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Extrapleural anterolateral decompression in tuberculosis of the dorsal spine

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We reviewed 64 anterolateral decompressions performed on 63 patients with tuberculosis of the dorsal spine (D_1 to L_1). The mean age of the patients was 35 years (9 to 73) with no gender preponderance. All patients had severe paraplegia (two cases grade III, 61 cases grade IV). The mean number of vertebral bodies affected was 2.6; the mean pre-treatment kyphosis was 24.8° (7 to 84). An average of 2.9 ribs were removed in the course of 64 procedures. The mean time taken at surgery was 2.45 hours when two ribs were removed and 3.15 hours when three ribs were removed. Twelve patients (19%) showed signs of neurological recovery within seven days, 33 patients (52%) within one month and 12 patients (19%) after two months; but six patients (10%) showed no neurological recovery. Forty patients were followed up for more than two years. In 34 (85%) of these patients there was no significant change in the kyphotic deformity; two patients (5%) showed an increase of more than 20°.

Spinal tuberculosis (TB) affects the body of the vertebrae in about 98% of cases, hence surgical decompression when needed should be anterior.[1] Laminectomy is advocated with posterior complex disease and intraspinous tubercular granuloma presenting as spinal tumour syndrome.[2] In the dorsal spine, anterior decompression can be performed through either a transthoracic, transpleural approach, or an extrapleural, anterolateral approach. The transthoracic approach has been described and studied by various authors.[3-6] The extrapleural anterolateral approach has not been similarly analysed. We present an analysis of 63 consecutive patients with dorsal spinal tuberculosis with neurological deficit, decompressed by way of an extrapleural anterolateral approach.

Patients and Methods

We have treated 63 patients with spinal tuberculosis with neurological deficit, using the 'middle path regimen'[2]; 64 surgical decompressions were performed through an extrapleural anterolateral approach. The mean age of the patient was 35 years (9 to 73). There were 32 men and 31 women. Two patients had grade III paraplegia and 61 grade IV paraplegia.

The indications of surgery were: 1) deterioration of neurological deficit during conservative treatment (n = 12); 2) the development of a neurological deficit while on anti-tubercular therapy (n = 8) and 3) no neurological improvement on anti-tubercular therapy (n = 43). The upper dorsal spine (D_1 to D_6) was affected in 17 patients. 39 patients were affected in D_7/L_1 regions. In seven patients there was involvement of several adjacent vertebrae (four or more vertebral bodies), involving both the upper and the lower dorsal spine; 21 patients had three, 32 patients had two and three patients had disease in a single vertebral body (mean = 2.6). Eighteen patients had active pulmonary tuberculosis at the time of presentation and 48 patients (80%) had a haemoglobin level of 8 gm% or less. No patient tested positive for HIV. The mean pre-treatment kyphus was 24.8° (7 to 84).

All the patients underwent extrapleural, anterolateral decompression from the left side (Fig. 1). Repeat anterolateral decompression was done from the right side in one patient. Three ribs were removed in 52 patients and two ribs were removed in seven patients. In two procedures, four adjacent ribs were removed; in another two patients with skip lesions, four ribs were removed with an intact rib left in between. In 61 anterolateral decompressions, the lesion was opened through a semicircular incision (Fig. 2a). In three patients a T-shaped incision was used (Fig. 2b) with posterior stabilisation by Hartshill instrumentation in one. Pus was found during surgery

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Fig. 1

An axial CT scan showing adequate anterolateral decompression from the left side.

Fig. 2a

Standard semi-circular incision of anterolateral decompression. The left is from the initial surgery and the right from repeat surgery.

