Differentiation between benign and malignant compression fractures by measuring apparent diffusion coefficients of vertebral body bone marrows

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Introduction

It is difficult to differentiate between the benign and malignant compression fractures of the vertebral body on the basis of signal intensity with conventional T1 and T2-weighted images. Diffusion-weighted imaging (DWI) appears to be useful for the differentiation between these pathologies. However, there have been no published apparent diffusion coefficient (ADC) values of vertebral body lesions with a higher b value. DWI with single shot fast spin echo (DW-SSFSE) is expected to improve conspicuousness of lesions because of its lower susceptibility effect. The aim of this study was to measure the ADC values of vertebral body bone marrows in benign and malignant compression fractures and thus to evaluate the effectiveness of DW-SSFSE to differentiate between them.

Subjects and Methods

Ninety-three lesions in the vertebral bodies with (n=79) or without (n=14) compression fractures were studied in forty-three patients (22 men and 21 women, mean age was 66.8 years ranging from 24 years to 80 years), including forty benign compression fractures and thirty-nine malignant ones. Fourteen lesions having tumor infiltration without any definite compression fracture were also studied. DW-SSFSE was implemented on a 1.5T MRI system. Three images in sagittal plane were acquired with diffusion sensitization along the three directions with b=1000sec/mm^2 following an acquisition with b=0. ADCs were calculated in regions of interest (ROI) from DW-SSFSE images. In twenty-five patients, a syringe of distilled water was simultaneously scanned and the ADCs were calculated as a reference value.

Results

In all forty-three patients, the ROI could be set and the ADC could be calculated. Mean ADC value (1.15+-0.19 x 10^{-3}mm^2/sec; mean+-SD) of benign compression fracture (n=40) (Figure 1) were significantly higher ($p<0.05$) than those of (0.84+-0.19 x 10^{-3}mm^2/sec /sec) metastatic one (n=39) (Figure 2). The ADC values of the normal vertebral bodies in patients with benign compression fractures (0.19+-0.07 x 10^{-3}mm^2/sec /sec; mean+-SD) and in patients with tumor infiltration (0.21+-0.07 x 10^{-3}mm^2/sec /sec; mean+-SD) were significantly ($p<0.05$) lower than those of the benign and malignant lesions. The ADC values (2.44+-0.18 x 10^{-3}mm^2/sec; mean+-SD) of distilled water were consistent with known ones. When an ADC smaller than 1.10 x 10^{-3}mm^2/sec was used for predicting malignant compression fracture, the accuracy of 78%, with 77% sensitivity and 78% specificity, was obtained.

Conclusion

Although the ranges of the ADC values in benign compression fracture and tumor infiltration with or without compression fracture showed slight overlapping among these lesions, the overall trend of ADC values of benign compression fracture were higher than those of the malignant ones. ADC measurements may be useful in differentiation between benign and malignant compression fractures.

References

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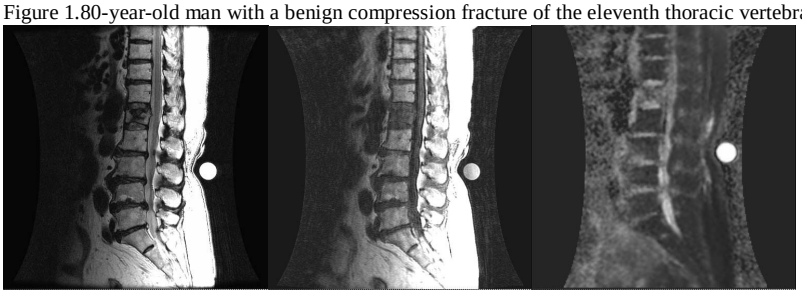
T2WI T1WI ADC map

Figure 1.80-year-old man with a benign compression fracture of the eleventh thoracic vertebral body. The ADC of the lesion was 1.81 x 10^{-3}mm^2/sec.



T2WI T1WI ADC map

Figure 2.78-year-old woman with a malignant compression fracture of the first lumbar vertebral body from hepatocellular carcinoma. The ADC of the lesion was 0.80 x 10^{-3}mm^2/sec.