Faculty of Pain Medicine
Australian and New Zealand College of Anaesthetists

Neuromodulation (spinal cord stimulation) in the management of patients with chronic pain

1. WHAT IS SPINAL CORD STIMULATION?

Stimulation of the spinal cord modifies patients' experience of pain, by replacing the unpleasant sensation with parasthesiae that may be considered pleasurable. Spinal cord stimulator (SCS) systems deliver low voltage electrical pulses to afferent nerve fibres within the dorsal columns. Pulses are delivered via an electrode that is placed near the spinal cord, percutaneously or by surgical implantation. This electrode is connected to and powered by a neurostimulator device that is surgically implanted under the skin. The electrode must be carefully positioned so that the area of paresthesia overlaps that in which pain is experienced. The patient can turn the stimulator on and off as required, and may vary the stimulation parameters within limits set by the supervising physician.

Neurostimulators may be battery-powered implanted pulse generators (IPG) or radio frequency devices that receive energy in the form of radio wave pulses from an external source. Non-rechargeable batteries used in IPGs have a life of two to eight years; rechargeable batteries may be used for patients requiring high currents. Selection of the type of device used and the neurostimulator parameters applied are the responsibility of specialist SCS clinical teams, and depend on the type, intensity and location of pain.

SCS has been reported as cost-effective compared with other invasive pain management techniques where there is good evidence of clinical benefit, such as failed back surgery syndrome (FBSS) and complex regional pain syndrome (CRPS). Evidence of comparative efficacy from randomised clinical trials is needed to determine the cost-effectiveness in other indications.

SCS is invasive, very expensive and labour-intensive, with potential complications and long term issues. It requires operation and supervision by specialists with specific skills and judgement and who are prepared to be involved with long-term management of the patient.

Successful SCS requires careful patient selection, work-up and management, even for patients with good indications. An experienced multidisciplinary pain management team that can deliver a range of pain therapies and provide long-term follow-up after SCS implantation is essential. The SCS team should implant and manage a number of patients sufficient to maintain competence.

2. INDICATIONS FOR SPINAL CORD STIMULATION

The literature identifies three broad categories of indications for SCS, by likelihood of response:

Conditions likely to respond:

- Failed back surgical syndrome
- Refractory angina pectoris
- Complex regional pain syndrome
- Neuropathic pain secondary to peripheral nerve damage

Conditions that may respond:

- Pain associated with peripheral vascular disease
- Brachial plexopathy: traumatic (partial, not avulsion), post irradiation
- Axial pain following surgery
- Intercostal neuralgia, such as post-thoracotomy
- Other peripheral neuropathic pain syndromes, such as those following trauma,

Conditions that rarely respond:

- Pain associated with spinal cord damage
- Central pain of non-spinal cord origin
- Spinal cord injury with clinically complete loss of posterior column function
- Perineal or anorectal pain

3. SELECTION OF SUBJECTS FOR SPINAL CORD STIMULATION

SCS may be considered in patients with the above conditions who have undergone comprehensive multidisciplinary assessment and management and in whom conservative treatment has failed. Essentially SCS is a trial-of-therapy, to determine its effectiveness in an individual patient's predicament. As such SCS should be part of an ongoing multimodal management plan with a prominent psychosocial component. At least two experienced pain specialists should assess a patient for consideration of SCS.

Contraindications for SCS include general contraindications to surgery, uncontrolled bleeding disorder, systemic or local sepsis and usage of illicit drugs.

Relative contraindications include ongoing anticoagulant therapy, immune suppression and the presence of a cardiac pacemaker or implanted defibrillator (as the pulse generator may compromise function of these devices). Cognitive impairment may preclude SCS if the patient is unable to understand the treatment, unless adequate support from carer or community services is available.

Situations that do not necessarily constitute a contraindication to SCS but which require amelioration prior to the procedure include psychological disorders such as active psychosis or major mood disorder, inappropriate use of alcohol or prescription medication, and unstable social or environmental circumstances.

4. PATIENT MANAGEMENT BY THE SCS TEAM

All patients being considered for SCS should undergo multidisciplinary assessment of physical, psychological and social functioning. Ideally, assessment should be carried out within a multidisciplinary pain centre.

The goals of SCS therapy should be discussed with the patient. The main goal is improvement of quality of life (including improved physical and social functioning); other goals may include reduction (not elimination) of pain, return to work and reduced requirement for medication, such as opioids.

All patients should undergo a trial lasting seven to ten days, during which SCS is delivered using an external stimulator device temporarily connected to implanted leads. To be successful, such a trial must result in patient-reported pain relief of at least 50% during appropriate (provocative) physical activity. Stable or reduced analgesic consumption and improved daily activity, social function and sleep may also be considered as factors indicating benefit. The screening trial provides important information that will influence the choice of lead and stimulator to be implanted and the optimum stimulator configuration.

An unsuccessful trial of stimulation is a contraindication to SCS implantation.

5. POTENTIAL PROBLEMS WITH SPINAL CORD STIMULATION

Major complications with SCS are rare, but minor complications can be common. The most common is lead migration which may require surgical intervention. Neurological damage relating to epidural electrode placement and infection of implanted neurostimulators are rare but serious complications requiring prompt attention from an experienced SCS team.

Early complications include:

- Epidural haemorrhage: rare but serious, requiring exporation and evacuation
- Superficial infection: may require removal of the implant
- Epidural infection: rare but requires removal of implant

Delayed complications include:

- Lead migration: may occur at any time
- Lead fracture, system malfunction
- Delayed cerebrospinal fluid leak, meningitis: rare

Other long-term issues of which patients should be aware include:

- Battery life: SCS systems with non-rechargable batteries will need to be replaced surgically at some stage.
- Security systems: Airport and other security systems may be activated by a stimulator. Patients should carry relevant documentation about the device at all times.
- Diathermy: Short wave diathermy, microwave diathermy and therapeutic ultrasound diathermy are hazardous for patients with an SCS implant. If possible, unipolar diathermy should be avoided.
- Pacemaker: Electrical activity from an SCS device may be misinterpreted by a cardiac pacemaker, leading to potentially dangerous pacemaker malfunction. A cardiac pacemaker is a relative contraindication for SCS, but if considered necessary, bipolar rather than unipolar pacemaker sensing should be employed.
- MRI: The magnetic field may produce SCS lead movement, resulting in loss of effect or neuronal damage, or heating of the implant components, leading to discomfort, tissue damage or software malfunction. The presence of the SCS implant may cause MRI image corruption. The need for MRI should be discussed with an experienced neuroradiologist who has full details of the make, model and serial number of the implant and alternative imaging techiniques considered. The SCS implant may need to be removed to allow MRI.

6. REFERENCES

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