Original Research Article

Evaluation of diameter of normal portal vein in adults on ultrasound

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Abstract

Background: Diameter of the portal vein at porta hepatis is measured on ultrasound to diagnosed portal hypertension. **Method:** 103 (51 male and 52 females)normal adults were included in the study group. Portal vein diameter was measured by the ultrasound at porta hepatis by expert. Various parameters such as Age, height, weight and body surface were noted and compared with diameter of portal vein to find the correlation. Significant correlation was identified with age, weight and body surface area. **Results:** Mean diameter of portal vein was observed 9.20 mm. Positive correlation were identified with the parameters such as height, and body surface area. **Conclusion:** To identify Portal vein diameter at porta hepatis by ultrasound is important and valuable finding in diagnosing the portal hypertension, Height and body surface area have to be considered while measuring the diameter of portal vein.
Key Word: portal vein, ultrasound.

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Received Date: 11/02/2019 Revised Date: 02/03/2019 Accepted Date: 19/03/2019
DOI: https://doi.org/10.26611/10011022

Access this article online

Quick Response Code:

Website: www.medpulse.in

Accessed Date: 07 May 2019

INTRODUCTION

Portal vein is commonly involved in the liver pathology such as cirrhosis and portal hypertension. Diameter is increased in the portal hypertension. Ultrasound being noninvasive and with no biological side effects becomes the first line of investigation in hepatobiliary disorders. Various parameter like age, sex, height, weight and body surface area have a definite relationship with diameter of portal vein.[1] Review of literature on ultrasonic measurement of diameter of portal vein with appropriate parameters have very few studies in Indian population. Hence we decided to study and to establish the values in the normal person which can be useful in a clinical context.

Hepatic portal system: The portal vein is formed at the second lumbar vertebra by the union of superior mesenteric vein a and splenic vein posterior to the neck of pancreas and anterior to the inferior vena cava.[2] On ultrasound main portal vein can be visualized at the porta hepatis in oblique view, appears as a linear tubular structure with reflective walls in the parenchyma of the liver. Portal vein lies anterior to the inferior vena cava.[3] The portal vein contains blood from territories of both splenic (& inferior mesenteric vein) and superior mesenteric vein. In sluggish stream, there is but little mixing of two blood streams, so that right branch receives mostly superior mesenteric blood and the left branch mostly splenic. Therefore carcinoma present territories of superior mesenteric vein meta-stasis's to the right lobe of the liver. Hydatid cyst amoebic liver abscess are common in right lobe. Ingested liver poisons also result in the greater concentration and damaging the right lobe of liver while the left lobe remains normal[4]

Primary carcinoma is common in the left lobe of liver. This fact is attributed to the deficiency of absorption of choline from the inferior mesenteric vein as small

How to cite this article: Vilas J Khandare, Nitin R Mudiraj. Evaluation of diameter of normal portal vein in adults on ultrasound. *MedPulse – International Journal of Anatomy*. May 2019; 10(2): 19-23. http://www.medpulse.in/Anatomy

intestines already being absorbed the choline. Deprived of the adequate supply of choline the left lobe shows exhibit cirrhosis leading to the primary carcinoma. Thus explained primary carcinoma is common in left lobe. (last 1984)[4]

Radiographic evaluation of portal vein: Ultrasound is safe, simple non-invasive method in hepatobiliary diseases and particularly portal hypertension in which ultrasound is first line of investigation.[5]

AIMS AND OBJECTIVES

To evaluate the measurements of diameter of portal vein at porta hepatis. Measurements are correlated with the: age, sex, height, weight and body surface area.

MATERIALS AND METHOD

Selection of cases: Ultrasonic measurements of diameter of portal vein of 103 cases (including 51 males and 52 females) were done in large teaching hospital. Patients were referred by various departments such as surgery, medicine, urology, and gynecology to the ultrasound department to examine the abdomen of patient ultrasonically to establish of to rule out any pathology. After scanning the abdomen of the adult patient by the expert, if no pathology was detected that is echotexture of liver, hepatobilliary tree and portal vein is normal, patient is included in the study group. Diameter of portal vein at porta hepatis is noted in millimeters. Thereafter height in meters and weight in kilogram was documented. Body surface area is calculated by the formula: $A= W^{0.425} X H^{0.725} X 71.84$(constant) Sq. M. A is body surface area in square meters, W is weight in kilogram Kg, H is height in meters[6] This study includes 103 cases, fifty-one males and fifty-two females for evaluations and correlation with various parameters.

