

Transthoracic approach for lesions involving the anterior dorsal spine: A multidisciplinary approach with good outcomes

ABSTRACT

Introduction: Anterior approach provides excellent visualization and access to the anterior thoracic spine. It may be used alone, in combination with a posterior midline approach or in a staged or sequential fashion.

Aims: To analyse our institutional experience in transthoracic approaches and to determine the safety and benefit of this approach in our patient series.

Materials and Methods: A total of 16 patients were operated for varying lesions of body of dorsal vertebra by the transthoracic approach. The study was for a period of 5 years from January 2011 to December 2015. Patients age ranged from 25 to 61 years with an average of 36.4 yrs. There were 7 males and 9 females. In our series 9 patients had Kochs spine, 4 patients were traumatic fracture spine and 3 had neoplastic lesion. Majority of patients had multiple symptoms with backache being present in all patients.

Results: There was one post operative mortality which was unrelated to surgery. One patient had post operative delayed kyphosis. Remaining patients improved in their symptoms following surgery.

Conclusion: With careful coordination by thoracic surgeons, neurospinal surgeons and anaesthetists, the anterior spine approach for dorsal spine is safe and effective. Adequate preoperative evaluation should stratify the risk and institute measures to reduce it. Accurate surgical planning and careful surgical technique are the key to yield a good outcome and to reduce the risk of complications.

Key words: Anterior approach for thoracic spine; thoracotomy for dorsal spine lesion; transthoracic approach for thoracic spine.

Introduction

Surgical approach to the spine can be classified into anterior, posterior, or combined approach.^[1] Each has its role and the choice of the best approach depends on several factors, such as the level of the disease in the spine, extent of the lesion, and need for spinal reconstruction or stabilization.^[1] The anterior approach presents several advantages such as direct access to the lesion, less surgical bleeding, low risk of infection, and use of shorter segment fixation devices.^[2] Anterior spine exposure may be used alone, in combination with a posterior midline approach, or in a staged or sequential fashion.^[1] Even though anterior approaches have many benefits in selected patients,

they have surprisingly received very less attention in literature. We did this study to analyse our institutional experience in transthoracic approaches and to determine the safety and benefit of this approach in our patient series.

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Subjects and Methods

The patients in our study were admitted in neurosurgery ward of a tertiary care hospital in Mumbai. A total of 16 patients were operated for varying lesions of body of dorsal vertebra by the transthoracic approach. The study was for 5 years from January 2011 to December 2015. Patients' age ranged from 25 to 61 years with an average of 36.4 years. There were seven males and nine females. In our series, nine patients had Koch's spine, four patients were traumatic fracture spine, and 3 had neoplastic lesion.

Inclusion criteria

- Pathology involving dorsal vertebral body
- Symptomatic
- Radiological compression of spinal cord.

Exclusion criteria

- Lesions involving the posterior spinal elements
- Spinal deformity
- Asymptomatic patients with no significant radiological compression on cord.

Clinical history and evaluation

A detailed clinical history of previous illness, symptoms, progress and duration of illness was taken. The majority of patients had multiple symptoms with backache (BA) being present in all patients. Other symptoms seen in our series included lower limb weakness (LLW), sensory loss (SL), and bowel and bladder disturbance [Table 1].

Neurodiagnostic studies

All patients were investigated thoroughly for their pathology as well as for anesthesia fitness point of view. Pulmonary function test was performed in all patients to assess lung function in view of intraoperative requirement of one-lung anesthesia.

X-ray of dorsal spine anteroposterior and lateral views was done in all patients. It was used to localize the level of lesion, status of adjacent vertebra, and deformity of spine. Computed tomography thorax was also performed in all patients. Magnetic resonance imaging (MRI) of dorsal spine

with whole-spine screening was done to know the status of cord and evidence of myelomalacia/edema.

Surgical treatment

All patients operated in our series were done in a standardized manner. The following was the standard operating procedure.

