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Metastatic spine oncology: symptom-directed management

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Abstract

Spinal tumors pose significant treatment challenges for the physicians treating them. Understanding the location of the tumor within the intramedullary, intradural extramedullary, or extradural (epidural) space is not only critical in determining a differential diagnosis but may also provide important information about current and future neurologic deficits. Despite significant advances in the treatment of spinal tumors over the past few decades, these patients may still experience significant symptoms related to the tumor or its treatment, such as pain, weakness, impaired sensation, and bowel and bladder dysfunction. Treatment of spinal tumors should involve a multidisciplinary team of neuro-oncologists, spine surgeons, medical and radiation oncologists, physiatrists, and pain specialists to provide comprehensive oncologic management, while optimizing the patient's functional status and quality of life.

Keywords

epidural spinal cord compression | rehabilitation | spinal metastases | spinal tumors

Tumors affecting the spinal column are often classified by their location as extradural, intradural-extramedullary, or intradural-intramedullary. The location of the tumor is only not important in developing a differential diagnosis for the tumor, but also in understanding neurologic symptoms that the patient may be experiencing or at risk for developing.[2] While patients with spinal tumors most commonly present with back pain, they may also have neurologic deficits at the time of diagnosis. Physiatrists may assist the multidisciplinary spine tumor team in diagnosing these deficits, treating their associated functional impairments, and helping to prevent additional complications related to them.[3] The goal of this paper is to provide an overview of symptom-directed management for functional impairments commonly experienced by patients with neoplastic spinal cord injuries (SCIs).

To better understand the symptoms associated with spinal tumors, a brief review of the epidemiology, presentation, and treatment is necessary. The literature suggests that 20% to 40% of cancer patients will develop spinal metastases during the course of their disease, and that 5% to 10% of patients will experience symptoms of metastatic epidural spinal cord compression (MESCC).[4–6] Metastatic extradural (epidural) tumors are the most common type of spine tumor and are most frequently found in the thoracic spine, though cadaver studies have also found significant involvement in the lumbar spine.[7] The most common symptom associated with MESCC is back pain (> 95% of patients at diagnosis) followed by motor weakness (35%-85%) and sensory impairments (60%).[6–9] MESCC most commonly occurs from direct extension of tumor from the vertebral body posteriorly into the epidural space but may also occur in the setting of pathologic fracture and retropulsion of bony fragments into the thecal sac.[5–7,10] Symptoms associated with MESCC depend on the spinal segments and spinal tracts involved.

Bilsky and Smith note the earliest symptoms of myelopathy may result from damage to the lateral spinothalamic tracts producing symptoms of "numbness with a pin level." Other signs of early cord compression include hyperreflexia and a Babinksi response.[10] With continued tumor expansion and cord compression, motor weakness from damage to the anterior horn cells and lateral corticospinal tracts may occur. Late findings of cord compression, with damage to the dorsal

columns, include impaired proprioception and altered sensation to vibration and light touch.[7,10] Ataxia without nystagmus or dysarthria on examination may occur with spinocerebellar tract involvement.[7] Patients may also report bowel and bladder dysfunction with MESCC.[10]

Patients with extramedullary metastases (leptomeningeal disease) may present with a constellation of multifocal neurologic symptoms, as the leptomeninges surround both the brain and the spinal cord.[11] Leptomeningeal disease favors the dorsal aspect of the cord, particularly at the level of the cauda equina.[5] Unlike other spinal metastases, intramedullary metastases most commonly affect the cervical cord followed by lumbar and thoracic levels.[5,7] Patients with intramedullary tumors most commonly present with weakness, but may experience pain, sensory disturbances, or bowel/bladder dysfunction.[5] Unfortunately, the prognosis for patients with spinal metastases is poor with intramedullary and extramedullary metastases often limited to months, and extradural spinal metastases months to years.[5,12] Despite prognosis, treatment goals should focus on providing adequate tumor control, maintaining spinal stability, preserving neurological function, and optimizing quality of life.[4,12]

