ELECTROSURGERY OBJECTIVES

The learner will be able to identify and define general electrosurgical terms

The learner will be able to identify patient and staff safety during electrosurgery

The learner will be able to identify hazards associated with the use of electrosurgery

Electrosurgery was introduced in the 1920’s. Much has changed over the years and while there is still risk with the use of electricity in surgery; it is much safer now when used appropriately.
AORN Guidelines for Safe Use of Energy-Generating Devices

Recommendation I: Precautions should be taken to mitigate the risk for injury to patients and personnel during the use of energy-generating devices.

Recommendation II: Precautions should be taken to mitigate the risk for injury associated with the use of electrosurgical units and electrosurgical accessories.

Recommendation III: Precautions should be taken to mitigate the risk for injury associated with the use of electrosurgery during minimally invasive surgery.

The remainder of the recommendations are related to lasers, phacoemulsifiers and argon enhanced coagulation.

Properties of Electricity

- **CURRENT** = Flow of electrons during a period of time, measured in amperes
- **CIRCUIT** = Pathway for the uninterrupted flow of electrons
- **VOLTAGE** = Force pushing current through the resistance, measured in volts
- **RESISTANCE** = Obstacle to the flow of current, measured in ohms (impedance = resistance)
1. Electrosurgery passes electrical current through tissue and uses alternating current.
2. Electrocautery uses electrical current to heat a metal wire that is then applied to the tissue. Usually a small, battery-powered device.

Principles of Electrosurgery vs Electrocautery

ELECTROSURGERY

- Electrosurgery is used routinely in most surgical procedures.
- Surgical energy system that provides the surgeon with the ability to cut, coagulate and ablate tissue in one instrument. Current flows from the instrument, through the patient and to a return electrode.

Electrical Waveforms
Effects of Electrical Waveforms

Electrosurgical cutting divides tissue with electric sparks that focus intense heat at the surgical site.

By sparking to tissue, the surgeon produces maximum current concentration.

To create this spark the surgeon should hold the electrode slightly away from the tissue. This will produce the greatest amount of heat over a very short period of time, which results in vaporization of tissue.

The Cut Mode

- Electrosurgical fulguration (sparking with the coagulation waveform) coagulates and chars the tissue over a wide area.

- Because the duty cycle (on time) is only about 6%, less heat is produced.

- The result is the creation of a coagulum rather than cellular vaporization.

The Coagulation Mode
Dessication

- Electrosurgical desiccation occurs when the electrode is in direct contact with the tissue.
- Desiccation is achieved most efficiently with the "cutting" current.
- By touching the tissue with the electrode, the current concentration is reduced.
- Less heat is generated and no cutting action occurs. The cells dry out and form a coagulum rather than vaporize and explode.

Monopolar

This involves placing the active electrode in the surgical site and the dispersive electrode close by on the patient’s skin, allowing the current to flow through the patient.

Bipolar

- Bipolar involves placing forceps containing the active and dispersive electrodes in its tip around the targeted tissue.
- Here the current is contained and doesn’t flow through the patient’s body.
Electrosurgical Tissue Effects

Variables Impacting Tissue Effect

• Waveform
• Power Setting
• Size of Electrode
• Time
• Manipulation of Electrode
• Type of Tissue
• Eschar

Tips on ESU Use

• Conductors of electricity can interfere with the intended electrosurgery circuit; creating alternative pathways causing harm to patient.
• Personnel should verify that no metal materials are in contact with the patient’s skin.
• Metal surfaces of positioning devices should be well padded and covered.

Tips on ESU Use

• Patients with pacemakers or ICDs should be continuously monitored during ESU use and defibrillator should be immediately available.

• ICDs should be deactivated by trained individuals before ESU is activated.

• In the presence of a cochlear implant, bipolar surgery be used at least 1 cm away from the implant.
ESU and Prepping Agents

- Ignition of flammable substances by active electrodes has caused fires and patient injury.
- Ensure prep does not pool under the patient. Take care so the solution doesn’t collect in crevices on the patient’s body.
- Drying prep times depend on the prep’s ingredients.

