

## ANTHROPOMETRIC CORRELATES OF SONOGRAPHICALLY-DETERMINED NORMAL PORTAL VEIN DIAMETER: RESULTS FROM A STUDY CONDUCTED IN RAJASTHAN, INDIA

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### ABSTRACT

**Background:** Dilatation of portal vein is predictive of portal hypertension and therefore requires accurate standards for normal measurements. Despite several studies to determine portal vein diameters, there exist considerable variations across communities. Moreover, body builds have been found to correlate with different diseases.

**Purpose of study:** We conducted a study among 200 normal participants belonging to Rajasthan in order to obtain data on sonographically measured diameters of portal vein and determine the association between portal vein diameters and age, sex, anthropometric measurements like height, weight, chest circumference, circumference at the transpyloric plane, circumference at the umbilicus and circumference at the hip.

**Results:** We found that the mean portal vein diameter assessed ultrasonographically was 10.2 mm (SD 1.47 mm), with diameter ranging from 8.0 mm to 14.5 mm. Although, there was no statistically significant difference in portal vein diameter among the various age groups, a statistically significant difference was found between males and females. Portal vein diameter showed a statistically significant, positive correlation, albeit poor with anthropometric measurements, viz. weight, chest circumference, circumference at transpyloric plane, circumference at umbilicus and circumference at hip. A strong positive correlation was found between portal vein diameter and height of the study subjects ( $r = 0.40$ ). On linear regression analysis, this relationship was found to be statistically significant, with an increase in portal vein diameter of 0.06 mm for every increase of one unit (1 cm) in height.

**Conclusion:** The upper limit of normality of portal vein diameter was found to be 14.5 mm. Width of portal veins determined by sonography is indirect indicator of portal pressure responsible for development of varices, and prompt further investigation.

**KEY WORDS:** Anthropometry, Portal vein, Ultrasonography

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### INTRODUCTION

A dilated portal vein is predictive of portal

hypertension; accurate standards for normal measurements must be available. In addition to

being quick and safe, ultrasonography is reliable and a well-established method of demonstrating the portal vein [1]. Several studies have been performed to establish the normal limits of portal vein diameter as measured by this technique. However, the normal ranges for exhibit significant variation between the different studies.

Diseases have been found to correlate with different kinds of body builds. The variations in the anthropometric features of various populations, races and regions are an established fact. The climatic conditions in the State of Rajasthan and the socio-economic status of its resident population are unique [2].

We conducted a study to obtain data on sonographically measured diameters of portal vein and common bile duct in a series of normal Rajasthani population and determine the association between portal vein diameters and age, sex, anthropometric measurements like height, weight, chest circumference, circumference at the transpyloric plane, circumference at the umbilicus and circumference at the hip. The results pertaining to common bile duct have been published [3]; here we present the results relating to portal vein.

## MATERIALS AND METHODS

The study was cross-sectional hospital-based in design, undertaken at Mahatma Gandhi Medical College and Hospital in Jaipur city of Rajasthan.

Ethnic Rajasthani people (both male and female), belonging to the age group of 18 years and above were considered for the study. Pregnant women and those reported to be suffering from hepatobiliary disease, cardiac disorders, splenomegaly and portal hypertension were excluded from the study.

Informed consent was obtained from all subjects prior to enrolment in the study.

Socio-demographic details related to age, sex and place of residence were recorded for each subject. The ultrasonographic finding with regard to portal vein diameter was obtained by experienced radiologist, using a 3.5 megahertz (MHz) transducer. The portal vein is identifiable in the long axis of the gallbladder, appearing

as a large, hypoechoic circle with echogenic walls. The common bile duct and hepatic artery appear as two smaller circles anterior to the portal vein; often giving the appearance of a face with two ears – also called a ‘Mickey Mouse’ sign. Standard procedures were used to undertake anthropometric measurements (height, weight, chest circumference, circumference at the transpyloric plane, circumference at the umbilicus and circumference at the hip), in a separate area, screened off to provide privacy [4].

