Multi-detector Computerized Tomography in pre-operative evaluation of living donors for liver transplantation

THESIS

Submitted in partial fulfillment of the degree of Medical doctorate (M.D) in Radiodignosis

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بسم الله الرحمن الرحيم

قَالُوا سُبْحَانَكَ لاَ عِلْمَ لَنَا
إِلاَّ مَا عَلَّمْتَنَا إِنَّكَ أَنتَ
الْعَلِيمُ الْحَكِيمُ

صدق الله العظيم

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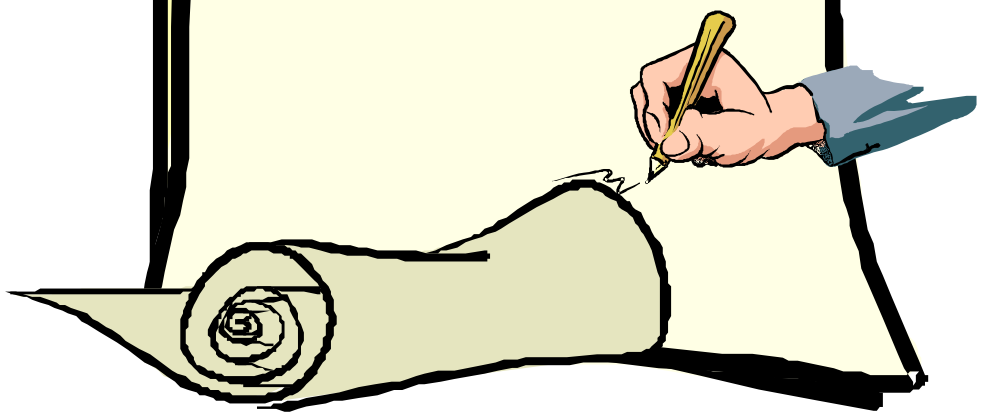
Yousef Ahmed Yousef

Dedication

To

My Beloved Father,
Mother, Brother, sisters
And My Wife



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List of Abbreviations:

AIDS	Acquired Immumo deficiency syndrome
CA	Celiac axis
CBD	Common bile duct
CHA	Common hepatic artery
cm	Centimeter
cm/s	Centimeter per second
CT	Computed tomography
ERCP	Endoscopic retrograde cholangiopancreatography
GB	Gall bladder
GDA	Gastro-duodenal artery
HBV	Hepatitis B virus
HCC	Hepatocelluar carcinoma
HCV	Hepatitis C virus
HIV	Human immuno deficiency virus
IVC	Inferior vena cava
IJV	Internal jugular vein
Kg	Kilogram
LGA	Left gastric artery
LPV	Left Portal vein
LDLT	Living donor liver transplantation
LHA	Left hepatic artery
MHV	Middle hepatic vein
MIP	Maximum intensity projection

List of Abbreviations (Cont.):

ml	milliliter
mm	millimeter
MPV	Main portal vein
MRA	Magnetic resonance angiography
MRC	Magnetic resonance cholangiography
MRI	Magnetic resonance imaging
MRV	Magentic resonance venography
PV	Portal vein
RHA	Right hepatic artery
RI	Resistive index
RPV	Right portal vein
SMV	Superior mesenteric vein
SPA	Splenic artery
TE	Echo time
٣ D	Three dimension
TR	Repetition time
U	Unit
US	Ultrasound
VR	Volume rendering

Introduction

Liver transplantation is a successful therapeutic option for patients with multiple irreversible acute and chronic liver diseases **(Redvanly et al., ١٩٩٥).**

Living donors liver transplantation has evolved into widely accepted therapeutic option to alleviate the critical shortage of cadaveric liver transplant organs **(Adam et al., ٢٠٠٣**). Living donors liver transplantation provides the advantage of performing an elective operation, having access to a graft in best condition, and lowering the likelihood of recipient death while waiting for a suitable organ **(Broelsch et al., ٢٠٠٢).**

In living donors liver transplantation, the donor undergoes partial hepatectomy for donation to a recipient, the right lobe of the liver is the lobe usually donated (**Pannu et al., ٢٠٠١).**

