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Letter to the Editor

Efficacy of Spinal Cord Stimulation for Pain Relief may depend not only on the Technology used, but also on Anatomical and Physiological Influencers

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We were interested to read the article by Will *et al.* on a prospective, multicenter, randomized, single-blinded, crossover study comparing the effect of evoked compound action potential (ECAP)-controlled closed-loop (CL) spinal cord stimulation (SCS) with traditional open-loop (OL)-SCS, by examining the reduction in hyperstimulation sensitivity in 42 patients with post-laminectomy pain (n=17), radicular pain syndrome (n=13), degenerative disc disease (n=9) and failed back surgery (n=3) [1]. The primary outcome was how patients felt during activities of daily living, which was assessed using a Likert scale [1]. Eighty-eight percent of patients preferred the CL-SCS, and variability in ECAP amplitude was lower with the CL-SCS compared to the OL-SCS [1]. The study concluded that ECAP-guided CL-SCS reduced or eliminated unwanted sensations and provided a more consistent and preferred SCS experience [1]. The study is excellent, but some points should be discussed.

The first point is that the therapeutic effect of SCS depends not only on the stimulation technique, but also on a number of other factors, such as the etiology and pathophysiology of pain, self-developed coping mechanisms to reduce pain, psychosocial background, defined outcome variables, and the instruments used to assess the outcome variables. Vertebrogenic pain may respond differently to SCS than, for example, neuropathic pain. Therefore, a homogeneous group of patients with the same disease and cause of pain in all included subjects should be examined.

The second point is that the amount of current reaching the target structures is highly dependent on the anatomical or pathoanatomical conditions around the stimulation site. Depending on the thickness of the dura, the thickness of the subarachnoid space, the thickness and congestion of the subarachnoid venous plexus and the thickness and nature of the pia mater, more or less current may reach the target structure. Because these variable anatomical and pathoanatomical structures greatly influence the results, these variables should be included in the interpretation of the results and therapeutic effect.

The third point relates to the statement that the ECAP amplitude is a measure of neuronal activation. Neuronal activation is strongly dependent on the excitability and conductivity of neurons. Excitability and conductivity may in turn depend on metabolism, signalling, nutrition, hydration, medications and comorbidities. Excitability and conductivity may also depend on the balance between sympathetic and parasympathetic tone and thus on a person's mental state. Therefore it is recommended to include only patients without comorbidities and those not taking medications.

The fourth point refers to secondary damage caused by neuropathies. Several of them, whether primary or secondary, can be complicated by trophic disorders that can lead to ischemia, phlegmon, ulceration, panniculitis, phlebitis, vasculitis or osteomyelitis. They can cause secondary pain in addition to the neuropathic pain and thus strongly influence the effect of the SCS. Therefore, patients with secondary complications of neuropathies responsible for additional pain should be excluded from the study.

The fifth point is that SCS can deliver electrical energy to the dorsal parts of the spinal cord. However, the dorsal side of the spinal cord contains the dorsal columns, which do not conduct pain sensations. Pain and temperature sensations are conducted in the spinal cord via the anterior and posterior spinothalamic tracts, so the electrical current should be applied to these structures in particular to achieve an optimal analgesic effect. Therefore, applying current from a lateral position should be considered.

The sixth point relates to the complications of electrode implantation for SCS. Since the tip of the electrode is not attached to any structure, it is prone to dislocation. Dislocation of the electrode can be an important reason for inadequate stimulation of the target structure. Electrodes that can be attached to the dura should be used.

The seventh point is that pain must be assessed individually. Each person affected can understand pain differently. Some patients mean paraesthesia, dysaesthesia, hypo- or hyperaesthesia, hypo- or hyperalgesia, cramps, myalgia, restless legs or

allodynia. Therefore, the assessment of pain using different scales can capture different qualities of pain.

To summarize, this interesting study has limitations that put the results and their interpretation into perspective. Addressing these limitations could strengthen the conclusions and support the message of the study. Since the current dose required for pain relief depends not only on the stimulation technique used, but also on the etiology and pathophysiology of the pain and the pathoanatomical constitution, the adjustment of the stimulation technique may not be the only variable to optimize the treatment effect. All influencing factors that determine the treatment effect of SCS must be included in the considerations for improving the therapeutic value of SCS.

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References

1. Will A, Fishman M, Schultz D, Danko M, Verill D, Davies C, *et al.* Improvements in Therapy Experience with Evoked Compound Action Potential Controlled, Closed-Loop Spinal Cord Stimulation - Primary Outcome of the ECHO-MAC Randomized Clinical Trial. *J Pain*, 2024, 104646. Doi: 10.1016/j.jpain.2024.104646.