



## **SONOGRAPHICAL ASSESSMENT OF PORTAL VEIN DIAMETER IN NORTHERN PART OF WEST BENGAL, INDIA**

Jayanta Bhattacharya,<sup>a</sup> Aditi Das<sup>b</sup> and Anish Bhowmik<sup>c</sup>

a,b,c. Department of Physiology, Malda Medical College, Malda, West Bengal – 732101, INDIA

\*Corresponding Author's e-mail: [anish.bhowmik@yahoo.co.in](mailto:anish.bhowmik@yahoo.co.in)

Received: 5<sup>th</sup> Sept. 2013

Revised: 11<sup>th</sup> Sept. 2013

Accepted: 23<sup>th</sup> September 2013

**Abstract:** 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. But there is paucity of data regarding normal portal vein diameter in northern part of West Bengal, India. Therefore this study was undertaken to throw light into this matter. In this work, we analyzed retrospectively the data regarding portal vein diameter obtained from 2D-Ultrasound of whole abdomen from 500 adults aged between 20 to 50 years of both sexes (male 276, female 224). All the cases met our selection criteria. The results were tabulated and analyzed statistically. The mean diameter of portal vein in male subjects was  $10.37 \pm 1.03$  mm and in females it was  $9.82 \pm 1.01$  mm. A standard for normal portal vein diameter has been set up which may help clinicians to detect and evaluate several clinical situations.

**Keywords:** Diameter, Portal vein, Ultrasonography.

**Postal Address:** Department of Physiology, Malda Medical College, Malda, West Bengal- 732101

### **INTRODUCTION**

The portal vein and hepatic artery form the liver's dual blood supply. Majority (about 75%) of hepatic blood flow is derived from portal vein while the remainder comes from the hepatic artery. The portal vein is formed by union of superior mesenteric vein and splenic vein, behind the neck of the pancreas at the level of second lumbar vertebra (Standing, 2005). For this reason, portal vein is sometimes called the splenic-mesenteric confluence (Dutta, 2003; Standing, 2005). It is about 8 Cm (3 inches) long in adults. Immediately before reaching the liver, the portal vein divides into right and left branches. Each branch enters the corresponding lobe of the liver, where they divide further into small venous branches leading to portal venules. Each portal venule courses alongside a hepatic arteriole and the two vessels form the vascular components of the portal triad. The venules ultimately empty into the sinusoids of the liver. From the sinusoids, the blood passes into the hepatic veins which join into the inferior vena cava. So, unlike most other veins, the portal vein does not drain into the heart. Rather, it is part of a portal venous system that delivers venous blood into another capillary system, the hepatic sinusoids (Romanes, 2002). The portal vein by carrying venous blood for the gastrointestinal tract accomplishes two functions; it supplies the liver with metabolic substrates and it ensures that ingested substances (foods, toxins etc.) are first processed by the liver before reaching the systemic circulation. This intimate and intricate relationship between the liver and portal vein maintains homeostasis in our body. The major abnormality of the portal venous system is portal hypertension which develops when increased resistance to portal flow and/or increased blood flow occur (Moore, 2006). The result of portal hypertension is enlargement of extra hepatic and intrahepatic portal vessels and development of spontaneous porto systemic collaterals (Anson and Mcvay, 1971; Moore, 2006). Portal venogram, splenoportography and arteriography have been used to diagnose portal

hypertension and portal thrombosis (Henrici, 1998). These methods are invasive, so evoke discomfort and risks. Moreover, majority of the patients suffering from portal hypertension have bleeding disorders which herald significant morbidity with the above said procedures. In contrast, ultrasound is simple, non-invasive yet informative, so well suited. Portal vein diameter can be easily accessed by ultrasound technique. Yet there is scanty data regarding normal portal vein diameter assessed by ultrasonography, particularly in northern region of West Bengal, India. So, we had sonographically measured the diameter of portal vein in a large series of people in this study.