## RESULTS AND DISCUSSION

The study population comprised of an equal proportion of males and females, totaling 200 participants. These participants belonged to the age group 18-85 years of age; mean age being 34.5 years (SD 13.24 years). Majority of the study participants belonged to the age group 18-25 years. The mean age for males and females were 35.8 years and 33.1 years, respectively; the difference in ages was not statistically significant.

The mean weight was 51.4 kg and mean height of the participants was 163.4 cm. The mean circumference which was measured at different levels was: chest- 83.5 cm, transpyloric plane- 75.2 cm, umbilicus- 78.1 cm and hip- 87.2 cm.

While the lower limit of portal vein diameter among the normal subjects was 8.0 mm, the upper limit was found to be 14.5 mm. The mean portal vein diameter was 10.2 mm, with a standard deviation of 1.47 mm.

There was an increase in portal vein diameter from 10.2 mm among those in the age group 18-35 years to 10.6 among those belonging to the age group 46-35 years of age. Thereafter, the diameter decreased to 9.6 mm in those more than 55 years of age. The difference in diameter across the age groups was not found to be statistically significant ( $p$ -value= 0.46).

The mean portal vein diameter was observed to be 10.8 mm (SD 1.39 mm) for males and 9.7 mm (SD 1.36 mm) for females. The difference was found to be statistically significant ( $p < 0.001$ ).

In order to assess the association between portal vein diameter and anthropometric measurements, both of which were continuous

variables, correlation was used. The degree of association was measured through calculation of Pearson correlation coefficient. The correlation coefficients along with the p-values for the association between diameter of portal vein and anthropometric measurements have been summarized in Table 1. Portal vein diameter showed a statistically significant ( $p < 0.05$ ) correlation with all the anthropometric measurements. The correlation coefficient was high for the relation of portal vein diameter with height ( $r = 0.40$ ).

On applying linear regression, height was found to have statistically significant relation with portal vein diameter. The regression line for this relation has been shown in Figure 1.

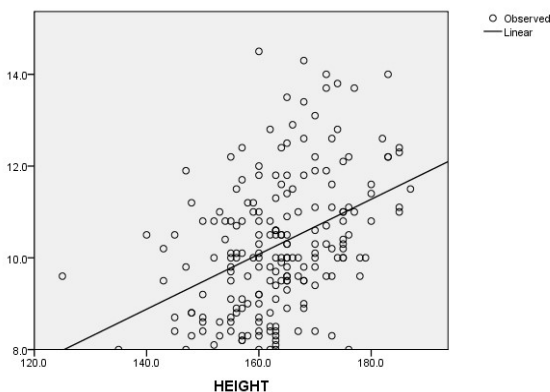
The slope of the fitted line was 0.06, which means an increase in portal vein diameter of 0.06 mm for every increase of one unit (1 cm) in height. The 95% confidence interval for the slope was 0.04 to 0.07 and was found to be statistically significant ( $p < 0.001$ ).

None of the other anthropometric variables were found to be statistically significant on applying linear regression analysis.

**Table 1:** Summary of Correlation between Portal Vein Diameter and Anthropometric Measurements.

Anthropometric Measurement	Correlation Coefficient	Sig. (p-value)
Weight	0.25	< 0.001
Height	0.4	< 0.001
Chest circumference	0.16	0.02
Circumference at transpyloric plane	0.23	0.001
Circumference at umbilicus	0.22	0.001
Circumference at hip	0.17	0.012

**Fig. 1:** Regression Line for Relation of Portal Vein Diameter with Height.



$$\text{Portal vein diameter} = 0.49 + 0.06 * \text{Height}$$

The mean normal portal vein diameter among our study participants was found to be 10.2 mm with a standard deviation of 1.47 mm. Our

results were similar to those reported from another Indian study site (Manipal in State of Karnataka) [5]. Similar results have been reported by other studies [6-9]. The diameters reported in our study were however, more than that reported in other studies; Webb et al reported the mean diameter of portal vein as 6.3 mm (SD 2.3 mm) [10-13]. On the other hand, higher mean portal vein diameters have been reported by some studies [14-15]. Based on the results from a community-based cross-sectional study, El Sharkawy E et al concluded that the Egyptian norms for ultrasonographic organometry of the portal vein were different from those of other countries [16]. Clearly portal vein diameters have been reported to be different across different countries.

