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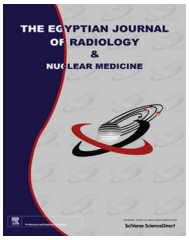

ORIGINAL ARTICLE

Atypical hemangioma and malignant lesions of spine: Can diffusion weighted Magnetic Resonance Imaging help to differentiate?

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KEYWORDS

Diffusion weighted Imaging (DWI) Magnetic Resonance Imaging (MRI);
Atypical hemangioma;
Metastasis

Abstract *Objective:* The aim of the work was directed to evaluate the value of diffusion weighted Magnetic Resonance Imaging in diagnosis, characterization and differentiation of atypical hemangioma and malignant lesions of spine.

Materials and methods: This study included three groups: group (A) 8 (33%) patients with metastatic bony lesions of spine, group (B) 6 (25%) patients with atypical hemangioma and group (C) 10 (42%) patients with typical hemangioma.

All patients were presented with different degrees of back pain. MRI was done for all patients (including T1, T2, T2 fat suppression and DWI with IV contrast administration when needed). Complementary non contrast CT was also done.

Results: Atypical hemangioma and malignant lesions were low in T1 and high in T2 WI. Restricted diffusion and low ADC values were seen in metastasis compared with atypical hemangioma. Complementary CT revealed the lytic nature of malignant lesions while in hemangiomas, it showed their characteristic striated appearance.

Conclusion: Diffusion weighted Magnetic Resonance Imaging is a useful tool in diagnosis, characterization and differentiation of atypical hemangioma and metastasis of spine.

1. Introduction

Metastasis to the spine has been reported to occur in 5–10% of patients having primary neoplasms. Therefore, in patients with a known primary or suspected unknown primary neoplasm presenting with back pain with or without spinal cord compression, metastasis is often suspected. One third of cancer patients with vertebral body compression had a benign lesion.

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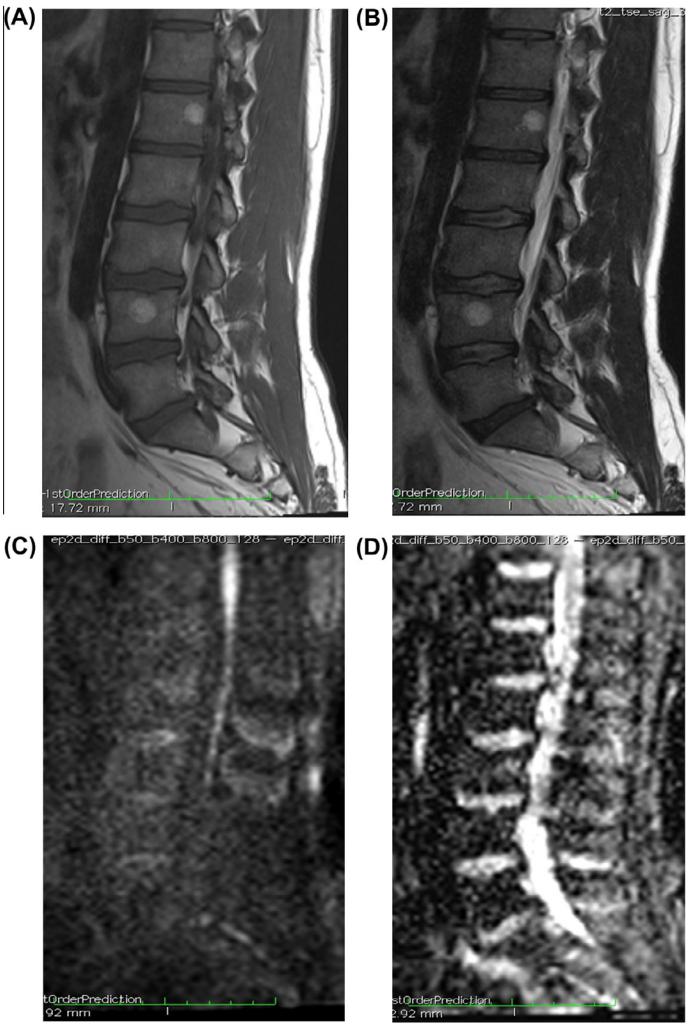

Fig. 1 Sagittal T1 (A) and Sagittal T2 (B)weighted images showing focal T1 and T2 hyper-intense lesion at LV4 and LV1 vertebral bodies with low signal at DWI (C) and subtle high signal at ADC map (D)...features of typical vertebral hemangiomas.

