Sudan University of Science and Technology

College of Graduate Studies

Characterization of Solid Liver Masses using Ultrasonography

توصيف أورام الكبد الصلبة بإستخدام التصوير بالموجات فوق الصوتية

A Proposal Submitted For a Partial Fulfillment of the Requirements of MS.c Degree in Medical Diagnostic Ultrasound

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Dedication

To ……

Great men and women who are working in the medical fields who exert great efforts for relieving patients' sufferings.

Acknowledgement

I wish to express my great appreciation to my competent supervisor Dr. Babikir Abdelwahab, for his constant support and encouragement. I'm very grateful to the magnificent guidance he offered me.

My thanks extend to Dr. Wafa Obied , Dr. Ahmed Abdelrahman , Dr. Osama Shareef, Dr. Hasan Mohamed, Dr. Mohamed Alhamadi, to their scientific and technical support.

I would like to gratefully thank my parents to their active support.

God keeps all of them

Abstract

This study was a descriptive cross sectional study aimed to characterize solid liver masses using ultrasonography, the study carried out in various hospitals in (Taif) kingdom of Saudi Arabia from June 2018 to September 2019.

The study covered 103 patients whom scanned Trans abdominal using Philips and GE ultrasound machines. Data was collected using data sheets and analyzed using collecting data program

Study found that; there were a good U/S accuracy in diagnosis of solid liver masses, the study showed that the solid liver masses were more frequent through elder patients and no correlation between liver masses and the gender.

The study revealed nearly equal distribution for cases of solid liver masses throughout the tribes that had been screened.

The study showed a significant correlation between complains of right upper abdominal pain and solid liver masses and association between complains of fever and solid liver masses.

The study concluded that there is highly U/S accuracy in diagnosis of hemangioma, metastasis, FNH, cholangiocarcinoma and low U/S accuracy in diagnosis of HCC and adenocarcinoma.

Study recommendedthat further studies should be done develop U/S diagnosis of solid malignancy and the reasons of correlation between upper abdominal pain.

المستخلص

كانت هذه الدراسة بمثابة دراسة وصفية مقطعية تهدف إلى توصيف كتل الكبد الصلبة باستخدام التصوير بالموجات فوق الصوتية ، الدراسة التي أجريت في مستشفيات مختلفة في (الطائف) بالمملكة العربية السعودية من يونيو 2018 إلى سبتمبر.2019

غطت الدراسة 103 مريضاً قاموا بمسح ترانس البطن باستخدام أجهزة الموجات فوق الصوتية من Philips و GE ، وتم جمع البيانات باستخدام أوراق البيانات وتحليلها باستخدام برنامج جمع البيانات.

وجدت الدراسة أن هناك دقة U / S جيدة في تشخيص كتل الكبد الصلبة ، وأظهرت الدراسة أن كتل الكبد الصلبة كانت أكثر تواترًا من خلال المرضى الأكبر سنًا ولا يوجد ارتباط بين كتل الكبد والجنس.

كشفت الدراسة عن توزيع متساوٍ تقريبًا لحالات كتل الكبد الصلبة في جميع أنحاء القبائل التي تم فحصها.

وأظهرت الدراسة وجود علاقة معنوية بين الشكاوى من آلام الجزء العلوي الأيمن من البطن وكتل الكبد الصلبة والارتباط بين الشكاوى من الحمى وتجمعات الكبد الصلبة.

خلصت الدراسة إلى أن هناك دقة U / S عالية في تشخيص ورم وعائي ورم خبيث و FNH وسرطان القنوات الصفراوية وانخفاض دقة U / S في تشخيص سرطان الكبد والسرطان الغدي.

أوصت الدراسة بمزيد من الدراسات لتطوير تشخيص U / S للأورام الخبيثة الصلبة وأسباب الارتباط بين ألم البطن العلوي.

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Chapter One

Introduction

1.1 Introduction:

Ultrasound (sonography) is an imaging technique that uses high-frequency sound waves to produce images of organs and structures in the body. These images are produced by recording the reflections (echoes) of ultrasonic waves directed into the body.

Sound waves with higher frequencies than with audible sound are called ultrasound. The range of sound waves heard by the human ear is approximately 20 Hz to 20 kHz (20 to 20,000 cycles per second). For medical ultrasound, the range of sound waves used is from 1 to 17 MHz. Sound waves of this frequency are transmissible only in liquids and solids, not in air or gas (Kennethl. Bontrager, 2001) .

Ultrasound imaging is painless and harmless, because no ionizing of tissue is involved. Studies have revealed no adverse biologic effects associated with the use of ultrasound. This makes it a safe and preferred imaging modality for certain radiosensitive exams such as obstetrics, in which the fetus is spared any radiation exposure

A liver scan produces an image of the liver with various internal echoes. The liver is an example of an echogenic structure with varying internal echoes representing biliary ducts and branches of the hepatic and portal veins.

Cystic structures are demonstrated by an “echo-free” or anechoic region surrounded by a well-defined margin or border. The gallbladder is an excellent example of a “fluid filled” or anechoic structure. A stone within the gallbladder or Biliary ducts can be demonstrated by the acoustic interface or “shadowing” that is produced. The region behind the stone will produce a shadow or an area void of signal (Suhas G Paruleker & Robert L. Bee, 2000).

Ultrasound appearance of solid hepatic mass is different from one disease to another. The multiple masses of various size and patterns which may have hypoechogenic rim, the centre may become necrotic and appear quite cystic, with

fluid filled cavities and thick, irregular margin. A solitary well defined hyperechogenic mass close to the liver capsule may be a haemangioma. A single homogeneous mass with low level echo around the periphery is probably a hepatoma (Churchill living stone, 2009).

It can be very difficult to differentiate a haemangioma from solitary metastasis, abscess, or hydatid cyst. A lack of clinical symptoms strongly suggests haemangioma. To confirm the diagnosis. color doppler ultrasound, CT, MRI, angiography or radionuclide scanning with labelled red blood cells is necessary(Churchill living stone, 2009).

1.2 problem of study:

There are many types of liver masses , ultra-sound can play role in differentiate between them depending on the image characteristics using color Doppler and good technique with full experience .

1.3 Objectives:

1.3.1 General objective:

To characterize of solid liver masses using ultrasonography.

1.3.2 Specific objectives:

To evaluate the role of ultrasound in diagnosis of solid hepatic masses.

To co-relate between clinical signs and solid liver masses.

To demonstrate ultrasound sign of solid liver masses.

Chapter Two

Literature Review

2.1 Anatomy of liver*:*

The liver, the largest gland in the body, weights 1500g. It has two surfaces, diaphragmatic and visceral. The diaphragmatic surface is boldly convex, molded to the under surface of the diaphragm, but it subdivided in to anterior, superior, posterior and right surfaces. The anterior surface, viewed from the front figure (2-1) is triangular and related to diaphragm, lungs and pleura (especially on the right), to ribs and costal cartilages 6-10 on the right, and to costal cartilages 6-7 on the left. The postero-inferior or visceral surface figure (2-2), is molded to adjacent viscera and is therefore irregular in shape; it lies in contact with the abdominal part of the esophagus, the stomach, the duodenum, the right colic flexure, the right kidney and suprarenal gland, and the gallbladder.

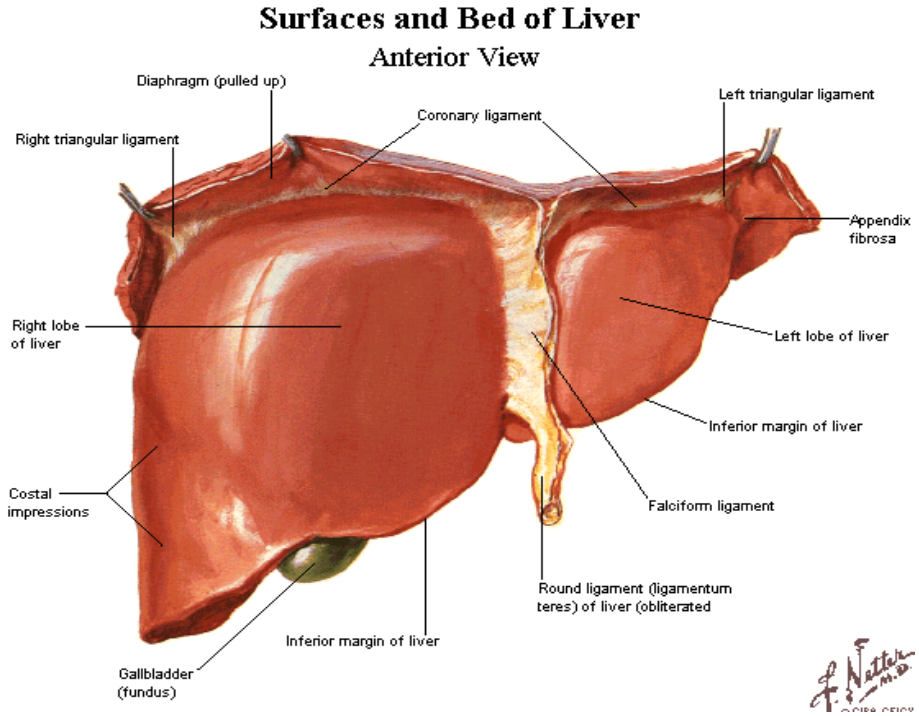

Figure (2. 1) shows anterior liver surface (H. Netter,1995).

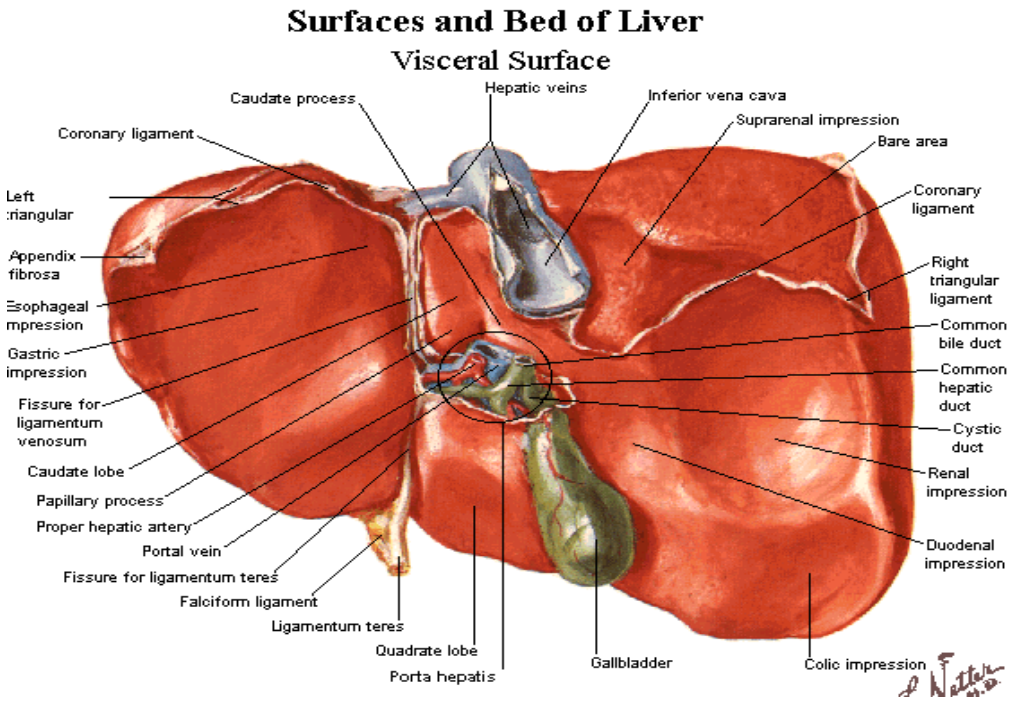

Figure (2. 2) shows visceral liver surface (H. Netter,1995).

2.1.1 Liver lobes:

The lobes of the liver are left, caudate, quadrate and right. At the front and above, the falciform ligament divides the anatomical left and right lobes. At the back, the caudate lobe lies between the inferior vena cava and the fissure for the ligamentum venosum, and is connected to the right lobe (to the right of inferior vena cava) by an isthmus of liver substance, the caudate process. The quadrate lobe lies between the gall bladder fossa and the fissure for the ligamentum teres.[1]

2.1.2 Liver Segments:

On the basis of blood supply and biliary drainage (see below) , there are four main anatomical segments: left lateral and left medial, right anterior and right posterior . The left lateral segments corresponds to the left anatomical lobe, and the left medical segment to the caudate and most of the quadrate lobe with the line of the fissures for the ligamentum venosum and ligamentum terses demarcating these segments from one another. The line of demarcation of the functional right lobe from the rest of the demarcation of the functional right lobe from the rest of the liver is along the vena caval groove and the gall

bladder fosses at the back , but at the front there is no visible landmark, the plane of division lies well to the right of falciform ligament. The right anterior and posterior segments again have no visible external making, but the line of division runs obliquely and medially from the middle of the front of the right lobe towards the vena caval groove.

