

Thematic area: Infectious, non-communicable Disease and Nutrition
Sub-Thematic: Diagnostic Methods Development and Evolution
Jimma University, Collage of Public Health and Medical Science,
Department of Radiology.

MEGA PROJECT: Diagnostic Imaging methods, Development and
Evolution

PROJECT MEMBERS

Dr Gemechu Geleto (MD, Resident)..... Principal investigator
Dr Wondim Getnet (MD, Radiologist).....Co investigator1
Ato Tsegaye Tewelde (MPHE, BSC)..... Co investigator2
Mr. Mesfin Zewdu (MSc, Medical Physics)Investigator
Dr. Gemechis Asefa (MD, Resident).....Investigator

RESEARCH TOPIC: Ultrasound Assessment of Normal Portal Vein Diameter in
Jimma University Specialized Hospital

MARC, 2015

Jimma, EthiopiaULTRASOUND ASSESMENT OF NORMAL PORTAL VEIN
DIAMETER IN JIMMA UNIVERSITY SPECIALIZED
HOSPITAL

BY DR GEMECHU GELETO
RADIOLOGY RESIDENT

A RESEARCH PAPER FOR A THESIS TO BE SUBMITTED TO
THE DEPARTMENT OF RADIOLOGY, JIMMA UNIVERSITY,
IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR A
SPECIALTY CERTIFICATE IN RADIOLOGY.

MARCH,2015

JIMMA, ETHIOPIAJimma University, Department of Radiology
A Research Paper On

Ultrasound Assessment of Normal Portal Vein Diameter in Jimma

University Specialized Hospital

By Dr Gemechu Geleto

Radiology Resident

Advisor

1- Dr.Wondim Getinet (MD, Radiologist)

2- Ato Tsegaye Tewelde (MPHE, BSC)

March, 2015

Jimma, Ethiopia

Research Summary

Background: Portal hypertension occurs when the portal venous pressure exceeds 15mm Hg.. Liver cirrhosis, whatever the primary cause, is the commonest cause of portal hypertension. Because of its accessibility, lack of ionizing radiation and rapid assessment, sonography plays a major role in the assessment of portal hypertension. Even if the additional use of color and spectral Doppler improves the assessment of patients suspected of having portal hypertension, gray scale assessment of portal vein diameter is corner stone in the initial evaluation. Therefore knowing the normal portal venous dimension in a study population of interest is so crucial.

Objective:

The main objective of the study is ultrasound assessment of normal portal vein diameter in Ethiopians patients visiting Jimma University Specialized Hospital.

Methods:

A prospective cross-sectional study was done at Jimma University Specialized Hospital to sonographically assess the normal portal vein diameter pattern. Data were collected from patients visiting radiology department on consecutive bases from Dec- Jan, 2014 and analyzed using spss version 16

Result:

A total of 195 patients were included on the study, 75(38.5%) were females while 120(61.5%) were males. Mean PVD in quiet respiration and in the extremes of respiration was almost the same, 10.3 +1.8mm and 10.66+1.8mm respectively. The mean of portal vein diameter in Male were 11.10 +1.7mm and of Females were 10.1 + 1.5 mm ,and there p-value =0.096. Nineteen (10%) of participants had mean portal vein diameter of greater than 13mm (above normal) while 176(90%) had less than 13mm (normal range). There is significant variation of PVD with age but not with sex.

The Pearson correlation between them was correlated at 0.001.

Conclusion:

The mean portal vein diameter of the majority of the participants was comparable with many other study results and can be used as a base line for further related studies and workup of the causes of abnormally high portal vein diameter noted in this study.II

Key word: Portal vein diameter, Quite, Deep inspiratory and Deep expiratory

Acknowledgements:

I would like to forward my heartfelt thanks and gratitude to my advisors: Dr Wondim Getnet and Ato Tsegaye Tewelde for their invaluable and fruitful advice along with technical support in the development of proposal to this research.III

List of tables

Table 1

Mean and standard deviation of portal vein diameter distribution by age and sex PVD at JUSH, Oromia region, South West Ethiopia, 2015

Table 2

Mean and standard deviation of Quite, Deep inspiration and Deep expiration at JUSH, Oromia region, South West Ethiopia, 2015

Table 3

Mean of Quite respiration and averaged mean of PVD (mean of deep inspiratory and expiratory) at JUSH, Oromia region, South West Ethiopia, 2015

Table 4

Proportion of Abnormally high of portal vein diameter at JUSH, Oromia region, South West Ethiopia, 2015IV

Table of Contents Page

Abstract	I
Acknowledgements.....	II
List of Tables	III
Acronyms and Abbreviations	VI
Chapter One: Introduction	1
1.1 –Background	1
1.2 –Statement of the Problem.....	3
Chapter Two: Literature Review	5
2.1- Literature Review	5
2.2- Significance of the Study.....	9
Chapter Three: Objectives	10
3.1- General Objective.....	10
3.2- Specific Objectives	10