The lower and the upper limits of normal portal vein diameter observed in our study were 8 mm and 14.5 mm respectively. The upper limit in our study is similar to that reported elsewhere [6,11,14,17]. However, a study in Iran reported the upper limit of normality as 20 mm [18].

The normal portal vein size as determined by ultrasonography has been found to vary as a function of age. We included in our study adult subjects above 18 years of age. The mean diameter of normal portal vein was found to increase progressively from 10.2 mm (SD 1.45 mm) among those aged 18-25 years of age to 10.6 mm (SD 1.68 mm) in those aged 46-55 years of age. Thereafter, the portal vein diameter decreased to 9.6 mm in those aged more than 55 years of age. This difference in portal vein diameters among the various age groups was not found to be statistically significant. Our results were similar to other studies [14,19]. However, researchers such as Anakwue (2009) and Ravi Shankar et al (2011) have demonstrated a significant positive correlation of portal vein diameter with age [19,21].

We observed a statistically significant difference in portal vein diameters among the males- 10.8 mm (SD 1.39 mm) and females- 9.7 mm (SD 1.36 mm). Whereas, significant differences between genders in portal vein diameter have been reported in other studies as well [22-24], no gender difference in portal venous measurements have also been observed [14,16,20,25]. In our study, portal vein diameter showed a

significant albeit poor correlation ( $r < 0.3$ ) with weight, chest circumference, circumference at transpyloric plane, circumference at umbilicus and circumference at hip. A strong correlation ( $r = 0.4$ ) was however, observed for the association of portal vein diameter with height of the subject. This finding was similar to that reported by in Germany [26] and in a more recent study conducted in India [21]. In the latter study, ultrasound measurements of portal vein diameter were carried out among 500 patients visiting MS Ramaiah Memorial Hospital in Karnataka. The findings showed significant positive correlation with height of the study participants. In all cases (including both male and female), with increase in age, portal vein diameter proportionately increased ( $r = 0.169$  and  $p < 0.001$ ), indicating the relation between these two variables being significantly positive. However, in a study among healthy subjects by Niederau C et al (1983), the portal vein diameters were found to have poor correlation with anthropometric measurements such as height, weight and body surface area [27]. A recent study undertaken in North-East India reported that portal vein diameter correlated with weight and BMI in total adult population and females but in males none of the body parameters were correlated significantly [28].

## CONCLUSION

This study was carried out among 200 normal participants belonging to Rajasthan. The mean portal vein diameter assessed ultrasonographically was 10.2 mm (SD 1.47 mm). The diameter ranged from 8.0 mm to 14.5 mm. There was no statistically significant difference in portal vein diameter among the various age groups. A statistically significant difference was found between the portal vein diameters among the males and females. Width of portal veins determined by sonography is an indirect indicator of portal pressure responsible for development of varices, and necessitates need for further investigation. Further, as reported by our study, the portal vein diameter showed a statistically significant positive correlation with anthropometric measurements, viz. weight, chest circumference, circumference at transpyloric plane, circumference at umbilicus

and circumference at hip. However, these correlations were found to be poor ( $r < 0.30$ ). A strong positive correlation was found between portal vein diameter and height of the study subjects ( $r = 0.40$ ). On linear regression analysis, this relationship was also found to be statistically significant, with an increase in portal vein diameter of 0.06 mm for every increase of one unit (1 cm) in height.

**Conflicts of Interests: None**

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