A plane through the middle hepatic vein and the gallbladder bed separates eight segments described by Couinaud, the left and right lobes, roughly equal in size. The right lobe is further divided into anterior and posterior sectors by right hepatic vein. The posterior sector of the right lobe consist of segment 6 inferiorly and segment 7 superiorly each of which supplied by a branch of the posterior division of the right portal vein. The anterior sector of the right lobe consists of segment 5 inferiorly and segment 8 superiorly. A branch of the anterior division of the right portal vein supplies each Fig. (2-3).

The plane separating the superior from inferior segments of the right lobe lies roughly at portal vein bifurcation. A plane defined by the proximal left hepatic vein above, and the fissure for the ligamentum teres below separates the medial segment of the left lobe (segment 4) from the lateral segments 2 and 3 (Churchill living stone,2011).

The caudate lobe (segment 1) lies superiorly on the posterior surface of the liver to the left of the inferior vena cava and includes the caudate process projection between the portal vein and the inferior vena cava. The blood supply to the caudate lobe comes from branches of left and right portal veins and hepatic arteries. Its venous drainage is directly into the inferior vena cava (Churchill living stone, 2011). , Fig. (2-4).

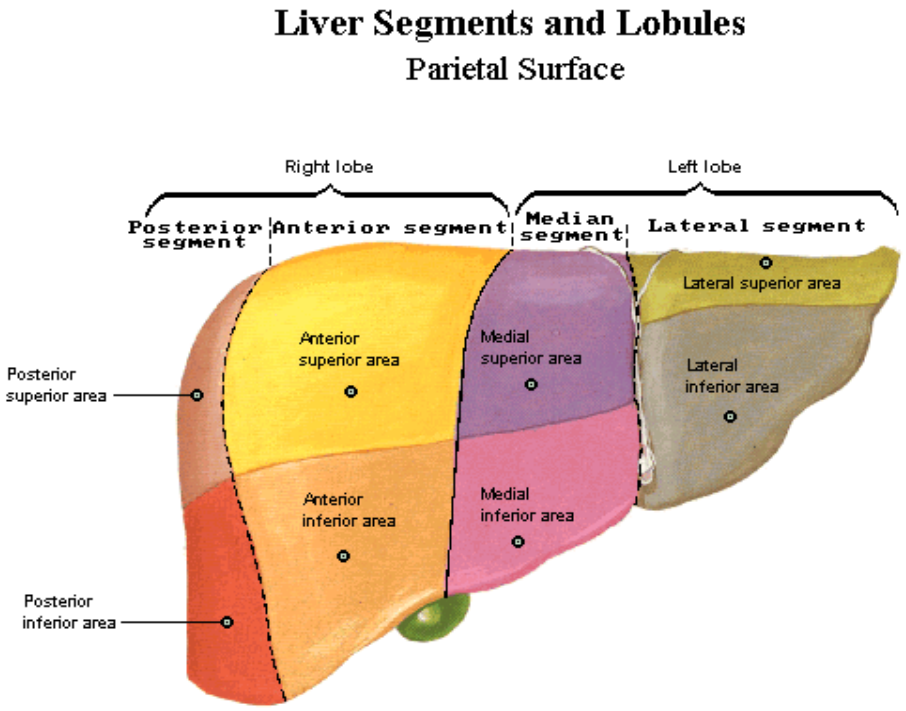

Figure (2. 3) shows parietal liver segments(H.Netter,1995).

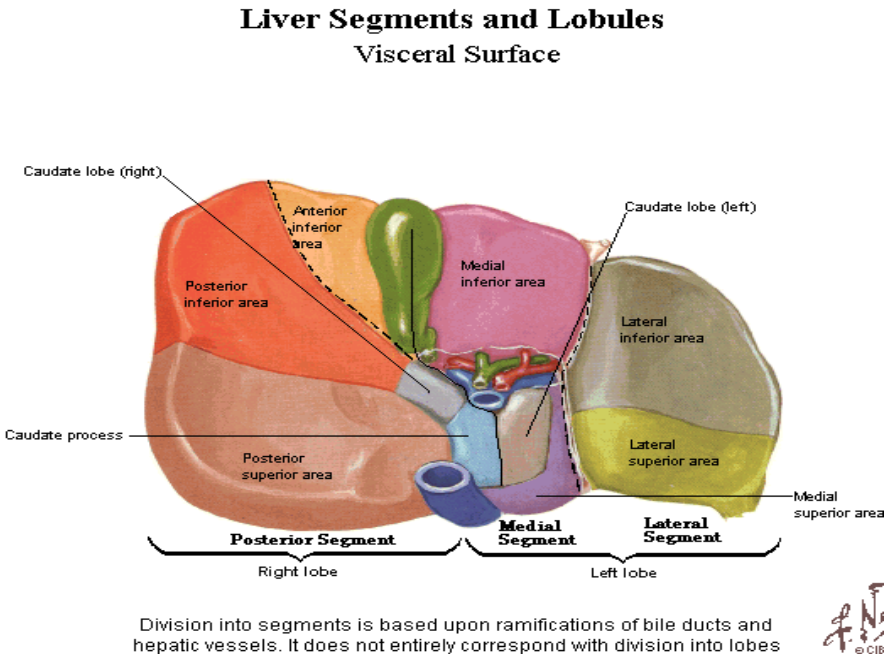

Figure (2. 4) shows visceral surface of liver (H. Netter,1995).

2.1.3 Blood supply:

The liver receives blood from two sources. Arterial (oxygenated) blood is furnishes by the hepatic artery, which divides into right and left branches in the porta hepatis. The division in Y – shaped, in contrast to the T –shaped division of the right and left branches of the portal vein. The right branch of the hepatic artery normally passes behind the common hepatic duct and in the liver divides into anterior and posterior segmental branches; the branch divides into medial and lateral segmental branches. Sometimes the common hepatic artery arises from the superior mesenteric artery or the aorta (instead of the coeliac trunk), in which case it usually runs behind the portal vien. The right and left hepatic branches may themselves arise from the superior mesenteric or left gastric arteries respectively, constituting the aberrant hepatic arteries. They may either replace the normal branches or exist in addition to them; the commonest is a left hepatic artery arising from the left gastric (in over 20% of bodies) Fig. (2-5).

Venous blood is carried to the by the portal vein, which divides in the porta hepatis into right and left branches which in turn give segmental branches like the arteries Fig. (2-6).

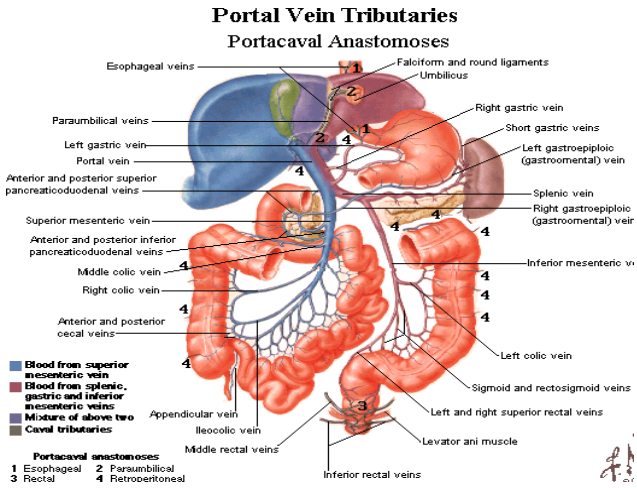

Figure (2. 5) portal vein tributaries (H. Netter,1995).

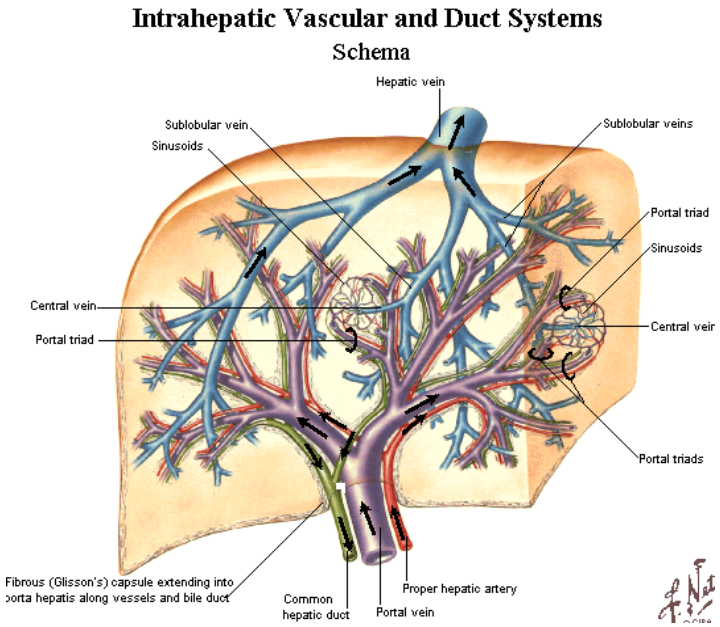

Figure (2. 6) Intrahepatic Vascular and Systems (H. Netter ,1995).

2.2 Physiology:

2.2.1 Functions of the Liver:

The liver regulates most chemical levels in the blood and excretes a product called bile, which helps carry away waste products from the liver. All the blood leaving the stomach and intestines passes through the liver. The liver processes this blood and breaks down the nutrients and drugs into forms that are easier to use for the rest of the body. More than 500 vital functions have been identified with the liver. Some of the more well-known functions include production of bile, which helps carry away waste and break down fats in the small intestine during digestion, production of certain proteins for blood plasma, production of cholesterol and special proteins to help carry fats through the body, conversion of excess glucose into glycogen for storage (glycogen can later be converted back to glucose for energy), regulation of blood levels of amino acids, which form the building blocks of proteins, processing of hemoglobin for use of its iron content (the liver stores iron), conversion of poisonous ammonia to urea (urea is an end product of protein metabolism and is excreted in the urine), clearing the blood of drugs and other

poisonous substances,regulating blood clotting and resisting infections by producing immune factors and removing bacteria from the bloodstream.

When the liver has broken down harmful substances, its by-products are excreted into the bile or blood. Bile by-products enter the intestine and ultimately leave the body in the form of feces. Blood by-products are filtered out by the kidneys, and leave the body in the form of urine (Richard S. Snell,1986)

2.3 Pathology:

2.3.1 Liver Mass

The common solid hepatic masses are divided in two types benign and malignang; benign solid hepatic masses includes cavernous hemangiomas, focal nodular hyperplasia, hepatic adenomas and lipomas. Malignant solid hepatic masses includes**;** metastatic tumors, hepatocellular carcinoma, cholangiocarcinoma, hepatoblatoma and adenocacinoma

2.3.2 Benign Solid Hepatic Masses

2.3.2.1 Cavernous Haemangioma

Cavernous haemangioma is the most common benign tumour of the liver and is reported in up to 7% of patients at autopsy. The tumour is composed of a network of vascular endothelial lined spaces filled with blood. The majority are entirely asymptomatic and required no treatment 4 Large hemangiomas may produce symptoms secondary to hemorrhage within the mass, compression by the large mass, or, rarely, rupture with intraperitoneal hemorrhage (Suhas G. Paruleker & Robert L. Bee, 2000).

Haemangioma is occurs at all ages, but is commonest in adults and rare in young children. It occurs in women predominantly, with a reported female-to-male ratio of 4:1 to 6:1. 6.

