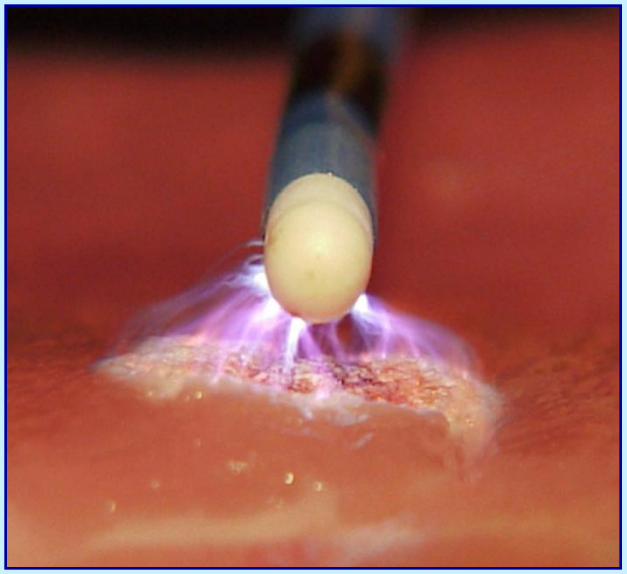
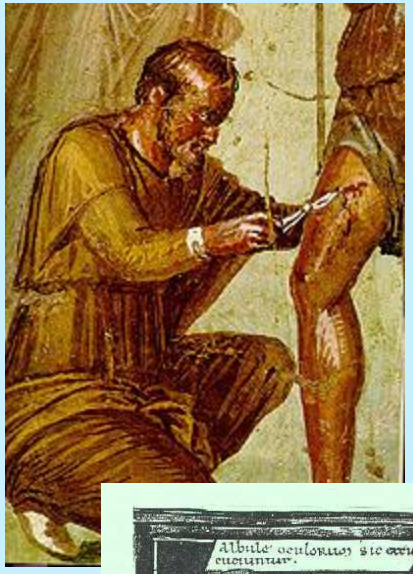


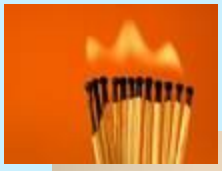
Using Argon Plasma Coagulation in GI and Pulmonary

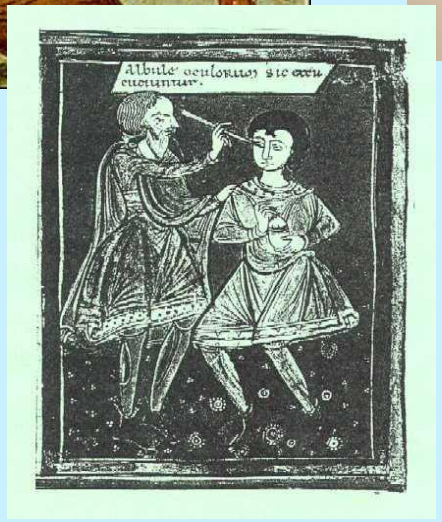
Objectives

- Discuss the history of Electrosurgery and Argon Plasma Coagulation (APC), the variables involved and how it is used therapeutically.
- Describe the basic properties and components of APC.
- Describe clinical indications of APC in GI and Pulmonary, proper technique and how to apply it safely.
- Discuss special nursing considerations in promoting optimal outcomes.

