Morbidity and Functional Status of Patients With Pelvic Neurogenic Tumors After Wide Excision

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Abstract

Background We previously reported that over the last 10 years our practice has evolved in the treatment of neurogenic tumors of the pelvis to include a multispecialty team of surgeons, a factor that might decrease morbidity and improve recurrence, survival, and function.

Questions/purposes Therefore, we (1) assessed the morbidity associated with surgical excision in patients with neurogenic tumors of the pelvis; (2) determined the function of these patients; and (3) determined the rates of local recurrence, metastasis, and overall survival with this new approach.

Methods We reviewed the records of all 38 patients who had surgery for a pelvic plexus tumor between 1994 and 2005. Twenty one were male. The mean age of all patients was 38 years and median follow up was 2.1 years. Twelve patients had a malignant tumor. We recorded demographic

data, postoperative complications, tumor-specific recurrence, and determined survival.

Results Postoperative complications occurred in nine of the 38 patients (23%): hematoma ($n = 3$), wound infection or deep abscess ($n = 3$), and deep venous thrombosis ($n = 3$). Surgical complications occurred more frequently in patients with malignant disease. Patients with benign tumors had a mean MSTS score of 94%, while survivors of malignant disease had a mean of 57%. For malignant tumors, the 5-year rate of local recurrence was 40%, the estimated 5-year rate of metastasis was 67% and 5-year survival rate was 50%.

Conclusion Using a team approach, surgical excision provided high functional scores for patients with benign disease with a low rate of complications. In patients with malignant tumors, intentional wide resection is associated with higher morbidity but yields acceptable functional scores.

Level of Evidence Level IV, therapeutic study. See Guidelines for Authors for a complete description of levels of evidence.

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Each author certifies that his or her institution approved the human protocol for this investigation, that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.

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Introduction

Neurogenic tumors of the pelvis are a rare and heterogeneous group of lesions. The incidence of pelvic neurogenic tumors is estimated to represent approximately 10% of presacral tumors [13]. In an early series of abdominal and pelvic neoplasia of neurologic origin, Ransom and Kay [18] described the rarity of these tumors and difficulty with diagnosis and management. They have an indolent growth pattern and patients usually present later with nonspecific symptoms related to advanced lesions involving or compressing adjacent structures. Benign tumors usually arise

spontaneously in an adult patient; however, malignant tumors can arise de novo or in association with neurofibromatosis Type I [12, 22]. Most previous studies of neurogenic tumors focus on extremity-located lesions [2, 3, 16, 20]. Previous reports on pelvic neurogenic tumors tend to have a relatively small number of cases [1, 6, 7] with a heterogeneous mix of histologic type and primary and recurrent tumors.

Several studies of neurogenic tumors in the extremities suggest surgical excision is the treatment of choice [3, 12, 15, 20]. Malignant neurogenic tumors of the extremities have recurrence rates ranging from 30% to 65% [2, 8, 10, 12, 15]. Initial treatment with wide resection may give the best chance of disease-free and overall survival [3, 11]. However, in pelvic lesions, an adequate margin is often difficult because of the extent of the tumor and the lack of fascial barriers. In addition, the complex anatomy of the pelvis and the proximity of the tumor to adjacent bone, neurovascular, and visceral structures make wide resection a challenge for the orthopaedic oncologist.

We previously reported on 89 patients with a neurogenic tumor of the pelvis operated on between 1956 and 2004 in our institution [7]. Among patients with malignant tumors, the percentage of intralesional versus wide and marginal resections decreased over the course of the 48-year study period (85% intralesional before 1990, 43% intralesional after 1990) while the proportion of marginal and wide resections increased. The probability of developing metastasis and overall survival at 5 years was 65% and 48% respectively. Thirty percent local recurrence rate was estimated for both benign and malignant disease altogether at 5 years. No functional evaluation was recorded in our previous study.

Over the past 10 years, the management of neurogenic tumors of the pelvis in our institution has evolved from a single surgeon approach into an approach involving a multidisciplinary team. The multidisciplinary team includes two or more surgical specialists, including neurosurgeons, colorectal surgeons, orthopaedic surgeons specialized in musculoskeletal oncology, orthopaedic spine surgeons, vascular surgeons, urologists, and plastic surgeons. A newly diagnosed patient with a neurogenic tumor involving multiple pelvic structures is seen by all members of the team who will be involved in the operative procedure. The team meets with a dedicated musculoskeletal radiologist to elaborate the appropriate surgical plan with the goal to obtain adequate margins. We have therefore evolved toward a more aggressive approach with the goal to obtain a wide surgical margin that theoretically would enhance local control and overall survival.

