

Anterior Transthoracic Approach for the Treatment of Thoracic Tubercular Spondylodiscitis - A Retrospective Study

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

Editor(s):

(1) Dr. Ikem, Innocent Chiedu, Professor, Department of Orthopaedic Surgery and Traumatology, Obafemi Awolowo University, Ile-Ife Nigeria.

Reviewers:

(1) Vijaya Krishnan, Maharashtra University of Health Sciences, India.

(2) Vinay Jagga, Prem Physiotherapy and Rehabilitation College, India.

Complete Peer review History: <https://sdiarticle4.com/review-history/51638>

Original Research Article

Received 06 July 2019
Accepted 19 September 2019
Published 26 September 2019

ABSTRACT

Study design: A Retrospective study.

Purpose: To determine the clinical and radiological outcome of thoracic tuberculous spondylodiscitis through anterior transthoracic approach.

Methods: We retrospectively reviewed 38 patients with thoracic tubercular spondylodiscitis in our hospital between January 2010 to December 2016. The indication for surgery was the neurological deficit and refractory cold abscess not responding or worsening with antitubercular chemotherapy, spinal instability, and kyphotic deformity > 40°. All patients underwent surgery by the anterior transthoracic approach and had debridement, decompression, rigid fixation, and placement of bone autograft. All the patients were evaluated clinically and radiologically on each follow-up. Frankel grading and VAS score were calculated.

Results: Total 38 patients in which 13 males and 35 females with a mean age of 45.02 years, a mean follow up of 47.84 months were included in our study. Preoperative neurological deficits were

present in 34 patients out of which 31 patients improved, 2 remained the same after surgery according to Frankel grading and one mortality took place on the 8th postoperative day due to acute myocardial infarction. Average VAS score was 7.4 at admission which was improved to 3.2 at final follow up. Preoperative kyphosis in the thoracic spine was 42.2° (22°-54°), which was corrected to mean of 25.3° (14°-29°) postoperatively. One patient developed chest infection one month after the surgery for which left sided pneumonectomy was done. There was no graft and implant-related complication.

Conclusion: Treatment of thoracic tubercular spondylodiscitis with anterior transthoracic approach provides adequate debridement thorough decompression of the neural tissue with good deformity correction and also achieves good clinical, neurological, radiological and serological outcomes.

Keywords: Anterior transthoracic approach; spondylodiscitis; kyphosis; frankel grade; VAS score.

1. INTRODUCTION

Tuberculosis (TB) remains a major disease especially in developing countries like India, which has been attributed to poverty, overcrowding, illiteracy, malnutrition, poor sanitation, alcoholism, failure in early detection of TB, lack of adequate health care facilities, the presence of drug-resistant strains of Mycobacterium tuberculosis and the effects of human immunodeficiency virus (HIV). The most frequent site for the extrapulmonary involvement of tuberculosis infection is the vertebral column [1] and it is found approximately 50% of all the affected TB patients will have TB of the spine [2]. Spinal tuberculosis is a destructive form of disease common in children and young adults. Characteristically, there is a destruction of the intervertebral disc space and the adjacent vertebral bodies and anterior wedging leading to kyphosis and gibbus formation. Thoracic region of the vertebral column is most frequently affected due to proximity to the lung. Paradiscal, anterior, and central lesions are the common types of vertebral involvement, paradiscal being the most common. Early diagnosis and prompt treatment are necessary to prevent permanent neurological disability and to minimize spinal deformity [1,2]. Anti-tubercular chemotherapy remains a mainstay of treatment, but in case of non-response to medicine, neurological status worsening and formation of large epidural abscess compressing neural elements surgical treatment is mandatory. Multiple surgical approaches like anterior, posterior, or combined approaches in single or two staged procedures have been described in literature [3-7].

The aim of our study is to assess clinical as well as radiological results of anterior debridement with instrumentation using the transthoracic approach in cases of thoracic spine tuberculosis among 38 patients.

