編號 096

臺北市政府 94 年度員工平時自行研究報告

以長 TE 值之 MRI T2 影響鑑別診斷肝腫瘤

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臺北市政府九十四年度計畫研究報告提要表

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填表日期：94 年 12 月 31 日

研究項目	以長 TE 值之 MRI T_2 影像鑑別診斷肝腫瘤		
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報 告 內 容 摘 要	建　議　事　項	建 議 參 採 機 關	
MR 影像之發展對肝腫瘤之鑑別診斷已有很好之正確性，但部分腫瘤仍有非典型表現，且大多鑑別診斷均需顯影劑，如何以非顯影劑方式來鑑別診斷一般之腫瘤，可否以此方式來幫助平時所遇到之非典型腫瘤，是本研究之主要目的。 本研究以 T2WI 影像內之長 TE 成像法來區分肝癌、肝血管瘤與肝水囊，在一般 T2WI 及 T2 fat sat MRI 做完後，則以 TE 為 750ms 分別作一組 breath hold T2 fat sat 影像，slice thickness 以 8mm~10mm 切完整個肝臟，共 89 位病患共 32 個肝癌，58 個肝血管瘤及 48 個肝水囊，發現所有肝癌病患在 TE 為 750ms 之長 TE 影像均看不到腫瘤，在血管瘤中 57 個看到訊號較一般 T2 下降，另一個持續高訊號；肝水囊則 46 個為持續高訊號，有 2 個看到訊號降低，用此區分敏感度為 98.32%，特異度為 95.7%，正確度為 96.4%，有統計學意義 ($P<0.001$) 以長 TE=750ms 可明顯區分肝癌、肝血管瘤與肝水囊，尤其在區分肝血管瘤及肝水囊這兩種均以極高 T2 訊號表現之肝良性腫瘤，不需任何顯影劑即可診斷，可用於健檢病患。	1. 長 TE 值(750ms)是一種很好的快速 MR 序列，可幫助以非顯影劑 MR 影像鑑別診斷肝血管瘤及肝水囊。 2. 此序列可用於健檢病患。 3. 此序列可幫助診斷一些小的肝水囊，可在未來作相關研究。	臺北市衛生局所屬各市立醫院，各醫療院所，尤其有 MRI 且從事健檢者。	

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MR 影像之發展對肝腫瘤之鑑別診斷已有很好之正確性，但部分腫瘤仍有非典型表現，且大多鑑別診斷均需顯影劑，如何以非顯影劑方式來鑑別診斷一般之腫瘤，可否以此方式來幫助平時所遇到之非典型腫瘤，是本研究之主要目的。

本研究以 T_2WI 影像內之長 TE 成像法來區分肝癌、肝血管瘤與肝水囊，在一般 T_2WI 及 T_2 fat sat MRI 做完後，則以 TE 為 750ms 分別作一組 breath hold T_2 fat sat 影像，slice thickness 以 8mm~10mm 切完整個肝臟，共 89 位病患，32 個肝癌，58 個肝血管瘤及 48 個肝水囊，發現所有肝癌病患在 TE 為 750ms 之長 TE 影像均看不到腫瘤，在肝血管瘤中 57 個看到訊號較一般 T_2 下降，另一個持續高訊號；肝水囊則 46 個為持續高訊號，有 2 個看到訊號降低，用此區分敏感度為 98.32%，特異度為 95.7%，正確度為 96.4%，有統計學意義($P<0.001$)。

以長 TE=750ms 可明顯區分肝癌、肝血管瘤與肝水囊，尤其在區分肝血管瘤及肝水囊這兩種均以極高 T_2 訊號表現之肝良性腫瘤，不需任何顯影劑即可診斷，可用於健檢病患。

第二章　研究動機、目的

第一節 研究動機

MR 影像之發展對肝腫瘤之鑑別診斷已有很好之正確性，但部分腫瘤仍有非典型表現【1,2,3】，且大多鑑別診斷均需顯影劑，如何以非顯影劑方式來鑑別診斷一般之腫瘤，可否以此方式來幫助平時所遇到之非典型腫瘤，是本研究之主要目的

