Posterolateral approach to intradural extramedullary thoracic tumors

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Six ventrally located intradural thoracic tumors were successfully resected through the posterolateral approach. This approach allows direct visualization of the ventral and dorsal boundaries of the tumor with minimal manipulation of the spinal cord. Compared to the traditional laminectomy, the operative time is increased but visualization of the tumor and spinal cord is markedly improved. Compared to the transthoracic approach, the posterolateral approach has fewer potential complications and eliminates the necessity of vertebrectomy. Neurological improvement occurred in all six patients. It is believed that this approach offers significant advantages for the treatment of ventrally located intradural thoracic tumors, and should be considered an alternative to the transthoracic approach.

KEY WORDS • lateral extracavitary approach  • spinal cord neoplasm  • lateral parascapular extrapleural approach  • thoracic spine  • surgical approach

RECENT advances in neuroimaging, spinal biomechanics, and improved spine instrumentation have led to a resurgence of interest in spine surgery. Beyond the usual problems facing a spine surgeon, surgery of the thoracic spine presents a unique series of challenges. The relatively small spinal canal, the thoracic cage, the adjacent mediastinal contents, and the paraspinal shoulder musculature all restrict access to the anterior and lateral vertebral elements. The lateral extracavitary approach is an anatomically guided surgical approach that achieves maximum exposure of the middle and lower thoracic vertebral bodies with minimal risk to the intraspinal, intrapleural, or mediastinal structures. The lateral paraspinal extrapleural approach is a modification of the lateral extracavitary approach that provides access to the upper thoracic vertebrae. The lateral extracavitary and lateral paraspinal extrapleural approaches are both posterolateral approaches and will be so called in this report.

We report six patients who presented with myelopathic symptoms secondary to ventrally located intradural extramedullary tumors and were successfully treated using these posterolateral approaches. The modifications of these approaches to address the intradural pathology and a comparison between them and other surgical options are presented.

Clinical Material and Methods

Case Material

Six patients with compressive myelopathy from intradural extramedullary thoracic tumors with predominant anterior components underwent gross total resection of the tumor via a posterolateral approach. These patients were all women and in good general health. They ranged in age from 28 to 61 years. Each patient presented with complaints of progressive leg weakness, three also complained of back pain, and two had a history of previous thoracic laminectomies for meningioma and presented with recurrent tumor.

On examination, all patients had weakness in their lower extremities with spasticity. Five of the six had loss of sensation to pain and proprioception. Each patient was evaluated with magnetic resonance imaging, which revealed an intradural extramedullary contrast-enhancing tumor with predominant anterior components (Fig. 1). Four tumors were located in the lower
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Fig. 1. Gadolinium-enhanced magnetic resonance images, sagittal (left) and axial (right) views, showing the anterior location of the tumor.

thoracic spine between T-9 and T-10, one in the upper thoracic spine from T-3 to T-5, and one at T7–8.

Surgical Procedure

The surgical technique of the lateral parascapular extrapleural approach has been described in detail previously for the treatment of upper thoracic vertebral pathology. The exposure for compressive vertebral pathology involves vertebrectomy, and frequently hemilaminectomy, pediculectomy, and facetectomy to allow complete visualization of the anterior and lateral thecal sac. A logical extension of this exposure would be to open the dura in order to visualize the anterior and lateral spinal cord, thus allowing removal of anterior intradural extramedullary tumors without retraction of the spinal cord. Therefore, morbidity associated with spinal cord manipulation would be avoided.