Treatment of Spinal Metastases

A multidisciplinary approach involving neuro-oncologists, medical and radiation oncologists, spine surgeons, physiatrists, and pain and palliative care specialists is essential to treating spinal metastases.[3,13] Perhaps the best illustration of this need is the neurologic, oncologic, mechanical stability, and systemic disease (NOMS) decision framework. NOMS aims to determine the best treatment strategy while also considering the patient's ability to tolerate treatments.[14] The neurologic and oncologic elements together help determine the best approach to radiation treatment, and whether surgery is indicated.[14] Spinal mechanical instability alone is generally an indication for surgical intervention if tolerated. Finally, the systemic component of NOMS considers extent and impact of systemic disease on treatment outcomes and tolerance[14]. Physiatrists and pain and palliative care specialists may assist with symptom evaluation and management, with goals to improve treatment tolerance and recovery.

Symptom Evaluation and Management

Because epidural spinal metastases are the most common spine tumors, the bulk of this section will focus on them.

Pain

The most common presenting symptom of epidural metastases is back pain.[5] A detailed history and physical examination are essential to delineate whether pain is local/biologic, mechanical, or radicular in nature, as management will vary.[7,10] (Table 1).

Localized back pain referred to as *biologic* or *tumor-related* pain is thought to be an "early symptom of bone metastases, representing tumor infiltration into the vertebral body." The prominence of biologic pain at night is

Table 1. Spine Pain in the Cancer Setting[7,10]

Pain type	Etiology	Unique characteristics	Aggravating factors	Response to medication management	Differential diagnosis
Biologic	Periosteal stretching and inflammation from tumor growth	-Improves with activity -Gnawing, aching in nature	Prominence at night	Improves with anti-inflammatory agents	-Tumor - Degenerative spine changes - Abscess - Hemorrhage/infarct - Fracture
Radicular	Nerve root compression	Sharp, shooting, stabbing	- Axial loading - Valsalva	May improve with anti-inflammatory agents, nerve stabilizers, opioids	-Tumor - Degenerative spine changes - Abscess - Fracture - Nerve root injury during treatment
Mechanical	Impending or established spinal instability	- Occurs with transitional movement/axial loading - Responds well to stabilization (surgical fixation/bracing)	- Axial loading - Activity - Laying supine/prone	Refractory to management medication	-Trauma -Tumor - Degenerative spine changes - Fractures

thought to be related to physiologic nocturnally reduced endogenous steroid secretion. Biologic pain typically responds well to anti-inflammatory medications, which may help in distinguishing this pain from other types of back pain. It may also be treated with radiation therapy with good results.[10]

Radicular pain may indicate epidural disease affecting local nerve roots. When present, imaging with MRI should be obtained to determine risk for epidural spinal cord compression.[10] Radicular pain is typically described as sharp, shooting pain that radiates into an extremity with cervical or lumbar spine involvement, or around the chest with thoracic involvement.[7]

Mechanical pain is an essential concept to understand because its treatment often requires surgical intervention. This movement-based pain worsens with position changes and activity and indicates spinal instability.[7] Patients may note worsening pain in the supine position and symptoms of mechanical radiculopathy, worsening radicular pain in the setting of axial loading.[10] Surgical consultation is required for mechanical pain, as this type of pain often does not respond to other treatment modalities.[7,10] Mechanical instability can be further assessed using SINS, the Spine Instability Neoplastic Score.[7,15]

Glare et al recommend a multidisciplinary approach to treating pain in patients with cancer, with a focus on improving pain and optimizing function.[16] In practice, this approach may involve use of interventional pain procedures/pain medications, prescriptions for physical/occupational therapy and/or orthoses, development of an exercise program, counseling, and complementary medicine techniques.

