

# Diagnostic Accuracy of Magnetic Resonance Imaging (MRI) in Tubercular Spondylitis

MARZIA SULTANA<sup>1</sup>, SHAHARA HAQUE ZERIN<sup>2</sup>, HOSNE ARA<sup>3</sup>, SAJIDA NAHID<sup>4</sup>, SHARMIN RAHMAN<sup>5</sup>, POLASH KUMAR SARKAR<sup>6</sup>, HASNA HOMAIRA CHOWDHURY<sup>7</sup>, UMAMA BINTA ASHRAF<sup>8</sup>

## Abstract:

**Objectives:** To detect the diagnostic accuracy of MRI in the evaluation of Tubercular Spondylitis.

**Material and methods:** This cross sectional observational study was conducted in Department of Radiology and Imaging, Dhaka Medical College Hospital (DMCH), Dhaka, from September 2019 to August 2021. Patients with suspected Tubercular Spondylitis, referred to Radiology & Imaging department of DMCH, for imaging investigation were included. Sample was selected by convenient and purposive sampling technique. Sample size was 30.

**Results:** In the study, mean age of the patients was  $38.3 \pm 5.7$  year. Out of 30 cases 17 (57.7%) cases were male and 13 (43.3%) were female. Male to female ratio was 1.3:1. MRI scan was done in all patients. Most of the cases (86.7%) had enhanced signal with clear margin. Regular & thin wall paravertebral abscesses were detected in 27 (90%) cases and multiple vertebral involvement was in 26 (86.7%) cases. T1 hypo intensity was in 21 (70%) cases and T2 hyper intensity in 24 (80%) cases. Diagnosis based on MRI findings showed that maximum number of cases (86.7%) were tubercular Spondylitis and 4 (13.3%) cases were other than Tubercular Spondylitis. Cytopathological diagnosis revealed that most 25 (83.3%) cases were tubercular Spondylitis and 05 (16.7%) cases were other than Tubercular Spondylitis. Comparison was done between cytopathology test and MRI findings. Sensitivity, specificity, positive predictive value, negative predictive value and accuracy of MRI scan for evaluation of Tubercular Spondylitis were 96%, 60%, 92.3%, 75% and 90% respectively. **Conclusion:** MRI is best diagnostic modality for diagnosis of Tubercular spondylitis.

**Address of correspondence:** Dr. Marzia Sultana, Clinical Staff, Department of Radiology and Imaging, Asgar Ali Hospital, Dhaka. E-mail: marzialina782@gmail.com

## Introduction:

Spinal tuberculosis is a classic form of extra pulmonary tuberculosis. Approximately half of all cases of musculoskeletal tuberculosis involve spine. It is more commonly encountered in children and young adults.<sup>1</sup> Due to the slow progression of the disease, there is a significant delay between symptoms onset and diagnosis. Back pain is the most common symptom. Spine deformities and neurological deficits are the worst complications of tuberculous spondylitis. Early diagnosis and prompt treatment is necessary to prevent permanent neurological disability and to minimize spinal deformity.<sup>2</sup>

The exact incidence and prevalence of spinal tuberculosis is not known. In countries with a high burden of pulmonary tuberculosis, the incidence is expected to be proportionately high. The spine is the most common site affected in skeletal TB. Epidemiological study in Bangladesh reported that spinal TB more commonly seen among the young age group with a male predominance.<sup>3</sup>

Predisposing factors for pulmonary TB in Bangladesh includes poverty, overcrowding, illiteracy, malnutrition, alcoholism, drug abuse, diabetes mellitus, immunosuppressive treatment, and HIV infection, which are also thought to be responsible for spinal tuberculosis.<sup>4</sup> Genetic susceptibilities to spinal tuberculosis has recently been demonstrated. FokI polymorphism in the vitamin-D receptor gene was found to be associated with susceptibility to spinal tuberculosis.<sup>5</sup>

Spinal tuberculosis secondarily occurs as a result of hematogenous spread of *M. tuberculosis* into the dense vasculature of cancellous bone of the vertebral bodies. The primary infection site is

