INTRODUCTION

Tuberculosis is a necrotizing bacterial infection with variable manifestations and wide distribution. The causative organism belongs to one of the different strains of Mycobacterium tuberculosis. Tuberculosis (TB) remains endemic in most of the developing countries. In recent years, the incidence of tuberculosis (TB) has increased; not only primarily in developing countries, but also in Europe and North America. Despite inclusion of BCG vaccination in the EPI program and availability of the anti-tuberculosis medicines at affordable prices, tuberculosis is still the number one cause of prolonged morbidity in Pakistan. The emergence of Human Immunodeficiency Virus and multi-drug resistant tuberculosis has added another dimension to an already complicated situation of tuberculosis globally.

ABSTRACT

Objective: To find out the frequency and patterns of various lesions in tuberculous spondylitis in adults on magnetic resonance imaging (MRI).
Study Design: Case series.
Place and Duration of Study: Radiology Department, Military Hospital (MH) Rawalpindi, from September 2006 to March 2007.
Methodology: Patients with features suggestive of tuberculous spondylitis underwent plain T1-weighted and T2-weighted images and T1-weighted contrast enhanced images in both axial and sagittal sections. The data was analyzed in terms of frequency and patterns of various lesions of tuberculous spondylitis causing abnormal signals in spinal and paraspinous areas. Mean ± standard deviation were calculated for numerical data using SPSS version 15.
Results: Out of 75 patients, 39 were females. The mean age was 42.4 years. Involvement occurred through SV1 vertebral levels. Most common involvement was seen in the thoracic vertebrae (40%) followed by lumbar vertebrae. The most common MRI feature was abnormal signal intensities appearing hypointense on T1W and hyperintense on T2W sequences with heterogeneous enhancement of the vertebral body in all patients. The characteristic findings of spinal tuberculosis included destruction of two adjacent vertebral bodies and opposing end plates, destruction of intervening disc, and occurrence of paravertebral and epidural abscesses.
Conclusion: MR imaging of spinal tuberculosis, characteristically show contiguous involvement of two vertebrae along with the intervening disc, skip lesions, and paraspinous collections and provides critical information about the involvement of spinal cord and the extent of the disease.

Key words: Magnetic resonance imaging. Postgadolinium. Tuberculous spondylitis.

ORIGINAL ARTICLE

Frequency and Magnetic Resonance Imaging Patterns of Tuberculous Spondylitis Lesions in Adults

Huma Zaidi¹, M. Hamid Akram² and Madiha S. Wala³

1 Department of Radiology, PAF Hospital Faisal Base, Karachi.
2 Department of Radiology, Military Hospital and Army Medical College, Rawalpindi.
3 Department of Radiology, PAF Hospital, Mianwali.

Correspondence: Dr. Huma Zaidi, House No. 156, D.O.H. Scheme II, Malir Cantt, Karachi.
E-mail: humazaidi514@yahoo.com

Received June 04, 2009; accepted January 18, 2010.

Disclosure: This is a dissertation-based article.

Tuberculosis (TB) of the spine is the most common site of osseous involvement and perhaps the most clinically important extrapulmonary form of the disease resulting in prolonged morbidity. Early recognition is, therefore, necessary to minimize residual spinal deformity and/or permanent neurological deficit. The spinal tuberculosis is usually a result of hematogenous dissemination from primary focus in the lungs or the lymph nodes. The central type of vertebral tuberculosis spreads along Batson’s plexus of veins, while paradiscal infection spreads through the arteries, and the diagnosis often remains elusive because of the indolent nature of tuberculous infection.

The need for prompt diagnosis and treatment is of utmost importance to prevent serious bone and joint destruction and severe neurological sequelae. Magnetic resonance imaging (MRI) is generally accepted as the imaging modality of choice for diagnosis and demonstrating extent of the disease. MRI has the advantages of improved contrast resolution for bone and soft tissues and versatility of direct imaging in multiple planes. In spinal tuberculosis, magnetic resonance imaging offers excellent visualization of contiguous vertebral involvement, skip lesions and para-spinal collection and provided critical information about the spinal cord and the extent of the epidural pus in patients presenting with neurological deficits. Further, response to treatment can effectively be assessed by it.
The objectives of the study were to analyze the magnetic resonance imaging features of tuberculous spondylitis in adults and to determine frequencies of various types of spinal and para-spinal lesions associated with tuberculous spondylitis.

