INTRODUCTION

Chronic liver disease encompass many different causes, including mainly viral infection, non alcoholic fatty liver disease, alcohol abuse, primary sclerosing cholangitis, primary hemochromatosis and auto immune disease. Chronic liver disease can lead to hepatic fibrosis, cirrhosis, end stage liver disease, portal hypertenstion, and hepatocelluar carcinoma (HCC) and constitute an important cause of morbidity, mortality and health care costs **(Afdhal and Nunes, 2004).**

Because of the importance of the liver and because it is one of the most common locals for spread of malignant disease, the liver is the abdominal organ of greatest interest for the use of imaging studies **(Semelka et al., 2005).**

The accurate diagnosis and staging of hepatic fibrosis is crucial for prognosis and treatment of liver disease. The current gold standard, liver biopsy, cannot be used for population-based screening and has drawbacks if used for monitoring of disease progression or treatment success. Elastographic measurements, either ultrasonography-based or magnetic resonance based, and magnetic resonance diffusion weighted imaging show the most promise for accurate staging of hepatic fibrosis.

Most currently available imaging techniques can detect cirrhosis or significant fibrosis reasonably accurately, however, to date only magnetic resonance elastography has been able to stage fibrosis or diagnose mild disease. Ultrasongraphic elastography and magnetic resonance diffusion weighted appear next most promising **(European Association for the study of the liver, 2008)**

MRI has become an increasingly important imaging technique for the investigation of patients with chronic liver disease. Several morphologic criteria have been described for the diagnosis of cirrhosis **(Ito et al., 2003).**

However, most of these findings can be subjective, and limited in sensitivity and specificity **(Awaya et al., 2002).**

Recent advances in MRI have led to a growing interest in optimizing and applying functional MRI methods for assessment of liver disease. These methods include but are not limited to diffusion weighted imaging (DWI), perfusion-weighted MRI and MR elastography (MRE) and MR spectroscopy (MRS) **(Sandrin et al., 2003).**

Future directions, multi parametric imaging combining conventional sequences with some of the functional methods could enable a comprehensive examination of the liver, including information on the presence of fat, iron and fibrosis as well as HCC and portal hypertension and could represent the future of liver imaging, possibly replacing the liver biopsy, at least for follow up studies. This development would constitute an important clinical tool that could be used as a non invasive technique for prospective drug trails assessing antiviral and antifibrotic therapy **(Gish, 2005).**

Cirrhotic and non cirrhotic liver may contain a number of benign, pre malignant and malignant hepatocellular nodules.

The detection and characterization of focal liver diseases, significantly improved using tissue specific MR contrast media compared to unenhanced MRI, MRI with nonspecific contrast agents and contrast-enhanced CT evaluation **(Semelka, 2001).**

AIM OF THE WORK

Accordingly, the aim of the work is to evaluate the role of advanced MRI methods in assessment of chronic liver disease int eh light of other existing imaging techniques.

GROSS LIVER ANATOMY

The liver is the largest visceral organ in the body and is primarily situated in the right hypochondrium and epigastric region, extending into the left hypochondrium (or in the right upper quadrant, extending into the left upper quadrant) **(Healy, 2005).**

Normal liver volume, derived from postmortem studies of liver weight, ranges from 1–2.5 kg, and varies with gender, age and body mass. Liver weight is maximal in the fifth and sixth decades and subsequently declines quite rapidly (**Lomas, 2008)**.

Surfaces of the liver include:

- a **diaphragmatic surface** in the anterior, superior, and posterior directions;
- a **visceral surface** in the inferior direction

Diaphragmatic surface

The diaphragmatic surface of the liver, which is smooth and domed, lies against the inferior surface of the diaphragm Associated with it are the subphrenic and hepatorenal recesses:

- The **subphrenic recess** separates the diaphragmatic surface of the liver from the diaphragm and is divided, into right and left areas by the **falciform ligament**, a structure derived from the ventral mesentery in the embryo.

- The **hepatorenal recess** is a part of the peritoneal cavity on the right side between the liver and the right kidney and right suprarenal gland **(Fig. 1)**.

