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Study of Clinico-Radiological Profile of Patients with Spinal Tuberculosis

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Abstract

Introduction: *Weight, height and a1% to 3% of TB patients have bone or joint disease, and spinal TB typically develops as a secondary infection following a primary infection that has devastating side effects including tubercular spondylodiscitis, spondylitis, collapsing vertebral elements, and even anterior wedging that results in the development of gibbus and kyphosis. Due to its delayed onset and vague symptoms, spinal TB is challenging to diagnose. This study investigates the clinical, radiographic, and resistance trends of spinal tuberculosis in a Tertiary care facility.* ***Material And Methods:*** *The observational cross-sectional research was place from 2020 to 2021. In the research, 54 patients were included. Magnetic resonance imaging (MRI) descriptive statistics were computed to determine the clinical and radiological spectrum. Additionally, we simultaneously collected tissue samples from the spine, evaluated them using Truenat, and used a Z-test to compare two sample proportions using traditional histopathological biopsies.* ***Results:*** *The thoracic and lumbar vertebrae were found to have spinal involvement most commonly, with more than four vertebrae being affected in most instances, according to MRI scans. In 85.19% of the instances, there was vertebral body degradation, in 42.59% there was vertebral collapse, and in 42.59% there was deformity. Of the 54 trial participants, 49 (90.74%) had spinal TB that was treatable with drugs, whereas 5 (9.26%) had the more severe form of the disease. Two individuals had Pre-XDR TB, two had multi-drug resistant TB (H+R) TB resistant to rifampicin and isoniazid and one patient had XDR-TB among those with drug-resistant spinal TB.* ***Conclusion:*** *The majority of the 54 patients who were recruited were male and had a prevalence of muscular spasm and back pain as their first recognized symptoms. The radiographic evaluation showed that 61.1% of the lumbar involvement and 63% of the thoracic involvement both exhibited disc enhancements, cold abscesses, decreased disc space, osteitis indications, cord compression with vertebral collapse, and limited disc space. In our analysis, the posterior portion was more often involved (74.1% of cases). Using the Truenat and Line Probe Assay test, drug-resistant spinal tuberculosis was identified in five out of fifty-four individuals.*

Keywords: *Spinal Tuberculosis, MDR Tb, Extrapulmonary TB, Lumber, Vertebral collapse*

1. Introduction

Mycobacterium TB is a fastidious, aerobic bacilli species that causes persistent granulomatous illness and grows slowly in vitro [1,2]. In India, there were 188 cases of tuberculosis per lakh people in 2020, according to estimates. According to the India TB report, a total of 18,56,385 new cases of TB and 6,07,830 instances of extrapulmonary tuberculosis were reported in 2021. Additionally, 11,73,137 cases were tested for rifampicin resistance, and 48,232 individuals were identified as having this resistance [3]. One percent to three percent of all TB patients have bone and joint TB. After a first infection, spinal TB often manifests as a secondary infection [4].

Since spinal TB often takes time to develop and only one-third of cases are accompanied by fever, diagnosis may be challenging [5]. The spinal TB initially manifests in the anteroinferior portion of the vertebral body. Later, it grows toward the center of the disc or body. Paradisal, central, and anterior lesions are typical spinal involvement patterns. Simultaneous spondylodiscitis, tubercular spondylitis, collapsing vertebral components, or anterior wedging, which results gibbus and kyphosis formation, are the most dangerous consequences [6–8]. Using the Tuli-proposed and subsequently amended Jain et al. paraplegia categorization system, all instances of paraplegia are divided into four categories of neurological disability depending on the degree of the cord compression. The location, severity, prognosis, and presence of complications such abscesses, sinuses, and deformities affect how spinal TB manifests [9–11].

Spinal TB has a wide clinical and radiological range with a rising treatment resistance trend. As a result, diagnosing spinal tuberculosis requires an immediate and effective response. With this, we want to look for indications of spinal tuberculosis in terms of trends in population's radiological, clinical, and drug resistance.

2. Materials And Methods

Study Design

The observational cross-sectional study was carried out over one year (2020-2021) within Swami Rama Himalayan Hospital, a tertiary care centre in Dehradun, India. Institutional review board approval and Ethical committee approval were obtained.