**METHODOLOGY**

This was a "Descriptive case series" conducted at The Department of Radiology, Military Hospital, Rawalpindi, from September 2006 to March 2007 after approval by hospital administration.

Seventy five cases were included in our study. Inclusion criteria of the study were adults of either gender, 18 years of age and above, coming to Radiology Department, MH, Rawalpindi for magnetic resonance imaging (MRI), referred by any clinician with features of tuberculous spondylitis. Only those patients were included in this study, who were already diagnosed provisionally for tuberculous spondylitis on MRI, tuberculosis was established by bacteriologic and/or histologic studies of specimens from spinal or paraspinal lesions or those who responded to anti-tuberculous therapy. They were selected by non-probability convenience sampling technique. Patients who have not given informed consent, those with life supporting equipments, patients already diagnosed or treated for any other pathology of spine and any patient with allergy or hypersensitivity to the contrast medium were excluded.

After taking informed consent, all patients are scanned in s Quantum gradient 1.5 Tesla MRI machine (MAGNETOM symphony version syngo MR 2002A by Siemens), available at the Department of Radiology, Military Hospital, Rawalpindi. Spine coil was used. Patients were positioned in head first, supine position Scout view was obtained in transverse position. Evaluation of the spine and para-spinal region was done with the help of T1- weighted plain images and T2 - weighted images in both axial and sagittal sections. Slice thickness was 4 mm with interslice gap of 30%. Injection Magnevist (Schering) was used as intravenous contrast medium for all the patients in a dose of 0.2 mmol/kg body weight. Immediately after the injection of contrast medium a T1- weighted sequence was applied. Images were taken in axial and sagittal planes. Same radiologist had initially reported all the cases included in this study. Findings were confirmed by another radiologist.

All the data gathered were recorded on a pre-designed proforma. SPSS version 15 was used for computation and analysis of data. Descriptive statistics were used to calculate proportion and percentage of various lesions of tuberculous spondylitis causing abnormal signals in spinal and para-spinal areas. Proportion and percentage was also calculated for the type of lesion (unifocal/ multifocal) and region of spinal columns involved. Mean, ± standard deviation was calculated for number of vertebrae and discs involved and for the age of patient.

**RESULTS**

Seventy five patients were included in this study, out of which 36 (48%) patients were male and 39 (52%) were female. Age of the patients ranged from 18 years to 80 years with mean age of 42.4±16.75 years. It was most frequent (22.7%) in age group of 31-40 years.

Backache (n=65, 86.7%) and fever (n=25, 33.3%) were the common presenting complaints while neurological deficit was the most frequent sign (n=46, 61.3%).

The disease process involved one location in 65 cases (86.6%) and two or multiple locations in 10 cases (13.3%). Involvement was seen throughout vertebral column with maximum involvement of thoracic vertebrae (n=30, 40%). The process involving 2 contiguous vertebrae was the most common pattern of involvement (n=49, 65.3%). Abnormal signal intensities on both T1W and T2W sequences were seen in the bodies of involved vertebrae of all the cases (100%). Similarly, enhancement of involved vertebrae on postgadolinium T-1 weighted images was exhibited in all the patients (100%).

Frequency and percentage of neural arches, facet joint involvement, end plates irregularities of involved vertebrae and vertebral collapse at one or more locations were shown in Table I. Fifty eight (77.3%) cases had intervertebral disc/discs involvement as seen by the presence of abnormal signal intensities on T1W and T2W sequences. Single disc involvement was the most common pattern seen in 48 (68%) patients.

