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Metastatic Spinal Tumor – Updated Therapeutic Approach

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Abstract
Metastases spinal tumor represent a challenging problem in an oncology practice, and their rising incidence can be attributed to the expanding aging population and increased survival rates among cancer patients. The decision-making process in the treatment of spinal metastasis requires a multidisciplinary approach that includes medical and radiation oncology, surgery, and rehabilitation. Various decision-making systems have been proposed in the literature in order to estimate survival and suggest appropriate treatment options for patients experiencing spinal metastasis. However, recent advances in treatment modalities for spinal metastasis, such as stereotactic radiosurgery and minimally invasive surgical techniques, have reshaped clinical practices concerning patients with spinal metastasis, making a demand for further improvements on current decision-making systems. In this review, recent improvements in treatment modalities and the evolution of decision-making systems for metastatic spinal tumors are discussed.

***Keywords**: Spinalmetastasis; Decision-making system; Radiosurgery; Minimally invasive surgical procedures; Separation surgery*

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I. Introduction

Metastases to the spine are a common problem seen in 5% to 10% [1] of all cancer patients during the course of their disease. It affect more than 70% of terminal cancer patients that eventually suffer from severe pain and neurological symptoms. Spinal cord compression develops in 10–20% of patients with spinal disease and in 5–10% of all cancer patients[2]. In a study of over 15,000 patients with metastatic spinal cord compression, the most common histologies were lung cancer (25%), prostate cancer (16%), and multiple myeloma (11%). Approximately 60% of cases involve the thoracic spine, 25% the lumbosacral spine and 15% the cervical spine[3]. While pain is the most frequent symptom, 10% of cancer patients develop weakness, sensory disturbances, bowel or bladder dysfunction, and gait disturbance from instability or spinal cord compression[4].

The appropriate treatment for an individual patient requires a multidisciplinary review include a pathologist, medical oncologist, radiologist, radiation oncologist, neurosurgeon and rehabilitation [5]. Therapeutic intervention can alleviate pain, preserve or improve neurologic function, achieve mechanical stability, optimize local tumor control, and improve quality of life. RT is accepted as the first-line choice for most patients with metastatic spinal tumor, but surgical advances over the last 15 years have dramatically improved surgical outcomes for these patients. These advances include anterior transcavitary and posterolateral approaches to the spine and the application of anterior locking plates and posterior segmental spinal fixation. Also, those cases that once required radical surgical resection followed by low-dose conventional radiotherapy, can now be more effectively treated by minimally invasive spinal surgery (MISS) followed by spine SRS with decreased morbidity, improved local control, and more durable pain control. This combination allows also extending this standard of care to patients that would be too sick for an aggressive surgical treatment[6].

PRESENTATION

Back pain, the most common presenting symptom in patients with metastatic tumor to the bone or epidural space, often precedes the development of other neurologic symptoms by weeks or months. Back pain may even begin years after the initial cancer diagnosis or may represent a new treatment-related tumor in the spine (e.g., post-radiation sarcoma). Two distinct types of back pain are encountered in patients with spinal tumors: tumor-related and mechanical. Tumor-related pain is predominantly nocturnal or early morning pain and generally improves with activity during the day. This pain may be caused by inflammatory mediators or tumor stretching the periosteum of the vertebral body. Tumor-related pain generally responds to administration of low-dose steroids (e.g., decadron 12 mg daily). Definitive treatment of the underlying tumor with radiation or surgery often relieves this pain. Recurrence of pain following treatment may be a harbinger of locally recurrent tumor.

Mechanical pain results from a structural abnormality of the spine, such as a pathologic compression fracture resulting in instability. This pain is movement-related and may be exacerbated by sitting or standing which increases from the axial load on the spine. Mechanical pain does not typically respond to steroids, but may be relieved with narcotics or an external orthosis, pending definitive therapy. Pathologic thoracic compression fractures often present with pain for a few days, which resolves without bracing, unless the tumor additionally involves the posterior spinal elements.

