Introduction

The chronic pain management has always been a great challenge for physicians. Pharmacological therapy has not provided good effectiveness rates in this type of pain, and the usefulness of this therapy is limited by the side effects in many cases. This has led to the search for other alternatives for the chronic pain management. Radiofrequency rhizolysis is one of the most commonly used interventional procedures for pain relief in patients with trigeminal neuralgia. It aims to interrupt the impulses of the nerves that transmit painful sensations. Although it is an effective procedure, it is not free of complications [1].

Since the 1980s, a growing number of patients with implantable cardioverter defibrillators and pacemakers have come to pain management clinics for evaluation and treatment. The presence of these devices makes some therapy and procedures difficult due to the electromagnetic interference generated by such devices [2].
Despite technological advances, pacemakers are still susceptible to electromagnetic interference in ranges from 0 to 109 Hz. Radiofrequency is included in this range. Different responses may result from this interaction, including inhibition or damage to electrical components [2]. For this reason, these devices must be deactivated or reprogrammed before some procedures, especially if the patient is dependent on them [2,3]. There are no specific guidelines for the use of radiofrequency in patients with pacemakers and, in general, the same considerations as those used with the electro-surgical scalpel are followed. This work makes a contribution to the experience in the management of patients with trigeminal neuralgia who require RF therapy of the Gasserian ganglion and patients with an electronic cardiac stimulation device.

**Study Description**

A report of two patients from the Pain Clinic Services, Hospital Centro Médico Nacional 20 de Noviembre, Mexico City, with cardiac pacemakers, trigeminal neuralgia secondary to herpes zoster and neuropathic pain refractory to conventional treatment was made.

**Clinical Case 1**

89-year-old female with neuropathic pain in the (V1, V2 and V3 branches) right hemifacial region secondary to herpes zoster, of a 1 year of development. The patient reported a Visual Analog Scale (VAS) pain score of 8/10, little response and tolerance to the medications at 4 months of follow-up. It was decided to schedule the patient for a right Gasserian ganglion block with RFP.

The patient had a cardiac pacemaker, so the cardiac electrophysiology service’s staff is asked to make an assessment to the patient. This staff performed the reading and review of the device, providing the following data: Boston Scientific™ bicameral pacemaker, which was programmed in DDD mode, with a baseline radiofrequency of 50 bpm and maximum radiofrequency 130bpm, 82% atrial pacing and 100% ventricular pacing. It was concluded that the patient is dependent on the pacemaker, it was suggested to reprogram the pacemaker to (DOO) asynchronous mode prior to the procedure. Patient underwent sedation and non-invasive monitoring. Under fluoroscopic guidance, the oval hole was located and a 10-cm 22-gauge RF needle with 10mm active tip was inserted to the Gasserian ganglion. Correct location of the needle was verified by motor and sensory stimulation at 2 and 50 Hertz, respectively in the 3 branches. 2 cycles of pulsed radiofrequency (RFP) were performed for 120 seconds at 42°C in each right trigeminal branches V2 and V3. During the procedure, a slight interference was observed in the ECG trace without repercussions on hemodynamic stability. The patient reported pain reduction with a VAS score of 2/10. Pain intensity remained in control one month after the procedure with a VAS score of 2/10. No complications were reported and pharmacological treatment was reduced.

**Discussion**

The electronic devices for cardiac stimulation (pacemakers, cardiac defibrillators, and cardiac synchronizers) are prone to suffer electromagnetic interference generated in other devices. RF, which has been used in many pain management procedures for more than 50 years, generates this interference. This interference may vary from an unjustified cardiac stimulation, reprogramming, or even a complete inhibition of the pacemaker. In addition, this interference may produce heating of the electrode causing myocardial damage and raising the thresholds of stimulation and sensing [1].

