Percutaneous Spinal Cord Stimulation for Chronic Pain: Indications and Patient Selection

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INTRODUCTION

Percutaneous spinal cord stimulation (pSCS) or dorsal column stimulation is a safe, minimally invasive, reversible treatment of patients with chronic neuropathic pain refractory to conventional medical management (CMM). Electrical stimulation of the dorsal columns was shown to inhibit pain transmission more than 40 years ago by Shealy.1 Since then, multiple studies have demonstrated superior clinical benefit to other treatments in properly selected patients.2,3 It is cost-effective over the long-term and complements other therapies in multimodal treatment. However, these devices continue to be used as a treatment of last resort despite known advantages.

INDICATIONS

Spinal cord stimulation (SCS) is currently approved in the United States by the Food and Drug Administration for the treatment of chronic pain of the back or limbs. In Europe, SCS for refractory angina pectoris (RAP) is frequently used in some centers but it is not considered a routine treatment in all countries. Several studies, including eight randomized controlled trials (RCTs) have tested SCS for RAP. However, the studies were small and several had methodological flaws.4 The Refractory Angina Spinal Cord stimulation and usuAL care (RASCAL), a pilot RCT on the effectiveness and cost-effectiveness of SCS for refractory angina, was recently completed at three centers in the United Kingdom.5 SCS has also been extensively


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studied in the treatment of inoperable chronic critical leg ischemia. A 2013 Cochrane review concluded that SCS may be better than conservative treatment alone in both pain relief and amputation risk reduction in select patients. However, the surgical risk of implanting an SCS, coupled with the costs of the implant in patients with expected short life spans (10%–30% mortality in 6 months), continues to favor amputation.

Over the last several years, several international expert panels have convened to establish the indications for pSCS based on a review of the available literature. Though a clear consensus has not been reached on many of the indications, the recommendations for SCS are relatively consistent with some notable exceptions. Almost universally, the panels agree that patients with failed back surgery syndrome (FBSS) or complex regional pain syndrome (CRPS) benefit from pSCS. Those with peripheral neuropathic pain due to illness or injury, including plexopathies, also seem to benefit. However, to date, this has not been evaluated with a properly powered study. Patients with central pain syndromes originating in the brain or spinal cord, including root avulsion, seem to benefit less with SCS except when the posterior columns are only minimally injured in the case of spinal cord injury. A synthesis of these recommendations is compiled into Table 1. SCS has only been studied in a rigorous RCT on three occasions (see later discussion).

**FBSS**

In the United States, the most common indication for an SCS implant is FBSS. Patients with FBSS who did not achieve the goals of the spinal operation, specifically the anticipated pain relief, or who developed recurrent pain following surgery and have limited response to nonsurgical therapies may be candidates for SCS. In the United States in 2002, more than 1 million spinal procedures were performed and it estimated that the rate of back surgery is nearly 40% higher in the United States than in any other country. It is difficult to measure the frequency of FBSS in the general population but it is estimated that between 0.02% and 2% of lumbar spinal surgeries have unsuccessful outcomes. Furthermore, the health-related quality of life and economic costs often exceed other chronic pain and medical conditions. Even if only a small portion of these patients were candidates for pSCS, the potential for improvement in health and cost savings could be considerable.

In addition to multiple long-term outcome studies and retrospective case series that support the use of SCS, there were two published RCTs in the last decade that specifically addressed the use of SCS for FBSS. In 2005, North and colleagues published the results from a RCT comparing reoperation to SCS for FBSS in an effort to move SCS ahead of reoperation in the treatment algorithm. Only subjects with radicular pain that exceeded or was equal to the axial back pain were included in the study. Subjects who experienced at least 50% pain relief with the trial were offered a permanent implant with a paddle electrode. Although the sample size was relatively small (24 in the SCS treatment arm and 26 in the reoperation arm), there were statistically significant differences between the two groups. At a mean follow-up of 2.9 years (+/− 1.1 SD), 47% of subjects randomized to SCS versus 12% of subjects randomized to reoperation achieved pain relief of at least 50% (P<.01). Narcotic use remained stable or decreased in subjects randomized to SCS compared with reoperation subjects (P<.025) and 54% of subjects who initially underwent reoperation crossed over compared with only 21% in the SCS group (P = .02). In this study, improvements in work status and activities of daily living were not improved following treatment.

