JMBR: A Peer-review Journal of Biomedical Sciences
June 2014, Vol. 13 No.1 pp 17-24

GREY-SCALE SONOGRAPHIC EVALUATION OF PORTAL VEIN DIAMETER IN HEALTHY NIGERIAN ADULTS.

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Abstract

To determine, by grey scale ultrasonography, normal portal vein diameter among healthy adults in Benin–City, Nigeria and correlate the values with age, gender and body mass index. This was a cross sectional ultrasound study of 250 randomly selected healthy subjects, under fasting conditions. Subjects with history of jaundice, alcoholism and liver disease were excluded. A 3.5MHz curvilinear transducer was used in scanning the selected subjects. Portal vein diameter was measured at its broadest part, distal to the union of the superior mesenteric and splenic veins. Two hundred and fifty apparently healthy subjects were assessed, comprising of 53 males (21.2%), and 197 females (78.8%). Portal vein diameter ranged from 6-14mm, with a mean value of 10.3±1.5mm. The mean value for males was 10.5±1.5mm, and, for females 10.2±1.3mm. There was no significant correlation between measured values and age, gender and body mass index. The range of measurements obtained in this study has provided reference values for portal vein diameter in our environment. Thus, objective assessment of changes in portal vein diameter as may occur in some disease conditions such as portal hypertension can be made.

Introduction

The portal vein is formed by the union of the superior mesenteric and splenic veins (portal confluence) behind the neck of the pancreas at the level of the first and second lumbar vertebrae. [1] It is easily located in the portal hepatis by grey-scale ultrasound, [2] thus changes in the main vessels in the portal venous system can be demonstrated. The major abnormality of the portal venous system is portal hypertension, which develops when increased resistance to portal blood flow occurs, resulting in enlargement of the vessels.

Ultrasound is well suited for imaging the portal vein because it is simple, non–invasive and rapidly accomplished. It can also differentiate between soft tissue and show motion in real time. However, it is operator dependent. Colour Doppler ultrasound can show the direction of flow of the vessels due to colour coding, and differentiate an artery from a vein. Power Doppler ultrasound is useful in assessing small vessels and slow flow. Other imaging methods like portal venography, splenoportography and arteriography are expensive, time consuming and involve risk and discomfort to the patient, while Computed Tomography and Magnetic Resonance Imaging are both expensive and the former exposes the patient to ionising radiation.

Studies on ultrasonography of portal vein are few in Nigeria. This study was therefore carried out to contribute to local data on the subject, and enable comparison with international reports. The information will possibly be useful in evaluation of suspected portal hypertension in a variety of clinical situations.

KEYWORDS: *portal vein diameter, ultrasonography, Benin–City.*

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Materials and Methods:
This was a cross-sectional study of 250 randomly selected, apparently healthy adults, comprising of staff and students of the University of Benin and University of Benin Teaching Hospital and other volunteer adults. The study period spanned four months, from January to April 2012. Approval for the study was sought and obtained from the Hospital Ethical Committee. Following informed content, subjects who met the inclusion criteria were recruited. These included adequate visualization of extrahepatic portal vein around the porta hepatis, absence of history or signs suggestive of chronic liver disease and chronic alcoholism while exclusion criteria included the following; signs suggestive of chronic liver disease, chronic alcoholism, pregnancy, and use of oral contraceptives.

Following an overnight fast, each subject was scanned with the 3.5 MHz curvilinear probe of a SONOACE X4 ultrasound machine (Medison Co; Korea, 2010). Each subject was exposed from the xiphisternum to the pelvic brim, and ultrasound gel applied to the four quadrants of the abdomen. Longitudinal and transverse scans of the upper abdomen were done in the supine or right anterior oblique position, during quiet respiration. During arrested respiration, when visualization of the portal vein was optimal, measurement was made at its broadest part, just distal to the union of the superior mesenteric and splenic veins, with the calipers placed between the inner margins of the echogenic walls of the vessel (Figure 1). Measurement (in mm) was made thrice and the average value recorded. After scanning, the subject's abdomen was wiped with a dry towel. Demographic data such as age, sex, weight and height were also recorded. Body mass index was calculated from weight and height using the Quetelet's formula; [3] BMI = Weight (Kg)/Height (m)^2.

The data obtained was statistically analysed using the Statistical Package for Social Sciences (SPSS) version 16. Portal vein diameter was compared with age and BMI using Chi-square test, while portal vein diameter and gender comparison was by student's t- test. Level of significance was tested at 95% interval and p-values less than or equal to 0.05 were considered significant.