Chapter Four: Methods and Materials	11
4.1 – Study area and period.....	11
4.2- Study Design.....	11
4.3 – Population	11
4.3.1 –Source Population	11
4.3.2 –Study Population/ Sample population.....	11
4.4- Inclusion and Exclusion Criteria	12
4.5- Sample size and Sampling technique	12
4.6- Data collection and Measurement	12
4.6.1 –Data Collection Process and Instrument.....	12
4.6.2- Variables.....	13
4.7-Operational Definitions	13
4.8-Data Analysis.....	13
4.9-Data Quality Control	14V
4.10-Ethical Clearance.....	14
4.11-Communication of Results	14
4.12-Protection of Participant Confidentiality.....	14
Chapter Five: Results and Discussion	
5.1 –Results	15
5.2-Discusion	18
Chapter Six: Conclusion and Recommendation	
6.1-Conclusion.....	20
6.2- Recommendation	20
References	21
Annexes 1 – Questionnaires	24
Annexes 2 - Ultrasound Report Sheet... ..	24
Ultrasound Report Sheet table.....	25VI
ACRONYMS AND ABBREVIATIONS	
CF CYSTIC FIBROSIS	
CLD CHRONIC LIVER DISEASE	
HTN HYPERTENSION	
JUSH JIMMA UNIVERSITY SPECIALIZED HOSPITAL.	

MHZ MEGA HERTZ

mmHg MILLIMETER OF MERCURY

MRN MEDICAL REGISTRATION NUMBER

NCPHT NONCIRRHOTIC PORTAL HYPERTENSION

PHT PORTAL HYPERTENSION

PPF PERIPORTAL FIBROSIS

PSCT PORTOSYSTEMIC COLLATERAL SHUNT

PV PORTAL VEIN

PVD PORTAL VEIN DIAMETER

PVHV PORTAL VEIN FLOW VOLUME

RUQ RIGHT UPPER QUADRANT

SPSS STATISTICAL PACKAGE FOR SOCIAL SCIENCES

USG ULTRASONOGRAPHY

Chapter One: INTRODUCTION

1.1 Background

Portal hypertension is defined as an increase in portal venous pressure which results in impendence of blood flow through the vein into the hepatic circulation. It exists when the portal venous pressure is above 15mmHg or the hepatic venous gradient is more than 5 mmHg [3, 11]

Portal hypertension is caused most often by cirrhosis (in developed countries), schistosomiasis (in endemic areas), or hepatic vascular abnormalities. [1] Portal hypertension is the most common complication and also one of the important causes of death in chronic liver diseases. [2]

Even if Cirrhosis is the most common cause, portal hypertension can also be present in the absence of cirrhosis in a condition referred to as "noncirrhotic portal hypertension". As a general rule, the clinical consequences of portal hypertension are similar regardless of the cause or site of obstruction. [4]

Portal hypertension leads to dilatation of portal vein, splenomegaly, and formation of portal systemic collaterals at different sites. The portal system and the systemic venous circulation are connected at several locations. . These are vascular channels that are functionally closed in normal conditions but become dilated in portal hypertension as a consequence of increased intravascular pressure and blood flow. As the result of that there is development of portosystemic collateral shunts which diverts blood away from the liver. Gastro-oesophageal varices is one of the consequence of collateral shunts which if responsible for the main complications of portal hypertension that is massive upper GI bleeding. [2, 4]

Ultrasound is important in obtaining information on the condition of the portal venous system in all patients with various medical conditions like chronic liver disease. In such cases it is used to detect diameter increment of portal vein as indicative of portal hypertension. Ultrasound can detect variable degree of periportal thickening along with dilatation of portal vein in schistosomiasis [5]2

Gray-scale and Doppler US allow anatomic and functional evaluations of the major tributaries of the portal venous system and, when performed by an experienced sonographer, can provide valuable information. [6]

Sonography, in addition of being nonionizing, its accessibility, noninvasiveness, portable nature, reliability, low cost and also its ability of rapidly accomplishment makes it a good diagnostic tool which plays a great role in the diagnosis and follow up of patients with PHN. It can also suggest the possible cause too.

Even if duplex sonography assessment of the portal vein has the added advantage of assessing also the flow rate, gray scale measurement of the portal vein diameter is the corner stone and also has a reasonable accuracy in diagnosing patients suspected of having portal hypertension. [4]

Ultrasound is an accurate non-invasive means of assessing its etiology, severity and complications but in order to maximize diagnostic accuracy a systematic and thorough approach is advised involving assessment of the liver, spleen, portal and hepatic circulations. [7]

In countries like ours where there is no local standards for most of the measurements made during sonography, this will serve as a baseline for local reference use of portal vein diameter measurement. Dilatation of portal vein or increase in diameter of portal vein was also the only preliminary criteria by gray scale ultrasound to detect portal hypertension but its sensitivity and specificity can be maximized by doing caliber change with respiration .[4].

The most common global causes of PHT in cirrhosis are alcohol and hepatic viral infections as it is true in all regions of Ethiopia. Schistosomiasis is one other common cause of portal hypertension which is endemic in Ethiopia including Jimma. Hence, using easily available Bgray scale ultrasound is very important for early detection of portal hypertension with PVD measurement and subsequent management decision and patient follow up. [8.9]3

1.2 Statement of problem:

The portal vein begins by the convergence of superior mesenteric and splenic veins, behind the neck of pancreas and at the level of second lumbar vertebra. In an adult it is about 8 cm long and lies anterior to inferior vena cava and posterior to the neck of the pancreas below and the first

part of duodenum above. The diameter of normal portal vein can vary, normal being 7 to 15 mm.

