WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 7.523
Volume 7, Issue 1, 634-645. Research Article ISSN 2277– 7105

MRI: A RADIOLOGICAL DIAGNOSTIC MODALITY AND TECHNOLOGY DEVELOPMENT IN SPINAL TUBERCULOSIS

Anil Yadav[1]*, Dr. Nouratan Singh[1], Dr. A. K. Gupta[2], Dr. (Brig.) T. Prabhakar[3] and Dr. Ramakant Yadav[4]

[1]PhD Scholar, Radiographer (MRI/CT SCAN) and Guest Faculty (Deptt. of Radiological and Imaging Technology) Paramedical College, Saifai.

[1]Department of Radiology, U.P. University of Medical Sciences, Saifai, Etawah (U.P.).

[1]Department of Pathology and Blood Bank, U.P. University of Medical Sciences, Saifai, Etawah (U.P.).

[2]Former H.O.D. Department of Radiology, U.P. University of Medical Sciences, Saifai, Etawah (U.P.), India.

[3]Vice Chancellor, U.P. University of Medical Sciences, Saifai, Etawah (U.P.), India.

[4]Head of Department of Neurology, U.P. University of Medical Sciences, Saifai, Etawah (U.P.), India.

Article Received on
10 Nov. 2017,
Revised on 30 Nov. 2017,
Accepted on 20 Dec. 2017
DOI: 10.20959/wjpr20181-10409

***Corresponding Author**
Anil Yadav
PhD Scholar, Radiographer (MRI/CT SCAN) and Guest Faculty (Deptt. of Radiological & Imaging Technology) Paramedical College, Saifai.

ABSTRACT

A round the world's one-third population is infected with TB infection which occurs in about 1% of the population each year. There were 9.6 million cases of active tuberculosis which resulted in 1.5 million deaths in 2014. In developing countries about more than 95% of deaths occurred due to TB infection. The commonest extrapulmonary manifestation of TB is spinal tuberculosis. Spinal TB spreads through hematogenous route in the body. In spinal tuberculosis clinically it present with constitutional symptoms such as back pain, paraparesis or paraplegia, tenderness, and kyphotic or scoliotic deformities in patient. In present MRI is the preferred imaging modality, preferred technique to define the activity and extent of infection in patients with suspected spinal tuberculosis for better diagnosis. The objective of the study is to describe various radiological features of spinal tuberculosis on MRI and to assess its role in evaluation of the extent of disease in this concern. Spinal tuberculosis is a destructive form of tuberculosis, it accounts for approximately half of all cases of musculoskeletal tuberculosis in

U.P. RIMS & R. Spinal tuberculosis is more common in young adults. In developing nations the incidence of spinal tuberculosis is increasing. Recently genetic susceptibility to spinal tuberculosis has been demonstrated. In spinal tuberculosis, there is destruction of the intervertebral disk space and the adjacent vertebral bodies due to push formation, collapse of the spinal elements, kyphosis and gibbus formation in the back. The thoracic or dorsal region of vertebral column is most frequently affected due to spinal tuberculosis. In generally clinical manifestations including constitutional symptoms, spinal tenderness, back pain, paraplegia and spinal deformities in the patient of spinal tuberculosis. For the better diagnosis for treatment of spinal tuberculosis magnetic resonance imaging is highly sensitive and specific imaging technique than others like x-ray and computed tomography. MRI frequently indicates involvement of the vertebral bodies on either side of the disk, vertebral collapse, disk destruction, cold abscess, presence of vertebral column deformities finding in patient. Involvement of the spinal column is less than 1% of all cases of tuberculosis (TB). It is a very dangerous type of skeletal TB because it can be associated with neurological abnormalities due to compression of adjacent neural structures and significant spinal deformity in patient. So, early diagnosis and management of spinal tuberculosis has also a special importance in preventing these serious complications in patient suffering from spinal tuberculosis. Therefore the development of more accurate imaging modality such as magnetic resonance imaging for advanced diagnosis of spinal TB much easier, this is very challenging and interesting topics.

KEYWORDS: Tuberculosis, Spinal tuberculosis, Magnetic Resonance Imaging, Abscess, Pott's spine.