The spectrum of appearances on ultrasound is variable. However, the majority have a very distinctive pattern. This is of sharply defined, highly reflective round

tumour usually less than 2cm in diameter and with a homogeneous echo pattern (David cosgrove & Hylton Meire & Keith Dewbury, 1994).Sonographically, the classic appearance is that of a rounded, hyperechoic, homogeneous solid mass with well-defined margins. Most hemangiomas are smaller than 3 cm in diameter. However, they can range in size from a few millimeters to more than 20 cm. When larger than 4 cm, they are termed giant hemangiomas. Hemangiomas are more commonly seen in the right lobe, especially the posterior segment, and frequently they are peripheral or subcapsular in location see Fig. (3-3)Hemangiomas larger than 2.5 cm in diameter are reported to show posterior acoustic enhancement this is an unusual feature although not unique in highly reflective masses and probably relates to the vascularity.A hyperechoic appearance may be secondary to numerous interspaces between the walls of the cavernous sinuses. Approximately 70% of hemangiomas are hyperechoic and homogeneous, and the remainder are hypoechoic, isoechoic, or of mixed echogenicity and rarely contain cystic areas. The heterogeneous appearance with central hypoechoic areas may be related to fibrosis, thrombosis, hemorrhage, or degeneration, and, in general, the echo pattern is more variable in larger (>4 cm) lesions (Suhas G. Paruleker and Robert L.Bee, 2000).

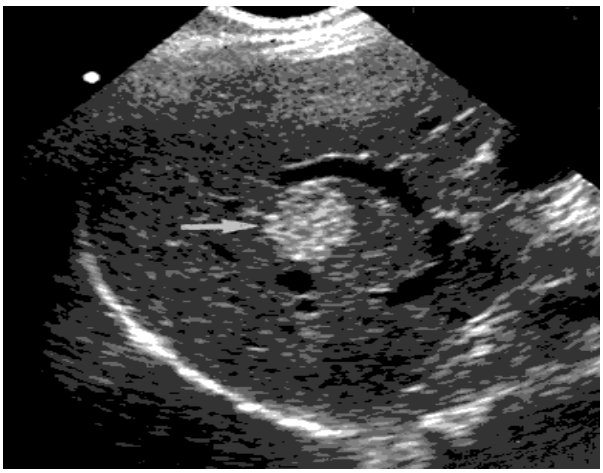

Figure (2. 7) Cavernous hemangioma. (hyperechoic) : Clinical Sonography a Practical Guide 2nd Edition by (Roger C. Sanders)

2.3.2.2 Focal Nodular Hyperplasia

Focal nodular hyperplasia is a rare benign tumour of the liver often discover by chance. Typically, is discover in women of 20 and 40 years of age but occurs in both sexes and in all age groups. Most patients are asymptomatic but up to a third may have pain or hepatomegaly. Focal nodular hyperplasia is generally a solid lesion in subcapsular location. It is well-circumscribed but non-encapsulated. The mass is composed of normal hepatocytes, kupffer cells, bile duct elements and fibrous connective tissue. Multiple nodules are separated by bands of fibrous tissue often radiating from a central stellate scar or a linear fibrous scar (David cosgrove & Hylton Meire & Keith Dewbury, 1994).

Sonographically, focal nodular hyperplasia appears as a solid mass of variable size and echogenicity. The tumors often measure less than 3 cm, although lesions up to 20 cm in diameter have been reported. Lesions may be hypoechoic (33%–36%) or hyperechoic (33%), and the remainder are either isoechoic or of mixed echogenicity. Focal nodular hyperplasia is usually solitary, but it may be multiple. It is usually located peripherally close to the liver capsule and may be pedunculated. The central scar may be seen as an echogenic linear or stellate structure within the central portion of the mass. However, demonstration of the central scar is infrequent. Moreover, central scar is a nonspecific finding that may be seen in other benign and malignant liver tumors. With color Doppler sonography, in addition to peripheral flow, centrifugal arterial flow originating from central portion of the tumor and, in some cases radiating peripherally from a central vessel in a stellate configuration Fig. (3-4) has been reported(Suhas G.Parleker and Robert L.Bee,2000)

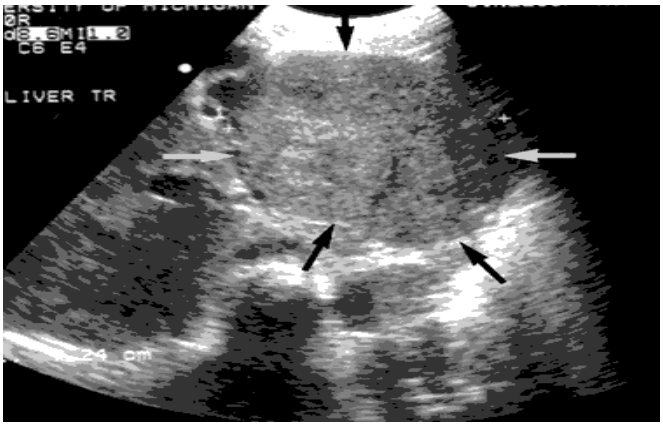

Figure (2. 8) Focal nodular hyperplasia. Slightly hyperechoic, inhomogeneous**:** Clinical Sonography a Practical Guide 2nd Edition by (Roger C. Sanders)

2.3.2.3 Hepatic Adenomas:

Liver cell adenoma consists of normal or slightly atypical hepatocytes containing areas of bile stasis and focal haemorrhage or necrosis. They are usually manifest as smooth solitary masses that are well-marginated and completely or partially encapsulated (David cosgrove & Hylton Meire & Keith Dewbury, 1994). Adenoma usually seen in women and associated with oral contraceptive use (Roger C.Sanders,2002)although adenomas have also described in men on androgens and anabolic steroid .The mass is usually symptomatic with presentations including a palpable mass, right upper quadrant pain and haemorrhage. Hepatic adenomas also occur in association with glycogen storage disease (David cosgrove & Hylton Meire & Keith Dewbury, 1994).

Sonographic features are variable particularly if haemorrhage and necrosis have complicated the adenoma. The most frequent appearance is of an echogenic mass which is well defined and relatively uniform in appearance, though hypoechoic and anechoic areas may be seen. A hypoechoic rim (target lesion) may also be seen. Appearances may be particularly unusual in adenomas associated with an underlying liver abnormality such as glycogen storage disease. In these cases the adenomas may appear poorly define, hypoechoic and in homogeneous on a background of a bright liver Fig. (3-5). There are no specific ultrasound features

that differentiate hepatic adenoma from focal nodular hyperplasia. Percuteneous biopsy is risky as haemorrhage may follow. Radionuclide studies can be helpful in differentiating adenoma from focal nodular hyperplasia (R.A.L.Bisset & A.N. Khan.2002)

Figure (2. 9) shows liver adenoma **:** Clinical Sonography a Practical Guide 2nd Edition by (Roger C. Sanders)

2.3.2.4 Lipomas:

Lipomas are rare primary benign tumours arising from mesenchymal elements. They are non-encapsulated and in continuity with the normal liver parenchyma. They show the typical high reflectivity of fatty tumour. (David cosgrove & Hylton Meire & Keith Dewbury, 1994).

Sonographically,lipoma appear as the solid well-defined hyper echoic masses with a variable degree of distal acoustic shadowing Fig. (3-6).Lipomas may appear similar to hemangiomas and hyperechoic metastases, which are two most common causes of solid hyperechoic masses in the liver hemangiomas may causes acoustic enhancement and rarely cause acoustic shadowing. Hyperechoic metastases are often inhomogeneous, are rarely solitary, and cause acoustic shadowing only when calcified. Moreover, hemogiomas and hyperechoic metastases do not cause artifactual displacement and continuity of diaphragm deep to mass. Compiuted tomography is helpful to confirm the diagnosis of lipoma. by demonstrating low density (-20 to -70 HU) within the lesion, thus confirming the fatty mature of the tumor.

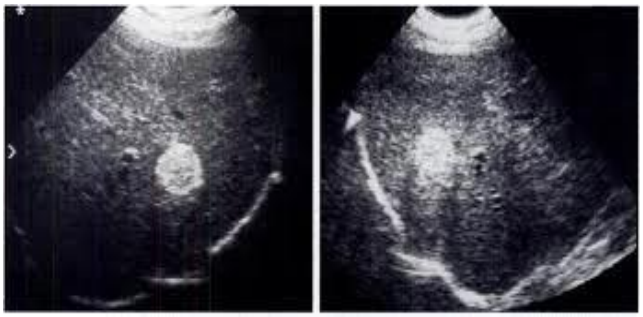

Figure (2. 10) liver lipoma appearance : Clinical Sonography a Practical Guide 2nd Edition by (Roger C. Sanders)

2.3.3 Malignant solid hepatic masses

2.3.3.1 Hepatocellular carcinoma (HCC):

Hepatocellular carcinoma is primary liver cancer is one or major malignancies in many countries throughout the world, particularly in sub-Saharan Africa and in the far East,5 it usually occurs as a complication of cirrhosis, most frequently as a result of alcoholic liver disease. It typically occurs in male patients between 50 and 70 years of age.). This tumor is rare in children and occurs between the ages of 5 and 15 years. It occurs predominantly in men, with male-to-female ratios ranging from 4:1 to 8:1 in high-incidence areas and 2.5:1 in the United States.81 Patients are usually asymptomatic in the early stages of the disease. The most common symptoms include abdominal pain and weight loss. This tumor usually occurs in association with chronic liver disease, most frequently cirrhosis, and is more commonly associated with nonalcoholic posthepatitic cirrhosis than with alcoholic micronodular cirrhosis (Suhas G. Paruleker & Robert L. Bee, 2000). Patient with primary liver malignancies may have any combination of right upper quadrant pain and anorexia without nausea, palpable liver mass or enlargement, and fever. Jaundice and ascites are usually late findings (Kathryn A. Gill, 2001).

Sonographically, the appearance of HCC is variable. The masses may be hypoechoic, hyperechoic, or of mixed echogenicity Fig. (3-7) and Fig. (3-8) Cystic areas within the tumor secondary to necrosis or hemorrhage are uncommon. The masses may be solitary, multiple, or, less frequently (7%–10%), diffusely

infiltrating, thereby distorting of the liver architecture.This disorder is more frequently hyperechoic when tumors are multiple than when a tumor is solitary. The echogenicity of solitary tumors may also be related to the size of the tumors and to their stage of development (Suhas G.Paruleker and Robert L.Bee, 2000).

Hepatoma can be classified into unifocal, multifocal and diffuse infiltration forms. On ultrasound, a small hepatoma, less than 3 cm is typically an echoic poor solid lesion. Eighty percent of small demonstrate arterial and/or venous flow on Doppler ultrasound distinguishing them from hyperplastic nodules. Occasionally, small hepatoma uniformly echogenic because of its fatty infiltration. As they increase in size, hemorrhage, necrosis cystic degeneration cause hepatomas to become echogenic and heterogeneous. Hepatoma larger than 5cm in diameter frequently demonstrates anteroportal shunting causing high velocity blood flow. This is manifest as frequently shifts of around 4 kHz. And helps differentiate hepatoma from metastasis (while around 3% of metastasis shows blood flow on Doppler ultrasound they do not have anteroportal shunting and frequency shift are generally less than 2 KHz. With 3.5MHz. Transducer (Taylor K, Ramos I, Carter D, 1988). Invasion of portal and hepatic is common and ultrasound shows either completes occlusion or enlargement of the vein with blob flowing around the tumor thrombus. Invasion of bile duct may be also occurring. Satellite lesions are another common feature of hepatoma and this helps distinguish them from metastasis.The fibrolamellar variant has a central echogenic scar with radiating bands of fibrosis or hemorrhage. Around 10 % of hepatoma has a complete fibrous capsule which shows on ultrasound as an echogenic rim 3-15 mm in thickness. This is reported with a higher frequency in Japanese series but is also seen in non-Asian patient.