2. MATERIALS AND METHODS

Our study is a retrospective study of 38 patients (15 males: 23 females, with a mean age of 45.02 years, range 17-65 years) treated surgically between January 2010 to December 2016 at our hospital. The study included only the patients with tubercular spondylodiscitis proven through microbiological examination. Spondylodiscitis due to non-tubercular pathology and previous spinal surgery were excluded in this study. Patients were admitted in the hospital with the complaint of severe back pain and/or neurological deficits. After admission, all the patients were submitted to go through clinical and radiological examination in the form of plain X-ray and MRI of the local part with the screening of the whole spine. Each patient's white blood cell count (WBC), erythrocyte sedimentation rate (ESR), and C-reactive protein (CRP) levels were measured. Patient's neurological statuses were assessed using Frankel grading (Table1) and the pain was assessed using the Visual Analogue Score (VAS).

The indications of surgery were either one of the following:

1. Presence of neurological complications with the failure of remarkable recovery despite a good trial of conservative treatment.
2. Deterioration of neurological complications while on conservative treatment
3. Development of new neurological complications.
4. Recurrence of neurological complications.
5. Evidence of instability.
6. Presence of epidural abscess compressing the dura or paravertebral abscess or granulation tissue or disc fragments compressing either the dura or nerve roots.

7. Severe pain not controlled by medication and compromising patient's mobility.

2.1 Treatment and Surgical Approach

23 out of 38 patients were started on AKT according to ICMR guidelines on admission and 15 patients were already on antitubercular treatment at the time of admission. In all the patient's anterior debridement, bone graft, and instrumentation were performed. In cases of D1-D4 Koch's, Double Lumen endotracheal tube (DLT) and for D5-D11 Koch's, single lumen tubes were used for anaesthesia. For D1-D4 level right lateral high transthoracic approach was used and for lower level disease left lateral position was given. A skin incision of around 12 cm is placed in the appropriate intercostal space which was decided preoperatively. We usually decide rib be cut in surgery through dorsal spine PA view, a horizontal line is drawn through the diseased vertebra and the outer most rib which is cut through this line is chosen. The anterior edge of the latissimus dorsi is determined and cut by cauterization in the posterior direction. Serratus anterior is cut toward anterior direction starting from its posterior side along the ribs. The first rib is palpated under the scapula, ribs are counted (for D1 to D3 level, 4th rib is cut). The parietal pleura is opened in cephalad and caudal directions. The intercostal artery and veins are ligated. The abscess is identified by needle aspiration at the preferred level and the content was sent for culture and antibiotic sensitivity. A longitudinal incision made over parietal pleura and subperiosteal dissection done at the targeted level. Radical debridement as much as possible was performed. Adequate decompression of the dural sac was ensured at the same time. Instrumentation was done with monoaxial 4.5 or 5.5 screws depending upon the height of the vertebrae with staples. Correction of deformity was done by pushing the kyphus anteriorly and rod was fixed. Filling of the defect was done by the rib graft or by fibular graft. Pleura was sutured if possible and a 32F or 36F chest tube is placed in the pleural cavity.

Post-surgery, the chest tube was usually withdrawn within 48-72 hours when 24 hour drainage was less than 50 cc and post chest tube removal x-ray was done to see for the proper chest expansion and post removal chest physiotherapy was advocated. All the patients were advised to take complete bed rest for 4-6 weeks and antitubercular chemotherapy regularly. Follow up of all patients were done at 1, 3, 6, 9, and 12 months after surgery and were followed up annually thereafter.

At each follow-up evaluation, Frankel grade and VAS score were assessed. Plain radiographic studies were obtained to determine fusion status. 3D CT scan was done to confirm fusion. We have used Bridwell's criteria [8] for fusion, documented on 3-dimensional computed tomography (3D CT) studies. Serial WBC, ESR, and CRP were done on each follow-up visits and documented.