Exclusion criterion: Any pathology if detected during the scanning, patient was excluded from the study.

Preparation of patient: The patient fast a minimum of eight hours before the examination so that bowel gas get limited and gall bladder was not clear contracted. The examination of abdomen was done in supine and in oblique position with the transducer of 3.5 MHz. Coupling agent was liberally applied on probe.

Scanning technique: Ultrasound examination was carried out preferably in the morning on an empty stomach, because only then aerophagia is prevented and bowel loops are relatively empty so as to make examination of whole abdomen possible without fallacy. Complete clinical examination and relevant history was obtained by sonologist to realize the probable pathology and its site of origin. Each Scanning was started in the midline from above downwards and left to right in supine position. Real-.time sonography allows for optimal imaging of a particular area of interest within abdomen. Various organs in abdomen can be imaged by the standard view for e.g. liver bile ducts and portal vein can be viewed in supine and oblique position. In the longitudinal scan, porta hepatis can be imaged. Structures to be viewed are main portal vein, common bile duct and their internal diameters were measured. (Sarti 1977)[7]

RESULT

The mean age was 34.94 years with standard deviation of 12.96 years. 95% Confidence limit of age are 31.96-37.92 yrs The mean height was 5.25 feet with standard deviation of 0.39 feet. 95% Confidence limit of height are 5.13-5.33 feet. The mean weight was 51.79 Kg. with standard deviation of 11.39 Kg. 95% Confidence limit of weight are 49.53 - 54.05Kg

Table 1:

Sn. No.	Variable	Mean	Std. Deviation	95% c.i.
1	Age	34.94 years	12.96 years	31.96-37.92 yrs
2	Height	160.02 cm	11.88 cm	156.36 - 162.45 cm
3	Weight	51.70 kg	11.39 kg	49.53-54.05 kg
4	Body surface area	1.5 Sq.m.	0.39 Sq.m.	1.29 - 1.73 Sq.m.
5	Portal vein diameter	9.20 mm	1.29 mm	8.94 - 9.46 mm

Mean values and standard deviation of variables

The mean diameter of portal vein at porta hepatis was 9.20 mm with standard deviation of 1.29 years. 95% Confidence limit are 8.94-9.46mm (Table/Fig 1)

Table 2:

SN	Group	No. of cases	%	PV in mm.
1	18-30	48	46.60	8.9
2	31- 40	25	24.27	9.7
3	41-50	15	14.56	9.3
4	51-60	11	10.67	8.6
5	61-70	2	1.94	9
6	71-80	11.6	9.5	9.5

Mean measurements of the diameter of portal vein in different age group

Mean Diameter of portal vein in age group 18-30 years (48 cases) was found to be 8.9 mm; Mean Diameter of portal vein in age group 31-40 years (25 cases) was found to be 9.7 mm , Mean Diameter of portal vein in age group 41-50 years (15 cases) was found to be 9.3 mm, Mean Diameter of portal vein in age group 51-60 years (11cases) was found to be 9.3 mm, Mean Diameter of portal vein in age group 61-70 years (2 cases) was found to be 9 mm ,Mean Diameter of portal vein in age group 71-80 years (11) cases was found to be 9.5 mm (Table/Fig 2)

Table 3:

SN	Age Group	No. of cases	%	PV in mm.
1	18-30	23	46.9	9.3
2	31- 40	14	28.6	10.1
3	41-50	6	12.2	10.0
4	51-60	4	8.2	9.8
5	61-70	1	2.0	8
6	71-80	1	2.0	10

