

Electrosurgery and Surgical Gloves

The purpose of this information is to:

- Create awareness and understanding of the basic principles of electrosurgery, as they relate to surgical gloves and the phenomenon of introspective burn or shock and;
- Describe the circumstances that can cause such surgical hazards.

What is Electrosurgery?

Electrosurgery is the application of an electric (Radio Frequency [RF]) current to biological tissue. There are two kinds of electric currents: an alternating current (AC) and a direct current (DC). Electrosurgery uses AC while battery-powered hand-held cautery (electrocautery) are DC sources. The terms “electrosurgery” and “electrocautery” are two distinctly different practices and the terms are not interchangeable.

An electrosurgery generator supplies the source of electric current, which transfers energy (electrons) to tissue. RF current is typically used by the surgeon to cut tissue, coagulate tissue to obtain hemostasis (stop bleeding) or fulgurate (destroy and remove) tissue. An electrosurgery device can deliver heat at a range of 100°C to 1200°C delivered by interchangeable tips such as a loop, needle, and blade tips.

The circuitry of an electrosurgical unit (ESU) is composed of the generator and active electrode (handheld instrument), the patient, and the patient return electrode/ dispersive pad, which is sometimes referred to as the passive or ground electrode (patient pad or plate). An electric current is a flow of electric charge. Electrons, or the electrical charge, travel from the generator through the active electrode, through the patient, and return to the

generator via the patient return electrode/dispersive pad, completing the electrical circuit.

Potential Hazards to the User

A burn on the hand of the operating surgeon suggests that a channel of an electric current was formed somewhere other than the active electrode or patient return electrode/dispersive pad path. Among surgeons, the cause of this burn accident has often been considered to be current leakage through a micro-fracture (pin hole) in the gloves to the surgeon's skin.

It is possible that the hazard to the glove wearer did not occur from a preexisting hole in the glove barrier but, in effect, a hole could result from the electrical procedure. It has been suggested by researchers that the potential for a member of the operative team to receive a shock or burn through the surgical glove—natural rubber or synthetic—may occur through these three conditions aside from a pre-existing hole:

1. DC Conduction

This suggests that the impedance of the glove barrier to the electrical current is low enough to let the current pass through. The impedance or resistance properties of a surgical glove may be reduced as a result of extended wear and exposure to blood and fluids, or from perspiration inside the glove.

2. RF Capacitive Coupling

During electrosurgery the operating surgeon's perspiring conductive skin and the metal hemostat applied, for example, to a blood vessel, are considered capacitors (two conductors) separated by an insulator, the glove barrier. When alternating current is applied to the hemostat from the active electrode, it induces electrical charge on the other conductor. The thinner the glove film, the more efficiently the electrical current can be

induced to surge from one conductor (the hemostat) to the other conductor (the surgeon's hand).

3. High-voltage Dielectric Breakdown

This phenomenon results when the glove barrier cannot withstand the effects of the high-energy force from an electrosurgery generator. If the voltage is sufficiently high, it can produce a hole in the glove and result in a burn. Again, there are contributing variables, such as the amount of time the electrical current is applied or the surgical technique used. For example, it is a very common practice for the surgeon or first assistant to clamp a bleeding vessel and "zap" the bleeder with the active electrode while holding onto the hemostatic instrument. The voltage or force from the generator is exerted onto the entire clamp. The real potential for an electrical hazard is to the person holding the instrument. If the instrument is being held by just the tip of one finger, this allows only a small area for the current to concentrate, increasing the current density to the finger holding the instrument. If all conditions are right, the result is an electrifying "zap."

Protection from an Electrosurgery Burn Accident

It is safe to conclude that it is impossible to offer protection from high frequency current with a pair of surgical gloves. Double donning and donning thicker gloves may be of some assistance; however, it will not provide complete insulation. There are some recommended practices that may be effective such as:

- Using the lowest effective power setting
- Routine re-gloving or double gloving
- Keeping a firm hold on the hemostat or clamp, ensuring a large area of contact
- Activating the active electrode in close proximity to the tissue being coagulated
- Using insulated forceps or instruments

Understanding how electricity flows and the knowledge that your glove acts as a capacitor and not an insulator will help to reduce the risk of an electrosurgery burn.

Key Terms

Current: The number of electrons moving past a given point per second. Measured in amperes, electrical current can be Alternating Current (AC), meaning that positive and negative ions flow along the current path in alternating directions, or Direct Current (DC) with the flow of electrical current in one direction only.

Capacitive coupling: The condition that occurs when alternating (AC) electrical current is transferred from one conductor (an electrode), across intact insulation, into adjacent conductive materials (tissue or skin) or another metal surgical instrument. Capacitance is stored electrical charge.

Electrosurgery: The passage of Radio Frequency (RF) or high-frequency electrical current through tissue to create a desired clinical effect on the tissue. RF current is measured in cycles per second.

Resistance (impedance): The lack of conductivity or the opposition to the flow of electrical current. Resistance is measured in ohms.

Dielectric breakdown: Breakdown of a non-conductive material, i.e. rubber glove, which may be caused by high voltage output from the electrical generator.

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