Sudan University of Science and Technology

College of Graduate Studies

Sonographic Assessment of the Portal Vein Diameter in Some Healthy Adults Saudi Population

تقييم ابعاد الوريد البوابى لدى السعوديين البالغين الاصحاء باستخدام التصوير بالموجات فوق الصوتية

A Proposal submitted for A Partial Fulfillment of the Requirement of Master Degree in Medical Diagnostic Ultrasound

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الآية

بسم الله الرحمن الرحيم

(ولقد خلقنا الإنسان ونعلم ما توسوس به نفسه ونحن أقرب إليه من حبل الوريد)

صدق الله العظيم

سورة ق الآية (16)

Dedication

I proudly dedicate thesis to:

The spirit of the my beloved mother .

My Father...

My Brothers and Sisters...

My wife…

And to my kind kids…

Acknowledgement

I thank Allah for granting me the ability to complete this work. Also my thank to my supervisor Dr. Babiker Abd Elwahab for his assistance and closed guidance throughout this research, I have learnt a lot from him, extend thanks to my Dr Mohamed Omer ,Dr Gaild Adam & Dr Salah Elbagir & Dr Omer Lwaz for their help and support. Also extend my thanks to my colleagues for their spending plenty of time and effort to help me.

I finally would like to thank all people who participated in completion of this study.

Abstract

This was cross sectional descriptive study aimed to measurement of normal main portal vein diameter among adults healthy Saudi using ultrasound, carried out in Elkarama Medical Center, Riyadh, Saudi Arabia, from November 2018 to May 2019.

There were a total of 124 participants were scanned using ultrasound machine HITACHI ALOKA F37 (SN-20499096, Japan) with curvilinear transducer with a frequency of 3.5Mega Hertz, among these, 68(55%) were females 56(45%) males, who underwent abdominal ultrasound for various reasons, at in Riyadh region. All cases had age of 18 to 91 years and had normal liver, any patient had age less than 19 or had liver disease was excluded from this study. ultrasound was done investigating portal vein diameter.

Ethical clearance was obtained from the ethical committee and the head of Radiology department.

Data was collected using data collection sheets and analyzed by Statistical Package for the Social Sciences.

Study found that, the mean age was 44.88±16.32years, mean portal vein diameter was 10.40± 1.22mm. Also study found, mean portal vein diameter was significantly higher in males (10.7± 1.1mm) than in females(10.1± 1.2).

Study revealed that no significant correlation between body mass index and portal vein diameter (P>0.O5).

The study concluded that the portal vien diameter in male is larger than female ,BMT and age had no significant with PVD.

Study recommended that further studies should be done with large sampling in different phases of respiration (inspiration , expiration & quiet respiration).

مستخلص الدراسة

كانت هذه دراسة وصفية مقطعية تهدف إلى قياس قطر الوريد البابي الرئيسي العادي بين البالغين الأصحاء السعوديين باستخدام الموجات فوق الصوتية ، والتي أجريت في مركز الكرامة الطبي بمدينة الرياض بالمملكة العربية السعودية في الفترة من شهر نوفمبر2018م الى مايو2019م

تم جمع البيانات ن اجمالي 124 مشاركا مشاركا من بينهم 68 (55٪) من الإناث 56 (45٪) من الذكور ، الذين خضعوا للفحص بالموجات فوق الصوتية في البطن مختلف الاسباب في منطقة الرياض باستخدام جهاز الموجات فوق الصوتية (SN- HITACHI ALOKA F37 20499096 صنع في اليابان) مع مسبار بتردد 3.5 ميجا هيرتز ، جميع الحالات كان عمرها من 18 إلى 91 سنة وكان الكبد طبيعي ، أي مريض كان عمره أقل من 19 أو كان بة اي مرض بالكبد قد تم استبعاده من هذه الدراسة. تم عمل فحص الموجات فوق الصوتية للبطن وتمقياس قطر الوريد البابي. تم الحصول على تصريح أخلاقي من اللجنة الأخلاقية ورئيس قسم الأشعة. تم جمع البيانات باستخدام أوراق جمع البيانات وتحليلها بواسطة برنامج الحزمة الإحصائية للعلوم الاجتماعيةSPSS.

وجدت الدراسة ان متوسط العمر كان بين 16.32±44.88 سنة.

كما وجدت الدراسة ان متوسط قطر الوريد البوابي كان1.22 ±10.40 ملم

وكان متوسط قطر الوريد البوابي مرتفع بدرجة كبيرة في الزكور منه في الاناث.

.فى الذكور (10.1± 1.2)في الاناث (10.7± 1.1 ملم)

وايضا خلصت الدراسة الى ان مؤشر كتلة الجسم والعمر لم تكن لديهم علاقة كبيرة مع مقياس قطر الوريد البوابي.

توصي الدراسة بانه لابد من اجراء دراسة اضافية وذلك باخذ عينات كبيرة واجراء القياس في مختلف مراحل التنفس.

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List of abbreviations

PV	The portal vein
GI	Gastrointestinal
CT	Computed Tomography
U/S	Ultrasound
SPSS	Statistical Package for Social Sciences
BMI	Body mass index
BSA	Body surface area
3-D	Three-dimensional
IVC	Inferior Vena Cava
mm	Millimeters
CT	Computed Tomography
MRI	Magnetic Resonance Image
cm	Centimeter
kg	kilogram

Chapter One

Introduction

1.1 Introduction:

The portal vein (PV) and hepatic artery forms 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 (PV)is formed by the confluence of superior mesenteric vein and splenic vein, behind the neck of the pancreas at the level of second lumbar vertebra (Bhattacharya J, et al. 2013) Sonographic measurement of the portal vein diameter is a corner stone and also has a reasonable accuracy in diagnosing patients suspected of having portal hypertension (Hawaz Y,et al, 2012). The intricate relationship between the liver and the portal vein maintains homeostasis in the human body (Bhattacharya J, et al. 2013).

The major abnormality of the portal venous system is portal hypertension which may occur due to increased resistance to portal blood flow due to alterations in the liver architecture that leads to enlargement of extra hepatic and intrahepatic portal vessels and the development of portosystemiccollateralsmay (Ghosh TN,et al.2014). The formation of portosystemiccollateralsmay leads to splenomegaly, ascites, encephalopathy among others (Mandal L, et al. 2011). Diagnostic imaging methods like portal venography, splenoportography, and arteriography have been used to evaluate patients suspected of having portal thrombosis which are invasive, expensive, time consuming and involve risk and discomfort to the patient, while computed tomography and magnetic resonance imaging have advantages of better cross sectional images but are both expensive and the former exposes patient to high doses of ionizing radiation (Adeyekun,A.et al.2014;Usman AU,et al 2015) .

Sonography, in addition to its use of non-ionizing radiation, its accessibility, non-invasive nature, portability, low cost and ability of rapid

accomplishment, makes it a good diagnostic tool which plays a great role in the diagnosis and follow up of patients with portal hypertension (Hawaz Y,et al, 2012).

These examinations are often challenging and sonographers must be confident in their use and manipulation of equipment, and have thorough knowledge and understanding of the anatomy and pathophysiology of the disease process.