1. Clinical Staff, Department of Radiology and Imaging, Asgar Ali Hospital, Dhaka. 2. Professor and Head, Department of Radiology and Imaging, Dhaka Medical College Hospital (DMCH), Dhaka. 3. Associate Professor, Department of Radiology and Imaging, DMCH, Dhaka. 4. Assistant Professor, Department of Radiology and Imaging, DMCH, Dhaka. 5. Medical officer, Department of Radiology and Imaging, DMCH, Dhaka. 6. Radiologist, Department of Radiology and Imaging, Shaheed Suhrawardy Medical College and Hospital, Dhaka. 7. Registrar, Department of Radiology and Imaging, BIRDEM, Dhaka. 8. Consultant Radiologist, Popular Diagnostic Center, Dhanmondi, Dhaka.

Received: 24 Feb. 2022

Revised: 25 April 2022

Accepted: 30 Sep 2022

Published: 01 Jan. 2023

either a pulmonary lesion or an infection of the genitourinary system. Spread occurs either via the arterial or the venous route.<sup>6</sup>

Spinal tuberculosis primarily affects the anterior inferior portion of the vertebral body. Later on it spreads into the central part of the body or disc. Collapse of the vertebral body produces vertebra plana which indicates complete compression of the vertebral body.<sup>6</sup> In younger patients, the disc is primarily involved because it is more vascularized. In old age, the disc is not primarily involved because of its age-related avascularity. More than one vertebral involvement is seen in spinal TB because its segmental arteries bifurcate to supply two adjacent vertebrae. Spread of the disease beneath the anterior or posterior longitudinal ligaments involves multiple contiguous vertebrae. A lack of proteolytic enzymes in mycobacterial infections (in comparison with pyogenic infections) has been suggested as the cause of the subligamentous spread of infection.<sup>1,6</sup>

Persistent and local back pain, spinal cord restraints, fever and neurologic complications can occur with the progression of disease process. Other symptoms that describe chronic illness are including malaise, weight loss and fatigue. Diagnosis is usually not suspected in patients without evidence of extra-spinal tuberculosis. Patient can come to the hospital with the complaints of weakness in their limbs.<sup>7</sup> The upper lumbar and lower thoracic spine are most frequently involved sites. Multiple vertebrae are typically affected in spinal tuberculosis, and the vertebral body is more frequently affected.<sup>8</sup>

Spinal tuberculosis has a potential to cause serious morbidity, including permanent neurological deficit and spinal deformity. Paraplegia is the most devastating complication.<sup>1</sup> Therefore, early diagnosis and early comprehensive treatment are very important. Magnetic resonance imaging is more sensitive imaging technique than x-ray and more specific than computed tomography. It demonstrates involvement of the vertebral bodies on either side of the disc, disc destruction, cold abscess, vertebral collapse, and presence of paravertebral abscess and vertebral column deformities.<sup>1,6</sup>

In a previous study it has been reported that thick rim enhancement in paravertebral abscesses is strongly suggestive of tuberculous infection and is not seen in non-granulomatous spondylitis.<sup>9</sup> Diagnosis of tuberculous spondylitis by microbiological and histopathological analysis is

time consuming. Non-invasive methods such as Magnetic resonance imaging (MRI) can thus be used for accurate diagnosis of spinal tuberculosis.<sup>10</sup>

The radiological diagnosis using MRI had a sensitivity of 85%, specificity of 87.5%, positive predictive value of 94.4%, negative predictive value of 70%, and accuracy of 85.7%.<sup>11</sup> MRI should be considered to be the imaging modality of choice for patients with suspected spinal TB as it provides necessary information to the physician for proper management by providing information about vertebral intra-osseous abscess, vertebral disc collapse, skip lesions, dural and intradural diseases and involvement of posterior elements more precisely.<sup>9</sup> Therefore, aim of this study was to detect the accuracy of MRI scan in tubercular Spondylitis.

