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Neurosurg Clin N Am 15 (2004) 453–457

NEUROSURGERY
CLINICS
OF NORTH AMERICA

Metastatic sacral tumors

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Metastatic disease to the sacrum has been shown to occur mostly in advanced stage cancer presenting with other spinal and extraspinal sites of involvement. Although some cases of direct extension from neighboring neoplasms, such as rectal carcinoma, have been reported, most sacral metastatic lesions originate from breast, lung, kidney, thyroid, and prostate carcinomas [1–3].

Anatomic considerations

A thorough understanding of anatomy is essential in evaluating structural and functional disorders of the sacrum. The sacrum is a pyramidal shaped bone found at the base of the spine. It measurements approximate 15 cm vertically, 6 cm in the transverse direction, and 2.5 cm in thickness. Its articulating surfaces include the sacroiliac joints and the termination of the lumbar spine at the L5 to S1 disk space. It represents the foundational support structure of the vertebral column. The posterior bony wall of the pelvis is defined by the anterior aspect of the sacrum. The sacral roots of the cauda equina depart between each pair of vestigial vertebrae. The dorsal nerve roots transmitted via the posterior rami supply sensation to the skin over the buttock area. The ventral nerve roots form the sacral plexus, which innervates muscles in the lower extremities and pelvis. The sacral roots at S2 to S5 control urethral and anal sphincter function as well as parasympathetics to the colon, urinary bladder, and genital organs [4,5].

Presentation

Tumors of the sacrum are rare overall, accounting for 1% to 7% of all spinal tumors that come to clinical attention [6]. This includes primary and metastatic lesions [7,8]. In selecting the optimal treatment option, one must carefully assess the patient's medical status, the location and extent of the lesion, and the biologic aggressiveness of the tumor type. As the result of a frequent delay in diagnosis, tumors may often present at a far advanced stage. Surgical resections frequently present unusual challenges because of the morbidity of the procedures. This may be complicated by the sacrifice of sacral nerve roots as well as by alterations in stability at the lumbosacral joint. Delay in diagnosis can extend for 2 years or more, as illustrated by a study by Feldenzer et al [6], and may be a result of unique properties of these tumors and their location, such as the capability of the sacral canal to permit asymptomatic tumor expansion, the nonspecific nature of the presenting symptoms, and the delay in interpretation of imaging studies.

The first presenting symptom is most often low back pain or referred pain to the leg or buttock secondary to irritation of the sacral sensory roots. Local pain may also be secondary to bony invasion and destruction [6,7]. Two mechanisms have been described to be the cause of neurologic deficits arising from sacral tumors: compression of the sacral roots within the spinal canal and direct involvement of the sacral plexus within the pelvis or sciatic nerve near its exit from the pelvis. These neurologic deficits comprise loss of bowel and bladder control as well as lower extremity weakness. Involvement of the S1 nerve root typically

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doi:10.1016/j.nec.2004.04.009

presents with gastrocnemius weakness as well as decreased ankle plantar flexion. Patients with lower sacral lesions in which the S1 nerve root is spared present with perineal numbness, incontinence of bowel and bladder, and loss of sexual function. Constitutional symptoms are essential in evaluating metastatic versus primary lesions. Common generalized symptoms may include weight loss, constipation, and abdominal fullness. Adequate physical examination is essential and includes a thorough evaluation of sensation in the saddle area, the posterior calf, and the plantar aspect of the foot as well as evaluation of rectal tone and bulbocavernosus, cremasteric, and anal reflexes [4].

The differential diagnosis includes lumbar spondylosis, herniated nucleus pulposus at the lumbar and lumbosacral levels, musculoskeletal injuries, and degenerative hip disease. By the time a sacral lesion is diagnosed, some patients may have been treated for lumbar spondylotic problems. Presenting factors in sacral tumors may be differentiated by their insidious onset, unilaterality, and involvement of continence and sexual function.

Imaging

Sacral tumors can easily be missed with conventional sacral radiographs because of the curvature of the sacrum, presence of intestinal gases, and rarity of neoplasms [7]. Evaluating symmetric projections of the sacral foramina through anteroposterior and lateral views can often aid in assessing plain radiographs [7,9]. Lytic lesions without sharply defined borders suggest malignancy, whereas sclerotic margins often reflect more benign pathologic findings. Pathologic changes must be significantly advanced to become observable on conventional radiographs in the sacral area.