In 2007, Kumar and colleagues reported the outcomes from a RCT that compared SCS to CMM for subjects with FBSS. The Prospective Randomised Controlled Multicentre Trial of the Effectiveness of Spinal Cord Stimulation (PROCESS) tested the hypothesis that SCS plus CMM (SCS+CMM) is more effective than CMM alone. Permanent lead type, percutaneous or paddle, was at the discretion of the surgeon. Unlike the study by North and colleagues, this was not a single institutional experience. The primary endpoint of the study was to calculate the proportion of subjects with at least 50% relief of leg pain at 6 months. One hundred subjects were initially included in the randomization. At 6-month follow-up, 44 subjects in the CMM-alone group were available for follow-up and 50 in the SCS+CMM group. After the 6 months, 28 (64%) of the subjects in the CMM group crossed over and received an implantable system. Twenty-four (48%) of the subjects in the SCS+CMM achieved the primary endpoint versus only four subjects (9%) in the CMM-alone group. Secondary outcomes at 6 months showed statistical significance favoring SCS+CMM versus CMM alone, including improvements in health-related quality of life, superior function, and greater treatment satisfaction. Nine subjects were able to wean off opioids in the SCS+CMM versus only one subject in the CMM group. There was no difference in return to work status between the two groups.
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<td>FBSS</td>
<td>Level B (probably effective) class II evidence: RCT that does not meet class I criteria</td>
<td>A: Well-designed RCTs; well-designed clinical studies; weighing risk vs potential benefit and expert consensus reveals a high likelihood of a favorable outcome</td>
<td>Neuropathic leg pain: good indication (likely to respond); axial pain: intermediate indication</td>
<td>Good indication (likely to respond)</td>
<td>Evidence quality: good; certainty: moderate; strength of recommendation; B</td>
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<td>Failed Neck Surgery Syndrome</td>
<td>No evidence</td>
<td>N/A</td>
<td>Neuropathic arm pain: good indication (likely to respond)</td>
<td>Neuropathic arm pain: good indication (likely to respond)</td>
<td>N/A</td>
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<tr>
<td>CRPS I</td>
<td>Level B (probably effective), class II evidence: RCT that does not meet class I criteria</td>
<td>A: Well-designed RCTs; well-designed clinical studies; weighing risk vs potential benefit and expert consensus reveals a high likelihood of a favorable outcome</td>
<td>Good indication (likely to respond)</td>
<td>Intermediate indication (may respond)</td>
<td>Evidence quality: good; certainty: moderate; strength of recommendation; B</td>
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<td>CRPS II</td>
<td>D, IV positive case series A: Well-designed RCTs; well-designed clinical studies; weighing risk vs potential benefit and expert consensus reveals a high likelihood of a favorable outcome</td>
<td>Good indication (likely to respond)</td>
<td>Intermediate indication (may respond)</td>
<td>Evidence quality: good; certainty: moderate; strength of recommendation; B</td>
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<td>Peripheral Nerve Injury</td>
<td>D, IV positive case series Consider as other peripheral neuropathic pain</td>
<td>Good indication (likely to respond)</td>
<td>Intermediate indication (may respond)</td>
<td>Evidence quality: fair; certainty: moderate; strength of recommendation: grade C</td>
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<td>Other Peripheral Neuropathy</td>
<td>D, IV positive case series</td>
<td>B: Well-designed clinical studies; case reports; weighing risk vs potential benefit and expert consensus reveals a good likelihood of a favorable outcome</td>
<td>Intermediate indication (may respond)</td>
<td>Intermediate indication (may respond)</td>
<td>Evidence quality: poor; certainty: low; strength of recommendation: grade I</td>
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<td>Postherpetic Neuralgia</td>
<td>D, IV positive case series</td>