Oral medications such as nonsteroidal anti-inflammatory drugs, steroids, antiepileptic medications, opioids, and tricyclic antidepressants may be used to treat pain in cancer patients.[7,17] Prior to initiating an oral medication, it is important to understand its side effect profile and potential for serious medication interactions.[7] In prescribing opioid medications, providers should screen patients for risk factors for opioid abuse.[16] Interventional pain procedures may be selected for patients who have focal pain and cannot achieve adequate analgesia with oral medication. These interventions may include cement augmentation, joint injection, peripheral nerve block, and ablative treatments.[3,16] For patients with more complex and/or diffuse pain symptoms, spinal cord stimulation or intrathecal drug delivery may be offered.[16]

External bracing with spinal orthoses may be considered as a conservative treatment option for vertebral compression fractures and pain related to spinal metastases. Bracing may assist patients in adhering to spinal precautions (no flexion or extension with rotation) and providing external support.[17,18] Literature guiding the use of bracing for management of pathologic compression fractures is limited, and there is conflicting evidence for use in traumatic or osteoporotic compression fractures.[19] One favorable study by Stadhouder et al randomly assigned patients with traumatic thoracic and lumbar compression fractures to physical therapy (PT) alone, bracing and PT, or casting and PT, and found those in the bracing group had the least residual pain and lowest long-term disability.[20] Though future studies are needed to help delineate the optimal population for bracing, type of brace, and duration of bracing, bracing appears to be a reasonable option for patients with pain related to compression fractures.[19] In fact, the 2017 Lancet Oncology International Spine Oncology Consortium Report endorses external bracing as one of the suggested treatment options for patients with spinal metastases.[3]

Patients may benefit from a course of targeted physical/occupational therapy once pain is reasonably controlled. For patients with symptomatic spinal metastases, therapy goals include core and spinal extensor strengthening, optimizing posture, and reducing risk for falls.[18]

Neurologic Impairments

Though spinal metastases can cause significant pain and functional impairments, the most feared complication of spinal metastases is MESCC.[3,5] Symptoms associated with MESCC depend on the spinal segments and spinal tracts involved. Several spinal cord syndromes have been reported in the literature, including anterior cord, posterior cord, Brown-Sequard, central cord, conus medullaris, and cauda equina.[1,21]

Patients who gradually develop symptoms of MESCC are thought to have a better prognosis for neurologic recovery, as opposed to patients who develop symptoms rapidly.[22] Acute MESCC is considered an emergency, requiring rapid treatment to prevent permanent neurologic deficits including paralysis.[8,9] Studies conducted on the return of ambulation after MESCC note that 2 of the most important predictors are neurologic function at presentation and time between onset of deficits and treatment.[6,17]

Initial and Serial Evaluations

The 2017 Lancet Oncology International Spine Oncology Consortium Report on multidisciplinary management of spinal metastases recommends a physical medicine and rehabilitation consultation for patients with neurologic impairments related to metastatic disease to optimize function and independence.[3] A systematic physical examination should be performed on any patient with neurologic impairments related to spinal metastases, incorporating strength, tone, sensation, reflexes, and sphincter function.[7] Though the International Standards for Neurological Classification of Spinal Cord Injury (ISNCSCI) is not validated for use in patients with MESCC, it has been recommended as a guide for this population.[7,23]

The ISNCSCI assessment classifies patients by the ASIA (American Spinal Injury Association) Impairment Scale. Patients are first assigned a sensory level and motor level, after which a neurological level of injury can be determined. The neurologic level of injury will be referred to as the level of injury throughout the rest of this paper. Finally, patients are designated as having a "complete" or "incomplete" injury, further classified by ASIA Impairment Scale (AIS) grade as grade A (complete), B (sensory incomplete), C (motor incomplete), D (motor incomplete), or E (normal).[24]

In our experience, dynamic changes from examination to examination are not uncommon, and may be related to tumor recurrence, surgery, effects of radiotherapy, or systemic effects from treatment (eg, fatigue or neuropathy).