Study Population

For inclusion and exclusion criteria, all patients who arrived at the hospital throughout the research period were screened. Time-based selection was carried out. In the research, 54 patients were included.

Inclusion criteria:

1. Age > 18
2. Vertebral TB evidence found clinically or by imaging.
3. Clinical proof of a cold abscess or disease activity.
4. Patients with spinal tuberculosis has neurological involvement ranging from little weakness to severe paraplegia.

Exclusion criteria:

1. Age less than 18.
2. Metastatic and cancerous spinal disorders.
3. Serious diseases that are not related to tuberculosis, such as rheumatoid arthritis or ankylosing spondylitis, may affect the evaluation.
4. We didn't include Tuberculosis in other organs or spread throughout the body.

Study Tools

(1) Radiological investigations: Chest Xray, Xray spine, Computed tomography spine or Magnetic resonance imaging of the spine
(2) Standardised case recording form.
(3) Biopsy Sample for histopathological examination.
(4) Biopsy or Pus sample for Nucleic acid tests like cartridge-based nucleic acid amplification test (Truenat) and Line Probe assay (LPA).

Study Protocol

Based on a thorough clinical history and examination, which included a neurological evaluation and symptomatology, every patient in the study group was analyzed. Patients had X-ray, CT, and MRI spine exams to evaluate their radiological profiles. Tissue samples from the pertinent lesions were taken during surgery or a CT-guided operation. Samples of tissue were submitted for histopathology and Truenat.

Statistical Analytics

MS Excel 2022 was used to gather and input the data. Version 22 of the SPSS statistical analysis program was used for the study. For quantitative variables, descriptive statistics were computed; for qualitative and categorical variables, frequencies and percentages were computed. The Z test was used to compare the proportions of the two samples, and the kappa coefficient was computed. To readily comprehend the findings, the variables were represented graphically, and categorical data were analyzed.

3. Results and Discussion

The age range of 31–40 years had the highest prevalence of spinal tuberculosis (35.2%) (n=19 cases), followed by the age ranges of 21–30 and 61–70 years (16.7% patients; n=9), 51–60 years (11.1%) (n=6), and 20 years (7.4%; n=4). Ages 71 to 80 years had the lowest prevalence of spinal TB illness, or 5.6% (n=3 cases). According to the participants' ages, Figure 1 shows that of the 54 patients in this research, 33 (61.1%) were men and 21 (38.9%) were women.

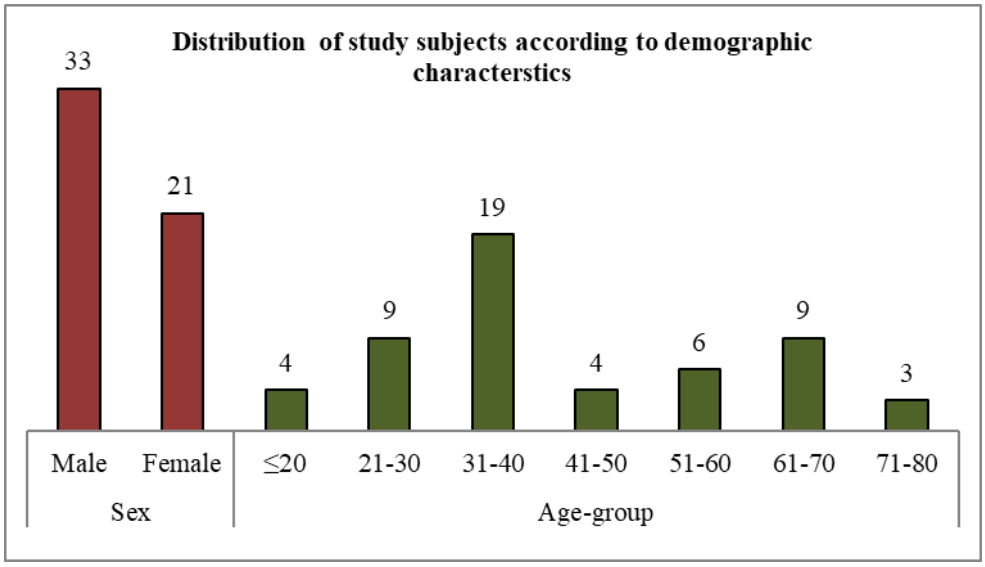

Figure 1: Distribution of study subjects according to demographic characteristics

Table 1 shows the earliest clinical symptoms reported among the study population.

