

Outcome of Surgical Intervention of Spinal Tuberculosis Patients

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Abstract

Background: Spinal tuberculosis is approximately 2% of all cases of tuberculosis. Both conservative and surgical management are practiced for its management worldwide. However, surgical management has excellent outcome.

Objectives: The aim of the study was to document the clinical and neurological outcomes of surgical intervention of spinal tuberculosis patients getting admitted in a tertiary care hospital of Bangladesh.

Materials & Method: This hospital based interventional study was conducted in the department of Neurosurgery, Chittagong Medical College and Hospital for a period of 12 months. Thirty-two cases with spinal tuberculosis underwent surgical intervention were enrolled in the study. All patients were treated with standard anti-TB drugs pre and postoperatively and were followed up regularly after surgery for 3 months. Neurological function and pain were evaluated preoperatively and postoperatively by Frankel's grade scale and visual analogue scale (VAS) respectively. Post operative outcomes were finally assessed 3 months after operation.

Results: Out of 32 cases, 2 were lost to follow up. Among the available 30 cases, 16 were men and 14 were women. The mean age was 36.10 (±13.70) years and age range were 18 to 65 years. At the final follow-up, the VAS score significantly improved from 6.97 (±1.87) preoperatively to 1.43 (±0.89) postoperatively ($P < 0.001$) and all patients became pain free, with final VAS score 0-3. At the final follow-up, the ESR and CRP significantly improved from preoperative status ($P < 0.001$). Twenty-nine (96.7%) patients improved by at least one Frankel grade and remaining one (3.3%) patient maintained their preoperative Frankel grade. Post operative deterioration was not observed in any of the included case. Out of 11 cases with bowel bladder dysfunction before surgery 10 (90.9%) recovered within three months.

Conclusion: Surgical intervention was safe and had satisfactory results in terms of symptomatic and neurological improvement.

Key Word: Tuberculosis, Spine, Surgery, Neurological involvement,

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Introduction

Surgical management of spinal tuberculosis has excellent outcome. In contrast to conservative management, candidates for surgical management

are small in number. Presence of neurological deficit, vertebral instability, failure of chemotherapy, large paravertebral abscess, progressive deformity are the conditions where surgery is indicated.¹ Bangladesh

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is one of the high TB burden countries with 4% of the world's total TB cases reported in 2019.² About 10% of all TB cases present with musculoskeletal involvement and 50% of these involve the spine.³ These data emphasize the necessity for preparation for a future resurgence of spinal TB. Spinal TB patients usually present with pain, progressive neurological deficit, bowel-bladder disturbance, kyphosis, etc. Paravertebral abscess is also a major cause of morbidity of the patients. It can lead to destruction of the intervertebral disc space and the adjacent vertebral bodies causing collapse of the spinal elements and that's why it results in characteristic angulation and gibbus formation.⁴ The thoracic spines are the commonest location followed by lumbar region. Clinical examination, laboratory and imaging studies are helpful; however definitive diagnosis is made only by identification of *Mycobacterium tuberculosis*. It can be done by image guided FNAC, Gene Xpert, postoperative tissue histopathology etc.

Anti-tuberculosis chemotherapy is needed for all the TB patients. In case of spinal TB cases, anti-TB regimen is longer. But there are different schools of thoughts. Moon et al. showed in their study that at least 12 months anti-TB regimen is required.⁵ Parthasarathy et al. concluded a study reporting that patients treated with anti-TB therapy alone for 6 months, 9 months or surgery had the same favorable functional outcome (94%, 99% and 90% respectively), with no statistically

significant difference.⁶ In our context, we use total 18 months of anti-TB drugs which is also recommended by National Tuberculosis Guideline. Currently, 4 chemotherapy drugs (Rifampicin, Isoniazid, Pyrazinamide and Ethambutol) are served at initial phase and 2 drugs (Rifampicin and Isoniazid) at continuation phase.

Most of the patients respond to conservative management within 3 months of starting anti-TB drugs. Sometimes it fails to respond. Failure of conservative treatment with neurological deficit is also a candidate for surgical management. In the later phase of untreated disease, kyphosis is also indication for surgical correction.⁷ Regarding surgery, various methods are available worldwide. Different approaches for different location with or without instrumentation are practiced. Anterior, antero-lateral, posterior or combined approach showed their own benefits and limitations. Some studies hold the superiority of

posterior approach for dorsal and lumbar regions.^{1,8} Two prospective series from Bangladesh demonstrated that surgical treatment of Pott's disease is safe and effective, with good clinical and neurological outcomes. The advantages of surgery include thorough debridement, thus better penetration of anti-TB drugs, as well as decompression of the spinal cord and adequate spinal stabilization.^{9,10} As an endemic zone, scopes are available to address the surgical management of spinal TB patients. In this context, this study was done to describe the clinical and neurological outcomes prospectively among consecutive patients of spinal TB patients in our institute.