本院肝腫瘤之病患眾多，在以往之經驗中認為肝腫瘤中 hemangioma 及 cyst 屬非實質(non-solid)腫瘤，在 T_2 表現上其 T_2 relaxation time 很長，一般以 TE=120msec 可與其他實質腫瘤區分【4】，但部分 hemangioma 之 TE 較短而出現所謂非典型表現【5】。

近年來國人健康意識抬頭，MRI 以其非輻射且清晰之成像獲得一般人在健康檢查選擇之厚愛，但因健檢一般不願使用顯影劑(危險性很低但仍有發生)，肝血管瘤與水囊在此非顯影劑之 MRI 無法區別，是否可以非顯影劑影像在此二非實質腫瘤上再加以區別？

本研究擬以 T_2WI 影像內長 TE 成像法來解決以上兩個問題，首先將根據以往文獻算出之 TE 值【4、6】，malignant hepatic tumor 85ms(±17ms)，hemangima 155ms(±35ms)，cystic lesion 583ms(±369ms)來定出 TE 值，HCC 為一組，hemangioma 為一組，cyst 為一組，將其結果以統計方式測其 P value 提供以上問題之答案。

第二節 研究目的

1. 以不需顯影劑之 MRI 來區分實質肝腫瘤(如肝癌)與非實質肝腫瘤(如 hemangioma, cyst)。
2. 適當之 MRI T_2 影像之長 TE 值來進一步區分非實質腫瘤之

hemangioma **及** cyst**。**

3. **提出一個少於** 1 **分鐘之檢查方式，加入** MRI **檢查中，並不影響整體檢查時間，但可提供進一步有用之資料。**

4. **提供以此** TE **值於** MRI **健康檢查，利用此可將以往必須靠顯影劑才能區分之腫瘤，有一初步之鑑別診斷，以提供檢查醫師決定下一步追蹤或檢查種類之依據。**

第三章　研究材料與方法

1. 以病人因肝腫瘤(大多為超音波偵測到)來作 MRI 以鑑別診斷之病患為研究對象，其中肝癌組必須有病理切片證實或 AFP≥400ng ，作前瞻性研究。

2. 病人作 MRI 之前與其溝通 consent form(此 form 已經人體實驗委員會通過)，讓其填寫人體實驗同意書。

3. 以一般腹部 MRI 研究，Dual T_1（TR：210；TE：2.3、4.6）及 T_2 TSE(TE 含 80 及 120，TR：2000，TSE factor：23)，T_2 fat sat，以 Gd-DTPA 為顯影劑，注射後 dynamic phase (T_1FFE)，late phase (T_1 fat sat axial 及 coronal), delay phase(T_1 FFE)。

4. 在一般 T_2WI 及 T_2 fat sat MRI 做完後，則以 TE 為 750ms 作一組 breath hold T_2 fat sat 影像，slice thickness 以 8mm~10mm 切完整個肝臟，每次閉氣 16 秒可得約 10 公分厚度，分兩次作完肝臟。

5. 根據 4.的影像，測量在"一般" T_2 訊號病灶之訊號值以及"非常長 TE 值" T_2 訊號之訊號值，以 ROI (region of interest) 5~10mm 大小，由一位放射科專家測量，看不到者則不必測量。

6. 研究共 89 位病患，年齡在 28~80 歲，32 個肝癌，58 個肝血管瘤及 48 個肝水囊病患，腫瘤大小在 0.8cm~5.7cm(平均 2.01±1.04cm)。

7. 請兩位不知診斷結果之放射線腹部 MRI 專家研讀 MRI，首先給予未打藥之片子，請其根據 TE=750ms 時之訊號比 T_2 及 T_2 fat sat 之訊號差距作記錄，再給予打藥後之片子，讓其根據所有影像作成診斷。原則上，T_2 為一般高，打藥後為已顯影者為疑似肝癌；T_2 為非常高，打藥後從周邊逐漸向中央顯影為肝血管瘤；T_2 非常高，打藥後不顯影為肝水囊。