In 2014, Barbieri published a cohort of 30 patients with implanted devices including pacemakers, cardiac defibrillators and spinal stimulators, who underwent different radiofrequency neurotomy procedures for the treatment of chronic pain. In this cohort, no patient had RF interference with the device. Patients...
with RF of the Gasserian ganglion were not included and most of the procedures were performed in the lumbar and sacral region [4]. In the literature, one case report [5] was found only, in which a rhizotomy of the Gasserian ganglion was successfully performed in a patient with atrial fibrillation who bearing a pacemaker. The authors suggest taking the necessary precautions such as reviewing and reprogramming the device before the surgical procedure, locating the pad as far as possible from the pacemaker and adequately monitoring the patient during the surgical procedure.

The cases we reported were carried out in a safe and successful manner following the recommendations from the guidelines of cardiology societies in pacemakers and cardiac stimulation devices. Although a slight interference caused by RF therapy was observed in the cardioscope tracing during the procedure, such interference was not of clinical relevance nor did it cause hemodynamic alterations in the patients. At the end of the surgical procedures, the devices continued to function properly. Based on our experience and in the review of the literature, we can suggest that patients with electronic cardiac pacing devices, who benefit from an interventional treatment for pain with RF, either conventional or with pulsed RF, should be assessed as a whole in the preoperative period by the cardiology/electrophysiology services and determined whether or not they require the device to be reprogrammed. In the case of pacemakers, this is determined taking into account whether the patient is dependent on it or not. The pacemaker of device-dependent patients must be programmed in an asynchronous mode (AOO/VOO/DOO) and non-dependent patients can be submitted to the procedure with adequate monitoring during the intraoperative, such monitoring could be more rigorous according to the clinical condition of the patient. The cardiopulmonary resuscitation equipment and specifically the percutaneous cardiac pacing pads should always be available in case of an emergency.

If monopolar RF is used, the plate should be located as far as possible from the device to reduce interference. Thanks to the fact that bipolar RF reduces and decreases the dispersion of energy between two needles, it may be indicated and be an interesting alternative in procedures where anatomy allows its use [6]. Unfortunately, it is not yet available in many places and in procedures, such as those reported by us, anatomy would limit its use. After the procedure, the patient must be evaluated and device should be reprogrammed to the initial mode. As a conclusion, we found that the radiofrequency used in the procedures for the relief of chronic pain, generates electromagnetic interference with the electronic cardiac pacing devices and the unawareness of this problem may generate a damage in these devices or interference in their operation with fatal consequences for the patient. Proper preparation and knowledge of the type of cardiac stimulation device are essential to safely and effectively perform this interventional procedure.

**Conflict of Interest**

The authors declare that they have no conflicts of interest.

**References**

1. Sluiter M, Racz G (2002) Technical Aspects of Radiofrequency. Pain Practice 2(3): 195-200.
2. Brignole M, Auricchio A, Barón Esquivias G, Bordachar P, Boriani G, et al. (2014) Guía de práctica clínica de la ESC 2013 sobre estimulación cardíaca y terapia de re sincronización cardíaca. Rev Esp Cardiol 67(1): 6-14.
3. Vardas P, Auricchio A, Blanc J, Daubert J, Drexler H, et al. (2007) Guías europeas de práctica clínica sobre marcapasos y terapia de re sincronización cardíaca. Rev Esp Cardiol 60: 1272.e1-1272.e51.
4. Barbieri M, Bellini M (2014) Radiofrequency neurotomy for the treatment of chronic pain: interference with implantable medical devices. Anaesthesiol Intensive Ther 46(3): 162-165.
5. Sun D, Martin L, Honey C (2004) Percutaneous Radiofrequency Trigeminal Rhizotomy in a Patient with an Implanted Cardiac Pacemaker. Anesthesiol Analg 99(6): 1585-1586.
6. Bautista A, Dadabayev A, Rosenquist E (2016) Bipolar Radiofrequency Neurotomy to Treat Neck and Back Pain in Patients with Automatic Implantable Cardioverter Defibrillator. Pain Physician 19(3): E505-E509.