Anesthesia

Transthoracic approaches are challenging cases for anesthetists. We have followed a strict protocol for anesthetic induction. All our cases were intubated with double-lumen tube. Central and arterial lines were secured. Bilateral air entry was checked before positioning. Induction and maintenance were done with intravenous propofol. Regular arterial blood gas and PO₂ were monitored. The patient was given one-lung ventilation during exposure of the vertebral body. The deflated lung was expanded every 30 min to prevent microatelectasis. Lung expansion was confirmed before extubation. Good postoperative pain relief was ensured. All our series patients except one were extubated on table. One patient needed ventilation till 30 h postoperatively.

Exposure (thoracotomy)

Semi-lateral position was given in which the right side is up by 45° with the help of pillow and sticking plaster. The help of thoracic surgeon is taken for thoracotomy and exposure. For posterolateral approach, the incision extends from anterior axillary line till 3 cm off midline posteriorly. We use the fifth intercostal space for pathology from upper thoracic spine to T10 and from T10, and lower, use sixth intercostal space. We divide the latissimus dorsi in the direction of the incision and divide the serratus anterior along the same line to the ribs. The periosteum is cut on upper border of rib to protect the intercostal nerve and vessels. We opened pleura. Rib spreader is inserted and space widened. Rib resection is usually avoided and reserved only for extensive exposure. Once the thorax is opened, the right lung is deflated and the spine exposed. Lesion is identified both clinically and C-arm imaging. Lung is retracted anteriorly with moist lap sponge. In some rare cases, the pleura over lateral esophagus are incised to allow for retraction of esophagus anteriorly. Most of the intercostal vessels are preserved and few which come in the way of surgery are tied off. The periosteum over the spine is reflected with elevators to expose involved vertebrae.

Intraoperative procedure

In 14 of 16 cases, the vertebral body was involved and corpectomy was performed. The lesion was excised till the cord was decompressed and pulsatile. The proximal and distal discs were excised and the vertebral body prepared for implant placement. After achieving hemostasis, an expandable titanium cage of appropriate size was inserted and distracted to achieve

Table 1: Symptom distribution of patients according to pathology

Symptom	Koch's	Trauma	Neoplastic	Total
BA	9	4	3	16
LLW	5	4	2	11
SL	4	4	1	9
BBD	2	2	1	5

BA - Backache; LLW - Lower limb weakness; SL - Sensory loss; BBD - Bowel and bladder disturbance

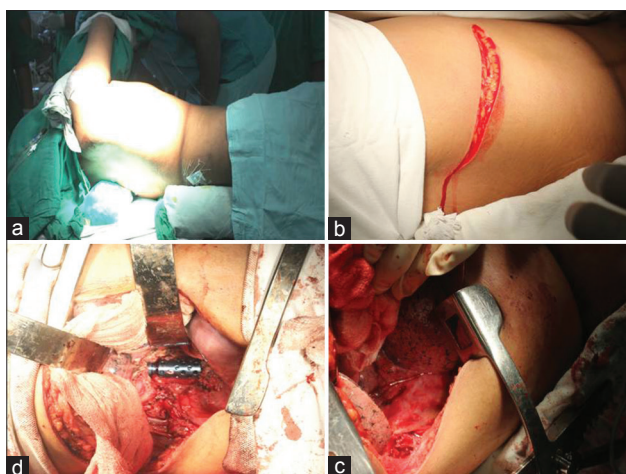


Figure 1: Intraoperative photographs (clockwise) (a) positioning of patient; (b) skin incision parallel to rib; (c) retraction of lung and identification of lesion; (d) after insertion of implant

stabilization [Figure 1]. Before closure, X-ray is taken to see implant placement and spinal orientation [Figure 2].

In the remaining two cases of schwannoma in the posterior mediastinum, the vertebral body was not involved, and hence corpectomy was not needed. These cases were operated in a staged manner. In the first stage, laminectomy with excision of intradural extramedullary (IDEM) component of tumor was done. In the second stage, thoracotomy with excision of posterior mediastinum component of tumor was performed.

