DISCLOSURES

I have no financial disclosures that would be a potential conflict of interest with this presentation.
OUTLINE

Definitions
Mechanism
Clinical uses
Cautions
Complications
Electrocautery

• *Not electrosurgery
• A metal wire is heated by resistance to flow of **direct current**
• The tip of the wire is **hot**
• Advantages:
  • Does not interfere with pacemakers / AICDs
  • Can achieve hemostasis in a wet field
• Disadvantages:
  • May lead to third-degree burns

Electrosurgery

(synonym: radiofrequency surgery)

- High-frequency alternating current is passed via a cold tipped electrode
  - Neuromuscular stimulation becomes negligible as frequency increases
- Tissue resistance to the passage of current converts electrical energy into heat
- Examples include electrocoagulation, electrodessication, electrosection, and electrofulguration

Electrosurgical unit (ESU) is the source of electron flow and voltage. The ESU takes a frequency of 60 Hz (standard outlet output) and converts it to over 300 kHz.
Circuit is composed of:

- Generator
- Active electrode
- Patient
- Return electrode*

Tissue provides resistance or impedance, generating heat.
**POLAR AND TERMINAL**

**Monopolar:** Electrode with 1 tip

**Bipolar:** Electrode with 2 tips; Active electrode and return electrode

**Monoterminal:** 1 electrode, no grounding electrode
- Most frequently used in dermatology

**Biterminal:** 2 electrodes are used; Treating electrode and grounding electrode
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Current can be **continuous** or **discontinuous**

**Continuous current**
- Cutting mode produces heat very rapidly leading to vaporization

**Discontinuous current**
- “On” time is reduced
- Instead of vaporization, a coagulum is produced
- Coagulation mode
- Fulguration mode

Fulguration mode has the highest peak voltage

CURRENT WAVEFORMS

Waveforms can be damped or undamped

Undamped waveforms remain unchanged in amplitude throughout the sine wave
- Increased cutting effect

Damped waveforms decrease in amplitude with time and eventually approach zero
- Increased coagulation effect

Tissue effect (e.g., coagulation, cutting) is determined by the rate at which heat is produced:

- High heat produced rapidly → Vaporization
- Low heat produced slowly → Coagulation
- Any waveform can accomplish both tasks

Electrocoagulation → **Slow heating below the boiling point** → Thermal denaturation of blood products

Electrodessication → **Slow heating above the boiling point** → Tissue drying

Electrosection (cutting) → **Rapid heating** above the boiling point → Explosive vaporization of water content in tissue and tissue fragmentation
ELECTROFULGURATION

↑ High voltage, ↓ Low amperage

Monoterminal circuit; Monopolar electrode

Discontinuous, damped waveform is applied

Active electrode is held a few millimeters above the tissue

An electrical discharge arc (spark) bridges the gap of air between the electrode and the tissue

Each spark acts as a very fine electrode

Allows for rapid coagulation over a larger area, when compared to contact electrocoagulation

Tissue destruction and coagulation is limited to superficial layer of tissue due to surface carbonization

ELECTRODESSICATION

↑ High voltage, ↓ Low amperage

Monoterminal circuit; Monopolar electrode

Discontinuous, damped waveform is applied

Electrode is in direct contact with the tissue causing superficial ablation

- Less heat is generated and no cutting effect occurs
- Tissue is heated until the stage of tissue drying

A popping sound will occur with desiccation
ELECTROCOAGULATION

↓ Low voltage, ↑ High amperage

Biterminal circuit; Monopolar or bipolar electrode

Damped waveform is applied

Electrode is brought into direct contact with the tissue being treated

Slow cellular heating leads to fluid evaporation, protein denaturation, and coagulation

Higher amperage allows current to penetrate deeper than electrodessication

Low voltage, High amperage

Biterminal circuit; Monopolar electrode

Continuous, undamped waveform produces a pure cutting effect

Slightly damped, blended current can achieve cutting and hemostasis at the same time

Sudden increase in temperature above the boiling point → Explosive vaporization of water content in tissue and tissue fragmentation

Useful for achieving relatively bloodless excisions

## SUMMARY

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<th>Amperage</th>
<th>Waveform</th>
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</table>
Electrodesiccation and Curettage is useful for treating superficial malignancies

- Preferred for treating small uncomplicated primary basal cell carcinoma and squamous cell carcinoma
- Provides 90-95% cure rates

Area is scraped with a curette in all directions and then charred with the electrosurgery device

- Can be repeated 2 or more times to remove any residual tumor

Wounds are allowed to heal by secondary intention

Scarring should be anticipated and discussed with the patient prior to the procedure

Images from Jere Mammino, DO.
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CAUTIONS

AICDs/Pacemakers

- Can theoretically lead to skipped beats, reprogramming of a pacemaker, or firing of an ICD
- To minimize risk:
  - Electrocautery → No risk
  - Bipolar forceps → Minimizes risk
  - Use short bursts of energy (< 5 seconds)
  - Avoid cutting currents (highest risk with electrosection)
  - Avoid use on skin around device
  - Hold magnet over device to avoid electrical interference
- Hyfrecators did not interfere with defibrillators and affected pacemakers only within 3 cm of the device (Weyer et al.)
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COMPLICATIONS

Fire or explosion
- Alcohol, oxygen, and bowel gases are flammable
- Note: Aluminum chloride solutions contain over 90% alcohol
- Avoid electrosurgery until alcohol has dried, turn off sources of oxygen, and exhibit precaution in the perianal area

Thermoelectric burns
- Burns can occur where the current exits the patient’s body
- Keep metal objects away from the patient’s body (E.g., ECG electrodes)

Microorganism transmission
- Can be transmitted by the electrode or smoke plume inhalation
- Use a new sterile tip for each patient
- Use an N95 mask and smoke evacuation system

RISKS OF SURGICAL SMOKE

Surgical smoke is comprised of 95% water and 5% particulate matter

- Surgical masks filter particles larger than 5 micrometers
- 77% of particulate matter is less than 1.1 micrometer
- Particles less than 2 micrometers can deposit in alveoli

Transmission of infection

- HPV, HIV, Staphylococcus, Corynebacterium, Neisseria

Risk of mutagenesis

- Chronic inflammation
- Transmission of HPV infection
- Viable cancer cells in smoke
MINIMIZING RISK OF SURGICAL SMOKE

High filtration masks (e.g., N95)

Smoke evacuation system
Awareness of Surgical Smoke Risks and Assessment of Safety Practices During Electrosurgery Among US Dermatology Residents

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