ELECTROSURGERY IN GI
The Nursing Fundamentals
Disclosure: Ms. Morris is the CEO of Genii, Inc. which manufactures and sells electrosurgery generators to the flexible endoscopy market. Any photo or reference to any brand or model of electrosurgery generator appearing in this presentation is solely provided for the purpose of example and in no way indicates an endorsement.


Geri Nelson, RN, Marcia L. Morris, MS Electrosurgery in the GI Suite: Knowledge is Power.. GJN 2015 38(6) Nov/Dec

ASGE Technology Status Evaluation Report. Electrosurgical Generators. 2013 Gastrointest Endosc;78(2)197-208. (J Tokar, B Barth, S Banerjee, S Chauhan, K Gottlieb et al.)


- Please also note the list of Additional References and Suggested Readings on the final slide.
LEARNING OBJECTIVES

- Identify the basic technology of electrosurgery (ES): How does it work?
- How do we commonly use it in GI?
- How can we use it safely?
IDENTIFY THE BASIC TECHNOLOGY OF ELECTROSURGERY: HOW DOES IT WORK?

Learning Objective One
HIGH FREQUENCY ALTERNATING CURRENT

- The generator (ESG) takes the current from the wall that is alternating (changing direction) 60 times a second and speeds it up.
- ES alternates over 300,000 times per second
- This bypasses most neuromuscular effects and just leaves heat.
Electrosurgery has the unique ability to cut and coagulate at the same time.
HOW DOES THE HEAT CUT?

- Very fast heating in a concentrated area promotes more cutting effect
- Water in cell boils and steam explodes the cell membrane
- Guided by an accessory this line of exploded cells is said to have been ‘electrosurgically cut’
HOW ABOUT COAGULATION?

- Cells farther away, or those heated more slowly
- Lose water without exploding (dessiccate)
- They are coagulated
- The ‘mix’ of how many are cut, and how many are coagulated gives the ‘tissue effect’
PREFERENCES ARE PHYSICIAN CHOICE

- But the literature does show that
  - More cutting can lead to more immediate bleeding
  - Too much coagulation in some cases can lead to more delayed bleeding or deeper injury
- Many factors are in play, but the intent is to try to get the balance about right.
- For example, many physicians often choose outputs with more coagulation for polypectomy, but with more cut for sphincterotomy.
THE ‘TISSUE EFFECT’ RESULTS FROM THE MIX OF CELLS THAT ARE ‘CUT’ AND THOSE THAT ARE ‘COAGULATED’

- **Current density** is the key
  - Spreading the energy over a larger area reduces the current density (intensity)
  - Being farther away from the energy source (accessory) lowers the current density (intensity)
  - Interrupting the delivery of the energy, rather than all at once, tends to lower the current density (intensity)
  - Delivering less total energy lowers the current density (intensity)
Electrosurgery is the correct term

- **ElectroCAUTERY**
  - Heats the TOOL, then the tissue
  - Can never ‘cut’
  - Can only coagulate
  - Example: The Olympus Heat Probe

- **ElectroSURGERY**
  - Heats the TISSUE not the tool
  - Can cut and coagulate
  - Can cut and coagulate at the same time
  - Always needs an electrosurgery generator to produce the high frequency outputs.
How do we commonly use ES in GI?

Learning Objective Two
MATCHED WITH APPROPRIATE ACCESSORIES, ES IS USED

- With these Accessories:
  - Snares
  - Sphinctertomes
  - Contact coagulators
  - Hot biopsy forceps
  - Needle and ESD knives
  - Argon coagulation probes
  - Bipolar endostasis probes

For

- General hemostasis of varied bleeding lesions
- Ablating unwanted diseased tissue
Electrosurgery energy requires a complete circuit in order to flow.
Both MONOPOLAR and BIPOLAR accessories are utilized in endoscopy. The terms refer to the manner in which the circuit is completed by the accessory.
Bipolar Accessories complete the circuit by having both the positive and the return electrode built into the accessory.
Monopolar accessories require a dispersive electrode—(grounding pad)—to complete the circuit.
**Why are the pads “Dispersive”?**

- Current that will boil water if concentrated onto one square millimeter of area will not even feel warm if spread over one square centimeter. (Tucker 2000)

- The pad’s function is to evenly spread out the energy used for therapy, so it can harmlessly exit the body on its way back to the generator to complete the circuit.
WHAT IS THE CURRENT PATH?

