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Original Research Article

Magnetic Resonance Imaging (MRI) and CT-Guided Biopsy for Tuberculous and Non-Tuberculous Spondylodiscitis

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Abstract:

Introduction: Magnetic resonance imaging (MRI) is critical for detecting tuberculous spondylodiscitis. Because of its high sensitivity and specificity, which may exceed 90%, it is an effective diagnostic tool for early diagnosis of spondylodiscitis. Computed tomography (CT)-guided biopsy is an excellent tool in the same field. Thus, the goal of this study was to discriminate between tuberculous and non-tuberculous spondylodiscitis using MR imaging and CT-guided biopsies.

Material and Methods: Fifty cases with suggestive finding of spondylodiscitis by MRI, referred to CT guided biopsy for suspected spondylodiscitis.

Results: There was no statistically significant difference between paravertebral infiltration, subligamentous spread, IVD involvement, and epidural involvement (P>0.05). The comparison of paravertebral abscesses was statistically significant (p <0.05). The diagnostic accuracy, specificity, and sensitivity for paravertebral infiltration to identify tuberculous spondylodiscitis are 90.6%, 78.2%, and 99.5%, respectively. Diagnosis accuracy is 86.8%, specificity is 93%, and sensitivity is 84% for subligamentous spread.

Conclusion: Magnetic resonance imaging (MRI) may differentiate between tuberculous and non-tuberculous spondylodiscitis by examining the presence of paravertebral infiltration, paravertebral abscess development, and subligamentous dissemination. A CT-guided biopsy is the most reliable method for finding pathogens in spondylodiscitis.

Keywords: Magnetic resonance imaging (MRI), CT Guided biopsy, tuberculous spondylodiscitis, diagnostic accuracy.

Introduction

Spinal infections occur 2.4–7.2 per 100,000 individuals annually [1,2]. Spinal infections may be caused by a variety of microorganisms, such as bacteria, mycobacteria, fungi, and parasites [3]. Pyogenic spondylitis (PS) and tuberculous spondylitis (TS) are the most prevalent forms. TB, or Mycobacterium tuberculosis, causes granulomatous spinal infections, one of which is TS [4]. When it comes to diagnosing musculoskeletal problems, computed tomography (CT)-guided biopsy is a remarkable tool.

Multiple studies have looked at this procedure's usefulness in cases of pyogenic spinal infection, and the results show a sensitivity range of 30% to 50% [5-7]. The diagnostic yield of CT-guided bone biopsy for spinal TB has not been widely used, even though the frequency of both tuberculous and pyogenic spinal infections has been on the rise recently [8,9]. MRI is the most suitable method for imaging tuberculous spondylodiscitis due to its non-invasive nature, superior ability to distinguish soft tissues (~92% sensitivity and 96% specificity), and capacity to detect infection and abscess formation via multidirectional imaging [10].

MRI is more effective than other imaging techniques in finding lesions at an early stage, scanning the whole spinal column, and providing better clarity in recognizing inflammation spreading to the paravertebral or spinal space.

This study was designed to differentiate between tuberculous and non-tuberculous spondylodiscitis by using MR imaging and CT-guided biopsies.

Material and Methods

This prospective study was conducted in the Department of TB & Chest and Department of Radiology at Apollo Institute of Medical Sciences, Jubilee hills, Hyderabad from April 2022 to May 2024. A total of 50 cases attending outpatient department of pulmonology and admitted in the wards were recruited. Cases with suggestive finding of spondylodiscitis by MRI, referred to CT guided biopsy for suspected spondylodiscitis and willing o participate were included. Cases with dermatological infections at biopsy site, with bleeding disorders, pregnancy and lactation, with systemic disorders and not willing to participate were excluded. Written informed consent was obtained from all the participants and study protocol was approved by the institutional ethics committee.

Each participant had a full clinical examination, including a particular spine examination, during which detailed information was obtained using a standardized form. Each subject had MR imaging and CT-guided biopsies. Four radiologists examined the MR images to detect radiological anomalies that suggest the presence of spondylodiscitis. Intervertebral disk edema, surrounding vertebrae edema, epidural and paravertebral space edema, and the development of abscesses were among the MR imaging findings that indicated infection.

