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Surgical Resection of a Giant Posterior Mediastinal Schwannoma Occupying the Entire Left Hemithorax: A Case Report

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Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
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Conflict of interest: None declared

Patient: Female, 48-year-old

Final Diagnosis: Mediastinal schwannomas

Symptoms: Persistent dull pain in the left upper abdomen

Clinical Procedure: Contrast-enhanced CT and MRI examinations and needle biopsy for histopathological examination were completed; surgical resection was performed, and the patient recovered well postoperatively

Specialty: Surgery

Objective: Rare disease

Background: Posterior mediastinal schwannomas are relatively uncommon. Cases presenting with abdominal pain as the initial symptom—particularly those involving massive benign tumors that occupy nearly the entire thoracic cavity, resulting in complete collapse of the ipsilateral lung and mediastinal shift—are exceedingly rare.

Case Report: A 48-year-old woman presented with a dull epigastric pain. Initial contrast-enhanced chest computed tomography (CT) on admission revealed a mass occupying nearly the entire left thoracic cavity, which resulted in complete left lung collapse and mediastinal shift. Subsequent contrast-enhanced CT, chest magnetic resonance imaging (MRI), and percutaneous needle biopsy confirmed the diagnosis of a posterior mediastinal schwannoma. The patient underwent surgical resection and had an uneventful postoperative recovery, with satisfactory re-expansion of the left lung.

Conclusions: For large posterior mediastinal tumors—particularly those causing pulmonary compression and mediastinal shift—preoperative integration of contrast-enhanced CT, functional MRI, and nerve root assessment is essential to delineate tumor vascularity and its relationship with intervertebral foramen nerve roots. For intrathoracic masses amenable to biopsy, CT- or ultrasound-guided needle aspiration should be performed to confirm the pathological nature of the tumor, thereby facilitating optimal treatment planning. This multimodal diagnostic approach is especially critical for characterizing the tumor's origin, size, histological type, vascular supply, and other key features. Notably, gross total resection of giant benign neurogenic tumors typically yields a favorable prognosis.

Keywords: Mediastinal Schwannoma • Pulmonary Atelectasis • Mediastinal Shift

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Introduction

Mediastinal schwannomas are benign intrathoracic neurogenic tumors that primarily originate from the posterior spinal nerves, intercostal nerves, or paraspinal sympathetic nerves. Giant schwannomas often present with nonspecific symptoms due to compression of the airways, vessels, nerves, or lung parenchyma, frequently leading to misdiagnosis as gastrointestinal or cardiopulmonary disorders. Concomitant total lung atelectasis is particularly rare. Key challenges in management include the accurate preoperative delineation of tumor origin and anatomical relationships, as well as the selection of a safe and effective surgical approach and strategy. Computed tomography (CT) and/or magnetic resonance imaging (MRI) are instrumental in characterizing tumor size, location, and features, thereby guiding the choice of surgical modality and incision [1]. Preoperative needle biopsy is crucial for determining the histological type and nature of large tumors. Surgical resection remains the gold standard treatment for benign lesions [2]. While the literature predominantly consists of case reports focusing on tumors in special locations or those invading adjacent structures, there is a paucity of systematic descriptions regarding preoperative assessment protocols, the decision-making process for converting from thoracoscopic exploration to open thoracotomy, and perioperative management in cases of giant mediastinal schwannomas causing total lung collapse and mediastinal shift. Herein, we report a case of a giant mediastinal schwannoma—nearly occupying the entire hemithorax—initially presenting with abdominal pain. We summarize our institutional experience with a multimodal diagnostic approach (including contrast-enhanced CT and MRI, ultrasound-guided core-needle biopsy), thoracoscopic exploration followed by conversion to an extended posterolateral thoracotomy for gross total resection, and integrated perioperative management. Our objective is to provide a practical reference regarding the preoperative assessment, surgical strategy, resection technique, and perioperative care for giant mediastinal tumors.

Case Report

A 48-year-old woman presented with persistent dull pain in the left upper abdomen for 2 weeks. The onset was insidious, and she denied associated nausea, vomiting, dyspnea, chest tightness, or fever. An initial non-contrast CT scan of the upper abdomen at the Third People's Hospital of Bengbu (affiliated to Bengbu Medical University) incidentally revealed a massive space-occupying lesion in the left thoracic cavity. The lesion compressed adjacent structures and caused rightward deviation of the heart and mediastinum, prompting admission to the Department of Thoracic and Cardiovascular Surgery for further evaluation and management. Physical examination

revealed rightward deviation of the trachea without thoracic deformity. The left intercostal spaces were widened compared to the right. Percussion over the left hemithorax produced a dull note, and breath sounds were absent on the left but clear on the right. The apical impulse and cardiac borders were markedly shifted to the right. Contrast-enhanced chest CT demonstrated a giant soft-tissue mass within the left thoracic cavity, measuring $22 \times 10 \times 12.1$ cm. The mass exhibited heterogeneous density with calcification and mixed consolidation, showing heterogeneous enhancement. Adjacent lung tissue was compressed, resulting in atelectasis. The cardiac silhouette was displaced to the right, and left-sided pleural effusion was noted. The mean CT attenuation value of the mass was approximately 39 Hounsfield units (HU). Imaging findings were suggestive of a pleural or mediastinal tumor (**Figure 1**). Laboratory investigations, including routine blood tests, blood biochemistry, and serum tumor markers, revealed no specific abnormalities.