Normal portal venous pressure is between 5 and 10 mmHg (14 cm of H₂O). If portal venous pressure is more than 15 mmHg (30 cm of H₂O) then it will lead to portal hypertension. [10]

As it is stated in many studies and standard text books it is safe to assume that a portal vein diameter greater than 13 mm is a fairly characteristic sign of portal hypertension in the appropriate clinical setting. [2,11, 12, 14]

Portal hypertension is the most common complication and also one of the important causes of death in chronic liver diseases.[2]

Ultrasound is important in obtaining information on the condition of the portal venous system in all patients with various medical conditions like chronic liver disease. An increase in the size of portal vein is indicative of portal hypertension. [5]

Ultrasound is an accurate non-invasive means of assessing its etiology, severity and complications but in order to maximize diagnostic accuracy a systematic and thorough approach is advised involving assessment of the liver, spleen, portal and hepatic circulations. [7]

Portal vein diameter is usually increased in most cirrhosis of liver with portal hypertension, and spleen is also enlarged in size. A few previously reported studies showed that there was a definite correlation between portal vein diameter and presence of gastroesophageal varices. Sarwar et al⁴ reported that patients with portal vein diameter more than 11 mm are more likely to have oesophageal varices. Another study by Dib et al⁵ showed that oesophageal varices developed when the portal vein diameter exceeded 13 mm. [2]

In one study done on pediatric patients with cystic fibrosis and 35 age-matched healthy control children, PVD was significantly increased in CF patients versus controls.[13]⁴

In schistosomiasis the liver parenchymal echogenicity is usually preserved. The portal vein and its tributaries are generally dilated. Collateral veins with hepatofugal flow are frequently reported, especially in the following veins: left gastric, short gastric, splenorenal and parumbilical. In the paraumbilical vein, the blood flows toward the umbilical scar, where it joins the superficial epigastric veins and may originate the "caput medusae". (Pinto-Silva et al. 1994).

In schistosomiasis, Portal hypertension can be suspected by B-mode sonography when dilation of one or more of the portal, mesenteric and splenic veins is observed (typical diameters for adults are: portal vein, < 12 mm; superior mesenteric and splenic veins, < 9 mm) and when the collateral veins are present.

Color Doppler increases the sensitivity of ultrasound because it detects the presence and direction of blood flow and the presence of hepatofugal circulation. Moreover, it is possible to measure flow velocity and to estimate the flow volume-per-minute, which indirectly assesses any physiopathological changes in portal circulation [12]

Abdominal ultrasonography is among the most valuable diagnostic tool for schistosomiasis-related organ lesions in endemic regions. Duplex-Doppler ultrasonography, allows the identification of a number of parameters related to the presence of portal hypertension: these are increase in portal vein diameter, lack of respiratory change in portal, splenic and mesenteric veins diameter, presence of portal-collateral circulation, decreased or reversed portal vein velocity, increased congestion index of the portal vein and presence of ascites and splenomegaly. Patients with thick PPF showed statistically significant higher values in PVD (Pvalue=0.001) and PVFV (P value=0.05) than those with fine PPF. [8]

The significance of this study is to assess the normal portal vein diameter pattern in using easily available B-scale Ultrasonography which is very crucial and helpful as a preliminary criteria above which portal hypertension can be strongly suspected in region like Jimma which hosts various risk factors for PHT.5

Chapter Two: Literature Review

2.1 Literature Review.

The hepatic portal vein is a component of the hepatic portal system of human body. By definition, the hepatic portal vein drains deoxygenated, but nutrient rich blood from different organs to the liver. Thus it is not a true vein, which by definition should drain the deoxygenated blood into the heart.[14]

The portal vein drains blood from the abdominal part of the gastrointestinal tract, which includes lower third of esophagus, stomach, all three parts of small intestine, all parts of the large intestine and upper half of the anal canal. It also drains blood from the accessory organs of digestive system including spleen, pancreas and gall bladder. The portal vein is about 8 cm long and is formed behind the neck of the pancreas by the union of the superior mesenteric vein and splenic vein. Immediately before reaching the liver, the hepatic portal vein divides into right and left branches. Each branch enters the corresponding lobe of the liver, where they divide further into smaller venous branches leading into the 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 liver, which supply blood to the organ. From the

sinusoids, the blood passes into the hepatic veins, which join the inferior vena cava [14.]

The portal venous supply for the left lobe can be visualized using an oblique, cranially angled sub-xiphoid view (recurrent subcostal oblique projection). The main and right portal veins are best seen in a sagittal or oblique sagittal plane. In normal individuals, the portal vein diameter does not exceed 13 mm in quiet respiration, measured in the liver hilum before bifurcation where the portal vein crosses anterior to the IVC. This assessment is usually conducted with ultrasound views along the long axis of the portal vein. Respiration and patient position greatly affect the size of the portal vein and its tributaries; therefore, diagnostic measurements must be standardised by examining the patient in the supine position and in a state of quiet respiration.

[2]6

As far as the site of measurement of PVD is concerned different studies used different reference points along the main portal vein, but all parts lie between the confluence of portal vein and before the bifurcation. Some researchers used to measure where the portal vein crosses anterior to the IVC{2}, in the liver hilum before bifurcation {4} and others took measurement just distal to the union of the SV and SMV in right oblique position.{5}. These all possible sites PVD values are literally accepted and compared with standard text book values.

