

Management of Nerve Sheath Tumors Arising in the Sympathetic Chain

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Background: Extradural schwannomas arising from the sympathetic chain are uncommon benign nerve sheath tumors. We present our experience with three patients having such tumors located in the cervical, thoracic and lumbar regions and we describe clinical presentation, surgical treatment, and outcomes.

Methods: Between 2002 and 2006, the medical records of three patients with pathologically proven sympathetic schwannomas at the Moffitt Cancer Center were reviewed retrospectively.

Results: The three patients were female, with a mean age of 44 years. Presentation and symptomatology varied between patients, and radiographic findings were not diagnostic. Complete excision of tumors was performed in all three patients without added morbidity or mortality. Surgical observation, histopathology, and immunohistochemistry confirmed the tumors to be schwannomas arising from the sympathetic chain. The schwannomas had a mean diameter of 3.2 cm and were all benign. At a mean follow-up of 21 months following resection, all patients remained free of disease recurrence.

Conclusions: Sympathetic schwannomas are rare tumors that are difficult to diagnose preoperatively. Diagnosis relies on clinical suspicion, and confirmation is often obtained by means of surgical pathology. Long-term surveillance is not recommended and surgical excision should be considered for this tumor, even though the tumor is considered benign and recurrence is rare.

Introduction

Extradural schwannomas arising from the sympathetic chain are uncommon benign nerve sheath tumors originating from Schwann cells. Diagnosis of the neural origin of the tumor and the ability to differentiate among the various histologic processes that occur in the paravertebral spine are important in preoperative planning.¹ Similar to most neurogenic tumors, schwannomas present as asymptomatic masses. Treatment is either surgical resection or close observation.²⁻⁴

We present our surgical experience with three such tumors located in the cervical, thoracic, and lumbar region. The clinical presentation, surgical treatment, and outcomes of patients with this pathology are described.

Materials and Methods

Medical records at the Moffitt Cancer Center were

reviewed for the years 2002 through 2006 to identify sympathetic chain schwannomas. Clinical features, radiographic findings, and pathology results of three patients with histologically proven tumors treated by single-stage resection and stabilization are illustrated.

Illustrative Cases

All three patients were women, with a mean age of 44 years (range 41 to 46 years). Two patients were asymptomatic from their thoracic and lumbar tumors and 1 presented with Horner's syndrome and dysphagia from a cervical region tumor. The tumors were positive on positron-emission tomography (PET) scan and mimicked a spindle cell sarcoma. Complete excision of tumors was performed in all three patients without any added morbidity or mortality. Surgical observation, histopathology, and immunochemistry confirmed the tumors to be schwannomas of the sympathetic chain. The schwannomas had a mean diameter of 3.2 cm (range 3.1 to 3.5 cm) and all were benign. At a mean follow-up of 21 months (range 6 to 48 months) following resection, all patients remained free of disease recurrence. The Table summarizes preoperative symptoms, clinical findings, surgical approach, and outcome of all three patients.

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Table. — Patient Demographics and Clinical Characteristics

Case	Age (yrs)	Sex	Tumor Location	Symptoms/Presentation	Surgical Approach	Outcome
1	45	Female	Right paraspinal	Asymptomatic	Right posterolateral thoracotomy	No complications. No recurrence at 7 months of follow-up.
2	46	Female	Left paracervical	Left Horner's syndrome/dysphagia	Anterior approach along medial sternocleidomastoid/clavicle	Persistent left Horner's syndrome. No recurrence at 26 months of follow-up.
3	41	Female	Left lumbar retroperitoneal	Asymptomatic	Midline incision laparotomy	No complications. No recurrence at 48 months of follow-up.

Case 1

A 45-year-old woman presented with a right paraspinal mass that was demonstrated in a preoperative chest x-ray for scheduled discectomy and laminectomy of L4-L5. The patient presented with radicular pain and right foot drop presumably related to disc herniation at L4-L5. The patient had no symptoms or signs attributable to the T5-T6 mass and denied shortness of breath, cough, chest pain, or recent weight loss. Physical examination was significant only for findings related to disc herniation at L4-L5. Urinalysis showed normal catecholamine levels, decreasing the possibility of pheochromocytoma.