Figure (2. 11) Hepatocellular carcinoma (Hypoechoic) : Clinical Sonography a Practical Guide 2nd Edition by (Roger C. Sanders)

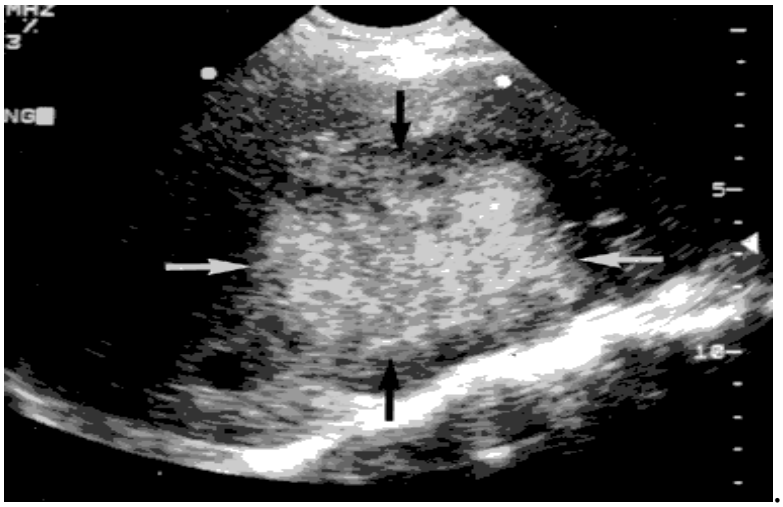

Figure (2. 12) Hepatocellular carcinoma (hyperechoic, inhomogeneous mass) : Clinical Sonography a Practical Guide 2nd Edition by (Roger C. Sanders)

2.3.3.2 Hepatoplastoma:

Hepatoblastoma, a malignant embryonal tumor of the liver, occurs almost exclusively in the first 3 years of life and is the most common symptomatic liver tumor occurring under the age of 5 years.it is rare in adults. The tumor usually presents as a large, palpable mass. Serum a-fetoprotein levels are elevated in most patients. It is the most common malignant neoplasm of childhood. It is well-defined hypoechoic solid mass occurring in 2-3 years old child.

Sonographically, most hepatoblastomas are hyperechoic with an inhomogeneous echo pattern, they frequently contain internal calcifications, and lobulation of the contour is often seen less commonly, tumors may be of mixed echogenicity or hypoechoic. Tumors occasionally contain cystic areas secondary to necrosis or hemorrhage. These tumors, which are usually solitary, range in size from 5 to 25 cm and are more common in the right lobe. The presence of multiple nodules or diffuse involvement of the liver is infrequent. Septations within the tumor may be seen on postcontrast CT. The tumors are usually hypervascular on angiography and may demonstrate a spoke-wheel pattern**.**

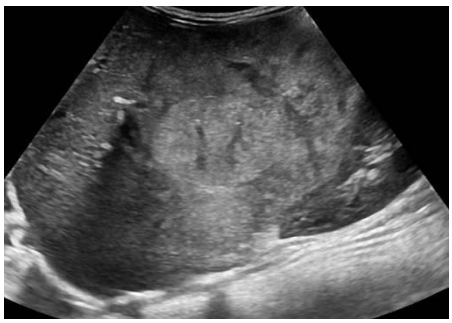

Figure (2. 13) Hepatoblastoma

Clinical Sonography a Practical Guide 2nd Edition by (Roger C. Sanders)

2.3.3.3 Cholangiocarcinoma:

It is the malignant tumor of the billiary ducts and present as solid hypoechoic mass in the bile ducts. It can cause the stenosis of the bile ducts with billiary obstruction. Cholangiocarcinoma is a malignant tumor of the biliary epithelium. It is 10 times more common in Japan than in the United States. Peripheral cholangiocarcinoma is considered to occur 10 times less frequently than HCC and accounts for 5% to 30% of primary liver cancer. It occurs in older persons and is rare before the age of 40 years. A higher incidence of cholangiocarcinoma has been associated with liver fluke infection, intrahepatic biliary calculi, ulcerative colitis, primary sclerosing cholangitis, cystic liver disease, congenital hepatic fibrosis, and exposure to thorium dioxide. Signs and symptoms of peripheral cholangiocarcinoma are similar to those of HCC, except that jaundice may be an earlier, more prominent,

and more frequent feature. Pathologically, peripheral intrahepatic cholangiocarcinoma usually forms a large, solitary tumor, but a multinodular type may occur (Suhas G. Paruleker & Robert L. Bee, 2000).

Sonographically, most masses are solid and may be hypoechoic or hyperechoic. Echogenicity, however, is variable, and the masses may also be isoechoic or of mixed echogenicity hypoechoic rim around the mass, calcification within the mass or intrahepatic biliary dilatation peripheral to the mass may be seen. The size of the tumors ranges from 5 to 20 cm. It is usually solitary, but it may be multiple. Much less commonly, the tumor is infiltrative type demonstrating diffuse distortion of the liver parenchyma.

Figure (2. 14) Cholangiocarcinoma

Clinical Sonography a Practical Guide 2nd Edition by (Roger C. Sanders)

2.3.3.4 Liver Metastases:

In Western countries, metastases are the most common cause of malignant focal liver lesions. Metastases are 18 to 20 times more common than primary malignant tumors. The most common primary sites causing liver metastases are colon, pancreas, stomach, breast, and lung. Metastases are most frequently multiple; however, solitary metastatic lesions can be seen (Suhas G. Paruleker & Robert L. Bee, 2000). In patients with colonic carcinoma, metastasis seeding to the liver via portal system means that the liver may be the only site of spread. The aim in these patients is to accurately demonstrate the size, number and location of metastases. This is necessary to determine whether curative local therapy is possible and to

determine the extent of resection and/or percutaneous therapy required (Werreke K, Henke L, Varrallo, 1992). The metastatic tumors are much more common than primary liver tumors. This is because the blood circulation to the liver. The liver receives the largest volume of blood by way of the portal system (Kathryn A. Gill, 2001).

The sonographic appearance of liver metastases is variable, and no definite association exists between the histologic type of the tumor and the sonographic appearance. Tumors of the same primary origin may have different sonographic appearances.Because of the nonspecific appearance of the metastases, ultrasound-guided biopsy of the mass is frequently necessary for the diagnosis. Sonographic patterns of metastases include target pattern, hypoechoic fig (3-9), isoechoic, hyperechoic Fig (3-10), calcified, cystic, and diffuse (Suhas G.Paruleker and Robert L.Bee 2000).

A poor halo is common feature of metastasis and should be carefully sought as it may helpful in distinguishing echogenic metastasis haemangiomas. The halo itself is usually a result of a highly cellular tumor margin with few stromal elements (Werreke K, Henke L, Varrallo P, 1992) but may occasionally represent compression of surrounding liver tissue. There was variety of sonographic appearances of metastatic lesions in the liver (Scheible W, Gosik B, Leopold G, 1977). However, no direct and reliable correlation between the sonographic appearance of a liver metastasis and the primary tumor has been documented. The echogenicity of liver metastasis has been correlated with mucin content, vascularity, and the presence or absence of internal cystic degeneration (Shawker T, Moran B,Linzer M, 1983). The target pattern or bull's-eye pattern is characterized by a central echogenic area and peripheral hypoechoic rim within the metastatic lesion. Generally, when the peripheral hypoechoic rim is thin (<3 mm), the appearance has been described as the halo sign, and when the hypoechoic rim is thick (>3 mm), it is the target or bull's-eye pattern. The hypoechoic peripheral rim is caused by compressed normal liver parenchyma around the tumor or, more

likely, by a zone of proliferating tumor in the periphery of the lesion.The halo or target pattern is not specific, but it is most often seen in malignant tumors, most commonly metastatic lesions in the liver, rather than benign tumors.

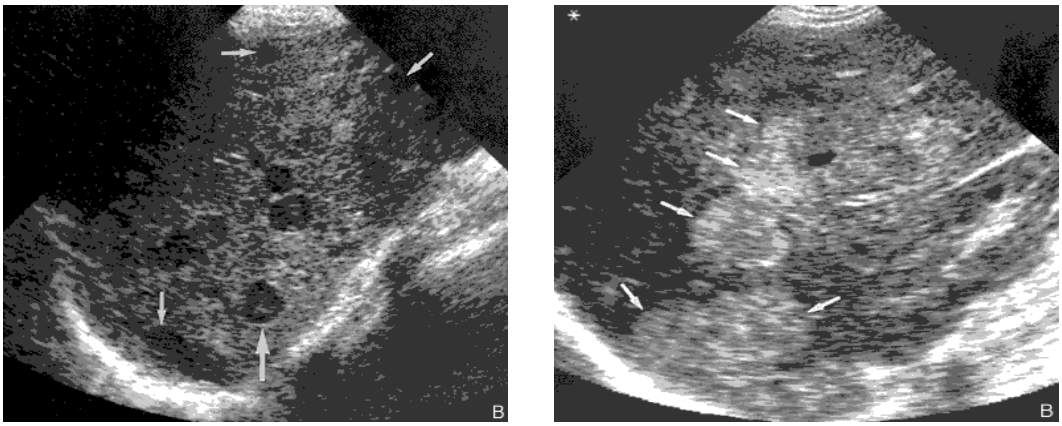

Figure (2. 15) Hypoechoic metastases **:** Clinical Sonography a Practical Guide 2nd Edition by (Roger C. Sanders)

2.4 Investigations done for liver:

2.4.1 Main laboratory test:

Common used tests to check liver abnormalities are; Alanine transaminase (ALT), aspirate aminotransferase (AST), alkaline phosphatase (ALP), albumin and bilirubin. The ALT and AST tests measure enzymes that liver release in response to damage or disease. The albumin test measure how well the liver creates albumin, while the bilirubin test measures how well it disposes of bilirubin. ALP can be used to evaluate the bile duct system of the liver

2.4.2 Imaging of Liver:

Imaging tests of the liver, gallbladder, and biliarybtract include ultrasonography, radionuclide scanning, computed tomography (CT), magnetic resonance imaging (MRI), endoscopic retrograde cholangio pancreatography (ERCP), and simple x-rays.

2.4.2.1 Sonography of Liver:

The improved resolution of real-time sonography flexibility of sonographic examination of the liver has increased the diagnostic utilization of sonography in the detection of intrahepatic masses such as metastasis (Lafortune M, Madone F, Patriquis H, Breton G,1991).

Indications of liver ultrasound are suspected focal or diffuse liver lesion, staging known extrahepatic malignancy, right upper quadrant pain or mass, hepatomegaly,jaundice, abnormal liver function tests, suspected portal hypertension,pyrexia of unknown origin, to facilitate the placement of needles for biopsy, assessment of portal vein, hepatic artery or hepatic vein, assessment of patients with surgical shunts or TIPS procedures and follow-up after surgical resection or liver transplant.

The patient should take nothing by mouth for 8 hours preceding the examination. If fluid is essential to prevent dehydration, only water should be given. If the symptoms are acute, proceed with the examination. Infants clinical condition permitting- should be given nothing by mouth for three 3 hours preceding the examination.

For adult use a 3.5 MHz transducer. For children or thin adults use a 5MHz transducer. 3-5-MHz transducer. Small scan head may be better for an intercostals approach, e.g. phased or annular array.

The patient leis supine. Apply coupling agent liberally, first over the right upper abdomen, then over the rest of the abdomen as the examination proceeds. Time-gain compensation set to give uniform reflectivity throughout the right lobe of the liver. The gain setting should allow the diaphragm to be clearly seen; the liver (when normal) should appear homogenous throughout its depth. It should be possible to see clearly the normal tubular structures (the portal veins with bright edge and the hepatic veins without bright edge). Suspended inspiration

Longitudinal scans from epigastrium or left subcostal region across to right subcostal region. The transducer should be angled up to include the whole of the left and right lobes. Transverse scans, subcostally, to visualize the whole liver. If visualization is incomplete, due to small or high liver, then right intercostals, longitudinal, transverse and oblique scans may be useful. Suspended respiration without deep inspiration may suffice for intercostal scanning. In patients who are unable to hold their breath, real time scanning during quiet respiration is often adequate. Upright or left lateral decubitus positions are alternatives if visualization is still incomplete

Scanning should be in sagittal, transverse and oblique plane, including scan through the intercostals spaces and subcostal spaces. Scanning should be done with slow rocking movement of the transducer in all planes to obtain the best visualization of the whole liver.

2.4.3 Ultrasound appearance

2.4.3.1 Normal Echo-texture:

The real-time sonograthy has greatly facilitated sonographic examinations of the liver. This is preliminary the result of greater imaging flexibility of the liver afforded by real-time transducers that require only a small contact area. For example, scan can be obtained through the intercostal spaces for complete delineation of the liver and its structures. Exstrahepatic masses can usually be differentiated from the intrahepatic masses based on the displacement of perirenal fat (P.E. S. Plamer,19950. If the perirenal fat is displaced inferiorly by a mass, it most likely arises from the liver. Conversely, if the perirenal fat is displaced superiorly, the mass is most likely of renal or adrenal origin. The normal liver has a characteristic parenchyma echo texture, which presents an interference pattern produced by sound waves reflected from multiple small tissue interfaces within the liver. Thus the tinny bright and dark foci, which make up normal liver texture, do not represent individual anatomic features Fig. (3-1). within this background, the

hepatic veins are visible anechoic structures draining superiorly towards the IVC. The portal vein lumen is also anechoic, but has echogenic walls because of the surrounding connective tissue in the portal tract. Normal bile duct may be visible centrally extending into the left and right lobe with the portal vein but they only measure 1-2 mm in diameter. Intrahepatic arterial branch are not generally visible without color Doppler. The liver is typically more echogenic than the renal parenchyma. Accurate comparison requires the liver and right kidney to be viewed in the same image at the same depth with no difference in the attenuation of overlying structures (P.E. S. Plamer, 1995).

