Sudan University of Science and Technology
College of Graduate Studies

Measurement of Normal Liver in Sudanese Pregnant Women using Ultrasonography

قياس الكبد الطبيعي لدى النساء الحوامل باستخدام التصوير بالموجات فوق الصوتية

A Thesis Submitted in Partial Fulfillment for the Requirement of M.Sc. Degree in Medical Diagnostic Ultrasound

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الآية

قال تعالى :

(قُل لَّوْ كَانَ الْبَحْرُ مِدَادًا لِّكَلِمَاتِ رَبِّي لَنَفِدَ الْبَحْرُ قَبْلَ أَن تَنفَدَ كَلِمَاتُ رَبِّي وَلَوْ جِئْنَا بِمِثْلِهِ مَدَدًا)

صدق الله العظيم
سورة الكهف الآية(109)

Dedication

To my parent whose support and counsel me all the time.

To my husband Hussam Aldeen for encourage, guided and belief in me.

To my children who motivated me until accomplished this research

Acknowledgment

Thanks to Allah that my work was brought to reality.

Thanks to my supervisor **Dr. Babiker Abdelwahab Awad Alla** and all teachers.

Thanks to every person helped me in this research.

Thanks for all.

Abstract

This study was conducted in Khartoum state, Sudan, in the ultrasound department of Bahry hospital.

This study was conducted between October 2016 to January 2017. Data were collected and analyzed by the statistical packages program.

The study aims to measurement of the liver span, right lobe and portal vein diameter in pregnant women and whether hormone changes due to pregnant affect in liver measurement.

The sampling include 50 pregnant women and 30 non-pregnant women (control group) aged between 18-42 years.

The mean measurement of liver was 27.05, the mean of right lobe was 12.01 and the mean of PVD was 1.016.

According to the study, there is no change in the measurement of liver in pregnant women even with different gestation age.

The study concluded that there is a difference in the measurement of the right lobe of liver in pregnant women compared to the non-pregnant women. But no difference is observed in the measurement of portal vein diameter.

المستخلص

أجريت هذه الدراسة في ولاية الخرطوم – السودان بأقسام الموجات فوق الصوتية بمستشفى بحري.

هذه الدراسة أجريت في الفترة من أكتوبر 2016 إلى يناير 2017م .

تم جمع البيانات وتحليلها بواسطة برنامج الحزم الإحصائية (SPSS). تم جمع البيانات من (50) مرأة حامل و (30) مرأة غير حامل وقد تراوحت أعمارهم بين (18–42) سنة.

تهدف هذه الدراسة إلى قياس الكبد والوريد البابي والفص الأيمن من الكبد في المراة الحامل وهل التغيرات التي تحدث في الجسم نتيجة الحمل تغير في قياس الكبد.

كان متوسط قياس الكبد 27.05، وكان متوسط قياس الفص الايمن 12.01 وكان قياس قطر الوريد البابي 1.016.

أفادت الدراسة أن لا تغير في قياس الكبد في المرأة الحامل حتى مع الاختلاف في عمر الجنين.

وقد خلصت الدراسة أن هناك اختلاف في قياس الفص الأيمن للكبد في المرأة الحامل مقارنة مع المرأة الغير حامل . ولكن لم يكن هناك اختلاف يذكر في قياس الوريد البابي.

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Chapter One

Introduction

1.1 Introduction

The liver is largest of abdominal viscera, occupying a substantial portion of the upper abdominal cavity. It occupies most of the right hypochondria and epigastrium, and frequently extends into the left hypochondria as far as the left lateral line as the body grows from infancy to adulthood the liver rapidly increases in size. This period of growth reaches plateau around 18 years and followed by gradual decrease in the weight from middle age. The ratio of liver to body weight decrease with growth from infancy to adulthood. The liver weights approximately 5% of the body weight in infancy and it decreases to approximately 2% in adulthood. The liver size increase with increasing age, averaging 5 cm span at 5 years and attaining adult size by age15 years. The size depends on several factors: age, sex, body size and shape, the mean liver size is 7 cm for women and 10.5 cm for men. A liver span to 3 cm larger or smaller than these values is considered abnormal. The liver weight 1200 to 1400 g in the adult woman and 1400 to 1500 g in the adult man. **(Grays, 2008)**

The main portal vein enters the liver at the portahepatis, also referred to as the liver hilum. The portal vein provides the liver with approximately 70% of its total blood supply. The blood within the portal vein is partially oxygenated, as it is derived from the intestines. The remainder of hepatic perfusion is via the hepatic artery. **(Grays, 2008)**

The female uterus provided to carry the fetus for 9month and 9days or we count it about 40 week carry the baby, conventionally divided into 3trimester. The body most change its physiological in pregnancy. It is major adaptations in maternal anatomy, physiology, and metabolisms are required for successful pregnancy. Nearly every organ system is affected. Understanding these

changes help to distinguish the normal physiology of pregnancy from pathological disease. **(Grays, 2008)**

Ultrasound is become the best, easier, the most image examination in abdominal noninvasive, use of high frequency (inaudible) sound to generate images. Ultrasound image has more features like minimal scan time, low cost imaging, flexible and reduced exposure to harmful radiation. **(Carol, 2011)**

1.2 Problem of the study:

Pregnancy is a physiological process that involve all system of the body. liver is expected to changes during pregnancy. result of this study will be useful to estimate normal liver measurement during normal pregnancy and potential changes. Ultrasound is anon invasive process with high sensitivity to detect changes in liver. it is facilitate estimate routine done during periodic follow-up of pregnancy.

1.3 Objective of the study:

1.3.1 General objective:

To measure normal liver in Sudanese pregnant women using ultrasonography.

Specific objective:

1. To measure the liver span.
2. To measure the portal vain.
3. To measure the right lobe of liver.
4. To correlate between live measurement in pregnant and nonpregnant women.

1.4 Overview of the study:

This study consists of five chambers: Chapter one, which is introduction. It present the statement of the study problem, objective of the study. Chapter two is divided into two sections, section one theoretical background (anatomy, physiology and pathology)and section two deals with literature

review (previous studies). Chapter three discusses the materials and method. Chapter four includes result. Finally Chapter five includes the discussion, conclusion, recommendations, references and appendices.

Chapter Two

Theoretical back ground and Previous Studies

Chapter Two

Theoretical back ground and Previous Studies

2.1 Theoretical back ground

2.1.1Anatomy:

The liver is the largest organ in the body weighing 1400-1600 gm in the males and 1200-1400 gm in the females **(Harsh 2010)** occupying a substantial portion of the upper abdominal cavity. It occupies most of the right hypochondrium and epigastrium, and frequently extends into the left hypochondrium as far as the left lateral line. As the body grows from infancy to adulthood the liver rapidly increases in size. This period of growth reaches a plateau around 18 years and is followed by a gradual decrease in the liver weight from middle age. The ratio of liver to body weight decreases with growth from infancy to adulthood. The liver weighs approximately 5% of the body weight in infancy and it decreases to approximately 2% in adulthood **(Grays 2008).**

The size of the liver is measures less than 15 cm and varies according to sex, age and body size. It has an overall wedge shape, which is in part determined by the form of the upper abdominal cavity into which it grows. **(Grays, 2008)**

The narrow end of the wedge lies towards the left hypochondrium, and the anterior edge points anteriorly and inferiorly. The superior and right lateral aspects are shaped by the anterolateral abdominal and chest wall as well as the diaphragm. The inferior aspect is shaped by the adjacent viscera. The capsule is no longer thought to play an important part in maintaining the integrity of the shape of the liver. The liver is usually described as having superior, anterior, right, posterior and inferior surfaces, and has a distinct inferior border.(**Grays, 2008)**.

Throughout life the liver is reddish brown in color, although this can vary depending upon the fat content. Obesity is the most common cause of excess fat in the liver (also known as steatosis), the liver assumes a more yellowish tinge as its fat content increases. The texture is usually soft to firm, although it depends partly on the volume of blood the liver contains and the fat content. .(**Grays, 2008)**.

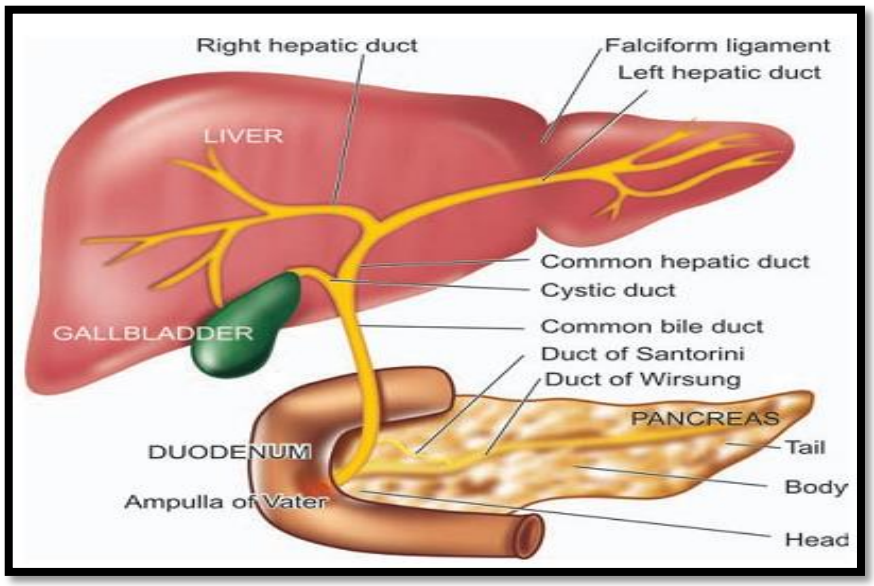


Figure (2.1). Anatomy of the liver and its relationship to the gall bladder, pancreas and duodenum.(Grays, 2008).

