Original Investigation

Differentiation Between Brucellar and Tuberculous Spondylodiscitis in the Acute and Subacute Stages by MRI: A Retrospective Observational Study

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Rationale and Objectives: The aim of this study was to reveal the distinctive features of magnetic resonance imaging (MRI) for distinguishing brucellar spondylodiscitis (BSD) from tuberculous spondylodiscitis (TSD) in the acute and subacute stages.

Methods: This study involved 14 patients with BSD and 18 patients with TSD from May 2011 to January 2015. BSD was diagnosed based on ≥1/160 titers of a Brucella agglutination test or isolation of *Brucella* spp. TSD was diagnosed based on the isolation of tuberculosis bacteria. All patients underwent T1- and T2-weight imaging (T1WI and T2WI) and fat suppression T2WI (FS T2WI). The height and the signal intensity (SI) of the vertebra and intervertebral disc were assessed. The distinctive MRI features were compared using the chi-square test. The SI of the vertebra between BSD and TSD was observed in terms of histogram characteristics of kurtosis, skewness, and percentile (75%–25%) on FS T2WI.

Results: Twenty-nine (76.3%) vertebrae of BSD were infected throughout the whole vertebra, and 49 (90.7%) vertebrae of TSD were infected near the osseous end plate ($P < .001$). Compared to TSD, the vertebral height of BSD was nearly intact ($P < .001$), owing to the new bone formation in the end plate without vertebral collapse. Furthermore, significant differences in the SI of the vertebra were observed between patients with BSD and TSD in terms of homogeneous characteristics on FS T2WI, that is, kurtosis (BSD vs TSD, 0.107 vs –0.250, $P = .023$), skewness (BSD vs TSD, –0.021 vs 0.266, $P = .017$), and percentile (75%–25%) (BSD vs TSD, 54.498 vs 79.399, $P = .00049$).

Conclusions: The nearly intact vertebra with homogeneous high signal on FS T2WI was an important MRI feature for distinguishing BSD from TSD in the acute and subacute stages.

Key Words: Spine; brucellosis; tuberculosis; magnetic resonance imaging.

INTRODUCTION

Brucellosis is an important systemic zoonotic infection. Having a worldwide distribution, it mainly affects people in developing countries (1). It is endemic in areas such as the Mediterranean region, the Arabian Peninsula, the Indian subcontinent, Mexico, and parts of Central and South America. It is considered a public health problem in many countries. Brucellosis has variable and nonspecific clinical signs and symptoms. The majority of symptoms are fever, sweat, weakness, anorexia, headache, and backache. Its diagnosis may be difficult because brucellar spondylodiscitis (BSD) may resemble tuberculous spondylodiscitis (TSD) regarding similar clinical presentation and symptom in the acute (<3 months) and subacute (3–12 months) stages (2). BSD is easy to miss or may be misdiagnosed as TSD. A delayed diagnosis without appropriate treatment in the acute or subacute stages may lead to clinical morbidity and loss of productivity (3). The clinical differentiation of BSD and TSD is important because the medications used to manage these infections are notably different. Early diagnosis and prompt treatment with antibrucellar chemotherapy is known to be an effective treatment, whereas surgical decompression is rarely needed (4–7).

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TABLE 1. Imaging Parameters of Magnetic Resonance Imaging Scan

Sequence	TR/TE (ms)	FOV (mm)	Matrix	ST (mm)	NEX	ETL	SN	TA
T1WI	520/8	270 × 270 (cervical)	236 × 234	3	3	33 (cervical)	12	2 min 3 s (cervical)
		350 × 350 (thoracic)				30 (thoracic)		2 min 31 s (thoracic)
		300 × 300 (lumbar)				26 (lumbar)		1 min 43 s (lumbar)
T2WI	3363/107	270 × 270 (cervical)	236 × 234	3	3	33 (cervical)	12	2 min 3 s (cervical)
		350 × 350 (thoracic)				30 (thoracic)		3 min 36 s (thoracic)
		300 × 300 (lumbar)				26 (lumbar)		2 min 7 s (lumbar)
FS T2WI	3500/60	270 × 270 (cervical)	236 × 234	3	3	33 (cervical)	12	2 min 41 s (cervical)
		350 × 350 (thoracic)				30 (thoracic)		2 min 18 s (thoracic)
		300 × 300 (lumbar)				26 (lumbar)		3 min 32 s (lumbar)

ETL, echo-train length; FOV, field of view; NEX, number of excitations; SN, slice number; ST, section thickness; TA, time of acquisition, TE, echo time; TR, repetition time.