3. RESULTS AND ANALYSIS

There were 61 involved vertebral bodies in total, with single level involvement in 16 patients, 2 levels in 21 patients, and 3 levels in 1 patient. The most commonly affected vertebra was D7, which was involved in 12 patients (31.5%) (Fig. 1). The duration of symptoms from onset to the time of diagnosis ranged from 1 week to 6 months. The local spinal pain was present in all of the patients. Of the 38 patients 14 patients were Frankel grade A, 10 were B, 8 were C, 2 were D and 4 were E at the time of admission. Preoperative neurological deficits were noted in 34 of the 38 patients. In terms of Frankel grade, 31 patients have improved, 2 have remained the same and one expired. Two had an improvement of 1 grade, 5 of 2 grade, 12 of 3 grades and 9 of 4 grades on the Frankel scale. 6 patients had remained the same (2 from grade C to grade C and 4 from grade E to grade E) and there was no worsening of neurological symptoms in any of

Table 1. Frankel classification

Frankel grade	Description
A	No motor or sensory function detected below the level of the lesion
B	Preserved sensation only. No motor function detected below the level of the lesion
C	Some degree of motor function but without practical usefulness
D	Useful motor function below the level of the lesion
E	Normal sensory and motor function, although there may be some abnormality of reflexes

the patient (Fig. 2). Average VAS score at presentation was 7.4 which improved to an average of 3.2 at final months follow up (Fig. 3).

Radiographic fusion was seen in all of the patients with an average time period of 23 weeks postoperatively confirmed with 3D CT scan. Preoperative kyphosis in the thoracic (T1–T12) was 42.2° (22°–54°), which was corrected to a mean of 25.3° (14°–29°) in the immediate postoperative radiographs. The percentage of immediate correction was 48%. There was an average loss of correction of 3.5° at final follow up.

Preoperative laboratory studies showed an average WBC of 9.2 mm³ (range, 4.2–16.6).

Erythrocyte sedimentation rate was elevated in 31 of 38 ranging from 5 to 102 mm with a mean of 44 mm in the 1st hr. C-reactive protein levels were elevated (range, 8–132 mg/dl; mean, 28 mg/dl) in all of the patients. At the final follow up the average WBC was 6.8 mm³ (range, 4.1–9.5) mean erythrocyte sedimentation rate was 14 mm in the first hour and the mean C-reactive protein was 8 mg/dl.

One patient had expired on the 8th postoperative day due to acute myocardial infarction and another patient developed chest infection one month after the initial surgery for which left sided pneumectomy was done and other than these there were no incidence of wound infection, graft, and implant-related complications.