Closure

Layered closure of thoracotomy was done with the help of thoracic surgeons. Intercostal drainage (ICD) tube was inserted into the pleural cavity. The ICD tube was connected with an underwater seal bag. The tube was removed when the column stops moving, and auscultation and postoperative X-ray chest showed adequate chest expansion. Sutures were removed on postoperative day 10.

Histopathological examination

Except cases of traumatic fracture spine, the excised specimen was sent for histopathological examination. The lesion was then correlated with the histopathology report and appropriate treatment instituted in the postoperative period.

Results

The mean follow-up period was 1 year. In the surviving patients (15), immediate postoperative X-ray and delayed MRI was done for the status of spinal cord, position of implant, and orientation of spine. The Nurick scale was used to evaluate preoperative and postoperative clinical status. The grading system is as follows: Grade 1 - signs of spinal cord



Figure 2: On table intraoperative X-ray to see status and alignment of implant

disease but no difficulty in walking; Grade 2 - slight difficulty in walking; Grade 3 - walking is difficult and prevents full-time employment, or the ability to undertake housework, but is not severe enough to require aid; Grade 4 - ability to walk only with aid; and Grade 5 - wheelchair bound or bedridden.^[3] The patient details in our series, postoperative results and complications are as mentioned in Table 2.

Complications

Early

One patient needed prolonged ventilation and had to be kept on ventilator for 30 h following surgery because of delayed lung expansion and unsatisfactory blood gas analysis. Postextubation, the patient made an uneventful recovery. One patient had wound infection and gaping of two sutures which healed with daily dressing and antibiotic cover.

Late

One patient developed kyphosis following the first surgery. We have advised resurgery with plate and screw fixation for which the patient is yet to consent. One patient having metastasis of adenocarcinoma succumbed on postoperative day 8. She was also a diabetic with cardiomyopathy. Her death was due to cardiac failure and not related to surgery.

Illustrative cases

Case 1

A 45-year-old female patient presented with complaints of BA, LLW, SL, and bowel and bladder disturbance. MRI showed lesion involving the body of D6–D7 vertebra with soft tissue compressing the spinal cord [Figure 3]. After all necessary investigations, the patient was operated by transthoracic approach. Corpectomy of two level vertebrae with removal of the intervening intervertebral disc was done. Adequate decompression of cord was achieved, and an expandable

titanium cage was inserted. Postoperative MRI showed adequate decompression of cord [Figure 4]. Histopathology was suggestive of tuberculous involvement of the spine. The patient improved clinically and was walking without support at 6-month postoperative interval.

Case 2

A 28-year-old male presented to us with BA, LLW, and SL below D8 dermatome. MRI showed tuberculous infection

involving the D10–D11 vertebra [Figure 5]. The patient was operated for two-level corpectomy with titanium cage fusion. The patient improved in the immediate postoperative period. However, at 7-month follow-up, he complained of BA with deformity in the spine. Repeat MRI and X-ray showed developing kyphosis and migration of implant [Figures 6 and 7]. The patient was advised resurgery with implant replacement and screw fixation. However, he is yet to consent for the same.



Figure 3: T2-weighted sagittal image showing tuberculous involvement of D6–D7 level vertebra with cord compression



Figure 4: Postoperative T2-weighted image of spine with expandable titanium cage *in situ* with adequate cord decompression



Figure 5: Postcontrast image of dorsal spine showing tuberculous involvement of D10–D11 vertebra with cord compression



Figure 6: Delayed postoperative T2-weighted image of dorsal spine showing migration of implant with resultant kyphosis. The cord also shows acute curvature due to anterior compression

Table 2: Details of the patients in our series including postoperative results and complications

