



**Karolinska  
Institutet**

**Institutionen för klinisk neurovetenskap**

# Advances in spinal cord stimulation - enhancement of efficacy, improved surgical technique and a new indication

**AKADEMISK AVHANDLING**

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av

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## ABSTRACT

**Introduction and aim:** Spinal cord stimulation (SCS) has been used for treatment of otherwise therapy-resistant chronic neuropathic pain for about four decades. However, 30-40 % of the patients do not benefit from SCS, despite careful case selection and technical advances. In search of ways to improve the outcome mechanisms underlying the pain relieving effect of SCS have been extensively explored. Experimental findings suggest a possibility to enhance the effect of SCS by concomitant intrathecal (i.t.) administration of pharmaceuticals, such as baclofen, clonidine and adenosine.

Animal research has indicated that hypersensitivity to colonic dilatation can be attenuated by SCS. This finding, as well as related clinical observations, forms a basis for the possibility of treating irritable bowel syndrome (IBS) with SCS.

Implantation of an SCS system with a plate electrode requires extensive surgery. This can be painful and cumbersome for the patient, since finding an optimal electrode position demands patient cooperation with reporting of stimulation evoked sensations.

Aims of the thesis were to study: <sup>1)</sup> if co-administration of baclofen (Study I and III), clonidine (Study III) or adenosine (Study I) can enhance the effect of SCS, <sup>2)</sup> if long-term i.t. administration of a drug will continue to support the effect of SCS over time (Study II), <sup>3)</sup> if implantation of plate electrodes can be performed in spinal anesthesia, retaining the possibility for the patient to feel and report stimulation evoked paresthesias and <sup>4)</sup> if SCS can be used as a treatment option for IBS, otherwise resistant to therapy.

**Methods:** In Study I, 43 patients with neuropathic pain either experiencing diminished effect of previously efficacious SCS or with insufficient effect of SCS were recruited for trials of bolus i.t. injections of baclofen. Patients responding to the addition of baclofen were offered continued administration either i.t., via an implanted pump, or orally. Seven patients were also tested with i.t. adenosine. In Study II, the patients who continued with i.t. baclofen via a pump were assessed for long-term results. In Study III, 10 neuropathic pain patients with insufficient effect of SCS were recruited for a randomized double-blind trial, with i.t. injections of baclofen, clonidine and placebo. In Study IV, results from 20 implantations of plate electrodes in spinal anesthesia are reported. In Study V, 10 patients with IBS participated in a study of SCS, comparing randomly assigned periods of active stimulation versus a period without stimulation.

**Results:** In Study I, 20 patients responded to i.t. baclofen, with or without SCS. Three patients tested oral baclofen as an adjunct to SCS, but terminated treatment due to side effects. Eleven patients had pumps implanted, two of which were explanted during the trial period. Two patients opted for i.t. adenosine delivery via a pump, but discontinued due to side effects. In Study II, it was confirmed that all 9 patients with remaining working pumps continued to benefit from the therapy, albeit with a dose increase. In Study III, 5 patients responded to either baclofen or clonidine and 4 received pumps for i.t. delivery (2 baclofen, 2 clonidine). In Study IV, it was demonstrated that in all 20 implantations it was possible to perform successful intra-operative testing in spinal anesthesia. In Study V, 6 out of 9 patients responded beneficially to SCS as a treatment for IBS (1 patient left the study).

**Conclusions:** I.t. medication with baclofen or clonidine can enhance the effect of SCS. This enhancement remains over a long-term follow up. Implantations of plate electrodes can be performed with intra-operative testing in spinal anesthesia. SCS may alleviate pain in IBS, but studies in larger patient materials are needed to investigate effects on other IBS symptoms.

**Key words:** spinal cord stimulation, neuropathic pain, baclofen, clonidine, adenosine, intrathecal medication, IBS