1. **RADIO FREQUENCY (RF) ELECTROSURGERY**

Electrosurgical Unit’s (ESUs) create an electrical circuit where Radio Frequency (RF) current is pushed through the patient’s tissue.

RF energy is used by:
- Monopolar
- Bipolar
- Advanced Bipolar (PK)
- Vessel Sealers
- Mechanical Energy

2. **ENERGY MODALITY**

**Monopolar**
- Energy flows from the tip of an instrument, through the patient, to a dispersive electrode (i.e. pad)
- Common Use: Dissection & transaction, Coagulation of very small vessels, Blunt dissection when not activated

**Bipolar**
- Energy flows between two jaws to affect tissue between the jaws.
- Common Use: Ligation of vessels, Grasping, retracting & blunt dissection

3. **TISSUE EFFECT**

- **Vaporization & Carbonization**: >100 °C
  - Converts cells to carbon
  - Eschar formation
- **Desiccation**: 60-95 °C
  - Tissue dehydration
  - Cell evaporation
- **Coagulation**: 60 °C
  - Protein denaturation
  - Tissue blanching

4. **Vessel Sealing Performance Factors**

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
<th>Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vessel Size Claim</strong></td>
<td>Maximum vessel size reliably sealed (per FDA clearance)</td>
<td>Larger is better</td>
</tr>
<tr>
<td><strong>Burst Pressure</strong></td>
<td>Pressure a seal can withstand before bursting</td>
<td>Benchmark = 3 x normal systolic pressure (360mm of Hg)</td>
</tr>
<tr>
<td><strong>Lateral Thermal Spread</strong></td>
<td>Thermal margins near jaw edge or seal area</td>
<td>Smaller is better Benchmark &lt; 2.0mm</td>
</tr>
<tr>
<td><strong>Histology Data</strong></td>
<td>Evaluation of tissue surrounding seal</td>
<td>Assesses seal formation &amp; effect at cellular level</td>
</tr>
<tr>
<td><strong>Seal Cycle Time</strong></td>
<td>Time to complete seal process</td>
<td>Varies by tissue type &amp; instrument</td>
</tr>
<tr>
<td><strong>Cut Function</strong></td>
<td>Transaction method:</td>
<td>Independent seal &amp; cut allows seal only &amp; cold cutting</td>
</tr>
<tr>
<td></td>
<td>- Blade vs. energy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Coupled vs. independent from seal</td>
<td></td>
</tr>
<tr>
<td><strong>Residual Heat</strong></td>
<td>Heat remaining at instrument tip</td>
<td>Low peak temperatures &amp; short cool time reduce burn risk &amp; inefficiencies</td>
</tr>
</tbody>
</table>

- **Monopolar**
  - Thermal Spread
  - Energy Waveform
  - Hemostatic
  - Tissue Effect: YES

- **Bipolar**
  - Thermal Spread
  - Energy Waveform
  - Hemostatic
  - Tissue Effect: YES

- **Advanced Bipolar**
  - Energy flows in a periodic, pulsed mode (controlled by tissue feedback) between two jaws to affect tissue between the jaws.
  - Minimizes thermal spread
  - Completion Feedback: Audio & Impedance measurement
  - Hemostatic: YES

- **Ultrasonic**
  - Mechanical vibrations cause friction.
  - Common Use: Dissection & ligation of vessels, Grasping & retracting when inactive
  - Hemostatic: YES

**ESU**

Energy flows between two jaws to affect tissue between the jaws.

**ESU**

Common Use: Ligation of vessels, Grasping, retracting & blunt dissection

**ESU**

Common Use: Dissection & transection, Coagulation of very small vessels, Blunt dissection when not activated

**ESU**

Common Use: Dissection & transection, Coagulation of very small vessels, Blunt dissection when not activated
## 4 Vessel Sealing: Energy Comparison

<table>
<thead>
<tr>
<th>Energy Modality</th>
<th>Energy Type</th>
<th>Ligation Claim</th>
<th>Waveform</th>
<th>Mechanical Cut Function</th>
<th>Impedance Feedback</th>
<th>Cycle Completion Indicator</th>
<th>Thermal Spread Claim</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monopolar (Cut &amp; Coag)</td>
<td>Radio Frequency</td>
<td>None</td>
<td>Continuous</td>
<td>No</td>
<td>No</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Bipolar</td>
<td>Radio Frequency</td>
<td>None</td>
<td>Continuous</td>
<td>No</td>
<td>No</td>
<td>None*</td>
<td>None</td>
</tr>
<tr>
<td>Advanced Bipolar (PK)</td>
<td>Radio Frequency</td>
<td>None**</td>
<td>Pulsed</td>
<td>No</td>
<td>Yes</td>
<td>Audible No Auto-Stop</td>
<td>None</td>
</tr>
<tr>
<td>Ultrasonic</td>
<td>Mechanical</td>
<td>≤ 5mm**</td>
<td>Continuous</td>
<td>Yes</td>
<td>No</td>
<td>None</td>
<td>&lt; 2mm</td>
</tr>
</tbody>
</table>