History of Electrosurgery

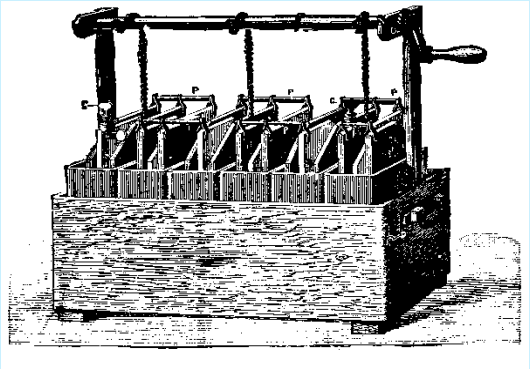




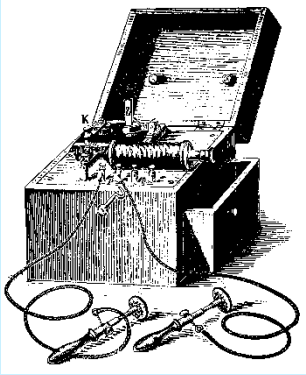


Electricity Becomes Electrosurgery

in Europe, 1923

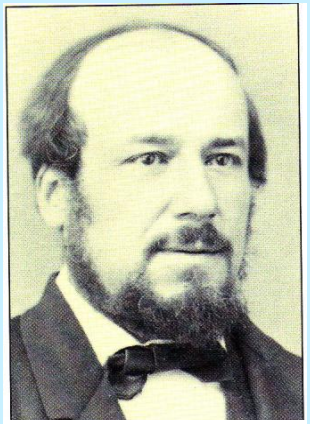


Galvanocautery - Hot wire



Battery and Coil

Vacuum Tube - 1923



1847 - 1882

Christian Heinrich ERBE

1882 - 1907

Christian Gottfried ERBE

1907 - 1962

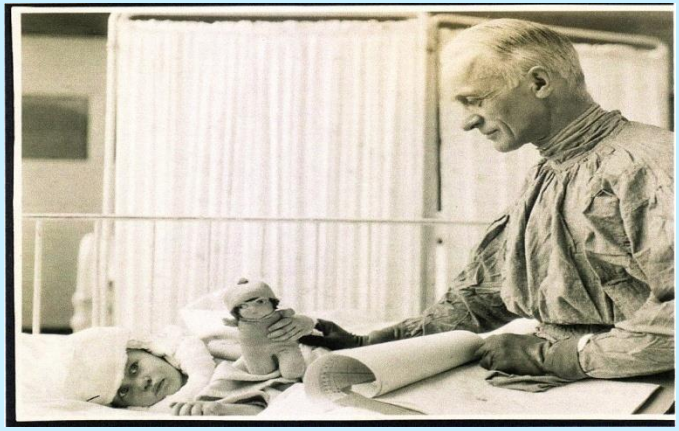
Christian Otto ERBE

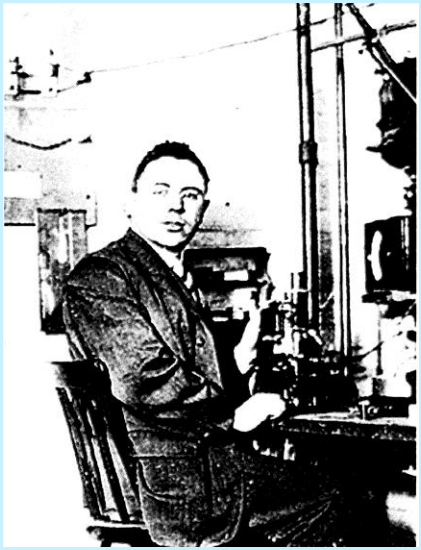
Electricity Becomes Electrosurgery

in the US, 1926

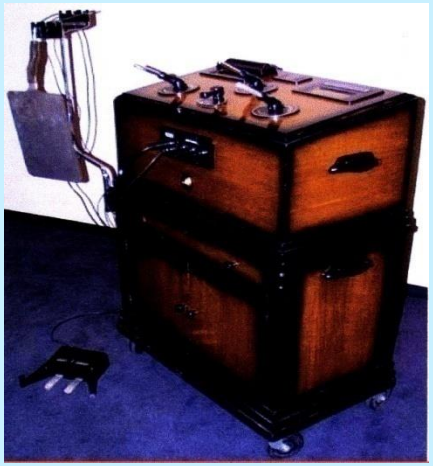
Father of American Neurosurgery

Harvey Cushing, MD

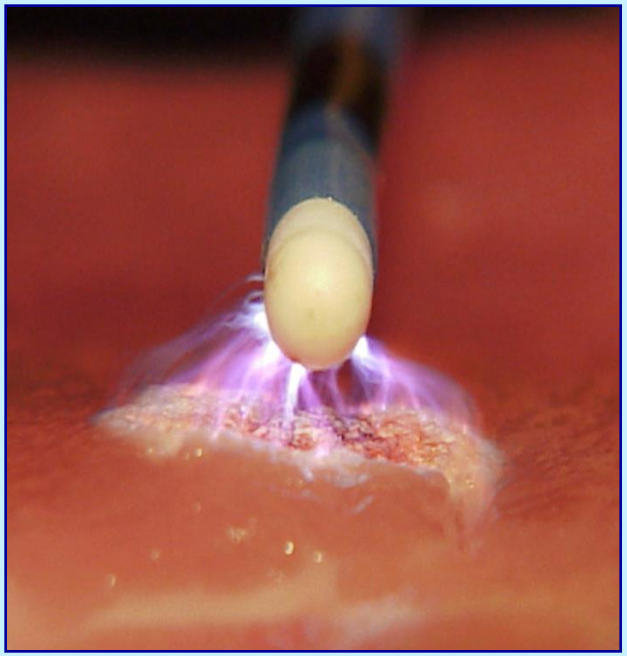




William T. Bovie, PhD.

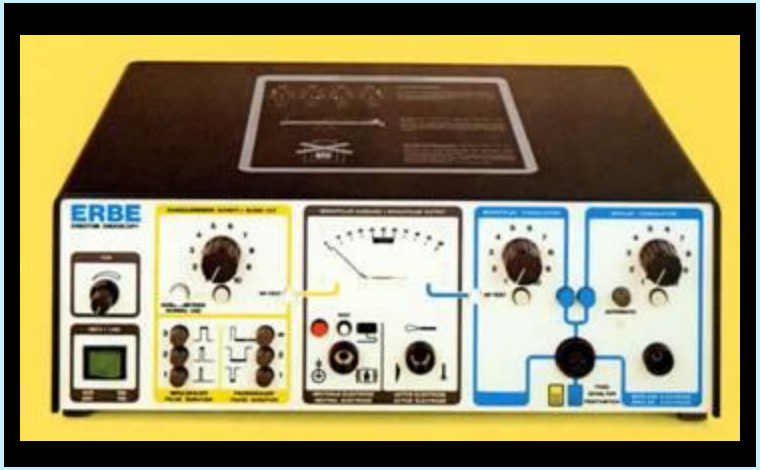


History of Argon Plasma Coagulation (APC)



- J L Glover, MD first began using a “plasma scalpel” in 1971
- APC was first used clinically in open surgery, shortly thereafter in laparoscopic and thoracoscopic surgeries
- In 1991, specialized probes enabled the use of APC in flexible endoscopy

