The Role of the Neuromodulation in Management of Chronic Pain

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Neuromodulation is a field of science, medicine, and bioengineering that encompasses implantable and non-implantable technologies, electrical, chemical, and optical that improves life for humanity. Neuromodulation is technology that impacts upon the neural interface.
Neuromodulation

Electrical

Spinal Cord Stimulation

Chemical

Intrathecal Drug Delivery
46 AD

Scribonius Largus describes the use of torpedos (aquatic animals capable of electric discharge) for medical applications.

“The live black torpedo when applied to the painful area relieves and permanently cures some chronic and intolerable headaches...carries off pain of arthrites...and eases other chronic pains of the body”
Early Applications of Electrical Stimulation for Pain
Gate Control Theory

Neuromodulation was Born

1965
Sweet W
Peripheral Nerve Stimulation

1967
Shealy C at al.
Spinal Cord Stimulation
First SCS Implant

C. Norman Shealy, MD, 1967
University Hospitals of Cleveland

Neuromodulation is the fastest growing medical field today, both in numbers of procedures performed and the increase in indications for these procedures.
NEUROMODULATION INDICATIONS

APPROVED

DBS / CORTICAL
Essential Tremor
Parkinson’s • Dystonia

COCHLEAR
Profound Deafness

VNS
Epilepsy • Depression

PNS / PNS
Chronic Pain

SCS
Chronic Pain

SPINAL
Chronic Pain
Malignant Pain • Spasticity

SNS
Incontinence

FUTURE

DBS / CORTICAL
OCD • Depression • Tinnitus • Epilepsy
Stroke • TBI • Pain • Coma • Paralysis
Tourette’s

BRAIN
Epilepsy • Parkinson’s • Alzheimer’s

ARTIFICIAL RETINA
Retinitis Pigmentosa

ONS
Headache

VNS
CHF • Obesity

PULMONARY
Respiratory Support

SCS
Angina Pain • PVD Pain

SPINAL
ALS • Huntington’s

GASTRIC
Obesity • Gastroparesis
Irritable Bowel Syndrome

SNS
Pelvic Pain • Sexual Dysfunction

OTHER THERAPIES
Hypertension • Renal Failure
Diabetes II • CHF • Paralysis
Fibromyalgia • RA • RLS
Eating Disorders
Peripheral Nerve Stimulation
Cortical Stimulation
Thalamic Stimulation
Spinal Cord Stimulation
Dorsal Root Stimulation
Peripheral Subcutaneous Field Stimulation
Neuropathic pain in the limb eg following lumbar or cervical spine surgery (FBSS) and secondary to peripheral nerve damage

Complex regional pain syndrome

Refractory angina

Pain associated with peripheral vascular disease

Bladder disorders

Bowel disorders
Expanded Indications of SCS

Greater and lesser occipital neuralgia

Headache

Abdominal disorders
  - Pancreatitis
  - Irritable bowel disorder

Pelvic pain
Nice Approval for Sacral Nerve Stimulation for Bowel and Bladder Dysfunction

1. Guidance
   1.1 Current evidence on the safety and efficacy of sacral nerve stimulation for urge incontinence and urgency-frequency is adequate to support the use of this procedure provided that the normal arrangements are in place for consent, audit and clinical governance.

2. The procedure
   2.1 Indications
      2.1.1 Sacral nerve stimulation is used to treat the symptoms of overactive bladders, including urinary urge incontinence and/or urgency-frequency in patients who have failed or are unable to tolerate conventional treatments.

   2.1.2 In patients for whom conservative treatments have been unsuccessful, the standard alternatives include bladder resection (such as augmentation and cystoplasty) and urinary diversion.

Interventional Procedure Guidance 64

This guidance is written in the following context:

Interventional procedure guidance is for health professionals and people using the NHS in England, Wales and Scotland.

2.2 Outline of the procedure

Interventional Procedure Guidance 99

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Nice Approval for Spinal Cord Stimulation for Neuropathic Pain

Spinal cord stimulation for chronic pain of neuropathic or ischaemic origin

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Review date: November 2011

NICE technology appraisal guidance 159
Nonmalignant Pain Treatment Algorithm

- Over the counter drugs
- Adjuvant analgesics
- Physical Medicine and Rehabilitation Therapy
- Cognitive-Behavioral Therapy
- Therapeutic Nerve Blocks
- Surgery Directed at Presumed Cause
- Weak and Strong Opioids
- Spinal Cord Stimulation
- Implantable Infusion Systems
- Neurolytic Blocks
- Neuroablative Therapies
Patient Selection Criteria/Team Approach

- Pain Consultant
- Psychologist
- Pain Nurse
- Implant coordinator
- Rehabilitation
- Specialty Consultant
Implantation

Stages

– Trial

• Can use a trial/permanent lead which is left in for 7-14 days (sometimes longer) and then removed

• Can use a permanent lead which is surgically anchored and left in for a short trial after which the generator is implanted if the trial is successful or the lead is removed if the trial fails
Implantation

- **2 Stages**
  - Permanent

- If the trail is successful, the patient returns after a few weeks for implantation of the permanent lead/s and pulse generator
Lead Placement

• Lateral decubitus or prone position
• Can use an ipsilateral or contralateral paramedian approach
• Enter the epidural space several levels below the intended level of lead placement to insure that all contacts of the lead will be in the epidural space
Lead Placement

- Once the epidural space is entered, insert the lead and slowly advance under continuous fluoroscopic guidance to the target level.
- The lead can be guided to the target site by:
  - Rotating the tip of the lead
  - Rotating the opening of the epidural needle
  - Manipulating the needle by pushing it laterally, medially, anteriorly or posteriorly
Target levels

- Cervical region: $C_2-5$
- Upper extremity: $C_5-T_1$
- Angina: $C_2-6, T_1-4$
- Thorax: $T_2-8$
- Abdomen: $T_5-9$
- Back: $T_8-9$
- Lower extremity: $T_{10}-L_1$
Trial of Spinal Cord Stimulation

7 to 14 days

Percutaneous vs Tunnelled Trials

Outcome:

- VAS
- Improvement in Function
- Reduce Medication
- Patient Satisfaction

If there is significant improvement of the above the patient will be fully implanted
Failed Back Surgery Syndrome with Double Incontinence
Caudo-cephalad ‘Sacral Hiatus’
Trans-sacral Field Stimulation
Complications

- Specific to SCS
  - Hardware failure (11-45%)
  - Generator failure
  - Electrode fatigue fracture
    - Electrode migration/malposition
    - Extraneous influences
  - Electromagnetic fields
Complications

- General spinal surgical/interventional
  - Spinal cord or nerve injury
  - CSF leak
  - Infection (3-5%)
  - Bleeding
Significant Progress in SCS Over the last few Years

Factors driving the progress:

• Improving understanding of indications and treatment guidelines
• Evolving technology & techniques
  • Dual lead systems
  • 8-contact leads
  • Wider parameter ranges
  • More complex programming
  • New lead configurations
  • High Frequency Stimulation
THE ROLE OF HIGH FREQUENCY SCS IN THE TREATMENT OF CRPS.
PRELIMINARY DATA FROM A PROSPECTIVE, OPEN-LABEL STUDY

A. Al-Kaisy, S. Palmisani, T. Smith, A. Shetty, N. Padfield

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Technology and procedure

- Rechargeable IPG
- Dual octad lead placed between T8-T11
- Pulse width up to 40µs and rate of up to 10KHz
Thank You

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