### **Material and methods:**

#### *Study procedure:*

This cross sectional observational study was conducted in Department of Radiology & Imaging, Dhaka Medical College Hospital, Dhaka from September, 2019 to August, 2021 to evaluate the accuracy of MRI scan in evaluation of Tubercular Spondylitis. Suspected Tubercular Spondylitis patients, referred to Radiology & Imaging department of DMCH, for imaging investigation were included and a total of 30 patients were studied over a period of 24 months. After fulfilling the inclusion and exclusion criteria, patient were enrolled with unique ID. Subjects were briefed about the objectives of the study, risk and benefits, freedom for participating in the study and confidentiality. Informed consent was obtained accordingly. Detail demographic data were collected from the patients and recorded in structured case report form. MRI was performed in each patient by 1.5 Tesla HITACHI ECHELON-II OVAL model equipment. CT guided fine needle aspiration (FNA) was performed in Radiology and Imaging department of DMCH. Materials obtained from diseased site were then evaluated in pathology department of DMCH for FNA cytopathological examination. FNAC (Fine needle aspiration cytology) reports were collected from pathology department and compared with the MRI diagnosis. All information was recorded in data collection sheet and was processed and analysed with the help of computer program SPSS (Version 22) and Microsoft excel.

#### **Magnetic resonance imaging technique:**

MRI sequences used for spine was as follows: a basic imaging protocol included T1-weighted images with TE-8.2 and TR- 500 and T2-weighted

images with TE-100 and TR-3000 in the axial, sagittal and coronal planes with a large field of view (350). The axial, sagittal and coronal section were taken in 3 mm, 4 mm and 4 mm thickness respectively. T1-weighted imaging with contrast enhanced (Gadodiamide 10 ml, IV) axial, coronal and sagittal section were taken. Imaging criteria included: a) Vertebral destruction, b) Disc destruction, c) Paravertebral abscess, d) Subligamentous collection, e) Spinal kyphosis f) Spinal canal stenosis & g) Cord compression.

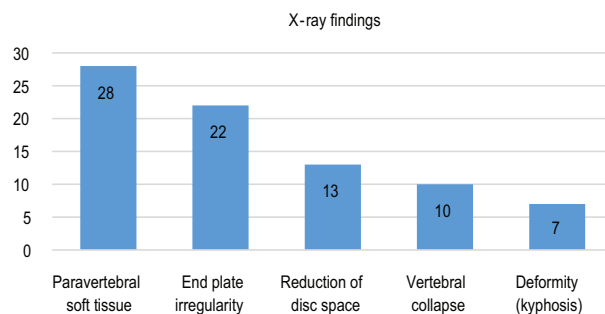
### Image analysis:

MRI images were interpreted by two expert radiologists separately to avoid bias.

### Results & observation:

Age range of the study subjects was 25 to 54 years. Maximum number of patients 22 (73.3%) were in the age group 35-44 years. Followed by 25-34 years' age group 05(16.7%) and 45 to 54 years' age group 03 (10%). Mean age was  $38.3 \pm 5.7$  years.

Among a total of 30 cases 17 (57.7%) cases were male and 13 (43.3%) were female with a male to female ratio of 1.3:1



**Fig.-1:** Bar chart showing distribution of patients according to x-ray findings

Figure shows distribution of patients according to x-ray findings. Paravertebral soft tissue was noted in 28 cases (93.3%). End plate irregularity was present in 22 (73.3%) patients. Reduction of disc space was found in 13 (43.3%), vertebral collapse in 10 (33.3%) and deformity (kyphosis) detected in 7 (23.3%) patients.

**Table-I**

*Distribution of patients according to MRI findings (N=30)*

MRI findings	Frequency	Percentage
Multi-segment sub-ligamentous collection	30	100
Spared disc space	13	43.3
Vertebral collapse	10	33.3
Signal abnormality of enhanced MRI		
Enhanced signal with clear margin	26	86.7
Enhanced signal with unclear margin	4	13.3
Abnormal contrast enhancement on the intervertebral discs/ soft tissue/ facet joints		
Present	6	20
Absent	24	80
Paravertebral abscess		
Regular and thin wall paravertebral abscesses	27	90
Irregular and thick wall paravertebral abscesses	3	10
Number of vertebrae involvement		
Single	4	13.3
Multiple	26	86.7
T1 signal intensity		
Isointense	7	23.3
Hyper intense	2	6.7
Hypo intense	21	70
T2 signal intensity		
Isointense	6	20
Hyper intense	24	80
Hypo intense	0	0
Spinal canal stenosis and cord compression	05	16.7