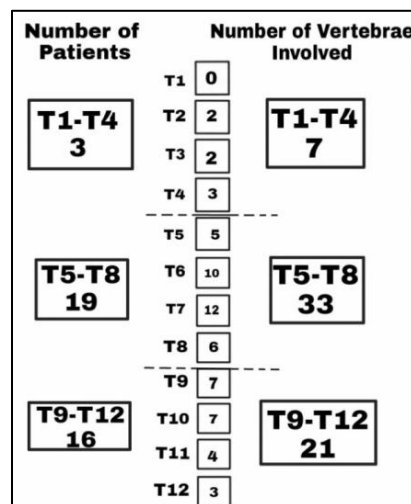


Fig. 1. Figure showing involved vertebrae and the number of patients involved

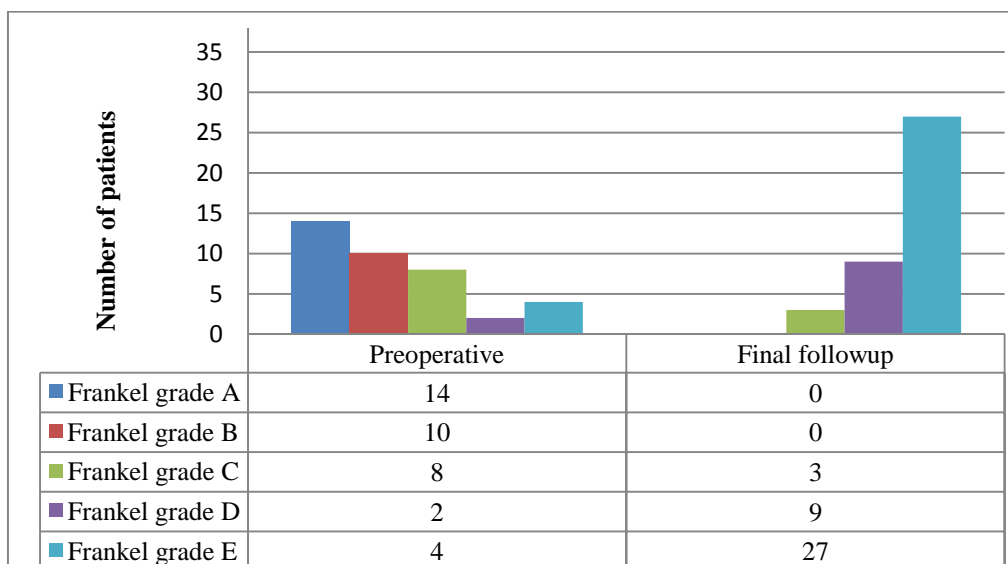


Fig. 2. Frankel grades of the Patients (preoperative and follow up)

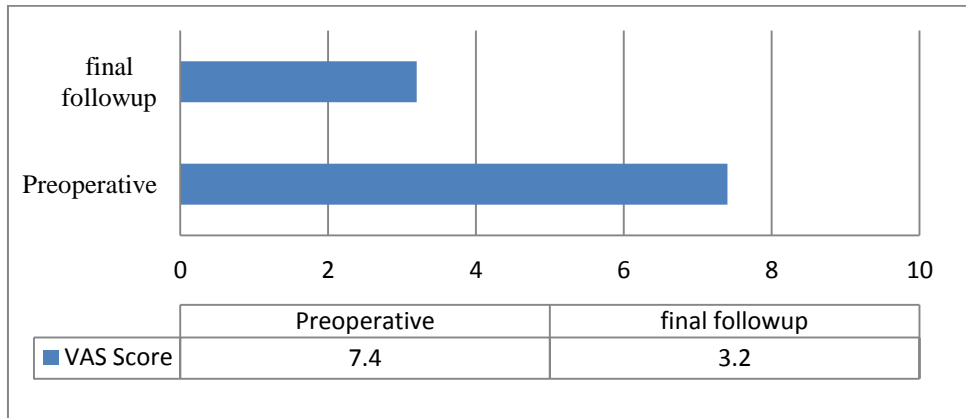
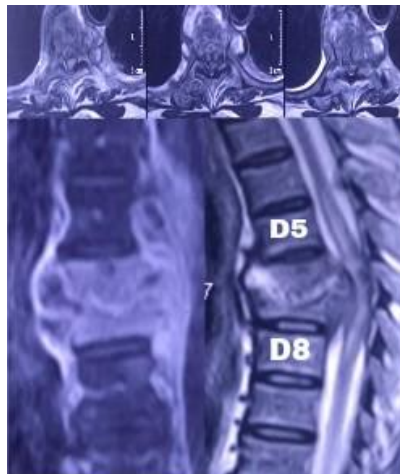


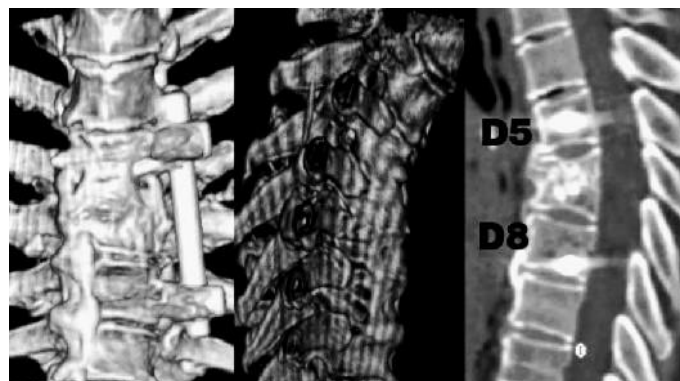
Fig. 3. VAS Score of the patients (preoperative and follow up)

