ORIGINAL ARTICLE

MRI findings in proven *Mycobacterium tuberculosis* (TB) spondylitis

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Abstract

The incidence of skeletal TB is increasing. A better understanding of the MRI features of proven TB spondylitis in our setting is needed.

Materials and methods. Histologically proven cases of TB spondylitis, with MR imaging performed at Universitas Hospital on a 1.5T scanner, were reviewed.

Results. Typical findings of vertebral column involvement were seen in all patients, namely multiple levels affected and paravertebral abscesses.

The thoracic spine was involved more than the lumbar spine. In nearly all cases intervertebral disc involvement was noted. Posterior longitudinal ligaments were intact in all but 1 patient, even though there was some elevation in a number of patients. Abscess walls were also found to be thick instead of thin as expected.

Introduction

There is a world-wide increased incidence of tuberculosis (TB), with the HIV pandemic contributing significantly to this trend.[1,2] The most common extrapulmonary location of TB is the spine; in over 50% of the cases of bone and joint involvement.[3] Because MRI facilities are more readily available, imaging of suspected spinal TB using this modality has increased. MRI is now the preferred imaging modality for patients with suspected spinal TB.[4,5] We wanted to evaluate the imaging features of histologically proven cases in our setting.

MRI features that suggest TB are:

- soft-tissue masses/abscesses
- involvement of multiple vertebral segments of the spine
- absence of reactive sclerosis.

Materials and methods

We identified all patients who had vertebral biopsies for suspected TB spondylitis, from July 2002 until November 2005. Of these, we selected all patients who had histology results confirming TB spondylitis, and a recent MRI of the affected vertebrae. Twenty-three patients conformed to the above-mentioned criteria, (11 male and 12 female). Patients' age ranged from 17 to 75 years, with an average age of 36 years.

All MR studies were performed at Universitas Hospital, on a GE Signa 1.5Tesla MR, with all patients imaged with T1 and T2 multiplanar spin echo sequences.

Additional STIR images were acquired for 10 of these patients, while gadolinium was administered in 16 cases.

Images were assessed by an experienced radiologist. Pre-prepared recording sheets were used. The histology results were known to the assessor.

Limitations of the study include examiner subjectivity regarding some findings, especially abscess wall thickness, and the fact that no follow-up imaging was performed after treatment.

Abnormalities

The following abnormalities were assessed:

1. Vertebral involvement
   - level(s) affected
   - number of vertebrae involved
     - complete destruction
     - partial destruction (including anterior, posterior and diffuse vertebral body involvement)
   - signal intensities in partially affected vertebrae
     - iso-intense, hyper-intense or hypo-intense compared with normal vertebrae
2. Disc involvement
   - Destruction
     - Partial destruction (including height loss and fragmentation)
     - Complete destruction
   - Signal changes in partially destructed discs
3. Paravertebral abscess/soft-tissue mass formation
   - Anterior location/ posterior location with intraspinal extension
     - Thin or thick walled
     - Septae present
4. Longitudinal ligament involvement
   - Elevation
   - Destruction
   - Anterior/posterior location

Table I. Level of epicentre of vertebral involvement

	N = 23	%
High thoracic (T1-4)	4	17
Mid thoracic (T5-8)	6	26
Lower thoracic (T9-12)	6	26
L1	0	0
L2	2	9
L3	2	9
L4	3	13
L5	0	0

Table II. Distribution of partial destruction

Part of vertebral body	Anterior and posterior	Only anterior	Only posterior
Thoracic	13 of 16 (81%)	2 of 16	1 of 16
Lumbar	7 of 7 (100%)	0	0

Table III. Signal intensities in partially affected vertebrae

	Iso-intense	%	High signal	%	Low signal	%	Total
T1	6 of 23	26	0 of 23	0	17 of 23	74	23
T2	3 of 23	13	17 of 23	74	3 of 23	13	23
Post Gd	3 of 16	19	13 of 16	81	0 of 23	0	16
STIR	1 of 10	10	9 of 10	90	0	0	10

Results

Vertebral involvement

There was complete destruction of at least one vertebral body in 14 patients (69%) (11 of 16 (69%) patients with thoracic and 3 of 7 (43%) with lumbar involvement).

Tables I-III show the levels of vertebral involvement, distribution of partial destruction and signal intensities in partially affected vertebrae.

Disc involvement

Tables IV and V show the extent of disc involvement and signal intensities in partially affected discs.

Table IV. Extent of disc involvement

	N = 23	%
No involvement	1	4
Complete destruction	8	30
Partial destruction only	7	35
Partially and completely destructed discs	7	30

Paravertebral abscess formation

Paravertebral abscess formation is shown in Table VI.

Longitudinal ligament involvement

Table VII lists the longitudinal ligament involvement.

Discussion

Tuberculous spondylitis/spondylodiscitis is caused by the *Mycobacterium tuberculosis* bacillus. The features of the disease were first described by Percival Pott. The disease has potentially serious morbidity with severe neurological impairment and disfiguring deformity.

