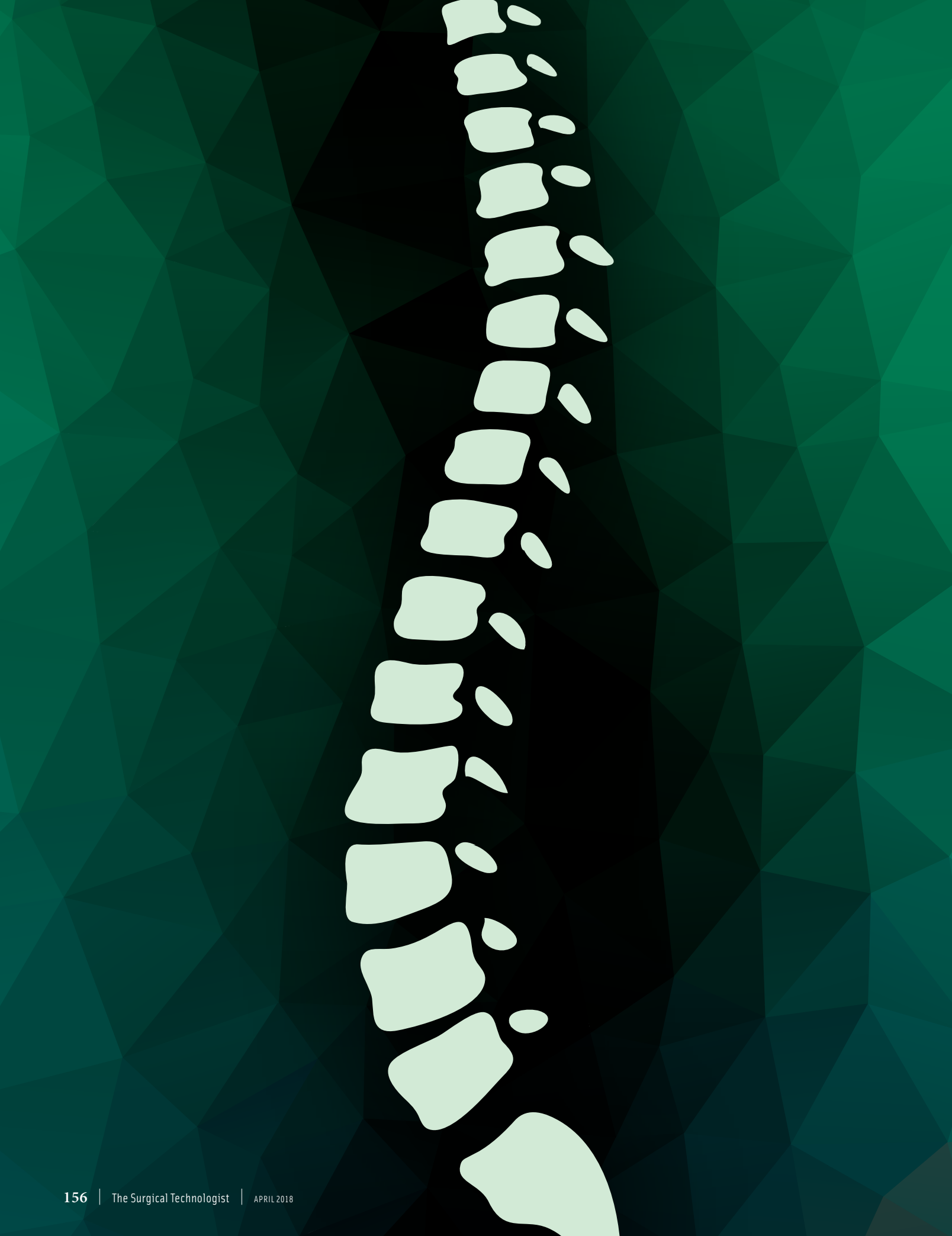


Spinal Cord Stimulator

Kassandra Bahr, CST, CSFA, DBA

Chronic pain is a misunderstood and largely under-treated disease that affects millions of people. Defined, chronic pain is moderate to severe pain lasting three months or longer. The American Pain Foundation states that chronic pain affects 76.5 million people. According to the National Institutes of Health, chronic pain impacts the US economy by $100 billion in medical expenses and lost time at work. This article will discuss the use of spinal cord stimulators to treat chronic pain, detail the preoperative patient preparation and identity the role of the Certified Surgical Technologist for this surgery.