Methods:

Study Design

This interventional study (Quasi-experimental) was done in the department of Neurosurgery, Chittagong Medical College and Hospital (CMCH), Chattogram in 2019- 2020. Consecutive sampling was done among patients with a diagnosis of spinal TB admitted in the Neurosurgery department, CMCH during study period. The sample size was 32. Patients of spinal TB were included in the study if they had progressive or severe neurological deficit, large paravertebral abscess, unstable spine compressing spinal cord, severe or progressive spinal kyphosis and failure to show improvement after antitubercular drugs for 4 weeks. However, patient with spinal TB was excluded if for the study if patient responded to conservative treatment (evidenced by clinical, radiological and laboratory parameters), patient or patient's attendant denied to undergo surgery, patient had associate severe heart and lung dysfunction or pregnancy and patient or attendants refused to participate in the study. A Structured Case Record Form was used to collect data. Based on the inclusion and exclusion criteria, patient was selected. Each patient was evaluated with a detailed history and physical examination including neurological examination. Diagnosis was done on the basis of plain Xray and MRI of spine or CT scan. Preoperative laboratory investigations for ESR and CRP done. Preoperative neurological evaluations were recorded by Frankel's grading. Assessment of bowel bladder involvement was recorded. Preoperative pain was assessed by Visual analogue scale score. Surgery was done after proper counseling and taking informed written consent. Ethical approval was taken before starting the study from the Ethical Review Committee of Chittagong Medical College

Data obtained were compiled in Microsoft Xcel sheet to generate a master sheet. Then they were fed into computer software package (SPSS, version 23) for processing and analysis. Continuous data were reported as the means ± SD. Qualitative or categorical data were described as frequencies

and proportions. Proportions were compared using chi-square. Independent sample t test was used for between-group comparisons of mean. Statistical significance was defined as P < 0.05.

Diagnostic Criteria for Spinal TB:

- i. Previous history of pulmonary tuberculosis or other extrapulmonary tuberculosis: the patient has the chest and back pain, emaciation, symptoms of low fever, neurological dysfunction,
- ii. Imaging studies: Xray chest for the diagnosis or exclusion of PTB; Xray, Magnetic resonance imaging (MRI) and/or Computed tomography (CT) consistent with spinal TB; (Loss of disc height, Vertebral body destruction, Paraspinal abscess, Calcification in paraspinal masses).
- iii. ESR, C-reactive protein increased to varying degrees;
- iv. Microbiologic evidence included at least one of the following: isolation of M. tuberculosis in blood, bone, deep soft tissues or (paravertebral, epidural, or psoas) abscess specimens; positive microscopy for acid-fast bacilli from bone, deep soft tissue or (paravertebral, epidural, or psoas) abscess (Ziehl–Neelsen staining); M.tuberculosis culture positive.

Frankel's grading

The Frankel's grading provides an assessment of spinal cord function and is used as a tool, as follows:

- Grade A: Complete neurological injury - No motor or sensory function detected below level of lesion
- Grade B: Preserved sensation only - No motor function detected below level of lesion, some sensory function below level of lesion preserved
- Grade C: Preserved motor, nonfunctional - Some voluntary motor function preserved below level of lesion but too weak to serve any useful purpose, sensation may or may not be preserved
- Grade D: Preserved motor, functional - Functionally useful voluntary motor function below level of injury is preserved

- Grade E: Normal motor function - Normal motor and sensory function below level of lesion, abnormal reflexes may persist.

Visual analogue scale

To determine the extent of pain in patients, the visual analogue scale (VAS) of pain scores was used where 0 represented no pain and 10 represented severe pain. Patients were asked to label a score of 0–4 for mild pain, 5–7 for moderate pain, and 8–10 for severe pain on the VAS.

Results:

Among the 30 patients, age ranges from 18-65 years with a mean age of 36.10 (±13.70) years. Male represents slight predominance. Majority (80%) of the patients was from rural area and only 6 (20%) patients came from urban area. Table I shows the clinical characteristics of the patients. Only 2 (6.7%) of patients have history of PTB. Motor weakness and pain are prominent symptoms present in 93.3% and 86.7% of the patients. Autonomic disturbance was present in 36.7% of the patients. Mean duration of the anti-TB chemotherapy prior to surgery was 1.58 months (ranged: 0.25 to 5 months).