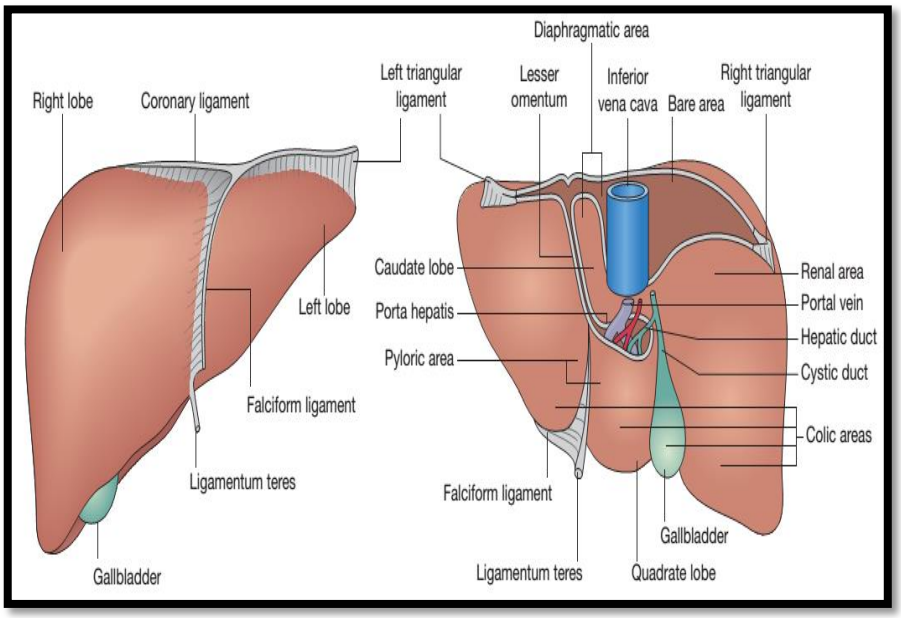


Figure 2.2: Lobes, surfaces and ligaments of the liver viewed anterior (left) and from aposteroinferior (right) .(Grays, 2008).

2.1.1.1 The PortaHepatis:

The portahepatis may also be referred to as the liver hilum. The three structures located within the portahepatis are the main portal vein, common bile duct, and hepatic artery.

2.1.1.2 Gross anatomical lobes:

Historically, the liver has been considered to be divided into right, left, caudate and quadrate lobes by the surface peritoneal and ligamentous attachments. **(Snell 2012)**

2.1.1.3 Right lobe:

The right lobe is the largest in volume and contributes to all surfaces of the liver. It is divided from the left lobe by the falciform ligament superiorly and the ligamentumvenosum inferiorly. On the inferior face to the right of the groove formed by the ligamentumvenosum there are two prominences separated by the portahepatis: the caudate lobe lies posterior and the quadrate lobe anterior to the portahepatis. The gallbladder lies in a shallow fossa to the right of the quadrate lobe. **(Snell 2012)**

2.1.1.4 Left lobe:

The left lobe is the smaller of the two main lobes, although it is nearly as large as the right lobe in young children. It lies to the left of the falciform ligament with no subdivisions, and is substantially thinner than the right lobe, having a thin apex that points into the left upper quadrant. **(Snell 2012)**

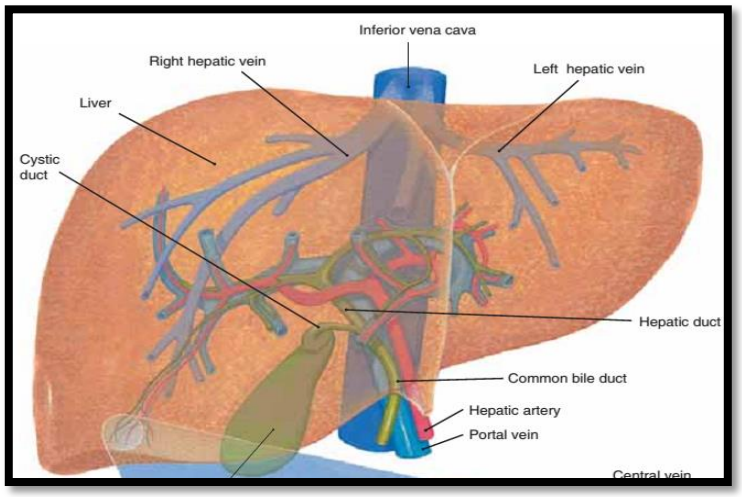
2.1.1.5 Quadrate lobe:

The quadrate lobe is visible as a prominence on the inferior surface of the liver, to the right of the groove formed by the ligamentumvenosum (and thus is incorrectly said to arise from the right lobe although it is functionally related to the left lobe). It lies anterior to the portahepatis and is bounded by the gallbladder fossa to the right, a short portion of the inferior border

anteriorly, the fissure for the ligamentumteres to the left, and the portahepatis posteriorly. **(Snell 2012)**

2.1.1.6 Caudate lobe:

The caudate lobe is visible as a prominence on the inferior and posterior surfaces to the right of the groove formed by the ligamentumvenosum: it lies posterior to the portahepatis. To its right is the groove for the inferior vena cava. Above, it continues into the superior surface on the right of the upper end of the fissure for the ligamentumvenosum. In gross anatomical descriptions this lobe is said to arise from the right lobe, but it is functionally separate.**(Snell 2012)**



Figure(2.3): The liver and gall bladder with blood vessels and bile ducts (Grays, 2008).

2.1.1.7 Fissures of the liver:

Knowledge of the fissures of the liver is essential for understanding liver surgery. Three major fissures, not visible on the surface, run through the liver parenchyma and harbor the three main hepatic veins (main, left and right portal fissures). Three minor fissures are visible as physical clefts of the liver surface (umbilical, venous and fissure of Gans). **(Grays, 2008)**

2.1.1.8 Sectors and segments of the liver:

The sectors of the liver are made up of between one and three segments: right lateral sector = segments VI and VII; right medial sector = segments V

and VIII; left medial sector = segments III and IV (and part of I); left lateral sector = segment II. Segments are numbered in an ante-clockwise spiral centered on the portal vein with the liver viewed from beneath, starting with segment I up to segment VI, and then back clockwise for the most cranial two segments VII and VIII. **(Grays, 2008)**

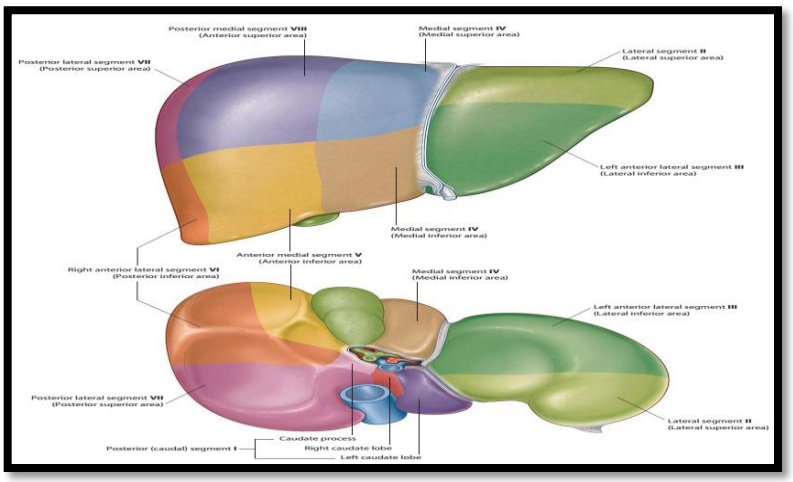


Fig. 2.4. Shows segments of the liver A. Anterior view. B. Posterior view(Grays, 2008)

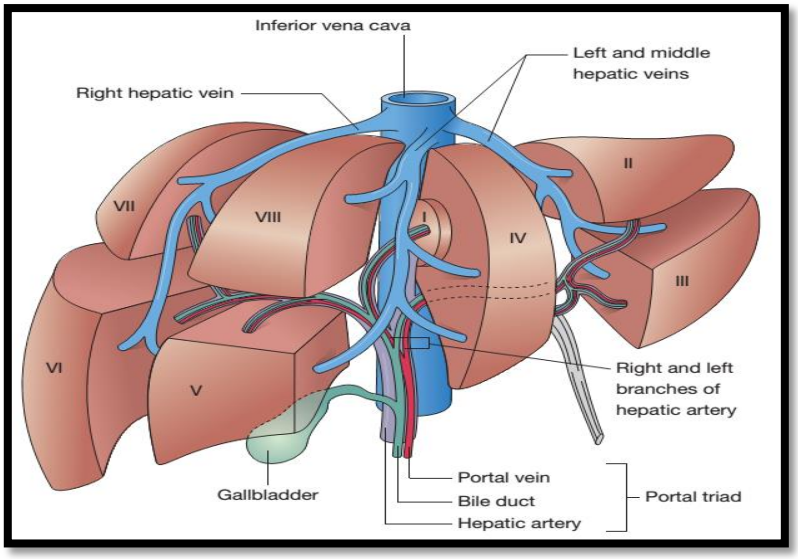


Figure 2.5: Division of the liver based on hepatic drainage and blood supply(Grays, 2008)

2.1.1.9 Supports of the liver:

The liver is stabilized and maintained in its position in the right upper quadrant of the abdomen by both static and dynamic factors. Suggested a three-tier classification of the anatomical factors: the suspensory attachments at the posterior abdominal wall to the inferior vena cava, hepatic veins,

coronary and triangular ligaments (primary factors); the support provided by the right kidney, right colonic angle and duodenopancreatic complex (secondary factors); the attachment to the anterior abdominal wall and diaphragm by the falciform ligament (tertiary factors). The inferior vena cava and the supra-hepatic veins, especially the right hepatic vein, appear to be the most important anatomical structures that support the bulk of the liver. Other factors which are responsible for the maintenance of the position of the liver within the abdominal cavity include positive intra-abdominal pressure and the movement of the diaphragm during respiration. **(Grays, 2008)**

