بسم الله الرحمن الرحيم

Sudan University of Science and Technology

College Of Graduate Studies

Title:

Assessment of Caudate and Right Hepatic Lobes Ratio in Patients withLiver Cirrhosisusing Ultrasound

تقويم نسبة الفص الكبدي الذيلي للفص الكبدي الأيمن في مرضى تليف الكبد بالموجات فوق الصوتية

A Thesis Submitted In Partial Fulfillment of the Requirements for Degree (Msc.)
In Medical Diagnostic U/S

by

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الآية

بسم الله الرحمن الرحيم

قال تعالى:

قَالَ رَبِّ اشْرَحْ لِي صَدْرِي (25) وَيَسِّرْ لِي أَمْرِي (26)

صدق الله العظيم

سورة طه الآيتان (25 و26)

Dedication

To

My parents

My family

To

All Believersin the world

My friends

To everyone who helped me in my life

Acknowledgement

First of all I thank God for enabling me to complete this thesis.

This research is made possible through the help and support from everyone, including parents, teachers, friends and in essence, all sentient beings. Especially please allow me to dedicate my acknowledgement of gratitude toward the following significant advisors and contributors:

First and foremost I would like to thank ***Dr. Caroline Edward*** for her most support and encouragement. She kindly read my offered invaluable detailed advices on grammar, organization and theme of the research.

Abstract

The objective of this study to assessment of caudate lobe to right hepatic lobe in patients with liver cirrhosis in which the right lobe atrophies and caudate lobe hypertrophy.

The study was conducted in Omdurman Teaching Hospital in the period from September 2015 to December 2015, for 40 patients of liver cirrhosis and 20 healthy adults from the same area as control group scanning for Abdomen using ultrasound machine Toshiba 3.5 mega hertz[2.]

The caudate lobe and right were measured and liver size, beside other investigations like MRI , CT and laboratory tests to find out the main disease that led to cirrhosis of the liver.

The result of this study when the right lobe atrophies to 8cm in position of AP transverse and caudate lobe hyper trophy to 4.8 cm when we divided the 4.8/8cm the ratio to be .6 in this ratio no liver cirrhosis seen, but when swelling of caudate lobe increases to 5.2cm and right lobe fixed in 8cm and divided 5.2/8 cm. The ratio to be .6s, this ratio will be an indication to the probability of cirrhosis of the liver (border line) , but when the swelling of caudate lobe increases more than 5.2 and the right lobe decreased from 8cm the ratio to be more than .6s, this ratio indication for liver cirrhosis and liver will be in a small volume (course or shrunken liver) that could reach to 4cm.

The study concluded that the use of this ratio .6s between caudate lobe and right hepatic lobe is correct to diagnosisultrasound image.

The study suggested that the presence of ultrasound devises in health centers terminal is very important because most of the patients cirrhosis come from areas peripheral and early detection of cirrhosis of the liver and the send the patients to the hospital specialized in treatment of liver diseases that must be by other devises such as CT, MRI and fibro scan which shorten the time to reach for diagnosis of rapid and accurate to help treat these patients and their recovery, god willing.

خلاصة البحث

تهدف هذه الدراسة لتحديد نسبة الفص الكبدى الذيلى للفص الكبدى الايمن فىمرضى تليف الكبد والذى يضمر فيه الفص الايمن و يتضخم الفص الذيلى.

أجريت هذه الدراسة بمستشفي امدرمان التعليمى فى الفتره من سبتمبر 2015م الى نهاية ديسمبر 2015م ل 40 مريض بتليف الكبد و 20 اصحاء بالغون من نفس المنطقة كمجموعه قياسية تم فحصهم بجهاز الموجات فق الصوتيه 3.5 ميغا هيرتز توشيبا لمنطقة البطن , تم قياس الفص الكبدى الذيلى و الفص الايمن وحجم الكبد وعملت فحوصات اخري كالاشعه المقطعية والرنين المغناطيسى ومناظير لمعرفه المرض الرئيسى الذى ادى لتليف الكبد.

نتيجة هذه الدراسه عندما يضمر الفص الكبدي الايمن ل 8 سم فى وضع AP ويتضخم الفص الكبدي الذيلى ل 4.8 سم فنقسم $\frac{4.8\text{سم}}{8\text{سم}}$ تكون النسبه 0.6 لايوجد تليف للكبد ولكن عندما يزداد تضخم الفص الكبدى ل 5.2 سم والفص الايمن يظل فى 8 سم فنقسم $\frac{5.2\text{سم}}{8\text{سم}}$ تكون تكون النسبه 0.65 فهذه النسبه فيها احتمالية لتليف الكبد ولكن عندما يزداد التضخم فى الفص الذيلى اكثر من 5.2 سم والفص الايمن يتناقص من 8 سم تكون النسبه اكثر من 0.65 عندها يتم تشخيص الحاله كتليف للكبد وتكون الكبد فى حجم صغير جداً قد تصل ل 4 سم .

خلصت الدراسه الى ان استخدام هذه النسبه0.65بين الفص الكبدى الذيلى والفص الكبدى الايمن يصلح كمقياس لمعرفه الكبد المتليفه من غيرها عند مسح الكبد بواسطه جهاز الموجات فوق الصوتيه من قبل اختصاصي الموجات فوق الصوتيه .

اقترحت الدراسه ضرورة وجود اجهزه الموجات فوق الصوتيه فى المراكز الصحيه الطرفيه لان معظم هؤلاء المرضى بتليف الكبد يأتون من المناطق الطرفيه وذلك للكشف المبكر لتليف الكبد ومن ثم ارسال المريض للمستشفيات المتخصصه فى علاج امراض الكبد التى لابد ان تكون بها اجهزه اخرى مثل الاشعه المقطعيه والرنين المغناطيسى وحديثاً جهاز الفايبروسكان مما يختصر الوقت للوصول للتشخيص الدقيق والسريع للمساعده في علاج هؤلاء المرضى وشفائهم بأذن الله .

LIST OF ABBREVIATIONS

C/R	Caudate -Right Lobes
CHF	Congestive heart failure
CLD	Chronic liver diseases
IHD	Ischemia heart disease
Ca.UB	Cancer of Urinary Bladder
HBV+	Hepatitis-B Virus
HCV+	Hepatitis-C Virus
HF	Heart Failure
DM	DiabeticMilletus
SA	SickleAmaemia
RHD	RhomatoidHeartDisease
CCF	Congestive Cardiac failure
HTN	Hypertension
PVH	Portal Vein Hypertension
DCM	Dilated Cardiac Muscle
M	Male
F	Female
AP	Antro-posterior
WHO	World Health Organization
Pt	Patient

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CHAPTER ONE
INTRODUCTION

CHAPTER ONE

1.1 Introduction:

The term cirrhosis was first introduced derived from Greek term *scirhus* and refer to orange or tawny surface of liver seen at autopsy, but in 1819 the French scientist Renia link is named in his research(Waul, 2004).

Cirrhosis of the liver is a result of prolonged and severe insult to hepatocytes which lead to hepatocellular necrosis, and inflammation that heals by fibrosis, septation and the development of regeneration nodules compromise of the hepatic and portal venous circulation may lead to development of portal hypertension (Vishant, et al,).1993

The cirrhosis is high rate in worldin 2002 cirrhosis caused 1.4% of all death worldwide average 126 death per million people in a year(WHO, 2014).

In according to WHO report 5/2014 the Sudan is 51 in world the rate 24.3% death per 10,000.

The main cause of liver cirrhosis alcoholism 70% and other causes include viral hepatitis, nutritional deficiencies, congestive heart failure, hepatic venoocculative (Budd chairi syndrome),

drugs like "methotexate – isoniazid nitrofurantion", billiary cirrhosis and ability obstructive.

The U/S is great role to diagnosis liver cirrhosis and explain any change in liver size and liver echogencity for these three types of liver cirrhosis "micronudeule – macronudule and mixed" which by calculate caudate lobe number divided right hepatic lobe number this ratio demonstrate liver cirrhosis is present or not.

This ratio calculate by measuring the distance from medial border to caudate lobe to lateral margin of portal vein and dividing the number by the distance from lateral margin of portal vein to the lateral margin of the liver.

Caudate lobe right lobe ration greater than 0.65 is consistent cirrhosis, caudate lobe of 0.6 indicates the absence of cirrhosis while a ratio of 0.6 – 0.65 suggests border line situation(Waul, 2004).

A number of studies were held to show the use of U/S in liver cirrhosis is best modalities and able explore a complication of cirrhosis like ascites, portal hypertension, etc.

This research done in Omdurman Teaching Hospital which is special chronic liver cirrhosis – September to December 2015.

1.2 Study Problem:

Lack of studies in measurement of caudate and right hepatic lobe ratio in patient with liver cirrhosis or suspected liver cirrhosis like CHF-TB drugs – CA drugs in Sudan.

1.3 Study Objectives:

Main Objective:

Evaluation of Caudate and Right Hepatic Lobes Ratio in Patients with Liver Cirrhosis at Omdurman Teaching Hospital.

SpecificObjectives:

- Evaluation of liver size and echogenicity.
- Caudate /Right Hepatic Lobes Ratio.
- Evaluation of causes of liver change.

1.4Overview of the study:

This study falls into five chapters:

Chapter one which is an introduction, deals with introduction problem, objective and method of the study.

Chapter two is theoretical background, literature review and previous studies.

Chapter three is about research methodology which include material and method.

Chapter four deals with result (data, presentation).

Chapter five include discussion, conclusion and recommendation.

CHAPTER TWO
LITERATURE REVIEW

CHAPTER TWO

LITERATURE REVIEW AND MEDICAL REVIEW

2.1 U/S Physics:

2.1.1Definition:

Ultrasound is a high frequency sound, exceeding the upper limit of human hearing – 20.000 cycles per second (20 KHz). Knowledge of basic ultrasound physics is essential for understanding image formation, echo machine settings optimization, advantages and limitations of the technique.

2.1.2General principles:

Sound is a longitudinal mechanical wave transmitted through the medium by local displacement of particles within the medium. The displacement of the particle from their equilibrium position produces changes in the medium density (areas of compression/rarefaction). Ultrasound is defined as sound with frequencies above the human audible range between 20 Hz and 20.000 Hz. Diagnostic medical ultrasound uses frequencies from 1.000.000 to 40.000.000 Hz = 1 to 40 megahertz (MHz). The ultrasound wave is often graphically displayed as a sine wave in which the peaks and nadirs represent the areas of compression and rare faction respectively.