- The monopolar *current path* is the invisible ‘road’ within the patient leading from the tissue therapy site to the pad.
- The current will travel a ‘path of least resistance’ to the pad

*We will return to this idea again when we talk about safety!*
Endoscopy Pad Placement

- Place close to procedure site
- Choose well vascularized area
- Avoid implants, bony areas, broken skin, scars, tattoos
- Clean or shave skin if needed
- Make sure pad is fresh and smoothly attached
- Check the pad if the patient has been moved
Pad Sensing Safety Systems rely on “Smart” (dual/split) Pads

- Dual/REM/Split Pads (Smart)
- Single/Mono Pads
CAUTION: Many generators will give you the “GREEN” light even if a MONO pad is not on the patient! You need to use special care with monopolar (non-sensing) pads. If the light is green, but no pad is on the patient, no power will be delivered. You may inadvertently perform a ‘cold’ procedure.
DUAL/SMART PADS ARE A GOOD IDEA

- Even though the risk of a pad burn in GI applications is VERY low (no known published case of an actual pad burn in GI)
- This is an excellent safety technology which is low cost and recommended by safety experts.
HOW DUAL ‘SMART’ PADS WORK

- When used with pad safety equipped generators:
  - Will have a ‘Red’ warning light if NO pad is plugged in or
  - Pad can’t read an acceptable BASELINE condition at the patient/pad site or
  - If at any time during the procedure, the pad no longer registers a safe condition at the pad/patient site.

- A green light is present if the generator has established an acceptable baseline

- And during the procedure any change from that baseline remains in an acceptable range.
**Red light—green light: tips!**

- Is the light slow to go green?
  - The pads need time to establish a baseline impedance reading for that patient, and send the ‘OK’ signal to the generator
    - Try ‘rubbing and waiting’ before starting over with a new pad
  - Is the pad gel fresh? (Don’t open until ready to use)
  - Is there too much hair, lotion, or an obstruction under the pad?
  - Is patient’s skin very dry? Moisture in the pad gel may need more time to adhere and signal
  - Are you storing your pads in too cool an area?
  - If this happens too often, you may try a better match between your generator and pad brand.
GETTING TO KNOW GENERATORS

- The generator’s job is to take the alternating current from the wall and speed it up.
- It delivers the energy to the accessory in defined ways called ‘wave forms’ or outputs.
THE GENERATOR WAVEFORM OUTPUT NAME

- Strong Cut
- Soft Coag®
- TouchSoft®
- Coag
- Forced Coag
- Blend One
- Pulse Cut
- EndoCut I or Q®
- Blend Coag
- Blend Cut
- Swift Coag
- Pulse Blend Cut
- Fulgurate
The names are just trying to tell you how much cut and/or coag to expect.

You just need to know which one ON YOUR GENERATOR is recommended for particular procedures and/or accessories.

Being able to select the waveform allows the ability to select appropriate outputs for the clinical need.
### Table of Available Outputs on Generator Units

<table>
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<tr>
<th>Genii gi4000</th>
<th>ERBE VIO300D</th>
<th>ERBE VIO200S</th>
<th>ERBE ICC200</th>
<th>ERBE VIO100C</th>
<th>ConMed BiCap® III</th>
<th>ConMed Beamer™Mate</th>
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<td>Coag</td>
<td>Forced Coag</td>
<td>Forced Coag</td>
<td>Forced Coag</td>
<td>Forced Coag</td>
<td>Coag</td>
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<tr>
<td>Blend Coag</td>
<td>Swift Coag®</td>
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<tr>
<td>Pulse Blend Cut</td>
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<td>Blend Cut</td>
<td>Dry Cut</td>
<td></td>
<td>Dry Cut</td>
<td>Blend</td>
<td></td>
<td>Blend Cuts 1 &amp; 2</td>
</tr>
<tr>
<td>Pulse Cut</td>
<td>EndoCut I or Q®</td>
<td>EndoCut I or Q®</td>
<td>EndoCut®</td>
<td>Pulse Cut</td>
<td>Pulse Cut (Polyp and Papilla)</td>
<td></td>
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<tr>
<td>Cut</td>
<td>Auto Cut®</td>
<td>Auto Cut®</td>
<td>Auto Cut®</td>
<td>Pure Cut</td>
<td>Pure Cut</td>
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<tr>
<td>Bipolar</td>
<td>Bipolar</td>
<td>Bipolar</td>
<td>Bipolar</td>
<td>Bipolar</td>
<td>Bipolar BiCap® &amp; Cut</td>
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<td>Sprayed Coag</td>
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</tr>
<tr>
<td>ArC Smart Beam™</td>
<td>APC 2 Forced, Pulse 1 &amp; 2, Precise (Requires an additional unit at additional cost)</td>
<td>APC 2 Forced (Requires an additional unit at additional cost)</td>
<td>APC300 Forced (Requires an additional unit at additional cost)</td>
<td>Beamer Plus: Argon Steady, Slow, Fast, Super (Requires an additional unit at additional cost)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Electrosurgery in Gastrointestinal Endoscopy: Principles to Practice. 2009 Am J Gastroenterol; 104(6); 1563-74

The setting on the Blue Panel is activated only by the Blue Pedal.