<td>B: Well-designed clinical studies; case reports; weighing risk vs potential benefit and expert consensus reveals a good likelihood of a favorable outcome</td>
<td>Intermediate indication (may respond)</td>
<td>Not indicated (rarely respond)</td>
<td>Evidence quality: poor; certainty: low; strength of recommendation grade I</td>
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<tr>
<td>Intercostal Neuralgia</td>
<td>No evidence</td>
<td>Consider as other peripheral neuropathic pain</td>
<td>Intermediate indication (may respond)</td>
<td>Intermediate indication (may respond)</td>
<td>Evidence quality: poor; certainty: low; strength of recommendation: grade I</td>
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<td>Brachial Plexus Injury</td>
<td>D, Class IV: positive case series</td>
<td>B: Well-designed clinical studies; case reports; weighing risk vs potential benefit and expert consensus reveals a good likelihood of a favorable outcome</td>
<td>Intermediate indication (may respond)</td>
<td>Brachial plexopathy: traumatic (partial); postirradiation: good indication (likely to respond)</td>
<td>Evidence quality: fair; certainty: moderate; strength of recommendation: grade C</td>
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<td>Brachial Plexus Root Avulsion</td>
<td>D, IV negative case series for avulsion</td>
<td>N/A</td>
<td>Root avulsion: unresponsive</td>
<td>Avulsion: not indicated (rarely respond)</td>
<td>N/A</td>
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<tr>
<td>Condition</td>
<td>D, IV Evidence</td>
<td>Study Nature</td>
<td>Grade/Outcome Description</td>
<td>Indication</td>
<td>Data Source</td>
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<td>Amputation Pain</td>
<td>D, IV positive case series</td>
<td>B: Well-designed clinical studies; case reports; weighing risk vs potential benefit and expert consensus reveals a good likelihood of a favorable outcome</td>
<td>Intermediate indication (may respond)</td>
<td>Not indicated (rarely respond)</td>
<td>N/A</td>
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<td>Central Pain of Spinal Cord origin</td>
<td>D, IV better success with incomplete lesion</td>
<td>B: Well-designed clinical studies; case reports; weighing risk vs potential benefit and expert consensus reveals a good likelihood of a favorable outcome</td>
<td>Intermediate indication (may respond) unless complete loss of posterior column function (poor response); complete spinal cord transection: unresponsive</td>
<td>Not indicated (rarely respond)</td>
<td>N/A</td>
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<tr>
<td>Central Pain of Brain Origin</td>
<td>D, IV negative case series</td>
<td>N/A</td>
<td>Poor indication (rarely respond)</td>
<td>Not indicated (rarely respond)</td>
<td>N/A</td>
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<td>Refractory Angina Pectoris Pain</td>
<td>N/A</td>
<td>N/A</td>
<td>Good indication (likely to respond)</td>
<td>Good indication (likely to respond)</td>
<td>N/A</td>
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<td>Peripheral Vascular Disease Pain</td>
<td>N/A</td>
<td>N/A</td>
<td>Good indication (likely to respond)</td>
<td>Intermediate indication (may respond)</td>
<td>N/A</td>
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<tr>
<td>Other</td>
<td>Facial pain: insufficient evidence; diabetic peripheral neuropathy: D, IV positive case series</td>
<td>Perineal or anorectal: poor indication (rarely respond); nonischemic nociceptive pain: unresponsive</td>
<td>Neuropathic pain secondary to peripheral nerve lesion: good indication (likely to respond); nociceptive axial back pain: not indicated (rarely respond)</td>
<td>N/A</td>
<td>N/A</td>
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*a Class IV studies in the EFNS guidelines included uncontrolled studies, case series, case reports, or expert opinion. A Level D grade was not published in the original guidelines by the EFNS. In some instances, the diagnoses were inconsistent from one guideline to the next, requiring minor modifications in organizing the recommendations.