Management for these impairments should be patient focused with the goal of maximizing independence, improving function, and preventing future complications.[25,26]

Weakness

The pattern of weakness experienced reflects site of injury and may present as upper motor neuron (UMN), lower motor neuron (LMN), or a mixed pattern. Management of weakness includes targeted physical and occupational therapy to work on strength, transfers (eg, from bed to chair or from chair to commode), stamina, balance, range of motion, and activities of daily living.[7,17,27] Certain patients may benefit from use of bracing and assistive devices.

Lower extremity orthoses are referred to by the joints that they encompass and commonly include ankle foot orthoses (AFOs), knee ankle foot orthoses, and hip knee ankle foot orthoses. A thorough examination of strength, sensation, range of motion, skin integrity, and edema must be performed to determine the appropriate orthosis. In addition, cognitive impairments and social support should be considered because certain bracing options may require assistance for donning and doffing.[28]

Orthoses may assist a patient with mild weakness by supplementing the desired movement and improving gait biomechanics. For example, a patient with mild ankle dorsiflexion weakness (ie, Medical Research Council score 2/5) may be able to ambulate longer distances with less energy expenditure with the addition of a lightweight, carbon-fiber ankle-foot orthosis. For more significant weakness, a brace may offer the stability and alignment needed for ambulation. A patient with substantial ankle dorsiflexion weakness may benefit from a rigid AFO, allowing the patient to ambulate short distances while protecting the ankle joint from injury. Lower extremity orthoses may also be helpful in preventing joint contractures. A patient with significant ankle dorsiflexion weakness is at risk for developing plantarflexion contractures, and thus may benefit from an AFO to stretch the Achilles tendon. Additional uses for orthoses may include treating spasticity and improving proprioception in those with impaired sensation.

Patients with limited mobility will require an evaluation/prescription for a wheelchair, as their primary method of mobility, and durable medical equipment such as shower benches and commodes.[29] Wheelchairs should be customized to the patient. An in-depth evaluation should be performed to obtain proper wheelchair dimensions, determine the best type of wheelchair (eg, manual wheelchair vs power wheelchair), and assess for certain modifications (eg, air-cushion, antitippers, truncal support, head and neck support).[30,31] Family education and needed home modifications are important aspects to review to ensure safety. For patients receiving orthoses, assistive devices, wheelchairs, and durable medical equipment, fit and function must be reassessed regularly. Patients and caregivers should be counseled on proper maintenance of their equipment.

Spasticity

Spasticity is often defined as a velocity-dependent increase in muscle tone and is a component of "upper motor neuron syndrome."[32] Appropriate evaluation of spasticity is important because it may cause significant pain and impair both mobility and activities of daily living. Spasticity may also increase risk of joint contracture and pressure ulcers.[32] Treatment of spasticity must balance the benefits of tone reduction to improve pain and function, with the risk of "unmasking" weakness as tone is diminished. In other words, for some patients, spasticity compliments available muscle strength and overaggressive treatment may result in weakness and reduced function.

Patients with mild symptoms of spasticity are generally treated conservatively with stretching and splinting.[7] More severe spasticity may require oral spasticity medications, chemodenervation to affected muscles, and potentially intrathecal baclofen treatment.[7,27]

Impaired Sensation/Pressure Wounds

Altered sensations such as dysesthesias and paresthesias may not only cause discomfort for patients, but also place them at risk for pressure injuries.[7,26] Patients with SCIs are at high risk for developing pressure ulcers related to reduced mobility, incontinence, and prolonged sitting. Cancer patients have additional risk factors for skin breakdown due to poor nutrition and prior radiotherapy causing skin fragility[7,26]. Areas of high risk include the ischial tuberosities, sacrum, coccyx, greater trochanters, ankle malleoli, occiput and calcaneous[33]. The Braden scale is a commonly used scoring system to assess risk for pressure ulcer development, and includes factors of sensory perception, moisture, activity, mobility, nutrition, and friction and shear[33]. Similarly, scoring systems developed specifically for SCI patients such as the Spinal Cord Injury Pressure Ulcer Scale include level of activity/mobility, severity of the SCI, urinary incontinence, patient comorbidities, residence in a nursing home, and nutrition.[33]

