Spinal cord stimulation for chronic pain

L. Calliauw
University of Ghent. Belgium

The treatment of pain by operative procedures means always that nerve tissue has to be destroyed; a destruction of nerve tissue gives sometimes very serious side effects. It is therefore logic that non-surgical treatment for reduction of pain has been used. It is indeed an attractive idea to try to treat the pain by activation of neurophysiological in-built nociceptive control mechanisms. The activation of this mechanisms could be done by electrical stimulation.

In 1967 Shealy used electrical stimulation for what he called «dorsal column stimulation», believing that by this technique the dorsal columns were indeed stimulated, resulting in a closure of the «gate». Nowadays this theory is considered very speculative as it is impossible to point out what might be the underlying mechanism of D.C.S. At least 30 different mechanisms have been postulated. In addition, D.C.S. is not only effective for pain control, but also for spasticity, vascular disorders, sphincter disturbances and even speech in multiple sclerosis. This lecture is limited to the treatment of pain by D.C.S.

Since the first description by Shealy, different series of patients have been published in the international literature. Some authors mentioned good results, other had essentially bad results.

What is common to all these series is, that the number of patients is limited. We present the experience from our Neurosurgical Clinic on about 80 patients with a follow up of 4-5 years. We will discuss the technique, the complications and the results, and we will try to make a conclusion.

In the selection of our patients, we have treated only chronic pain that means pain that lasted for more than six months and that was already treated by less invasive therapy, such as drugs, infiltrations, TENS etc.

The pain was a neurogenic pain of organic origin. Failed back surgery was the main indication, followed by causalgia and phantom limb pain.

Technique:

A positive trial procedure during a minimum of 2 weeks is essential before neurosurgical implantation. The electrode is introduced into the epidural space through a Tuohy needle and is located 2 segments above the level of the painful area. During the stimulation, the painful area has to be overlapped by paresthesies. The choice of the optimal stimulus-parameters is done by trial and error.

After a successful trial procedure the electrode is implanted neurosurgically between the leaves of the dura and fixed by a suture; a minilaminectomy is performed for this purpose.

Choice of the electrode: There are monopolar, bipolar and multipolar electrodes. The choice depends on the area that has to be overlapped. A monopolar system delivers more stimulation energy to the spinal cord and this energy is dispersed; the bipolar and multipolar electrode allows more concentrated stimulation of the cord.

Choice of the stimulation system: A battery stimulation system is totally implantable and has to be replaced after «normal end of life». A radiofrequency-coupled system allows larger stimulus variations but is not implantable. Pros and cons have to be discussed. For the stimulation a bifasic current is used and the best stimulation frequency seems to be between 50 and 100 Hz.

Complications:

a. Functional complications such as neurological deficit, Horner sign, cooling or warming of the legs, etc.
   The mechanism of these complications is unknown.

b. Technical complications.
   Reinterventions are very frequent (+ in 50%).
   Some reinterventions are unavoidable such as
replacement of a battery for «normal end of life»
Other technical complications are: migration of the electrode, breakage of the electrode, electrode dislocation, formation of scar tissue, infection, etc.
Many patients had multiple interventions.

**Results**

Assessment of pain suppression with spinal cord stimulation in man is very difficult. There is no golden standard to demonstrate the effect. The therapy success of our patients will be analysed in the light of the patients’ initial pathologic condition and their need for analgesic drugs.

The patients are divided into 4 groups:
A. Good pain relief, no need for medication.
B. Good pain relief but need for non-narcotic analgesics.
C. Little pain relief and need for narcotic analgesics.
D. Failure; Stimulation system stopped.

Scrutinizing the literature on this subject it becomes obvious that:
1. A thorough patient selection increases the success rate.
   Only neurogenic pain of organic origin is a good indication and a psychological preoperative examination is mandatory.
2. There is a success ratio decreasing over time; 83% success at short-term and 65% success at long-term.
   In our patients a beneficial effect was seen in ± 80% of the patients; the decreasing over time was minimal, but sometimes many reinterventions were necessary to maintain a good result.

**Conclusion**

— D.C.S. is effective for pain of neurogenic origin.
Selection of patients is mandatory.
— The physiological mechanisms underlying the chronic pain suppression effects of D.C.S. are unknown.
   — A positive trial procedure is essential before neurosurgical implantation. It is necessary that the patient feels paresthesia in the painful area to obtain an analgesic effect.
   — Long lasting success, with minimal decreasing of the initial success ratio over time, is possible but requires sometimes many reinterventions.
   — New (more rigid, multipolar) and better electrodes, will reduce the number of reinterventions.