Chest computed tomography (CT) demonstrated a 3.2-cm right paraspinal tumor at T5-T6, and a subsequent PET scan demonstrated intense glucose hypermetabolism in the region of the lesion but in no other location. The lesion was enhancing on magnetic resonance imaging (MRI), and no evidence of spinal or intervertebral foramen invasion was present. Given the history and imaging findings, it was believed that the tumor was likely to be of neurogenic origin (Fig 1A-C).

The patient underwent resection of the tumor by means of right posterolateral thoracotomy through the bed of the fifth rib. The tumor was easily visualized as an extrapleural mass on the T5-T6 vertebral bodies that was

not adherent to the lung. Grossly, it appeared as a bosselated mass with hyperemia that did not extend into the neuroforamen and appeared to be originating from the right sympathetic chain. The sympathetic chain was therefore cut both superiorly and inferiorly to the tumor and submitted with the tumor for pathologic evaluation. The patient recovered with no complications and has had no recurrence at 7 months of follow-up.

Case 2

A 46-year-old woman presented with a left-sided Horner's syndrome that retrospectively was determined to have been developing for 6 years prior to presentation. The patient was referred to our institution after discovery of a left-sided paracervical tumor. The patient described anhidrosis of the left forehead area, noticed drooping of her left eyelid, and also reported intermittent dysphagia. She denied neck pain and experienced no numbness or weakness in the left arm. On physical examination, a tender mass was evident deep to the left inferior sternocleidomastoid muscle. Miosis of the left pupil was also noted, although all other physical examination findings were within normal limits.

Magnetic resonance imaging (MRI) demonstrated a 3.5 cm × 2.5 cm homogenous and well-circumscribed

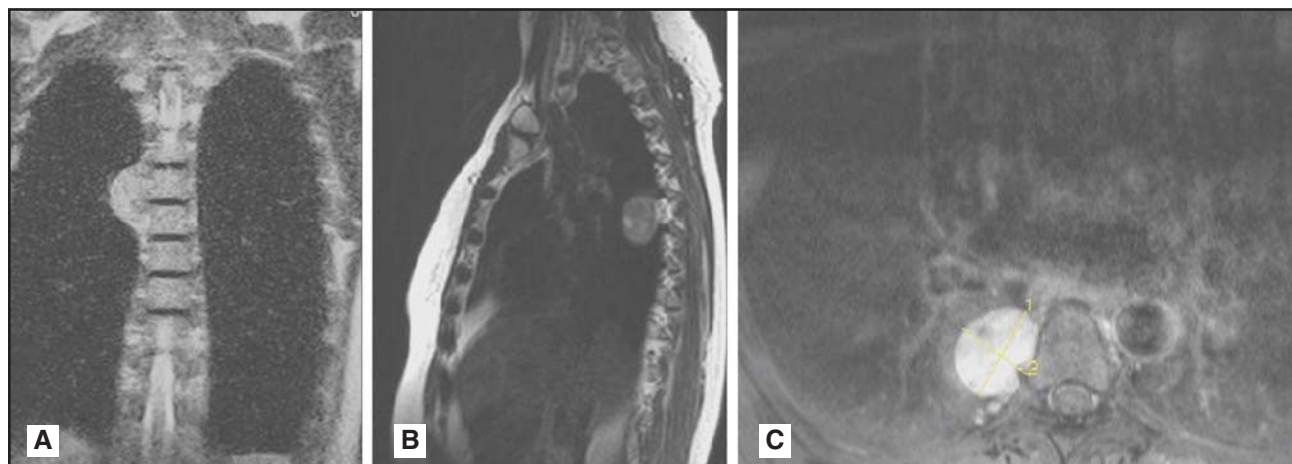


Fig 1A-C. — MRI of coronal (A), sagittal (B), and axial (C) views of thoracic spine of a 45-year-old woman with an incidental large 5- to 6-cm mass involving posterior mediastinum and paraspinal region at T4 level. Preoperative PET scan showed hypermetabolism in the lesion. Tumor was excised by standard transthoracic approach. The patient had an uneventful postoperative course and is doing well 7 months following surgery.

left paracervical mass, the bottom edge of which was at the level of the clavicle. The tumor was at the level of C7-T1 and was located posterior to the carotid sheath and lateral to the trachea and esophagus, causing some esophageal compression. Prior to resection, it was felt that this tumor was likely arising from the cervical sympathetic ganglion.