Table-I

Clinical characteristics of the patients (n=30)

Characteristics	Frequency (percentage)
History of PTB	
Yes	2 (6.7)
No	28 (93.3)
Symptoms at admission	
Motor weakness	28 (93.3)
Pain	26 (86.7)
Autonomic disturbance	11 (36.7)
Gross deformity	3 (10)
Duration of anti-TB^a (in month)	
Mean ±SD	1.58±0.95
Range	0.25-5.00

^a Before surgery

Dorsal vertebra (60%) was the commonest site of lesion followed by lumbar vertebrae (16.7%). Cervical vertebrae involvement was present in 2 (6.7%) and dorsolumbar vertebrae involvement in 4 (13.3%) of the patients. The number of involved segments was 1 in 2 (6.7%) cases, 2 in 25

(83.3%) cases, 3 in 2 (6.7%) cases, and 4 in 1 (3.3%) case (Table II).

Table-II
Characteristics of the lesion of the patients with spinal TB (n=30)

Characteristics	Frequency (percentage)
Level of involvement	
Cervical vertebrae	2 (6.7)
Dorsal vertebrae	18 (60)
Dorsolumbar vertebrae	4 (13.3)
Lumbar	5 (16.7)
Lumbosacral	1 (3.3)
Number of affected vertebrae	
1 segments	2 (6.7)
2 segments	25 (83.3)
3 segments	2 (6.7)
4 segments	1 (3.3)

Preoperative neurological status of the patients is shown in Figure 1. According to the Frankel classification (Grade A: completely paralyzed; Grade B: preserved sensation only and no motor function; Grade C: preserved sensory function and nonfunctional motor function; Grade D: preserved sensory function and functional motor function; Grade E: normal motor and sensory function), majority of the patients (22/30=73.3%) were either in Grade B or Grade C, followed by 16.7% (5/30) in Grade A. Only 3 (10%) patients were in Grade D and none of the patients were in Grade E.

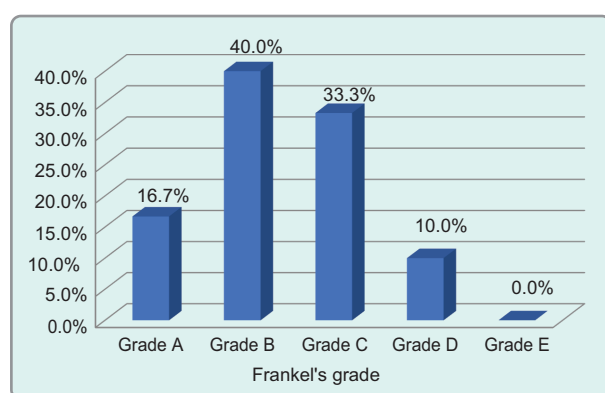


Fig.-1: Pre-operative neurological status in 30 patients with spinal TB.

Intensity of pain was measured in the study by VAS. Figure 2 depicts that, 9 patients reported score 7 and 5 patients reported score 9 in the scale. Two patients had constant severe pain and accordingly score 10 (highest score) in the scale. Mean VAS score was 6.97 (± 1.87) in the studied patients

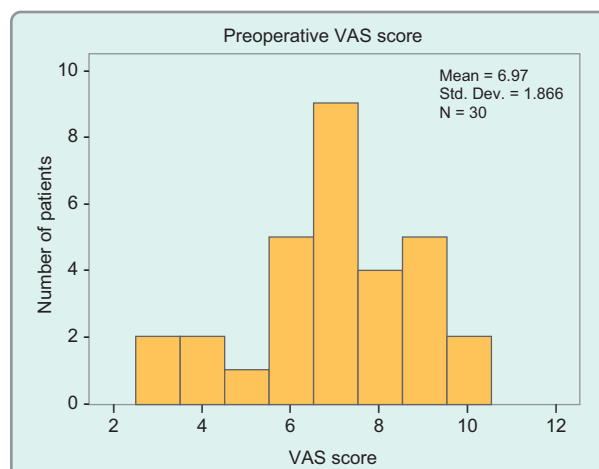


Fig.-2: Distribution of preoperative VAS score in the patients

Table-III
Surgical procedure of 30 patients and the level of involvement

Sl. no.	Surgical procedure done	Number of patient
1.	Drainage of pus	2
2.	Laminectomy	10
3.	Decompression & stabilization	16
4.	Costotransversectomy	2
	Total=30	

In the present series, pain was significantly reduced in 3 months following surgery. Preoperative mean (\pm SD) VAS score was 6.97 (± 1.87) and 3 months after the mean score decreased to 1.43 (± 0.89). The mean difference of 5.53 VAS score was statistically significant ($P < 0.001$, 95% CI 4.84-6.23).

