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The Efficacy of Anterior Thoracic Decompression Combined with Cage Fixation in Patients Suffering from Spinal Tuberculosis

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Abstract

Background: *Tuberculosis (TB) is a common problem in developing countries. Although it is on decline but still present in developed countries due to immigrants from underdeveloped countries and the prevalence of HIV in these countries. Treatment modalities are available in both medical and surgical forms*

Objective: *To determine the effectiveness of Anterior Thoracic Decompression with cage fixation in patient of spinal tuberculosis.*

Study Design & location: *Descriptive case series, Department of Neurosurgery Bolan Medical College Quetta*

Duration*: January 2023 to December, 2023*

Methodology: *This study was conducted at Department of Neurosurgery Bolan Medical College Quetta. The study design was a descriptive case series and the duration of the study was one year in which a total of 160 patients were observed, using 72% accuracy of anterior decompression, 95% confidence level and 7% margin of error under WHO software for sample size determination.*

Results: *In this study mean age was 56 with standard deviation ± 2.26. Fifty eight percent patients were male and 42% patients were female. In pre operative MRC grading, 72% patients had MRC grade 1 and 28% patients had MRC grade 2 while after surgery 35% patients had MRC grade 1, 24% patients had MRC grade 2, 23% patients had MRC grade 3 and18% patients had MRC grade 4. On the bases of MRC grading efficacy was analyzed as Anterior Thoracic Decompression with CAGE fixation was effective in 70% patients and was not effective in 30% patients.*

Conclusion: *Our research concludes that the procedure of Anterior Thoracic Decompression with internal fixation, employing a cage and rod with screws, is an effective treatment for dorsal spine tuberculosis. This method aids in restoring and preserving sagittal plane alignment after extensive resection of infected bone, mitigating concerns about potential instability. Moreover, the use of TMC has shown no correlation with a heightened risk of recurrent infections. Additionally, the application of TMC has demonstrated no significant association with an increased risk of infection recurrence. Our study highlights that the decompression and stabilization achieved through TMC have significantly contributed to pain reduction and enabled early mobilization, along with enhancements in motor function. The procedure is associated with minimal complications and produces favorable outcomes.*

Keywords: Anterior Decompression, Cage, Spine Tuberculosis

INTRODUCTION

Tuberculosis (TB) remains a significant issue in developing nations. While its incidence is decreasing, it continues to affect developed countries, primarily due to immigration from less developed regions and the high rates of HIV in those areas. In Pakistan, it is reported that one in every 564 individuals is afflicted with tuberculosis, with Mycobacterium Tuberculosis being a major cause of numerous spinal and vertebral infections. There are around 2.85 million cases of tuberculosis in the country, and around 100,000 new cases are added each year, the experts quoted recent studies on the subject, adding that one per cent of all tuberculosis cases affect a person's spin [2]. Spinal TB is the most common and dangerous form of skeletal tuberculosis because of its capacity to cause bone destruction, deformity, and paraplegia[3]. It was initially described by Sir Percivel Pott as painful kyphotic deformity of the spine associated with paraplegia in 1782[1]. The disease spread to the spine from primary focuses either directly or through blood i.e. intercostal arteries or batson's plexus[4]. Destruction of vertebra starts in cancellous bone and then spread to involve another vertebrae. Usually one motion segment is involved[5]. Even after achieving healed status spinal deformities continue to advance during growth due to biochemical stresses on the structurally weakened vertebral column and produce severe degenerative changes in the proximal and distal segments of the spine[3,6].

Treatment is either medical or surgical[7]. The development of antituberculus chemotherapy has revolutionized treatment of spinal tuberculosis but chemotherapy alone may induce residual kyphotic deformity and neuologic complications after treatment[5,8].

Surgery is required in cases of epidural abscess, neurological defecit and instability due to structural destruction. Surgical pre requisites are debridement with resection of involved vertebrae followed by reconstruction and stabilization with implant[3]. Traditionally there has been two approaches to the spine in spinal tuberculosis; Anterior Thoracic Decompression and the posterior decompression[9]. The anterior approach has been preferred throughout the spine to achieve these goals because the pathology of tuberculosis mainly affects the vertebral bodies and disc spaces, and the anterior approach allows direct access to the infected focus and is convenient for debriding infection and reconstructing the defect[9].