The patient underwent resection of the tumor by means of an anterior approach involving an incision along the inferior medial border of the sternocleidomastoid muscle and the medial border of the clavicle. Because of the proximity of the tumor to the C8-T1 nerve, brachial plexus monitoring was performed during the surgery. After dissection and identification of surrounding structures, the tumor was visualized inferior to the internal jugular vein and appeared grossly as a well encapsulated mass with yellow necrotic contents. The tumor was specifically identified as arising from the left stellate ganglion of the cervical sympathetic chain, and parts of the tumor were sent for frozen section. The tumor was carefully dissected from the carotid artery and removal of the tumor and the left stellate ganglion was completed. The patient recovered with no complications other than persistent left Horner's syndrome.

Case 3

A 41-year-old woman presented with a 3-cm retroperitoneal mass that was found on routine abdominal ultrasound. After CT-guided biopsy revealed the mass to be a schwannoma, the patient was referred to our institution for further evaluation. The patient was asymptomatic at presentation, denying symptoms suggestive of a secreting tumor such as flushing, headaches, or hypertension. She was in good health with no personal or family history of malignancy or neurofibromatosis. Physical examination was unremarkable and within normal limits.

A PET scan demonstrated increased uptake in the area of the mass as well as in the left iliac node area. An MRI of the abdomen with contrast revealed a 3.1×2.3 -cm enhancing mass located between the aorta and inferior vena cava just beneath the level of the left renal vein. The mass was visualized as external to the inferior vena cava and was causing compression due to its close proximity.

Surgical management involved joint efforts of the urological and neurological surgery teams. A midline incision was made from the xiphisternum to below the umbilicus and the abdomen was opened for exploration, with the intestines being retracted superiorly. Surrounding structures were dissected away from the tumor, which was located retroperitoneally just beneath the inferior vena cava and renal vein. The tumor was not vascular and was well encapsulated, appearing to arise from the sympathetic chain on the right side of the lumbar spine. After careful mobilization, the tumor was removed en bloc along with the associated ganglion and was sent for pathologic evaluation along with corresponding lymph nodes. The patient recovered from the procedure with no complications.

Pathology

Intraoperative consultations and final diagnosis for all three cases were identical and are described together. The tumors consisted of a typical spindle cell population with modest pleomorphism. Focally hypocellular areas (Antoni type B) were present amid hypercellular spindle cell populations (Antoni type A). Vascular hyalinization and occasional hemosiderin deposits were seen. Immunohistochemistry for S-100 protein was strikingly positive in all three cases, and neurofilament-positive processes were not identified within the body of the tumor. These histologic and immunohistochemical features are characteristic of schwannomas or neurilemmomas (Fig 2A-B).

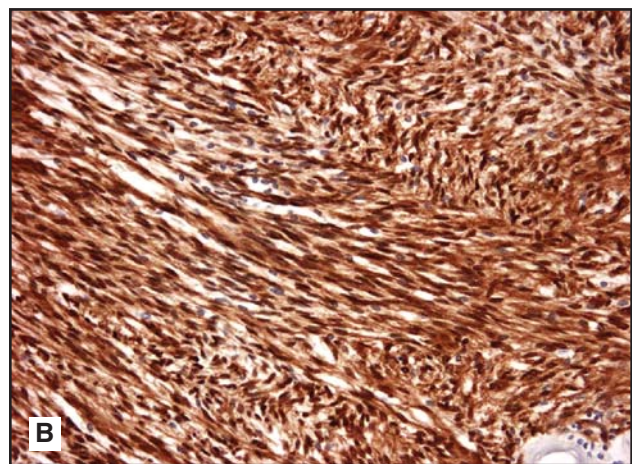
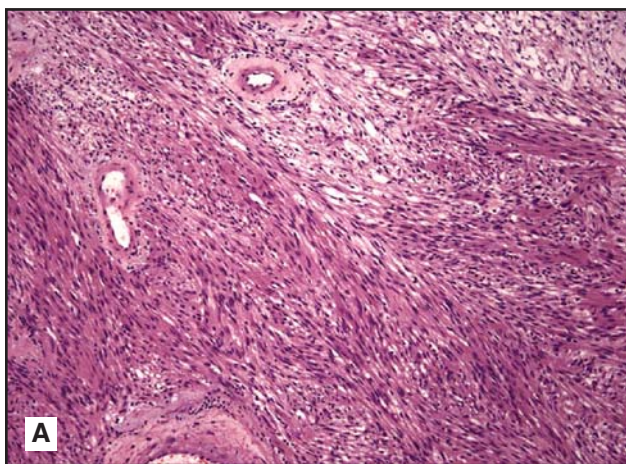