Neurologic symptoms and signs often begin with radiculopathy (nerve root symptoms) and are followed by myelopathy (spinal cord compression). Radiculopathy in the cervical or lumbar spine causes pain or weakness in the upper or lower extremity, respectively.

Myelopathy begins as hyperreflexia, a Babinski reflex and clonus, but progresses to weakness, proprioceptive sensory loss, and loss of pain and temperature below the level of the spinal cord compression. Isolated loss of bowel and bladder function in the absence of motor or sensory symptoms most often results from compression at the conus medullaris (tip of the spinal cord at approximately L1) or sacral tumor.

The evaluation of spinal patients should include a pain assessment, quantitative neurologic score, and a general performance score. Pain assessment can be most readily performed with a visual analog scale which is familiar to many cancer patients. The score can be converted to reflect mild (0 to 4), moderate (5 to 6) and severe (7 to 10) pain [7]. The two most commonly used neurologic scales include the Frankel grading system [8] and the American Spinal Injury Association (ASIA) score [9] (Table 1).

Table 1

Table 1. ASIA impairment scale

Grade	Description
A	Complete.: No motor or sensory function is preserved in the sacral segments S4-S5
B	Incomplete: Sensory but not motor function is preserved below the neurological level and extends through the sacral segments S4-S5
C	Incomplete: . Motor function is preserved below the neurological level, and the majority of key muscles below the neurological level have a muscle grade less than 3.
D	Incomplete: Motor function is preserved below the neurological level, and the majority of key muscles below the neurological level have a muscle grade greater than 3
E	Normal: Motor and sensory function is normal

Both assess motor function with a score of “E” being normal and “A” being complete paralysis. Performance status reflects ambulation, medical comoribidities and extent of disease. A patient may have normal motor strength, but be unable to ambulate from loss of proprioception, fracture in the lower extremity, poor nutritional status, poor pulmonary function and a variety of other symptoms. We have used the Eastern Cooperative Oncology Group (ECOG) performance status [10] as a functional assessment. It is important to include both neurologic and performance status when reviewing outcomes in cancer patients.

IMAGING

Advances in imaging have improved the sensitivity of detecting spinal metastases and the specificity of differentiating from other processes that involve the spine. Magnetic resonance imaging (MRI) has revolutionized assessment of metastatic spinal tumor, but many imaging modalities play a role in evaluating patients with metastatic spinal tumor including plain radiographs, bone scan, computerized tomography (CT) scan, myelogram, and positron emission topography (PET). The goal of imaging is to be 100% sensitive and specific in identifying tumor, give precise anatomic detail, identify distant metastases, and show recurrent tumor following the placement of instrumentation. No single imaging modality accomplishes all of these goals, but understanding the advantages and disadvantages of different imaging modalities will assist the clinician in patient screening and treatment planning.

Plain radiographs are the first test to evaluate a patient with cancer who has new onset of back pain, but are relatively poor screening tests for metastases. Visualization of a radiolucent defect on plain radiographs requires a 50% destruction of the vertebral body. Additionally, metastatic tumor often infiltrates the bone marrow of the vertebral body without destroying the cortical bone. Compression and burst fractures are readily identified. Plain radiographs can identify sagittal (kyphosis) and coronal (scoliosis) plane deformities in a weight-bearing state[11]. Following surgery, plain films are the best imaging modality for assessing spinal alignment and structural integrity of the instrumentation.

Bone scan (99mTc-MDP) is more sensitive than plain radiographs for detecting spinal metastases. The advantage of bone scan is the ability to screen the entire skeleton with a single image. Bone scans rely on an osteoblastic reaction or bone deposition to detect spinal metastases [11]. Thus, patients with rapidly progressive, destructive tumors may not be detected. Bone scan is relatively insensitive for multiple myeloma and tumors confined to the bone marrow. It also has a low specificity for tumor. Fractures, degenerative disease, and benign disorders of the spine (Schmorl's nodes, hemangioma) all may be positive. Frank et al. [12] reviewed a series of 95 patients in which 28% had a negative bone scan with MRI scan showing tumor and a discordance rate between the two imaging modalities of 31%.