1.2 Problem of the study:

Portal vein diameter and Doppler studies give hemodynamic information that can correlate with disease status. Their normal values are not established in Sudanese population. Main portal vein diameter is considered as the best indicator for portal hypertension. However, the cutoff point differs from study to study despite the existence of normal mean portal vein diameter in different settings. This implies the existence of limited evidence on normal portal vein diameter for all populations in all countries prior to setting the cutoff points. Therefore, the aim of this study was sonographic assessment of normal mean portal vein diameter among adults Saudi. This study can add significant information

1.3 Objectives of the study:

1.3.1 General objective:

Sonographic measurement of the portal vein diameter in healthy adults Saudi population

1.3.2 Specific objectives:

- To establish the normal values of portal vein diameter, in Saudi population
- To study portal vein diameter variability with age, gender and ethnicity

1.4 Research outline:

- Thee research will be formed of five chapters. Chapter one will deal with the general introduction about the research , problem statement and the objectives of the study. Chapter two will deal with literatures review cover the theoretical background and previous studies. Chapter three will deal with the methodology of the study, including materials , method and equipment . Chapter four will cover the results. And chapter five will cover discussion, conclusion, recommendations and references.

Chapter Two

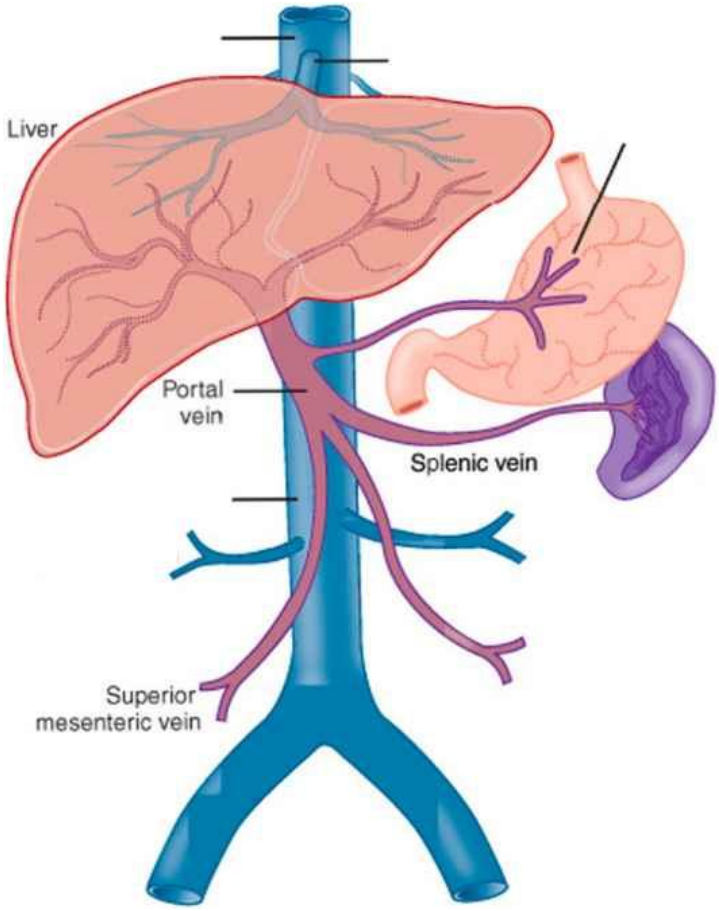
Literature Review & Pervious Studies

Chapter Two

Literature Review

2.1 Portal Vein anatomy

Portal vein. The hepatic portal vein is a vessel that moves blood from the spleen and gastrointestinal tract to the liver. It is approximately three to four inches in length and is usually formed by the merging of the superior mesenteric and splenic veins behind the upper edge of the head of the pancreas. (Harold M Chung, Chung, Kyung Won , Gross anatomy. 2008).



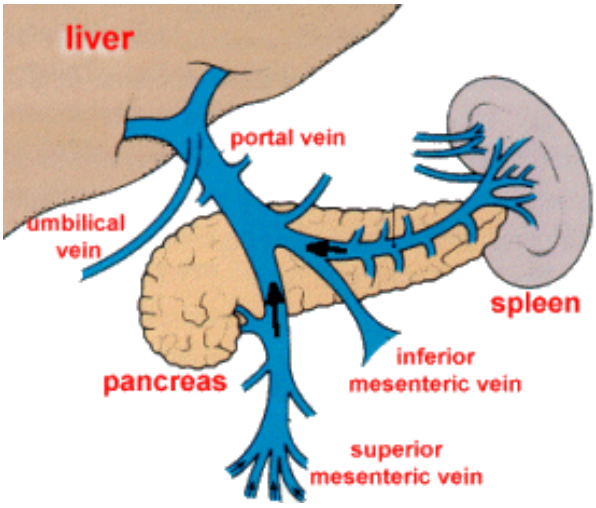
(Fig2-1) Portal Vein Anatomy ®
https://www.anatomynote.com/wp-content/uploads/2018/09/3439/Portal-vein-and-splenic-vein-anatomy.jpg

In some individuals, the inferior mesenteric vein may enter this intersection instead.

In most people, the portal vein splits into left and right veins before entering the liver. The right vein then branches off into anterior and superior veins.

The portal vein supplies approximately 75 percent of blood flow to the liver. The portal vein is not a true vein, which means it does not drain into the heart. Instead, it brings nutrient-rich blood to the liver from the gastrointestinal tract and spleen. Once there, the liver can process the nutrients from the blood and filter out any toxic substances it contains before the blood goes back into general circulation.

Abnormally high blood pressure in the portal vein is known as portal hypertension. The condition may cause the growth of new blood vessels that bypass the liver, which can result in the circulation of unfiltered blood throughout the body. Portal hypertension is one of the potential serious complications of liver cirrhosis, which is a condition where normal liver tissue is replaced with scar tissue. (Harold M Chung, Chung, Kyung Won , Gross anatomy. 2008).



(Fig. 2-2) Portal vein Anatomy

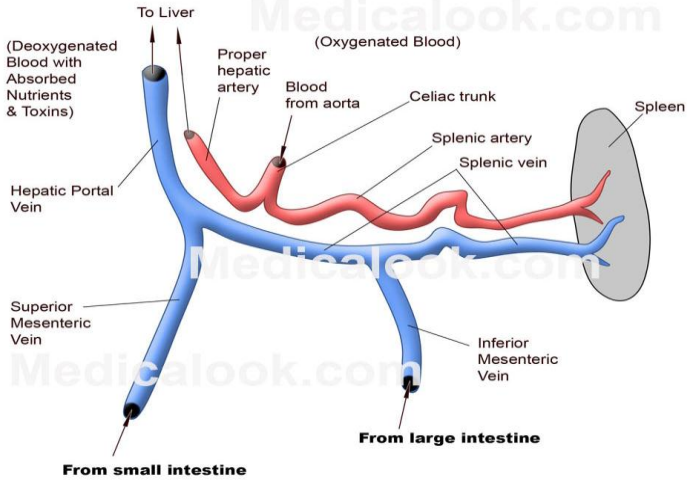
https://www.pinterest.com/pin/267119821623312945/

2.1.1 The Portal Circulation

The liver is unusual in that it has a double blood supply; the right and left hepatic arteries carry oxygenated blood to the liver, and the portal vein carries venous blood from the GI tract to the liver.

The venous blood from the GI tract drains into the superior and inferior mesenteric veins; these two vessels are then joined by the splenic vein just posterior to the neck of the pancreas to form the portal vein. This then splits to form the right and left branches, each supplying about half of the liver. On entering the liver, the blood drains into the hepatic sinusoids, where it is screened by specialised macrophages (Kupffer cells) to remove any pathogens that manage to get past the GI defenses. The plasma is filtered through the endothelial lining of the sinusoids and bathes the hepatocytes; these cells contain vast numbers of enzymes capable of braking down and metabolising most of what has been absorbed.

The portal venous blood contains all of the products of digestion absorbed from the GI tract, so all useful and non-useful products are processed in the liver before being either released back into the hepatic veins which join the inferior vena cava just inferior to the diaphragm, or stored in the liver for later use. (Harold M Chung, Chung, Kyung Won , Gross anatomy. 2008).