Various studies have shown different effectiveness of Anterior Thoracic Decompression for spinal tuberculosis i.e.72%[4], 94%[6]. The data presented indicates that the effectiveness of Anterior Thoracic Decompression differs across various regions, and there is a scarcity of localized research concerning the anterior approach and its clinical outcomes. In our investigation, we assess the procedure's effectiveness by evaluating the improvement in the patient's strength. This study aims to provide insights into the procedure's outcomes and enhance prognostic capabilities. Additionally, it seeks to mitigate the morbidity and mortality associated with spinal tuberculosis, thereby alleviating the economic burden on the community.

METHODOLOGY

The study was conducted after approval from hospitals research and ethical committee. All consecutive patients meeting the inclusion criteria (all patients with carries spine had power less than 4 on Medical Research Council grading, Radiologic evidence of cord

compression) and Exclusion criteria (age more than sixty years. Patients with history of other co-morbidities like diabetic neuropathy. Patient with multiple level involvement at non contagious site which was assess on Magnetic Resonance Imaging) The above mentioned factors act as confound and had make the study result biased if included with diagnosis of carries spine i.e. involvement of intervertebral disc and both end plates visible on MRI was enrolled in the study through outpatient and emergency department and was admitted to neurosurgery ward for further work up.

All patients were subjected to detailed history followed by complete physical and neurological examinations and routine set of investigations was performed in all patients. The enrolled patients were put on the OT list for the next OT day after performing anesthesia assessment through an expert anesthesiologist.

On the next OT day decompressive carpectomy with cage fixation was performed under general anesthesia by single expert neurosurgeon. All the patients were followed up till 72 hours post operatively for the determination of effectiveness in terms of improvement in MRC grading. All the above mentioned information including name, age, gender and address was recorded in a predesigned proforma. Exclusion criteria had followed strictly to control confounders and bias in the study results.

The data was entered, stored and analyzed in SPSS version 22.0. Mean $\pm$ SD was calculated for quantitative variables like age, preoperative and postoperative grading. Frequencies and percentages were calculated for categorical variables like gender and effectiveness. Effectiveness was stratified among age, gender and Pre op MRC grading at presentation to see the effect modification. All results were presented in the form of tables and graphs.

RESULTS

This study was conducted at Department of Neurosurgery Bolan Medical College/Hospital Quetta in which a total of 160 patients were observed to determine the effectiveness of Anterior Thoracic Decompression with cage fixation in patient of spinal tuberculosis and the results were explained as:

Age distribution among 160 patients was analyzed as 16 (10%) patients were in age range 21-30 years, 35 (22%) patients were in age group 31-40, 48 (30%) patients were in age group 41-50, 61 (38%) patients were in age group 51-60. Mean age was 56 with standard deviation ± 2.26. Gender distribution among 160 patients was analyzed as 93(58%) patients were male and 67 (42%) patients were female. Pre operative MRC grading among 160 patients was analyzed as 115 (72%) patients had MRC grade 1 while 45 (28%) patients had MRC grade 2. Post operative MRC grading among 160 patients was analyzed as 56 (35%) patients had MRC grade 1, 38 (24%) patients had MRC grade 2, 37 (23%) patients had MRC grade 3 and 29 (18%) patients had MRC grade 4. (Table No 1)

Efficacy of the procedure among 160 patients was analyzed as Anterior Thoracic Decompression with CAGE fixation was effective in 112 (70%) patients and was not effective in 48 (30%) patients. (Figure No 1)

Stratification of efficacy in age distribution was analyzed as in 112 effective cases, 13 patients were in age range 21-30 years, 24 patients were in age group 31-40, 34 patients were in age group 41-50 and 41patients were in age group 51-60. (Table No 2)

Stratification of efficacy in gender distribution was analyzed as in 112 effective cases, 65 patients were male and 47 patients were female. (Table No 3)