8. 肝癌組病人接受病理切片或開刀。

9. 肝血管瘤及水囊病患接受半年後之超音波或 MRI 追蹤。

10. 以 Boferrni Correct t test 作統計學研究，並以

$$\frac{\text{SI(long TE 750ms)} - \text{SI}(T_2\text{ fat sat})}{\text{SI}(T_2\text{ fat sat})}$$

來計算 SI 在兩者差異度，以 Receiver of Operating Calculation(ROC) curve 來算出理想差異值，並以此理想差異值來鑑別診斷之敏感度、特異度及正確性。

第四章　研究結果

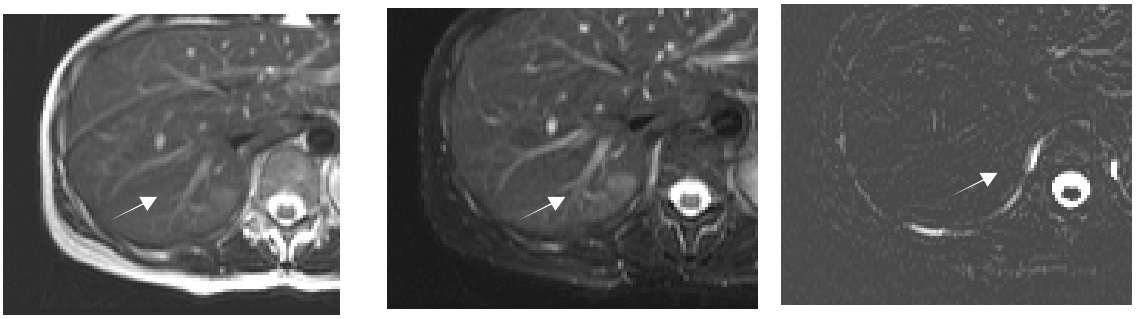
在放射線專家的目測診斷上，32 **個肝癌在** TE=750ms **時均看不到** (Fig 1)**；肝血管瘤中** 57 **個看到訊號較一般** T_2 **下降，另一個持續高訊號** (Fig 2)**；肝水囊則** 46 **個為持續高訊號，有** 2 **個看到訊號降低** (Fig 3)**，用此區分敏感度為** 98.32%**，特異度為** 95.7%**，正確度為** 96.4%**，有統計學意義**(P<0.001)**。兩位專家均很容易以目測方式診斷，**inter-observer variation **很少，**kappa value **為** 0.94**，**p<0.0001**。**

血管瘤在 TE=750ms **時之** SI **為** 276.4±19.6**，在** T_2 fat sat **為** 1237±37.8**；肝水囊在** TE=750ms **時之** SI **為** 2172±172.2**，在** T_2 fat sat **為** 1412±49.6**；肝癌則在** TE=750 **看不到，所以無法測量，以** Beferroni correct t test**，三者有統計學意義之差距** P<0.001**。**

在 SI **差異值** signal intensity difference ratio **上，根據** ROC curve**，肝血管瘤與肝水囊之差異值為－**0.38**，以此值分別兩者** sensitivity **為** 98.4%**，**specificity **為** 97.7%**，**accuracy **為** 98.8%**。肝癌因** TE=750ms **已看不到，所以無法算差異值。**

