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Association of Anthropometric and Sociodemographic Factors with Portal Vein Diameter as Assessed by Ultrasonography: A Cross Sectional Study

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ABSTRACT

Background: Portal vein is the vessel formed by the confluence of superior mesenteric artery and splenic vein. Its diameter varies with sociodemographic and anthropometric factors.
Objective: To determine association of the normal portal vein diameter with sociodemographic factors and anthropometric factors using ultrasonography.
Methodology: Three hundreds and eighty-five patients of both genders were randomly selected. The study participants were examined in radiology department of the Mardan Medical Complex by using ultrasonography technique to examine portal vein diameter, height was measured using tape, weight through weighing scale and BMI through SPSS.
Results: The mean portal vein diameter in the population of district Mardan was 10.41±1.65mm. Portal vein diameter of normal individuals had positive correlation with sociodemographic factors such as gender, age and anthropometric factors such height, weight and body mass index.
Conclusions: There was positive correlation between age, height, weight and BMI, correlation was statistically significant.
Keywords: Portal Vein Diameter, Ultrasonography, Anthropometric Factors, Sociodemographic Factors

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INTRODUCTION

The portal vein is a major blood vessel of the porto-venous system of the human body. It gets nutrient rich blood supply from gastrointestinal tract (GIT) and spleen to the hepatic circulation(1).[1] Liver gets 3/4th of its blood from PV and 1/4th from the hepatic artery, which originates from celiac trunk. Portal vein doesn't drains directly to heart through caval system that's why it is not a true vein in such a sense, rather it supplies the metabolic substrates which are nutrient rich from GIT to the liver(2).[2] Hepatic artery and PV(portal vein) both supply blood to the liver(3). Hepatic sinusoids receive blood from spleen and bowel wall(intestinal) through it(4).[3] Portal triad is comprised from portal vein, bile duct and hepatic artery, which are closely covered in a protective sheath, composed of connective tissue. This connective tissue covering gives the echogenic appearance of portal vein's wall during ultrasonography(5)(6).[4] The normal diameter of portal vein ranges from 7 to 15mm and venous pressure lies in between 5 to 10mm of Hg which is approximately 14cmH_2O(7)(8).[5] Portal vein can be evaluated through angiography by CT, MR angiography and traditional angiographic technique(9)(10) but the well-established method for the evaluation of portal vein is ultrasonography(11), it is non-ionizing, non-invasive, cost effective, time saving and easily available tool for assessing the portal vein(12).[6] One of the common pathology of portal vein is portal hypertension(13) with numerous causes, these causes could be either pre hepatic, hepatic or post hepatic(14) and in chronic liver disease directly leads to death(15).[7] Portal hypertension is defined as when the diameter of portal vein exceeds than the normal diameter of portal vein which is 14.5mm(16).[8]16 It exists when the pressure exceeds than 10 millimeter of mercury or difference between portal vein and hepatic vein is more than 5mmHg, approximately 7cmH_2O(17).[9] Portal HTN leads to other medical conditions such as splenomegaly (enlarged spleen), portal vein dilatation and formation of collateral routes for blood flow at various sites which results in increment of mortality and morbidity rate, as chronic liver disease that is scarring of liver parenchyma is caused by these conditions(18)(19).[10] It is classified as extrahepatic, intrahepatic and hyper-dynamic portal hypertension. Intra-hepatic portal hypertension is more common than extra-hepatic and hyper-dynamic portal hypertension(18)(20).[11] Normalities and abnormalities of portal veins can be assessed through ultrasonography, it is a diagnostic tool for patients having symptoms of portal hypertension(21)(22).[12]

This study sought out normal mean portal vein diameter value in association with age, sex, height, weight and BMI in the population of Mardan. As researches show variations for the normal value of portal vein diameter with sociodemographic and

anthropometric factors. This sought out standard value will help in the management of portal hypertension.

MATERIALS AND METHODS

This study was a cross sectional analytical, carried out in Radiology Department of Tertiary Care Hospital, Mardan Medical Complex (MMC), Mardan by using non probability, convenience sampling technique for sample size of 385 with confidence level of 95% which was calculated on the basis of population. The duration of this study was approximately five months from July 2023 to November 2023. All healthy Individuals with NBM 6 Hrs prior scan were included in the study, while individuals with history of liver transplant, Chronic liver disease, Portal hypertension, Pregnancy, Respiratory Distress, Esophagastric varices, Excessive bowel gases were excluded from the study.

First of all, approval was taken from the Institutional Research Committee of MCMT-BKMC. Before starting to collect data, an ethical approval was requested from the Ethical Committee of hospital as well as consent from each participant. The designed questionnaire had given to each participant prior ultrasound examination and explained every question in a simple way to everyone. All the questions contained the important information regarding our study. Height, weight and BMI had been calculated of each participant through a specific protocol/formula and stored it in each participant's data. Ultrasound machine equipped with linear-array transducer (7.50 Megahertz) and convex-array (3.50 Megahertz) transducers was used for the assessment of subjects. Machine was quality assured prior the study. After completion of the examination, the same procedure was performed for the next participant. Through this technique the data was collected concerning our study.

