

BIPOLAR RADIOFREQUENCY ABLATION OF CERVICAL MEDIAL BRANCHES IN A PATIENT WITH A DEEP BRAIN STIMULATOR: A NOVEL TECHNIQUE TO AVOID DEVICE INTERFERENCE

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Background: We describe the successful use of bipolar radiofrequency ablation (RFA) of the cervical medial branches in a patient with a deep brain stimulator (DBS).

Case Report: The patient had Parkinson's disease that was well controlled with DBS and presented with chronic right-sided neck pain. After 2 positive diagnostic medial branch blocks at C3-C5, he was considered for RFA. However, given the risk of damaging the DBS system with standard monopolar RFA near the cervical spine, we used bipolar RFA with paired electrodes at each level. The patient experienced complete resolution of his neck pain without disrupting his DBS function.

Conclusion: Our case highlights a safe and effective alternative to monopolar ablation in patients with implanted neuromodulation devices and adds to the limited literature on bipolar RFA in the cervical spine.

Key words: Bipolar, radiofrequency ablation, cervical, medial branches, deep brain stimulator, neck pain

BACKGROUND

Radiofrequency ablation (RFA) is a minimally invasive procedure that uses electrical currents to generate thermal energy, creating a controlled lesion in targeted nerves to interrupt pain signals (1). It is commonly used for pain that originates from innervated anatomical structures. It is an established treatment for chronic facet-mediated neck pain, cervicogenic headaches, occipital neuralgia, and certain types of migraines (1,2). Cervical facet joints are a frequent source of chronic neck pain, and the use of cervical RFA has increased significantly in recent years. Current guidelines recommend its use in patients with consistent pain relief after diagnostic medial branch blocks (1,3).

The standard monopolar RFA technique is generally

effective. Still, in patients with deep brain stimulators (DBSs), there is a potential risk that the electrical field generated during ablation could cause heating or interfere with the device leads. In monopolar RFA, current enters the patient through an active electrode, travels through the body, and exits via a dispersive ground electrode. This wide current path can create a regional electromagnetic (EM) field that may interact with implanted devices (4,5). To reduce this risk, the neurostimulator should be turned off before the procedure, and bipolar RFA may be considered (1,6). In bipolar RFA, current flows between 2 closely spaced electrodes at the ablation site, producing a localized EM field with minimal spread. This design substantially reduces the

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theoretical risk of electromagnetic interference (EMI) compared to monopolar RFA (5,7). Although bipolar RFA has been used in lumbar procedures, its use in the cervical spine for patients with DBS has not been well described. This report, therefore, describes a case in which bipolar cervical RFA was performed safely and successfully in a patient with a DBS, providing a practical alternative to monopolar ablation in this situation.

CASE PRESENTATION

A 42-year-old male patient with a 22-year history of Parkinson's disease, depression, anxiety, and chronic pain issues, which had been difficult to manage medically, underwent successful DBS implantation and experienced reasonable control of his symptoms. He was taking apomorphine (Onapgo), injections for advanced Parkinsonian symptomatology, carbidopa/levodopa, and venlafaxine. His DBS was implanted 4 years ago. He later presented to our clinic with chronic right-sided neck pain consistent with facet-mediated pain. After 2 diagnostic medial branch blocks at the right C3-C5 levels, both of which provided complete but temporary relief, RFA was recommended. However, due to the proximity of the cervical medial branches to his DBS leads and generator, standard monopolar RFA posed a risk of damaging the device or disrupting its function. To minimize this risk, the patient was instructed to turn his DBS off before the procedure, and bipolar RFA was performed using 2 cannulas at each level to create targeted lesions, while limiting electrical spread (Figs. 1 and 2). Bipolar lesioning was performed at 80°C for 90 seconds. Sensory and motor testing was performed ≤ 2 V before the lesioning. The procedure was uneventful, and at follow-up, the patient reported complete resolution of his neck pain with no changes to his DBS settings or function.

DISCUSSION

Monopolar RFA creates a wide electrical field that can interfere with implanted devices, primarily when the procedure is performed in the head and neck area. DBS systems are being used more often to treat conditions, such as Parkinson's disease, dystonia, essential tremor, epilepsy, and some psychiatric disorders. These systems include leads placed in specific brain areas, most commonly the subthalamic nucleus, connected by an extension wire to an implantable pulse generator (IPG) typically located in the chest (8,9). The IPG delivers electrical stimulation that can be adjusted by changing

settings, such as amplitude, frequency, and pulse width (9,10).

