

ORIGINAL RESEARCH

Role of vertebral transpedicular biopsy under fluoroscopic guidance in diagnosis of suspected spinal tubercular lesions

¹Dr.Saifer khan, ²Dr.Rajat Kumar Singh, ³Dr. Deepak Srivastav, ⁴Dr. Karan Bedmutha

^{1,2,3,4}Department of Orthopaedics, Hind institute of Medical Sciences Barabanki, Uttar Pradesh, India

Corresponding Author

Dr. Karan Bedmutha

Department of Orthopaedics, Hind institute of Medical Sciences Barabanki, Uttar Pradesh, India

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ABSTRACT

Introduction: Spinal tuberculosis a type of extrapulmonary TB, is a common occurrence. Despite its widespread incidence and high rate of long-term morbidity, there are no clear diagnostic or treatment criteria for spinal TB. To avoid permanent neurological dysfunction and to limit spinal deformity, early diagnosis and treatment are essential. **Materials & Methods:** A total of 24 patients were selected patients with clinico-radiological features suggestive of tubercular spondylo discitis and meeting the inclusion and exclusion criterion were taken into study. A transpedicular biopsy was done in the operation theatre under all aseptic precautions under fluoroscopy guidance. The sample collected was sent for further analysis for histopathology, AFB stain for TB, Gram stain, CBNAAT/Line Probe Assay to the respective departments for further evaluation. **Results:** Adequate amount of sample was obtained in 22 of the 24 cases. Out of the 24 patients biopsy was positive for tuberculosis in 75% of cases, suggestive of metastasis in 2 cases and 2 sample suggestive non specific chronic granulomatous lesion. Statistically, MRI was not specific to tuberculosis in the cases with most cases suggestive of end plate erosion and paravertebral collection. This study has tried to validate different diagnostic procedures which showed spinal infections with large abscess with thin wall, subligamentous spread of abscess and vertebral collapse were highly suggestive of spinal tuberculosis. **Conclusion:** In the present study using this method we could identify 25% non-tubercular pathologies which mimic TB spine clinic-radiologically and avoided the additional misery of the patients. Percutaneous transpedicular biopsy of spine under fluoroscopic guidance is a safe, rapid, reliable, sensitive and feasible method of obtaining tissue or pus sample for confirmatory diagnosis of suspected spinal tubercular lesion. The study needs evaluation over larger sample size to find the difference between significance of Clinical, Radiological and histopathological findings.

Keywords: Diagnosis; transpedicular biopsy, spinal tuberculosis.

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INTRODUCTION

Tuberculosis (TB) is a disease caused by the bacteria *Mycobacterium tuberculosis*. In 2019, 1.4 million people died from tuberculosis (including 208 000 people with HIV). TB is one of the top ten causes of death worldwide with second most cases of death due to a single infection. MDR-TB, or multidrug-resistant tuberculosis, is still a public health concern and a security threat. In 2019, 2,06,030 patients with multidrug or rifampicin-resistant tuberculosis (MDR/RR-TB) were identified and notified globally, up 10% from 1,86,883 in 2018.

Between 2000 and 2019, TB detection and treatment saved an estimated 60 million lives. The United Nations Sustainable Development Goal (SDGs) states the health goal of ending the cases of tuberculosis by 2030.¹

Tuberculosis affects the lungs in most cases, although it can also affect other regions of the body which are referred to as Extrapulmonary Tuberculosis.

Despite its wide spread incidence and high rate of long-term morbidity, there are no clear diagnostic or treatment criteria for spinal TB. To avoid permanent neurological dysfunction and to limit spinal deformity, early diagnosis and treatment are essential.^{5,6}

The presence of specific clinical features, neuro-imaging evidence, culture of biopsy fluids helps to diagnose spinal TB. The presence of acid-fast bacilli on microscopy or culture of material acquired after doing the biopsy of the lesion is required for etiological confirmation.