Therefore, we (1) assessed the morbidity associated with wide surgical margins in patients with malignant neurogenic tumors of the pelvis; (2) determined the MSTs

functional score of these patients; (3) and determined the rates of local recurrence, metastasis, and overall survival using the multidisciplinary team approach.

Patients and Methods

We identified and retrospectively reviewed the charts of 38 patients with benign or malignant neurogenic tumors of the pelvis treated surgically by a standardized multidisciplinary team at our institution between 1994 and 2005. There were 21 males and 17 females, with a median age of 38 years (range, 1–71 years). Twelve patients (32%) had an initial procedure performed at another institution and 1/2 of them did not have tissue diagnosis before a definitive attempt at resection. Low back or pelvic pain was the most common presenting symptom followed by a change in bowel or urinary habits (Table 1). The indications for surgical resection for benign tumors were presence of symptoms, lesions larger than 5 cm on MRI and tumors that demonstrated rapid growth ($> 10\%$ increase in 1 year). These 38 patients were a subset of our earlier report including patients operated on in our institution over a 48-year period [7]. Clinical records were examined for demographics, tumor characteristics, adjuvant therapies, surgical approach, local recurrence of disease, development of metastasis, and overall survival. Nine patients died of their disease, including seven with malignant and two with benign tumors. The minimum followup was 7 days (median, 2.1 years; range, 7 days to 7 years). No patients were recalled to the clinic for this followup; all data came from available records or a telephone interview. Approval from the Institutional Review Board at our institution was obtained before the study was begun.

Thirty-five patients underwent MRI before definitive surgical management at our institution and the remaining three patients had an ultrasound combined with CT. Tumor size was determined as the greatest diameter of the resected tumor specimen and the average was 9.7 cm. Patients treated at our institution received a CT-guided core or fine-needle aspiration biopsy before definitive surgery, either

Table 1. Chief complaint at presentation

Complaint	Frequency
Pain	18 (47%)
Bowel habit change	4 (10%)
Urinary	4 (10%)
Mass (detected by patient)	3 (8%)
Neurologic deficit	1 (3%)
Rectal burning	1 (3%)
None (incidental diagnosis)	7 (18%)

parasacral or transperineal. Thus, 32 of 38 patients (84%) had a tissue diagnosis before definitive surgery. Tumors were classified as benign or malignant and subclassified according to histology pattern as reported elsewhere [15]. Twenty-six (68%) patients had benign disease while 12 (32%) had malignant tumors. Schwannoma was the most common benign histologic diagnosis, and malignant peripheral nerve sheath tumors were the majority of malignant lesions (Table 2). We defined intralesional excision as dissection within the tumor pseudocapsule, marginal excision as a margin of less than 2 cm, and wide excision as a margin of greater than 2 cm.

At time of surgery the lines of resection were finalized based on the local extent of the tumor which may include adjacent organs and bone with the goal of getting a wide margin. We performed an external hemipelvectomy in patients with loss of spinopelvic continuity, sacrificed the lumbosacral trunk, and resected the native hip joint. In patients with lesser extent of tumor, resection of a portion of the involved hemipelvis was possible with preservation of the limb. Frozen section pathologic analysis is performed in every case to guide the extent of resection.

All patients were accessed in the preoperative period for their expected neuromuscular dysfunction by a Physical Medicine and Rehabilitation (PMR) team. The specific rehabilitation protocol was determined by the level of resection and morbidity after surgery. Patients were followed closely postoperatively with particular attention to local recurrence and pulmonary metastasis. Patients were evaluated one month after discharge from the hospital by the multispecialty team involved in the surgery. A CT scan of the abdomen, pelvis and chest and an MRI of the pelvis were obtained every year for the first five years.

Patient ability to walk with or without assistant device was recorded at last followup. Function status was graded according to the MSTS [9] scoring system made available by contacting all 29 living patients for telephone interview with a minimum interval of 3 years after initial surgery. Major complications were defined as wound hematoma requiring surgical evacuation, infection (deep abscess or wound infection requiring surgical débridement), deep

venous thrombosis with prolonged use of reversal medication and death.

