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Surgical Treatment of Mediastinal Neurogenic Tumors in Adults: A 10-Year Experience

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Background: Neurogenic tumors are often observed in the paravertebral sulcus. They are generally benign in adults and are good candidates for resection by video-assisted thoracic surgery (VATS). We review our series of thoracic neurogenic tumors, focusing on their surgical management. **Methods:** The medical charts of 25 patients with mediastinal neurogenic tumors, treated from September 1997 to January 2008, were reviewed regarding the radiographic presentation, histopathology, and surgical treatment of these tumors. Results: The patients included 16 men and nine women (mean age, 41 years; range, 20-65 years). Seventeen patients were pathologically diagnosed with schwannomas, three with neurofibromas, and five with ganglioneuromas. The median tumor size was 6.2 cm (range, 1.9-15 cm). The tumors were located in the paravertebral sulcus in 19 patients, chest wall in five patients, and visceral compartment in one patient. Seventeen patients (68%) underwent resection via standard thoracotomy, whereas the remaining were resected with VATS, including one with robotic VATS. The postoperative hospital stay was shorter in patients treated with VATS than in those treated with thoracotomy. There were no tumor-related deaths or recurrence during follow-up. **Conclusion:** As expected, the most frequent mediastinal neurogenic tumor was schwannoma originating from the sympathetic chains. Infrequently, tumors may arise from the vagus nerve in the visceral compartment of the mediastinum or from an intercostal nerve if they are located at sites distant from the mediastinum. VATS is a good alternative for mediastinal neurogenic tumors smaller than 5 cm or that preoperatively lack features of intraspinal extension.

Key words: neurogenic tumor, mediastinum, VATS

INTRODUCTION

Mediastinal neurogenic tumors frequently originate from autonomic or paraganglionic nerves throughout the thorax, and mainly occur in the paravertebral sulcus or are described as posterior mediastinum[1]. They occur frequently in adults and are generally asymptomatic and benign in character. They are occasionally detected on chest radiography or chest computed tomography (CT) scans. Surgical resection is the primary treatment for these tumors and is usually performed with a thoracotomy. The use of video-assisted thoracic surgery (VATS) for the removal of mediastinal neurogenic tumors has been gaining popularity since its first reported use in 1992 to extirpate a 4 cm posterior mediastinal neurogenic tumor[2]. The aim of this report is to review our 10-year experience of these tumors.

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PATIENTS AND METHODS

We performed a retrospective review of the medical charts of 25 patients with mediastinal neurogenic tumors treated at the Tri-Service General Hospital from September 1997 to January 2008. The clinical characteristics of the mediastinal neurogenic tumors are shown in Table 1. A contrast-enhanced CT scan of the chest was performed in all patients. Magnetic resonance imaging (MRI) was also performed in patients with suspected cystic lesions or in those whose preoperative chest CT scans showed intraspinal extensions. A double-lumen endotracheal tube was inserted to produce lung collapse for maximal exposure of the tumor. An epidural catheter was inserted for postoperative pain management, consisting of the patient-controlled administration of analgesics. Until November 2001, tumor removal was performed by standard thoracotomy, whereas

Table 1 Profile of patients

Number	25	
Age (y)	41(range, 20-65)	
Male/female	16/9	
Symptom (present/absent)	13/12	
Location		
Paravertebral sulcus	19	76%
Chest wall	5	20%
Visceral compartment	1	4%
Mean size (cm)	6.2(range, 1.9-15)	
Operative procedure		
Thoracotomy	17	68%
VATS	8	32%
Histology		
Schwannoma	17	68%
Neurofibroma	3	12%
Ganglioneuroma	5	20%

VATS: video-assisted thoracic surgery

video-assisted thoracic surgery (VATS) was used in the case of a 4 cm lesion. Subsequently, the approach to tumor removal was selected based on the location, size, or spinal extension of the tumor. In November 2004, one patient was successfully treated with robot-assisted VATS (da Vinci Surgical System, Intuitive Surgical, Sunnyvale, CA). Overall, the intraoperative blood loss was negligible and was similar between the groups that underwent standard thoracotomy and those treated with VATS. The mean follow-up period was 50 months (range, 1-125 months).

RESULTS

Most of the patients were asymptomatic (52%, with incidental detection of radiographic abnormalities). The following symptoms were observed in 12 patients: five patients with cough, three with chest pain, three with chest tightness, and one with Horner's syndrome. In two patients, the tumors were associated with von Recklinghausen's disease. Diagnostic examinations began with chest radiography, which often revealed soft tissue density in the thorax. The preoperative CT scan of the chest showed a circumscribed solid lesion in all patients. However, in two patients (8%) with intraspinal growth, so-called "dumbbell tumors" were observed on the scan. MRI was performed on these two patients (Fig.1).