Until MRI became widely available, myelogram and CT scan were the best diagnostic modalities for assessing acute spinal cord compression. CT scan continues to be useful for assessing the degree of bone destruction and whether bone or tumor is causing the spinal cord compression. For patients who have had spinal reconstruction with placement of metallic instrumentation, including titanium, it is often difficult to obtain accurate images of the spinal canal with MRI [13]. Myelography and postmyelogram CT images continue to be used for imaging these patients.

MRI is the most sensitive and specific modality for imaging spinal metastases. Sagittal screening images of the entire spine reveal bone, epidural, and paraspinal tumor. The extent and degree of spinal cord compression can be readily appreciated [14]. Hybrid scans of the brachial or lumbosacral plexus may reveal tumor in patients with extremity weakness that is not entirely related to spinal cord or root involvement. Leptomeningeal metastasis is often well visualized, but requires the use of contrast agents (Gd-DPTA) [15].

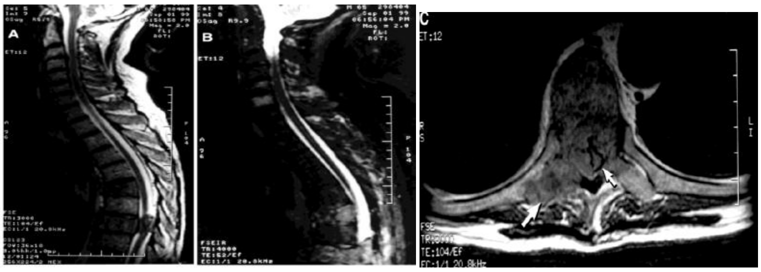

Figure 1. 65-year-old male with metastatic rectal carcinoma presented with a two-day history of lower extremity weakness. He had prior spinal radiation to overlapping ports at T8. A) Midline sagittal fast spin echo T-2 weighted image showing compression fracture at T6 and spinal cord impingement at T8. Tumor is not well visualized. B) STIR image reveals multiple levels of spinal tumor seen as hyperintense including the vertebral bodies of C5, C6, T6 and T8. Also noted are several areas of posterior element involvement in the cervical and thoracic spine. C) Axial T1-weighted image shows circumferential high grade epidural tumor with spinal cord compression (small arrow) and lateral extension of the tumor into the epidural space (large arrow).

While MRI is an excellent screening tool for metastatic tumor to bone, differentiating tumor from osteomyelits, osteoporotic compression fractures, and previously treated tumor may be difficult. The T1 and T2 signal characteristics are similar in all of these conditions. Osteomyelits is more likely to cause changes in the end plate and disc space whereas tumor rarely, if ever, involves the disc space[16]. Osteoporotic compression fractures are extremely common in a cancer population and have been differentiated from pathologic fractures with 94% accuracy based on T1-weighted imaging characteristics [17]. Osteoporotic fractures are more commonly thoracic, lack signal change or have band-like abnormality, and do not involve the pedicle or have contour abnormality. Pathologic fractures showed homogeneously decreased signal, convex vertebral contour, and involved the pedicles and lumbar location.

Response to RT or chemotherapy is difficult to assess in bone tumors because of the lack of signal change on MRI. Oncologists often rely on imaging changes to determine the efficacy of treatment. On T1-weighted images both treated and viable tumor appear hypointense relative to normal marrow signal. In a study of breast cancer patients, only 3% of patients had a reduction in the volume or number of vertebral bodies involved following treatment [18]. In a palliative situation, clinical response to therapy (resolution of tumorrelated pain) may suffice despite the absence of radiographic change. Therapeutic decisions for some metastatic tumors (e.g., Ewing's sarcoma, neuroblastoma, seminoma) rely on differentiating viable from necrotic tumor. MRI cannot reliably differentiate.

The use of 2-[F-18] flouro-2-deoxy-D-glucose (FDG-PET) for differentiating osteoporotic from pathologic compression fractures, and the viability of previously treated tumor[19]. Osteroporotic compression fractures greater than three days from the onset of symptoms are hypometabolic with a standardized uptake value (SUV) of less than 3. In general tumors have an SUV greater than 5. Additionally, FDG-PET may help direct the biopsy site to the area of most metabolic tumor with the highest likelihood of having viable, diagnostic tumor.

