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ORIGINAL ARTICLE

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Brucellar spondylitis: MRI findings

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Abstract This study was carried out to identify the distinguishing features of brucellosis on magnetic resonance imaging (MRI). MRI examinations were performed in 14 patients with spinal brucellosis. A 1-T Magnetom (Erlangen, Siemens) was used to obtain T1-weighted (TR/TE 500/30) and T2-weighted (TR/TE 2000/80/20) spin echo sequences, in both sagittal and axial planes. Thirty-three percent of the vertebrae and 18 levels of disc were involved in the 14 brucellar spondylitis cases. Eleven patients (79.8%) with discitis revealed anterior superior vertebral body involvement. Fourteen (77.7%) of the levels with discitis displayed soft tissue swelling without presence of abscess formation. Seven facet joints of five patients with discitis displayed signal increase after contrast enhancement. Vertebral body signal changes without morphologic changes marked signal increase in the intervertebral disc on T2-weighted and contrast-enhanced sequences, and soft tissue involvement without abscess formation can be accepted as specific MRI features of brucellar spondylitis. The facet joint signal changes following contrast enhancement is another MRI sign of spinal brucellosis, which has not been mentioned so far.

Keywords Brucellosis · Facet joint · MRI · Spondylitis

Introduction

Brucellosis is a zoonosis of worldwide distribution that is caused by small, gram-negative coccobacilli of the genus *Brucella* [10, 13, 15]. Although few cases are found in industrialized countries, it is still endemic and considered as a public health problem in the Mediterranean basin, the Middle East, and Central and South America [7, 15]. The annual incidence of human brucellosis in the US is 0.1 cases per 100,000 population, while it reaches 86 cases per 100,000 population in the Middle East [15]. The frequency of osteoarticular involvement of chronic brucellosis is high, and varies between 10 and 85% in the published series [2, 3, 7, 10]. The most prevalent manifestation is spondylitis, which is mainly located at the lumbar spine [3, 5].

The clinical and radiological diagnosis of brucellar spondylitis is not always easy, but it is very important for the patients' treatment. Though it is not always possible to differentiate various infections on the basis of imaging findings alone, it has been reported that magnetic resonance imaging (MRI) can differentiate brucellar spondylitis from other spinal infections, along with a good clinical background [8, 11].

In this present study, we described our MRI findings and tried to identify the distinguishing features in 14 patients with clinically proven brucellar spondylitis.

Table 1 The pattern of spinal involvement on magnetic resonance imaging (MRI) in order of frequency

MRI findings	No. of cases	Percentage
Disc involvement	14	100.0
Disc and vertebral body involvement	11	78.6
Disc involvement and soft tissue swelling	11	78.6
Disc space narrowing	7	50.0
Loss of vertebral body height without gibbosity	7	50.0
Circular osteophytic end-plate changes	6	42.9
Facet involvement	5	35.7

Materials and methods

There were 14 patients (nine male, and five female), with a mean age of 43.6 (range 18–64 years). Brucellar spondylitis was diagnosed according to their clinical findings, *brucella* agglutination tests and clinical response to the treatment. The histological examination revealed a non-caseating granuloma in two patients. All the patients were examined by MRI.

The MRI examinations were performed with 1-T Magnetom (Erlangen, Siemens), by means of spin echo sequences – T1 (TR/TE 500/30, T2 (TR/TE 2000/80/20) – in both sagittal and axial planes. In all patients, Gd-DPTA was administered at a rate of 0.1 mmol/kg. Additionally, in six patients, fat-saturation technique selective on the basis of frequency was used with contrast enhancement. Sections were obtained in 4-mm thicknesses with a 1-mm gap, in a 192×256 matrix. MR images were interpreted by two radiologists (D.Ö., İ.K.) and classified as focal or diffuse findings and according to their location, extension, the morphological and signal changes in affected vertebra, intervertebral disc spaces, paravertebral soft tissue changes and facet joint involvement (Table 1). Contrast-enhanced images and the fat-saturation technique supplied more information for the patients.

Results

Thirty-three vertebrae and 18 levels of disc were identified as being involved in 14 brucellar spondylitis cases. Three patients (21.4%) showed multilevel disc involvement (Fig. 1).

