

---

---

---

---

---

---

---

---

**OBJECTIVES**

- Describe basic electrosurgical principles and how they apply to MIGS
- Manipulate the varying and desired tissue responses based on electrosurgical concepts.
- Reduce the possibility of electrosurgical injuries during laparoscopy and hysteroscopy.

The Ottawa Hospital • Ottawa Health Research Institute • University of Ottawa • American Association of Gynecologic Laparoscopists

---

---

---

---

---

---

---

---

**THE BASICS**

The Ottawa Hospital • Ottawa Health Research Institute • University of Ottawa • American Association of Gynecologic Laparoscopists

---

---

---

---

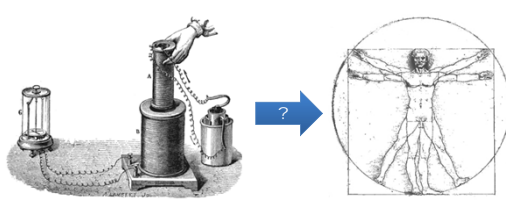
---

---

---

---

### FLOW OF ENERGY



The image shows a historical scientific apparatus on the left, consisting of a hand crank, a cylindrical container, and various wires and components. A blue arrow with a question mark points from this apparatus to a Vitruvian Man figure on the right, which is inscribed within a circle and a square.

The Ottawa Hospital • Ottawa Health Research Institute • University of Ottawa • American Association of Gynecologic Laparoscopists

---

---

---

---


---

---

---

---

### CHARACTERISTICS OF ELECTRICITY



- Direct vs Alternating
- Frequency
- Current
- Voltage

The Ottawa Hospital • Ottawa Health Research Institute • University of Ottawa • American Association of Gynecologic Laparoscopists

AC

60 Hz

<20 A

110 V

---

---

---

---

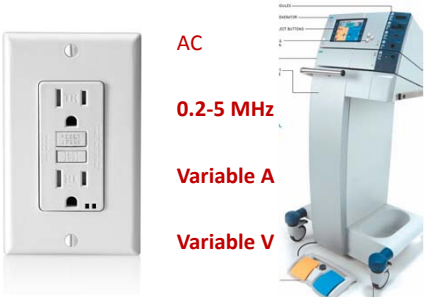
---

---

---

---

### CHARACTERISTICS OF ELECTRICITY



- Direct vs Alternating
- Frequency
- Current
- Voltage

The Ottawa Hospital • Ottawa Health Research Institute • University of Ottawa • American Association of Gynecologic Laparoscopists

AC

60 Hz

<20 A

110 V

AC

0.2-5 MHz

Variable A

Variable V

---

---

---

---

---

---

---

---

**IT IS NOT CAUTERY!**

$Q = f(P, t, A)$


$P = I^2R$

← Resistance (tissue)

← Current

$V = IR$

Therefore,  $P = IV$



The Ottawa Hospital • Ottawa Health Research Institute • University of Ottawa • American Association of Gynecologic Laparoscopists

---

---

---

---

---

---

---

---

**IT IS NOT CAUTERY!**

$Q = f(P, t, A)$


*Watts = Joules / second*

*Therefore, tP = Joules*

$Q = tP$

Remember,  $P = IV$

$Q = tIV$



The Ottawa Hospital • Ottawa Health Research Institute • University of Ottawa • American Association of Gynecologic Laparoscopists

---

---

---

---

---

---

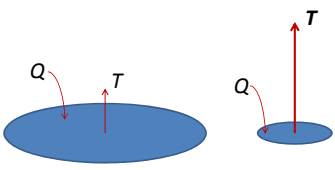

---

---

**IT IS NOT CAUTERY!**

$Q = f(P, t, A)$

$PD = P / A$

The Ottawa Hospital • Ottawa Health Research Institute • University of Ottawa • American Association of Gynecologic Laparoscopists

---

---

---

---

---

---

---

---

### QUICK RECAP

- $P = IV$ 
  - ← ESU sets these values
  - ← We set this value
- Temperature change
  - Power
  - Time
  - Surface area

The Ottawa Hospital • Ottawa Health Research Institute • University of Ottawa • American Association of Gynecologic Laparoscopists

---

---

---

---


---

---

---

---

### CUT & COAG CURRENTS



The Ottawa Hospital • Ottawa Health Research Institute • University of Ottawa • American Association of Gynecologic Laparoscopists

---

---

---

---

---


---

---

---


### WAVEFORMS

**CUT**



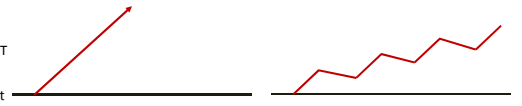
**On 100%**

**COAG**



**On 6% + Off 94%**

T



t

The Ottawa Hospital • Ottawa Health Research Institute • University of Ottawa • American Association of Gynecologic Laparoscopists

