ABSTRACT

Objective: To evaluate and compare the effectiveness of the modified Hong Kong procedure performed with and without additional instrumentation, in terms of improvement in neurological and kyphotic disabilities in spinal tuberculosis.

Study Design: Quasi-experimental study.

Place and Duration of Study: Department of Orthopaedic Surgery, Rawalpindi General Hospital, Rawalpindi, from June 1999 to May 2006.

Methodology: Sixty-two cases of tuberculosis of spine, underwent modified Hong Kong procedure. In 44 cases (group A), no instrumentation was used, while in 18 cases (group B), additional anterior instrumentation in the form of narrow Dynamic Compression Plate (DCP), fixator spinae or Moss Miami instrumentation was used. Changes in the neurological status (following Frankel classification system) and kyphotic angle (as measured on X-ray) after an average of 18 months post-operative follow-up were evaluated and also compared between the two groups using t-test.

Results: There were 23 males and 39 females with mean age of 31.6±17.1 years. An average neurological improvement of 1.1±0.7 Frankel grade was achieved overall, which was statistically significant (p < 0.05). There was no significant difference in degree of neurological improvement on comparing the two groups (p = 0.272).

In group A patients, mean improvement in kyphotic angle of 2.8º±5.5º was achieved. In group B patients, treated with additional instrumentation, an average 8.9º±7.6º correction was recorded. The difference in improvement between the two groups was statistically significant (p < 0.05).

Conclusion: Modified Hong Kong procedure alone for spinal tuberculosis (TB) was successful in producing significant neurological recovery. The addition of stabilization instruments achieved better and maintained correction of kyphosis.

Key words: Spinal tuberculosis. Spinal surgery. Kyphosis. Neurological deficit.

INTRODUCTION

Tuberculosis of the vertebral column, first described by Percival Pott and since associated with his name, is a slowly developing disease, characterized by pain, spinal deformity (mostly kyphosis) and, occasionally, paralysis.1

Pakistan ranks sixth among the 22 high-burden tuberculosis countries worldwide according to the World Health Organization (WHO) Report 2007. With an incidence of 181 per 100,000 population every year, approximately 297,000 people in Pakistan (primarily adults in their productive years) develop TB.2

Approximately 3% of overt cases have involvement of the skeletal system, with spinal tuberculosis being the most common form of skeletal tuberculosis, comprising approximately 50% of all such cases. In underdeveloped and some developing countries, where malnutrition and overcrowding prevail, tuberculosis of the spine is relatively common.3

Despite achieving the eradication of micro-organism with medical treatment, kyphosis and neurological impairment are the major problems requiring surgical intervention.4 Various surgical approaches have been advocated including anterior spinal decompression and grafting (modified Hong Kong procedure) with and without instrumentation in the treatment of spinal tuberculosis.5 The advantages of anterior debridement and arthrodesis of spine include direct access to and excision of the focus of disease, with the ability to decompress the cord, if necessary; rapid healing by osseous union; and a decreased tendency for progressive collapse of the kyphosis.

The objective of the study was to evaluate and compare the effectiveness of the modified Hong Kong procedure, performed with and without instrumentation, in terms of improvement in neurological and kyphotic disabilities.

METHODOLOGY

This study was conducted on consecutive patients with tuberculosis of lower cervical, thoracic and lumbar spine who underwent surgical treatment at the Department of Orthopaedic Surgery, Rawalpindi General Hospital, Rawalpindi, between June 1999 to May 2006.

Inclusion criteria were patients who underwent anterior spinal surgery for tuberculosis of spine and in whom tuberculosis of spine was confirmed histopathologically.
after surgery. Exclusion criteria were patients suffering from concurrent illnesses, unfit for surgery and those lost to follow-up.

Patients presenting with back pain, deformity, weakness of limbs and constitutional symptoms (anorexia, weight loss, and evening fever) were asked about any past history of pulmonary, abdominal or urogenital tuberculosis. In examination, special attention was given to spine and neurological findings in limbs along with pulmonary and abdominal signs of tuberculosis.

Neurological examination was performed on each patient with the use of the classification system of Frankel et al. According to this system, grade A indicates a complete spinal cord injury. Grade B assigned on spinal cord injury with only the presence of sensation. Grade C assigned on an injury with the presence of motor function but not useful. Grade D was given to an injury with useful motor function. Grade E was an injury with no impact on neurological function.

Laboratory investigations included Erythrocyte Sedimentation Rate (ESR) and Montoux test and liver function tests to detect drug induced hepatitis. Pre-operative X-rays and CT scans were performed in all cases. The kyphosis was measured on lateral radiographs.

The diagnosis was made on clinical, laboratory and radiological investigations. Diagnosis was confirmed on histological examination of samples taken during the surgery. Patients were started on anti-tuberculosis 4-drug therapy two weeks before surgery.

