

Oncology Emergency Series

Understanding spinal cord compression

By Roberta Kaplow, PhD, APRN-CCNS, AOCNS, CCRN, and Karen Iyere, MSN, RN

SPINAL CORD COMPRESSION (SCC) is a life-threatening complication of primary and metastatic cancer that can significantly impact a patient's quality of life. Prompt diagnosis and treatment are critically important. Identified by the Oncology Nursing Society as a structural oncologic emergency, SCC occurs when a tumor puts pressure on the spinal cord.

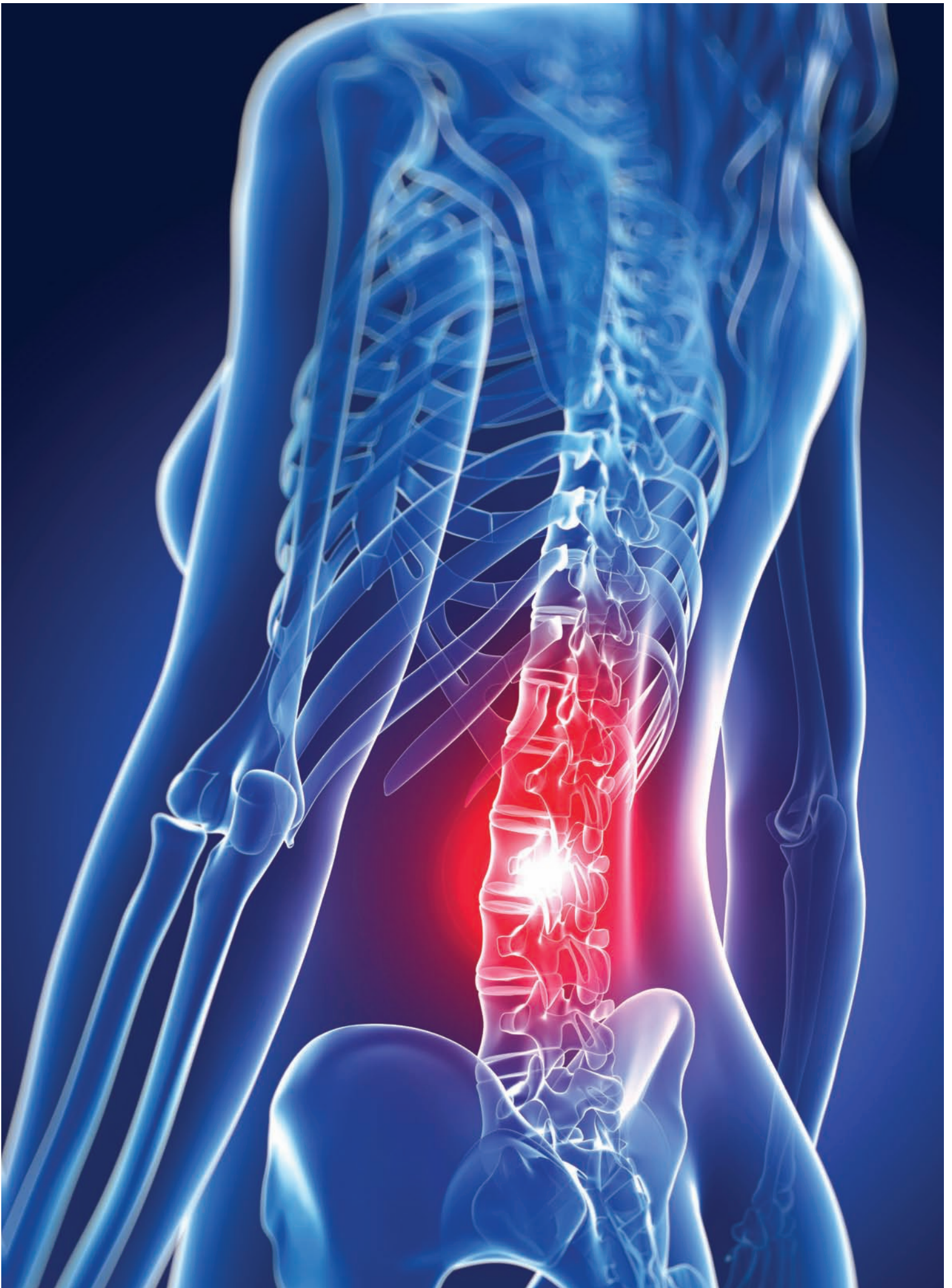
This article, the first of a three-part series on oncology emergencies, describes signs and symptoms of SCC and the diagnosis, treatment, and nursing care for patients with SCC.

