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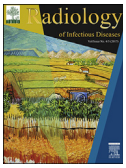
Radiology of Infectious Diseases 4 (2017) 102−107



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Research Article

Diagnosis and classification in MRI of brucellar spondylitis

Lianfang Shen [a], Changqin Jiang [a], Ruisheng Jiang [a], Wei Fang [a], Qiang Feng [a], Lishan Wang [a], Cuiping Wu [b], Zhijun Ma [a,*]

[a] *Department of Radiology, Affiliated Yidu Central Hospital, Weifang Medical University, Weifang 262500, Shandong, People's Republic of China*
[b] *Department of Infectious Diseases, Affiliated Yidu Central Hospital, Weifang Medical University, Weifang 262500, Shandong, People's Republic of China*

Received 3 August 2017; accepted 21 August 2017
Available online 21 September 2017

Abstract

Objective: To explore the magnetic resonance imaging (MRI) features of patients with brucellar spondylitis and try to classify them depending on the MRI findings.
Material and methods: 67 patients (male&female: 50&17) with brucellar spondylitis were recruited in this study. MRI examinations were performed in all patients. Firstly, MRI data were analyzed by two senior radiologists. Secondly, according to the imaging findings, patients were divided into different types.
Results: In all 67 patients with spinal brucellosis, 5 cases only had paravertebral soft tissue involved, 62 cases showed abnormal signal in single or multiple adjacent vertebrae. Thirty-five patients focused on the L4 vertebral involvement. 18 cases had appendage involvement. 27 cases hand intervertebral disc narrowing and cystic signal. Paravertebral, epidural and psoas abscesses were detected in 35, 20 and 8 cases.

Patients were grouped according to MRI findings. The vertebral inflammatory type was the most frequently type with the rate of 35.8%, followed by discitis type 32.9%, adnexitis type 11.9%, paravertebral and psoas abscess type 11.9% and paravertebral soft tissue type 7.5%.
Conclusion: It is not difficult to diagnose brucellar spondylitis in MRI findings based on clinical background and laboratory tests. According to the performance of MRI, five types can be classified.

Keywords: Brucellar; Spondylitis; MRI; Classification

1. Introduction

Brucellosis is an endemic zoonotic disease, especially in some developing countries including China [1]. The osteoarticular involvement of brucellosis is the most common complication and the ratio can range from 10 to 85% in the published series [2]. Osteoarticular involvement includes spondylitis, spondylodiscitis, sacroiliitis and arthritis, and paraspinal abscess et al. The spondylitis is the most prevalent manifestation, which is mainly located at the lumbar spine [3].

The diagnosis of brucellar spondylitis is always difficult, because the clinical and radiological findings are usually nonspecific and easy misdiagnosed as other disease. Despite all of these, it has been reported that MRI can differentiate brucellar spondylitis from other spinal infections, along with a good clinical background [4]. MRI is the most sensitive technique to the signal changes in vertebral, intervertebral disc and paravertebral soft tissues.

The purpose of this study was to report the clinical and MRI findings of patients with brucellar spondylitis and try to classify the brucellar spondylitis into different types according to the performance of MRI.

2. Material and methods

This retrospective study included 67 cases (17 women and 50 men; mean age 56.6 years; age range 18−83 years) of brucellar spondylitis which were all visited our Department of

* Corresponding author.
E-mail address: fmrishenlf@126.com (Z. Ma).
Peer review under responsibility of Beijing You'an Hospital affiliated to Capital Medical University.

http://dx.doi.org/10.1016/j.jrid.2017.08.005

Infectious Diseases between October 2013 to March 2017. The diagnosis of brucellosis was accord to their clinical presentation, laboratory examinations and clinical response to the treatment [5].

A 1.5-T (Avanto, Siemense) and 3-T (Skyra, Siemense) MRI scanner were used for scanning.

MRI sequences and imaging protocol of 3-T were obtained sagittal spin-echo T1 weighted images (TR/TE: 746/8.7), fast spin-echo T2-weighted images (TR/TE: 3620/109) and fat-suppressed T2-weighted images (TR/TE: 3000/82), axial spin-echo T2-weighted images (TR/TE: 3000/94). 1.5 T MRI scanner was obtained sagittal spin-echo T1-weighted and fast spin-echo T2 weighted images and fat-suppressed T2-weighted images (TR/TE; 624/11, 3000/98, 3500/85) and axial spin-echo T2-weighted images (TR/TE: 3740/105).