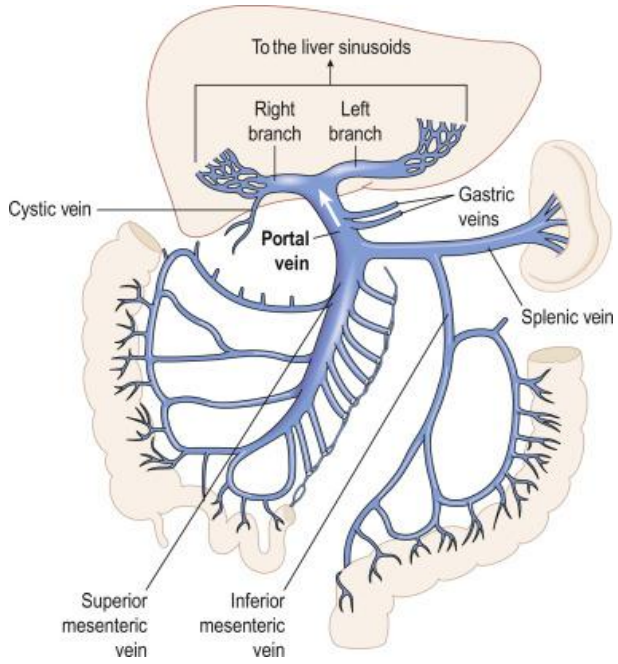
(Fig.2-3)**Portal Vein Blood drain**

http://www.medicalook.com/systems_images/Hepatic_Portal_System_large.jpg

2.1.2 Hepatic Portal Vein circulation

In many respects, the hepatic portal vein resembles many systemic veins. Its branches arise from capillary networks in the intestines (see Fig…….) and the stomach. In addition, it receives venous blood from the spleen (Fig……..). The blood entering the hepatic portal system from the intestines is rich in digestive products and hormones secreted by enteroendocrine cells of the digestive tract. From a functional standpoint, it is more efficient to bring this enriched blood directly to the major metabolic center (the liver) than to empty it into the general circulation, where it would go the heart and then be distributed generally to all parts of the body. Instead, the hepatic portal vein brings all of this blood directly to the liver, where it branches into smaller caliber veins which finally empty into the hepatic sinusoids The open nature of the sinusoidal walls allows free access of all the contents of the portal blood to the hepatic parenchymal cells (hepatocytes) for their

metabolic use. From the sinusoids, the blood, now depleted of metabolites, but enriched in newly synthesized molecules, travels into branches of hepatic veins and ultimately empties into the inferior vena cava and into the heart.



(Fig. 2-4)Portal Vein circulation

https://www.sciencedirect.com/topics/veterinary-science-and-veterinary-medicine/hepatic-portal-system

2.2 Physiology of Portal Vein

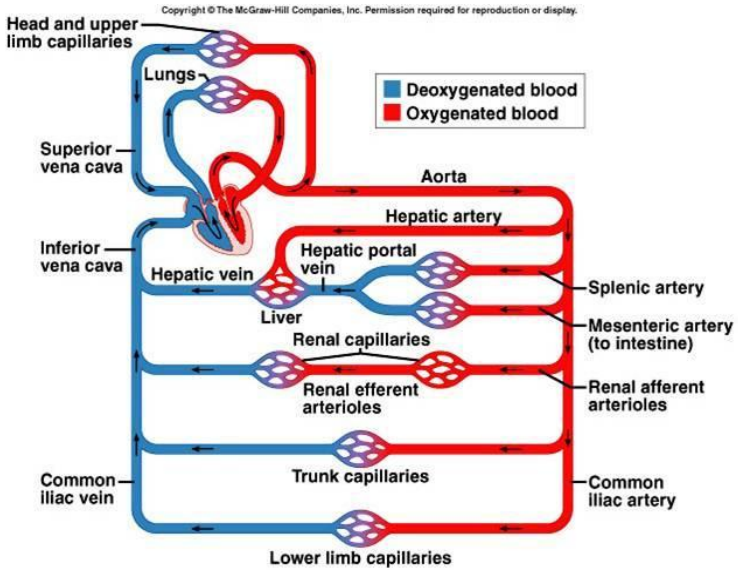
Hepatic portal vein arises from mainly from the gastrointestinal tract and a tributary that comes from the spleen. The vessel, only three inches in length in an adult, thus receives deoxygenated blood and drains into the nearby liver.

Thus it could be safely said that the Hepatic Portal Vein is not able to supply necessary oxygen to liver tissue . (For that purpose, hepatic artery brings oxygenated blood.)

The significance of the portal vein lies in the fact that it

1. receives absorbed nutrients from intestine, and

2. delivers most of those to the metabolic hub of the body, i.e. to the liver before returning the blood to systemic circulation.



(Fig2-5) Physiology of Portal Vein https://socratic.org/questions/how-does-the-hepatic-portal-vein-differ-from-other-veins

2.3 Portal vein Pathology

Inherited and acquired disorders of the coagulation pathway are frequent causes of portal vein thrombosis, Infectious and inflammatory processes may also lead to venous thrombosis. Portal vein obstruction does not affect the liver function unless the patient has an underlying liver disease such as cirrhosis.

Portal vein obstruction can result from one or several of the following 3 mechanisms: thrombosis, invasion by a malignant tumor (mainly hepatocellular carcinoma) and constriction within a malignant tumor (adenocarcinoma of the pancreas or bile ducts). Compression in the absence of thrombosis, invasion or constriction does not produce portal vein

obstruction. Usually, the vein passes round the space-occupying lesions. Clinically, portal vein thrombosis represents an almost pure form of portal vein obstruction. The consequences of portal vein thrombosis are related to the extension of the thrombus. Upstream from the thrombus, there is little effect on the intestine as long as the mesenteric venous arches remain patent. Ischemia results from extension of the thrombus into the mesenteric veins and the mesenteric venous arches (Bhattacharya J, et al. 2013). It is likely that thrombosis of the arches prevents them from functioning as a collateral circulation to drain intestinal blood toward the adjacent patent territories. Alternatively, reflex arteriolar vasoconstriction might occur when the arches are thrombosed (Bhattacharya J, et al. 2013) . When ischemia is prolonged for several days, intestinal infarction may follow. In 20-50% of the cases, intestinal infarction is responsible for death due to peritonitis and multiple organ failure, even when resection of the infarcted gut is carried out (Bhattacharya J, et al. 2013)

3. Ghosh TN, et al. 2014). Extensive intestinal resection due to venous thrombosis is one of the main causes of the short bowel syndrome. Short bowel stenosis can be a late sequela of mesenteric venous ischemia (Mandal L, et al. 2011). Downstream from the portal vein thrombus, the consequences for the liver are hardly discernible (Adeyekun,A.et al.2014; Huxley R, et al. 2010 and Usman AU, et al 2015). Clinically, signs of liver disease are absent or transient (unless thrombosis occurs in a patient with cirrhosis). Biochemically, serum albumin level and prothrombin time ratio usually remain within low normal values, while serum bilirubin is normal. Histologically, there is little alteration in liver architecture when the obstruction is limited to the extrahepatic portal vein and its largest intrahepatic branches. However, there are indications of a deleterious

influence of portal vein thrombosis on the liver. Experimentally, apoptosis of the liver cells can be demonstrated in rats with graded portal vein ligation (Clavien PA, et al.1988). The degree of apoptosis is related to the grade of portal vein obstruction. There is a simultaneous increase in mitotic activity in the remaining well-perfused liver. Similar findings have been observed clinically following embolization of a portal vein branch to induce atrophy of the embolized lobe and hypertrophy of the other lobe in order to augment the tolerance of extensive liver resection (Harward TRS,et al. 1989). These subtle alterations in the liver may explain why, in particular circumstances (gastrointestinal bleeding or infection), transient signs of decompensated liver disease may develop.

