Management of Spinal Tumors: Physical Therapy Implications and Interventions

Lauren Geib, PT, DPT
Amanda Molnar, PT, MSPT
APTA Combined Sections Meeting
Thursday, January 24, 2019

The presenters have no conflict of interest to report regarding any commercial product/manufacturer that may be referenced during this presentation.

All photos/illustrations are used with permission.

Photos/illustrations are for the sole use of educational purposes and are not to be replicated or redistributed in any manner.

Learning Objectives
• To gain a general knowledge of both primary and metastatic spinal tumors
• To review the various medical and surgical treatment options for patients with spinal tumors
• To discuss the implications of rehabilitation’s vital role within the multi-disciplinary care team for patients with spinal tumors
• To identify safe and appropriate interventions and strategies throughout the continuum of care for this patient population

Overview of Primary and Metastatic Spinal Tumors

Spinal Tumors1,2,3,4
• Primary spinal tumors: masses of abnormal cells originating in the spinal cord, dura, or the vertebral bodies that grow out of control
• Metastatic spinal tumors: cancer cells originate in another area of the body and spread to the spinal cord, dura, or vertebral bodies via the bloodstream or lymph vessels

Anatomical Classification1,2
• Intradural – within dura mater
  • Intramedullary – within spinal cord
  • Extradural – outside spinal cord
• Extramedullary – outside dura mater
  • Often arise in bony vertebrae
  • Most common site for spinal tumors
  • Most often metastatic spinal tumors
Spinal Tumors

Histological Classification

- **Intradural**
  - Primary intramedullary
    - Benign
    - Ependymoma
    - Hemangioblastoma
    - Malignant
    - Astrocytoma
  - Primary extramedullary
    - Benign
    - Meningioma
    - Nerve sheath tumor (schwannoma, neurofibroma)
- **Metastatic**
  - Leptomeningeal disease (LMD)

Histological Classification

- **Extradural**
  - Metastatic
  - Primary benign
    - Giant cell tumor (GCT)
    - Osteochondroma
    - Osteoid osteoma/osteoblastoma
  - Primary malignant
    - Chordoma
    - Chondrosarcoma
    - Osteosarcoma
    - Ewing sarcoma
    - Lymphoma
    - Plasmacytoma

Location of Spinal Tumors

- Cervical: 20%
- Lumbosacral: 20%
- Thoracic: 70%
- Cervical: 10%

Etiology

- Primary spinal tumors
  - Most tumors NOT linked to any known factors or causes
    - Genetics
    - Familial/inherited syndromes
    - Previous radiation exposure
- Metastatic spinal tumors
  - Lung cancer
  - Breast cancer
  - Prostate cancer
  - Renal cancer
  - Thyroid cancer
  - Multiple myeloma
  - Lymphoma

Statistics

- One person in 100,000 (~10,000) people per year develop spinal tumors
- 15-20% of all CNS tumors occur in the spine
- Primary spinal tumors
  - Benign tumors – 55-65% all primary spinal tumors
- Metastatic spinal tumors
  - Most common – 70% all spinal tumors
  - Spinal metastases occur in 20% of all patients with cancer
    - 5-10% develop spinal cord compression
Diagnosis

- Signs and symptoms
  - Pain
  - Weakness
  - Sensory symptoms
  - Impaired coordination
  - Bowel/bladder dysfunction
- Neurological exam
- Imaging
- Blood tests
- Biopsy*

Signs & Symptoms

- Pain Syndromes
  - Biological
    - Tumor related pain
    - Deep, gnawing, aching
    - Night or morning pain resolving over course of the day
    - Improves with activity or anti-inflammatory agents
  - Mechanical
    - Impending or existing spinal instability
    - Movement related pain – transitional movement, axial loading
    - Unresponsive to medical management
  - Radiculopathy
    - Pain (often radiating) from nerve root compression
    - Sharp, shooting, stabbing
    - Cervical – radiating unilaterally into UE
    - Thoracic – band-like bilaterally around chest/abdomen
    - Lumbar – radiating unilaterally into LE

- Myelopathy
  - Indicates high-grade spinal cord compression
  - Symptoms – dependent on tumor location
    - Pain
    - Weakness/paralysis
    - Loss of sensation (light touch, pin-prick, proprioception)
    - Abnormal reflexes
    - Impaired balance and coordination
    - Autonomic changes (bowel and bladder)

Treatment

- Primary spinal tumor
  - Goal of treatment → curative
- Metastatic spinal tumor
  - Goal of treatment → palliative
- Treatment options
  - Surgical resection
  - Radiation
  - Chemotherapy
  - Other drugs