Case: 58 year old female with D6-D7 Koch's



(Fig. 4A, 4B and 4C)

Fig. 4. Preoperative axial (4A), coronal (4B) and sagittal (4C) T2-weighted MRI showing destruction D6–D7 vertebral bodies with disc space



(Fig. 5A, 5B and 5C)

Fig. 5. Postoperative CT scan Anteroposterior (5A) Lateral (5B) and sagittal (5C) view showing stable fusion at 19 months follow-up period

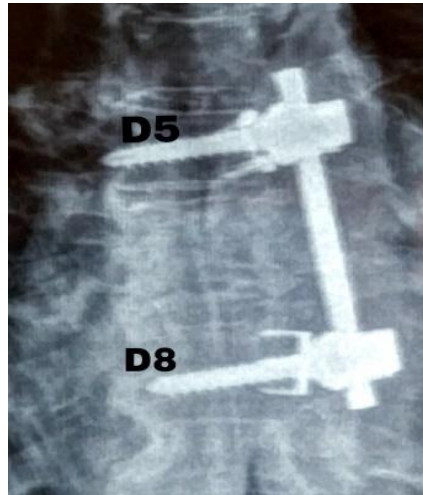


Fig. 6. Postoperative X-ray at 19 months follow-up period showing stable fusion

4. DISCUSSION

Tuberculosis of the spine is an old and devastating disease. In 1782, Sir Percival Pott described spinal TB and surgical treatment of paravertebral abscess [9]. The tubercle bacillus begins its destruction in cancellous bone and eventually extends to the cortex. The infection gradually spreads to an adjacent vertebra via the disc space. In advanced stages of the disease, progressive vertebral collapse occurs, resulting in kyphosis and gibbus formation [10]. In spinal TB, the onset of symptoms is usually insidious and disease progression is slow. The usual presentation consists of pain overlying the affected vertebrae, low-grade fever, chills, loss of appetite and weight and nonspecific constitutional symptoms of varying duration.

Neurological deficit is one of the most important symptoms of tuberculous spondylodiscitis. In our series, >90% of the patients had neurological deficit. The delay between the onset of initial symptoms and the diagnosis was 1 week to 6 months respectively. A rise in ESR was seen in 31 out of 38 and a rise in CRP was seen in all the patients. Leucocytosis occurs in <50%. Viral markers of all the patients were negative. Lestini and Bell suggested that CRP is superior to ESR in the evaluation of spinal infection as it rises more quickly and is less influenced by other plasma factors [11]. Plain radiographs have very low sensitivity in the early stages of tuberculosis. The abnormalities are disc space narrowing, blurring of the endplates, loss of height and wedging of the affected vertebral bodies. Magnetic resonance

imaging is the most sensitive and specific means of confirming an early diagnosis for tubercular spondylodiscitis with 96% sensitivity, 94% specificity, and 92% accuracy [12].

The dismal outcome of tuberculosis of the spine in the pre-antibiotic era has improved significantly because of the use of potent antitubercular drugs, modern diagnostic aids, and advances in surgical management [1]. Antitubercular chemotherapy remains a mainstay of treatment, but in the case of nonresponse to medicine, neurological status worsening and formation of large epidural abscess compressing neural elements surgical treatment is mandatory. The Principles of Control and Treatment of infection in Koch's are thorough debridement of lesion; proper antibiotics, rigid fixation and bone graft to fill the space created by debridement were followed. Multiple surgical approaches like anterior, posterior, or combined approaches in single or two staged procedures have been described in literature [13-20]. Factors which affect the decision on the surgical approach in the presence of spinal infections include the age, general health status, site of the infection, and the experience of the surgeon in using the surgical approaches and stabilization method.