2.4 Ultrasound physics:

Ultrasound is made up of mechanical waves that can transmit through different materials like fluids , soft tissues and solids. Ithas afrequency higher than auditory limit of 20 kHz, Ultrasound frequency is defined as the number of ultrasound waves per second ,the velocity of ultrasound in a specific medium equals the frequency of ultrasound multiplied by its wave length ,there are different method that control the way ultrasound waves are emitted from the ultrasound transducers they can be either interrupted or continues , interrupted emission generates brightness (B) mode images while continues emission generates Doppler mode ,imaging one line over time is called the moving mode (M mode),changing the frequency of ultrasound waves will control the penetration and resolution of the images.(Fikri et al,2011).

2.4.1 Ultrasound machine:

Medical ultrasound machine generate and receive ultrasound waves brightness mode is the basic mode that is usually used ,ultrasound waves are

emitted from piezoelectric crystals of the ultrasound transducer depending on the acoustic impedance of different materials, which depends on their density, there are different methods that can control the quality of ultrasound waves including timing of ultrasound wave emission, frequency of waves ,the received ultrasound signal can be amplified by increasing the gain ,the operator should know sonographic artifacts which may distort the studied structures or even show un real ones probes of low frequencies should be used for deep structures while probes of high frequencies should be used for superficial structures ,ultrasound waves are emitted perpendicular to the surface of the transducer, it is possible to widen the deep sonographic field by bending the surface of the transducer (convex array transducer),waves will be parallel to each other when the probe surface is flat (linear array transducer) ,linear array transducers usually have high frequencies (10-12MHz),less penetration and excellent resolution.(Fikri et al, 2011).

2.5 Ultrasound Technique of the liver:

2.5.1 Patient Preparation

It is recommended that a patient undergo a period of fasting prior to upper abdominal imaging to maximize the distension of the gall bladder and to reduce food residue and gas in the upper GI tract which may reduce image quality or precluded liver imaging. This is essential for full imaging of the liver and related biliary tree but may not be required in an acute situation such as trauma where imaging of the gall bladder is not immediately essential. A patient may take small amounts of still water by mouth prior to scan, particularly for taking any medications. There is some evidence that smoking can reduce image quality when scanning upper abdominal structures and it is good practice to encourage a patient not to smoke for 6-8 hours prior to US scan. Smoking increases gas intake into upper GI tract and

may reduce image quality. Also, some chemicals in tobacco are known to cause contraction of the smooth muscle of the GI tract and this can cause contraction of the gall bladder, even when fasting has occurred, and the gall bladder cannot be scanned. [33]

2.5.2 Protocol:

The liver is a large, pyramidal shaped organ and liver sectional anatomy may be best described imaged and defined using by real time ultrasound imaging. Linear, convex or sector transducers may be used to assess pathology of the liver, spleen and abdominal vessels.

Visualisation is usually easier with a convex or sector probe.

Measurements are more accurate using a linear probe. The protocol must always state which probe was used.

2.5.3 Standard views

1-Longitudinal liver scans:

a. Left parasternal longitudinal view:With the abdominal aorta as reference, measure the left liver lobe from the upper to the caudalmargin in the left parasternal line (PSL). This view is similar to the one used to demonstrate paraumbilical and coronary vein collaterals.

b. Right mid-clavicular view:Used to assess the size of the right liver lobe in the right midclavicular line (MCL).

c .Right anterior axillary view :The probe should be placed vertically, in a section through the right kidney as reference. This view is used to assess the echogenicity of the liver parenchyma by comparing it with the echogenicity of the kidney. A normal liver in children and adolescents is slightly less echogenic than the kidney, whereas in adults it is slightly more echogenic than the kidney parenchyma. If present, ascites can be seen with this view.

Used to assess the size of the right liver-lobe.

2. Substernal transverse view:

Used to assess the shape of the left liver lobe and to detect the coronary vein. This is one of the views particularly useful for comparing the liver appearance with an image pattern.

In this view the peripheral portal branches of second order emerging from the left portal branch are visualised.

3. Subcostal transhepatic view

The probe should be placed below the right costal margin and directed cephalad.

This view is used to assess the liver surface and parenchyma appearance, to detect deviation of hepatic veins, and to measure periportal wall thickening of the peripheral branch.

This is another view that is particularly useful for assigning an image pattern to the picture of the liver parenchyma.

4. Right oblique view

The point of reference should be where the maximum diameter of the portal vein is seen. Usually the diameter of the portal vein is measured at this position. Portal vein measurements must be performed with the patient quietly breathing, avoiding forced inspiration (Valsalva.s manoeuvre).

5. Left intercostal oblique view

The probe is placed in a section through the splenic hilus as the point of reference. Splenic varices are visualized in this view.

The probe is than adjusted until the major longitudinal diameter of the spleen is seen. When splenomegaly is present, spleen length usually exceeds the dimensions of the transducer. In such cases,spleen length can be assessed by marking the upper tip on the patient.s abdomen, then moving the

transducer downwards until the lower tip is visualised. The distance between these points can then be measured with a measuring-tape.

2.6 Previous studies:

Luntsi G, et al (2016) studied Sonographic assessment of the portal vein diameter in apparently healthy adults in a Northern Nigerian population**.** This study aimed at determining the mean portal vein diameter based on age, gender and anthropometric variables. Its A cross sectional study conducted among 201 apparently healthy adults in Bauchi Metropolis. Participants were recruited from the school of ursing AbubakarTafawa Balewa Teaching Hospital (ATBUTH), Bauchi. Ultrasound machine ALOKA SSD-1000, (IP-1233EV, SN-57324, Japan) with curvilinear transducer with frequency of 3-5MHz was used for a period of four months, (December 2015 to April 2016). Participants' heights were measured while standing against a meter rule with the head in Frankfurts' position and weight measured using a weighing scale. Data analysis was done using SPSS version 22.0.Descriptive statistics (mean, standard deviation), and Pearson's Correlation were used. The mean portal vein diameter was 9.60 ± 1.41mm for both sexes. The mean value for males was 9.71 ± 1.42mm, and 9.35±1.46mm among females. There was a positive correlation correlation between the PV diameter and Body Mass Index (P≤ 0.01).Their study found the mean values of PV diameter in apparently healthy adults in our environment to be 9.60 ± 1.41mm and that PV diameter positively correlates with anthropometric variables.

GeletoG, et al(2016) studied Mean Normal Portal Vein Diameter Using Sonography among Clients Coming to Radiology Department of Jimma University Hospital, Southwest Ethiopia the aim of this study was sonographic assessment of normal mean portal vein diameter among patients referred to The Department of Radiology in Jimma University Hospital. Its cross-sectional study was conducted from November to December 2014 at

Jimma University Hospital on a total of 195 clients. Data about portal vein diameter for eligible clients were collected by radiologists using Sonography. Data were edited manually, entered and analyzed using SPSS version 16. Their study included 195 participants. Among these, 121(62.1%) were males and the median age of the participants was 35 years. The study revealed a normal mean portal vein diameter of 10.6 mm ±1.8 SD with a respirophasic variation of 25.6%. Likewise, the normal mean portal vein diameter seemed to have varied significantly by age and sex. The study revealed a normal mean portal vein diameter ranging below 13 mm. Hence, decisions made in clinical settings should base on these findings. Besides, there is a need for large scale study to determine portal vein diameter variation by age and sex, controlling other confounders.