Following thorough discussion with the patient and her family, ultrasound-guided left pleural puncture and catheter drainage were carried out on day 4 of hospitalization, yielding a large volume of hemorrhagic pleural fluid. Routine pleural fluid analysis revealed red, turbid fluid with a nucleated cell count of $324 \times 10^6/L$ and polymorphonuclear cell percentage of 19.1%. The Rivalta test was negative. Biochemical analysis of the pleural fluid showed total protein 45.5 g/L, albumin 24.7 g/L, and glucose 4.51 mmol/L. Carcinoembryonic antigen (CEA) in pleural fluid was 0.43 ng/L. Pleural effusion cytology revealed no tumor cells. A total of 1800 ml of bloody fluid was drained. A repeat complete blood count revealed no significant changes compared to admission levels. Based on the comprehensive interventions described above, a benign tumor was considered highly probable. A follow-up non-contrast chest CT scan demonstrated partial re-expansion of the left lung and persistent visualization of the giant mass within the left thoracic cavity. Notably, the imaging revealed no distinct cleavage plane between the tumor and the posterior chest wall, strongly suggesting that the tumor originated from the posterior chest wall (**Figure 2**).

Ultrasound-guided percutaneous biopsy of the thoracic mass was performed on the 10th day of hospitalization. Ultrasound revealed a large, irregular, predominantly solid mixed mass with heterogeneous internal echoes and well-defined borders. Under ultrasound guidance, the needle entered solid tissue within the left pleural cavity, extracting 4 white-tissue strands. Immunohistochemical pathology revealed proliferating spindle cells and foamy cells in the left pleural biopsy specimen. Spindle cells tested CK(-), SMA(-), S-100(+), CD34(-), STAT6(-), ALK-D5F3(NC)(-), calretinin(-), D2-40(+), Ki-67 (focal 1%+), consistent with schwannoma. To further delineate the tumor's origin and its relationship with the chest