2.4.3.2 Doppler Ultrasound of Liver:

Color Doppler allows visualization of blood flow in normal hepatic veins, arteries and in portal veins Fig. (3-2). The Doppler waveform of the normal hepatic artery has a characteristic low resistance pattern with sharp systolic upstroke and sustained flow throughout diastolic.

The main portal vein and intrahepatic portal veins show slight cyclical variation related to the cardiac cycle and also to respiration. Portal flow remains antegrade throughout the normal cardiac and respiratory cycle.

Figure (2. 16) shows normal liver parenchyma: Clinical Sonography a Practical Guide 2nd Edition by (Roger C. Sanders)

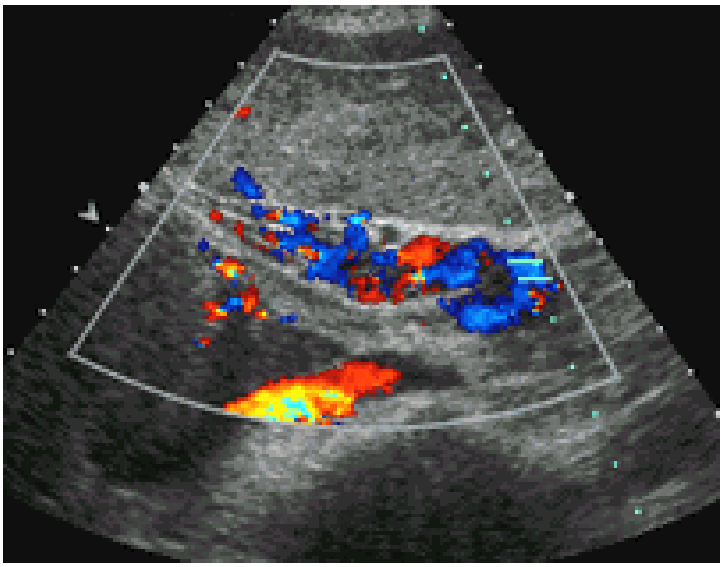

Figure (2. 17) shows portal vein thrombosis**:** Clinical Sonography a Practical Guide 2nd Edition by (Roger C. Sanders)

2.5 Previous studies:

Study done by Ibrahim Abdallah et al, 2015(Saudi Arabia) which include sonographic appearance of liver masses in adults and its correlates in the city of Ryadah. Result: Ultrasound has a good accuracy in diagnosis hepatic lesions.

Study one by Dr. Hiral Hapani1, Dr. Jagruti Kalola2, Dr. Anjana Trivedi3, Dr. Anirudh Chawla 2014,aimed to evaluate the role of ultrasound in evaluation of focal liver lesions, to study the imaging spectrum of focal hepatic lesions, to study the relative prevalence of different focal hepatic lesions, and to correlate the ultrasound findings with FNAC and/or CT scan. The study was prospective and was carried out between September 2014 and November 2014 at the Department of Radiology, P.D.U. Govt. Medical College and Civil Hospital, Rajkot. Abdominal ultrasound and ultrasound guided-fine needle aspiration cytology and/or CT scan of 50 patients with clinical diagnosis of hepatic focal lesions or incidentally discovered focal hepatic lesions was performed.

Study resulted that: Out of 50 patients diagnosed by ultrasound, the most common focal liver lesions seen in study were- liver abscess, hemangiomas, cysts, metastasis, primary liver tumors, contusions/lacerations and hydatid cysts. Correlating with FNAC and/or CT scan, ultrasound had an average specificity of 93.6%, with 100% specificity for common benign lesions like hemangiomas and simple cysts.

Study concluded that: Ultrasound is a safe and effective method of detecting focal liver lesion. Its low cost, easy availability and lack of ionizing radiation and iodinated contrast media makes it most ideal for imaging the liver. It aids in defining therapeutic decision quickly and allows ultrasound guided interventions. High degree of specificity of ultrasound diagnosis in the present study confirms the value of ultrasonographic evaluation of focal liver lesions and suggests that it can be effectively used in the routine diagnostic work.

Another study done by *Stephanie R. Wilson, Hyun-Jung Jang, Tae Kyoung Kim and Peter N. Burns.* The purpose of this study was to compare the diagnostic accuracy, confidence level, and recommended management of focal liver masses after contrast-enhanced ultrasonography (CEUS) compared with unenhanced ultrasonography alone.

One hundred sixty-seven patients were referred for CEUS to characterize a focal liver mass. A 2-person blind read determined benignancy or malignancy, comparative diagnosis, and accuracy on both ultrasonography and CEUS. Results were compared with the final diagnoses.

Study resulted that; The 2 readers could not determine benignancy or malignancy in 77 (46.1%) and 46 (27.5%) of 167 unenhanced scans compared with 2 (1.2%) and 1 (0.6%) of 167 CEUS scans. The confidence level increased from 0 responses in the 2 highest grades (4 and 5) on the unenhanced scans to 135 (81.8%) and 132 (79.5%) of 167 at level 5 for CEUS. Regarding the diagnosis, the confidence level was lowest (grade 1) on the unenhanced scans in 128 (82.1%) and 79 (65.3%) of 167 for the 2 readers and improved to the highest (grade 5) in 110 (65.9%) and 113(68.1%) of 167. Regarding diagnostic accuracy, the unenhanced scans agreed with the correct diagnosis in 85 (50.9%) and 63 (37.7%) of 167, and CEUS agreed with the correct diagnosis in 133 (79.6%) and 142 (85%) of 167 for readers 1 and 2, respectively. Recommendations for further imaging decreased from 166 (99.4%) and 147 (88%) of 167 on the unenhanced scans to 30 (18%) and 5 (3%)of 167 on CEUS for readers 1 and 2.

Study concluded that; Contrast-enhanced ultrasonography improves the accuracy and confidence of diagnosis of focal liver lesions and reduces recommendations for further investigations.

Chapter Three

Materials and Methods

Materials and Methods

3.1Type of the study:

The study is descriptive and analytical dealing with Saudi patients

3.2Area of Study:

Kingdom of Saudia Arabia (Taif),King Faisal hospital , Alslamah hospital and Adawi hospital

3.3 Time Available:

The study has done in extended over the period from September 2017 to June 2019. Time available will be six days a week. During these days three hours per day will be spent on the research work.

3.4 Population Available for Research:

The Study population will comprise of 100 patients who will be referred for ultrasound evaluation of liver lesions. . Patients will be scanned by the candidate and a senior ultrasonologist having good experience in ultrasound. Alslamah hospital, daily number of the patients for abdominal ultrasound is more than 70. King Faisal hospital, daily numbers of the patient for abdominal ultrasound was more than 40. Adawi hospital, daily number of patients was referred for abdominal ultrasound about 20.

Through those patients there was daily 5 to 6 patients of hepatic complains.

3.5 Field of the Research:

This study (Ultrasound evaluation of solid hepatic masses) has been carried out in various hospitals in Kingdom of Saudi Arabia (Taif),Alslamah hospital in the west area in Saudi Arabia in Taif city which has the biggest number of population, and there is few patients came from Jedddah, Makkah and other areas. It’s a good private hospital and has a good consultant so that the patients refer to it from other hospitals to do advanced investigation. Then King Faisal hospital which is big

hospital related to ministry of health and Adawi hospital. All of these hospitals are equipped with a good diagnostic ultrasound machines and facilities.

3.6 Data collection:

Primary data from data collection sheets

Secondary data from books and internet

3.7 Data storage:

All data collected during study will be stored in computer

3.8 Data and statistic analysis:

Data will be analyzed by the soft ware program, Statistical Package for Social Sciences SPSS and presented in tables and figures. The result will be concluded from the processed data, and will be discussed in details to see the ultrasound accuracy in diagnosis the solid hepatic masses. Discussion will be done and the results will be summarized to draw the conclusion. The references will be given in the appendix.

3.9 Ethical issues:

Ethical issues there are no patient identification or any individual patient details will not be published.

3.10 Equipments:

Philips ATL	HDI. 3000.
Probe: Curved array	C 5-2 40R.
Philips ATL	HDI. 5000.
Probe: Curved array	C 5-2 40R.
Philips EnVisor.	
Probe: Curved array	C 5-2.
G.E. Logiq.	
Probe: Curved array	C 5-2.

Voluson 730(GE Kretz) V 730, 3D.

Probe: Curved array AB 2-5.

3.11 Method:

Transabdominal ultrasound will be performed for 70-103 patients of Saudi population that come to ultrasound departments in 2019.

The examination will be performed with the patient lying comfortably in supine or on the right and left decubitus, arms beside the body.

Scanning should be in sagittal, transverse and oblique plane, including intercostals and subcostal spaces. Scanning should be done with slow rocking movement of the transducer to obtain best liver visualization.

CHAPTER FOUR

Results

Results

Table (4. 1) Evaluation of Solid Hepatic Masses

Solid Hepatic Masses	32	31%
different liver lesions	71	69%
Total	103	100%

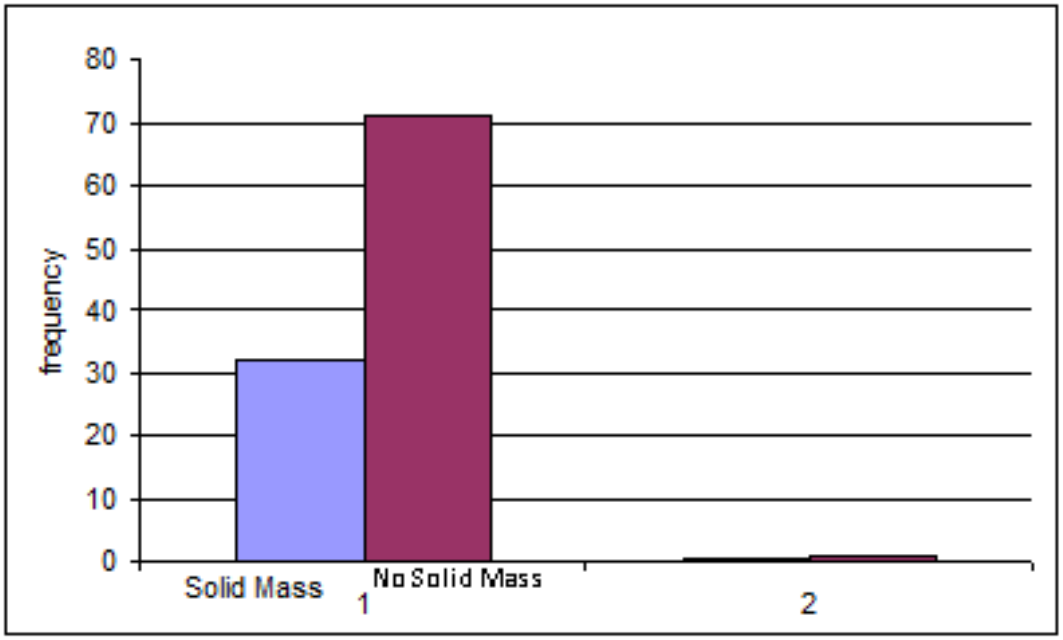

Figure (4. 1) Evaluation of Solid Hepatic Masses.