Songmen S, et al 2017 studied Measurement of Portal Vein Diameter, Peak Systolic Velocity and Pulsatility Index by Ultrasound Doppler Evaluation in Asymptomatic Nepalese Population. This study aims to establish the normal values of portal vein diameter, PSV and PI in Nepalese population and study their variability with age, gender and ethnicity. Its Cross-sectional hospital based study. All adults more than 20 years of age attending ultrasound OPD of Tribhuvan University Teaching Hospital, Maharajgunj, Kathmandu for general health check up were included. Patients with liver disease, cardiac disease and ascites were excluded. A single observer took all measurements. Data were entered in a predesigned proforma and analysis was performed with SPSS 21.0. They found that Two hundred patients were included in the study. The mean age was 44.34+12.9 years. The mean portal vein diameter was 10.41+1.18mm. The mean portal vein PSV was 33.35+9.3cm/s and PI was 0.76+0.07. There was a positive correlation of portal vein diameter with age ($r=0.345$; $p<0.001$). Also, mean portal vein diameter was significantly

higher in males (10.9+0.99mm) than in females (9.9+1.1mm). PSV and PI did not differ with age, gender or ethnicity. Mean portal vein diameter in this study is comparable with previous standards.

Gareeballah A et al (2017) studied Measurement of Normal Portal Vein Diameter in Sudanese using Ultrasonography is a valuable tool in the assessment of porto-systemic pathologies. This was descriptive cross sectional study conducted in Alpolice hospital in Khartoum in the periods from June to August 2017.The problem of study was that there are many different pathological conditions affect the portal vein diameter and ultrasound able to determine normal and abnormal measurement of portal vein. The aim of this study was to measure of normal main portal vein diameter in Sudanese by real time sonography and to correlate measurement with other body parameter. The sampling includes 122 patients came to area of study for other scanning purpose rather than liver or portal vein pathologies or any diseases that can affect on portal vein diameter 63 female and 59 male age range (11-85) year. Sonoline G60s machine with 3.5MHZ sector curvilinear transducer probe was used. Measurements of main portal vein diameter was taken in quiet respiration at the liver hilum before bifurcation, the diameter was taken inner to inner. The age categorized into five groups. Descriptive statistics used to analyze quantitative and qualitative variables (percent and means ± SD). Person correlations test was used to find correlation between mean main portal vein diameter and age, height, weight, body mass index of the patients. The study found that the mean main portal vein diameter (PVD) in Sudanese population was 10.73±1.47 mm, the mean in age group (10- 15) years was 9.43±1.27 mm, in (16- 30) years was 10.52 ±1.27 mm, in (31-45) years was 11.21±1.45 mm, in (46-60) was 11.19 ±1.20 mm, in (61-75) years was 10.20 ± 1.66 mm and in

(76-85)years was 8.45 ±2.47 mm. The mean PVD for male was 11.11 ±1.38 mm which is slightly more than the diameter for female which was 10.38±1.48 mm. The study found that there was no significant correlation between portal vein diameters with age, body mass index and there was significant positive correlation between portal vein diameter height and weight.

Usman A U, et al (2015) studied Ultrasound Determination of Portal Vein Diameter in Adult Patients with Chronic Liver Disease in North-Eastern Nigeria The aim of this study was to determine the mean and range of PV diameter in chronic liver disease (CLD) patients in our local environment. This cross-sectional prospective study was carried out at the University of Maiduguri Teaching Hospital between January and June, 2013. Two hundred and fifty adult male and female CLD patients and equal number of age and sex matched controls aged 18 years and above had abdominal ultrasonography for measurement of their main, right and left PV diameter in both inspiration and expiration. Transverse and longitudinal measurements were obtained, and the averages of the two measurements were used to determine their final diameter. There were 187 (74.8%) male and 63 (25.2%) female CLD patients aged between 19 and 77 years (mean ± standard deviation [SD], 43.78 ± 12.97 years). The mean diameter of the main PV (±SD) in CLD was 18.68 ± 2.59 mm which is higher than that of the control (10.87 ± 0.81 mm). The mean diameter of the right and left PVs in CLD were 9.04 ± 1.26 mm and 8.58 ± 1.23 mm respectively, which were higher than the respective values of 4.35 ± 0.52 mm and 4.12 ± 0.52 mm in the control. The PV diameter correlated with age and respiratory phases in both CLD and the control group ($P < 0.05$). There was statistically significant difference in PV diameter between males and females ($P < 0.05$)

with values higher in females. The mean value and range of PV diameter in CLD patients in this environment were statistically and significantly higher than controls. The diameter correlated with age and showed significant difference between the two sexes and respiratory phases.

Chapter Three

Methodology

CHAPTER THREE

Methodology of the study

Material and Methods (Material, equipment and Technique)

3. 1.Material

3.1.1 Patient:

This study is a cross-sectional prospective study included a 124 healthy adult subjects 68(55%) were females 56(45%) males in Riyadh region, for a period of six months from November2018 to May 2019.Ethical clearance was obtained from the ethical committee and the head of Radiology department and informed consent will be obtained from all the participants, prior to the study. Participants who recruited (Voluntarily) .

3.1.1.1 Inclusion and exclusion criteria: Healthy individuals with normal ultrasound findings of the liver formed the inclusion criteria while ill individuals, pregnant women, subjects on hepatotoxic drugs such as anti-tuberculous and antiretroviral drugs Will be excluded from the study.

3-2 Equipment used

An ultrasound machine HITACHI ALOKA F37 (SN-20499096, Japan) with curvilinear transducer with a frequency of 3.5MHz was used. Quality control maintenance check was routinely performed on the equipment by the medical physicist of the department prior to measurements.

Measurements was carried out using the electronic calipers of the ultrasound machine after freezing the image.

Anthropometric parameters, like height, weight and body mass index of each participants were measured, Participants' heights were measured and their weight.

(Fig3-1)Ultrasound machine HITACHI ALOKA F37

3-2 Methods

3-2.1 Scanning Technique

The Ultrasound examination was carried out with the subjects in the supine and right anterior oblique position following an overnight fast. Subjects were exposed from the xiphisternum to the pelvic brim, ultrasound gel will be applied to the right upper quadrants of the abdomen, and the transducer placed in the epigastrium in both the transverse and longitudinal planes to assess the main portal vein during quiet respiration, when the visualization of the portal vein was optimal, measurements were made at a point where the portal vein crosses anterior to the

inferior vena cava (IVC) with the calipers placed between the inner margins of the echogenic walls of the vessel. Measurements (in mm) will be made twice by each of the two sonographers and the average values of the two measurements were recorded as the final value. Demographic data such as age, sex, weight, and height will be recorded and the body mass index (BMI) will be calculated using Quetelets' formula: BMI= weight (Kg)/height(m^2).