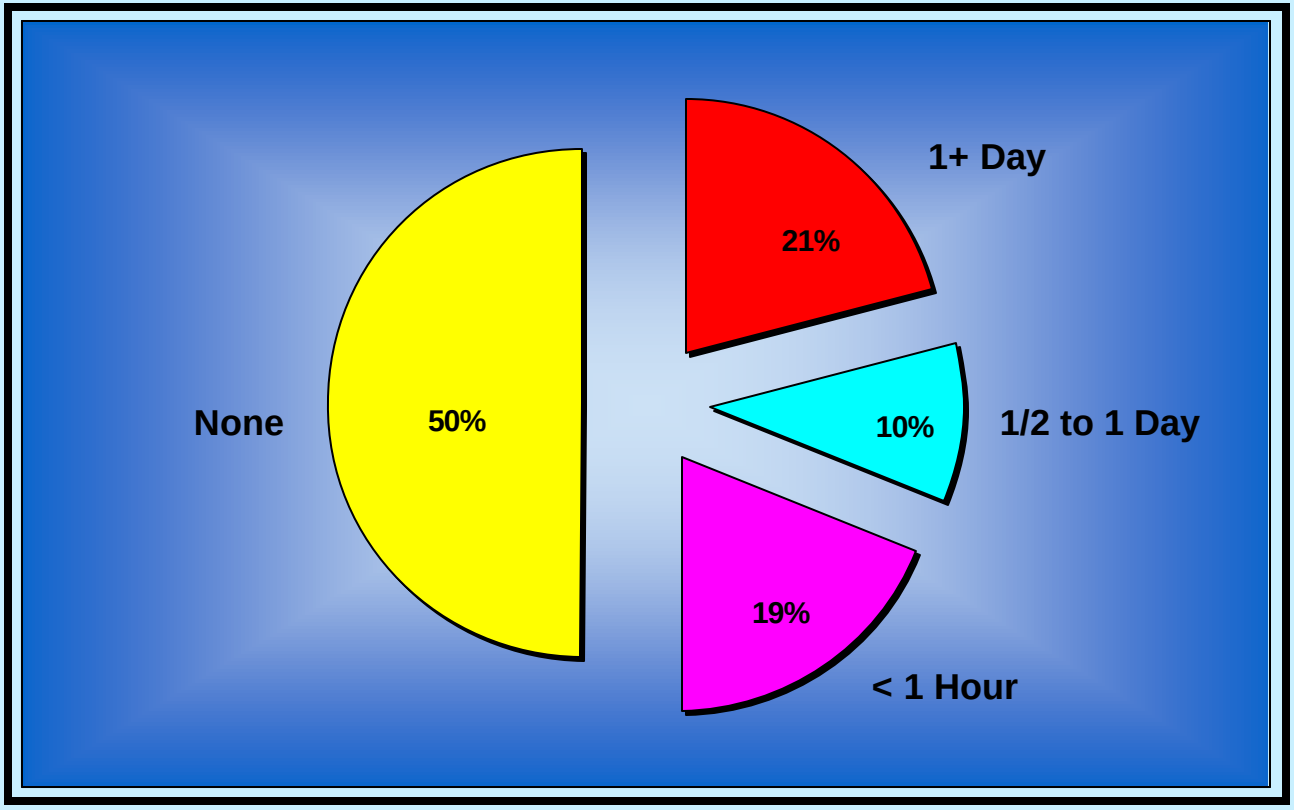
1978 J.L. Glover, MD



"There is no group of instruments in the surgical armamentarium that is used as frequently and understood as poorly as Electrosurgery units…."

We are educated…

> Formalized Education on Electrosurgery



Survey of 400 Surgeons

This Happened to *Experts?*

The Clinical Circuit

<u>Circuit</u> - flow of current from the ESU to the active electrode, to the patient, to the pad, and back to the ESU

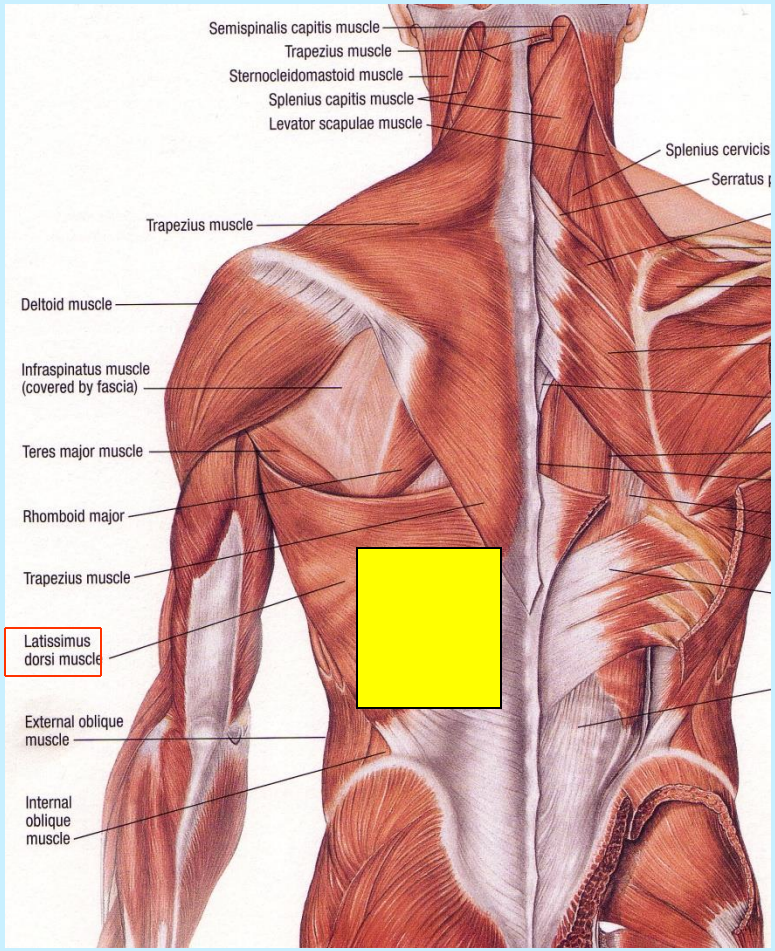
Three variables always present during electrosurgery:

- *<u>Current</u>* – flow of electrons through the electrical circuit
- *<u>Voltage</u>* - electrical force pushing current around the circuit, through varying degrees of tissue resistance
- *<u>Impedance</u>* (Resistance) - literally the tissue being treated, which has varying characteristics

Two Basic Principles of Electricity

- Always seeks ground
- Always seeks the path of least resistance

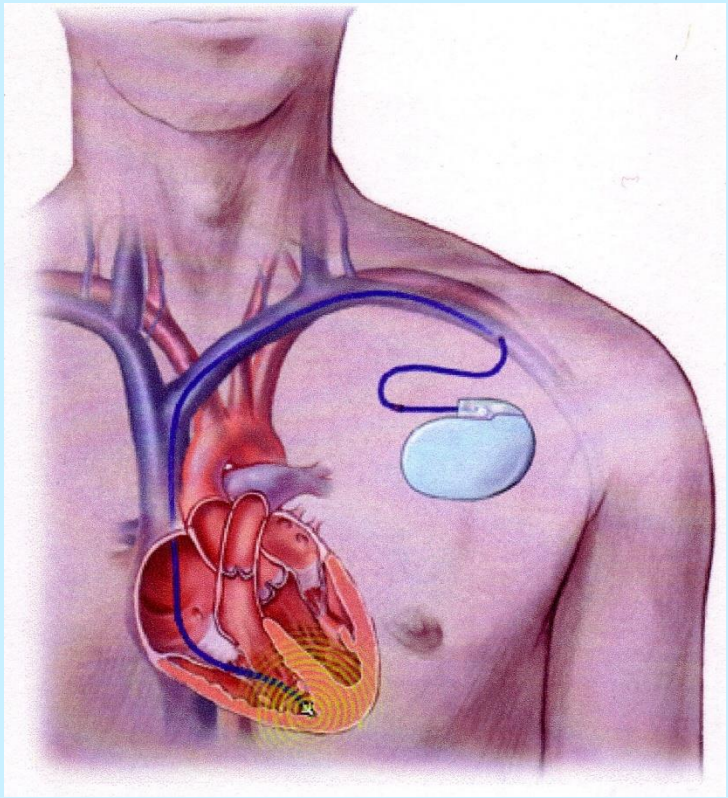
GI Endoscopy Pad Placement



- Well vascularized area
- Shortest circuit possible
- Optimum – on flank
- Alternatives – Thigh or Arm