Anatomy and pathophysiology

The spinal cord is the third most likely site where cancer cells metastasize.¹ Although the exact incidence of SCC isn't known, it's estimated to affect 5% of patients with cancer; the incidence is reported at 10% in patients with spinal metastases.^{2,3}

The spinal cord is composed of nerves that transmit messages to and from the brain. A tumor growing on or adjacent to the spinal cord can compress the thecal sac and the cauda equina. The thecal sac, which surrounds the spinal column, contains cerebrospinal fluid that circulates around the spinal cord and the nerve roots. The cauda equina at the distal end of the spinal cord is a collection of nerve roots resembling a horse's tail, hence its name.⁴

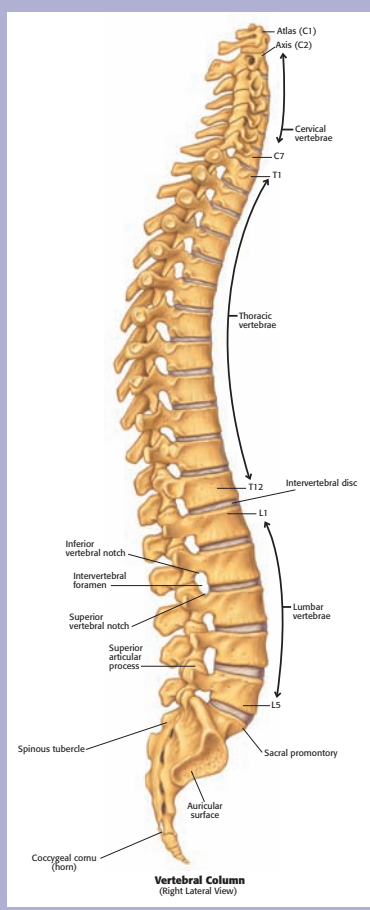
The spine is composed of vertebrae and the spinal cord. (See *Looking at the vertebral column*.) Thirty-one pairs of spinal nerves connect the spinal cord to muscles through vertebral openings. The fibers innervate different parts of the body. The spinal cord conducts two types of signals. Sensory signals are



transmitted via afferent nerve fibers to the spinal cord. Motor responses are transmitted via efferent fibers from the spinal cord to the muscles. A mnemonic used to remember this is **SAME**: **S**ensory (Afferent) signals go to the spinal cord; **M**otor (Efferent) signals leave the spinal cord. For example, if someone touches a hot surface, sensory signals go to the spinal cord via the afferent pathway and to the brain, creating the pain sensation. The reflex is to pull the hand away quickly via the motor (efferent) pathway.

Looking at the vertebral column

The vertebral column, which protects the spinal cord, consists of 7 cervical, 12 thoracic, 5 lumbar, 5 sacral, and 4 coccygeal vertebrae.



COHEN BJ, TAYLOR JJ. MEMMLER'S THE HUMAN BODY IN HEALTH AND DISEASE, 11TH EDITION. BALTIMORE: WOLTERS KLUWER HEALTH, 2009.

Each nerve is a cell and if it's compressed, as it is with SCC, the signal will be inhibited; nerve damage due to compression can be temporary or permanent. Compression may also inhibit blood flow to the spinal cord, which can cause nerve cell ischemia or infarction.