Mean measurements of the diameter of portal vein in males of different group

Mean measurements of the diameter of portal vein in males of different group, Mean measurements of the diameter of portal vein in males of 18-30 age group (23 cases) is 9.3 mm, Mean measurements of the diameter of portal vein in males of 31-40 age group (14 cases) is 101 mm (Table/Fig 3)

Table 4

SN	Age Group	No. of cases	%	PV in mm.
1	18-30	25	46.3	9
2	31- 40	11	20.4	9
3	41-50	9	16.7	9
4	51-60	7	13.0	8
5	61-70	1	1.9	10
6	71-80	1	1.9	9

Mean measurements of the diameter of portal vein in females of different group

The Mean measurements of the diameter of portal vein in females of different group, Mean measurements of the diameter of portal vein in females 18-30 group (25 cases) is 9, Mean measurements of the diameter of portal vein in females 31-40 group (11 cases) is 9, Mean measurements of the diameter of portal vein in females 41-50 group (09 cases) is 9, Mean measurements of the diameter of portal vein in females 51-60 group (07 cases) is 9 (Table/Fig 4)

Table 5:

SN.No.	Variable pair	Correlation of coefficient	Significance
1	Age and Diameter of portal vein	0.10661	P>0.05,Df =99 Not significant

Statistical significance of age with diameter of portal vein

Statistical significance of age with diameter of portal vein (Table/Fig 5) To test the association between pairs of variables, Pearson's moment correlation coefficient was calculated.

Age: Age and diameter of portal vein at porta hepatis. The correlation coefficient was 0.10661 which at degrees of freedom was not significant (p> 0.05) Thus it is found that there is no significant association between age and diameter of portal vein.

Table 6

SN	Group	No. of cases	%	PV in mm.
1	120-135	3	2.9	9
2	136- 150	22	21.3	8.6
3	151-165	52	50.4	9.2
4	166-180	26	25.2	9.2

Correlation of measurements of diameter of portal vein ranging from 124 to -75 cm

Correlation of measurements of diameter of portal vein with height ranging from 124 to -75 cm (Table/Fig 6) Mean measurement of diameter of portal vein in the group of 120-135 cm (cases 3) is 9 mm, Mean measurement of diameter of portal vein in the group of 136-150 cm (cases 22) is 8.6 mm, Mean measurement of diameter of portal vein in the group of 151-165 cm (cases 52) is 9.2 mm, Mean measurement of diameter of portal vein in the group of 166-180 cm (cases 26)is 9.2 mm

Table 7:

SN.No.	Variable pair	Correlation of coefficient	Significance
1	Height and Diameter of portal vein	0.2912	P<0.01,Df =99 Very highly significant

Statistical significance of height with diameter of portal vein

Statistical significance of height with diameter of portal vein (Table/Fig 7)

Height: Height and diameter of portal vein at porta hepatis. The correlation coefficient was 0.2912 which at degrees of freedom was very highly significant (p<0.01) Thus it is found that there is positive relationship between age and diameter of portal vein.

Table 8:

SN	Group	No. of cases	%	PV in mm.
1	31-40	21	20.3	8.7
2	41- 50	33	33.03	8.8
3	51-60	28	27.18	9.3
4	61-70	13	12.62	9.8
5	71-80	7	6.7	10.3
6	81-90	1	0.9	9

Correlation of Mean measurements of diameters of portal vein with weight of the individuals ranging from 32-83 Kg Correlation of Mean measurements of diameters of portal vein with weight of the individuals ranging from 32-83 Kg, Mean measurement of diameter of portal vein in the group of 31-40 kg (cases 21) is 8.7 mm, Mean measurement of diameter of portal vein in the group of 41-50 kg (cases 33) is 8.8 mm, Mean measurement of diameter of portal vein in the group of 51-60 kg (cases 28) is 9.3 mm, Mean measurement of diameter of portal vein in the group of 61-70 kg (cases 13) is 9.8 mm, Mean measurement of diameter of portal vein in the group of 71-80 kg (cases 7) is 6.7 mm (Table/ Fig 8)