2.1.3Properties of sound waves:

Sound waves are characterized by the following parameters: **Frequency** - The frequency of the sound wave is the number of oscillations per unit of time.

Amplitude - The magnitude of the pressure changes, i.e. the difference between the pressure peaks and pressure nadirs (The strength of the wave, loudness of the sound). Amplitude is measured in decibels, a logarithmic unit that relates acoustic pressure to some reference value. The primary advantage of using a logarithmic scale to display amplitude is that a very wide range of values can be accommodated and weak signals can be displayed alongside much stronger signals. There are some other logarithmic variables used in clinical practice (e.g. pH).Since sound waves are mechanical waves, they are further characterized by the following additional parameters which depend on the medium in which the wave propagates: **Wavelength** - The length of one period of the wave; e.g. from one pressure peak to the next. The wavelength depends on the frequency and the medium in which the sound wave propagates.

Velocity - The speed at which sound propagates through a given medium. Velocity through a given medium is inversely related to the density and directly related to stiffness of that medium. Ultrasound waves travel faster through a stiff medium, such as

bone. In echocardiography, the velocity of sound is assumed to be approximately 1,540 m/sec (or 1.54 m/msec). Sound waves travel through the air with speed of 330 m/s. The typical velocities for different tissues are provided in table 1.

The wave equation: product of wavelength (λ) and frequency (f) represents the velocity (c) of the sound wave.

$c = \lambda f.$

Velocity through soft tissue is assumed to be constant (1540 m/s) hence there is an inverse relationship between frequency and wavelength:

Attenuation

Attenuation is a measure of the rate at which the intensity of the ultrasound beam diminishes as it penetrates the tissue. Attenuation always increases with depth and the higher the frequency of ultrasound is, the more rapidly it will attenuate (medcastle.com, 2009).

2.2 Surface Anatomy:

2.2.1 The Liver:

The liver, the largest gland in the body, has both external and internal secretions, which are formed in the hepatic cells. Its external secretion, the bile, is collected after passing through the bile capillaries by the bile ducts, which join like the twigs and branches of a tree to form two large ducts that unite to form the

hepatic duct. The bile is either carried to the gall-bladder by the cystic duct or poured directly into the duodenum by the common bile duct where it aids in digestion. The internal secretions are concerned with the metabolism of both nitrogenous and carbohydrate materials absorbed from the intestine and carried to the liver by the portal vein. The carbohydrates are stored in the hepatic cells in the form of glycogen which is secreted in the form of sugar directly into the blood stream. Some of the cells lining the blood capillaries of the liver are concerned in the destruction of red blood corpuscles. It is situated in the upper and right parts of the abdominal cavity, occupying almost the whole of the right hypochondrium, the greater part of the epigastrium, and not uncommonly extending into the left hypochondrium as far as the mammillary line(Snell, 2004).

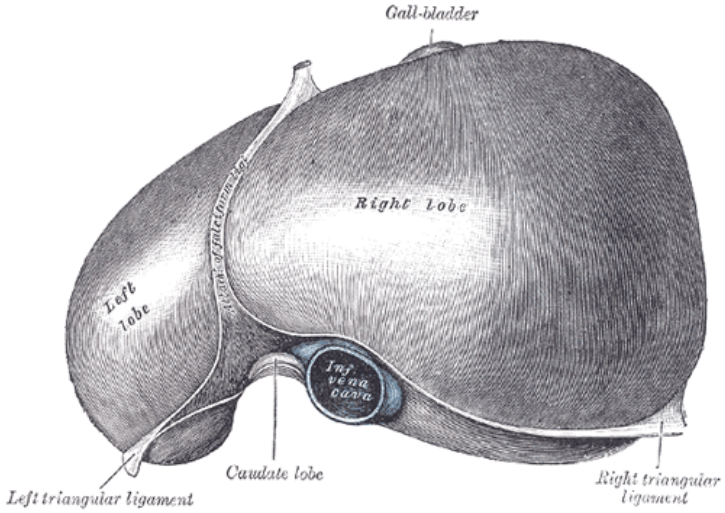


Figure (1) The superior surface of the liver(Snell, 2004)

2.2.2 Peritoneal ligaments:

Peritoneal ligaments are folds of peritoneum that are used to connect viscera to viscera or the abdominal wall.

There are multiple named ligaments that usually are named in accordance with what they are.

- gastrocolic ligament, connects the stomach and the colon.
- splenocolic ligament, connects the spleen and the colon.
- round ligament
- triangular ligament

The liver is unique among organs in that it receives blood via two distinct circulatory routes: systemic circulation and hepatic portal circulation. Each of these routes provides blood of differing compositions that allow the liver to perform its unique and vital digestive and metabolic functions(Snell, 2004).

2.2.3 Liver Lobes:

The right lobe (*lobushepatisdexter*) is much larger than the left; the proportion between them being as six to one. It occupies the right hypochondrium, and is separated from the left lobe on its upper surface by the falciform ligament; on its under and posterior surfaces by the left sagittal fossa; and in front by the umbilical notch. It is of a somewhat quadrilateral form, its under and posterior surfaces being marked by three fossæ: the porta and the fossæ for the gall-bladder and inferior vena cava, which separate

its left part into two smaller lobes; the quadrate and caudate lobes. The impressions on the right lobe have already been described.

The quadrate lobe (*lobusquadratus*) is situated on the under surface of the right lobe, bounded in front by the anterior margin of the liver; behind by the porta; on the right, by the fossa for the gall-bladder; and on the left, by the fossa for the umbilical vein. It is oblong in shape, its antero-posterior diameter being greater than its transverse.

The caudate lobe (*lobuscaudatus; Spigelian lobe*) is situated upon the posterior surface of the right lobe of the liver, opposite the tenth and eleventh thoracic vertebræ. It is bounded, below, by the porta; on the right, by the fossa for the inferior vena cava; and, on the left, by the fossa for the ductusvenosus. It looks backward, being nearly vertical in position; it is longer from above downward than from side to side, and is somewhat concave in the transverse direction. The caudate process is a small elevation of the hepatic substance extending obliquely lateralward, from the lower extremity of the caudate lobe to the under surface of the right lobe. It is situated behind the porta, and separates the fossa for the gall-bladder from the commencement of the fossa for the inferior vena cava.

The left lobe (*lobushepatis sinister*) is smaller and more flattened than the right. It is situated in the epigastric and left

hypochondriac regions. Its upper surface is slightly convex and is moulded on to the diaphragm; its under surface presents the gastric impression and omental tuberosity(Wick et al, 2005).

2.2.4 Liver Blood Flow:

Oxygenated blood leaving the heart first passes through the aorta, which descends from the thorax into the abdomen as the abdominal aorta.

The celiac trunk branches from the abdominal aorta and splits into three major branches, one of which, the common hepatic artery, supplies blood to the liver and gallbladder along with the stomach, small intestine, and pancreas. The common hepatic artery further divides into three more branches, with the proper hepatic artery supplying blood to the liver, gallbladder, and part of the stomach. The common hepatic artery further bifurcates into the left and right hepatic arteries to deliver blood the left and right sides of the liver. As the right hepatic artery approaches the gallbladder, it branches off to form the cystic artery, which supplies the gallbladder and cystic duct with oxygenated blood. These arteries further branch off into many smaller arteries and arterioles and, finally, capillaries to provide oxygen and nutrients to all of the tissues of the liver and gallbladder.

The hepatic portal vein provides the liver’s tissues with deoxygenated blood that has passed through the tissues of the

stomach, pancreas, spleen, and intestines. This blood is rich in dissolved nutrients absorbed from digested food, as well as any toxins or medications consumed by the body. Before this material can reach the other tissues of the body, it passes through the hepatic portal vein and enters the liver, wherein it is divided among many specialized capillaries, known as sinusoids. In the sinusoid, the deoxygenated blood is processed by hepatocytes, which can absorb or release nutrients as needed and metabolize dangerous chemicals before they can affect the rest of the body(Snell, 2004).

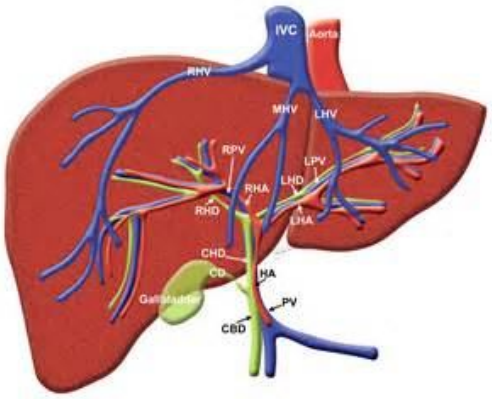


Figure (2) liver blood flow(Snell, 2004)

2.2.5 Liver Biliary Flow:

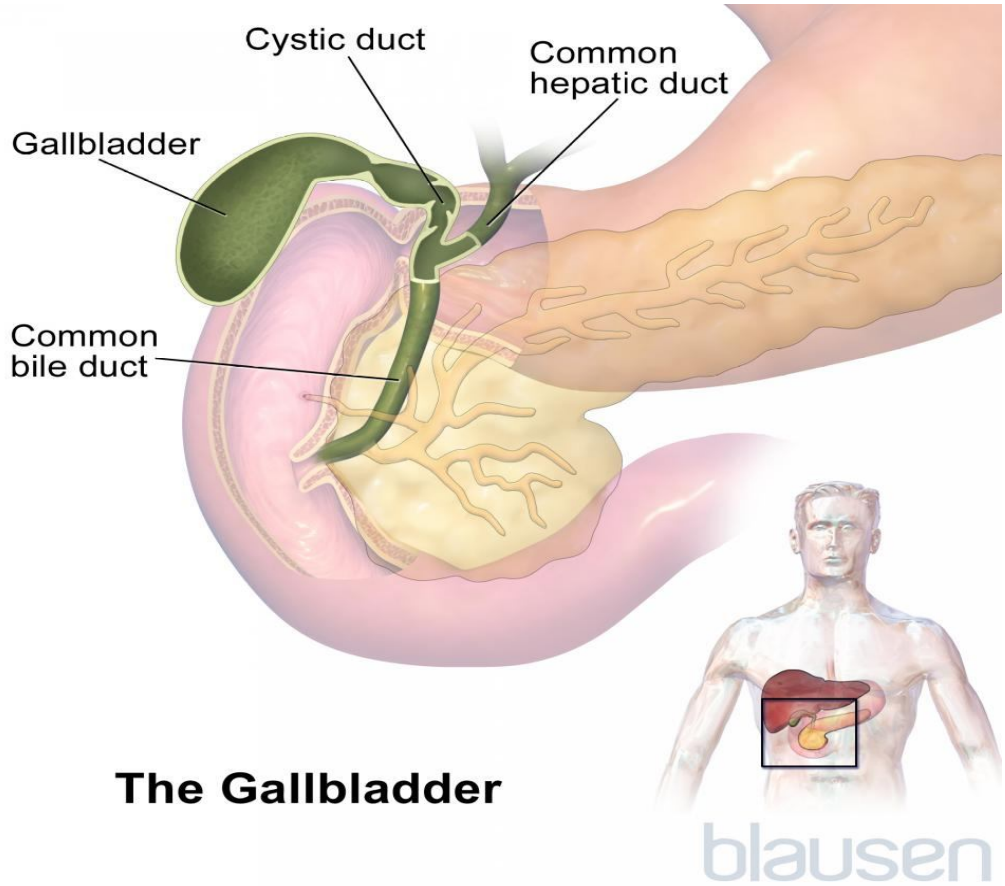
The gallbladder is a small, pear-shaped, muscular storage sac that holds bile. Bile is a greenish yellow, thick, sticky fluid. It consists of bile salts, electrolytes (dissolved charged particles, such as sodium and bicarbonate), bile pigments, cholesterol, and other fats (lipids). Bile has two main functions: aiding in digestion and