The treatment of the mediastinal neurogenic tumor was either diagnostic or therapeutic surgical resection. Of the 19 paravertebral sulcus tumors, two presented as dumbbell tumors. These tumors require combined neurosurgical—thoracic resection. We also encountered a rare case of a patient with a preoperative large circumscribed heterogeneous mass in the left visceral compartment of the mediastinum. The mass was suspected to be malignant. It

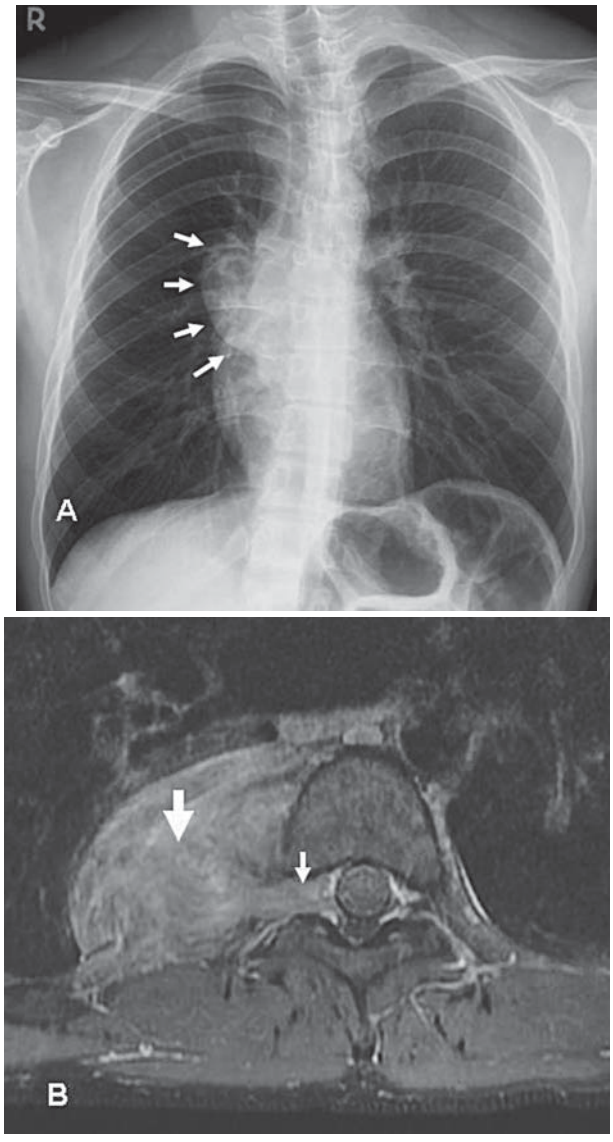

Fig. 1 20 year-old man with an asymptomatic right paravertebral sulcus ganglioneuroma. A. Posteroanterior radiograph shows a large mediastinal tumor at the level of right hilum (arrows). B. MR imaging demonstrates narrow waist of tumor connecting large intrathoracic tumor (large arrow) with smaller intraspinal component (small arrow). The tumor shows heterogeneous signal intensity on T2-weighted image. Note enlargement of the neural foramen.

was removed with a left thoracotomy and was diagnosed pathologically as a schwannoma (Fig.2). Eight patients were treated with VATS, including one with robotic-assisted VATS[3], and 17 patients were treated with conventional thoracotomy, including 13 posterolateral thoracotomies and four axillary thoracotomies. In the patients who underwent VATS, the tumors were located on the chest

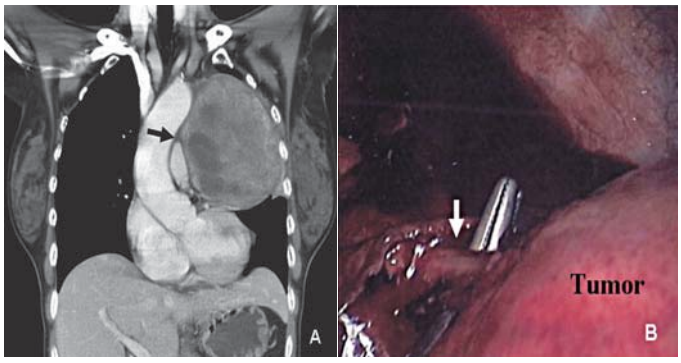

Fig.2 65 year-old female with a large mediastinal schwannoma. A. Coronal CT with contrast shows a circumscribed heterogeneous mass measuring about 11x11x8.5 cm with soft tissue and cystic components (arrow). B. Intraoperative view shows that the tumor derived from the left vagus nerve (arrow).

wall in four patients and in the paravertebral sulcus in four patients. Table 2 compares the two groups. There was no statistically significant age difference between the two groups. Smaller tumors are candidates for VATS resection, which can be achieved in a shorter operation and more effectively, with rapid recovery resulting in a shorter hospital stay. There was no operative death in either group.