All of the images were evaluated by two experienced radiologists independently and a classification was made. Indicators evaluated included their location, the morphological and signal changes in affected vertebra bodies and accessories, intervertebral disc spaces, paravertebral soft tissue and epidural spaces.

3. Results

3.1. Clinical and laboratory features

All 67 patients were diagnosed with spinal brucellosis. The mean age of patients was 56.6 ± 12.1 years (50 males, 17 females; age range: 18−83 years). 64 patients had a history of close contact with sheep. At admission, 64 patients had fever, and all were showed undulating pattern, 33 patients above 38 °C were found. 67 patients had back pain, leg pain was presented in 6 patients and arthralgia in 14 patients (hip 9, knee 3, wrist 1, shoulder 1). Sweating was found in 12 patients. 11 patients presented with Weakness or fatigue. In addition, anorexia, nausea or vomiting, testicular pain flustered and abdominal distention were found in patients.

65 (97%) patients were positive for the Rose Bengal Plate test. Standard tube agglutination testing of initial samples (before the onset of treatment) from the 35 (52.2%) patients was positive (titer, ≥1/160). Blood cultures were positive in 26 (38.8%) patients. 10 (14.9%) patients were positive for antibody to Brucella.

The symptoms, clinical and laboratory findings were shown in Table 1.

Table 1
Symptoms, Clinical and laboratory features of 67 patients with brucellar spondylitis.

Patients	Sex	50 male (74.6%), 17 female (25.4%)
	Age (mean ± SD years)	(56.6 ± 12.1)
	Occupational exposure	64 (95.5%)
Symptom	Fever (≥38 °C)	33 (49.3%)
	Back pain	67 (100%)
	Leg pain	6 (9%)
	Arthralgia	Hip 9 (13.4%), knee 3 (4.5%), wrist 1 (1.5%), shoulder 1 (1.5%)
	Sweating	12 (17.9%)
	Weakness or fatigue	11 (16.4%)
	Anorexia	5 (7.5%)
	Nausea	3 (4.5%)
	Vomiting	2 (3%)
	Other	Testicular pain 1 (1.5%) headache 1 (1.5%) flustered 1 (1.5%) abdominal distension 1 (1.5%)
Laboratory findings	RBPT[a]	65 (97%)
	SAT[b](>1:160)	35 (52.2%)
	Blood culture	26 (38.8%)
	Brucella antibody	10 (14.9%)

[a] RBPT: Rose Bengal plate test.
[b] SAT: Standard tube agglutination test.

3.2. MRI findings and types

Sixty-two patients had abnormal signal in affected vertebral body (Fig. 1). Single vertebral involvement was found in 6 patients (9.0%, 6/67), two vertebral bodies involvement was found in 40 patients (59.7%, 40/67), more than two vertebral bodies involvement was found in 16 patients (23.9%, 16/67). And in these 56 patients (≥2 vertebral bodies involvement), 54 patients with contiguous affection were obtained. The lower lumbar vertebral was the most frequently involved region, particularly at the level of the L4 vertebra (52.2%, 35/67), followed by L5 vertebra (44.8%, 30/67) and L3 vertebral (40.3%, 27/67). MRI imaging showed long T1 and long T2 or heterogeneous signal intensity of the vertebral bodies. Hyperintense signal on T2 or fs T2-weighted image of disc was found in 27 patients (Fig. 2). Affected disc space narrowing was detected in 27 patients (Fig. 2). 18 patients showed hyperintense signal on T2 weighted imaging in appendage. 35 cases had paravertebral abscess, epidural abscess formation was detected in 20 patients, whereas paravertebral abscess formation was detected in 8 cases (Fig. 3). And 5 cases only had paravertebral soft tissue involved (Fig. 4).

The imaging abnormalities in patients with brucellar spondylitis were summarized in Table 2.