The setting on the Yellow Panel is activated only by the Yellow Pedal.
GETTING TO KNOW ES GENERATORS

- Waveform names are not standardized
- Suggested settings may vary between units and brands
- All current brands use microprocessors to add safety features and to read and adjust to changes in impedance—

The first patent for dual (split) grounding pad safety was US Pat. No. 4,416,276 by David Newton for ValleyLab in 1983

The first patent describing the use of a microprocessor to control output characteristics was filed in 1986 by Michael Manes of Aspen Labs. US Pat. No. 4,574,801

JHG, 2016 1(1):1-5
MICROPROCESSORS

- They allow us to have INFORMATION messages
- And WARNING alerts
...AND THE ABILITY TO MONITOR TISSUE RESISTANCE WHICH IMPROVES GENERATOR PERFORMANCE

- As tissue becomes coagulated or cut, it becomes more resistant to letting the energy flow through the tissue.

- Microprocessors in the generator track these changes. (They are also monitoring the grounding pad and any change in impedance there!)

- The generator then adjusts current and/or voltage as needed to produce the power directed by the software design. The design can be ‘mapped’ on a graph called a ‘power curve’.
TWO BASIC POWER CURVE TYPES

Narrow

Broad

Resistance going up
Two basic power curves

Narrow

- Power ramps up quickly into ‘bleeding’ tissue
- Falls automatically as tissue gets ‘white’
- Bipolar is our best known example!
- TouchSoft® or Soft Coag® work like this, too.

Great For:

- Contact coagulation
  - Bipolar probes
  - TouchSoft Coagulator®
  - Coagrasper™

The power setting you see is only the max power it targets! By the time you see white only a watt or two is being delivered!
**Two basic power curves**

**Broad**
- ‘Cruise control’ aligns voltage and/or current around a target setting or effect
- Avoids things like ‘snare entrapment’ because it keeps things going smoothly

**Great For:**
- Snare polypectomy
- Sphincterotomy
  - Can add a ‘pulse’ feature too! (EndoCut® or Pulse Cut)
  - Nice smooth cutting with varying coagulation is the goal
What you see? What you get?

- Depending on the power curve, the power setting you see displayed may or may not be close to the power that is delivered.

- In all cases the AVERAGE power actually delivered is LESS than the target MAXIMUM.

- Convention is to chart the power output shown on the display.

- The entire generator is not ALL one type of power curve or the other: All modern generators have some OUTPUTS of each.

- Power curves are listed in every generator’s user manual.
WHAT ABOUT ARGON COAGULATION?

- It also uses ES energy
- The generator provides the energy needed to ionize the gas—turn it into the gas plasma beam that you can see.

- It is a monopolar application. You use a grounding (dispersive) pad.
- Placing the pad as close to the treatment site as possible can help to get a longer ‘beam’.
ARGON COAGULATION

- Called APC, ABC® or ArC (argon plasma coagulation, argon beam coagulation, or argon coagulation)
- Provides non contact application of thermal effect
- The eschar produced is more pliable and can be less likely to re-bleed than other methods
- It coagulates or ablates
  - Effect tends to be superficial, but the depth of the effect is controlled by
    - Adjusting Time and/or Power
    - The nature of the beam: amplified or non amplified
    - Not all systems use the same settings! Know your generator!
ARGON COAGULATION PEARLS

- Can be used in the lung
- Changing the argon flow rate does not alter the tissue effect
- As long as an adequate argon cloud present, turning UP the argon flow rate will NOT make the beam longer
- Too high flow rates can increase patient distention and increase the risk of pneumatosis
- Safe and effective for a wide range of applications especially for diffuse lesions
- It really can go around corners! It always follows the circuit to the nearest tissue
- It really can cut off stents
- It will ignite under water
- The manufacturer’s suggested power settings vary with the beam type (pulsed or constant, amplified, linear, etc.) Be sure not to try to make one setting fit all!
HOW CAN I USE ES MORE SAFELY?

Learning Objective Three
Final outcomes in perspective

- Patients being treated with anticoagulants have higher bleeding risk.
- One large study (167,208 polypectomies) concluded that hypertensive patients were at higher risk for post PP bleeds.
- Previous PP site biopsy or failed sphincterotomy can leave scarring increasing risk for subsequent treatments.
- At least three large studies have shown that the risk of PP bleeding was found to increase by 5 to 13% for every additional mm of polyp size.
- Large Rutter et al study found that the greatest risk factor for both PP bleeding and perforation was polyp size.
**SPECIAL PATIENT CONSIDERATIONS**

- Don’t perform ES procedures if patient movement is uncontrolled
- Try not to activate if you can’t see
- Do not use any ES (including argon coagulation) with an improper bowel prep.
  - Catastrophic bowel explosions are uncommon, but a real risk as rare combinations of methane, hydrogen and oxygen can occur in some patients.
  - A complete, full length colon prep should be ordered even if the ES is to performed only in the sigmoid or rectum.
- Always monitor patients for distension when using argon coagulation, especially on long cases.
Special Patient Considerations: Implanted Cardiac Devices