eliminating certain waste products (mainly hemoglobin and excess cholesterol) from the body. Bile salts aid in digestion by making cholesterol, fats, and fat-soluble vitamins easier to absorb from the intestine. The main pigment in bile, bilirubin, is a waste product that is formed from hemoglobin (the protein that carries oxygen in the blood) and is excreted in bile. Hemoglobin is released when old or damaged red blood cells are destroyed.

Bile flows out of the liver through the left and right hepatic ducts, which come together to form the common hepatic duct. This duct then joins with a duct connected to the gallbladder, called the cystic duct, to form the common bile duct. The common bile duct enters the small intestine at the sphincter of Oddi (a ring-shaped muscle), located a few inches below the stomach.

About half the bile secreted between meals flows directly through the common bile duct into the small intestine. The rest of the bile is diverted through the cystic duct into the gallbladder to be stored. In the gallbladder, up to 90% of the water in bile is absorbed into the bloodstream, making the remaining bile very concentrated. When food enters the small intestine, a series of hormonal and nerve signals triggers the gallbladder to contract and the sphincter of Oddi to relax and open. Bile then flows from the gallbladder into the small intestine to mix with food contents and perform its digestive functions.

After bile enters and passes down the small intestine, about 90% of bile salts are reabsorbed into the bloodstream through the wall of the lower small intestine. The liver extracts these bile salts from the blood and resecretes them back into the bile. Bile salts go through this cycle about 10 to 12 times a day. Each time, small amounts of bile salts escape absorption and reach the large intestine, where they are broken down by bacteria. Some bile salts are reabsorbed in the large intestine. The rest are excreted in the stool(Snell, 2004).



Figure(3) Liver Biliary System(Snell, 2004)

2.2.6 Liver Ultrasonography:

Role of Ultrasound is to assess the:

- Size
- Capsular contour (smooth, coarse, lobulated)
- Parenchymal echogenicity
- Vascularity
- Biliary tree
- Masses or collections

Limitations:

- Obesity and patients with severe cases of metabolic disorders such as haemochromatosis and fatty infiltration will reduce detail and the diagnostic yield of the scan.

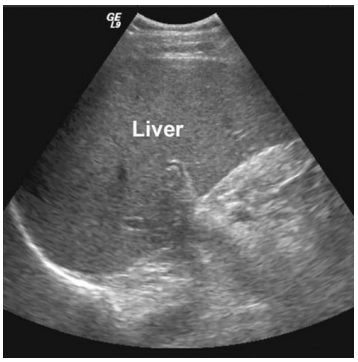
Preparation:

- Ideally, fast the patient for 6hours to reduce bowel gas and prevent gall bladder contraction.

Equipment Selection:

- Depending on the size of the patient a curved linear array 2-6Mhz.
- If there is nodularity of the liver border then a linear array with a 7-12MHZ frequency will better appreciate this. Good colour / power / Doppler capabilities when assessing vessels or vascularity of a structure.

- Be prepared to change focal zone position and frequency output of probe (or probes) to adequately assess both superficial and deeper structures(Hogen, 2002).



Figure(4) U/S: Normal Liver(Hogen, 2002)

2.3 Liver Physiology:

Every day, your liver helps your body by providing it with energy, fighting off infections and toxins, helping clot the blood, regulating hormones and much, much more. To give you an idea of the liver's critical roles, here is a partial list of its functions:

Cleanses blood:

- metabolizing alcohol and other drugs and chemicals,
- Neutralizing and destroying poisonous substances.

Regulates the supply of body fuel:

- producing, storing and supplying quick energy (glucose) to keep the mind alert and the body active,
- Producing, storing and exporting fat.

Manufactures many essential body proteins involved in:

- transporting substances in the blood,

- clotting of blood,
- Providing resistance to infection.

Regulates the balance of many hormones:

- sex hormones,
- thyroid hormones,
- Cortisone and other adrenal hormones.

Regulates body cholesterol

- Produces cholesterol, excretes and converts it to other essential substances.

Regulates the supply of essential vitamins and minerals such as iron and copper.

Produces bile which eliminates toxic substances from the body and aids digestion(Hogen, 2002).

2.4 Liver Pathology:

2.4.1 Liver Cirrhosis:

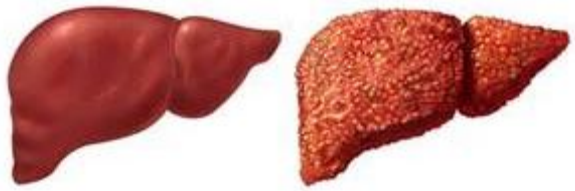
Cirrhosis is a condition in which the liver does not function properly due to long-term damage. Typically, the disease comes on slowly over years. Early on, there are often no symptoms. As the disease worsens, a person may become tired, weak, itchy, have swelling in the lower legs, develop yellow skin, bruise easily, have fluid buildup in the abdomen, or develop spider-like blood vessels on the skin. The fluid build-up in the abdomen may become spontaneously infected. Other complications include hepatic

encephalopathy, bleeding from dilated veins in the esophagus or dilated stomach veins, and liver cancer. Hepatic encephalopathy results in confusion and possibly unconsciousness.

Cirrhosis is most commonly caused by alcohol, hepatitis B, hepatitis C, and non-alcoholic fatty liver disease. Typically, more than two or three drinks per day over a number of years is required for cirrhosis to occur. Non-alcoholic fatty liver disease is due to a number of reasons, including being overweight, diabetes, high blood fats, and high blood pressure. A number of less common causes include autoimmune hepatitis, primary biliary cirrhosis, hemochromatosis, certain medications, and gallstones. Cirrhosis is characterized by the replacement of normal liver tissue by scar tissue. These changes lead to loss of liver function. Diagnosis is based on blood testing, medical imaging, and liver biopsy.

Some causes of cirrhosis, such as hepatitis B, can be prevented by vaccination. Treatment partly depends on the underlying cause. The goal is often to prevent worsening and complications. Avoiding alcohol is recommended. Hepatitis B and C may be treatable with antiviral medications. Autoimmune hepatitis may be treated with steroid medications. Ursodiol may be useful if the disease is due to blockage of the bile ducts. Other medications may be useful for complications such as swelling, hepatic encephalopathy, and dilated esophageal veins. In severe cirrhosis, a liver transplant may be an option.

Macroscopically, the liver is initially enlarged, but with progression of the disease, it becomes smaller. Its surface is irregular, the consistency is firm, and the color is often yellow (if associated steatosis). Depending on the size of the nodules there are three macroscopic types: micronodular, macronodular, and mixed cirrhosis. In micronodular form (Laennec's cirrhosis or portal cirrhosis) regenerating nodules are under 3 mm. In macronodular cirrhosis (post-necrotic cirrhosis), the nodules are larger than 3 mm. The mixed cirrhosis consists of nodules with different sizes(Mohan, 2007).



Figure(5) Normal and abnormal liver(Mohan, 2007)

2.4.1.1 Sonographic Appearance of Liver Cirrhosis:

Ultrasound is a major screening tool for cirrhosis and its complications. It is also useful to aid in biopsy. Appearances include:

Surface nodularity: (88% sensitive, 82-95% specific.

Overall coarse and heterogeneous echotexture.

Segmental hypertrophy/atrophy.

Caudate width: right lobe width >0.65 (43-84% sensitive, 100% specific)reduction of the transverse diameter (<30 mm) of the medial segment of the left lobe (segment IV)(Mohan, 2007).

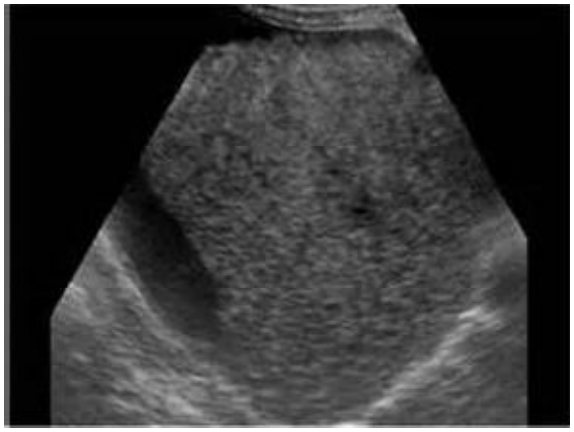


Figure (6) Liver cirrhosis (Mohan, 2007)

Signs of portal hypertension:

Doppler flow changes:

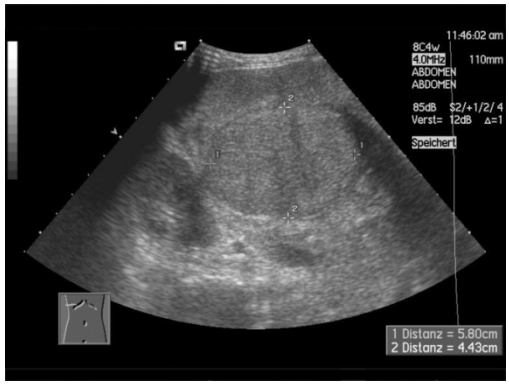
- portal venous system
- Enlarged portal vein: >13 mm (42% sensitive, 95-100% specific).
- slow portal venous flow <15 cm/sec
- reversal or to-and-fro portal venous flow
- portal vein thrombosis +/- cavernous transformation
- enlarged SMV and splenic vein: >10mm
- Note: this should be measured during deep inspiration as size can vary.
- Loss of respiratory variation in SMV and splenic vein spectral Doppler waveforms.

