



The Role of MRI in Characterization of Benign Hepatic Focal Lesions

Thesis

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

قالوا

لسبحانك لا علم لنا
إلا ما علمتنا إنك أنت
العليم العظيم

صدق الله العظيم

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List of Abbreviations

FLL	Focal Liver Lesions
MRI	Magnetic Resonance Imaging
2D	Two Dimensions
3D	Three Dimentions
GRE	Gradient Recalled Echo
VIBE	Volumetric Interpolated Breath Hold Examination
IP	In Phase
OP	Out Of Phase
DWI	Diffusion Weighted Images
ADC	Apparent Diffusion Coefficient
CSF	Cerebro-Spinal Fluid
CT	Computed Tomography
Gd-DTPA	Gadolinium Di ethylene Tri amine Penta- Acetic Acid
HCC	Hepatocellular Carcinoma
SPIO	Super Paramagnetic Iron Oxide
TE	Time Echo
TR	Time Repetition
U/S	Ultrasonography
FNH	Focal Nodular Hyperplasia

List of Abbreviations

HCA	Hepatocellular Adenoma
PLAS	Pyogenic Liver Abscesses
CHFC	Ciliated Hepatic Foregut Cyst
BCA	Biliary Cyst Adenoma
HAE	Hepatic Alveolar Echinococcosis
ROI	Region of Interest
NEX	Number of Excitation
eTHRIVE	Enhanced T1 High Resolution Isotropic Volume Examination
BDH	Bile Duct Hamartomas

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Introduction

Nowadays, magnetic resonance plays a key role in management of liver lesions, using a radiation-free technique and a safe contrast agent profile (*Bartolozzi et al., 2012*).

The heightened soft-tissue resolution and sensitivity to intravenous contrast agents provided by magnetic resonance imaging (MRI) makes it an invaluable problem-solving tool for fully characterizing focal liver lesions (FLL) (*Acay and Bayramoglu, 2014*).

The majority of FLL arising in noncirrhotic liver are benign, even in patients with known extra-hepatic malignancy. Cysts, hemangiomas, focal nodular hyperplasias (FNH), and hepatocellular adenomas (HCA) are the most commonly encountered benign lesions (*Nault, Bioulac-Sage and Zucman-Rossi, 2013*).

A tremendous development of new imaging techniques has taken place during these last years. Maximizing accuracy of imaging in the context of FLL is paramount in avoiding unnecessary biopsies, which may result in post-procedural complications up to 6.4%, and mortality up to 0.1% (*Strassburg and Manns, 2006*).

Definitive characterization by magnetic resonance (MR) imaging may alleviate patient anxiety, drastically alter management in someone, and help avoid unnecessary biopsy or costly follow-up imaging. MR imaging offers important advantages over computed tomography (CT), such as the lack of ionizing radiation and improved soft tissue contrast (*Cogley and Miller, 2014*).

MRI can be used as the primary imaging examination for patients who cannot receive iodinated IV contrast material and patients in whom the liver is the only organ of concern. MRI is useful as a problem solving technique when other imaging studies show equivocal findings (*Lee et al., 2006*).

The American College of Radiology Appropriateness Criteria assigns the highest rating to MR imaging without and with contrast for characterization of indeterminate liver lesions, regardless of whether the patient is otherwise healthy, has liver disease, or has a known extra hepatic malignancy (*Nelson et al., 2014*).

With the current state of the art technology, magnets of 1.5 Tesla (T) and 3T field strength are considered the standard of reference in providing high-quality and consistent MR images. Giant advances in MRI have been achieved in the last decade in regards to each of the

following: hardware (high-performance gradient coils and phased-array surface coils), software (new sequence design and new parallel imaging technology and acceleration techniques), and contrast agents (hepatocyte-specific agents) have made a major impact on imaging of the liver (*Ramalho et al., 2007*).

The state of the art MRI protocols rely on a combination of fat-suppressed and non-fat-suppressed T2-weighted images (T2-WI), in- and opposed-phase (IP/OP) T1-WI and dynamic pre- and post-contrast fat-suppressed T1-WI (*Fowler, Brown and Narra, 2011*).

The detection and characterization of focal hepatic lesions continues to be a challenge. Magnetic resonance (MR) imaging plays an important role in the evaluation of a wide range of benign and malignant focal hepatic lesions. The use of three-dimensional (3D) gradient-recalled-echo (GRE) sequences such as volumetric interpolated breath-hold examination (VIBE) has improved MR imaging by providing dynamic contrast material-enhanced thin-section images with fat saturation and a high signal-to-noise ratio (*Rofsky et al., 1999*).

Contrast-enhanced 3D GRE MR imaging demonstrates characteristic enhancement patterns that can be helpful in the diagnosis of various focal hepatic lesions.

These enhancement patterns are seen during specific phases of imaging and include arterial phase enhancement, delayed phase enhancement, peripheral washout, ring enhancement, nodule-within-a-nodule enhancement, true central scar, pseudocentral scar, and pseudocapsule (*Hamm et al., 1994*).

Recently, diffusion-weighted imaging (DWI) sequences have been shown to be an emerging contributor for liver MRI and are being incorporated in most abdominal MR protocols (*Galea, Cantisani and Taouli, 2013*).

The underlying principle is that different biologic tissues exhibit varying levels of restricted water diffusion, dependent on such factors as tissue cellularity and cell membrane integrity (*Koh and Collins, 2007*).



Aim of the Work

The aim of this work is to study the role of MRI in characterization of benign hepatic focal lesions.