---

---

---

---

---


---

---

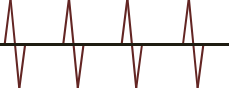
---

### WAVEFORMS

**CUT**



**COAG**



Current: 100% (high)

Voltage:  $V = P / 100\%$  (high)

V = low

Current: 6% (low)

Voltage:  $V = P / 6\%$  (low)

V = high

$P = IV$

The Ottawa Hospital • Ottawa Health Research Institute • University of Ottawa • American Association of Gynecologic Laparoscopists

---

---

---

---

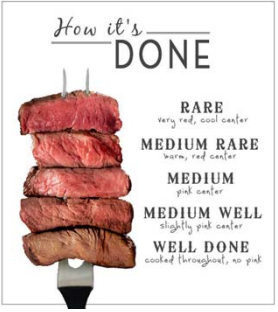
---

---

---

---

### TISSUE EFFECTS



The Ottawa Hospital • Ottawa Health Research Institute • University of Ottawa • American Association of Gynecologic Laparoscopists

---

---

---

---

---

---

---

---

### CUT/VAPORIZATION

- Tissue temperatures raise rapidly (>100°C)
- Intracellular fluid vaporizes rapidly
- Cells explode to release steam
  
- No char
- No coagulum
- Collateral thermal spread 100-400 mcm

The Ottawa Hospital • Ottawa Health Research Institute • University of Ottawa • American Association of Gynecologic Laparoscopists

---

---

---

---

---

---

---

---

### COAGULATION

- Tissue temperature is raised slowly (50-80°C)
- Proteins denature
- Coagulum forms
  
- Coag current with varying degree of contact
- Cutting current with broad point of contact



---

---

---

---

---

---

---

---

### DESICCATION

- Tissue temperature is raised slowly (50-80°C)
- Water vaporizes
- Leaves cell slowly as steam
- Cells dry; coagulum forms
- Cells do not burn or char
  
- Occurs with coagulation



---

---

---

---

---

---

---

---

### FULGURATION

- Coagulation current is most effective
- Electrode is held off tissues = capacitor
- Fulguration is capacitor overload failure
  
- Temperature change is rapid
- Temperatures can reach 1000°C
- Carbonization



---

---

---

---

---

---

---

---

### PATIENT SAFETY



The Ottawa Hospital • Ottawa Health Research Institute • University of Ottawa • American Association of Gynecologic Laparoscopists

---

---

---

---

---

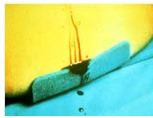
---

---

---

### TYPES OF SKIN AND TISSUE INJURIES DURING THE PERIOPERATIVE PERIOD

- Pressure sores
- Allergic reactions
  - Latex
  - Adhesive
- Chemical
- Shearing
- Thermal



The Ottawa Hospital • Ottawa Health Research Institute • University of Ottawa • American Association of Gynecologic Laparoscopists

---

---

---

---

---

---

---

---

### OF THESE INJURIES . . .



- Only thermal injury is caused by electrocautery current
- *It is preventable!*

The Ottawa Hospital • Ottawa Health Research Institute • University of Ottawa • American Association of Gynecologic Laparoscopists

---

---

---

---

---


---

---

---

### ELECTROSURGICAL SAFETY IN MIS

- Direct coupling
- Insulation failure
- Capacitive coupling



The Ottawa Hospital • Ottawa Health Research Institute • University of Ottawa • American Association of Gynecologic Laparoscopists

---

---

---

---

---

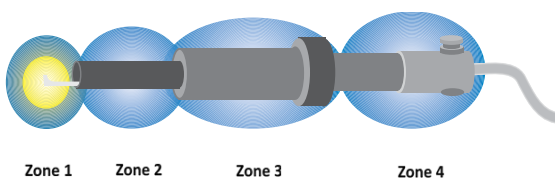
---

---

---

### FOUR ZONES OF INJURY

Intended      Unintended



Zone 1      Zone 2      Zone 3      Zone 4

The Ottawa Hospital • Ottawa Health Research Institute • University of Ottawa • American Association of Gynecologic Laparoscopists