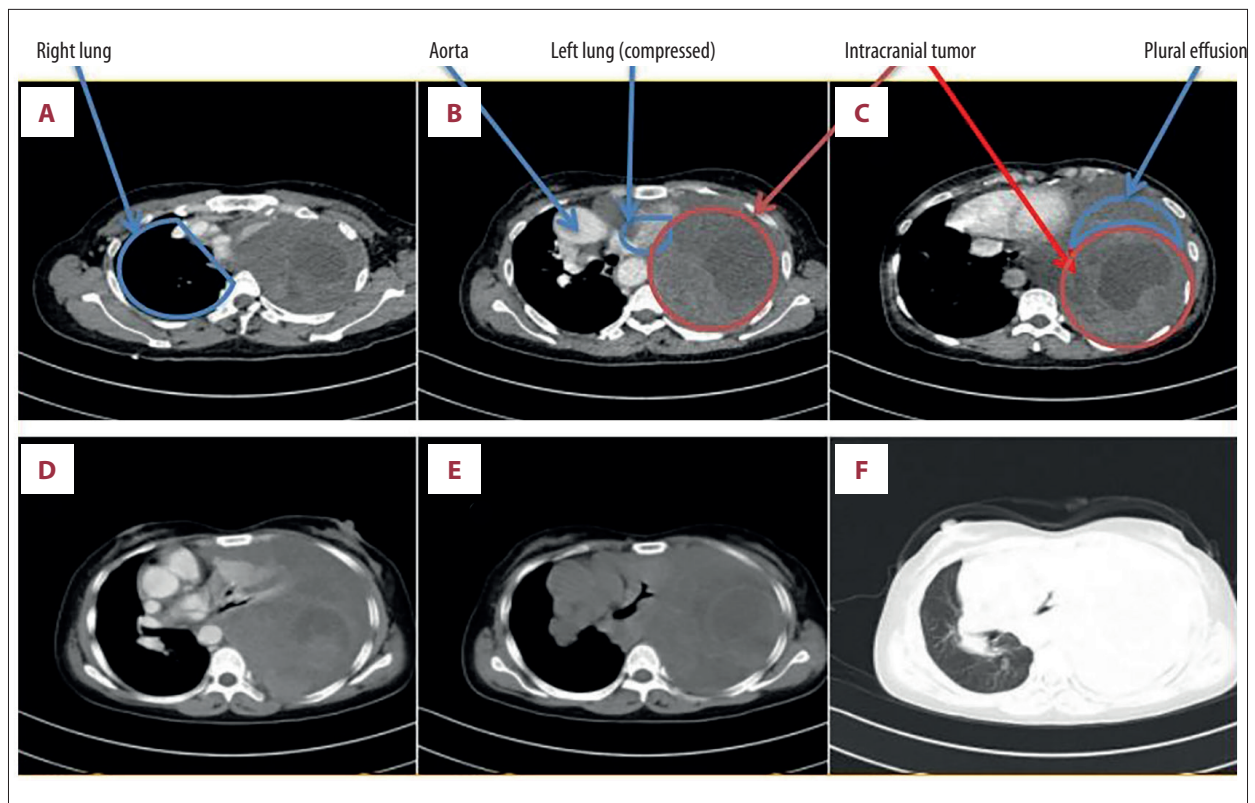


Figure 1. Massive left-sided intrathoracic mass, left lung atelectasis, cardiac shadow shifted to the right. Axial contrast-enhanced CT images of the chest demonstrating a giant intrathoracic (posterior mediastinal) schwannoma (red circles) occupying almost the entire left hemithorax. The mass caused severe compression and collapse of the left lung (blue label), displaced the mediastinum, and was in close proximity to the descending thoracic aorta. Associated left-sided pleural effusion is also noted (blue circle/label). (A) CT-enhanced imaging at the level of the main bronchi. (B) CT-enhanced imaging at the level of the tracheal carina. (C) CT-enhanced imaging at the level of the inferior vena cava. (D) CT-enhanced imaging at the level of the lower lobe bronchi. (E) Non-contrast CT imaging at the level of the lower lobe bronchi. (F) Lung-window non-contrast CT imaging at the level of the lower lobe bronchi.

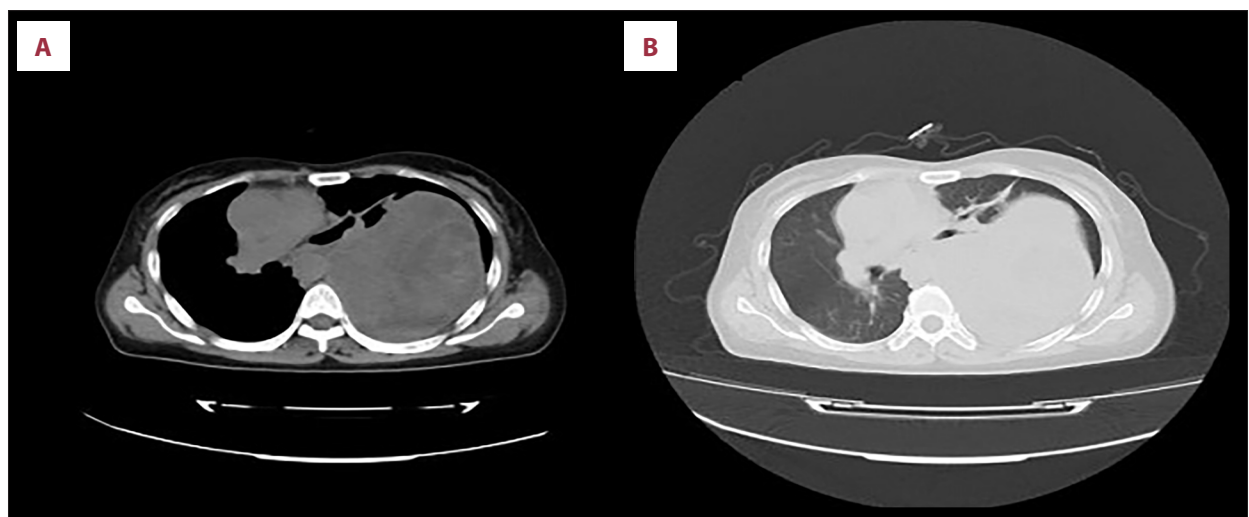


Figure 2. Left pleural cavity cystic-solid mass, partial re-expansion of left lung, cardiac shadow shifted to right. (A) CT plain scan (mediastinal window) at the level of the lower lobe bronchi. (B) CT plain scan (lung window) at the level of the lower lobe bronchi.