Therefore, it is essential to screen first, relying on the imaging characteristics to determine whether it is brucellosis.

There are no previous studies differentiating BSD and TSD in the acute and subacute stages. The earliest response to vertebral osteomyelitis is the accumulation of water in the marrow. Early changes in the infected vertebral bodies have been previously observed on conventional T1- and T2-weighted images (T1WI and T2WI) (8). Fat suppression (FS) T2WI is more sensitive and reliable in the detection of water protons in contrast to T1WI and T2WI (9). Hence, the aim of our study was to compare the height and signal intensity (SI) of the vertebra and intervertebral disc to distinguish BSD from TSD in the acute and subacute stages using FS T2WI technique.

MATERIALS AND METHODS

Patient Selection

This was a retrospective observational study in which patients with BSD and TSD were enrolled in our hospital from May 2011 to January 2015. The study was approved by the institutional review board of the hospital and the patients signed informed consent forms.

The inclusion criteria were as follows: (1) Relevant clinical symptoms for less than 12 months and without any treatment. (2) All magnetic resonance (MR) images were obtained 1 week before the microbiological examination. Magnetic resonance imaging (MRI) manifestations of spondylodiscitis should include at least one morphologic and signal abnormality in the vertebra or the intervertebral disc or paravertebral or epidural region in accordance with infectious signs (8). (3) Microbiological evidence should suggest a positive agglutination test at a titer of 1/160 or higher or isolation of *Brucella* spp. or tuberculosis bacteria from the blood, bone, bone marrow, deep soft tissue, or (paravertebral, epidural) abscess (8,10).

MRI Protocols

The MRI of spine was performed using 1.5 T clinical scanner (Achieva, Philips Healthcare, Amsterdam, The Netherlands). Conventional spine MR images were acquired with a 15-channel cervical-thoracic-lumbar spinal radiofrequency coil (SYN Spine, Philips Healthcare). The fast spin-echo sequence was used for sagittal T1WI, T2WI, FS T2WI, and transverse T2WI. The scanning parameters were summarized in Table 1.

Image Analysis

Assessment of Vertebra Signal Distribution and Height of the Vertebra and Disc

As stated in prior reports (4), the infected vertebra of BSD and TSD in the early stage presented high SI on FS T2WI. According to the distribution location of high SI, the infected vertebra was classified into two forms. In type A (4), the high SI is distributed throughout the whole vertebra. In type B (4), the high SI is located near the osseous end plate. On T1WI, the height of the involved vertebra and intervertebral disc were classified as normal or flat compared with the adjacent normal vertebra and intervertebral disc (11,12).

Signal Intensity Measurement of the Vertebra and Disc

For the SI of the vertebra, the region of interest (ROI) in the middle section of the sagittal FS T2WI was manually drawn along the margin of the lesion (Fig 1a). For the SI of the disc and cerebrospinal fluid (CSF), an oval ROI with area of 5–10 mm^2 was manually drawn in the middle section of sagittal FS T2WI (Fig 1a). The average ratio of SI_{disc}/SI_{CSF} was acquired and classified into three grades according to Jaakko's study (13). The ratios of 0%–30%, 30%–60%, and 60%–100% correspond to grades 1 to 3, respectively.

All MR images were assessed by two experienced radiologists (with 17 and 13 years of experience in spine MRI) with blinded clinical information. They independently reviewed the images twice with a 2-week interval. The MR images were anonymized and reviewed on the same workstation with the same window width and level. The intra- and interobserver agreements were evaluated. Finally, disagreements regarding image findings were resolved by discussion and mutual agreement.