ESR was significantly reduced in 3 months following surgery. Preoperative mean (\pm SD) ESR level was 69.57 (± 24.49) mm in first hour and 3 months after the mean level decreased to 24.23 (± 8.43) mm in first hour. The mean difference of 45.33 ESR level was statistically significant ($P < 0.001$, 95% CI 37.57-53.10).

In the present series, CRP was significantly reduced in 3 months following surgery. Preoperative mean (\pm SD) CRP level was 23.40 (± 18.92) mg/dL and 3 months after the mean level decreased to

9.15 (± 4.95) mg/dL. The mean difference of 14.25 CRP level was statistically significant ($P < 0.001$, 95% CI 8.42-20.08).

Frankel's grading at presentation and at final follow-up was analyzed. Two patients (6.7%) recovered neurologically to Frankel grade E and both of them were in Grade D preoperatively. Twenty patients

Table-IV
Neurological outcome according to the Frankel classification grading system preoperative and at 3 months after surgery (n=30)

Baseline Frankel's Grading	n	Outcome in Frankel's Grading at 3 months after surgery					P value
		A	B	C	D	E	
A	5	0 (0)	1 (20.0)	2 (40.0)	2 (40.0)	0 (0)	<0.001 (chi-square test)
B	12	0 (0)	0 (0)	5 (41.7)	7 (58.3)	0 (0)	
C	10	0 (0)	0 (0)	0 (0)	10 (100)	0 (0)	
D	3	0 (0)	0 (0)	0 (0)	1 (33.3)	2 (66.7)	

Data are expressed as frequency (percentage). Figure in bold faces had at least one Frankel grade improvement.

(66.7%) who showed neurological recovery to Frankel grade D, preoperatively 2 of them were in grade A, 7 in grade B and 10 in Grade C. Only 1 patient (3.3%) in grade D did not show any signs of recovery (Table IV).

Figure 3 shows that, before surgery majority of the cases had Frankel's grade B or C. In contrast 3 months after surgery majority of the patients had Frankel's grade D or C. Figure 4 shows changes in Frankel's grade after 3 months of surgery.

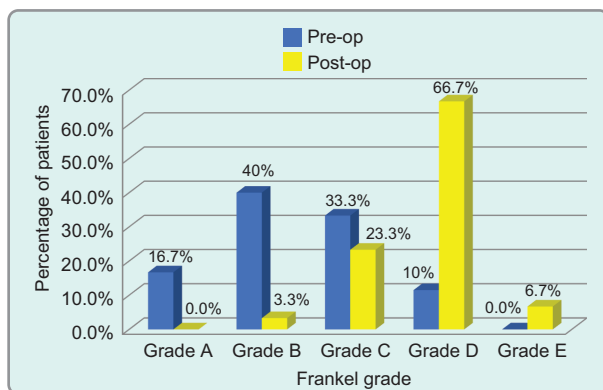


Fig.-3: Frankel's grading for patients at presentation and final follow-up

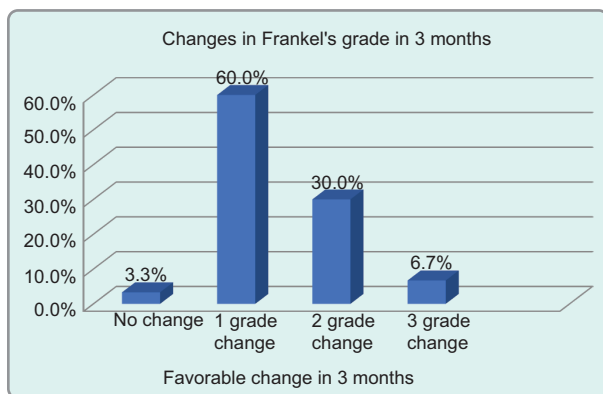


Fig.-4: Changes in Frankel's grading in the patients 3 months after surgery

In the present series, out of 30 cases of spinal TB 11 cases had no bowel bladder control preoperatively and other 19 cases had bowel and bladder control (0.004). Out of 11 cases with bowel bladder disturbance 10 (90.1%) cases showed improvement with bowel-bladder control. Only 1 (9.9%) case did not recover bladder function till 3 months post-surgery.