Table1: Earliest clinical symptom reported in the study population

First Symptom	No. of Patients	Percentage
Malaise	1	1.9
Numbness	3	5.6
Muscle spasm	19	35.2
Neck pain/ dysphagia	1	1.9
Fever	9	16.7
Weight loss/ weakness	6	11.1
Back pain	15	27.8
Total	54	100.0

Muscle spasm was the most prevalent symptom, which comprised of 35.2% (n=19) of cases, subsequently following back pain in 27.8% (n=15) cases, fever in 16.7% (n=9) instances along with numbness in 5.6% (n=3). However, just 1.9% (n=1) of instances each of malaise, neck discomfort, and dysphagia were prevalent symptoms.

According to Table 2, among the 54 patients, muscular spasms were the most common symptom in 51 (94.4%) of them, then back pain in 50 (92.6%), a general feeling of unwellness in 42 (77.8%), limb weakness in 40 (74.1%), weight loss in 33 (61.1%), and fever in 26 (48.15%) of them.

Table 2: Symptoms of patients with spinal Tuberculosis at the time of presentation

Symptom	No. of Patients	Percentage
Neck pain	1	1.9
Limb weakness	40	74.1
Loss of bladder/ bowel control	7	13
Deformity	13	24.1

Back pain	50	92.6
Fever	26	48.15
Malaise	42	77.8
Weight loss	33	61.1
Muscle spasm	51	94.4
Dysphagia	1	1.9

In addition, there were 13 instances of deformity (24.1%), seven (13%) of lost bladder function, one (dysphagia), and one (neck discomfort).

According to Table 3, the average time it took for the first symptom to show was around 89 days, with the highest time being 280 days with the smallest time being 15 days.

Table 3: Appearance of the first symptom

	N	**Minimum**	**Maximum**	**Mean±SD**
Days of appearance of the first symptom	54	15	280	89.17±51.96

Approximately 96.3% (52) of the participants experienced local discomfort, as shown in Figure 2, while 31.5% (17) of them had a deformity, 24.1% (13) had edema, and 18.5% (10) had sinuses that were found during local inspections.