INTRODUCTION

Mycobacterium tuberculosis is constructive agent of tuberculosis. Tuberculosis is very common particularly in developing countries. Spine is the most common extrapulmonary location of tuberculosis, accounting for more than 50% of musculoskeletal tuberculosis.[1] In the developing countries, the disease has an aggressive role, particularly in young adults resulting in abscess formation in the body. Consequently, neurological complications and spinal deformities are frequently observed.[2]

Tuberculosis of the spine is the common extrapulmonary form of TB, one of the oldest demonstrated diseases of mankind. In developing countries with dense population, the morbidity and mortality rate due to spinal TB is higher than other infections. The

development of antitubercular drugs and improved public health measures, spinal tuberculosis has become uncommon in industrialized countries; therefore it is still a significant cause of disease in developing countries. Spinal tuberculosis has the potential for serious problems as morbidity, including permanent neurological deficits and severe deformity.[3,4] WHO estimates that the largest number of new pulmonary tuberculosis cases in 2015occurred in the southeast Asia Region, it accounted for 35% of incident cases globally. MRI is the most useful to diagnose the tuberculosis, now the preferred imaging modality for patients with suspected spinal tuberculosis.[5] It is the most valuable method for detecting early disease and its preferred technique to explain the activity and extent of infection in human. MRI shows not only bony involvement but also the edema and soft tissue swelling of the patient spine, caused primarily by hematogenous spread of pulmonary infection in most of the cases.[6] The infection typically begins from the anterior part of vertebral body and spreads to the disc it causes bone destruction and formation of abscess in the spine. The involvements in subligamental extension of abscess beneath the anterior longitudinal ligament and the intervertebral disc with subsequent loss in height of disc. As the vertebral bodies collapse into each other and become a sharp angulation or kyphosis develops. The formation of cold abscess or fluid collection and caseation may extend into the neighboring vertebra or escape into the paravertebral soft tissue. Cord compression and edema is occur either due to pressure by the abscess or displaced bone or due to involvement of spinal artery resulting in neurological deficits.[6] Disc involvement is seen early in pyogenic infection and later in tuberculosis, important to differentiate between tuberculosis and pyogenic spondylitis. The main purpose of the study is to describe various radiological features of spinal tuberculosis and evaluate the role of MRI in assessing the particular of disease. Spinal tuberculosis about 2% of all cases of tuberculosis, 15% of the cases of extrapulmonary TB and 50% of the cases of skeletal TB.[3] Spinal TB is usually secondary to abdominal or lung involvement and may also be the 1st manifestation of tuberculosis. These usually two continuous vertebrae are involved but many vertebrae may be affected, solitary vertebral involvement and skip lesions may also be seen. The skip lesion or a second lesion not adjoining with the more obvious lesion is seen in 4 to10% cases.[7] Lower dorsal and lumbar vertebrae are the most common sites of pott's of spine followed by central thoracic and cervical vertebrae.[8,9,10] The lamina of vertebra is most commonly involved followed by pedicles and processes (articular, spinout and transverse).[11,12]

METHODS

This study was conducted at Department of Radiodiagnosis, U.P. Rural Institute of Medical Sciences & Research, Saifai, Etawah. MRI case records of 40 patients (Male-25 & Female-15) with proven tuberculosis between 2014 to 2015 were relevant clinical history and retrospectively reviewed was also noted. Diagnosis was based on history of patient, investigations and clinical examination. Pathological investigations included were CBC, ESR, Sputum cytology and histological demonstration of acid-fast bacilli (mycobacterium tuberculosis) in the lesion, demonstration of growth of mycobacterium on culture of ascitic fluid or tissue, satisfactory therapeutic response of drug treatment with clinical, radiological and operative evidence of spinal tuberculosis.

The MRI scan was performed in 1.5 Tesla PHILIPS ACHIEVA NOVA MRI scanner at department of radiology. The following MRI sequences were studied: Sagittal and axial T1 weighted (T1 SE), Sagittal and axial T2 weighted (T2 FSE), Coronal and sagittal STIR sequences followed by post-contrast T1 weighted sequences in axial, coronal and sagittal planes. Post-contrast sequences T1W sequence were obtained by using intravenous administration of gadolinium (GdDTPA) of 0.1 mmol/kg doses.