BACKGROUND

The neurosurgeon Willem Noordenbos reported that in the spinal cord, a signal carried along large diameter fibers for pressure, touch or vibration could potentially interrupt the signal sent by thinner pain fibers. Consequently, Melzak and Wall introduced the gate control theory of pain, which helps account for the importance of the mind in pain perception. The theory involves the complex nature and interaction of the nervous system, specifically the two major divisions: the peripheral nervous system (nerves outside spinal cord and brain, nerves in the extremities and torso, nerves in lumbar spine); and the central nervous system (spinal cord and brain). This theory helped provide the framework for use and development of spinal cord stimulation (SCS) as a clinical and surgical treatment for chronic pain. From 1972-1974, the first clinical trials of spinal cord stimulators were performed on patients who suffered from intractable chronic pain.

LEARNING OBJECTIVES

- Learn about how many people are affected by chronic pain
- Identify the differences between pain as a result of an injury to that of someone who suffers from neuropathic pain
- List the indications for SCS surgery
- Examine the anatomy of the spinal cord in relation to this procedure
- Discuss the surgical steps taken to implant a SCS

CHRONIC PAIN

According to the American Association of Neurological Surgeons, chronic neuropathic pain is long-term pain that continues beyond the usual recovery period or pain that accompanies a chronic health condition. Pain that is not a result of an injury is considered pathological, and is therefore treated as a condition, not a symptom. Patients likely suffer from neuropathic pain when there is disease, injury or trauma to the spinal cord or peripheral nervous system. These patients have symptoms which may include stabbing or sharp pain in lower or upper extremities. They may feel a high degree of pain from a light touch, and they often have an elevated response to painful stimuli. Many sufferers of chronic pain have difficulty working, participating in physical activity or enjoying life. It is not uncommon for patients suffering from chronic pain to have a mild to severe addiction to painkillers. However, some patients significantly reduce their intake of opioid medications after they undergo surgery for a spinal cord stimulator.

> If the trial spinal cord stimulator has success with at least a 50% reduction of the patient's pain, surgery will be scheduled to permanently implant the SCS.

SPINAL CORD STIMULATOR

Known as "pacemakers for pain," a SCS device is a surgically implanted neurostimulation device placed under the patient's skin. There are various types of SCS systems; however, all have three components:

- Lead wire with 8 to 32 electrodes to deliver electrical pulses to the spinal cord
- Pulse generator or neurostimulator with a battery that creates the electrical pulses
- Patient controller remote that turns the system on and off and allows the patient to adjust the stimulation settings (parameters set by the physician)

The doctor or clinician also has a programmer device to adjust or modify the stimulation program in the pulse generator.