It is very difficult to differentiate spinal tuberculosis from pyogenic and fungal infections or other granulomatous lesions of spine and lesions like primary and secondary malignancies when we solely

consider clinical and radiological findings, even in specific endemic areas. Unfortunately, the maximum sensitivity of microbiological diagnosis in spinal TB by culture is 80% and the traditional methods require 6–8 weeks for isolation and identification of the organism [2]. There have been a small number of cases where imaging and clinical findings were suggestive of tubercular infection but organism could not be obtained even after doing repeated cultures [3]. This is where the role of biopsy of the lesion and histopathological examination (HPE) comes into play. The C-arm-guided biopsy may be a safe, less costly and effective technique to obtain tissue samples to reach confirmatory diagnosis and start planning of the treatment, it can be performed as a daycare procedure and is associated with a very low morbidity rate[4]. This study was conducted to assess the efficacy of C-arm image-guided biopsy in the diagnosis of Tuberculosis of spine, as limited literature is available about the safety, sensitivity and specificity of this procedure. Our study aimed at finding a correlation between clinically and radiologically suspected TB spine and C-arm image-guided biopsy-proven cases.

MATERIAL AND METHODS

The study was conducted in Department of Orthopaedics, Hind Institute of Medical Sciences, Barabanki between 1 July 2020 to 1 October 2021. 24 patients with clinic-radiological features suggestive of tubercular spondylodiscitis and meeting the inclusion and exclusion criterion were taken for further study.

INCLUSION CRITERIA

It included those patients with clinic-radiological diagnosis suggestive of spinal tubercular lesions which includes-

- 1) Constitutional Symptoms - Severe backache, fever, chronic dull backache, evening rise of temperature, loss of weight and appetite, chronic history of cough with prolonged backache.
- 2) X-Ray and MRI - suggestive of vertebral tubercular lesions of dorso-lumbar and sacral vertebrae.
- 3) *MRI findings suggestive of vertebral lesions are-Posterior bulge of vertebral body, vertebral collapse, paradiscal involvement, para vertebral abscess, soft tissue extension, multiple lesions, disc space narrowing, cord compression and cord changes.
- 4) Patients of both sexes between the age group of 18-80 years.

EXCLUSION CRITERIA

- Patients with age less than 18 years or more than 80 years.
- Patient with bleeding diathesis and suspected vascular lesions.
- Patients with local site of infection.
- Cervical spine lesion
- Pregnancy.

Patients with sensori-neural deficit.

Pre biopsy work-up

The prebiopsy work-up should include (a) routine spine radiographs; (b) identification of vital structures that can potentially be damaged and evaluation of the hypervascularity of the lesion; and (c) complete blood count, activated partial thromboplastin time (APTT), and prothrombin time (PT).

TECHNIQUE

The percutaneous transpedicular biopsy is performed in the prone position on the fluoroscopy table. In planning the needle route, vital anatomical structures such as major blood vessels, nerves, peritoneal cavity, and spinal canal and its contents are avoided.

Anteroposterior (AP) and lateral images are obtained on fluoroscopy once the level is determined, and the level of the biopsy is marked with the needle.

Before performing the percutaneous transpedicular biopsy, all aseptic measures are taken. At the entry location, local anaesthesia (1 mL 0.1 percent lidocaine) is given. A 0.5 cm incision is then made 3–4 cm lateral to the midline with a No. 15 blade. An intravenous cannula needle is then used to administer 10 ml bupivacaine up to the pedicle. The biopsy is done with a Jamshidi needle, which has a trocar, cannula, obturator, and lock. The biopsy is performed using an 8-gauge Jamshidi needle with a 3 mm core cut. The needle is passed up to the pedicle through the soft tissues.

The level of the biopsy is verified using AP and lateral views. The anterior trajectory may be seen clearly from the lateral perspective. The needle's tip should be in the centre or lateral to it in AP view. It's very important not to harm the pedicle's inferior and medial walls. This is to prevent the spinal cord from being damaged by entering the canal or harming the nerve root.

The trocar is withdrawn after the cannula is 0.5 cm away from the lesion, and the core biopsy is performed with a screwing motion. Aspiration is used to extract the cultural material.