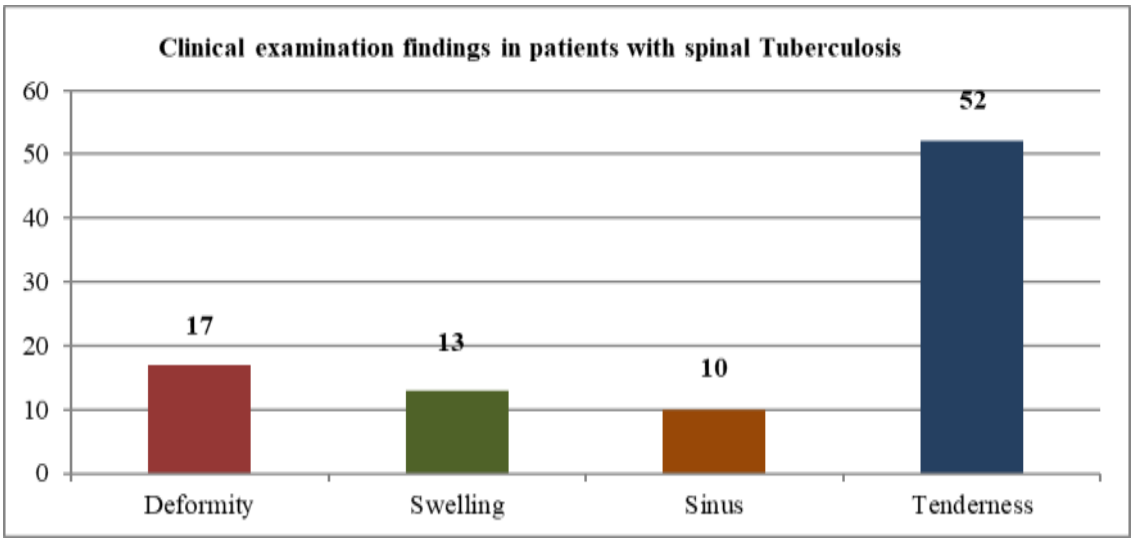

Figure 2: Clinical examination findings in patients with spinal Tuberculosis

The allocation of the vertebrae among 54 spinal tuberculosis patients is shown in Figure 3. The L5 and L2 vertebrae were affected the most, 15 times, followed by the D9, D12, and L1 vertebrae, 13 times, the D10 vertebrae, 12 times, and the D8, D11, and L4 vertebrae, 10 times. On the other hand, C3, C4, D1, D2, S4, and S5 were only engaged in one instance. Thoracic vertebrae were affected in 63% (n=34) of patients, as seen in Figure 3. 11.1% (n=6) of cervical vertebrae, 20.4% (n=11) of sacral vertebrae, and 61.1% (n=33) of lumbar vertebrae were affected.

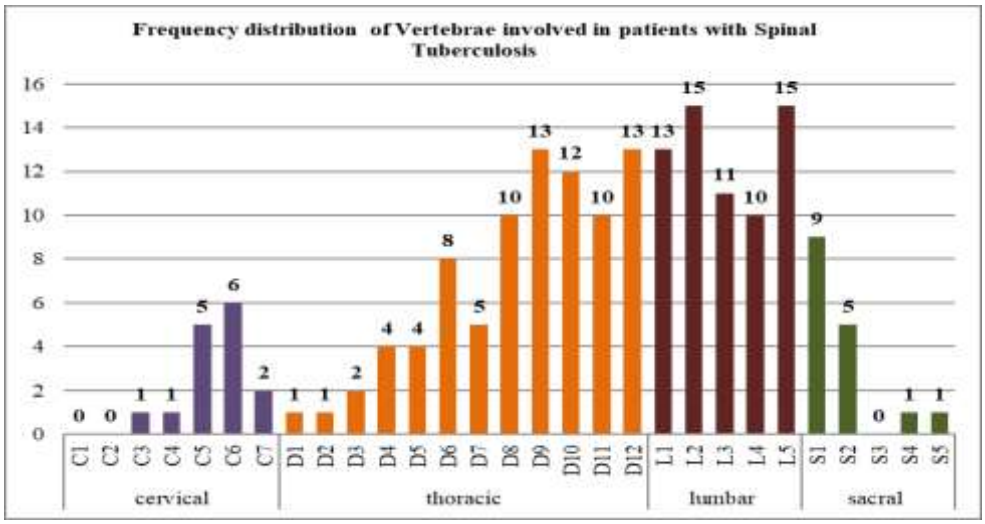

Figure 3: Frequency distribution of Vertebrae involved in patients with Spinal Tuberculosis.

More than 4 vertebrae were affected in 35.2% (n = 19) of the patients, as opposed to 2 and 3 vertebrae in 31.5% (n = 17) of the patients. Only 1.9% (n=1) of the patients had only one affected vertebra. According to Table 4, disc augmentation was noted in 51 (94.4%) individuals, whereas 52 (96.3%) patients had intervertebral disc gap narrowing.

Table 4: Radiological Findings in Patients with Spinal Tuberculosis

Radiological Findings		No. of Patients	Percentage
Osteitis	Vertebrae body erosion /destruction	46	85.19
	Posterior elements involvement	40	74.1
Discitis	Enhancement	51	94.4
	Reduced disc space	52	96.3
Collapse	Yes	23	42.59
	No	31	57.41
Abscess	Yes	43	79.63
	No	11	20.37
Deformity	Yes	23	42.59
	No	31	57.41

In 46 (85.19%) of the patients, the vertebral bodies were destroyed, and 40 of the patients had involvement of the posterior components. 43 patients (79.63%) had paravertebral abscesses. The number of patients with collapse and deformity was equal, or 23 (42.59%).

Table 5 shows that 29 (53.7%) and 13 (24.1%) patients, respectively, had cord compression and canal stenosis.