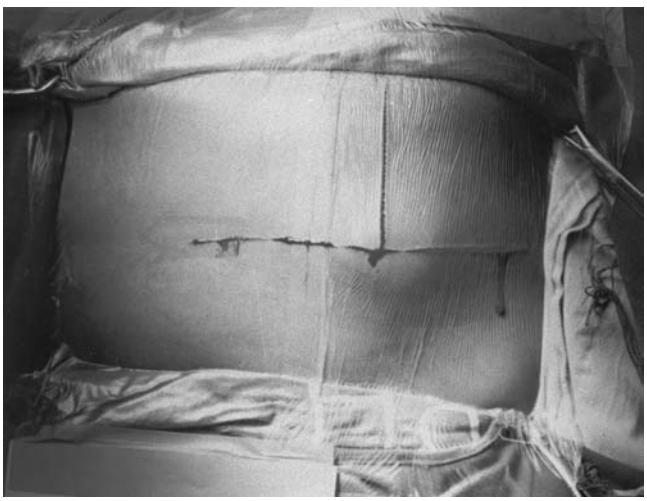

Fig. 2b

T-shaped incision of anterolateral decompression. The patient is in right lateral position.

(wet lesion) in 57 patients; six patients had dry lesions. The mean time taken to perform a decompression was 2.45 hours when two ribs were removed and 3.15 hours when three ribs were removed. Removal of the second, third, 11th and 12th ribs was easier compared with other ribs. The mean blood transfusion required was 2.6 units.

No patient required observation in the intensive care unit following surgery. Oxygen support was not required for more than six hours and no patient required chest tube drainage. All patients were nursed in bed with regular turning at two-hourly intervals. Parenteral antibiotics to cover against both Gram-negative and Gram-positive organisms were given six hours before surgery and for 48 hours after surgery. All the patients received uninterrupted multi-drug anti-tubercular therapy for 12 to 18 months.

Operative technique. The patients are placed in the right lateral position. A semi-circular incision is used starting 7 cm proximal to the apex of the kyphus in the midline. It is curved distally and laterally to a point 7 cm away from the midline on the left at the apex of the kyphus, to 7 cm distal in the midline (Fig. 2a).

A T-shaped incision starts in the midline for about 14 to 15 cm with the apex of the kyphus as its centre. The transverse cut is made to about 8 cm from the midline at the apex of the kyphus on the left side (Fig. 2b). The skin, subcutaneous tissue and the deep fascia are incised in the same line. In both approaches this creates a full thickness fasciocutaneous flap. The trapezius, latissimus dorsi and periscapular muscles are divided in a T-shaped manner.

The ribs to be removed are identified and marked. The periosteum of each rib is incised in the long axis of the rib and elevated. Since the intercostal muscles are attached obliquely to the ribs, the dissection is performed in the axilla between muscle fibres and the rib. Thick periosteum in the adolescent, facilitates its removal. The rib is divided lateral to its angle, about 8 cm away from the tip of the transverse process using bone cutting forceps, and is freed

to its head. The paraspinal muscles are divided transversely in the line of each rib. A cleavage is created between the transverse process and the head of the rib dividing the costotransverse ligaments. The transverse process is removed from its base and the rib including its head is detached.

After the removal of the middle rib, adjacent ribs can be removed in a similar manner. The intercostal artery and the nerve, leading to the intervertebral foramen, are ligated and divided 2 inches away from the spinal foramina. The lowermost intercostal nerve is spared when four of the lower six ribs are removed. At this stage, pus may trickle from a pre- or paravertebral abscess. The lateral and anterior surface of vertebral body is exposed and a blunt spatula is inserted anterior to the vertebral body. Any loose bony sequestra, sequestrated disc tissue, pus and granulation tissue are removed. The vertebral body is breached at the junction of the pedicle and the transverse process and the bone is removed bit by bit until the lateral and anterior wall of the spinal canal is decompressed. The spinal cord is exposed for the whole length of three vertebrae (i.e. 5 cm x 1 cm). Patency of the spinal canal is confirmed by inserting an infant feeding tube proximally and distally. A bone graft may not be required in every case but when it is, a slot is made in the proximal and the distal healthy vertebral body. The kyphos is corrected manually by applying pressure at its apex. Two ribs of appropriate length are fitted into the gap which is created. When the pressure on the back of the spine is released, the graft is locked in position. The lungs are inflated to check that no inadvertent pleural tear has been made before wound closure. No chest drain is inserted.

Fig. 3a Fig. 3b

Lateral radiographs at a) six months and b) 2.5 years follow-up of dorsal spine tuberculosis (D_4 to D_6) showing final increase in kyphosis by 3°.