Results
A total of 250 apparently healthy subjects were studied, consisting of 53 males (212%) and 197 females (78.8%). The male: female ratio was 1:3.7, while the age range of subjects was 18-87years. Table 1 shows the age and sex distribution of the study subjects.

The mean diameter of the portal vein for all study subjects was 10.3 ± 1.3mm; with a range of 6-14 mm. Age group 18-27yrs had a mean value of 9.9 ±1.4mm; while age group 78-87yrs had a mean portal vein diameter of 10.7 ± 2.2mm.

There was no significant correlation between portal vein diameter and age of subjects (p=0.10). The age related values of portal vein diameter are shown in Table 2.

Table 3 shows portal vein diameters according to gender. The mean diameter for males was 10.5±1.5mm, while the value for females was 10.2 ± 1.3 mm. The difference was not statistically significant (p=0.08).

Table 4 shows the values of portal vein diameter according to body mass index. Subjects were classified as normal (BM1: 18.5–25.0), underweight (<18.5), overweight (>25.0) and obese (30.0-35.00). The mean values for portal vein diameter

for both males and females in the subjects with normal BMI were 10.6±1.7 mm and 10.3±1.3mm respectively. Comparison of values of body mass index and portal vein diameter of respondents shows no statistically significant correlation between these two parameters (X^2=2.565; df= 2; p=0.28).

Figure 2 is the scatter diagram of the relationship between average portal vein diameter and body mass index.

Discussion

Real time grey-scale ultrasonography has made it possible to elevate the portal venous system in patients with various medical conditions like chronic liver disease, where portal hypertension can be diagnosed, since an increase in size of the portal vein is indicative of portal hypertension.[4] Sonographic evidence of portal hypertension includes lack of caliber variation in one of the major tributaries of the portal vein during respiration.[5, 6] A non-invasive imaging tool like ultrasound is particularly useful in patients suspected of having portal hypertension, since the associated impairment of renal and coagulation functions may compound the risk involved in invasive studies like angiography and phlebography.[7] In the initial investigation of suspected class of portal hypertensive, a scan with a normal portal and splenic vein excludes extra hepatic venous obstruction[7]

There exists variations in the reported values of normal portal vein diameter due to reasons such as wide age range of study subjects, sites of measurement, as well as postures of subjects and respiratory phase.[8,9] In one of the earliest studies Webb et al, [10]reported a mean portal vein diameter of 6.3 ±2.3mm among 22 subjects studied; this relatively low mean value in that study was attributed to the inclusion of both paediatric and adults subjects. The low sample size could also be responsible. Among African subjects, Anakwue et al[11] studied 200 healthy adult volunteers in South-Eastern Nigeria and reported a mean portal vein diameter of 11.5 ± 1.5mm. Ukperi[12] in Ibadan, South, West Nigeria, studied 340 subjects and reported a mean value of 8.1 ± 0.12mm while this present study assessed 250 subjects and got a mean value of 10.3 ±1.3mm. Ongoiba et al,[13] in Bamako, Mali, reported a mean value of 9.2 ± 2.6mm among 60 subjects studied. These findings tend to suggest a lack of significant variation in portal vein diameter among ethnic groups in Nigeria and, indeed, among Africans.

Tasu et al, [14] in Iran, reported mean values of 11.0 ± 0.3mm for portal vein diameter in 30 normal individuals. Weinreb et al[15] studied 148 subjects in the United States of America reported a mean value of 11.0 ± 2.0mm. The similarity in values between these two studies and the present one would suggest lack of significant variation in portal vein diameter among races.

Some studies have documented portal vein diameter to vary with age, sex and body mass index. The mean portal vein diameter among males in this study was higher than females, being 10.5 ± 1.5 mm and 10.2 ± 1.2 mm respectively. This difference was not statistically significant; p = 0.08. This is in agreement with the reports of Weinreb et al, [15] Goya et al, [16] and Kurol et al, [17] who found no significant influence of gender on portal vein diameter.

The influence of age on portal vein diameter has been documented by previous studies with varied results. This study showed no statistically significant influence of age on portal vein diameter; p=1.10. It however

contrasts with the findings of Patriquin et al, [17] who studied portal vein diameter among 150 children, where they demonstrated a significant increase in portal vein diameter with age. The reason for this linear increase could be due to the fact that most of the body organs tend to increase in size during the active growth phase in childhood.

This study did not show any significant correlation between body mass index (BMI) and portal vein diameter. This agrees with the work of Goyal et al,[16] on factors influencing the dimensions of the portal vasculature in normal adults, where the correlation between factors such as age, sex and BMI and portal vein diameter was reported as poor.

