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A staged approach to treating chronic low back and radicular pain: Basivertebral nerve ablation in conjunction with surgical decompression: A case report

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ABSTRACT

Low back pain is the leading cause of disability worldwide and the course of treatment patients and clinicians pursue to help alleviate it can be difficult at times. When conservative approaches fail, patients may ultimately require surgical intervention. In the presence of predominant axial back pain of discogenic and/or vertebrogenic origin without deformity or spinal instability, fusion surgery is less likely to reliably result in an optimal outcome for the patient. Literature is growing in support of vertebrogenic pain as a primary etiology of axial low back pain, with the degenerated vertebral endplates and their associated basivertebral nerve as a therapeutic target. Intraosseous basivertebral nerve ablation is a minimally invasive treatment for treating chronic, axial low back pain that is attributed to pathologically degenerated vertebral endplates that has been shown to significantly improve pain and overall function in patients. Furthermore, patients with predominantly axial low back pain with associated neuropathic lower extremity pain can benefit from a staged approach utilizing intraosseous basivertebral nerve ablation in conjunction with traditional decompressive surgery.

1. Introduction and background

Low back pain is the leading cause of disability worldwide and the course of treatment patients and clinicians pursue to help alleviate it can be arduous and discouraging at times. When conservative approaches such as physical therapy, analgesic medications and injections fail, patients may ultimately require surgical intervention.

Traditional decompressive spine surgery is highly effective for radicular or claudicatory limb pain from spinal nerve root compression, but in the presence of predominant axial back pain from disc and/or endplate origin without deformity or spinal instability, fusion surgery is substantially less likely to reliably result in an optimal outcome for the patient [1]. Current evidence-based options for interventional spine procedures are limited when it comes to targeting the axial component of anterior column pathology. However, literature is growing in support of vertebrogenic pain as a primary etiology of axial low back pain, with the degenerated vertebral endplates and their associated basivertebral nerve (BVN) as a therapeutic target.

The *BVN*, a branch of the sinuvertebral nerve, runs along the basivertebral vascular plexus and courses through the basivertebral foramen, located midline in the posterior aspect of the vertebral body [2]. It then travels anteriorly through the posterior half to one third of the vertebral body where it then splits and distributes fibers in a cephalad and caudad direction towards the vertebral endplates (Fig. 3). This junction at which the BVN splits to branch in a cephalad and caudad trajectory is the target site for ablation of the nerve [2]. The BVN plays a major role in the transmission of nociceptive input to the vertebral endplates and the substances transmitted include inflammatory and pain-related factors such as substance P, calcitonin gene-related peptide (CGRP), and protein gene product 9.5 (PGP 9.5) [3].

The combination of physical degeneration and exposure to inflammatory mediators can lead to changes of the endplates that are visible on magnetic resonance imaging (MRI) as hyper or hypo-attenuated regions in the vertebral body endplates that border the degenerated discs and are known as Modic changes. Modic Type 1 changes represent bone marrow edema and inflammation of the endplate, while Modic Type 2 changes represent bone marrow ischemia resulting in red marrow infiltration by yellow fatty bone marrow. It is postulated that evidence of these Modic changes on diagnostic imaging in conjunction with a concordant history and physical exam, likely indicates low back pain of vertebrogenic etiology [2]. The presence of vertebrogenic back pain with confirmed Modic type 1 or 2 changes on imaging and exclusion of other possible pain generators supports patient candidacy for an ablative procedure such as intraosseous basivertebral nerve ablation.

Intraosseous basivertebral nerve ablation (Intracept®) is a minimally invasive treatment for treating chronic, axial low back pain that is attributed to pathologically degenerated vertebral endplates evidenced by Modic Type 1 and/or 2 changes on magnetic MRI between the L3-S1 levels [4]. Intracept is indicated for patients with axial low back pain greater than 6 months duration with significant pain levels and functional impairment that is refractory to conservative management [5].

Intracept has been shown to significantly improve pain and overall function in patients when compared to sham and standard of care controls in several multicenter and multiyear randomized controlled trials [6]. One study that examined 5-year clinical outcomes reported favorable outcomes for post-ablation patients, with 66 % of patients reporting a greater than 50 % reduction in pain, 47 % reporting a greater than 75 % reduction in pain, and 34 % reporting complete resolution of pain [6]. In addition, BVN ablation also notably reduced the number of future injections and opioid medications [6].

In this case report, we will review the treatment of a patient with predominantly axial low back pain with associated neuropathic lower extremity pain. We will discuss the benefit of intraosseous basivertebral nerve ablation when utilized in a staged approach alongside traditional

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decompressive surgery, with the goal of optimally addressing both his axial lower back pain and leg symptoms.

2. Case presentation

The patient is a 57-year-old male who presented with chronic axial low back pain and associated leg pain. He described the low back pain as constant, aching in quality, 8/10 in severity and the leg pain as right greater than left anterior thigh burning pain with a feeling of generalized weakness in both legs. He reported that the axial pain was worse with prolonged sitting, standing, bending, lifting and limb pain was worse with prolonged standing and walking and relieved with sitting. Furthermore, axial low back pain component was his predominant symptom and accounted for about 70 % of his overall pain, compared to the 30 % from his legs. These symptoms prevented him from performing activities of daily living and exercising.

His lumbar radiographs revealed moderate disc height loss at L3-L4, L4-L5 and L5-S1 with a stable grade 1 retrolisthesis at L5-S1 without instability on flexion/extension. MRI of the lumbar spine (Figs. 1 and 2) revealed mild central, moderate to severe lateral recess stenosis at both L4-5 and L5-S1 and Modic Type 1 endplate changes at both levels.