The subphrenic and hepatorenal recesses are continuous anteriorly **(Healy, 2005)**.

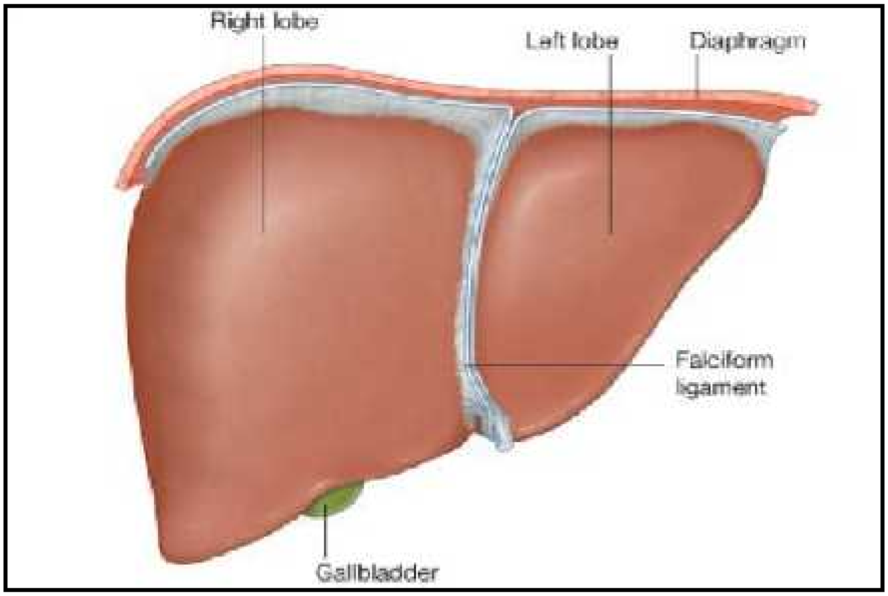

Fig. (1): Diaphragmatic surface of the liver **(Quoted from Healy, 2005)**.

Visceral surface

The visceral surface of the liver is covered with visceral peritoneum except in the fossa for the gallbladder and at the porta hepatis, the structures related to it include:

- The right anterior part of the stomach
- The superior part of the duodenum
- The lesser omentum
- The gallbladder
- The right colic flexure
- The right transverse colon
- The right kidney
- The right suprarenal gland (Fig. 2).

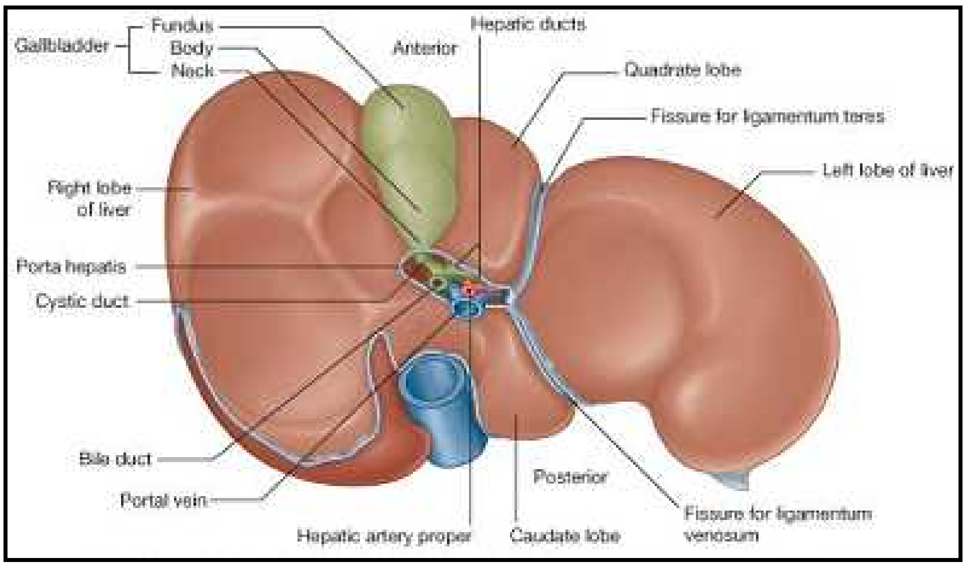

Fig. (2): Visceral surface of the liver **(Quoted from Healy, 2005).**

The porta hepatis serves as the point of entry into the liver for the hepatic arteries and the portal vein, and the exit point for the hepatic ducts (Fig. 2) **(Healy, 2005)**.

