

Combined Anterior and Posterior Operation for Thoracic Tuberculous Spondylitis

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Objective : The purpose of this study is to evaluate the clinical outcome of the two-stage operation for thoracic tuberculous spondylitis.

Methods : Eleven patients (4 male, 7 female) with thoracic tuberculous spondylitis were treated with two-stage operation. First stage consisted of anterior debridement and interbody fusion using rib graft and second with posterior instrumentation with fusion. Mean age was 46 years, and mean follow-up period was 18 months. All patients were treated with 12 months of antituberculous medication postoperatively, and evaluated before and after surgery with respect to pain level, neurological status, associated lesions, hematological parameters and change of kyphotic angle.

Results : The associated lesions were pulmonary tuberculosis in 4 cases. There were no recurrences of infection and bone union was obtained within 6 months of the operation in all cases. Changes in the pain severity, neurological status, and hematological parameters demonstrated significant clinical improvement in all patients. The mean kyphotic angle was corrected from 17.8° to 9.8° after surgery. The most recent follow-up of the mean kyphotic angle was 12.3°, with a loss of correction of 2.5°. The preoperative VAS averaged to be 7.18 [range, 4-10]. It decreased significantly an average of 1.45 ($p < 0.001$).

Conclusion : These results indicate that two-stage surgical treatment for thoracic tuberculous spondylitis provide safe and satisfactory results. Spine instability and kyphosis can be also prevented by two-stage operation.

KEY WORDS : Thoracic tuberculous spondylitis · Anterior rib graft · Posterior screw fixation.

Introduction

Despite the diverse surgical or non-surgical treatment modalities, tuberculous spondylitis may cause various complications such as kyphotic deformity, neurological deficits. With the development of anti-tuberculosis drugs in the 1950s, the treatment of tuberculous spondylitis patients has improved dramatically. Nonetheless, surgical treatment methods are required in the cases with unresponsiveness to drug treatments, frequent recurrences, abscess in the vicinity of spine, excessive destruction of the vertebral body and severe deformity, and neurological abnormal findings. Surgical options are either anterior or posterior approach. The anterior curettage and fusion is the only method that could directly remove the lesion compressing the spinal cord, and it has the advantage of possible anterior support. Posterior instrumentation such as transpedicular screw fixation and fusion has the advantages such as the correction of kyphotic deformity

and its maintenance, the achievement of firm bone union, and early rehabilitation^{2,12)}. In this study, 11 patients with thoracic tuberculous spondylitis who underwent the two-stage operation consisting of the anterior autologous bone fusion using the rib graft followed by spinal fixation from February 1999 to January 2004 were evaluated for clinical and radiological improvements. The results are described with a review of the literature.

Materials and Methods

From February 1999 to January 2004, a total of eleven patients with thoracic tuberculous spondylitis, in whom severe bone destruction, spinal deformity, neurological deficits, or resistant to conservative treatment were presented, were reviewed. These patients represent only those who were evaluated and followed for the minimum period of 18 months. The main symptom of the patients was back pain. Hypoes-

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Fig. 1. A : Preoperative magnetic resonance image showing T9–T10 tuberculous spondylitis in a 66–year–old female patient. B : Simple lateral radiograph obtained after the first operation. Anterior debridement and fusion with rib graft is performed at T9–T10 level. C, D : Simple radiographs obtained after the second stage operation. Posterior screwing and fusion are been at T8–L1 level.

Table 1. Clinical characteristics of patients with thoracic tuberculous spondylitis (n=11)

Cases	Age/Sex	Involved segment	Corpectomy level	Paraparesis	Back pain	Mean follow up (months)
1	57/M	T8,9	2 level	(+)	(-)	12
2	66/F	T9,10	2 level	(-)	(-)	14
3	68/F	T10–T12	2 level	(+)	(-)	14
4	53/F	T6,7	2 level	(+)	(-)	17
5	43/F	T8,9,10	2 level	(+)	(-)	15
6	61/F	T11–L1	2 level	(-)	(+)	18
7	49/M	T10–12	2 level	(+)	(+)	13
8	71/F	T9–T12	2 level	(+)	(+)	13
9	54/M	T11–L1	2 level	(+)	(+)	17
10	36/M	T10–L1	2 level	(+)	(+)	14
11	62/F	T9–T12	2 level	(+)	(+)	16