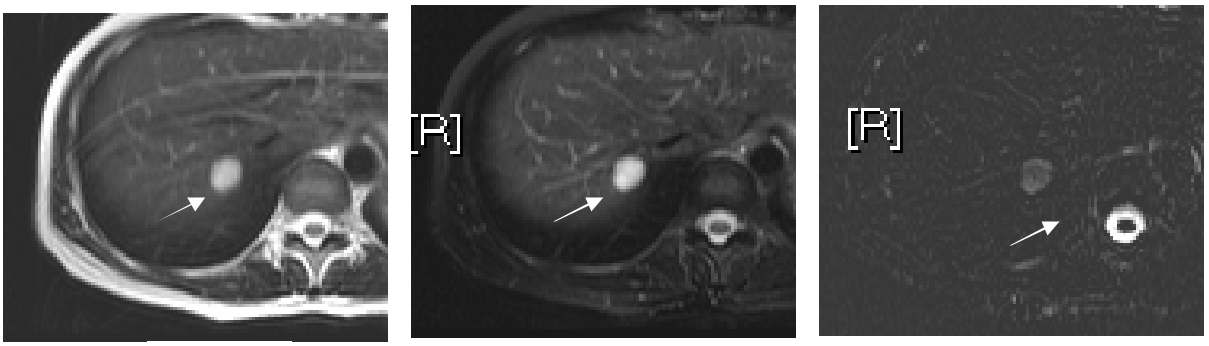
圖示

Fig 1　**有一** 2 **公分肝癌在** S_7 **，**(a) T_2 **為一般高訊號，**(b) T_2 fat sat **為一般高訊號，**(c)TE=750ms **時看不到。**



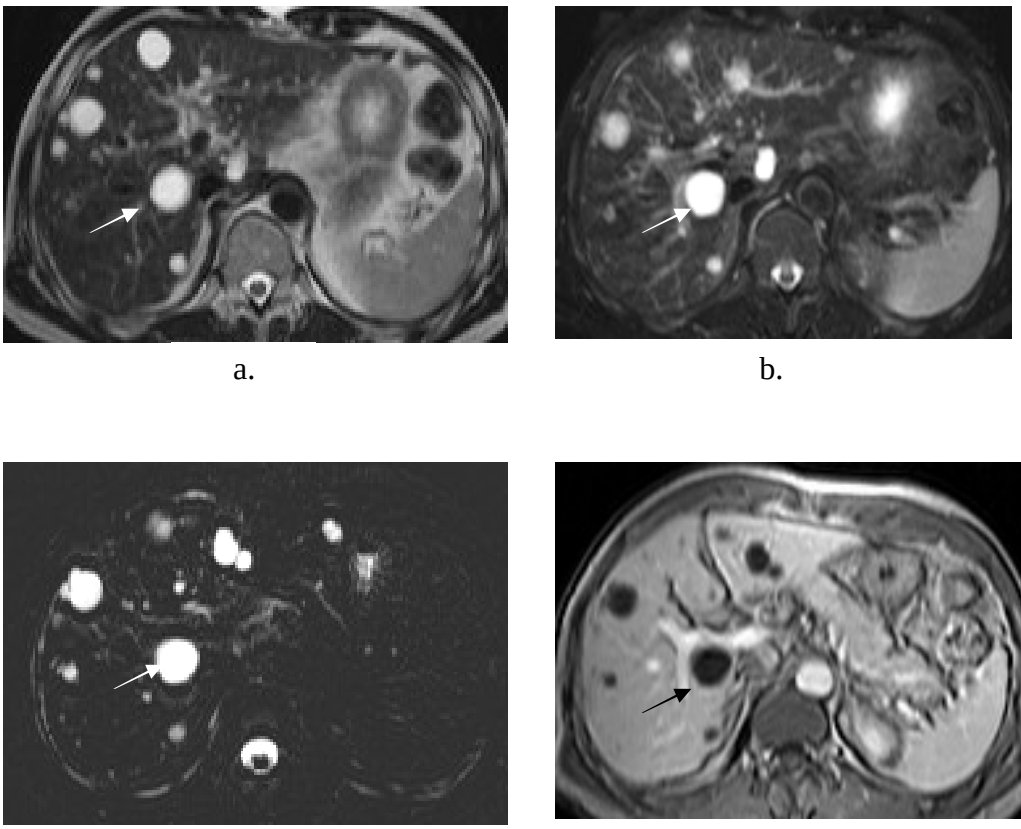
a.　　b.　　c.

Fig 2 **有一** 2 **公分肝血管瘤在** S_{7-8}**,** (a)**、** (b)T2 **與** T_2 fat sat **為非常高的訊號，** (c)TE=750 **之長** TE **值為低訊號。**



a. b. c.

Fig 3 **多發性肝水囊病患，**(a)**、** (b))T_2 **與** T_2 fat sat **為高訊號，**(c) TE=750 **之長** TE **值仍為高訊號，**(d)**顯影劑後之** T_1FFE **為不顯影。**



a. b.

c. d.

