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Neoplasm

Management of Patients with Schwannomatosis: Report of Six Cases and Review of the Literature

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BACKGROUND
Schwannomatosis is a rare tumor syndrome characterized by the presence of multiple schwannomas without the stigmata of neurofibromatosis (NF) Type 1 or 2. To better understand the natural history and clinical management of the syndrome, a retrospective review was conducted of patients diagnosed with schwannomatosis over an 11-year period at the University of Pennsylvania Medical Center (UPMC).

METHODS
Between 1990 and 2001, 131 patients underwent surgery for resection of spinal or peripheral nerve schwannomas in the Department of Neurosurgery at the University of Pennsylvania Medical Center. Among the 131 patients, there were 6 who had two or more pathologically proven schwannomas without radiographic or clinical evidence of vestibular schwannomas. The hospital charts, clinic notes, radiology films, operative reports, pathology slides, and reports from all 6 patients were retrospectively reviewed.

RESULTS
The patient population consisted of 6 patients with a mean age of 48.7 (3 male: 3 female). All patients had enhanced brain magnetic resonance imaging (MRI) scans that were negative for vestibular schwannomas. Ophthalmological and general physical examinations did not reveal any findings suggestive of NF. There was no family history of NF or schwannomatosis. The locations of the schwannomas included intraspinal (multiple sites), paraspinal, brachial plexus, femoral nerve, sciatic nerve, calf, forearm, retroperitoneum, and middle cranial/infratemporal fossa region. The common presenting symptoms included paresthesias, palpable mass, pain, or weakness. All 6 patients underwent surgical resection of symptomatic lesions.

CONCLUSIONS
For patients with schwannomatosis, surgery is indicated for symptomatic lesions, while asymptomatic tumors are followed conservatively. Because these patients are at increased risk for developing multiple schwannomas, we recommend regular surveillance and offer genetic counseling even though the pattern of inheritance is unknown.

KEY WORDS
Schwannoma, peripheral nerve tumors, schwannomatosis, neurofibromatosis Type 1, neurofibromatosis Type 2.

Schwannomas are benign, slowly growing, encapsulated peripheral nerve tumors. Most schwannomas occur as a solitary lesion, but they can occur as multiple lesions and can affect one or several nerves [2–4,10]. The presence of multiple schwannomas in a single patient suggests a genetic predisposition to tumorigenesis and possibly an association with one of the several syndromes, most commonly with neurofibromatoses. Of the several different subtypes of neurofibromatosis that have been described in the literature, only neurofibromatosis Type I (NF1) and Type II (NF2) have recognized National Institute of Health (NIH) consensus guidelines for diagnosis [15,16]. NF1 is by far the most common of the neurofibromatoses, with an estimated incidence of 1/2500 at birth, representing >90% of neurofibromatosis patients [9,16,18]. The NF1 gene has been localized to chromosome 17q11.1 with its product neurofibromin regulating ras oncoproteins [8,24]. NF2 is much less common than NF1, occurring in approximately 1/33,000 births and is associated with a significantly higher morbidity and mortality because of the higher incidence of intracranial and spinal tumors [14–16]. Mutations on chromosome 22q12 in NF2 cause inactivation of the tumor suppressor merlin, and

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1 Summary of Patients with Schwannomatosis ($N = 6$, University of Pennsylvania Medical Center, 1990–2001)

Patient	Age	Sex	Presenting Symptoms	Tumor Distribution	Clinical Findings	Surgery	Tumor Pathology	Follow Up (years)	Family History
1	28	M	L leg paresthesia and pain; tinnitus	Multiple spinal tumors	Ophth exam: nl	(1) T11-L1 Lami with resection of 2 lesions 12/90 (2) T4-5 lami resection 8/91 (3) T12-L1 tumor resection 6/99	schwannoma	10	Brother with tinnitus; otherwise negative.
2	17	F	Paresthesias of left arm	3 left forearm	One café-au-lait spot in left axilla; positive Tinel's sign.	Surgical resection of 3 lesions of left arm 2/99	schwannoma	6	Negative
3	44	M	R arm palpable mass & paresthesia, developed right arm pain after biopsy. Leg pain and paresthesia.	Brachial plexus, 2 intraspinal, tongue, right femoral nerve, right sciatic nerve, 3 left calf, right psoas muscle	Dec. hearing on left, one café-au-lait spot on left thigh. Right arm mass mobile to palpation.	R Brachial plexus lesion biopsy 1985; lumbar lami 11/99 left calf tumor resection 09/00.	schwannoma	11	Negative
4	79	F	L sciatica	Retroperitoneum and right middle cranial fossa; lumbar spine lesions.	Dec. hearing on right	Prior needle biopsy of middle-fossa lesion revealed schwannoma; lumbar laminectomy resection of tumor 10/99	schwannoma	3½	Negative
5	68	F	L leg pain	Femoral nerve, multiple spinal tumors	Nl hearing.	L groin tumor resection 10/58 L-Lami 5/00	schwannoma	4	Negative
6	56	M	R shoulder pain & atrophy	Cervical spine tumors (C5-6); right brachial plexus tumor	Nl hearing; right BP mass palpable & nonmobile; positive Tinel's sign.	(1) Cervical laminectomy 9/98 (2) R BP exploration 12/98	schwannoma	4	Negative

