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Case Report

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Successful integration of interdisciplinary pain rehabilitation and spinal cord stimulation for chronic naive back pain

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Abstract

Spinal cord stimulation for naive back pain is a therapeutic option that is rarely considered, especially when conventional stimulation parameters are used. Interdisciplinary pain rehabilitation program is another less feasible but effective therapeutic approach for the management of chronic pain that is not usually used in conjunction with interventional procedures.This case report presents a successful integration of an interdisciplinary pain rehabilitation program with an interventional procedure spinal cord stimulation using conventional stimulation parameters in a patient with chronic, predominantly nociceptive to nociplastic, naïve back pain.

Keywords: Chronic pain, Interdisciplinary Rehabilitation, Spinal Cord Stimulation, Neuromodulation, Case Report.

Introduction

The management of chronic low back pain is a clinical challenge. After an acute episode, more than half of patients still report significant low back pain at 12 months [1,2]. Prognostic markers for persistent pain and disability range from biological (pain intensity in the acute phase) to psychological (pain catastrophizing, higher perceived risk of pain persistence) and various social factors [3,4]. Low back pain may be nociceptive or mixed, with a neuropathic component [5]. A new mechanistic descriptor nociplastic pain is defined as "pain that results from altered nociception, although there is no clear evidence of actual or impending tissue damage or evidence of disease or lesion of the somatosensory system" [6]. It is influenced by central and peripheral sensitization and may occur in various rheumatologic or musculoskeletal chronic pain conditions, including low back pain [7,8]. Differentiating the potential mechanisms involved may help in treatment decision making [9]. Given the complex interactions between biological and psychosocial factors described in the phenomenon of central sensitization [10,11], a clinical practice that aims to address multiple potential mechanisms simultaneously may provide better solutions.This case report presents a successful integration of an interdisciplinary pain rehabilitation program (IRP) with an interventional procedure such as spinal cord stimulation using conventional stimulation parameters in a patient with chronic, predominantly nociceptive to nociplastic naïve back pain.

Participant

Patient Description

Fifty-eight-year old male patient presented to the chronic pain rehabilitation outpatient clinic with severe chronic pain in his back and right thigh for at least two years. The pain developed gradually, worsening with sitting and especially at night. His medical history reported surgical treatment for an inguinal hernia at the age of 25 without complications and an episode of severe bronchitis requiring several months of home oxygen treatment four years earlier. Formerly very physically active, his back pain caused severe limitation of movement and weight gain. He did not smoke or abuse alcohol. Clinical examination revealed obesity (body mass index 36.3 kg/m2), no neurological deficits, no signs of arthritis or other musculoskeletal disorders. Diagnostic workup ruled out possible "red flag" conditions, with some significant findings on MR imaging studies: L5S1 annulus fiber rupture, arthropathy of lumbar facet joints with effusions L4L5 on both sides and L5S1 on the right side. Physical therapy consistently exacerbated the pain. He was treated with analgesic infusions (combination of tramadol, metamizole, and dexamethasone) at least 300 times in the 18 months prior to the first clinical examination at our institution. He had to be hospitalized 4 times for severe limitation of movement, which lasted for 10 days. In addition, he regularly took 225 to 450 mg of tramadol daily in combination with paracetamol per os. Because of the side effects, nonsteroidal anti-inflammatory drugs and pregabalin were out of the question. He experienced up to 50% pain reduction on medication and reported average pain of 4-6 out of 10 on the numeric rating scale. He received facet joint infiltrations, with no lasting success. He reported several adverse experiences in childhood and adulthood. His primary defense mechanisms were directed toward exercise; accordingly, he loved athletic activities and hard work. Pain caused him to lose much of

what he truly valued. His sleep was fragmented and not restful; he experienced moderate fatigue and difficulty concentrating, which interfered with his job as a merchant.

Treatment Plan

Mechanistically, the pain could be primarily nociceptive (annulus fibrosus tear, arthropathy of the lumbar facet joints) with a nociplastic aggravation, indicated by a higher score on the painDETECT questionnaire (pDq) without evidence of somatosensory system disease or lesion [7]. He responded well to multicomponent analgesic therapy, which was also suggestive of a nociceptive pain component, but the medications significantly impaired his overall functional abilities (fatigue, difficulty concentrating). At the behavioral level, he recognized patterns of physical overexertion (which exacerbated his nociceptive pain and possibly led to nociplastic pain) that resulted in intense pain episodes and progressive exercise intolerance. After neuroscience-based pain education, he was motivated to participate in an interdisciplinary pain rehabilitation program based on cognitive behavioral training to support behavioral adaptation. Treatment goals would be directed at improving physical function (coordination, body mechanics, endurance) through viable structural physical activity while improving body awareness. At the same time, psychological goals would be directed toward recognition of affective responses and acceptance of physical changes to further enhance the potential for behavioral adaptation. During the rehabilitation program, goals and expectations regarding spinal cord stimulation would be discussed, a trial of spinal cord stimulation would be planned, and if successful, implantation of the stimulator would be scheduled. The main treatment goal of spinal cord stimulation would be to wean the patient off medication while achieving approximately 50% pain reduction.