There was an L4-L5 discitis in 12 cases (66.6%). One patient displayed thoracolumbar and another cervical spondylodiscitis (Fig. 2). Eleven patients (78.6%) with

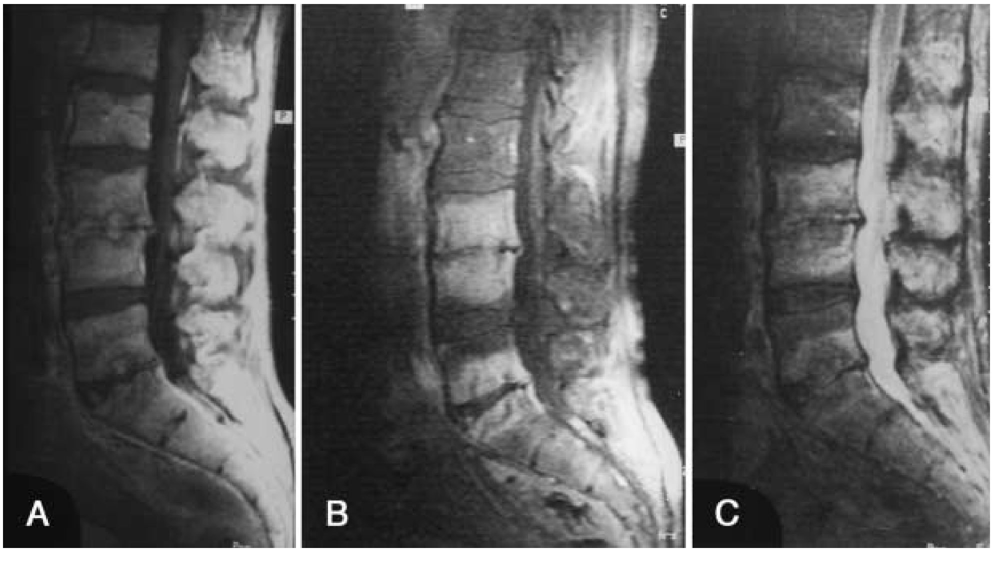

Fig. 1 **A** T1-weighted image: an incomplete heterogeneous hypointense lesion was seen in the L3, L4, L5 and S1 vertebral bodies. There are osteophytic changes on end-plates, with a narrowing of disc space. **B** T1-weighted contrast-enhanced image: there is signal increase in disc spaces and related halves of vertebral bodies. **C** T2-weighted image: the same signal changes are seen as in **B**, but they are more pronounced. The inferior end-plate of L5 and the superior end-plate of S1 demonstrate signal enhancement

Fig. 2 **A** T1-weighted image shows discitis as hypointense signal changes in adjacent vertebral bodies, and also paravertebral fusiform soft tissue involvement causing cord compression. **B** T1-weighted contrast-enhanced image: complete contrast enhancement was seen in two vertebral bodies and soft tissue. **C** Similar changes are seen on a T2-weighted image

discitis revealed anterior superior vertebral body involvement. Fourteen (77.7%) of the levels with discitis displayed soft tissue swelling without presence of abscess formation. Chronic cases of discitis showed hypointense incomplete homogeneous areas on T1-weighted images and hyperintense signal changes on T2-weighted images in vertebral bodies.

The L4 vertebral body was involved in 10 and L5 in 11 vertebrae. Seven of 33 vertebral bodies involved without discitis showed incomplete signal changes. The only patient detected at an early stage showed focal vertebral changes at three levels, without discitis.

Eight patients were additionally examined with contrast enhancement; all vertebral lesions were enhanced. Four patients with spondylodiscitis showed a complete vertebral enhancement, and four showed an incomplete contrast enhancement with contrast-enhanced MR images.

Discitis was evaluated as disc space narrowing and signal heterogeneity. Seven of the discitis levels displayed disc space narrowing. Thirteen levels showed heterogeneous signal and increase on T2-weighted images.

Eight vertebral bodies displayed minimal loss of height without gibbosity and spinal cord compression. In 14 vertebral bodies (42%), circular osteophytic end-plate changes were detected.

Two bilateral and three unilateral (seven in total) facet joints of five patients with discitis and/or degenerative changes displayed signal increase after contrast enhancement. Four of seven vertebral bodies (57.1%) with only focal lesions showed anterior superior end-plate involvement, two showed anterior inferior end-plate involvement and one showed anterior superior plus inferior complete end-plate involvement with signal increase after contrast enhancement.

Discussion

Brucellosis is still considered as a public health problem, particularly in developing countries. Human-acquired brucellosis is contracted by handling contaminated animal products or by consuming dairy products made of unpasteurised milk [6].

Kulowski and Vinke, as reported in Tekkök et al. [15], first described involvement of the spine in brucellosis in 1932. It usually occurs in the elderly and in those with chronic brucellosis [6]. Spondylitis is among the most frequent and serious complications of brucellosis. Lumber spinal involvement in brucellosis ranges from 2 to 58% in reported studies [3, 5, 9]. The early radiological signs of brucellar spondylitis are non-specific, and may appear as late as 3 months or more after the onset of symptoms [12].