Consequently, benign spinal lesions may be confused with metastatic lesions and may even be treated as neoplasms unnecessarily using irradiation or chemotherapy (1).

Hemangiomas may be single or multiple, and they are being recognized with increasing frequency on magnetic resonance images. The stereotypical hemangioma usually causes no problems, because on MRI it appears hyperintense (bright) on T1- and T2-weighted images and enhances intensely on postcontrast T1-weighted, fat suppressed images. These lesions are sharply demarcated (2).

However, some hemangiomas do not have these stereotypical characteristics. Atypical hemangiomas, which may vary in appearance, include those that are hypointense on T1-weighted images but retain the typical characteristics on T2-weighted and fat-suppressed postcontrast images (2).

Conventional MR techniques cannot always be used to differentiate benign from malignant lesions because of their similar appearances. For example osteopenic or infective compression fracture can be indistinguishable from metastatic compression in the acute phase (3).

The rationale for using DWI is that differences between benign and malignant fractures are mainly due to cellularity and the free water content. As DWI is highly sensitive to cellularity and free water molecule mobility, DWI should be useful in differentiating between vertebral body compression fractures caused by malignant (tumor) and benign (infection and osteoporotic) lesions (3).

Differentiating atypical benign focal vertebral lesion from fractures caused by a malignant lesion poses a distinctive diagnostic problem, since both types of fracture exhibit similar signal changes on routine MR images. Recently, diffusion-weighted MR imaging has shown promising results in solving this diagnostic dilemma (4).

2. Materials and methods

This study included three groups: group (A) six patients with atypical hemangioma, group (B) eight patients with metastatic bony lesions of spine and group (C) 10 patients with typical hemangioma.

All patients were subjected to full history taking, and thorough clinical examination. Conventional and diffusion weighted MRI examinations of the spine were performed for all patients included in this study using Avanto 1.5T closed magnet MRI machine (Siemens, Germany).