During RFA, EMI can travel through the DBS system and cause it to malfunction, deliver unintended stimulation, or even permanently damage it. This can result in the need for reprogramming or hardware replacement. Patients may also experience uncomfortable sensations, such as jolting or shocking, if the device is activated inappropriately (9,11). EMI from RFA treatments may be transmitted to implanted DBS devices. Delivery of excess electrical energy through the leads can potentially cause neurolytic changes, resulting in severe injury or even death. Clinically, patients may describe "jolting" or "shocking" in cases of increased stimulation. Further, EMI can cause system damage or reset, requiring reprogramming or surgical replacement. Thus, to reduce these risks, the DBS should be turned off or set to surgery mode before starting RFA, and the grounding pad should be placed as close as possible to the treatment site (1,6).

Bipolar RFA is not commonly used to treat facetogenic pain as a first choice. Monopolar RFA is primarily used with precise needle positioning and larger lesions with the current available technology. Bipolar RFA has only been reported previously in the presence of pacemakers and automatic implantable cardioverter-defibrillators.

Bipolar RFA may be safer in these patients because the current flows only between 2 closely spaced electrodes, creating a smaller and more focused electrical field. This lowers the chance of affecting the DBS hardware (9,12). Although bipolar RFA has been used in the lumbar spine, there are very few reports of its use in the cervical spine in patients with DBS. Our case adds to the small amount of published evidence. It shows that bipolar cervical RFA can be performed safely when proper precautions are followed, including preoperative device management, careful current localization during the procedure, and postoperative device checks.

There are some limitations with our case report. This is a single case, short-term follow-up only. Future directions can include multicenter registry, safety guidelines, or in vitro studies testing DBS interference.

CONCLUSIONS

Our case demonstrates that bipolar cervical RFA can be a safe and effective treatment for facet-mediated neck pain in patients with implanted DBS systems when appropriate precautions are taken. By localizing the electrical field between 2 closely spaced electrodes, bi-

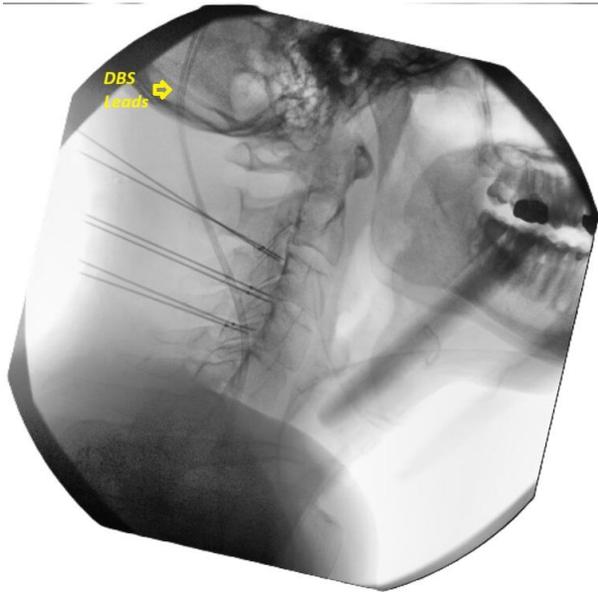


Fig. 1. Lateral view showing 2 cannulas at each level, C3-C5, in close proximity to the DBS leads, consistent with best practice standards. DBS, deep brain stimulation.



Fig. 2. The contrast-lateral oblique view demonstrates 2 cannulas posterior to the C3-C5 neuroforamina in close proximity to the DBS leads. DBS, deep brain stimulation.

polar RFA reduces the risk of EMI and potential damage to neuromodulation hardware. Although monopolar RFA remains the standard technique, its use near DBS leads can carry theoretical and practical risks. Given the increasing prevalence of DBS implantation and the limited literature addressing RFA in this population,

this report adds valuable clinical evidence supporting bipolar RFA as a viable alternative in select cases. Further studies are needed to develop standardized safety guidelines and confirm the long-term outcomes of this approach.

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