Continuous data were summarized as mean or median unless noted otherwise, while discrete data have been summarized as count (percentage). Survival, local recurrence, and distant metastasis were calculated using the Kaplan-Meier method [14]; local recurrence and metastasis are presented as the probability of occurrence (ie, proportion who have experienced the event), while survival is presented as the probability of survival (ie, proportion who have not experienced the event [death]). All analyses were conducted using SAS® Version 9.1, (SAS Institute, Inc, Cary, NC).

Results

Major complications occurred in 45% of the patients and included hematoma, wound infection or deep abscess, and deep venous thrombosis (Table 3). Complications occurred more frequently in patients with malignant disease. The most common complication was some grade of nerve paralysis after surgery. Intentional nerve excision to obtain adequate margin was often performed in malignant tumor resections. As a consequence, seven of 12 patients had clinical evidence of nerve palsy on physical examination compared to 19% in patients with benign tumors. Patients with benign disease most commonly underwent surgical resection with intralesional (18 of 26) or marginal (eight of 26) surgical margins. In the patients with malignant tumors, the surgical margins were intralesional in four, marginal in six, and wide in two. Nine patients received chemotherapy, six had postoperative radiotherapy, and two underwent intraoperative radiation therapy.

Patients with benign disease scored an average of 94% on the MSTS score functional evaluation while malignant disease survivors scored an average of 57%. In the malignant disease group, patients were most satisfied if neurogenic pain was relieved, despite physical disability. Seven of the 12 patients in this group were able to walk with or without assistive devices.

For malignant tumors, the 5-year rate of local recurrence was 40% (95% confidence interval [CI], 0%–69.1%),

Table 2. Histopathologic diagnosis

Diagnosis	Frequency
Benign (68%)	
Schwannoma	14 (37%)
Neurofibroma	12 (31%)
Malignant (32%)	
Malignant peripheral nerve sheath tumor	8 (21%)
Ependymoma	3 (8%)
Neuroblastoma	1 (3%)

Table 3. Benign/malignant complications (potentially multiple complications per patient)

Complication	Benign (n = 26)	Malignant (n = 12)	Overall (n = 38)
Hematoma	2 (8%)	1 (8%)	3 (8%)
Abscess/wound infection	1 (4%)	2 (17%)	3 (8%)
Deep venous thrombosis	0 (0%)	3 (25%)	3 (8%)

which was higher than the recurrence rate for benign tumors. The estimated 5-year rate of metastasis was 67% (95% CI, 26%–86%). The 5-year survival rate estimated by the Kaplan-Meier method for patients with malignant tumors was 50% (95% CI, 27%–88%) compared to 71% (95% CI, 40%–100%) in patients with benign disease (Fig. 1).

Fig. 1A–C Kaplan-Meier curves show (A) survival free of local recurrence for malignant tumors, (B) survival free of metastasis, and (C) overall survival for malignant tumors. Bars = 95% CIs.

Discussion

Neurogenic tumors of the pelvis represent a rare heterogeneous group of lesions. The true incidence of pelvic neurogenic tumors is unknown but estimated to represent 10% of presacral tumors [13]. Most reports on neurogenic tumors focus on extremity located lesions and those on pelvic tumors tend to have a relatively small number of cases including a heterogeneous mix of histologic types and both primary and recurrent tumors [1, 6, 7, 10]. We present one of the largest single institution series of neurogenic tumors of the pelvis treated by a multidisciplinary surgical team in the modern era. We explored the morbidity associated with wide surgical margins and the functional status after multimodal treatment of neurogenic tumors of the pelvis. We further evaluated the rates of local recurrence, metastasis, and overall survival in patients with malignant tumors.

There are limitations to our study. First, it is a retrospective study of a heterogeneous group of both benign and malignant tumors. We believe that including both benign and malignant tumors was important. We were able to show that benign tumors usually underwent surgical resection with intralesional (18 of 26) or marginal (eight of 26) surgical margins. These patients had high functional scores. Patients with malignant tumors had more extensive resection and a lower functional score. Second, given the limited number of patients we did not have enough statistical power to address important issues such as the influence of the extent of surgical margin and use of radiation and chemotherapy on local recurrence, metastasis, and survival in our malignant tumor group. Nevertheless neurogenic tumors are rare and it is difficult to obtain a large series from a single institution. Third, we could not determine the influence of our current multidisciplinary approach as compared to before 1990. However, in the current series, only four of 12 patients underwent resection with intralesional margins compared to 85% before 1990, which represents a tendency toward more aggressive surgical approach. Furthermore, given the limited data in the literature to guide treatment in neurogenic tumors of the pelvis, and the fact that a prospective randomized trial is unlikely to be undertaken, our results have reinforced the continued current approach to these patients.