Also known as Pott's disease, spinal infection follows haematogenous seeding from a distant source, and an extraspinal source of infection should be considered. The basic lesion is a combination of osteomyelitis and arthritis. Typically, more than one vertebra is involved. The area usually affected is the anterior aspect of the vertebral body adjacent to the subchondral plate. TB may spread from that area to adjacent intervertebral discs. In adults, disc disease is secondary to the spread of infection from the vertebral body. In children, because the disk is vascularised, it can be a primary site.

Vertebral collapse and kyphosis follows progressive bone destruction. Spinal canal luminal diameter narrowing is due to abscess formation, granulation tissue, or direct dural invasion. Consequently there is

Table V. Signal intensities in partially affected discs

	Iso-intense	%	High signal	%	Low signal	%	Total
T1	11 of 14	79	0 of 14	0	3 of 14	21	14
T2	0 of 14	0	8 of 14	57	6 of 14	43	14
Post Gd	0 of 10	0	3 of 10	30	7 of 10	70	10
STIR	0 of 5	0	2 of 5	40	3 of 5	60	5

Table VI. Paravetebral abscess formation

	N = 23	%
Only anterior	1	4
Only posterior (with spinal extension)	1	4
Anterior and posterior (with spinal extension)	21	92
Thin wall	9	39
Thick, irregular wall	14	61
Septae present	18	78

Table VII. Longitudinal ligament involvement

	N = 23	%
None	0	0
Elevation anterior and posterior, without destruction	12	52
Elevation and destruction anterior with only elevation posterior	10	43
Elevation and destruction posterior, without anterior involvement	1	4

spinal cord compression and thus neurological deficits. Kyphotic deformity may follow collapse of the anterior vertebral bodies. Paraspinal abscesses in the lumbar region gravitate along the sheath of the psoas to the femoral region and erosion through to the skin may follow.

In our study the epicentre of involvement was at the thoracic level in 16 of 23 patients (69%), with the epicentre in the remainder (31%) at the lumbar level.

This is contrary to the findings of Sinan *et al.*[6] where involvement was greater in the lumbar spine. With thoracic involvement, the distribution at different levels (high, mid and lower) was fairly equal.

None of the patients had L1 or L5 as the epicentre of involvement.

There was complete destruction of at least one vertebral body in 14 patients (69%). Partially affected vertebrae showed destructive changes in both the anterior and posterior parts of the vertebral body in 87% (20 of 23). Signal intensities in partially affected vertebrae were predominantly hypo-intense on T1 (74%), hyper-intense on T2 (74%), hyper-intense after gadolinium administration (81%), and hyper-intense on STIR sequences (Figs 1 - 3).

All patients, with the exception of one who had no disc involvement, had varying degrees of complete and partial disc destruction at different levels.

Fig 1. T1 sagittal image. Partial destruction of the anterior and posterior vertebral bodies of L2 and L3.

All 23 patients showed paravertebral abscess formation, extending between 2 and 6 vertebral levels. In the majority of patients (21 of 23, 91%) there was extension of the abscess adjacent to the anterior and posterior aspects of the vertebral bodies, while 61% (14 of 23) of the abscesses had a thick irregular wall, with a thin smooth wall in the remainder. Septae were present in 18 of 23 abscesses (78%). Sclerosis was

Fig 2. T2 sagittal image. Predominantly anterior vertebral body destruction of L2, with gibbus formation.

seen in 13%(3 of 23) of affected vertebrae (Fig. 4).

In all 23 patients there was longitudinal ligament involvement, with:

- Elevation anterior and elevation posterior in 12 (52%)
- Elevation and destruction anterior, with only elevation posterior in 10 (44%)
- Elevation and destruction posterior without anterior involvement in 1 (4%).

Fig. 5 shows elevation with an intact posterior longitudinal ligament.

Fig 3a. T1 sagittal image. Low signal in affected thoracic vertebrae.

Fig 3b. T2 sagittal image. High signal in affected vertebrae.

Fig 3c. Sagittal STIR image. High signal in affected vertebrae.

Conclusion

This study confirmed the findings of previous studies, namely:

- Paravertebral abscess formation involving multiple levels[7-9]
- Subligamentous spread to multiple levels[6]
- Hyper-intensity of affected vertebrae on T2 images[6]
- Hypo-intensity of affected vertebrae on T1 images[6]

We found that abscess walls were thickened in about 60% in contrast to previously reported thin, smooth walls.[6]

In our study all but one patient had at least partial disc destruction.

The posterior longitudinal ligaments were elevated in all patients, but only destroyed in one. Anterior ligaments were elevated in 22 patients, with associated destruction in 10 (43%). These findings have not previously been specifically reported.

Further studies that focus on the pattern of ligament involvement and the abscess walls would be of value. Objective measurement of the abscess walls would obviate examiner subjectivity.

