The Role of Diffusion Weighted MRI in the Characterization of Hepato-Cellular Carcinoma

Essay

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By

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Contents

List of Abbreviations

ADC	**:**	Apparent diffusion coefficient.
APA	**:**	Arterio-portal anastomoses.
BH	**:**	Breath hold.
CCA	**:**	Cholangiocellular carcinoma.
CT	**:**	Computed tomography.
CV	**:**	Central venule.
DW	**:**	Diffusion weighted.
DW MRI	**:**	Diffusion weighted magnetic resonance imaging.
DWI	**:**	Diffusion weighted imaging.
EHE	**:**	Epithelioid heamangioendothelioma
EPI	**:**	Echo planner imaging.
FFE	**:**	Fast field echo.
Fig	**:**	Figure.
FLC	**:**	Fibrolamellar carcinoma.
FLL	**:**	Focal liver lesions.
FS	**:**	Fast spin.
FSE	**:**	Fast spin echo.
GB	**:**	Gall bladder
Gd	**:**	Gadolinium.

Gd DTPA	**:**	Gadolinium diethylenetriamine pentaacetic acid (hepatocyte-specific contrast agent taken by hepatocytes and excreted into biliary system).
GI	**:**	Gastrointestinal.
GRAPPA	**:**	Generalized auto- calibrating partially parallel acquisition.
GRE	**:**	Gradient recalled echo.
H& E	**:**	Hematoxylin and eosin
HA	**:**	Hepatic artery.
HCC	**:**	Hepatocellular carcinoma.
HCV	**:**	Hepatitis C virus.
HMS	**:**	Hepatic microvascular subunits.
IVC	**:**	Inferior vena cava.
min	**:**	Minute.
MR	**:**	Magnetic resonance.
MRI	**:**	Magnetic resonance imaging.
msec	**:**	Millisecond.
NEX	**:**	Number of excitations.
NH	**:**	Focal nodular hyperplasia.
PSC	**:**	Primary sclerosing cholangitis.
PV	**:**	Portal vein
RT	**:**	Respiratory triggered.

SE	**:**	Spin echo.
sec	**:**	Second.
SGE	**:**	Spoiled gradient echo
SI	**:**	Signal intensity.
SNR	**:**	Signal to noise ratio.
SOR	**:**	Standard of reference.
SPAIR	**:**	Spectral attenuated inversion recovery (fat suppression MRI technique).
T	**:**	Tesla.
TE	**:**	Echo time.
THRIVE	**:**	High resolution isotropic volume examination.
TR	**:**	Repetition time.
TSE	**:**	Turbo spin echo.
US	**:**	Ultrasonography.
VIBE	**:**	Volumetric interpolated breath hold examination.
WIs	**:**	Weighted images.
3D	**:**	Three dimensional.

List of Tables

List of Figures

Abstract

Differentiating between cancerous tissue and healthy liver parenchyma could represent a challenge with the only conventional Magnetic Resonance (MR) imaging. Diffusion weighted imaging (DWI) exploits different tissue characteristics to conventional Magnetic Resonance Imaging (MRI) sequences that enhance hepatocellular carcinoma (HCC) detection, characterization, and post-treatment evaluation. Detection of HCC is improved by DWI, infact this technology increases conspicuity of lesions that might otherwise not be identified due to obscuration by adjacent vessels or due to low contrast between the lesion and background liver. It is important to remember that DWI combined with contrast-enhanced MRI has higher sensitivity than DWI alone, and that some patients are not eligible for use of contrast on CT and MRI; in these patients DWI has a prominent role. MRI has advanced beyond structural anatomic imaging to now showing pathophysiologic processes. DWI is a promising way to characterize lesions utilizing the inherent contrast within the liver and has the benefit of not requiring contrast injection. DWI improves detection and characterization of HCC. Proposed clinical uses for DWI include: assessing prognosis, predicting response, monitoring response to therapy, and distinguishing tumor recurrence from treatment effect. Ideally, DWI will help risk stratify patients and will participate in prognostic modeling.

Key words: Hepatocellular Carcinoma; Diffusion weighted imaging (DWI); Hepatic carcinogenesis.

Introduction

Hepatocellular carcinoma (HCC) is the most common primary hepatic malignancy of adults. It is the sixth most common cancer worldwide and the third most common cause of cancer death. In Egypt, liver cancer forms 11.75% of the malignancies of all digestive organs and 1.68% of the total malignancies. HCC constitutes 70.48% of all liver tumors among Egyptians. HCC represents the main complication of cirrhosis, and shows a growing incidence in Egypt, which may be the result of a shift in the relative importance of hepatitis B virus (HBV) and HCV as primary risk factors, and improvements in screening programs and diagnostic tools.

Although most HCC develop in the background of chronic liver disease, some may occur on a normal liver and usually correspond to specific types, including fibrolamellar HCC ***(Hola, 2015).***

The radiological evaluation of HCC is an overall procedure able to provide its accurate diagnosis and prognosis by evaluating both the macroscopic and the microscopic features of the tumor and aspects of the

non tumoral tissue, especially the identification of preneoplastic changes. Therefore, various studies aimed to report the epidemiological, clinical, and histopathological properties of HCC patients eligible for surgical intervention, and those whom able to interact with medical and conventional treatment ***(Hola, 2015).***

A number of imaging techniques are available to detect the presence of lesions, evaluate focal liver lesions, and determine the stage of the disease. They include ultrasound (US), computed tomography (CT), magnetic resonance imaging (MRI), and positron emission tomography (PET). Understanding the diagnostic accuracy of imaging methods and how they affect clinical decision making, and ultimately patient outcomes, is a challenge. Imaging techniques may be used alone, in various combinations or algorithms, and/or with liver-specific biomarkers, resulting in many potential comparisons. Technical aspects of imaging methods are complex, and they are continuously evolving ***(Chou et al., 2015).***

HCC characterization with Magnetic resonance imaging (MRI) is based on their morphology, signal intensity on different sequences (HASTE, T1) and on their behaviour with paramagnetic contrast agents (Gadolinium). Specific contrast agents have also been used, but due to their high cost they are not commercially available in our country. However, even with regular protocol studies, including above mentioned sequences, there are still lesions where an accurate differentiation between benign and malignant lesions is not always achieved ***(Vergara et al., 2010).***

Diffusion-weighted MR imaging (DWI), theoretically described as far back as the 1950s and 1960s by ***Carr and Purcell, (1954)*** and ***Stejskal and Tanner (1965),*** has become an established method in neuroradiology since the introduction of the intravoxel incoherent motion technique by ***Le Bihan et al. (1988).***

The international accepted diagnosis criteria for hepatocellular carcinoma (HCC) in cirrhosis are highly accurate for large tumors, but offer relatively low sensitivity for small (<2 cm) tumors. diffusion