

## Portal vein diameter in a tertiary care centre in North-East India

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**Abstract:** The diameter of portal vein is variable according to gender, age, weight, height, body mass index (BMI) and with factors like, respiration, postural changes and absorptive state. Therefore, this study was conducted to determine the normal portal vein diameter and to evaluate its relationship with parameters like age, gender distribution, weight, height and body mass index (BMI). A total of 108 healthy individuals age ranged from 15 to 85 years attending Radiodiagnosis department were chosen for the study. Variables were: sex, age, weight, height, basal metabolic rate (BMI), portal vein diameter respectively. Transabdominal ultrasound was done to measure the diameter of the main portal vein with average of three times measurements. In present study, the portal vein diameter in males and females were  $9.17 \pm 2.33$  mm and  $8.55 \pm 1.90$  mm respectively. The diameter correlated with weight and BMI in total adult population and females but in males none of the body parameters were correlated significantly.

**KeyWords:** Portal vein, Portal vein diameter, Ultrasound

### I. Introduction

The portal vein arises from the confluence of superior mesenteric and splenic veins posterior to the neck of pancreas.<sup>1</sup> It carries 80% of venous blood from intestine and spleen to the liver to supply up to the one half of the oxygen requirements of the hepatocyte.<sup>2</sup> Various studies revealed that, the portal vein diameter (PVD) changes with the age and gender distribution.<sup>3,4</sup> The upper limit of portal vein diameter was found to be 13 mm.<sup>5</sup> Portal hypertension is the most common complication and also one of the important cause of death in chronic liver diseases.<sup>6</sup>

Variations in the anthropometric features of various populations, races, regions are an established fact. The diameter of portal vein varies according to gender, age, weight, height, body mass index (BMI). There was a correlation between portal vein diameter and various physical parameters like age, sex and height.<sup>7</sup> Factors like, respiration, postural changes, absorptive state influences the calibre of portal vein.<sup>5</sup> So, a comprehensive anthropometric study on normal portal vein diameter is essential for identifying the normal from abnormal diameter to diagnose the disease state. Hence, this study was conducted to determine the normal portal vein diameter and to evaluate its relationship with different ages, gender distribution, weight, height and body mass index (BMI).

### II. Materials & Methods

This cross-sectional study was conducted in the Department of Anatomy and Radiodiagnosis, Regional Institute Medical Sciences, Imphal, among 108 healthy individuals. Patients (49 males and 59 females), age ranged from 15 to 85 years who attended Radiodiagnosis department for conditions other than portal hypertension or any other diseases related to portal vein directly or indirectly, liver, spleen or cardiac, malaria, any abdominal surgery and pregnant lady, gastrointestinal and hematologic diseases. For this conceptualisation opinion from Medicine professional also was taken. Formal permissions from the Institutional Ethics Committee, RIMS, other concerned authorities and written informed consent from the concerned individuals were taken. Transabdominal ultrasound was done by Medison SONOACE X8 with 3.5 MHz sector curvilinear transducer probe. Study variables were: sex, age, weight, height, basal metabolic rate (BMI), portal vein diameter. The individuals were divided among five groups according to the age. Group I – 15 to 30 years, Group II – 31-45 years, Group III – 46 to 60 years, Group IV – 61 to 75 years and Group V – more than 75 years.

The individuals were kept in fasting after dinner of the previous night. With an elaborate history of present & previous history of illness, history of alcohol consumption, menstrual history in females mainly to exclude pregnancy, a physical examination was done. The weight, height were measured and BMI was calculated with the formula  $BMI = \text{weight (kg)} / \text{height (meter)}^2$ . The abdomen was scanned routinely to check sonographic exclusion criterias, lying in supine position in relaxed conditions and in quite respiration. The portal vein at porta hepatis was evaluated. The diameter of the main portal vein was measured at the crossing point anterior to the inferior vena cava (IVC) at the hilum of liver just before bifurcation into right and left. The central portion of the two cursors was fixed in the inner wall of the portal vein. The wall of the portal vein was

excluded from measurements. The diameter was taken in millimeter. The measurements were obtained by calculating the average of three times measurements.



Fig 1: Showing portal vein diameter (D2) just before the bifurcation of the portal vein anterior to inferior vena cava.

A single radiologist took all the measurements to avoid inter-observer variation. Sonographic measurements were done by the same examiner and were repeated for three times. All the individual records were entered in the in the master chart with full confidentiality. Statistical calculation was done with SPSS version 20.