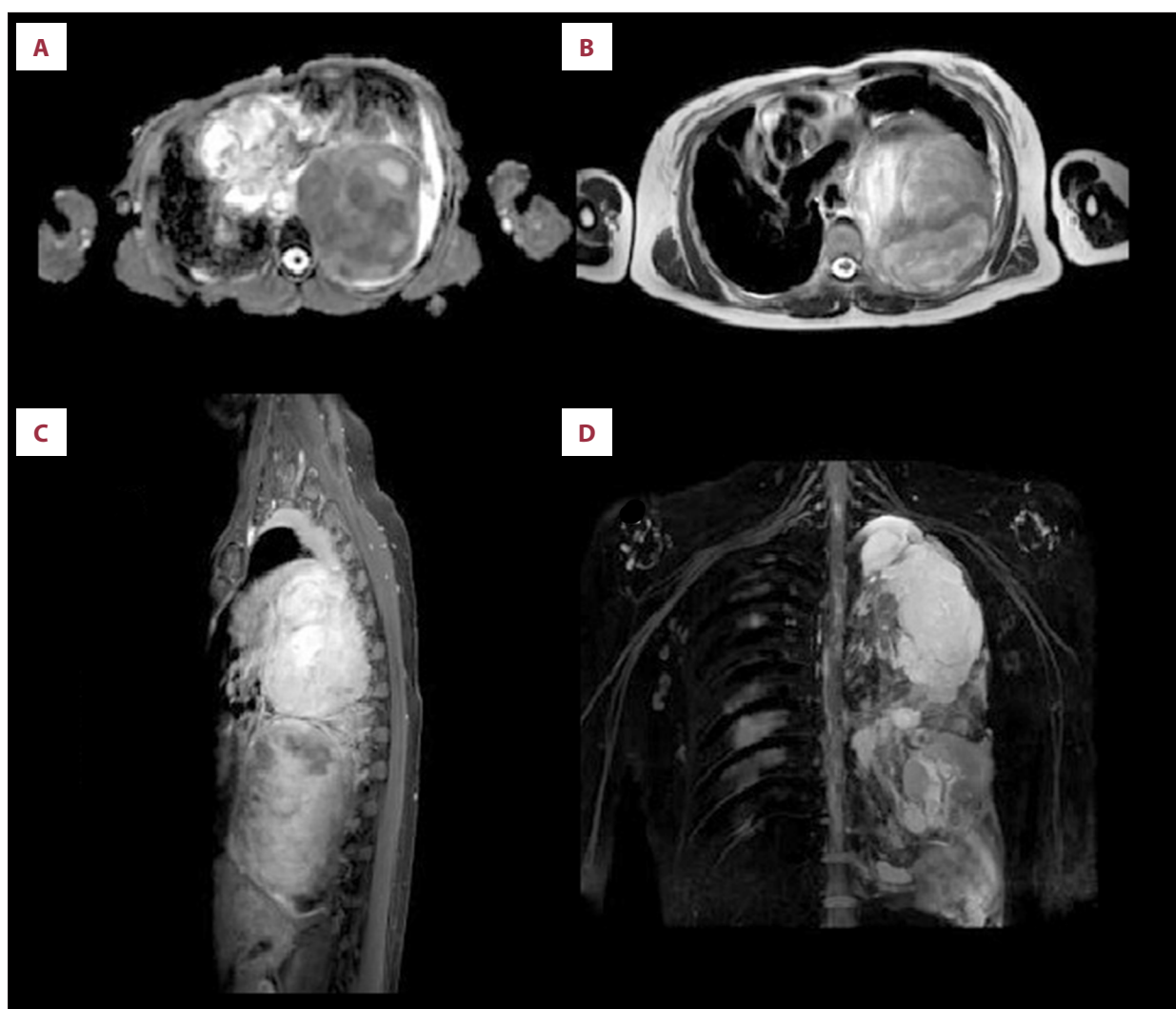


Figure 3. Giant cystic-solid space-occupying lesion in the left thoracic cavity arising from the left posterior mediastinum, with obvious compression of the left lung and diaphragm and rightward shift of the mediastinum. The lesion presents lobulation and septation with smooth margins. On T1-weighted imaging, it shows heterogeneous signal intensity with predominantly hypointense signal, while partial cystic areas demonstrate slightly higher signal intensity. On T2-weighted imaging, it manifests heterogeneous mixed hyperintense and hypointense signals, with markedly hyperintense signal in the cystic degeneration areas. (A) Axial FS-T2-weighted MRI at the level of the lower trachea, (B) Axial T1-weighted MRI at the same level, (C) Sagittal FS-T2-weighted MRI, (D) Coronal FS-T2-weighted MRI.

wall, spine, and intervertebral foramina, contrast-enhanced thoracic MRI combined with neurographic imaging was performed. Imaging revealed a giant cystic-solid mass in the left thoracic cavity. The lesion originated from the left posterior mediastinum, causing marked compression of the left lung and diaphragm with rightward mediastinal shift. The mass demonstrated internal lobulation and septation with smooth margins. On T1-weighted imaging (T1WI), it presented as a mixed low-signal mass with slightly hyperintense areas indicating partial cystic degeneration; on T2-weighted imaging (T2WI), it exhibited heterogeneous hyperintense and hypointense signals, with the cystic components showing markedly

high signal intensity. No adjacent bony destruction was observed. Contrast enhancement revealed heterogeneous augmentation of the solid components with delayed enhancement. Neurographic imaging showed no abnormalities in the cervical plexus, brachial plexus, or thoracic spinal nerve roots. The exits of the thoracic spinal nerves were symmetrical, the intervertebral foramina were not widened, and there was no evidence of nerve root discontinuity. These findings confirmed a giant cystic-solid neurogenic tumor originating from the posterior chest wall. The tumor was encapsulated, with no signs of external invasion, and was clearly demarcated from adjacent organs (Figure 3).

