

ULTRASOUND IN THE DIAGNOSIS OF LIVER CIRRHOSIS

THESIS

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TO
MY MOTHER
MY HUSBAND
AND
MY SON



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CONTENTS

	Page
INTRODUCTION AND AIM OF WORK	1
ANATOMY:	3
- Basic Anatomy of the Liver.	3
- Normal Gray-Scale Hepatic Echoanatomy.	23
- Echo-Doppler imaging of Hepatic Vasculature.	38
PHYSIOLOGICAL CONSIDERATIONS AND HEMODYNAMICS.	44
PATHOLOGY OF LIVER CIRRHOSIS.	51
MATERIAL AND METHODS.	80
RESULTS	96
ILLUSTRATIVE CASES.	115
DISCUSSION	153
SUMMARY AND CONCLUSION.	204
REFERENCES	212
ARABIC SUMMARY	

INTRODUCTION AND AIM OF WORK

INTRODUCTION AND AIM OF WORK

Liver cirrhosis has steadily gained recognition as a major health problem, principally because of the world-wide distribution of viral hepatitis and chronic hepatitis and the relationship of both to the increasing incidence of one of the world's most common malignant tumours, hepatocellular carcinoma.

The clinical diagnosis of liver cirrhosis often rests on such non-specific symptoms as anorexia, dyspepsia, malaise, and abdominal discomfort, while the specific signs of liver disease, such as jaundice may not occur until liver failure is advanced. Biochemical tests can be used to quantitate impaired liver function but are of limited use in the differential diagnosis of diffuse liver disease.

Although cirrhosis has been extensively studied by sonographic imaging techniques, the effectiveness of ultrasound in its diagnosis is still being evaluated.

The use of ultrasonography in the diagnosis of cirrhosis has acquired an increasing importance because of the technologic improvements of the equipment.

Currently there are three techniques available for sonographic study of the liver and its vasculature including; real time - gray scale echography, duplex Doppler imaging and color Doppler flow mapping. These techniques are capable of demonstrating valuable diagnostic information about parenchymal changes, gross morphological abnormalities, hemodynamic alterations and common complications of liver cirrhosis.

Thus, it is important for the radiologist to be aware of these broad spectrum manifestations of this disease process in order to confirm a clinical suspicion or suggest the diagnosis of cirrhosis.

The aim of this work is therefore to demonstrate the value of ultrasound imaging modalities and their contributions in diagnosis of liver cirrhosis and its complications.

Many ultrasound diagnostic parameters including both qualitative and quantitative informations will be studied to varify the diagnostic ability of gray-scale sonography in liver cirrhosis with an attempt to display the various sonographic findings of the disease.

In addition, applications of duplex Doppler sonography and color Doppler flow mapping in evaluation of hemodynamic alterations in this group of patients will be discussed emphasising the role of complementary sonographic imaging using gray scale sonography and Doppler techniques.

ANATOMY

Basic Anatomy of the Liver

Normal Gray-Scale Hepatic Echoanatomy

Echo-Doppler Imaging of Hepatic Vasculature

ANATOMY OF THE LIVER

Embryological aspects:

The liver develops by proliferation of cells from the blind ends of a Y-shaped diverticulum which grows from the foregut (The future duodenum) and invades the septum transversum. The cranial part of the septum transversum becomes the pericardium and diaphragm. The caudal part becomes the ventral mesogastrium into which the developing liver bud grows (Last, 1984; Auh *et al.*, 1984).

The portion of the ventral mesogastrium between the liver and the body wall becomes the falciform ligament of the adult whereas the part between the liver and the foregut becomes the lesser omentum. As a result of growth into the ventral mesogastrium and the septum transversum, the adult liver is nearly surrounded by peritoneum, but maintains contact with the diaphragm at the bare area (O'Rahilly, 1986).

