Unintentional RF Energy Transfer during Endoscopy

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Endoscopy is a medical procedure that allows surgeons to diagnose and treat conditions that affect the esophagus, stomach, and beginning of the small intestine (duodenum). It is performed by inserting an endoscope through the mouth, viz. a long, thin, and flexible tube, with integrated camera and fiber optic light source. In a typical scenario, an electrosurgery generator is used to send high-frequency current to an active electrode which is controlled by the endoscopist. The patient's tissue resistance causes heating that results in the desired clinical effect (e.g., cutting of tissue or coagulation of bleeding). Current then returns to the generator using a return electrode. Unfortunately, thermal injuries outside of the endoscopist's vision can cause devastating complications. To date, the mechanism of these injuries has not yet been delineated.

In this work, we demonstrate unintentional radiofrequency (RF) energy transfer from the endoscope to nearby metal objects and into the patient's tissue. *In-vivo* measurements were carried out via a porcine model. An active electrode was used in standard fashion on the esophageal mucosa via an endoscope inserted though the pig's mouth. A grounding pad was placed upon the animal to serve as the return electrode. A standard, metal-reinforced breathing tube was inserted into the animal's airway. Three sensors were employed: a) an RF current sensor that recorded the current on the return electrode, b) an RF current sensor that recorded the current on the breathing tube (also known as the unintentional RF current), and c) a temperature sensor placed on healthy tissue, adjacent to the breathing tube. As was seen, 1-3% of RF energy was unintentionally coupled to the breathing tube. In turn, this unintentional RF energy transfer increased tissue temperatures alongside the breathing tube thus causing unintentional burns to the airway.

At the conference, we will present and discuss *in-vivo* measurement results for several operational scenarios.