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Case Study
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Spinal Cord Stimulation for Abdominal Pain in a Patient with Complete Spinal Cord Injury: A Case Report

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Abstract

Spinal cord stimulation has been investigated in the past for the relief of spinal cord injury related pain. Spinal cord injury pain is often resistant to many treatment modalities including pharmacological and surgical interventions. Few cases have reported its use in complete spinal cord injuries or its success. This case report pertains to a quadriplegic patient with a complete cervical transection at C6 with T10 dermatome pain obtaining significant relief with spinal cord stimulation. Spinal cord injury patients can be medically complex due to the accumulation of comorbidities this patient population often develops. These comorbidities can create barriers to spinal cord stimulation consideration, and this report highlights some of those challenges regarding infection and anticoagulation. We found that our spinal cord injury patient had the greatest relief from a newer burst type neuromodulation program in combination with tonic stimulation. Typically, parameters and programs used for spinal cord stimulation on spinal cord injury patients are not mentioned in reports. The authors of this case report believe that providing the parameters from our successful spinal cord stimulation for spinal cord injury pain are relevant to share. By including our neuromodulation parameters, we believe this may provide guidance to other clinicians during the narrow trial window in this medically complex subset of patients.

Introduction

Pain after Spinal Cord Injury (SCI) can be difficult to treat. Unfortunately, pain is common after SCI with up to 80% of patients experiencing pain, and 50% reporting their pain as severe [1]. Neuropathic Pain (NP) after SCI can be further categorized as at level neuropathic pain and below level neuropathic pain [1]. The exact mechanism of spinal cord injury pain remains unknown. At level lesion pain is thought to be due to both peripheral and central processes, whereas below the level lesion pain may be due to residual spinothalamic tract function [2]. SCI pain can often be refractory to pharmacological, non-pharmacological, and invasive procedures. Anti-epileptics (gabapentin and pregabalin) and tricyclic antidepressants (e.g. amitriptyline) are considered first line recommendations over opioid therapy [3]. Non-pharmacological options such as transcranial magnetic stimulation, cranial electrical stimulation, direct current stimulation and transcutaneous electrical nerve stimulation have been investigated with modest results and more studies need to be conducted to evaluate the overall effectiveness of these treatments [3-5]. Invasive procedures may be considered when pain control has been refractory to conventional medical therapy. Procedures such as Dorsal Root Entry Zone (DREZ) lesioning or microsurgical DREZotomy can be considered, but only in patients with complete SCI due to potential loss of further function below the lesion [3]. Spinal Cord Stimulation (SCS) has been utilized as a potential therapeutic option for SCI pain with varying results [3,5,6]. Recent successes treating NP with SCS in the setting of SCI have been reported [7,8]. The SCI patient population can develop several comorbidities that create barriers to consideration of SCS. Comorbidities such as frequent bladder infections due to bladder dysfunction, pulmonary thromboembolism requiring anticoagulation, and pressure ulcers are not uncommon and present unique challenges [9]. Careful perioperative coordination of care for this patient population is needed to safely proceed with SCS utilizing the NACC guidelines [10,11]. This case report pertains to a quadriplegic patient with below lesion level NP who obtained significant relief from SCS.

Case Study

A 53 years old male with complete transection of the spinal cord at C6 after a motor vehicle accident resulting in quadriplegia presented to our pain clinic with intractable T10 dermatome level NP pain. He had undergone extensive evaluation by his primary care physician to rule out possible