thesia accompanying motor weakness of lower extremities was seen in 9 cases, and a radiating pain in lower extremities was noted in 2 cases. In all the patients, posterior instrumentation fixation was performed following 10–14 days after anterior fusion using a rib graft. In anterior approach, 8–10 sliced ribs were tied with wires to reach the size of the corpectomy site. Interbody fusion was done after the debridement without any use of instruments (Fig. 1). An average of 2.6 vertebrae were involved. Although efforts have been made to perform the fixation of segments as little as possible, up to one segment above or below was fixed when the resected vertebral body were too small for the fixation of anterior or posterior screws. In cases with severe deformity where sagittal planes were more than 20 degrees, posterior fixation would have been performed prior to anterior surgery. However, in our case, none of the cases had a severe deformity of sagittal plane, and thus anterior surgery was performed first in all the patients (Table 1). As soon as patients were diagnosed as tuberculous spondylitis, anti-tuberculosis medication such as isoniazide, rifampicin,

ethambutol, pyrazinamide were initiated. The principle was to administer the drugs for a minimum of one year, until erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) values become normalized. It was administered for an average of 13.3 months. The pain severity of the patients was evaluated by visual analogue scale (VAS). Regarding the change of neurological status, the Frankel grading system was used. As a marker of infection, ESR and CRP were

measured. These parameters (VAS, ESR, CRP, and Frankel's grade) were evaluated just prior to operation, after the second stage operation, and at the final follow-up. Postoperative plain radiographs were used to evaluate the bony fusion. Paired t-tests were used to compare parameters at each stage in the course of the twostage operation.

Results

Preoperative ESR was increased in all cases, and it averaged to be 50.5mm/h (normal is less than 18mm/h). After the surgery, it became normalized after an average of 8.5 months.

Preoperative CRP was also increased in all cases except one. The average was 3.62mg/L (normal is less than 0.5mg/L), and became within normal range at an average of 4.6 months after the surgery. These markers became normalized after surgery in all cases. As preoperative neurological symptoms, incomplete paralysis was seen in 9 cases but remaining cases

Table 2. Pain level, Kyphotic angles and Frankel grades of patients

Case No	Pain level (VAS) (cm)			Frankel grade			Kyphotic angle(°)			
	Pre. op.	After 2nd op.	Final follow up	Pre. op.	After 2nd op.	Final follow up	Pre. op.	After 2nd op.	Final follow up	Final predicted kyphotic angle
1	9	3	2	B	C	C	22	12	14	17
2	8	4	2	D	D	D	8	4	7	15
3	4	1	0	D	E	E	32	21	22	24
4	10	2	1	C	D	E	12	8	10	17
5	7	3	1	D	E	E	18	9	13	14
6	7	2	2	D	D	D	16	9	12	15
7	9	4	3	B	B	C	20	14	16	24
8	4	2	1	B	D	D	12	9	13	15
9	8	3	1	C	D	E	22	7	9	14
10	7	4	1	C	E	E	18	9	12	19
11	6	3	2	C	D	D	15	6	8	15

did not have any neurological symptoms except varying degree of pain depending on lesions involved. At the time of admission, there were 4 patients with concomitant pulmonary tuberculosis, and patients with concomitant liver cirrhosis or diabetes were noted in 2 cases.

Pain level

The pain level steadily and gradually decreased throughout the follow-up period in all 11 patients. The preoperative VAS averaged to be 7.18 (range, 4-10). It decreased significantly to an average of 1.45 at final follow up ($p < 0.001$) (Table 2).

Neurological status

Before surgery, three patients were classified as Frankel type B, four as Frankel type C, and four as Frankel type D. All of these patients improved after the second stage operation. Over the entire follow-up period, the Frankel types of these patients were maintained (Table 2).

Radiological assessment

On plain radiographs, radiologic evidence of stable bony fusion at the infected anterior site was observed in all patients. Bony fusion was observed on average of 6.6 months after the second stage operation. The mean kyphotic angle was corrected from 17.8° to 9.8° after surgery. In the most recent follow-up, the mean kyphotic angle was 12.3°, a loss of correction of 2.5°. We also analyzed the predicted final deformity angle using the simple formula by Rajasekaran (final angle of gibbus deformity = $5.5 + 30.5 \times$ initial vertebral body loss)¹¹ (Table 2).

Complications

One case was complicated by pneumonia. But, there was no loosening of instrumentation or recurrence of spondylitis.

Discussion

In Korea, the incidence of active pulmonary tuberculosis is average 10.1 cases in 100,000, and the incidence of new pulmonary tuberculosis is shown to be still high in the young adults. Tuberculous spondylitis comprises of 2-3% of the entire tuberculous diseases. Among them, tuberculosis in the bone and joint is known to consist of 50% of the cases. It has also been reported to develop primarily in the lower thoracic and thoracolumbar region¹⁰. Indications of surgical treatment include cases with the abscess in the anterior of the vertebral body that compresses adjacent soft tissues and thus induces neurological symptoms, in cases with unstable spines, the cases with severe neurological impairment, the cases with neurological impairment that do not improve after the administration of anti-tuberculous medication for 6 months⁸. As for surgical treatment for tuberculous spondylitis, posterior fusion was introduced by Hibbs⁴ in 1911. Posterior fusion has the advantage having simple technique. Since bone graft is performed in the area without any lesion, it has the advantage of a good fusion rate. However, it is impossible to remove directly the causality of cord compression and thus having shortcoming of recurrent inflammations in many cases¹². Since 1934, Ito et al.⁶ described an anterior approach to the lumbar vertebral area and described radical debridement and bone fusion. Good outcomes of anterior debridement and bone graft started to be reported in 1960 by Hodgson and Stocks' breakthrough improvements on the treatment method of spinal infection⁵. The advantages of anterior debridement and bone graft are that lesions are removed directly and decompressed, the defect area caused by bony destruction is corrected directly by performing bone graft.