leads to the generation of multiple neural tumors [19,23]. The diagnostic hallmark of NF2 is the presence of bilateral eighth cranial nerve schwannomas, which occur in almost 95% of NF2 patients [14]. Patients with NF2 also have increased incidence of single and multiple meningiomas as well as multiple peripheral schwannomas [1,5].

Recently, several reports have pointed to the existence of a small subset of patients with multiple schwannomas without any radiologic or clinical evidence of vestibular nerve schwannomas or any other stigmata associated with NF2 [13,17,20,21, 25,26]. Molecular and genetic analysis of these patients' tumors suggests that schwannomatosis may be a distinct genetic and clinical syndrome [11,13,20]. Our experience in the Department of Neurosurgery at the University of Pennsylvania Medical Center (UPMC) supports the existence of schwannomatosis as a distinct clinical entity. In this report we present our 11-year experience with treatment of patients with multiple schwannomas without clinical or radiologic evidence of NF2.

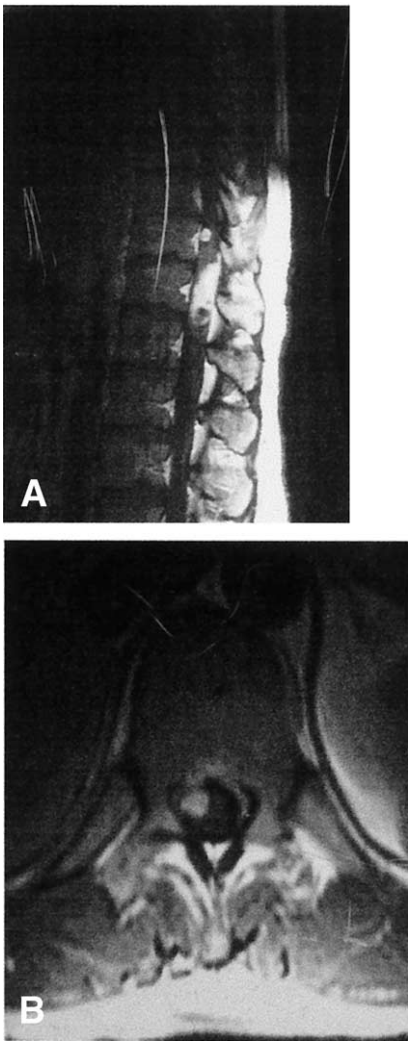
Materials and Methods

Between 1990 and 2001, 131 patients underwent operation for spinal and peripheral nerve schwannomas at the Department of Neurosurgery, University of Pennsylvania Medical Center. Among the 131 patients, there were 6 who had two or more pathologically proven schwannomas. Magnetic resonance images (MRI) of the head with and without gadolinium contrast were obtained in all 6 patients and revealed no evidence of vestibular schwannomas. In addition, ophthalmological and general physical examinations did not reveal any findings suggestive of NF. There was no family history of NF or schwannomatosis in any of the 6 patients. The hospital charts, clinic notes, operative reports, and pathology slides from all 6 patients were retrospectively reviewed. All patients underwent surgery for symptomatic lesions by a single neurosurgeon (ELZ).