When SCC develops, depending on the level of the compression, it can cause loss of function to the affected nerves and those distal to the site of the compression. Not only do sensory and motor deficits result, but the autonomic nervous system can be affected. When this occurs, bowel, bladder, and sexual function may be lost. (See *Breaking down the nervous system*.)

Although tumors may affect any area of the spinal cord, most cases of SCC involve metastasis to the vertebral body. Tumors can also invade the epidural space, the area between the vertebrae and the dura or outermost layer of the spinal column, and compress the thecal sac.

Compression or constriction affects signal conduction and blood supply to the spinal cord. It also increases vascular permeability, resulting in interstitial edema, which impedes blood flow to arterioles and stops capillary blood flow to the area. Decreased blood flow to the spinal cord can lead to a life-threatening emergency: infarction or collapse of affected vertebrae. If not recognized and treated promptly, this can cause permanent paresis, paraplegia or quadriplegia, loss of bowel and bladder control, and sexual dysfunction.⁵

Where does SCC appear?

SCC may develop from tumors within the spinal cord (intramedullary), outside the spinal cord (extramedullary), intradural (within the dura mater), or extradural (outside the dura mater); however, intramedullary SCC is unusual. Rarely,

SCC can also occur when cancer spreads within the epidural space; this typically happens in the latter part of the metastatic disease trajectory.⁵

Most cases of SCC affect the thoracic area, but a few affect the lumbosacral area. Cases affecting the cervical spine are even more unusual.

Metastatic disease can appear in more than one area of the spinal column.⁵ Depending on the compression's location, signs and symptoms may develop gradually or abruptly.

Although SCC can occur in patients with any cancer involving bone, some cancers are more likely to spread to the spine than others. (See *Cancers that raise the risk of SCC*.) SCC may also occur due to primary tumors that affect the paravertebral area (the area on either side of the vertebral column) and spread to the vertebrae. Gastrointestinal and pelvic cancers typically impact the lumbosacral spine while the thoracic spine is typically involved with lung or breast cancer.⁵

Recognizing SCC

In some patients, SCC is the presenting sign of cancer; about 20% of patients with SCC have an undiagnosed malignancy.⁶ Back pain, the most common first symptom of SCC, is reported in 90% to 98% of cases.¹

Three types of pain are associated with SCC:

- **Local pain** is typically described as a dull ache that increases in intensity as the day passes. The pain is located within one or two spinal divisions of the compression.
- **Radicular pain** is described as a dull ache that's difficult to localize. It can also be a sharp, shooting pain that occurs with spinal movement. Radicular pain spreads in a bandlike manner (back to front in the chest or

abdomen). It can also radiate along an affected dermatome.

- *Referred pain* is difficult to localize because it's referred from one site to another, may affect multiple dermatomes, and is felt in an area away from the compression.⁵ An example of referred pain is someone who has right upper quadrant pain due to acute cholecystitis. Often the pain is referred to the right shoulder.

Typically, signs and symptoms of SCC progress in a similar pattern: Symptoms begin with motor symptoms, followed by sensory symptoms, and finally autonomic symptoms. (See *Clinical manifestations of SCC*.)

Diagnosing SCC

Early recognition of signs and symptoms and prompt diagnosis of SCC are essential to prevent permanent disability.⁶ For instance, if the patient who had ovarian cancer begins to complain of back pain, the health-care provider should be suspicious of metastasis to the spine.

To diagnose SCC, several assessments and diagnostic studies should be performed. The first step is to complete a comprehensive history and physical assessment.