TREATMENT

Metastatic spinal tumor are treated by multimodality treatment which include chemotherapy, Radiotherapy and surgery. Chemotherapy can be divided into antitumor drugs and drugs that prevent or ameliorate the effects of tumor. Antitumor chemotherapy currently plays a relatively limited role in the treatment of spinal metastases. Dexamethasone reduces vasogenic edema of acute spinal cord compression to stabilize or improve neurologic status in some patients and relieve tumor related pain. The optimal dose used to treat patients with acute spinal cord compression is controversial [20]. Doses range from moderate (16 mg/day in divided doses) to high (96 mg/day in divided doses) with a 10 to 100 mg loading dose. It is unclear whether higher dose steroids improve neurologic outcomes compared to moderate dose, but significantly more complications result from the higher doses [21].Steroids are not required to prevent acute RT complications as they do for brain RT, and thus do not need to be given in patients undergoing RT for malignant spinal cord compression who are fully ambulatory [22]. In a patient with an undiagnosed spinal mass, one must resist the temptation to deliver steroids prior to biopsy because of the oncolytic effect for certain tumors, such as lymphoma and thymoma.

Biphosphonates are drugs that inhibit osteoclastic acitivity, suppress bone resorption, and are effective in the treatment of malignancy-associated hypercalcemia. Pamidronate is the most commonly used biphosphonate for cancer patients. In combination with systemic antitumor therapy, pamidronate has been shown to reduce or delay skeletal events, such as pathologic fractures[23].

Antitumor chemotherapy has an important role in the treatment of chemosensitive tumors, such as neuroblastoma, Ewing's sarcoma (PNET) [24], osteogenic sarcoma, germ cell tumors, and lymphoma. At our institution chemotherapy may be used as primary treatment for patients with these tumors even with epidural compression. Surgery and RT may be used as adjuncts for residual radiographic tumor.

RADIOTHERAPY

In the 1960s and 1970s, when numerous comparative studies showed no difference in outcome between patients undergoing external photon beam RT and laminectomy without posterior segmental fixation, often in combination with RT, RT replaced laminectomy as first-line therapy [12,25,26,27]. In these older series, approximately 75% of patients were nonambulatory at the time of presentation [28]. Patients undergoing RT alone showed a 79% rate of maintaining ambulation and a 42% rate of return to ambulation in paraparetic patients. Both ambulatory and nonambulatory patients had an approximate 21% risk of neurologic decompensation during RT. Patients undergoing laminectomy alone or with postoperative RT had a 48% to 67% rate of maintaining ambulation and a 33% rate of recovering ambulatory status in paraparetic patients. A range of 17% to 52% showed neurologic decompensation following surgery with or without the addition of postradiation RT. The post-treatment morbidity was significantly less from RT than from surgery.

One of the sentinel studies shifting the emphasis from surgery to RT was a retrospective review of 235 patients by Nater et al.[25] in which analysis was based on the radiation sensitivity of the tumor and preoperative functional status. The overall rate of postoperative ambulation in the laminectomy and RT versus RT alone was 46% and 49%, respectively. Patients with radiosensitive tumors (breast, myeloma lymphoma) had better functional neurologic outcome compared to less radiosensitive tumors (lung, colon, renal cell), regardless of the treatment.

A more recent radiation study again confirms the utility of this modality for the treatment for spinal metastases [29]. De Felice et al. conducted a prospective trial in which patients were treated with RT for metastatic spinal cord compression over a six-year period with a median follow up of 49 months. No patient died from treatment. An additional 20 patients (7%) underwent surgery as initial treatment for an unknown diagnosis, vertebral body collapse with bone impingement in the spinal canal, prior RT and or spinal instability. All patients were treated to a total dose of 3,000 cGy using two different fractionation schedules. Patients were divided into radiosensitive (e.g., breast, prostate, lymphoproliferative) and radioinsensitive tumors (e.g., lung, renal, colon). The overall rate of maintaining or improving to ambulatory status and of improving sphincter control was 76% and 44%, respectively. Regardless of radiosensitivity of the tumor, patients who were functionally normal or with minor ambulation difficulties had a 94% rate of maintaining post-RT ambulation. In nonambulatory patients, the rate of return to ambulation post-RT was 60% and was heavily dependent on radiosensitivity of the tumor.