Portal vein diameter variation across the age ,but with no gender variation, is observed in one study done in USA. In 21 patients aged 0-10 years, the mean diameter of the portal vein (\pm SD) was 8.5 ± 2.7 mm (range, 5-12 mm). In 20 patients aged 11 -20 years, the mean diameter was 10 ± 2 mm (range, 7-13 mm). In 49 patients aged 21-30 years, the mean diameter was 11 ± 2 mm (range, 6-15 mm). In 58 patients aged 31 -40 years, the mean diameter was 11 ± 2 mm (range, 6-15 mm). The overall mean diameter in 107 patients aged 21 -40 years was 11 ± 2 mm. There was no difference between the portal venous measurements of male and female patients.[11]

In light of the abundance of sonographic literature dealing with normal and abnormal portal veins anatomy, only limited studies have specifically dealt with portal vein measurements. The results have often been at variance and have resulted in some confusion in the sonographic literature. The earliest study reported a normal mean portal vein diameter of 6.3 ± 2.3 mm [15]. Other studies on groups of healthy patients reported measurements of 13.1 ± 1.7 mm [17] and 9.7 ± 1.6 mm [11] In the most recent report [16],a mean portal vein diameter of less than 13 mm was described. In one study done on patients aged 21 -40 years, no significant caliber variations in the normal portal vein during different phases of respiration noted [17]. This may be due to the age of those recruited for the study, variations of the site of measurement of the portal vein

diameter and posture of the subjects. .

Similar PVD values were reported in the study done on Nigerians and Caucasians. A mean portal vein diameter of 11.13mm \pm 2.11 in subjects 20-29yrs and 11.45mm \pm 1.49 in subjects aged 20-79yrs, is obtained in Nigerians with measurements taken just distal to the confluence of SV and SMV in the supine position. In this study done on adults from the southeast Nigeria presents 11.45mm as the mean portal vein diameter. This is in keeping with the work of Weinreb et al in7 Caucasians who reported a mean diameter of 11mm \pm 2mm in subjects aged 21-40yrs, with measurements taken just distal to the union of the SV and SMV in right oblique position. [5] Many researches done on portal vein diameter have shown the possibility of racial variation as average life span (age,) body mass index and other anthropometries varies with race. [21] In anatomical portal vein diameter cadaver study done in Sirilanka, showed a mean value of PVD less than the standard anatomy text books, for which racial variation is attributed as a factor. [22]

In one study done in England, for PVD and flow comparison among normal individuals and patients with cystic fibrosis showed, Diameter of portal vein (PVD) and flow data for portal vein showed consistent statistically significant abnormalities differences for CF-patients versus controls.[18]

Though Doppler study is not a topic of our interest in this study, Other US and Doppler-US signs of PHT include dilatation of portal vein (diameter >13 mm) ,reduced portal vein velocity, and lack or reduced respiratory variations of portal vein, splenic and superior mesenteric vein diameter.[19]

The study done in Egypt has enlightened schistosomiasis patients with periportal fibrosis (PPF) had relatively abnormal PVD than those patients without PPF. A total of 50 patients with their mean age 34.9 years were included in the study, No statistically significant differences in portal vein diameter (PVD), portal vein velocity (PVV) and portal vein flow volume (PVFV) between patients and control found. But patients with thick PPF showed statistically significant higher values in PVD (P value=0.001) and PVFV (P value=0.05) than those with fine periportal fibrosis (PPF). The portal hypertension of schistosomiasis is intra-hepatic and presumably related to the portal zone reaction. In advanced schistosomiasis, hepatic arterial hypertension contributes to increased sinusoidal pressure [8]. Qurashi et al [39] (1999) observed significant association between grades of PPF and PVD; as moderate and advanced fibrosis is associated with increased PVD. [8]

Another study done in Indian children with visceral leishmaniasis(VL) for assessment of PHN.

Eighty-eight consecutive cases (50 male) of VL were subjected to ultrasonography. Portal hypertension was present in 8 children as evidenced by dilated caliber of the portal and Splenic veins and splenic/peri-pancreatic collaterals. Two children had evidence of periportal, splenic and peripancreatic collaterals, and another child showed cavernous transformation of the portal vein. At follow-up, one month and 6 months later, ultrasonography of hepatobiliary system of eight children with portal hypertension showed no change in calibre of portal vein, splenic veins and Splenic or peripancreatic collaterals [20]

In one study in Austria, Changes of portal venous hemodynamics were investigated in 32 patients with cystic fibrosis (CF) with a mean age of 11.6 years. Hepatic profile of these patients included total bilirubin and albumin together with determination of size and echogenicity of the liver and spleen, determination of the diameter of the portal vein by real-time Sonography and quantization of flow volume of the portal vein using Duplex Doppler Sonography. As a control, 35 age matched healthy children were also examined. Diameter of the portal vein was significantly increased in CF patients versus controls. Comparison of the mean flow volume of the portal vein showed a significant increase in CF-patients over 12 y old versus controls. In patients less than 12 y no significant difference of flow volume of the portal vein between CF patients and controls was noted [13]

