Role of MRI in Detecting and Characterizing Small Hepatic Focal Lesions

Thesis

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List of Abbreviations

Abb.	Full term
HFL	*Hepatic focal lesion*
MRI	*Magnetic resonance imaging*
US	*Ultrasound*
CT	*Computed tomography*
DWI	*Diffusion weighted imaging*
WI	*Weighted imaging*
FNH	*Focal nodular hyperplasia*
HCC	*Hepatocellular carcinoma*
Gd	*Gadolinium*
SS SE-EPI	*Single-shot spin echo echoplanar imaging*
ICC	*Intrahepatic cholangiocarcinoma*

INTRODUCTION

Despite the recent advances in liver imaging, the detection and characterization of small hepatic focal lesions is still a real challenge. Particularly in cancer patients where the classification of a small HFL as benign or malignant and thus precise tumor staging is critical for optimal treatment planning ***(Holzapfel et al., 2010)***.

Also with the widespread of cross-sectional imaging, a growth of incidentally detected hepatic focal lesions (HFL) has been observed. Hence, maximizing the accuracy of imaging to have a reliable detection and characterization of HFLs is critical for optimal patient management and to avoid unnecessary biopsies, which may result in post-procedural complications ***(Matos et al., 2015).***

Several studies have investigated the clinical importance of small HFLs that could not be adequately characterized by CT. These studies reveal that in 12.7–50% of cancer patients small hepatic lesions are found. Although most of small HFLs discovered incidentally or in patients with known malignancy are benign, 5–27.5% of those lesions eventually found to be malignant. These numbers maximize the importance of a correct characterization of small HFLs, particularly, as gaining a histopathological verification of small lesions by biopsy is invasive as well as is technically challenging ***(Holzapfel et al., 2010).***

Magnetic resonance imaging (MRI) plays a key role in management of small HFLs. It uses a radiation-free technique and a relatively safe contrast media to obtain a non-invasive correct characterization of HFLs. Thus MRI is capable of providing comprehensive and highly accurate diagnostic information, with the additional advantage of lack of harmful ionizing radiation. These properties make MRI the cornerstone of the noninvasive assessment of small HFLs ***(Matos et al., 2015).***

AIM OF THE WORK

The specific aim of our study was to explore the effectiveness, and hence the clinical utility, of MRI detection and characterization of small focal hepatic lesions either only discovered on MRI or as a further work up of CT/US-indeterminate lesions.

Chapter 1

ANATOMY

The liver is the second largest organ in the human body. It is located between the right intercostal space and the right subcostal margin. The use of standardized segmental anatomy helps to accurately localize focal lesions which are crucial in treatment planning process. Historically, there have been several systems that use different terminology to identify liver anatomy until the couinaude's classification system has evolved. Couinaud's system of hepatic nomenclature provides the anatomic basis for modern hepatic surgical resections. In this system, the liver segments are defined by their relationships to vascular structures, hepatic ligaments, and the gallbladder ***(Smith et al., 1998).***

The liver is divided into right and left lobes or hemilivers by the plane of middle hepatic vein. This plane runs from the left of the IVC to the left of the gallbladder fossa (Cantlie's line). The right lobe is divided into anterior and posterior sectors by the plane of the right hepatic vein. The left lobe is divided into medial and lateral sectors by an oblique plane connecting the left hepatic vein and the falciform ligament. The liver is divided into upper and lower segments at the level of main portal vein (MPV) bifurcation **(Figure 1 and table 1)** ***(Chernyak et al., 2018).***

Table (1): Showing the different segments of the liver

Segment I	Caudate
Segment II	Superior left lateral sector/section
Segment III	Inferior left lateral sector/section
Segment Iva	Superior left medial sector/section
Segment IVb	Inferior left medial sector/section
Segment V	Inferior right anterior sector/section
Segment VI	Inferior right posterior sector/section
Segment VII	Superior right posterior sector/section
Segment VIII	Superior right anterior sector/section

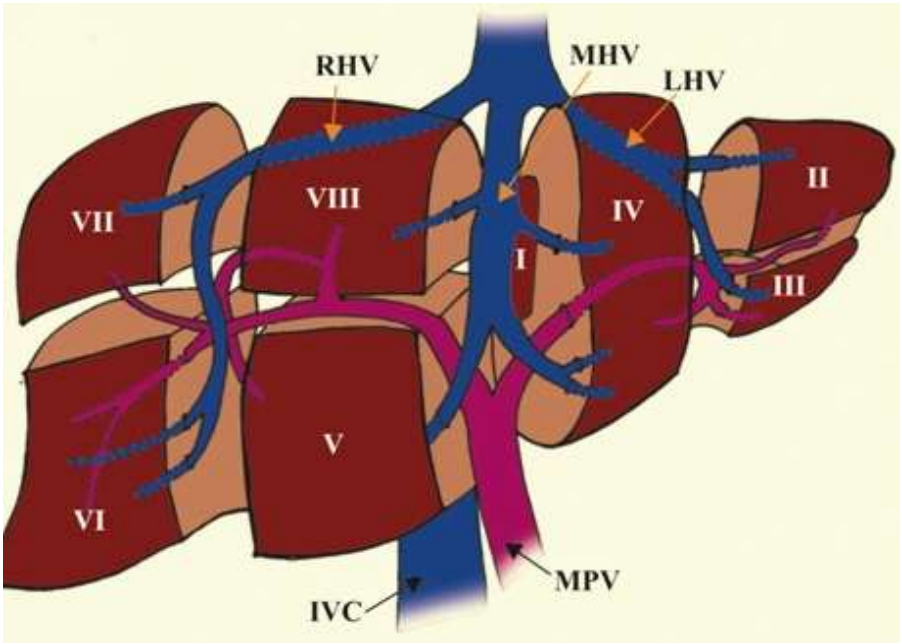

Figure (1-2): A diagram of the liver showing different segments according to couinaud's classification ***(Quoted from Iqbal, 2017).***

Segment I: Caudate lobe:

Bounded anteriorly and medially by the fissure for ligamentum venosum.

Segment II: Superior segment of the left lateral sector/section:

Bounded medially by falciform ligament and inferiorly by plane of MPV.

Segment III: Inferior segment of left lateral sector/section:

Bounded medially by the falciform ligament and superiorly by the plane of the MPV bifurcation, also referred to as lateral anterior sector.

Segment IV: Left medial sector/section:

Bounded laterally by falciform ligament and medially by Cantlie's line.

- IVa: Superior to the MPV bifurcation.
- IVb: Inferior to the MPV bifurcation.

Segment V: Inferior segment of the right anterior sector/section:

Bounded anteriorly by the gallbladder fossa and posteriorly by the plane of the right hepatic vein, superiorly bounded by the plane of MPV bifurcation.

Segment VI: Inferior segment of the right posterior sector/section:

Bounded anteriorly by plane of the right hepatic vein and superiorly by the plane of the MPV bifurcation.

Segment VII: Superior segment of the right posterior sector/section:

Bounded anteriorly by the plane of the right hepatic vein and inferiorly by the plane of the MPV bifurcation.

Segment VIII: Superior segment of the right anterior sector/section:

Bounded anteriorly by the plane of the gallbladder fossa and middle hepatic vein, bounded posteriorly by the plane of the right hepatic vein and inferiorly by the plane of the MPV bifurcation ***(Chernyak et al., 2018).***