Stratification of efficacy in pre operative MRC grading was analyzed as in 112 effective cases, 72 patients had MRC grade 1 and 40 patients had MRC grade 2. (Figure No 2)

Table no 1. Age, Gender Distribution, Pre Operative MRC Grading, Post Operative MRC Grading

Age Distribution	Frequency	Percentage
21-30 years	16	10%
31-40 years	35	22%
41-50 years	48	30%
51-60 years	61	38%
Total	160	100%
Gender Distribution		
Male	93	58%
Female	67	42%
MRC grading		
1	115	72%
2	45	28%
3	0	0%
4	0	0%
MRC grading		
1	56	35%
2	38	24%
3	37	23%
4	29	18%
5	00	0%

Mean age was 56 with standard deviation ± 2.26
Mean MRC Grade was 1 with standard deviation ± 1.67
Mean MRC Grade was 3 with standard deviation ± 2.12

Figure no 1. EFFICACY

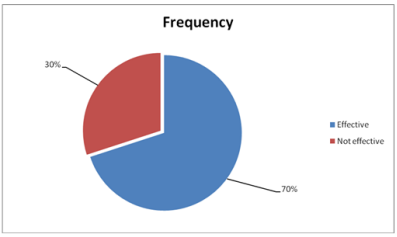


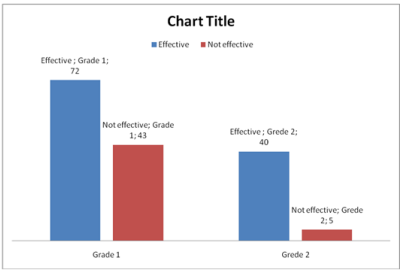
Table no 2. Stratification of Efficacy with Age

Efficacy	20-30 years	31-40 years	41-50 years	51-60 years	Total	P-Value
Effective	13	24	34	41	112	0.042
Not effective	3	11	14	20	48	
Total	16	35	48	61	160	

Table no 3. Stratification of Efficacy with Gender

Efficacy	male	female	Total	P-Value
Effective	65	47	112	0.042
Not effective	28	20	48	
Total	93	67	160	

Figure no 2. STRATIFICATION OF EFFICACY WITH PRE OPERATIVE MRC GRADING



P-Value was significant = 0.042

DISCUSSION

The skeletal system is involved in 1-2 % cases of tuberculosis of which 50% involve the vertebral bodies. Spinal tuberculosis is definition, an advanced disease requiring meticulous assessment and aggressive systemic therapy. The objective of treatment is spinal tuberculosis is to cure the disease with normal neurology and almost near normal functional spine. As most of the spinal cord compression is usually located anteriorly, anterior approach and decompression is the preferred route for neural decompression.[10]

In our study the total patients were 160 in which 58% patients were male and 42% patients were female. Other studies have also reported that males are commonly affected than females in spinal tuberculosis. In a study of 162 cases there were 89 males and 73 females however according to some authors this disease is more common in females. The reason that men were more common in our study is exactly unknown. The mean age of our patients was 58 years ranged for 20-60 years. Ali and colleagues studied 81 patients with spinal tuberculosis with mean age 60 years. Other studies have reported average age of 50 years and 55 years.[11]

One of the indications for Anterior Thoracic Decompression in tuberculosis spine is progressive neurological deficit due to cord compression. In the one study 76% of the patients had preoperative neuro deficit, gobriel and colleagues studied seventy patients with vertebral osteomyelitis who underwent anterior debridement and deconstruction of the anterior column with titanium mesh cage. In their study neurological deficit was seen in 45% patients. The neurodefict was more in our study this could be because of late presentation and diagnosis of the patients. [12,13]

Like other surgical procedures this approach also have some complications. We observed complication in 8% cases. The most common complication was wound infection in 5% cases followed by post operative dyspnea in 3% cases. None of the patient had dural tear or deterioration in neurology. [14]