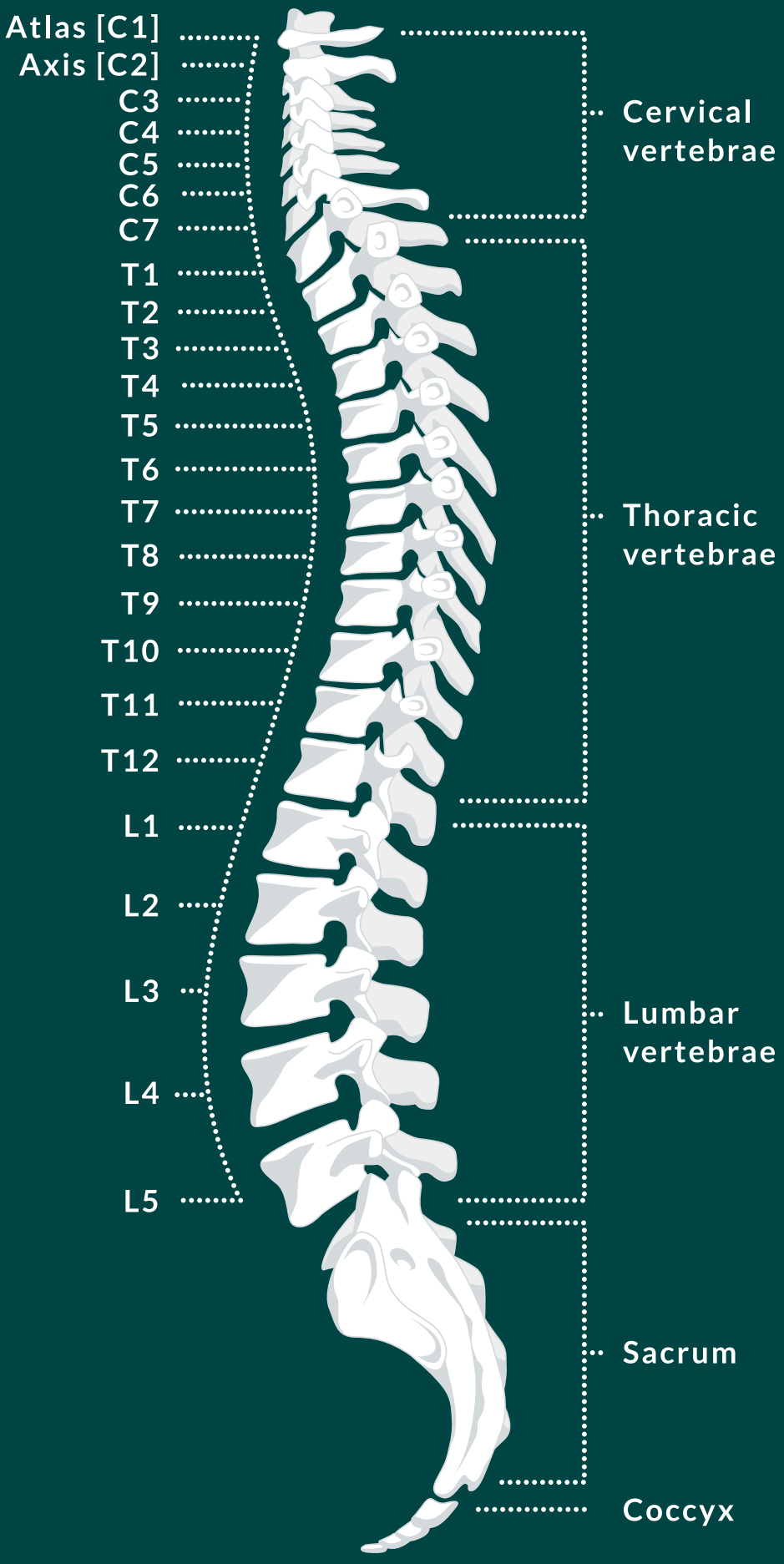
The mechanism action in a SCS system is to mask pain signals before they reach the brain. The device components (lead wires) are implanted in the body to deliver electrical pulses to the spinal cord. The SCS sends a mild electric current to the patient's spinal cord. The lead wire carries the current from the neurostimulator to the nerve fibers in the spinal cord. The SCS stimulates the nerves where the patient feels pain, most often in the lower extremities. Because the electrical pulses mask and modify the pain signal from reaching the brain, the patient experiences less pain. SCS systems may use a low-frequency current to replace pain sensation with a mild tingling feeling (paresthesia). Alternatively, some SCS systems use high-frequency or burst pulses to mask pain without a tingling sensation. It is important to note that spinal cord stimulators do not eliminate the source of the patient's pain – rather, the SCS changes how the brain perceives the pain signal.

INDICATIONS

Patients are selected for SCS surgery if they have had lower back, leg or arm chronic pain for three months or more. In most cases, these patients had previous spine surgery. The ideal patient for this procedure is in the early stage of a chronic pain condition. SCS systems are implanted in patients to help reduce pain caused by:

- Failed back surgery syndrome – failure of spine surgery to relieve leg pain, but not due to technical failure of the original procedure (hardware) or technique
- Regional pain syndrome – nervous system disease in which patients feel progressively increased chronic burning pain, generally in the foot or hand
- Chronic leg (sciatica) – persistent pain caused by nerve damage or from degenerative conditions such as arthritis or spinal stenosis
- Cervical and lumbar radiculitis; neuropathy
- Arachnoiditis – inflammation of the protective lining of the spinal nerves