Spinal brucellosis usually starts in the superior end-plate, because of its rich blood supply, but occasionally the inferior end-plate may also be involved [15]. The subsequent progress of the infection depends on the balance between the virulence of the organism and the host factor. The process can involve the entire vertebral body, and may extend to the adjacent disc space and adjacent vertebrae, i.e., the intervertebral disc is involved in spinal brucellosis as a secondary process. In the early stages, there is bone destruction in the superior vertebral end-plate and, while the bone is healing, the new bone formation is called "parrot beak" osteophyte [9, 10, 15]. In our study, 89% of the cases showed discitis and anterior end-plate involvement in the vertebral body close to the inferior edge of the intervertebral disc space. The relatively high incidence of discitis and involvement of adjacent vertebrae in our series may be explained by the chronic stage of the disease and the sensitivity of MRI at this stage. This may support the idea that spinal involvement usually commences as an intervertebral disc infection [3, 5]. Cordero and Sanchez and Colmenero et al. reported the rate of disc involvement as 66% and 78% respectively, which is similar to that reported by us [3, 4]. Although Sharif et al. [13] stated that "diffuse brucellar infective process involves initially an entire vertebral body and ultimately extends to involve neighboring discs", none of our cases displayed total signal change in the vertebral body without discitis. This is further evidence of the chronicity of the infective process in our cases. The lumbar region was involved in 75% of our cases, particularly at the level of the L4/L5 vertebra, which is similar to the study of Cordero et al. [4], and slightly higher than those reported by Glasgow and by Sharif et al. [5, 13].

Even in severe spinal involvement, none of our cases showed vertebral collapse, gibbous deformity, or spinal cord compression, as described by other authors [10]. This feature may be helpful in distinguishing brucellar from tuberculous spondylodiscitis. In spondylitis, vertebral bodies displayed partial homogeneous hypointensity on T1-weighted images and hyperintensity on T2-weighted images. In advanced cases with intervertebral disc space narrowing (38%), T2-weighted images revealed decreased intensity due to fibrosis, while early cases displayed heterogeneous increased intensity and marked contrast enhancement. End-plate new bone formation (48%) was usually associated with intervertebral disc space narrowing. There was no true bony ankylosis across the disc space.

Fat-saturation technique with contrast enhancement is impressive in displaying and delineating the changes in vertebral body, intervertebral disc, and paravertebral soft tissue involvement [14]. Eighteen instances of discitis in 14 patients were associated with paravertebral soft tissue involvement in this series (78%) (Fig. 3). This is the highest percentage of abnormality to be reported in spinal brucellosis, which may be related to the sensitivity of MRI compared to techniques used in other studies [3, 5, 9, 13]. In contrast to tuberculous spondylitis, the soft tissue involvement was less and more localized and no abscess was seen in any patient in this series.

Fig. 3 Fat-saturated sagittal image shows superb early signal increase at multiple focal points of different levels

Fig. 4 Right facet joint involvement and paravertebral soft tissue involvement (*arrow*) was depicted on T1-weighted contrast-enhanced axial images with signal changes in the disc space due to discitis. The difference in signal intensity may be the result of involvement of tissues at different stages of the disease

Another unique MRI finding was facet joint involvement, which has not been reported in previous studies. Twenty-seven percent of involved discs displayed involvement of the facet joints – bilateral in two cases and unilateral in three –which were detected as increased intensity on contrast-enhanced axial images (Fig. 4). Similar changes were also seen in granulation tissue and discitis, especially using the fat-saturation technique. However, the exact cause of the high signal in the facet joints is not known. The possible causes of the hyperintensity include primary facet joint involvement by brucellosis or a reactive process, and spontaneous fusion process.

Spinal brucellosis may mimic other diseases that affect the spine, such as tuberculous spondylitis, pyogenic osteomyelitis, intervertebral disc herniation (one of our cases had undergone operation for disc prolapse), metastatic lesions, plasmocytoma and actinomycosis. Bone marrow signal changes can be seen in degenerative disc disease and spondylosis [1, 3, 4, 6, 14].

In conclusion, our study has shown that brucellar spondylosis affects predominantly the lumbar spine, particularly the L4-L5 level. The incidence of anterior superior end-plate and disc involvement is very high in chronic cases. Vertebral body signal changes without morphologic changes, marked signal increase in the intervertebral disc on T2-weighted and contrast-enhanced sequences, soft tissue involvement without abscess formation and facet joint involvement, can be accepted as distinguishing MRI features of brucellar spondylitis. Facet joint involvement has not previously been described in the MRI evaluation of spinal brucellosis. This is the first study revealing facet joint signal change after contrast enhancement, although its cause remains unknown. MRI, particularly using the fat-suppression technique with contrast enhancement, is the most useful method for detecting the presence and extent of brucellar spondylitis.

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