A groundbreaking study done in our country Ethiopia, AAUMF, a total of 502 patients were included in the study and out of these 312 (62.2%) were females and the rest 190 (37.8%) were males. Patients' age ranges between 5 – 85 years with a mean age of 39.6 ± 1.5 years. The mean portal vein diameter during quiet respiration was 7.9 ± 2 mm and the mean increase in diameter with inspiration being 21.5% was found. Under normal circumstance increase in diameter of portal vein with inspiration above 20% dictates the normality of portal vein. The increase in diameter in most studies is more than 20% also true in this Ethiopian study. [4]9

2.2 Significance of the study

Some researches done on portal vein diameter have shown some variation in PVD from the standard text books and have attributed the cause to be possibility due to racial variation [21, 22.] In addition there are limited researches done in Africa as well as in our country Ethiopia, on this area of study. [4, 5] The B-scale ultrasound available in most peripheral part of Ethiopia, do not have Doppler flow and spectral flow study of portal vein. But it can be used to measure the PVD and observe the respirophasic variation for the assessment of portal hypertension.[19] Alcohol and viral hepatitis are globally known to be the most common causes of cirrhotic portal

hypertension, similarly in almost all regions of the country, Ethiopia. The Jimma zone which is located in the southwest region of the Ethiopia is one of the regions where schistosomiasis is endemic. Schistosomiasis poses additional risk for the development of portal hypertension. This study was targeted to address the normal portal vein diameter pattern in JUSH, which is located where these multiple risk factors for PHT exist. The PVD measurement, by using easily available B-scale ultrasound, is technically easy but very crucial for early detection and assessment of portal hypertension,¹⁰

Chapter 3: OBJECTIVES

3.1 General Objective: –

To assess, with Sonography, the normal portal vein diameter pattern of clients coming to Radiology Department of Jimma university hospital for routine sonographic scanning in the study period.

3.2 Specific objectives:-

1. To assess mean and standard deviation of portal vein diameter among clients in radiology unit in Jimma University hospital,
2. To assess the proportion of portal vein diameter above 13 mm among clients in radiology unit in Jimma University hospital
3. To assess distribution of mean and standard deviation of portal vein diameter by sociodemographic characteristics of clients: age and gender in radiology unit in Jimma University
4. To assess the percentage of change in PVD with respiration among clients in radiology unit in Jimma University hospital¹¹

Chapter 4: Methods and Materials

4.1 Study Area and study period

A prospective cross sectional study was conducted in JUSH from Nov1 –Dec 30 2014 .JUSH is a referral hospital for around 15 million people from Jimma town and surrounding districts of Jimma zone and adjacent, regions, zones of South-Western Ethiopia. Jimma University Specialized Hospital (JUSH) is one of the teaching medical schools of the country. It has both undergraduate and graduate programmes, paramedical and medical departments. The hospital is located in Jimma town which is located 355 kms southwest of Addis Ababa. It has been providing radiological service with dedicated radiologist for more than one and half decade of years and recently launched pilot postgraduate study in radiology since 2011/12GC.

4.2 Study design

A cross sectional descriptive study was conducted using both quantitative and qualitative methods.

4.3 Study Participants

4.3.1 Source Population

All patients attending the radiology department for routine abdominal sonographic scanning during the specified study period

4.3.2 Study population

All patients attending the radiology department for routine abdominal ultrasound scanning and fit the inclusion criteria during the study period were selected for the study.¹²

4.4 Inclusion and Exclusion Criteria

4.4.1 Inclusion Criteria:-

All patients from every department of the hospital came to Radiology department for routine ultrasound scanning and who were fasted for at least six hours, and those who were cooperative included in the study.

4.4.2 Exclusion Criteria:-

Patients having the clinical diagnosis or sonographic features suggesting the presence of hepatobiliary disease, debilitated patient with hypertension ,diabetes mellitus cardiac disease, pregnant women, those having hepatobiliary surgery or recent surgery for other reasons too were excluded from the study.

4.5 Sample size and sampling technique

All patients fitting the inclusion criterion within the specified study period were included in the study. At least 200 clients were expected to be included in the study during the study period according to the flow pattern of patients to the department and resource limitation to extend the number of participants.

4.6 Data collection and Measurement

4.6.1 Data Collection Process and Instrument

A radiologist obtained measurements using an LOGIQ P6R3.5MHZ convex probe. Before specific measurement of the portal vein diameter, routine scanning was done to check for the presence or absence of sonographic exclusion criterias. If no exclusion criteria found we proceeded to the portal vein measurement. The patient was scanned in supine and right anterior oblique position with the transducer in the oblique position in the RUQ of the abdomen.

Measurement of the portal vein diameter was taken in quite respiration at the hilum of the liver just before bifurcation into right and left. The diameter was taken by putting the two cursors in the internal wall of the portal vein; the wall of the portal vein was excluded from the measurement. Supervision was made during the data collection by the principal investigators to assure the data quality¹³

4.6.2 Variables

Dependent Variable: portal vein diameter (PVD)

Independent Variables:

Age

Gender

4.7 Operational Definitions

Dilated PV: the portal vein diameter is said to be dilated if the measured value of PV according to the above mentioned standard of operation is greater than 13mm

Respirophasic variation: is calculated by the mean of deep inspiratory minus deep expiratory and divided by deep expiratory times 100%. It is considered normal if above 20%.

