A Comparative Study of Thoracoscopic vs Open Removal of Benign Neurogenic Mediastinal Tumors*

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**Study objective:** To assess the relative benefit of thoracoscopy vs open thoracotomy in the removal of benign neurogenic mediastinal tumors (BNMTs).

**Design:** Retrospective comparative study of thoracoscopy and open thoracotomy.

**Setting:** Patients underwent surgery at the thoracic surgical services of two institutions from 1988 to 1994. Patients who underwent thoracotomy were operated on more recently, 1992 to 1994. Patients who had thoracotomies underwent resection from 1988 to 1992.

**Patients:** All adult patients undergoing isolated removal of BNMTs at both institutions were included. Eleven patients underwent removal by posterolateral thoracotomy while six patients underwent thoracoscopic removal.

**Interventions:** BNMTs were removed by standard posterolateral thoracotomy or by three-hole thoracoscopic techniques with extension of incisions and conversion to an open procedure as necessary.

**Measurements and results:** Larger tumors were more difficult to remove thoracoscopically. Two cases of transient postoperative ptiotic were noted among the patients who underwent thoracoscopic operation.Operative time was longer in the thoracoscopy group (171 vs 112 min; p<0.05). Postoperative stay was significantly shorter (2.6 vs 4.5 days; p<0.02) and return to work tended to be more rapid (4.3 vs 7.7 weeks; p=0.13) among patients who underwent thoracoscopic removal.

**Conclusions:** Thoracoscopic resection of BNMTs can be achieved safely and effectively with more rapid postoperative recovery when compared with an open thoracotomy approach to these mediastinal tumors.


**Key words:** mediastinal tumor; neurogenic tumor; thoracoscopy; thoracotomy

**Abbreviations:** BNMT=benign neurogenic mediastinal tumor

Thoracoscopic techniques have been advocated for a variety of general thoracic surgical procedures. Pulmonary resections ranging from wedge biopsy to lobectomy to pneumonectomy have been described.1-7 Similarly, a variety of mediastinal cysts and tumors have been removed with thoracoscopic assistance.8,9 Some of these reports indicate that a video-assisted approach results in improved patient recovery and shortened hospital stay. However, true comparative studies of thoracoscopic mediastinal tumor resection with open procedures over a similar time period have not been reported (to our knowledge).

To assess the utility and the functional benefit of thoracoscopic techniques in the management of mediastinal tumors, we undertook a retrospective review of all benign neurogenic mediastinal tumors (BNMTs) removed from the mediastinum over a 6-year period at two institutions. Patients with BNMTs were chosen for this review because they provide a uniform population of patients with similar abnormalities requiring standard techniques of removal.

**Materials and Methods**

Records of the thoracic surgical services at the Washington University School of Medicine and the Medical College of Wisconsin were reviewed. All adult patients who underwent isolated removal of BNMTs from the posterior mediastinum were included with the exception of one patient who had intraspinal tumor extension. Patient information was obtained through thoracic surgery clinic charts, inpatient records, pathology reports, and operative reports. From 1988 to 1992, 11 patients underwent removal of BNMTs via posterolateral thoracotomy. From 1992 to 1994, six patients underwent thoracoscopic removal of BNMTs. Each case was reviewed for demographic data and clinical presentation (Table 1). Diagnosis was suspected by chest radiograph in all patients (Fig 1). Additional preoperative studies included CT and MRI (Fig 2). Size of the tumor was recorded from operative and pathology reports. The duration of the procedure was measured from the time of incision to skin closure. Operative complications were noted for both open and closed procedures. The postoperative course was reviewed for...
length of hospital stay and complications. Patients were interviewed following their recovery. They reported the time period over which they were able to return to work or full activity, the duration of severe pain following the procedure, and the presence of ongoing or continuing pain. Inquiries regarding long-term complications were also made. Seven of the 11 patients undergoing thoracotomy and all patients undergoing thoracoscopic surgery had follow-up interviews. The average age of patients undergoing thoracotomy was 42.7 years (range, 19 to 68 years). Seven were male and four were female. The mean age of those undergoing thoracoscopic resection was 34.6 years (range, 20 to 64 years). Two were male and four were female. Nine of the 11 patients undergoing thoracotomy were treated at Washington University whereas 4 of 6 patients undergoing thoracoscopic removal were treated at the Medical College of Wisconsin.

Thoracoscopy was performed with the patients in the lateral decubitus position. Ventilation was achieved through a double-lumen endotracheal tube with ipsilateral lung deflation. Video-assisted thoracoscopic removal was performed through three ports. Most commonly, the thoracoscope was introduced through the seventh intercostal space in the mid axillary line. An incision was made in the fifth intercostal space in the anterior axillary line and through this portal the lung was retracted inferiorly and anteriorly. Most of the surgical dissection was performed through a posterior port in the fourth or fifth intercostal space. These anterior and posterior portals ranged from 2 to 5 cm in length. Occasionally it was necessary to extend one of these incisions to facilitate tumor dissection and removal (see below).