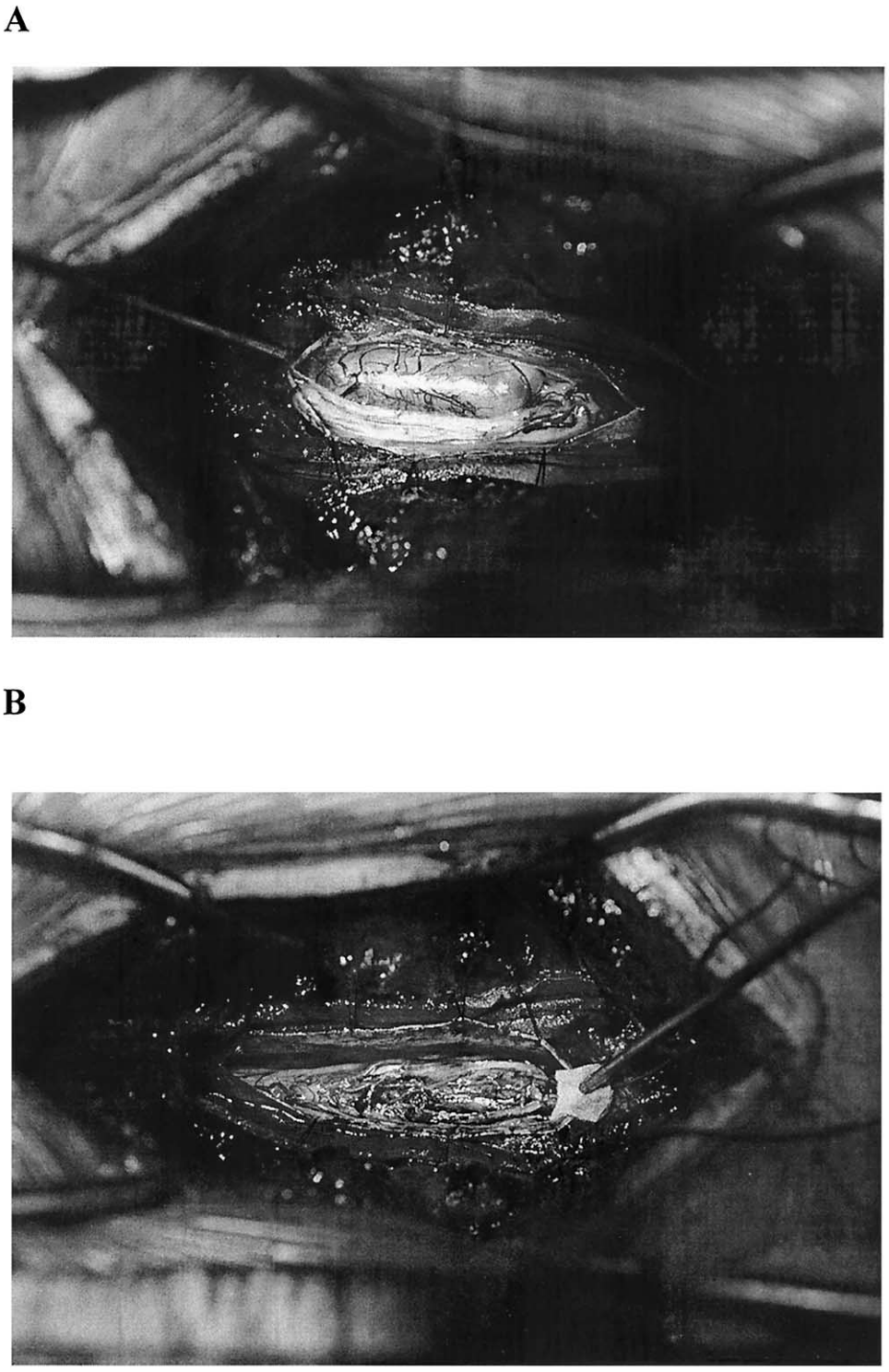
Results

Among the 131 patients with spinal or peripheral nerve schwannomas treated during an 11-year period, we identified 6 patients with schwannomatosis (4.6%). Table 1 provides an overview of the characteristics of 6 patients. At presentation, the patients had a mean age of 48.7 years (range, 17–79 years). The average follow-up was 6.4 years (range, 3.5–11 years). There was no family history of NF or schwannomatosis. The locations of the schwannomas included intraspinal (multiple sites), paraspinal, brachial plexus, femoral nerve, sciatic nerve, calf, forearm, retroperitoneum, and middle cranial/infratemporal fossa region. The common presenting symptoms included paresthesias, pain, weakness, or palpable mass (Table 1).

All 6 patients underwent surgical resection for their symptomatic lesions. Preoperatively, all tumors were imaged with MRI. Intraoperative neurophysiological monitoring was used in all operative cases. At the end of the follow-up period, all patients were in good clinical condition.



1 Patient 1. **A:** Sagittal T1-weighted MRI with gadolinium contrast demonstrating a large mass at T12 level and a smaller mass at T11 level. **B:** Axial T1-weighted MRI with gadolinium contrast revealing a mass at T5 level.