Surgical and Medical Treatment Options

- Advances in medicine, technology, and techniques have improved safety and effectiveness of treatment of spinal tumors
  - Surgery
    - Minimally invasive → complex procedures to remove tumors, decompress spinal cord, and stabilize spine
  - Radiation
  - Systemic therapy
    - Chemotherapy
    - Other drugs
      - Corticosteroids
      - Immunotherapy
Primary Spinal Tumors\textsuperscript{2,12,15}

- Surgery
  - Dependent on distinct tumor border
    - Clear border: gross total resection $\rightarrow$ curative
    - Infiltrative tumor: subtotal resection +/- adjuvant therapy
- Radiation
  - EBRT, SBRT
  - Dependent on tumor histology, extent of resection, and recurrence
    - Most often utilized following incomplete resections or with high grade, infiltrative tumors
- Chemotherapy
  - Dependent on tumor histology, extent of resection, and recurrence
    - Limited role
    - Most often utilized with systemic involvement and in pediatric population

Metastatic Spinal Tumors\textsuperscript{4,12}

- Medical treatment options
  - Radiation
    - EBRT, SBRT
  - Chemotherapy
  - Other drugs
  - Surgery

Metastatic Spinal Tumors

- NOMS – decision framework that facilitates treatment of metastatic spinal tumors\textsuperscript{4}
  - N - Neurologic
  - O - Oncologic
  - M - Mechanical instability
  - S - Systemic disease

- Radiation\textsuperscript{1,12}
  - EBRT
    - Used for radiosensitive tumors regardless degree of cord compression
    - Lower dose, more fractions
    - Risk of RT-induced toxicity and side effects
  - SBRT
    - Used for radioresistant tumors
    - More precise: higher dose, less fractions
    - RT-induced toxicity rare, mild complications/side effects

- Surgery\textsuperscript{4,12}
  - Dependent on
    - Mechanical instability
  - Radioresistant tumors – “separation” surgery
    - Minimal tumor resection carried out to separate tumor margin from spinal cord
    - Role of surgery to create “target” for SBRT
    - Bulk of tumor treated with SBRT

Metastatic Spinal Tumors Treatment Framework
Surgical Procedures

- En-bloc resection
- Percutaneous cement augmentation
- Decompression with stabilization
- Sacrectomy

En-Bloc Resection \(^{1,12}\)

- Surgical technique removing tumor in a single piece
- Main goal = remove ALL cancer
  - Remove tumor + normal surrounding tissue $\rightarrow$ clear margins
- Often used to completely eliminate primary tumors
  - Complete resection correlates with progression-free survival

Percutaneous Cement Augmentation \(^{1,12}\)

- Minimally invasive procedure to treat vertebral compression fractures
  - Vertebroplasty – image-guided injection of bone cement into the fractured vertebra
  - Kyphoplasty – balloon-like device inserted/inflated to expand the compressed vertebra, space then filled with bone cement
- May require additional stabilization such as percutaneous screws for compression fractures extending past vertebral body

Decompression with Stabilization \(^{1,12}\)

- Relieves pressure on spinal cord and nerve roots
  - Often posterolateral approach - removing back part (lamina) of the vertebrae
  - Creates space to allow EBRT or SBRT without risking injury to spinal cord
- Spinal stability achieved by surgical fixation/fusion
  - Pedicle screws and/or rods redistribute stress and maintain alignment of bones
  - Needed with significant spinal cord compression, collapsed vertebra, or severe burst fractures

Laminectomy

Spinal Post-op Precautions

- Spinal precautions - activity restrictions to promote safe mobility and allow healing
  - Activity restrictions (No BLT)
    - No Bending (forced flexion/extension of spine)
    - No Lifting > 5-10lbs.
    - No Twisting of spine
  - Additional ROM restrictions for cervical $\rightarrow$ upper/mid thoracic surgery
    - No reaching overhead
    - No horizontal adduction past midline
  - Generally followed 5-6 weeks post-op
Sacrectomy

- Partial to complete removal of the sacrum to effectively remove/debulk tumors of the sacrum
- Resection of sacral nerve roots
  - Partial – removal of only a portion of the bony structure of the sacrum and potentially nerves
  - Complete – removal of the entire sacrum AND the nerves
- Reconstruction
  - Wound closure from rectus abdominus muscle flap
  - Spinal instrumentation and bone grafts

Sacrectomy Post-op Precautions

- Activity determined by wound closure
  - Pressure-relieving mattress
  - No SITTING (6 weeks)
  - No supine (rare)
  - WB status – WBAT
  - Orthostatic hypotension