The site of measurement been documented as possibly influencing portal vein diameter. Among the Iranian population, Rokni-Yazdi et al[18] measured the portal vein diameter in 37 apparently healthy subjects at the point of crossing with the inferior vena cava during normal respiration and obtained a mean value of 9.4 ±1.7mm. Cosar et al[19] in Turkey measured the portal vein diameter at its broadest part, just distal to the confluence, in a cohort of 30 alcoholics and equal number of asymptomatic controls. The mean value reported was 11.7±0.3mm. This present study measured portal vein diameter at its broadest part just distal to the confluence of the splenic and superior mesenteric veins and got a mean value of 10.3 ±1.3mm. Although similar in methodologies, probable explanations for the slight difference in mean values between this study and that of Cosar et al[19] include lower sample size and measurements that were taken in deep inspiration.

The range of measurements for portal vein diameter in this study (6–14 mm), is in agreement with previous similar studies. [8, 11-12, 15]

Conclusion:

This study has established baseline mean and normal range of portal vein diameters for healthy adults in a Nigerian population. It has also shown that no significant correlation exists between portal vein diameter and age, gender and body mass index. A portal vein diameter greater than 14mm may be suggestive of portal hypertension in some clinical situations.

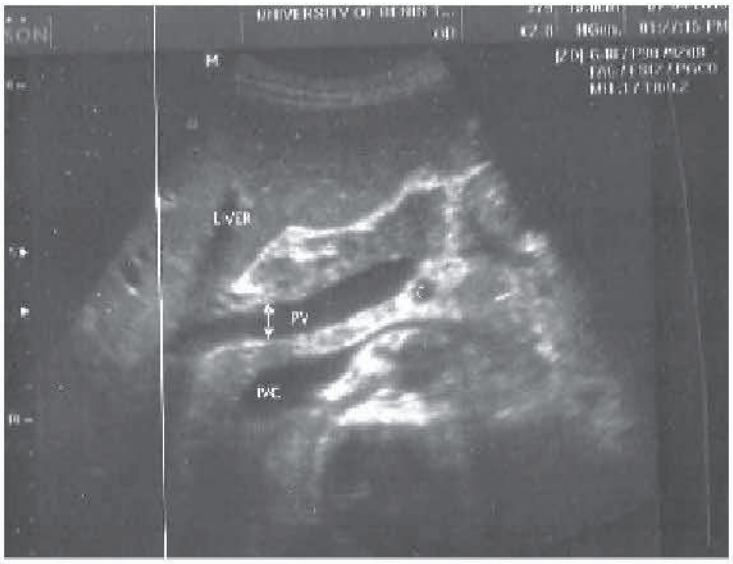

Figure 1: MEASUREMENT OF THE PORTAL VEIN DIAMETER AT THE LEVEL OF THE INFERIOR VENA CAVA (IVC) ON A LONGITUDINAL SCAN

C. Celiac artery, PV. Portal vein, IVC. Inferior vena cava

TABLE 1

Age and Sex Distribution of subjects.

Age group (years)	Male n(%)	Female n(%)	Total n(%).
18 – 27	13 (5.2)	62(24.8)	75(30)
28 – 28	16 (6.4)	55 (22)	71(28.4)
38 – 47	6 (2.4)	39 (15.6)	45 (18)
48 – 57	2 (0.8)	23 (9.2)	25 (10)
58 – 67	10 (4)	14 (5.6)	24 (9.6)
68 – 77	5 (2)	1 (0.4)	6 (2.4)
78 – 87	1 (0.4)	3 (1.2)	4 (1.6)
TOTAL	53 (21.2)	197 (78.8)	250 (100)
$\bar{X}$ ± SD	42.6 ± 18.3	36. 4 ± 13.4	

TABLE 2

Subjects age group and portal vein diameter.

Age (years)	portal Vein Diameter ($\bar{X}$ ± S D)mm
18 – 27	9.9 ± 1.4
28 – 37	10.5 ± 1.3
38 – 47	10.4 ± 1.3
48- 57	10.2 ±1.2
58 – 67	10.4 ±1.2
68 – 77	10 .8 ± 1.4
78 – 87	10.7 ± 2.2

X^2 =33.09 df = 24 p=0.10

TABLE 3

Subjects age group and corresponding mean portal vein diameter according to gender.