Data from Refs. 6–10
CRPS

Although less common in the general population, especially compared with FBSS, the treatment of CRPS with SCS is well established and includes one RCT. The trial compared SCS plus physical therapy (PT; SCS+PT) in 36 subjects with PT alone in 18 subjects.2 At 6 months, pain was reduced by 3.6 cm (in those who received the implant) on the visual analogue scale in the SCS+PT group and it was increased by 0.2 cm (P<.001) in the PT-alone group. The functional status and health-related quality of life did not improve in the SCS+PT group at the 6 month mark. Follow-up was available for subjects implanted in the initial study at 24 months and at 5 years.13,14 Visual analogue scores, which were significantly better in the SCS+PT group at 2 years (3.0 cm–0 cm; P<.001), showed no difference at 5 years (1.7 cm SCS+PT vs 1.0 cm; P = .25). However, 95% reported they would undergo the treatment again for the same result.

PATIENT SELECTION

Diagnostic Evaluation

Patients referred for pSCS with an established diagnosis of neuropathic pain should be reevaluated at the initial visit. The diagnosis of neuropathic pain is made in the clinic by medical history, the description of pain, and sensory examination. There are many validated pain assessment tools that discern neuropathic from nonneuropathic pain that could be completed before the office visit.15 Traditionally, it is the causal diagnosis that determines surgical candidacy for pSCS trials and implants. However, the somatosensory phenotype may prove to be better predict outcomes than cause alone and allow for individualized therapies.16 Unrecognized or overlooked conditions are common and should be considered before proceeding with neuromodulation. Patients with surgically remediable compression of the neural elements due to conditions such as degenerative disc disease, ligamentum hypertrophy, and/or foraminal stenosis may be considered for reoperation but could also be considered for SCS as the next alternative. This is a complex decision and takes into account a patient’s overall health, surgical candidacy for larger procedures, risk of spinal implantation, and estimated likelihood of benefit from spinal operation versus neuromodulation. Benign tumors, such as schwannomas and neurofibromas, though less likely, may initially have been radiographically undetectable or overlooked at the onset of pain. Standing or dynamic plain radiographs may demonstrate either frank instability or abnormal motion at the facets, across the disc space, or both. Patients with persistent pain after a spinal fusion should be checked for pseudoarthrosis and hardware that is either broken or displaced. A preoperative spinal MRI or radiographic CT myelogram is usually ordered to check the diameter of the spinal canal. Dorsal calcifications or other obstruction may dissuade the surgeon from proceeding or alter the surgical plan (Fig. 1). In the future, it may be possible to use functional neuroimaging methods, such as functional MRI, to determine biomarkers of chronic pain that indicate which patients will likely respond well to SCS.17 Functional neuroimaging may one day provide the tools to tailor the stimulation and medications to each patient (ie, personalized medicine) to maximize therapeutic benefit while minimizing side effects.18

Nonsurgical Management

Patients are often referred very late for SCS evaluation, enduring undertreated pain for years or even decades. In the PROCESS study, subjects randomized to the SCS arm, waited on average, 4.7 years (SD 5.1) between the last surgery and implant and a more recent analysis reported a delay of 65.4 months between pain onset and implant.3,19 The reason for delay is multifactorial but includes patients unwilling to consent to additional surgery and skepticism and/or unfamiliarity with neuromodulation devices on the part of the referring physicians. In some cases, there is a mutual reluctance to end a longstanding physician-patient relationship built around the management of a chronic disease. On average, patients are managed by their primary care physician for approximately 12 months and nearly 40 additional months by a physician who is not an implant specialist.19 In one study, subjects waited more than 4 months for surgery after referral to an implanting physician so other diagnostic investigations could be completed.3

Guidelines for managing neuropathic pain with medical therapy alone are prevalent and include well established class I evidence for many of the pain-alleviating medications, including antidepressants, anticonvulsants (sodium and calcium channel blockers), opioid agonists, cannabinoids, and topical therapies.20 Most patients with chronic neuropathic pain are trialed initially on oral monotherapy with either a gabapentinoid, tricyclic antidepressant or a serotonin-norepinephrine reuptake inhibitor in addition to complementary therapies such as physical or psychological therapy. The dose should be titrated up if the response is
incomplete or, if there is no relief, the patient should be switched to another class. Combinations of medications should then be tried before considering opioid medications. Failure of opioid medications to control the pain at lower doses should prompt referral for surgical therapy.

Unfortunately, many patients are trialed on one after another of these medications either alone or in combination with an escalating dose of opioids before their pain is deemed refractory. This strategy is both costly and detrimental to outcomes because the likelihood for significant pain relief is reduced with each year of chronic pain.21,22 Furthermore, it has been shown that those with chronic pain will develop measurable changes in brain function and structure. For example, abnormal hemodynamic activity has been recorded in the insular and anterior cingulate cortex of chronic pain patients compared with normal healthy subjects and gray matter atrophy is accelerated in patients with low back pain.23,24 Whether these changes are reversible has yet to be determined.

**Drug Use or Abuse**

The widespread legal and illegal distribution of prescription narcotics over the last two decades has led to an epidemic of overdose deaths in the United States that exceeds 15,000 per year, a rate that has tripled since 1990.25 The causes are multifactorial and include patient misuse or mixing with unauthorized substances, self-medication to control a comorbid mental health disease, lack of familiarity with opioid conversion, and overestimation of opioid tolerance.26 In addition, methadone use, in particular, is associated with one-third of opioid-related deaths even though it accounts for only 5% of the prescriptions (this is related to both mixing with unauthorized substances, unapproved dose escalations, and wide variation in conversion guidelines).26 It is the responsibility of physicians who treat chronic pain to identify at-risk patients, counsel those on chronic opioids about the risks, and make a concerted effort to reduce the chance of death in their patient population. In fact, this is frequently the first hurdle that a patient should clear when seen in clinic for evaluation. Signs of drug abuse include dose escalation without a practitioner’s approval, lost or stolen prescriptions, requests for frequent refills, loss of opioid medications, and obtaining opioids from multiple prescribers or other sources.