- Which patients have them?
- About 20% of patients are pacing dependent—which are they?
- Implanted Cardiac Devices- Pacemakers and cardioverter defibrillators (ICDs) are designed to sense and react to electric signals from the heart
  - This makes them sensitive to electric signals from external sources like ESUs
  - Newer models are more robust in resisting interference
  - Patients with these devices can usually safely receive electrosurgery treatment, but precautions should be noted.
**CAUTIONS FOR CARDIAC DEVICE PATIENTS**

- Have a protocol in place to identify these patients
  - And those who are dependent on the device for moment to moment maintenance of proper cardiac rhythm.
  - And to discern the type of device

- Help writing your protocol can come from consensus statements by
  - American College of Cardiology Foundation/American Heart Association (ACCF/AHA)
  - American Society of Anesthesiologists (HRS/ASA)
  - American Society of Gastrointestinal Endoscopy (ASGE)

- An up to date summary appears in the Gastrointestinal Nursing Journal Nov/Dec 2015 issue
MIND THE CIRCUIT TO BE SAFER

- Modern generators make sure that nearly all energy returns to the generator ONLY via the dispersive pad.
- Most safety concerns and accidents can be mitigated with a good understanding of the monopolar circuit and current path.
ES WITH JEWELRY: KEEP IT IN PERSPECTIVE

- It is always a good idea for patients to remove valuables before coming for ANY medical procedure.
- Loss, theft, tearing of pierced sites, and swelling are all risk factors.
- But the risk from ES has often been exaggerated!

- “I certainly agree that the majority of jewelry should be left at home, not because of the potential for electric injury, but rather for commonsense safekeeping.” RD Tucker, GNJ letter to editor 2007

- “Although there may be other reasons for removal of all patient jewelry (eg, risk of swelling, theft) the risk of an alternative site injury from stray current is negligible.” AORN
EXPERTS AGREE: **STRAY** CURRENTS ARE NO PROBLEM!
BUT METAL OBJECTS, INCLUDING JEWELRY, IN THE
*DIRECT CURRENT* PATH CAN HAVE SOME RISK

Earring? OK!
THINK: WHERE IS THE CURRENT PATH?

Ankle? OK!
METAL OBJECTS, INCLUDING JEWELRY, IN THE DIRECT CURRENT PATH? GENITAL PIERCE?

Gown snap or pierced jewelry in current path? Stop and think.

And never UNDER the pad!
SOMETHING NEW: DERMAL PIERCINGS

- Darn! That's prime real estate for grounding pad placement!
- Many ornaments are removable. If in the path and you can remove, do.
Keep things in perspective

- Don’t place a grounding pad directly over any metal
- If metal is in the current path, re-direct the pad, or try to remove the metal
- If not possible, use short energy bursts and monitor the metal for heating.

SGNA member with a dermal piercing!
OTHER SAFETY TIPS:

- Don’t connect or disconnect an accessory when current is flowing (pedal is down)
- Don’t wrap active cords, grounding pad cords and/or patient monitoring cords all together
- Try to avoid adapters and connectors. If you have them, make sure they fit well and are in good repair.
- Watch for worn spots or breaks in insulated coverings on active cords.
IN SUMMARY: OUR LEARNING OBJECTIVES
IDENTIFY THE BASIC TECHNOLOGY OF ELECTROSURGERY (ES) HOW DOES IT WORK?

- Electrosurgery uses high frequency (RF) alternating current energy to produce heat in tissue.
- The intensity of ES heating can be regulated by changing the waveform, the power setting, the electrode and/or the time energy flows.
- Rapid, intense, local heating creates more cutting effect, while slower heating or heating over a larger area produces more coagulation.
- Use correct terms, best practices and encourage education to promote electrosurgical safety and efficiency.
How do we commonly use it in GI?

- Dispersive pads disperse exit energy and complete the circuit with monopolar accessories
- Most GI accessories are monopolar
- Argon coagulation is also a monopolar procedure
- Bipolar accessories do not require the use of a dispersive electrode (grounding pad)
HOW CAN WE USE IT MORE SAFELY?

- Mind the circuit
- Be aware of patient factors that might increase some risks:
  - Uncontrolled or uncooperative patients
  - Poor bowel preps
  - Implanted devices
  - Pierced jewelry IN the current path
- Promote high quality ES education for all team members
THANK YOU!
ADDITIONAL REFERENCES AND SUGGESTED READING

- AORN. Recommended practices for electrosurgery. Perioperative Standards and Recommended Practices. Denver, CO; AORN, Inc. 2010; 105-125