Saha et al.[11] and Ghosh et al.[3] have also reported a positive correlation. However, Adeyekun et al.[5] did not find a statistically significant influence of BMI on portal vein diameter.

Mixed results have been reported regarding influence of height on portal vein diameter. This study showed a positive correlation between height and portal vein diameter which is in partial agreement with a study by Saha et al.[11]who found a weak positive correlation between height and portal vein diameter in males, but not in females.

CONCLUSION

The study established the normal range of portal vein diameter in healthy Nepalese adults to be 9.57 ± 0.66mm and found a positive correlation between portal vein diameter and anthropometric variables, suggesting that factors such as age, body weight, height and BMI may influence portal vein diameter.

AKNOWLEDGEMENT

All the members of the Department of Radiology, National Medical College and Teaching Hospital, Birgunj, Parsa, Nepal.

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