Finally, after a small rotation, the cannula carrying the core biopsy sample is extracted.8-12

A 20-cc disposable syringe is used to apply negative pressure to the trephine, and the specimen is then evacuated via the obturator.

In the thoracic spine, care is taken to avoid the pleural cavity, thoracic aorta and superior vena cava. In the lumbar spine, care should be taken to prevent not to puncture of the abdominal aorta, inferior vena cava, renal vessels, nerve roots, and kidneys. The lesion depth, entry point, and angle of the chosen needle route are estimated pre-procedure. On the basis of prior plain radiographs, MRI, the degree of biopsy is determined. The spinous process should be in the midline of the vertebral body in AP pictures, evenly spaced between both pedicles¹³ with a vertical inclination of 60

Tissue from two consecutive vertebrae and the intervertebral disc might be retrieved by shifting the needle's route in a cephalad or caudal manner.

The patient is asked whether he has any sensory or motor weakness while the needle is advanced and then the needle is advanced and the needed sample is taken. All the samples that are submitted are to be cultured, sensitivity tested, and histopathological examination (HPE) is done.

The operation takes about 25–30 minutes on average. Following the biopsy, the puncture site is examined for evidence of blood or the development of a hematoma. Single stitch is taken at entry point incision and is cleaned with spirit and dressing is given.14-15

THE SAMPLE WAS COLLECTED IN 3 STERILE CONTAINERS

- 1) 1st container- It had tissue sample immersed in normal saline which was sent for AFB staining, gram staining and pyogenic culture, BACTEC.
- 2) 2nd container- It had tissue biopsy sample immersed in 10% formalin solution to be sent for histopathological examination.
- 3) 3rd container- 1) In this container we sent pus or other liquid sample for culture testing like Gene Xpert / CBNAAT.
- 4) 2)When we obtained a solid tissue sample we sent it for Line Probe Assay.
- 5) The material was sent for histopathological examination and reported by qualified pathologists.

RESULT

The mean age of the patients was 43.75 ± 14.86 years with maximum cases from age group 50-59 years (41.7%) followed by the age range 20-29 years (25%). The minimum age of the cases was 20 years and maximum 70 years.

The distribution of various involvements showed that Pott's spine was involved in 18 (75%) cases. The vertebrae L2-L4 was involved in maximum proportion (25%) followed by the L2-L3 (20.8%). Out of 24 study cases, majority 16 (66.7%) belong to the lower socio-economic status and rest 8 (33.3%) cases belong to the middle socio-economic status. So the study consisted lower and middle class cases in proportion 2 : 1.

Out of 24 study cases, all had the complaint of loss appetite and lower backache (100%), fever was present in 18 (75%) cases and kyphus deformity in 17 (70.8%) cases. Tingling sensation, swelling and night cries was observed in 41.7%, 29.2% and 62.5% cases respectively.

Out of 24 study cases, Cord changes was present in maximum 16 (66.7%) cases followed by the Paravertebral collection (62.5%), end plate erosion (50%) and vertebral destruction (50%). Further bone marrow oedema and cord compression was present in 29.2% and 41.7% cases respectively.

The AFB test was found to be positive for TB in 8 (33.3%) cases and in rest 16 (66.7%) cases it was found to be negative.

The Gram Stain test was found to be positive for TB in 12 (50%) cases and in rest 12 (50%) cases it was found to be negative.

The CBNAAT test was found to be positive for TB in 12 (50%) cases and in rest 12 (50%) cases it was found to be negative.

The Biopsy test was found to be positive for TB in 18 (75%) cases while in 4 (16.7%) cases it was found to be negative. In rest 2 (8.33%) cases the biopsy test was inconclusive.

The Microscopic finding was definitive for Tb in 7 (29.2%) cases, Granulomatous/Chronic inflammation was found in 13 (54.2%) cases, metastasis was found in 2 (8.3%) cases while 2 (8.3%) cases were inconclusive by microscopy.

The association of TB with Spine Involvement showed that significant association of vertebrae involvement was found with TB ($p=0.016$). L2-L3 and D8-D10 involved in maximum proportion in positive TB cases.