The modified Hong Kong procedure comprising of anterior debridement, spinal decompression and interbody arthrodesis with strut bone grafts was the standard practice for the treatment of spinal tuberculosis. In order to improve the results, keeping in view the international standards, the modified Hong Kong procedure was overtime supplemented with different forms of anterior instrumentation, beginning from 2002. In 44 patients, modified Hong Kong procedure alone was performed. These were designated as group A. Eighteen patients were managed with modified Hong Kong procedure plus anterior instrumentation. These were designated as group B. The anterior instrumentation included Dynamic Compression Plate (DCP), Moss Miami instrumentation, fixator spiniae and DCP with cage.

With the destruction of 2 or less than 2 vertebrae, one healthy vertebrae above and one below were incorporated for spinal instrumentation. With the destruction of more than 2 vertebrae, 2 healthy vertebrae above and 2 below for spinal instrumentation were tried to be incorporated.

For the modified Hong Kong procedure in both groups, strut grafts was used to fill the defect in spine after the debridement of disease vertebrae were taken from either fibular graft or resected ribs or anterior iliac crests.

On the 1st operative day, patients were made to sit using a thoracolumbar orthosis or a hard cervical collar. The neurological status determined the degree of mobilization. The orthosis was discarded after clinical and radiological evidence of fusion had been obtained, generally in about three months. Anti-tuberculous therapy was continued for at least one year with necessary modifications according to individual patient’s response.

Patients were followed up monthly for three months, three monthly for one year and six monthly thereafter. During follow-up, X-rays of the involved vertebrae and neurological examination was performed at each visit. Radiographs of spine were obtained until the bony union was evident. Change in angle of kyphosis was assessed following the same procedure as adopted pre-operatively.

Data was computed on the statistical software, SPSS version 13, for Windows. Descriptive statistics including frequencies, mean and standard deviation was calculated for all continuous variables and proportions were calculated for categorical variables. Differences between pre-operative and postoperative kyphosis angle and neurological improvement was measured using paired t-test. Differences in the postoperative kyphotic and neurological improvement between the two groups was measured using unpaired t-test. Level of significance was taken as 5%.

RESULTS

There were 23 males and 39 females in the study with a male to female ratio of 1:1.7. The average age of patients was 31.6±17.1 years, (range from 3 years to 75 years). More than 50% of the study population was young adults in the age group of 20 to 40 years.

The number of vertebrae affected in individual patients ranged from 1 to 7. Approximately, 10% of patients presented with single vertebral involvement, 73% with 2 and 13% with 3 vertebral involvement. The thoracolumbar region was most commonly affected. Details of frequency of vertebral involvement sites are presented in Figure 1. The average operative time for modified Hong Kong procedure was 2.53 hours (range 2:33 to 4:00 hours) and for modified Hong Kong procedure with anterior instrumentation was 3:41 hours (range 3:30 to 5:00 hours).

At 18 months, the neurological recovery recorded in the patients was compared to pre-operative status using Frankel system of grading. The maximum number of patients (n=26) presented with grade D involvement. Four patients each were assessed as Frankel grades A and B and 14 patients each as Frankel grades C and E.
Changes in individual cases are presented graphically in Figure 2. The overall mean improvement in neurological status following surgery, according to Frankel system of neurological grading, was 1.1±0.7 grades, which was statistically significant (p < 0.05). Comparison of neurological improvement between the two groups, A and B, showed that there was no significant difference following the two different surgical approaches (p=0.272).
Pre-operative angle of kyphosis in all cases ranged from 0° to 60° with average of 27.8±12.7°. At 18 months, post-operative average angle of kyphosis was 23.6±12.3°. The average overall improvement in kyphotic angle was 4.5±6.7°, which was statistically significant (p < 0.05).

On evaluating the two groups separately, it was seen that in group A patients, the pre-operative average angle of kyphosis was 28.3±11.6°, postoperatively, the average angle of kyphosis was 25.6±1.2°. The average correction of kyphosis achieved was 2.8±5.5° i.e. 9.9% correction of angular deformity, which was significant (p < 0.05).

In group B patients, pre-operative average angle of kyphosis was 26.4±15.4°. Postoperatively, the average angle of kyphosis was 18.5±13.8°. The average correction of kyphosis in group B was 8.9±7.6°, i.e. 33.7% correction was achieved, which was significant (p < 0.05). Some examples of the surgical interventions are depicted in Figure 5 and 6.

Comparison of reduction of kyphotic deformity between the two groups, A and B, showed that there was a statistically significant difference following the two different surgical procedures (p < 0.05) as shown in Figure 3 and 4.