- Avoid Buttock placement
- Remove pads carefully to prevent shearing of skin

Pad Placement Exceptions



- *Fluro procedures*
  - ERCP
  - Pulmonary

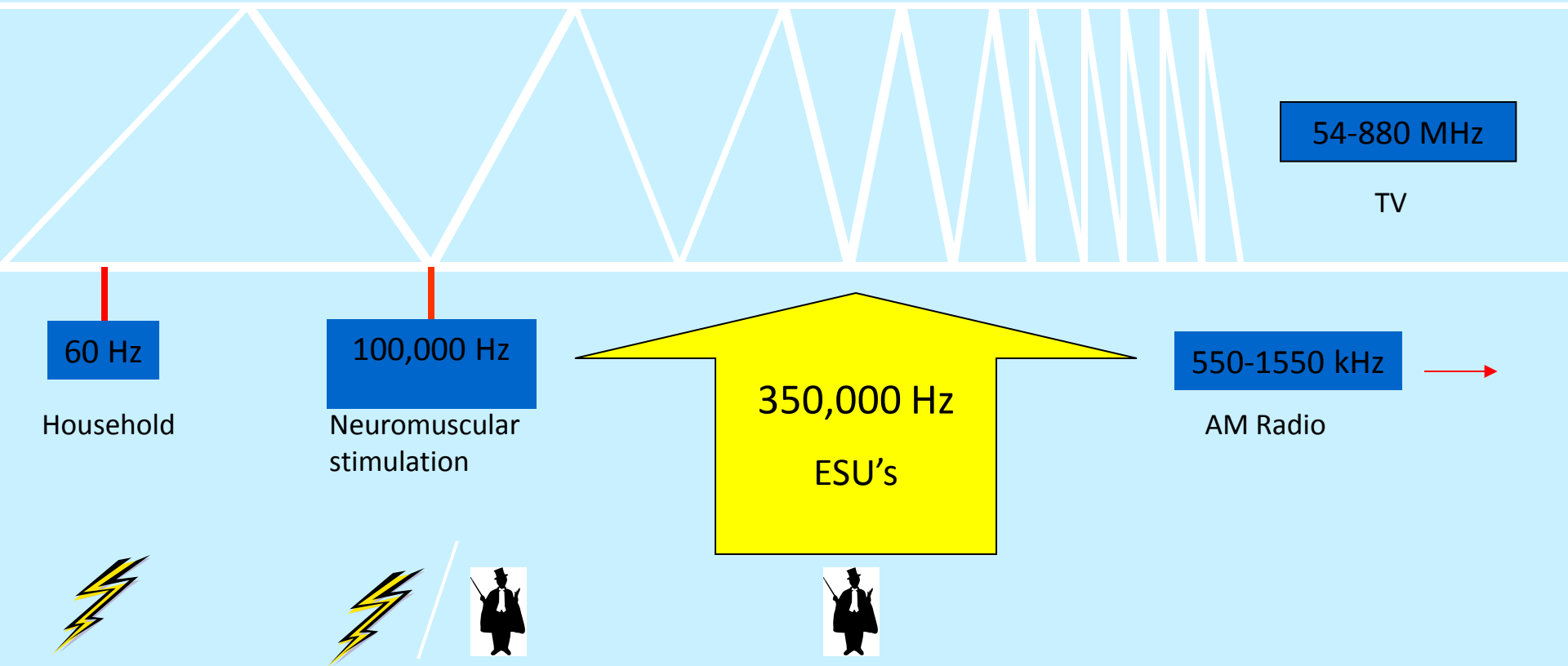
- *Pacemaker / AICD / IED Patients*

  - Draw current AWAY from implanted device

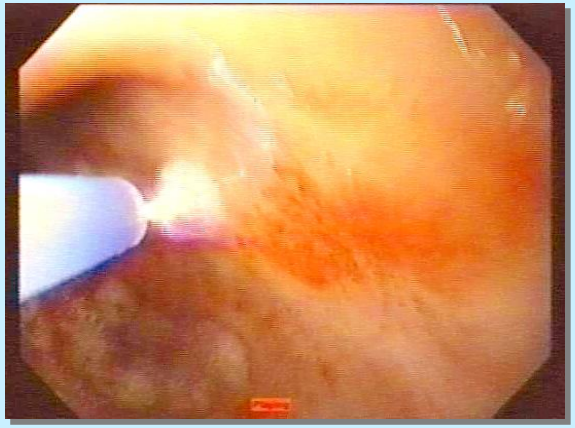
  - Pad placement opposite side of body, lower extremity if possible

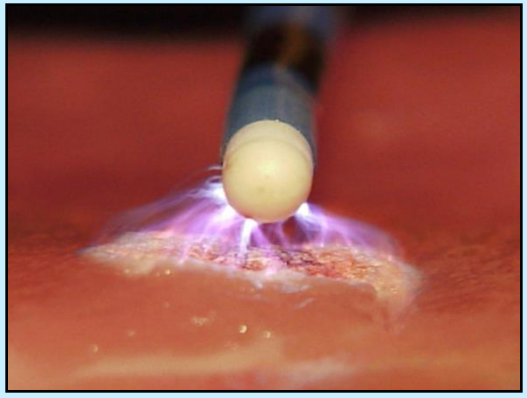
The Electrical FREQUENCY Spectrum

(Why patients do not feel electrosurgery?)