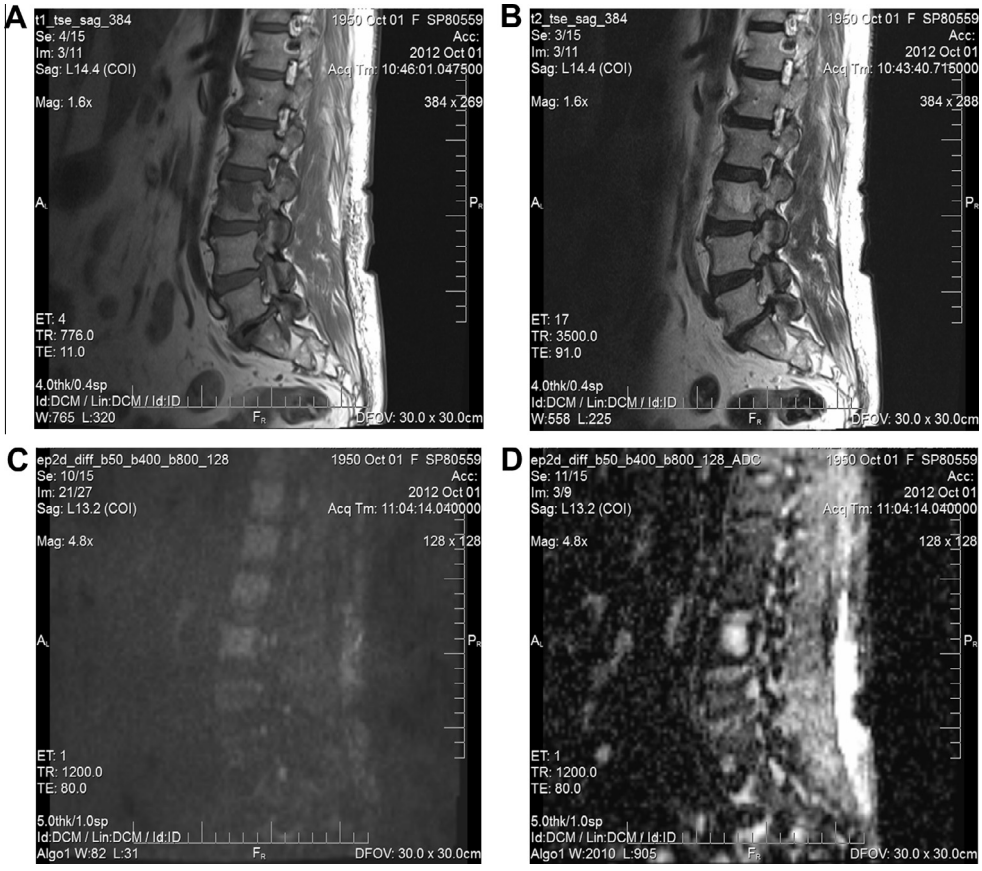

Fig. 2 Sagittal T1 (A) and Sagittal T2 (B)weighted images showing focal T1 hypo-intense and T2 hyper-intense lesion at LV3 vertebral body with minimal high signal at DWI (C) and high signal at ADC map (D). The corresponding axial (E), Sagittal (F) and coronal (G) CT images revealed a well defined hypo-dense lesion with internal coarse vertical trabeculae matching with atypical hemangioma.

Patients were subjected to the following MRI protocols: Axial and sagittal T1-weighted spin echo (SE), Axial and sagittal T2-weighted turbo spin echo (TSE), Sagittal T2-weighted fat suppression turbo spin echo (TSE), and Axial and sagittal T1-weighted fat suppression spin echo (SE) after intravenous administration (when needed) of 0.1 mmol/kg of Gad-DTPA (Magnevist, Germany).

The diffusion-weighted images were obtained in the sagittal plane by using a single-shot echo-planar sequence. The *b* values corresponding to the diffusion-sensitizing gradient were 0, 500, and 1000 s/mm^2. Isotropic DW images were generated by using the three orthogonal axis images. Diffusion-weighted images were processed to generate trace apparent diffusion coefficient maps for the whole patients.

Complementary non contrast CT was also done using 128 multislice CT unit (Aquilion, Toshiba, Japan).

3. Results

A total of 24 patients were examined. This study included three groups: group (A) 8 (33%) patients with metastatic bony lesions of spine, group (B) 6 (25%) patients with atypical hemangioma and group (C) 10 (42%) patients with typical hemangioma.

Atypical hemangioma (Fig. 2A–G) and metastatic bony lesions (Fig. 3A–D) of spine were low in T1 and high in T2 WI. Restricted diffusion was seen in metastasis while in atypical hemangioma it shows no restriction. Complementary CT revealed the lytic nature of metastatic bony lesions while in hemangiomas it shows its characteristic striated appearance.

Typical hemangioma (Fig. 1A–D) of spine displays high signal intensity in T1 and T2 WI. No restricted diffusion was seen in this group of patients compared with metastasis. Complementary CT revealed its characteristic striated appearance.

Significantly low ADC values were seen in metastatic bony lesions compared with typical and Atypical hemangioma. These differences were grossly apparent.

The mean ADC value of hemangiomas was found as 1.54×10^{-3} mm^2/s. The mean ADC value of metastatic bony lesions was found as 0.83×10^{-3} mm^2/s. We used the reported optimal ADC threshold of 0.96×10^{-3} mm^2/s for differentiating malignant from benign lesions. (8).

4. Discussion

Diffusion weighted magnetic resonance imaging is an excellent non-invasive modality to differentiate vertebral compression fracture from benign and malignant causes, and the presence of iso- or hypo intensity of the collapsed vertebral bodies is suggestive of a benign lesion while hyper intensity is highly suggestive of malignancy. Similarly low signals on ADC are highly suggestive of collapse from a malignant cause (1).