A critical issue of this procedure remains the risk it imposes on the healthy donors which is reflected in a post operative morbidity rate of ٢١% and a mortality rate of ٠.٥% **(Russo et al., ٢٠٠٤**). One reason for this drawback is seen in a high number of either unrecognized or during the operation, extemporaneously handled biliary and vascular variants (**Imamura et al., ٢٠٠٠).**

To reduce such risk to a minimum and also to ensure optimal surgical results in the recipient, the donation candidate have to undergo an extensive stepwise – fashioned evaluation of the condition of the transplantation candidate and that of the potential donor **(Schroeder et al., ٢٠٠٦)**

Living donors for liver transplantation (LDLT) is a radiology intensive process that involves the performance of preoperative assessment of potential liver donors to exclude focal lesions, ensure

adequate liver volume, evaluate for fatty infiltration of the liver, and determine hepatic vascular anatomy (**David et al.,٢٠٠٥)**.

A primary goal of imaging living potential right lobe liver donors is to determine the suitability of the donor liver for transplantation. The ideal liver graft has a sufficiently large right lobe relative to the body mass of the graft recipient, minimal hepatic steatosis, and favorable vascular anatomy (**Benjamin et al., ٢٠٠٧**).

With the development of the new multidetector computed tomographic (CT) techniques, the radiologist plays a relevant role, providing, with a minimally invasive procedure, valuable information that will be useful in choosing the most suitable candidate. Knowledge of the volumes of the entire liver and of both of its lobes required prior to planning for surgery can be measured by using computed tomographic (CT) volumetric techniques **(Arne** ,٢٠٠٦).

Anatomic variations of the vasculature are common, well recognized, and easily depicted with CT angiography. Since certain anomalies may result in modification of the planned surgical procedure, it is important to document variations in arterial and venous anatomy that may occur in donors, particularly those variations that traverse the anticipated hepatectomy plane (**Ana, ٢٠٠٥**). Inadvertent damage to a major vessel may cause ischemic injury to the graft or to the donor liver (**Guiney et al., ٢٠٠٣**).

Aim of the work:

To evaluate the rule of multi-detector CT as a comprehensive minimally invasive tool in the assessment of the hepatic morphology (parenchymal evaluation), volumetry, vascular mapping of the liver in potential living donor for liver transplantation.

Normal Anatomy of the Liver

Gross Morphology:

The liver is the largest gland in the body. It has considerable individual variations in size and shape. It is situated in the cranial and right parts of the abdominal cavity occupying most of the right hypochondrium, epigastrium and not uncommonly extending to the left hypochondrium. It has two surfaces: diaphragmatic and visceral surfaces. The diaphragmatic surface is dome shaped and conforms to the diaphragm. It is divided into superior, anterior, right and posterior portions or surfaces ***(Lencioni and Bratolozzi, ٢٠٠٣).***

A- <u>Diaphragmatic surface</u>: *(Blumgartr and Hamm, ٢٠٠٠).*

١-*The superior portion:* It is completely covered by peritoneum except for a small triangular area where the two layers of the falciform ligament diverge. The major landmark of the superior surface is the sagittal groove which is a deep notch providing access for the ligamentum teres that runs in the free edge of the falciform ligament. This portion is related through the diaphragm to the base of the right lung, pericardium and the heart on its extreme left side.

٢-*The anterior portion:* It is completely covered by peritoneum except along the line of attachment of the falciform ligament. It lies against the diaphragm, the costal margin, and the xiphoid process and the abdominal wall.

٣-***The right portion:*** It is covered by peritoneum and merges with the other three parts of the diaphragmatic surface and continues down to the right margin that separates it from the visceral surface.

