

Preventing Skin Burns During Thermal Radiofrequency Neurotomy FactFinder

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Committed to providing helpful information to International Spine Intervention Society members about key patient safety issues, the Society's Patient Safety Committee has developed a FactFinder series. FactFinders will explore and debunk myths surrounding patient safety issues. The intent of this FactFinder is to address prevention of skin burns resulting from thermal radiofrequency neurotomy.

Myth: Placing an electrical dispersive pad on a patient during radiofrequency neurotomy prevents the risk of skin burn.

Fact: The risk of a patient suffering a skin burn during thermal radiofrequency neurotomy is minimized if (a) an electrical dispersive pad is applied correctly at an appropriate distance from the nerve(s) being treated, and (b) the patient is awake and alert so they can report any discomfort at the dispersive pad site.

Though thermal radiofrequency (RF) neurotomy has multiple indications across diverse medical disciplines, minimally invasive tissue destruction is the goal. In pain management, the selective targeting of sensory nerves to prevent nociceptive signals from reaching the brain is well described.¹ Percutaneous thermal RF neurotomy works by denaturing the nerve. Electromagnetic energy is converted to heat by resistive heating. The RF current leaves the body through a large dispersive pad placed on the skin. Dispersive pads are constructed from a conductive metal covered by an adhesive polymer gel to increase the contact surface area between the pad and patient.² The large surface area of a dispersive pad allows RF current to leave the body without increasing the skin temperature to the point of a burn.

Even though the dispersive pad decreases the risk of skin burns, there are case reports of skin burns in the peer-reviewed literature. Skin burns at the site of the dispersive pad during RF neurotomy have been described in the cardiac,^{3,4} interventional radiology,⁵ and surgery⁶ literature.

In an animal model Goldberg *et al.* demonstrated that improper dispersive pad placement could lead to an increased risk of burns.⁷ They identified four variables that can reduce dispersive pad temperature, thereby decreasing the risk of burns: surface area, direction, distance, and material. The first three variables are under the control of the clinician. A dispersive electrode with a larger surface area is less likely to cause a burn. The size of dispersive electrodes is limited to commercially

available products; therefore placing a larger electrode is not possible. The clinician must ensure that the entire electrode is properly attached to the skin. A poorly placed electrode will decrease the surface area available for the exiting RF current and increase the skin's temperature at the current's exit points. A properly placed dispersive electrode should be as far away from the RF needle as possible. The distance between the dispersive electrode and RF needle is inversely related to temperature; therefore increasing the distance between the electrode and needle translates into decreased temperatures at the electrode surface. Finally, placing the dispersive electrode with the longest side facing the RF needle decreases the temperature along the leading edge of the electrode reducing the risk of a burn.

Though an appropriately placed dispersive pad should allow the RF current to leave the body without a burn, temperature-sensing pads have been described in the literature.^{8,9} Though a temperature-sensing pad could be necessary for radiofrequency neurotomy when a patient is sedated, an awake and alert patient should feel the heat at an improperly placed RF dispersive pad and notify the physician.

In conclusion, in an awake and alert patient with a properly placed dispersive pad, which is completely attached to the skin with the long axis of the pad facing the active electrode, there is minimal risk of a dispersive skin burn during radiofrequency neurotomy. In procedures requiring higher energy and sedation, there is an increased risk of dispersive skin burns.

References:

1. Lord S, Barnsley L, Wallis B, McDonald G, Bogduk N. Percutaneous Radio-Frequency Neurotomy for Chronic Cervical Zygapophyseal-Joint Pain. *N Engl J Med* 1996; 335:1721-1726.
2. Schutt DJ, Haemmerich D. Sequential activation of a segmented ground pad reduces skin heating during radiofrequency tumor ablation: optimization via computational models. *IEEE Trans Biomed Eng.* 2008;55:1881-1889.
3. Goette A, Reek S, Klein HU, Geller JC. Case report: severe skin burn at the site of the indifferent electrode after radiofrequency catheter ablation of typical atrial flutter. *J Interv Card Electrophysiol.* 2001;5:337-40.
4. Dhillon PS, Gonna H, Li A, Wong T, Ward DE. Skin burns associated with radiofrequency catheter ablation of cardiac arrhythmias. *Pacing Clin Electrophysiol.* 2013;36:764-767.
5. Huffman SD, Huffman NP, Lewandowski RJ, Brown DB. Radiofrequency ablation complicated by skin burn. *Semin Intervent Radiol.* 2011 Jun;28(2):179-182.

6. Steinke K, Gananadha S, King J, Zhao J, Morris DL. Dispersive pad site burns with modern radiofrequency ablation equipment. *Surg Laparosc Endosc Percutan Tech.* 2003;13:366-371.
7. Goldberg SN, Solbiati L, Halpern EF, Gazelle GS. Variables affecting proper system grounding for radiofrequency ablation in an animal model. *J Vasc Interv Radiol.* 2000;11:1069-1075.
8. Thiagalingam A, Pouliopoulos J, Barry MA, Salisbury E, Pathmanathan N, Boyd A, Ross DL, Kovoov P. A thermochromic dispersive electrode can measure the underlying skin temperature and prevent burns during radiofrequency ablation. *J Cardiovasc Electrophysiol.* 2005;16:781-788.
9. Trivedi S, Lim T, Barry M, Byth K, Ross D, Thiagalingam A, Kovoov P. Clinical evaluation of a new technique to monitor return electrode skin temperature during radiofrequency ablation. *J Interv Card Electrophysiol.* 2013;36:307-314.