Fig 2A-B. — Depiction of tumor from case 2. (A) Hypercellular spindle cell areas (Antoni A) with focally hypocellular (Antoni B) regions are shown. Hyalinized vessels are also noted (hematoxylin-eosin, original magnification $\times 100$). (B) The tumor cells are strongly immunoreactive for S-100B protein (hematoxylin-eosin, original magnification $\times 200$).

Discussion

Schwannomas were first described by Verocay in 1908.⁵ Since that time, they have been called neurilemmomas, solitary nerve sheath tumors, perineural fibroblast tumors and, most recently, schwannomas, according to the World Health Organization (WHO) classification.^{6,7}

Epidemiology

Schwannomas may occur sporadically or in association with syndromes such as neurofibromatosis type 2 or schwannomatosis.^{5,8,9} Sympathetic chain schwannomas are rare, with fewer than 50 cases reported in the literature, and are predominately located in the cervical or lumbar retroperitoneal region.^{1-3,5,8,34} Schwannomas of the sympathetic chain occur between the ages of 30 and 70 years³⁴ but are most common in patients between 20 and 50 years of age.¹ The male:female ratio has been reported as 3:1.³⁴ No other etiologic factors or predispositions have been delineated from the small series or case reports that have been reported.

Clinical Presentation

The majority of sympathetic schwannomas are asymptomatic at the time of presentation. Sympathetic chain schwannoma may be accompanied by vague symptoms such as sore throat, hoarseness, or dysphagia in cervical region tumors and abdominal/flank pain in lumbar retroperitoneal tumors. Although schwannomas rarely compress or destroy the nerve, clinical findings related to sympathetic chain involvement may be present. The presence of Horner's syndrome before excision has been recorded in 6 previous cases of cervical schwannomas and also in our patient with cervical tumor.^{10,18,19,26-30,32,34} Histopathologically, there appeared to be nothing to distinguish the patient presenting with Horner's syndrome from the other patients who did not have this syndrome. In contrast, sympathetic hyperactivity has also been described in association with sympathetic schwannoma; one report describes a cervical sympathetic chain schwannoma presenting with ipsilateral lacrimation, hyperhidrosis, conjunctival injection, and nasal congestion.¹²

Diagnosis

The most challenging aspect of treating these lesions is distinguishing the benign sympathetic schwannoma from other pathologic processes with similar findings and presentations. Differential diagnosis depends on location of the mass and may include carotid artery lesions, paragangliomas, spindle cell sarcomas, or sympathetic chain neurogenic lesions. Retroperitoneal schwannomas may mimic renal or adrenal tumors or adnexal masses. Clinical examination may be helpful, but surgical intervention is often required to arrive at a definitive diagnosis and to exclude malignancy. Histopathology and immunohistochemistry are essential in diagnosis.