Patients may discuss SCS surgery as an alternative to a more complex spine surgery once they have had a successful spinal cord stimulator trial. Additional criteria for patients being considered for SCS include: pain not associated with malignancy, no pacemaker or other medical contraindications, no major psychiatric disorders, no related litigation and the willingness to stop inappropriate drug use prior to implantation.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T10
T11
T12
L1
L2
L3
L4
L5
Cervical vertebrae
Thoracic vertebrae
Lumbar vertebrae
Sacrum
Coccyx

ANATOMY AND PHYSIOLOGY

A surgeon will make a skin incision in the middle of the patient's back at approximately the 10th thoracic level (T10), as determined by a fluoroscopy. Once the spinous process has been exposed, a laminotomy or removal of the bony arch will be performed. This allows a place for the SCS leads to be inserted in the epidural space above the spinal cord, at approximately T8 to T9. The leads will be connected to the extension wire and tunneled to the pulse generator, and then surgically implanted in the buttocks or lateral abdomen.

TEMPORARY SPINAL CORD STIMULATOR

Determining if an SCS will be appropriate for the location, type and severity of a patient's pain will be accomplished with the use of a trial or temporary SCS, performed at an outpatient center. The patient will be given local anesthetic to numb the area in the lower back. This is a minor procedure where the physician will use fluoroscopy to insert a hollow needle through the skin into the epidural space between the bone and the spinal cord. Once the trial lead has been inserted and positioned over pre-determined nerves, the wires will be attached to an external generator. The temporary SCS will help the patient and physician determine whether the system effectively relieves pain. During the trial period the patient and physician will be able to evaluate various stimulation settings and programs. For the next seven days, the patient will keep a journal of the stimulation settings and pain relief during various activities. Lastly, the patient will discuss a permanent spinal cord stimulator system. For patients who experience less than 50% pain relief from the trial stimulator, a permanent SCS will not be indicated.

PERMANENT SPINAL CORD STIMULATOR

If the trial spinal cord stimulator has success with at least a 50% reduction of the patient's pain, surgery will be scheduled to permanently implant the SCS. Before surgery, patients will be scheduled for preoperative blood tests, an electrocardiogram and a chest X-ray. The surgeon will advise the patient to stop taking all non-steroidal anti-inflammatory medicines and blood thinners approximately 10 days prior to surgery. Patients also will be advised to cease smoking, chewing tobacco and drinking alcohol from 10 days prior to the surgery and 14 days following the surgery.

SPINAL CORD STIMULATOR SURGICAL PROCEDURE

In the majority of cases where a permanent spinal cord stimulator has been implanted, the patient will be given sedation and a local anesthetic in order for the surgeon and the SCS device coordinator to determine proper placement of the leads on the spinal cord. As a result, personnel traffic, music and conversation will need to be kept at a minimum in the operating room. Equipment, instruments, supplies and surgical counts will need to be ready before the patient enters the OR.

The equipment in the operating room will include a fluoroscopy unit (C-arm), suction machine, cautery unit, electric or nitrogen powered drill, bipolar device, monitor showing patient's pre-operative MRI or CT scans, spine appropriate operating table (Jackson top) with proper adaptors for the patient as they are placed in the prone position during surgery. The hardware that will be implanted for the SCS system will be brought in the day of surgery and will not be opened onto the sterile field until the patient enters the operating room. This will ensure that no unused leads or that a neurostimulator generator has been opened and not used in situations where the case cancels the day of the patient's surgery.

> The SCS stimulates the nerves where the patient feels pain, most often in the lower extremities. Because the electrical pulses mask and modify the pain signal from reaching the brain, the patient experiences less pain.

POSITIONING THE PATIENT

The patient will be brought into the operating room on a gurney, and the appropriate World Health Organization checklist will be completed. This will include an introduction of the patient identified with the name to the surgical team, announcement of what procedure will be completed and the identification of any potential concerns from anes-

thesia regarding blood loss, as well as concerns from the surgical technologist about concerns on the sterile table or instrumentation.

The anesthesia provider generally will wait to give the patient heavy sedation (usually propofol) until after positioning. This will allow the patient to communicate with the surgical team while being placed in the prone position on the Jackson table.

