ELSEVIER

Journal of Medical Imaging and Radiation Sciences xx (2017) 1-7

Journal of Medical Imaging and Radiation Sciences

Journal de l'imagerie médicale et des sciences de la radiation

www.elsevier.com/locate/jmir

Diffusion-weighted Magnetic Resonance Imaging in Non-traumatic Vertebral Collapse: A Relook Into Its Utility in Making the Diagnosis in Population Where Infections of Spine Are a Common Cause

Shazia Naaz, MD[a], Shagufta Wahab, MD[a*], Ekramullah, MD[a] and M.K.A. Sherwani, MS, MCh[b]

[a] *Department of Radiodiagnosis, JNMCH, AMU, Aligarh, Uttar Pradesh, India*
[b] *Department of Orthopaedics, JNMCH, AMU, Aligarh, Uttar Pradesh, India*

ABSTRACT

Aim: Magnetic resonance imaging (MRI) is the imaging investigation of choice in vertebral collapse. In this study, we considered various MRI features and appearance based on morphological features, signal intensity, contrast enhancement characteristics, and diffusion-weighted imaging (DWI) of various types of non-traumatic vertebral collapse for differentiating benign from malignant causes and its role in differentiating cases of infectious causes of vertebral collapse from malignant causes.

Materials and Methods: Between November 2014 to November 2016 a total of 100 consecutive patients from the MRI centre of JN Medical College and Hospital, Aligarh, were evaluated for the study. Inclusion criteria included patients presenting with backache, limb weakness, and fever who had undergone radiography of the spine that showed features of collapse. All patients underwent MRI on a 1.5 T MR Scanner. Coronal, sagittal and axial spine images were obtained using T1 weighted, T2 weighted, short tau inversion recovery, T1 postcontrast, and DWI sequences.

Results: In our study, we found different causes of non-traumatic vertebral collapse that were broadly categorized as benign or malignant. The benign causes were further sub-categorized into osteoporotic or infectious based on morphological features, signal intensity characteristics, and DWI. However, on DWI, the patients with infective collapse showed mean apparent diffusion coefficient values of 884 $\times 10^{-6}$ mm^2/s ranging between 700 and 1,100 $\times 10^{-6}$ mm^2/s between those of malignant and benign osteoporotic collapse, with significant overlap. The statistical difference between the malignant and infective cases, as well as between osteoporotic and infective cases, was not found to be statistically significant ($P > .05$).

Conclusion: MRI plays a key role in establishing the cause of vertebral collapse, classifying it as either benign or malignant. DWI, although described in various studies as highly sensitive in differentiating benign osteoporotic and malignant collapse, was found to be good in differentiating only osteoporotic from malignant collapse, with the infectious cases proving to be a grey zone with significant overlap of quantitative diffusion findings.

RÉSUMÉ

But : L'IRM est la modalité de choix en cas de tassement vertébral. Dans cette étude, les auteurs ont examiné différentes caractéristiques de l'image et son apparence selon les caractéristiques morphologiques, l'intensité du signal, les caractéristiques d'amélioration du contraste et l'imagerie de diffusion pour différents types de tassement vertébraux non traumatiques, de façon à différencier les causes malignes des causes bénignes et son rôle dans la différentiation des cas de causes infectieuses du tassement vertébral des causes malignes.

Matériel et méthodologie : Un total de 100 patients consécutifs de novembre 2014 à novembre 2016 qui se sont présentés au centre d'IRM du JN Medical College and Hospital d'Aligarh ont été évalués dans le cadre de cette étude. Les patients présentaient des caractéristiques cliniques comme des maux de dos, une faiblesse des membres inférieurs et de la fièvre, et avaient subi des radiographies de la colonne vertébrale indiquant un tassement vertébral. Tous les patients ont subi un examen d'IRM sur un scanner 1.5 T MR. Des images coronales, sagittales et axiales ont été prises au moyen de séquences d'images T1 pondéré, T2 pondéré, STIR, T1 post-contraste et diffusion.

Résultats : Les auteurs ont constaté différentes causes de tassement vertébral non traumatique, largement catégorisées entre causes malignes et bénignes. Les causes bénignes ont ensuite été sous-catégorisées en causes ostéoporotiques et causes infectieuses, selon les caractéristiques morphologiques, les caractéristiques d'intensité du signal et les résultats de l'imagerie de diffusion. Cependant, sous imagerie de diffusion, les patients affichant un tassement infectieux présentent une valeur ADC moyenne de 884 10^{-6} mm^2/s, avec des variations entre 700–1,100 $\times 10^{-6}$ mm^2/s, une valeur intermédiaire entre le tassement ostéoporotique malin et bénin, avec cependant des chevauchements importants. L'étude n'a pas permis de trouver une différence

Conflict of interests: The authors have no financial disclosures or conflicts of interest to declare.