2.1.1.10 Peritoneal attachments and ligaments of the liver:

The liver is attached to the anterior abdominal wall, diaphragm and other viscera by several ligaments which are formed from condensations of the peritoneum which are Falciform ligament, Coronary ligament, Triangular ligaments, Lesser omentum, Ligamentumvenosum, Portahepatis, hepatoduodenal ligament and hilar plate and Glisson'ssheat. **(Grays, 2008)**

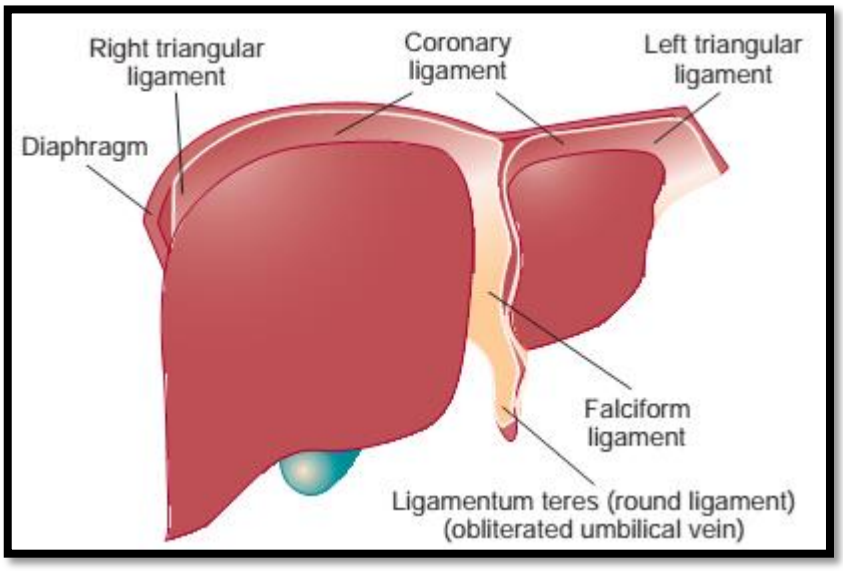


Figure 2.6. Hepatic Ligaments. Diagram of anterior surface of the liver(Gray's, 2008).

2.1.1.11 Vascular supply and lymphatic drain:

The vessels connected with the liver are the portal vein, hepatic artery and hepatic veins. The portal vein and hepatic artery ascend in the lesser omentum

to the portahepatis, where each bifurcates. The hepatic bile duct and lymphatic vessels descend from the portahepatis in the same omentum

The hepatic veins leave the liver via its posterior surface and run directly into the inferior vena cava. **(Grays, 2008).**

2.1.1.12 Hepatic artery:

In adults the hepatic artery is intermediate in size between the left gastric and splenic arteries. In fetal and early postnatal life it is the largest branch of the coeliac axis. The hepatic artery gives off right gastric, gastroduodenal and cystic branches as well as direct branches to the bile duct from the right hepatic and sometimes the supraduodenal artery. After its origin from the coeliac axis, the hepatic artery passes anteriorly and laterally below the epiploic foramen to the upper aspect of the first part of the duodenum. It may be subdivided into the common hepatic artery, from the coeliac trunk to the origin of the gastroduodenal artery, and the hepatic artery ‘proper', from that point to its bifurcation. It passes anterior to the portal vein and ascends anterior to the epiploic foramen between the layers of the lesser omentum. Within the free border of the lesser omentum the hepatic artery is medial to the common bile duct and anterior to the portal vein. At the portahepatis it divides into right and left branches before these run into the parenchyma of the liver. The right hepatic artery usually crosses posterior (occasionally anterior) to the common hepatic duct. This close proximity often means that the right hepatic artery is involved in bile duct cancer earlier than the left hepatic artery. Occasionally the right hepatic artery crosses in front of the common bile duct and may be injured in surgery of the common bile duct. It almost always divides into an anterior branch supplying segments V and VIII, and a posterior branch supplying segments VI and VII. The anterior division often supplies a branch to segment I and the gallbladder. The segmental arteries are macroscopically end-arteries although some collateral circulation occurs between segments via fine terminal branches. **(Grays, 2011).**

A small number of normal variants are important to demonstrate angiographically because they may influence surgical and interventional radiological procedures. A vessel that supplies a lobe in addition to its normal vessel is defined as an accessory artery. A replaced hepatic artery is a vessel that does not originate from an orthodox position and provides the sole supply to that lobe. Rarely a replaced common hepatic artery arises from the superior mesenteric artery and is identified at surgery by a relatively superficial portal vein (reflecting the absence of a common hepatic artery that would normally cross in front of the vein). More commonly a replaced right hepatic artery or an accessory right hepatic artery arises from the superior mesenteric artery. In this case they run behind the portal vein and bile duct in the lesser omentum and can be identified at surgery by pulsation behind the portal vein.

2.1.1.13 Veins:

The liver has two venous systems. The portal system conveys venous blood from the majority of the gastrointestinal tract and its associated organs to the liver. The hepatic venous system drains blood from the liver parenchyma into the inferior vena cava. **(Gray s, 2008).**

Portal vein: The portal vein begins at the level of the second lumbar vertebra and is formed from the convergence of the superior mesenteric and splenic veins. It is approximately 8 cm long and lies anterior to the inferior vena cava and posterior to the neck of the pancreas. It lies obliquely to the right and ascends behind the first part of the duodenum, the common bile duct and gastroduodenal artery. At this point it is directly anterior to the inferior vena cava. It enters the right border of the lesser omentum, ascends anterior to the epiploic foramen to reach the right end of the portahepatis and then divides into right and left main branches which accompany the corresponding branches of the hepatic artery into the liver. In the lesser omentum the portal vein lies posterior to both the common bile duct and hepatic artery. It is

surrounded by the hepatic nerve plexus and accompanied by many lymph vessels and some lymph nodes. **(Grays, 2008).**

Porto-systemic shunts: Increased pressure within the portal venous system may result in dilatation of the portal venous tributaries: a reversal of flow may occur where these veins form anastomoses with veins which drain into the systemic venous circulation.

Hepatic veins: Liver is drained by three major hepatic veins into the suprahepatic part of the inferior vena cava and a multitude of minor hepatic veins that drain into the intrahepatic inferior vena cava. There are three major veins are located between the four major sectors of the liver which are Right hepatic vein, Middle hepatic vein, Left hepatic vein and Minor veins. **(Gray s, 2008).**

2.1.1.14 Lymphatics:

Lymph from the liver has abundant protein content. Lymphatic drainage from the liver is wide and may pass to nodes above and below the diaphragm. Obstruction of the hepatic venous drainage increases the flow of lymph in the thoracic duct. Hepatic collecting vessels are divided into superficial and deep systems. **(Grays, 2008).**

2.1.1.15 Innervation:

The liver has a dual innervation. The parenchyma is supplied by hepatic nerves which arise from the hepatic plexus and contain sympathetic and parasympathetic (vagal) fibres. They enter the liver at the portahepatis and most accompany the hepatic arteries and bile ducts. A very few may run directly within the liver parenchyma. The capsule is supplied by some fine branches of the lower intercostal nerves, which also supply the parietal peritoneum, particularly in the area of the ‘bare area' and superior surface. **(Grays, 2008).**

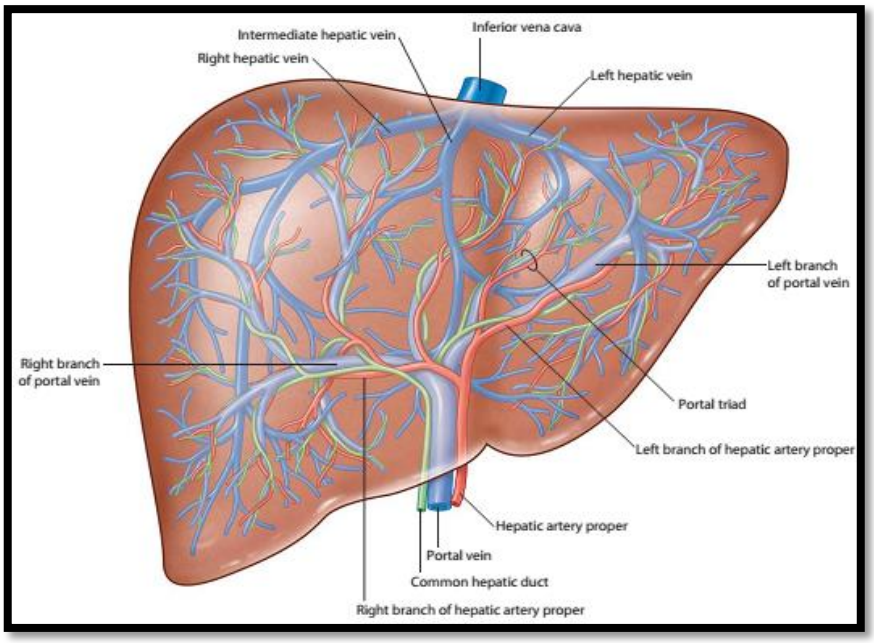


Figure 2.7. Anterior surface of liver with hepatic veins, portal veins and associated vessels (Grays, 2008)