### III. Results

The present study was conducted among 49 (45.37%) males and 59 (54.63%) females. The participants were divided among five groups according to their age as mentioned.

Table 1: Showing the group wise gender distribution of participants.

| Parameters     | Group |       |       |       |      | Total |
|----------------|-------|-------|-------|-------|------|-------|
|                | I     | II    | III   | IV    | V    |       |
| Male           | 10    | 12    | 15    | 09    | 03   | 49    |
| Female         | 24    | 22    | 07    | 04    | 02   | 59    |
| Total          | 34    | 34    | 22    | 13    | 05   | 108   |
| Percentage (%) | 31.48 | 31.48 | 20.37 | 12.04 | 4.63 | 100   |

Table 2: Showing mean and standard deviation of body parameters and portal vein diameter.

| Parameters           | Parameters (Mean & Standard Deviation) |             |                |  |                           |
|----------------------|--|-------------|----------------|--|---------------------------|
|                      | Age (years)                            | Weight (Kg) | Height (meter) | BMI= $\frac{\text{weight}}{\text{height}^2}$ | Portal vein diameter (mm) |
| Adults total (n=108) | 42.30±18.01                            | 54.22±1.07  | 157±8.67       | 21.75±2.95                                   | 8.83±2.12                 |
| Males (n=49)         | 48.24±18.32                            | 58.87±1.06  | 163.14±7.19    | 22.04±1.33                                   | 9.17±2.33                 |
| Females (n=59)       | 37.36±16.30                            | 50.36±9.25  | 153±6.72       | 21.51±3.15                                   | 8.55±1.90                 |

Table 3: Showing mean and standard deviation of body parameters and portal vein diameter in Groups I to V.

| Parameters   |           | Parameters (Mean & Standard Deviation) |             |                |  |                           |
|--------------|-----------|--|-------------|----------------|--|---------------------------|
|              |           | Age (years)                            | Weight (Kg) | Height (meter) | BMI= $\frac{\text{Weight}}{\text{height}^2}$ | Portal vein diameter (mm) |
| Group I to V | Group I   | 23.26±5.46                             | 53.38±8.94  | 156.87±7.70    | 21.60±2.80                                   | 8.50±1.94                 |
|              | Group II  | 38.53±4.27                             | 55.85±1.20  | 157.94±9.96    | 22.22±3.21                                   | 9.17±2.43                 |
|              | Group III | 52.64±4.74                             | 56.11±8.96  | 158.82±7.93    | 22.13±2.32                                   | 9.69±2.00                 |
|              | Group IV  | 69.69±5.41                             | 51.38±1.42  | 155.69±9.09    | 20.89±3.43                                   | 7.88±1.23                 |
|              | Group V   | 80.60±3.29                             | 47.87±8.87  | 155.80±1.20    | 20.12±3.26                                   | 7.48±1.92                 |

Table 4: Mean and standard deviation in males of Groups I to V.

| Parameters (males) |           | Parameters (Mean & Standard Deviation) |             |                |   |                           |
|--------------------|-----------|--|-------------|----------------|---|---------------------------|
|                    |           | Age (years)                            | Weight (Kg) | Height (meter) | BMI = $\frac{\text{weight}}{\text{height}^2}$ | Portal vein diameter (mm) |
| Group I to V       | Group I   | 23.90±4.36                             | 57.30±6.32  | 163.50±5.36    | 21.41±1.90                                    | 8.39±2.01                 |
|                    | Group II  | 38.17±4.26                             | 65.79±1.16  | 167.25±8.55    | 23.39±2.52                                    | 10.03±2.77                |
|                    | Group III | 52.53±4.36                             | 57.00±8.68  | 161.13±7.12    | 21.85±2.14                                    | 10.35±1.85                |
|                    | Group IV  | 70.44±5.48                             | 56.78±1.38  | 160.22±6.49    | 21.91±3.54                                    | 7.68±1.13                 |
|                    | Group V   | 81.67±2.89                             | 52.00±8.89  | 164.33±3.51    | 20.03±4.46                                    | 6.93±2.40                 |

Table 5: Mean and standard deviation in females of Groups I to V.