Weight: Weight and diameter of portal vein at porta hepatis. The correlation coefficient was 0.33669 which at degrees of freedom was very highly significant (p<0.01) Thus it is found that there is positive relationship between weight and diameter of portal vein. (Table/Fig 9)

Table 9

SN.No.	Variable pair	Correlation of coefficient	Significance
1	Weight and Diameter of portal vein	0.33669	P<0.01,Df =99 Very highly significant

Statistical significance of weight with diameter of portal vein

Table 10

SN	Group	No. of cases	%	PV in mm.
1	1.00-1.15	3	2.9	8.3
2	1.16- 1.30	12	11.7	8.8
3	1.31-1.45	29	28.2	8.5
4	1.46-1.60	28	27.2	9.7
5	1.61-1.75	21	20.4	9.9
6	1.76-1.90	10	9.7	10

Correlation of Mean measurements of diameter of portal vein with body surface area ranging from 1.05 to 1.88 sq.m, Mean measurement of diameter of portal vein in the group 1.16-1.30 sq.m (cases 12) is 8.8 mm, Mean measurement of diameter of portal vein in the group 1.31-1.45 sq.m (cases 29) is 8.5 mm, Mean measurement of diameter of portal vein in the group 1.46-1.60 sq.m (cases 28) is 9.7 mm, Mean measurement of diameter of portal vein in the group 1.61-1.75 sq.m (cases 21) is 9.9 mm, Mean measurement of diameter of portal vein in the group 1.76-1.90 sq.m (cases 10) is 10 mm (Table/ Fig 10)

Body surface area (BSA): BSA and diameter of portal vein at porta hepatis. The correlation coefficient was 0.333 which at degrees of freedom was very highly significant (p<0.01) Thus it is found that there is positive relationship between weight and diameter of portal vein. (Table /Fig 11)

Table 11:

SN.No.	Variable pair	Correlation of coefficient	Significance
1	BSA and Diameter of portal vein	0.3334	P<0.01,Df =99 Very highly significant

Statistical significance of Body surface area with diameter of portal vein

Comparison of the Mean values of height, weight, body surface area, diameters of portal vein in males and females

Table 12:

Gender .	No. Of cases	Mean Height	Mean weight	Mean BSA	Mean PV
Female	54	150	47.3	1.39	8.7
Male	49	165	55.98	1.61	9.63

Comparison of the Mean values of height, weight, body surface area, diameters of portal vein in males and females. Mean diameter of portal vein in female is 8.7 mm and in male 9.63, that is in females the diameter is lesser than in males (Table/Fig 12)

DISCUSSION

Evaluation of the portal vein on ultrasound is of better advantage as sonography is noninvasive, rapid and reliable. The description normal ultrasound of portal venous system is described in detail[8] In Pathological conditions such as portal vein thrombosis, cavernous transformation of portal vein, portal invasion by tumour and mostly portal hypertension, evaluation and measurement of portal vein can be of utmost importance to establish the diagnosis on ultrasound. Few studies have dealt with the normal measurement of portal vein on ultrasound. Normal mean diameter of portal vein 6.3. 3. Another study reported the mean diameter of portal vein at porta hepatis on ultrasound to be 10 mm +_2 mm.[1]. Yet another studies found the diameter of portal vein to be less than 13 mm.[9] In our study, we have not included the changes caused by the phases of respiration on diameter of portal vein. carried out the normal measurement of portal vein and found to to correlating with the parameters age, height, weight and body surface area The visualisation of portal vein along with its collaterals is important to established the diagnosis portal hypertension. Diameter of portal vein greater than 13 mm is suggestive of the portal vein hypertension.[10] In our study, mean diameter of portal vein is found 9.22 mm with standard deviation of 1.29 mm. We found the very highly significant correlation between other parameters like height, weight, and body surface area. Thus while evaluating the portal vein diameter of height weight and body surface has to be considered for the accurate diagnosis

CONCLUSION

Diameter of portal vein at porta hepatis was found to be 9.30 +2.29 mm. It has positive correlation with the physical data such as height, weight and body surface area.

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Source of Support: None Declared
Conflict of Interest: None Declared