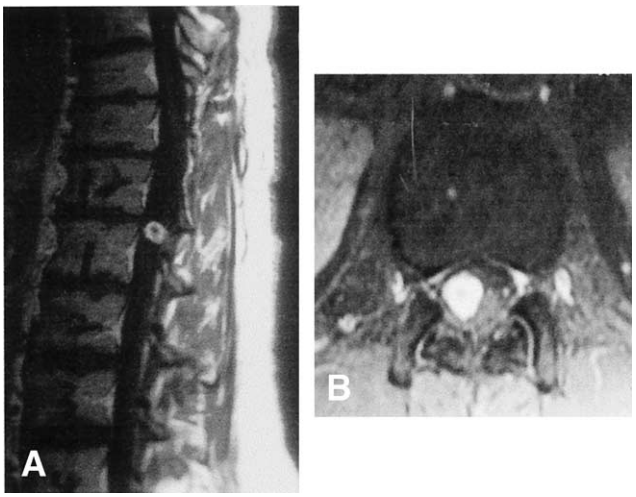


2 Patient 1. Intraoperative photographs showing before (**A**) and after (**B**) removal of the large T12 intradural extramedullary tumor.

Illustrative Cases

PATIENT 1

This 28-year-old male presented with paresthesias and pain radiating from his left hip to the knee. He had no associated bowel or bladder dysfunction. On physical examination he had weakness and atrophy of the left gastrocnemius muscle. An electromyogram (EMG) study revealed multiple radiculopathies. MRI showed an enhancing intradural,



3 Patient 1. **A:** Sagittal T1-weighted MRI with contrast demonstrating a new lesion at the L1 level. **B:** Axial T1-weighted MRI with contrast showing the same lesion.

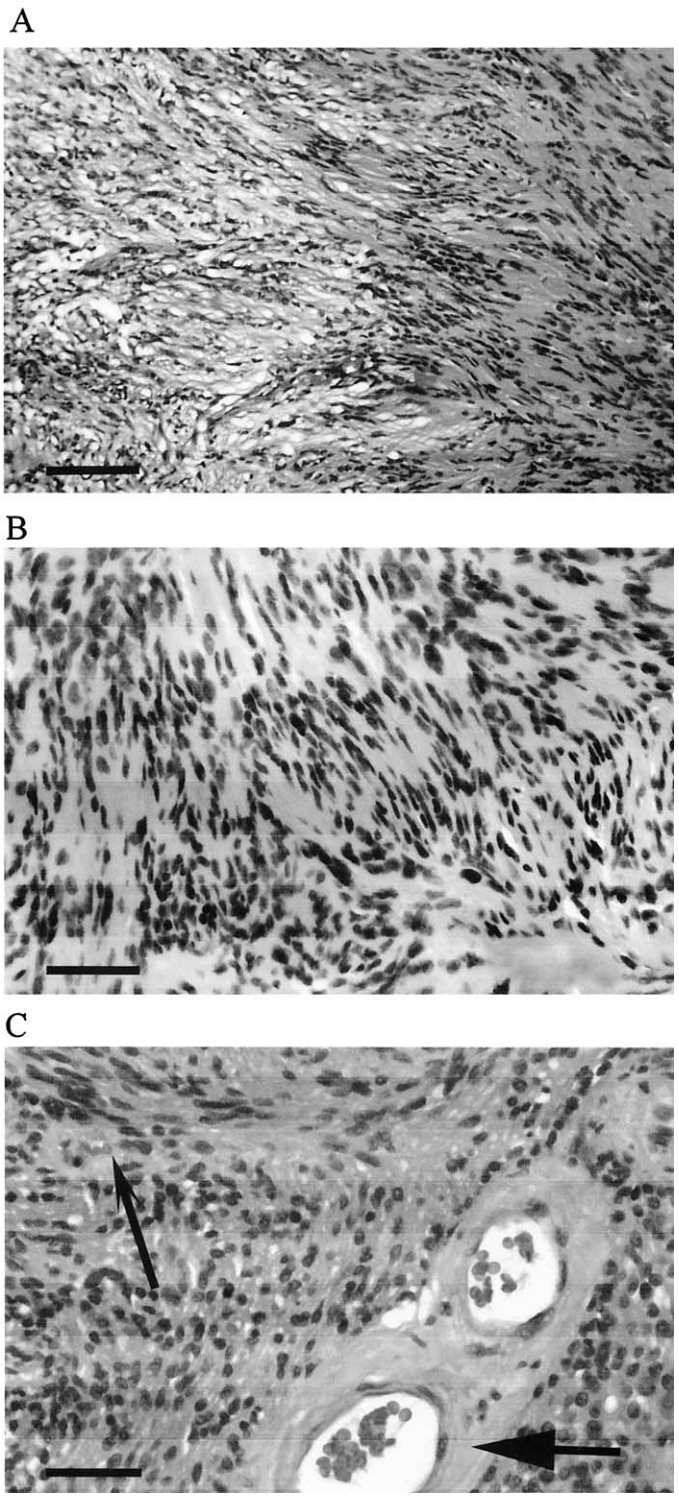
extramedullary mass at the T12 level with compression of the conus and proximal cauda equina as well as smaller lesions in the neural foramina of T5 and T11 and small asymptomatic enhancing lesions at multiple levels (Figure 1). The patient underwent a T12 laminectomy with complete resection of the tumor in December 1990 (Figure 2) with diagnosis of schwannoma. In August 1991, he underwent T5 hemilaminectomy with tumor removal. Eight years later, the patient began experiencing pain in the right flank and hip when sitting. Repeat MRI showed significant progression of the lesion at the L1 level with compression of the thecal sac (Figure 3). The patient underwent an L1 laminectomy with complete resection of the tumor, with the final diagnosis of schwannoma (Figure 4**A**). Patient had no Lisch nodules, CAL, axillary freckling, or history of any other neural tumors. There was no family history of NF1 or NF2. In October 1999, a brain MRI with and without contrast was negative for any intracranial mass. His small asymptomatic lesions at L3 are being followed with yearly MRI studies.