With this remarkable results, the anterior debridement and bone graft became the standard of surgical treatment for tu-

berculous spondylitis. However, a shortcoming of anterior bone graft is that, the sagittal alignment is lost with time after the surgery in cases with invasion of 2 or 3 vertebrae. When more than two vertebrae are involved, anterior debridement and bone graft leads to a great defect in the anterior structures causing spinal instability. This may lead to kyphotic deformity. Therefore, the anterior debridement and bone graft can not prevent the collapse of vertebral body when 2 or more vertebrae are involved. Bailey et al.¹⁾ recommended that posterior fusion be combined with the anterior debridement and bone graft in such cases. Kemp et al.⁷⁾ reported good results when posterior fusion was done in the case of spinal instability that involved 2 or more vertebral bodies or posterior elements destruction. Fountain et al.³⁾ have pointed out that the causes of such change after the correction of kyphotic angle are due to the movement of grafted bone or fracture, depression within the spinal body, continuous maintenance of tuberculosis, insufficient bone graft, in children, and overgrowth of the posterior area, etc. Due to these reasons, Rajasekaran¹⁰⁾ suggested that second stage posterior fusion should be performed 6-12 weeks after performing anterior debridement and fusion to prevent the increase of kyphotic angle after the surgery. Moreover, he predicted the final angle of gibbus deformity allowing the surgeon to select the patients who will require radical resection to prevent a severe kyphosis. Particularly, in the cases when the invasion of the spine is multicentric, the length of bone supporting the anterior and middle column defect has to be long which might lead to a high failure rate of bone graft. It is very difficult to maintain the corrected angle of kyphosis. High risk factors that are associated with increased kyphotic deformity after anterior fusion are grafted bone supporting more than two intervertebral discs, lesions in the thoracic or thoracolumbar vertebral area, and the case with severe initial kyphotic deformity prior to surgery. For the fusion in tuberculous spondylitis, several types of graft materials can be used such as rib, iliac crest, and allograft. Most commonly, autogenous iliac crest or ribs are used for intervertebral fusion. When a rib graft is used alone, especially when two or more segments are involved, complications such as correction loss, nonunion, and inadequate stability may occur more frequently compared with iliac crest⁹⁾. But added posterior instrumentation can prevent these complications by providing structural support. Careful follow up evaluation of patient who undergo underwent anterior fusion is needed to decide whether posterior fusion is required. In our study, all study subjects had lesions developed in the lower thoracic vertebral area and the thoracolumbar area. These cases have variable degree of normal kyphotic angle, thus the mechanical stress on the grafted bone is high, with, the possibility of high incidence of failure of grafted bone. Hence, until the bone

grafted to the anterior area of the spine is fused successfully, the instrumentation stability in the posterior area is usually added obtain good results. There are several limitations in this study as being a retrospective, uncontrolled review of the clinical outcome of two-stage operation in a small sample of patients. A randomized controlled trial in large population is required to elucidate more clearly the benefits and risks of our treatments.

Conclusion

In the treatment of tuberculous spondylitis in the thoracic and thoracolumbar area, the two-stage operation consisting of the anterior fusion using a rib graft and additionally performing the fixation on the posterior instrumentation is considered as a stable and effective method that can prevent the kyphotic deformity and instability of the spine.

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Commentary

The authors have presented a nice series of patients with 11 thoracic tuberculous spondylitis cases. They stressed successful outcome with combined anterior and posterior

approach. Ribs were used as a graft material without instrumentation anteriorly and then posterior instrumentations were done to augment the structural support. What impressed me most was they filled the anterior debridement gap with this autograft material, which spans more than 2 segments. The concept of using autograft, segments longer than 2 and avoiding anterior instrument material (foreign body) right next to infected tissue can not be usually available with most clinical settings. They showed us these are possible with combined approach and rib graft material as a good

treatment modality. However, I wish there were more detailed elaboration on the technical aspect of the procedure-like on how the ribs were harvested, how they filled the debridement gap, how much ribs were needed to filled the gap. I thank the authors for showing this particular graft material for resilient tuberculous spondylitis.

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