Patients with brucellar spondylitis can be classified into 5 types. The vertebral inflammatory type was the most frequently type with the rate of 35.8% (24/67). 22 (32.9%, 22/67) patients were defined as discitis type, and the rate of adnexitis type and paravertebral and psoas abscess type was 11.9% (8/67) and 11.9% (8/67). Five cases (7.5%, 5/67) only had paravertebral soft tissue involved, that was being taken for paravertebral soft tissue type.

4. Discussion

Brucellosis is still a major public problem, which may cause a high degree of morbidity in many countries [1]. Direct or indirect contact with infected animals or milk products is common way of spread to human. Because of many organs and tissues affected, the patients can present with a wide of clinical symptoms [6]. In Qingzhou City, there are many Muslim residents. They have more opportunity of close

Fig. 1. Lumbar magnetic resonance images from a 65-year-old man with brucellar spondylitis, vertebral inflammatory type. (A) T1-weighted image reveals homogeneous hypointensity in L1 and L2 vertebral bodies (white arrow). (B) Fat-suppressed T2-weighted image shows hyperintense signal intensities corresponding to the same level (white arrow).

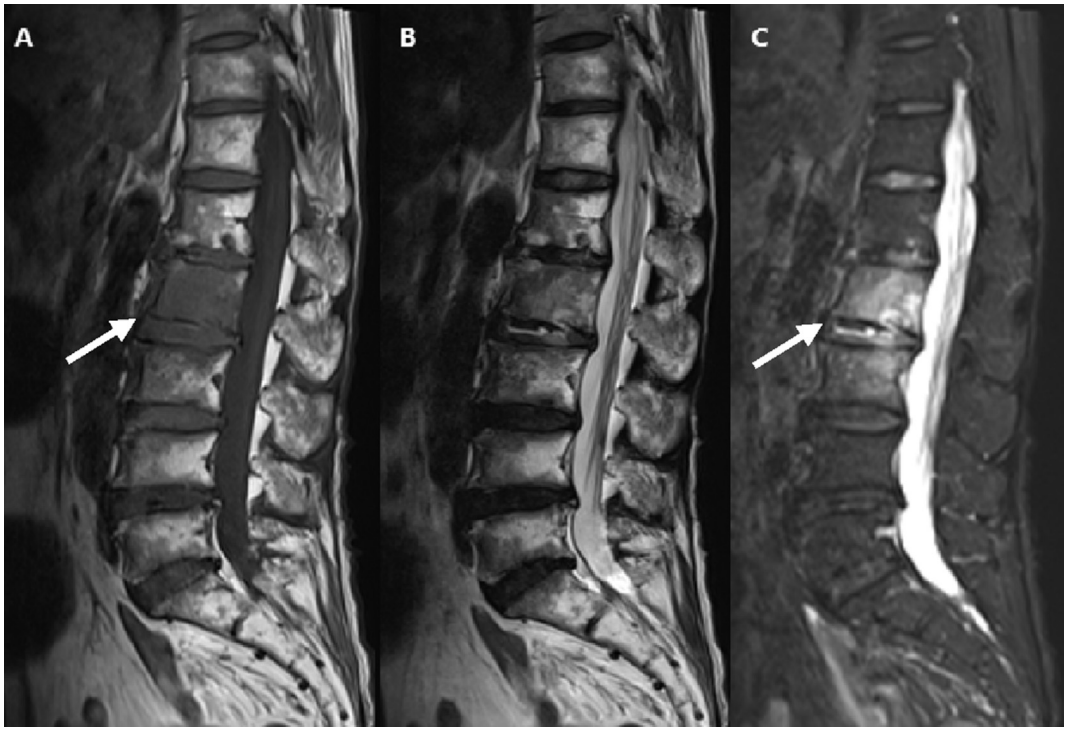

Fig. 2. (A) 65-year-old woman. A Sagittal T1-weighted image reveals hypointensity in L2-3 vertebral bodies (white arrow). (B and C) Sagittal T2 and fat suppressed T2-weighted image shows high signal in the same vertebral bodies as well as narrowing and hyperintensity of intervertebral disk spaces.