第五章　討論

在肝腫瘤的診斷上常以超音波為第一線檢查，在最近的文獻上，均以 MRI 為最佳的進一步鑑別診斷工具【7】，本實驗提出了以長 TE 值 (TE=750ms)為一種不用打顯影劑而能分辨肝癌、肝血管瘤及肝水囊的方法。

在以往的報告中，Fenlon's 【8】以 TE=125ms 來分辨良性肝腫瘤與惡性肝腫瘤，其他報告中也有人提及以 heavily T2-weighted MR imaging 來區分肝水囊或肝血管瘤和其他實質腫瘤【9,10】。Jafari 曾利用 0.5T MR 機型之 Rapid Acquisition Relaxation Enhanced sequence with TE=500ms 來測量肝實質與肝血管瘤【11】，在他的研究中，TE=500ms 時，肝血管瘤的訊號仍很亮，於是本研究決定以更長之 TE 值，TE=750ms 來研究，在本研究中發現 TE=750ms 時，肝癌已看不見；肝血管瘤可看見，但訊號下降許多；肝水囊不但看得見，且訊號並不降低。如此，可很輕易的分出三種腫瘤。

為了減少人為目測的誤差，在本研究也以量化的 ROI 測量訊號值來比較各組之差異，我們發現肝癌組均無法得到訊號值，而肝血管瘤之 signal variation ratio 均小於－0.38，肝水囊則大於此，用此值可達到 sensitivity 98.4%，specificity 97.7%，accuracy 98.8%。

現今有很多人以沒有輻射的健檢來作身體檢查【12,13】，健檢的病患很少使用顯影劑，在以往的論文中多以顯影劑來區分肝癌、肝血管瘤、肝水囊【14】，其中肝癌與後兩者 T_2 影像不同，可作初步區分，後兩者則無法區分；雖然同為良性腫瘤，但卻無法給檢查者一明確的診斷，我們利用長 TE 值(750ms)可輕易的提供此答案。

本研究的限制在實質的肝腫瘤內只列入肝癌，而肝癌在 TE=750ms 時已沒有訊號，因此 TE=750ms 可能無法將肝癌與其他的實質腫瘤作區分，如良性再生結節、惡性肝膽管癌、惡性轉移性腫癌等。所以未來的研究可針對肝血管瘤及肝水囊兩種本來在 T2 就有極高訊號之腫瘤作此序列而加以鑑別。

第六章　結論與建議

1. 長 TE 值(750ms)是一種很好的快速 MR 序列，這種序列在以前並沒有被使用在除了 MRCP,MRU 以外 ,在本實驗中發現此序列可幫助以非顯影劑 MR 影像鑑別診斷肝血管瘤及肝水囊。
2. 此序列因為不需要顯影劑即可作以上的鑑別診斷,可用於健檢病患。
3. 此序列可幫助診斷一些小的肝水囊與小血管之差異，此點可在未來作相關研究。

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第八章　英文版論文

(摘要、論文、參考資料)

Abstract

Purpose: Radiologists have generally acknowledged that hepatic hemangioma and hepatic cysts are high signal intensity lesions on conventional T2-weighted images. The T2 signal intensity of HCC is moderate high. The appearance of T2 in long TE might be different. Therefore the purpose of this study is to examine the reliability of very long TE sequence in distinguishing hepatic cysts, hepatic hemangiomas and HCC.

Material & Methods: A total of 89 patients, with 32 HCCs, 58 hepatic hemangiomas and 48 hepatic cysts, were recruited for the study. Full approval from the medical ethics committee was obtained. All patients underwent ultrasound and MR imaging (including a heavily T2, TE=750ms), and these were reviewed independently by two radiologists. The signal intensities of the lesions were measured by user-defined region of interest. Each lesion's variation in signal intensities, between heavily T2 with long TE and fat-suppressed T2-weighted images, is calculated using the formula:

$$\text{Signal Variation} = \frac{(\text{SI in TE 750ms} - \text{SI in T2 fat-saturated})}{(\text{SI in T2 fat-saturated})}$$

The results were validated using a Receiver of Operating Calculation curve (ROC curve).

Results: All of the HCC are not visible in heavily T2 (TE=750ms). The signal intensities of hemangiomas is 276.4 ± 19.6 on heavily T2 (TE=750ms).