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abdominal visceral origin for his pain. The patient was otherwise healthy prior to his SCI, however developed multiple comorbidities. The patient had a complex medical history including bladder dysfunction requiring placement of a suprapubic catheter, frequent urinary tract infections, Methicillin Resistant *S. aureus* (MRSA) colonization, chronic right buttock pressure ulcer, and finally a history of pulmonary embolism requiring anticoagulation with warfarin. He was not a candidate for surgical correction and his intractable pain did not respond to conventional medical management including antineuropathics and opioid therapy. The patient was referred to our pain clinic for evaluation for SCS. After education about the procedure and undergoing psychological evaluation he was deemed a potential candidate. Coordination and communication between the patient's hematologist and our institutions infectious disease department prior to trial were necessary due to his anticoagulation and infection risk. Withholding anticoagulation for the trial and its increased risk of thromboembolism were discussed. A plan was developed with his hematologist to help minimize the time without anticoagulation for the trial. The patient's warfarin would be held with bridging for 5 days with enoxaparin for 24 h up to the trial. At the conclusion of the trial, enoxaparin and warfarin would restart 24 h after spinal cord stimulator lead removal. The patient was evaluated with MRSA swab testing and urinalysis with reflex culture for pre-procedure testing. The patient was found to be MRSA positive with *Citrobacter* and *Acinetobacter* growing from his urine culture. The patient began treatment with ciprofloxacin after susceptibility studies were completed from his urine culture. From our institution's infectious disease recommendations, given his history of frequent symptomatic urinary tract injections, antibiotics for the urinary tract infection/colonization were to be continued through the trial. MRSA decolonization was performed with nasal mupirocin ointment and chlorhexidine baths 5 days prior to the trial. Weight based intravenous vancomycin was administered prior to the trial and the patient was given oral clindamycin post-procedure for MRSA coverage in addition to ciprofloxacin for the duration of the trial. The patient underwent a SCS trial utilizing a generator with burst and high frequency programming available (Boston Scientifics Spectra Wave Writer™). Two epidural percutaneous 16 contact leads were placed for the trial. Intraoperative testing yielded stimulation of the patient's approximate T10 dermatome level abdominal pain and the final lead vertebral body levels were T8 on the left and T9 level on the right. Several programs where utilized for the duration of the trial including high frequency settings, however the parameters of the trial program that provided the most relief was a burst type program (Micro Burst™). The burst settings during the trial were a pulse width of 310 μs, 450 Hz intra-burst frequency, 40 Hz inter-burst frequency, at 7.1 milliamps. The trial was considered a success and the epidural leads were removed at the conclusion of the 5 days trial. Six weeks later, the patient underwent T9 laminectomy for T7 and T8 spinal cord stimulator paddle implant, with right flank spinal cord stimulator battery implant. Since implantation, the patient utilizes a combination program with standard tonic stimulation and burst programming at the T8/T9 level. The standard tonic stimulation component settings are a pulse width of 310 μs, with a 60 Hz frequency, at 8.9 milliamps. The burst settings of the combination program are 310 μs pulse width, 450 Hz intra-burst frequency, 40 Hz inter-burst frequency, at 2 milliamps. On a 6 month follow up visit he had continued relief of his approximate T10 dermatome level abdominal NP post SCI pain.

Discussion

This case report demonstrates that SCS can be used successfully for SCI pain. Spinal cord injury patients can develop multiple comorbidities making it difficult to consider SCS as a viable treatment option [9]. This case reports demonstrates some of those challenge and the solutions to mitigate those obstacles. One of the learning points from this case is how critical it is to find a SCS program that provides relief, especially when extending a trial or re-trialing may pose several risks. There are only a few recent case reports using spinal cord stimulation for SCI pain control, and fewer with complete cervical level spinal cord transection lesions [7,8]. Several studies in the past have evaluated SCS for SCI pain with limited success and relief, however most of those were performed several years ago prior to the recent advancements in neuromodulation programming [6]. Further investigation evaluating newer neuromodulation programs is needed [5]. In this case report, our patient found relief utilizing a combination of tonic and burst programming. Only one of the cases reported their successful SCS settings for SCI pain, in which they utilized a generator (St. Jude Medical™) with a burst frequency of 40 Hz with an intra burst-frequency of 500 Hz and duration of each pulse of 1000 μs [7]. One of our objectives with this case report was to provide the parameters from our trial and subsequent implantation.

Conclusion

This case describes a medically complex SCI patient who underwent a successful SCS trial and permanent placement with significant pain relief of his T10 intractable abdominal pain. Though the mechanism of SCI pain remains elusive and difficult to treat, investigating treatment options remains a worthwhile cause due to the impact on quality of life for this patient population [1-4]. The efficacy of recent neurostimulation programs for the treatment of SCI pain has not been fully evaluated [5,7]. This case adds to that limited data and may provide additional guidance to clinicians with SCI pain patients who consider SCS therapy as a therapeutic treatment modality.

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