MRI assessed the following features:

Compartment of spine involved: Epidural/ Intradural/ Intramedullary/ Multiple levels

Epidural involvement assessed for the following

1. Extent of vertebral column involvement: body / posterior involvement – signal changes.
2. Wedging or cord compression.
3. Involvement of vertebral disc.
4. Subligamentous extension.
5. Extent of abscess as: Epidural / paravertebral / psoas.
6. Spinal cord changes.

Intradural/ intramedullary: Enhancement of the lesions and nature.

The scan films were independently reviewed by radiologists and any conflict in findings was resolved by consensus of expertise.

RESULTS

This study included total 40 patients, with an age range of 21-60 years with majority of them in the 31-40 year age group (Table 1). There were 25 males (62.5%) and 15 females (37.5%) (Table 1).

MRI scan showed that most affected level of the spine was thoracic spine with Thoracic vertebrae were being the most common affected vertebra seen in 42.5% (Table 2) of the cases followed by thoracolumbar (25%), and lumbar vertebra (20%). The Different clinical presentations such as fever, backache, malaise, weight loss were noted with most common being backache (87.5%) in 35 cases (Table 3).

The involvement of intervertebral disc was seen in 85% of the cases with an epidural component occurring in 75% of the cases (Table 4). It also shows cord oedema noted in 15% of the cases.

Table 1: Age & sex distribution.

Age Group	Male (25)	Female (15)	Overall %
21-30	3	1	10
31-40	14	6	50
41-50	6	6	30
51-60	2	2	10

Table 2: Regional distribution of Spinal Tuberculosis.

Region	No. of cases	%
Cervical	3	7.5
Thoracic	17	42.5
Thoracolumbar	10	25
Lumbar	8	20
Multiple levels	2	5

Table 3: Spinal TB patient's clinical profile.

	Fever	Backache	Malaise	Weight loss
No. of cases	25	31	19	9
Percentage (%)	62.5	77	47.5	22.5

Table 4: Extent of tuberculosis spine in various compartments.

Symptoms	No. of cases	Percentage (%)
Involvement of Intervertebral disc	34	85
Complete destruction of vertebra	10	25
Wedge collapse of body	20	50
Subligamental extension	20	50
Epidural collection	30	75
Intradural involvement	5	12.5
Pre and paravertebral collection	22	55
Intramedullary involvement	3	7.5
Cord oedema	6	15

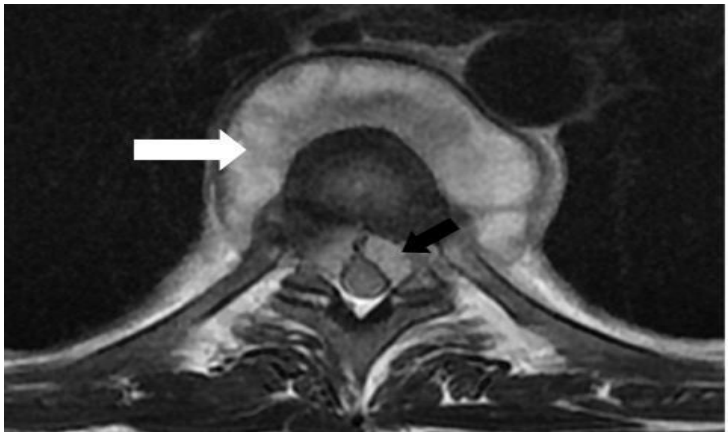

Figure 1: T2 WI showing smooth well defined epidural component (Black arrow) and pre vertebral collection (white arrow).

Figure 2: Sagittal T2 WI showing wedge collapse of T6 vertebra with an epidural component (black arrow) and adjacent cord edema is also noted. Sagittal T2 WI also showing multiple level involvements Prevertebral collection with subligamental extension is seen in the cervical region (white arrow) and thoracic region, the hyperintensity of affected cervical vertebrae (arrow head).

