Role of percutaneous vertebroplasty in treatment of different types of spinal metastasis

Essay

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By

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Abstract

Keywords

ACR

EBRT

ESCC

MSCC

PVP

In this study this simple procedure must be treated with respect, as its application, without appropriate patient selection and physician knowledge, can quickly produce increased pain, permanent neurologic injury, and even death.For patients with refractory back pain related to a pathologically fractured vertebra, vertebroplasty is suggested, as long as there are no contraindications and a physician with appropriate experience is available to perform the procedure. Percutaneous vertebroplasty has been shown to be very effective at relieving the pain associated with compression fractures of vertebrae caused by osteoporosis or metastasis. Percutaneous vertebroplasty is rapidly becoming the standard of care for compression fracture pain not responding to conservative medical therapy.

Table of Contents

List of Figures

Abbreviations

- ACR American College of Radiology
- AP Anteroposterior
- CT Computed Tomography
- CNS Central nervous system
- CSF Cerebrospinal fluid
- EBRT External beam radiation therapy
- ESCC Epidural spinal cord compression
- Gy Gray
- MM Multiple Myeloma
- MRI Magnetic Resonance Imaging
- MSCC Metastatic spinal cord compression
- PET Positron Emission Tomography
- PMMA PolyMethylMethAcrylate (Bone Cement)
- PVP Percutaneous Vertebroplasty
- RT Radiotherapy
- SBRT Stereotactic body radiotherapy
- SCLC Small cell lung cancer
- SINS Spine Instability Neoplastic Score
- SRS Stereotactic radiosurgery
- STIR Short T1 Inversion Recovery
- SUV Standardized Uptake Value
- VAS Visual Analog Score
- VB Vertebral body
- VCF Vertebral Compression Fracture

INTRODUCTION

Chronic pain that is severe enough to warrant long-term opioid therapy is experienced by 30 to 50 percent of cancer patients undergoing active antineoplastic therapy and by 75 to 90 percent of those with advanced disease [1,2]. Treatment guidelines for cancer pain emphasize the primary role of systemic opioid therapy [3-5], which can yield adequate relief in 70 to 90 percent of patients [6]. This favorable statistic underscores the need to provide patients with access to opioid-based systemic pharmacotherapy for moderate to severe cancer pain.

However, despite optimization of opioid therapy and the use of analgesic adjuvants, a substantial number of patients with cancer pain do not obtain satisfactory relief with first-line analgesic therapy. When effective pain relief cannot be achieved through pharmacologic means, nonpharmacologic approaches offer an important alternative.

The most important of these nonpharmacologic approaches are the so-called “interventional” pain management strategies. Interventional strategies comprise a very diverse group of invasive therapies, most of which are nondestructive and performed using needles:

- Celiac plexus/splanchnic nerve blocks for abdominal pain.
- Hypogastric plexus/ganglion impar block for pelvic pain.
- Intercostal blocks for fractures.
- Kyphoplasty and vertebroplasty for vertebral compression fractures.
- Lumbar sympathetic block for rectal tenesmus.
- Myofascial injections for muscle spasm.
- Neuraxial infusions.
- Suprascapular block for shoulder pain.

With the exception of some simple injections (eg, trigger point injections), interventional therapies for pain management are implemented by professionals who have received specialized training. Ideally, all patients with cancer pain that does not respond promptly to systemic pharmacotherapy should have access to a specialist who can assess the appropriateness of interventional treatments.

Kyphoplasty and vertebroplasty for vertebral compression fractures:

Two specialized injection approaches, vertebroplasty and kyphoplasty, have been developed to address pain that originates from vertebral collapse, either from osteoporosis or neoplastic disease.

Vertebroplasty: involves the percutaneous injection of bone cement (methylmethacrylate) under fluoroscopic guidance into a collapsed vertebral body.