Table 5: Demonstration of patients with cord compression and canal stenosis

Variable		No. of Patients	Percentage
Cord compression	No	25	46.3
	Yes	29	53.7
Canal stenosis	No	41	75.9
	Yes	13	24.1

Table 6 showed that 52 (96.3%) patients had normal upper limb sensation while only 2 (3.7%) had reduced sensation in upper limbs.

Table 6: Sensory Examination of Upper Limb

Upper Limb		Normal	Decreased
Right	Touch	52(96.3%)	2(3.7%)
	Pain & Temp.	52(96.3%)	2(3.7%)

	Vibration & position	52(96.3%)	2(3.7%)
Left	Touch	52(96.3%)	2(3.7%)
	Pain & Temp.	52(96.3%)	2(3.7%)
	Vibration & position	52(96.3%)	2(3.7%)

Patients with spinal tuberculosis are shown in Table 7 as having lower limb feeling. 22, 27, and 28 patients, respectively, reported normal perceptions of touch, pain, warmth, and vibration, while 30, 27, and 26 patients had diminished feelings in the right lower limb. In contrast, 24, 28, and 29 patients, respectively, reported normal feelings of touch, pain, warmth, and vibration.

Table 7: Sensory Examination of Lower Limb

		Normal	**Decreased**
Right	Touch	22(40.7%)	30(55.6%)
	Pain & Temp.	27(50%)	27(50%)
	Vibration & position	28(51.9%)	26(48.1%)
Left	Touch	24(44.4%)	2(3.7%)
	Pain & Temp.	28(51.9%)	26(48.1%)
	Vibration & position	29(53.7%)	25(46.3%)

In the left lower leg of patients 2, 26, and 25, there were less feelings. Plantar extensor reaction was seen in 19 out of 28 individuals with cord compression, while flexor sensitivity was observed in 9 cases. In contrast, 5 (20%) of the patients with no cord compression had an extensor plantar reflex. According to Tuli's categorization, 19 participants were given the grade III label, which denotes that individuals were non-ambulatory as well as had sensory deficits of less than 50%. Grade 2 Tuli has 17 instances. Additionally, grade IV (severe) was assigned to 14 cases. Four individuals were categorized as grade I patients without neurological abnormalities in cases where doctors found evidence of upper motor neuron injuries. Table 8 reveals that whereas 49 individuals were drug-sensitive, five patients developed drug-resistant spinal TB.

Table 9 reveals that of the five spinal TB patients that were drug-resistant, two were Pre-XDR, two were Isoniazid & Rifampicin (H+R) resistant, and one was XDR.

Table 8: Number of patients with drug-resistant Spinal Tuberculosis

		No. of Patients	**Percentage**
Spinal TB Resistance profile	**Sensitive**	49	90.74
	Resistant	5	9.25

Table 9: Pattern of drug resistance among cases of drug-resistant spinal Tuberculosis

Drug-resistant Spinal TB	**No. of Patients**	**Percentage**
Pre XDR TB	2	3.7
XDR TB	1	1.85
Isoniazid and rifampicin (H+R) Resistant	2	3.7
Total	5	9.26

Out of the 54 patients, 33 (61.1%) had tuberculosis according to the histological analysis of the biopsy sample, while 21 cases lacked tubercular characteristics.

Table 10 demonstrates that out of 54 patients, 45 (83.3%) had MTB Complex, as determined by Truenat analysis of the biopsy material.

Table 10: Number of patients diagnosed based on Truenat

		No. of Patients	**Percentage**
Truenat	**Not Detected**	9	16.7
	Detected	45	83.3

The comparison of biopsy histology and Truenat testing is shown in Table 11. According to both examinations, spinal tuberculosis affected 24 individuals (72.7%). With a p-value of 0.0001, a difference that was significant was discovered.

Table 11: Comparison of Biopsy histopathology and Truenat examination for the diagnosis of spinal Tuberculosis

		Truenat		Z-test	Kappa-value
		Absent	Present		
Biopsy histopathology	Absent	0 (0%)	21 (100%)	<0.0001	44.40%
	Present	9 (27.3%)	24 (72.7%)		
	Total	9 (16.7%)	45 (83.3%)		

With a 44.4% kappa-value, there was a moderate to fair degree of agreement between biopsy histology and Truenat testing.