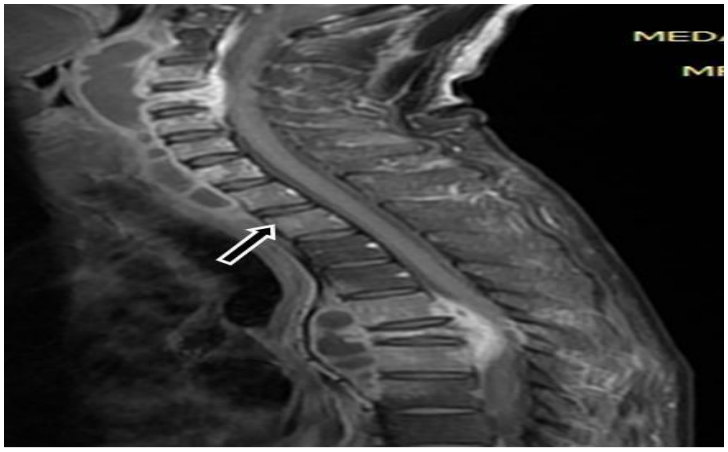

Figure 3: T1 WI + contrast image showing enhancement of involved thoracic vertebra which was not seen in Figure 2 (arrow) which shows smooth irregular enhancement of prevertebral collection is also seen.

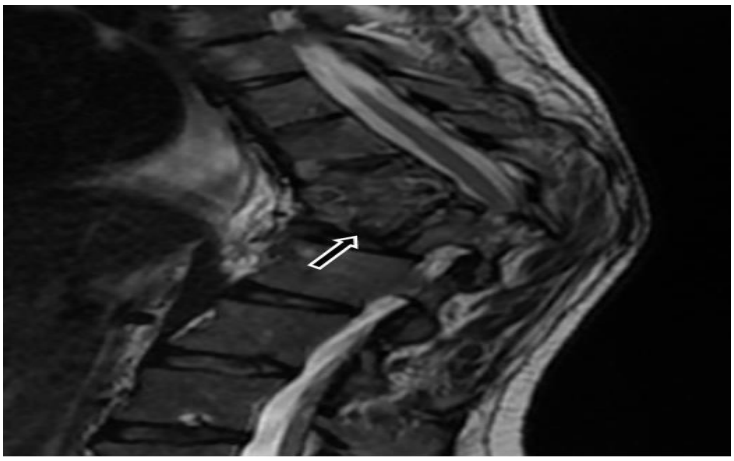

Figure 4: T2 WI shows kyphosis complete destruction of T10- T11 vertebra.

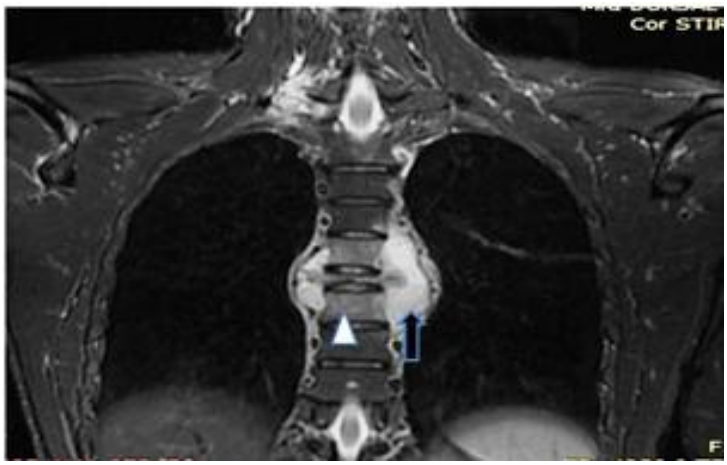

Figure 5: T1 WI + contrast image showing bilateral peripherally rim enhancing paravertebral collections at T4 and T5 vertebral level with enhancement of the affected vertebrae.

