

# Safe and effective intraosseous basivertebral nerve radiofrequency neurotomy in a patient with a permanent pacemaker

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## ABSTRACT

**Introduction:** Intraosseous basivertebral nerve radiofrequency neurotomy is a fairly novel technique which is currently considered contraindicated in patients with an implanted pacemaker. Re-evaluation of this restriction is important given the comorbidity of chronic low back pain and cardiac disease.

**Case:** A 78-year-old male with chronic low back pain (CLBP) that had failed both conservative and operative management with work-up including MRI spine suggestive of vertebrogenic low back pain. Patient agreed to undergo this procedure using a magnet to convert the active pacemaker to asynchronous pacing, resulting in fixed ventricular rate, perioperatively. The procedure was accomplished successfully with sustained improvement of his CLBP at six months follow up.

**Conclusion:** This is the first published case demonstrating successful intraosseous basivertebral nerve radiofrequency neurotomy in a patient with a permanent pacemaker with appropriate precautions.

## 1. Introduction

Chronic low back pain (CLBP) is a prevalent and expensive issue that has been estimated to cost an estimated \$100 billion in US healthcare costs annually [1]. Radiofrequency ablation or neurotomy (RFA) targeting specific pain generators has been shown as an important adjunct to the management of CLBP, but its use is complicated by limited clinical data about the risk for electromagnetic interference (EMI) with cardiovascular implanted electronic devices (CIEDs) [2]. Though itself subdivided into a number of often-comorbid pathologies, CLBP as a general category disproportionately affects the elderly, having been estimated to display greater than 30 % prevalence in community-dwelling US adults older than 60 years old [3]. The increased prevalence of CIED requirement as the population ages [4] is particularly salient given chronic pain and cardiac disease are known to be comorbid conditions [5]. Though bipolar radiofrequency neurotomy and electrocautery is generally considered to be safer than monopolar applications in individuals with a CIED and has been safely utilized to manage zygapophysial (facet) joint pain in the CLBP population [6,8], there has not been any published research or case series demonstrating its safe application in intraosseous basivertebral nerve bipolar radiofrequency neurotomy for the

management of vertebrogenic back pain. The present case report demonstrates successful and safe application of this technique in a 78 year old patient with an active implanted permanent pacemaker and therefore represents a meaningful contribution to the pain management literature.

## 2. Case report

The patient is a 78-year-old male with a cardiac history including coronary artery disease and symptomatic bradycardia status post dual chamber permanent pacemaker placement with a history of greater than 10 years of chronic low back pain that only partially responded to PT, chronic opioid therapy, lumbar spinal injections, as well as bilateral L3-L5 laminectomies and foraminotomies with non-instrumented in situ fusion in January 2021. He initially presented to our office in September 2021 with persistent and generally constant achy right low back pain that radiated into the right groin. Physical examination revealed pain in all planes of motion, pain with axial loading, absent bilateral ankle and medial hamstring reflexes, difficulty with bilateral heel raises, and a wide-based antalgic gait. After trying multiple medication regimens with limited benefit and based on initial physical examination and

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diagnostic work-up including lumbar spine MRI and x-rays, he underwent a lumbar epidural in Feb 2022, lumbar spinal cord stimulator trial in June 2022 and an L3-L5 intradiscal steroid injections in Feb 2023. Unfortunately, he only had 50 % relief with the intradiscal steroid injection for approximately 4–6 weeks. We subsequently obtained an updated lumbar spine MRI in September 2023 demonstrating progressive scoliosis with apex at L3, multi-level degenerative disc disease and z-joint DJD, stable grade 1 anterior spondylolisthesis of L3 on L4, multi-level foraminal stenosis as well as type 2 Modic changes at L3-S1 (see Figs. 1-3).

Given that he had low back pain greater than 6 months, did not readily respond to conservative care options for greater than 6 months, had type 2 Modic changes at L3-S1 on his MRI, and had symptoms with consistent with anterior column-element pain, one of our main diagnoses was vertebrogenic low back pain. His symptoms included pain with walking greater than 50 yards, standing greater than 3–5 minutes but, in particular, sitting greater than 10 minutes and bending forward. Preoperative cardiac clearance was obtained from the patient's cardiologist with a recommendation to place a magnet over the patient's pacemaker to convert it to fixed ventricular rate asynchronous pacing to minimize the potential for electromagnetic interference (EMI) during the case. He underwent L3-S1 intraosseous basivertebral nerves radiofrequency neurotomy (RFN) in September 2023 without any issues. Post-procedure EKG monitoring demonstrated no issues. The patient did follow-up with his cardiologist, and there were no reported pacemaker issues.

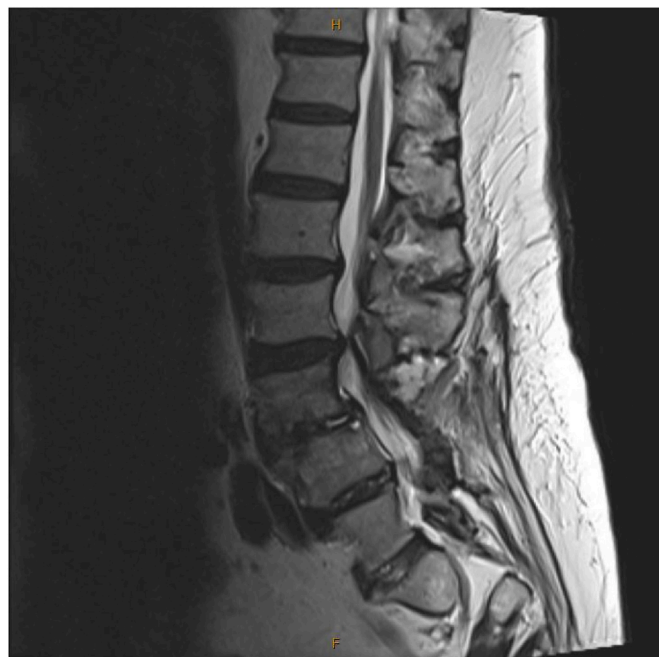
The patient did follow-up two weeks after the procedure, and he reported 50 % relief of his typical low back pain that was persistent at the six month follow-up with no interval complications or malfunctions of his pacemaker.

