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Case Report

Dorsal Root Ganglion Stimulation for Spinal Nerve Schwannoma: A Case Report

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Abstract

Schwannomas are the most prevalent benign tumors affecting the spinal nerve sheath. They are usually well-defined, circumscribed, and encapsulated tumors. The clinical presentation of patients with spinal nerve schwannomas is related to compression of adjacent neural structures and may include radiating pain, weakness, and sensory deficit in the distribution of the affected spinal nerve. The management of Schwannomas ranges from observation for small asymptomatic tumors to surgical resection for large symptomatic tumors. Radiation therapy may be an option in cases of recurrent tumors or when surgery is not a viable option. We present a case of recurrent schwannoma of the first sacral nerve with refractory neuropathic pain. The patient exhibited differential responses to Spinal Cord Stimulation (SCS) and Dorsal Root Ganglion (DRG) stimulation, with the DRG stimulation providing astounding long-term pain relief and a significant improvement in overall quality of life. In individuals refractory to both medical and surgical interventions for spinal nerve Schwannomas, DRG stimulation could be a promising option to alleviate symptoms and enhance functionality.

Keywords: Dorsal Root Ganglion Stimulation; Neurostimulation; Radicular pain; Shwannoma

Introduction

Schwannomas stand out as the most prevalent benign tumors affecting the spinal nerve sheath [1,2]. The annual incidence in the United States is approximately 0.24 per 100,000 people [3], with patients typically manifesting symptoms in their fourth to fifth decade of life [4,5]. Recent research indicates a higher occurrence rate in males, while lower incidence rates are associated with Black and American Indian/Alaska Native races [3]. Ponti et al reported a significant occurrence of about 48% in the lumbosacral region [5]. Schwannomas are characteristically solitary, well-defined, and encapsulated tumors [6]. Histologically, they are made up of mixed bundles of long spindle-shaped Schwann cells (referred to as Antoni A type tissue) intermingled with regions of more loosely textured polymorphic Schwann cells (referred to as Antoni B type tissue) [4]. The clinical presentation of spinal schwannomas commonly involves localized pain or complications arising from the compression of adjacent neural structures [4]. Symptoms may include radiating pain, weakness, and sensory deficit in the distribution of the affected spinal nerve.

The approach to treatment varies, ranging from observation for small asymptomatic tumors to surgical resection for large, symptomatic tumors [7]. In cases of recurrent tumors or when surgery is not a viable option, radiation therapy may be used [8,9]. In this context, we present a case of recurrent schwannoma of the first sacral nerve with refractory neuropathic pain. The patient exhibited differential responses to Spinal Cord Stimulation (SCS) and Dorsal Root Ganglion (DRG) stimulation, with the latter providing dramatic pain relief and a significant improvement in overall quality of life.

Case Presentation

The patient, a 55-year-old male, has a significant medical history involving depression and a schwannoma affecting his first

sacral (S1) spinal nerve root. This condition has led to severe right lower back and leg pain. Initially, in December 2007, the patient underwent laminectomy and resection, resulting in relief for over nine years. However, a recurrence was identified in April 2017, leading to an attempted laminectomy and resection in June 2017. Unfortunately, the tumor's intricate connection with the S1 nerve precluded successful resection. Subsequently, the patient faced challenges in mobility, relying on a wheelchair due to persistent low back pain and weakness in the right lower extremity. Chronic steroid therapy and opioids were prescribed, and the patient underwent stereotactic radiotherapy in September 2017. Despite these interventions, debilitating pain persisted, prompting a referral to a pain clinic. At the pain clinic, the patient reported daily pain levels of 9-10/10, describing it as sharp and stabbing, predominantly located in the lower back, groin, and radiating down the right lateral leg. Functional disability was severe, affecting daily activities and exacerbating depression. A multimodal pain regimen was initiated but provided inadequate relief. Given the persistent pain, a spinal SCS device was recommended. Following a successful trial, a permanent SCS implant was placed in January 2018, providing partial relief.

Despite the improvement, the patient sought evaluation at the Cleveland Clinic Foundation pain clinic in June 2018 for ongoing right low back and lower extremity pain, rated 8/10. Further adjustments to the pain regimen were made, including the addition of Duloxetine and Lidocaine patch. Notably, the patient demonstrated reduced OxyContin dosage and improved functionality. However, the pain persisted, prompting a diagnostic right S1 transforaminal epidural steroid injection. After receiving no relief from the injection, a DRG stimulation trial was conducted in December 2018. The patient reported substantial improvement, with a 60% reduction in pain, enhanced mobility, and improved quality of life. Consequently, a permanent DRG stimulation implant was performed in February 2019 (Figure 1), resulting in remarkable pain reduction to approximately 2/10. Post-implant, the patient experienced a transformative outcome, discontinuing opioids for three months and reporting enhanced sleep and daily activities. His quality of life significantly improved, and he described the therapy as "life-changing." During a recent visit in December 2023, the patient remained enthusiastic about the sustained pain relief and reported successful discontinuation of OxyContin, gabapentin, and Cymbalta. Current pain management includes Hydrocodone/acetaminophen, Ibuprofen, and Lidocaine patch. The patient expressed gratitude for the positive impact of DRG stimulation on his life.