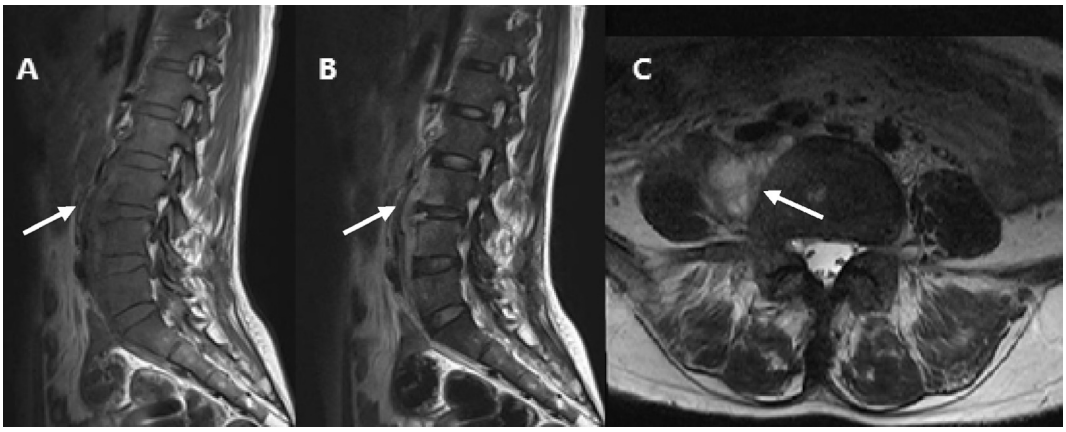

Fig. 3. (A) 38-year-old woman, paravertebral and psoas abscess type. (A and B) sagittal T1 and T2-weighted MRI of lumbar spine showing spondylitis on L3-4 and discitis, as well as paravertebral abscess (white arrow). (C) Axial T2-weighted MRI showing the psoas abscess (white arrow).