Positioning the patient in a prone position will need to be carefully handled by all members of the surgical team. The patient's head will be placed in a cushion head foam pillow or regular pillows, depending on the patient's preference. The patient's arms will be placed on foam arm cushions and rest on arm boards attached to the Jackson table. The chest and abdomen will need to rest comfortably on the appropriate sized pads, and their hips/pelvis will be placed in the padded area of the table. Their knees will need to rest on the cushioned foot board with gel padding. The patient's feet will need to be supported with two to three pillows placed under their lower legs. The feet also will need to be separated with foam or a blanket to prevent decubitus forming on their heels. Once the patient is comfortable, a safety strap will be applied and the anesthesia provider will be able to give sedation to relax the patient for the initial part of the case.

The patient's lumbar and buttock region will be prepped by removing any excess hair. The skin will be prepped in a customary manner, according to the surgeon's preference. The surgical team will enter the operating room and be gowned and gloved by the Certified Surgical Technologist. Once the appropriate time has elapsed for the skin prep application, the patient will be draped according to the surgeon's preference. This likely will include four to six sterile towels, a ¾ sheet for the lower body, an antimicrobial incise drape over the surgical area and a laparotomy drape over the entire patient. The portion of the drape over the patient's head will be clipped to poles to allow the anesthesia provider easy access to the patient's airway in case of an emergency. The cautery, suction, bipolar and drill cords will be passed off the sterile field and connected for use during the case. The time out is completed according to World Health Organization guidelines, with all members in the operating room listening to the patient's name, identifier, procedure to be completed, surgeon, medications on the field and patient allergies.

INSTRUMENTATION AND SUPPLIES

Laminectomy set:

- Kerrison rongeurs
- Pituitary
- Penfield 4
- Penfield 3
- Freer elevator
- Bayonet pick-ups
- Cerebellar retractor
- Cobb elevator
- Frazier suction tips

Basic/Minor Set:

- Debakey pickups
- Adson pickups
- Weitlaner retractor
- Army-Navy retractors
- Senn retractors
- Metzenbaum scissors
- Mayo scissors
- Knife handles
- Lumbar retractor such as a Versatrac with shallow/narrow blades 35mm in depth or Adson Beckman retractor (or surgeon retractor of choice)

Supplies:

- ½ x ½ inch cottonoids
- ¾ x ¾ inch cottonoids
- Raytec sponges
- #10 and #15 blades

Suture:

- 0 CT1 polyglactin 910 pop-offs
- 3-0 SH polyglactin 910 pop-offs
- 0 nonabsorbable suture
- 3-0 PS-2 poliglecaprone 25

Hemostatic agents:

- Thrombin 20,000 units applied to a hemostatic matrix

THE PROCEDURE

The surgeon will begin with a fluoroscopy C-arm, draped with a sterile cover, to determine the proper location for the initial lumbar incision, generally at the T-10 level. A local anesthetic such as .5% bupivacaine hydrochloride with epinephrine will be applied to the lumbar and buttock regions. An incision will be made with a #10 blade, and a dissection with hemostasis will be applied to expose the spinous process. A portion of the spinous process may be removed, and a section of the bony vertebra will be exposed. A laminotomy will be performed with the electric drill and/or Kerrison rongeurs. The leads of predetermined size will have been opened to the sterile field and verified by the Certified Surgical Technologist. The surgeon will use the Debakey or appropriate atraumatic forceps to gently place the SCS leads in the epidural space above the spinal cord. The leads will eventually be secured to surrounding lamina and the supportive tissue with nonabsorbable sutures.

The Certified Surgical Technologist will connect the lead wires to the extension leads and will pass these off the sterile field to the SCS representative. These extensions will be connected to a programming device operated by the SCS representative while the patient is awakened from the sedation to communicate with the surgeon about how well the stimulation covers his/her pain pattern. Stimulation settings will be varied, and the patient will be asked to describe the location of tingling felt from the neurostimulator. If the patient feedback indicates lack of coverage for pain, the leads will be re-positioned and the process will be repeated to ensure the best possible placement of the SCS leads.