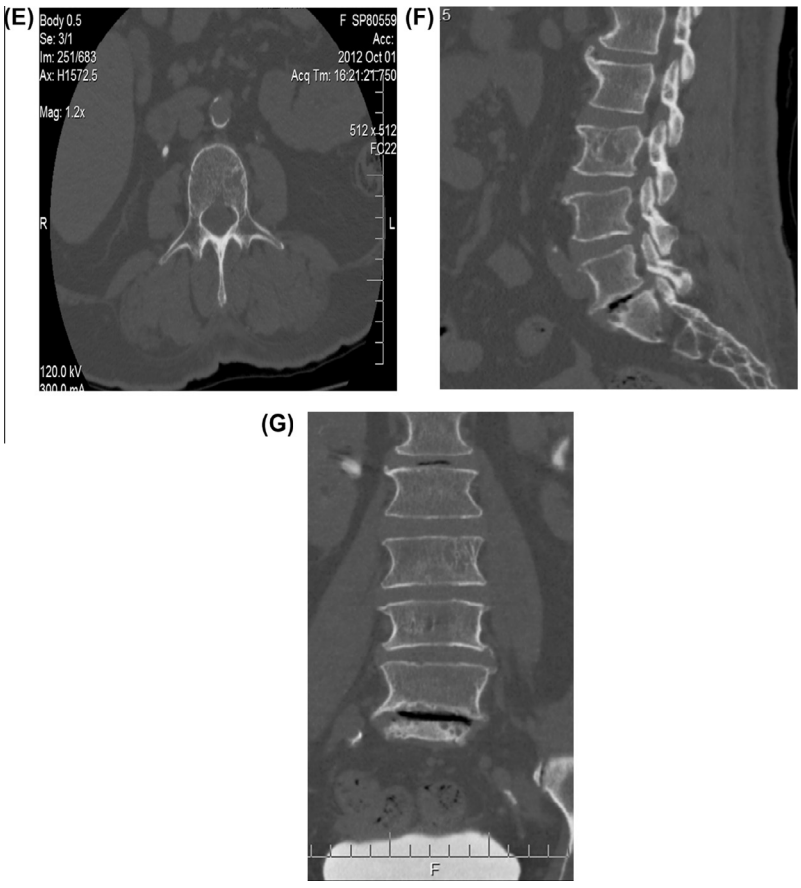

Fig. 2 (*continued*)

Over the last decade, DWI MR imaging of the vertebral body has proved its value and has been successfully implemented for the differentiation of vertebral benign collapse due to osteoporosis and malignant collapse due to tumor infiltration (6).

Navigated diffusion weighted interleaved echo-planar MR imaging of the spine is feasible for quantitative analysis of diffusion effects, and the ADC calculated from diffusion weighted MR images is a reliable parameter to distinguish vertebral metastases from normal vertebrae (7).

Vertebral bone-marrow pathologies could be differentiated with high sensitivity and specificity as benign or malignant with the help of ADC values calculated from maps obtained by DWI (8).

Common benign lesions that may be mistaken for metastases include acute osteopenic compression fractures of the spine and atypical hemangiomas. Contrary to the report by Castillo et al. (5), the new technique of using DWI combined with ADC mapping provides more reliable information to differentiate benign spinal lesions from metastases and may obviate the need for biopsy when in doubt (2,9).

In malignant disease, there are often multiple lesions. However, confusion may occur more often with a single lesion. Metastases usually are well-marginated or round lesions that are not parallel or related to the vertebral end plates. These lesions are hypointense on T1-weighted images, hyperintense on T2-weighted images, and enhanced on T1-weighted, fat-suppressed post-contrast images. Atypical hemangiomas, which may vary in appearance, include those that are hypointense on T1-weighted images but retain the typical characteristics on T2-weighted and fat-suppressed post-contrast images (5).

We report herein our experience regarding the value of diffusion weighted Magnetic Resonance Imaging in diagnosis, characterization and differentiation of atypical hemangioma and metastasis of spine.

We found atypical and typical hemangiomas in our study expressing non restricted diffusion in the form of low signal on DWI, while the metastases showed restricted diffusion in the form of high signal in DWI and low signal in ADC maps.