The 54 participants in the current research were split between 21 (38.9%) girls and 33 (61.1%) men. It showed that spinal TB had a greater impact on men. In their investigation of 178 instances of spinal TB, Boruah et al. [11] found that the average age of the patients was 41 15 and that there was a male to female ratio of 1.3. The typical age of patients with spinal TB was found to be about 50 years old in many investigations [13-15], with a broad range in the sex ratio, ranging from 1:3 to 4: l. The age of patients in our study varied from 18 to 80 years, with an average mean age of 42.7 years and a male predominance. In our investigation, the sex ratio was 1.6:1. Ages 31 to 40 were the most common age range for cases, accounting for 35.2% of the study's participants.

Among 54 patients, muscular spasm was the most prevalent symptom at the time of presentation in 51 patients (94.4%), followed by back pain in 50 (92.6%), a general feeling of unwellness in 42 (77.8%), limb weakness in 40 (74.1%), weight loss in 33 (61.1%), and fever in 26 (48.15%) people. Having said regional symptoms of contractions and pain occur earlier, and signs of illness like malaise, fever, or weight loss occur later in the course of the disease, according to Suryawanshi et al. [8], who also noted an analogous pattern of indications, with back pain being the most prevalent and being followed by night sweats and low-grade fever.

In the majority of patients, 52 (96.3%), the local spinal area was painful during the local clinical examination. This was followed by obvious deformity in 17 (31.5%), local edema in 13 (24.1%), along with sinus in 10 (18.5%) individuals. Regional discomfort is the most prevalent sign and symptom during the active period, mostly caused by bone inflammation and seldom being radicular, according to Kant et al. [12]. Rest discomfort at the affected level was pathognomonic, and the severity was inversely correlated with bone instability and degeneration.

The imaging technique of choice for diagnosing spinal TB has been MRI. The first alterations in the spine are found using MRI. MRI is essential for identifying skip lesions because it provides the greatest visualisation of the degree of soft tissue involvement, the spread of abscess, and neurological compression. Using gadolinium-enhanced MRI, it is possible to distinguish between tubercular lesions and infectious spondylodiscitis. The multi-planar capabilities and absence of ionizing radiation make MRI safe for postoperative evaluation. It is very helpful in assessing therapy response [10].

The degree of vertebral column involvement was as follows in this research of 54 individuals: thoracic in 34 (63%) patients, lumbar in 33 (61.1%), cervical in 6 (11.1%), and sacral in 11 (20.4%) people. The L-5, L-2, D-9, D-12, and L-1 vertebrae were implicated in 13 cases, respectively, and had the greatest incidence of involvement (15 times each). 35.2% of the patients had an average involvement of more than four vertebrae. Additionally, skip lesions were seen in 35.2% of the study's subjects. According to [11], the dorsal spine was the most often affected region (45%), followed by the lumbosacral spine (33%), several levels of involvement were present in 12% of cases, and the cervical spine (10%).

In this research, intervertebral disc augmentation and decreased disc space were seen in 51 (94.4%) and 52 (96.3%) instances, respectively, while vertebral body erosion was observed in 46 patients (85.19%). In addition, 43 patients (79.63%) reported having cold abscesses. 23 patients (42.59%) in our research population had vertebral collapse, and 23 patients (42.59%) had deformity. Due to the rarity of posterior element involvement and the difficulties in interpreting signs of posterior element TB or occult, diagnosis is often delayed or missed [9,14]. In the research, a large percentage of patients with bone illness (74.1%) exhibited involvement of the posterior elements, which were all linked to vertebral body disease.

Spinal cord compression and canal stenosis were seen in 29 (53.7%) and 13 (24.1%) individuals, respectively, in our research group. Radiculopathy is caused by the compression of nerve roots as a consequence of vertebral collapse, which results in paraplegia. The first signs of compression include increased spasticity, which may not be seen by the patient but is noticeable to the physician, as well as heightened deep tendon reflexes and plantar extensor. Compression begins anterior to the spinal cord across the anterior column. Later, severe compression blocks all nerve transmission in the lateral and anterior columns, resulting in some sensory impairment. Further compression results in posterior column involvement, which impairs sphincter function and causes sensory loss. The last effect of prolonged compression is spasticity, which is followed by flaccidity and flexor spasm (15).