PATIENT 2

This 17-year-old female initially presented at age 11 with numbness and tingling of the extensor aspect of her left forearm as well as bilateral paresthesias in her upper extremities. EMG was consistent with carpal tunnel syndrome, and she underwent bilateral carpal tunnel release at a local hospital with only minimal relief of symptoms. Approximately 9 months after surgery, the patient fractured her left distal forearm and was treated with casting. Following the fracture, she continued to have pain in her left hand and forearm. Three years later, the patient reported feeling a "popping" sensation in her left forearm and was recasted on suspicion of recurrent fracture. Persistent pain prompted an MRI 1 year later, which revealed a nerve sheath tumor between distal ulna and radius. The tumor was resected along with the involved distal posterior interosseous nerve, with no neurologic deficit postoperatively. No pathology report is available for this procedure. Within 1 year after surgery, the patient noticed recurrence of pain in her forearm as well as pain in her neck and proximal upper extremities. The patient was referred to UPMC for further management. Repeat MRI revealed multiple small enhancing lesions in the forearm (Figure 5), but EMG examination was normal. Physical examination revealed a single CAL, tenderness over the left distal forearm, and a firm fullness that appeared to correspond to the location of the largest lesion seen on MRI. There was notable atrophy of the left hypothenar eminence with weak extension, abduction and adduction of the fourth and fifth digits. In 1999, the patient underwent surgical resection of 3 nerve sheath tumors from the left distal forearm, with final diagnosis of schwannoma (Figure 4**B**). The patient has no family history of NF1 or NF2, no Lisch nodules, negative MRI spine and head, and a genetic test negative for NF1.

PATIENT 3

This 44-year-old male presented with paresthesias of the right arm, and a palpable mass in the right supraclavicular fossa was found. Subsequent biopsy at a local hospital confirmed the diagnosis of schwannoma. He developed neuropathic pain of the right arm after the biopsy and was followed with periodic MRI. His pain was controlled with Tegretol. In October of 1999, the patient developed right knee numbness and pain that progressed with time. In addition, he had pain originating in the posterior thigh radiating to the buttock. He was seen by his orthopedist who obtained an MRI of the lumbar spine, which revealed two large intraspinal tumor masses (Figure 6) and a mass in the right psoas muscle consistent with nerve sheath tumors. Additional studies revealed a lesion in the tongue, right femoral nerve, right sciatic nerve and three lesions in the left calf. MRI of the brain was negative for any intracranial lesion. The patient was referred to UPMC for management. On physical examination, it was noted that the patient had a single large CAL on the medial aspect of his left thigh. The patient has no family history of neurofibromatosis. In November 1999 he underwent a lumbar laminectomy with resection of the intraspinal masses at UPMC. Pathology confirmed the diagnosis of schwannoma



4 Histopathological features classic for schwannoma were seen in these patients with schwannomatosis. **A:** Photomicrograph (Case 1, at medium magnification) demonstrates that the tumor consists of spindle-shaped cells in different patterns, including cell-dense (Antoni Type A, on the right side of the figure) and relatively cell-sparse (Antoni-Type B, on the left) areas. **B:** Photomicrograph (Case 2, at higher power) demonstrates an Antoni-Type A area with the characteristic horizontally oriented rows of tumor nuclei, which typify Verocay bodies. **C:** Photomicrograph (Case 3, again at higher power) demonstrates some of the other features seen in schwannomas, including fresh and old hemorrhage (slender arrow) and hyalinized blood vessels (thicker arrow). One can also appreciate the benign cytological features of the tumor cells, which is characteristic of schwannomas. Scale bar = 200 microns in **A**, 100 microns in **B** and **C**.

