

What You Should Know About Stray Current

Although electrosurgical technologies such as isolated generators and Contact Quality Monitoring Systems (CQMS) have reduced the risks associated with electrosurgery, stray current continues to be a cause of serious injury to surgical patients. The incidence of stray current injury has become more prevalent due to the increasing popularity of Minimally Invasive Surgery (MIS).¹ However, it is important to note that stray current injury is not limited to MIS. Stray current injuries due to insulation failure, direct coupling, and capacitive coupling can occur during any open or minimally invasive procedures.

Insulation failure is the breakdown of the material used to insulate the electrode sheath. It is not limited to reusable electrodes and can result from any of the following:

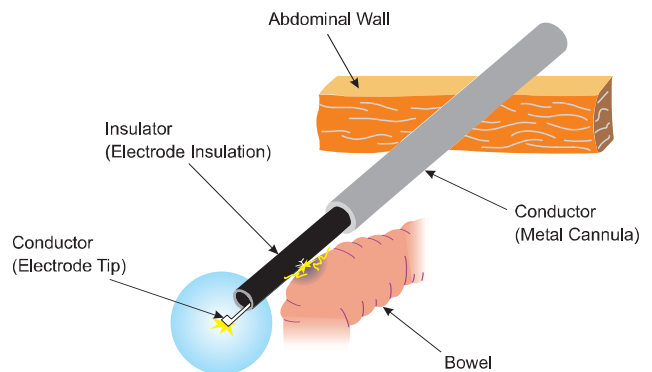
- Poor manufacturing technique
- Microscopic imperfections
- Wear and tear during normal use (i.e., high temperature sterilization)
- Damage due to improper handling (i.e., nicks from sharp objects on the sterile field)
- Incorrect sterilization (not following the manufacturer's guidelines)
- Re-sterilization of a SUD (single use device)

In all cases, insulation failure occurs because of a degradation in the insulation, whatever the cause.²

Insulation breakdown creates an alternate pathway for electrosurgical current to flow. The current that is redirected through an alternate pathway could cause a serious burn to an unintended site (see Figure 1). Alternate site burns during MIS may go unnoticed due to the surgeon's limited vision through a scope, and because of the initial lack of signs and symptoms of the injury. The surgeon only views approximately 10% of the active electrode through the scope; therefore, 90% of the electrode is not visible and may cause unintended injury to the patient.³

Figure 1

Insulation Failure



Direct coupling occurs when the active electrode comes into direct contact with, or is in close proximity to, other metal instruments within the surgical field. Energy can be transferred from the active electrode through a conductive instrument to patient tissue, causing a burn. Direct coupling injuries occur

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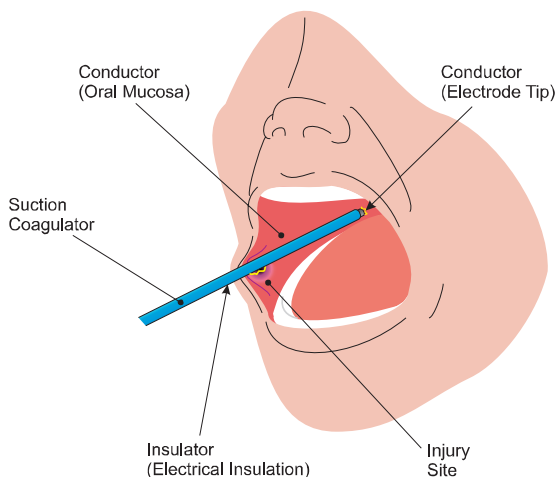
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less frequently than insulation failure or capacitive coupling injuries because of increased visibility. Electrical sparks or arcing may be seen, alerting the surgeon that direct coupling is occurring.⁴