Table-I shows distribution of patients according to MRI findings. Typical MRI findings included multi-segment sub-ligamentous collection, well-defined paravertebral abscess with relatively thin, regular abscess walls, relatively spared disc space and heterogeneous enhancement of vertebral body. In most cases, 26 (86.7%) had enhanced signal with clear margin, 27 (90%) cases had regular & thin wall paravertebral abscesses and 26 (86.7%) cases showed multiple vertebrae involvement. Results shows that 21 (70%) cases had hypo intense lesion in T1 and 24 (80%) cases had hyper intense lesion in T2.

**Table II**  
*Distribution of patients according to MRI diagnosis (N=30)*

MRI diagnosis	Frequency	Percentage
Tubercular Spondylitis	26	86.7
Other than tubercular Spondylitis	4	13.3

Table II shows distribution of patients according to MRI diagnosis. Maximum 26 (86.7%) cases were

tubercular Spondylitis & 4 (13.3%) cases were other than Tubercular Spondylitis.

Table III shows distribution of patients according to cytopathological diagnosis. Maximum 25 (83.3%) cases were tubercular Spondylitis and 5 (16.7%) cases were other than Tubercular Spondylitis.

Table-IV shows the correlation between cytopathology test and MRI findings in the diagnosis of tubercular spondylitis. Out of 30 cases 26 were diagnosed as tubercular spondylitis by MRI and among them 24 were confirmed by cytopathological evaluation. They were true positive and another 2 cases were false positive. Out of 4 cases of other than tubercular spondylitis which were confirmed by MRI, single case confirmed as tubercular spondylitis and 3 were other than tubercular spondylitis by cytopathology diagnosis. They were false negative and true negative respectively. The result was statistically significant.

Table-V shows the validity test results. Sensitivity, specificity, positive predictive value, negative predictive value and accuracy of MRI scan for evaluation of Tubercular Spondylitis were 96%, 60%, 92.3%, 75% and 90% respectively.

**Table III**  
*Distribution of patients according to cytopathology (N=30)*

Cytopathology findings	Frequency	Percentage
Tubercular Spondylitis	25	83.3
Other than tubercular spondylitis (e.g., pyogenic spondylitis)	5	16.7

**Table IV**  
*Comparison of MRI diagnosis with CT guided FNAC diagnosis (N=30)*

MRI diagnosis	FNA Cytopathology findings			p-value
	Tubercular Spondylitis	Other than TB Spondylitis	Total	
Tubercular spondylitis	24	2	26	0.008
Other than Tubercular Spondylitis	1	3	4	
Total	25	5	30	

P value was obtained from fisher exact test

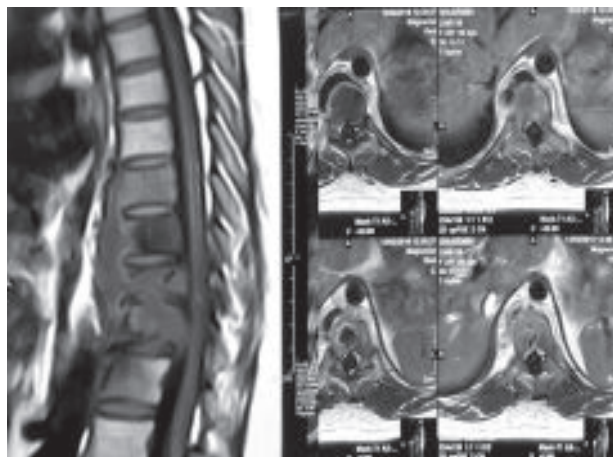
**Table V**  
*Diagnostic value of MRI scan for evaluation of Tubercular Spondylitis (N=30)*

Validity test parameters	Percentage (%)
Sensitivity	96%
Specificity	60%
Positive Predictive Value (PPV)	92%
Negative Predictive Value (NPV)	75%
Accuracy	90%