2.1.1.16 Lobulation of the liver:

The liver is composed of small functional units called lobules. Each lobule contains numerous canals which channel blood between the cell of the lobule into a central vein **(Robert, 1996).** The lobule is a roughly hexagonal arrangement of plates of hepatocytes, separated by intervening sinusoids which radiate outward from a central vein, with portal triads at the vertices of each hexagon. The central vein is a tributary of the hepatic vein that drains the tissue. In some species, the classic lobular units are delimited microscopically by distinct connective tissue septa. However, the lobular organization of the human liver is not immediately evident in histological sections: the lobules do not have distinct boundaries, and connective tissue is sparse. The plates do not pass straight to the periphery of a lobule like the spokes of a wheel but run irregularly as they anastomose and branch. **(Grays, 2008).**

2.1.2 Physiology of the liver:

The liver performs a wide range of metabolic activities required for homeostasis, nutrition and immune defense. For example, it is important in the removal and breakdown of toxic, or potentially toxic, materials from the

blood and the regulation of blood glucose and lipids, the storage of certain vitamins, iron, and other micronutrients, and in breaking down or modifying amino acids. It is involved in a plethora of other biochemical reactions. Since the majority of these processes are exothermic, a substantial part of the thermal energy production of the body, especially at rest, is provided by the liver. The liver is populated by phagocytic macrophages, components of the mononuclear phagocyte system capable of removing particulates from the blood stream. It is an important site of haemopoiesis in the fetus. The liver functions are briefly listed as:

One of the many functions of the liver is synthesizes cholate and chenodeoxycholate (primary bile salts) from cholesterol and secrete bile, normally between 600 and 1000 ml/day. Bile serves two important functions: First, bile plays an important role in fat digestion and absorption. Second, bile serves as a means for excretion of several important waste products from the blood. These include especially bilirubin, an end product of hemoglobin destruction, and excesses of cholesterol, Manufacture of several major plasma proteins such as albumin, fibrinogen and prothrombin. Metabolism of proteins, carbohydrates and lipids. Storage of vitamins (A, D and B12) and iron. 5. Detoxification of toxic substances such as alcohol and drugs. **(Agamemnon, 2003)**

2.1.3 Liver pathology (Diffuse Liver Disease)

2.1.3.1 Fatty Liver Disease

Is a reversible disease characterized by deposits of fat within the hepatocytes. Causes of fatty liver include obesity, alcohol abuse, chemotherapy, diabetes mellitus, pregnancy, glycogen storage disease, and the use of some drugs. Although fatty liver is typically asymptomatic, patients may present clinically with elevated liver function tests. Fatty changes within the liver can be diffuse or focal. **(Edward, 2008)**

2.1.3.2 Hepatitis:

Hepatitis is inflammation of the liver, which can ultimately lead to cirrhosis, portal hypertension, and hepatocellular carcinoma (HCC). Hepatitis can be acute or chronic, **1.** Acute viral hepatitis is characterized by jaundice and dramatically elevated liver enzymes (aspartate aminotransaminase [AST] and alanine aminotransaminase [ALT]). **2.** Chronic viral hepatitis requires symptoms persisting for longer than 6 months**.** Viral hepatitis comes in many forms, including hepatitis A, B, C, D, E, and G. The two most common forms are hepatitis A and B.8 Hepatitis A is spread by fecal–oral route in contaminated water or food. Hepatitis B is spread by contact with contaminated body fluids, mother-to-infant transmission, or inadvertent blood contact, as seen in the case of intravenous drug abuse or occupational exposure. An additional concern for healthcare workers is work-related exposure to hepatitis C. This form of hepatitis is also spread by means of contact with blood and body fluids. Hepatitis may also be triggered by reactions to viruses. Patients with any form of hepatitis can experience a wide range of clinical troubles including fever, chills, nausea, vomiting, fatigue, hepatosplenomegaly, dark urine, and jaundice. However, the jaundice related to hepatitis is on a cellular level and is not associated with biliary obstruction. This is referred to as non obstructive jaundice. Elevation in the liver function tests is often apparent as well. Sonographically, a patient with hepatitis may initially have a completely normal-appearing liver. With time, hepatomegaly and splenomegaly can be observed with sonography. As the liver enlarges, it tends to become more hypoechoic. Periportal cuffing may be seen in some patients with hepatitis. This is described as an increase in the echogenicity of the walls of the portal triads. The sonographic manifestation of this phenomenon is referred to as the “starry sky” sign. The gallbladder wall may also be thickened in the presence of hepatitis. **(Edward, 2008)**

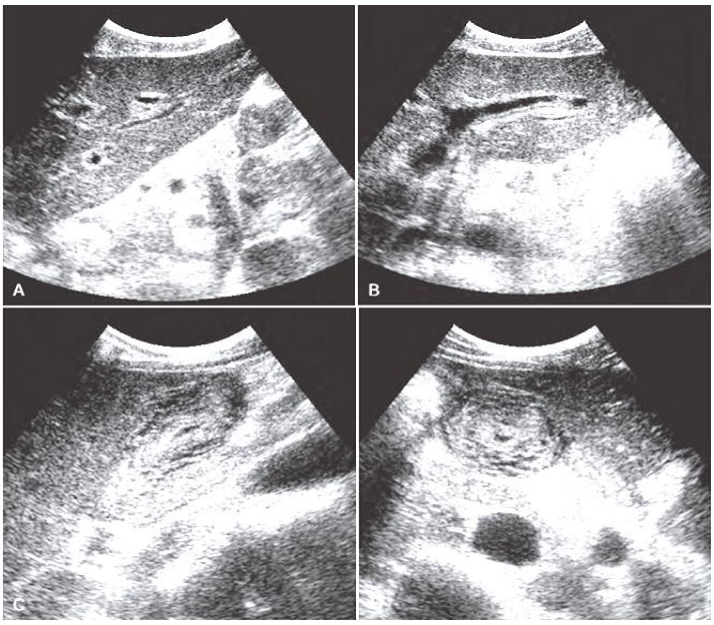


Figure 2.8. Ultrasound images A, sagittal and B, transverse, images of the left lobe of the liver show marked increased thickness and echogenicity of the soft tissue surrounding the portal vein branch. C, sagittal and D, transverse, views of the thickened gall bladder wall with extensive hypoechoic pocket of edema fluid.(Carol, 2011)

2.1.3.3 Cirrhosis:

Cirrhosis is a devastating liver disorder that is defined as hepatocyte death, fibrosis and necrosis of the liver, and the subsequent development of regenerating nodules. Common sequela of cirrhosis includes portal hypertension, the development of varicosities within the abdomen, portal vein thrombosis, splenomegaly, and HCC. The most common cause of cirrhosis is alcoholism. However, cirrhosis can also be caused by primary biliary cirrhosis, hepatitis, cholangitis, and hemochromatosis. Patients may have normal laboratory findings until cirrhosis advances into end-stage liver disease. However, when laboratory abnormalities are evident, they include elevation in aspartate aminotransferase, alanine aminotransferase, lactate dehydrogenase, and bilirubin. Patients may also present with jaundice, fatigue, weight loss, diarrhea, initial hepatomegaly, and ascites. Sonographic findings of cirrhosis include an echogenic, small right lobe, an enlarged caudate and left lobe, nodular surface irregularity, coarse echo texture, ascites, and splenomegaly. Cirrhosis caused by alcoholism will lead to the

development of nodules that typically measure less than 1 cm, while cirrhosis caused by hepatitis will cause macronodular development, or nodules that measure between 1 and 5 cm. These nodules may be readily seen when ascites surrounds the liver. If ascites is not present, a high-frequency linear transducer can be used to analyze the liver surface for lumps. Doppler findings include monophasic flow within the hepatic veins and hepatofugal flow within the portal veins. These are both findings consistent with advanced cirrhosis and portal hypertension. With these findings, the sonographer is encouraged to further investigate the liver and abdomen for signs of portal hypertension, portal vein thrombosis, and HCC. **(Edward, 2008)**

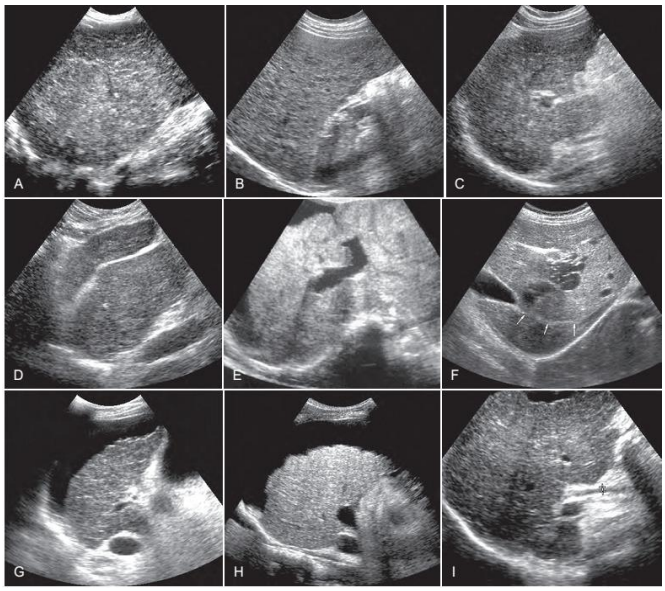


Figure 2.9. Ultrasound images of cirrhotic liver show A, Coarse parenchyma and innumerable tiny, hyperechoic nodules. B, Coarse parenchyma and innumerable tiny, hypoechoic nodules. C, Coarse parenchyma and surface nodularity. D, Sagittal image showing an enormous caudate lobe. E, Transverse sonogram shows the right lobe is small with enlarged the left lateral segment. G and H, Small, end stage liver with surface nodularity, best appreciated in patient with ascites. I, liver contour varies greatly. (Carol, 2011)