Results

Twelve patients showed the first signs of neurological recovery within seven days; 33 showed signs of recovery at one month. The 18 patients who showed no sign of neurological recovery one month after surgery underwent myelography which revealed no block in 17 patients. This indicated that an adequate surgical decompression had been achieved. The single patient with a myelographic block required repeat surgical decompression. Twelve of these patients showed the first sign of neurological recovery after two months while in six patients there was no recovery at one year. A total of 54 patients had an excellent neurological recovery (from grade III or IV, to grade I or normal); three patients had partial recovery (from grade IV to grade II). Forty patients were followed up for more than two years. In 34 (85%) of these, there was no significant change in the kyphosis (Fig. 3) but in four (10%) there was an increase in the angle of kyphosis between 11° and 20°, and two (5%) had an increase of more than 20°.

Discussion

In osteoarticular tuberculosis the areas of bone which are infiltrated with granulation tissue and are ischaemic but not necrosed, will recover and reconstitute under multi-drug therapy only. Surgery, in addition to chemotherapy, is essential for areas of necrosis that are past recovery and must be assumed to harbour tubercular bacilli, and for complications such as paraparesis and spinal deformity. While performing surgical debridement, all pus, caseous material and sequestra should be removed. Removal of unaffected and viable bone is restricted to that which is required in order to provide adequate access to the infective focus and to decompress the spinal canal.[1] By contrast radical surgery (the Hong Kong procedure) is defined as excision of bone until healthy bleeding cancellous bone with suitable surfaces for reception of bone graft is exposed. The marginal correction of the kyphus and healing of the lesion was reported by Upadhyay et al[6] in a comparative series of either radical or debridement surgery in a total of 112 patients with a mean follow-up of 15.3 years. However most of the cases in their series had disease affecting two vertebrae with minimal neurological deficit. The disadvantage of the radical procedures, particularly when three or more vertebrae are involved, is the large gap that remains to be bridged after resection. Graft-related complications such as displacement, breakage and late recurrence of a kyphus have been reported in 41% to 46.4% of cases.[7,8] When the graft spans two or more vertebral bodies, supplementary posterior instrumentation is recommended in order to prevent deterioration of the kyphosis.[9] Radical resection of the lesion in children destroys the anterior growth plate and

limits the capacity for remodelling. It is not recommended in that situation.[10] A relatively stable spine is left after debridement surgery and graft-related complications are minimised. A rib graft can be added for correction of a kyphosis.

Patients with spinal TB are anaemic, often with evidence of healing pulmonary TB, have paretic or paralysed intercostal muscles with compromised pulmonary function and have moderate to severe kyphosis. Thoracotomy in such cases is a procedure of some magnitude and should not be undertaken lightly, even where adequate surgical facilities exist. It certainly should not be undertaken where surgical facilities are poor.[3] In a series of 91 patients treated by thoracotomy seven died with respiratory failure.[11] In patients with co-existent pulmonary tuberculosis and compromised respiratory function, thoracotomy may aggravate the symptoms. Major surgery in the presence of HIV infection has a high rate of complications and is not normally advised.[12]

Surgical decompression is better tolerated in patients with TB of the cervical spine and quadriplegia than in those with TB of the dorsal spine with paraplegia. It seems that thoracotomy adds more morbidity to an already compromised pulmonary function, than does direct pressure on the cervical cord.[11] Adendorff et al[5] have shown that when paraplegia is graded as moderate, there is a mortality of 6%, but 11% when it is graded as severe, after thoracotomy.

Alexander developed an operation with Dott of Edinburgh in which he opened the paravertebral abscess and decompressed it from the front after removal of the posterior end of three or more ribs, their corresponding transverse processes and pedicles, and an adjacent portion of the vertebral bodies.[13] Capener[14] described the lateral rhachotomy, in which the purpose was to deal directly with the cause of the cord compression.