### 3. Discussion

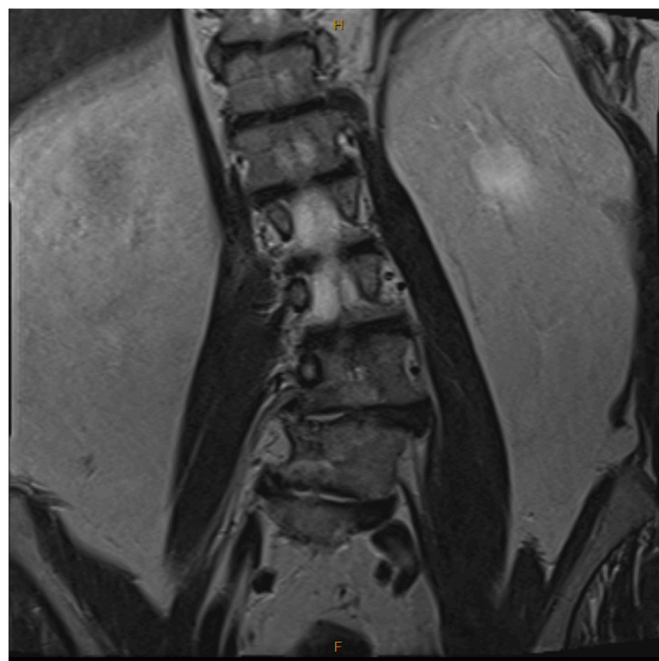
Our case is a novel demonstration of the safe application of bipolar RFN for intraosseous basivertebral nerve ablation in a patient with a cardiovascular implantable electronic device. The patient endorsed a 50 % reduction of his pain compared to pre-intervention at 6 months which is within the range of benefit achieved by responders to this treatment



**Fig. 1.** Sagittal T1 image demonstrating hyper-intense signal changes in the L3-S1 vertebral bodies.



**Fig. 2.** Sagittal T2 image demonstrating hyperintense signal changes in the L3-S1 vertebral bodies.



**Fig. 3.** Coronal T2 image demonstrating hyperintense signal changes in the L3-L5 vertebral bodies (S1 vertebral body not visualized).

modality [7] with no concomitant cardiac events. Because systematic assessment of the safety of bipolar RFN with CIEDs in the chronic pain population is acknowledged to be limited by current available clinical outcomes data [6], this case represents an important expansion of the literature in the pain management field.

There are three points of discussion with respect to the current body of literature. First, there are suggested guidelines [15], although not firm standards, for preoperative workup or clearance for monopolar radiofrequency neurotomy in a CIED patients. Our case was successful following these guidelines, but further prospective studies would be

beneficial to replicate safety in intraosseous basivertebral nerve bipolar radiofrequency neurotomy (BVRFN). There have been case reports where the magnet application over a CIED led to unexpected negative outcomes [9] that can be mitigated with a multidisciplinary approach [10]. Second, this is the first documented case of intraosseous basivertebral nerve radiofrequency neurotomy being performed safely in a CIED patient, and further studies may be warranted to replicate its safety in this population and other populations for whom the current evidence is limited such as patients with implanted deep-brain stimulators in Parkinson's Disease. Finally, there may be inherent aspects to this procedure as distinct from other chronic pain applications of radiofrequency that have positive bearing on its safety in the CIED patient population. With use of radiofrequency neurotomy, it has been demonstrated that the intact cortex can potentially act as insulating barrier against adjacent neural injury as long as the needle is not abutting the cortex [11–14]. In addition, bipolar technology may be safer than other ablation techniques because they form smaller, more precise, and more predictable zones of ablation [13].

These three points amongst others are worthy of further consideration and research and highlights the importance of this case given the current landscape of CLBP and its increasing prevalence in the world-wide population.

#### 4. Conclusion

This is the first published case demonstrating the safe application of bipolar BVRFN for a patient with an active cardiovascular implantable electronic device with appropriate preoperative and perioperative considerations. The pacemaker was set in asynchronous mode as per FDA contraindication. Current guidelines suggest the presence of an active pacemaker is a contraindication to BVRFN. Intraosseous basivertebral nerve RFN is performed with bipolar energy. Bipolar energy has been safely demonstrated in other applications with CIEDs, but the literature is limited. This case displays the need for further investigation to determine the safety of bipolar BVRFN in cardiac pacemakers and other implanted neurostimulators.

#### Declarations

No funding was received for this case study. The authors have no financial or proprietary interests in any material discussed in this article. The authors do not have any competing interests to disclose. The LifeBridge Health, Inc. Institutional Review Board approved this project in the non-human subject research category based on the review and application of 45 CFR 46.102(d) and (f). In preparation for this case report, the authors followed the CARE guidelines and obtained written informed consent from the patient to participate and publish. All data generated for this study are included in this published case report. All authors contributed to the case report's content and design. Data collection and analysis were done by both authors. The first draft of the manuscript was written by Dr. Thomas S. Lee and Dr. Azeem Ahmad. All authors commented on and revised all previous versions, and all authors

read and approved the final manuscript.

#### 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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