Table (4. 2) **Age -Solid Hepatic Masses**

Age (years)	**One -19**	**20-39**	**40-49**	**>50**
Total liver lesion	3	10	20	70
Solid Hepatic Mass	2	1	8	21

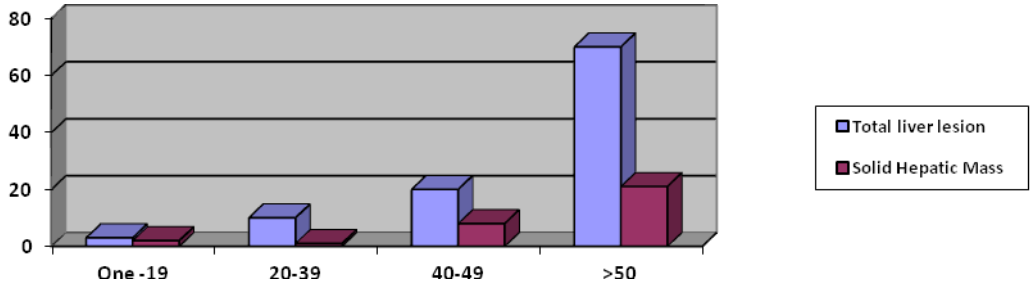

Figure (4. 2) Age-Solid Hepatic Masses

Table (4. 3) Gender Solid Hepatic Mass –Gender Ratio

	No solid Mass	Solid Hepatic Mass	Total
Female	30	14	44
Male	41	18	59
Total	71	32	103

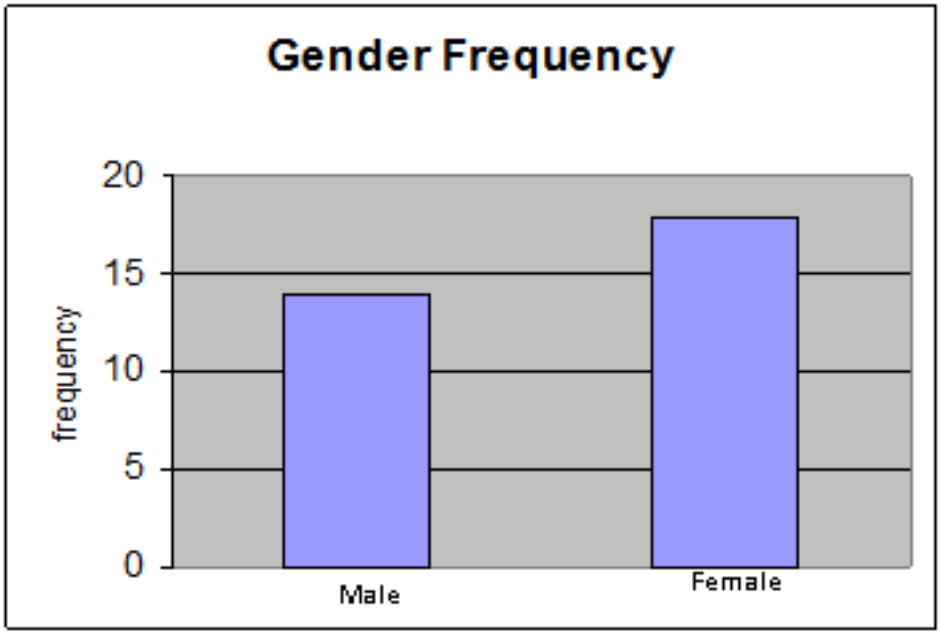

Figure (4. 3) Gender & Solid Hepatic Masses

Table (4. 4) Residence &Solid Hepatic Masses

Residence	No mass	Solid Hepatic Mass	Total
Taif	59	29	88
Jeddah	7	2	9
Makkah	5	1	6
Total	71	32	103

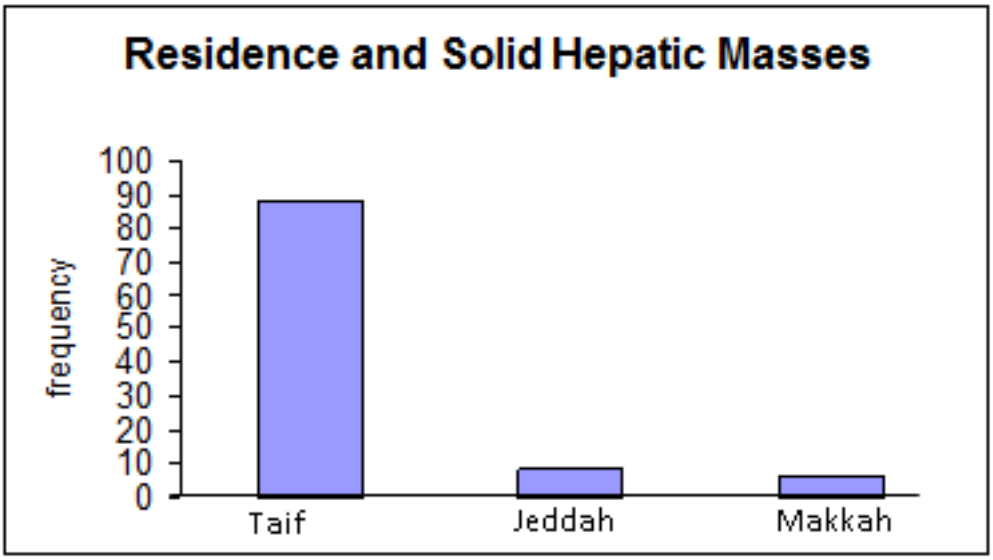

Figure (4. 4) Residence & Solid Hepatic Masses

Table (4. 5) Tribe & Solid Hepatic Masses

Tribe	No Mass	Solid Hepatic Mass	Total
Al-Gedaani	8	3	11
Al-Maliki	7	2	9
Al-Hrbi	9	4	13
Al-Zahrani	5	3	8
Al-Ghamidi	8	5	13
Al-Ghtani	5	3	8
Al-Shiheri	7	2	9
Al-Nagdi	5	2	7
Al-Roffae	3	2	5
Al-Sobaee	2	1	3
Others	12	5	17
Total	71	32	103

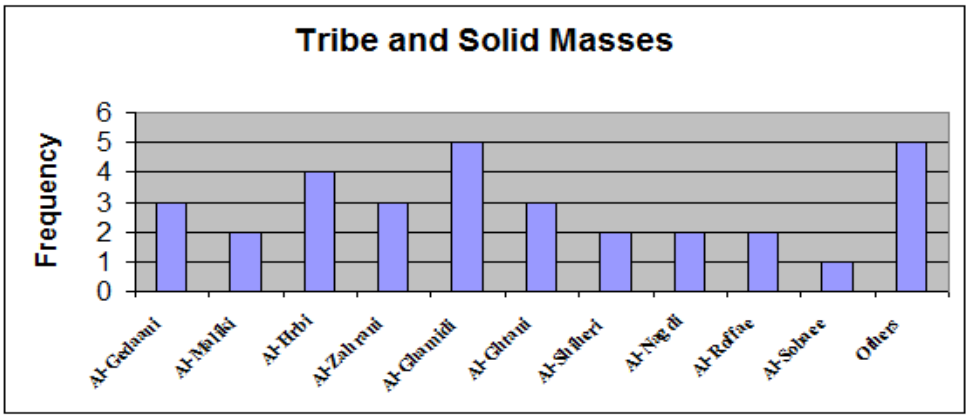

Figure (4. 5) Tribe & Solid Hepatic Masses

Table (4. 6) Occupation & Solid Hepatic Mass

Occupation	No mass	Solid hepatic mass	Total
Housewife	25	10	35
Employee	12	5	17
Labor	9	7	16
Child	5	2	7
Others	20	8	28
Total	71	32	103

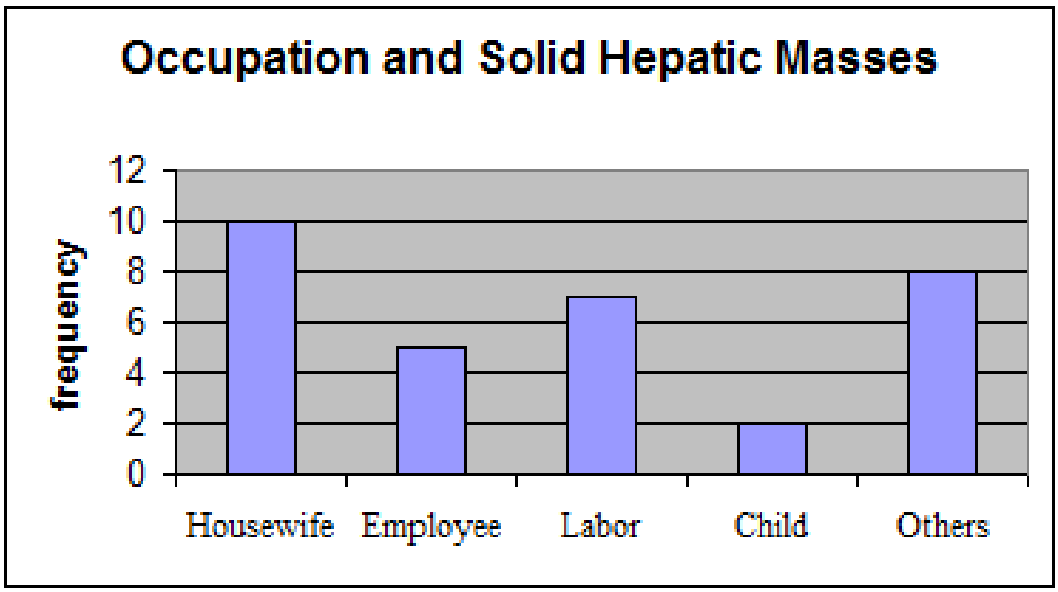

Figure (4. 6) Occupation & Solid Hepatic Masses

Table (4. 7) Solid Hepatic Masses & Abdominal Pain

	No solid hepatic Mass	Solid Hepatic Mass	Total
Abdominal pain	16	17	33
No Abdominal pain	55	15	70
Total	71	32	103

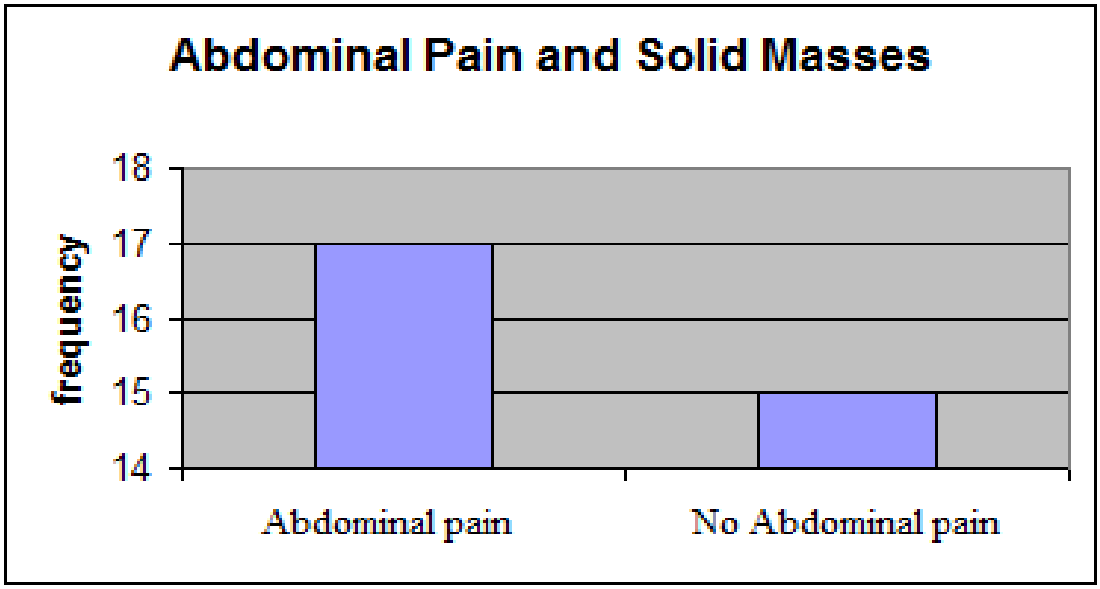

Figure (4. 7) Solid Hepatic Masses & Abdominal Pain

Table (4. 8) History of Fever & Solid Hepatic Mass

Patients	Without Mass	With Solid Hepatic Mass	Total
Experienced fever	6	8	14
No fever	65	24	89
Total	71	32	103

