Role of diffusion-weighted MR imaging in differentiation between malignant and benign portal vein thrombosis in patients with Hepatocellular carcinoma

Thesis

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By

Amr Mohamed Kamal Moharram

M.B., B, Ch, Faculty of Medicine

Under supervision of

Prof. Dr. Ahmed Mohamed Hussien

Assistant-Professor of Radio-diagnosis
Faculty of Medicine, Ain Shams University

Dr. Allam El Sayed Allam

Lecturer of Radio-diagnosis
Faculty of Medicine, Ain Shams University

Faculty of Medicine
Ain Shams University
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Amr Moharram

List of Contents

List of Tables

List of Figures

List of Figures Cont...

List of Figures Cont...

List of Figures Cont...

List of Figures Cont...

List of Abbreviations

Abb.	Full term
ADC	Apparent diffusion coefficient
CT	Computed tomography
DW	Diffusion-weighted
HCC	Hepatocellular carcinoma
IVC	Inferior vena cava
LPV	Left portal vein
MPD	Myeloproliferative disease
MPV	Main portal vein
MRI	Magnetic resonance imaging
OATP	Organic anionic transporting polypeptides
PACS	Picture archiving and communication system
PC	Protein C
PVT	Portal vein thrombosis
RAPV	Right anterior portal vein
RF	Radiofrequency
ROIs	Regions of interest
RPPV	Right posterior portal vein
RPV	Right portal vein
SMV	Superior mesenteric vein
SV	Splenic vein

INTRODUCTION

Hepatocellular carcinoma (HCC) is the fifth most common tumor in the world, and its incidence is increasing, especially in Western nations ***(Choi et al., 2014).***

In Egypt, HCC is the second most common cancer in men and the 6th most common cancer in women. Hospital-based studies from Egypt have reported an overall increase in the relative frequency of all liver-related cancers in Egypt, from approximately 4% in 1993 to 7.3% in 2003. Former studies in Egypt have shown the increasing importance of HCV infection in the etiology of liver cancer, estimated to account for 40–50% of cases, and the declining influence of HBV and HBV/HCV infection (25% and 15%, respectively) ***(El-Zayadi et al., 2005).***

HCC may be associated with portal vein thrombosis which could be either bland or malignant ***(Choi et al., 2014).***

Neoplastic portal vein thrombi in patients with HCC gravely affect the prognosis and the subsequent treatment options. These patients are considered unsuitable for most of the therapeutic options ***(Catalano et al., 2010).*** These patients are considered unsuitable for most therapeutic options, including ethanol ablation, trans arterial chemoembolization, liver resection, and even orthotopic liver transplantation. Five-year survival after surgical resection is 12%–39% in patients with neoplastic vascular invasion and 59% in those without. Such patients usually undergo palliative or experimental treatment ***(Kuan et al., 2016).***

Although the reference standard in the diagnosis of the malignant portal vein thrombosis is the pathologic examination, diagnostic imaging plays a pivotal role; demonstration of arterial flow within the thrombus by using spectral Doppler US is 100% specific for tumor thrombus. Also contrast-enhanced US has been demonstrated to be 88%sensitive and 100% specific in the diagnosis of malignant portal vein thrombosis ***(Tarantino et al., 2006).*** These figures are similar to those obtained at contrast-enhanced CT, with a sensitivity of 86% and a specificity of 100% ***(Shah et al., 2010).***

Multiple studies have demonstrated excellent sensitivity and specificity of MRI for the detection and characterization of HCC, particularly for smaller tumors, 1–2 cm in size with sensitivity up to 84% and 47% with MRI and CT, respectively ***(Ayuso et al., 2012).***

DW imaging is an MR technology that measures the diffusion of water molecules in the tissue. Therefore, characterization of tissue is enabled; in malignant tissue, the diffusion of water molecule is restricted, so lower ADC values are noted as compared to benign lesions. Also, DW imaging does not require contrast medium administration; therefore, it can be safely done in patients with contraindications to contrast media ***(Catalano et al., 2010).***

AIM OF THE WORK

To determine the role of DW imaging in differentiating between the benign and malignant portal vein thrombosis in patient with HCC.

Chapter 1

EMBRYOLOGY AND ANATOMY OF THE PORTAL VEIN

1. Embryological development

The development of the portal venous system occur between the 4th and 12th weeks of gestation.It results from a complex process that includes selective persistence of parts of the vitelline venous system and communication with the umbilical venous system around the developing liver (Fig.1) ***(Lee et al., 2011).***

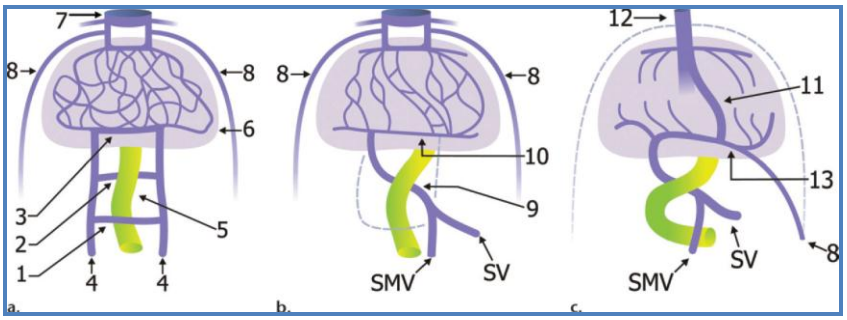

Figure (1): Drawings illustrate the embryologic development of the portal venous system. **(a)** Initially, the caudal-ventral (1), dorsal (2), and cranial-ventral (3) anastomoses develop from the paired vitelline veins (4) around the duodenum (5). They pierce the septum transversum (6), forming multiple sinusoids, and drain into the sinus venosus (7). The paired umbilical veins (8) also drain into the sinus venosus. **(b)** In the next stage, involution of parts of the vitelline veins and caudal-ventral anastomosis (dashed line) occurs. The dorsal anastomosis becomes the portal vein (9), and the cranial-ventral anastomosis becomes the left portal vein (10). **(c)** Next, the right umbilical vein and cranial portion of the left umbilical vein involute (dashed line). The ductus venosus (11) forms between the caudal left umbilical vein (8) and the inferior vena cava (12). Last, a new communication forms between the left umbilical vein and the left portal vein (13). SMV = superior mesenteric vein, SV = splenic vein ***(Lee et al., 2011).***