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Spinal Cord Stimulators and Chronic Regional Pain Syndrome (CRPS)

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SCS and CRPS



- CRPS
 - When
 - Screening predictors
 - Mechanism
 - Physiology
 - Economic outcome evaluation
 - Five year follow-up
 - Other Studies
 - Pregnancy and SCS
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Some statistics and facts



- CRPS **commonly** arises **after injury** to that limb. However, there is no relationship to the severity of trauma, and in some cases there is **no precipitating trauma** at all (**9%**).
- CRPS **usually** affects **one limb**, but in **7%** of cases later spreads to involve **additional limbs**.
- The European incidence rate of CRPS is **26/100,000 person-years**.
- Characteristically, there is interplay between **peripheral** and **central** pathophysiologies.
- The earlier concepts that the predominant problem is sympathetic dysfunction and that CRPS occurs in (stereotyped) stages are now obsolete.
- It is also now clear that CRPS is **not associated** with a history of pain-preceding psychological problems, or with somatisation or malingering.

Statistics and facts continued



- Limb signs (such as **swelling, sweating and colour changes**) usually **reduce with time**, even where pain persists.
 - The **onset** of symptoms for the majority occurs **within one month** of the trauma or immobilisation of the limb.
 - There is no proven cure for CRPS.
 - Approximately **15%** of sufferers will have unrelenting pain and physical impairment two years after CRPS onset and are considered to have a **long-term condition**, although more patients will have a **lesser degree of ongoing pain and dysfunction**.
 - **Prompt diagnosis** and **early treatment** are considered best practice in order to avoid secondary physical problems associated with disuse of the affected limb and the psychological consequences of living with undiagnosed chronic pain.
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The Budapest Criteria (CRPS)



- **A:** *continuing pain* , disproportionate to the inciting event
- **B:** The patient has at least *one sign in two* or more of the categories
- **C:** The patient reports at least *one symptom in three* or more of the categories
- **D:** *No other diagnosis* can better explain the signs and symptoms

The Budapest Criteria (CRPS):



- **Sensory:** *Allodynia* (to light touch and/or temperature sensation and/or deep somatic pressure and/or joint movement) and/or *hyperalgesia* (to pinprick)
 - **Vasomotor:** *Temperature* asymmetry (more than 1 deg.) and/or skin colour changes and/or skin *colour* asymmetry
 - **Sudomotor/oedema:** *Oedema* and/or *sweating* changes and/or sweating asymmetry
 - **Motor/trophic:** Decreased range of motion and/or *motor dysfunction* (weakness, tremor, dystonia) and/or trophic changes (hair/nail/skin)
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Spinal cord stimulation as treatment for complex regional pain syndrome should be considered earlier than last resort therapy. Poree et al. Neuromodulation 2013. USA

- Reviewed literature on pain care algorithm
- Based on considerations of safety, efficacy, cost efficacy, and cost neutrality, SCS *should not be considered a therapy of last resort* for CRPS but rather should be applied earlier (e.g., three months) as soon as more conservative therapies have failed.



Neurostimulator placement in the body.
Image courtesy of Medtronic Inc.

Psychological screening/phenotyping as predictors for spinal cord stimulation.

Campbell et al. Curr Pain Headache Reports 2013.USA



- Spinal cord stimulation frequently considered as a pain management option when conservative or less invasive techniques have proven to be ineffective.
- Potential indications for SCS include complex regional pain syndrome (CRPS)
- In addition to *psychological assessment*, *quantitative sensory testing (QST)* procedures offer another valuable resource in forecasting who may benefit most from SCS



Neurostimulator with leads. Image courtesy of Medtronic Inc.

What does the mechanism of spinal cord stimulation tell us about complex regional pain syndrome?

Prager JP. Pain Med. 2010. USA



- Spinal cord stimulation (SCS) can have *dramatic effects on painful, vascular, and motor* symptoms of complex regional pain syndrome (CRPS)
 - Better understanding of the physiologic effects of SCS may improve understanding not only of this treatment modality but also of CRPS pathophysiology.
 - Effects on pain perception are likely to occur through *activation of inhibitory GABA-ergic and cholinergic spinal interneurons*. *Increased release of both neurotransmitters* has been demonstrated following SCS in animal models
 - Effects of SCS on vascular symptoms of CRPS are thought to occur through two main mechanisms: *antidromic activation of spinal afferent neurons and inhibition of sympathetic efferents*. Cutaneous vasodilation involve antidromic release of calcitonin gene-related peptide and possibly nitric oxide, from small-diameter sensory neurons expressing the transient receptor potential V1 (TRPV1) receptor.
 - The involvement of *sympathetic efferents* in the effects of SCS has been demonstrated in models of angina pectoris
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Spinal cord stimulation for complex regional pain syndrome (Physiology). Shrivastav. Conf Proc IEEE Eng Med Biol Soc. 2009. USA



- The therapy of spinal cord stimulation (SCS) is based on *producing an electrical field on the dorsal surface of the spinal cord that blocks only neuropathic pain* (ie, pain from damage to the nervous system).
- Most SCS devices deliver a *biphasic pulse* consisting of a pair of equal amplitude pulses with opposite polarity.
- SCS therapy is based on the *gate control theory of pain* and has been used for the treatment of diverse conditions of neuropathic pain, including complex regional pain syndromes (CRPS)



Spinal cord remote controller. Image courtesy of Medtronic Inc.

