The detection of diffuse bone marrow metastasis by dual phase chemical shift imaging

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Introduction

MRI is highly useful for detecting bone metastases. MRI of bone metastasis shows low signal intensity on T1-WIs and high signal intensity on T2-WIs. However it is difficult to diagnose diffuse bone metastastases with intertrabecular spread, because of poor contrast of vertebral signal intensity[1)]. In phase and opposed phase MRI has been proven to be an effective and non invasive method for evaluating the in vivo fat and cellular marrow element in bone marrow [2,3)].

The purpose of this study is to evaluate the usefulness of in-phase and opposed phase MRI of bone marrow for diagnosing diffuse bone marrow metastasis.

Subjects and Method

Seventy-four patients with suspected bone metastases (42 males and 32 females, 24-87 years old [mean 64.8]) were entered the study. The malignant diseases were 15 multiple myeloma, 13 Non-hogikin lymphoma, 13 prostatic gland cancer, 13 Hepatocellular carcinoma, 10 lung cancer, 5 leukemia, 4 pancreatic cancer and 2 colon cancer. All patients were studied with 1.5 T MRI units (Magnetom Quantum and Sonata, Siemens, Germany) with a phased array spine coil. In additional to the routine sequences such as T1-weighted images and fast STIR images, dual chemical shift sequences (FLASH, TR/TE/FA=140/2.3 and 4.7/70). The patients were divided into diffuse or non diffuse bone metastases group. Diffuse bone marrow group was proven by biopsy or bone scintigram, and non diffuse bone metastasis was proven by biopsy and clinical follow up. The relative signal intensity ratio (SIR) was calculated at SIR=Opposed phase signal intensity/In phase signal intensity. Measurement of the region of interest was done at mid-sagittal L2, and L3 excluding cortex. Mean and SDs were calculated for SIRs of the two groups. The mean values of SIR were compared the Student t-test using commercially available software (JMP; SAS Institute Inc.). Significance was defined at p less than 0.01.

Results

Diffuse bone metastases group was 15 patients and non-diffuse bone metastases group was 59 patients (Fig.1 and Fig. 2). The mean SIRs for the diffuse bone metastsis group was 0.98+/- 0.09(mean +/- SD) with range 0.76-1.13. The mean SIR for non-diffuse bone metastasis group was 0.50+/- 0.13 with a range 0.29-1.02(Fig. 3). The mean SIRs for diffuse bone metastasis group were significantly higher than non-diffuse bone marrow metastasis group ($p<0.01$).

Discussion and conclusion

Our results revealed that SIRs of diffuse bone metastases yielded high values and SIRs of non diffuse bone metastases yielded low values. This result suggests diffuse bone marrow metastasis group contain little bone marrow cell containing fat element, and non-diffuse bone metastasis group are rich in fat element of bone marrow cells. In the case of suspicious of diffuse bone metastasis, in-phase and opposed phase MRI by dual phase chemical shift MRI could be useful.

Reference

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2. Dovid G. Disler et al: AJR 169:1439-1447, 1997
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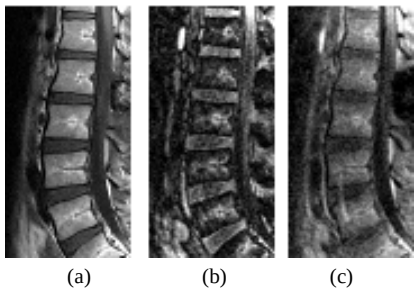
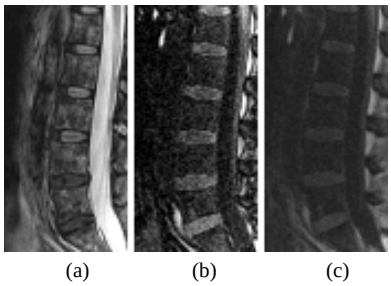


(a) (b) (c)

Fig. 1 A 63-yearold female of breast cancer: SIR=0.67 (a) T1-weighted image (b) Opposed phase image (c) In phase image



(a) (b) (c)

Fig. 2 A 75-year old male of prostatic gland cancer SIR=1.13; (a) STIR images (b) Opposed phase image (c) In-phase image

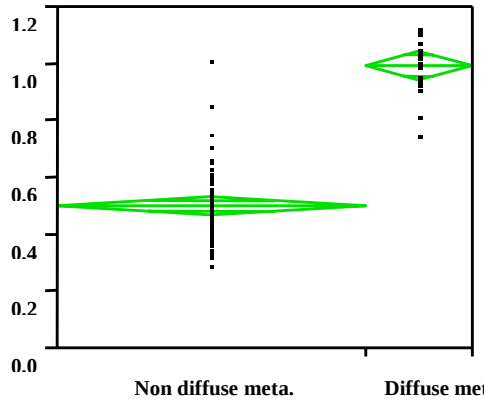


Fig. 3 SIR of non-diffuse bone metastasis group vs. diffuse bone metastasis group.