As for hepatic cysts, their signal intensities on T2W is 2172 $\pm$ 172.2 on heavily T2 (TE=750). These demonstrate a significant difference between the signal intensities of hepatic hemangiomas and cysts, ($P<0.001$). The Kappa value, representative of the inter-observer variation between the two radiologists in this study, is 0.94 ($P<0.0001$). Using this, the derived sensitivity is 98.4%, the specificity 97.7%, and the accuracy 98.8%.

Conclusion: HCC, Hepatic hemangiomas and cysts have significantly different signal intensities on T2 with very long TE. The long TE T2WI is a non-invasive, reliable, and accurate imaging technique for their differentiation.

Introduction

From experiences with MRCP and MRU [1,2], we found that although both hepatic cysts and hemangiomas display very high signal intensities on conventional T2 images, they appearances are quite distinct on heavily T2 with very long TE[3]. Whilst hepatic cysts emit very high signal intensity on heavily weighted T2 with long TE, the hepatic hemangiomas display only a slightly high intensity. Their distinct appearances are most likely related to their different MR properties. Previous literatures suggest that for a 1.5T MRI device, the relaxation time of hemangiomas is approximately 140-178msec, and 341-517 for hepatic cysts [4,5]. Despite this piece of well-known information, HCC, hepatic cysts and hemangiomas are still routinely distinguished by contrast-enhanced MR studies. Whether T2WI with very long TE is a feasible technique in the differentiation of HCC, hepatic cysts from hemangiomas has not been examined in detail. Therefore the purpose of this study is to investigate the reliability of the heavily T2 (TE=750ms) as a non-contrast alternative to discriminate these two lesions.

Material & Methods

Patients

This was a prospective study which was conducted over, from Jan 2005 to Nov 2005. 89 patients, who had hemangioma-like or cystic lesions on sonography, or histologically proved HCC were referred for MRI to have the lesions further characterized. These revealed 32 HCC, 58 hepatic hemangiomas and 48 hepatic cysts, were selected for the study (since only the largest three cysts from each patient was selected). The diagnosis of hepatic cysts relied on its characteristic sonographic and MRI findings, which includes hypoechogeneity with posterior enhancement, and high T2 signal intensity without enhancement in contrast-enhanced MRI. Hemangioma was confirmed by its distinctive variable echogeneity with clear and/or geographic margin, as well as a peripheral white ring. In addition, its MR characteristics are also quite unique. It is lesion of very high T2 signal intensity, which enhances in a peripherally nodular or rapidly homogenous pattern in early arterial phase, and fills-in or remains persistently homogenous in late and delayed phases. All of the HCC were proved by fine needle biopsy and histology findings. Informed consents were obtained from all of them prior to the MR examinations. The MR examinations were composed of conventional pre- and post-IV gadolinium dynamic hepatic series, complemented by multi-slice single shot Heavily T2WI (TE=750ms).

The size of the tumors ranged from 0.8cm to 5.7cm in diameter (mean 2.01±1.04 cm). After their MR examinations, all patients with hemangiomas and cysts were followed up by ultrasound for a minimum of six months. Should there be any discrepancies between the findings of the two modalities, then a repeat MR examination similar to the initial set was done for further

clarification.

Imaging

The sonographic examinations were performed with a Logiq 700 sonography unit (Logiq 700, GE medical system, Milwaukee, Wisconsin, USA), using a 3.5-4.0MHZ probe. MR images were acquired through a 1.5T MR scanner (Philips Gyroscan ACS-NT, the Netherlands), and a phased-array body coil. Dual T1-weighted images (TR/TE: 210/2.3 and 4.6; slices thickness 8mm, gap 0.8mm) were performed within one breath hold. Turbo spin-echo (TSE) T2-weighted images (TR/TE: 2500/100; TSE factor, 23) with and without fat saturation, and coronal T2-weighted imaging were obtained with respiratory triggering.