Once the leads are in place, the patient will be given sedation for the remainder of the surgery. The extension leads will be disconnected from the lead wires and passed off the sterile field. An incision will be made in the buttock or lateral abdomen for the placement of the pulse generator. The surgeon will use retractors, Metzenbaum scissors and bipolar electrosurgery to create a small subcutaneous pouch. The tunneler will be used to pass the lead wires under the skin from the spine to the buttock, where the generator has been implanted. The lead wires will connect to the generator, verified by the SCS representative and then locked into the device with the system screwdriver. The lumbar and buttock incisions will be closed with polyglactin 910 and poliglecaprone 25 sutures, and dressings will be applied.

POST-OPERATIVE PATIENT CARE

The patient will be taken to the postoperative recovery area, where their blood pressure, heart rate, respiration and pain will be monitored. The patient will most likely be discharged the same day or the following morning, and the pulse generator will be programmed before the patient leaves the hospital. Restrictions on the patient after surgery (until after follow-up appointment with the surgeon) include avoidance of bending, twisting, lifting heavy objects, housework, yardwork or sexual activity. Recovery is approximately 10 days, and the patient will return to the surgeon's office to make any necessary adjustments to the programming of the SCS stimulator.

AUTHOR ACKNOWLEDGEMENTS

I would like to thank Dr Hugh Moncrief for all of his guidance, advice and education for this article and in my profession as a Certified Surgical First Assistant.

ABOUT THE AUTHOR

Kassandra Bahr has been a Certified Surgical Technologist for 12 years since obtaining her associate degree of science in surgical technology. She has been a member of the neurosurgery team at Miami Valley Hospital, the region's only Level 1 Trauma Center. While employed at the hospital, Kassandra completed her master and doctorate degrees in healthcare administration, and now splits her time between work as a professor at Sinclair College and as a CST at MVH.

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Spinal Cord Stimulator

#412 April 2018 1.5 CE credits $9

1. The American Pain Foundation states that chronic pain affects ____ million people.

a. 76.5 **c.** 100
b. 50.5 **d.** 24.5

2. The gate control theory of pain, which helps account for the importance of the mind in pain perception, involves the complex nature and interaction of the nervous system, specifically the two major divisions:

a. Spinal cord and brain
b. Vascular system and respiratory system
c. Peripheral nervous system and central nervous system
d. Central nervous system and respiratory system

3. Patients likely suffer from neuropathic pain when there is disease, injury or trauma to the _____ or peripheral nervous system.

a. Brain
b. Spinal cord
c. Respiratory system
d. Upper extremities

4. Where will the SCS leads be surgically implanted?

a. Lateral abdomen
b. Bony arch
c. Buttocks
d. Both b and c

5. The mechanism action for a spinal cord stimulator is for the system to mask pain signals before they reach the _____.

a. Heart
b. Central nervous system (brain)
c. Spinal cord
d. Lungs

6. SCS systems are implanted in patients to help reduce pain caused by:

a. Failed back surgery syndrome
b. Regional pain syndrome or sciatica
c. Cervical, lumbar radiculitis or neuropathy
d. All of the above

7. A skin incision is made in the middle of the patient's back at approximately the _____ level, as determined by a fluoroscopy.

a. Thoracic (T2)
b. Thoracic (T10)
c. Lumbar (L1-L2)
d. Thoracic (T6)

8. The patient will be placed in which position for this procedure?

a. Prone
b. Supine
c. Trendelenburg
d. Lateral

9. When were the first clinical trials of spinal cord stimulators administered?

a. 1949-1951
b. 1963-1964
c. 1972-1974
d. 1981-1983

10. If a trial of the spinal cord stimulator has a success of at least a ____ reduction of the patient's pain, surgery will be scheduled to permanently implant the SCS.

a. 20% **c.** 40%
b. 30% **d.** 50%

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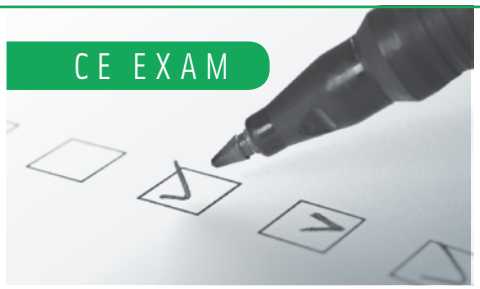

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