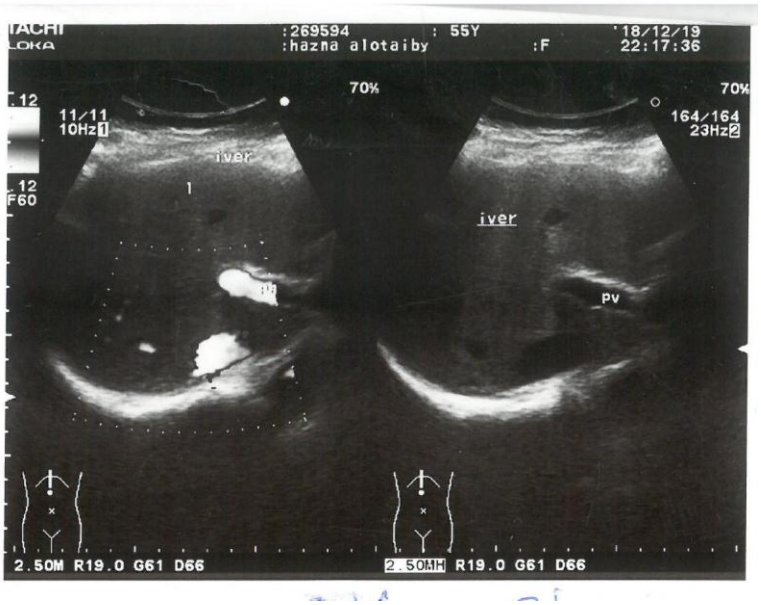


Fig3-1 Transverse view of the portal vein showing the levels of measurement

3-2-2 Methods of Data Collection:

The data was analyzed using SPSS version 21. The Berson correlate to test the association between two categorical variables. , the significance level was set at p=0.05.

3-2-4 Ethical considerations:

No part of this study relies on data which normaly collected from routine scaning. All patients were informed,that the result of examination will form part of research project. No patient identification or individual patient detail will bublished,and all specific information relating to patient's identities will be protected in the same way.

Chapter Four

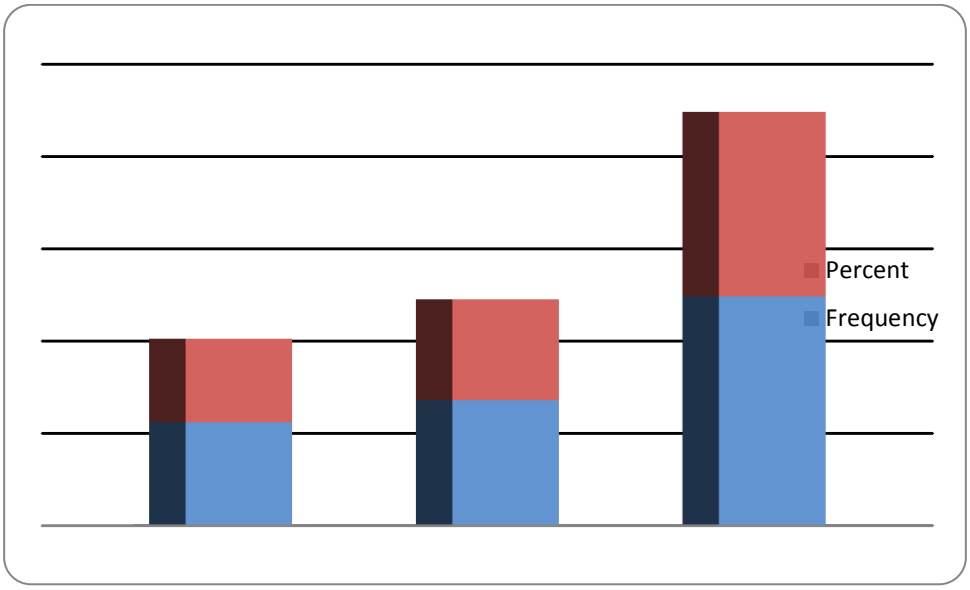
Results

CHAPTER FOUR

4. Results

Table (4-1):Shows Gender Frequency Distribution

Gender	Frequency	Percent
Male	56	45.2
Female	68	54.8
Total	124	100.0



Fig(4-1):Shows Gender Frequency Distribution

Table (4-2). Descriptive statistic for Age , height ,weight ,BMI and PVD

	N	Minimum	Maximum	Mean	Std. Deviation
Age Ys	124	18.0	91.0	44.879	16.3178
Weight(KG)	124	39.0	925.0	90.528	100.7241
Height CM	124	10.0	188.0	161.177	17.0633
Body surface area	124	.13	43.4	4.11	4.85
PVD(MM)	124	8.0	13.0	10.403	1.2159
DOPPOR(PVD-MM)	124	7.0	13.0	10.403	1.3430

Table (4-3).. Descriptive statistic for Age , height ,weight ,BMI and PVD of female

	N	Minimum	Maximum	Mean	Std. Deviation
Age Ys	68	18.0	91.0	45.838	17.0781
Weight(KG)	68	39.0	925.0	88.647	104.5025
Height CM	68	10.0	188.0	154.397	19.7787
Body surface area	68	.13	43.42	3.87	4.95
PVD(MM)	68	8.0	13.0	10.132	1.2205
DOPPOR(PVD-MM)	68	7.0	13.0	10.147	1.4064

Table (4-4).. Descriptive statistic for Age , height ,weight ,BMI and PVD of Male

	N	Minimum	Maximum	Mean	Std. Deviation
Age Ys	56	18.0	81.0	43.714	15.4163
Weight(KG)	56	45.0	795.0	92.813	96.8272
Height CM	56	145.0	182.0	169.411	6.9799
Body surface area	56	1.81	38.87	4.40	4.76
PVD(MM)	56	8.0	13.0	10.732	1.1360
DOPPOR(PVD-MM)	56	8.0	13.0	10.714	1.2017

Figure (4-2).: Scatter Diagram Showing Correlation of Portal Vein Diameter with Age

Table (4-5).. Showing Correlation of Portal Vein Diameter with Age and Body mass index

		AgeYs	Bodymassindex	PORTALVIENDIAMENTIONMM
Age Ys	Pearson Correlation	1	-.149	-.028
	Sig. (2-tailed)		.098	.759
	N	124	124	124
Body mass index	Pearson Correlation	-.149	1	-.038
	Sig. (2-tailed)	.098		.672
	N	124	124	124
PORTALVIENDIAMENTIONMM	Pearson Correlation	-.028	-.038	1
	Sig. (2-tailed)	.759	.672	
	N	124	124	124

Table (4-6).. PV GRAY SCALE DIAMENTIONS

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	8.00	7	5.6	5.6	5.6
	9.00	25	20.2	20.2	25.8
	10.00	29	23.4	23.4	49.2
	11.00	41	33.1	33.1	82.3
	12.00	18	14.5	14.5	96.8
	13.00	4	3.2	3.2	100.0
	Total	124	100.0	100.0	

Table (4-7).. DOPPLER DIAMENTIONS

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	7.00	2	1.6	1.6	1.6
	8.00	7	5.6	5.6	7.3
	9.00	25	20.2	20.2	27.4
	10.00	28	22.6	22.6	50.0
	11.00	34	27.4	27.4	77.4
	12.00	23	18.5	18.5	96.0
	13.00	5	4.0	4.0	100.0
	Total	124	100.0	100.0	