- **History.** The history of the symptoms and disease process will help determine if the patient is experiencing autonomic dysfunction. For instance, ask about bowel and bladder habit changes, incontinence, and changes in sexual function. History and duration of any neurologic findings as well as relief measures should be ascertained.⁶

- **Physical assessment.** The patient should have a thorough neurologic assessment. Patients should be evaluated for pain as well as other sensory, motor, and autonomic dysfunction.⁶

To assess for back pain, ask the patient to raise one leg and flex the neck. The pain's location may indicate the level of SCC. For instance, if

Breaking down the nervous system¹³

The nervous system is divided into two main divisions and several subdivisions. The central nervous system (CNS) consists of the brain and the spinal cord. The peripheral nervous system (PNS) consists of nerve tissue outside the brain and spinal cord. The PNS comprises the somatic nervous system and the autonomic nervous system. The somatic nervous system is responsible for sensory and motor innervation of the CNS and PNS except for the viscera, smooth muscle, and glands. Motor innervation for the viscera, smooth muscles, the heart, and the glands is the responsibility of the autonomic nervous system.

Now consider the difference between sensory (afferent) nerves and motor (efferent) nerves. Sensory (afferent) nerves carry impulses from the periphery to the central nervous system for processing. The motor (efferent) nerves carry a response to the affected organ, smooth muscle, or gland. The two pathways for the motor response are the somatic nervous system and the autonomic nervous system. In the somatic nervous system, the motor nerves innervate an organ. The motor neurons of the autonomic system take the response to the smooth muscle, heart, or glands.

The autonomic nervous system is responsible for involuntary responses, such as regulating body temperature, digestion, elimination, pupillary constriction, blood flow to organs, and even BP. The autonomic nervous system is divided into the sympathetic and parasympathetic branches. The sympathetic branch upregulates the body systems (fight or flight) while the parasympathetic branch downregulates the body systems (rest and digest). The three neurotransmitters in the autonomic nervous system are acetylcholine, epinephrine, and norepinephrine.

the pain is in the lumbar area, the patient likely has a SCC of the lumbar area. Assess the location, type of pain (such as acute or chronic), severity, and characteristics of the pain (for example, dull or sharp, radiating or local).^{5,6} Ask what causes pain to start and what, if anything, brings relief. Ask about the pain's intensity, location, duration, and aggravating and alleviating factors. Perform the same maneuver using the opposite leg.

Assess motor function by observing the patient's posture, balance, and gait while he or she walks across the room, turns, and walks back. Test muscle strength by asking the patient to actively resist your movement. Assess and grade deep tendon reflexes, including the plantar (Babinski) response.^{5,6} (See *Evaluating the Babinski response*.)

The patient's ability to ambulate is a gauge of the patient's baseline neurologic status and helps determine prognosis. In general, patients who

are ambulatory on presentation will retain that ability. Patients who can't ambulate before treatment probably won't regain this ability. Data suggest that patients who can't ambulate after radiation therapy to treat SCC will have a poor prognosis for survival.⁵

To assess the sensory system, begin most distally and move proximally to determine the highest level of intact sensory function. Assess light touch with a fine wisp of cotton. With the patient's eyes closed, touch the patient's skin lightly and ask the patient to respond whenever a touch is felt. Compare one side of the body to the other. Use a pinprick to assess pain sensation. Evaluate proprioception by grasping the patient's big toe, pulling it away from the other toes, and demonstrating "up" and "down" as you move the patient's toe. Then with the patient's eyes closed, ask the patient to state if you're moving the toe up or down.⁶

Assess the anal reflex by using a cotton swab or other dull object to stroke outward from the anus in four quadrants while you observe for reflex contraction of the anal musculature.⁶

Upon initial assessment of signs and symptoms related to SCC, immediately notify the healthcare provider and prepare the patient for diagnostic testing. Continue to closely monitor the patient for any deterioration in neurologic functioning, such as progressive weakness or development of autonomic neuropathy.

Diagnostic studies

• **Magnetic resonance imaging (MRI) and computed tomography (CT).** The healthcare provider will obtain one or more imaging studies, such as X-rays of the spine, MRI, or CT scan. MRI of the spine is the diagnostic study of choice for SCC because it provides the best visualization of spinal lesions and allows the healthcare provider to evaluate the complete spine for multiple metastatic sites. An MRI can be used to distinguish between a lesion and other causes of signs and symptoms.⁵ Other diagnostic studies may be performed to help rule out other

causes such as degenerative joint disease.