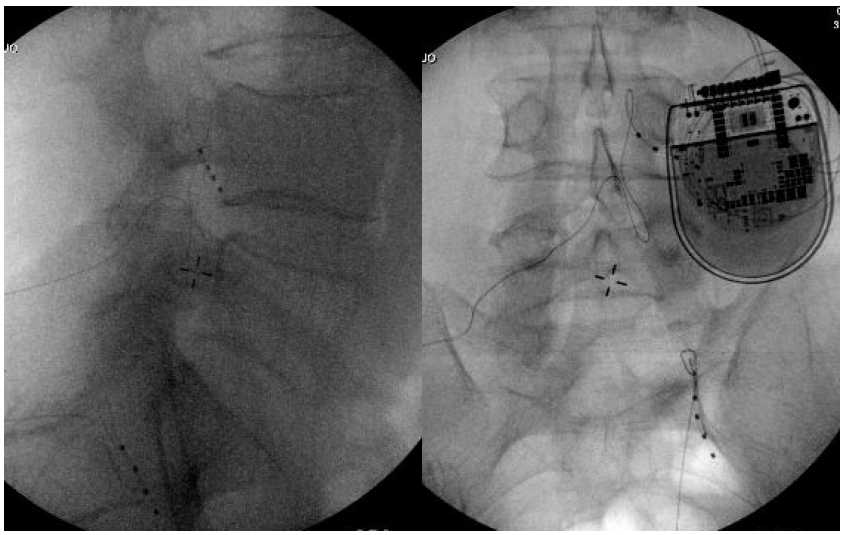

Figure 1: Lateral and Posterior-Anterior Fluoroscopy Imaging following Permanent DRG Stimulator Implantation.

Discussion

Despite being non-malignant, spinal nerve schwannomas can significantly impact patients' quality of life due to their location within the spinal cord [4]. Our patient experienced profound and persistent pain along with functional impairment following the recurrence of the schwannoma. Despite interventions such as spine surgery, multimodal pain management, and SCS, the relief was minimal. The patient's radicular pain, predominantly in the S1 dermatome, prompted consideration of DRG stimulation as a viable option. The DRG implant yielded remarkable and sustained pain relief, leading to the patient's successful discontinuation of opioids and independence from mobility aids. The DRG serves as a critical relay center and gatekeeper for sensory information traveling from the periphery to the central nervous system [10,11]. Positioned between the dorsal root and the spinal nerve, the DRG is located within the neuroforamen, nestled between the zygapophyseal (facet) joints and the intervertebral disc. Prolonged mechanical compression or irritation of spinal nerves can result in hyperexcitability and ectopic discharge of primary sensory neurons within the DRG, leading to neuropathic pain [12]. Electrical stimulation of the DRG has demonstrated efficacy in reducing excitability, frequency, and amplitude of these abnormal discharges, effectively modulating the DRG and proving highly effective in managing regional pain [13,14]. The distinct advantage of DRG stimulation over SCS lies in its ability to target specific nerves, providing enhanced efficacy in treating localized neuropathic syndromes [14]. This targeted approach contributes to the notable success of DRG stimulation in alleviating the patient's regional pain and improving overall outcomes.

The primary approach to managing spinal nerve Schwannomas with compressive features is surgical resection [6, 15]. A study conducted by Seppälä et al, involving 187 patients who underwent surgical resection for spinal nerve Schwannomas, revealed that only 20% were symptom-free at follow-up. The most common issues reported were local pain, radicular pain, and paraparesis [4]. For patients experiencing persistent pain post-surgery, particularly due to recurrence or unresectable tumors, Dorsal Root Ganglion (DRG) stimulation emerges as a potential solution after unsuccessful attempts with medical and radio-oncological treatments. While there have been a few successful reports on the use of SCS or peripheral nerve stimulators for treating peripheral nerve Schwannomas or post-resection neuropathic pain [16,17], our case represents the first documented instance of DRG being employed for the treatment of recurrent spinal nerve Schwannoma. Further research is essential to further assess the efficacy of DRG in this specific patient population. In conclusion, for individuals facing challenges with both medical and surgical interventions for spinal nerve Schwannomas, DRG stimulation stands as a promising option that can significantly alleviate symptoms and enhance functionality.

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