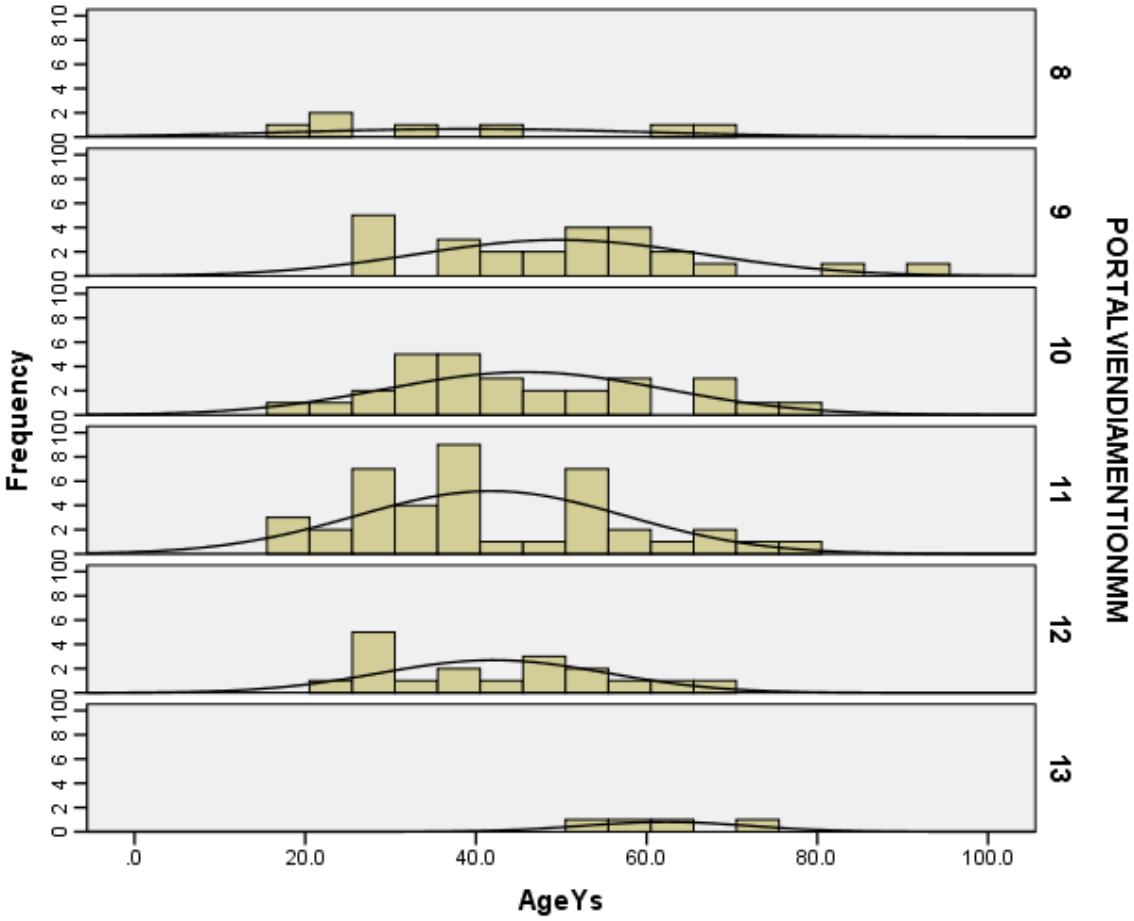


Fig 4-3 PV gray scale dimensions in all the patients studied

Chapter Five

Discussion, Conclusion and Recommendations

Discussion, Conclusion and Recommendations

5.1 Discussion

Ultrasound imaging plays an important role in the assessment of the portal vein diameter, flow rate, and peak systolic velocity which gives an accurate and a reliable method of diagnosing disease conditions of the liver such as chronic liver diseases (Hawaz Y, et al.2012; Usman AU, et al. 2015).

The mean portal diameter in this study was 10.40 ± 1.22mm.Similar findings were reported by other studies in Nigeria; Usman et al. 2015, found 10.87±0.81mm in North-Eastern Nigeria, Ukperi2008 and Adeyekun et al2005 in south western Nigeria found 8.1±0.12mm and 10.3±1.5mm respectively.

Anakwue et al2009 in South Eastern Nigeria found 11.5±1.5mm as the mean portal vein diameter. This similarity in the reported portal vein diameter could be due tothe similarities in the methods adopted by these studies as the measurements were all done using the trans-abdominal approach and using similar probe frequencies.

However, studies conducted in other countries also report similar findings. Ongoiba et in Bamako, Mali reported a mean value of 9.2±2.6mm. Hawaz et al2 among Ethiopians reported a mean value of 10.0±1.8mm, Webb et reported mean portal vein diameter of 6.3±2.3mm, Weinerb et in USA reported a mean value of 11±2.0mm, Rokni-Yazdi et in Iran, reported a mean value of 9.36±1.65mm, Bhattacharya et al1 in West Bengal, India reported a mean value of 10.02±0.89mm. The reported values of the PV diameter from studies from other countries and among different ethnic groups and races, with varying samples sizes, did not vary with the values obtained from our study. This implies that using similar methodology and

equipment in the hands of a qualified sonographer and /or sonologist, the measurement of the portal vein diameter can be reproducible and reliable.

However, one of the limitations of this present study is that only the diameter of the portal vein was measured and not the portal flow which was also assessed by Rokni Yazdi et al13

Some literature had documented portal vein diameter to vary with age, gender, and Body Mass Index. The mean portal vein diameter among males in this study was higher than females, being 10.7± 1.1mm mm and 10.1± 1.2mm respectively. This is in agreement with the reports of Hawaz et al2, Gosh et al3, Adeyekun et al5, Siddiqui et al14, Saha et al15 and Goyal et al16 who found no significant influence of gender on portal vein diameter. This similarity may be attributed to larger number of females participants involved in the studies. Moreover, the influence of age on portal vein diameter has been documented by various researchers with varied results. This study showed negative correlation of age with portal vein diameter ($p>0.01$).But it is not significant.

This was in line with the study of Bhattacharya et al1,Hawaz et al2, Gosh et al3, Anakwue et al9, Weinreb et al12, Saha et al15 and Patriquin et al17. It however contradicts the findings of Adeyekun et al5 who reported there was no statistically significant influence of age on portal vein diameter. This study also showed a positive correlation between Body Mass Index (BMI) and portal vein diameter ($p<0.01$). This is in agreement with the reports of Saha et al15 and Gosh et al3.However, it was in contrast to the findings of Adeyekun et al5 who reported that there was no statically significant influence of BMI on portal vein diameter. The difference in the reported value may be attributed to the sedentary life style in the Western part of

Nigeria compared to the nomads in northern Nigeria who are either farming, grazing or leaving an active life.

Rajashree et al18 also reported a positive correlation between the portal vein diameter and other anthropometric parameters. The knowledge of these normal variations is essential for surgeons, sonologist and sonographers during diagnosis of problems that may relate to the portal system.

5-2 **Conclusion:**

This study had established baseline values for normal range of portal vein diameter in apparently healthy adults in Saudi Arabia population to be 10.40± 1.22mm and also found that PV diameter positively correlates with anthropometric variables. Also study had certain limitations. The study was carried out in patients who visited the hospital for the general health checkup, thus may not be representative of the population.

Study found that the mean portal vein diameter in male was larger than female.

BMI and age had no significant correlation with PVD.

