Radiofrequency Ablation And Its Effect On Heat Generation On Ground Pads

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Abstract

Radiofrequency ablation (RFA) is a minimally invasive procedure that can be used to treat chronic pain. Radiofrequency (RF) energy is emitted through a probe that is placed near a sensory nerve in the region of pain. The RF energy excites the nearby ions in the tissue causing them to vibrate rapidly. These vibrations generate heat that damage the nerve and the surrounding tissue, ultimately blocking the pain signal. In order to complete the circuit for a monopolar RF procedure, a dispersive electrode or ground pad is placed perpendicular to the RF probe typically on the back of the thigh. The energy flows through the probe, into the patient, and out through the ground pad. If enough current runs through the circuit, the current density builds on the ground pad and can lead to skin burns. Recommended tissue models for testing the heat generation on the ground pad are human or porcine. Both models are costly and time consuming to pursue and pose difficult challenges to overcome. Using a COMSOL® model, however, allows for rapid testing of different ground pad configurations while using minimal resources.
Using the Heat Transfer Module and AC/DC module, the heat generation at the ground pad was modeled and tested for various current levels and ground pad geometries. The model geometry consists of a one-meter cube of muscle tissue with a 5mm thick border of skin. A cube with dimensions of 5cm, located just inside the muscle tissue acted as the source of RF current, while the ground pad geometry was placed on the other end and acted as the return electrode. The system was also modeled for voltage and power control using the Events Module. During simulations, the model monitored the voltage, current, and power being applied through the RF terminal. When these values exceed their defined limits, an implicit event is triggered that restricts the flow of RF energy to safe levels. As expected, preliminary testing has indicated that a larger leading edge and surface area of the ground pad reduces the amount of heat generation on the ground pad.