Preventing External Skin Burns During Thermal Radiofrequency Neurotomy

Zachary L. McCormick, MD; Clark C. Smith, MD, MPH; and Andrew J. Engel, MD on behalf of the Spine Intervention Society's Patient Safety Committee

1 University of Utah, Division of Physical Medicine and Rehabilitation, Salt Lake City, Utah, U.S.A; 2 Columbia University Medical Center, Rehabilitation and Regenerative Medicine, New York, New York, U.S.A; 3 Affordable Pain Management, Chicago, Illinois, U.S.A

Myth: Placing an electrical dispersive pad on a patient during radiofrequency neurotomy always prevents the risk of skin burn regardless of its position and orientation.

Fact: The risk of a patient suffering an external skin burn during thermal radiofrequency neurotomy is likely 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, alert, sensate, and able to communicate reliably so that they can report any discomfort at the electrical 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 [1-4]. 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 electrical dispersive pad (“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 [5]. The large surface area of a dispersive pad allows RF current to leave the body without increasing the skin temperature to the threshold for an epidermal burn.

Even though the dispersive pad decreases the risk of skin burns, there are case reports of external 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 [6-9], interventional radiology [10-12], and surgery [13] literature. Literature on RF neurotomy for cardiac arrhythmia demonstrates that higher body mass index (BMI) and longer procedure time are associated with a greater likelihood of skin burn at the site of the dispersive pad [9].

In an animal model Goldberg et al. demonstrated that improper dispersive pad placement could lead to an increased risk of burns [14]. These investigators 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 pad with a larger surface area is less likely to cause a burn.

The size of the dispersive pad is limited to commercially available products; therefore placing a larger dispersive pad is not possible. The clinician must ensure that the entire dispersive pad is properly attached to the skin. A poorly placed dispersive pad will decrease the surface area available for the exiting RF current and increase the temperature of the skin at the location where the current exits the patient’s body. A dispersive pad should be properly placed as far away from the RF electrode as possible. The distance between the dispersive pad and RF electrode is inversely related to temperature; therefore increasing the distance between the dispersive pad and the RF electrode results in decreased temperatures at the dispersive pad surface. As an example, for a left lumbar medial branch nerve RF neurotomy procedure, the dispersive pad might be placed on the right calf in order to maximize its distance from the RF electrode. Finally, placing the dispersive pad with the longest side facing the RF electrode decreases the temperature along the leading edge of the dispersive pad reducing the risk of a burn.

Though an appropriately placed dispersive pad should allow the RF current to leave the body without a skin burn, temperature-sensing pads have been described [15,16]. While an awake, alert, sensate patient without cognitive impairment should feel the heat at an improperly placed dispersive pad and notify the physician, a temperature-sensing dispersive pad might add an additional layer of safety, though this is not considered standard of care.
In conclusion, in an awake, alert, and sensate patient without cognitive impairment, when a properly placed dispersive pad is completely adhered to the skin with the long axis of the pad facing the active RF electrode, there is minimal risk of a dispersive pad skin burn during RF neurotomy. In procedures requiring higher energy, longer procedure time, the use of sedation, and in patients with higher BMI, there is likely an increased risk of dispersive pad skin burns.

References