2.1.4 Sonographic Anatomy:

The normal liver is homogeneous, contains fine - level echoes, and is either minimally hyperechoic or isoechoic compared to the normal renal cortex. The liver is hypoechoic compared to the spleen. This relationship is evident when the lateral segment of the left lobe is elongated and wraps around the spleen,

with the bright echoes of the portal triads and echo-free areas corresponding to large hepatic veins its outline is smooth, the inferior margin coming to a point anteriorly. **(Carol, 2011)**

The liver is surrounded by a thin, hyperechoic capsule, which is difficult to see on ultrasound unless outlined by fluid. The smooth parenchyma is interrupted by vessels and ligaments and the liver itself provides an excellent acoustic window on to the various organs and great vessels situated in the upper abdomen. The ligaments are hyperechoic, linear structures; the falciform ligament, which separates the anatomical left and right lobes, is situated at the superior margin of the liver and is best demonstrated when surrounded by ascetic fluid. **(Carol, 2011)**

It surrounds the left main portal vein and is known as the ligamentumteres as it descends towards the infero-anterior aspect of the liver. The ligamentumvenosum separates the caudate lobe from the rest of the liver. The size of the liver is difficult to quantify, as there is such a large variation in shape between normal subjects and direct measurements are notoriously inaccurate. Size is therefore usually assessed subjectively. Look particularly at the inferior margin of the right lobe which should come to a point anterior to the lower pole of the right kidney. A relatively common variant of this is the *Reidel's lobe*, an inferior elongation of segment VI on the right. This is an extension of the right lobe over the lower pole of the kidney, with a rounded margin, and is worth remembering as a possible cause of a palpable right upper quadrant 'mass'. To distinguish mild enlargement from a Reidel's lobe, look at the left lobe. If this also looks bulky, with a rounded inferior edge, the liver is enlarged. A Reidel's lobe is usually accompanied by a smaller, less accessible left lobe. **(Carol, 2011)**

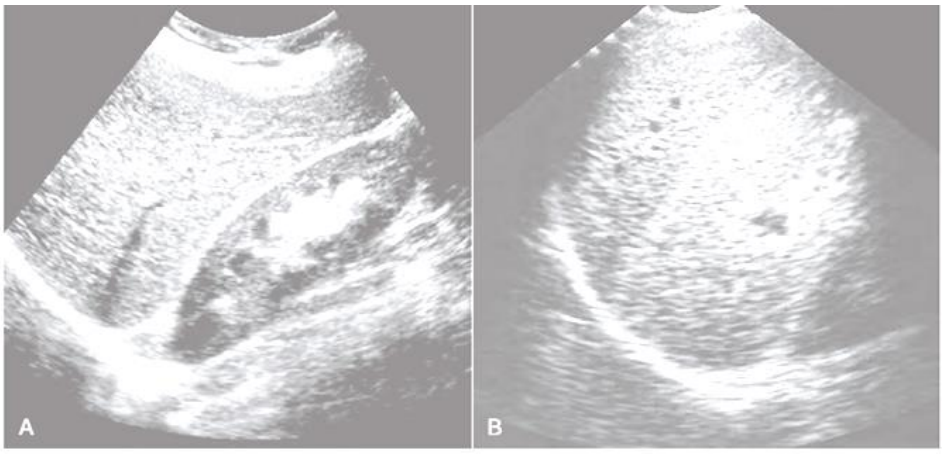


Figure 2.10. Shows normal liver echogenicity. A. the liver is more echogenic than the renal cortex. B. The liver is less echogenic than the spleen, as seen it left lobe wraps around the spleen. (Carol, 2011)

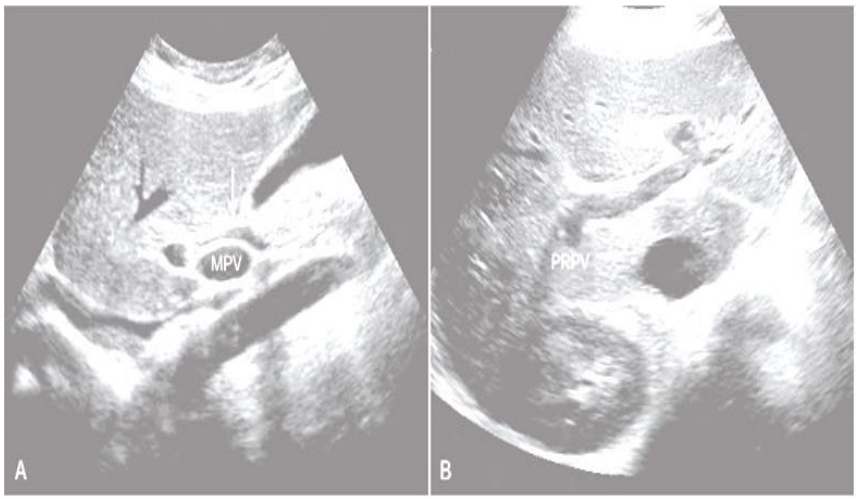


Figure 2.11. Shows normal porta hepatic. A, Sagital image and B, Transverse image(Carol, 2011)

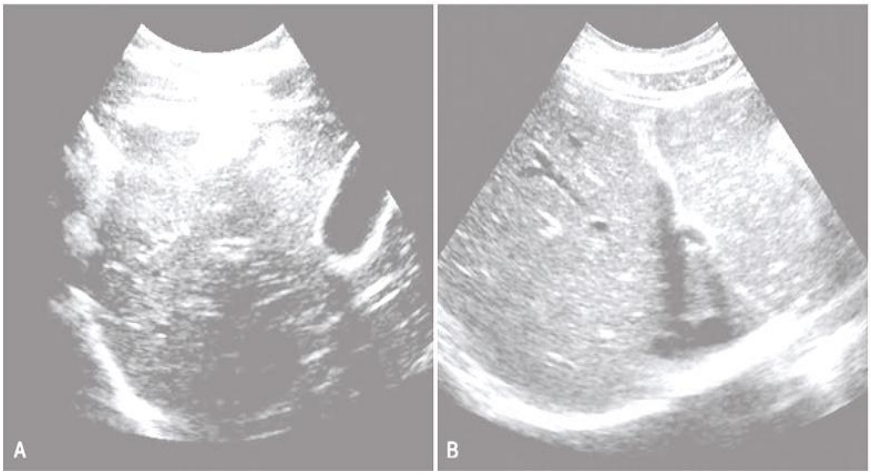


Figure 2.12. Shows falciform ligament. A, Sagittal image through falciform ligament. B, Subcostal view of falciform ligament.(Carol, 2011)

2.2 Previous study:

Study done by (Tarawneh. et al. 2009) "Ultrasound Measurement of liver span in jordnian adult- A Preliminary Experience, 2008". The study was carried out at Jordan University Hospital between March 2007 and April 2008, on non-selected population sample of 242 male and 275 female adults with age range of 18-76 years. The result in this study was the liver span in female was 12.2-12.5. **(Tarawneh. et al. 2009**)

Study done by (Saurabh. et al, 2010): on what Does liver size say about my health, 2018. The study group in cloud adult female between 18 to 88 years. The study result found (18 to 15 years) 13.6 cm, 26 to 35 years was 13.7 cm and 36 to 45 was 14.

Study done by (Luntsi and Mohammed, **2006):** "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. A cross sectional study conducted among 201 apparently healthy adults. The results 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 between the PV diameter and Body Mass Index ($P \leq 0.01$). **(Luntsi and Mohammed**, **2006)**

Study done by (**Weinreb. et al., 1982):** "Portal vein measurements by real-time sonography". AJR Am J Roentgenol. 1982 Sep;139(3):497-9. This study was done in 21 patients aged 0-10 years, the mean diameter of the portal vein was 8.5±2.7 mm. in 20 patients aged 11-20 years, the mean diameter was 10± 2 mm. in 49 patients aged 21-30 years the mean diameter was 11± 2 mm. in 58 patients aged 31-40 years the mean diameter was 11±2. There was no difference between the portal venous measurements of male and female patients. (**Weinreb. et al., 1982)**

Chapter Three

Materials and methods

Chapter Three

Materials and Methods

This study is performed in ultrasound department in Bahry Hospital during October 2016 to January 2017.

3.1 Materials

3.1.1Study population:

80 patients of female (50 pregnant and 30 non-pregnant) was examined by high resolution B-mode ultrasonography of abdomen scanning protocols

3.1.2 Ultrasound machine:

U/S machine was mindray used with transducer convex 3.5 MHZ.

3.2Methods:

3.2.1 Position of the patient:

Patient lying supine .

Scanning procedure: The examiner is on the patient's right side and the ultrasound machine is on the same side toward the head of the bed. A 3.5 MHz curvilinear transducer

Scanning: The patient should be examined from the sub- to the intercostals in the decubitus position as well in the modified, slightly oblique, positions with the right arm above the head and the right leg stretched during all respiration cycles to identify the best approach and to avoid artefacts caused by the thorax.

3.2.2 Methods of data collection:

The variable that collected from patient include age of female, number of parity, fetal age and finding ultrasound liver scan include liver span, portal vein diameter, right lobe of liver, liver shape and texture.

3.2.3 Data collection:

Data collected according to data collection sheet (appendix) include all above variable data

3.2.4 Data analysis :

The data first summarized into master sheet and then analyzed, by using SPSS(Statistical Package of the Social Science).