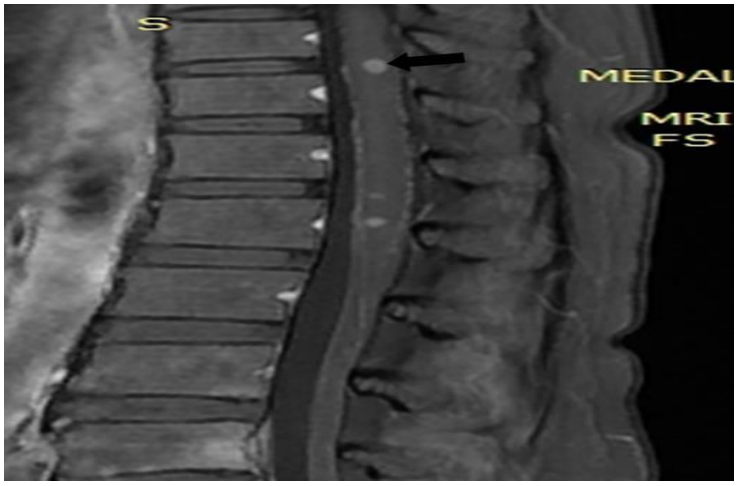

Figure 6: Sagittal T1 WI + contrast image showing nodular enhancement in thoracic cord suggestive of intramedullary involvement.

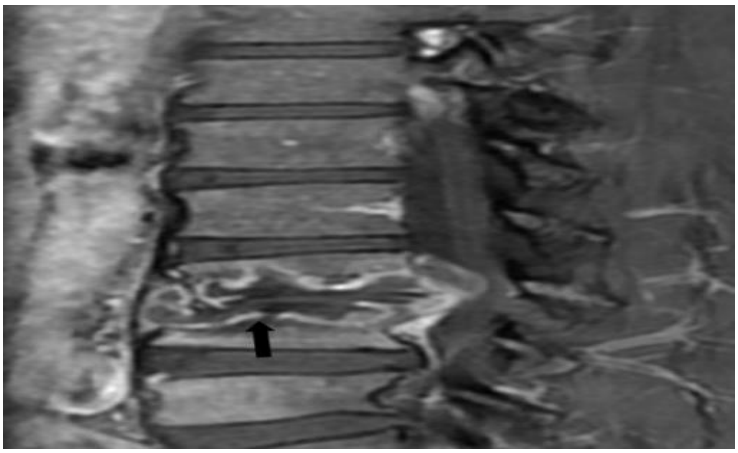

Figure 7- T1 WI + contrast image showing irregular peripherally rim enhancing intraosseous abscess with extension into anterior epidural space.

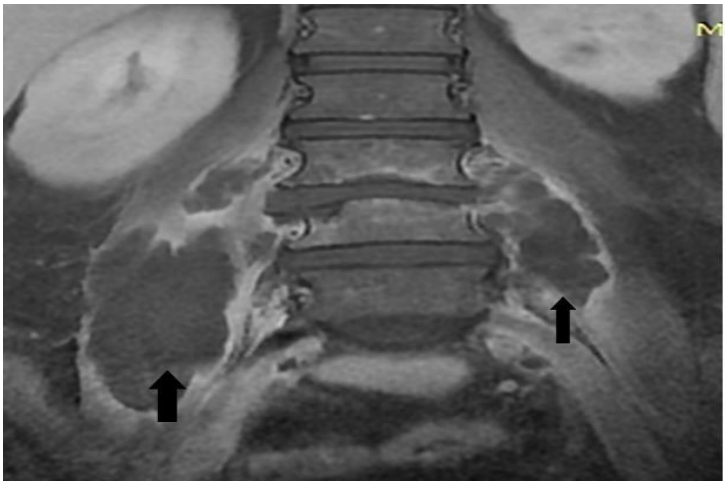

Figure 8: T1WI + contrast coronal image showing large bilateral psoas muscle abscesses with enhancement of L3 and L4 vertebrae (Black arrow).

DISCUSSION

In developing countries tuberculosis is a major public health issue in which poor hygienic conditions, poverty, malnutrition, overcrowding and the presence of drug-resistant strains are the predisposing factors which aid in spread of the tuberculosis disease. Pott's spine is clinically important form of extrapulmonary tuberculosis accounting for majority of the musculoskeletal tuberculosis cases.[1] Pott's spine was first described in 1782 by Percival Pott, a British orthopedic surgeon usually occurs due to haematogenous seeding of the vertebra from a distant source of infection. This disease usually begins as a focal lesion which is a combination of osteomyelitis and arthritis. Usually affects the anterior aspect of the vertebral body more than one vertebra is involved and adjacent to the subchondral plate and from there on spreads to involve of adjacent intervertebral discs. As the disc is vascularized in adults it can be a secondary site of disc, to the spread of infection from the vertebral body. Further involvement of bone, wedge collapse (figure 2) and vertebral destruction (figure 4) occurs which results in kyphosis. Epidural abscess formation (figure 3) results with narrowing of the spinal canal diameter with resultant compression and neurological abnormalities in the patient.[13]

In this study, we have also attempted to describe the various spectrum of presentations of spinal tuberculosis with clinical findings correlation.