Menard (1900) as quoted by Capener[14] used a 5 to 7 cm long transverse incision over the rib, which seemed to correspond with the apex of the kyphus. Tuli,[2] Dott,[13] Capener,[14] and Seddon[15] all described a semicircular incision, concave medially, for decompression of the spinal cord. The incision was modified to a T-shaped incision in our series so that the spine could be instrumented, if required. Spinal instrumentation is required in cases where 1) the pretreatment kyphus measures 60° or more; 2) the spine is mechanically unstable or 3) the whole of a vertebral body has to be removed as a separate sequestrum. Capener[14] used a right-sided incision, with the patient in the prone position. Hodgson et al[3] preferred to work from the left side while performing a transpleural anterior decompression because the aorta forms a useful landmark and on the right side the inferior vena cava and the azygos vein are more easily damaged.[3]

The right side is indicated if an anterolateral decompression has already been performed from left or if imaging suggests predominant destruction of the right pedicle and the right side of the vertebral body.

Rib selection. Removal of three ribs gives adequate exposure for anterolateral decompression. The selected ribs should correspond with the number of dorsal vertebra involved. In two-vertebra disease above D_{10}, a lower rib is taken as the third rib to be removed. The second to tenth ribs are attached to the upper border of the corresponding vertebra and to lower border of vertebra above. In two-vertebra disease, removal of the same number of ribs exposes the upper healthy vertebra and the upper half of lower affected vertebral body. The removal of the lower third rib provides adequate exposure to the lower diseased vertebral body. In D_{10} to D_{12} vertebral disease, removal of two ribs usually provides adequate exposure. Except for the first rib, all ribs can be removed including the 12th. A maximum of four consecutive ribs can be removed. In such instances one intercostal nerve out of four should be preserved below D_6, to prevent the development of a paralytic hernia. Removal of four ribs is seldom required. The senior author (AKJ) has removed four consecutive ribs only on two occasions. Pre-operative AP radiographs are necessary to see the number of ribs. If ribs are crowded separation may be difficult at the apex of the kyphosis. The middle rib should be removed first because its head separates easily from the diseased vertebra.

Hodgson et al[3] reported complete neurological recovery in 74% of their patients, partial recovery in 10%, no recovery in 6%, and 8% died after transthoracic transpleural anterior decompression in 100 consecutive patients. Adendorff et al[5] reported 80% recovery in moderate paraplegia and 48% in severe paraplegia after transthoracic, transpleural decompression. Moon et al[16] reported 84.5% recovery in 33 patients with TB of the dorsal spine. Using extra pleural anterolateral decompression, Tuli[2] reported 69% complete recovery, 14% partial recovery, and 17% having no or poor recovery in a series of 63 patients. We observed 86% complete recovery, 4.5% partial recovery and 9.5% with no recovery. The rate of neurological recovery in our series is comparable with that after transthoracic, transpleural radical anterior decompression in other studies.

Behaviour of kyphosis. Upadhyay et al,[6] in two-vertebra disease, reported marginally better correction of the kyphosis following radical resection as compared with debridement. Rajasekaran and Soundasapandian[7] reported 41% deterioration of kyphosis during a long-term follow-up of 81 patients, in 22% the kyphosis increased by more than 20°.[7] Chen et al[9] (n = 50) achieved correction of kyphosis by only 10° (1 to 44) after anterior radical resection with instrumentation and 22% of their patients showed deterioration of the kyphosis.[9] The kyphosis improved or remained static, or deteriorated by less than 10°, in 80% of Tuli's series[2] (n = 104, average vertebral body involvement 2.5). In only 20% did the kyphosis worsen by more than 10°.[2] In our series the kyphosis remained static or improved in 60% of patients and deteriorated by less than 10° in 25%. The kyphosis increased by 10° to 20° in 10% and by more than 20° in only 5%.

An associated posterior instrumentation was found to be difficult with the standard semicircular incision. We modified the incision to a T-shape to give adequate exposure for anterolateral decompression. Simultaneous instrumentation was performed by us in one case.

Anterolateral decompression is not free of problems. There is a long learning curve and one may find difficulty in graft placement. It is, however, basically simple and safe; by not opening the pleural cavity, pulmonary complications are few. Even a debilitated patient can be operated upon with little post-operative morbidity. The determining factors for a particular approach are preference, the technical skill of the surgeon, the availability of surgical and intensive care facilities and the pulmonary reserve of the patient.

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