The original diverticulum from the endoderm of the foregut becomes the bile duct, its Y-shaped bifurcation produces the right and left hepatic ducts. The hepatic ducts divide and re-divide until finally liver cells grow, from the blind end of each, into the blood in the vitelline veins. The embryological centre of each liver lobule is a bile duct, but this is not the histological centre of the adult lobule. The lobules of the embryo fuse and redevide by the growth of fibrous septa along the bile ducts which thus lie at the periphery of the adult lobule. The proliferating liver cells break through the venous walls and grow freely in the blood-stream; thus in the adult liver the blood in the sinusoids is in direct contact with liver cells (Last, 1984).

In prenatal life, the paired vitelline veins and the paired umbilical veins drain independently into the sinus venosus. As the liver develops it intercepts these veins and incorporates them into its sinusoids. The left umbilical vein maintains a direct communications with the sinus venosus via the ductus venosus. The right umbilical vein disappears early in prenatal development. The right and left vitelline veins develop into the portal vein. The left umbilical vein then drains into the left branch of the newly formed portal vein (Lafortune *et al.*, 1985).

The umbilical vein runs from the umbilicus in the free border of the falciform ligament to the porta hepatis, creating a furrow on the visceral surface of the liver. The left umbilical vein and the ductus venosus represent two segments of the major venous channel through which, about 50% of the placental blood is shunted directly to the fetal heart. After birth both become non-functional, occluded, and fibrotic (Fig. 1) forming the ligamentum teres and ligamentum venosum (Hollinshead and Rosse, 1985).

The fetal liver receives its blood flow from three sources. The hepatic artery, the portal vein, and the umbilical vein. The hepatic artery provides separate branches to the liver substance, as in adult, but the portal and umbilical veins join in the portal sinus which is often presented as a confluence, from which right and left portal veins and the ductus venosus arise (Rudolph, 1983).

Much of the placental blood is diverted from the liver parenchyma by the ductus venosus. This large venous channel is embedded in the liver and shunts blood from the umbilical vein to the proximal end of

the vitelline vein, from which the hepatic veins and the proximal segment of the inferior vena cava develop (Hollinshead and Rosse, 1985).

Gross Morphology and Relations of the Liver:

The liver is an intraperitoneal solid organ occupying most of the right upper quadrant of the abdomen and extending as a wedge to a variable degree across the midline (Cosgrove, 1985).

Surface Anatomy: (Fig. 2).

Following the curvature of the diaphragm, the liver rises to its highest point behind the fifth rib in the right mammary line. Its superior outline is continued to the median line in the plane of the xiphisternal junction and ends on the left just below the apex of the heart (the left fifth inter-space approximately 8 cm. from the median line). The inferior margin descends diagonally from that point leaving the diaphragm, passing the left costal margin at the junction of the costal cartilage of the eighth rib with that of the seventh, and in the median line, is about midway between the xiphoid process and the umbilicus. The inferior border of the liver reaches the right costal margin at the tip of the ninth costal cartilage and then follows the costal margin downward and posteriorly (Woodburne, 1978).

The liver changes in position with any postural changes that affects the diaphragm and it also follows the excursions of the diaphragm with ascent and descent of its lower edge during respiratory movements (O'Rahilly, 1986).

At birth the liver is relatively large and occupies nearly two-fifths of the abdomen. In infancy and childhood, the liver extends slightly below the costal margin. In thin subjects with narrow chests, the liver lies mainly or entirely to the right of the median plane. Its inferior margin slopes sharply downward and to the right and its lower right corner may reach the iliac crest. In plump subjects with broad chests, the liver extends much more to the left of the median plane and the slope of the inferior border is much less (O'Rahilly, 1986).

Liver Size:

The liver is the largest gland in the human body, weighing 1 to 2 kg in the adult. Individual variations in size and configuration are common. The adult liver measures approximately 10 to 12.5 cm in its anteroposterior dimension, 20 to 22.5 cm in its transverse diameter, and 15 to 17.5 cm vertically, near its lateral or right surface (Steinberg and Bernardino, 1987).

The adult liver weight contributes close to one-fortieth of the total body weight. Its relative size in newborn is considerably greater representing one-twentieth of the weight of the body at birth (Woodburne, 1978).

Shape, Surfaces and Borders:

The liver is an irregular, wedge-shaped organ on which only two surfaces and one margin can be defined distinctly: a diaphragmatic and a visceral surface and an inferior margin.