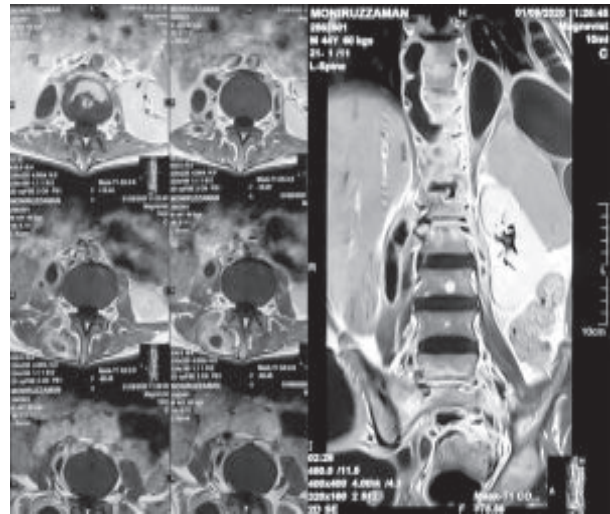




**Image-1 (case no-1) :** Multiplanar post gadolinium T<sub>1</sub> coronal and T<sub>1</sub> sagittal images shows contiguous vertebral involvement, collapse, subligamentous spread with pre, para vertebral and epidural abscess with thin abscess wall. Features suggesting tubercular spondylitis.



**Image-2 (Case No-5):** Multiplanar T<sub>1</sub> sagittal and post gadolinium T<sub>1</sub> axial images shows contiguous vertebral involvement, anterior sub-ligamentous spread with intraosseous and paravertebral rim enhancing abscess. Features suggesting tubercular spondylitis.



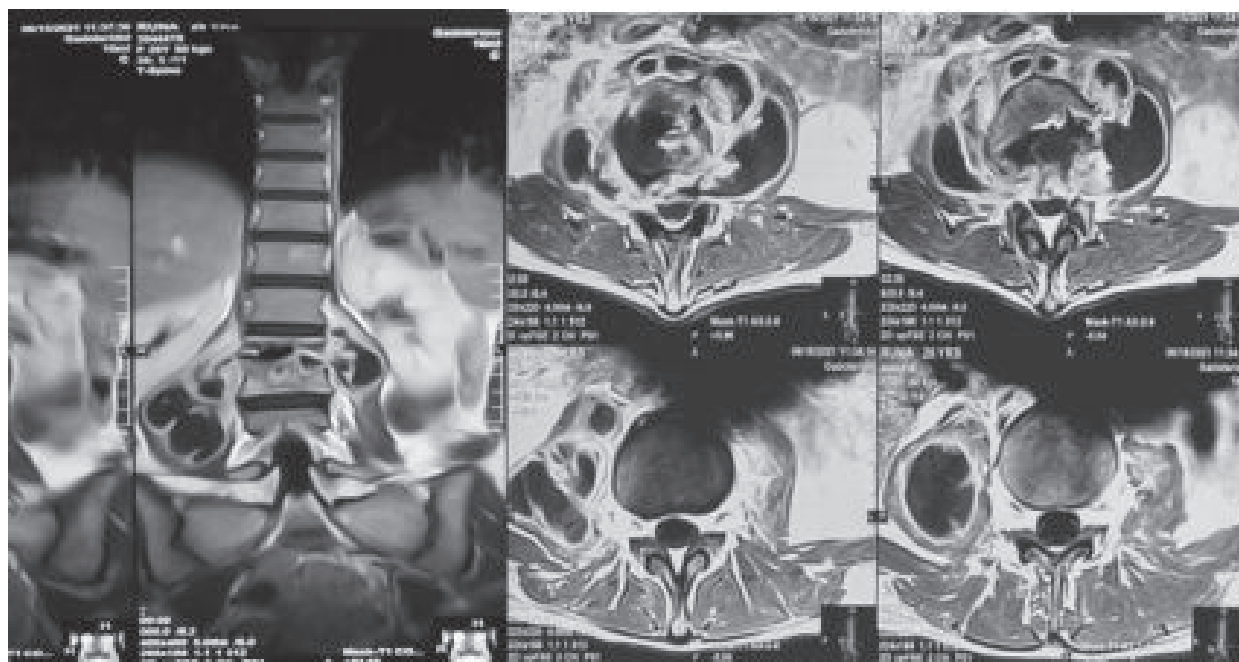
**Image-3 (Case No-9) :** Multiplanar post gadolinium T<sub>1</sub> axial and coronal images shows contiguous vertebral and multilevel involvement, sub-ligamentous spread, pre, paravertebral abscess, Iliopsoas and quadratus abscess with thin smooth abscess wall. Features suggesting tubercular aetiology.