The association of TB with MRI finding showed that insignificant association of TB was found with Bone marrow oedema ($p=0.476$), end plate erosion ($p=0.219$), vertebral destruction ($p=0.219$), paravertebral collection ($p=0.459$), cord compression ($p=0.188$) and cord changes ($p=0.562$).

The significant association of TB was found with Gram stain finding ($p=0.005$). Though specificity of Gram stain was 100% but sensitivity was relatively low (66.7%). Further the diagnostic accuracy of Gram stain was found to be 75%.

The significant association of TB was found with CBNAAT finding ($p=0.005$). Though specificity of CBNAAT was 100% but sensitivity was relatively low (66.7%).

The significant association of TB was found with microscopic finding ($p=0.028$). All the Granulomatous/Chronic inflammations were observed in TB cases only.

The significant association of AFB was found with Biopsy ($p=0.046$). The AFB and Biopsy were matched for TB positive in 33.3% cases. The Kappa measure of agreement was calculated to be 0.286.

DISCUSSION

We carried out this study with an aim to evaluate the usefulness of biopsy and safety of percutaneous image guided spinal biopsy using a large bore needle in the diagnosis of suspected Spinal Tuberculosis and correlate between Histology, microscopy and Clinico-radiological features.

The Gram Stain test was found to be positive for TB in 12 (50%) cases and in rest 12 (50%) cases it was found to be negative. In line with previous study done by Nam KH et al.¹⁶ which revealed that of the 57 cases radiologically consistent with spinal infection, 29 (50.9%) biopsy specimens resulted in positive

cultures and 28 (49.1%) returned negative cultures. Staatz et al.¹⁷ reported 76% culture-positive rate using CT- guided biopsy, Perronne et al.¹⁸ reported a 74% culture-positive rate by the fluoroscopy-guided needle biopsy, and Gull et al.¹⁹ obtained bacteriological diagnosis in 36% biopsies using a Mazabraud trocar. In our study, a significant association of TB was found with Gram stain finding ($p=0.005$). Though specificity of Gram stain was 100% but sensitivity was relatively low (66.7%). Further the diagnostic accuracy of Gram stain was found to be 75%.

Pott's paraplegia describes paraplegia which occurs from tuberculosis of the spine. The distribution of various involvements showed that Pott's spine was involved in 18 (75%) cases in the present study. Spinal TB cases constitute 50% of skeletal tubercular infections (Rajasekaran Set al; Kulchavenya E et al.)²⁰⁻²¹ The World Health Organisation (WHO) reported an incidence of 10.4 million new cases of tuberculosis in 2016, among which 46.5% of cases were reported from the South East Asian Region alone. India contributed to 23% of the global TB burden. Contrary to the findings Garg RK et al.⁷ found 3 patients with Pott's disease out of 48 patients.

In our study; all the patients had complaint of loss of appetite and lower backache (100%), fever was present in 18 (75%) cases and Kyphus deformity in 17 (70.8%) cases. Tingling sensation, swelling and night cries were observed in 41.7%, 29.2% and 62.5% cases respectively. Liu Z et al.²² observed among his subjects that 92.5% presented with back pain and the remaining 7.5% with spinal deformity or numbness in the limbs without back pain. Gupta AK et al.²³ observed among the 50 patients studied the most common symptom was back pain 50 (100%), fever detected in 12(24%), malaise in 9(18%) and weight loss in 25(50%) of cases. In neurologic examination 45(90%) had paraparesis. 43(86%) had sensory loss, 18(36%) of patients complained of sphincter problem, and immobility 44(88%) cases.

In our study, there was no significant association of swelling with TB ($p=0.012$). It was more in No-TB cases than the TB cases. All other symptoms were found to have insignificant association with TB. Fuentes FM et al.²⁴ revealed that abdominal pain and swelling are considered rare presentations of this disease.

