Spinal Cord Stimulation

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History of Spinal Cord Stimulation (SCS)

► 1965 - Gate Control Theory of Pain - proposed by Melzack and Wall

► Two years later, Shealy and associates introduced spinal cord stimulation

Mechanism of Action:

- Segmental antidromic activation of A-beta afferents
- Blockage of transmission in the spinothalamic tract
- Inhibition of supraspinal pain
- Activation of central inhibitory mechanisms influencing sympathetic efferent neurons
- Activation of putative neurotransmitters or neuromodulators

Indications for SCS

- Arachnoiditis
- Failed Back Syndrome
- Radiculopathy
- Plexus Lesions
- Spinal Cord Injury
- Phantom Limb Pain
- Ischemic Limb Pain
- Peripheral Neuropathy/Neuralgia
- CRPS Type I and II
- Angina Pectoris
- Multiple Sclerosis
- Pelvic Pain

Complex Regional Pain Syndrome

- Traditionally last option therapy - "when everything else failed"
- Trend - SCS earlier in course of therapy
  - Low cost of SCS trial
  - Low risk-benefit ratio
  - Favorable outcomes

Assessment by clinical psychologist to evaluate:

- Personality disorders
- Drug addiction issues
- Issues of secondary gain
- Realistic expectations
Psychological Testing

- Psychology testing alone is of little value in predicting long-term outcome.
- Psychological and medical findings, along with the patient’s direct response to SCS trial, should be considered in the selection process.

Two approaches to SCS trials:

- Percutaneous Placement
  - Lead removed after trial period
  - New lead and generator placed on separate occasion
- Open Surgical Approach
  - Tunnel and anchor trial lead via surgical incision
  - Internalize it later for permanent SCS placement

Percutaneous Placement Trial:

- Minimal invasiveness
- Low risk of complications - routine epidural catheter placement

Single Lead Trial: Post-Herpetic Neuralgia

Electrode Placement

- Lateral
  - Ipsilateral sensation pattern in a radiating band
  - Due to stimulation of the nearest dorsal roots
- Medial
  - Generate stimulation bilaterally
  - Wider distribution distal to the electrode placement
Dual Lead Trial for Failed Back Syndrome

Distal End of Lead Connected to External Extension Wire

Post-trial appointment in one week - lead removal / assessment:

- Improve pain by 50% or more
- Decrease pain meds
- Improve function
- Improve rest
Impedance Check - Intra-op

Follow-up Two Weeks-
Wound Check and
Reprogramming
Retrograde Placement:

- 60 year old pilot
- 15 year history of rectal neuralgia
- Failed conservative therapy
- Successful dual lead trial

Open Surgical Trial:

- Pro
  - Simplifies the final procedure.
  - Assures that stimulation coverage remains the same during both the trial period and permanent implantation.
- Con
  - Need for a second visit to OR for lead removal in case of an unsuccessful trial

Dx: Occipital Neuralgia

- 50 year old female with cervical disc disease with chronic occipital headaches.
- Occipital blocks every six weeks by referring physician with good response.
- History of previous aneurysm clipping in remote past – cleared to proceed by her neurosurgeon.
Leads placed via Laminotomy:

- Wider electrodes might provide better coverage in certain patients
- Lower voltage requirements
- Less prone to migration


- On average, 59% of patients had > 50% pain relief
- Average complication rate – 42% but related to mainly minor complications
Besides pain relief, SCS improves functional status in a significant number of patients:

- 25% return-to-work rate

- Up to 61% improvement in ADL

Reduced Consumption of Analgesics with Spinal Cord Stimulation Treatment – Varies from 40% to 84%


Cost effectiveness:
- For those patients for whom spinal cord stimulation is clinically efficacious, SCS pays for itself within 2.1 years.

Complications:
- Surgical - Bleeding
- Inadequate Coverage or Malfunction
- Decrease in stimulation amplitude

Hematoma

Malfunctioning System:
- 50+ year old female
- Dual Leads placed for Failed Back Syndrome
- SCS unit working wonderfully for 9 months
- Now feeling stimulation, but not covering pain
**Troubleshooting:**

- Analysis – very low impedance
- X-ray - slight migration in office
- Immediately pre-op for lead revision, patient complains of sharp pain over battery site
- History of ex-husband threw her to the ground in “domestic argument”.

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**Decrease in Stimulation Amplitude**

- Can be caused by intrathecal migration of lead
- Can cause serious complication – spinal cord injury
- Most common in patients with significant spinal stenosis

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**Damaged Battery**

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**FACIAL NEURALGIA**
Controversy

- Single Versus Dual Lead System
- Four Versus Eight Electrode System
- Internal Versus External Power
- Percutaneous Versus Laminotomy Approach

Future Trends: 2004 slide

- Smaller Battery
- Rechargeable
- Longer Battery life
- Enhanced Programming Options

Systems