Computed tomography (CT) scanning often permits delineation of the tumor. CT is essential in assessing bony structures and is an invaluable tool for planning reconstructive surgical procedures. Nevertheless, it remains difficult to differentiate primary from secondary lesions solely based on this modality [7]. Magnetic resonance imaging (MRI) is useful in evaluating soft tissue involvement in sacral tumors. It may also aid in evaluating the extent of bony destruction [7]. This modality is further used in assessing recurrent cases. MRI provides sagittal views, which are essential in evaluating tumor extent and anatomic relations to adjacent structures.

Other diagnostic modalities that have shown benefit in initial diagnostic evaluation of local disease as well as in evaluation of the extent of the systemic involvement, anatomic assessment, and surgical planning include radionucleotide bone scans and gallium scans and pelvic arteriograms.

Diagnosis of sacral metastases

Metastatic tumors remain the most common malignancy to occur in the sacrum. The most common route of spread is hematogenous. Carcinomas that metastasize to the sacrum include breast, lung, prostate, renal cell, and gastrointestinal cancer as well as multiple myeloma and thyroid cancer [7,10].

Involvement of the sacrum usually signifies advanced metastatic disease. Ozdemir et al [7] reviewed 34 cases of metastases to the sacrum; distant organ involvement was detected in 61% of these cases at the time of diagnosis of the sacral tumor, and 43% had metastasis to other vertebrae at that time. These distributions of concurrent distal metastases and other vertebral metastases are comparable to the ones in our study.

Presentation typically includes insidious onset of lower back pain and radiculopathy in the lower extremities. Presentation may be relatively acute compared with primary sacral tumors because of the rapid progression and invasive behavior of these metastatic lesions [10]. Diagnosis of sacral metastasis may be assisted with the performance of a biopsy. A biopsy may aid in making the decision to proceed with surgery or in assessing the extent of surgery, as dictated by the pathologic diagnosis. Whereas benign pathologic entities of the sacrum are managed by extensive surgical resection alone with wide margins of excision, malignant tumors are often treated with a combination of surgical resection or debulking with adjuvant radiation and chemotherapy or radiation and chemotherapy alone. Percutaneous and open biopsy techniques have been used. The percutaneous CT-guided biopsy provides the least risk and is believed to be the method of choice by the current authors.

Treatment

Treatment is typically palliative and is often achieved using radiation and chemotherapy alone. Surgery may be recommended if the patient has a life expectancy greater than 6 months and presents with a progressive neurologic deficit.

Table 1
Presentation data on 19 patients who underwent surgical resection of sacral metastases

	n	Percent
Levels of involvement		
S1	18	95%
S2	13	68%
S3	3	16%
S4	2	11%
Lumbosacral junction	4	21%
Sacroiliac junction	4	21%
Other spinal levels	10	53%
Other extraspinal levels	13	68%
Presenting signs and symptoms		
Motor	3	16%
Sensory	8	42%
Bladder	3	16%
Pain	18	95%
Histopathology		
Renal cell carcinoma	13	68%
Breast carcinoma	2	11%
Melanoma	1	5%
Multiple myeloma	1	5%
Colon carcinoma	1	5%
Myxoid liposarcoma	1	5%

Table 2
Surgical detail in 19 patients who underwent resection of sacral metastases

	n	Percent
Indications for surgery		
Pain	17	89%
Neurologic deficit	12	63%
Instability	5	26%
Oncologic	2	11%
Reason for surgery		
Primary therapy	4	21%
Salvage therapy	12	63%
Procedure details		
Laminectomies	18	95%
Vertebrectomies	13	68%
Instrumentation	12	63%

The main goals of treatment are pain control and salvage of neurologic function [4].

Careful selection of patients based on specific criteria is usually necessary for surgical intervention. These criteria include patients deemed to be medically stable enough to undergo the proposed surgery and having at least one of the following conditions: obvious spinal deformity; retropulsed bone or disk fragment in the spinal canal; radiographically significant compression or impending nerve root compression; prior irradiation of the site of progressive spinal involvement; or medically intractable mechanical, local, or radicular pain [7].

The selection of surgical approach is dictated by the location of the lesion within the sacrum and its extent through the bony margins. Masses originating from neural tissue are commonly approached posteriorly because of their proximity to the spinal canal.