- re-canalisation and hepatofugalparaumbilical venous flow
- portosystemic collaterals
- hepatic veins.
- portalization of hepatic vein waveform
- hepatic arteries.
- "corkscrew" apperance
- increased velocity (compensating for decreased portal vein flow) :
    - Splenomegaly
    - Ascites
    - Fatty change (variable).

Sono-elastography may also be useful to assess the amount of liver fibrosis. Suggested values for diagnosis

- >7 kPa: advanced fibrosis
- 12.5-15 kPa: cirrhosis

Contrast-enhanced ultrasound may have a role in diagnosis of cirrhosis(Palmers, 1999).



Figure(7) U/S Liver Cirrhosis(Palmers, 1999)

2.4.2 Complication Liver Cirrhosis:

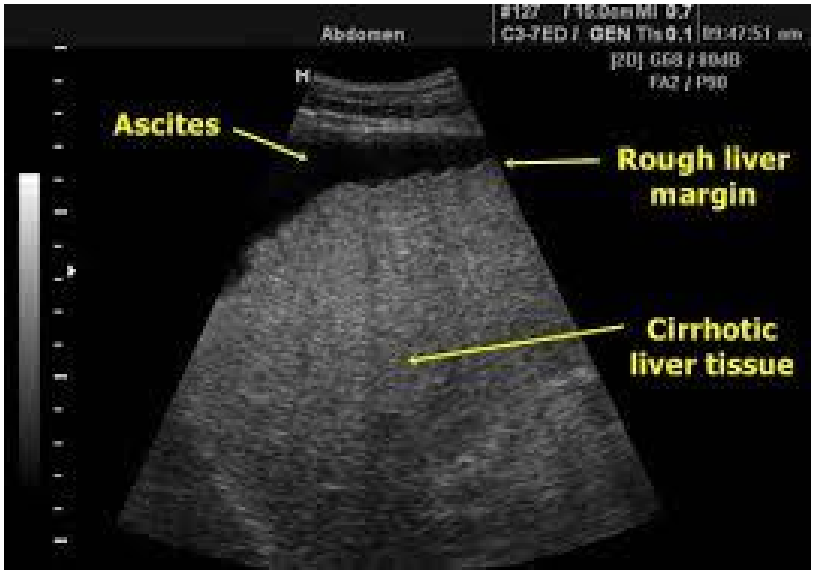
Complications related to blood flow:

- **High blood pressure in the veins that supply the liver (portal hypertension).** Cirrhosis slows the normal flow of blood through the liver, thus increasing pressure in the vein that brings blood from the intestines and spleen to the liver.
- **Swelling in the legs and abdomen.** Portal hypertension can cause fluid to accumulate in the legs (edema) and in the abdomen (ascites). Edema and ascites also may result from the inability of the liver to make enough of certain blood proteins, such as albumin.
- **Enlargement of the spleen (splenomegaly).** Portal hypertension can also cause changes to the spleen. Decreased white blood cells and platelets in your blood can be the first sign of cirrhosis.
- **Bleeding.** Portal hypertension can cause blood to be redirected to smaller veins. Strained by the extra load, these smaller veins can burst, causing serious bleeding. High blood pressure also may cause enlarged veins (varices) and lead to life-threatening bleeding in the esophagus (esophageal varices) or the stomach (gastric varices). If the liver can't make enough clotting factors, this also can contribute to continued bleeding.

Other complications:

- **Infections.** If you have cirrhosis, your body may have difficulty fighting infections. Ascites can lead to bacterial peritonitis, a serious infection.
- **Malnutrition.** Cirrhosis may make it more difficult for your body to process nutrients, leading to weakness and weight loss.
- **Buildup of toxins in the brain (hepatic encephalopathy).** A liver damaged by cirrhosis isn't able to clear toxins from the blood as well as a healthy liver can. These toxins can then build up in the brain and cause mental confusion and difficulty concentrating. With time, hepatic encephalopathy can progress to unresponsiveness or coma.
- **Jaundice.** Jaundice occurs when the diseased liver doesn't remove enough bilirubin, a blood waste product, from your blood. Jaundice causes yellowing of the skin and whites of the eyes and darkening of urine.
- **Bone disease.** Some people with cirrhosis lose bone strength and are at greater risk of fractures.
- **Gallstones and bile duct stones.** Blocked flow of bile can lead to irritation, infection and the creation of stones.

- **Increased risk of liver cancer.**
- **Acute-on-chronic cirrhosis.** Some people end up experiencing multiorgan failure. Researchers now believe this is a distinct complication in some people who have cirrhosis, but they don't fully understand its causes(Corton, 2004).



Figure(8) U/S Complication of Liver Cirrhosis(Corton, 2004)

2.5 Sonographic Technique of Measurement of the Liver:

Because of the time regarded however sonographic determination of live volume remains unstable for routine diagnostic application and is reserved for specific clinical situation. Three dimensional volume of liver is difficult to quantify in terms of a single measurement parameter. Routine clinical assessment however, demands a simple and reliable reproducible measurement method, one of the most commonly sonographic examinations(Hogen, 2002).

1. Caudiocaranial technique for all liver:

Usually at mid-clavicular line but particularly at auxiliary line is better to measure full liver right kidney is recommended in the view where as we have normal for this measurement running from 14 cm to 16.5 cm.

A line is drawn straight from the lowest most corner of left lobe and another line is drawn from middle of dome which touches the first (Hogen, 2002).

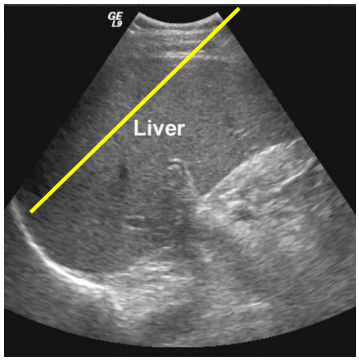


Figure (9) Caudiocaranial technique (Hogen, 2002)

2. Antro-posterior technique for right lobe:

At mid-clavicular line to measure normal 13.5 to 15.5 cm again above mentioned factors effect (Hogen, 2002).

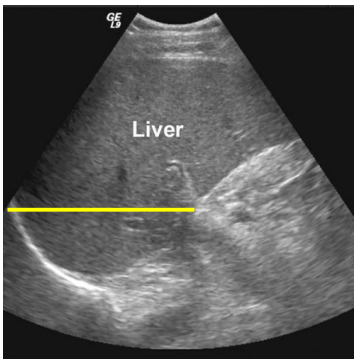


Figure (10) AP technique for Rt Lobe(Hogen, 2002)

3. Caudiocaranial technique for Rt lobe:

At sub-costal with slightly oblique to diameter of Rt lobe13 to 14 cm is taken as normal.(Palmers, 1999).

4. AP Sonographic Technique for Caudate lobe:

At mid-clavicular with oblique to left side to measured caudate lobe 2.5 cm is upper limited.(Palmers, 1999).

5.Caudiocaranial technique for Caudate lobe:

At sub-costal to measured caudate lobe 6 to 7 cm is normal.

6.Caudate Rt lobe Ratio:

Is measured by AP technique it found as:

- C/RL < 0.6 normal no cirrhosis.
- C/RL < 0.6 to 0.65 boarder line.
- C/RL > 0.65 likely to be cirrhotic.(medcastle.com, 2009).

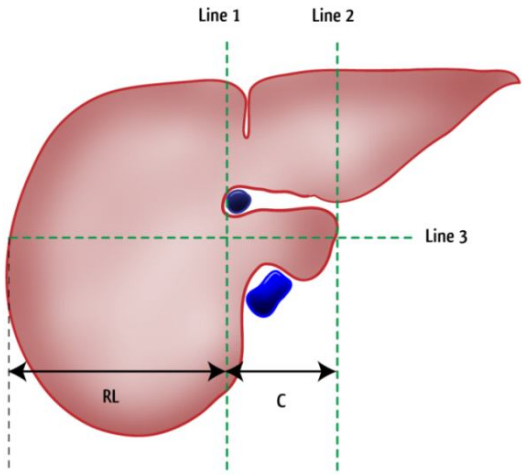


Figure (11) Caudate lobe and Rtlobe measurement(medcastle.com, 2009)

Previous Studies:

A number of studies were conducted to show the use of U/S in liver cirrhosis. U/S was used to demonstrate clearly liver cirrhosis and complication likespleenomegaly, PVH,Asacites, etc.

- G. Stefano et al search the value of U/S in diagnosis of liver cirrhosis. The ratio of transverse caudate lobe width to Rtlobe width (C/RL) was determined with U/S in 25 healthy subject and 156 consecutive Pt with chronic persistent or chronic active hepatitis or liver cirrhosis the C/RL ratio had sensitivity of 43% a specificity of 100% and accuracy of 79% in cirrhosis.The sensitivity was very low in alcoholic cirrhosis low in cryptogenic and cirrhosis high in hepatitis-B virus related cirrhosis in spite of its fairly low overall sensitivity.The C/RL ratio is a useful measurement in assessing chronic liver disease because of its high specificity in cirrhosis(Gon, 2006).
- Mohamed A. Allah Abdo. 2011 (M.Sc.) Sudan University. Evaluation of caudate lobe and Rt hepatic lobe ratio in Pt with schistosomamansoni.

The study was carried out on 50 Pt adult of known cases of schistosomasis in Alfaw area and 20 on adult volunteers. The study measuring liver caudate lobe and Rtlobe by U/S. The study concluded that C/RL ratio has ability to detect change in liver size C/RL lobe ratio in a coarse liver more than 0.64 and in complication more than 0.7 (Abdo, 2011).

CHAPTER THREE
METHODOLOGY

CHAPTER THREE
METODOLOGY

3.1 Type of the Study:

This practice and descriptive study with known cases of pt with liver cirrhosis come to U/S Department.

3.2 Area and Duration of the Study:

This study was started in September 2015 and continued to December 2015. It was carried out in Omdurman Teaching Hospital – Khartoum State.

3.3 Sample of the Study:

There are 40 cases in Sudanese patients with liver cirrhosis and 20 control volunteers from the same area.

Patients with liver cirrhosis adult on male and female patients with or without complication of liver cirrhosis.

3.4 Instrumentation:

Real time U/S machine model.