5.3 Recommendations:

- Study recommended that Government should introduce the modern ultrasound machines and increased the training institutes of ultrasound and computer programs for increasing the sonologists skills and experiences
- According to the high cost of scientific research which the researcher was faced, the government should appeal universities in KSA and companies to support the researchers in order to improve plans of treating and management of such diseases.
- Further studies should be carried out in this field on many aspects such as increasing the number of patients in different phases of respiration (inspiration,expiration & quiet respiration)

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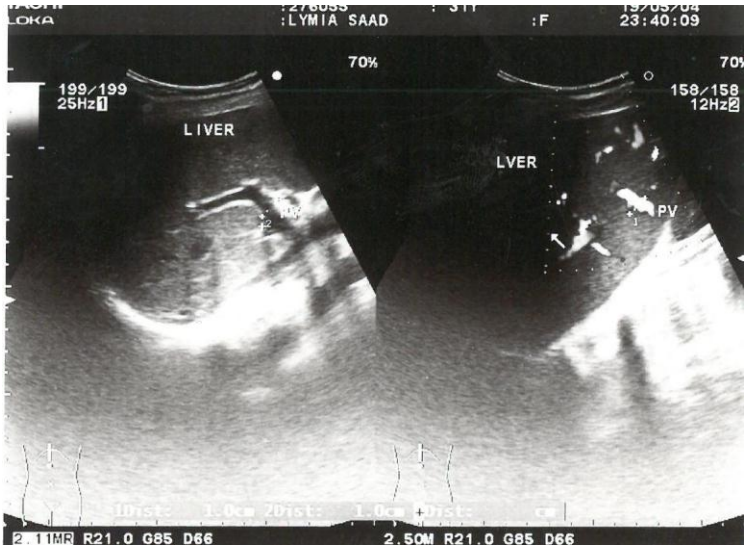
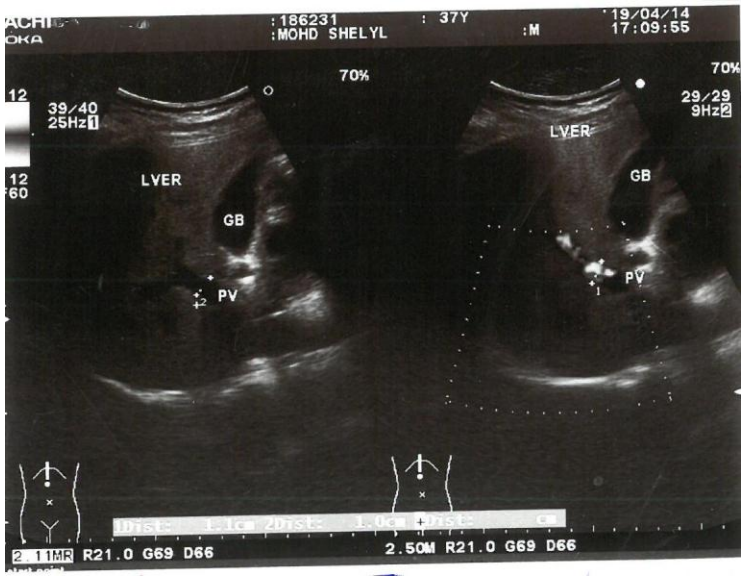
Appendices

APPENDIX(A) Ultrasound Images

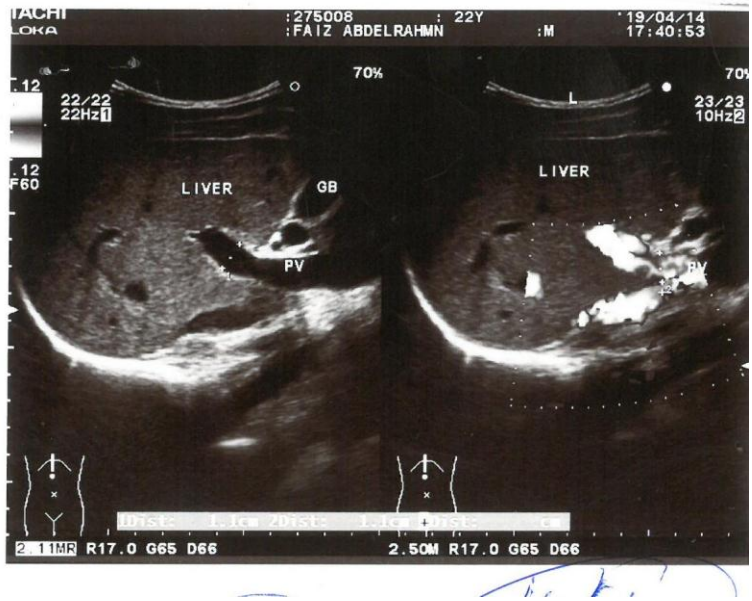


Appendix (A-1) U/S image of female -31ys-shows PVD 10mm

Appendix (A-2) U/S image of female -55ys- shows PVD 11mm



Appendix (A-3) U/S image of male -33ys- shows PVD 11mm

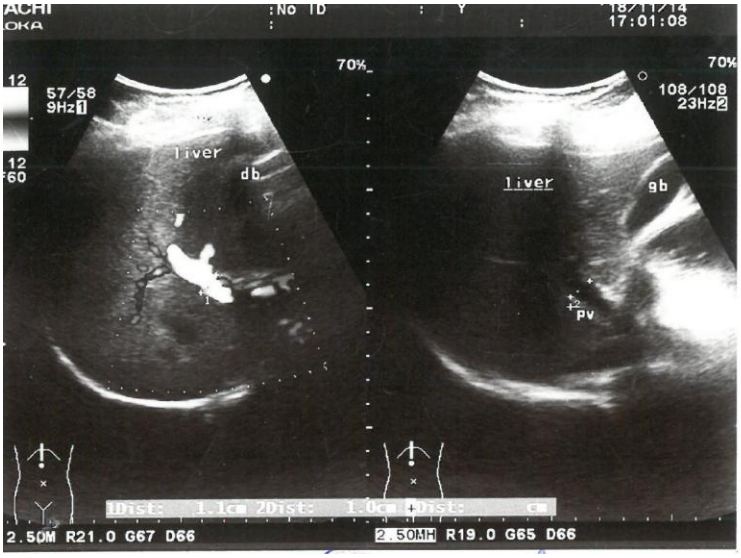


Appendix (A-4) U/S image of male -22ys- shows PVD 11mm

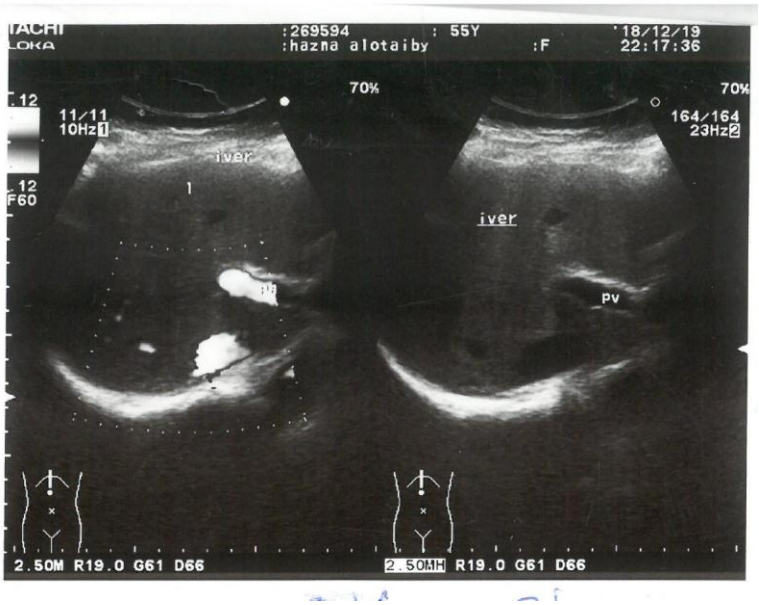
Appendix (A-5) U/S image of female -50ys- shows PVD 9mm

Appendix (A-6) U/S image of male -30ys- shows PVD 12mm

Appendix (A-7) U/S image of female -57ys- shows PVD 11mm



Appendix (A-8) U/S image of female -37ys- shows PVD 10mm



Appendix (A-9) U/S image of female -61ys- shows PVD 12mm

Appendix (A-10) U/S image of female -43ys- shows PVD 10mm

APPENDIX (B) Data collection and sheet

No	Age	Gender	*Weight (KG)*	*Height (M)*	*Height (CM)*	*Body mass () index*	*DOPPLOR PV DIAMENTION (MM)*	*PORTAL VIEN DIAMENTION (MM)*