Portal hypertension is defined as an increase in portal venous pressure which results in impendence of blood flow through the vein into the hepatic circulation. It exists when the portal venous pressure is above 15 mmHg or the hepatic venous gradient is more than 5 mmHg (1).

4.8 Data Analysis

The collected data were checked for completeness and cleaned. Statistical Package for Social Sciences for window (SPSS) version 16 was used to enter and analyze the data. The mean portal vein diameter, Standard deviation and proportion of change of PVD with respiration were calculated. The portal vein diameter was cross tabulated with the age and sex of the patient. Respirophasic variation of the PVD was assessed by tabulation of the changes in number and in percentages. The value of $p < 0.05$ was considered as statistically significant. The result were presented in the form tables.¹⁴

4.9 Data quality Assurance.

The prepared questionnaire was pre tested on other patients who were not part of the study before it is administered to the actual study group in the presence trained sonographer.

The principal investigator trained the sonographer on filling the questionnaire and also supervised the completeness and relevance of the data collected daily on data collection days. Two different investigators (sonographers), who were not informed about the test, are made to

conduct the measurement of PVD using the above set standards of operation and the consistency of the result was checked among the two investigators.

4.10 Ethical Considerations

This study doesn't involve any potentially harmful intervention to the patient. Patients were scanned to get the routine sonographic examination service, and as part of the scanning process portal vein measurements are made. Before official commencement of the data collection process, ethical clearance was obtained from the ethical committee of PHMSC of Jimma University. Every participant in the study would be asked for his/her willingness to be involved in the study and verbal consent would be obtained based on free will. The information collected from participants was remaining confidential. Medical registration number(MRN) rather than patients name was used for data collection.

4.11 Communication of Results

The results of this study will be submitted to the department of Radiology, Jimma University.

4.12 Protection of Participant Confidentiality

The information collected from participants was remaining confidential. Medical registration number (MRN) rather than patients name was used for data collection.¹⁵

Chapter Five

5. Results and Discussions

5.1 Results

Mean and standard deviation of portal vein diameter distribution by age and sex:

A total of 195 participants were included on the study, of these 75(38.5%) were females while 120(61.5%) were males. As it is shown in the table below more males participated on the research. As it can be seen below, the mean of portal vein diameter in Male who were 120(61.5%) be 11.10 +1.7mm and of Females who were 75 (38.5%) 10.1 + 1.5 mm. Fifty six(28.7%) of the participants or patients were between the age of 21-30 with mean PVD of 11+1.4 and the next to the first were the age group of 51-60 which accounts 28(17.9%) had mean PVD of 10.9+1.7. While 13(6.7%) and 8(4.1%) patients whose age were >71 and between 61-70 respectively had similar mean PVD range (10.8+1.9). This table shows that the mean PVD has increasing pattern with age till the sixth decade and then shows slight drop (Table:1).

Table: 1 Mean and standard deviation of portal vein diameter distribution by age and sex

PVD at JUSH, Oromia region, South West Ethiopia, 2015.

variables Frequency Percent Mean PVD +SD

Age category < 10 12 6.2 7.8+ 1.6

11-20 28 14.4 9.9+1.7

21-30 56 28.7 11+1.4

31-40 25 12.8 11.1+1.4

41-50 18 9.2 11.6+1.6

51-60 35 17.9 10.9+1.7

61-70 8 4.1 10.8+1.9

>71 13 6.7 10.8+1.9

Total 195 100.0 10.66+1.8

sex Female 75 38.5 10.1+1.5

Male 120 61.5 11.10+1.716

Variation of Mean and Standard deviation of portal vein diameter by Respiratory status

The following table shows the comparison of mean and standard deviation of portal vein diameter in case of Quite, Deep inspiration and Deep expiration individually. In that the mean + sd of Deep inspiration was 12.3 +1.9mm which greater than the others two. A portal vein diameter during Quite was 10.3+1.8mm and portal vein diameter during Deep expiration 9.1+1.8mm (Table:2).

Table: 2 Mean and standard deviation of Quite, Deep inspiration and Deep expiration at JUSH, Oromia region, South West Ethiopia, 2015.

Parameters	N	Mean(mm)	Std. Deviation
------------	---	----------	----------------

Quite	195	10.3	1.8
-------	-----	------	-----

Deep Insp	195	12.3	1.9
-----------	-----	------	-----

Deep Expi	195	9.1	1.8
-----------	-----	-----	-----

Where N is number of respondent

Mean of Quite respiration and averaged mean of PVD (mean of deep inspiratory and expiratory)

The following table compares the mean PVD measured in quiet respiration and averaged Mean PVD of extremes of respiratory phase(deep inspiratory and deep expiratory) ,in that 10.3 +1.8mm and 10.66+1.8mm respectively. Therefore just mean PVD is used in the subsequent sessions. (Table:3) .

Table: 3 Mean of Quite respiration and averaged mean of PVD (mean of deep inspiratory

and expiratory) at JUSH, Oromia region, South West Ethiopia, 2015.