**Image-4 (Case No-12):** T<sub>2</sub> weighted sagittal and parasagittal images shows focal kyphosis, mild prevertebral and epidural collection. Features suggesting tubercular spondylitis.



**Image-5 (Case No-15):** Multiplanar post gadolinium T<sub>1</sub> coronal and sagittal images shows contiguous and multiple vertebral involvement, sub-ligamentous spread, pre & paravertebral abscess with thin smooth abscess wall. Features suggesting tubercular aetiology.



**Image-6 (Case No-26):** Multiplanar post gadolinium T<sub>1</sub> coronal and axial images shows contiguous vertebral involvement, sub-ligamentous spread, pre-, paravertebral, disc and psoas abscess with spinal canal stenosis and cauda equina compression. Features suggesting tubercular spondylodiscitis.



### Discussion:

This cross sectional study was conducted in Dhaka Medical College Hospital, Dhaka, to detect the accuracy of MRI scan in the evaluation of Tubercular Spondylitis. In the study, maximum number of patients 22(73.3%) were in the age group 35-44 years, mean age was  $38.3 \pm 5.7$ . In a previous study Dharmajaya et al<sup>7</sup> the average age of the patient was 34.85 years (youngest was seven years, and the oldest was 65 years).

In our study male were predominant in number. Male to female ratio was 1.3:1. This might be due to male are more active and exposed to external environment in Bangladesh. In previous study Dharmajaya et al<sup>7</sup> reported that there were 20 cases of TB Spondylitis with four female patients and 16 male patients (ratio: 1: 4). Alam et al<sup>3</sup> reported that incidence of spinal TB was more in male in comparison to female, which is consistent with our study.

In my study, X-ray findings showed presence of paravertebral soft tissue in 93.3%, end plate irregularity in 73.3%, reduction of disc space in 43.3%, vertebral collapse in 33.3% and spinal deformity in 33.3% of cases. In a previous study, Ansari et al<sup>4</sup> reported that typical radiographic features were narrowing of disc spaces and indistinct para-discal margin of vertebral bodies, anterior wedging or collapse, kyphosis, paravertebral abscess which are similar to our study.

In our study, Typical MRI findings found are multi-segment sub-ligamentous collection, the occurrence of well-defined paravertebral abscess with relatively thin, regular abscess walls, relatively more involvement of disc space and heterogeneous enhancement of vertebral body were detected. Most of the cases (86.7%) had enhanced signal with clear margin, regular & thin wall paravertebral abscesses were detected in 27 (90%) cases and multiple vertebrae involvement was in 26 (86.7%) cases. T1 hypo intense lesions were found in 21 (70%) cases and T2 hyper intense lesions in 24 (80%) cases. According to MRI diagnosis, maximum (86.7%) cases were tubercular Spondylitis and 4 (13.3%) cases were other than Tubercular Spondylitis. In previous study, Yueniwati & Christina<sup>11</sup> reported that contrast enhancement of a paravertebral abscess is divided

into enhancement in the regular thin walls and irregular thick walls. Usually most of the patients with tuberculous spondylitis showed regular, thin walled paravertebral abscess (80%), while pyogenic spondylitis showed irregular and thick walled paravertebral abscess. In another study, double vertebrae involvement along with continuous vertebral involvement was in 85.71%, collapse case was in 88.10%, para spinal soft tissue involvement was in 80.95%.<sup>9</sup> These study results are close to our study results. The reason of finding more cases with paravertebral abscess, multilevel involvement and more disc involvement in our study is possibly due to delay in hospital consultancy in Bangladesh.

