**Electrical hemostasis**

By Michael J. Visconti, DO, Zac Zheng, DO, and Kent J. Krach, MD, FAAD

<table>
<thead>
<tr>
<th>Definitions</th>
<th>Electrode tip temperature (Before contact the skin)</th>
<th>Electrical energy form (i.e., type of current)</th>
<th>Current flows...</th>
<th>Relies on human tissue for energy conversion?</th>
<th>Implantable device electromagnetic interference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrocautery</td>
<td>Hot</td>
<td>Direct current</td>
<td>To the device tip</td>
<td>No</td>
<td>Not present No current passing to skin</td>
</tr>
<tr>
<td>Electrosurgery Electrodesiccation Electrofulguration Electrocoagulation Electrosection</td>
<td>Cold</td>
<td>Alternating current</td>
<td>To the skin</td>
<td>Yes Electrical energy converted to thermal energy on skin</td>
<td>Present Biterminal forceps reduce risk of interference</td>
</tr>
</tbody>
</table>

**Electrocautery**

*Device generates a direct current*

Converted to thermal energy within device

Thermal energy relayed to electrode tip

HOT electrode tip is directly applied to tissue

Thermal energy is conducted to tissue

Heat-induced tissue destruction

**Electrosurgery**

*Device generates high-frequency alternating current (HF-AC)*

Cold electrode tip is applied to tissue, relaying HF-AC

High resistance of human tissue does not conduct current

Thermal energy is delivered to point of contact

Heat-induced tissue destruction

**Definitions**

- **Electrode tip temperature (Before contact the skin)**
  - Hot
  - Cold

- **Electrical energy form (i.e., type of current)**
  - Direct current
  - Alternating current

- **Current flows...**
  - To the device tip
  - To the skin

- **Relies on human tissue for energy conversion?**
  - Yes
  - No

- **Implantable device electromagnetic interference**
  - Not present
  - Present
  - Biterminal forceps reduce risk of interference
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### Electrosurgical modalities

<table>
<thead>
<tr>
<th>Electrodesiccation</th>
<th>Electrofulguration</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Electrodesiccation Image]</td>
<td>![Electrofulguration Image]</td>
</tr>
</tbody>
</table>

**MONOTERMINAL**

- LOW amperage / HIGH voltage
- DIRECT contact
  - Slow heating of tissue
  - Dehydration/water loss
  - Superficial ablation
  - NO significant protein denaturation

**BITERMINAL**

- HIGH amperage / LOW voltage
- Moderately damped waveform
- Less cutting, more coagulation
- DIRECT contact
  - Slow cellular heating
  - Intracellular fluid evaporation, coagulum formation, protein denaturation
  - Penetrates deeper compared to electrodesiccation --- Deeper tissue destruction/hemostasis

**MONOTERMINAL**

- LOW amperage / HIGH voltage
- NO DIRECT contact = less controllable damage
- Electrical probe is held at distance
- Produces spark gap
- Superficial ablation
- More limited/superficial compared to electrodesiccation

**BITERMINAL**

- HIGHEST current of all modalities
- HIGH amperage / LOW voltage
- Undamped waveform
  - Pure cutting through tissue
- DIRECT contact
- Blended mode
  - Utilized with electrocoagulation
  - Mixture of hemostasis and cutting

**Electrocoagulation**

- DIRECT contact
  - Slow cellular heating
  - Intracellular fluid evaporation, coagulum formation, protein denaturation
  - Penetrates deeper compared to electrodesiccation --- Deeper tissue destruction/hemostasis

**Electrosection**

- electrode probe held at distance
- produces spark gap
- produces coagulum
- more superficial compared to electrocoagulation
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Summary of electrosurgical modalities

<table>
<thead>
<tr>
<th>Type</th>
<th>Current</th>
<th>Terminal</th>
<th>Voltage</th>
<th>Amperage</th>
<th>Waveform</th>
<th>Tissue destruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrodesiccation</td>
<td>Direct</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Moderate</td>
</tr>
<tr>
<td>Electrofulguration</td>
<td>Alternating</td>
<td>Monoterminal</td>
<td>High</td>
<td>Low</td>
<td>Markedly damped</td>
<td>Modest / Superficial</td>
</tr>
<tr>
<td>Electrocoagulation</td>
<td>Biterminal</td>
<td>Low</td>
<td>High</td>
<td>Moderately damped</td>
<td>Moderate / Deep</td>
<td></td>
</tr>
<tr>
<td>Electrosection</td>
<td>Biterminal</td>
<td>Low</td>
<td>High</td>
<td>Undamped</td>
<td>Minimal</td>
<td></td>
</tr>
<tr>
<td>Electrocautery</td>
<td>Direct</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Moderate</td>
</tr>
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Adapted from Review of Dermatology, 2017.
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<table>
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<tr>
<th><strong>Electrical hemostasis risks &amp; precautions</strong></th>
<th><strong>Risks</strong></th>
<th><strong>Precautions</strong></th>
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<tbody>
<tr>
<td><strong>Pacemaker or ICDs</strong></td>
<td>Skipped beats, misfires, bradycardia, asystole, reprogramming/resetting</td>
<td>Consider preoperative cardiology consult</td>
</tr>
<tr>
<td></td>
<td>High-frequency electrosurgery devices can interrupt signal</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Short bursts (&lt;5 sec)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Avoid cutting current</td>
</tr>
</tbody>
</table>

| **Fire hazard** | **Flammable agents:** Alcohol, Ethyl chloride anesthesia, Supplemental oxygen, Aluminum chloride, Bowel gas (methane) | **Topical preparations:** Utilize non-alcoholic cleansers (chlorhexidine, povidone-iodine) | Allow adequate time for evaporation of alcohol prep |
| | | **Supplemental oxygen:** Discontinue use during electrical hemostasis | Bowel gas: Cautious use in perianal area |

| **Non-cardiac electrical stimulators** | Spinal cord stimulators, Deep brain stimulators, Vagal and phrenic nerve stimulators, Gastric stimulators, Cochlear implants/hearing aids | Usually equipped with an “OFF” function compared to ICDs | Similar precautions to pacemakers or ICDs |
| | | | |

| **Thermal injury** | Touching grounding element (metal), Inadequate contact between patient and dispersive electrode plate, Channeling current through small area | Pre- and intra-operative counseling on grounding element contact | |
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<tr>
<td><strong>Risks</strong></td>
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<td>Channeling</td>
</tr>
<tr>
<td>Tissue damage distant from local site secondary to high-frequency current transmitted along nerve bundles</td>
</tr>
<tr>
<td>Increasing cross-sectional area of current flow (i.e., wrapping a saline-soaked sponge around mass with a narrow base)</td>
</tr>
<tr>
<td>Plume smoke</td>
</tr>
<tr>
<td>Similar mutagenic potential to cigarette smoke (benzene H-cyanide)</td>
</tr>
<tr>
<td>HPV exposure after electrodessication</td>
</tr>
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<td>Aerosolizes HSV, HPV particles</td>
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**References:**