The surgical wounds healed uneventfully in 26 patients, in 3 patients, superficial infection was observed which was healed by regular dressing. 1 patient had developed deep infection which was healed by secondary closure after regular dressing. No other complication like, cerebrospinal fluid leak, implant failure was not observed in the present series.

Discussion:

This study presents characteristics of spinal TB patients, who have undergone surgical intervention along with their anti-TB chemotherapy. Due to the limited time frame, it was not easy to enroll a large enough sample population to assess the outcome of surgical procedure and finally 30 patients with spinal TB were enrolled in the study. The patients were operated and assessed in the time interval of one year that is from August 2019 to August 2020. These patients were followed up from 1st POD till the end of 3rd months to see the symptomatic improvement and neurological outcome. Excellent results were found in most of the cases with reduction of pain intensity and improvement of neurological deficit in the current study.

In the current study, it shows that, spinal TB occur over a wide age range (18 to 65 years), with mean age at surgery being 36.10 (±13.70) years. Previous studies conducted in patients with spinal TB reported a lower mean age. Alam et al. reported that, mean age was 25.4 years and ranged from 7 years to 68 years.⁹ Ghosh et al. reported a mean age of 28.4

years and ranged from 1-65 years.¹¹ As the current study included only the adult patients the mean age was higher than these studies which have included the entire age group. It is to be noted that, studies conducted to analyze the surgical outcome of spinal TB reported similar or higher age than the current study. Mean age was 33.55 ± 14.74 years (range, 24 to 65 years) in the study of Tang et al. 46.63 ± 18.21 years in the study of Sharma et al. and 50.8 years (31-70 years) in the study of Sahoo et al..¹²⁻¹⁴ A recent large study from China reported that, young and middle-aged adults (18–60 years old) accounted for 70% of the patients with spinal TB.¹⁵

Regarding sex there is slight male predominance (16 male and 14 female) in the current study. It is similar to the previous studies though significant male predominance were reported.^{10,11,16} In the

current study, 80% patients were from rural areas. Rural areas of Bangladesh are associated with poor economic level and poor medical and health conditions. Previous study from China reported that, 80% of patients with spinal TB lived in rural areas.¹⁶ However, it is to be noted that, sample size was small and collected consecutively in the current study rather than randomly which might limit its ability to determine the real demographic picture of spinal TB.

Back pain is the most frequent symptom of spinal TB. Such pain is typically localized to the site of involvement, which is most commonly the thoracic and lumbar spine.¹⁷ In one study, chronic back pain was the only symptom in 61% of patients with spinal TB.¹⁸ In the present study, 86.7% patients had pain at the site of lesion and this was the main reason for patients seeking medical evaluation and treatment.

In the present study thoracic vertebrae (60%) were most commonly affected followed by lumbar vertebrae (16.7%). It was in agreement with the studies of Liu et al. and Sharma et al..^{13,16} However, some of the studies have reported thoracolumbar level as most commonly involved, whereas others have found thoracic vertebrae as the most commonly affected.¹⁷

Regarding the preoperative neurological status of the included spinal TB patients the current study demonstrated that, majority of the patients (73.3%) were either in Frankel's Grade B or Grade C, followed by 16.7% in Grade A. Only 3 patients were in Frankel's Grade D and none of the patients were in Grade E. It is in agreement with the findings of Sahoo et al. who

reported that, 22%, 44%, 22%, and 11% of their patients were in Grade A, B, C, and D respectively at the time of surgery.¹⁴ Cao et al. reported that, from their 638 cases of spinal TB who have undergone surgical management 2.7% were in Grade A, 8.2% were in Grade B, 21.6% were in Grade C, 24.3% were in Grade D and 43.2% were in Grade E.¹⁹

Several researchers reported that patients with spinal TB who suffered from functional neurological disturbance obtain satisfactory functional restoration and recovery from tuberculosis through debridement, stabilization, and decompression of the spinal cord.^{12,19-22} In the current series, only one patient (3.3%) with preoperative Frankel's grade D failed to show any improvement in his Frankel's grade as it was same after 3 months of surgery. Majority (60%) had one grade improvement in their preoperative Frankel's grade, followed by 9 (30%) patients with 2 grade improvement and 2 (6.7%) with 3 grade improvement. Postoperatively, there was no increase in neurological deficit in the present study. Rawall et al. reviewed 67 cases of thoracolumbar TB who underwent single stage all posterior surgery with follow-up of 31.37 months.²³ They reported that, of 38 patients with deficit, 8 improved by 3 Frankel grades, 16 improved by 2 Frankel grades, whereas 10 improved by 1 grade. Two patients had neurological deterioration by 1 grade.