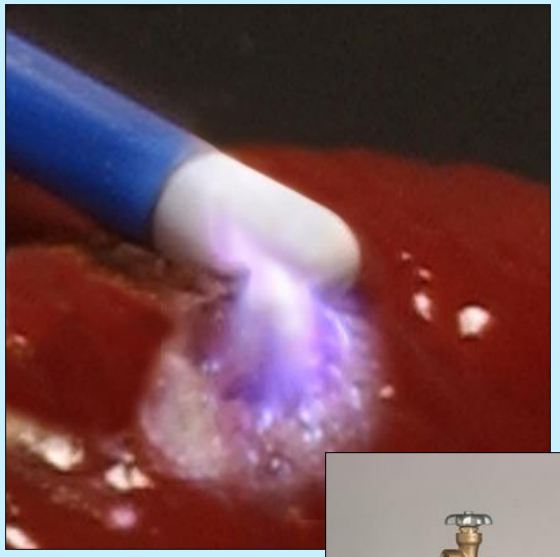
Argon Plasma Coagulation





APC is a non-contact monopolar application

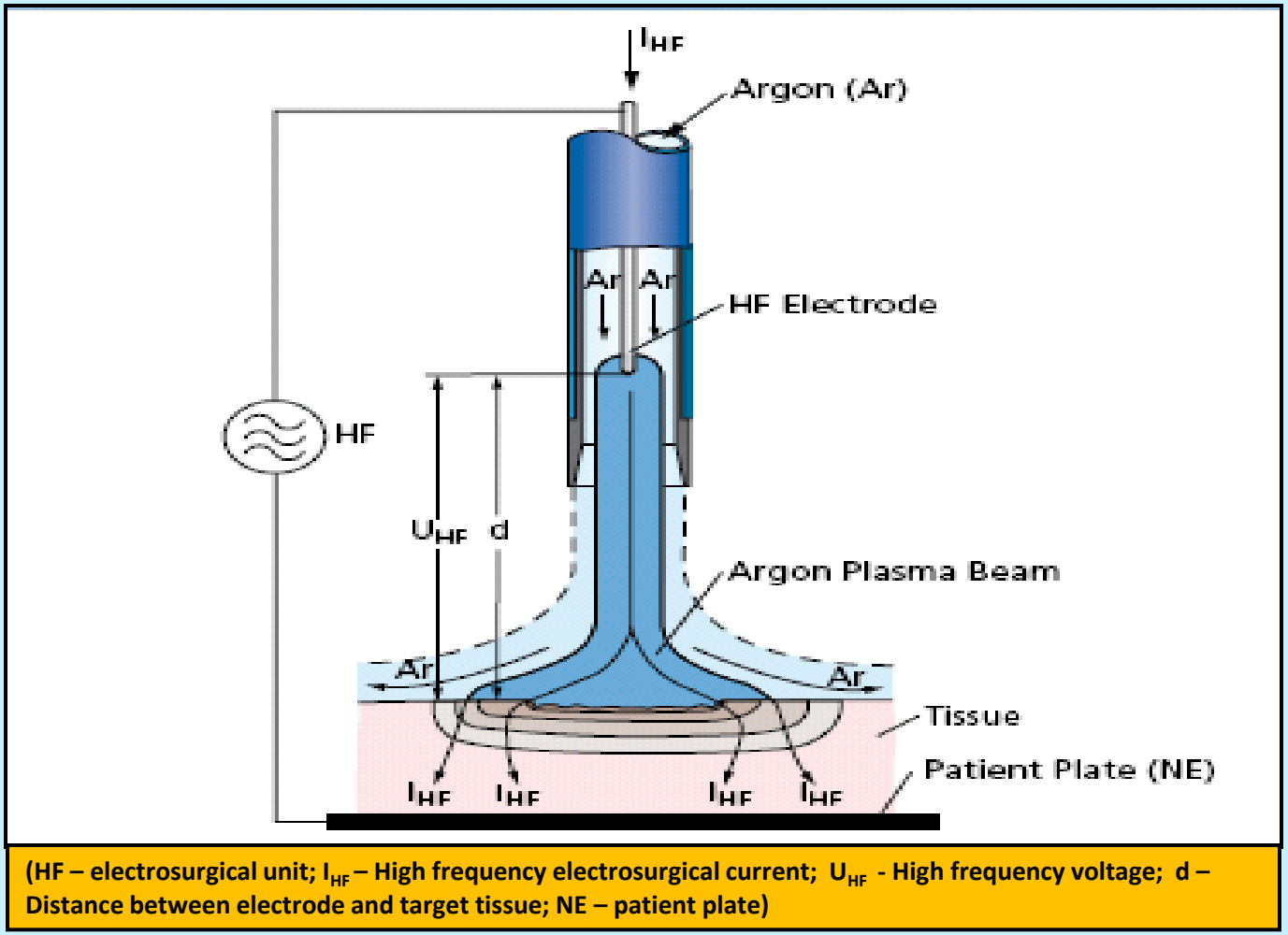
Properties of Argon Gas



Properties:

- Non-flammable
- Non-toxic
- Colorless, odorless, tasteless
- Ionizes easily
- Relatively inexpensive
- Noble gas – very stable
- 99.99% pure

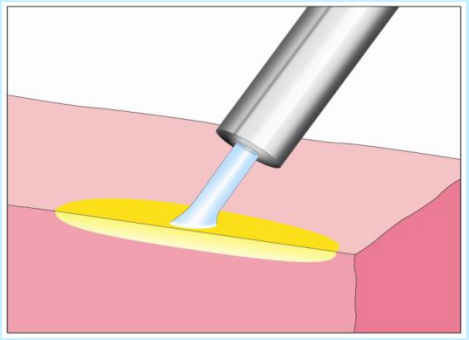
Argon Plasma Coagulation



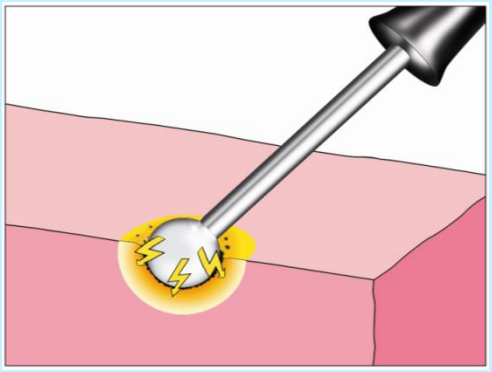
(HF – electrosurgical unit; I_{HF} – High frequency electrosurgical current; U_{HF} - High frequency voltage; d – Distance between electrode and target tissue; NE – patient plate)

APC is a monopolar application in which HF electrical energy is transferred to the target tissue using ionized (conductive) argon gas (plasma), without the electrode coming in contact with the target tissue