Drug abuse or aberrant drug-related behaviors that may lead to abuse need to be considered before proceeding with neurostimulation therapy. In one evidence-based review of subjects exposed to chronic opioid analgesic therapy with nonmalignant pain, 3.27% developed abuse or addiction and additional 11.5% showed aberrant

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**Fig. 1.** (A) CT myelogram of the thoracic spine in a patient with chronic neuropathic pain who underwent evaluation for SCS. There are three contiguous thoracic disc herniations displacing the thecal sac and abutting the spinal cord ventrally. There is a reduced volume of cerebrospinal fluid (CSF) dorsal to the spinal cord. A paddle lead (2 mm thick) would displace considerably more CSF than a percutaneous lead and potentially could cause neurologic symptoms. A percutaneous lead may be a better alternative in this case. (B) A normal CT myelogram from a second patient is shown for comparison. (C) CT myelogram of a patient with two cylindrical pSCS leads implanted in the epidural space dorsal to the spinal cord. Outlines show the approximate locations of the cylindrical leads as well as the spinal cord.
drug-related behaviors. However, there are several predictive screening questions that can be used to minimize the chance of inadvertently operating on a drug abuser or someone with tendencies. These include the disclosure of any previous or current history of alcohol or illicit drug use, a family history for alcohol or illicit drug use, prior treatment in a drug rehabilitation facility, use of multiple drugs, use of needles, and use of tobacco. It is important to discuss who the prescribing physician is and what the anticipated plan will be postoperatively. Prescription drug monitoring programs are now available in several states in the United States. The reporting systems are often the only evidence that a patient may have drug use or abuse problems. The details and usefulness of these systems vary from state to state.

Psychological Testing

Failure to control pain and improve quality of life following a technically successful surgical implant is not uncommon. Furthermore, many patients may experience a loss of efficacy despite adequate coverage when pSCS is used long-term. Some failures may be preventable through appropriate psychological evaluation and treatment. Although, many chronic pain patients in the United States undergo psychological consultation as a condition of approval for a neuromodulation device, the initial visit is an opportunity to explore inconsistencies in the patient’s history, physical examination, pain rating, and imaging, as well as nonorganic signs of a major underlying psychiatric disorder. In fact, up to 50% of patients with chronic pain may have an underlying or undiagnosed personality disorder. In particular, patients grouped into cluster B, especially those with antisocial personality disorders or borderline personality disorders, are difficult to manage. Patients with a psychological need to be cared for by others, such as those with dependent personality disorders, are likely to have false-positive trials and to pose greater management risk. Along those same lines, those who depend on the medical system may not be prepared for the improvement they may find with neurostimulation therapy.

Doleys has written extensively on the patient psychological factors that are more or less likely to influence patient outcomes following SCS. Patients with specific, well-localized pain with a clear-cut cause who are psychologically intact are most likely to achieve a good outcome. On the other hand, patients who place too much emphasis on the implant and who disregard the influence of psychosocial factors are more likely to have a negative outcome. Unlike almost any other surgical procedures, physician perceptions about pain can also influence treatment outcomes, especially when they acknowledge that chronic pain is a multifactorial disease process and treatment is long-term. Physicians should not focus solely on the subjective relief of pain intensity. Rather, it is useful to discuss improvements in function or quality of life. Realistic expectations about pain relief are discussed along with an outline of the steps needed to achieve long-term benefits. It is important that the patients are ready and willing to undergo lifestyle modifications. This often comes in the form of tobacco cessation, eagerness to return to work, willingness to lose weight and exercise, commitment to wean off of medications (especially opioids), and willingness to continue with physical therapy exercises.

The psychological evaluation should consist of a clinical interview (with a significant other if available) and validated tests. As of now, there is no universally accepted psychological test that is used to screen potential SCS candidates. The Minnesota Multiphasic Personality Inventory (MMPI) was the most commonly used assessment test in a systematic literature review conducted between the years 1967 and 2009. Six studies identified in this article, reported that depression was associated with poorer outcome after SCS but SCS did, in some instances, improve premorbid depression. Other premorbid psychological conditions, such as mania, hysteria, and hypochondriasis, were inconclusive as predictors. In another review, presurgical somatization, depression, anxiety, and poor coping, along with older age and longer pain duration, predicted poor outcomes.