(Figure 4**C**). In 2000, he had 3 schwannomas resected from the left calf because of progressive pain, with good pain relief postoperatively. The other lesions are being followed with MRI and neurologic examinations.

Discussion

This paper describes our experience treating patients with multiple schwannomas without evidence of vestibular schwannomas. Tumors were

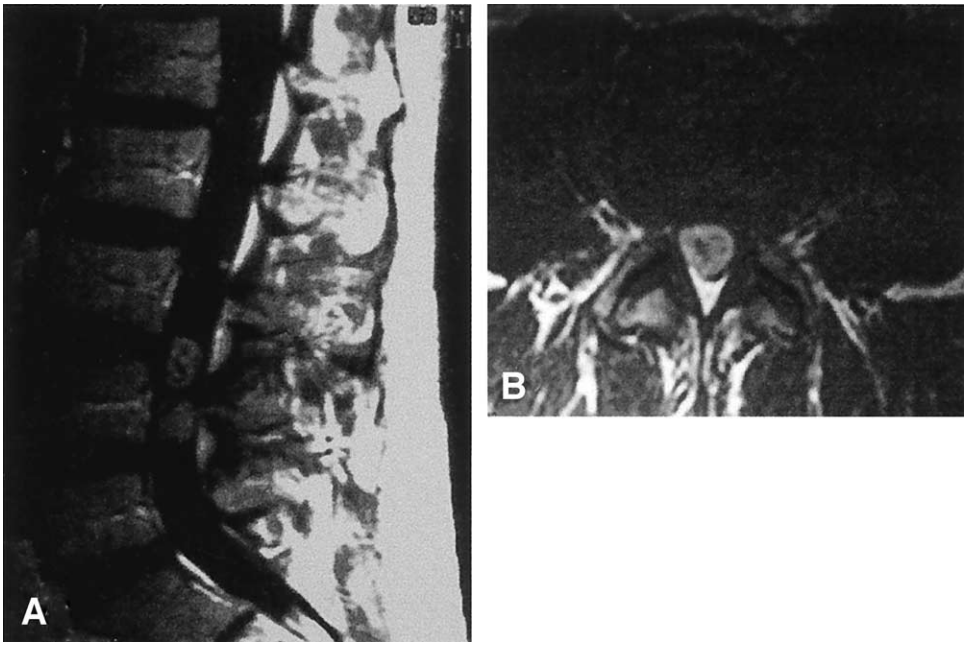
5 Patient 2. **A:** Sagittal T1-weighted MRI with contrast material demonstrating a large as well as a smaller mass at the forearm close to the ulna. **B:** Sagittal T1-weighted MRI with contrast material demonstrating a third lesion in the forearm of the same patient.

found in all regions of the body, including spinal, peripheral nerve, or subcutaneous regions. Patients commonly presented with a palpable mass, pain, and paresthesias as well as weakness and atrophy. In all 6 patients, symptomatic tumors were treated with surgery and asymptomatic tumors were observed for further growth. MRI was used to rule out the presence of asymptomatic vestibular schwannomas, which would suggest the diagnosis of NF2. While 2 of the 6 patients did exhibit 1 CAL, no patients had any ocular findings or other stigmata of NF. None of the patients had a family history of NF or schwannomatosis.

The earliest reports of schwannomatosis may be traced back to the early 1980s. Shishiba et al reported 33 patients with "neurilemomatosis," or multiple schwannomas [22]. A number of case reports followed, documenting at least 30 additional cases of multiple schwannomas, including patients with multiple tumors on the same peripheral nerve or in the same body segment [2,3,17,21]. In 1988, the NIH consensus guidelines included bilateral acoustic neuromas in the diagnostic criteria for NF2 [16]. Nearly 45% of Shishibi's original patients were then reclassified as NF2 patients. Evans et al argued that the remainder of these original patients and many in other case studies included those who were too young to have the diagnosis of NF2 excluded, as the mean age for development of acoustic neuromas in NF2 is 20 to 22 years of age [6]. Instead of a separate entity, Evans suggested that schwannomatosis was a subcategory of NF2 [6].

MacCollins et al studied 14 patients with multiple schwannomas without the clinical or radiologic criteria for NF1 or NF2 [13]. They reported that schwannomatosis did not follow the normal pattern of autosomal dominant inheritance seen in NF2. Only 1 out of the 14 patients had a positive family history for NF2. Antinheimo et al had similar results when they analyzed the Finnish Cancer Registry for cases of multiple schwannomas [1]. While 2% (11 of 455) of schwannoma patients had multiple schwannomas without NF2, only 2 of these 11 had familial schwannomatosis [1].