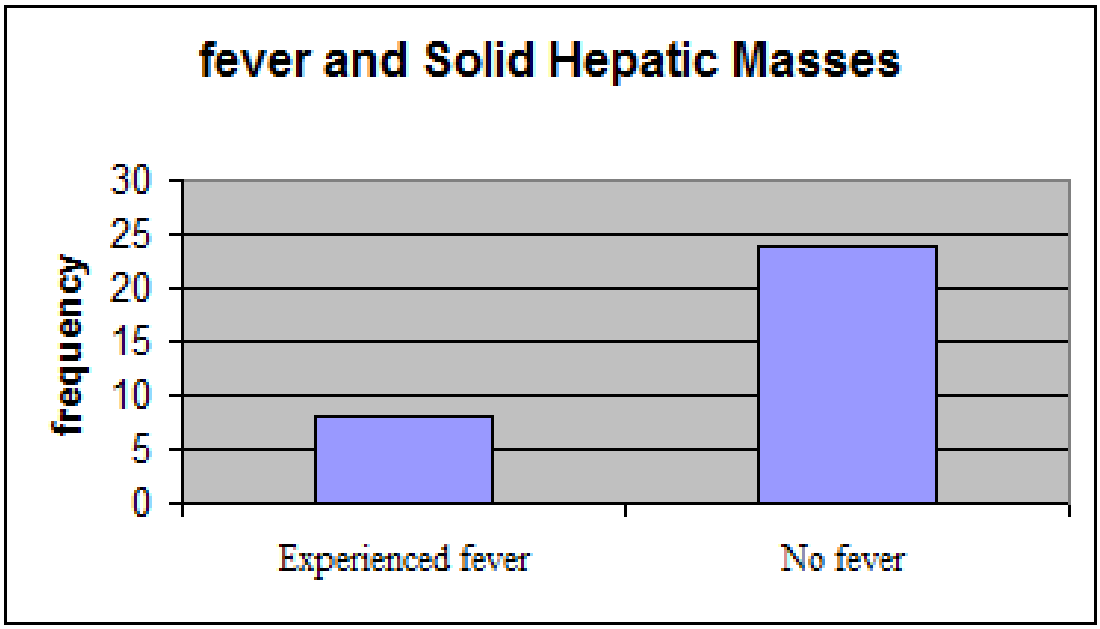

Figure (4. 8) History of Fever & Solid Hepatic Mass

Table (4. 9) Jaundice & Solid Hepatic Mass

Patients	Without Mass	With Solid Hepatic Mass	Total
Jaundice	9	7	16
No Jaundice	62	25	87
Total	71	32	103

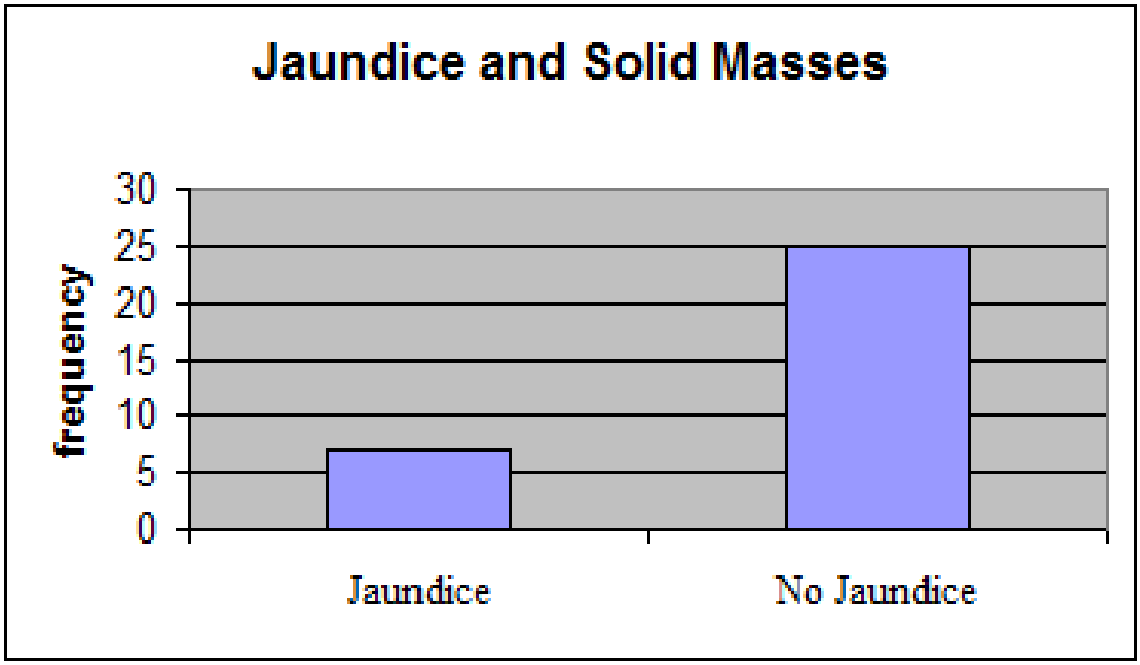

Figure (4. 9) Jaundice & Solid Hepatic Mass

Table (4. 10) Solid Hepatic Masses & Palpated Abdominal Pain

Patients	Without solid Mass	With Solid Hepatic Mass	Total
palpated abdominal mass	5	3	8
No palpated mass	66	29	95
Total	71	32	103

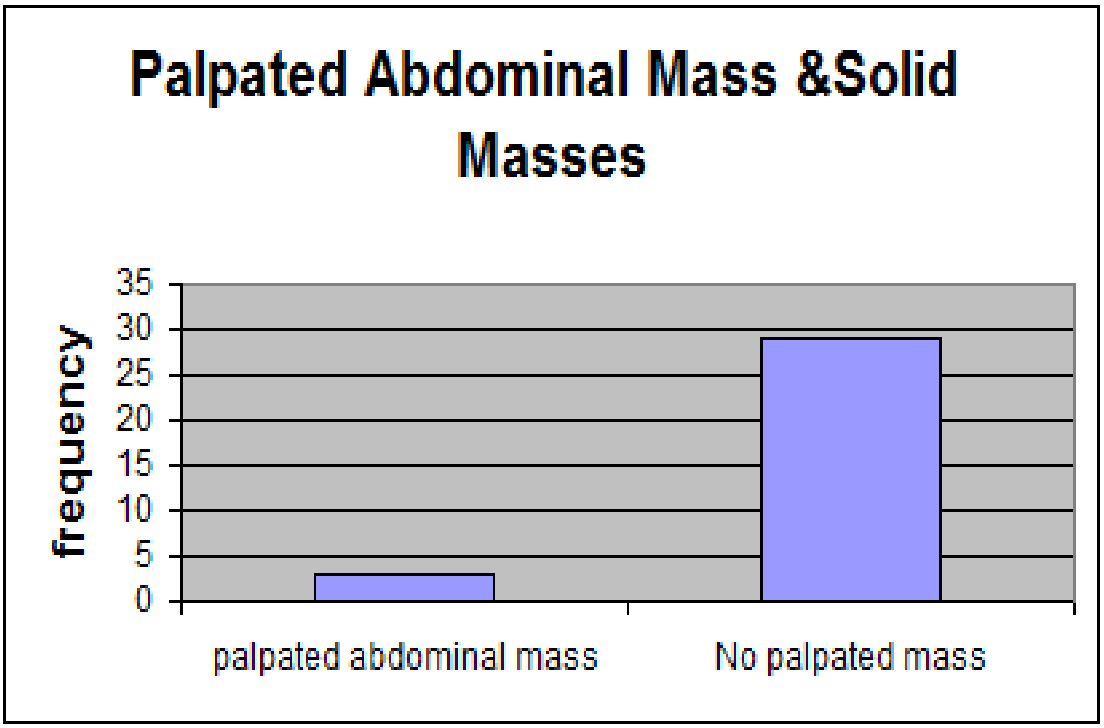

Figure (4. 10) Solid Hepatic Masses & Palpated Abdominal Pain

Table (4. 11) Solid Hepatic Masses frequencies.

Solid Hepatic Mass	Frequency
Liver Metastasis	14
Hepatocellular carcinoma	7
Hemangioma	4
focal nodular hyperplasia	3
Cholangiocarcinoma	2
Adenocarcinoma	2
Total	32

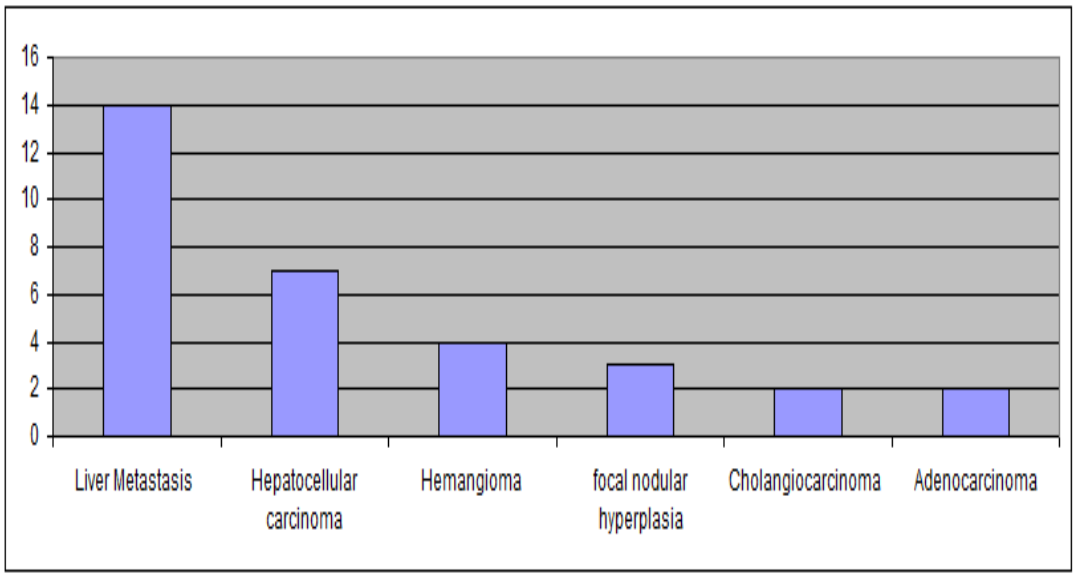

Figure (4. 11) Solid Hepatic Masses frequencies

T **Table (4. 12)** *U/S Accuracy & Solid Hepatic Masses*

Solid hepatic masses	Frequency	Diagnosis by U/S	Percentage
Liver Metastasis	14	9	64%
Hepatocellular carcinoma	7	1	14%
Hemangioma	4	4	100%
focal nodular hyperplasia	3	2	66.6%
Cholangiocarcinoma	2	1	50%
Adenocarcinoma	2	0	0%
Total	32	17	53%

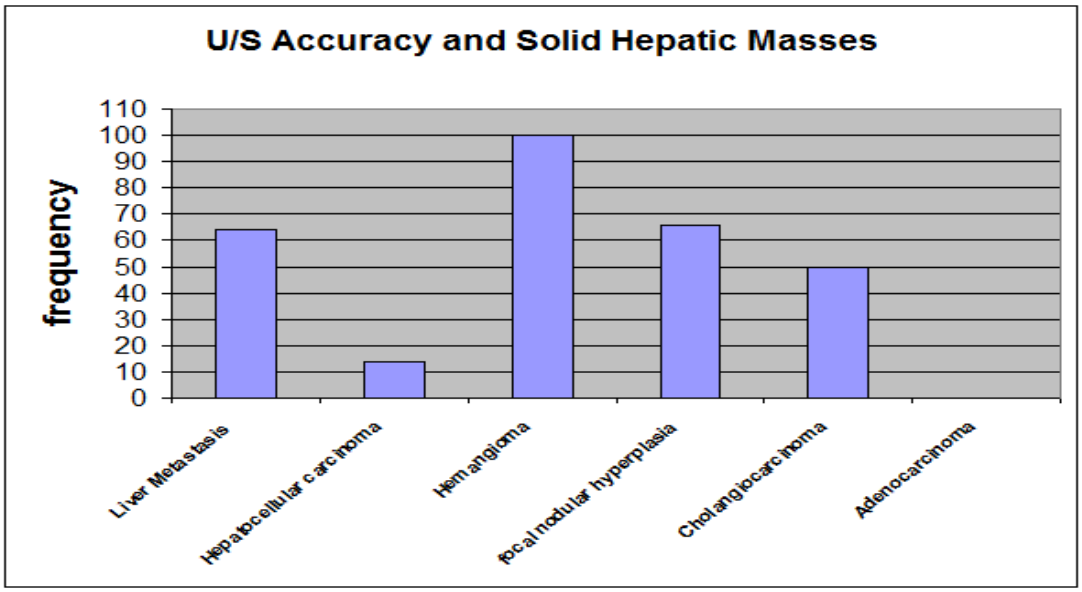

Figure (4. 12) *U/S Accuracy & Solid Hepatic Masses*

Chapter Five

Discussion, Conclusion and Recommendations

5.1 Discussion

There were 32 patients of solid hepatic masses, have been found out of 103 liver lesion. Through these cases U/S showed a good accuracy in diagnosis of solid hepatic masses, 17 cases were diagnosed by U/S (53%), which were found malignant and benign solid masses. These include liver metastasis, hepatocellular carcinoma, cholangiocarcinoma, adinocarcinoma, hemangioma, and focal nodular hyperplasia.