The superior surface of the liver is dome-shaped, follows the contours of the diaphragm and may extend anteriorly as far as the inferior edge of the liver. Its major landmark is the sagittal groove, a notch for the ligamentum teres (formerly the umbilical vein), which lies in the free edge of the falciform ligament **(Shahid, 2007)**.

The porta hepatis, the main feature of the inferior or visceral surface, is a central depression for the passage of the portal vein, hepatic artery and common bile duct.Anterior to this is the gallbladder fossa with the quadrate lobe to its left. Posteriorly the caudate lobe separates the porta from the inferior vena cava (IVC), several shallow impressions are found and related to the shape of adjacent organs, the most significant being that caused by the right kidney **(Lomas, 2008)**.

Associated ligaments

The liver is covered by peritoneum, except for the surfaces apposed to the inferior vena cava (IVC), the gallbladder fossa, and the posterosuperior aspect of the diaphragm (the bare area); it is attached to the diaphragm anterosuperiorly by the falciform ligament and posteriorly by the coronary ligaments.The liver is attached to the anterior abdominal wall by the falciform ligament and, except for a small area of the liver against the diaphragm (the bare area); the liver is almost completely surrounded by visceral peritoneum. Additional folds of peritoneum connect the liver to the stomach (hepatogastric ligament), the duodenum (hepatoduo-denal ligament), and the diaphragm (right and left triangular ligaments and anterior and posterior coronary ligaments) **(Lee et al., 2006)**.

The bare area of the liver is a part of the liver on the diaphragmatic surface where there is no intervening peritoneum between the liver and the diaphragm:

- The anterior boundary of the bare area is indicated by a reflection of peritoneum-the anterior coronary ligament.
- The posterior boundary of the bare area is indicated by a reflection of peritoneum-the posterior coronary ligament.
- Where the coronary ligaments come together laterally, they form the right and left triangular ligaments (Fig. 3) **(Healy, 2005)**.

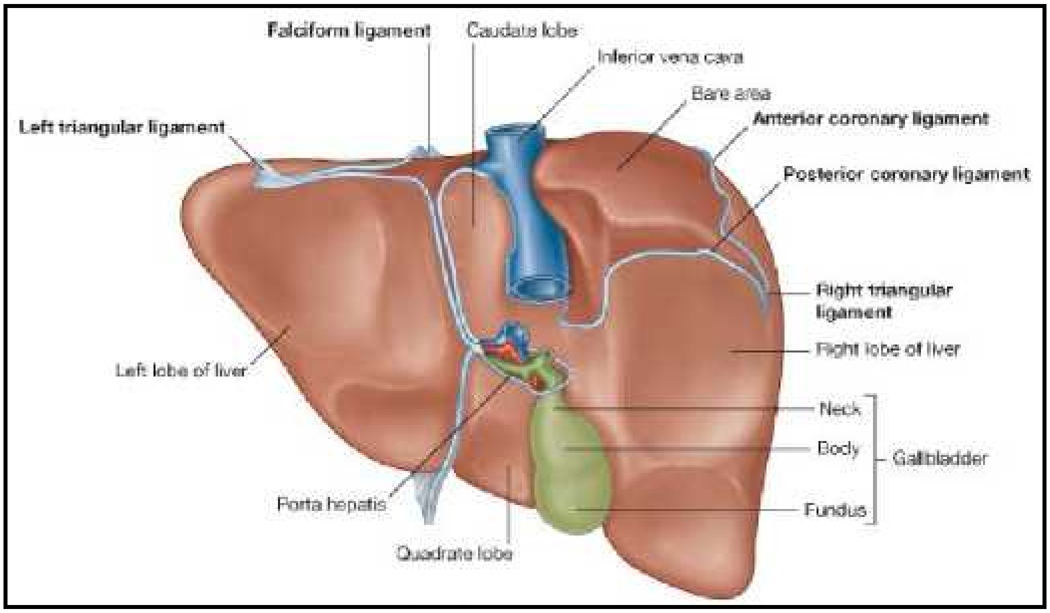

Fig. (3): Posterior view of the bare area of the liver and associated ligaments **(Quoted from Healy, 2005).**