Data were compared between patients undergoing thoracotomy and thoracoscopy using unpaired t tests.

**RESULTS**

Resection of neurogenic tumors via posterolateral thoracotomy was performed in 11 patients. Ten patients were asymptomatic, having come to surgical attention by serendipitous chest radiograph. One patient presented with chest discomfort attributable to the tumor. There were no immediate intraoperative complications. All tumors were solitary. They ranged in size from 2 to 7 cm. A histologic review identified eight schwannomas, one neurofibroma, and two ganglioneuromas. Operative times ranged from 60 to 180 min with a mean of 112 min. Postoperative stay was 3 to 8 days with a mean of 4.5 days (Table 1). There were two postoperative complications in the thoracotomy group. One patient who had a postoperative hemothorax following chest tube removal was treated with reinsertion of a chest tube. In the second, removal of a 7-cm midthoracic neurofibroma resulted in persistent chylous drainage requiring surgical reexploration and ligation of the thoracic duct.

From 1992 to 1994, six patients underwent thoracoscopic removal of benign posterior neurogenic tumors. One patient presented with a Horner’s syndrome. All others were asymptomatic. Neurogenic tumors ranged in size from 3 to 7 cm. There were five schwannomas and one ganglioneuroma. Operative time was significantly longer in the thoracoscopic group averaging 171 min with a range of 120 to 270 min.

![Figure 1](Image1.png)  
**Figure 1.** Posterior-anterior chest radiograph demonstrates an apical rounded density typical of a BNMT.

![Figure 2](Image2.png)  
**Figure 2.** This MRI demonstrates the lesion in the costovertebral sulcus without intraspinal extension.

**Table 1—Comparison of Demographic and Outcome Data of Patients Undergoing Thoracotomy and Thoracoscopy**

<table>
<thead>
<tr>
<th></th>
<th>Thoracotomy (n=11)</th>
<th>Thoracoscopy (n=6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient age, yr</td>
<td>42.7</td>
<td>34.6*</td>
</tr>
<tr>
<td>Operative time, min</td>
<td>112</td>
<td>171*</td>
</tr>
<tr>
<td>Hospital stay, d</td>
<td>4.5</td>
<td>2.6*</td>
</tr>
<tr>
<td>Return to work, wk</td>
<td>7.7</td>
<td>4.3*</td>
</tr>
<tr>
<td>Severe pain, wk</td>
<td>1.5</td>
<td>2.1</td>
</tr>
</tbody>
</table>

*p=NS (not significant).

*p<0.05.

*p<0.02.

*p=0.13.
Most of these lesions were near the stellate ganglion and meticulous circumferential tumor dissection was utilized to avoid injuring it.

Two patients with larger tumors presented the most difficult problems of dissection. One patient with a 6-cm lesion ultimately required conversion to an open procedure to safely complete circumferential dissection. The operative time on this patient was 270 mins. A second patient with a 5×7-cm lesion underwent extension of the posterior incision to 7 cm with a rib resection to facilitate dissection and tumor removal. The thoracoscope was used throughout and retraction of the wound was minimal. This tumor abutted the intercostal brachial nerve. By downward traction of the tumor, the nerve was dissected free. This operation lasted 210 mins. Transient numbness along the inner arm was noted by the patient following surgery. Two patients were noted to have mild postoperative ptosis that resolved within 2 months of surgery. The average postoperative stay was 2.6 days (range, 2 to 4 days), significantly shorter than in patients undergoing open thoracotomy.

Postoperative interviews were obtained in 7 of the 11 patients undergoing thoracotomy and in all of the patients undergoing thoracoscopy. Patients reported a more rapid return to work following thorascopic removal compared with open removal of BNMTs, 4.3 weeks vs 7.7 weeks; however, this did not reach statistical significance. The longest recovery period in the thorascopic group was in the patient who required conversion to an open procedure (8 weeks). Patients reported similar duration of postoperative severe pain in both groups (thoracoscopy, 2.2 weeks; thoracotomy, 1.5 weeks). One patient in each group reported recurrent intermittent pain for more than a year following the surgical procedure. No patient had long-term complications or unrelenting disability following either thoracotomy or thoracoscopy.

**DISCUSSION**

Prior to the advent of video-assisted thoracoscopy, resection of neurogenic tumors of the posterior mediastinum required wide exposure via posterolateral thoracotomy. Such exposure usually included division of the latissimus dorsi muscle and rib retraction to open the intercostal space. Intercostal neuralgia and prolonged shoulder immobility were not uncommon postoperative sequelae. Neurogenic tumors are ideally suited for thorascopic removal because the video imaging techniques allow visualization and removal of these lesions via relatively small instrument and scope access portals with less associated muscle injury. The expectation is that thoracoscopy will allow mediastinal tumor removal with less postoperative morbidity and reduced pain. However, this goal has not been clearly demonstrated in a comparative report.