The regional distribution of vertebra in this study was also similar to the findings of DJ Kotzke[5] and Sajid Ansari.[10] Radiographic manifestations of tubercular spondylitis evaluated by Shanley DJ[6] like intraosseous and paraspinal abscess formation as seen in our study mentioned in Figure 5 & 7.

Paraspinal abscesses in the lumbar region gravitate along the psoas sheath in figure 8 which can extend to the femoral region and cause of overlying skin erosion.[14,15]

MRI provides superior soft tissue resolution, multiplanar capability and gold standard of imaging in TB Spondylitis due to its golden standard quality. The classical pattern of spread starting and moving to involve antagonistic vertebrae via subligamentous spread anteriorly is clearly seen on MRI with high quality and standard. We observed in our study, T1- WI usually show hypointensity signal within the affected vertebral marrow and on T2-WI a relative hyperintensity within the diseased specified tissues.[16] Meningeal involvement indicate active inflammation and enhancement of intensity of paraspinal soft tissue abscesses,

which are rarely seen in non-tubercular abscesses are best demonstrated on contrast enduced MRI.[17]

We had 3 cases in our study, showing intramedullary tuberculomas (Figure 6), On MRI tuberculomas appear as low or intermediate signal intensity on T1WI and low signal on T2WI. Post contrast study shows ring /nodular enhancement in the scan.[18] The spinal cord involvement extent, nerve root integrity and involvement of posterior elements and also response to therapy is best assessed by MRI scan.[19-20]

MRI is shown one of the accurate in differentiating pyogenic spondylitis from tubercular spondylitis. The presence of a well-defined smooth abscess and thin wall, subligamentous spread to three or more vertebral levels, multiple vertebral or entire body involvement and paraspinal abnormal signal are more suggestive of tubercular spondylitis than pyogenic spondylitis.[21] Its importance to differentiate tubercular spondylitis from other spondylitis because proper treatment of the different types can decrease the rate of disability and functional impairment in patient.[21-22] Therefore Early recognition and prompt treatment are necessary to minimize residual spinal deformity or permanent neurological abnormalities, Conservative treatment by anti-tubercular drugs has shown favorable results in early diagnosed cases as anti-tubercular drugs will be able to reach the tubercular lesion.[23] However in patients with severe bone involvement along with cord compression, surgical treatment is the only beneficial.[24]

CONCLUSION

MRI is a very effective and useful tool in the evaluation of spinal tuberculosis. It is also highly sensitive in the detection of various pathological findings of spinal tuberculosis and the type of lesion and displays accurate site of occurrence and also provides excellent depiction of soft tissue involvement, cord involvement and nerve root integrity in the spine. It is also an accurate modality in differentiating spinal tuberculosis from pyogenic spondylitis and useful in diagnosing spinal tuberculosis in early stages and hence prompt treatment so minimizes spinal deformity, permanent neurological abnormalities and avoid the fatal condition. Follow up MRI scans can also be used to assess the disease response to treatment compare with previous stage of disease.

ACKNOWLEDGEMENTS

The authors are highly acknowledged to department of Radiology, U.P.RIMS&R for providing kind support to perform this study.