Chapter Four

Results

Chapter Four

Results

Table (4.1) frequency distribution of age

Age/years	Frequency	Percent	Valid Percent	Cumulative Percent
18-24	19	38.0	38.0	38.0
25-31	19	38.0	38.0	76.0
32-38	10	20.0	20.0	96.0
39-42	2	4.0	4.0	100.0
Total	50	100.0	100.0	

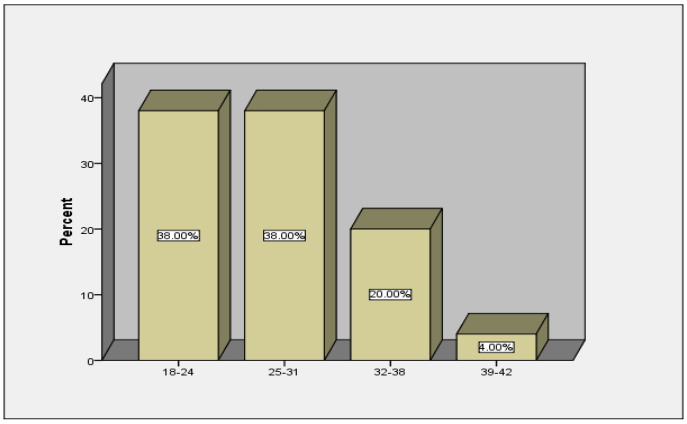


Figure (4.1) frequency distribution of age

Table (4.2) frequency distribution of gestational age

GA \ weeks	Frequency	Percent	Valid Percent	Cumulative Percent
4-13 (first trimester)	9	18.0	18.0	18.0
13w1d-26 weeks (second trimester)	21	42.0	42.0	60.0
26w1d -40 weeks (third trimester)	20	40.0	40.0	100.0
Total	50	100.0	100.0	
4-13 (first trimester)	9	18.0	18.0	18.0

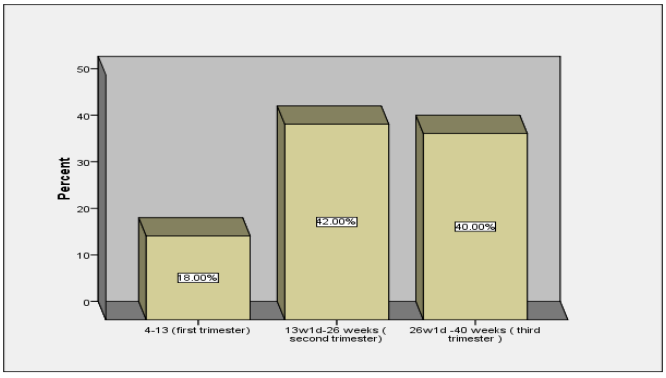


Figure (4.2) frequency distribution of gestational age

Table (4.3) frequency distribution of parity

Parity	Frequency	Percent	Valid Percent	Cumulative Percent
0	3	6.0	6.0	6.0
1	10	20.0	20.0	26.0
2	9	18.0	18.0	44.0
3	14	28.0	28.0	72.0
4	3	6.0	6.0	78.0
5	5	10.0	10.0	88.0
6	3	6.0	6.0	94.0
7	1	2.0	2.0	96.0
9	1	2.0	2.0	98.0
10	1	2.0	2.0	100.0
Total	50	100.0	100.0	

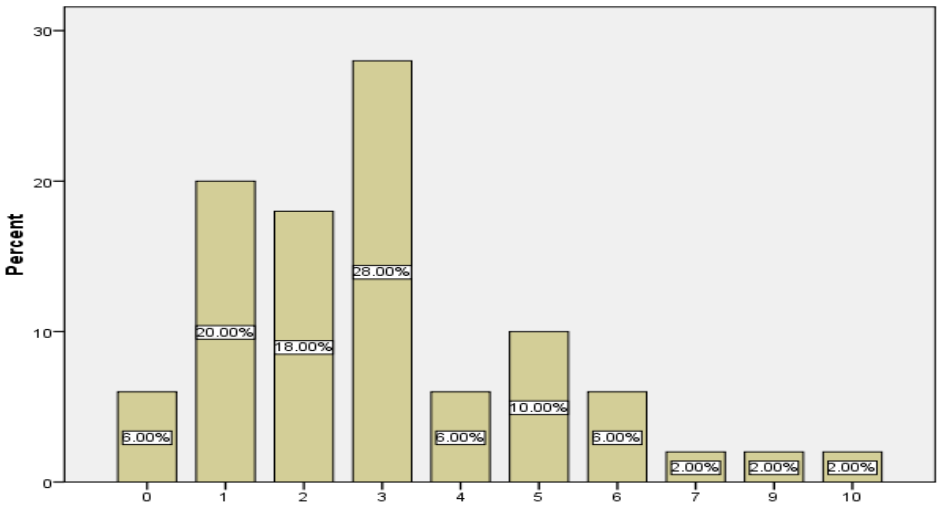


Figure (4.3) frequency distribution of parity

Table (4.4) frequency distribution of parity in range

Parity range	Frequency	Percent	Valid Percent	Cumulative Percent
0-2	22	44.0	44.0	44.0
3-5	22	44.0	44.0	88.0
6-8	4	8.0	8.0	96.0
9-10	2	4.0	4.0	100.0
Total	50	100.0	100.0	

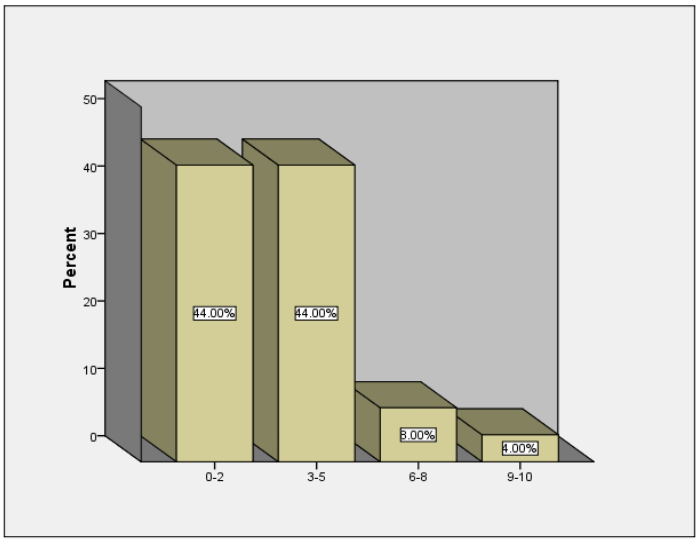


Figure (4.4) frequency distribution of parity in range

Table (4.5) descriptive statistic for age , parity , GA , liver span ,right liver lobe ,PVD

Variables	N	Minimum	Maximum	Mean	Std. Deviation
Age	50	18	42	27.06	5.947
parity	50	0	10	3.02	2.152
GA	50	4	40	22.76	10.773
Liver span	50	11.5	15.1	13.704	.8875
Rt Lobe	50	8.5	14.1	12.014	1.0898
PVD	50	.8	1.3	1.016	.1406
Valid N (listwise)	50				

Table (4.6) correlation between age, parity , GA and liver span ,right liver lobe ,PVD

		Age	parity	GA
Liver span	Pearson Correlation	.215	.247	.038
	Sig. (2-tailed)	.134	.084	.795
	N	50	50	50
Rt Lobe	Pearson Correlation	.303*	.261	.102
	Sig. (2-tailed)	.033	.067	.480
	N	50	50	50
PVD	Pearson Correlation	.132	.122	-.057-
	Sig. (2-tailed)	.359	.397	.693
	N	50	50	50
*. Correlation is significant at the 0.05 level (2-tailed).				

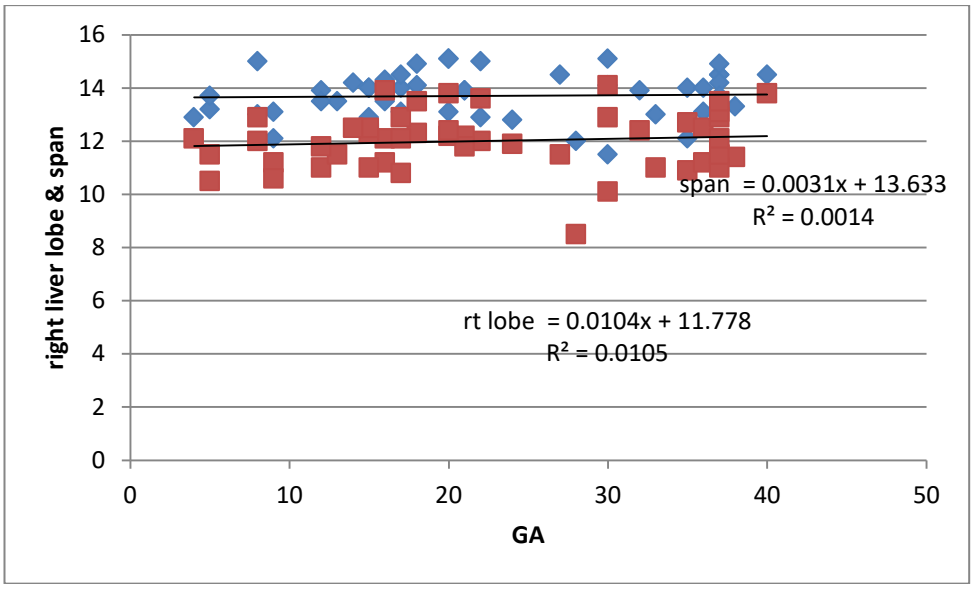


Figure (4.5) scatterplot shows relationship between GA and liver measurements

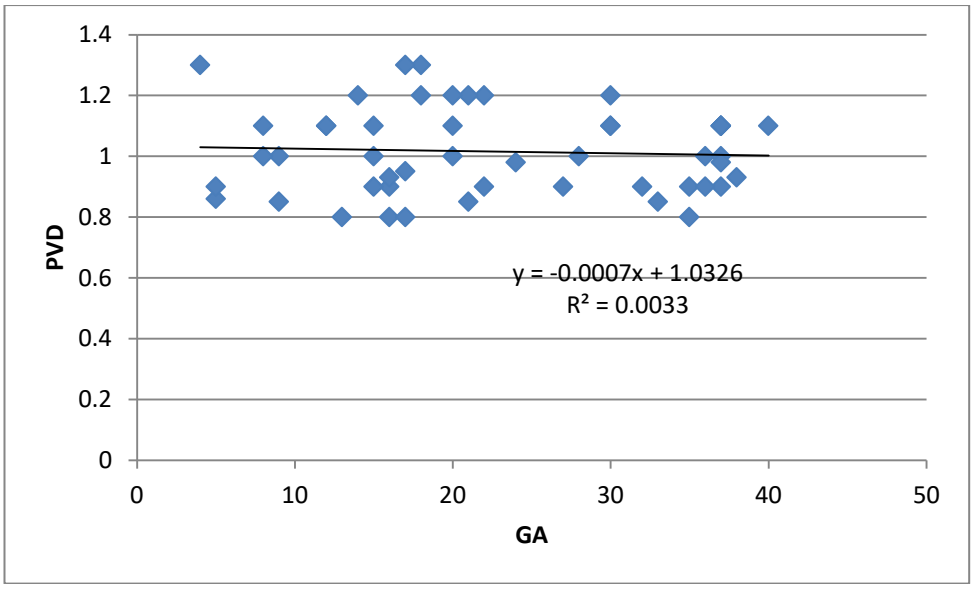


Figure (4.6) scatterplot shows relationship between GA and PVD

Table (4.7) compare mean liver span ,right liver lobe ,PVD in different trimester of pregnancy