Patients with SCI must be instructed to carefully examine their skin and to perform regular pressure relief techniques.[7,26,27] Repositioning and pressure redistribution efforts should begin as soon as it is safe to do so from a medical perspective. For example, in the acute rehabilitation phase, patients are commonly repositioned in their hospital beds every 1 to 2 hours. Additional considerations for patients with pressure ulcers may include use of pressure-redistribution mattresses/wheelchair cushions, prescription of a wheelchair with tilt-in-space capability, use of padded toilets, and referral to nutrition.[33]

Neurogenic Bladder

Symptoms of neurogenic bladder presenting with a UMN pattern, LMN pattern, or mixed pattern may occur. Bladder dysfunction can result in difficulty with urinary drainage and abnormalities in intravesicular pressure, placing an individual at risk for infections, renal disease, skin breakdown, and social embarrassment. An effective bladder regimen should provide a safe and effective way to drain the bladder, while taking patient preference into account.[7]

Patients with UMN patterns experience frequent urges to void with limited ability to store urine. Treatment strategies may include a "timed-toileting" schedule to reduce

likelihood of incontinence, pharmacologic treatment with anticholinergic medications, or botulinum toxin injections.[7,26]

Patients with LMN patterns are prone to store urine to the point of overdistension before "voiding," which often represents overflow incontinence.[27] Treatment strategies may include use of Crede, double void, or pharmacologic treatment with cholinergic medications. An intermittent catheterization strategy may be employed for patients with either UMN or LMN bladder dysfunction to better regulate bladder emptying.[7] In certain situations, an indwelling Foley catheter or suprapubic catheter may be more appropriate.[26] (Table 2).

Neurogenic Bowel

Similarly, patients may develop neurogenic bowel dysfunction with UMN, LMN, or mixed patterns. Bowel dysfunction creates difficulty with stool evacuation, resulting in social inconvenience, infection, and skin breakdown.

Patients with UMN patterns are placed on a bowel regimen that employs the use of stool softeners, bowel stimulants, suppositories, and digital stimulation for a goal of a bowel movement daily or every other day.[7,26] With LMN patterns, medications to promote stool-bulking are used so that the stool may be manually evacuated.[7,26] For patients with mixed patterns, a detailed history and sphincter examination should be performed to gain more insight into appropriate strategies for a bowel regimen. It is important to note that in the cancer population digital stimulation and suppository use may be limited by severe thrombocytopenia and neutropenia.[7,26] (Table 3).

Table 2. Neurogenic Bladder Management[7,26]

	Upper motor neuron	Lower motor neuron
Characteristic	Frequent urges, small voids	Overdistension
Goal	Improve storage by	Improve emptying by
	a) Reducing "overactive" bladder symptoms	a) Increasing bladder contraction
	b) Increasing urethral resistance	b) Reducing urethral resistance
Behavioral	-Timed toileting	- Crede or double void
	- Biofeedback	- Biofeedback
	- Electrical stimulation	- Electrical stimulation
	- Dietary modifications	- Dietary modifications
	- Pelvic floor therapy	- Pelvic floor therapy
Medications	a) Anticholinergics	a) Cholinergics
	b) Alpha agonists	b) α blocker or β agonists
	c) Botulinum toxin	
Other:	Intermittent catheterization may be used for both conditions	