Fig 3d. T1 postcontrast sagittal image. Enhancement of the affected vertebrae.

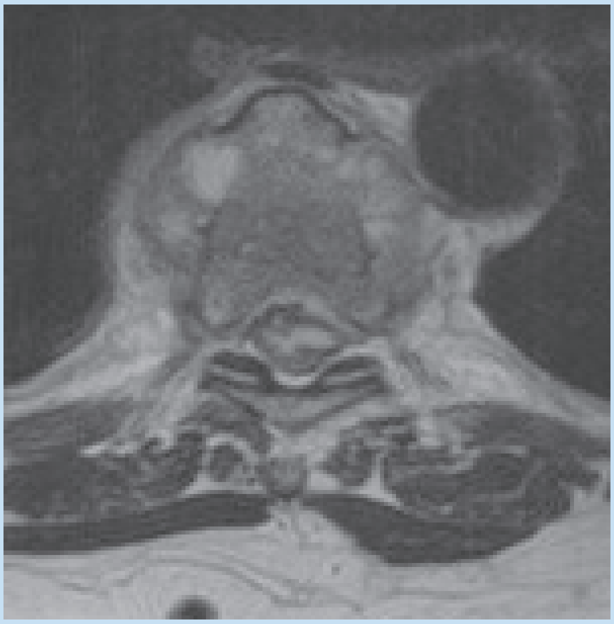

Fig 4a. T2 axial image.

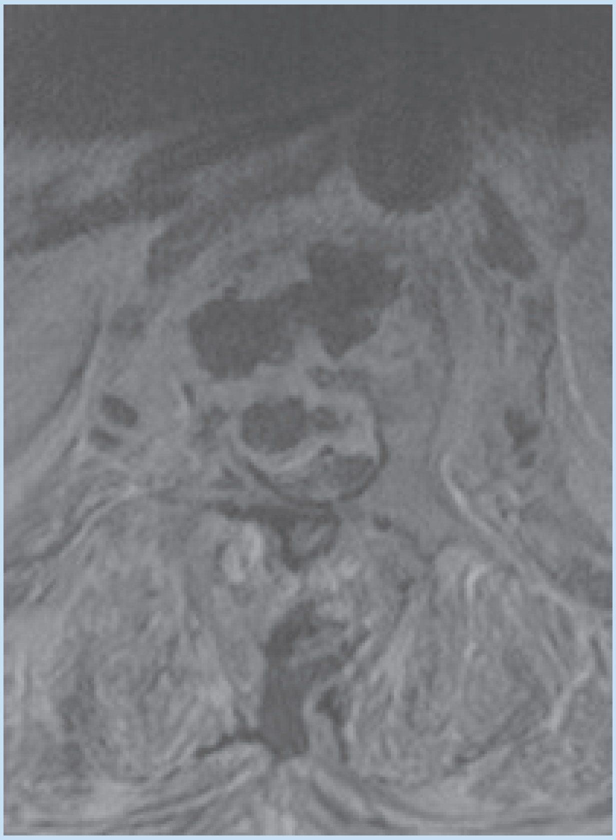

Fig 4b. T1 postcontrast axial image. Demonstrating thick irregular paravertebral abscess walls.

Fig 5. T2 sagittal image. Elevated, but intact posterior longitudinal ligament.

REFERENCES

1. Restrepo CS, Lemos DF, Gordillo H, *et al.* Imaging findings in musculoskeletal complications of AIDS. *Radiographics* 2004; **24:**1029-1049.
2. Engin G, Acuna B, Acuna G, Tunaci M. Imaging of extrapulmonary tuberculosis. *Radiographics* 2000; **20:**471-488.
3. Tuberculous spodylitis; *Wheeless Textbook of Orthopaedics.* Duke University Medical Center, http://www.wheelessonline.com online book.
4. Kotevoglu N, Tasbasi I. Diagnosing tuberculous spondylitis: patients with back pain referred to a rheumatology outpatient department. *Rheumatol Int* 2004; **24:** 9-13.
5. Hidalgo JA, Alangaden G. http://www.emedicine.com/med/topic 1902.htm eMedicine online article- Pott disease July 2005.
6. Sinan T, Al-Khawari H, Ismail M, Ben-Nakhi A, Sheikh M. Spinal tuberculosis: CT and MRI features. *Ann Saudi Med* 2004; **24**(6): 437-441.
7. De Vuyst D, Vanhoenacker F, Gielen J, Bernaerts A, De Schepper AM. Imaging features of musculoskeletal tuberculosis. *Eur Radiol* 2003; **13:** 1809-1819.
8. Khoo LT, Mikawa K, Fessler R. A surgical revisitation of Pott distemper of the spine. *The Spine Journal* 2003; **3:** 130-145.
9. NaYoung Jung, Jee WH, Ha KY, Park CK, Byun JY. Discrimination of tuberculous spondylitis from pyogenic spondylitis on MRI. *AJR* 2004; **182:** 1405-1410.