Argon Plasma Coagulation



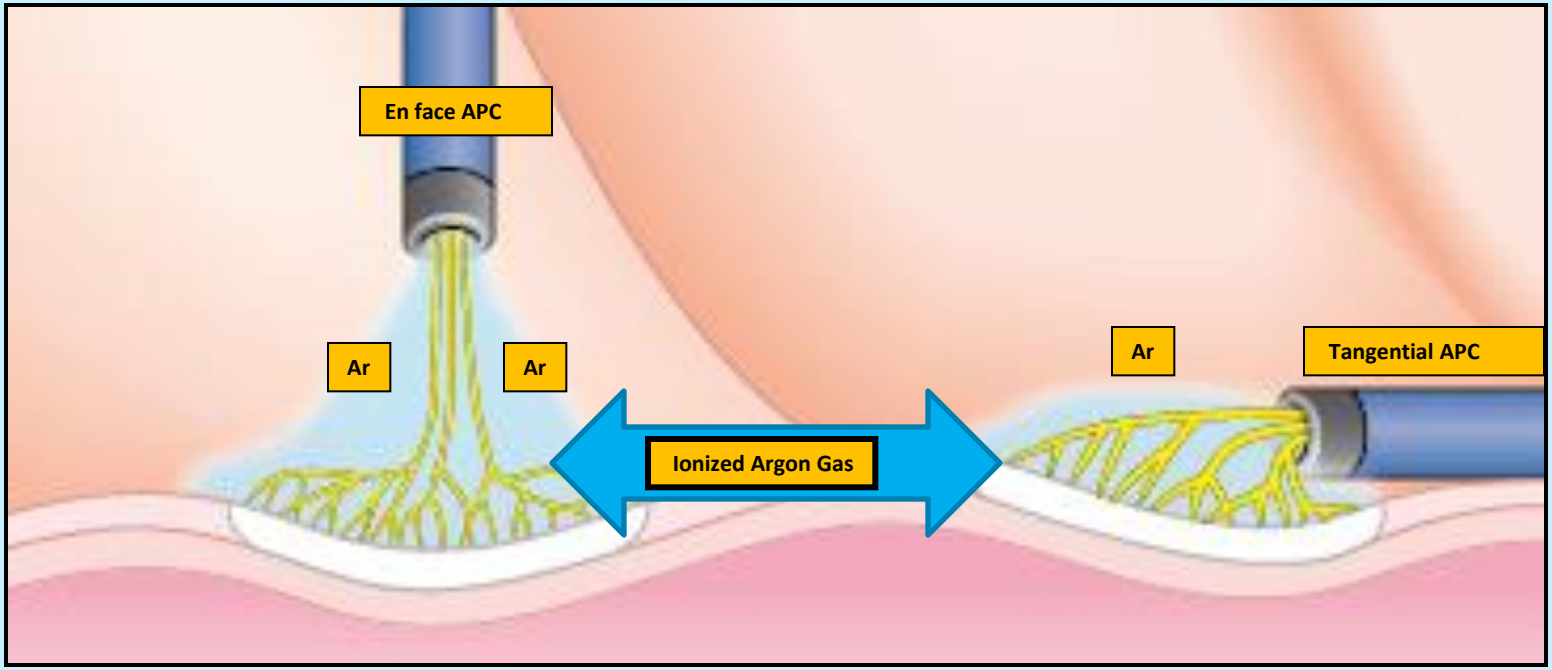
Non-contact
no sticking to tissue



Advantages:

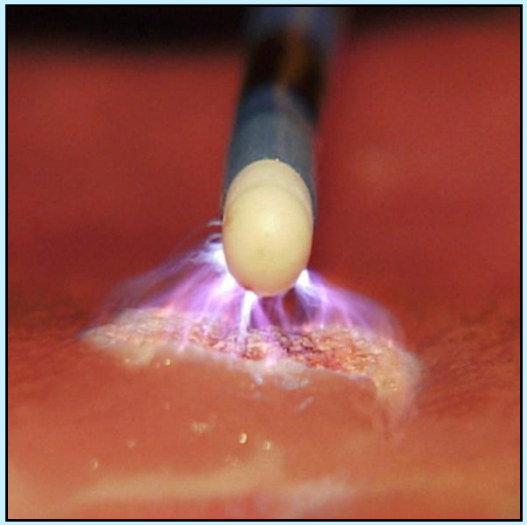
- Non-contact application
- As target tissue becomes coagulated, current automatically seeks new conductive tissue resulting in uniform hemostasis
- Smoke is reduced
- Thinner eschar, more flexible
- Limited penetration depth of approximately 3mm

Argon Plasma Coagulation



Argon Plasma Coagulation offers particular advantages for endoscopic applications, as it allows APC to be applied en face or tangentially, enabling less accessible areas to be easily treated

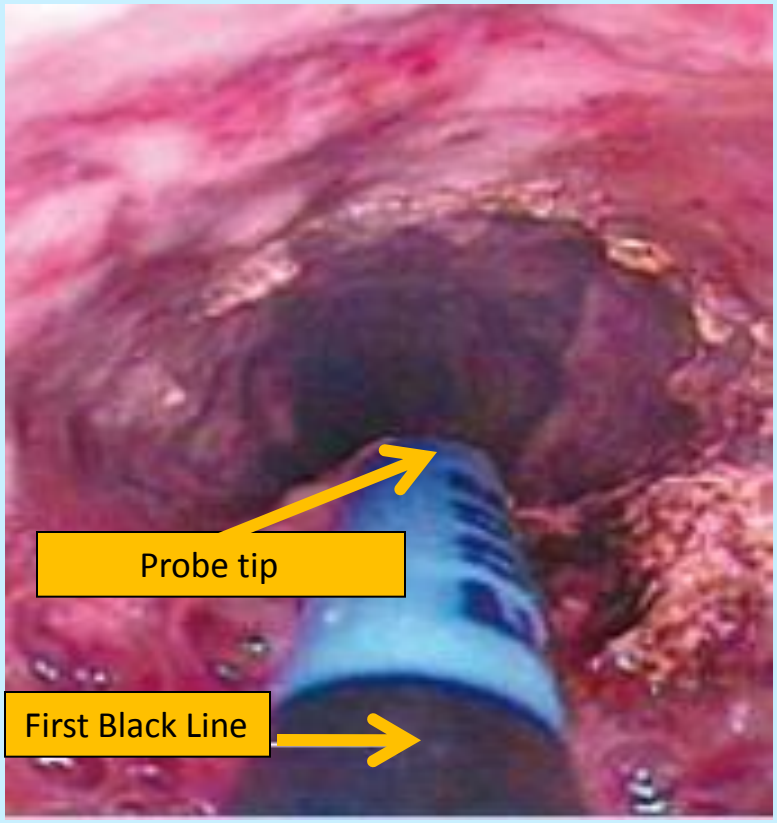
Argon Plasma Coagulation



Three items needed for Argon Plasma Use:

- Sufficient voltage to jump the air gap
- Proximity to tissue: 1-5 mm
- Conductive tissue – moist surface, feeder vessels