Sexual Dysfunction

There are several factors to consider when evaluating the sexual function of a patient with an SCI. While the SCI itself may affect the physiology and sensation involved in sexual function, other factors such as body image, positioning, skin care, and bowel/bladder maintenance must also be considered.[26,34] As with the other impairments, a thorough history and examination is essential in determining a treatment plan for the patient. The 2010 Consortium for Spinal Cord Medicine Sexuality and Reproductive Health Clinical Practice Guidelines recommend "asking direct, open-ended questions to facilitate a discussion of sexual matters."[34] An ISNCSCI examination with close consideration of the sensation along the T11 to L2 and S2 to S5 areas, as well as the presence of reflexes and voluntary anal contraction, is critical.[34]

Alexander and Alexander note that preservation of sensation to light touch and pinprick in the T11 to L2 dermatomes has been shown to be related to ability to experience psychogenic genital vasocongestion in women and increased penile circumference in men.[35] Thus, patients with intact sensation in the T11 to L2 areas are counseled to use the psychogenic component of sexuality and increase foreplay activities.[35] Genital stimulation/reflexogenic stimulation may be effective for patients with a lesion above the conus medullaris and presence of a bulbocavernosus reflex.[35]

Treatment for sexual dysfunction may involve counseling, education, pharmacologic treatment, and use of assistive devices.[26] Patients should be encouraged to perform bowel and bladder care prior to sexual activity and to position themselves in ways in which they are not at risk of

Table 3. Neurogenic Bowel Management[7,26]

	Upper Motor Neuron	Lower Motor Neuron
Characteristics	Rectal tone present	Low/Absent rectal tone
	- Preserved rectocolic reflex	- Reduced peristalsis, slow bowel transit
Goal	Soft but formed stool that is easy to pass	Firm stool, bulked to ensure continence
Behavioral	- Digital stimulation	- Manual removal of stool
	- Bowel program to begin 30 min after eating (gastrocolic reflex)	
Medications	- Stool softener	- Fiber
	- Laxatives	- Polyethylene glycol
	- Suppository	
Other	Patients should be counseled on adequate hydration	

injuring skin/limbs.[34] Counseling on changes in spasticity or development of autonomic dysfunction with sexual activity should also be performed.[34]

Cardiovascular Dysfunction

Orthostatic hypotension, due to reduced sympathetic efferent activity and reduced vasoconstriction, may occur in individuals with SCI depending on the level of injury. For incomplete injuries, it is seen most commonly with cervical involvement.[36] Treatment of orthostatic hypotension may include ensuring adequate hydration, use of compression stockings and abdominal binders, and pharmacologic treatments such as midodrine and salt tablets.[36]

Autonomic dysreflexia (AD) is a medical emergency that typically affects SCI patients with complete injuries above the level of T6.[36] It is usually diagnosed by a sudden increase in the normal systolic blood pressure by 20 mm Hg to 40 mm Hg. Signs and symptoms of AD include headache, diaphoresis, elevated blood pressure, and bradycardia. AD is generally triggered by a noxious stimulus below the level of injury, resulting in sympathetic overactivity below the level of injury, and parasympathetic overactivity above the level of injury. Treatment of AD involves identifying and neutralizing any clear triggers, such as an overdistended bladder, tight-fitting clothing, or bowel constipation. If symptoms do not resolve with these interventions, pharmacologic treatment with short-acting, rapid-onset medications (nifedipine, captopril) may be trialed.[36]

Bone Health

Individuals with SCI experience a rapid decline in bone mineral density (BMD) after injury, with some studies noting a 20% to 50% reduction in BMD in the first few years after injury.[37] Bone loss is thought to be related to reduced mobility and paralysis, impairing a patient's ability to perform necessary weight-bearing required to stimulate bone formation.[37] Additional factors such as endocrine, vascular, and metabolic changes have also been thought to affect BMD after SCI.[38] Cancer-specific risk factors include presence of bony metastatic disease and treatments with hormonal or radiation therapy.[39] In a study of patients treated with stereotactic body radiotherapy, the 1-year cumulative incidence of vertebral compression fracture was 12.4%, with most occurring within the first 4 months after treatment.[40]