3.5 Sonographic Technique:

Examination of patients in supine position subjects were instructed to raise the right hands behind their heads. Thus increasing intercostals space and the distance from the lower costal margin to the iliac crest. The examination was carried out during deep inspiration and with a real red abdominal wall.The patient

was fasting for at least 4 hours before the examination to reduce the amount of gasses and fecal masses.

The whole liver was measured by AP technique. The caudate and right lobes were measured by AP technique and then calculated C/RI lobe ratio.

3.6 Data Collection:

The data were collected by clinical data sheets and U/S images.

3.7 Data Analysis:

Data were analyzed using SPSS programme version 16 and the results were presented in form of tables and graphs.

3.8 Ethical Consideration:

- No identification or individual will be published.
- No information or patient details will be disclosed or used for other reasons than the study.

3.9 Data Storage:

The data were stored on:

- Personal computer.
- Patient data collection sheet.

CHAPTER FOUR
RESULT AND ANALYSIS

CHAPTER FOUR

RESULTS

This study included 40 Pt know cases of Pt with liver cirrhosis in Khartoum state and 20 volunteer from the same area as control group, the study intended to demonstrate the change of liver size and detected early cirrhosis by calculating the caudate right hepatic lobe ratio.

The data analyzed done by using SPSS program.

The results were tabulated in from of figures and tables depending on the different variable used in the study.

Table (4.1) shows the Pt gender frequency and percentage

Gender		Frequency	Percent
Validity	Male	23	57.5
	Female	17	42.5
	Total	40	100.0

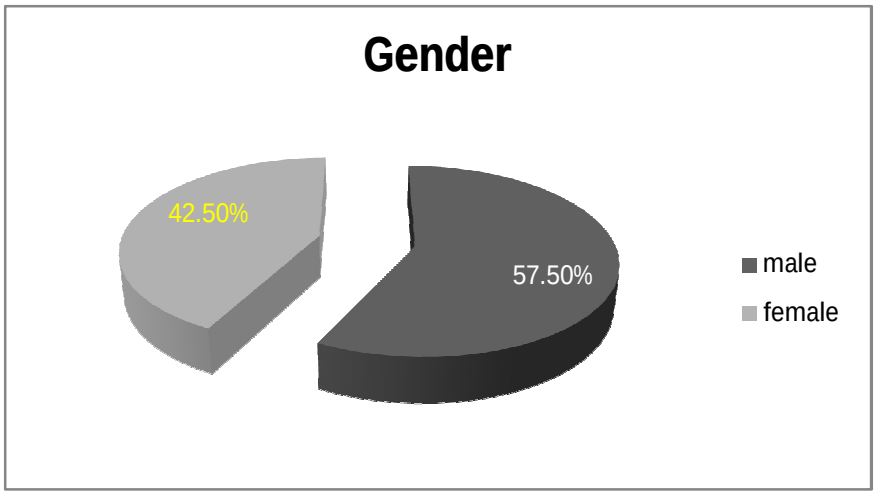


Figure (4.1) show the Pt gender and percentage

Table (4.2) shows the control group gender frequency and percentage.

Gender		Frequency	Percent
Validity	Male	10	50.0
	Female	10	50.0
	Total	20	100.0

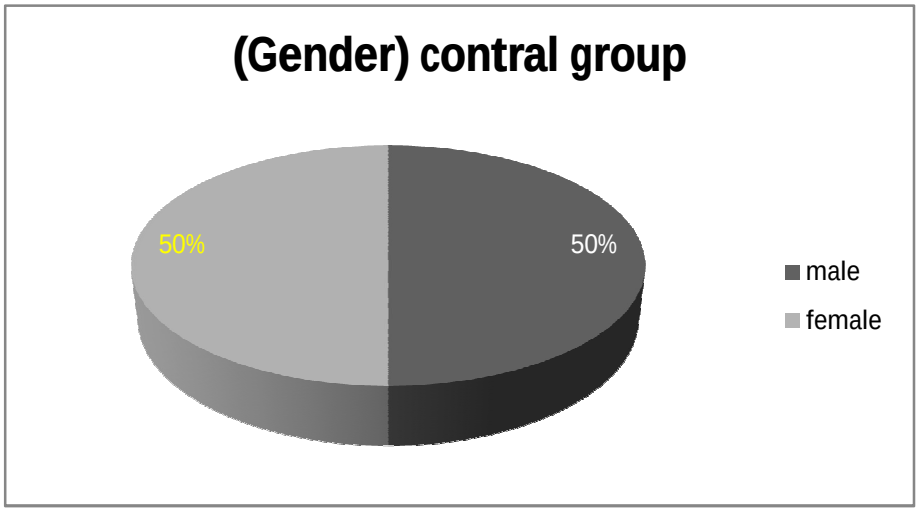


Figure (4.2) shows control group gender, frequency and percentage

Table (4.3) shows the Pt age group, percentage and frequency

Gender		Frequency	Percent
Validity	21– 30	8	20
	41– 50	5	12.5
	51– 60	14	35
	61– 70	8	20
	81– 100	5	12.5
	Total	40	100

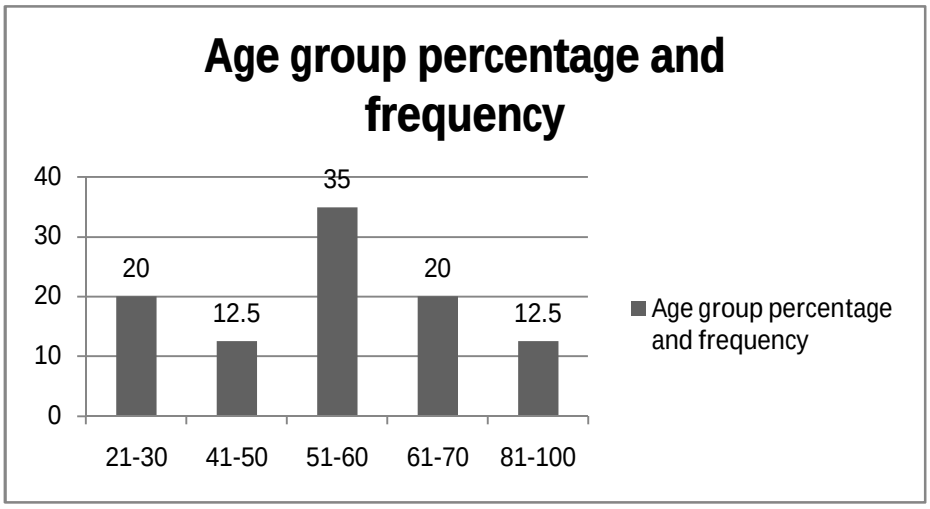


Figure (4.3) shows the pt age group, frequency and percentage

Table (4.4) shows the pt age group, frequency and percentage.

Gender			Frequency	Percent
Validity	farmer	6	12.2	15.0
	free work	34	69.4	85.0
	Total	40	81.6	100.0

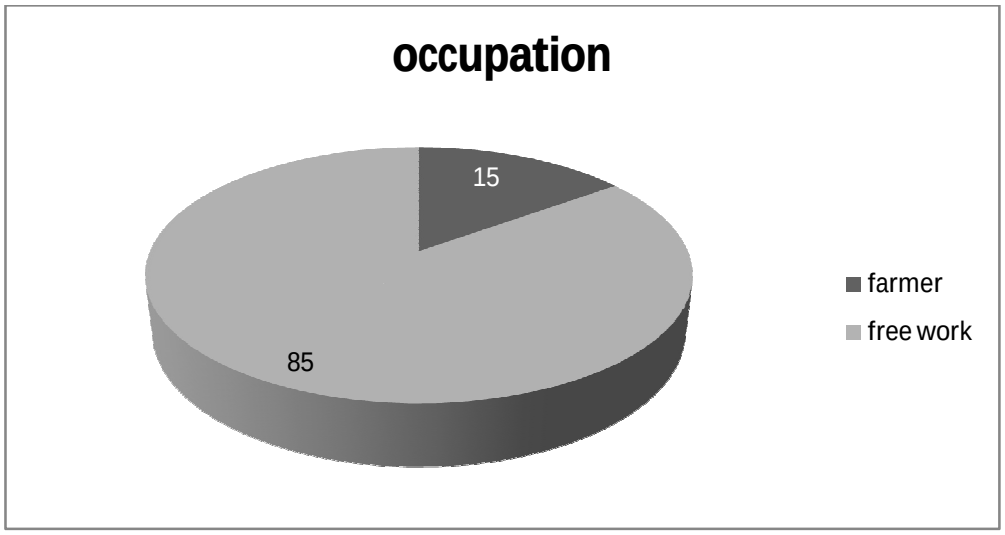


Figure (4.4) shows the pt age group, frequency and percentage

Table (4.5) shows the control group occupation and percentage

Gender		Frequency	Percent
Validity	student	6	30.0
	farmer	2	10.0
	free work	2	10.0
	teacher	6	30.0
	housewife	3	15.0
	worker	1	5.0
	Total	20	100.0