Heavily T2WI was axial 2D single shot, multi-slice sequences, with fat-saturation, acquired within one breath hold (TR/TE, 8000/750; TSE factor 128; 12 slices; slice thickness, 8mm; gap, 0.8mm, matrix 256x204, NEX 2). The total acquisition time was only 16 seconds, and all patients were examined using the same techniques described above. The total thickness of tissue scanned for each 2D MR hydrography was 10cm typically, however there are times two separate sequences were required to fully cover the entire livers.

Dynamic MR images were obtained by applying T1-weighted fast field echo (FFE) sequence (175-210/1.3-2.1; flip angle, 80°) before intravenous contrast administration, and 18-20 seconds (arterial-dominant phase), 50-55 seconds (portal venous phase), 5 minutes (5-minute delayed phase) after manual intravenous administration of gadopentetate dimeglumine (Magnevists; Schering, Berlin, Germany; 0.1mmol/kg body weight). Another delayed phase axial images and coronal images were then acquired about 10 minutes after intravenous contrast administration (10-minute delayed phase). These pulse

sequences were all obtained with single acquisitions during one breath hold.

Image Analysis

The task of image analysis was subdivided between three separate radiologists. One measured the signal intensity of lesions on T2W images, fat-saturated T2W images, and MR hydrography. This was performed on a PACS system with high-resolution monitor, using an operator-defined region of interest (ROI) which was defined as an ovoid area 5-10mm in diameter. The other two radiologists independently reviewed all MR images in two stages, without prior knowledge of diagnosis. The non-contrast images including heavily T2WI (TE=750ms) were given to the radiologists for review, and they were asked to record lesions' signal intensities on T2WI, T2W fat-saturated, and heavily T2WI (TE=750ms), and the variation between them. Preliminary diagnoses were then made based upon these readings. Should a lesion's signal intensity in heavily T2WI (TE=750ms) be comparable with or higher than in T2WI or T2WI with fat-saturation, it is labeled a hepatic cyst. If the reverse occurs and the lesion's heavily T2WI (TE=750ms) signal intensity is lower than that of T2 images, the lesion is regarded as a hemangioma. If the lesions were not defected is heavily T2 (TE=750ms), the lesion is labeled a HCC. After this was completed and the preliminary diagnoses were made, the radiologists then reviewed the dynamic MR images with contrast enhancement. This produced the definitive diagnoses to be used as the gold standard, and these were recorded separately from the preliminary diagnoses.

Statistical Analysis

For the statistical analysis of the signal intensities of the lesions in different MR

series, we used the Beferroni Correct T Test.

The variation of lesions' signal intensities, between heavily T2 (TE=750ms) and T2WI with fat-saturation, is central to this study. This is defined by the formula:

$SI_{(\text{in T2WI with TE750ms})} - SI_{(\text{in T2 fat sat})} / SI_{(\text{in T2 fat sat})}$. The resulting variations derived from this formula is evaluated and validated by a Receiver of Operating Calculation (ROC) curve, from which an ideal cut-off value was also obtained. Thus lesions with signal intensity variation that falls beneath the cut-off value would be diagnosed as hemangiomas, and lesions with signal intensity variation above the cut-off value considered hepatic cysts. All of the HCC were not detected in T2WI with TE750ms. The formula cannot be calculated. This method's sensitivity and specificity can also be derived from the ROC curve.

The sensitivity and specificity of the visual assessment by two radiologist were calculated. Their inter-observer variation was analyzed by the Kappa test.

Result

The radiologist successfully diagnosed 57 out of 58 hepatic hemangiomas, and 46 out of 48 hepatic cysts, all 32 HCCs based on his visual assessment of their signal intensity variations. The sensitivity is 98.32%, specificity 95.7%, and accuracy 96.4%. The Kappa value was 0.94 in two radiologist. ($P<0.0001$) The inter-observer variation appeared minimal.