| Parameters (females) |           | Parameters (Mean & Standard Deviation) |             |                |   |                           |
|----------------------|-----------|--|-------------|----------------|---|---------------------------|
|                      |           | Age (years)                            | Weight (Kg) | Height (meter) | BMI = $\frac{\text{weight}}{\text{height}^2}$ | Portal vein diameter (mm) |
| Group I to V         | Group I   | 23.00±5.93                             | 51.75±9.46  | 154.1±6.84     | 21.69±3.13                                    | 8.54±1.96                 |
|                      | Group II  | 38.73±4.35                             | 50.43±8.25  | 152.86±5.65    | 21.58±3.41                                    | 8.70±2.15                 |
|                      | Group III | 52.85±5.84                             | 54.21±9.96  | 153.86±7.78    | 22.73±2.75                                    | 8.30±1.64                 |
|                      | Group IV  | 68.00±5.60                             | 39.25±4.19  | 145.50±4.20    | 18.59±1.86                                    | 8.35±1.49                 |
|                      | Group V   | 79.00±4.24                             | 41.50±4.95  | 143.00±2.83    | 20.25±1.62                                    | 8.30±0.99                 |

Table 6: Correlation of portal vein diameters and body parameters.

| Body parameters          | Portal vein diameter           |                         |                           |
|--------------------------|--------------------------------|-------------------------|---------------------------|
|                          | Adults total<br>r<br>(p value) | Males<br>r<br>(p value) | Females<br>r<br>(p value) |
| Age (years)              | 0.015<br>(0.880)               | -0.118<br>(0.421)       | 0.067<br>(0.615)          |
| Weight (Kg)              | 0.288<br>(0.003)               | 0.204<br>(0.160)        | 0.311<br>(0.017)          |
| Height (meter)           | 0.130<br>(0.179)               | 0.083<br>(0.570)        | 0.020<br>(0.879)          |
| BMI (Wt/Ht) <sup>2</sup> | 0.322<br>(0.001)               | 0.249<br>(0.085)        | 0.379<br>(0.003)          |

p value < 0.05 is significant.

#### IV. Discussion

A cross sectional gray scale ultrasound assessment of portal vein in Ethiopian population was done, age of the subjects varied from 5 to 85 years. The mean diameter of portal vein was calculated as 10.0±1.8 mm (range 8.2 to 11.8). The results concluded that gender did not have any effect on the diameter of portal vein but with increasing age the diameter also increased.<sup>4,7</sup> Subsequently, the same results also reported in a Nigerian population establishing the mean portal vein diameter as 11.45±1.45 mm and also concluding that the diameter varies with age but not with gender.<sup>3</sup> A Doppler ultrasonic study which is a more advanced and accurate imaging technique was conducted in Iran on 37 healthy subjects. The age varied from 20-40 years and the mean portal vein diameter was calculated as 9.36 ± 1.65 mm.<sup>8</sup> In the present study, mean portal vein diameter was 8.83±2.12 mm (range 4.10 to 16.80 mm). The portal vein diameters in males and females were 10.5 mm (9.8-11.2 mm) and 8.3 mm (7.7-8.9 mm) respectively. There was a statistical significance in between the values of males and females (p =0.0001).<sup>8</sup> In current study, the PVD diameters in males and females were 9.17±2.33 mm and 8.55±1.90 mm respectively. They ranged from 4.50 to 16.80 mm and 4.10 to 13.10 mm in males and females respectively. The mean diameter was more in males than females, though there were no statistical significant changes found in gender distribution. The mean diameter increased from 15 to 60 years but gradually

decreased after 60 years in males. But in females the diameter increased up to 60 years, after that remained almost similar. No statistical significant changes were found among the groups both in males as well as females.

In the previous study, in males there was no correlation between portal vein diameter and age, indicating that PVD does not vary with the age. But, height had a correlation with portal vein diameter. With increase in height PVD proportionately increases. In females there is no correlation between portal vein diameter and age as well as height, indicating that portal vein diameter had not varied with the age and height. But sex has a correlation with the portal vein diameter.<sup>7</sup> In this present study, portal vein diameter had changed significantly with increasing weight and BMI. In males, none of the body parameters were significantly correlated with portal vein diameter. But in females, though height was not correlated with the diameter but it was significantly correlated with increasing weight and BMI.

#### **V. Conclusion**

In this study, portal vein diameter in adult males and females were found within the normal range. The diameter correlated with weight and BMI in total adult population and females but in males none of the body parameters were correlated significantly. Therefore, portal vein diameter in this local population may provide a reference value for assessing variation of size for clinical practice in this set up.

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