Data analysis was carried out through SPSS version 22, descriptive statistical analysis was used for the description of normal portal vein diameter. Pearson's test was used to associate normal diameter of portal vein with sociodemographic-factors (age, gender) and anthropometric-factors (height, weight and BMI). Analysis was summarized in graphical and tabular form.

RESULTS

In this study there were 385 subjects, and was categorized according to gender including 171 (44.4%) males and 214 (55.6%) females. Age was categorized into 7 categories that were <11 with frequency of 21 (5.5%), 11-20 with frequency of 72 (18.7%), 21-30 with frequency of 120 (31.2%), 31-40 having frequency of 76 (19.7%), 41-50 with frequency of 44 (11.4%), 51-60 with frequency of 31 (8.1%), >60 having of frequency of 21 with 5.5%. The highest frequency was in age group 21-30 (120) and the least one was in age groups < 11 and >60 (21).

The mean portal vein diameter for male was noted 10.64mm with standard deviation of 1.68 while the female was noted 10.23mm with standard deviation of 1.61. The highest mean portal vein diameter for male was noted in age group 51-60 which was 13.17mm with standard deviation of 2.80 while the least one was noted in age group(male) <11 which was 8.46mm with STD of 1.23. The highest mean PVD for female was in age group 51-60 of 11.20mm with STD of 1.64 and the least one was noted in age group 11-20 which was 9.48mm with STD of 1.15(Table 1).

The highest mean weight mass noted in 51-60 age group (69.23kg with STD 8.60) while the least was noted in age group <11 (24.25kg with STD 5.58). The overall mean height was 156.01cm with STD 18.05, the highest was noted in age group >60 which was 165.3cm with STD of 7.82 while the least one was noted in age group <11 which was 105.86cm with STD of 11.30. There was a positive correlation between mean portal vein diameter with weight and height with correlation coefficient of 0.636 with P ≤ 0.001 and 0.495 with P value ≤ 0.01 (Table 2).

All subjects/individuals were categorized into three categories based on BMI, all those having BMI <18.5 were classified as underweight, 18.5-24.5 were classified as normal and those having BMI of >24.5 were overweight. Correlation of portal vein diameter with BMI was significant in all classes (Table 3).

DISCUSSION

The evaluation of the PV diameter, blood flow rate, and peak systolic velocity (PSV) using ultrasonography is crucial because it provides an accurate and reliable way for identifying liver disease situations like chronic hepatic diseases.[13]

Our study found that the mean diameter of PV was 10.415±1.65mm. Same findings were reported by Zaman *et al.,* in Lahore, Pakistan that the diameter of PV was 10.27±1.78mm.[4] Aqeel *et al.*, also found in her study in Pakistan that the diameters of PV were 10.51±1.47mm and 10.08±1.33mm for males and females respectively.[10] The fact that these studies all used the trans abdominal acoustic window and used transducer having similar frequencies for their assessments may explain the uniformity in the documented portal vein diameter.

Although studies carried out in other different regions similar findings were documented in literature. Same findings were reported by Saha *et al.,* in north east India that the mean portal vein diameter 9.17±2.33mm and 8.55±1.90mm for males and females respectively.[16] Usman *et al.,* had mean portal vein diameter in North Eastern Nigeria found that mean portal vein diameter was 10.87±0.81mm.[7] Albagir *et al.,* in Riyadh Saudi Arabia found that the mean portal diameter were 10.40±1.22mm and 10.1±1.20mm.[1] Usman *et al.*, in Nigerian north-eastern part reported that the average portal diameter was 10.87mm±0.81.[7] The mean PV diameter was reported to be 11.5±1.5mm by Anakwue *et al.,* in Southest Eastern region of Nigerian country.[26] A mean value of 112.0mm was reported by Weinerb *et al.,* in the US of America.[18] Luntsi *et al.,* reported that the average PV diameter was 9.60±1.41mm for both genders.[27] Rokni *et al.,* documented in literature that the average PV

diameter was 9.36mm with standard deviation of 1.65.[14]

The documented values of the PV diameter in literature from research conducted in other nations, among various racial and ethnic populations, with various sample sizes, did not differ from the values discovered in this study. This suggests that the portal venous diameter measured can be accurate and repeatable when done using comparable

Table 1: Gender and Age Correlation with Mean PVD

Age of Individual (years)	Gender of Individual		Total	P Value
	Male ♂ (Mean PVD±STDmm)	Female ♀ (Mean PVD±STDmm)		
Less than 11	8.462 ± 1.2310	00.00±00.00	8.462±1.2310	0.014
11-20	10.549 ±1.0744	9.476±1.1510	10.117±1.2191	
21-30	10.738 ±1.5787	10.233±1.3123	10.468±1.4586	
31-40	11.371±.9608	9.993±1.7467	10.374±1.6817	
41-50	10.617±.3764	10.434±1.8725	10.459±1.7428	
51-60	13.167±.2805	11.208±1.6414	11.587±1.6695	
Greater than 60	11.450±2.1740	11.167±.2887	11.410±2.0090	