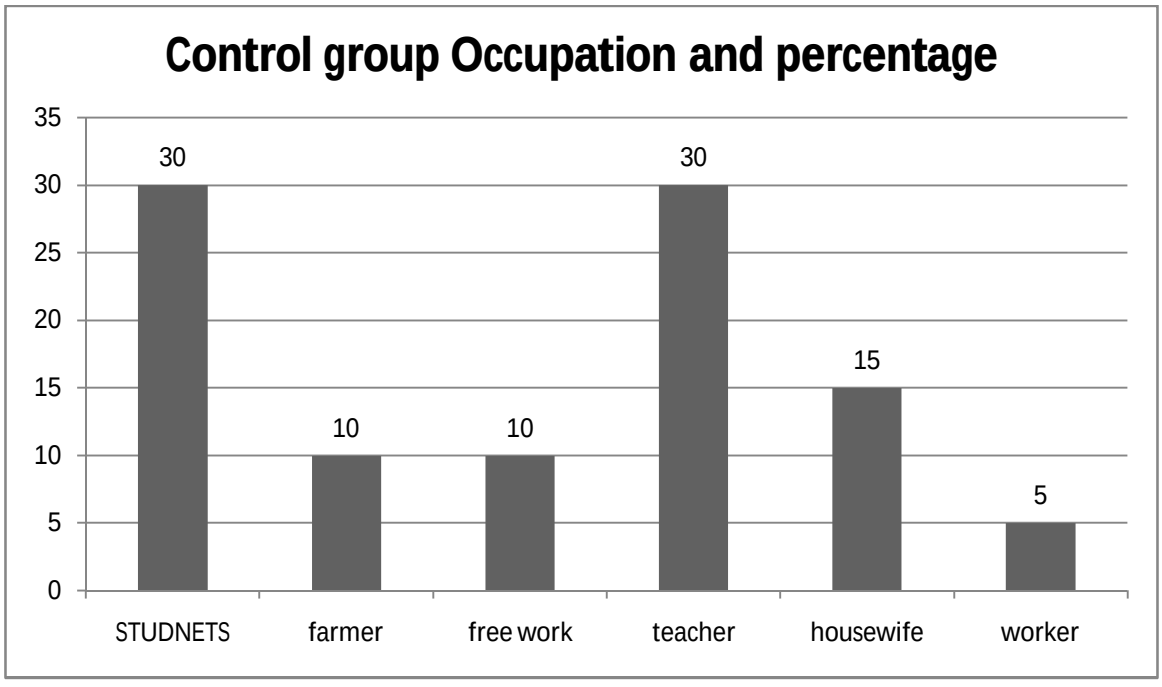


Figure (4.5) shows the control group occupation and percentage

Table (4.6) shows average mean of all patients

	N	Minimum	Maximum	Mean	Std. Deviation
Age	40	23.00	100.00	50.5250	20.39229
Gender	40	1.00	2.00	1.4500	0.50383
Occupation	40	2.00	3.00	2.8500	0.36162
Liver Size	40	5.00 cm	15.00 cm	6.8175	1.97833
CL	40	3.5 cm	8.0 cm	6.038	0.9026
RL	40	7.20 cm	12.50 cm	8.3525	1.16663
CR/RL ration	40	0.64	0.9	0.73	0.5271

Table (4.7) shows average mean control group

	N	Minimum	Maximum	Mean	Std. Deviation
AGE	20	20.00	70.00	40.3500	17.70303
liver size	20	11.10 cm	12.60 cm	11.8200	0.40079
CL	20	1.1 cm	2.2 cm	1.860	0.3085
RL	20	11.00 cm	12.40 cm	11.8000	0.43205
CR/RL ration	20	0.1	0.19	0.1520	0.3105

Table (4.8)shows cross tabulation between normal and cirrhosis

	Normal	**Cirrhosis**
CL	1.8 cm	5.75 cm
RL	11.8 cm	8.35 cm
Liver size	11.8 cm	6.11 cm
CL/ RL ratio	0.15	0.73

Table (4.9)Disease ratio

Disease	N	Minimum	Maximum	Mean	Std. Deviation
Bilharzias	8	0.64	0.76	0.7143	0.4276
CHF	11	0.68	0.90	0.7527	0.7058
Alcohol	6	0.70	0.80	0.7333	0.3882
CLD	3	0.65	0.80	0.7167	0.7638
CaUB	2	0.68	0.80	0.74	0.8485
HBV^{+}	7	0.67	0.78	0.7257	0.4756
UTI	1	0.74	0.74	0.74	
Anemia	1	0.78	0.78	0.78	
SA	1	0.68	0.68	0.68	

Table (4.10)shows the main causes of liver cirrhosis for all patients.

Diseases	**N**	**%**
CHF	11	27.5%
Bilharzias	8	20%
HB V^{+}	7	17.5%
Alcohol	6	15%
CLD	3	7.5%
Ca UB	2	5%
SA	1	2.5%
UTI	1	2.5%
Anemia	1	2.5%
Total	40	100%

Table (4.11)shows the main causes for female liver cirrhosis

Disease	**N**	**%**
CHF	7	41.1%
Alcohol	3	17.3%
CLD	2	11.8%
Bilharzias	2	11.8%
HBV^{+}	2	11.8
UTI	1	5.9
Total	17	100%

Table (4.12)shows the main causes for male liver cirrhosis

Disease	**N**	**%**
Bilharzias	6	26%
HBV^{+}	5	21%
CHF	4	17.4%
Alcohol	3	13%
CA UB	2	8.7%
Anemia	1	4.4%
CLD	2	9.5%
Total	23	100%

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATION

CHAPTER FIVE
DISCUSSION

The data in this study was collected from 40 patients and 20 volunteers in Omdurman Teaching Hospital.

In this study tale measurement for caudate and right lobe for liver to see liver cirrhosis or not by this ratio C/R lobe and then to see some diseases in those patients which causes liver cirrhosis.

The study showedthat the number of female patients was 17 women (42.5%), while the number of male patients was 23 men (57.5%).

The studyshowedthat the age of affected group was from 51 – 60.

The studyshowedthat the occupation of affected group was free work(85%) and farmers (15%).

The studyshowedthat when we didmeasurement for liver and caudate lobe and right lobe we saw:

In the normal control group the mean of liver size was 11.8 cm and right lobe was 11.8 cm, caudate lobe size was 1.8cm and C/R was 0.15.

In patients' groupthe mean of measurements are as follows:

Liver size	6.11 cm
Right lobe	8.35cm

Caudate lobe size 5.75cm

The mean C/R ratio is 0.65.

Measurement the liver decreasedto 5.6 cm the difference between normal liver and abnormal liver and right lobe decreased to 3.45cm but the caudate lobe increased to 3.95, while C/R ratio increased to 0.58.

The C/R ratioincreased in anemia to 0.78, CHF 0.75, alcohol 0.74, bilharzias was 0.72 and HBV^{+} was 0.73, while decreased in SA to 0.68.

The main causes of liver cirrhosis CHF 27.5%, bilharzias 20%, HBV^{+}17.5%, butin alcohol it was 17.5%. This refers to the increase of female affected by CHF.

The study showedthat more than one disease in patient like Ca.UB + bilharzias, HBV^{+} +TB and in male patients alcohol and other diseases like HBV^{+}+ alcohol, DM + alcohol, CHF + alcohol, etc.

The studyagreed with previous study did in Alfaw area for patients with schistosomamansoni in 2011 agreed with this study ratio 0.65 forcirrhosis and 0.7 and more for patients with complication but different in measurement for liver right lobe and caudate lobe. This is normal difference from patient to patient or area to area.

CONCLUSSION

As the main aim of this study is to show usefulness of U/S in demonstrating the change liver size and echogenicity by C/RL ratio to explore main pathology causes liver cirrhosis.

This C/RL ratio is able to diagnostic liver cirrhosis when the measurement to more than 0.65 the caudate lobe is hypertrophy to 5.2 while right lobe is atrophy to 8 cm and liver becomes very small shrinkingor coarse liver to be till 4 cm.

The main causes for liver cirrhosis not alcohol we found that the main cause isbilharzias and congestive heart failure and hepatitis-B virus and CA urinary bladder may be alcohol is first in country which are people heavy drinking alcohol abuse, but another countries are different.

RECOMMENDATIONS

- Use U/S to detect the features of patients with liver cirrhosis.
- Use U/SABD to detect liver cirrhosis for patients CHF – HBVT – CAUB – CLD – alcohol abuse bilharzias, anemia SA – TB.
- DopplerU/S machine must be in all hospitals in Sudan.
- CT – MRI – also must be found.
- Fibro-scan is better than biopsy.
- It is very important measuring right and caudate lobe in patients suffering from this disease CHF – HBVT – bilharzias CA – TB – anemia alcohol abuse HBVT to any change in size atrophy for right lobe or hypertrophy or caudate lobe if this may happens this indicates to liver cirrhosis.

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Appendices

Appendix No. (1)