Surgical resection of sacral metastasis presents a unique challenge because of the deep location of the tumor in the pelvis and surrounding neurovascular bundles. Gross total resection is believed to be the best management approach so long as an acceptable functional result is anticipated [11]. Surgical treatment is generally not curative; it is used for palliation, histologic diagnosis, neurologic decompression, debulking of tumor mass, and lumbopelvic stabilization. Sacral reconstruction is often required after resection of tumor invading S1, S2, and the sacroiliac joint. Reconstruction is needed to provide early mobilization and to prevent lumbopelvic instability [7]. A posterior approach is recommended for tumors distal to S2, and a combined anterior and posterior approach is recommended for tumors at S1 to S2 [7]. Huth et al [11] have demonstrated the advantages of simultaneous resection through an anterior transabdominal approach and a posterior approach. They demonstrated 100% continence of bowel and 43% continence of bladder in their patients after surgery. Adjuvant cryosurgery in tumor resection has been also suggested and shown to demonstrate promising results [1,12].

Outcome

Although metastatic tumors are the most common lesion involving the sacrum, there is a paucity of studies related to the outcome of patients undergoing surgical resection of these lesions [7]. Most reports on surgical treatment of sacral lesions discuss techniques of surgery [13,14] or focus on the outcome of specific groups of primary sacral tumors [13,15]. Ozdemir et al [7] reviewed the outcome of 34 patients who underwent surgical treatment of malignant tumors of the sacrum. The most common pathologic diagnosis observed in their study was breast cancer (in 20% of the cases), and they only had 1 patient (2%) with renal cell carcinoma as the primary tumor. Their complication and recurrence rates were 23% and 19%, respectively. Of

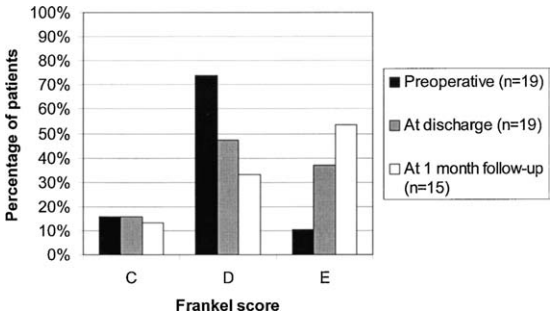

Fig. 1. Frankel grade outcomes in 19 patients who underwent resection of sacral metastases.

the complications, 16% were considered major complications. Kollender et al [1] reviewed a series of 14 sacral masses surgically resected with the use of adjuvant cryosurgery. Five of these 14 masses were metastatic, 2 of which originated from renal cell carcinoma. Survival in the metastatic lesion group was from 6 to 36 months. There were no local recurrences.

A retrospective study was conducted in 19 patients who underwent resection of sacral metastatic lesions at the University of Texas M.D. Anderson Cancer Center between August 30, 1993 to February 2, 2002. Pre- and postoperative pain levels based on a visual analog scale (VAS), analgesic medication use, and functional capacity based on modified Frankel grade scores were assessed. Data on patient presentation and outcome are presented in Tables 1 and 2. Results obtained demonstrated that 16 patients (84%) were ambulatory before surgery (n = 19), 2 of whom (11%) were ambulatory without assistance before surgery (Frankel grade E). After surgery, 16 patients (84%) remained ambulatory, but 7 (37%) were ambulatory without assistance. Only 2 patients (11%) from the Frankel groups D and E became nonambulatory. Three (16%) patients had a worse Frankel score on discharge, and 8 (42%) had an improved score on discharge (Fig. 1). Sixteen patients reported pain scores based on a VAS. Of these patients, 9 (56%) reported severe pain (VAS score: 8–10) before surgery and 6 (38%) had moderate pain (VAS score: 4–7) (Fig. 2). After surgery, no patients reported significant exacerbation of their pain (n = 16). Eleven of 16 (69%) patients reported significant improvement in their pain on discharge, and 5 (31%) reported no pain on discharge. Major and minor surgical complications occurred in 16% and 16% of patients, respectively. The median survival time of patients after the first spinal surgery, based on Kaplan-Meier estimates, was 21.80 months (95% confidence interval: 5.09–38.51). Their overall survival rate from the time of first spinal surgery was 82% at 3 months, 75% at 6 months, 61% at 12 months, and 47% at 24 months.