Post-op Complications

- Wound healing issues
  - Infection
  - Dehiscence
- DVT/PE
- CSF leak
- Neurological injury
- Pulmonary complications
- Hardware migration/failure

Rehabilitation of Patients with Spinal Tumors

Role of Rehabilitation

- Rehabilitation of patients with spinal tumors focuses on relieving symptoms, improving quality of life, enhancing functional independence, and preventing further complications.
  - Impairments may be caused by the cancer, treatment side effects, and/or co-morbidities
- Prognosis, POC, and goals of patient dictate rehab interventions and recommendations
- Multidisciplinary team approach
- Patients CAN and WILL be encountered in any rehab setting!
Functional Mobility

- Promoting safe and efficient mobility to maintain and maximize patients’ function along the continuum of care
  - General mobility techniques
  - Maintaining spinal precautions
    - With spinal disease
    - Post-op
  - Post-sacrectomy precautions

- PT interventions
  - Positioning
    - For skin and joint integrity
  - Bed mobility
  - Functional transfers
  - Gait training
  - Adaptive equipment, assistive devices, DME
    - Cushion, wheelchair fit and train
    - Patient and caregiver education

Pain Management

- Multidisciplinary approach to medical management of pain
- Variety of medications to address different types of pain
  - Incisional pain
    - Opioids, NSAIDS
  - Neuropathic pain
    - Gabapentin, Lyrica
  - Muscle spasms
    - Baclofen, Botox

- Pain often most limiting barrier for successful rehabilitation
- Role of PT - dependent on
  - Type of pain
  - Physical impairments
  - Cancer-care continuum
    - Treatments received
    - Future POC
    - Prognosis
    - Co-morbidities

Pain Management

- PT interventions
  - Positioning
    - For comfort
  - Postural bracing
  - Modalities
    - Heat, cold
    - TENS
  - Manual therapy
    - Soft tissue massage

Bracing

- Bracing serves as a conservative care measure or as an adjunct to medical and interventional management
- Brace selection based on
  - Individual patient need
  - Medical and oncologic status
  - Surgical status and stability
  - Goals and mobility
Bracing

- Indications
  - Flexible, supportive, or rigid bracing for
    - Postural correction
    - Strengthening or stretching
    - Proprioceptive awareness
    - Stabilization of fractures

- Cervical collars
  - Soft cervical collar
  - Hard cervical collar
- Clavicle strap
- TLSO
- Multipodus boot
- AFO
- Additional support
  - Abdominal binder
  - Compression stockings

Cervical Collars

- Soft cervical collar
  - No concern of mechanical instability
  - Comfort, postural support
  - Worn as needed
- Hard cervical collar
  - Mechanical instability present
  - Limits cervical motion
    - Best limits flexion/extension
  - Worn at all times vs for OOB mobility

Clavicle Strap

- Facilitates upright posture and restores more optimal alignment of the head, shoulders, and thoracic spine
- Provides gentle reminder to retract shoulders
- Gradual stretching of anterior chest musculature and strengthening of back musculature

TLSO

- Prescribed for thoracic fractures and multi-level compression fractures of thoracic and lumbar spine
  - TLO, LSO for less extensive multi-level fractures
- Restricts flexion/extension, side-bending of spine
- Assists in pain management, muscle fatigue, and postural correction
  - Promotes safe core strengthening and body mechanics
**TLSo/LSO**

- TLSO
- LSO

**Multipodus Boot**

- Positioning brace while in bed
- Promotes neutral alignment of foot drop
  - Provides gentle DF stretch of ankle
  - Prevents PF contracture
  - Maintains skin integrity

**AFO**

- Supports and stabilizes weak ankle and foot during mobility and ambulation
- Provides proprioceptive input during weight bearing
- Off-the-shelf vs custom options

**Additional Support**

- Abdominal binder
  - Utilized for cervical and upper thoracic injury
    - Enhances postural support
    - Improves efficiency of respiration
    - Minimizes effect of orthostatic hypotension
- Compression stockings
  - Improves LE circulation – reduces blood pooling
  - Minimizes effect of orthostatic hypotension

**Neuromuscular Re-education**

- Postural re-education
  - Addressing missing components during functional activities
    - Facilitating neutral alignment
    - Facilitating trunk and pelvic control
    - Progressing from static mobility to dynamic activity
      - Sitting → standing → functional
        - Pre-gait training
- Balance
  - Manipulating proprioceptive input
    - Supported → unsupported activities
    - Stable → unstable surfaces
    - Altering BOS
  - Removing visual input
  - Compression/bracing/weights to assist in controlling movement
- Functional use of tone
ROM/Flexibility

- Keep spinal ROM to functional, pain-free limit in post-op patients
  - Ok for limited cervical spine rotation to complete ADL and functional activities safely
- Once cleared by MD gradual progression of ROM and flexibility exercises for neck and back
  - Pain guides progression
  - Focus on returning patient back to activity level appropriate for them
    - Very individualized!

