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High-Frequency Spinal Cord Stimulation for Pain Management in Refractory Ankylosing Spondylitis: A Case Report

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Background: Ankylosing spondylitis (AS) affects men more than women and commonly results in chronic back pain with spine and sacroiliac joint involvement.

Case Report: The patient is a 53-year-old man with a 25-year history of worsening AS. After not responding to available conservative therapies and not qualifying for back surgery, the patient underwent a 10-kHz high-frequency spinal cord stimulation (HF10 SCS) trial. After a successful trial without complications, permanent implantation was pursued with subsequent one-week postoperative outcomes demonstrating Visual Analog Scale score reductions of 87.5% in back pain and 50% in leg pain, an Oswestry Disability Index score decrease of 83%, and overall improvement in previously problematic health concepts on the EuroQol-5 Dimensions-3 Levels and 36-Item Short Form version 2 surveys.

Conclusions: This report highlights the successful use of Senza's SCS system applying Nevro's HF10 therapy in a patient with refractory symptoms of AS, highlighting potential applications of this technique which have yet to be studied.

Key words: Ankylosing spondylitis, high-frequency spinal cord stimulation, chronic pain, back pain, case report

BACKGROUND

Axial spondyloarthritis (axSpA) is a family of diseases that include radiographic axSpA, such as ankylosing spondylitis (AS) or nonradiographic axSpA (e.g., reactive arthritis and psoriatic arthritis). Clinical manifestations include chronic back pain with involvement of the spine and sacroiliac joints, commonly before the age of 45. AS data display a prevalence of 1.29/1000 in a Caucasian population, whereas AS occurred less frequently in African Americans. The United States estimates for the prevalence of AS in men ≥ 25 years old is 7.3/1000, women ≥ 50 years old is 3.0/1000, and overall is 5.2/1000 (1,2).

Initial treatments for symptomatic AS include patient education, exercise, physical therapy, smoking cessation, depression screening, and nonsteroidal anti-inflammatory drugs (NSAIDs). If NSAIDs are inadequate and contraindications, such as latent tuberculosis are simultaneously excluded, tumor necrosis factor-alpha inhibitors or anti-IL-17 monoclonal antibody therapies can be prescribed (3).

Few data are available regarding spinal cord stimulation (SCS) as a potential treatment option for refractory AS. Two case reports (4,5) have published positive outcomes using traditional SCS for chronic back and leg pain symptoms in patients with AS. However, there are no reports on the use of high-frequency SCS in AS thus far.

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CASE DESCRIPTION

This case focuses on a 53-year-old man with a past medical history of smoking, hyperlipidemia, well-controlled asthma, chronic back pain, and history of AS. The patient had a > 20-year history of gradually worsening pain in the middle to lower back which would intermittently radiate to the bilateral lower extremities. On physical exam, the patient had tenderness to palpation in the lumbar midline and paraspinal area in addition to a positive bilateral facet loading test, a positive bilateral flexion abduction external rotation test, and pain on forward flexion at 80° and extension at 20°. Imaging studies included a lumbar magnetic resonance imaging showing mild lateral recess narrowing on the left at L5/S1.

The patient had failed to respond to multiple treatments for AS including physical therapy, NSAIDs, and biologics. In addition, he had lumbar epidural steroid injections (ESIs) with pain relief on the first injection, but no relief on the second injection. The patient also had no relief with a lumbar medial branch block (MBB) and was not a candidate for surgery after completing neurosurgical evaluation. With his back pain gradually becoming worse after failing to respond to almost all methods of conservative treatment and a growing dependence on taking hydrocodone/acetaminophen combined pills for pain relief, the decision was made to trial 10-kHz high-frequency (HF10) SCS.

After a 7-day trial period, the patient reported no complications and a > 80% reduction in back pain with a much-improved quality of life and ability to more easily perform daily activities. Based on these positive results, a thorough discussion of the risks and benefits of HF10 SCS implantation was held with the patient, and a joint decision was made to pursue the procedure.

On the day of permanent implantation, Senza's SCS system applying Nevro's proprietary HF10 therapy was used, with lead placement at the top of the T8 and T9 vertebral bodies (Fig. 1).

During his one-week postoperative visit, the patient endorsed significant improvement in his chronic pain levels, with Visual Analog Scale (VAS) score reductions of 87.5% in back pain and 50% in leg pain (Table 1). His Oswestry Disability Index (ODI) score decreased by 83%, and the severity of problems rated on the EuroQol-5 Dimensions-3 Levels (EQ-5D-3L) questionnaire decreased from moderate to none in the areas of mobility, usual activity, and pain/discomfort (Fig. 2). The patient's self-perception of health and well-being as demonstrated by the 36-Item Short Form Health Survey version 2 (SF-36v2) showed improvements in all health concepts, including physical functioning, energy/fatigue, pain, and emotional well-being (Table 2).

DISCUSSION

Traditional SCS involves relief of neuropathic pain through both spinal and supraspinal mechanisms. These mechanisms include wide dynamic range neuron suppression in the dorsal horn of the spinal cord, large A-beta fiber activation, and the participation of descending inhibitory pathways. The depolarization of these A-beta fibers generate paresthesias which then inhibit small, painful nerve fibers, such as A-delta and C fibers. These paresthesias are then directed to predetermined areas, providing pain relief (6,7).

As demonstrated with the PROCESS trial (7), traditional SCS has been shown to produce a greater, sustained reduction in neuropathic leg pain in patients with failed back surgery syndrome compared to conventional medical management. However, limitations of this treatment continue to exist, including limited reduction in chronic, low back pain due to difficult paresthesia coverage of this area.