Medical Comorbidities

In general, pSCS is a well-tolerated, minimally invasive operation that does not require general anesthesia. Therefore, it lends itself to the management of chronic pain even in patients with an American Society of Anesthesiologists (ASA) class III or, in some cases, class IV who have comorbidities that would preclude more invasive operations requiring general anesthesia. Even so, the risk of a minimally invasive operation will still exceed the risks of nearly all nonsurgical treatments. Consequently, the physician should proceed with caution in a high-risk patient because, in one study, the risk of mortality in a large sample of subjects...
undergoing elective surgery was 7.3% in the ASA 4 group.³⁴ Patients with very poor nutrition or hypoalbuminemia may be at increased risk for wound breakdown over the hardware sites. In morbidly obese patients or those with sleep apnea or chronic obstructive pulmonary disease, extended time in the prone position may increase the risk of airway compromise mandating judicious use of sedation. Active treatment with an antiplatelet or anticoagulant medication that cannot be stopped is an absolute contraindication, as are untreated bleeding disorders. In patients who carry a high risk of stroke or thrombosis when not therapeutically anticoagulated, opting for a permanent implant without a trial may be the safest option. Patients with implanted pacemakers or defibrillators are able to have an SCS device implanted and vice versa.³⁵ However, the manufacturers of both devices should be queried before proceeding. Bipolar stimulation settings should minimize the chance of an inadvertent shock being delivered or interfere with pacing. In general, patients who do not have the cognitive capacity to use or understand the device, or who are unwilling or unable to return for intermittent follow-up and programming, are not suitable candidates for neuromodulation therapy.

Minimizing the Risk of Infection

A postoperative infection of the surgical site that involves a nonbiological implantable device, specifically an SCS system, will usually necessitate hardware removal and lengthy antibiotic treatment. Unfortunately, this process not only poses a serious risk to the patient but also reverses the clinical benefit and, in so doing, erodes the cost savings of the operation.³⁶,³⁷ Fortunately, postoperative infection can be minimized through careful patient selection and through the use of proven perioperative prophylaxis. The estimated risk of postoperative infection following SCS varies between studies with a recent review of SCS complications citing a range of 2.5% to 14% in the published literature with a mean of approximately 5%.³⁷ This is in line with the infection rate of 4.5% (32 patients) reported by single center with a large experience that included 707 cases of SCS, a rate that doubled in its diabetic patients.³⁸

Patients should be screened for a history of poor wound healing, malnutrition, malignancy, immunosuppression (especially secondary to chronic steroid use), evidence of active infections, history of prior hardware-related infections, and diabetes. Although not all of these factors are modifiable, extra attention to wound care or an infectious disease consultation may be helpful in certain situations. In addition to routine presurgical testing, screening, and decolonizing for asymptomatic nasal carriage of Staphylococcus aureus with mupirocin has been shown to reduce the incidence of surgical infection.³⁹ Preoperative hospitalization also increases the infection risk up to four times and, in general, SCS should not be undertaken in a patient admitted to the hospital for another reason (and likely after a recent hospitalization).⁴⁰ Preoperative bathing with chlorhexidine has not been shown to reduce surgical site infection.⁴¹ Preoperative urinalysis and treatment of bacteriuria in patients undergoing implant of a foreign body has limited support in the literature but is frequently recommended.⁴² Given the overall low costs and low risks associated with these preventative options, inclusion in the preoperative protocol for physicians who implant neuromodulation devices should be a consideration.

The risk of infection is significantly increased in those who are actively smoking. Even 4 weeks of abstinence from smoking reduces the risk of infection.⁴³ Because this is a modifiable risk factor with other obvious health benefits, some practitioners elect not to trial or implant patients who are actively smoking because this may be an indirect surrogate for a commitment to adopting the healthy lifestyle that predicts a long-term clinical success.

SUMMARY

Although pSCS is a well-described treatment of FBSS and refractory neuropathic pain, it remains underused in these patient populations. Early referral for pSCS therapy should be considered in patients who require long-term opioid medication to achieve pain control, especially in light of the number of deaths from prescription painkillers. Diagnostic workup can reveal anatomic findings that may underlie the pain condition. In these cases, it is important to carefully judge and discuss with the patient the advantages and disadvantages of each treatment modality. Psychological factors contribute significantly to the patient’s pain, their ability to cope, and the likelihood of long-term clinical success and should not be overlooked. In general, ordinarily high-risk surgical candidates may still be considered for pSCS because it does not require general anesthesia. Every effort should be made to minimize the risk of infection, which often requires expeditious removal of the device if it does occur. Improvements in the devices have enabled an ever-expanding array of programming combinations, longer battery life, and improved patient satisfaction.
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