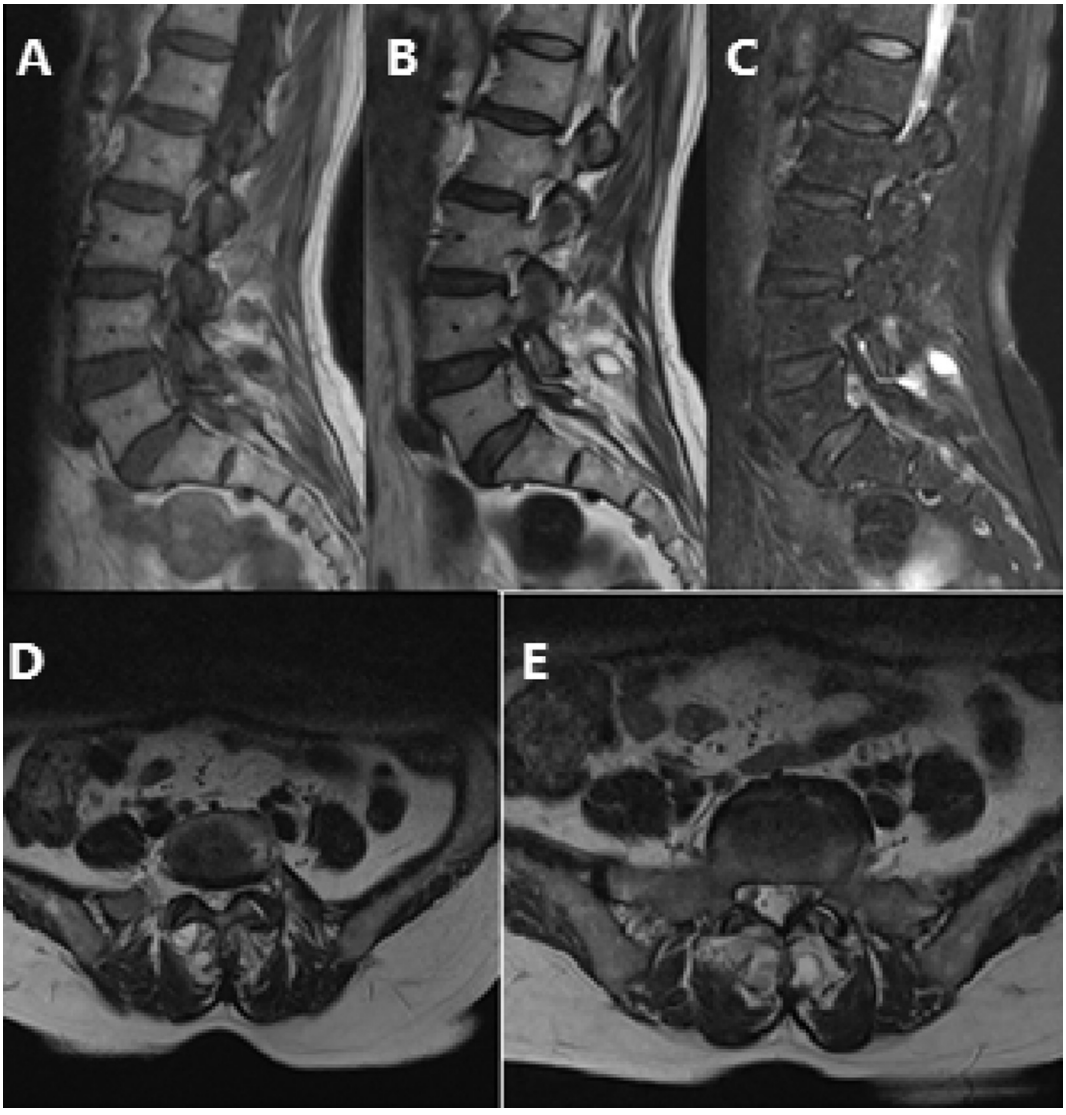

Fig. 4. (A) 59-year-old woman, paravertebral soft tissue type. (A, B and C) Sagittal T1, T2 and fs T2-weighted MRI demonstrates the infectious lesion affecting the soft tissue behind the processus spinosus (white arrow). (D and E) Axial T2-weighted MRI showing hyperintensity in affected soft tissues (white arrow).

Table 2
MRI findings in 67 patients with brucellar spondylitis

MRI findings		Results
Location	L3	27 (40.3%)
	L4	35 (52.2%)
	L5	30 (44.8%)
Number(s) of affected vertebral	0	5 (7.5%)
	1	6 (9.0%)
	2	40 (59.7%),
	≥3	16 (23.9%)
Intervertebral disc	Hyperintense signal on T2-weighted image of disc	27 (40.3%)
	Disc space narrowing	27 (40.3%)
Appendage	Hyperintense signal on T2-weighted image	18 (26.9%)
Paravertebral soft tissues	Paravertebral abscesses	35 (52.2%)
	Epidural abscesses	20 (29.9%)
	Psoas abscesses	8 (11.9%)

contact with an animal or consumption of meat (mainly cattle and sheep) or dairy products infected by bacteria of the genus Brucella, so the incidence of brucellosis disease is higher.

Brucellosis is a systemic infection, so any system or organ can be involved, such as musculoskeletal system, central nervous system, respiratory system, liver and epididymis, especially in bone and joint [2,7−10]. Osteoarticular involvement includes spondylitis, sacroiliitis, osteomyelitis, peripheral arthritis, bursitis and tenosynovitis, but the spine is the most frequent site [3]. Lumbar region was noted as the most common location of involvement which was considered to be related rich blood supply of this region. And endplate degeneration is more frequent at lumbar vertebrae and this may be considered another contributing factor [11,12].

Brucellosis was diagnosed by their clinical presentation, laboratory examinations and clinical response to the treatment [5]. In our work, all patients had lumbar involvement. Brucellar spondylitis has been reported more frequently in adults and the elderly, especially those over 50 years of age [13]. In ours, the mean age of patients was 56.6, slightly higher than the result reported by Bodur [13]. In this work, most patients were male, which was consistent with a previous study [14]. We consider that is related to following reasons: 1. sample differences; 2. men have more opportunity of occupational exposures than women in this region. The disease exhibits nonspecific sympomatology and clinical manifestations, such as back pain, fever, and constitutional symptoms. In our study, back pain (100%) was most commonly encountered. And fever, arthralgia, sweating or weakness et al. was found in partial patients. All of the above symptoms were reported.