Spinal cord stimulation for chronic pain of neuropathic or ischaemic origin: systematic review and economic evaluation. Simpson et al. Health Technol Assess. 2009. UK



- 'What is the clinical and cost-effectiveness of spinal cord stimulation (SCS) in the management of chronic neuropathic or ischaemic pain?
- 13 electronic databases [including MEDLINE (1950-2007), EMBASE (1980-2007) and the Cochrane Library (1991-2007)]
- 6000 citations identified, 11 randomised controlled trials three of neuropathic pain and eight of ischaemic pain
- Trials were available for the neuropathic conditions failed back surgery syndrome (FBSS) and CRPS type I, and they suggested that SCS was *more effective than conventional medical management (CMM) or reoperation in reducing pain*

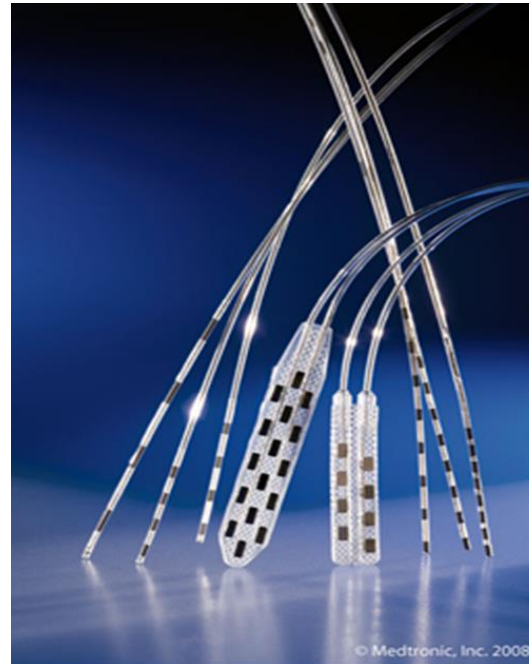


© Medtronic, Inc. 2008

Physician programmer. Image courtesy of Medtronic Inc

Spinal cord stimulation: indications and outcomes. Lee et al. Neurosurg Focus. 2006. USA

- Effective pain relief was obtained in *60 to 80%* of patients with FBSS and CRPS Type I
- *Significant improvements in quality of life (QOL)* and a significantly greater chance of returning to work than patients who did not undergo SCS



Percutaneous and Paddle electrodes. Image courtesy of Medtronic Inc.

Effect of SCS for CRPS Type I: five-year final follow-up of patients in a randomized controlled trial

KEMLER et al. Netherland. J Neurosurgery 2008



- 36 patients with CRPS-I were allocated to receive SCS and physical therapy (PT) and 18 patients to receive PT alone
 - Twenty-four patients who received SCS+PT also underwent placement of a permanent spinal cord stimulator after successful test stimulation
 - The authors assessed pain intensity, global perceived effect, treatment satisfaction, and health-related quality of life
 - Patients were examined before randomization, before implantation, and every year until 5 years thereafter
 - Significantly reduced pain and increased quality of life up to 2 years
 - Effect on pain not significant from 3 years onwards
 - At 5 years post treatment, SCS+PT produced results similar to those following PT for pain relief and all other measured variables
 - For long standing disease duration there was limited evidence
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High-Frequency Spinal Cord Stimulation at 10 kHz for the Treatment of Complex Regional Pain Syndrome: A Case Series of Patients With or Without Previous Spinal Cord Stimulator Implantation.

Gill JS et al. 2019 USA



- 12 patients had HF10-SCS implanted in this small case series.
- This may be a superior option for pain relief and increased function in patients with CRPS with debilitating and intractable pain, including patients who did not benefit from traditional spinal cord stimulators.

A Case Study of Combined Perception-Based and Perception-Free Spinal Cord Stimulator Therapy for the Management of Persistent Pain after a Total Knee Arthroplasty.

Urits et al. 2019. USA



- pain following total knee replacement surgery are poorly understood; but various neuropathic causes like neuroma formation and complex regional pain syndrome (*CRPS*) have been suggested.
- At 6-month follow-up patient reported complete resolution of his symptoms.

Complex Regional Pain Syndrome Management: An Evaluation of the Risks and Benefits of Spinal Cord Stimulator Use in Pregnancy.

Jozwiak MJ et al. 2019. USA



- a young woman diagnosed with complex regional pain syndrome (CRPS) after knee surgery, had spinal cord stimulator (SCS) implantation.
- She had 2 successful pregnancies following implantation.

Thank you
Questions would be taken during Coffee and Lunch
breaks