• **Myelography.** This is generally used only when a patient can't undergo CT or MRI. A myelogram also permits cerebrospinal fluid analysis.

• **Electromyography (EMG).** EMG is typically used for patients who report weakness, pain, or paresthesias. During an EMG, electrical activity of muscle fibers is evaluated individually and collectively by assessing the degree muscles can respond to stimuli.⁷

• **Nerve conduction velocity testing.** This test assesses how quickly electrical signals travel through a nerve. The conduction velocity along the nerve depends on the state of myelination. This test is often performed at the same time as EMG.⁸

Diagnosis of SCC is based on the presence of risk factors, including a tumor or metastasis in the spinal cord, and presenting signs and symptoms along with diagnostic study results.

Treatment strategies

To treat SCC and manage signs and symptoms, the healthcare provider may prescribe the following therapies.

Cancers that raise the risk of SCC^{2,6}

- multiple myeloma
- lymphoma
- lung cancer
- breast cancer
- prostate cancer
- renal cell carcinoma
- gastrointestinal cancer
- melanoma
- sarcoma
- gliomas
- astrocytomas
- ependymomas
- oligodendrogliomas
- hemangioblastomas.

• **Corticosteroids.** Patients with SCC are treated initially with I.V. corticosteroids to reduce edema around the cord or involving the cord itself, alleviate pain, and improve neurologic function. Dexamethasone is the steroid of choice for SCC. Acute adverse reactions associated with corticosteroid therapy include nausea, vomiting, increased appetite, weight gain, fluid retention, heartburn, headache, difficulty sleeping, and facial puffiness. Long-term adverse reactions may include hypertension, hyperglycemia, immunosuppression, osteoporosis, cataracts, peptic ulcers, and depression or other mood changes.⁵

• **Radiation therapy (RT).** Begun soon after the diagnosis of SCC and the initiation of corticosteroid treatment, RT relieves SCC by decreasing tumor size. Immediate RT is required in patients who aren't surgical candidates; they should receive therapy within 24 hours of SCC diagnosis.²

• **Analgesia.** Pain management is vital to both acute and chronic treatment. Patient self-report is the most valid and reliable measure of pain. If patients can, they should be

Clinical manifestations of SCC^{5,12}

Motor symptoms	Sensory symptoms	Autonomic symptoms
• fatigue	• numbness	• urinary retention
• hyporeflexia	• paresthesia	• urinary hesitancy
• decreased muscle tone	• loss of thermal sensation	• frequent small voids
• spasticity	• loss of proprioception	• urinary incontinence
• gait disturbance	• loss of deep pressure and vibration sensations	• loss of bowel control
• leg weakness	• progressive lower (lumbar) spinal pain	• constipation
	• pain in the middle (thoracic) or upper (cervical) spine	• decreased ability to bear down
	• other pain	• impotence

asked to rate their pain intensity using a numeric rating scale (or equivalent) ranging from 0 (no pain) to 10 (the worst pain imaginable) per hospital policy. If patients can't quantify their pain, use another valid and reliable tool recommended by the facility. Use the same pain intensity rating scale for subsequent assessments.

The first-line treatment for severe pain in patients with SCC is opioids. Nonsteroidal anti-inflammatory drugs may also be used if pain isn't severe. Adjuvant therapies, including antidepressants, antiepileptic drugs, or steroids, may be prescribed to augment the effects of analgesics. Note and document efficacy. Complementary therapies, if available and not contraindicated, may also be offered. These therapies may include acupuncture, massage therapy, external Qigong therapy, capsaicin cream, hydrotherapy, or any combination of these.^{4,5}