Trimester		Liver span	Rt Lobe	PVD
4-13 (first trimester)	Mean	13.378	11.511	1.023
	N	9	9	9
	Std. Deviation	.8012	.7753	.1446
13w1d-26 weeks (second trimester)	Mean	13.924	12.310	1.029
	N	21	21	21
	Std. Deviation	.7300	.8596	.1677
26w1d -40 weeks (third trimester)	Mean	13.620	11.930	.998
	N	20	20	20
	Std. Deviation	1.0436	1.3448	.1095
Total	Mean	13.704	12.014	1.016
	N	50	50	50
	Std. Deviation	.8875	1.0898	.1406
P value		0.266	0.168	0.773

Table (4.8) compare mean liver span ,right liver lobe ,PVD in different parity

Para		Liver span	Rt Lobe	PVD
0-2	Mean	13.427	11.486	.970
	N	22	22	22
	Std. Deviation	.9009	1.1068	.1215
3-5	Mean	13.941	12.536	1.064
	N	22	22	22
	Std. Deviation	.8716	.9343	.1456
6-8	Mean	13.675	12.100	1.000
	N	4	4	4
	Std. Deviation	.4349	.6976	.1826
9-10	Mean	14.200	11.900	1.015
	N	2	2	2
	Std. Deviation	1.2728	.7071	.1202
Total	Mean	13.704	12.014	1.016
	N	50	50	50
	Std. Deviation	.8875	1.0898	.1406
P value		0.230	0.012	0.173

Table (4.9) frequency distribution of age in non-pregnant women

Age \years	Frequency	Percent	Valid Percent	Cumulative Percent
18-24	6	20.0	20.0	20.0
25-31	8	26.7	26.7	46.7
32-38	10	33.3	33.3	80.0
39-42	6	20.0	20.0	100.0
Total	30	100.0	100.0	

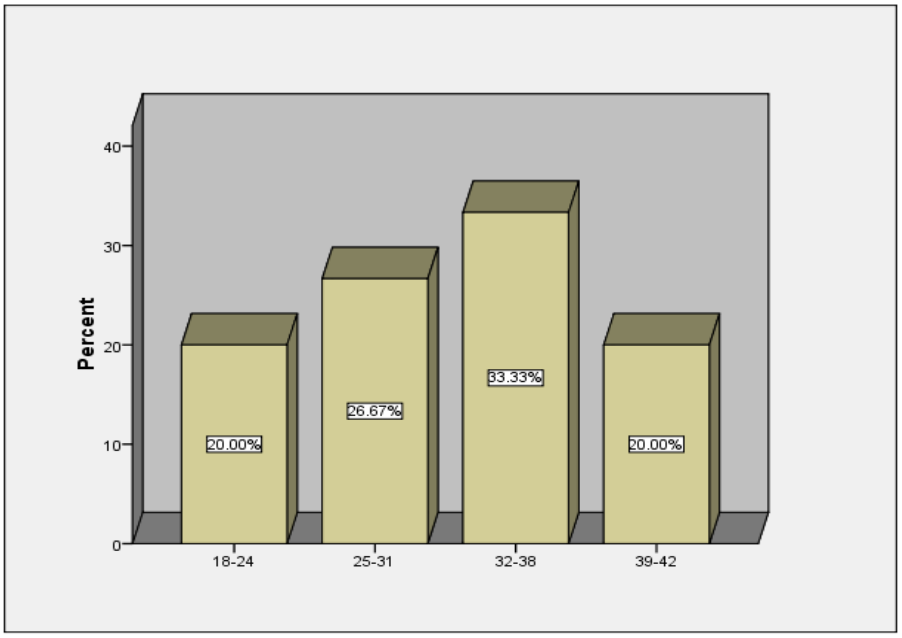


Figure (4.7) frequency distribution of age in non-pregnant women

Table (4.10) Descriptive statistic for age liver span ,right liver lobe ,PVD in control group (non- pregnant women)

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Age	30	18	42	31.03	6.946
Rtlobe	30	8	13	11.33	1.484
Liver span	30	10.4	14.0	13.000	.9865
Pv	30	.8	1.3	1.027	.1574
Valid N (listwise)	30				

Table (4.11.a) Independent sample t-test for compare mean age liver span ,right liver lobe, PVD in control group and pregnant women

a. Mean

	stat	N	Mean	Std. Deviation	Std. Error Mean
Age	pregnant	50	27.06	5.947	.841
	non pregnant	30	31.03	6.946	1.268
Liver span	pregnant	50	13.704	.8875	.1255
	non pregnant	30	13.000	.9865	.1801
Rt Lobe	pregnant	50	12.014	1.0898	.1541
	non pregnant	30	11.330	1.4835	.2709
PVD	pregnant	50	1.016	.1406	.0199
	non pregnant	30	1.027	.1574	.0287

Table (4.11.b) Independent sample t-test for compare mean age liver span ,right liver lobe, PVD in control group and pregnant women

t. test

	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Age	-2.715-	78	.008	-3.973-	1.463	-6.887-	-1.060-
	-2.611-	53.945	.012	-3.973-	1.522	-7.024-	-.923-
Liver span	3.294	78	.001	.7040	.2137	.2785	1.1295
	3.207	56.170	.002	.7040	.2195	.2643	1.1437
Rt Lobe	2.368	78	.020	.6840	.2889	.1089	1.2591
	2.195	47.853	.033	.6840	.3116	.0574	1.3106
PVD	-.326-	78	.745	-.0111-	.0340	-.0787-	.0565
	-.317-	55.819	.753	-.0111-	.0349	-.0811-	.0589

Chapter Five

Dissection Conclusion and Recommendations

Chapter Five

Discussion, Conclusion and Recommendations

5.1 Discussion

The study done in 50 pregnant women and 30 control concerning pregnant the age range 18 to 42 years most of them in age group 18-24 and 25-31 years 76% as shown in table (4.1) figure (4.1).

GA rang to 40 weeks in the second trimester 42%, in third trimester 40% as shown in table (4.2) figure (4.2).

Para 0 to 2 and para 3 to 5 are more common 44% . table (4.4) figure (4..4).

The mean age was 27.06 with std deviation 5.947 the mean parity was n3.02 with std deviation 2.152. the mean GA was 22.7 with std deviation 10.77 the mean liver span was 13.70 with std deviation 88.7 . the mean Rt lobe was 12.01 with std deviation 1.08. the mean PVD was 1.016 with std deviation 0.1406. table (4.5).

No significant correlation between GA and liver measurement P. value more than 0.05 also no significant correlation between GA and PVD which decreased by GA P. value more than 0.05. table (4.6).

No significant linear relationship between Rt lobe and GA R^2 0.001 and 0.0105 for liver span and right liver lobe with GA figure (4.5).

PVD decreased by increased GA no linear relationship between them R^2 0.003. figure (4.6).

No significant difference in mean liver span Rt lobe and PVD in different trimester of pregnant P more than 0.05 table (4.7).

Significant difference in Rt lobe measure in differ parity P value 0.012. table (4.8).

Non pregnant most of them in age range 32 to 38 years and 25 to 31 years 26%. Table (4.9) figure (4.7).

Concerning compare mean liver measurement in pregnant versus non pregnant the study found that there was significant difference in liver span and right lobe measure as it was 13.704 -13 and 12.01-11.33 for pregnant and non pregnant respectively P value less than 0.05. table (4.11).

No sig difference in PVD in pregnant and non pregnant P value more than 0.05.

5.2 Conclusion:

The study shows that is no change in liver measurement in pregnant women , even with the difference in GA.

In the comparison between pregnant and non pregnant women found that is a difference between them in the measurement of Rt lobe of liver but in PVD there is no observed difference.

5.3 Recommendations:

- Further studies should be done with large sampling in pregnant female for liver measurement.
- Ultrasound is non invasive established, safe, quick and accurate. Method for liver so it should always be available in hospitals.
- Ultrasound should be used for pregnant women in tests because it is safer for her and the fetus than other.