In our study, the vertebrae L2-L4 was involved in maximum proportion (25%) followed by L2-L3 (20.8%). Zhang Z et al.²⁵ observed in his findings that the most commonly affected vertebra was L4 in 23 cases (25.8 %), followed by L3 in 15 cases (16.9 %). Several other studies done by Bakhsh A et al Chandra SP et al. and Jutte PC et al. ²⁶⁻²⁸ revealed that thoracic or thoracic lumbar were the most commonly involved segments.

In our study, Cord changes were present in maximum 16 (66.7%) cases followed by the Paravertebral collection (62.5%), end plate erosion (50%) and

vertebral destruction (50%). Further bone marrow edema and cord compression was present in 29.2% and 41.7% cases respectively. Singh R et al.²⁹ found through MRI findings: bone marrow edema (50/50 cases), discitis (53/62 discs), endplate erosions (105/123 endplates), pre- and para-vertebral collections (45/50 cases), epidural involvement (26/50cases), epidural spread (77/109 vertebrae), and subligamentous spread (42/50 cases). Jain et al.³⁰ reported that out of total 220 endplates, 192 showed erosions, 26 were destroyed, and two were spared. Various authors have reported incidence of endplate erosions between 25% to 100% (Teo EL et al., Joseffer SS et al.)³¹⁻³² The reported incidence of paravertebral abscess is between 58% and 100% (Andronikou S et al. and al-Mulhim FA et al.)³³⁻³⁴ In our study, the association of TB with MRI finding showed insignificant association of TB was found with Bone marrow oedema ($p=0.476$), end plate erosion ($p=0.219$), vertebral destruction ($p=0.219$), paravertebral collection ($p=0.459$), cord compression ($p=0.188$) and cord changes ($p=0.562$). Singh R et al.³⁵ observed that there was significant increase in the vertebral involvement in the first 6 months ($P = 0.01$) although incidence of disc involvement remained fairly constant. Paravertebral abscesses showed statistically significant steady decline in incidence and size ($P < 0.01$).

The Biopsy test was found to be positive for TB in 18 (75%) cases while in 4 (16.7%) cases it was found to be negative. In rest 2 (8.33%) cases the biopsy test was inconclusive. The significant association of TB was found with Biopsy finding ($p<0.001$). Further specificity and sensitivity of Biopsy was 100% and diagnostic accuracy too was 100%. Staatz et al.¹⁷ reported 76% positive rate using CT-guided biopsy.

In our study, the microscopic finding was definitive for Tb in 7 (29.2%) cases, Granulomatous/Chronic inflammation was found in 13 (54.2%) cases, metastasis was found in 2 (8.3%) cases while 2 (8.3%) cases were inconclusive by microscopy. Observations of Li Y et al.³⁶ revealed that out of total of 181 patients 68 had granulomatous inflammation. The significant association of TB was found with microscopic finding ($p=0.028$). Most of the Granulomatous/Chronic inflammations were observed in TB cases only while 2 of them were of metabolic bone disease. However, Bartoloni A et al.³⁷ noted that sensitivity of ICT tuberculosis (61.1%) in TB patients was significantly less than that (88.9%) of the microscopic detection of acid-fast bacilli in smears ($P < 0.01$).

This section summarises the findings and contributions made in this study. A further novel finding is that the significant association of AFB was found with Biopsy ($p=0.046$). The AFB and Biopsy were matched for TB positive in 33.3% cases. The Kappa measure of agreement was calculated to be 0.286. The significant association of Gram stain was found with Biopsy ($p=0.005$). The Gram stain and

Biopsy were matched for TB positive in 50% cases. The Kappa measure of agreement was calculated to be 0.500.

CONCLUSION

Percutaneous transpedicular biopsy of spine under fluoroscopic guidance is a safe, rapid, reliable, sensitive and feasible method of obtaining tissue or pus sample for confirmatory diagnosis of suspected spinal tubercular lesion. It is performed effectively as an outpatient procedure with high diagnostic success rate and minimal morbidity. Success depends on accurate placement of the trocar and qualified interdisciplinary clinical co-operation.

This study still requires further evaluation with a larger sample as the number of patients are less especially in the non-tubercular group. Also, the study needs evaluation over larger sample size to find the difference between significance of Clinical, Radiological and histopathological findings.

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