Data Sheet

Sudan University For Science And Technology

College Of Graduate Studies

Measurement Caudate Lobe / Rt Hepatic Lobe ratio For Pt With Liver Cirrhosis

Data Sheet

Pt No. Age Occupation

Gender

Caudate Lobe Size Rt Lobe Size CL/RL Ratio

Liver Size Liver Echogencity

Complication

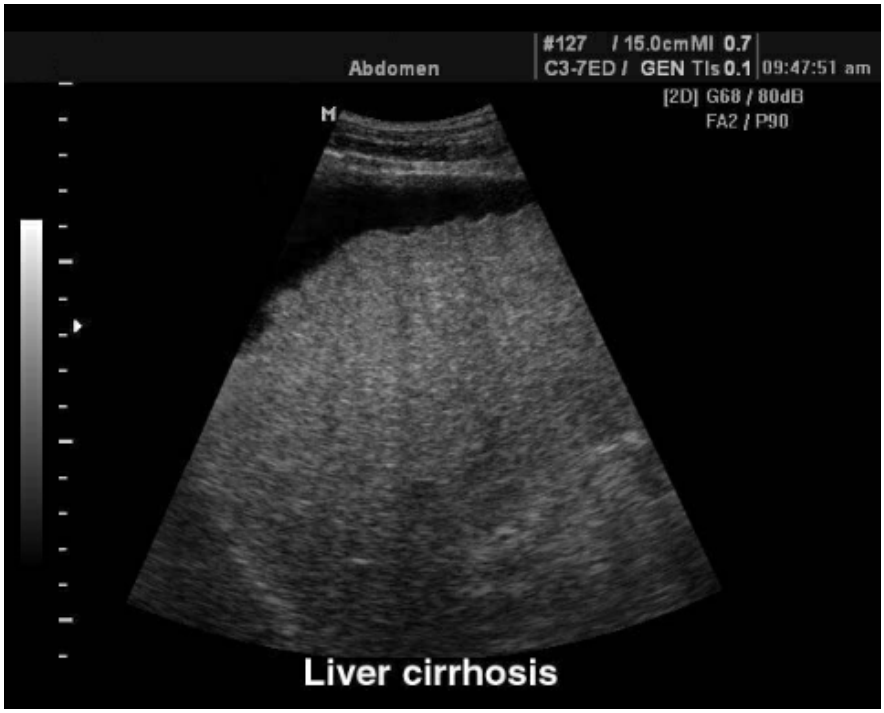
Pathology

Author : Ahmed A.Fadiel

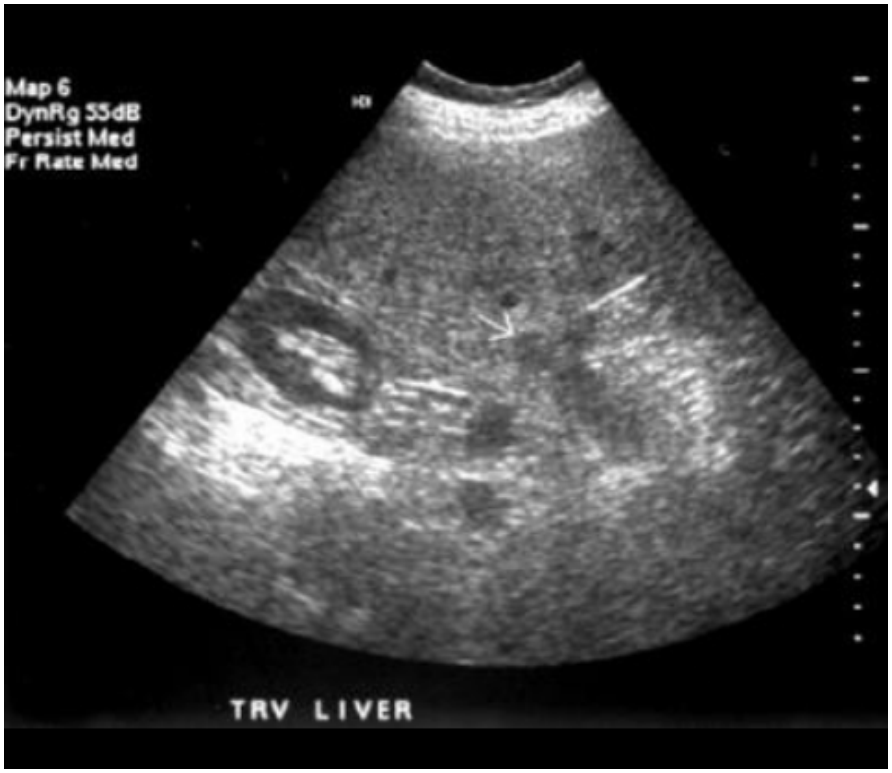
September 2015

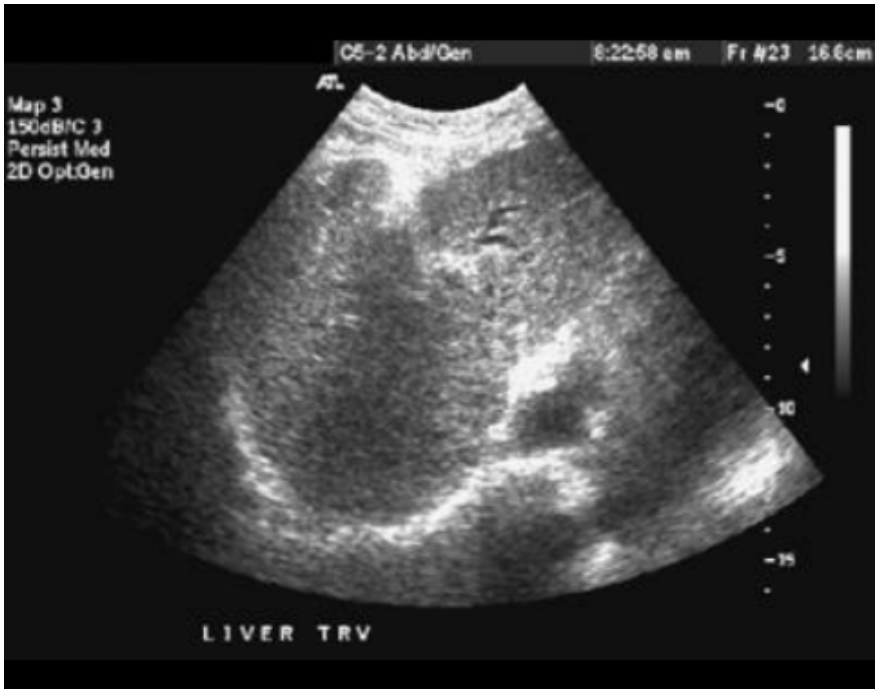
Appendix No. (2)

Ultrasound Images (Liver Cirrhosis)