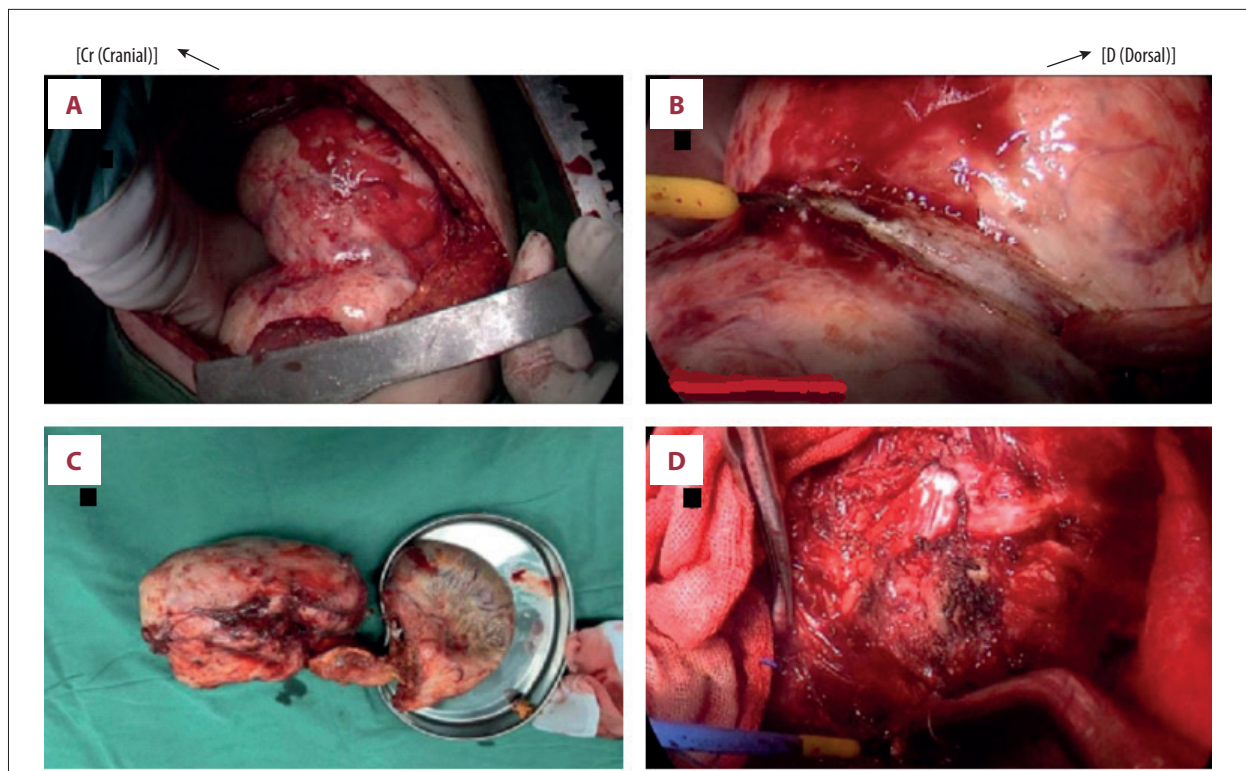


Figure 4. Exploration of a large, encapsulated mass in the left mediastinum. Surgical exposure of the massive intrathoracic mass via posterolateral thoracotomy with a thoracic retractor. Cr = cranial direction toward the thoracic inlet; D = dorsal direction corresponding to posterior thoracic wall and vertebral column. Segmented resection revealed its origin at the root of the left posterior sympathetic chain. The tumor was firm and grey-white in consistency, with partial dark fluid accumulation within the cystic cavity. (A) Tumor morphology as seen in the open thoracic cavity. (B) Piecemeal tumor resection performed intraoperatively. (C) Gross specimen of the resected tumor; the cystic contents were evacuated after opening. (D) Post-resection wound surface on the posterior wall of the thoracic cavity.

Based on core-needle biopsy and contrast-enhanced CT and MRI findings, a giant intrathoracic tumor was suspected to originate from the posterior chest wall, consistent with a neurogenic tumor. Contrast-enhanced chest CT demonstrated a mixed cystic-solid mass with heterogeneous enhancement. No hypervascularity was observed. In view of the lesion's poor vascularity and the lack of evidence of invasion into neighboring structures, the possibility of achieving complete surgical resection was considered to be high. A staged approach was planned: initial thoracoscopic exploration followed by conversion to an open thoracotomy if radical resection was deemed feasible upon intraoperative assessment. The operation was performed under general anesthesia with the patient in the standard right lateral decubitus position. Thoracoscopic exploration was initiated via a 4-cm utility incision at the fifth intercostal space along the mid-axillary line. Intraoperatively, a small amount of dark-brown pleural effusion was observed. The left hemithorax was almost entirely occupied by a well-encapsulated tumor, which exhibited focal adhesions to the surrounding lung parenchyma, diaphragm, and pericardium. After careful dissection of these adhesions, the tumor was found to

be densely adherent to the posterior chest wall, leaving minimal operative space. To ensure complete resection, a 20-cm posterolateral thoracotomy incision was made. Considering the massive size and fixed adhesion of the mass, coupled with its relatively avascular nature, a rib-sparing technique was employed. The tumor was resected in 2 separate parts (upper and lower segments). It was intimately attached to the sympathetic chain, with its pedicle originating from the T6 to T8 intercostal levels. En bloc resection included the tumor, the surrounding parietal pleura, and partial intercostal muscles at the root. Gross examination confirmed complete tumor removal with no residual disease. Intraoperatively, low-pressure high-frequency ventilation was applied to facilitate ipsilateral lung recruitment; no pulmonary edema or other complications occurred. A chest tube was placed postoperatively, and no air leakage was noted. The patient was successfully extubated following anesthesia recovery, with stable cardiopulmonary status, and required no postoperative mechanical ventilation. Postoperative management included antimicrobial prophylaxis and respiratory physiotherapy. The patient was discharged uneventfully and remains under regular follow-up (Figure 4).

