

## NEUROMODULATION FOR PERSISTENT PAIN

### WHAT IS NEUROMODULATION?

Also called neurostimulation, neuromodulation involves electrical stimulation of the nervous system for the purpose of modulating or modifying a function, such as the perception of pain. It has a long history, dating all the way back to Ancient Rome using contact with an electrical Torpedo fish as a treatment for gout pain. Observations over time and advances in science have refined the technique and leaders in the field continue to discover new ways to help reduce pain perception (Gildenberg, 2006).

### HOW DOES IT WORK?

Neuromodulation is thought to work either via:

1. The gate control theory of pain put forth by Melzack and Wall (1967). The stimulation of lots of other nerve fibres (such as those for touch) floods the 'gate' and the pain signals 'can't fit through the gate', and effectively the 'gate is closed' to pain.
2. Stimulating one system and inhibiting another system.

Functional MRI studies have shown that with neuromodulation the same regions of the brain light up as the pain signals are coming in but the person is not bothered by the pain ie. their perception has vastly changed about their pain.

This is an exciting new field of research involving the limbic system (linked to our emotions and memory and generates the quality to our pain) and the autonomic nervous system (involuntary nervous system for many body functions such as digestion, heart rate, blood vessel control etc).

### WHAT TYPES OF NEUROMODULATION ARE AVAILABLE?

#### Transcutaneous Electrical Nerve Stimulation (TENS)

This is an in-expensive portable self-management device that provides stimulation via stick-on electrodes through the skin. TENS machines are regularly recommended at WHRIA as an adjunct to physiotherapy, osteopathy and pain education consultations. The preferred model is portable, can be used discreetly as you go about your daily activities and has variable settings to find the right combination for you. It is important to ensure correct electrode placement to ensure optimum benefit.

### **Pulsed radio frequency (PRF)**

involves placing a needle under the skin close to the nerve (usually parallel) with brief periods of low energy, high frequency alternating current to produce a small heat lesion (usually 4 minutes at a time) surrounding the electrode at the end of the needle. PRF can target both somatic (body) and visceral (organ) pain depending on the needle placement, always with ultrasound guidance. PRF can provide long term (up to 6-12 months) of relief without the permanency of an implantable device, although it often needs to be repeated. PRF for PN has evolved at WHRIA from stimulation at the level of the pudendal nerve, to the sacral spinal nerve roots and most recently the dorsal root ganglia (DRG) which is a the next target for advances in pain medicine.

WHRIA is currently conducting a study on the effectiveness of PRF for pudendal neuralgia, including the most effective current and time of use as this is still in debate world-wide. See our Current Studies if you would like more information or to be involved.

### **Spinal Cord Stimulators (SCS)**

Have evolved from 4 electrodes all with the same stimulation to 32 electrodes with individually programming ability. Current models have very slim leads and a small rechargeable battery pack (sits under the skin on the upper buttock) with a remote. SCS's are evolving to no battery pack so an MRI will then be possible (already available outside Australia via one company) and soon no remote will be necessary and the programming will likely occur via your mobile phone. Bursts of very high frequency stimulation then a pause has been shown to produce better results for pain relief with fewer side effects. The exact mechanism of action for SCS is still unclear and more high quality research is needed. At present we use **Boston Scientific SCS** at WHRIA. A review of the last 20 years of literature suggests SCS's are a safe and effective therapeutic modality, but it must be emphasised that SCS are one part of a whole pain management program.

### **WHERE CAN WE USE MODULATION?**

Historically the classic neuro-stimulators or neuromodulators were at a spinal cord level, now we have more options to interfere with the nervous system's signals and to tailor it directly to your particular pain or complaint.

### **Field Stimulation**

Right where it hurts. A TENS machine through the skin via stick-on electrodes (non-invasive, home device), or via an implantable device (requires surgery) with the leads covering the area of pain (see below for more information). This is particularly effective for cluneal neuralgia, where the pain is located at the lower part of the buttocks.

### **Direct stimulation of the nerve causing the pain.**

Once confirmed via a diagnostic nerve block (temporary relief from your particular pain) this method can be very specific. WHRIA was the first clinic in the world to use this method for pudendal neuralgia (PN), where the leads are placed close to the pudendal nerve as a part of the nerve release surgery. PRF is another form of direct stimulation of the nerve and is an option when the bladder and bowel are the main symptoms of PN. The pudendal nerve is easily accessed via the perineum and can provide long term relief without the permanency of an implantable device. WHRIA is currently conducting a study on PRF and PN.

### **At the level of the spine**

- at the spinal nerves within the spinal column
- at the spinal cord itself

Spinal cord stimulators (SCS) used for back pain or headaches, the leads are placed at a spinal cord level on the correlating area of the spine. For pudendal neuralgia the leads are placed near the S2/3/4 spinal nerves, in the sacrum (tail bone), as the spinal cord ends well above this level.

Pulsed radio frequency (PRF) is an excellent, minimally-invasive option at this level for PN as the spinal nerves are readily accessible via the sacrum (tailbone). We can target different aspects of the nerve depending on your predominate symptoms. The dorsal root ganglion (DRG) is a swelling of the nerve roots that is involved in somatic or body pain, is a new target for lead placement of SCS and for PRF. WHRIA is a world leader in this field for pudendal neuralgia, and has been using this method since 2014. Other ganglia nearby are called the prevertebral ganglia and these can be targeted for organ pain and dysfunction such as for bladder symptoms associated with PN, interstitial cystitis or bladder pain syndrome.

### **Deep brain stimulation.**

This area is evolving quickly thanks to new advances in neuroscience and our understanding of the great capacity of the brain to change. The results look promising for diseases such as Parkinson's (particularly for controlling tremor) and Alzheimer's, and we look forward to more research into the use of deep brain stimulation for pain management.

### **References:**

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- Gildenberg, P. L. (2006). History of electrical neuromodulation for chronic pain. *Pain Medicine*, 7(s1), S7-S13.
- Melzack, R., & Wall, P. D. (1967). Pain mechanisms: a new theory. *Survey of Anesthesiology*, 11(2), 89-90.