Quantitative Liver MR Imaging with DWI Sequence and Normalized ADC in Diagnosis and Staging of Hepatitis C Virus Liver Fibrosis and Cirrhosis, A Comparative Study with Transient Elastography (FibroScan) In Egyptian Patients

Thesis

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Presented by

Hesham Salah Mohammed Rashad

M. Sc of Radiodiagnosis

Faculty of Medicine- Ain Shams University

Supervised by

Prof. Dr Amany Emad El Din Rady

Professor of Radiodiagnosis

Faculty of Medicine - Ain Shams University

Prof. Dr Eman Mahmoud Fathi Barakat

Professor of Tropical medicine

Faculty of Medicine - Ain Shams University

Prof. Dr Remon Zaher Elia

Assistant Professor of Radiodiagnosis

Faculty of Medicine - Ain Shams University

Dr. Essam Mohamed Abdel Hafez

Lecturer of Radiodiagnosis

Faculty of Medicine - Ain Shams University

Faculty of Medicine

Ain Shams University

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بسم الله الرحمن الرحيم

قالوا

سبحانك لا علم لنا
إلا ما علمتنا إنك أنت
العليم الحكيم

صدق الله العظيم

سورة البقرة الأية: ٣٢

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Hesham Salah M. Rashad

Deduction

To the man who taught me all

And the women who gave me all

Father and Mother how can I ever repay you

I am indebted to great wife, my daughter for their endless and continuous help and support

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List of Abbreviations

Abb.	Meaning
ADC	Apparent diffusion coefficient.
CHA	Common hepatic artery.
CT	Computed tomography.
DW	Diffusion weighted.
DWI	Diffusion weighted imaging.
EPI	Echo planner imaging.
FOV	Field of view.
FSE	Fast spin echo.
HA	Hepatic artery
HCC	Hepatocellular carcinoma
HCSs	Hepatic cells stellates
HCV	Hepatitis C virus
IVC	Inferior vena cava
MIP	Maximum intensity projection.
MRI	Magnetic resonance imaging.
ms	millisecond
NEX	Number of excitations.
PACS	Picture archiving and communication system

List of Abbreviations

Abb.	Meaning
PV	Portal vein
ROI	Regions of interest
s/mm^2	Second per square millimeter.
SE	Spin echo.
SI	Signal intensity.
SNR	Signal to noise ratio.
T	Tesla.
TE	Echo Time
TR	Repetition time
TSE	Turbo spin echo.
US	Ultrasound
WI	Weighted images

INTRODUCTION

Hepatic fibrosis is a wound-healing response to multiple types of chronic liver disease and injury. liver fibrosis in chronic liver disease results from excessive accumulation of an extracellular matrix in response to chronic inflammation ***(Taouli et al., 2007)*.**

Beyond being a marker of hepatic injury, fibrosis appears to play a direct role in the pathogenesis of cirrhosis, hepatocellular carcinoma, and portal venous hypertension, leading to increased morbidity and mortality. Viral hepatitis C infection represents the most common cause of hepatic fibrosis in Egypt ***(Castera, 2012)*.**

Patients with hepatitis C virus infections are at high risk for development of hepatic fibrosis that proceeds to cirrhosis, The assessment of liver fibrosis in patients with viral hepatitis is essential not only to determine prognosis but also to select patients who are in need for antiviral therapy ***(Ghany et al., 2011)*.**

Liver biopsy was the standard reference method for evaluation of liver fibrosis, but it has several complications such as hemorrhage, pain and several limitation such as interobserver variability, sampling errors and also it lacks the patient acceptance ***(Castera, 2012)*.**

This made the need for a noninvasive, fast, safe and reliable method that allows evaluation of liver fibrosis, and repetitive measurements for monitoring disease progression and treatment response ***(Kovač et al., 2012).***

These non invasive methods include routine biochemical and hematological liver function tests, serum markers of connective tissue, and scoring systems using a combination of clinical and/or laboratory tests ***(Ghany et al., 2011).***

Imaging techniques are an attractive means of detecting liver fibrosis, given their availability and non-invasive nature, although their capacity to detect structural changes is dependent up on resolution and the stage of liver fibrosis.The search for the best diagnostic technique in terms of non-invasiveness and accuracy is still a major focus of recent research activities ***(Feier et al., 2016).***

Recently, a wide variety of non invasive promising imaging-based methods had been used for assessing hepatic fibrosis, including ultrasound, CT and MRI . The measurement of liver stiffness with ultrasound transient elastography (FibroScan) was proven to be accurate in the detection of significant fibrosis in patients with hepatitis C. However, transient elastography (TE) cannot be used in obese patients or patients with ascites or narrow intercostal spaces ***(Kovač et al., 2012).***

Although magnetic resonance (MR) elastography ***(Wang et al., 2011)*** has demonstrated the best diagnostic performance for the detection and staging of liver fibrosis thus far,it is impractical, since the technique remains expensive and is not widely included in routine imaging for patients with various liver diseases ***(Feier et al., 2015).***

Several other MR based techniques, such as diffusion weighted magnetic resonance imaging (DW-MRI) and measuring apparent diffusion coefficient (ADC) value have become an important noninvasive diagnostic tool in the evaluation of liver fibrosis ***(Pasquinelli et al., 2012).***

DW MRI allows whole liver examination with an insight into distribution of liver fibrosis permitting detection of the most affected liver segments ***(Bonekamp et al., 2011)***.

The ADC of livers with moderate or advanced fibrosis and cirrhosis has been reported to be lower than that of normal livers or livers with mild fibrosis across these multiple studies, although reported ADC values vary between studies, partly because of differences in acquisition parameters. A hurdle to the widespread clinical application of DWI lies in the lack of standardization of parameters and reproducibility of ADC measurements, with reported interscanner and intrascanner variability of approximately 5–15% ***(Koh et al., 2009).***

The variability in reported ADC measurements is further complicated by the use of different b values and acquisition methods based on breath-hold, free-breathing, or respiratory triggered techniques, which can affect ADC quantification ***(Richard et al., 2010 & Taouli et al., 2010)***.

Normalization of ADC using a reference organ that remains relatively constant across patients or systems may help reduce vriability in ADC calculations. For instance, a recent study showed that normalized ADC (using the spleen) appeared to decrease variability of ADC on the basis of choice of b values for benign and malignant liver lesions. The spleen may be an ideal reference organ, because it maintains a relatively stable ADC even in the setting of liver disease ***(Richard et al., 2010) & Papanikolaou et al., 2010)*****.**