The treatments the patient received prior to our consultation consisted of physical therapy, chiropractic, various medications including NSAIDs, muscle relaxers, gabapentin, and duloxetine, in addition to multiple epidural steroid injections with transient relief and diagnostic medial branch blocks with negative anesthetic response.

Pertinent findings on physical exam included moderately limited lumbar flexion and extension, no localized facet or sacroiliac tenderness, full pain-free hip range of motion, negative seated straight leg raise and no focal motor, sensory or reflex deficits in either lower limb.

3. Treatment plan & outcome

After evaluation by his orthopedic spine surgeon and interventional pain specialist, the decision was made to pursue a collaborative treatment plan. In a staged approach, the original plan was to first undergo basivertebral nerve ablation for the dominant axial symptoms, followed by surgical decompression to address the limb symptoms. Due to a prolonged insurance appeals process for basivertebral nerve ablation, the decompression was performed first.

Fig. 1. Modic I endplate changes at the L4-5 and L5-S1 levels in sagittal view on T2 MRI.

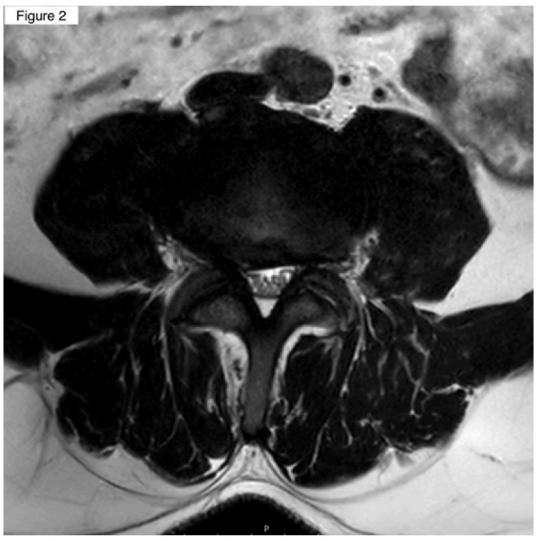

Fig. 2. Central and lateral recess stenosis at L4-5 in axial view on T2 MRI.

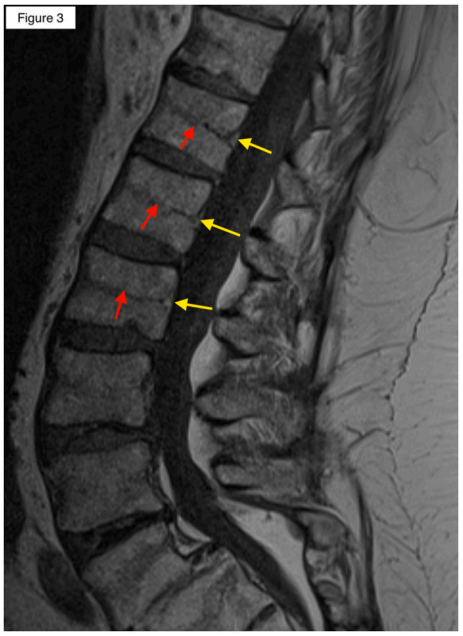

Fig. 3. Distribution of the basivertebral nerve (red arrows) and foramen (yellow arrows) (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article).

The first intervention was a right L4-L5 and a left L5-S1 hemilaminectomy. At his post-operative evaluation one month later, he reported complete relief of his leg symptoms. At subsequent evaluation 4 months later, he reported continued relief of his leg symptoms but no improvement in the severity of his axial low back pain and continued to have 8/10 pain with prolonged sitting, standing, bending, and lifting.

The second intervention was a basivertebral nerve ablation at L4-S1 via the Intracept procedure performed 6 months later, which was shortly after insurance approval was obtained after the lengthy appeals process. At his first post-operative evaluation 2 weeks later, he reported mild low back pain that he rated as a 4/10 in severity, as compared to 8/10 in

severity at initial and second follow up evaluation. At his 3-month post-operative evaluation, his low back pain was rated 0–1/10 in severity, with an overall greater than 90 % reduction in axial low back pain and continued complete resolution of his leg symptoms. He was also able to resume all activities of daily living and exercise without an increase in pain and discontinued all pain medications.

4. Discussion

The patient was treated successfully utilizing a staged, two-prong approach and experienced substantial improvement in both his axial low back pain and leg symptoms. He was able to return to his desired activity and exercise levels without pain or limitations, which greatly improved his quality of life. This outcome would not have been possible with either procedure in isolation.

Future research focusing on staged approaches such as this with BVN ablation for the axial pain and decompression for the limb pain will be important to help both patients and physicians with traditionally treatment-resistant mixed pathology such as this. Persistent axial back pain after spine surgery can be an ongoing problem for many patients, with some estimates of approximately 20–40 % of patients reporting worsening or no change in low back pain up to 1–2 years after surgery [7]. In select clinical scenarios with appropriate patient selection, planning a staged approach earlier in the patient's course could help avoid persistent post-operative and chronic axial low back pain.

With further exploration, this two-step approach of surgical decompression and BVN ablation may prove to provide superior therapeutic benefit to those suffering from similar combinations of chronic axial low back pain and claudicatory or radicular leg pain, than either treatment alone. Despite the potential to provide superior therapeutic benefit, it remains imperative that adequate time is given after decompression to best assess the results of decompression alone.

5. Conclusion

Given this patient's mixed presentation, it was unlikely likely that spinal decompressive surgery, with or without fusion, would adequately reduce both the patient's axial-predominant low back and claudicatory leg symptoms. Likewise, basivertebral nerve ablation would not have addressed his neuropathic limb pain. However, with this staged approach, the patient obtained near-complete resolution of both issues, and was able to resume his regular activities with little to no pain. This combination should be further studied and considered for this mixed clinical entity to optimize patient outcomes.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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