---

---

---

---

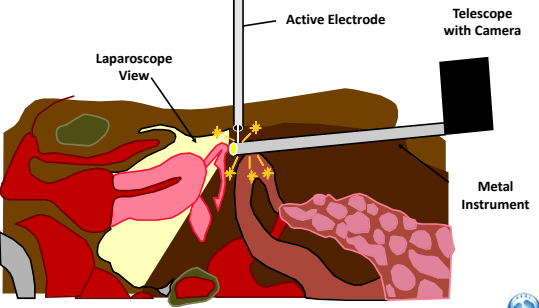
---

---

---

---

### DIRECT COUPLING



The Ottawa Hospital • Ottawa Health Research Institute • University of Ottawa • American Association of Gynecologic Laparoscopists

---

---

---

---

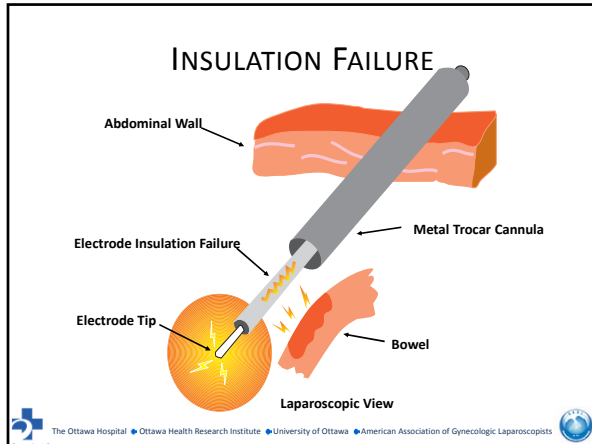
---

---

---

---





---

---

---

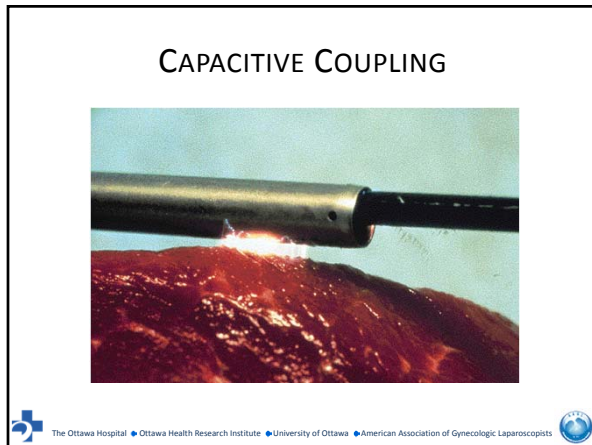
---

---

---

---

---



---

---

---

---

---

---

---

---

### BIPOLAR

- A safe alternative
  - Provides precise controlled desiccation
    - Always select cutting waveform
    - Usually automatically preset
  - Limited amount of tissue impacted by current
  - Works well in irrigated environments

The Ottawa Hospital • Ottawa Health Research Institute • University of Ottawa • American Association of Gynecologic Laparoscopists

---

---

---

---

---

---

---

---

### MONOPOLAR SURGERY TIPS

- Use lowest possible power setting
- Use a low voltage waveform (cut)
- Use brief intermittent activation (3 sec)
- Do not activate in open circuit
- Do not activate in close proximity or direct contact with another instrument
- Use bipolar electro-surgery where appropriate
- Use a return electrode monitoring system




---

---

---

---

---

---

---

---

---

---

Association of Academic Professionals in Obstetrics and Gynaecology



Association des académiciens professionnels en obstétrique-gynécologie

### THANK YOU



The Ottawa Hospital | L'Hôpital d'Ottawa

Compassionate People. World-Class Care. Des gens de compassion. Des soins de calibre mondial.



AAGL Advancing Minimally Invasive Gynecology Worldwide




---

---

---

---

---

---

---

---

---

---

### REFERENCE

- Vilos GA, Rajakumar C. Electrosurgical generators and monopolar and bipolar electro-surgery. J Minim Invasive Gynecol. 2013 May-Jun;20(3):279-87. doi: 10.1016/j.jmig.2013.02.013.

### IMAGE CREDITS

- Title Image: [www.powerpointstyles.com](http://www.powerpointstyles.com)
- Ottawa Health Research Institute
- American Association of Gynecologic Laparoscopists
- "Building Blocks": <http://www.osstransformation.com/Home>
- "Faraday: Induction": [http://en.wikipedia.org/wiki/Faraday's\\_law\\_of\\_induction](http://en.wikipedia.org/wiki/Faraday's_law_of_induction)
- "The Vitruvian Man": [leonardodavinci.stanford.edu](http://leonardodavinci.stanford.edu)
- Electrical Outlet: [laudanelectric.com](http://laudanelectric.com)
- ERBE tower: ERBE USA VIO trifold (manual)
- Bovie Cautery: [www.medshop.com.au](http://www.medshop.com.au)
- Safety slides: Dr. S. Singh




---

---

---

---

---

---

---

---

---

---