In comparison, HF10 SCS is paresthesia-free and does not appear to involve supraspinal mechanisms. It typically involves application of HF (10 kHz) pulses of lower amplitude and shorter duration directed to the T8-T11 epidural space. More recently, the results from the landmark SENZA-Randomized Controlled Trial study were published (6,8), showing long-term superiority of HF10 SCS compared to traditional SCS. The 2-year-long study demonstrated a sustained, increased reduction in both lower back and leg pain in HF10 therapy patients with no significant increase in serious adverse events or neurological deficits compared to the traditional SCS group.

This case report demonstrates the effectiveness of HF10 SCS implantation in a patient with unremitting symptoms of AS. The decision to pursue HF10 SCS implantation was supported by multiple reasons. The patient had exhausted all conservative management options and had a failed lumbar ESI and lumbar MBB, but was not an appropriate candidate for back surgery. Subsequently, he was continuing to have worsening chronic mid- to low-back mechanical and radicular pain affecting his daily functioning. With the results from the SENZA-RCT study (6) showing greater back and leg pain reduction with HF10 therapy than traditional SCS, an HF10 SCS trial was pursued with the patient's consent. The HF10

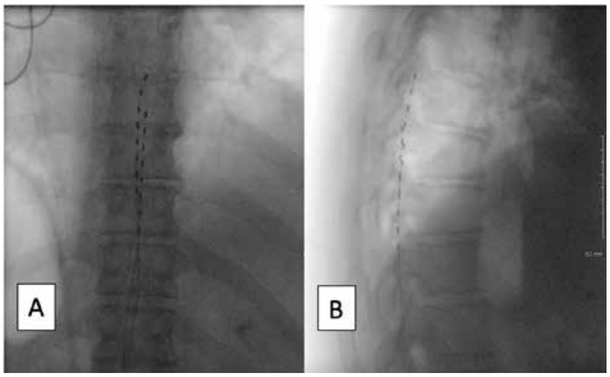

Fig. 1. Lead Placement, A (anterior) and B (lateral) views. Intra-operative fluoroscopy images demonstrating placement of 10-kHz high-frequency spinal cord stimulator leads at the top of the T8 and T9 vertebral bodies.

Table 1. Pain and Functional Disability Levels

Pain Assessment	Preoperative	1 Week Follow-up
Oswestry Disability Index Score	36%	6%
Visual Analog Scale Score (Back Pain)	8	1
Visual Analog Scale Score (Leg Pain)	4	2

SCS trial proceeded without complications, with much improvement in pain scores and quality of life. Weighing in all these factors, there was clearly increased benefit over risk of performing permanent implantation.

At the patient's one-week postoperative follow-up, positive outcomes were reported using the same assessments that were previously completed preoperatively. The VAS, ODI, EQ-5D-3L, and SF-36v2 demonstrated improvements in all aspects of the patient's life including pain and functioning, as well as his self-perception of his overall health. In addition, he endorsed decreased intake of oral pain medications, such as the hydrocodone/acetaminophen pills he was taking preoperatively. Although the patient endorsed only positive outcomes with no complications at the one-week postoperative mark, longer term follow-up of outcomes beyond this time frame would allow a better assessment of the sustained effects from the implantation.

Fortunately, the patient in this case report was able to maintain his job despite gradually worsening back pain and was more easily able to complete his required duties at work after SCS implantation. The socio-economic impact of disease is becoming a greater topic of interest, and AS is no exception. In patients with AS, the economic impact of the disease can be significant despite its lower prevalence due to its relatively early onset in life and progressive course. Older age at diagnosis, lower educational level, worse physical function, and greater fatigue are associated with lower employment and higher work disability, with the cost of lost productivity being the greatest contributor to the cost of illness overall (9). Therefore, HF10 SCS implantation could have far-reaching effects beyond just the individual level.

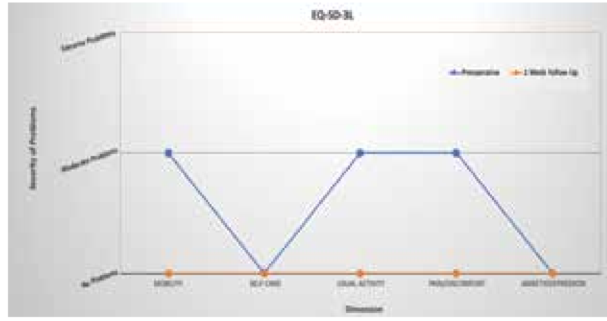

Fig. 2. Quality of Life.

Table 2. Self-Perception of Health and Well-Being

SF-36v2		
Health Concepts	**Preoperative**	**1 Week Follow-up**
Physical Functioning	60	90
Role limitations due to physical health	50	87.5
Role limitations due to emotional problems	100	100
Energy/Fatigue	62.5	75
Emotional well-being	90	95
Social Functioning	50	100
Pain	35	77.5
General Health	45	50
Health Change	25	100

Although there is still much to be studied regarding the underlying mechanisms of HF10 SCS and its therapeutic potential for a wide variety of chronic back and leg pain etiologies, this case report further elucidates its ability to treat AS-specific pain patterns that may not be well-controlled by medical management or traditional SCS alone.

CONCLUSIONS

Despite limited research available on the application of HF10 SCS in patients with AS, this case report highlights its potential utility in these patients with classical axSpA pain patterns. Because HF10 SCS therapy has been shown to have a greater impact on lower back and leg pain than traditional SCS, it could be a potential treatment modality for previously hard-to-treat lower back pain, such as in the patient described. Relief of chronic back and leg pain disorders, such as AS, also has implications beyond just improved physical, mental, and emotional health. There are economic considerations as well, such as decreased direct and indirect costs from reduced AS-related work disability and sick leave. Further studies are needed to fully understand the longer-term effects and range of applicability of HF10 SCS in treating chronic pain diagnoses.

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