Postoperative Spine Imaging in Cancer Patients

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KEYWORDS

• Postoperative spine • Spinal surgery • Spine tumors • Imaging • Complications • Spinal tumors • Metastases

KEY POINTS

- Postoperative imaging of patients with spinal tumors plays a vital role in their management.
- Advances in magnetic resonance imaging, CT, and nuclear medicine have optimized postoperative imaging in patients with spinal cancer.
- Understanding of imaging protocols, expected postoperative findings, postoperative complications, and the appearance of tumor residual/recurrence is crucial for radiologists.

INTRODUCTION

Spine tumors can be classified according to their location in the spine: extradural, intradural extramedullary, and intramedullary. Metastatic spinal tumors are the most common type of malignant lesions of the spine, accounting for an estimated 70% of all spinal tumors. Common primary cancers that spread to the spine are lung, prostate, and breast cancer. The spine is the third most common site for metastatic disease and is the most common site for osseous metastases. Metastases to the spine can involve the bone, epidural space, spinal cord, and leptomeninges. Approximately 95% of metastatic spinal lesions are extradural in location, consisting of pure epidural lesions and lesions arising from the vertebral bodies, spreading to the epidural space.[1]

Most extradural tumors are metastatic, and the thoracic spine is the most commonly affected site. Multiple myeloma, lymphoma, and leukemia can also involve the spine and often present with multifocal or single-level extradural involvement. Primary malignant extradural tumors, such as osteosarcomas and Ewing sarcomas, are less common, as are primary nonmalignant entities, such as osteoid osteomas and aneurysmal bone cysts. Management of extradural tumors includes gross total or subtotal surgical resection for surgical decompression with stabilization, chemotherapy, radiation therapy, and bone grafting.

Intradural extramedullary spread of systemic cancer comprises approximately 5% to 6% of spinal metastases.[1] Primary intradural extramedullary tumors comprise approximately 66% of all primary spinal tumors.[2] The most common intradural extramedullary tumors are schwannomas, followed by meningiomas. These tumors are usually slow-growing tumors that are treated by surgical resection only if patients exhibit significant neurologic symptoms caused by cord compression. The location of the tumor (ie, ventral or dorsal to the spinal cord) determines the operative approach: anterior, lateral, or posterior.

Intramedullary metastases are rare and comprise 0.5% to 1% of spinal metastases.[1] Primary intramedullary tumors include glial neoplasms, most commonly ependymomas and astrocytomas, and nonglial neoplasms, such as hemangioblastomas. These tumors are commonly treated with surgical resection. For ependymomas and astrocytomas, adjuvant radiation therapy may

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be used for lesions that undergo subtotal resection, and chemotherapy for failed radiation therapy or recurrence.

The treatment of spinal metastatic disease is multidisciplinary, dependent on patient presentation, and mostly palliative. Patients who present with pain without neurologic symptoms are treated primarily with site-directed radiation therapy and chemotherapy. Surgery is indicated for patients presenting with progressive neurologic deficits, neural compression due to retropulsed bone or epidural disease, spinal deformity or instability, and for treatment of radiation-resistant tumors.[3] A variety of surgical methods are available to treat metastatic disease to the spine. Dorsal spinal decompression and stabilization is the standard surgical technique to treat thoracic and lumbar metastases. Cervical metastases are treated with ventral decompression with corpectomy, vertebral body replacement, and ventral, stable-angle plate osteosynthesis.[4]

INDICATIONS FOR POSTOPERATIVE IMAGING

In the immediate postoperative period, imaging is performed to assess the extent of tumor resection. If surgical debulking of the tumor has been performed with the intention of subsequent radiation therapy or chemotherapy, an immediate follow-up magnetic resonance (MR) imaging is generally obtained to establish a baseline before therapy. Comparison with the preoperative imaging examination is a critical step in interpreting the postoperative study properly and in making distinctions between postoperative changes and the presence of residual neoplasm. Imaging evaluation is sometimes obtained on an emergent basis in symptomatic patients to assess for postsurgical complications. Common postsurgical complications in this patient population include hematoma, infection, ischemia, cerebrospinal fluid (CSF) leak, and malpositioning of hardware (**Table 1**).

Long-term routine follow-up imaging is obtained 4 to 6 months after surgery in the asymptomatic patient to assess for tumor recurrence or progression of disease. Long-term imaging is also obtained in the symptomatic patient to assess for hardware malpositioning or failure and to assess for treatment-related complications, such as radiation therapy–related vertebral compression fractures, radiation myositis, and radiation myelitis.

IMAGING PROTOCOLS

MR Imaging

Following tumor resection, postsurgical inflammation and neovascularity may develop within 24 hours, causing enhancement. Early MR imaging is therefore necessary to establish an accurate baseline, allowing the radiologist to distinguish between tumoral and postsurgical enhancement.

Due to the oftentimes subtle nature of tumoral enhancement and the difficulty in identifying it in the background of postsurgical scarring, postcontrast sequences must be performed with reliable fat saturation. Frequency-selective fat-saturation methods depend on the different resonance frequencies of water and fat. To suppress the fat signal accurately, the magnetic field must be homogeneous. This suppression is not possible in postoperative spines with hardware or metallic debris. Therefore, an alternative method of fat saturation with short tau inversion recovery (STIR) is preferred.[5] STIR imaging relies on the different relaxation times of tissues, using a 180° inversion pulse, allowing the longitudinal recovery of fat to reach a null point, and then applying a 90°

Table 1
Indications for postoperative imaging

Immediate	Routine	1. Assess extent of resection 2. Baseline for follow-up imaging (pre-RT and chemotherapy)
	Emergent/symptomatic	Assess for complications • Hematoma • Ischemia • Infection • CSF leak • Hardware failure/malposition
Long-term	Routine (4–6 mo) Emergent/symptomatic	Assess for tumor recurrence or progression 1. Assess for tumor recurrence 2. Assess for hardware failure 3. Assess for treatment-related effects (RT-VCF, myositis, myelitis)

Abbreviations: RT, radiation therapy; RT-VCF, radiation therapy-vertebral compression fractures.