Age group (Years)	Portal Vein Diameter Male $\bar{X} \pm SD$ (mm)	Female $\bar{X} \pm SD$ (mm)	t- test	P value
18 – 27	10. 1 ± 1.5	9.8 ± 1.3	0.49	0.62
28 – 37	10. 4 ± 1.7	10.6 ± 1.2	-0 .52	0.61
38 – 47	11.4 ± 1.2	10.3 ± 1.3	1.82	0.08
48 – 57	10.8 ± 2.0	10.2 ± 1.2	0.70	0.49
58 – 67	10.9 ±1.0	9.9 ± 1.1	2.17	0.04
68 – 77	10.7 ± 1.5	10.8 ± 0.0	-0.04	0.97
78 – 87	7.7 ± 0.0	11.7 ± 0.9	-3.85	0.06
Mean ($\bar{X}$)	10.5 ± 1.5	10.2 ± 1.3	2.73	0.08

TABLE 4: Portal vein diameter according to body mass index

BMI (kg/m^2)	MALES n(%)/Mean	FE MALES n(%)/Mean	*P – value*
Underweight (≤18.5)	1(0.4)/9.3±0.0mm	6(2.4)/7.5±1.1mm	0.813
Normal (18.5 – 25.0)	31(12.4)/10.6±1.7mm	91(36.4)/10.3±1.3mm	0.377
Overweight (>25.0)	21(8.4)/10.5±1.3mm	100(40)/10.2±1.3mm	0.406

X^2=2.565; df=2; p=0.28

*BMI classification was adapted from WHO Expert Consultation Report[3]

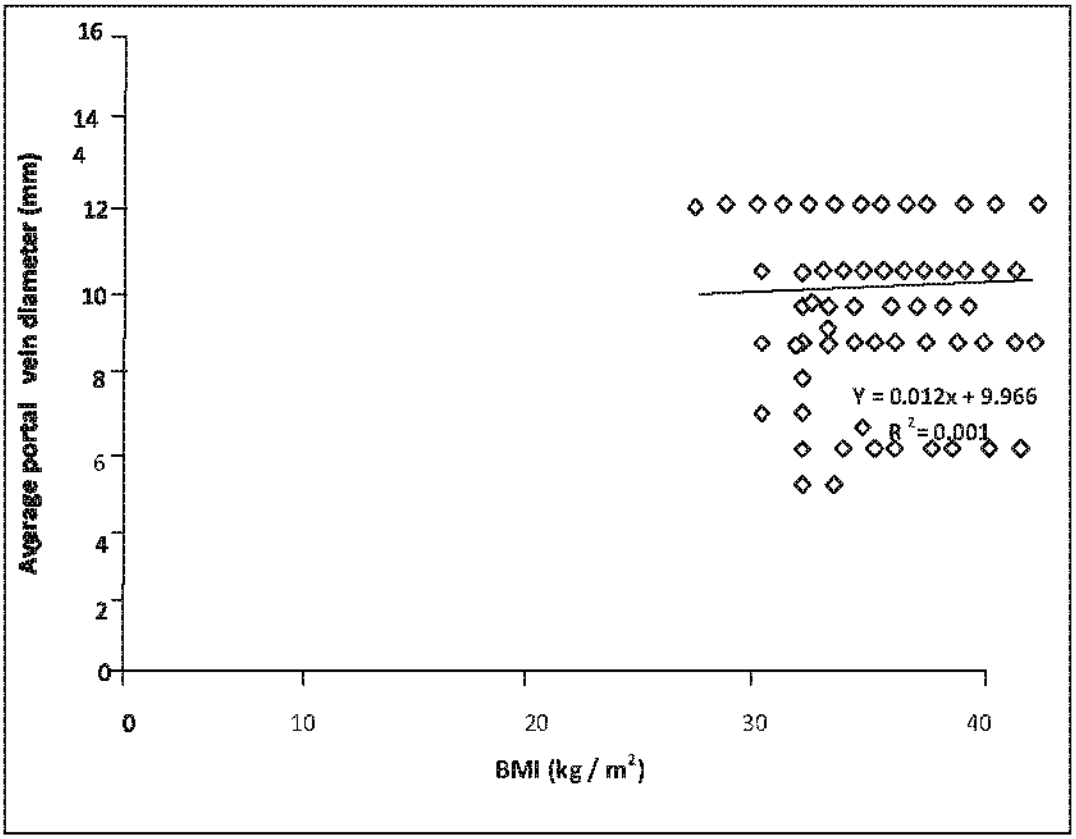

Fig. 2: SCATTER PLOT SHOWING RELATIONSHIP BETWEEN AVERAGE PORTAL VEIN DIAMETER AND BODY MASS INDEX.

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