Studies comparing thorascopic and limited thoracotomy surgical approaches to pulmonary resection have been recently reported. A multicenter prospective nonrandomized study demonstrated lower narcotic requirements and reduced pain perception among patients undergoing thoracotomy; however, patients undergoing limited thoracotomy were subjected to more extensive pulmonary resections. Landreneau et al investigated the problem of chronic pain following thoracic surgical procedures. Patients undergoing video-assisted pulmonary resection had less perception of pain and better mobility in the first year following surgery when compared with a similar group of patients undergoing lateral thoracotomy. After 1 year, the pain-related morbidity parameters between the two surgical approach groups were similar. Molin et al reported a retrospective study of lung biopsy for interstitial disease and found no benefit of thorascopy over limited thoracotomy in terms of operating time, specimens obtained, postoperative stay, or postoperative analgesic usage; however, operating room and anesthesia costs were significantly increased.

Recent reports have advocated the use of thoracoscopy for the removal of a variety of mediastinal masses. Benign mediastinal cysts are commonly removed by this technique. Hazellrigg et al reported an ability to remove these tumors and give patients a shortened hospital stay and an absence of intraoperative or postoperative complications. Thorascopic removal of BNMTs has also been reported mostly on a case by case basis. Ishida et al reported a mean operative time of 156 min and minimum blood loss. Postoperative stay was relatively long at 6 days; however, the authors reported that the patients rapidly returned to full activity. Larger reviews of thorascopic procedures have included subgroups of patients who have undergone posterior mediastinal tumor resection, although detailed analysis of patient outcomes has not been reported. Recently, the removal of neurogenic tumors with intraspinal extension by a combined microneurosurgical and thorascopic approach was reported.

This review comparing thorascopic with open techniques for removal of BNMTs demonstrated that both approaches can be performed safely and with acceptable results. There were no major complications in the thorascopic group, although two cases of ptosis occurred in patients with tumor immediately adjacent to the stellate ganglion. Since the deficits were transient, it is likely a traction rather than transection injury was causative. Proper positioning of the thoracoscope and use of a 30° angled scope may improve one’s ability to perform precise dissection in this.
region. The one procedural complication in the thoracotomy group—a chylothorax—is a rare complication following neurogenic tumor removal. Operative times were significantly longer in the thoracotomy group, although they tended to decrease as experience with thoracoscopic techniques was gained. Average operative time was 200 min in the first three patients who underwent thoracoscopy and 143 min in the last three patients. Additionally, operative time was longer in the two patients with large tumors who underwent thoracoscopy. Patients who underwent thoracoscopy were discharged from the hospital more rapidly than patients who underwent thoracotomy. This benefit may be related to the recent emphasis on cost containment and shorter hospital stays noting that thoracoscopic resections were performed from 1992 to 1994 while open resections were performed between 1988 and 1992. The associated financial benefit may also be reduced by higher operating room costs related to longer procedures and expensive thoracoscopic equipment.

A more compelling result implicating greater morbidity with the open resection method was the longer time period before patients were able to return to work or full activity. Patients who underwent thoracoscopic procedures were able to return to full activity despite having a similar duration of severe pain. On further questioning, patients who underwent thoracoscopic procedures who had severe pain tended to describe symptoms consistent with intercostal neuralgia that did not interfere with arm range of motion. However, patients who underwent thoracotomy were limited from work not only by pain but also by a functional deficit related to the incision. Admittedly these impressions were not quantified in a standardized quality of life or physical assessment questionnaire.

Larger tumors present a difficult thoracoscopic problem because they prevent adequate exposure of the sulcus. In such instances, we have divided the tumor which is relatively avascular to better view this area. Alternatively, following initial inspection, subsequent dissection can be made more effective by enlarging either the anterior or posterior portal into a limited non-rib-spreading thoracotomy. This allows the placement of more than one instrument through the thoracotomy and the use of standard chest instruments for dissection. The improved feel and ability to manipulate the tumor expedites removal. Realization of these difficulties from the outset should further reduce operative time and nonproductive dissection.

Acute postoperative pain and chronic intercostal neuralgia following thoracotomy may not be uniformly prevented since instruments and trochars must pass through the intercostal space. In an effort to minimize postoperative pain, we currently attempt to block the areas of intercostal access with local anesthetic prior to the procedure. Alternatively, the use of an epidural catheter with a narcotic or local anesthetic administered intraoperatively may achieve a similar effect. Such preemptive analgesic techniques may reduce or eliminate the firing of pain afferent fibers to the spinal cord during the procedure. The dampening of this CNS process known as “wind-up” may be effective in reducing subsequent pain perception.

In conclusion, thoracoscopic resection of BNMTs can be safely and effectively achieved. When compared with thoracotomy, patients who underwent thoracoscopy were able to be discharged from the hospital sooner and returned to work or full activity more promptly following their procedure. A thoracoscopic approach may prompt patients to accept surgical intervention at an earlier stage, before tumors enlarge, while they are able to be removed with minimally invasive techniques.

REFERENCES