We have used anterior transthoracic approach for 38 patients in our study. The anterior approach to the spine was first described as early as 1750 by Geraud [18] Hodgson and Stock [19]. The first anterior approach to the lumbar spine was reported by Burns in 1933 [20]. Since then, various anterior procedures for the treatment of thoracic and thoracolumbar lesions

have been described [19,21-25]. Paradiscal and vertebral body involvement are common in tuberculosis as compared to posterior elements. Decompression is achieved by easily accessing the lesions that are localized in the posterior part through laminectomy. However, if the lesion is localized in the anterior part, it is difficult to access the lesion and take the biopsy material and it may also cause instability and deterioration of existing deformity because the posterior elements are removed; therefore laminectomy is contraindicated in such cases. Posterior fusion does not appear to alter the natural course of the disease process, pseudoarthrosis and bending of the fusion mass very frequently lead to a substantial increase of the kyphotic deformity [17-19]. Posterior fusion had been the standard surgical procedure for the limited correction and prevention of progression of deformity in many centers before the safe and liberal use of anterior spinal surgery became feasible. The anterior approach provides a direct approach towards diseased portion without damaging noninfected and intact posterior elements. Adequate debridement of the diseased tissue, thorough decompression, instrumentation and reconstruction of the gap by filling the bone graft seems easier and complete through the anterior approach. We took a right lateral high transthoracic approach in D1-D4 level patients to prevent injury to thoracic duct and left sided approach in rest of the patients.

In our study, the Average operative time was 180 mins (range: 110 min – 235 min) and blood loss was 220 ml (range: 120-360 ml) compared to the study conducted by Naunheim et al. [26] (1982-1993) where the mean time of operation was 344 minutes (range: 160-680 mins). Information on estimated blood loss was available in 105 patients. The mean blood loss was 1,097 mL (100-7000 ml). The average time for fusion was 23weeks according to Bridwell criteria [8].

In our study, the Preoperative kyphosis in the thoracic spine (D1-D12) was 42.2° (22°–54°), which was corrected to a mean of 25.3° (14°–29°) in the immediate postoperative radiographs. The percentage of immediate correction was 48%. There was an average loss of correction of 3.5° at final follow-up as compared to a study done by Garg et al. [27] where kyphosis in the thoracic and thoracolumbar spine (T1–L1) was 44.6° (25°–58°), which was corrected to a mean of 21.3° (14°–26°) in the immediate postoperative radiographs. The percentage of

immediate correction was 52.3%. There was an average loss of correction of 2.8° at final follow-up. Our study showed that by anterior approach there is a dramatic improvement in the neurological status and in the pain of the patient in a short period of time. The Intact posterior element with lateral fixation from anterior side gives very good postoperative stability not necessitating any brace postoperatively and mobilization in the form of supported sitting up to 45° can be done in the immediate post-operative period with physiotherapy of all limbs. This approach also allows breaking down of lung adhesions on the affected side which probably allows for better chest rehabilitation. The main limitation of our study is its retrospective nature and less sample size showing only midterm follow-up. The strength of our study is that this study is done by a single surgeon through the same approach to avoid bias.

5. CONCLUSION

Treatment of thoracic tubercular spondylodiscitis with anterior transthoracic approach provides direct access to the pathology, adequate debridement and allows thorough decompression of the neural tissue with good deformity correction and stabilization by internal fixation and also achieves good clinical, neurological, radiological and serological outcomes. This is a safe approach with less blood loss, less operative time, fewer complications and an early recovery when done by an experienced surgeon.

CONSENT AND ETHICAL APPROVAL

As per international standard or university standard guideline participant consent and ethical approval has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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