Seventy (93.3%) patients had pre-vertebral/paravertebral soft tissues involvement and in 69 (92%) patients associated abscesses were noted. Descriptive statistics of epidural abscesses, spinal canal compression either due to epidural abscess or focal kyphotic deformity, spinal cord/thecal sac compression and abnormal signal intensities within spinal cord were shown in the Table I.

| Table I: Frequency and percentage of various lesions of tuberculous spondylitis on MRI. |
|-------------------------------------------------|----------------|----------------|
| **Spinal lesions**                              | **Frequency** | **Percentage** |
| Abnormal signals in vertebral bodies           | 75            | 100            |
| Abnormal signals in neural arches              | 10            | 13             |
| Abnormal signals in disc/ discs                | 58            | 77.3           |
| Facet joints involvement                       | 3             | 4.5            |
| Irregularity of end plates                     | 58            | 77.3           |
| Vertebral collapse                             | 27            | 36             |
| Epidural abscess                               | 59            | 78.7           |
| Spinal canal compression                       | 56            | 74.7           |
| Spinal cord/ thecal sac compression            | 48            | 64             |
| Abnormal signal in spinal cord                 | 2             | 2.3            |
| **Paraspinal lesions**                         | **Frequency** | **Percentage** |
| Para/prevertebral soft tissues involved        | 70            | 93.3           |
| Paravertebral abscesses                        | 69            | 92             |

*This includes post contrast enhancement of both spinal and paraspinal lesions.*
DISCUSSION

In this study, most of the patients were young; this is comparable with many national and international studies. The female preponderance is also in accordance with certain national and international studies. However, many studies conducted in developed countries showed male pre-dominance and that the majority belonged to older age groups. This disparity could be due to the reason that tuberculosis is more common in local population, so tuberculous spondylitis is more prevalent in this deprived group of patients.

As in other studies, backache and fever were the most common presenting complaints in this study. Neurological deficit was the most frequent sign, while other patients presented with spinal tenderness and local kyphotic deformity in decreasing order of frequency. This was in accordance with a study carried out by Le Page et al.

In this study, vertebral column was predominant involved by the lesion at one site followed by two locations’ involvement. In one patient the tuberculous spondylitis involved almost the whole vertebral column. This pattern is quite similar with pattern seen in other studies carried out by Ousehal et al. and Jung et al. The most common involvement was seen in thoracic vertebrae, followed by lumbar vertebrae. This observation possibly reflected the near vicinity of the lesion from the primary site as osseous involvement is usually secondary to haematogenous spread from the primary site that is lungs. These results are in accordance with other studies.

De Backer et al. found that classic finding of tuberculous spondylodiscitis was characterized by destruction of two or more contiguous vertebrae and opposed end plates, disc infection, and commonly a para-spinal mass or collection. The second pattern was atypical form of spondylitis without disc involvement. This less aggressive behaviour has been proposed to be due to the lack of proteolytic enzymes in the Mycobacterium as compared with pyogenic infection resulting in relative preservation of the intervertebral discs. Certain other studies also showed quite similar results. The results of this study were also comparable to these international studies showing predominantly classical pattern followed by the atypical pattern.

Abnormal signal intensities on both T1W and T2W sequences were observed by MRI in the bodies of involved vertebrae of all the cases as a consequence of inflammatory changes. These appeared as intermediate or low T1 signal intensity and heterogeneous high T2 signal intensity. This was in accordance with many other studies.

In this study, neural arches showed abnormal signal intensities in 16% and facet joint involvement was seen only in 4.05% of cases. Although this observation was comparable to the study conducted by Ousehal et al., this could be due to the fact that much sophisticated and advanced version of the MRI machines with better resolutions are used in most of the centres internationally.

Akhmetov et al. studied that bony compression and destruction of involved vertebra was specific for tuberculosis. This is due to progressive necrosis of the bone but relative scantiness of sclerotic reaction. In this study destruction and vertebral collapse is noted in 36% patients at one or more locations.

The reported frequency of pre-vertebral/para-vertebral soft tissues involvement in most of the studies had been 70-80%, whereas, 93.3% of the presently reported patients had pre-vertebral/para-vertebral soft tissues involvement and in 92% patients associated abscesses were noted. This considerably higher frequency could be due to the reason that patients in poorly resourced countries like Pakistan, report late when the disease is quite advanced because of the scarcity and expense of MRI facilities.