Recurrence of psoas abscess occurred in 2 patients (3%). They were drained later with smaller incisions. Loosening of cortical screw occurred in 2 cases, where plate and screw system was used. The loosened screws were removed later on. Anti-tuberculosis therapy induced hepatitis in one patient (1.6%). He was switched over to modified ATT.9

DISCUSSION

Although rare in the West, tuberculosis is still endemic in underdeveloped and overpopulated countries. In surgical management of such cases, the insertion of strut grafts after debridement of diseased vertebral bodies provides some support anteriorly, but is usually insufficient.10 When two or more than two levels are involved, the grafts frequently fail or are resorbed. This requires added instrumentation, anterior, posterior or both, for additional support.11,12 Anterior approach in all the cases is the preferred approach for the typical form of spinal tuberculosis, which involves the body of vertebra in 92% cases.13

Spinal tuberculosis is most frequent at the dorsolumbar junction i.e. 9th thoracic vertebra to 4th lumbar vertebra as seen in this study.14-19

In the cervical or upper thoracic spine, the spinal cord is prone to compression, as the spinal canal is relatively small compared to its contents. Because of the mobility of the cervical spine, pain is usually a marked symptom, and anterior surgery generally provides dramatic relief. 4

The lumbosacral region may accommodate tuberculosis better than other areas of the spine as particular anatomical features make tuberculous infection in this region amenable to conservative treatment. A natural lordosis, with the normal axis of weight-bearing, lying posterior to the centre of the vertebral bodies, retards the tendency of anterior disease to cause a kyphosis. Hence, much destruction of a vertebral body is required before a kyphosis is induced.

In a study by Rajasekaran et al.,19 it has been shown that final kyphotic angle correlates well with the vertebral body loss in thoracic and lumbar vertebrae lesions. In thoracic spine, without surgery, final angle of deformity was 30-35° with loss of one vertebrae whereas in lumbosacral region, he reported that the kyphotic angle per vertebrae loss was 4.9° in adults.18 In the presently reported patients too, a greater deformity was seen in disease affecting the thoracic spine as compared to lumbar region, the average angle of kyphosis of 35° in thoracic region as compared to 21° in lumbar spine.

In the present study, after anterior arthrodesis, narrow DCP alone was used for stabilization in 7 cases. We found it to be economical and to provide satisfactory stabilization, although there was loosening of cortical screw in 2 cases. Its use for anterior stabilization has also been reported by Cengiz Yilmaz et al.10

Moss Miami instrumentation was also used in 8 cases. It provided better stabilization and maintenance of correction of kyphosis than DCP. The fixator spinae system is relatively new,8 and with the limited number of patients, we found it a stable support.

Unlike other infections, metal can be placed in area of tuberculous infection after thorough debridement. Oga et al. found that Mycobacterium tuberculosis produced much less biofilm on stainless steel disks than did other bacteria.11 They also found abundant colonies of Staphylococcus epidermidis under the biofilm on the metal surface compared with very few colonies of Mycobacterium tuberculosis.11 These studies were further confirmed clinically showing that even in the presence of metallic foreign body, the disease responds well to anti-tuberculous therapy.20 In 18 patients, in whom metal was used for stabilization after anterior debridement and arthrodesis, all showed clinical and radiological evidence of sound fusion. In 18 months follow-up, none of the cases showed any evidence of infection related to metal used.

In the hands of its originators, Hodgson and Stock, anterior spinal arthrodesis definitely proved to be helpful in inhibiting the progression of deformity.21 In a series of 271 patients, who were treated conservatively, a mean increase of 10 degrees in the angle of kyphosis at 16 months was reported, whereas in patients who had surgical intervention of debridement, the increase in the mean angle was reduced to 4 degrees and in those who had anterior spinal arthrodesis, there was no deterioration or increase in the mean angle.21
The present experience was favourable at 18-month follow-up in group A patients who underwent modified Hong Kong procedure. The average correction of kyphosis was 2.8 degrees i.e. 9.9% improvement. In the group B patients, when anterior spinal arthrodesis was accompanied by anterior stabilization with instrumentation, the average correction obtained in last follow-up was significantly better at 8.9 degrees i.e. 33.7% correction.

Yilmaz et al., using plate and screw system and Kaneda instrumentation, combined with anterior spinal arthrodesis, produced 64% correction;10 while Louw combined posterior instrumentation with anterior spinal arthrodesis, produced 44.8% correction in 14 months follow-up.22 He used Harrington compression system or internal fixator in adults and Luque rectangle with wires in children.

Iliac crest grafts have been preferred to rib graft by many surgeons.23-25 Patients who had rib graft had slow rate of union and the graft often failed to incorporate since the end-bearing surface was small, leading to slippage of the graft.11 We also generally resorted to iliac crest grafts, which reported favourably.

Neurological recovery after anterior debridement and arthrodesis was remarkable both with and without anterior instrumentation. Neurological improvement started on the 1st postoperative day in 60% of cases and maximum recovery took place during the first 2 weeks; neurological improvement continued for an average of 2.5 months (ranging from 1 month to 4 months). Eighty five percent of the patients with neurological deficit (i.e. groups A to D) showed improvement to various degrees. However, patients with neurological deficit of more than 6 months duration showed the least favourable results.12

CONCLUSION

The modified Hong Kong procedure for tuberculosis of the spine was highly successful in producing significant neurological recovery, but correction of kyphotic deformity in two or more vertebrae disease was not satisfactory. Better and maintained correction of kyphosis can be achieved by adding stabilization instruments such as DCP, Moss Miami, fixator spinae and cages etc.

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