Age/sex	Clinical symptoms	Etiology	Preoperative NG	Level of lesion	Postoperative NG and outcome
36/Male	BA	Tuberculosis	1	T7	1
45/Female	BA, LLW, SL, BBD	Tuberculosis	3	T6-T7	1
51/Female	BA, LLW	Schwannoma	2	T5	1
38/Male	BA, LLW, SL	Tuberculosis	3	T6	2
61/Female	BA, LLW, SL, BBD	Metastasis	4	T5	Expired
26/Male	BA, LLW, SL	Trauma (fall)	3	T4-T5	1
28/Female	BA	Tuberculosis	1	T11	1
32/Female	BA	Schwannoma	1	T8	1
46/Male	BA, LLW	Tuberculosis	4	T4	2
25/Female	BA	Tuberculosis	1	T7	1
37/Female	BA	Tuberculosis	1	T11	1
36/Male	BA, LLW, SL, BBD	Trauma (RTA)	5	T10	3
28/Male	BA, LLW, SL	Tuberculosis	5	T10-T11	Kyphosis, 4
31/Female	BA, LLW, SL, BBD	Tuberculosis	4	T8	2
36/Male	BA, LLW, SL, BBD	Trauma (RTA)	5	T6	2
27/Female	BA, LLW, SL	Trauma (RTA)	2	T10	1

BA - Backache; LLW - Lower limb weakness; SL - Sensory loss; BBD - Bowel and bladder disturbance; NG - Nurick grade; RTA - Road traffic accident



Figure 7: Anteroposterior and lateral X-ray dorsal spine showing migration of implant and resultant kyphosis

Case 3

A 51-year-old female presented to us with BA, LLW for almost a year. She also had occasional breathlessness. MRI showed a huge dumbbell-shaped schwannoma arising at D5 level. There was a small IDEM component with a huge intrathoracic component [Figure 8]. We operated the patient first for the IDEM tumor in prone position. D5 level laminectomy with excision of IDEM tumor was performed. After a week, we followed it up with transthoracic approach and radical excision of the tumor. As the vertebral body was intact, no reconstruction was needed. Histopathology was suggestive of schwannoma. The patient was given a thoracic brace for 1 month and also underwent rigorous physiotherapy. Postoperative MRI showed complete tumor excision with fluid collection in the cavity [Figure 9]. The patient is now asymptomatic and mobile.

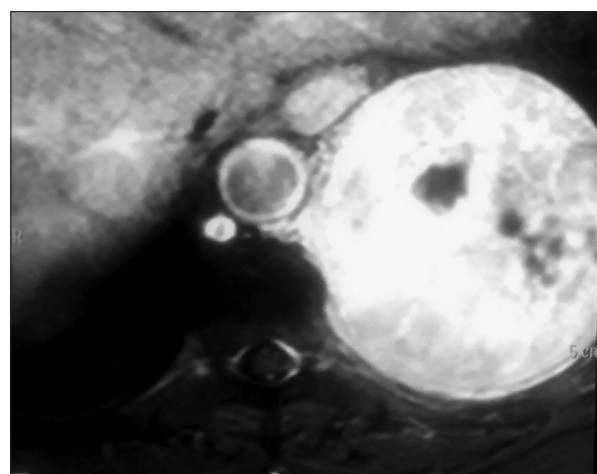


Figure 8: Postcontrast axial image showing a large posterior mediastinum mass at D5 level which is on left side and in close relation with aorta

Discussion

Anterior surgical approaches have been used since the beginning of the second half of the 20th century. Hodgson *et al.* were the first surgeons to perform spinal fusion with anterior approach for the treatment of a paraplegic patient with Pott's disease in 1956. Cauchoix and Binet reported access to vertebral corpuses from C7 to T4 using a median sternotomy in 1957. In 1969, Perot and Munro described transthoracic removal of a thoracic disc causing compression on the spinal cord. Similarly, Dwyer *et al.* described the use of anterior approach for the surgical treatment of scoliosis (1969) and Harrington anteriorly stabilized vertebral fractures due to tumors with methyl methacrylate.^[4,5] Anterior approach to thoracic spine with VATS was first described by Mack *et al.*^[6]