The frequencies of intraspinal extradural granulation tissue/abscess, spinal canal compression either due to epidural abscess or focal kyphotic deformity, spinal cord/thecal sac compression and abnormal signal intensities within spinal cord as documented by magnetic resonance imaging were quite similar to results reported in other studies.

De Backer et al. found that classic finding of tuberculous spondylodiscitis was characterized by destruction of two or more contiguous vertebrae and opposed end plates, disc infection, and commonly a para-spinal mass or collection. The second pattern was atypical form of spondylitis without disc involvement. This less aggressive behaviour has been proposed to be due to the lack of proteolytic enzymes in the Mycobacterium as compared with pyogenic infection resulting in relative preservation of the intervertebral discs. Certain other studies also showed quite similar results. The results of this study were also comparable to these international studies showing predominantly classical pattern followed by the atypical pattern.

Abnormal signal intensities on both T1W and T2W sequences were observed by MRI in the bodies of involved vertebrae of all the cases as a consequence of inflammatory changes. These appeared as intermediate or low T1 signal intensity and heterogeneous high T2 signal intensity. This was in accordance with many other studies.

In this study, neural arches showed abnormal signal intensities in 16% and facet joint involvement was seen only in 4.05% of cases. Although this observation was comparable to the study conducted by Ousehal et al., this could be due to the fact that much sophisticated and advanced version of the MRI machines with better resolutions are used in most of the centres internationally.

Akhmetov et al. studied that bony compression and destruction of involved vertebra was specific for tuberculosis. This is due to progressive necrosis of the bone but relative scantiness of sclerotic reaction. In this study destruction and vertebral collapse is noted in 36% patients at one or more locations.

The reported frequency of pre-vertebral/para-vertebral soft tissues involvement in most of the studies had been 70-80%, whereas, 93.3% of the presently reported patients had pre-vertebral/para-vertebral soft tissues involvement and in 92% patients associated abscesses were noted. This considerably higher frequency could be due to the reason that patients in poorly resourced countries like Pakistan, report late when the disease is quite advanced because of the scarcity and expense of MRI facilities.

The frequencies of intraspinal extradural granulation tissue/abscess, spinal canal compression either due to epidural abscess or focal kyphotic deformity, spinal cord/thecal sac compression and abnormal signal intensities within spinal cord as documented by magnetic resonance imaging were quite similar to results reported in other studies.

In this study, gadopentetate dimeglumine intravenous magnetic resonance (MR) contrast agent was given to all the patients, exhibiting tuberculous spondylitis lesions and postcontrast T1 weighted images showed heterogeneous contrast enhancement and/or rim enhancement in all of them. This is because of the presence of phlegmon (inflammatory mass of granulation tissue) and greatly improved our confidence to diagnose tuberculous spondylitis. This observation is in agreement with many other studies.

This study shows that MR imaging is invaluable for detecting vertebral tuberculosis. The spectrum of MR findings in tuberculous spondylitis in our region is quite similar with the pattern established internationally. However, spectrum of findings depicts much advanced stage of the disease when patients presented. As MRI is established as a very sensitive tool for diagnosis of spinal tuberculosis and as this facility is becoming more readily available in our country, early screening of patients suffering from chronic backache, having neurological deficits can be suggested. This can prevent a delay in diagnosis and may limit the morbidity that is caused by this aggressive, but curable infectious disease.

There were few limitations in this study. Firstly, the sample size was small consisting of 75 patients. Secondly,
MR images were interpreted by only two radiologists. Thus, inter-observer variability and accuracy could not be assessed.

CONCLUSION

MR imaging of spinal tuberculosis, characteristically showed contiguous involvement of two vertebrae along with the intervening disc, skip lesions, and para-spinal collections. It provided critical information about the involvement of spinal cord and the extent of the epidural pus in patients presenting with neurological deficits.

REFERENCES