In this study finally comparison was made between MRI diagnosis & cytopathological diagnosis. Out of 30 cases 26 were diagnosed as tubercular spondylitis by MRI and among them 24 were confirmed by cytopathological evaluation. They were true positive and another 2 cases were false positive. Out of 4 cases of MRI diagnosis of other than tubercular spondylitis, single case was confirmed as tubercular spondylitis and rest 3 as other than tubercular spondylitis by cytopathology. They were false negative and true negative respectively. Sensitivity, specificity, positive predictive value, negative predictive value and accuracy of MRI scan for evaluation of Tubercular Spondylitis were 96%, 60%, 92.3%, 75% and 90% respectively. Yueniwati & Christina<sup>11</sup> demonstrated that the radiological diagnosis of tubercular spondylitis using MRI had a sensitivity of 85%, specificity of 87.5%, positive predictive value of 94.4%, negative predictive value of 70%, and accuracy of 85.7%.<sup>11</sup> High sensitivity in our study may be due to most cases presented with advanced disease so, MRI detected the presence of disease confidently. But advanced disease mimics other infections. It was difficult to exclude other infection by imaging finding alone. So, specificity of my study is relatively lower.

In present study comparison of MRI diagnosis of tubercular spondylitis with cytopathological diagnosis was done by fisher exact test. The p value was significant ( $<0.05$ ). Thus MRI in diagnosis of tubercular spondylitis correlated well with cytopathology diagnosis. Results of the present study concluded that MRI is the most accurate imaging modality in the diagnosis of tubercular

spondylitis. Gadolinium enhanced MRI permit almost confident diagnosis. So MRI should be the choice of investigation in suspected tubercular spondylitis patients for early diagnosis and better management.

#### References:

1. Garg RK, Somvanshi DS. Spinal tuberculosis: a review. *The journal of spinal cord medicine* 2011 Sep 1;34(5):440-54.
2. Lacerda C, Linhas R, Duarte R. Tuberculous Spondylitis: A Report of Different Clinical Scenarios and Literature Update. *Case reports in medicine* 2017:1-4.
3. Alam MS, Salam MA, Farzana T, Newaz AR, Islam MS. Socio-demographic characteristics of patients with tuberculosis spine in Bangladesh. *Bangladesh Journal of Infectious Diseases* 2016;3(1):3-5.
4. Ansari S, Amanullah MF, Ahmad K, Rauniyar RK. Pott's Spine: Diagnostic Imaging Modalities and Technology Advancements. *North American Journal of Medical Sciences* 2013 Jul 1;5(7):404-11.
5. Zhang HQ, Deng A, Guo CF, Wang YX, Chen LQ, Wang YF, Wu JH, Liu JY. Association between FokI polymorphism in vitamin D receptor gene and susceptibility to spinal tuberculosis in Chinese Han population. *Archives of medical research* 2010 Jan 1;41(1):46-9.
6. Rajasekaran S, Soundararajan DC, Shetty AP, Kanna RM. Spinal tuberculosis: current concepts. *Global Spine Journal* 2018 Dec;8(4\_suppl):96S-108S.
7. Dharmajaya R. Tuberculous spondylitis in Haji Adam Malik hospital, Medan. In IOP Conference Series: *Earth and Environmental Science* 2018 Mar;125(1):012095.
8. Moon MS. Tuberculosis of the spine: controversies and a new challenge. *Spine* 1997 Aug 1;22(15):1791-7.
9. Khalequzzaman SI, Hoque HW. Tuberculosis of spine magnetic resonance imaging (MRI) evaluation of 42 cases. *Medicine today* 2012;24(2):59-62.
10. Sadineni RT, Anupama NV, Pushpa BT, Mikkineni K, Kannan M, Rajasekharan S. A novel magnetic resonance imaging scoring system in making specific diagnosis of tubercular spondylitis in advanced infection. *Indian J Musculoskelet Radiol* 2019; 1:7-13.
11. Yueniwati Y, Christina E. The challenges in differentiating tuberculous from pyogenic spondylitis using magnetic resonance imaging. *Reports in Medical Imaging* 2017 Jun 30; 10:37-43.
12. Alvi AA, Raees A, Aslam HM, Saleem S, Ashraf J. Magnetic Resonance Image findings of Spinal Tuberculosis at first presentation. *International archives of medicine* 2014 Dec;7(1):1-7.