Characterization of bone tumors with in-vivo ^{1}H MR spectroscopy

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Objective

The objective was to assess the potential of in-vivo MR spectroscopy in differentiating malignant and benign bone tumors.

Introduction

Dynamic contrast enhanced MR imaging has been used to differentiate malignant and benign tumors of the musculoskeletal system. Even though there is statistically significant difference in the slope of the time-intensity curve, the sensitivity and specificity is not adequate to apply this technique in a clinical setting. Many benign lesions like giant cell tumors (GCT), granulation tissues and aneurysmal bone cysts show similar enhancement pattern like malignant lesions, while low vascular osteosarcomas and chondrosarcomas (malignant tumors) show relatively low slope characteristic of benign lesions. Higher sensitivity and specificity of MR spectroscopy in differentiating musculoskeletal tumors has been reported[1].

Materials and Methods

Thirty-two patients (male = 23, female = 9, mean age = 27 ± 14 years) with histological proven bone tumors were recruited for the study. All MR examinations were performed at 1.5 T using Siemens whole body MR scanners (Sonata/Avanto) with appropriate surface receiver coils. After localization and routine imaging, dynamic contrast enhanced images were acquired. Single voxel spectroscopy (SVS) using PRESS sequence was acquired with TR =2000 ms, TE = 30/135/270 ms and NS = 128-256. In case of heterogeneous and big tumors, volume selective 2D chemical shift image (CSI) was also performed by placing a 10-20 mm slab on the tumor, there by ensuring adequate sampling of the lesion (TR= 2000 ms, TE= 30/135/270 ms, NS = 4, FOV = 80 x 80 mm, VOI = 30 x 30 – 50 x 50 mm). Both single and multi-voxels were placed on the early enhancing portion of the tumor as revealed in dynamic contrast images. In all patients, at least two MR spectra were acquired at two different echo times from the same lesion. Water and fat resonances were simultaneously suppressed in both SVS and CSI using MEGA pulse wherever necessary. The criterion for determining the presence of choline resonance in a lesion is the appearance of an unperturbed resonance at 3.2 ppm in at least two of the spectra acquired at different echo times.

Results

In fifteen patients with histologically proven benign lesions (hemangioma = 1, Gorham's disease = 1, osteochondroma = 1, GCT = 12) choline resonance was absent except in four patients with GCT. In seventeen malignant lesions (Ewing's sarcoma = 4, chondrosarcoma = 5, osteosarcoma = 4, metastasis = 4) choline resonance was observed in thirteen cases, except in two cases of chondrosarcoma and two cases of osteosarcoma. In-vivo MR spectroscopy showed 76% sensitivity and 73% specificity in differentiating malignant and benign bone neoplasm. The positive and negative predictive values were 76 % and 73 %, respectively.

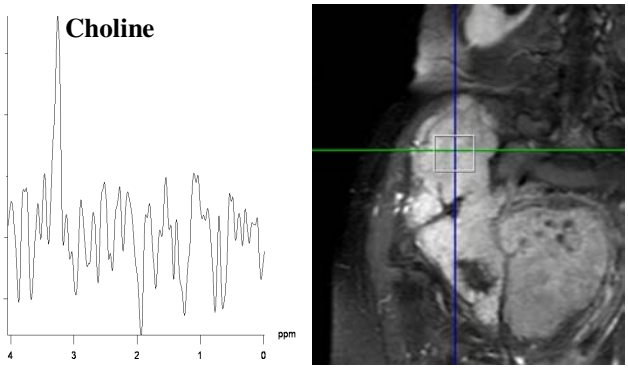

Fig.1 Spectrum obtained from GCT showing choline resonance

Discussion

Four benign lesions (GCT) showed false positive result (presence of choline), which may be due to that giant cell tumors are aggressive benign tumors with high cellularity and vasculature. Earlier studies support the observation of choline in such hyper cellular benign tumors[1]. Two cases each of chondrosarcomas and osteosarcomas gave false negative result. Post-operative histopathology examination of two patients with chondrosarcomas revealed that these were intermediate grade malignant tumors (Grade II). Unlike the previous report[1], the present study did not include any soft tissue tumors, which reduced the sensitivity and specificity of MR spectroscopy. Further work is in progress.

Conclusion

Due to the poor utility of dynamic contrast enhanced MRI in differentiating bone tumors, our results on MR spectroscopy shows the potential role in a clinical setting to differentiate malignant and benign bone tumors, even with its moderate sensitivity and specificity.

Reference

1. Wang C-K, et al., Radiology 2004; 232:599-605