We found significantly low ADC values calculated in metastatic bony lesions compared with typical and atypical hemangioma. These differences were grossly apparent.

In our results the mean ADC value of hemangiomas was found as 1.54×10^{-3} mm^2/s. The mean ADC value of metastatic bony lesions was found as 0.83×10^{-3} mm^2/s.

This is in agreement with Taşkın et al. (8) who found that ADC values for atypical hemangiomas were between 1.94 and 2.82×10^{-3} mm^2/s. with a mean ADC value of $1.80 \pm 0.37 \times 10^{-3}$ mm^2/s, while the ADC values of malignant lesions were between 0.43 and 1.44×10^{-3} mm^2/s with a mean ADC value of $0.94 \pm 0.34 \times 10^{-3}$ mm^2/s. They reported a statistically proven optimal ADC threshold of 0.96×10^{-3} mm^2/s that can be used for differentiating malignant from benign vertebral lesions.

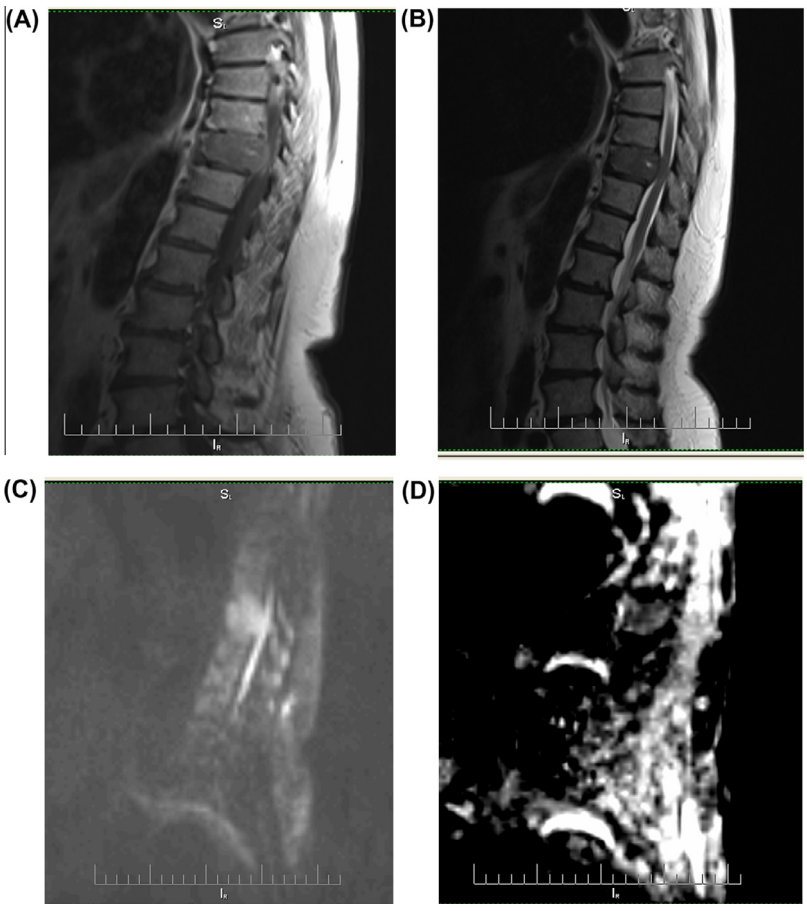

Fig. 3 Sagittal T1 (A) and Sagittal T2 (B)weighted images showing focal T1 hypo-intense and T2 (mixed hypo and hyper-intensity) at DV10 lesions of vertebral body with high signal at DWI (C) and low signal at ADC map (D) denoting restricted diffusion . . . features of metastasis.

Also our results are in agreement with Leeds et al. (2) who reported that hemangiomas had ADC values higher than those of metastases because of the contribution of water molecules within the vascular spaces.

5. Conclusion

We concluded that diffusion weighted Magnetic Resonance Imaging is a useful tool in diagnosis, characterization and differentiation of hemangioma (whether typical or atypical) and metastasis of spine. We recommend that DWI should be applied routinely in imaging of the spine especially if the patient has a history of primary neoplasm elsewhere.

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