With the lateral approach, complete exposure of the anterolateral thecal sac has been accomplished when the posterior longitudinal ligament and the posterior vertebral body surface are identified. The dura is opened in the midline and reflected laterally, exposing the anterior and lateral spinal cord (Fig. 2). Microsurgical technique is used to resect the tumor away from the spinal cord with minimal manipulation. The dura is then closed with 3-0 silk suture and covered with a piece of Gelfoam. If the dura needs to be reconstructed because of partial excision, a fascial graft is placed and sealed with fibrin glue, and a lumbar drain is utilized for 72 hours. Prior to closure, the surgeon must check for the presence of a pleural tear by filling the wound with saline and performing a Valsalva maneuver. If a pleural tear is present, as in 5% of our cases, a chest tube can be easily placed through the operative exposure. An intertransverse process rib graft is placed and secured with wire or cables across the operative defect for added stability. The wound is closed in layers. Drains are placed deep in the operative field, between the paraspinous musculature and the musculocutaneous flap. The patient is monitored in the intensive care unit overnight. Drains are removed on Day 2 after surgery and mobilization in a clamshell orthosis is begun.

Fig. 2. Illustration of the posterolateral approaches showing dural opening. Note that two ribs have been removed to expose the length of a vertebral body. The lamina, transverse process, facet complex, and pedicles have also been removed. N = nerve; A = artery.

Operative Results

Postoperative Neurological Examination

The immediate postoperative neurological examination was unchanged in five of the six patients. The remaining patient experienced transient weakness in her legs postoperatively. She had presented with a spinal cord that was markedly thinned and draped over the surface of a 5-cm tumor. At the time of her discharge on Day 10, her neurological status had returned to baseline. Four of the six tumors had a pathological diagnosis of schwannoma and two of meningioma. Follow-up monitoring ranged from 3 to 36 months. Five patients had significant sustained neurological improvement. One patient improved neurologically for a period of 28 months and then developed recurrent lower-extremity numbness. Magnetic resonance imaging revealed recurrence of the schwannoma. This recurrence was anticipated secondary to incomplete resection during the original surgery due to extensive adhesion to the anterior spinal artery. She underwent a second tumor resection via the lateral extracavitary approach and her symptoms resolved.

Complications

One patient developed fever and malaise on postoperative Day 14 after she had been discharged from the hospital. A chest x-ray film revealed a right-sided pleural effusion. The effusion was drained, revealing an underlying pneumonia that resolved with administration of antibiotic agents. A sympathetic effusion is not uncommon after surgery via this exposure; it is generally well tolerated and resolves spontaneously in the majority of patients. We do not recommend thoracentesis unless the patient is symptomatic or has evidence of an unexplained infectious process. No patient in this series required chest tube drainage for pleural tear.
Discussion

Meningiomas and schwannomas comprise the majority of intradural extramedullary spinal tumors.\textsuperscript{1,2} Schwannomas typically arise from the dorsal root and are, therefore, usually located laterally and posteriorly. Meningiomas have a more variable location but are often situated anterior to the spinal cord.\textsuperscript{1} Although rare, masses located in the anterior thoracic spinal canal provide a difficult surgical challenge. The thoracic spinal canal is comparatively small and is mainly filled by the spinal cord. Access to the anterior thoracic spinal canal is obstructed by the spinal cord posteriorly, the thoracic cage and musculature laterally, and the mediastinum and pleural cavity anteriorly. The blood supply for the lower thoracic spinal cord may depend upon a single radiculomedullary artery, the artery of Adamkiewicz.\textsuperscript{11} This artery is located on the left side in 60% of patients; it enters the spinal canal between T-9 and T-12 in 75% of cases, between T-7 and T-8 in 15%, and between L-1 and L-2 in 10%.\textsuperscript{12,16} Spinal arteriography was not performed in these patients. Five patients were operated on from the right side, with one case of a T9–10 tumor being approached from the left side because of tumor extension to the left. Whether injury or ligation of a unilateral segmental radicular artery will result in spinal cord ischemia is controversial.\textsuperscript{13} It is prudent, nonetheless, to attempt preservation of the segmental radicular arteries when possible.