* Corresponding author: Dr. Shagufta Wahab, MD, Kashan-e-Wahab, Street no 4, Iqra Colony, Aligarh, Uttar Pradesh, India.
E-mail address: drshaguftawahab@rediffmail.com (S. Wahab).

1939-8654/$ - see front matter
http://dx.doi.org/10.1016/j.jmir.2017.07.001

statistiquement significative entre les cas malins et bénins et entre les cas d'ostéoporose et d'infection ($P > 0.05$).

Conclusion : L'IRM joue un rôle important pour établir la cause du tassement vertébral, en permettant de le classer selon les causes bénignes ou malignes. L'imagerie de diffusion, bien que décrite dans plusieurs études comme étant hautement sensible pour différencier entre le tassement ostéoporotique et malin, n'a permis dans notre étude que de distinguer le tassement ostéoporotique du tassement malin, le tassement infectieux s'avérant une zone grise présentant un chevauchement significatif de résultats quantitatifs.

Keywords: Vertebral collapse; MRI; diffusion weighted imaging

Introduction

Vertebral collapse is a frequently encountered entity in clinical practice and broadly categorized into traumatic vertebral collapse and non-traumatic vertebral collapse. The non-traumatic vertebral collapse is further subcategorized as benign or malignant collapse. Magnetic resonance imaging (MRI) is not only important in making the diagnosis, but also helps in determining the exact site of vertebral collapse and extent of disease, which is important for deciding the management strategies [1, 2]. Distinction into benign and malignant etiology is often problematic, especially in the elderly, where benign osteoporotic collapse are as frequent as malignant collapse; and in India, infections such as tuberculosis also contribute significantly [3, 4]. Even in cases with known primary malignancy, more than one-third of the cases of vertebral collapse are due to benign causes mostly because of the malignancy-associated osteopenia and osteoporosis. Also, because many primary cancer patients may be immunocompromised, the possibility of infectious vertebral collapse must also be entertained [1, 3, 5].

This study helped in differentiating and diagnosing various causes of non-traumatic vertebral collapse, which were broadly categorized as benign or malignant. The benign causes were further sub-categorized into two major groups, infective or osteoporotic. The purpose of this study was to evaluate the MRI appearance of various types of non-traumatic vertebral collapse and to differentiate benign from malignant causes based on morphological features, signal intensity characteristics, and diffusion-weighted imaging (DWI).

Materials and Methods

This was a prospective observational study conducted on 100 patients from November 2014 to November 2016 in JN Medical College and Hospital. Ethical approval was granted from the institutional research ethics board. The age selection range varied from 16 to 80 years. Before undergoing imaging investigations, patients were assessed by thorough clinical history and physical examination. All the patients had previous radiography of the spine that showed collapse for selection of MRI data sets.

Imaging

All patients were subjected to MR examination of the spine on a 1.5 T superconducting system (MAGNETOM Avanto; Siemens). Standard surface coils were used. Initially, Scout imaging was performed in at least 2 planes. After scout views, T1-weighted spin-echo MR images with a short repetition time (TR 400–500 ms) and a short echo time (TE 20 ms) was performed. T2-weighted turbo spin-echo image with long repetition time (TR 3,000–7,000) and long echo time (TE 120–150 ms) was performed in sagittal plane. Short tau inversion recovery (STIR) sequence with inversion time (TI 160 ms), repetition time (TR 3,400 ms), time to echo (TE 370 ms), and postcontrast images were also obtained. OptiMARK (Gadoversetamide) contrast injection was administered in the dose of 0.5 mmol/kg and post-contrast fat-saturated T1-weighted images were obtained. Coronal, axial, and sagittal images were obtained in various sequences as mentioned previously as per the clinical indication.

DWIs were acquired in sagittal section using Echo Planar Imaging with diffusion gradient applied in slice selection, phase encoding, and readout gradient at 3 b-values (b-value 0, 400, and 800). The individual source images were combined to form trace image by the work station with further acquisition of apparent diffusion coefficient (ADC) map. Quantitative assessment of ADC was done using region of interest curve, placing it over the collapsed vertebra and covering its entire circumference. The MRI images were then analyzed based on the location, segment of the spinal cord involvement, and severity of the injury. After preliminary findings were noted by two radiologists (with 3 years and more than 7 years of experience, respectively), the report was finalized by the senior radiologist (with more than 10 years of experience). The malignant and infective etiologies were confirmed by Fine Needle Aspiration Cytology.

Statistical Analysis

Data obtained were statistically analyzed using an unpaired t-test to evaluate the hypothesis that quantitative diffusion studies can better distinguish between benign osteoporotic, infective, and malignant vertebral collapse. Results were treated as statistically significant when P values were $< .05$.

Results

In our study, we found different causes of non-traumatic vertebral collapse that were broadly categorized into benign or malignant based on MRI features. Benign cases were further sub-categorized into osteoporotic or infectious. Of 100 patients, 48 were male and 52 were female. The age