## MATERIALS AND METHODS

Our study was a cross-sectional study with sample size of five hundred (500). For this study, we collected retrospectively ultrasonograms with full report of whole abdomen of these five hundred people attending radiodiagnosis department of Malda Medical College and Hospital, Malda, West Bengal, India, a district of northern part of West Bengal. The data covered time duration of 6 months (January 2013 to June 2013). The study group comprised individuals of different age groups ranging from 20 to 50 years of both sexes. Permission from the Ethical Committee of the Institution was taken. Written consent was obtained from all the subjects to use findings of their ultrasound reports in our study. Subjects with history of hepatobiliary disease, pancreatic disorders, cardiac disorders, splenomegaly and portal hypertension were excluded. All our subjects were undergone ultrasonography as part of their routine investigations as advised by the outdoor clinicians of this Institution. The study group was undergone ultrasonography of whole abdomen using transabdominal 2D Siemens Sonoline-2 with a 4.2 MHz sector probe. Each subject was undergone ultrasonography (USG) in the morning after an overnight fasting as certain types of food may affect the diameter of portal vein. USG in each case was done in supine position and during quiet respiration. For the measurement of portal vein, the transducer was placed transversely at the epigastric region with sight adjustment depending on the position of the pancreas of the subject. When visualization was optimal, measurement was done at the level immediately superior to the head of the pancreas, distal to the confluence of splenic vein and superior mesenteric vein. The measurements were obtained 'lumen to lumen' and measured in millimeters (mm). The data was tabulated and statistically analyzed.

## RESULTS AND DISCUSSION

The average portal vein diameter of males in the age group of 20-50 yrs as reflected in our study was  $10.37 \pm 1.03$  mm and in females it was  $9.82 \pm 1.01$  mm. It was observed to be  $10.02 \pm 0.89$ mm when taken both genders together. Age group wise male and female average portal vein diameters were also measured and displayed (Tables 1 and 2). Several other studies reported a normal portal vein diameters of  $11.02 \pm 1.7$  mm (Niedern et al., 1983),  $9.7 \pm 1.6$  mm (Rosner, 2000) and  $9.92 \pm 1.6$  mm (Dahnert, 2003) in 18-60 years of age group. So, this study is in tune with these previous studies conducted in Western countries.

**Table 1: Gender wise and Age wise distribution of study group**

Age Group	Number	Male	Female
20 – 30 yr.	118	68	50
31 – 40 yr.	180	98	82
41- 50 yr.	202	110	92
	Total Number =500	No. of male = 276	No. of female=224

**Table 2: Mean Diameter of Portal Vein**

Age Group	Total Number	Male	Mean Diameter (mm)	Female	Mean Diameter (mm)
20-30 yr	118	68	$10.32 \pm 0.71$	50	$9.81 \pm 1.13$
31-40 yr.	180	98	$11.12 \pm 0.81$	82	$10.36 \pm 1.12$
41-50 yr.	202	110	$11.08 \pm 1.20$	92	$10.52 \pm 0.98$

Average Portal vein Diameter in Males : 10.37 ± 1.03 mm  
Average Portal vein Diameter in Females : 9.82 ± 1.01 mm  
Average Portal vein Diameter (both male and female included) : 10.02 ± 0.89 mm

In majority of the reports, a mean portal vein diameter less than 13 mm was described. When portal hypertension is suspected, sonography provides a valid initial screening method. In these situations, sonography may provide valuable information about the potency and caliber of the portal vein (Barnett 1985; Rumalk et al., 2005). For example, in case of acute gastrointestinal hemorrhage, an enlarged portal vein (more than 13 mm diam.) could rapidly identify portal hypertension as a possible aetiology (Kane and Latcz, 1992; Marks et al., 1999). Ultrasonography technique such as duplex ultrasonography is non-invasive, rapid, sensitive and specific to evaluate a case of portal hypertension. Unlike the invasive angiographic techniques such as transhepatic portography, transumbilical catheterization, wedge hepatic venography and arterial portography, it is more acceptable to the patient (Dach et al., 1981). When respiratory variation in the size of portal, splenic and superior mesenteric veins does not occur or when it is less than 20%, portal hypertension may be diagnosed with a sensitivity of 80% and a specificity of 100% (Dach et al., 1981; Grainger and Allison, 2001).

In all cases having bleeding varices that are unresponsive to endoscopic sclerotherapy or when intractable ascites are present, a procedure known as transjugular intrahepatic portosystemic shunt (TIPS) is undertaken. TIPS is a radiology-guided creation of a shunt between the portal and hepatic veins in the liver via percutaneous transjugular approach. TIPS is performed after portal vein patency is documented by duplex ultrasonography. Because of its proven safety and effectiveness, TIPS has largely replaced surgical decompressive shunt procedures (Grace 2003; Jarrcil, 2008). In these cases, also, the idea of normal portal vein diameter will help the performer of this life- saving procedure. In vast majority of patients, portal vein diameter is less than 13 mm. The portal vein may dilate in patients with cirrhosis of liver, but rarely exceeds 20 mm (Juttner et al., 1998). Patients having portal vein diameter more than 20 mm, particularly if the dilatation is focal or fusiform in nature, may be thought to have portal venous aneurysm (Merritt, 1990; Biondil et al,1992) The diameter of the portal vein during quiet breathing in normal patients typically increases more than 20% with deep inspiration. This increase is typically dampened in patients with cirrhosis and portal hypertension (Biondil et al, 1992). So, by a simple, noninvasive ultrasonographic method, a standard for normal portal vein diameter has been established which may help to identify and evaluate several clinical situation.