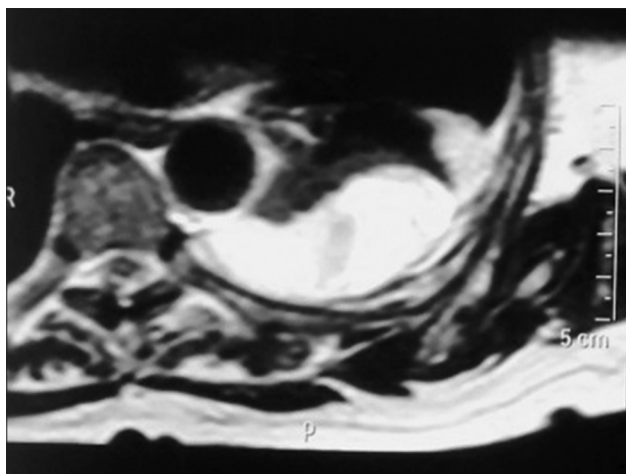


Figure 9: Immediate postoperative T2-weighted image showing complete tumor excision. There is some fluid collection in the tumor bed

Table 3: Indication in literature for transthoracic approaches

Infectious lesions
Granulomatous inflammation, e.g., tuberculosis
Pyogenic infections
Neoplastic lesions
Malignancy-Primary or metastasis
Benign, e.g., schwannoma
Trauma
Burst fracture
Fracture dislocation
Degenerative lesions
Spondylosis
Spondylolisthesis
Disc herniation
Spinal deformity

Initial reports of the anterior approach to dorsal spine were related to Pott's disease.^[7] However, with the advent of antitubercular therapy, a decline in the number of cases was seen.^[1] We suggest that the majority of asymptomatic patients can be managed with antituberculous therapy and bed rest but certain cases in which patients develop neurologic deficits and have radiologically significant cord compression have to be decompressed surgically. The work of Harrington, Kostuik *et al.*, and Sundaesan *et al.* represented a major technical and conceptual advance and confirmed the feasibility, safety, and efficacy of anterior decompression of the spine for malignant disease.^[8-10]

Indications are mentioned in literature [Table 3].

Spinal deformity cases have been referred to our orthopedic services and hence not included in our series. We have not encountered any degenerative disease of dorsal spine which needed anterior approach. All such cases have been operated by posterior approach.

Complications described in literature are as follows: (1) Injury to intercostal vessels which are most vulnerable during rib resection when running along under surface of rib. (2) Injury to lungs can be avoided by careful use of sharp instruments in the chest cavity. Prolonged collapse of lungs during one-lung ventilation can cause microatelectasis. Hence, lungs need to be expanded every 30 min. A 10% loss of pulmonary function has been reported in patients with thoracotomy.^[11] (3) Other structures prone to injury are esophagus and artery of Adamkiewicz. In our series, we had one mortality not related to surgery, one postoperative kyphosis, and one minor wound infection.

Previous series by Giacomo *et al.* had 142 patients (65 males and 77 females) with a mean age of 49.6 years. The indication for surgery was traumatic fracture in 20, malignancy in 35, degenerative disease in 29 patients, and correction of scoliosis in 58 patients.^[1] In the series by Seol *et al.*, the series size was 18 patients (8 males and 10 females) with mean age of 55 years. The indication of surgery was neoplasm in 13 cases, tuberculosis in 2, 1 case each of Ossified Posterior Longitudinal Ligament (OPLL), spinal stenosis with disc displacement and trauma.^[3] In our series, patients age ranged from 25 to 61 years with an average of 36.4 years. There were seven males and nine females. In our series, nine patients had Koch's spine, four patients were traumatic fracture spine, and three had neoplastic lesion.

Conclusion

With careful coordination by thoracic surgeons, neurospinal surgeons, and anesthetists, the anterior spine approach for dorsal spine is safe and effective. Adequate preoperative evaluation should stratify the risk, and institute measures to reduce it. Accurate surgical planning and careful surgical technique is the key to yield a good outcome and to reduce the risk of complications. Neurosurgeons should aware of this approach and should use it without hesitation in lesions involving the vertebral body and when there is anterior compression on the cord.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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