The standard RT treatment for palliation of spinal metastases is daily 300 cGy fractions to a total dose of 3,000 cGy. Either a single posterior field or opposed fields are used to encompass the involved segment plus one to two levels above and below this involved region. Spinal cord or cauda equina tolerance to RT is the limiting factor in significantly raising the dose to greater levels to achieve higher rates of local control. Higher doses of RT place the patient at an increased risk for pathologic radiation myelopathy and functional spinal cord transection. Schiff et al.[30] reviewed the Mayo Clinic experience in patients with malignant spinal cord compression who either underwent reirradiation for locally recurrent tumor within the port or were treated for separate sites of disease but with overlapping ports. All patients were ambulatory following the first course of RT, and 69% of patients remained ambulatory following the second course of RT at a median follow-up of 4.2 months. Pre-RT ambulation was a predictor of good outcome. Five patients became nonambulatory at 6.5 to 35 months. In this group four of the patients had documented spinal cord compression at the time of functional decompensation. The limited life expectancy of these patients may make it possible to reirradiate the spine with limited risk.

Advances in radiation delivery, patient immobilization, and dosing schemes may continue to improve outcomes either alone or in combination with surgery. These advances include intraoperative radiation therapy (IORT), three-dimensional conformal radiation therapy (3D-CRT), intensity-modulated radiation therapy (IMRT), IGRT, Rapid arc, Vmat. Lead shields [31] and gold foil [32] have been used to shield the spinal cord. In a retrospective review by Seichi et al. [31], 37 patients underwent IORT with electron beams following surgical resection to a total dose of 2,000 cGy, a dose estimated by the authors to be biologically equivalent to 4,500 cGy of conventional fractionated external beam RT. Twenty-two patients also received fractionated external beam RT to a median dose of 3,400 cGy. One patient who was not shielded developed symptomatic radiation myelopathy. Local control was achieved in all patients at a median follow-up of 11 months.

IMRT represents an advanced form of 3D-CRT in which multileaf collimators are used to dynamically change the field shape during treatment, thus permitting the delivery of an inhomogeneous dose that conforms more tightly to the target region. Because of the precise dosimetry of both 3D-CRT and IMRT, accurate delivery of these complex plans requires reproducible patient setup and positioning, also using the body frames and infrared camera systems to improve the accuracy of treatment delivery. In addition, in IGRT the internal organ motion is being evaluated by CT whose gantry is connected to the linac treatment couch. Such approaches may permit the delivery of a higher dose of radiation to a target tissue while maintaining the dose delivered to the spinal cord within an acceptable tolerance level[33]. This may improve the clinical outcome of inoperable patients and those requiring a boost after surgical resection.

SURGERY

The role of surgery in the treatment of spinal metastases is still being defined. Results using laminectomy as initial therapy either alone or with adjuvant radiation yielded relatively poor outcomes. Laminectomy does not provide exposure to resect lateral and anterior epidural or vertebral body tumor. Additionally, resection of the posterior elements without instrumentation often leads to progressive kyphosis and increased neurologic deficits.

Improved surgical outcomes have been seen using techniques that provide exposure for more radical tumor resection than laminectomy. Reconstruction following these aggressive approaches is now possible using rigid posterior segmental fixation and anterior instrumentation. These approaches include anterior transcavitary[1,2,33-39] and posterolateral, transpedicular [34,35,37-40]. The decision to use a particular surgical approach is dependent on the location of the bone, epidural, and paraspinal tumor, type of reconstruction required, patient comorbidities, extent of disease, and surgeon’s familiarity.