Table 2: Individual Relation of PVD (mm), Height (cm), Weight (kg) to Age-Groups

Age of Individual (years)		Weight of Individual (kg)	Height of Individual (cm)	Portal Vein Diameter (mm)	P Value
Less than 11	Mean	24.57	105.86	8.462	0.001
	Std. Deviation	5.582	11.297	1.2310	
11-20	Mean	46.78	146.28	10.117	
	Std. Deviation	10.368	21.087	1.2191	
21-30	Mean	59.49	161.18	10.468	
	Std. Deviation	7.966	10.730	1.4586	
31-40	Mean	65.03	162.16	10.374	
	Std. Deviation	8.088	6.936	1.6817	
41-50	Mean	68.07	161.50	10.459	
	Std. Deviation	8.281	3.695	1.7428	
51-60	Mean	69.23	163.32	11.587	
	Std. Deviation	8.601	6.710	1.6695	
Greater than 60	Mean	63.86	165.33	11.410	
	Std. Deviation	6.658	7.825	2.0090	
Total	Mean	58.30	156.01	10.415	
	Std. Deviation	13.729	18.052	1.6508	

Table 3: Individuals BMI and Mean Portal Vein Diameter Correlation

Body mass index (kg/m2)	Gender of Individual	Mean	Std. Deviation	P Value
Underweight (<18.5)	Male	9.007	1.1049	0.001
	Female	9.625	.7500	
	Total	9.144	1.0501	
Normal (18.5-24.5)	Male	10.759	1.6957	

	Female	10.182	1.5461	0.036
	Total	10.463	1.6432	
Overweight (>25.0)	Male	11.053	1.1153	
	Female	10.387	1.7934	0.008
	Total	10.530	1.6871	
Total	Male	10.645	1.6762	.
	Female	10.231	1.6107	
	Total	10.415	1.6508	

Table 4: Comparison of present study findings with other national and international studies

Author	Region	Date	Mean PVD (mm)
Luntsi *et al.*,12	Nigerian	2016	9.60±1.14
Rokni *et al.,14*	Iranian	2006	9.36±1.65
Lal *et al.,15*	Indian	2018	10.2±1.47
Geleto *et al.,5*	Ethiopian	2016	10.6±1.8
Usman *et al.,7*	Nigerian	2015	10.87±0.81
Hawaz *et al.,13*	Ethiopian	2012	7.9±2.0
Saha *et al.,16*	Indian	2015	8.83±2.12
Bellamy *et al.,17*	British	1984	7.2±2.3
Weinreb *et al.,18*	American	1982	11.0±2.0
Cosar *et al.,19*	Turkish	2004	11.68±0.26
Rahim *et al.,20*	British	1985	8.76±1.50
Anakwe *et al.,7*	Nigerian	2009	11.45±1.49
Our study	Pakistani	2023	10.41±1.65
Weirsema *et al.,21*	American	1995	10.7±1.70
Ghareeballah *et al.,22*	Sudanian	2007	10.73±0.81
Rokni *et al.,23*	Iranian	2005	8.9±1.08
Mildenburger *et al.,24*	German	1987	9.7±1.7
Adeyekun *et al.,25*	Nigerian	2014	10.3±1.50
Ekta Gupta *et al.,23*	Indian	2013	9.87±1.082

techniques and tools by qualified ultrasonographers and/or sonologists. Although, one among the limitations of this carried out study is that merely the diameter of portal vein was assessed, as portal flow and correlation of PVD with cranio-caudal length of the spleen carried out by Zaman *et al.,*.[4]

Additionally, this study demonstrated a significant (p-value 0.01) positive connection between hepatic PV diameter and body mass index (BMI). This links the findings of Saha *et al.,* and Gosh *et al.,* Adeyekun *et al.,* findings,[16, 25, 28] on the other hand, showed that there was a lack of statistical significance between body mass index and PV width. The contrast between the stated value and the population in Mardan, Pakistan, who are either livestock farmers or trading up an active life, may be due to the lack of physical activity in the western portion of Nigeria. Rajashree *et al.,*.[29] Also noted a favourable connection between various anthropometric measurements and the portal vein diameter. When diagnosing issues that can be related to the portal system, specialists in surgery, ultrasonologists, and ultrasound professionals must be aware of these typical changes. The limitation of this study was its target population, as only the population of Mardan were the subjects of this study.

CONCLUSION

The study carried out resulted in baseline values for the normal range of diameter of portal vein in people from district Mardan, Pakistan who appeared to be in good health, and it also discovered a favourable positive correlation between portal vein diameter and anthropometric and sociodemographic factors.

CONTRIBUTIONS OF AUTHORS

Ghazan Khan created the idea, performed interpretation, statistical anaylsis and writing. Muhammad Shahzeb helped in supervision, Awais Nangyal helped in literature review and data acquisition while Haseena Aziz and Rabia Kamal did data collection.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest regarding this publication.

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