The signal intensities of adjacent intervertebral discs, vertebrae, epidural and paraspinal soft tissues were compared. Before performing a CT guided biopsy, a thorough clinical examination was conducted, and laboratory parameters such as prothrombin time were assessed. In addition, informed consent for the biopsy process was obtained. After reviewing the MRI data, a biopsy was performed utilizing a 16 Slice CT machine guided by a CT scan. Before the biopsy, all of the patients had not had antibiotic therapy. Following the initial axial CT scan, the best slice was selected to guide the needle placement into the lesion. The preliminary scan provided measures of the biopsy needle's angulations and depth. The skin is then marked to indicate the position of the entry point. When there are many lesions, the largest and most superficial one was chosen.

The data were analyzed using SPSS version 26.0. Quantitative data were shown using descriptive statistics such as mean and standard deviation, while categorical variables were represented by frequency and percentages. Statistical significance was determined using a P-value of <0.05. The sensitivity, specificity, positive and negative predictive values, and diagnostic accuracy of each MR imaging result for tuberculous spondylodiscitis are computed and presented. These results are compared to the gold standard for pathogen identification, CT guided biopsy. The findings contain the associated 95% confidence intervals (CI). The screening test's reliability is assessed using kappa statistics, which include the 95% confidence interval (CI) and P value.

Results

Table 1: Sociodemographic characteristics of study participants

Demographic data	Tuberculous spondylodiscitis (n=30)		Non-Tuberculous spondylodiscitis (n=20)	
	Frequency	Percentage	Frequency	Percentage
Age (In years)				
21-30	10	33.33%	07	35%
31-40	08	26.67%	04	20%
41-50	06	20%	04	20%
51-60	04	13.33%	03	15%
>60	02	6.66%	02	10%
Gender				
Male	18	60%	14	70%
Female	12	40%	06	30%

Table 2: Comparison of disease extent among study participants

Parameter	Tuberculous spondylodiscitis (n=30)		Non-Tuberculous spondylodiscitis (n=20)		Chi square value	p-value
	Frequency	Percentage	Frequency	Percentage		
Paravertebral infiltration						
Present	30	100%	05	25%	17.64	0.0210
Absent	-	-	15	75%		
Subligamentous spread						
Present	21	70%	03	15%	22.18	0.0436
Absent	09	30%	17	85%		
Involvement of intervertebral disc						

Present	17	56.67%	16	80%	1.025	0.846
Absent	13	43.33%	04	20%		
Epidural involvement						
Present	14	46.67%	09	45%	0.562	1.750
Absent	16	53.33%	11	55%		
Paravertebral abscess						
Present	29	96.67%	07	35%	27.137	0.001
Absent	01	3.33%	13	65%		

Table 3: Outcome evaluation of present study

Outcome	Sensitivity	Specificity	Diagnostic accuracy
Paravertebral infiltration	99.5%	78.2%	90.6%
Subligamentous spread	84%	93%	86.8%
Involvement of IVD	67.2%	31.34%	45%
Involvement Epidural	38.9%	73.1%	55.33%
Paravertebral abscess	100%	72.83%	87.2%

Discussion

Among the study participants 30 cases were diagnosed with tuberculous spondylodiscitis and 20 cases were diagnosed with non-tuberculous spondylodiscitis. Majority participants were between 21-30 years (33.33% in TBS & 35% in non-TBS), followed by 31-40 years (26.67% in TB & 20% in non-TBS) and 41-50 years (20% in each) with male predominance (Table 1).

Paravertebral infiltration was seen in all TBS patients and 25% of non-TBS cases. Subligamentous spread was found in 21 TBS patients (70%) and 3 non-TBS cases (15%). The intervertebral disc was involved in 17 TBS patients (56.67%) and 16 non-TBS cases (80%). Epidural involvement was found in 14 instances (46.67%) and 9 cases (45%) with non-TBS. Paravertebral abscess was observed in 29 cases (96.67%) of TBS and 7 (35%) of non-TBS patients. There was no statistically significant difference between paravertebral infiltration, subligamentous spread, IVD involvement, and epidural involvement (P>0.05). The comparison of paravertebral abscesses was statistically significant (p <0.05) (Table 2).