N Mean(mm) Std. Deviation

Averaged Mean of PVD 195 10.66 1.8

Quite 195 10.3 1.817

Proportion of Abnormally high of portal vein diameter

According to the following table, 19 (10%) of individuals were with mean portal vein diameter of greater than normal value of portal diameter that is less than 13mm while less than 13mm were 176(90%) who were in normal range(Table:4).

Table: 4 Proportion of abnormally high of portal vein diameter at JUSH, Oromia region, South West Ethiopia, 2015.

Mean PVD Number percent

>13 19 10

<13 176 90

5.2 Discussions

Our study on sonographic assessment of portal vein diameter ,showed the mean portal vein diameter in our setting was 10.66+1.75mm (range 8.91 to 12.41) which is in agreement with other study done in USA which has very similar mean PVD distribution across the age and which summarizes the overall mean PVD of individuals in the age 21-40 as 11+2mm.[11] Another study done in Nigeria which showed mean PVD of 11.45mm and the study done on Caucasians which showed mean PVD of 11mm+2mm agree with our study result. [5] However, study conducted in Addis Ababa, Ethiopia, at Tikur Anbessa Specialized Hospital, on 502 individuals showed mean of quite respiration as 7.9+2mm which is lower than the result of our study. [4]. The discrepancy of the mean PVD between our study and that of Addis Ababa can be attributed to varies factors. The discrepancy can be due to actual variation of geographic or epidemiologic factors of the study population or it may be due to small study sample in our case. But our result has encouraging evidence for its similar result with other above mentioned studies and the presence additional risk factor, schistosomiasis, in our area might have contributed to the rise of mean PVD as compared to that of Addis Ababa.

Our study showed that Mean portal vein diameter varies with age, even though there was no difference in gender. According to this research, in 12 patients aged less or equal to 10 years the mean portal vein was 7.8 + 1.6 mm .In 25 patients aged 11-20 years ,the mean portal vein diameter was 9.9 + 1.7mm.In 59 patients age 21-30 years, the mean portal vein diameter was 11

+ 1.4mm. In 25 patients aged 31-40 years, 11.1 ± 1.4. In 18 patients aged 41-50 years, the mean portal vein diameter was 11.6 ± 1.6mm. In 35 patients aged 51-60 years, the mean portal vein diameter was 10.9 ± 1.7mm. In 8 patients aged 61-70 years, the mean portal vein diameter was 10.8 ± 1.9mm which is similar with the patients aged greater than 70. This study is in agreement with the study done at USA, Nigeria and Caucasians that dealt with the variation of mean portal vein diameters with age but not with a significant difference in gender (5,11). Nineteen (10%) of individuals have a mean portal vein diameter of greater than normal value (PVD > 13mm) while 176 (90%) participants had PVD within normal range (< 13mm). This abnormally high value of PVD in the high-risk area and with this small sample size pilot study warrants further exploration for the cause.

The mean portal vein diameter during quiet respiration was 10.3 ± 1.8 mm. The mean increase in diameter with inspiration was 35%, this study has agreed with normal circumstances of portal vein diameter increase during inspiration that is above 20%. The study done at Addis Ababa university also confirms it (4).

The respirophasic variation was calculated by the mean of deep inspiratory minus deep expiratory and divided by deep expiratory times 100%. 20

Chapter Six

6 Conclusions and Recommendations

6.1 Conclusion

Based on the finding, the researcher is concluding that the mean portal vein diameter during quiet respiration was 10.3 ± 1.8 mm in at JUSH, Oromia region, South West Ethiopia. The mean increase in diameter with change in respiration was 35% (normal above 20%). There was a statistically significant variation between age and portal vein diameter (P-value = 0.001). But there was no variation in gender (p-value = 0.096).

Ten percent of individuals mean portal vein diameter was above normal value (> 13mm) though the normal standard mean portal diameter in healthy individuals is less than 13mm.

This study has comparable results with studies done in many other sites and normal standard books so can be used as a base line for further population based studies.

6.2 Recommendation

Large scale research should be conducted to validate and produce normative data for the real magnitude of abnormal portal vein diameter and portal hypertension in the Ethiopian

setting

- Further studies should be done in correlation with the risk factors for portal hypertension and actual incidence of portal hypertension in the area using all possible radiological imaging modalities.²¹