Capacitive coupling is the most complicated of stray current injuries and, also, the least understood. A capacitor is created when electrical current is transferred from one conductor (i.e., a metal instrument) to another conductor (i.e., a metal instrument or patient) through a non-conductor or insulator (insulation on the active electrode). Even though an insulator separates the two conductors, a rapidly alternating electrostatic field between the two conductors induces current to flow through the insulation.⁵ For example, a capacitor is created by inserting an insulated active electrode down a metal cannula. Capacitively coupled electrical current can be transferred from the active electrode, through intact insulation, and into the conductive metal cannula. If the cannula then comes into contact with body structures, that energy can be discharged into these structures and cause injury. With an all metal cannula, electrical energy stored in the cannula will tend to disperse into the patient through the relatively large contact area between the cannula and the abdominal wall. Because the contact area is relatively large, the electrical energy is less concentrated and less dangerous. For this reason, it is unwise to use plastic anchors to secure metal cannulas, commonly known as hybrid systems. Hybrid systems isolate the current from the abdominal wall, which could cause the current to seek an alternate path. Some institutions use plastic trocar cannula systems because they mistakenly believe them to be safer. The plastic system can also be dangerous because the patient's own conductive tissue may form the second conductor, creating a capacitor. If the patient's omentum or bowel is draped over the plastic cannula, the cannula could discharge stored energy to adjacent body structures.⁶

As previously stated, capacitive coupling is not limited to MIS. For example, a capacitor is created when a suction coagulator is misused as a retractor. Capacitively coupled electrical current can be transferred from the suction coagulator (active electrode), through intact insulation, and into the conductive mucosa of the patient. If the current becomes highly concentrated, the result is a burn and, possibly, permanent injury (see Figure 2).

Figure 2 Capacitive Coupling



Below are recommendations to help avoid potentially dangerous situations:

- Ensure that the insulation of disposable and reusable instrumentation is intact and uncompromised. This can be done through visual inspection, as well as using instrument scanning devices pre, intra, and postoperatively. Both sterile processing personnel and the perioperative staff should be involved in this process. If there are any signs of compromised insulation, the instrument should not be used.
- Use the lowest power setting that achieves the desired surgical effect. Using a low voltage waveform (pure cut or desiccate) will lessen the potential for insulation failure or the potential for capacitive currents to occur.⁷
- Do not activate the generator in an open circuit condition. Activate the generator only when the active electrode is near or touching the target tissue.⁸
- Do not activate the electrode while in contact with other instruments, as unintended tissue injury may occur. If the surgeon chooses to “buzz a hemostat” or other metal instrument, manufacturer guidelines should be followed.
- Keep the distal end of the active electrode within the surgeon’s field of vision during activation.
- Use brief, intermittent activation instead of prolonged activation.
- Do not use hybrid trocars that are composed of both metal and plastic components. Use all metal as the first choice for the operative channel.⁹
- Use active electrode monitoring devices to monitor and actively shield against stray electrosurgical current. Do not use active electrode monitoring systems with capacitively coupled patient return electrodes.¹⁰
- Do not use active electrodes as retractors. Only the distal end of the electrode should come in contact with patient tissue.

Although electrosurgical technology has come a long way in developing safety mechanisms to protect the patient, injuries can still occur. It is the responsibility of all perioperative personnel to work together to prevent injuries from stray current.

1) Reed, A. Preventing Thermal Burns from Electrosurgical Instruments. *Infection Control Today*. July 2001. www.infectioncontrolday.com/articles/171instruments.html.

2) Maintenance of Electrosurgical Accessories. *Guide to Maintenance of Electrosurgical Accessories National Panel on Clinical Engineering/BEAG (NSW)*. February 2000.

3) Reed, A. July 2001.

4) HealthStream. *Preventing Stray Electrosurgical Burns in Laparoscopy with Active Electrode Monitoring*. March 23-27, 2003 [Brochure].

5) ShoreLaser and Esthetics. RadioFrequency Skin Tightening. Available at www.shorelaser.com/RF%20Skin%20Tightening.html. Accessed August 12, 2003.

6) Ulmer, BC, RN, MN, CNOR. *Electrosurgery Self-Study Guide*. August 2001: 11.

7) Valleylab, *Force FX™-C Electrosurgical Generator with Instant Response™ Technology User's Guide*. 1999: 3-11.

8) Ibid.

9) AORN, *Standards, Recommended Practices and Guidelines*. Denver, CO; 2003: 240.

10) ECRI Health Devices Alerts, *Excision-Electrode Monitoring Systems: Monitor Presents Burn Hazard if Used with Capacitively Coupled Patient Return Electrodes*. September 19, 2003.