## CONCLUSION

Establishment of normal portal vein diameter will enrich our own data bank based on which different clinical condition can be better evaluated. This is particularly true in cases of portal hypertension. More elaborate studies involving more number of patients are required in this regard.

**Acknowledgements:** Authors are thankful to the staffs of the Department of Radio-diagnosis, Malda Medical College and Hospital, Malda, West Bengal, India for their active co-operation during collection of the data used in this study.

## REFERENCES

- Anson and Mcvay, (1971). Surgical Anatomy, 5<sup>th</sup> Edn. Oxford University, New York, pp. 579-581.  
Barnett, E. (1985). Clinical Diagnostic Ultrasound. 1st Edn. Black Scientific Publication, Oxford, pp. 388-391.  
Biondil, J. Fisher, M. Collin, PR. Marks, M. (1992). Ultrasonography in the Diagnosis of Portal Hypertension: Diminished Response of Portal Vessels to Respiration. Radiology. Vol.142. pp.167-172  
Dach, JL. Ratchel, C. Bruce, EJ. Simpson, PL. (1981). Sonography of Hypertensive Portal Venous System. Correlation with Arterial Portography. AJR Vol. 137, pp. 511-517.

- Dahnert, W. (2003). *Radiology Review Manual*. 5th Edn. Lippincott, Williams and Wilkins, Philadelphia, pp. 733-736.
- Dutta, A.K. (2003). *Essentials of Human Anatomy*. 6<sup>th</sup> Edn. Current Books International, Kolkata. pp. 244-247.
- Grace, C. (2003). *Clinical Surgery*. 2<sup>nd</sup> Edn. Black Well Sciences, Oxford. pp. 325-326.
- Grainger and Allison, (2001). *Diagnostic Radiology*, Vol 2. 4<sup>th</sup> Edn. Harcourt, Churchill Livingstone, pp. 1237-1240.
- Hennrici, M. (1998). *Vascular Diagnosis with Ultrasound*, 2<sup>nd</sup> Edn. Stuttgart, Germany, pp.285-286.
- Jarrcil, BE. (2008). *National Medical series for Independent Study on surgery*. 5<sup>th</sup> Edn. Lippincott, Williams and Wilkins, Philadelphia. pp. 248 – 249.
- Juttner H., Philler C.K., Marritt G., Romany J., (1998). *Ultrasound Demonstration of Portosystemic Collaterals in Cirrhosis and Portal Hypertension*. *Radiology*, Vol. 142. pp. 167-172.
- Kane and Latz., (1992). *The Spectrum of Findings in Portal Hypertension*. *Radiology*, 142:453-458.
- Marks WM., Filly R.A., Callen P.W., (1999). *Ultrasonic Anatomy of the Liver : a Review with New Application*. *JCU*, Vol. 7. pp.137 – 146.
- Merritt, CB. (1990). *Ultrasonographic Demonstration of Portal Vein Thrombosis and Hypertension*. *Radiology* 133:426-428.
- Moore, KL. (2006). *Clinical Oriented Anatomy*. 5<sup>th</sup> Edn. Lippincott, Williams and Wilkins, Philadelphia. pp. 260 -262.
- Niedern C., Rossen L., Klause PJ., Morkel GS., (1983). *Sonographic Measurement of the Normal liver, Spleen, Pancreas and Portal vein*. *Radiology* Vol. 149, pp.537 – 540.
- Romanes, GJ. (2002). *Cunningham's Manual of Practical Anatomy*. Vol.2. 15<sup>th</sup> Edn. Oxford University, New York; pp. 199-151.
- Rosner, B.( 2000). *Fundamentals of Biostatistics*. 5<sup>th</sup> Edn. Duxbury, USA. pp. 80-140.
- Rumalk Cm., Patter J., Mossen CM., (2005). *Diagnostic ultrasound*. Vol. 3<sup>rd</sup> Edn. Elsevier Mosby, St. Louis, pp. 101-103.
- Standing, S. (2005). *Gray's Anatomy*. 39<sup>th</sup> Edn. Elsevier, Churchill Livingstone pp.1218-1220.
- 

**CONFLICT OF INTEREST** : Nothing