٤-***The posterior portion:*** A large part of this posterior portion of the diaphragmatic surface is not covered by peritoneum and this uncovered area is frequently called the bare area that is bounded by the superior and inferior reflections of the coronary ligament. This surface is broad and rounded on the right but narrow on the left. To the right of vena cava and partially on the visceral is a small triangular depressed area that is named supra-renal impression for the suprarenal gland and to the left of the ductus venosus fossa there is oesophageal groove for antrum cardium of the esophagus**.**

B- <u>The visceral or inferior surface</u>:

It is facing downward, backward and to the left, and it is covered by visceral peritoneum except at the porta hepatis, fissure for ligamentum teres and fossa for the gall bladder. This surface bears the imprint of the adjacent viscera and this surface is closely related to the pylorus, the duodenum, the gall bladder, the right colon, the hepatic flexure, the right third of the transverse colon, the right kidney and the right supra-renal gland ***(Blumgartr and Hamm, ٢٠٠٠).***

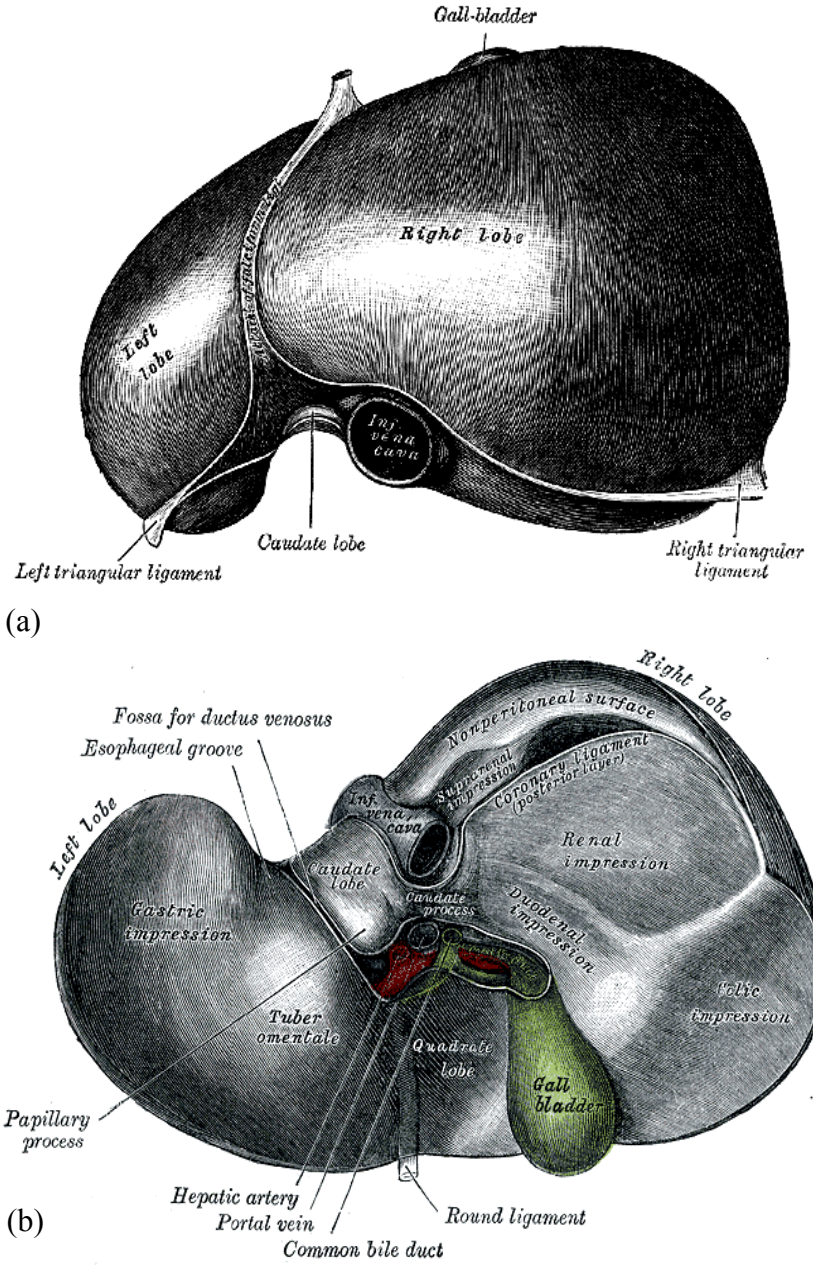

Figure (١): (a): The superior, anterior and right lateral surfaces of the liver (**b):** The inferior surface of the liver ***(Quoted from Williams, ١٩٩٩).***