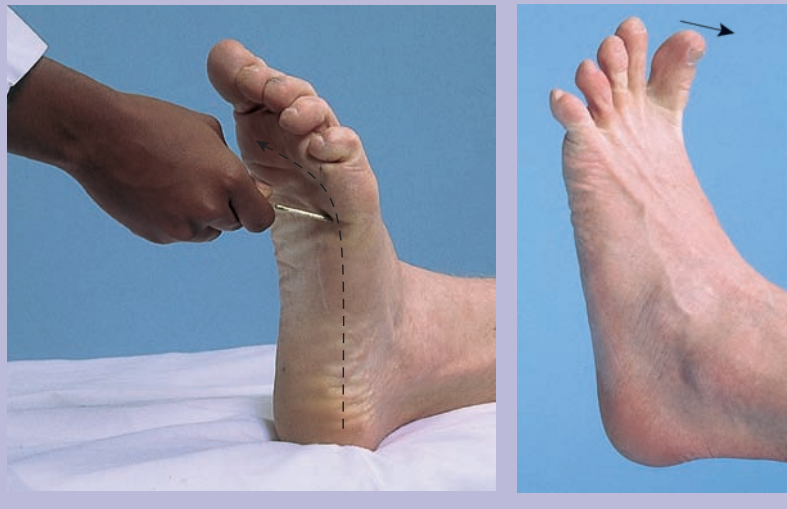
Patients may need a vertebroplasty or kyphoplasty to decrease compression and chronic pain. For a vertebroplasty, a balloon is inflated in the compressed vertebral space to alleviate the compression. In a kyphoplasty, special cement is used to keep the vertebral body from collapsing back onto the spinal cord.

• **Bisphosphonates.** Zoledronic acid, pamidronate, or other bisphosphonates are used to help manage signs and symptoms associated with bone metastases, including bone pain and pathologic fractures. Bisphosphonates help reinforce bones and prevent them from breaking down. They also can help prevent certain complications of cancer therapy such as hypercalcemia of malignancy.⁹ Bisphosphonates may reduce the risk of SCC and related signs and symptoms and can be used to prevent further bone metastasis.

Evaluating the Babinski response

The Babinski or plantar response is assessed by stroking the lateral aspect of the patient's sole from the heel to the ball of the foot, curving medially across the ball. Use an object such as a key or opposite end of a reflex hammer and use the lightest stimulus that will evoke a response. Note movement of the big toe, which is normally plantar flexion as shown in the picture at left.

Dorsiflexion of the big toe and fanning out of the other toes is a positive Babinski response, as shown in the picture at right.



• **Surgery.** To decompress the spinal cord, the entire tumor or a segment of the tumor can be removed via laminectomy. Surgical treatment is used to improve mobility, decrease pain, and improve quality of life. To make it more effective, surgical treatment may be combined with RT. Surgical treatment is typically appropriate for patients with:

- a life expectancy of more than 4 months.
- rapidly progressing paraplegia.
- pathologic fracture with dislocation of bone fragments.
- intractable pain.
- recurrence after RT (radioresistant tumors).

One of the main objectives of surgical intervention is to stabilize the spine. Postoperative spinal stabilization may be accomplished with a brace until any stabilization devices inserted in the OR or grafts heal and the spine is strengthened. A custom-

made brace may be created and worn for 6 to 10 weeks.^{5,6}

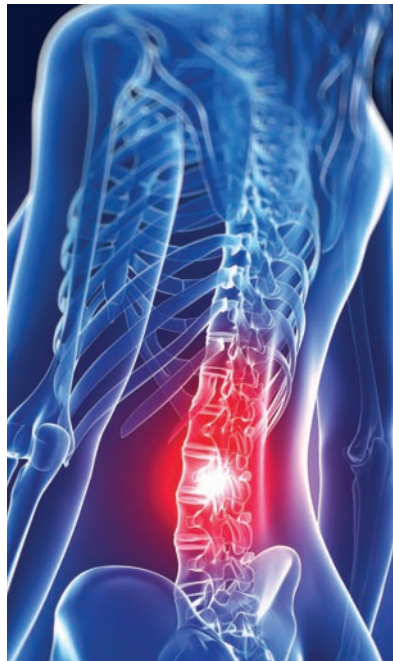
Nursing interventions

Nurses play a vital role in the management of SCC. After diagnosis of this oncologic emergency, the nurse will assist with stabilizing the patient's clinical status and work to prevent further complications. Nurses are responsible for the following steps.