ESU’s Power Setting

- Operator and user must confirm power settings before activation.
- Use of voltage settings in excess of what is needed, it’s risk of collateral damage.
- Start low and move higher to find the appropriate voltage.
- If there is more than normal smoke generated, the setting may be too high or electrode may need cleaning.

Surgical Smoke
Electrode Safety

- Place the active electrode in a clean, dry, well-insulated safety holster when not in use.
- Keep electrode tip clean.
- Careless handling and storage of active electrode between uses can result in injuries to yourself or patients and accidental ignition of flammable materials.
- Stand your ground to efficiency-minded surgeons who do not want to remove electrodes from the surgical site.

ESU Cords Are Insulated

- Wrapping cords around conductive materials (metal clamps) creates an alternative pathway.
- Minimize stray current.
- When securing the active electrode cord to the drapes, use non-conductive materials such as non-penetrating clips or velcro.

Warning!

“Electrosurgical injuries occur during laparoscopic operations... and the majority go unrecognized at surgery only to present 3-7 days afterward with fever and abdominal pain.”

Causes and prevention of Electrosurgical Injuries, Aug. 1994
Journal of the American College of Surgeons
Zones of Injury

- Surgeon has only 10% limited view of active electrode
- Surgeon only views the "target tissue"
- Burns outside the field of view can go undetected- caused by "Stray current"

Stray Current Causes Injury

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Insulation Failure

**Insulation Failure:** The condition that occurs when the insulation barrier around an electrical conductor breaks down. As a result, current can "leak" outside the instrument, burning nearby tissue. Along the shaft of the electrode, insulation can break down.
Capacitive Coupling

The condition that occurs when electrical current is transferred from one conductor (e.g. an electrosurgical instrument or active electrode), through intact insulation, into adjacent conductive materials (e.g. tissue.)

Direct Coupling

Direct Coupling - the active electrode "electrifies" another conductor.

Active Electrode Monitoring

A surgical instrument system combining a shielded instrument design that is continuously monitored during surgery to ensure the integrity of the instrument is not compromised, thereby preventing the risk of stray burn injury to the patient.
Dispersive Pad Placement

- Tissue damage at dispersive electrode site is most frequently reported patient injury.

- Electric current travels easily through muscular and vascular tissue but not through bone, scar tissue or adipose tissue.

Suggested Sites for Pad Placement

- Calf
- Upper Arm
- Abdomen
- Mid back
- Buttocks
- Anterior and posterior thigh

Pad Placement
Maintain AORN guidelines for ESU.

Exercise caution on surgery of the head and neck near combustible anesthetic gases.

Keep the active electrode as far from the oxygen source as possible and use the lowest practical level of oxygen.

Prevent Fires

Ask anesthesia providers to lower or eliminate oxygen flow when surgeons activate electrodes around the head or neck. Tent drapes around head to prevent oxygen buildup.

Keep water, saline or CO2 extinguisher available

Whoever controls the active electrode must also control the floor pedal that activates it.

Set alarms loud enough to be heard over all other sounds in the OR - You need to know when the active electrode is fired and locate it quickly if the activation was unintentional.

The active electrode should not be activated until it is in close proximity to the tissue - This minimizes the risk of contacting unintended tissue.
Summary

- Any patient injury carries the potential for medicolegal problems. The easiest way to prevent or defend against malpractice claims is to avoid injuring the patient in the first place.
- Make sure you understand and comply with existing standards of care and that you document that care.
- Use state-of-the-art technology and recommended nursing practices.

References

AORN Guidelines for Perioperative Practice, 2016

Kneedle, Julia, and Gwen H. Dodge, eds Perioperative Patient Care, 3rd edition

Valley Lab, www.valleylabeducation.org

- See more at: https://www.encision.com/resources/glossary-of-medical-terms