- Continuous passive stretching exercises on limbs as tolerated
  - Muscle tightness
    - Consider hip flexors, hamstrings, heel cords
  - Spasticity
  - Joint ROM
- Splinting/bracing
  - Muscle weakness
  - Muscle/joint tightness
  - Spasticity

Strengthening

- Clear communication with surgeon and physiatrist imperative before initiating strength training
  - Post-surgical patients may be progressed more conservatively than non-surgical patients.
  - Pain ALWAYS limiting factor
  - Post-surgical patients
    - No spinal muscle or core strengthening x 5-6 weeks post-op
    - Ok for light LE strengthening
    - After 5-6 weeks – cleared for gradual strengthening
    - Isometric \(\rightarrow\) progressive resistive exercises
    - No heavy weight recommended
- Progressive resistive exercises
  - Upper and lower extremities
  - Scapular/shoulder girdle
  - Core – often most important to improve pain, posture, and diminish bracing needs
  - Abdominal muscles
  - Paraspinal muscles
  - Pelvic floor muscles
- Progress level of difficulty by altering position, BOS, and/or surface

Bowel and Bladder Management

- Based largely on level of injury, current function, and anticipated recovery
  - Incomplete vs complete spinal cord injury
- Classified as upper motor neuron (UMN) or lower motor neuron (LMN) dysfunction
  - UMN
    - Injury above conus medullaris
    - Hyperreflexic (spastic)
  - LMN
    - Injury below conus medullaris
    - Hyporeflexic (flaccid)
- Important to address skin integrity (high risk for skin breakdown and pressure ulcers)

Neurogenic Bladder

- Symptoms
  - Urgency
  - Frequency
  - Retention
  - Incontinence
  - Frequent UTI
- Management
  - Voiding schedule
  - Catheterization techniques
    - Indwelling
    - Intermittent
  - Fluid intake maintenance
  - Medications
  - Pelvic floor therapy
Neurogenic Bowel

- Symptoms
  - Constipation \(\rightarrow\) impaction
  - Incontinence
- Management
  - Voiding schedule
  - Effective bowel evacuation
    - Digital stimulation
    - Manual removal
  - Diet
  - Medications
  - Positioning
  - Pelvic floor therapy

Pelvic Floor Therapy (PFT)

- Considered for sensory retraining, pelvic muscle and sphincter coordination, and biofeedback
  - Dependent on severity of injury
  - Re-educating pelvic floor muscles to contract AND relax to void and defecate efficiently.
- UMN – relax muscles
  - Diaphragmatic breathing
  - Positioning
  - Gentle stretches
- LMN – strengthen muscles
  - Muscle agility
  - Muscle endurance

Rehab Considerations Across the Continuum

- Rehabilitation of patients with spinal cord tumors is essential
  - Advances in treatment \(\rightarrow\) increased survivorship!
  - Increased survivorship \(\rightarrow\) NEED for rehabilitation services!
- Research shows the positive effects of inpatient rehabilitation on these patients’ function and QOL

Literature Review

- McKinley WO, et al, 1999
  - Prospective comparison study
  - Compared outcomes of patients with neoplastic SCC vs traumatic SCI after inpatient rehab
  - Main outcome measures
    - Hospital/rehab LOS
    - FIM scores
    - Rate of DC home
  - Neoplastic SCC \(\rightarrow\) significantly shorter rehab LOS; significantly lower DC FIM scores
  - Neoplastic SCC can achieve rates of functional gain comparable to traumatic SCI
  - Similar DC rates home

  - Prospective comparison study
  - Compared paraplegic patients who received 2 weeks of directed rehab with control group who received no directed rehab
  - Main outcome measures
    - Survival
    - Longer median survival
    - Independence
    - 67% rehab group independent with transfers (vs 0% control group)
    - 75% rehab group DC home (vs 20% control group)
    - Pain levels
      - Lower pain rating
    - Depression/satisfaction of life
      - Lower depression scores
      - Higher satisfaction of life scores
Case Study 2

Conclusion

• “As survival after treatment for spinal cord tumors improves, it is important to understand how to apply rehabilitation principles and practices to this patient population.”

• It is important to have an understanding of primary and metastatic spinal tumors, including the various treatment options that will affect physical therapy’s role.

• Clear communication and collaboration between the multidisciplinary team is crucial.

• Physical therapy interventions, when utilized safely and appropriately, can greatly impact function and QOL.

References


References