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Appendix (1)

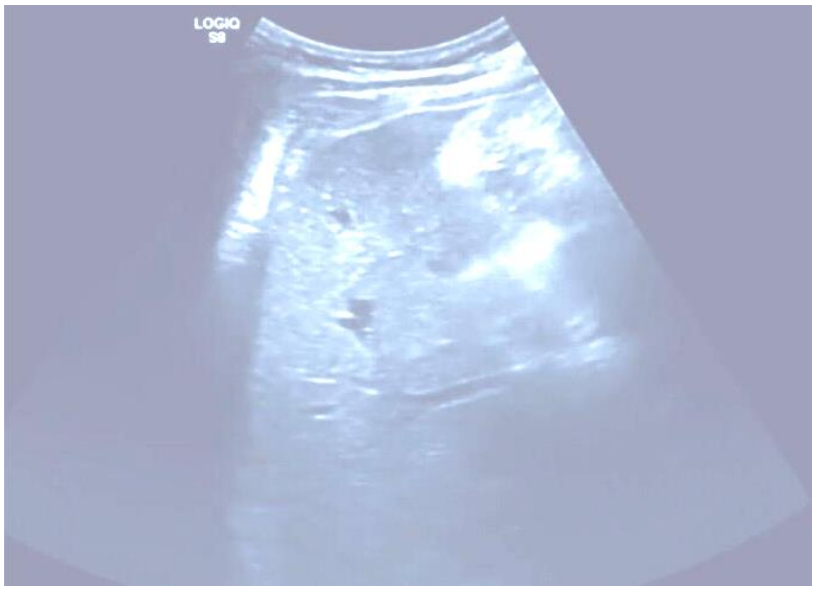

Image (1) 23 age transverse transabdomenal scan shows right lobe in non pregnant woman.

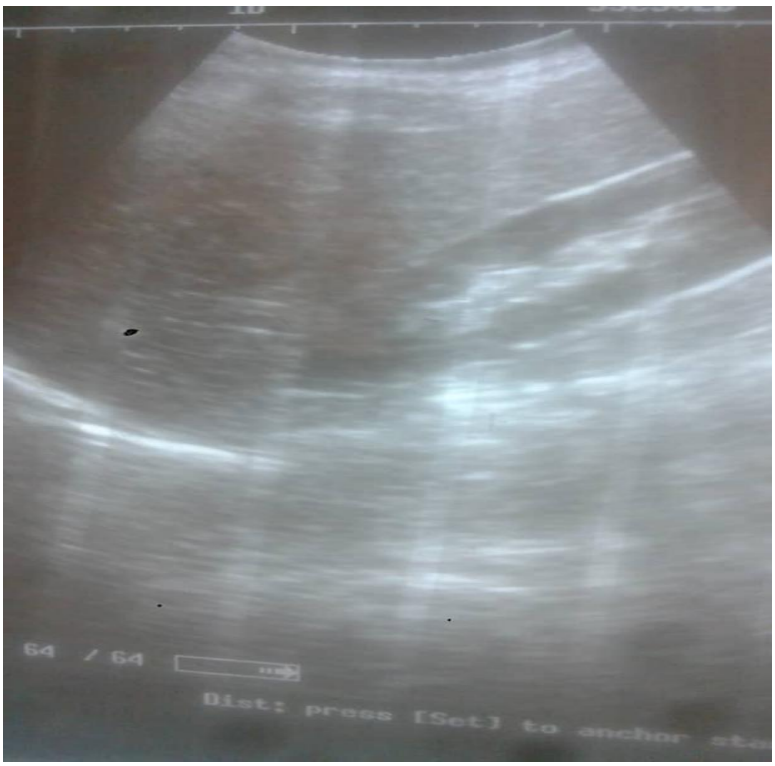

Image (2) 30 age pregnant women longitudinal transabdomenal scan shows liver span.

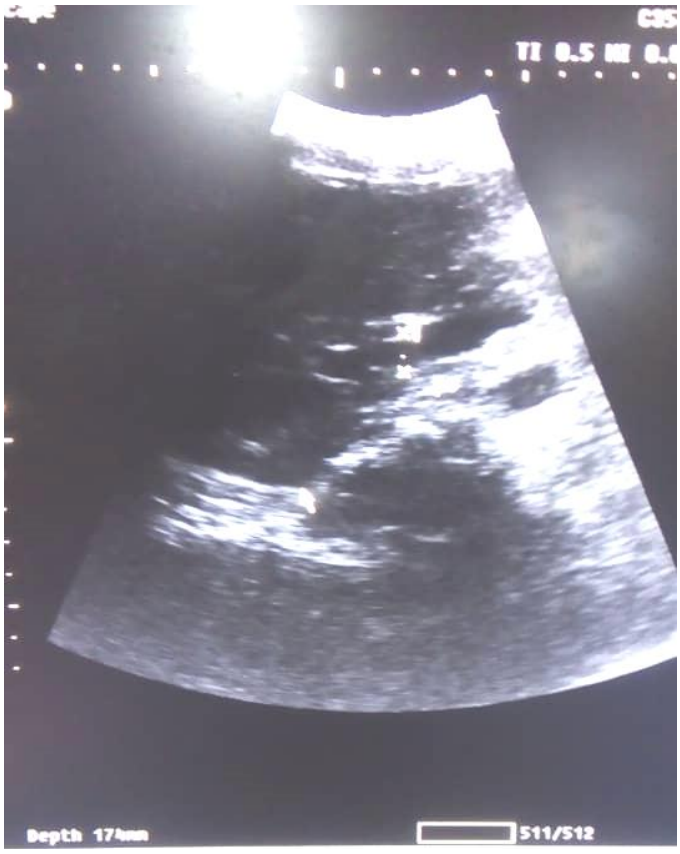

Image (3) 39 age pregnant women longitudinal transabdomenal scan shows portal vein

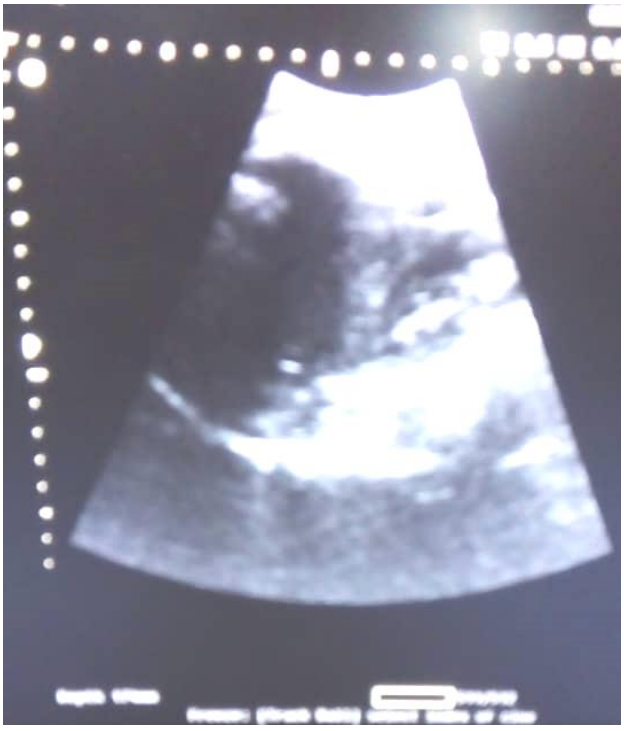

Image (4) 25 age non pregnant women longitudinal transabdomenal scan shows liver span

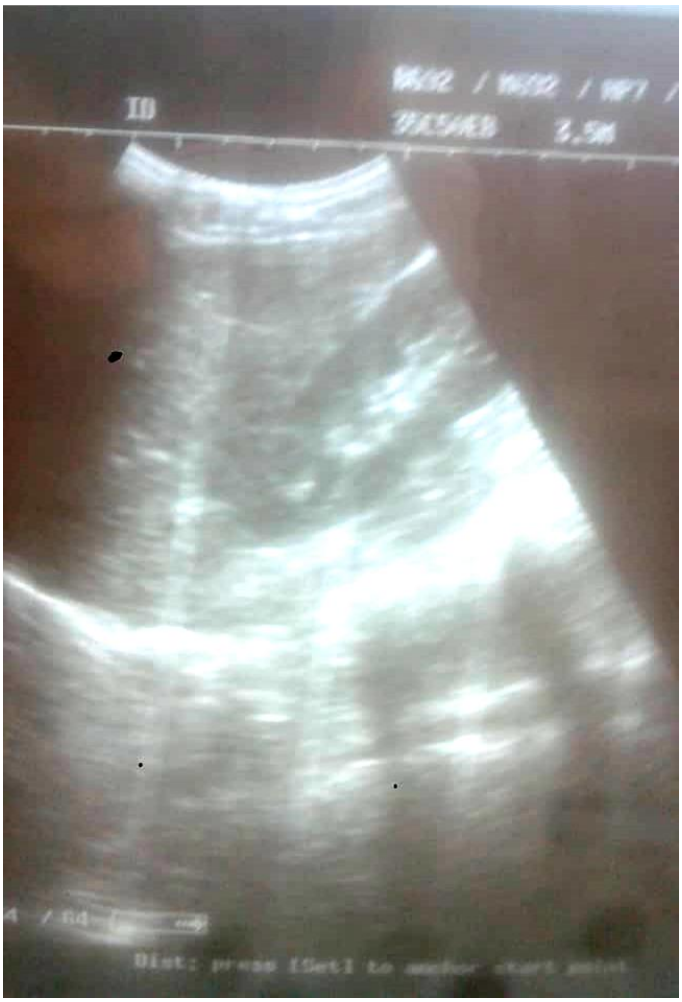

Image (5) 34 age non pregnant women longitudinal transabdomenal scan shows liver span

Appendix (2)

(Data Collection Sheet)

Date ---------- NO ------

Age -------- Occupation ----------

Number of parity: ( ) Ges age: ( )

U/S findings:

Liver span : ( )

Right lobe : ( )

Caudate lobe : ( )

PVD: ( )

Liver shape : Normal ( ) Abnormal ( )

Liver Texture : Normal ( ) Hypoechoic ( ) Hyperechoic ( )

Comments:

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