Treatment of Thoracic Lesions

Laminectomy. Early attempts at operative treatment of thoracic lesions located anterior to the spinal cord had poor results. Patterson and Arbit,\textsuperscript{14} in a review of the literature in 1978, found that of 91 reported cases of thoracic disc herniation treated with laminectomy, 18% became paraplegic and another 20% were not improved. Anterior epidural metastatic lesions have also traditionally been treated with laminectomy. Most spine surgeons now advocate a direct anterior or lateral surgical approach to these lesions.\textsuperscript{17-19} It has been argued that one of the major reasons for failure of surgical treatment to benefit patients with vertebral metastasis is the indiscriminate use of laminectomy for anteriorly placed tumors.\textsuperscript{19} The primary alternatives to laminectomy are the transthoracic and posterolateral approaches.\textsuperscript{4,8,15,17,18}

Transthoracic Approach. The transthoracic approach to the thoracic spine has been used for the treatment of traumatic, infectious, neoplastic, and degenerative lesions.\textsuperscript{4,8,15,17,18} This approach is best suited for anterior pathology below the T-3 segment. The T-1 and T-2 segments can be approached anteriorly via a transsternal approach or a posterolateral thoracotomy with resection of the upper three ribs.\textsuperscript{16} Access to the thoracolumbar junction requires that the diaphragm be taken down. The transthoracic approach provides excellent exposure of the vertebral body and the lateral aspects of the vertebral column. With various amounts of bone removal, one can obtain access to the lateral and anterior thecal sac. Disadvantages of the transthoracic approach are that it requires violation of the pleural space and manipulation of the lungs and mediastinal structures. Chest tube drainage is required, which adds to the morbidity of the operation and delays mobilization of the patient. The anterior approach also places a ventral tumor between the surgeon and the spinal cord, thus putting the surgeon in the difficult position of having to remove tumor from the spinal cord that he can not directly see.

Posterolateral Approaches. The posterolateral approaches provide the surgeon with an alternative to thoracotomy. The primary posterolateral approaches are the costotransversectomy, lateral extracavitary, and lateral paraspinal extrapleural techniques. Costotransversectomy can be carried out along the length of the thoracic spine, and has been used for intradural extramedullary tumors ventral to the cord.\textsuperscript{1} In the standard costotransversectomy, a 5-cm section of rib is resected to provide lateral exposure. However, this approach provides limited access to the ventral spinal canal, resulting in decreased visibility of the pathology, increased cord manipulation, and increased risk.

The lateral extracavitary approach, a modification of the lateral rhachotomy originally developed for the treatment of tuberculous spondylitis,\textsuperscript{3} has subsequently been used for the treatment of thoracolumbar fracture and thoracic disc herniation with good results.\textsuperscript{5-13} Maiman, et al.\textsuperscript{13} reported 23 cases of thoracic disc herniation treated via this approach, with 20 patients improving and none becoming worse. The lateral paraspinal extrapleural approach is a modification of the lateral extracavitary approach for the upper thoracic spine from T-1 to T-4. We have used this approach for resection of vertebral metastatic lesions of the upper thoracic spine, as well as for trauma, infection, and disc herniation.\textsuperscript{5,9} These posterolateral approaches provide simultaneous exposure of the ventral, lateral, and dorsal aspects of the spinal canal at any level of the thoracic spine. They do not require violation of the pleural space, manipulation of the mediastinal structures, or vertebrectomy, and they enable immediate posterior stabilization, if necessary.

In the patients in our series, the posterolateral approach was extended to resect ventrally located intradural extramedullary tumors. Most tumors of the thoracic spine can be approached posteriorly with excellent results. However, occasionally these tumors are positioned directly in the midline, and the thinned spinal cord is located completely dorsal to the tumor. For these tumors, we believe that posterolateral procedures provide the safest approach for complete resection.

Conclusions

The lateral extracavitary and lateral paraspinal approaches offer the surgeon access to intradural pathology in the ventral, lateral, and dorsal aspects of the thoracic spine without requiring manipulation of the spinal cord. Exposure is obtained through an extrapleural approach and avoids the morbidity associated with violation of the pleura and manipulation of the lungs and mediastinum. We found this exposure to be very
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helpful in this series of six cases of anteriorly located intradural extramedullary tumors of the thoracic spine. The posterolateral approaches can be performed safely with minimal morbidity and allows for early mobilization of the patient.

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References

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