At the last follow-up examination, remarkable improvement of pain reduction was noted in the present study. All of the patients reported VAS score 3 or less (indicating mild pain/ local discomfort) 3 months after surgery in the present study. Pain is the main symptom of spinal TB and previous studies also in line with the findings of the present study. Kiran et al. reported that, 33 of the 34 patients with local pain were symptom free and only one patient complained of mild local discomfort at the last follow-up examination.²⁴

Ten (90.1%) of the 11 patients who presented with bladder/bowel involvement recovered complete function postoperatively. Only one patient noted persistent bladder involvement at the last follow-up visit. It is in agreement with the findings of Kiran et al. who reviewed 48 cases of spinal TB underwent surgery. 88% of their patients who presented with bladder involvement recovered complete function postoperatively.²⁴

Improvement of ESR and CRP level at the final follow-up was significant. In the present study, ESR level

was 69.57 (± 24.49) mm in 1st hour preoperatively and 24.23 (± 8.43) mm in 1st hour postoperatively ($P < 0.001$). CRP level was 23.40 (± 18.92) mg/dL preoperatively and 9.15 (± 4.95) mg/dL postoperatively ($P < 0.001$). Both the parameters correspond to other studies like Cao et al. who reported that preoperative ESR level was 44.65 (± 16.30) mm in 1st hour and postoperative ESR level was 20.67 (± 8.73) mm in 1st hour.²⁵ They also reported similar result regarding CRP level (preoperative and postoperative 53.34 \pm 24.49 and 28.60 \pm 17.15 mg/dL respectively).

In the present series during three months follow-up period most of the surgical wound healed uneventfully. Superficial and deep infection were observed complications in the present study and observed in 4 (13.3%) patients. These wounds were healed with regular dressing. Secondary closure needed after dressing in case of deep infection. Rawall et al. described 67 cases of thoracolumbar TB managed by Posterior approach. They observed that superficial infection, deep infection and cerebrospinal fluid leak were associated only in 6 cases.²³ Yin et al. also reported complications like delayed wound healing, cerebrospinal fluid leakage and internal fixation loosening occurred infrequently in postoperative period in their series of cervical spinal TB.²²

Probable confounders of this study were comorbidities, drug non-compliance and physiotherapy. Before the study design, comorbid conditions were restricted by setting exclusion criteria. Drug non-compliance and physiotherapy might influence the outcome. Health cards provided by DOTS corners showed that all the patients had regularly taken anti-TB drugs. As no deterioration of neurological status, pain, autonomic disturbance was found, probable confounder physiotherapy was controlled by restriction.

International guidelines acknowledge the dearth of high-quality evidence to recommend for or against surgery. However, they conclude the trials found no additional benefit with surgical debridement over chemotherapy alone in most cases and conclude the decision to be made on a case-by-case basis.^{26,27} Again, there is wide variation in the literature regarding age distribution, neurological involvement, methods of neurological assessments, which can make the studies less comparable with each other. Currently, in our setting it is observed that, spinal TB is treated medically in the absence of major neurological deficits or concerns for major deformity. This present study

provides evidence that, surgical intervention along with the anti-TB chemotherapy is safe for the patients with spinal TB and it provides symptomatic relief as well as recovery of neurological deficit. However, larger prospective stratified controlled trials could be further helpful to get more reliable results of surgical outcome in spinal TB.

Conclusion:

We conclude that a significant proportion of the patient's exhibit remarkable improvement in neurological deficits, bladder symptoms, and pain.

Limitations

These results should be interpreted in the light of several limitations of our study. The study was conducted with a very small sample size. Laboratory data were not collected from same source, so some variations were present. This study also had a short follow-up period, which made it unable to comment on complete cure, bone fusion or recurrence of infection. There are also large variations in level, amount of destruction, and neurological involvement.

Recommendation

Anti-TB drug treatment is the gold standard for the treatment of spinal TB, whereas surgical treatment could play an important role as adjuvant therapy. A prospective study with controlled variables may facilitate the comparison of the efficacy between different surgical modalities in the treatment of spinal TB.

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