Anterior transcavitary approaches may be used to address tumors in any spinal segment. The particular approach depends on the level of spine involved. For example, the high thoracic spine (T1 to T3) can be addressed through a median sternotomy or trap door approach [41], midthoracic spine (T4 to T10) through a standard thoracotomy, and the low thoracic spine (T11 to T12) via a thoracoabdominal approach. In terms of tumor resection, anterior transcavitary approaches address anterior paraspinal tumor, vertebral body tumor, and anterior or unilateral epidural tumor on the side of the approach.

Reconstruction is most often achieved using methylmethacrylate and Steimann pins, autologous bone graft, or cages with the addition of an anterior locking plate, such as a Z-plate (Danek; Memphis, TN). An anterior approach may be followed by a laminectomy or posterolateral approach for maximal tumor resection and circumferential fusion [40].

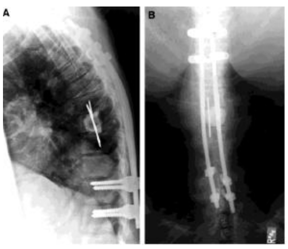

Figure 2. A, B) Postoperative plain radiographs showing reconstruction of a posterolateral approach with anterior methylmethacrylate and Steinmann pins and posterior segmental fixation using pedicle screws and sublaminar hooks.

The posterolateral approach is used mainly to resect tumor in the thoracic and lumbar spine (Figs. 2A, B). The posterior midline incision and lamina resection are identical to a laminectomy. Additional bone including the pedicle and facet joint are then removed to provide a relatively wide exposure to the vertebral body. Epidural and vertebral body tumor can then be piecemeal resected. Reconstruction is most often achieved with long posterior segmental fixation and may be augmented with an anterior strut, generally with methyl methacrylate and Steinmann pins. The posterolateral approach may be indicated in patients with three-column involvement, multilevel vertebral body or epidural tumor, vertebral body tumor with bilateral or circumferential epidural spinal cord compression, or major spinal deformity. Additionally, some cancer patients who require vertebrectomy or circumferential decompression and fusion may be poor candidates for an anterior approach due to poor pulmonary function, concurrent medical illness, previous surgery, previous RT, and/or unresectable, anterior paraspinal tumor or scar.

Results using these techniques have improved surgical outcomes compared to laminectomy alone or in combination with RT. Resection of the tumor and spinal fixation have resulted in dramatic improvements for both tumor-related pain and mechanical back pain. Multiple series reporting pain outcomes have shown a 76% to 100% improvement [1, 2,33, 35-40]. Neurologic outcomes are similar using both anterior and posterolateral approaches. Functional and neurologic improvements have been seen in 50% to 76% of patients. Additionally, patients who were operated on without a deficit (in our system ASIA E, ECOG 0) maintained function in greater than 95% of cases.

As with RT, factors that impact on outcome include preoperative neurologic and functional status and favorable tumor histology. Bilsky MH [39] reviewed patients who underwent operation for metastatic spinal tumor prior to receiving adjuvant therapy (RT or chemotherapy) for their spinal tumor. The operations included posterolateral (79%), anterior transcavitary (12%), and anterior and posterior approach (9%). Ninety-six percent of patients who were ambulatory preoperatively maintained the ability for at least three months, while only 22% of patients nonambulatory regained ambulation for the same duration. This maintenance or recovery of function is similar to the RT data presented by De Felice [29]. Additionally, 89% of patients maintained continence for three months, but only 31% regained autonomic function. Patients with favorable tumor histology (e.g., breast, kidney, thyroid, prostate) had significantly better neurologic outcome and survival than those with unfavorable histologies (lung, gastrointestinal tract, and unknown primary).

Review of multiple series shows complication rates from surgery ranging from 10% to 52% [1,2,29-35]. Complications include medical issues such as deep venous thrombosis, myocardial infarct, and pneumonia. Surgical complications include failed fixation requiring revision and postoperative hematoma. Wound dehiscence and infection are complications seen predominantly with posterolateral approaches in up to 15% of cases. We have found that trapezius or latissimus dorsi rotation flaps provide excellent soft tissue coverage and markedly reduces the morbidity from this complication. Mortality rates are as high as 13%. Frequently these are related to the medical or oncologic condition of the patients. As with RT, advances in surgical technique may help improve the quality of life for patients with metastatic spinal tumor. Preoperative embolization for vascular tumors (e.g., renal cell, papillary thyroid carcinoma, leiomyosarcoma) dramatically reduces operative blood loss [39]. In our series of 25 patients operated via a posterolateral approach with circumferential instrumentation, there was no significant difference in blood loss between embolized tumors (i.e., renal, thyroid, angiosarcoma) and those not requiring embolization, 1,900 ml and 1,620 ml, respectively.