The surface of the liver between the superior and inferior coronary ligaments is devoid of peritoneum and is referred to as the bare area, Because of the lack of peritoneum on this hepatic surface, peritoneal fluid cannot accumulate between the liver and the diaphragm in this area.

Fluid identified posterior to the liver in this region is located in the pleural space, in the superior recess of the retroperitoneum, or beneath the liver capsule. Laterally the superior and inferior coronary ligaments come together to form the left and right triangular ligaments **(Lee et al., 2006)**.

Lobation and Segmentation:

The liver is divided into right and left lobes by fossae for the gallbladder and the inferior vena cava. The **right lobe of liver** is the larger lobe. The quadrate and caudate lobes are described as arising from the right lobe of liver, but functionally are distinct:

- The **quadrate lobe** is visible on the upper part of the visceral surface of the liver and is bounded on the left by the fissure for ligamentum teres and on the right by the fossa for the gallbladder. Functionally it is related to the left lobe of the liver.
- The **caudate lobe** is visible on the lower part of the visceral surface of the liver and is bounded on the left by

the fissure for the ligamentum venosum and on the right by the groove for the inferior vena cava. Functionally, it is separate from the right and the left lobes of the liver **(Healy, 2005)**.

Riedel's lobe is an extension of the tip of the right lobe inferiorly to or beyond the costal margin, a diagnosis originally based on palpation. The term is misleading as it is not truly an accessory lobe and represents part of the normal spectrum of liver shape and size (**Lomas, 2008)**.

Three hepatic fissures help define the margins of the hepatic lobes and the major hepatic segments:

The interlobar fissure is an incomplete structure on the inferior margin of the liver that is oriented along a line passing through the gallbladder fossa inferiorly and the middle hepatic vein superiorly.Although it is well defined in some patients, it may be difficult to identify in others.The interlobar fissure forms the inferior margin of the border between the right and left hepatic lobes **(Healy, 2005)**.

The left intersegmental fissure (fissure for the ligamentum teres), which forms a well defined sagittally oriented cleft in the caudal aspect of the left hepatic lobe, divides the lobe into medial and lateral segments. The ligamentum teres, which is usually surrounded by a small amount of fat, runs through the fissure after entering it via the free margin of the falciform ligament **(Lee et al., 2006).**

A third fissure, the fissure for the ligamentum venosum, is oriented in a coronal or oblique plane between the posterior aspect of the left lateral hepatic segment and the anterior aspect of the caudate lobe. This fissure, which is in continuity with the intersegmental fissure, contains a portion of the gastrohepatic ligament (lesser omentum), seen on images obtained cephalad to the fissure for the ligamentum teres **(Lee et al., 2006).**

Based on external appearance, four lobes of the liver can be distinguished: right, left, quadrate, and caudate.

The falciform ligament divides the liver into the right and left anatomic lobes. The ligamentum venosum divides the caudate lobe from the left lobe **(Shahid, 2007)**.

An understanding of the segmental anatomy of the liver is critical for localization and appropriate management of hepatic neoplasms.

Confusion regarding hepatic segmental anatomy relates primarily to differences between American and European nomenclature; the system proposed by **Goldsmith and Woodburne (1957)** and used by most American radiologists does not provide a level of detail adequate for the surgical planning of subsegmental hepatic resections.

The stystem proposed by **Couinaud (1980)** and later modified provides the surgically relevant information and is easily applicable to cross-sectional imaging techniques (**Lee et al., 2006).**

In **Goldsmith et al. (1957)** described the right and left lobes and four segments: lateral, medial, anterior and posterior, each segment consists of two subsegments: superior and inferior.