REFERENCES

1. Merck Sharp & Dohme Corp., a subsidiary of Merck & Co., Inc., Whitehouse Station, N.J, U.S.A ,Portal Hypertension , 2010-2013.
2. Lopamudra Mandal, Sanjay Kumar Mandal, Dipanjan Bandyopadhyay, Saumik Datta, Correlation of portal vein diameter and splenic size with Gastroesophageal varices in cirrhosis of liver JIACM 2011; 12(4): 266-70
3. Hg Ong JP, Sands M, Younossi ZM: Transjugular intrahepatic portosystemic shunts (TIPSS) a decade later. J Clin Gastroenterol 2000;30(1):14–28
4. Y. Hawaz, D. Admassie, T. Kebede, Ultrasound Assessment of Normal Portal Vein Diameter in Ethiopians Done at Tikur Anbessa Specialized Hospital. Addis Ababa University (AAU) – Ethiopia, ISSN 2073-9990 East Cent. Afr. J. surg.(Online)
5. Anakwue AC, Anakwue RC, Ugwu AC, Nwogu UB, Idigo FU and Agwu KK, Sonographic Evaluation of Normal Portal Vein Diameter in Nigerians, European Journal of Scientific Research, ISSN 1450-216X Vol.36 No.1 (2009), pp.114-117, © Euro Journals Publishing, Inc. 2009
6. Wai-Kit Lee, MBBS, Silvia D. Chang, MD, Vinay A. Duddalwar, MD, Jules M. Comin, MBBS, Warren Perera, MBBS, Wing-Fai E. Lau, MBBS, Elhamy K. Bekhit, MBBS, and , Oliver F. Hennessy, MD: Imaging Assessment of Congenital and Acquired Abnormalities of the Portal Venous System, July-August 2011, volume 31, issue 4
7. Nizar A Al-Nakshabandi The role of ultrasonography in portal hypertension , Year : 2006 | Volume : 12 | Issue : 3 | Page : 111-117
8. Hasan Sedeek Mahmoud, Seham F Ahmed, Mohamed A Al-Senbesy, Evaluation of Portal Hypertensive Doppler Parameters in Patients with Bilharzial Periportal Fibrosis, Published online: April 21, 2014
9. Amare Mengistu, Solomon Gebre-Selassie, Tesfaye Kassa Prevalence of intestinal parasitic infections among urban dwellers in southwest Ethiopia, Ethiop.J.Health Dev. 2007;21(1):12-1722
10. Ravi Shankar.G Shailaja Shetty, Srinath.M.G, Roopa Kulkarn., Estimation of Portal

- Vein Diameter in co – Relation with the Age, Sex and Height of An Individual.,
Anatomica Karnataka. 2011; 5(2): 13-16
11. Jeffrey Weinreb, Sheila Kumari, Gail Phillips ,Rubem Pochaczewsky, Portal Vein Measurements by Real-Time Sonography, AJR139:497-499,September 1982 0361-803X/82/1393-0497,www.ajronline.org
 12. Rogério Augusto Pinto-Silva; Leonardo Campos de Queiroz; Letícia Martins Azeredo; Luciana Cristina dos Santos Silva; José Roberto Lambertucci Ultrasound in schistosomiasis mansoni,Memórias do Instituto Oswaldo Cruz, Vol. 105, No. 4, 2010, pp. 479-484.
 13. Vergesslich KA, Götz M, Mostbeck G, Sommer G, PonholdW.Portal venous blood flow in cystic fibrosis: assessment by Duplex Doppler sonography. Pediatr Radiol. 1989;19(6-7):371-4
 14. A MAN Anatomy and Anatomy of the Human Body. Henry Gray (1821–1865). The Portal System of Veins, 1918.
 15. Webb U, Berger LA, Sherlock S. Gray scale Ultrasonography of portal vein. Lancet 1977;2:675-677
 16. Bolondi L, Gandolfi L, Arienti V, et al. Ultrasonography in the diagnosis of portal hypertension: diminished response of portal vessels to respiration. Radiology 1982;1 42 : 167-1 72
 17. Dach JL, Hill MC, Palaez JC, LePage JA, Russell E. Sonography of hypertensive portal venous system: correlation with arterial portography. AJR 1981 137:511-517
 18. Hasmann R, Grunert D, Reuter N, Stern M, Early detection of hepatobiliary involvement in children with mucoviscidosis using duplex sonography of the portal system, Klin Padiatr. 1991 Mar-Apr; 203(2):97-103.
 19. Jaime Bosch, MD, PhD; Annalisa Berzigotti, MD, PhD; Susana Seijo, MD; Enric Reverter, MD Assessing Portal Hypertension in Liver Diseases: Noninvasive Techniques to Assess Portal Hypertension, CME Released: 01/28/201323
 20. Rajniti Prasad, Utpal Kant Singh, O P Mishra, Bp Jaiswal And Sunil Muthusami, Portal Hypertension with Visceral Leishmaniasis, Accepted: December 30, 2009..
 21. Tanya Raza Siddiqui, Nuzhat Hassan, and Pashmina Gul Impact of anthropometrical parameters on portal vein diameter and liver size in a subset of Karachi based population ,Pak J Med Sci. 2014 Mar-Apr; 30(2): 384–388.

22. Pinsara G.H.M., K.N.Palahepitiya, B.G.Nanayakkara, I.Ilayperuma , Anatomical dimensions of the portal vein: A cadaver study, 2011, page-11624

Annex 1-

Questionnaire for A Research On Ultrasound Assessment Of Normal Portal Vein Diameter In Jimma University Specialized Hospital

1- Socio-demographic

Medical Registration No: _____ Age _____ . Sex _____ .

1.1 If female: pregnancy yes no

2- Morbidities:

2.1 History of chronic liver disease/ any illness on follow up: HTN, DM

Yes No

2.2 Any recent / past hepatobiliary surgery: Yes No

Annex 2

ULTRASOUND REPORT SHEET

PVD Taken at liver hilum before bifurcation of PV in supine right anterior oblique position

1- Portal vein diameter (PVD) in mm

a. Quite _____

b. Deep inspiration _____

c. Deep expiration _____

2- Have you had your breakfast /meal?

a. Yes

b. No

Ultrasound Report Sheet table

Sr No MRN Age

/yr

sex Meal Portal vein Diameter

Yes No Quite

respiration

Dee p

inspiratory

Deep

expiratory