Although the most common sites for pathologic fractures in able-bodied patients are the spine and proximal femur, those with SCI are at risk for fractures below the level of injury, typically in the lower extremities (distal femur and proximal tibia).[38] It is important to note that these fractures may occur with minimal to no trauma. In addition, patients may endure many complications after a fracture, including development of pressure ulcers, increased pain, nonunion of fracture, and prolonged hospitalizations.[41] Risk stratification for fracture in patients with SCI is limited, as the World Health Organization Fracture Risk Assessment Tool has not been validated in an SCI population, and dual-energy x-ray absorptiometry scans measure the sites of fracture that are most common in able-bodied patients (lumbar spine and proximal femur).[41]

Although there are no standard guidelines for the management of bone health in patients with SCI, pharmacologic treatment with bisphosphonates may be considered.[36] Rehabilitation strategies may be employed such as increasing weight-bearing with the use of a stander, ambulating with orthotics, and functional electromagnetic stimulation.[36]

Role of Acute Inpatient Rehabilitation

Patients with a cancer-related SCI may benefit from acute inpatient rehabilitation, if aligned with their goals and life expectancy.[3,42] McKinley and colleagues compared functional gains made in acute inpatient rehabilitation between patients with traumatic SCI and neoplastic SCI and found that though the traumatic SCI group made greater gains, they also had significantly longer lengths of stay.[43] When averaging the gains made per day admitted to the hospital, the values were similar between the groups and the groups had similar rates of discharge to the community.[43]

Additional inpatient rehabilitation studies on patients with MESCC demonstrate significant functional gains and discharge to home.[42] Ruff et al found that patients with MESCC who participated in a 2-week course of inpatient rehabilitation had improved pain, less depression, and better life satisfaction than historical cohorts that did not receive inpatient rehabilitation.[44] These differences were found to persist until the end of life and were attributed to the rehabilitation group's "increased likelihood of returning home, independently transferring, and having bowel and bladder management programs."[45] If acute inpatient rehabilitation is deemed appropriate, it should ideally be conducted in a dedicated SCI unit because outcomes in this setting have been found to be better than in general rehabilitation units.[23,25]

It is important to note that there are additional settings in which rehabilitation can take place. These include subacute inpatient rehabilitation, home-based therapies, and outpatient therapies. A physiatry consultation can assist in determining the appropriate setting based on a patient's goals, and functional, medical, and oncologic status.

Consistent communication between all members of the care team (patient, family, medical/surgical/radiation oncology, and rehabilitation) is essential to setting realistic and safe rehabilitation goals of care. It is especially vital during periods when a patient's clinical status, prognosis, and treatment strategies are changing.

Conclusion

Spinal tumors pose significant challenges for patients and the physicians treating them. The tumor and tumor treatments can cause symptoms of pain and neurologic impairment that significantly affect quality of life. Treatment of spinal tumors should involve a multidisciplinary team of neuro-oncologists, spine surgeons, radiation oncologists, physiatrists, and pain specialists to provide comprehensive oncologic management, while optimizing the patient's functional status and quality of life.

Resources for Stakeholders

American Spinal Injury Association International Standards for Neurological Classification of Spinal Cord Injury (ISNCSCI). https://asia-spinalinjury.org/wp-content/uploads/2016/02/International_Stds_Diagram_Worksheet.pdf
American Spinal Injury Association Online Guide to Durable Medical Equipment for Persons with Spinal Cord Injury and Dysfunction. https://asia-spinalinjury.org/information/dme/
American Spinal Injury Association Guidelines for Use of Durable Medical Equipment for Persons with Spinal Cord Injury and Dysfunction. https://asia-spinalinjury.org/product/guidelines-for-use-of-durable-medical-equipment-for-persons-with-spinal-cord-injury-and-dysfunction/
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Paralyzed Veterans of America Consumer Guides: https://pva.org/research-resources/publications/consumer-guides/

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