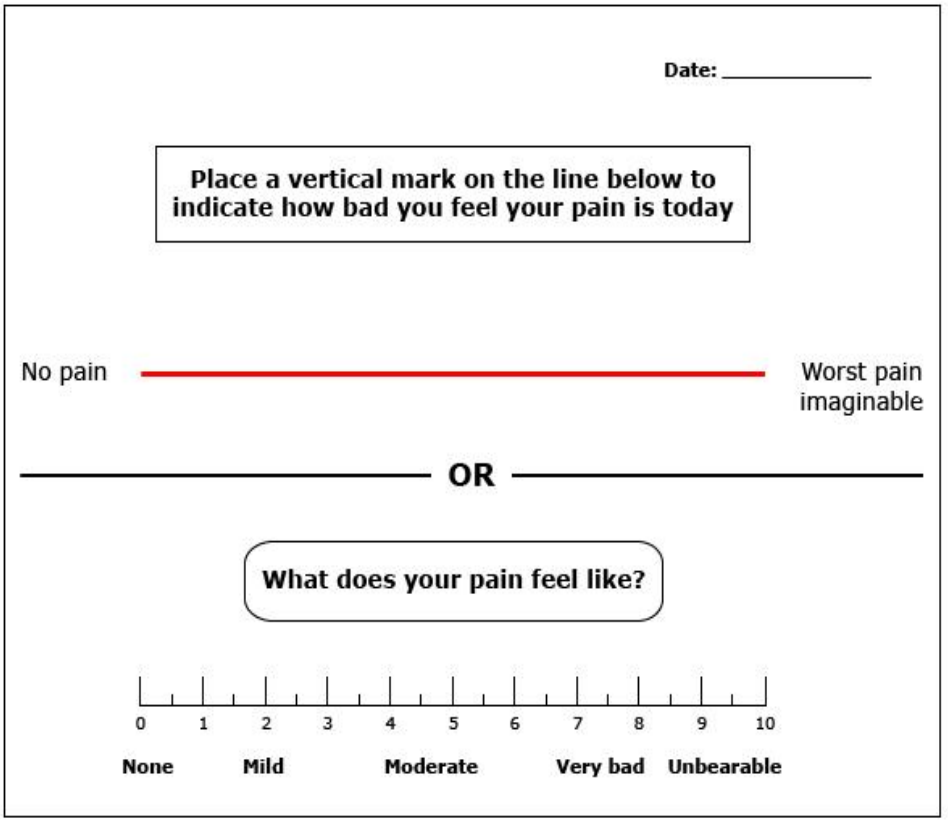
Kyphoplasty: involves the introduction of inflatable bone tamps into the vertebral body; once inflated, the bone tamps variably restore the height of the vertebral body, while creating a cavity that can then be filled with viscous bone cement.

Among patients with osteoporotic vertebral compression fractures, the benefits of vertebroplasty and kyphoplasty are controversial.

A short-term placebo-controlled (sham procedure) trial of vertebroplasty in patients with osteoporotic compression fractures failed to show a significant benefit in reducing pain; a second trial of kyphoplasty versus non-surgical conservative treatment (no sham control) showed better pain control with kyphoplasty one month after treatment, but the benefits were no longer evident at one year.

Two prospective uncontrolled trials suggest that carefully selected cancer patients with pathologic vertebral body fractures can experience prompt and sustained pain relief from vertebroplasty and kyphoplasty [7,8]; a single randomized trial, reported only in abstract form, also supports benefit of balloon kyphoplasty over nonsurgical management for vertebral compression fractures:

- In the only prospective trial of vertebroplasty, 33 patients with painful malignant vertebral compression fracture underwent percutaneous vertebroplasty of 42 symptomatic vertebrae [7]. Pain control was “significantly effective” (pain on visual analog scale [VAS] ≤2 or a decrease of ≥5 points compared with before therapy) in 20 patients (61 percent), moderately effective (VAS score did not reach ≤2 but there was a decrease between two and five points compared to the VAS prior to therapy) in three (9 percent), and ineffective (VAS score increased, or decreased by <2 points, or there was an increased need for analgesics) in 10 (30 percent).



Visual analog scale (VAS)

- The clinical benefit of kyphoplasty was addressed in a phase II study of 65 patients with metastatic vertebral body fractures who underwent 99 balloon kyphoplasty procedures [8]. The mean pain VAS score dropped from 8.3 presurgery to 3.3 postsurgery, and continued to improve at the three month time point; benefit was sustained for up to 24 months.
- The benefit of balloon kyphoplasty over nonsurgical treatment was directly addressed in a phase III trial in which 134 patients with cancer and fewer than three painful vertebral compression fractures were randomly assigned to balloon kyphoplasty or nonsurgical management, and followed for 12 months [9]. Crossover to kyphoplasty was allowed for patients undergoing nonsurgical management at one month. Patients who underwent kyphoplasty had significantly less self-reported disability, and showed significant improvement in pain at one and four weeks, while there was no change in either disability or pain status in those who had nonsurgical management. In addition, those undergoing kyphoplasty reported significantly fewer days with limited activity due to

back pain and greater quality of life. All patients who underwent kyphoplasty (whether initially or after crossover from the control group) had sustained improvements over 12 months. There were two adverse events in the kyphoplasty group: one non-Q wave infarction attributed to anesthesia, and one cement leakage to the disc resulting in an adjacent fracture one day following the kyphoplasty procedure.

There are no comparative studies of kyphoplasty versus vertebroplasty; kyphoplasty is more expensive.

Aim of Work

The aim of this work is to outline the role of vertebroplasty in the treatment of destructive vertebral neoplastic lesions, of which Metastases and Multiple Myeloma are most common.

The review of relevant literature examines the pathology, presentation and available treatment options for destructive vertebral lesions. It then proceeds to examine in details the technique of vertebroplasty in particular its indications, contraindications and methodology.

Spinal cord tumors

INTRODUCTION — Spinal cord tumors can occur within or adjacent to the spinal cord. They are considered to be intraaxial in location and can be either primary or metastatic. Primary spinal cord tumors account for 2 to 4 percent of all primary central nervous system (CNS) tumors, one-third of which are located in the intramedullary compartment.