We also attempted to quantify the signal intensity variation that distinguish the hepatic hemangioma and hepatic cyst. For hemangiomas, the signal intensity was 276.4 ± 19.6 on heavily T2WI (TE750ms). (Fig 1) For cysts, the signal intensity was 2172± 172.2 on heavily T2WI (TE=750ms). (Fig 2) When these

numbers were analyzed with the Boferroni correct t test, it appears this difference in signal intensity variation is consistent and statistically significant ($P<0.001$). It also demonstrates that allowing for few exceptions, a ratio of –0.38 appears to be a good cut-off value for discriminating hemangiomas and cysts. Which means that lesions with signal intensity reduction ratio less than –0.38 would be considered as hemangiomas, whereas lesions whose ratio is more than –0.38 should be diagnosed as cysts. The area under the ROC curve was 0.988. (Fig 4) Quantitative analysis of MR hydrography's performance reveals that MR hydrography has a sensitivity of 98.4%, specificity of 97.7%, and accuracy of 98.8%, when differentiating hepatic hemangiomas from cysts.

Discussion

Sonography is a common screening tool and diagnostic imaging modality for hepatic lesions. It does however has some difficulty differentiating hepatic hemangiomas and cysts, often because hemangiomas may be hypoechoic. This is especially pronounced in obese patients [7, 8]. Recently, there is an increasing trend to utilize whole body computed tomography or magnetic resonance imaging for routine health examinations. Since these are clinically asymptomatic patients, intravenous contrast medium is seldow use a to avoid unnecessary drag reaction [9,10]. However without the administration of intravenous contrast medium the differentiation of HCC, hepatic hemangiomas and cysts is difficult with conventional MRI. Despite the fact that both diagnoses are benign, patients often prefer to have an exact diagnosis [11]. Heavily T2 WI (TE=750ms) is able to highlight static or very slow-flowing fluid by applying a heavily weighted T2 pulse sequence. In Fenlon's study, extreme T2 weighted imaging with TE of 125ms is useful for distinguishing

benign hepatic lesions from malignant ones [1]. Other investigators also used heavily T2-weighted MR imaging to differentiate hepatic cysts and hemangiomas from other solid tumors. Jafari et al measured the T1 and T2 signal intensities of liver, spleen, and hemangioma with Rapid Acquisition Relaxation Enhanced (RARE) sequence on a 0.5T MR imager, setting the TE at 500ms. They noted that even with TE set at 500ms the signal intensity of hemangioma remained high. In view of this pre-existing phenomenon we have increased TE to 750ms for our MR hydrography, and noted a significant drop in the signal intensity of the hemangiomas' compared to cysts', obvious even to the naked eye.

To remove the confounding factor of indigenous signal intensity differences in different lesions, the difference in signal intensity of the lesion between on heavily T2 WI (TE=750ms) and on fat-saturation T2-weighted imaging was expressed in a ratio. It was mentioned earlier that the ideal cut-off value is –0.38, according to the ROC curve and the dot diagram. This gives heavily T2 WI (TE=750ms) a sensitivity of 98.4%, a specificity of 97.7%, and an accuracy of 98.8%. Looking at these figures it is obvious that heavily T2 WI (TE=750ms) is an excellent tool for differentiating hepatic hemangiomas from cysts.

A recent paper explored the feasibility of differentiating hepatic cyst from hemangiomas using multisection FLAIR-HASTE. This MR technique appears workable, however there is a particular dilemma. That is the fact that in that study only 85% of the cysts can be nulled effectively by the FLAIR-HASTE. In this study, long TE=750ms accuracy is 96.4%, which is boosted to 98.8% when ROI measurement replaces visual assessment. Therefore, we believed that MR hydro may be a move reliable technique in differentiating these two

lesions.

In our current day to day practice, delayed phase post-contrast MRI sequence is still occasionally required for confirmation of hepatic cysts or hemangiomas, and exclusion of other lesions. This typically adds five to ten minutes to the study duration. In comparison, heavily T2 WI (TE=750ms) does not require contrast enhancement, takes only sixteen seconds for twelve images, and can be done as an add-on as soon as prior MR sequences reveal suspicious hepatic lesions. Most importantly, it is both sensitive and specific, with or without ROI measurement. ($p<0.001$)

Conclusion

HCC, Hepatic hemangiomas and cysts may be differentiated by heavily T2 WI (TE=750ms). It is a fast and reliable technique, and does not require the administration of intravenous contrast agent. It can be a useful MRI technique, especially as part of the whole body MRI for routine health examinations.

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