Inadvertent Internal Skin Burn Caused by Radiofrequency Electrodes During Ablation Procedures

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Myth: During radiofrequency ablation procedures, inadvertent skin burns occur only due to improper positioning of the electrical dispersion pad. They are not caused by radiofrequency electrodes since the lesions produced by electrodes cannot reach the overlying skin.

Fact: Full-thickness skin burns caused by radiofrequency electrodes have been described as complications of radiofrequency ablation of the thoracic medial branch nerve, the sacral lateral branch nerve, and the inferomedial genicular nerve.

In this FactFinder "internal skin burn" refers to a burn generated by the radiofrequency electrode itself as opposed to an external skin burn related to improper use of an electrical dispersion pad.

A previous publication highlighted the occurrence of inadvertent internal skin burns in association with two novel radiofrequency ablation (RFA) technologies [1]. One of these two skin burns occurred in a patient with a low-end of normal range body mass index (BMI) (21 kg/m2) during a thoracic medial branch nerve (MBN) ablation procedure in which water-cooled RFA technology was used [2]. This complication was thought to have resulted from a combination of factors: (1) target of relatively superficial nerve in a thin patient, (2) lack of electrode advancement to the full depth of the thoracic MBN due to the forward lesion projection when water-cooled RFA technology is used [3, 4], and (3) possibly an RFA lesion that was larger than expected based on previous ex-vivo tissue study descriptions [3, 4].

The second of these two internal skin burns related to novel RFA technologies occurred during a sacral lateral branch nerve ablation procedure in which a multi-electrode RFA probe was used [1]. This device creates monopolar lesions at three active electrode sites in sequence that are positioned along the RFA probe shaft as well as bipolar lesions between electrode one and two, and two and three, which forms a "strip lesion" [5]. This complication was thought to have resulted from a technical error on the part of the operator. During the creation of the strip lesion, the most superficial of three electrodes - located in sequence along the shaft of the multi-electrode radiofrequency probe - was unintentionally activated. Because the RFA probe had been withdrawn incrementally in order to extend the length of the strip lesion per manufacturer instructions [5], the third electrode was located close to the skin; thus, the unintentional electrode activation resulted in a third-degree skin burn. Concern was expressed in association with this case, as there appears to be no protective mechanism against unintentionally activating the proximal electrode when using current multi-electrode RFA technology [5] when it is positioned too superficially.

A third case of an unintentional internal skin burn was reported in a patient with a normal BMI (24 kg/m2) who underwent genicular nerve ablation using an 18 gauge conventional RFA probe with a 10mm active tip [6]. Electrodes were placed at the sites described by an accepted protocol [7-9]; these positions were confirmed by anterior-posterior and lateral fluoroscopic views before and during the lesioning procedure, yet a skin burn developed superficial to the inferomedial genicular nerve. This case serves as a warning that even when the most common elecrode placement protocol is used, along with meticulous fluoroscopic confirmation, inadvertent skin burn is a possible complication of conventional RFA at the side of the inferomedial genicular nerve in patients with a normal BMI. This is likely due to a paucity of subcutaneous tissue that overlies the medial tibial flare. The resulting recommendation is that operators should consider using RFA probes with shorter active tips at the site of the inferomedial genicular nerve, particularly in patients with minimal subcutaneous tissue in this location.

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Recommendations to prevent inadvertent internal skin burns:

- Inspect the RFA cannula insulation for defects. Burns could occur at unintended sites along the shaft, proximal to the active tip, if the electrode is exposed.
- Proper electrode placement, confirmed by multi-planar imaging, is vital in preventing inadvertent skin burns during RFA procedures. The location of electrodes should not only be confirmed prior to lesioning, but should also be monitored during lesioning, given the possibility of incorrect positioning or migration during the procedure.
- Carefully consider the optimal RFA active tip gauge, length, lesion duration, and lesion temperature, which all influence lesion size [4]. Adjust these factors for patient-specific differences in body habitus and lesion location.
- If the patient complains of a sensation of superficial burning or pain during lesioning, the procedure should be paused immediately, and the location of the electrode tip(s) should be confirmed.

References

1. McCormick ZL, Chung B, Smith C; Spine Intervention Society's Patient Safety Committee. Internal skin burn due to novel radiofrequency ablation technology. Pain Med 2018;19:1497-1498.
2. Walega D, Roussis C. Third-degree burn from cooled radiofrequency ablation of medial branch nerves for treatment of thoracic facet syndrome. Pain Practice 2014;14:154-158.
3. Vallejo R, Benyamin R, Tilley DM, Kelley CA, Cedeño DL. An ex vivo comparison of cooled-radiofrequency and bipolar¬radiofrequency lesion size and the effect of injected fluids. Reg Anes Pain Med 2014;39:312-321.
4. Cosman ER Jr, Dolensky JR, Hoffman RA. Factors that affect radiofrequency heat lesion size. Pain Med 2014;15:2020-2036.
5. NeuroTherm Simplicity III Physician Brochure. Neurotherm Inc, Wilmington, MA 2008.
6. McCormick ZL, Walega DR. Third-degree skin burn from conventional radiofrequency ablation of the inferiomedial genicular nerve. Pain Med 2018;19:1095-1097.
7. Choi WJ, Hwang SJ, Song JG, Leem JG, Kang YU, Park PH, Shin JW. Radiofrequency treatment relieves chronic knee osteoarthritis pain: a double-blind randomized controlled trial. Pain 2011;152:481-7.
8. McCormick ZL, Korn M, Reddy R, Marcolina A, Dayanim D, Mattie R, Cushman D, Bhave M, McCarthy RJ, Khan D, Nagpal G, Walega DR. Cooled radiofrequency ablation of the genicular nerves for chronic pain due to knee osteoarthritis: six-month outcomes. Pain Med 2017;18:1631-1641.
9. Davis T, Loudermilk E, DePalma M, Hunter C, Lindley D, Patel N, Choi D, Soloman M, Gupta A, Desai M, Buvanendran A, Kapural L. Prospective, multicenter, randomized, crossover clinical trial comparing the safety and effectiveness of cooled radiofrequency ablation With corticosteroid injection in the management of knee pain From osteoarthritis. Reg Anesth Pain Med 2018;43:84-91.