Ansell

CLINICAL SUMMARY

PROTECTION FROM AN ELECTROSURGERY BURN ACCIDENT

By Luce Ouellet

BASIC PRINCIPLES[1]

Electrosurgery units (ESUs) are commonly used in the operating room (OR) to cut, ablate and dissect tissues through heat from an electrical current. This electrical current is generated by the movement of electrons, driven by voltage, which is the force behind this movement. There are two types of current: direct current (DC), where electrons flow in a single direction, and alternating current (AC), where the current periodically reverses direction, such as in a wall outlet.

ESUs convert standard electrical current from the wall into higher frequencies at the electrode, making them useful in the operating room. ESUs can run with either monopolar or bipolar instruments. The primary difference between the two lies in the current's path.

In monopolar surgery, the electrical current produced by the ESU flows through a single electrode to the tissue, achieving effects like cutting (low voltage), coagulation (high voltage), and fulguration, desiccation, or vaporization. The tissue effect occurs near the electrode. To complete the circuit, the current exits the patient and follows the path of least resistance back to an electron reservoir, such as a grounding pad. This technique is commonly used in laparoscopic and hysteroscopic procedures.

In bipolar surgery, the current generated by the ESU is restricted to the tissue between the two electrodes of the surgical instrument, which can be the tines of forceps, blades, scissors, or graspers. This method does not require a dispersion pad or return electrode. It is sometimes employed in the pulsatile cutting technique at low voltage due to the low tissue impedance, making it particularly useful for managing vascular areas, blood vessels, and the uterine artery.

POTENTIAL HAZARDS TO THE USER

Due to the electrical current in use, performing electrosurgery can have potential hazards. A burn on the operating surgeon's hand is specifically caused by the formation of an electrical current channel, somewhere other than the active electrode or patient return electrode / dispersive pad path. For surgeons, the cause of these burns has often been current leakage through a micro-fracture (pinhole) in the gloves to the surgeon's skin. It is possible that the hazard to the glove wearer was not from a pre-existing hole in the glove barrier, but a hole created by the electrical procedure. Researchers suggest that the potential for a member of the surgical team **to receive a shock or burn through the surgical glove for either natural rubber latex or rubber synthetic, could occur through three conditions in addition to a pre-existing hole:**[2]

1. Glove hydration - low resistance conduction

This shows that the impedance of the glove barrier to the electrical current is low enough to allow the current to pass. Hentz et al, 2000 studied the electrical resistance of a surgical glove. The authors demonstrated that gloves, when hydrated, exhibit a significant loss of electrical and mechanical resistance. The glove film undergoes a gradual process of water absorption, resulting in a reduction in electrical resistance compared to a non-hydrated glove.

RECOMMENDATIONS: **Change gloves regularly every 60 to 90 minutes or when the glove elongation at the fingertips is noticed.**[4]

2. Capacitive Coupling (Common)

In the context of electrosurgery, the conductive skin of the surgeon and the metal hemostat applied to a blood vessel, are capacitors (two conductors) separated by an insulator, namely the glove barrier. The application of an alternating current to the hemostat from the active electrode will induce an electrical charge on the conductive skin. It is crucial to acknowledge that the resistance of the glove film can exhibit notable discrepancies between different manufacturers, which may have implications for the efficacy and safety of the procedure.

A study by Neal et al, found that punctures in gloves were more likely to happen under specific conditions. These conditions were:

1. Highest coagulation current: When the electrical current used for coagulation (a process to stop bleeding) was at its maximum setting.

2. Largest surface contact: When the hemostat (a surgical tool used to control bleeding) had the most extensive contact with the surface of the glove.

RECOMMENDATIONS: **Double gloving would reduce the chances of these events to occur**

3. High voltage dielectric breakdown

This phenomenon occurs when the glove barrier cannot withstand the effects of the high energy force of an electrosurgical generator. If the voltage is high enough, it can puncture the glove and cause a burn. Again, there are contributing variables such as the duration of the electrical current or the surgical technique used. For example, it is common for the surgeon or first assistant to clamp a bleeding vessel and "zap" the bleeder with the active electrode while holding the hemostatic instrument. The voltage or force from the generator is applied to the entire clamp. The real potential for electrical hazard is to the person holding the instrument. If the instrument is held by only the tip of a finger, there is 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".[4]

RECOMMENDATIONS:

- **Avoid skin contact with metals**
- **Hold the hemostat or clamp firmly to ensure a large contact area.**
- **Use insulated forceps or instruments**
- **Activate active electrode close to coagulated tissue/site**

IN SUMMARY

It is safe to conclude that it is impossible to offer protection from high frequency current with only one pair of surgical gloves. Double donning and wearing thicker gloves will increase resistance, but it will not provide complete insulative properties.

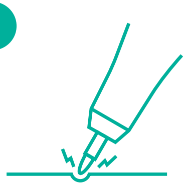
RECOMMENDATIONS OF PRACTICE[1-4]

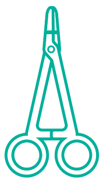
1  **Use the lowest effective power setting**

2  **Routinely change gloves**

3  **Double gloving**

4  **Hold the hemostat or clamp firmly to ensure a large contact area**

5  **Activate active electrode close to coagulation tissue/site**

6  **Use insulated forceps or instruments**

References:

1. Meeuwsen FC, Guédon ACP, Arkenbout EA, van der Elst M, Dankelman J, van den Dobbelsteen JJ. The Art of Electrosurgery: Trainees and Experts. Surg Innov. 2017 Aug. 24 (4):373-378
2. Neal JG, London SD, Kheir JN, Hunter FP, Thacker JG, Eldich RF, Studies of determinants of glove hole puncture during electrosurgery, J Biomed Mater Res. 1996 Winter;33(4):285-90
3. Hentz R.V., Traina G.C., Cadossi R., Zucchini P., Muglia M.A., Giordani M., The protective efficacy of surgical latex gloves against the risk of skin contamination: how well are the operators protected? Journal of Materials Science: Materials in Medicine, 12 (2000) 825-832
4. Association of periOperative Nurses (AORN). Gloves. In: Guidelines for Perioperative Practice, 2024 edition. Denver, CO: AORN 2024: Accessed September 2024

For more information or additional clinical resources, please visit: www.ansell.com/AnsellCARES

AnsellCARES℠
Education. Evidence. Engagement.

CS.12.24