REFERENCES

1. Hodgson AR, Skinsnes OK, Leong CY. The pathogenesis of Potts paraplegia. J Bone Joint Surg Am, 1967; 49: 1147–56.
2. Ho EKW, Leong JCY. The pediatric spine: principles and practice. In: Weinstein SL, ed. Tuberculosis of the spine, 3rd ed. New York: Raven, 1994: 837–49.
3. World Health Organisation. The global tuberculosis control. November, 2010.
4. Padyana M, Bhat RV, Dinesha M, Nawaz A. HIV-Tuberculosis: A Study of Chest X-Ray Patterns in Relation to CD4 Count. N Am J Med Sci., 2012; 4: 221–5. [PMCID: PMC3359433] [PubMed: 22655281]
5. Kotevoglu N, Tasbasi I. Diagnosing tuberculous spondylitis: patients with back pain referred to a rheumatology outpatient department. Rheumatol Int, 2004; 24: 9-13.
6. Bajwa GR. Evaluation of the role of MRI in spinal Tuberculosis: A study of 60 cases. Pak J Med Sci., 2009; 25(6): 944-7.
7. Moore SL, Rafi M. Imaging of musculoskeletal and spinal tuberculosis. Radiol Clin North Am., 2001; 39: 329–42. [PubMed: 11316362]
8. Dass B, Puet TA, Watanakunakorn C. Tuberculosis of the spine (Pott's disease) presenting as ‘compression fractures’ Spinal Cord, 2002; 40: 604–8. [PubMed: 12411970]
9. Yusof MI, Hassan E, Rahmat N, Yunus R. Spinal tuberculosis: The association between pedicle involvement and anterior column damage and kyphotic deformity. Spine (Phila Pa 1976), 2009; 34: 713–7. [PubMed: 19333105]
10. Narlawar RS, Shah JR, Pimple MK, Patkar DP, Patankar T, Castillo M. Isolated tuberculosis of posterior elements of spine: Magnetic resonance imaging findings in 33 patients. Spine (Phila Pa 1976), 2002; 27: 275– 81. [PubMed: 11805691]
11. Zaidi H, Akram MH, Wala MS. Frequency and magnetic resonance imaging patterns of tuberculous spondylitis lesions in adults. J Coll Physicians Surg Pak, 2010; 20: 303–6. [PubMed: 20642920]
12. Mohammadreza E, Fariborz S, Gholamreza B. Pott's Disease: A review of 58 cases. Med J Islamic Republic Iran, 2010; 23: 200–6.

13. Kotzé DJ, Erasmus LJ. MRI findings in proven Mycobacterium tuberculosis (TB) spondylitis.
14. Shanley DJ. Tuberculosis of the spine:imaging features. AJR. Am J Roentgenol, 1995; 164: 659-64.
15. Sharif HS, Clark DC, Aabed MY, Haddad MC, Al Deeb SM, et al. Granulomatous Spinal Infections: MR Imaging. Radiology, 1990; 177: 101-7.
16. Sharma A, Goyal M, Mishra NK, Gupta V, Gaiwak SB. MR Imaging of Tubercular Spinal Arachnoiditis. AJR, 1997; 168: 807-12.
17. Prakash ML, Sarwagi R, Ramkumar, Srilatha K, et al. Spinal intramedullary tuberculoma: typical, atypical presentation on magnetic resonance imaging. Journal of Case Reports, 2013; 3(2): 404-9.
18. Sinan TH, Al Ismail M, et al. Spinal tuberculosis: CT and MRI features. Ann Saudi Med., 2004; 24(6): 437-41.
19. Ansari S, Rauniyar RK, Dhungel K, et al. MR evaluation of spinal tuberculosis Al Ameen J Med Sci., 2013; 6(3): 219-25.
20. Narlawar RS, Shah JR, Pimple MK, Patkar DP, Patankar T, Castillo M. Isolated tuberculosis of posterior elements of spine: magnetic resonance imaging findings in 33 patients. Spine, 2002; 27: 275-81.
21. Arizono T, Oga M, Shiota E, Honda K, Sugioka Y. Differentiation of vertebral osteomyelitis and tuberculous spondylitis by magnetic resonance imaging. Int Orthop, 1995; 19: 319–22.
22. Jung NY, Jee WH, Ha KY et al Discrimination of Tuberculous Spondylitis from Pyogenic Spondylitis on MRI. AJR, 2004; 182: 1405–10.
23. TB infection Apley's system of Orthopedic and fracture, 8th edition, Arnold, Oxford University Press Inc, New York, 2001.
24. Sinha S, Singh A, Gupta V. Surgical management and outcome of tuberculosis at lantoaxial dislocation: A 15 years experience. Neurosurgery, 2003; 52(2): 331-9.