In a study of 73 cases that were treated with surgical debridement and inter body grafting and fixation, 3% patients developed sinus next to the incision and in 4% cases appeared subcutaneous emphysema. The overall morbidity was 7% , in one study in which both anterior and posterior approach was adopted, the incidence of infection was 4% and graft related problems 7% with total complications rate of 10%.[15]

In another study it was also been described that patients seek medical care after some neurological deficit or some structural deformity, leaving surgical management as the only choice. Prerequisites of spinal surgery are for carries spine are

the removal of pus as well as necrotic bone and tissue debridement, neural decompression , deformity correction and stabilization of the affected spinal segments. [16] Stabilization can be done with the help of bone graft or with instrumentation using metal implants. [17] Although instrumentation is required for deformity correction and stabilization, many arguments have been disputed regarding the use of instrumentation. In patients requiring surgical intervention, use of instrumentation should be justified against the structural stability and deformity correction provided by the instrumentation and the increased chance of infection by the presence of foreign material in the area which may diminish the effects of infection eradication. In other words instrumentation offers the theoretical advantage of deformity correction and stability but has also been closely related with an increased of infection, although this notion has been challenged by some results, [19, 20]

Titanium Mesh cage with bone grafts is better than structural bone graft alone as it provides more secure and accurate stability and deformity correction. It is more dependable as compared to bone graft alone. [21] Cage provides a fixation which is more rigid and there is also less risk of graft subsidence or dislodgement, that are well-documented complications when structural bone graft only is used. [22] Cages with bone also provide stability to enable earlier and safer mobilization.

In our study, all the patients showed definite improvement of kyphosis without infection recurrence. Oga et al,[23] studied the risk of persistence and recurrence of infection in posterior spinal instrumentation surgery for spinal tuberculosis in eleven patients. They operated the patients with debridement, anterior fusion, and combined posterior instrumentation. There was no case of persistence or recurrence of infection after surgery, and they found that instrumentation provided immediate stability and protected against development of kyphotic deformity. The adherence property of Mycobacterium tuberculosis to stainless steel was evaluated experimentally also. They found that little Mycobacterium tuberculosis adhered to stainless steel while Staphylococcus heavily colonized stainless steel. They concluded that posterior instrumentation surgery was not a hazard to a spinal TB when it is combined with radical debridement and intensive anti-tuberculosis chemotherapy.

The differences in adherence and biofilms formation between Staphylococcus epidermidis and Mycobacterium Tuberculosis on various spinal implant surfaces. They found that Staphylococcus epidermidis heavily colonized on the metal rod and form thick biofilms, while Mycobacterium tuberculosis, rarely adhered to metal surfaces and showed scanty biofilms formation. Many experimental studies suggest Mycobacterium tuberculosis, unlike bacteria, has low adherence to stainless steel and forms less polysaccharide biofilms.[25] Therefore the use of implants is theoretically safe in the presence of spinal TB by He et al [24] evaluated.

There were few studies about Titanium alloys and Mycobacterium tuberculosis. That titanium alloys, in general, showed relatively friendly toward the host bone and had lower infection risk. On the other hand, Mycobacterium tuberculosis has low adherence properties to stainless steel, but its behavior towards Titanium has not been studied yet. Our study suggested Mycobacterium tuberculosis may behave towards titanium implants in a similar fashion as towards stainless steel implants Solutions et al[26] reported.

In regard to the Neurological status improvement all the patients showed an improved status.11 patients were neurologically intact who remained same, while 9 patients out of the rest 14 become ambulatory post operatively. Sphincter function and

sensations improved. So we assume that anterior fixation provides increased stability and lead to favorable environment for infection control, and solid fusion. [132]

CONCLUSIONS

Our research concludes that the procedure of Anterior Thoracic Decompression with internal fixation, employing a cage and rod with screws, is an effective treatment for dorsal spine tuberculosis. This method aids in restoring and preserving sagittal plane alignment after extensive resection of infected bone, mitigating concerns about potential instability. Moreover, the use of TMC has shown no correlation with a heightened risk of recurrent infections. The decompression and stabilization afforded by TMC, as observed in our study, have played a crucial role in alleviating pain and facilitating early mobilization, resulting in improved motor strength.

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