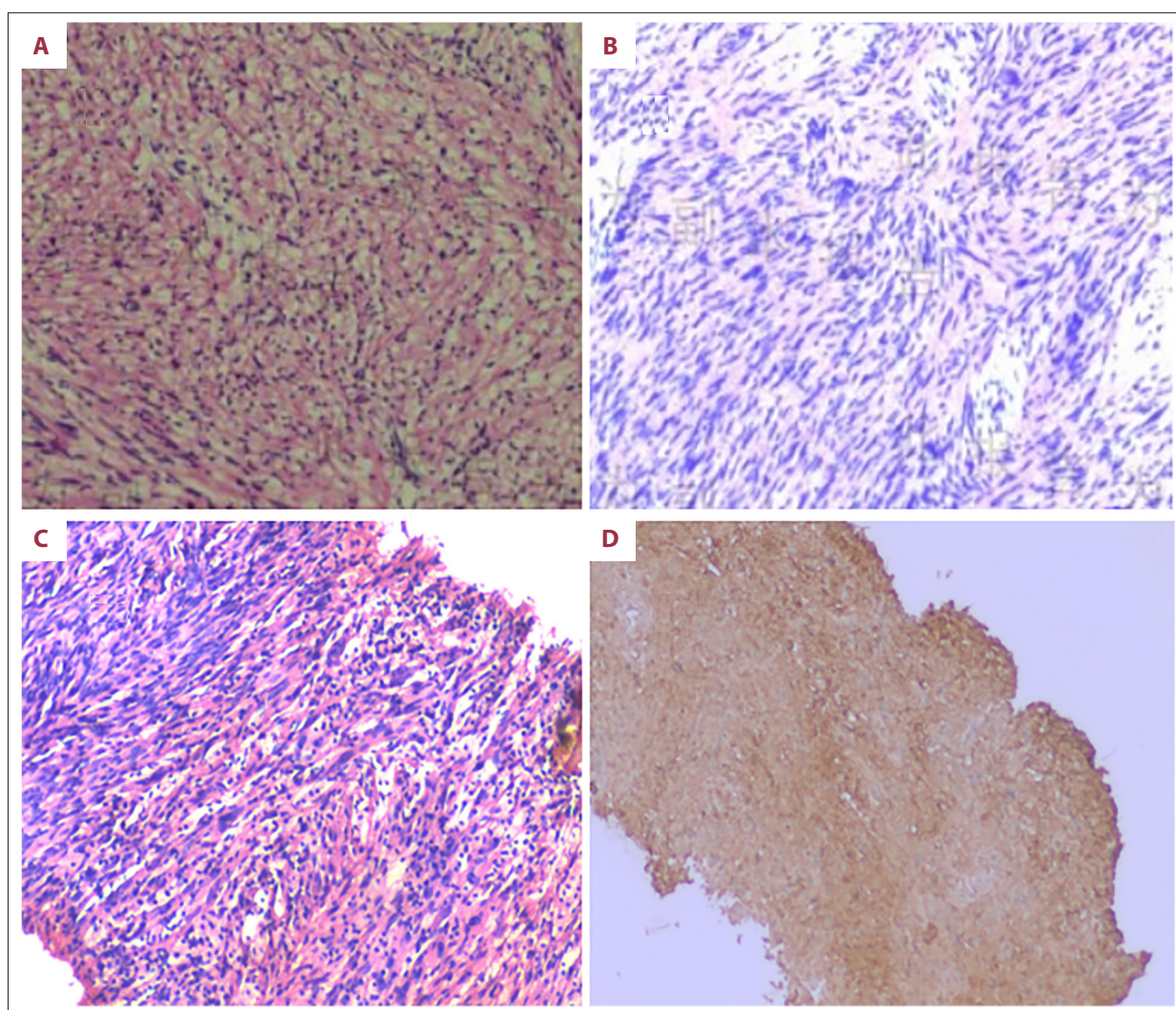


Figure 5. Histopathological features of the resected tumor. (A-C) Hematoxylin and eosin (H&E) staining shows spindle-shaped tumor cells arranged in interlacing fascicles, with focal hypercellularity and areas of cystic degeneration (original magnification $\times 100$). (D) Immunohistochemical staining for S-100 protein shows diffuse strong positivity, supporting the diagnosis of schwannoma with cystic changes. Original magnification: $\times 100$ for all panels.

Pathological examination and intraoperative/postoperative pathology reports indicated a left-sided thoracic spindle cell tumor. Microscopically, it exhibited focal cellularity and immunohistochemical S-100 positivity, consistent with a schwannoma with cystic changes (Figure 5). To exclude the possibility of a malignant peripheral nerve sheath tumor (MPNST), we integrated the immunohistochemical profile obtained from the preoperative biopsy with the morphological findings of the resected specimen. The biopsy revealed a low Ki-67 labeling index ($< 3\%$) and diffuse strong S-100 immunoreactivity, which are typical of benign schwannoma and distinctly different from MPNST, in which S-100 expression is usually focal or absent and the proliferative index is generally elevated. Furthermore, the resected tumor demonstrated histologically benign features, including Antoni A and Antoni B patterns, Verocay bodies, and

hyalinized vessels, with no evidence of necrosis, atypical mitoses, or infiltrative growth. These combined findings confidently ruled out MPNST.