Radiological diagnosis of spondylitis is based on the MRI findings, radiographs of the spine, and computed tomography (CT). Compared with radiographs of the spine and CT, MRI has some advantages like higher sensitive to the signal changes in vertebral, better definition of the involvement of the paravertebral and intervertebral disc [15]. In addition, because of non-invasive and non-radiation, MRI has a better repeatability compared with the other examinations stated above. So, MRI imaging is currently the best imaging tool for diagnosis and follow-up in patients with spinal infections.

The patients of brucellar spondylitis showed hypointense signal on T1-weighted imaging, heterogeneous hyperintense signal on T2-weighted imaging and obvious hyperintense signal on fat suppressed T2-weighted imaging. It can infect single vertebral body or multiple vertebral bodies. Previous studies reported the rate of multilevel involvement was around 4.5−36% [12,16]. And in this study, the rate of multilevel (≥2 vertebral bodies) involvement was 83.6% (56/67), especially in two vertebral bodies. Single vertebral involvement was detected in 9% (6/67) patients. We suspected that the difference may be caused by the different sample sizes.

Infection can spread to neighbour vertebral bodies or discs via the ligaments and vascular communications, contiguous involvement of more than one vertebral or noncontiguous multifocal spinal involvement has been reported [4,17]. But noncontiguous spine levels involvement are rare in brucella spondylodiscitis [4,17]. In our series, contiguous involvement at multiple levels (≥2 vertebral bodies) was detected in 54 patients and noncontiguous involvement at multiple levels was detected in 2 patients. That was consistent with previous studies. L4 vertebra was the most frequently involved region in this study, with the rate of 52.2%. That was identical with a previous literature [2]. However, Ozaksoy et al. reported that L5 was the most common affected vertebral body [11]. The difference between L4 and L5 had not statistical significance. None of our cases showed vertebral collapse, as described by other author [11]. The process can extend to the adjacent disc space, which showed disc space narrowing and increased signal intensity. In our study, 40.3% of the cases showed discitis in the vertebral body close to the inferior edge of the intervertebral disc space, and slightly lower than that reported by Kazak et al. [6]. These high rates may be attributed to the fact that most patients have a long medical history when the first admission. In our study, 18 patients showed vertebral bodies and their accessories signal changes. That may support that the development of brucellar spondylitis from vertebral to adjacent structures. Compared with other infective diseases, soft tissue swelling, paravertebral and/or epidural abscess formation was a rare finding [3]. However, paravertebral abscess was detected in 35 cases, epidural abscess formation was showed in 20 patients, and paravertebral abscess formation occurred in eight of our patients. Additionally, 5 cases showed only paravertebral soft tissue involved in our groups. That was not mentioned in other literatures.

A recent study showed the duration of treatment was longer if an abscess was present [18]. Based on this previous study, we consider there may have differences in prognosis of patients with different MRI performances. In our daily works, we found the brucellar spondylitis may show different MRI features. So, in our study, we try to classify them according to the different MRI features. In this group, 24 patients showed vertebral inflammatory, 22 patients were defined as discitis type, and the rate of adnexitis type and paravertebral and psoas abscess type was 11.9% (8/67) and 11.9% (8/67). Five cases

only had paravertebral soft tissue involved. But which requires long-term follow-up to certify if it's reasonable.

There have some disadvantages in this work. Firstly, contrast-enhanced MRI was obtained in few patients. Secondly, there was no comparison between the MRI with CT images. Thirdly, there was no long-term follow-up for patients and we have not yet evaluated the relationship between this subtype and treatment effect or prognosis.

5. Conclusion

In conclusion, our study has shown that brucellar spondylitis in lumbar spine affects predominantly the L4 level. Vertebral body and partial attachment signal changes without morphologic changes, marked signal increase in the intervertebral disc and narrowed intervertebral disc space on fat suppressed T2-weighted, soft tissue involvement with or without abscess formation, can be detected on MRI in patients with brucellar spondylitis. According to the different imaging features, MRI can be used as an effective method to identify the types of brucellar spondylitis, so as to improve the efficiency of diagnosis, treatment and the prognosis of patients.

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