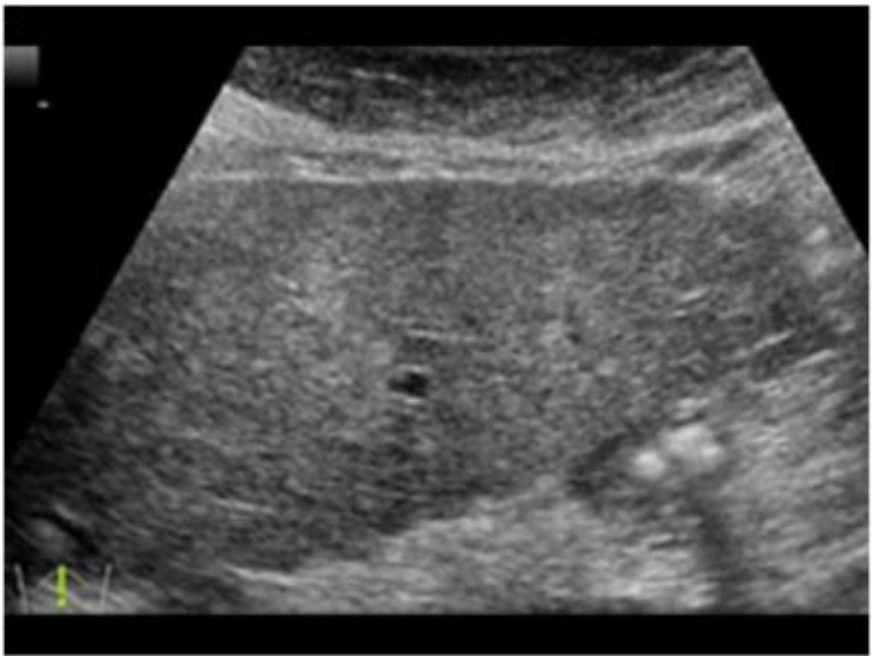


Bilharzias female 55 years

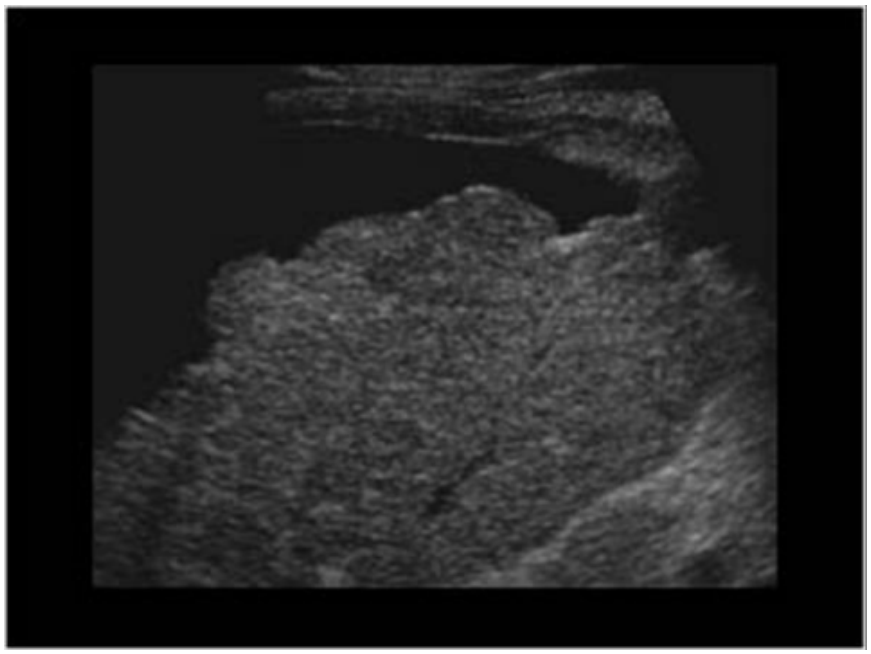




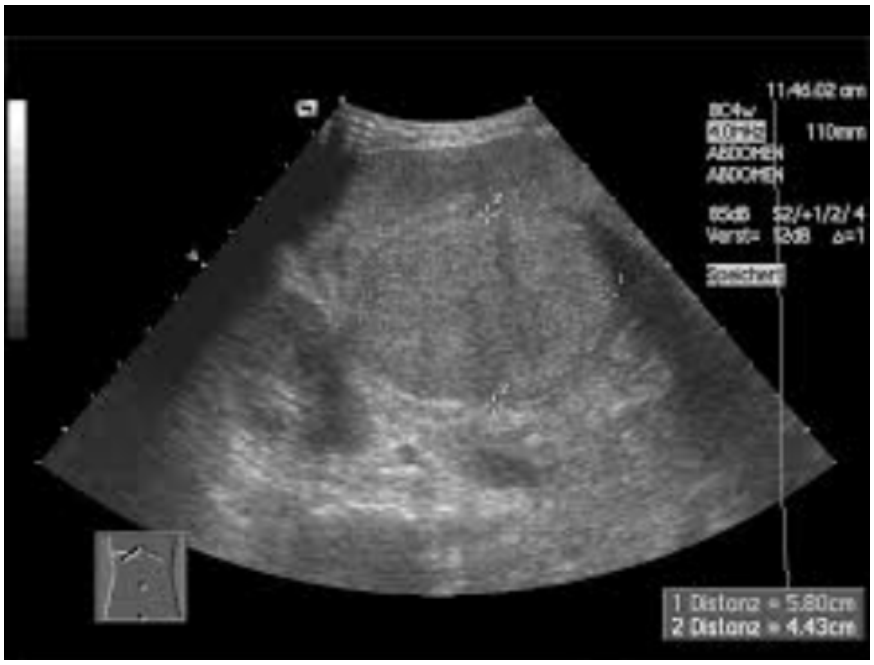
HBV^{+} female 60 years



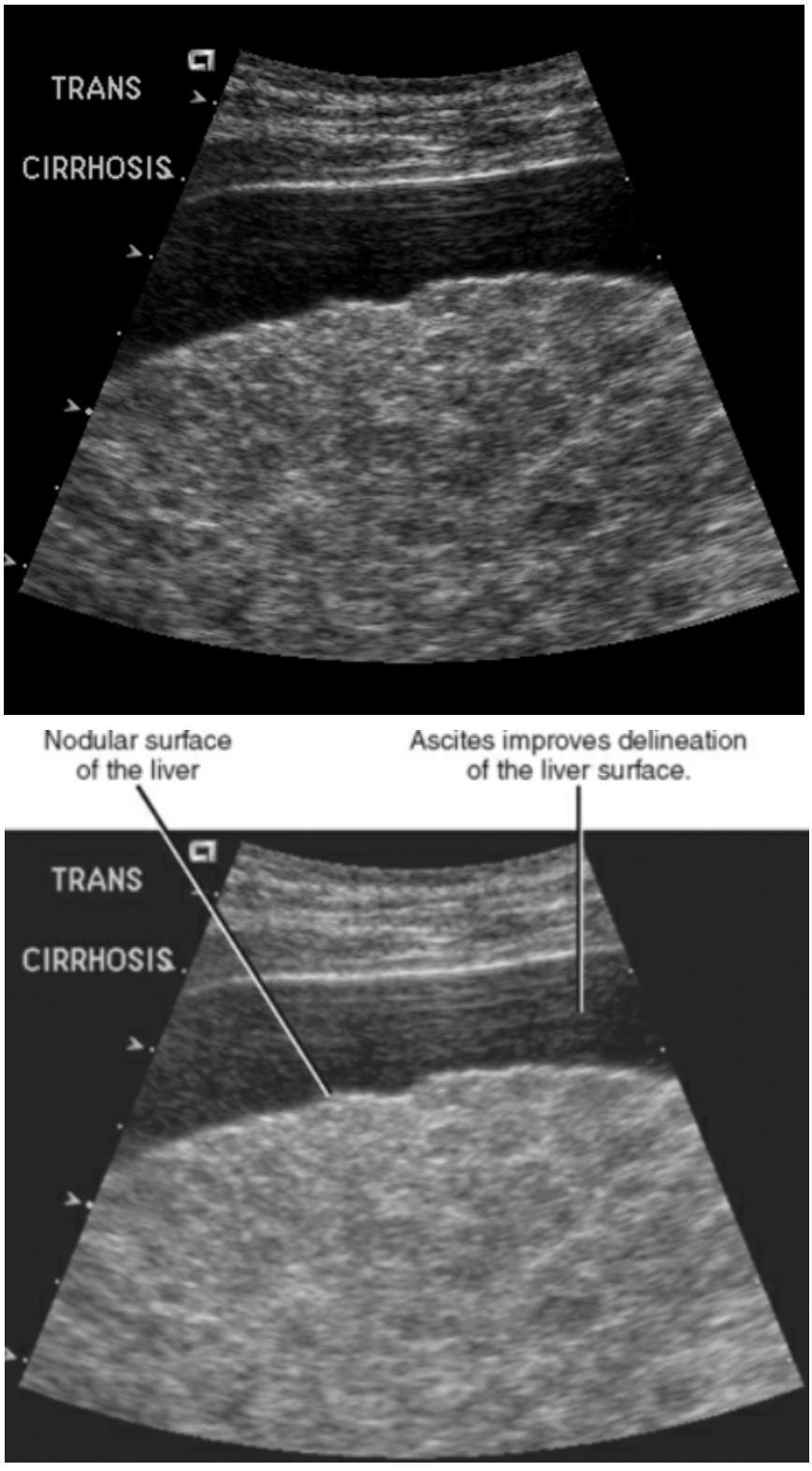
HBV^{+} male 65 years



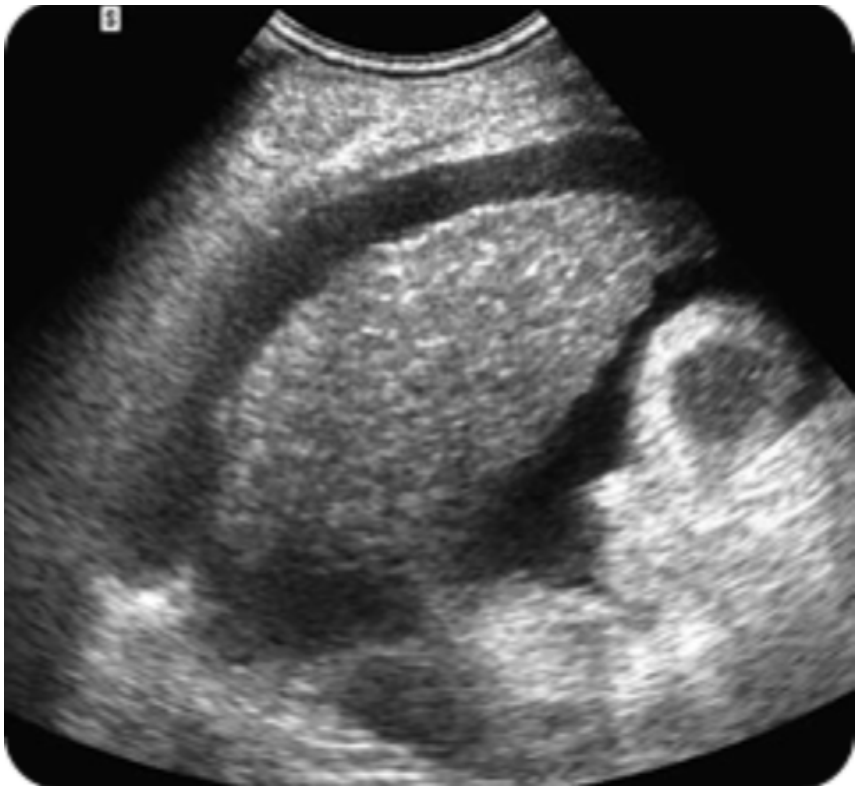
Alcohol female 35 years



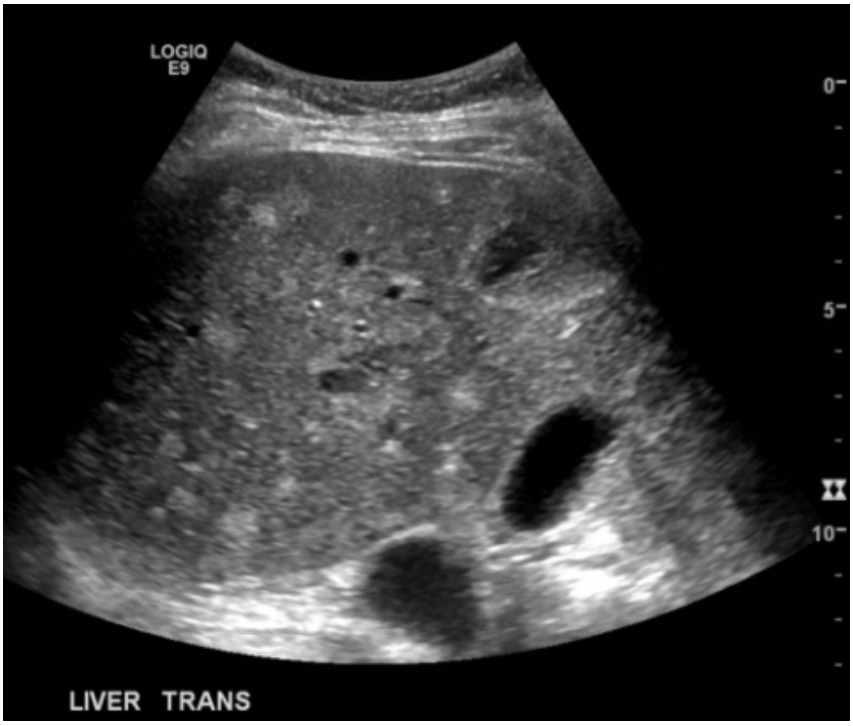
Alcohol male 70 years



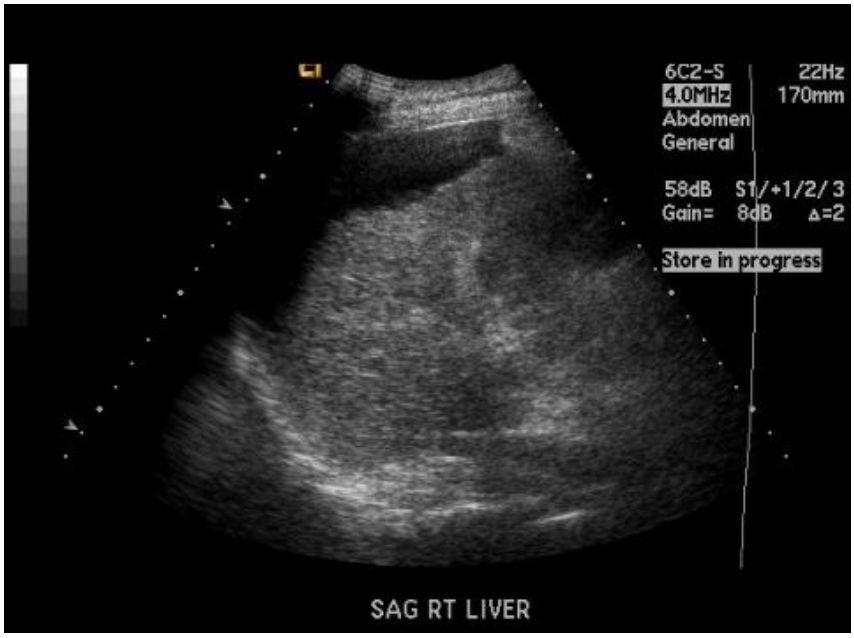
CHF male 75 years



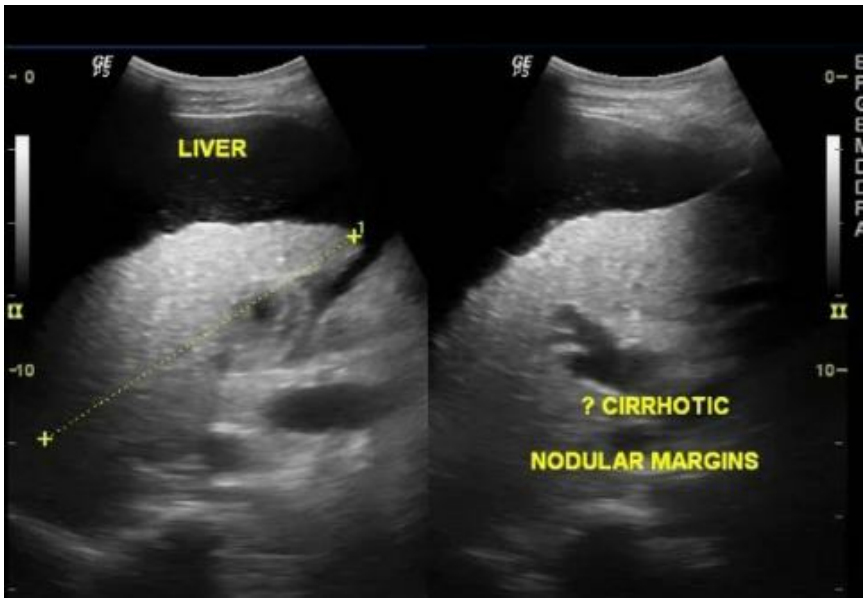
Anemia female 68 years



Bilharzias male 60 years



CHF female 60 years



CA.UB male 75 years