The study showed that the solid hepatic masses were more frequent through elder patients. There were 65.6% of the patients of solid hepatic masses who were over 50 years old. This may be due to the high incidence of malignant lesions at this age. The number of reported cases of malignancy increased after the age 50 Table (4.2).

The study showed no correlation between the solid hepatic masses and the gender. There were 56.3% males, and 43.7% females.

The area of the study is kingdom of Saudi Arabia (Taif) so that the study shows that Taif city has highest rate of lesion (90.6%), this may be due to big number of population in Taif and a few patients that came from another cities in K.S.A. to do investigation in Taif. The health facilities are available in most of kingdom cities.

The study revealed nearly equal distribution of cases of solid hepatic masses throughout the tribes that had been screened.

There was no correlation found between the solid hepatic masses and the occupation, although housewives were found more affected (31.2%).

The study showed a significant correlation between complains of upper abdominal pain and solid hepatic masses. Out of 32 patients of solid hepatic masses .There were 17 patients (53.1%) came with upper abdominal pain. Right upper abdominal pain is also a common combination to the liver masses, (Kathryn A.Gill, 2001).

The study revealed an association between complains of fever and solid hepatic masses. The fever is a common combination to the liver masses (Kathryn A.Gill, 2001).

The study showed weak association between the sign of palpated upper abdominal mass, and the solid hepatic mass. Out of 32 patients of solid hepatic masses, there were 3 patients (9.4%) came with palpated upper abdominal mass , Patients with primary liver malignancies may have any combination of palpable liver mass or enlargement (Kathryn Gill, 2001).

Out of 32 cases of solid hepatic masses there were 7 (21.8%) came with jaundice. The study revealed a correlation between the jaundice and solid hepatic masses.

The cases of solid hepatic masses that diagnosed in this study show that the accuracy of U/S in diagnosed liver metastases 64%, HCC 14%, hemangioma 100%, FNH 66.6% and cholangiocarcinoma 50%.

The study showed high accuracy of U/S in diagnosis hemangioma, metastases, FNH and cholangiocarcinoma so that there were low accuracy of U/S in diagnosis HCC and adenocarcinoma.

Most of hepatocellular carcinomas were single lesion, few were multiple or diffused. In metastases lesions, the majority were multiple, few of it found as a single lesion (Wetchsetnont D et al,.1984). The study showed that 78.5% of the cases of metastases lesions were multiple. The majority of the metastases lesions were involving the right lobe (50%). Hepatocellular carcinomas were found invade right lobe (71.4%),. Most of the metastases lesions appeared hypoechoic, while a heterogeneous pattern was recorded in most of the cases of hepatocellular carcinoma (42.8%).the study showed an association between the cirrhosis and hepatocelular carcinoma.

The study show that all cases of hemangioma were single well define hyperechoic and all were detected in right lobe. The study showed a correlation between hemangioma and abdominal pain.

The study show that focal nodular hyperplasia were appeared in different echoginicity

Cholangiocarcinoma was found invade the right lobe of the liver.

The study showed that the adenocarcinoma was detected as hyperechoic single lesions and all of them in left lobe.

5.2 Conclusion

U/S showed a good accuracy in diagnosis of solid hepatic masses, highly accuracy in diagnosis hemangioma, metatasis FNH and cholangiocarcinoma, and low accuracy in HCC and adenocarcinoma.

Also Study concluded that; complain of upper abdominal pain, was a common combination to the solid hepatic masses and there was a weak association between palpation of upper abdominal mass, and the solid masses.

5.3 Recommendations

The study showed that low accuracy in diagnosis of solid malignancy (HCC and adenocarcinoma). Study recommended further studies to develop U/S diagnosis in these lesions. Also there were high association between upper abdominal pain and solid hepatic masses. We recommended further studies on them to know the reasons of correlation.

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Appendices

Appendix "A"

Data Sheet

Tribe---------- ge----------

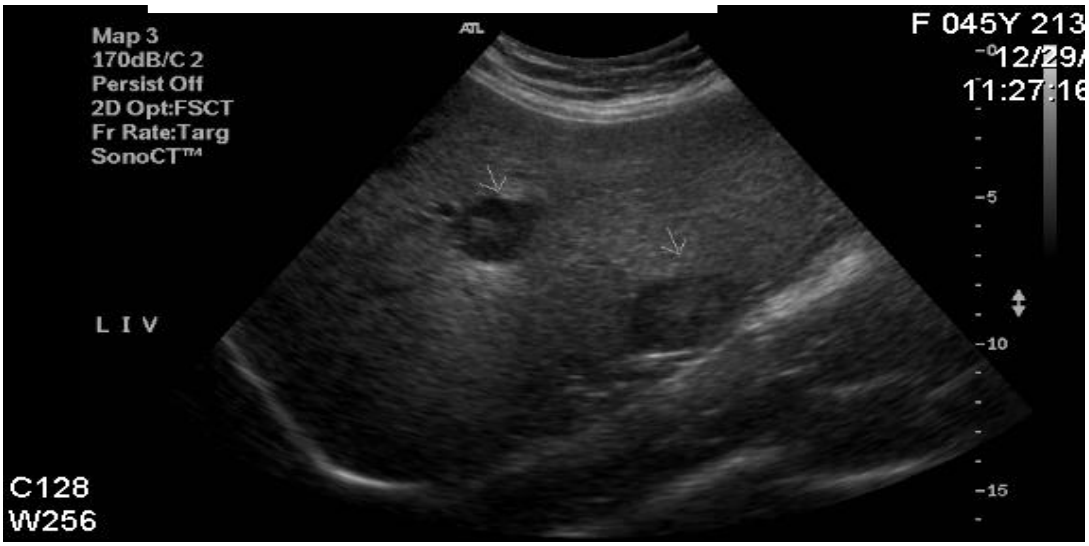
Residence --------- :cupation----------

Gender---------- Date ----------

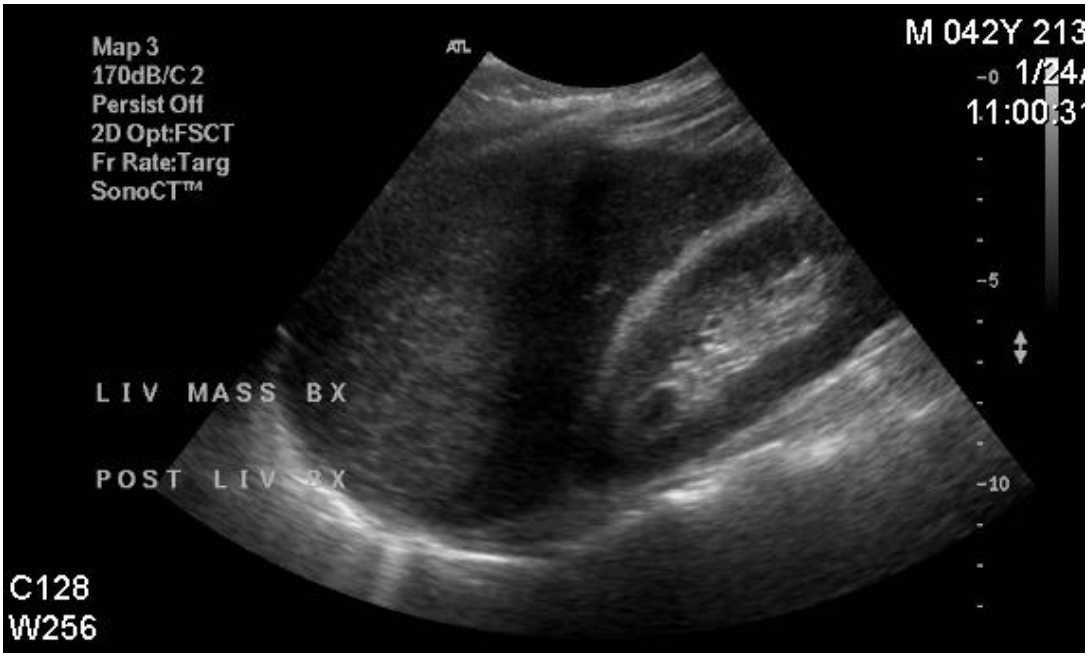
1. Clinical Finding:	**Yes**
Asymptomatic	
Jaundice.	
RUQ Pain.	
RUQ Mass.	
Fever.	
Hepatomegaly.	
Others.	

2.Ultrasound Findings :	
i. Single Solid hepatic mass.	
ii. Multiple Solid hepatic masses.	
iii. Hepatomegally.	
iv. Normal liver Parenchyma.	
v. Liver cirrhosis	
vi. **Others**	
3. Suggestion Ultrasound Diagnosis:	
4. Comment:	
5. Other investigations :	
6- Number of the Study:	

Appendices “B” Ultrasound images

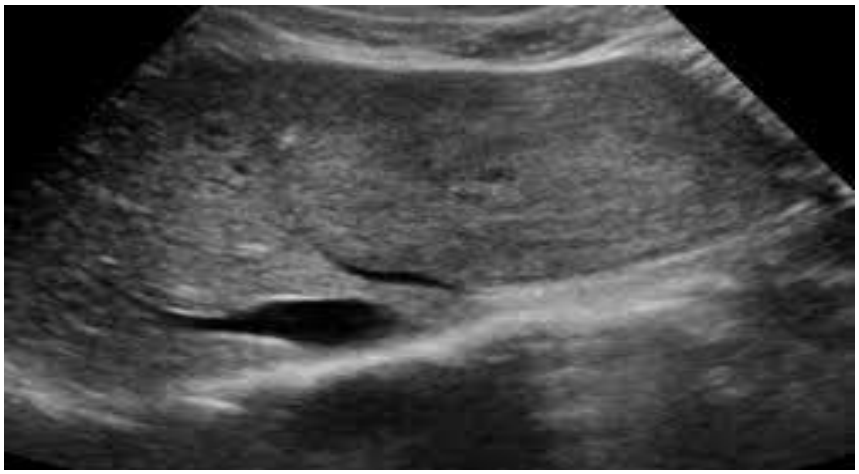


Appendix (1)U/S image of 55 years old male shows Multiple liver metastases.



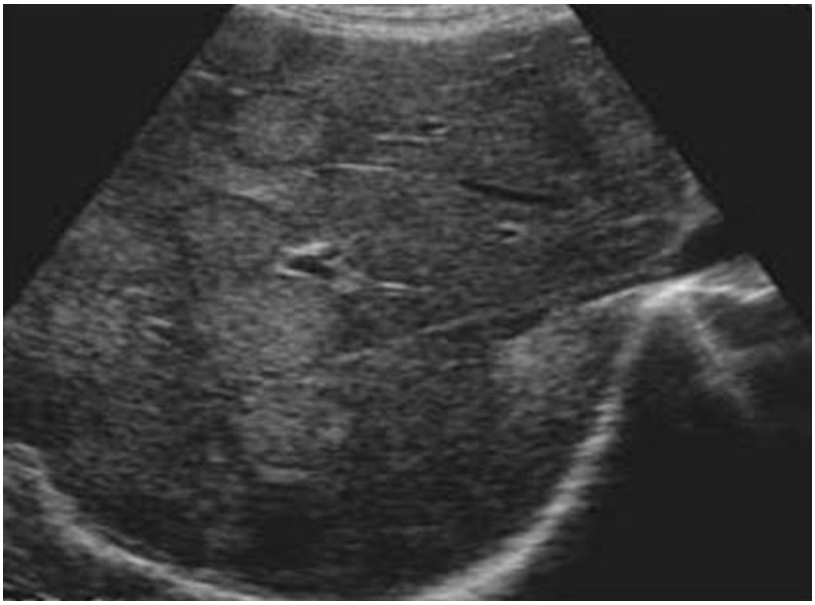
Appendix (2)U/S image of 59 years old male Single Mass Hepatocellular

Appendix (3)U/S image of 55 years old male Haemangioma



Appendix (4)U/S image of 35 years old female shows Focal Nodular Hyperplaisa

Appendix (5)U/S image of 35 years old male show**s** Cholangiocarcinoma



Appendix (6)U/S image of 42 years old female shows Adinocarcinom**a**)