"En bloc" spondylectomy was recently described by Tomita [44]. This technique is based on sound oncologic principles. The intent of this surgery is en bloc resection of the tumor with negative histologic margins. This surgery is feasible as a one or two-stage procedure [45] but is technically quite demanding. Results with this approach are encouraging, both in terms of functional outcome and local control; however, we reserve this approach for patients in whom the spine surgery is being performed as a curative, rather than palliative procedure. Based on anatomic considerations, the majority of patients with metastatic tumor are not candidates for this type of surgery because of the extensive epidural disease, multilevel vertebral body involvement, and large paraspinal masses.

Thoracoscopic vertebral body resection for tumor has been reported in a small series [46,47]. This relatively noninvasive approach has proven useful for removing anterior thoracic discs and anterior releases for scoliosis corrections. The potential use for most tumors requiring resection is probably limited. We currently reserve this technique for biopsies in patients who have failed CT-guided biopsies.

At our institution RT is first-line for most patients who present with metastatic spinal tumor. Surgery is reserved for a variety of indications (Table 2). Patients with radioresistant tumors (e.g., sarcoma, renal cell carcinoma), spinal instability, and/or a pathologic fracture with bone in the spinal canal are considered for surgery prior to RT. Additionally, patients with circumferential epidural tumor that is moderately to highly radio-resistant are more likely to worsen during RT when compared to other patterns of epidural tumor and are considered for surgery as initial treatment. A frequently reported indication for surgery is lack of a diagnosis, but this can frequently be accomplished with CT-guided needle biopsy or thoracoscopic biopsy.

Table 2.

Table 2.	**Surgical indications**
	Primary Surgery
1	Radioresistant tumors (e.g. sarcoma, renal cell carcinoma)
2	Spinal instability
3	Pathologic fracture with bone in the spinal canal
4	Circumferential epidural tumor - Moderate to highly radio-resistant tumors (e.g. colon, lung).
5	Occult primary tumor
	Post-treatment (RT/chemotherapy) surgery
1	Progressive neurologic symptoms
2	Progression of tumor with high grade spinal cord compression.
3	Spinal instability
4	Rule out residual tumor post RT/chemotherapy (e.g. Ewing's sarcoma, osteogenic sarcoma, germ cell tumor).

All patients should be assessed medically and for extent of disease by a medical internist and treating oncologist.

Following prior RT that has reached spinal cord tolerance, patients are considered for surgery based on progression of neurologic symptoms, radiographic progression of tumor, and spinal instability. Patients with residual radiographic tumor following radiation or chemotherapy may be considered for curative surgery (e.g., osteogenic sarcoma, Ewing's sarcoma, germ cell tumor). Patients undergoing surgical resection are medically assessed for their ability to tolerate the proposed surgical procedure by an internist and have limited extent of disease[48]. Contraindications to surgery include a limited life expectancy, significant medical comorbidities and extensive disease. Additionally paraplegic patients rarely undergo surgery because of the significantly low rate of recovery particularly after 24 h.

II. Conclusion

The diagnosis and treatment of spinal metastases require multidisciplinary review. Regardless of the treatment, diagnosis before the development of significant neurologic and functional deficits improves outcomes. Back pain is generally the earliest sign of metastatic tumor and most often is nocturnal or early morning pain. Proper use of imaging will greatly assist in screening for tumor and may help distinguish tumor from other spinal pathology. RT remains the mainstay of therapy for metastatic spinal tumor. The role of RT, surgery and chemotherapy is still being defined. Continued advances in imaging, chemotherapy, RT and surgery combined with increased physician awareness may continue to help improve the quality of life for these patients.

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