No malignant tumor behavior was observed in our series. The visceral compartment tumor originated from the vagus nerve, 19 paravertebral sulcus tumors from the sympathetic nerve, and five chest wall tumors from the intercostal nerve. Among these patients, the two with von Recklinghausen's disease had one neurofibroma and one ganglioneuroma. No recurrence was observed during the follow-up. In the patient with Horner's syndrome, the syndrome was present even after surgery. This could be attributed to an injury to the sympathetic ganglia during surgery.

DISCUSSION

About 90% of mediastinal neurogenic tumors typically occur in the posterior mediastinum or paravertebral sulcus[1,4]. Infrequently, the tumor arises from either the phrenic or vagus nerve in the visceral compartment[5,6]. Most of these tumors are nerve sheath tumors, such as schwannomas, neurofibromas, and paraganglionic tumors, or of ganglionic origin, such as ganglioneuromas and neuroblastomas[1]. The majority of these tumors are asymptomatic in adults[7]. However, as they grow, they cause symptoms of local compression or spinal-cord extension. It should be noted that Horner's syndrome, which is usually caused by paralysis of the sympathetic nerve, may be the initial presentation in upper mediastinal neurogenic tumors[8]. Ribet et al. reported that 14.1% of mediastinal neurogenic tumors are associated with von Recklinghausen's disease, a rare genetic defect[7]. However, in our series, only 8% of the mediastinal neurogenic tumors were associated with this disease.

Table 2 Comparison with different methods of operation

	Thoracotomy	VATS	*P* value*
Age (year)	41.5 ± 17.1	40 ± 11.1	0.93
Tumor size (cm)	7.6 ± 3.8	3.2 ± 1.1	0.002
Hospital stay (d)	14 ± 5.2	8 ± 1.3	0.003
Operative time (min)	266 ± 32	108 ± 16	<0.001

Values are mean ± standard deviation
*A P value < 0.05 was considered as statistically significant in the Mann-Whitney U-test.

Preoperative evaluations are generally performed with radiography. Unlike in children, mediastinal neurogenic tumors in adults are generally benign lesions. However, in patients with suspected malignancy, the tumors can be examined by needle aspiration biopsy[9]. CT scans can diagnose mediastinal or chest wall lesions with high accuracy[10]. In addition to distinguishing cystic lesions and intraspinal extensions, MRI techniques, used as adjuncts to CT scans, can precisely evaluate the severity of the disease and can be used in planning surgical treatment[11,12]. Moreover, during the excision of dumbbell tumors located in the lower paravertebral sulcus, the location of the artery of Adamkiewicz, which supplies the lower spinal cord, should be carefully determined to avoid intraoperative spinal-cord injury[13].

Complete resection is the standard treatment for mediastinal neurogenic tumors in adults[1], whereas observation is rarely justified. Extended resection with a standard thoracotomy should be performed if there are doubts regarding the accuracy of the resection. There are still no guidelines regarding the choice of surgical approach for the excision of these tumors. Standard thoracotomy often requires a large incision, which impairs the respiratory muscles, whereas VATS can minimize the access trauma. In a comparative study of the thoracoscopic removal and open removal of benign neurogenic mediastinal tumors, thoracoscopic resection was found to be safe, with rapid recovery and a shorter postoperative hospital stay[14]. Our experiences in resecting mediastinal neurogenic tumors

with VATS have shown the same results. The diameter of the lesions for which thoracoscopic removal can be performed has been strongly debated[15,16]. In our series, VATS is the preferred surgical approach for lesions smaller than 5 cm, without intraspinal extension. When the diameter of the lesions is greater than 5 cm, when dumbbell tumors are present, or when malignancy is suspected, thoracotomy is the standard approach, mainly because additional procedures are required for the dissection of these large tumors, which have vascular and nervous structures that may entail additional risk. We also used the robotic VATS technique in a patient with a ganglioneuroma located in the upper paravertebral sulcus[3]. Robotic systems provide three-dimensional hand ― eye coordination and are feasible for the extirpation of mediastinal neurogenic tumors[17]. However, the major disadvantages of these robotic systems are the high cost and longer set-up times required compared with VATS.

In conclusion, the diagnosis of mediastinal neurogenic tumors depends on a thorough microscopic examination of the resected tumor. Complete resection remains the mainstay cure. Minimally invasive techniques, such as VATS, are the preferred surgical approach for small tumors. Standard thoracotomy with extended resection should be considered for patients with large tumors, intraspinal growth, or a high probability of malignancy.

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