Course and Outcome of Treatment

The time course of the treatment interventions is shown in Figure 1. During the first IRP, the main goals were achieved, as measured by physical function tests (Table 1) and pain interference by the Brief Pain Inventory (Figure 2). In contrast, symptoms of depression, catastrophizing, and the neuropathic pain symptoms measured by pDq, were more pronounced at the end of the first IRP. During the 2-week SCS trial, the goal of 50% pain reduction was not met (Figure 1). But the trend toward better sleep, fewer neuropathic pain symptoms, and dramatic reduction in tramadol consumption during the trial (from at least 400 mg to 100 mg daily) argued for implantation of the spinal cord stimulator. Pain was covered by conventional stimulation (100 Hz, 300 mcs) and one octopolar electrode whose tip was in the lower quarter of Th8. He preferred the paresthesia type of stimulation. We were able to achieve excellent coverage of the back and right thigh. He was motivated to return to an interdisciplinary rehabilitation program after SCS implantation. Brief Pain Inventory and pDq scores continued to show improvement during the second IRP, and symptoms of depression and catastrophizing were not significant even before the second IRP and remained so in the long term. At the 17-month follow-up, he reported almost no pain, occasionally took a combination of 37.5 mg tramadol and 325 mg acetaminophen, and remained physically active and mentally resilient.

IRP 1 5 weeks	**No treatment** 3 months	**SCS trial** (2 weeks) & implantation (4 weeks)	**IRP 2** 5 weeks	**Follow-up** 17 months

Note: the drawing is only approximately to scale.

Figure 1: Time course of treatment interventions.

Table 1: Outcome measures, used to assess treatment goals.

Outcome measure	Before IRP1	Completing IRP1	Completing SCS trial	Completing IRP2	Follow-up
Berg Balance Scale	48	55	56	56	56
6-minute walk test	185	303	305	340	375
Beck Depression Inventory II	12	15	4	3	0
Pain Catastrophizing Scale	25	29	8	7	0

Notes: The Berg Balance Scale is a clinical test that measures static and dynamic balance abilities, gait mechanics, and coordination [20]; the 6-minute walk test is used to assess aerobic capacity and endurance [31]; Beck Depression Inventory is commonly used to screen for depression in patients with spinal pain [32]; Pain Catastrophizing Scale is used to assess exaggerated negative perception of pain sensation [15]; IRP: Interdisciplinary pain rehabilitation program; SCS: Spinal cord stimulation.

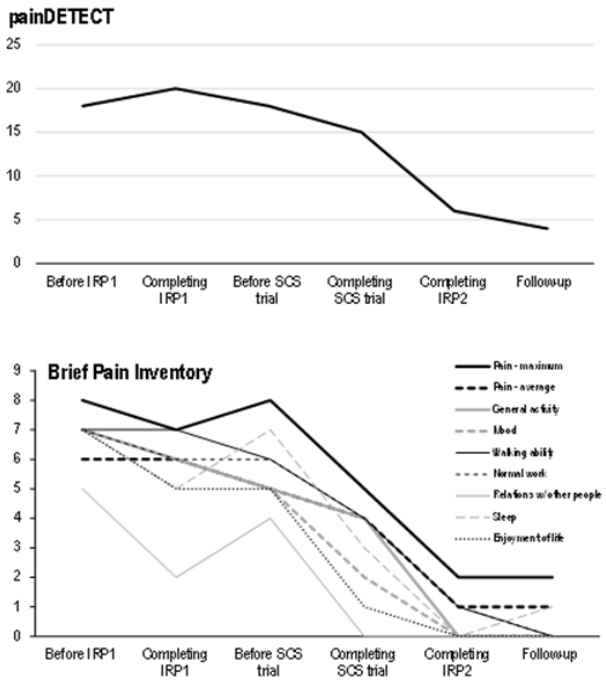

Figure 2: Outcome measures to assess neuropathic pain symptoms, pain intensity and pain interference: painDETECT [5] and Brief Pain Inventory [33].