28 research participants at most (53.7%) exhibit cord compression, with 19 patients exhibiting plantar extensor and 9 patients exhibiting plantar flexor. In order to facilitate early detection of spinal TB, the plantar reflex response, if it is extensor, may be the first indicator of neurological involvement [16].

All research participants had surgical sampling biopsies, and tissue samples were submitted for histopathological analysis, Truenat MTB plus testing, and line probe genotyping. 33 (61.1%) of the sample specimens underwent histological analysis and revealed characteristics indicative of spinal TB. However, despite obtaining a clinic-radiological diagnostic of spinal TB, the samples from 21 individuals did not provide a diagnosis of tuberculosis on histology [14]

In 45 (83.3%) of the 54 research participants' biopsy tissue samples, the Truenat test identified the MTB complex. MTB complex, however, was not found in 9 (16.7%) of the samples. We evaluated Truenat and histopathological biopsies for the diagnosis of spinal TB, and found a 44.4% kappa-value indicated moderate to excellent agreement between the two diagnostic methods [7].

The major cause of drug-resistant tuberculosis is ineffective therapy. The most horrifying effects of MDR strains have been caused by improper dose and inadequate treatment time. If the genetic strain of tuberculosis is resistant to both isoniazid and rifampicin, with or without resistance to other first-line ATT, MDR tuberculosis is identified [15]. Patients with MDR TB may exhibit increased resistance to any/all FQ or other ATT. When TB strains meet the criteria for MDR/RR TB and are additionally resistant to either fluoroquinolone (levofloxacin or moxifloxacin) plus at least one additional Group A medication (either bedaquiline or linezolid), the condition is known as extensively drug-resistant TB (XDR TB). Pre-XDR TB is brought on by MTB strains that meet the criteria for RR-TB and are also fluoroquinolone resistant [16]

Our research included 54 participants, of whom 49 (90.74%) had drug-sensitive spinal TB and 5 (9.26%) had drug-resistant spinal TB. Two individuals had Pre-XDR TB, two had multi-drug resistant TB (H+R) TB resistant to isoniazid and rifampicin, and one patient had XDR-TB among those with drug-resistant spinal TB. In the study group, no H mono-resistant TB cases were found. Researchers in [17] conducted study on 150 patients with primary spinal Tuberculosis with drug susceptibility testing, demonstrated that 43 (28.6%) had resistance. Seven (16.27%) of the DRTB had MDR status, nine (20.93%) had pre-XDR, and four (9.3%) had XDR.

The development of MDR and XDR TB has made treating spinal TB very difficult. Drug resistance and spinal TB have been more quickly diagnosed thanks to rapid genotypic molecular techniques. The extended oral M/XDR-TB regimen is advised by India's national tuberculosis eradication program. The key to controlling spinal TB is early resistance detection, administration of medications in accordance with sensitivity profiles for the right period, and surgical repair of problems [12-17].

4. Conclusion

The first indications of sickness, as identified by 63% of the chosen patients, were muscle twitches and discomfort in their backs. The most uncommon symptom was neck ache. The average number of days with symptoms preceding a diagnosis was 89.1751.96. In 85.19% of patients, the osteitis-related symptoms of vertebral body degradation, collapse, and deformity were present. The study's posterior spinal components were used more often than normal. In virtually all instances, there were abscesses, disc space reductions, and disc enhancements. According to Tuli's categorization, neurological deficits were categorized; the majority fell into category III. Spasticity and the plantar extensor muscle were indicators of early spinal cord involvement. 9.26% of the spinal TB patients in the research were drug-resistant, including XDR and PreXDR cases, necessitating a more extensive and specific ATT regimen. With a 44.4% kappa-value and moderate to excellent agreement between the two testing modalities, the research comparing histology and Truenat also had the added advantage of identifying the resistance profile.

Conflict of Interest: None

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