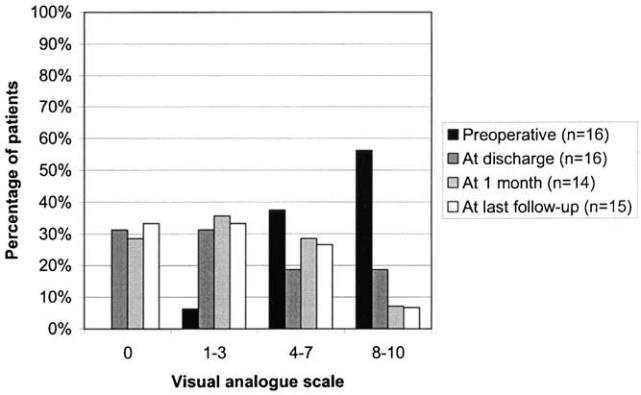

Fig. 2. Visual analog scale outcomes in 19 patients who underwent resection of sacral metastases.

Summary

Therapeutic approaches are still a matter of debate. Given the complexity of the sacral anatomy and the vicinity of major neural structures and vital organs, advantages of radical resection for local disease control must be weighed against the anticipated treatment morbidities and complications. It becomes imperative to establish a multidisciplinary team approach to provide the best environment for establishing individualized management plans.

References

[1] Kollender Y, Meller I, Bickels J, Flusser G, Issakov J, Merimsky O, et al. Role of adjuvant cryosurgery in intralesional treatment of sacral tumors. Cancer 2003;97(11):2830–8.

[2] Wuisman P, Lieshout O, Sugihara S, van Dijk M. Total sacrectomy and reconstruction: oncologic and functional outcome. Clin Orthop 2000;381:192–203.

[3] Llauger J, Palmer J, Amores S, Bague S, Camins A. Primary tumors of the sacrum: diagnostic imaging. AJR Am J Roentgenol 2000;174(2):417–24.

[4] Raque GH Jr, Vitaz TW, Shields CB. Treatment of neoplastic diseases of the sacrum. J Surg Oncol 2001;76(4):301–7.

[5] Parent A. Carpenter's human neuroanatomy. Baltimore: Williams & Wilkins; 1996.

[6] Feldenzer JA, McGauley JL, McGillicuddy JE. Sacral and presacral tumors: problems in diagnosis and management. Neurosurgery 1989;25(6):884–91.

[7] Ozdemir MH, Gurkan I, Yildiz Y, Yilmaz C, Saglik Y. Surgical treatment of malignant tumours of the sacrum. Eur J Surg Oncol 1999;25(1):44–9.

[8] Xu R, Ebraheim NA, Mohamed A, el-Gamal H, Yeasting RA. Anatomic considerations for dorsal sacral plate-screw fixation. J Spinal Disord 1995; 8(5):352–6.

[9] Turner ML, Mulhern CB, Dalinka MK. Lesions of the sacrum. JAMA 1981;245:275–7.

[10] Disler DG, Miklic D. Imaging findings in tumors of the sacrum. AJR Am J Roentgenol 1999;173(6): 1699–706.

[11] Huth JF, Dawson EG, Eilber FR. Abdominosacral resection for malignant tumors of the sacrum. Am J Surg 1984;148(1):157–61.

[12] Nader R, Alford BT, Hadjipavlou AG, Crow W, Nauta HJW. Preoperative embolization and intraoperative cryotherapy as adjuncts in resection of hypervascular lesions of the thoracolumbar spine. J Neurosurg 2002;97(Spine 3):294–300.

[13] Gokaslan ZL, Romsdahl MM, Kroll SS, Walsh GL, Gillis TA, Wildrick DM, et al. Total sacrectomy and Galveston L-rod reconstruction for malignant neoplasms. Technical note. J Neurosurg 1997;87(5):781–7.

[14] Salehi SA, McCafferty RR, Karahalios D, Ondra SL. Neural function preservation and early mobilization after resection of metastatic sacral tumors and lumbosacropelvic junction reconstruction. Report of three cases. J Neurosurg 2002;97(1 Suppl): 88–93.

[15] Gennari L, Azzarelli A, Quagliuolo V. A posterior approach for the excision of sacral chordoma. J Bone Joint Surg Br 1987;69(4):565–8.