Role of Diffusion MRI & Dynamic contrast-enhanced MRI in assessment of hepatocellular carcinoma after transarterial chemoembolization

Thesis

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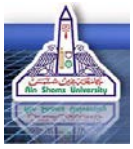

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Introduction

Hepatocellular carcinoma (HCC) is the fifth most common malignancy in the world and the third most common cause of cancer death, with 600,000 to 1 million new cases diagnosed each year ***(Kloeckner et al., 2010).***

Transarterial chemoembolization (TACE) of hepatocellular carcinoma (HCC) is used in some cases as a bridge to liver transplantation. It is also used for patients with unresectable HCC, and has been shown to improve survival ***(Kim et al., 2010).***

Patients who undergo TACE are routinely monitored with imaging that determines subsequent therapeutic planning. Therefore, an accurate imaging method for estimating tumor necrosis is required. At the present time, there is no clear consensus on which imaging method should be used to monitor response of HCC to TACE ***(Kim et al., 2010).***

Early assessment of the effectiveness of TACE is critical in planning future therapy whether earlier treatment of residual viable portions of the tumor, delaying re-treatment in cases of good response to avoid unnecessary toxicity, or switching to a different local-regional therapy approach ***(Eisenhauer et al., 2009).***

Assessment of tumor response after TACE on CT is generally based on the radio-opacity of the iodized oil that selectively accumulates in the tumor in addition to tumor enhancement and tumor size on contrast enhanced CT. Hyperattenuating iodized oil impairs assessment of residual tumor enhancement on contrast enhanced CT ***(Yuan et al., 2010).***

Dynamic contrast–enhanced magnetic resonance (MR) imaging and diffusion-weighted (DW) MR imaging have been investigated for assessment of early treatment response to TACE ***(Mannelli et al., 2009).***

In contrast to CT, the high concentration of iodized oil after chemoembolization does not affect MR signal intensity. Enhancing portions of the tumor are presumed to be viable, whereas non-enhancing portions are presumed to be necrotic. After gadolinium injection, assessment of tumor response is based on tumor enhancement & tumor size as in CT ***(Yuan et al., 2010).***

The change in tumor size is based on the change in the longest diameter of the target lesion(s) in the axial plane which is the currently accepted standard in assessing treatment response in HCC ***(Eisenhauer et al., 2009).***

The disadvantage of contrast-enhanced MRI is the incapability to distinguish viable cells from reactive granulation tissue. Contrast-enhancement in granulation tissue is believed to be caused by increased capillary permeability and marked increase in the passive distribution of gadolinium. After TACE, an enhancing rim can appear on contrast-enhanced MRI. This rim can correlate to either viable tumor as well as to reactive tissue ***(Yuan et al., 2010).***

Diffusion-weighted imaging (DWI), a functional MRI technique, detects MR signal changes in tissues due to water proton motion that varies based upon the degree of cell membrane integrity. The intact membranes of viable tumor cells restrict water diffusion, whereas necrotic tumor cells with disrupted cell membranes exhibit increased water diffusion. This mobility of water is quantified by a constant known as the apparent diffusion coefficient (ADC) ***(Churg et al., 2010).***

Diffusion-weighted MRI (DWI) provides unique information related to tumor cellularity and the integrity of cell membranes and thus may be sensitive to changes in the tumor microenvironment that occur after treatment. It has been shown that hepatocellular carcinoma had a significant increase in the ADC after TACE. DWI can determine treatment response several weeks earlier than anatomical imaging, where changes in tumor size usually occur 6–12 months after treatment ***(Kamel et al., 2009).***

Aim of the work

The aim of this study is to assess the effectiveness of diffusion & Dynamic contrast enhanced MRI in imaging of hepatocellular carcinoma after transarterial chemoembolization & monitoring response to treatment.

Anatomy of the Liver

The liver is the largest organ in the body. It lies in the upper part of the abdominal cavity just beneath the diaphragm and mostly under cover of the ribs. It fills the right hypochondrium and extends across the epigastrium into the left hypochondrium. The liver is shaped like a wedge, with its base against the right abdominal wall and its tip pointing to the spleen ***(Gosling et al., 2002).***

The normal liver extends vertically from the fifth intercostal space in the right midclavicular line down to the right costal margin. It measures 12 to 15 cm in the coronal plane and 15 to 20 cm transversely. The median liver weight is 1800 gm in men and 1400 gm in women. The adult liver weight is between 1.8% and 3.1% of body weight ***(Schiff et al., 2007).***

The liver is supported in its position in the upper abdomen by several factors. Tone in the anterolateral abdominal muscles is important in holding the liver in place. Ligamentous attachments of the liver capsule to the diaphragm and anterior abdominal wall provide support, and prevent rotation of the liver ***(Johnson et al., 2005).***

Surfaces of the liver:

The liver is usually described as having superior, anterior, right or lateral, posterior and inferior surfaces. The superior, anterior and right surfaces are continuous & grouped as the diaphragmatic surface, which is mostly separated from the inferior or visceral surface, by a narrow inferior border (fig.1-1&2) ***(Johnson et al., 2005).***