Discussion

In chronic non-cancer pain patients, especially in tertiary health care settings, pure nociceptive or neuropathic pain may be less common than a "mixed" type of pain, the latter referring to the coexistence of nociceptive and neuropathic pain. Many studies have shown that in a significant proportion of osteoarthritis patients, pain has neuropathic features (altered proprioception, hypoesthesia at the painful joint and at a distance) that are less responsive to usual treatment [12]. We decided to use the painDETECT questionnaire as a bedside measure to define chronic back and leg pain in a patient with MRI-confirmed degenerative changes of the lumbar spine in terms of possible central sensitization [13,14]. Knee osteoarthritis patients with more than 13 points on the pDq showed functional brain connectivity changes and higher neuronal activity in the Rostral Ventromedial Medulla, which correlated with less favorable outcomes after knee surgery, increased fear of movement, and pain catastrophizing [14]. An interdisciplinary pain rehabilitation program could address concomitant emotional and cognitive processes, and it is also possible that spinal cord stimulation influences the affective component of pain processing [15].

The distinction between nociplastic and neuropathic pain seems to be an open question, especially in clinical practice. The absence of clinical and imaging evidence of a lesion of the somatosensory system and high score on pDq argues for nociplastic pain [16]. Nociplastic pain refers not only to central sensitization but also to peripheral sensitization, which might be plausible in the case of MRI-confirmed local degenerative changes of the lumbar spine with good correlation to pain localization.

Spinal cord stimulation may be less effective in patients who have experienced childhood trauma [17]. Clinically, it is very difficult to differentiate such cases because patients who have experienced trauma do not differ from other patients in terms of back pain intensity, duration of back pain, functional back ability, or quality of life, despite objective differences in psychophysiological somatosensory patterns [18]. Nonetheless, personal history of trauma or significant adverse events could be associated with unique underlying neurophysiological mechanisms that influence the long-term efficacy of spinal cord stimulation, particularly for neuropathic pain [17]. Although the patient reported adverse life events, his willingness to adapt during the first IRP indicated considerable psychological flexibility, possibly mediating the effect of adverse life events and pain [19].

After the first IRP, the patient's physical performance improved more than psychological functioning. Physical therapy combined with neuroscience-based pain education is known for its benefits in general and specifically with regard to postoperative outcomes after lumbar surgery [10,21]. Physical activation resulted in more neuropathic symptoms as measured by pDq, pain intensity remained the same, while walking distance, balance, and coordination improved significantly. Better physical functioning was very important for the patient, as previous activation attempts led to more pain and disability. Interdisciplinary clinical settings may be the best opportunity for exposure (e.g., in physical therapy) while addressing affective responses and possible emotional suppression. Active suppression of emotion, but not experiential avoidance, may partially explain why patients with a history of distressing events have greater pain [11]. The worsening of catastrophizing and depressive symptoms (although clinically insignificant) at the end of the first IRP might be related to the increased body and self-awareness, which may transitionally produce more symptoms than expected. On the other hand, psychological functioning improved dramatically during spinal cord stimulation. Neuropathic symptoms improved more during the second IRP than during the 2-week stimulation phase, possibly due to easier progression in physical functioning, which consistently improved only as an effect of the rehabilitation program.

In recent years, paresthesia-based spinal cord stimulation (P-SCS) has been questioned for its long-term efficacy, and new stimulation waveforms and frequencies promise better pain relief [22,23]. There is more evidence in favor of high-frequency spinal cord stimulation (HF SCS) for naïve back pain, especially in the long term [24]. On the other hand, it has been shown that a successful outcome is more likely with P-SCS than with HF-SCS or burst stimulation, but especially in patients with pain localized in the lower extremity and with a history of spinal surgery [25]. In our case with predominant low back pain, we assumed that the pain was primarily nociceptive with good response to tramadol analgesia. In nociceptive pain, tramadol could act via HT3 receptors in the spinal cord by increasing 5 HT and NA [26,27]. Linderoth et al. first demonstrated that dorsal column stimulation increases 5-HT levels in the dorsal horn, and there is evidence that P-SCS mediates orthodromic activation of serotonergic analgesia [28,29]. The patient preferred paresthesia-based stimulation and immediately perceived pain relief, similar to the effect of tramadol, leading to dramatic discontinuation of tramadol.

Conclusion

Based on our clinical practice, some patients require an interdisciplinary pain rehabilitation program for various reasons before spinal cord stimulation is considered. During rehabilitation, some patients recognize their own ability to manage pain without additional interventional treatment. For others, it is the best way to set realistic goals for spinal cord stimulation and possibly prevent ex-plantation of SCS due to ineffectiveness. Interdisciplinary rehabilitation uniquely impacts physical functioning in people with residual pain (including after SCS). Neuroscience-based pain education combined with physical therapy could be another possible adjunctive treatment regimen, if such rehabilitation programs are not available. The available SCS technologies are changing rapidly and so should the adjunctive clinical practice to enable the best possible outcomes for patients using rational clinical pathways. As spinal cord stimulation emerges as a potential first-line therapy for chronic low back pain, such an integrative clinical approach could offer better clinical outcomes.

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