The patient attended regular outpatient follow-up appointments after discharge. Her recovery was satisfactory, with no abnormal discomfort. Follow-up chest CT demonstrated good left lung expansion and left pleural thickening (Figure 6).

Discussion

Neurogenic tumors are the most common neoplasms of the posterior mediastinum, with only 5% to 15% being malignant. Thoracic neurogenic tumors can originate from any intrathoracic

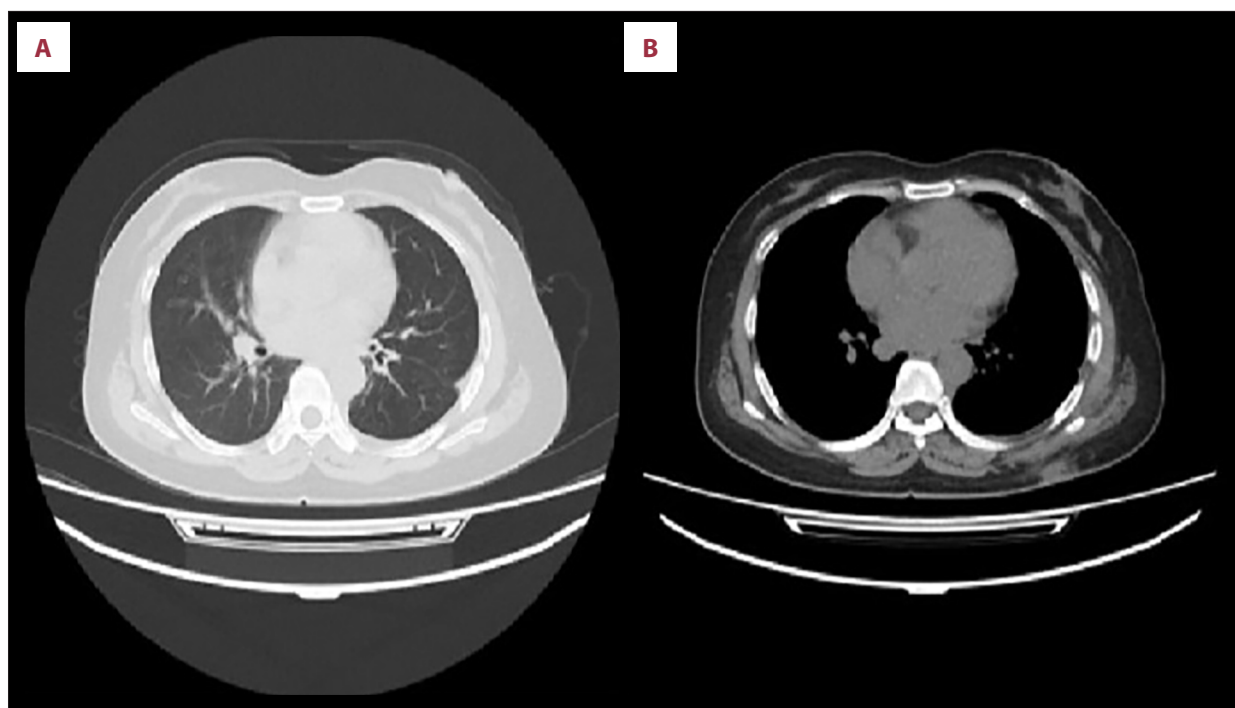


Figure 6. Six-month postoperative chest CT scan showing left pleural thickening without effusion or abnormal mass. (A) Lung-window CT image at the level of the lower lobe bronchi. (B) Mediastinal-window CT image at the level of the lower lobe bronchi.

neural structure and are generally classified into 3 categories based on cellular origin: schwannocytes derived from peripheral nerves, sympathetic ganglion cells, or spinal ganglion cells of the parasympathetic system [1,2]. Typically, schwannomas in the posterior mediastinum exhibit outward growth, readily compressing the heart and lungs. Consequently, patients often present with chest tightness and dyspnea as initial symptoms [4]. In cases with larger tumors, bronchial compression can cause obstructive pneumonia, manifesting as coughing and sputum production—symptoms mimicking pneumonia. Some patients have chest pain or sensory abnormalities due to pleural irritation, while others present with limb numbness from nerve compression [5]. Additionally, many patients remain asymptomatic until incidentally detected during physical examinations. The present case involved a posterior chest wall schwannoma originating from the left sympathetic chain. Although the mass occupied nearly the entire left hemithorax, resulting in severe lung atelectasis and marked mediastinal shift, the patient was admitted for abdominal pain, which is an atypical clinical presentation.

Diagnosis primarily relies on imaging studies, with CT and MRI being the most effective methods for determining lesion characteristics. The tumor typically presents as an isolated, round or oval mass projecting laterally from the vertebral column. Most exhibit a well-defined capsule with clear margins, a smooth surface, and a soft or firm consistency. Larger tumors can show cystic changes, while hemorrhage and calcification are uncommon.