Jacoby et al analyzed the DNA of tumors and



6 Patient 3. **A:** Sagittal T1-weighted MRI with contrast demonstrating 2 lesions at the L4 level. **B:** Axial T1-weighted MRI with contrast showing one of the lesions at the L4 level nearly filling the spinal canal.

blood samples from 20 patients with schwannomatosis, including the patients reported in MacCollins' study [11]. Tumors from these patients frequently had the same truncating mutations and loss of heterozygosity at the Nf2 locus as NF2 patients. However, normal tissue did not contain these changes, implying that the underlying genetic mechanism of NF2 and schwannomatosis differs. Some of the patients in this study were found to be somatic mosaics, including 1 patient who had multiple schwannomas in a single limb. In 4 patients they found that individual tumors had unique mutations in the same allele. It is likely that there are several genetic mechanisms at play in the generation of multiple schwannomas. Further studies are needed to clarify the genetic basis for schwannomatosis.

Currently, there is no NIH diagnostic criteria for schwannomatosis. In 1997, Jacoby et al proposed a definition that has been widely adopted in the literature [11]. By this definition, patients can be definitively diagnosed with schwannomatosis if they have had two or more pathologically proven schwannomas and without radiographic evidence of a vestibular nerve tumor at age greater than 18. If a radiographic test such as MRI of the brain is not available, then a probable or presumptive diagnosis may be made if the patient has two or more pathologically proven schwannomas and no clinical symptoms of eighth nerve dysfunction at age greater than 30 or two or more schwannomas in an anatomically limited distribution without clinical finding of eighth nerve dysfunction at any age.

Patients with schwannomatosis represent a very small fraction of patients with spinal or peripheral schwannomas who are managed neurosurgically. Seppälä et al reported a series of 243 patients with spinal schwannomas over a 40-year period and identified 9 patients (3.7%) with schwannomatosis [20]. The incidence is similar to the 4.6% in our current 11-year experience of 131 patients with schwannomas. These patients commonly undergo multiple operative procedures over the course of their lifetime. Most of the patients were middle-aged at presentation with a mean age in our series of 48.7, which is similar to the mean age of 43.5 reported by Seppälä et al [20]. In contrast, patients with NF2 tend to become symptomatic at a much younger age, with a reported mean age of 21.5 in a large clinical series [5].

Most symptomatic schwannomas can be removed safely surgically by surgeons with experience resecting nerve sheath tumors [4,7,12]. We recommend the use of intraoperative neurophysiological monitoring for all cases. Asymptomatic tumors can be monitored conservatively with serial MRI studies, usually at a yearly interval. In addition, patients are educated about their condition so that they can recognize the early signs and symptoms of a symptomatic schwannoma. If there is any clinical indication for pathologic diagnosis, such as ruling out malignancy, computed tomography-guided biopsy may be utilized. However, the outcome for surgical resection following initial biopsy are reportedly worse than the outcome in cases with no prior biopsy, presumably because of biopsy induced fibrosis and/or nerve injury [7,12].

For long-term management of these patients, it is important to consider genetic testing. Currently genetic testing has limited clinical use because it has little impact on surgical decision making. However, a molecular diagnosis of NF2 rules out the diagnosis of schwannomatosis and makes genetic counseling more straightforward. Because the exact genetic mechanisms underlying schwannomatosis have not been fully identified, patients should be informed of the possibility of germ-line mutations, particularly in light of rare reports of a familial incidence.

Conclusions

Schwannomatosis is a rare tumor syndrome characterized by the presence of multiple schwannomas without the stigmata of neurofibromatosis (NF) Type 1 or 2. We reviewed our experience of managing 6 patients with schwannomatosis during an 11-year period: for patients with schwannomatosis, surgery is indicated for symptomatic lesions, while asymptomatic tumors are followed conservatively. Patients are counseled to monitor themselves for any new onset of neurologic symptoms. Because these patients are at increased risk for developing multiple schwannomas, we recommend regular surveillance and offer genetic counseling.

