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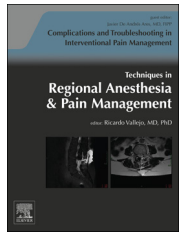

# Radiofrequency techniques: Complications and troubleshooting

*Gisela Roca, MD, PhD*[a,*], *Javier de Andrés Ares, MD, FIPP*[b], *Maria Luisa Franco Gay, MD*[c], *Consuelo Nieto, MD, PhD*[d], *Maria Teresa Bovaira, MD, FIPP*[e]

[a]*Department of Anesthesiology, Hospital Universitari Germans Trias i Pujol, Universitat Autònoma de Barcelona, Badalona, Spain*
[b]*Department of Anesthesiology, Hospital Universitario La Paz, Madrid, Spain*
[c]*Clinica Vizcaya, Bilbao, Spain*
[d]*Department of Anesthesiology, Hospital Universitario Fundacion Alcorcon, Madrid, Spain*
[e]*Department of Anesthesiology, Hospital Intermutual de Levante, Valencia, Spain*

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ABSTRACT

Radiofrequency (RF) is a minimally invasive, target-selective technique that has demonstrated success in reducing pain in several chronic pain conditions. The lack of standard continuous RF ablation protocols for specific targets makes it difficult to compare the percentage of complications of RF between different studies addressing the same pain syndrome. The present article reviews the most frequent complications associated with the most widely used percutaneous continuous RF techniques in pain treatment, and the strategies used to minimize such complications.



## Introduction

Radiofrequency (RF) is a minimally invasive, target-selective technique that has demonstrated success in reducing pain in several chronic pain conditions. However, the growing use of RF is still not based on good-quality evidence. Regarding this, the difficulty in conducting methodologically sound studies is because of problems in assessing chronic pain (a subjective variable) and in obtaining a homogeneous study population, as in many chronic pain syndromes, it is not easy to establish a precise etiological diagnosis. Conversely, evaluation of the balance between the analgesic efficacy and complications of an interventional technique adds both difficulties in designing the comparator arm and bias generated by the experience of the individual performing the technique.[1]

Furthermore, the lack of standard continuous RF ablation protocols for specific targets makes it difficult to compare the percentage complications of RF between different studies addressing the same pain syndrome.

The present article reviews the most frequent complications associated with the most widely used percutaneous continuous RF techniques in pain treatment and the strategies used to minimize such complications.

## Complications related to the circuit

Monopolar RF systems use grounding pads to complete the RF circuit. Thermal injuries at the grounding pad site have been increasingly reported with the use of higher currents

*Corresponding author.
E-mail address: giselaroca@gmail.com (G. Roca).

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and more powerful systems, as in the cooled RF treatment of malignant tumors.[2] The incidence of skin burns has decreased following the publication of the guidelines by Goldberg et al.[3] However, no thermal injuries at the grounding pads have been described within the current ranges used for the RF management of pain.

## Types of RF

Cooled RF ablation is gaining popularity over conventional thermal RF in the treatment of targets characterized by important anatomical variability, as it generates greater thermal injuries and thus increases the probability of successful denervation. Furthermore, the spherical shape of the lesions minimizes the need to position the needle as parallel as possible to the target to optimize the volume of damaged tissue, as in conventional RF ablation.

As cooled RF is comparatively more expensive, there is growing interest in simply using the bipolar circuit to produce lesions of certain target structures equal to or greater than those obtained with cooled RF. However, in this case, we need to use larger caliber needles, with a certain maximum distance between them, and longer RF application times. However, no comparative studies have yet appeared in the literature.[4]

The first case of third-degree burns has recently been reported with cooled RF for the treatment of thoracic facet syndrome[5] (Figures. 1 and 2). In summary, the distance between the target and the skin should be taken into account, particularly in thin patients with little subcutaneous or muscle tissue in selecting both the type of RF and the caliber and active tip of the needle.


**Fig. 1 – Spherical burn 20 mm in diameter encompassing a superficially charred cennter following 3 days after cooled RF. Reprinted with permission from Walega and Roussis.[5]**


**Fig. 2 – A scar of 12 mm in diameter with a 2-mm defect in the skin surface at 20 weeks following cooled RF. Reprinted with permission from Walega and Roussis.[5]**

## Electromagnetic field

The protocol for applying RF in patients with a defibrillator or pacemaker is well known to interventional physicians. However, the same cannot be said of other types of implants. In this respect, a recent study has described the unexpected activation of a cervical neurostimulation electrode during RF targeted to the third occipital nerve.[6] As the use of neurostimulators is increasingly becoming widespread, special caution is required when RF electrodes are positioned close to implants of this kind.

## Cranial procedures

### *Trigeminal ganglion RF ablation*

RF ablation of the trigeminal (Gasser) ganglion is a percutaneous technique used to treat trigeminal neuralgia when drug therapy proves ineffective. Although RF has been defined as the first option in most algorithms in elderly patients, ahead of other neuroablation techniques, a critical analysis of the studies published to date shows that there is little evidence on which to base the best surgical option.[7] The most important complications are related to incorrect placement of the needle during extracranial and intracranial approaches to the foramen ovale, which is not always easy to visualize. Some authors have tried to optimize the anatomical references during the procedure. One of the latest attempts in this sense corresponds to the study published by Peris-Celda et al,[8] in which the 40°–45° inferior transfacial, −20° oblique radiographic projection visualized 96.2% of the