The tumor demonstrates uniform internal density and generally exhibits a distinct border from surrounding normal tissue [6]. Contrast-enhanced CT and MRI not only determine lesion size, morphology, location, and relationship with surrounding organs and tissues, but also clearly display the tumor's internal structure. Most importantly, they can exclude tumor invasion of the vertebral body or communication with neural structures within the intervertebral foramen. Preoperative surgical planning based on MRI findings [7,8] effectively mitigates surgical complications. Our patient underwent preoperative progressive MRI contrast-enhanced scanning with neurofunctional imaging, confirming the lesion's origin in the left posterior mediastinum with a high likelihood of benignity. For patients with large tumors, preoperative guided needle biopsy histology remains the most valuable method for confirming posterior or mediastinal masses. In clinical practice, obtaining pathological specimens can be achieved through either needle biopsy or surgical resection [9]. CT- or ultrasound-guided percutaneous biopsy offers minimal invasiveness and is particularly advantageous for patients with large intrathoracic masses at risk of progressive compression-related complications. In this case, preoperative contrast-enhanced CT confirmed the tumor's relatively avascular nature, while contrast-enhanced MRI with nerve-root imaging excluded a foraminal or intraspinal origin. Ultrasound-guided core-needle biopsy established the diagnosis of a benign schwannoma. Given the patient's young age and the potential for further tumor enlargement leading to severe compressive symptoms or life-threatening complications, radical

surgical resection was indicated. A thoracotomy was subsequently performed, and histopathology confirmed a giant schwannoma originating from the left sympathetic chain. Admittedly, a full panel of immunohistochemical markers was not repeated on the resected specimen. However, because the preoperative core-needle biopsy had already provided a comprehensive immunophenotypic characterization sufficient for diagnosis, we prioritized histomorphological evaluation of the entire tumor to confirm complete resection and rule out malignant features.

For posterior mediastinal neurogenic tumors, the choice of surgical approach depends on the tumor's location, size, and relationship with surrounding structures [10]. For small-to-medium-sized tumors in the posterior mediastinum or those located posterior to the pleural dome, video-assisted thoracoscopic surgery is preferred due to its minimal invasiveness and adequate exposure. For resection of dumbbell-shaped tumors [11], preoperative MRI assessment is essential to identify the tumor's position relative to spinal nerves and intervertebral foramen. It is recommended to first perform an intra-laminar approach via neurosurgical spine surgery to remove the intraspinal tumor, followed by thoracoscopic or open thoracotomy resection of the posterior mediastinal tumor. Simultaneous resection of both the intrathoracic tumor and intraspinal invasive lesions can prevent intraspinal hemorrhage, hematoma formation, spinal cord injury, and residual tumor tissue, and minimize postoperative complications such as paraplegia and cerebrospinal fluid leakage. For large or massive posterior mediastinal tumors, surgical approaches should be selected based on tumor location, including posterolateral thoracic, anterolateral, transverse, or curved incisions. For highly vascularized massive tumors, preoperative interventional embolization of major tumor vessels can be performed to facilitate en bloc resection and reduce intraoperative hemorrhage [12]. For tumors of specific origin, such as those arising from motor nerves or adjacent to major nerves (eg, recurrent laryngeal nerve, brachial plexus), intraoperative use of a surgical microscope may be necessary to preserve motor fibers. In neurogenic tumors originating from the vagus nerve, meticulous dissection to free the vagus nerve is essential to avoid excessive traction and injury to the recurrent laryngeal nerve [13]. In this case, preoperative contrast-enhanced CT and MRI showed a posterior mediastinal mass abutting the diaphragm and chest wall, radiologically consistent with a neurogenic tumor arising from the posterior chest wall. The lesion demonstrated paucivascular enhancement without evidence of adjacent organ invasion, supporting candidacy for curative resection. Surgery commenced with diagnostic thoracoscopy via a 5th intercostal space mid-axillary port. Upon confirmation of resectability, the utility incision was extended. Intraoperatively,

the tumor was well-encapsulated with discrete margins but was densely adherent to the posterior chest wall within a restricted operative field. Given the large tumor volume and the lack of hypervascular enhancement on preoperative contrast-enhanced chest CT, the lesion was considered to be poorly vascularized. Therefore, rib resection was not performed, and a piecemeal resection strategy was used. Conversely, for tumors exhibiting marked enhancement on contrast-enhanced CT—suggesting hypervascularity—direct piecemeal resection should be avoided. In those settings, preoperative transcatheter embolization may be a viable option to minimize intraoperative blood loss, and the surgical team should ensure generous exposure and be well prepared for potential major bleeding. In the present case, the tumor was definitively traced to its origin along the sympathetic chain.

Conclusions

For large posterior mediastinal tumors associated with pulmonary and mediastinal compression or displacement, comprehensive preoperative evaluation integrating contrast-enhanced CT, MRI-based functional imaging, and nerve root assessment is essential to delineate the relationship between the tumor and the intervertebral foramen. This approach enables accurate determination of tumor origin, size, histologic characteristics, and vascularity. Superficially located masses warrant image-guided biopsy—via CT or ultrasound—to establish a definitive histologic diagnosis, thereby informing optimal therapeutic planning. For benign neurogenic tumors, complete surgical resection yields an excellent prognosis.

Department and Institution Where Work Was Done

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Patient Consent

Informed written consent was obtained from the patient for publication of this report and any accompanying images.

Declaration of Figures' Authenticity

All figures submitted have been created by the authors who confirm that the images are original with no duplication and have not been previously published in whole or in part.

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