* CoagWav, and Ethicon ESUs sometimes include a visual or audible impedance meter.
** Recently launched THUNDERBEAT by Olympus, a combination of ultrasonic and advanced bipolar, has a ligation claim of ≤ 7mm

## 5 Vessel Sealing: Competition

### Covidien
- **Ligasure** 5mm Blunt Tip (newest product)
  - Shaft Size: 5mm
  - Seal Claim: 7mm
  - Seal Length: 19.5mm
  - Cut Length: 17.8mm
  - Jaw Type: Straight Blunt
  - Independence: Independent
  - Angle: -30°
  - Motion: Single

- **Ligasure Dolphin Tip** (formerly Ligasure V)
  - Shaft Size: 5mm
  - Seal Claim: 7mm
  - Seal Length: 18mm
  - Cut Length: 12mm
  - Jaw Type: Dolphin Shaped
  - Independence: Independent
  - Angle: -30°
  - Motion: Single

- **Ligasure Advance**
  - Shaft Size: 5mm
  - Seal Claim: 7mm
  - Seal Length: 18mm
  - Cut Length: 15.5mm
  - Jaw Type: Curved w/mono tip
  - Independence: Independent
  - Angle: -30°
  - Motion: Dual

- **Ligasure Atlas**
  - Shaft Size: 10mm
  - Seal Claim: 7mm
  - Seal Length: 22mm
  - Cut Length: 20mm
  - Jaw Type: Straight Blunt
  - Independence: Independent
  - Angle: -30°
  - Motion: Dual

### Ethicon Endo-Surgery
- **ENSEAL Tri/o Round Tip (current)**
  - Shaft Size: 5mm
  - Seal Claim: 7mm
  - Seal Length: 16.6mm
  - Cut Length: 15mm
  - Jaw Type: Curved 3mm
  - blade: Coupled
  - Independence: -30°
  - Motion: Single

- **ENSEAL G2 Round Tip** (not yet released)
  - Shaft Size: 5mm
  - Seal Claim: 7mm
  - Seal Length: 16.6mm
  - Cut Length: 15mm
  - Jaw Type: Straight Blunt
  - Independence: Coupled
  - Seal-only: -30°
  - Motion: Single

- **Harmonic ACE** (lap & da Vinci)
  - Shaft Size: 5mm
  - Seal Claim: 5mm
  - Seal Length: 14.2mm
  - Cut Length: 14.2mm
  - Jaw Type: Curved
  - Independence: Coupled
  - Angle: -30°
  - Motion: Single

### Intuitive Surgical
- **EndoWrist One™ Vessel Sealer**
  - Shaft Size: 8mm
  - Seal Claim: 7mm
  - Seal Length: 16.3mm
  - Cut Length: 13.2mm
  - Jaw Type: Straight w/dissectoring tip & grasping tooth
  - Independence: Independent
  - Angle: 40°
  - Motion: Dual Articulated

## 6 Additional Materials

**Product Brochure PN 874939**
- Selling: ●
- In-Service: ●
- Case Support: ●
- Reference: ●

**Quick Reference Guide PN 551182**
- Selling: ●
- In-Service: ●
- Case Support: ●
- Reference: ●

**In-Service Guide PN 210252**
- Selling: ●
- In-Service: ●
- Case Support: ●
- Reference: ●

**User Manual PN 551027**
- Selling: ●
- In-Service: ●
- Case Support: ●
- Reference: ●

**Covidien Ligasure Product Information:**
- [http://www.ees.com/Clinician/Product/energy/enseal-g2-tissue-sealers](http://www.ees.com/Clinician/Product/energy/enseal-g2-tissue-sealers)

**Ethicon Endo-Surgery ENSEAL Product Information:**
- [http://www.aes.com/Clinician/Product/energy/ensealtripsurgeonalingdevices](http://www.aes.com/Clinician/Product/energy/ensealtripsurgeonalingdevices)
- [http://www.aes.com/Clinician/Product/energy/enseal-g2-tissue-sealers](http://www.aes.com/Clinician/Product/energy/enseal-g2-tissue-sealers)

© 2012 Intuitive Surgical, Inc. All rights reserved. Intuitive Surgical, Ethicon EndoWrist and da Vinci are trademarks or registered trademarks of Intuitive Surgical, Inc. Other parties’ trademarks are the property of their respective owners and should be treated as such.