Major complications occurred in 45% of our patients and included hematoma, wound infection, and deep venous thrombosis. This is consistent with the 20% to 66% incidence of complications reported in the literature for surgical resection of malignant tumors of the retrorectal space [4, 13, 17, 19]. Complications were more common after surgical treatment for malignant disease (six of 12) compared to benign lesions (three of 26).

Table 4. Comparison between the current and previous series on malignant neurogenic tumors

Study	Number of patients	Location	Complication rate (%)	5 years (%)			MSTS functional score (%)
				LR	Metastasis	Survival	
Anghileri et al. [2] ¶	205	All	NA	27	28	60	NA
Ducatman et al. [8] ¶	120	All	NA	40	65	34	NA
Hruban et al. [12]	43	All	NA	NA	26	NA	NA
Baehring et al. [3] ¶	54	All	NA	26	20	NA	NA
Kar et al. [15] ¶	24	All	NA	54*		58	24
Dozois et al. [7] §	89	Pelvis	13	35	65	48	NA
Alderete et al. [current study] §	38	Pelvis	45%	40	67	50	Benign 94 Malignant 57

* Combined recurrence rate; LR = local recurrence; MSTS = Musculoskeletal Tumor Society; NA = not available. ¶ All locations. § pelvic only.

The higher complication rate observed in malignant tumors may be influenced by the more aggressive type of resection and use of radiation therapy. Some degree of nerve palsy was the most common complication observed. Seven of the total of 12 patients with malignant tumors had some clinical evidence of nerve palsy on physical examination.

Patients with benign tumors had a better functional outcome when compared to patients with malignant tumors. The higher mean MSTS score (94%) in patients with benign tumors reflect nerve-sparing surgical techniques employed to maximize function while minimizing residual disease. The mean MSTS score of 57% in patients with malignant tumors was attributed to the more commonly performed intentional nerve resection to obtain adequate surgical margins. Although not objectively measured, survivors from the malignant group were most satisfied if neurogenic pain was relieved, despite physical disability. Previous series on malignant neurogenic tumors have focused on the rate of local recurrence, metastasis, and survival without addressing functional outcomes [2, 12, 15] (Table 4). We believe the functional score in our series was expected to be lower than that reported for other tumors in the pelvis because of intentional nerve root resection to obtain adequate surgical margin. Nevertheless, seven of 12 patients treated for malignant tumors were able to walk with or without an assistive device.

We observed a 40% rate of local recurrence at 5 years for malignant tumors in our series, which is comparable to recurrence rates ranging from 30% to 65% in previous reports of neurogenic tumors of all locations [2, 8, 10, 12, 15]. Malignant peripheral nerve sheath tumor was the most common malignant tumor in our series (eight of 12). These tumors have been reported to have a high risk for local recurrence that is directly associated with tumor size [2]. Pelvic tumors usually present with later diagnosis and the

tumor commonly has large size and volume [7], which may have contributed to the local recurrence rate we found. During the study period, the cumulative rate of metastasis at 5 years was 67%. In a large series including 230 patients with localized malignant peripheral nerve sheath tumors, Anghileri et al. [2] reported a 26% rate of metastasis at 5 years. The 5-year overall survival in patients with malignant tumors in this series was 50%, which is consistent with the results of previous studies on malignant peripheral nerve sheath tumors of all locations [2, 7, 8, 12, 15] and results of series on soft tissue sarcoma including the pelvis [5, 21]. In malignant peripheral nerve sheath tumors, the adequacy of surgical resection determines the best chance of disease-free and overall survival [10]. In two recent studies, adjuvant or neoadjuvant radiation therapy increased disease-free and overall survival in patients with malignant peripheral nerve sheath tumors [2, 15].

Although neurogenic tumors arising in the pelvis is a challenging treatment problem, we have demonstrated an aggressive surgical treatment can give good MSTS score results for patients with benign disease with a low rate of complications. In patients with malignant tumors, intentional wider resection is associated with higher morbidity but yields an acceptable functional outcome. Our findings encourage us to continue to manage patients with neurogenic pelvic tumors with a multidisciplinary team approach focusing on maximizing function and minimizing morbidity in benign disease. In malignant tumors, the aim is to obtain an appropriate surgical margin to obtain a curative resection, even though this may require ablation of viscera, bone, or neurovascular structures and major reconstruction procedures.

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