- Tumors located in the cervical spine may alter pulmonary function, necessitating emergency endotracheal intubation; therefore, closely assess the the patient's airway and respiratory status.
- Perform a thorough neurologic assessment including vital signs and evaluation for presence of clinical manifestations at least every 2 hours.
- Optimize patient mobility and mitigate sequelae of immobility. Patients with spinal instability diagnosed by MRI should be maintained on bed

rest, lying flat to prevent further neurologic damage. For patients with spinal instability, use log-rolling technique when changing position. As symptoms improve, gradually assist the patient to a sitting position. If symptoms worsen, return the patient to the most comfortable position. Perform range-of-motion exercises, as tolerated. Collaborate with the physical therapist to optimize function. Obtain equipment to maintain alignment, augment patient mobility, and promote spine stabilization. Initiate and maintain venous thromboembolism (VTE) prophylaxis, such as intermittent compression devices, graduated compression stockings, or low-molecular-weight heparin or unfractionated heparin.

- Although constipation is usually a result of loss of voluntary control of the anal sphincter, it's also an adverse reaction to opioid therapy. Collaborate with the provider to initiate a bowel regimen, including administration of stool softeners, laxatives, and suppositories every 1 to 2 days as needed for bowel elimination.
- Collaborate with the healthcare provider to determine the need for intermittent or indwelling urinary catheterization. If an indwelling



The spinal cord is the third most likely site where cancer cells metastasize.

urinary catheter is inserted, implement the catheter-associated urinary tract infection prevention bundle and monitor for signs and symptoms of urinary tract

infection such as urinary frequency and dysuria.

- Decreased mobilization and RT increase the risk of skin breakdown. Perform a thorough assessment of the skin and risk for pressure ulcer development using a valid and reliable tool each shift and as needed. Initiate preventive strategies such as turning and repositioning every 2 hours, using pressure-relieving devices, and maintaining adequate nutrition.^{10,11}

Patient education and support

Besides providing clinical care, nurses must also be attentive to the patient's psychosocial needs. Nurses must provide education to help patients and families understand the reason for signs and symptoms and what to expect during treatment.

To achieve optimal outcomes from the education sessions, nurses should first identify patients' and their families' readiness to learn and determine which methods are most effective for each learner. Consider what environment and timing will be most conducive to learning. (See *Patient and family education topics*.)

Patients and their families may experience significant psychological stress after SCC is diagnosed. Patients may feel hopeless and unable to cope with their new diagnosis. Because quality of life can be significantly decreased in patients with SCC, it's imperative to identify ways to improve outcomes. Supportive care and rehabilitation should include consultation with psychiatry, social work, and spiritual support. Families may benefit from support services to help them care for their loved ones.^{4,5}

Nursing's critical role

Clinical manifestations can be devastating and significantly impact a

Patient and family education topics⁴⁻⁶

Topics to include during the acute phase:

- signs and symptoms to report
- importance of reporting pain
- importance of reporting changes in sensory and motor function
- specific preparation for diagnostic testing
- specific treatment modalities
- importance of VTE prevention.

Topics to include when preparing for discharge:

- importance of rehabilitation
- specific discharge medications
- importance of following instructions to taper steroids instead of stopping them abruptly
- self-catheterization
- bowel regimen
- pressure ulcer prevention.

patient's quality of life, but meticulous nursing care can help to optimize outcomes. This includes using critical thinking, evidence-informed clinical decision making, and caring practices. ■

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RESOURCE

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Roberta Kaplow is an oncology clinical nurse specialist at Emory University Hospital in Atlanta, Ga. Karen Iyere is a staff nurse at Veterans Administration Medical Center in Decatur, Ga.

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