The diagnostic accuracy, specificity, and sensitivity for paravertebral infiltration to identify tuberculous spondylodiscitis are 90.6%, 78.2%, and 99.5%, respectively. Diagnosis accuracy for tuberculous spondylodiscitis is 86.8%, specificity is 93%, and sensitivity is 84% when using the subligamentous spread. With a sensitivity of 67.2%, specificity of 31.34%, and diagnostic accuracy of 45%, IVD may identify tuberculous spondylodiscitis. The sensitivity, specificity, and diagnostic accuracy of identifying tuberculous spondylodiscitis based on epidural involvement is 38.9%, 73.1%, and 55.33 percent, respectively. For the diagnosis of tuberculous spondylodiscitis, the paravertebral abscess has a diagnostic accuracy of 87.2%, a specificity of 72.83%, and a sensitivity of 100% (Table 3).

A study done by NA-Young Jung et al. discovered that tuberculous spondylitis has a sensitivity of 100% (20/20), specificity of 80% (16/20), and accuracy of 90% (36/40). Similarly, pyogenic spondylitis was 80% sensitive (16/20), 100% specific (20/20), and 90% accurate (36/40). Patients with tuberculous spondylitis had a considerably greater incidence of MRI abnormalities than those with pyogenic spondylitis (p<0.05). These findings included a well-defined abnormal signal in the paraspinal region (95% in tuberculous spondylitis vs 25% in pyogenic spondylitis), a thin and smooth abscess wall (95% vs 15%), a combination of both abnormalities (90% vs 0%), the presence of abscesses in the paraspinal region or within the bone (95% vs 50%), the spread of infection beneath the ligament to three or more vertebral levels (85%) Furthermore, the research found that the MRI was accurate in discriminating between tuberculous and pyogenic spondylitis [11].

Dhodapkar MM et al. stated that MRI is the preferred imaging modality for distinguishing between pyogenic and tuberculous spondylodiscitis, evaluating the presence or absence of subdural or epidural abscesses, and identifying the spread of infection into adjacent soft tissues [12]. Contrast-enhanced MRI is the preferred imaging technique for detecting spinal infections, with a sensitivity of 97%, specificity of 93%, and accuracy of 94% in diagnosing spondylodiscitis. It effectively reveals the full scope of the illness, generating distinct images of the paraspinal soft tissues and epidural region. Nevertheless, over the first 2-4 days [13-16], it may seem to be within the expected range.

In a study conducted by Park JH et al., a total of 41 instances of infectious spondylitis were analyzed. The researchers found that two magnetic resonance imaging (MRI) results were statistically significant

in distinguishing between tuberculous spondylitis and pyogenic spondylitis. These findings included a clearly defined aberrant signal in the paraspinal area and a thin and smooth wall around the abscess. There were no notable variations in the MR imaging findings, including paraspinal abscess or intraosseous abscess, subligamentous spread to three or more vertebrae, involvement of multiple vertebrae, hyperintense signal on T2-weighted images, heterogenous low signal on T1-weighted images, involvement of the posterior element, epidural extension, involvement of the intervertebral disk, disk space narrowing, rim enhancement of the abscess, skip lesion, and endplate destruction.

The study also determined that MR imaging is a suitable method for distinguishing between tuberculous spondylodiscitis and pyogenic spondylodiscitis [17]. According to Griffith JF et al. (2002), Thrush A and Enzmann D (1990), and Harada Y et al. (2008), it is common for tuberculous spondylodiscitis to extend to three or more vertebral levels below the ligament. The infection may spread from a front lesion of the vertebral body located below the anterior longitudinal ligament to the front sections of adjacent intervertebral discs and vertebral bodies [18-20].

Nevertheless, our investigation revealed that subligamentous spread was present in 70% of patients diagnosed with tuberculous spondylodiscitis, in contrast to only 15% of individuals with non-tuberculous spondylodiscitis. Our study has limitations in terms of limited sample size and assessed tuberculous spondylodiscitis alone.

Conclusion

Magnetic resonance imaging (MRI) is the most effective method for evaluating individuals suspected of having spondylodiscitis. Magnetic resonance imaging (MRI) may differentiate between tuberculous and non-tuberculous spondylodiscitis by examining the presence of paravertebral infiltration, paravertebral abscess development, and subligamentous dissemination. A CT-guided biopsy is the most reliable method for finding pathogens in spondylodiscitis.

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