Couinaud (1980) described eight segments (Fig. 4), one for the caudate lobe (segment I), three on the left (segments II, III and IV) and four on the right (segments V, VI, VII and VIII). The caudate lobe receives vessels both from the left and right branches of the portal vein and hepatic artery: its hepatic veins are independent and drain directly into the inferior vena cava (IVC). Recent studies suggest that the caudate lobe could be divided into a left part or Spiegel's lobe or segment I and the right part or segment IX or paracaval portion **(Shahid, 2007)**.

The modification by **Bismuth (1995)** divides segment IV into superior (IVa) and inferior (IVb) subsegments (Table 1) **(Lee et al., 2006).**

Table (1): Anatomic segments of the liver and corresponding nomenclature **(Lee et al., 2006).**

Anatomic Subsegment	Nomenclature		
	Couinaud	**Bismuth**	**Goldsmith and woodburne**
Caudate Lobe	I	I	Caudate Lobe
Left Lateral Superior Subsegment	II	II	Left Lateral Segment
Left Lateral Inferior subsegment	III	III	Left Lateral Segment
Left Medial Subsegment	IV	IVa, IVb	Left Medial Segment
Right Anterior Inferior Subsegment	V	V	Right Anterior Segment
Right Anterior Superior Subsegment	VIII	VIII	Right Anterior Segment
Right Posterior Inferior Subsegment	VI	VI	Right Posterior Segment
Right Posterior Superior Subsegment	VII	VII	Right Posterior Segment

Vascular Anatomy

Hepatic artery

The afferent vessels of the liver are the hepatic arteries and portal veins, which enter the liver at the hilum (porta hepatis) and branch in a recognizable pattern within the liver parenchyma. They are accompanied by corresponding branches of the bile ducts with which they form the portal triads. The hepatic veins are the efferent vessels of the liver. They run separately from the afferent vessels and drain directly into the IVC **(Lee et al., 2006).**

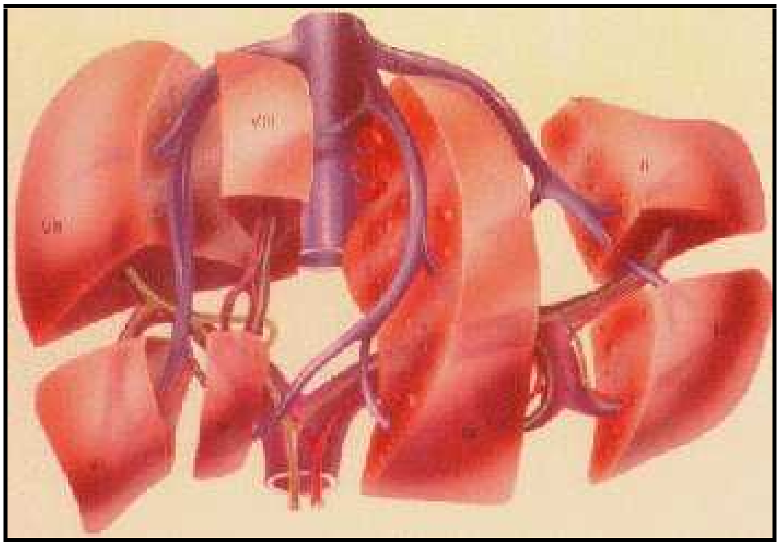

Fig. (4): Diagrammatic illustration of hepatic segmental anatomy. As described by Couinaud, the liver consists of eight functional hepatic segments, which are numbered in a clockwise direction when the liver is viewed from its ventral aspect. Each segment has a precise arterial supply, venous drainage, and biliary ductal drainage. The main hepatic veins run between hepatic segments **(Quoted from Lee et al., 2006)**.

The common hepatic artery is one of the three major branches of the coeliac axis. After giving off the gastroduodenal artery, the main hepatic artery continues and divides into the right and left hepatic arteries. Several variations of the normal hepatic arterial supply are of particular importance for radiologists and hepatic surgeons. Other rare variations include the common hepatic artery having a separate origin from the aorta **(Lomas, 2008).**

The hepatic artery provides only 25% to 30% of the afferent hepatic blood flow but carries approximately 50% of