Spinal cord tumors can be classified according to their anatomic location:

- Intramedullary — Intramedullary tumors arise within the spinal cord itself. Most primary intramedullary tumors are either ependymomas or astrocytomas. Metastases are being recognized with increasing frequency, primarily because of improvements in imaging modalities.
- Intradural-extramedullary — Tumors arising within the dura but outside the actual spinal cord are termed intradural-extramedullary. The most common tumors in this group are meningiomas and nerve sheath tumors.
- Extradural — Extradural tumors are usually metastatic and most often arise in the vertebral bodies. Metastatic lesions can cause spinal cord compression either by epidural growth that results in extrinsic spinal cord or cauda equina compression or less frequently by intradural invasion.

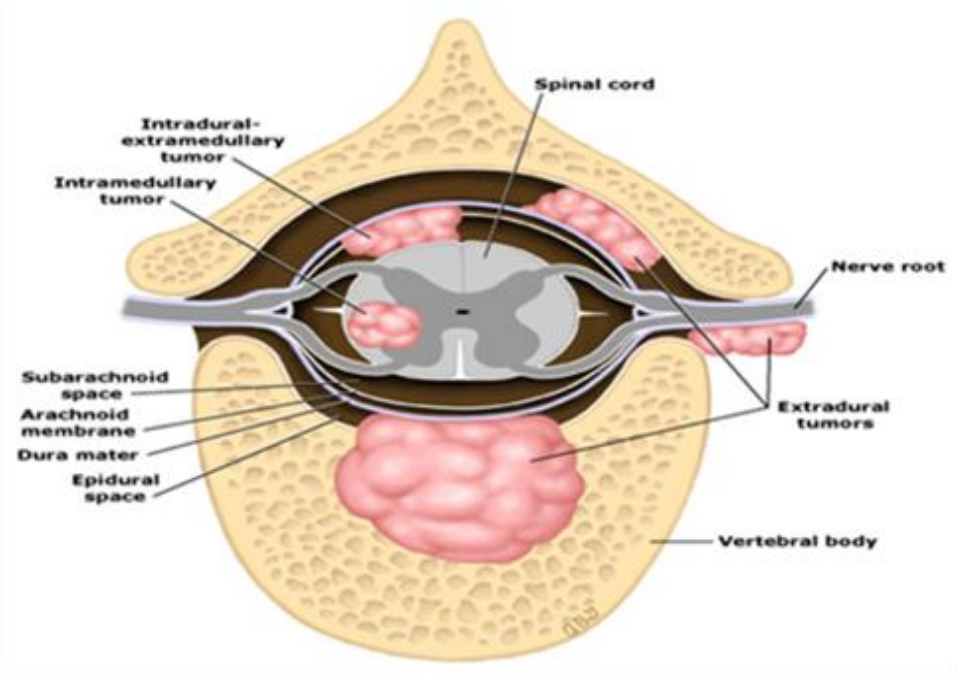


Fig.(1): Location of spinal tumors

PRESENTATION

Symptoms — Tumors within or extrinsic to the spinal cord can cause symptoms through disruption of normal neural elements and pathways, producing both local and distal effects.

The most frequent local effect is pain that causes nocturnal awakening. Patients often describe this pain as a gnawing and unremitting [10]. The site of this may provide an indication of the anatomic location of the tumor.

Neurologic dysfunction distal to the lesion is due to interruption of ascending and descending spinal cord pathways. The most common sequelae are sensory dysesthesias and muscular weakness, especially of the iliopsoas musculature. Patients often report progressive difficulty in ambulation. Severe distal sensory loss and sphincter dysfunction also may occur. Although neurologic manifestations may begin unilaterally, they can progress to involve both sides of the spinal cord and thereby produce bilateral symptoms and signs.

History — A prior history of cancer may suggest a diagnosis of metastasis to the spinal column, which may cause axial or radiating pain. Referred pain, eg, to the shoulder or neck, is also common with spinal metastases [11].

The spine is a common metastatic site for many tumor types. As an example, vertebral metastases have been found at autopsy in 90 percent of patients who died of prostate cancer, 74 percent with breast cancer, and 45 percent with lung cancer [12,13].

Physical examination — A thorough physical examination is necessary to define probable sites of tumor involvement, document preoperative neurologic deficits, and determine progressive neurologic deterioration. An assessment of the patient's ambulatory status is also necessary since this carries important prognostic significance.

Imaging

Magnetic resonance imaging (MRI) of the spine is currently the diagnostic study of choice, providing excellent delineation of the spinal cord and surrounding structures. Almost all intrinsic spinal cord tumors and metastases enhance with gadolinium [14].

INTRAMEDULLARY TUMORS

The majority of intramedullary primary spinal cord tumors are gliomas. The term glioma refers to a tumor bearing a histologic resemblance link to normal glial cells. The major types of glial tumors are ependymomas, astrocytomas, and oligodendrogliomas, and mixtures of these cell types are occasionally seen within a single tumor [15].

Fig. (2): MR image of a spinal cord ependymoma (upper arrow) discovered to be metastatic to multiple sites within the neuraxis (lower arrows) at diagnosis.

Courtesy of Mark Kieran, MD.

INTRADURAL EXTRAMEDULLARY TUMORS

Both meningiomas and nerve sheath tumors (schwannomas and neurofibromas) can develop in the intradural extramedullary spinal compartment.