MRI has been shown to demonstrate high signal intensity on T2-weighted images, with relatively low signal intensity on T1-weighted images. In contrast with paragangliomas, there are no vascular flow voids in schwannomas. In general, schwannomas are hypodense compared with muscle on CT scan without contrast. When contrast is added, some degree of enhancement may be present. In paracervical schwannomas, direct visualization with ultrasound has been described as useful in differentiating vagus nerve schwannoma from sympathetic chain schwannoma.¹⁷ Carotid angiogram may also be useful in evaluating paracervical tumors; while hypervascularity is characteristic in carotid body tumors, schwannomas lack hypervascularity.^{25,27,33} Due to the compartmentalization of the cervical region, it is possible to suspect a diagnosis based on the anatomical region. In comparison to schwannomas, paragangliomas usually have a more cranial origin in the lateral cervical region. Schwannomas may have their origin in the parapharyngeal space, including cranial nerves IX, X, XI, and XII. Schwannomas of the vagus nerve grow between the common carotid artery and the internal jugular vein. This growth pattern often leads to a divergence of both structures, which is visible in CT scan or MRI. Furthermore, these tumors tend to be vascular; schwannomas of the sympathetic chain do not cause this separation of the common carotid artery and the internal jugular vein and are not typically vascular tumors.¹

Histopathology

As noted earlier, histopathology and immunohistochemistry are essential in establishing the diagnosis. The WHO classification of tumors of the central nervous system categorizes the schwannomas (synonymous: neurilemmoma, neurinoma) under tumors of cranial and paraspinal nerves. The classification differentiates between cellular, plexiform, and melanotic subtypes.^{6,7} Immunohistochemistry in schwannomas is characteristically positive for S-100 and negative for neurofilament protein.³⁵

Treatment

The issue of watchful waiting vs surgical resection is debated in clinical practice. However, there are several reasons to prefer a surgical resection. First, sympathetic chain schwannoma patients in our series and reported in the literature are young (20 to 50 years)¹ and have a life expectancy of several decades, which means that even currently asymptomatic tumors will finally grow to a size that will cause problems. Second, as already noted, there are several differential diagnoses to consider, some of which require more urgent surgical resection (eg, sarcomas, lung carcinomas). Since sympathetic chain ganglia schwannomas are rare, it is more likely for a cervical or thoracic paraspinal lesion to belong to the aforementioned category. Third, schwannomas may

be or may become malignant in rare cases and require adjuvant therapies. Therefore, it is important to obtain a reliable histologic diagnosis. In summary, these points illustrate the frequent need of a surgical resection vs long-term surveillance. The surgical approach to the paravertebral space is well known and within the armamentarium of all spine surgeons and neurosurgeons. All vascular structures and neural structures should be identified and preserved. The entrance and exit of the sympathetic nerve inferiorly and superiorly to the mass are isolated. In all of our cases, the nerve could not be preserved or dissected free from the tumor; the nerve was excised with a superior and inferior cuff. Postoperative complications involved with removing the cervical sympathetic chain commonly include Horner's syndrome, as detailed previously, as well as first bite syndrome.^{19,26,34} First bite syndrome is described as pain that is worst with the first bite of a meal and is related to hypersensitivity resulting from sympathetic denervation of the parotid gland.³⁴ In our patient with a cervical sympathetic chain tumor, Horner's syndrome was present preoperatively but did not require intervention, and first bite syndrome was not reported.

Postoperative Morbidity

The most common complications after resection of a sympathetic chain schwannoma of the cervicothoracic region are Horner's syndrome and facial anhidrosis of the contralateral side. The ptosis is due to the paralysis of Mueller's muscle and can be treated by advancement of the levator aponeurosis or by resection of the conjunctiva and Mueller's muscle.^{1,36} In our series, Horner's syndrome in the patient with the C7-T1 sympathetic chain schwannoma persisted after surgery. Typically, this syndrome is not debilitating as it does not alter vision but primarily affects cosmetic appearance.

Study Limitations

This series comprises tumors in different locations that may cause different neurological deficits and functional impairment and may require different surgical techniques and approaches. However, all the tumors belong to the same histologic entity, having presumably the same biological behavior. Given that sympathetic schwannomas are rare, it seems to be justified to include cervical and thoracic tumors in one series.

Conclusions

Sympathetic schwannomas are rare tumors that are difficult to diagnose preoperatively. Radiologic findings are usually nondiagnostic. Diagnosis relies on clinical suspicion, and confirmation is often obtained by means of surgical pathology. Long-term surveillance is not recommended, even though these tumors are benign and mostly asymptomatic. Surgical excision should be considered for this tumor, and recurrence is rare.

Disclosures

No significant relationship exists between the authors and the companies/organizations whose products or services may be referenced in this article.

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