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References

1. Antinheimo J, Sankila R, Carpen O, et al. Population-based analysis of sporadic and type 2 neurofibromatosis-associated meningiomas and schwannomas. Neurology 2000;54:71–6.
2. Barre PS, Shaffer JW, Carter JR, et al. Multiplicity of neurilemomas in the upper extremity. J Hand Surg [Am] 1987;12:307–11.
3. Daras M, Koppel BS, Heise CW, et al. Multiple spinal

intradural schwannomas in the absence of von Recklinghausen's disease. Spine 1993;18:2556–9.
4. Donner TR, Voorhies RM, Kline DG. Neural sheath tumors of major nerves. J Neurosurg 1994;81:362–73.
5. Evans DG, Huson SM, Donnai D, et al. A clinical study of type 2 neurofibromatosis. Q J Med 1992;84:603–18.
6. Evans DG, Mason S, Huson SM, et al. Spinal and cutaneous schwannomatosis is a variant form of type 2 neurofibromatosis: a clinical and molecular study. J Neurol Neurosurg Psychiatry 1997;62:361–6.
7. Ganju A, Roosen N, Kline DG, et al. Outcomes in a consecutive series of 111 surgically treated plexal tumors: a review of the experience at the Louisiana State University Health Sciences Center. J Neurosurg 2001;95:51–60.
8. Gutmann DH. Recent insights into neurofibromatosis type 1: clear genetic progress. Arch Neurol 1998;55: 778–80.
9. Gutmann DH, Aylsworth A, Carey JC, et al. The diagnostic evaluation and multidisciplinary management of neurofibromatosis 1 and neurofibromatosis 2. JAMA 1997;278:51–7.
10. Halliday AL, Sobel RA, Martuza RL. Benign spinal nerve sheath tumors: their occurrence sporadically and in neurofibromatosis types 1 and 2. J Neurosurg 1991;74:248–53.
11. Jacoby LB, Jones D, Davis K, et al. Molecular analysis of the NF2 tumor-suppressor gene in schwannomatosis. Am J Hum Genet 1997;61:1293–302.
12. Lusk MD, Kline DG, Garcia CA. Tumors of the brachial plexus. Neurosurgery 1987;21:439–53.
13. MacCollin M, Woodfin W, Kronn D, et al. Schwannomatosis: a clinical and pathologic study. Neurology 1996;46:1072–9.
14. Martuza RL, Eldridge R. Neurofibromatosis 2 (bilateral acoustic neurofibromatosis). N Engl J Med 1988; 318:684–8.
15. Mulvihill JJ, Parry DM, Sherman JL, et al. NIH conference. Neurofibromatosis 1 (Recklinghausen disease) and neurofibromatosis 2 (bilateral acoustic neurofibromatosis). An update. Ann Intern Med 1990;113:39–52.
16. NIH: Neurofibromatosis. Conference statement. National Institutes of Health Consensus Development Conference. Arch Neurol 1988;45:575–8.
17. Purcell SM, Dixon SL. Schwannomatosis. An unusual variant of neurofibromatosis or a distinct clinical entity? Arch Dermatol 1989;125:390–3.
18. Riccardi VM. Von Recklinghausen neurofibromatosis. N Engl J Med 1981;305:1617–27.
19. Rouleau GA, Merel P, Lutchman M, et al. Alteration in a new gene encoding a putative membrane-organizing protein causes neuro-fibromatosis type 2. Nature 1993;363:515–21.
20. Seppälä MT, Sainio MA, Haltia MJ, et al. Multiple schwannomas: schwannomatosis or neurofibromatosis type 2? J Neurosurg 1998;89:36–41.
21. Shin KH, Moon SH, Suh JS, et al. Multiple neurilemomas. A case report. Clin Orthop 1998;171–5.
22. Shishiba T, Niimura M, Ohtsuka F, et al. Multiple cutaneous neurilemmomas as a skin manifestation of neurilemmomatosis. J Am Acad Dermatol 1984;10: 744–54.
23. Trofatter JA, MacCollin MM, Rutter JL, et al. A novel moesin-, ezrin-, radixin-like gene is a candidate for the neurofibromatosis 2 tumor suppressor. Cell 1993;72: 791–800.
24. Wallace MR, Marchuk DA, Andersen LB, et al. Type 1 neurofibromatosis gene: identification of a large transcript disrupted in three NF1 patients. Science 1990; 249:181–6.
25. Wolkenstein P, Benchikhi H, Zeller J, et al. Schwannomatosis: a clinical entity distinct from neurofibromatosis type 2. Dermatology 1997;195:228–31.
26. Yamamoto T, Maruyama S, Mizuno K. Schwannomatosis of the sciatic nerve. Skeletal Radiol 2001;30:109–13.

COMMENTARY

These authors from the University of Pennsylvania very thoroughly describe 6 patients with multiple schwannomas, and yet, without vestibular schwannomas. Their review of the literature regarding this interesting subtype of neural sheath tumors is excellent, and the histiology presented is especially fine. I would agree with their management paradigm of surgical removal of the symptomatic lesions or those threatening dysfunction followed by counseling including genetic advice.

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Mr. Gorbachev, tear down this wall!

—Ronald Reagan (1911–2004)
40th President of the United States of America
Remarks at the Brandenburg Gate
West Berlin, Germany
June 12, 1987