Argon Plasma Coagulation

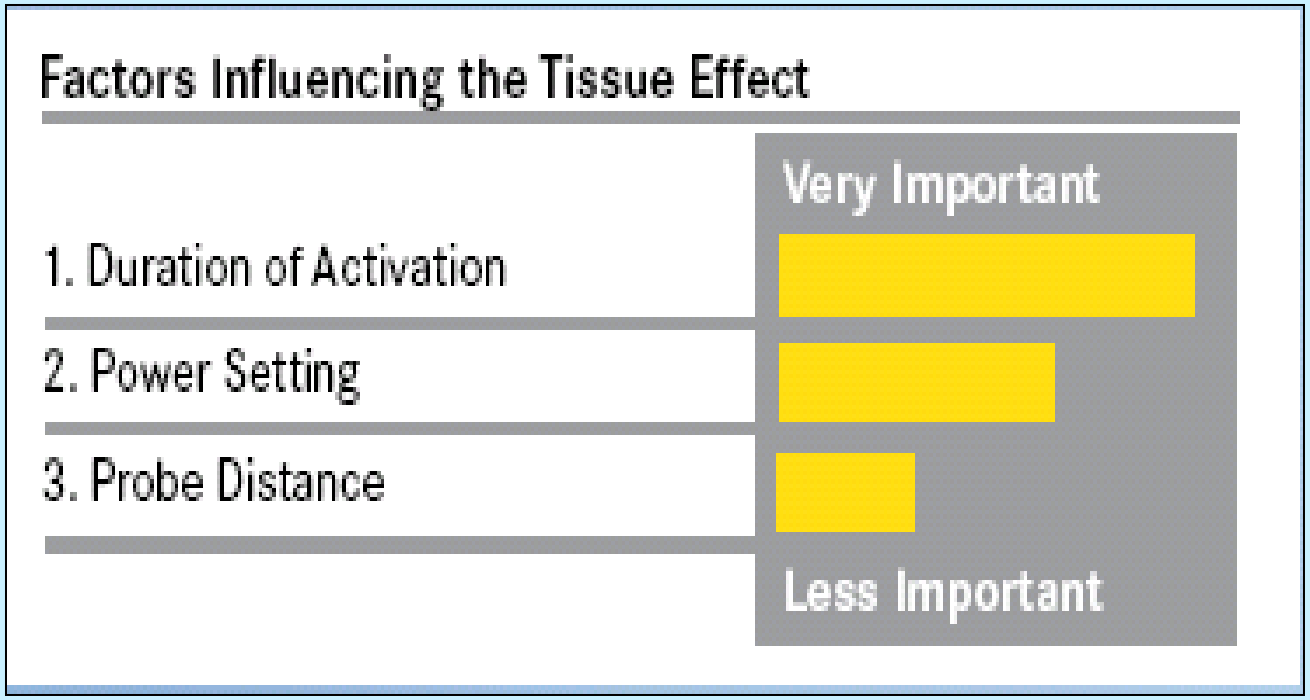


Scope Technique:

- Purge at least twice before placing the probe in the scope
- Advance the tip of the probe until the first black line is visible on the monitor
- Leave the probe stationary – move the SCOPE
- APC probe must always remain in the clinicians field of vision
- Activate only when the tissue being treated is within the field of view

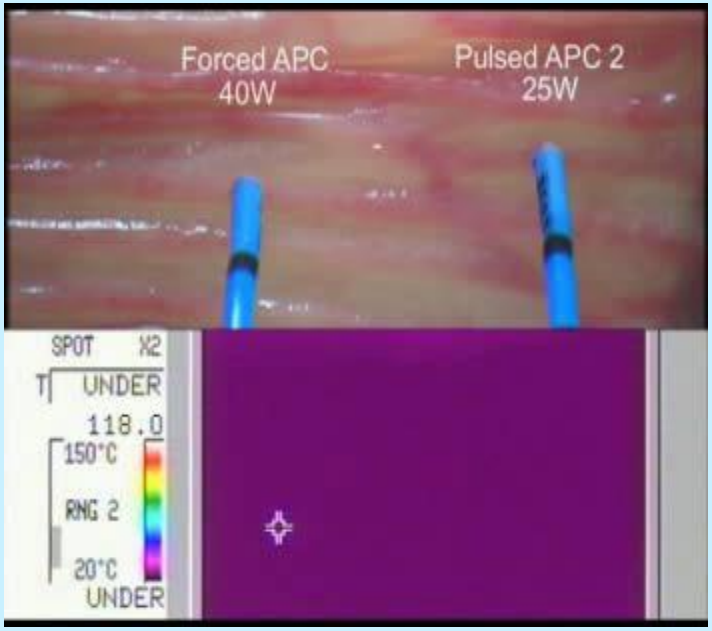
Argon Plasma Coagulation

The extent of the thermal effect of APC on tissue depends on several factors:



Argon Plasma Coagulation

Thermal effect - Mode chosen



APC has evolved through specialized modes with more controllable thermal effect:

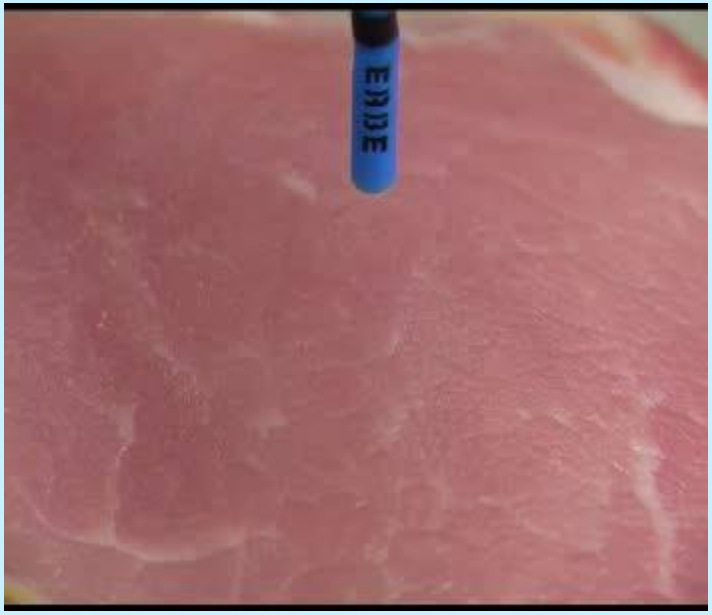
Pulsed 1 APC: pulses one time per second and used for focused coagulation

Pulsed 2 APC: pulses 16 times per second and used for wide spread coagulation

Forced APC: Constant beam and often used for devitilization of tissue

Argon Plasma Coagulation

Modes



Video

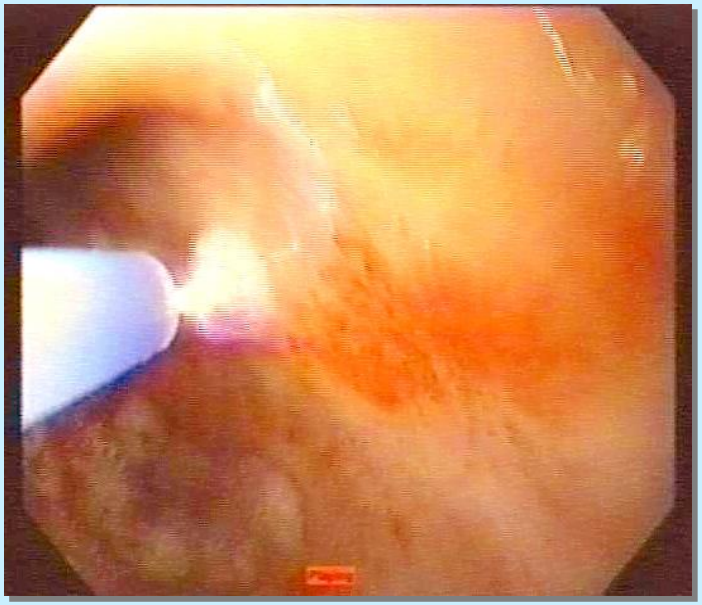
Precise APC:

The Precise mode creates a superficial coagulation effect using a low-energy output and is therefore suitable for temperature sensitive, thin-walled areas

Due to its ability to auto-regulate the beam, it can also be used on patients with increased peristalsis

Regula J, Wronska E, et al. Vascular lesions of the gastrointestinal tract. *Best Practice and Research Clinical Gastroenterology* 2008; 22: 313-328

Argon Plasma Coagulation



Application techniques:

Static:

- The probe is focused in one single area, thermal penetration will increase over time

- If applied for long periods of time in the same area, carbonization and vaporization can occur

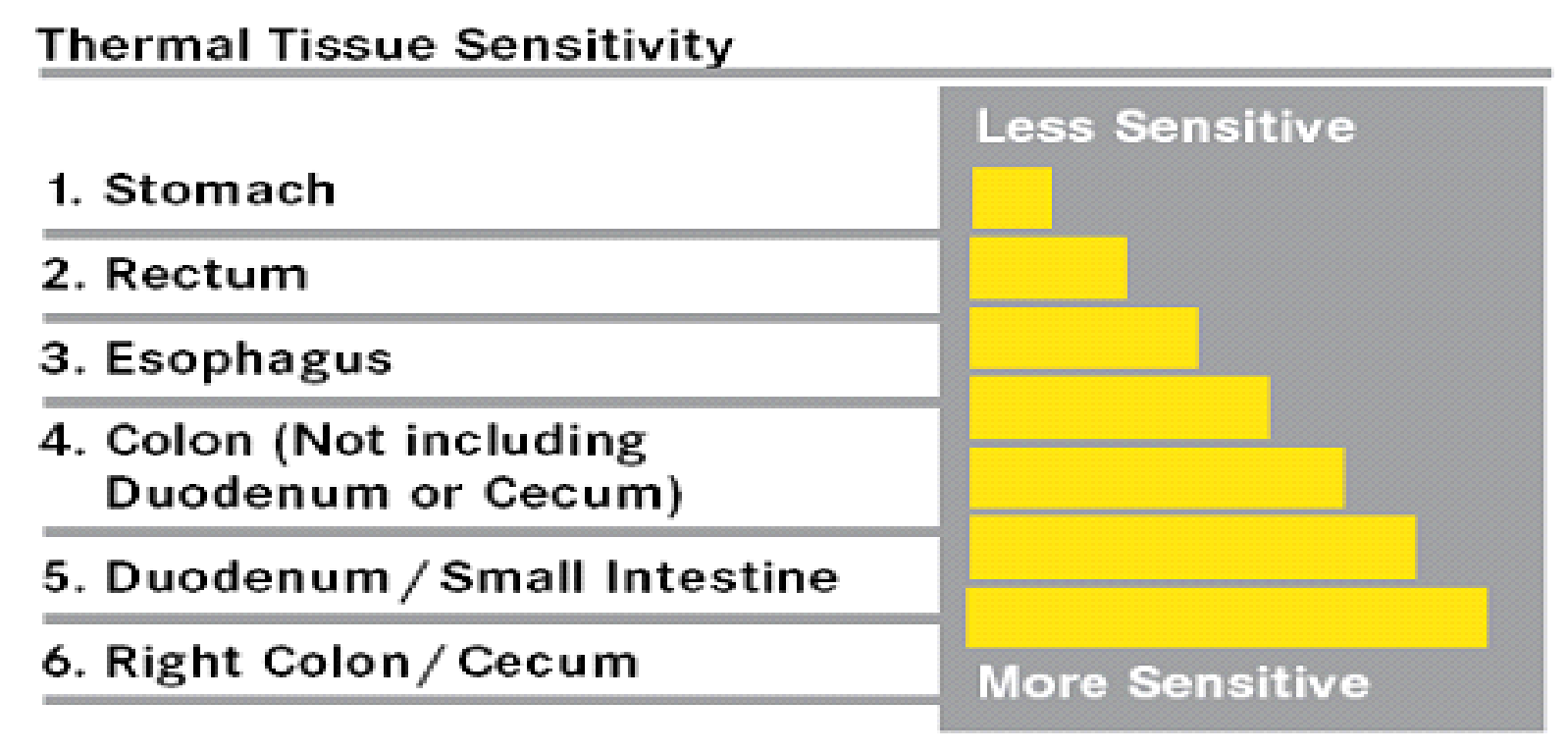
- For superficial treatment, short activation times of 1 to 2 seconds are used

Dynamic:

- The probe is moved with paintbrush-like strokes over the target area while observing the target tissue effect

Argon Plasma Coagulation

GI Thermal Tissue Sensitivity



APC GI Clinical Applications

Gastroenterology Uses found in Clinical Literature

- **Radiation Induced Proctopathy**
- **Watermelon Stomach (GAVE)**
- **Treatment of Residual Adenomatous Tissue**
- **Stent Shortening (e.g. migrated stents)**
- **Strictures**
- **Exophytic Benign or Malignant Tumors**
- **Oozing from Vascular Lesions (e.g. Angiodysplasias, Arteriovenous Malformations (AVMs), Telangiectasias)**

Argon Plasma Coagulation

Gastroenterology Uses found in Clinical Literature

References:

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2. Brooker, J. Treatment with APC reduces recurrence after piecemeal resection of large sessile colonic polyps: a randomized trial and recommendations. Gastrointestinal Endoscopy, 2002.
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5. Eickhoff, A, et al. Prospective nonrandomized comparison of two modes of argon beamer (APC) tumor desobstruction: effectiveness of the new pulsed APC versus forced APC. Endoscopy 2007: 39: 637-642. Ferreira, L, et al. Post-Sphincterotomy Bleeding: Who, What, When, and How. American Journal of Gastroenterology. 2007.
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8. Fukami, N. Endoscopic treatment of large sessile and flat colorectal lesions. Current Opinions in Gastroenterology. 2006:22:54-59.
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Argon Plasma Coagulation

Gastroenterology Uses found in Clinical Literature

References:

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18. Norton, I, et al. A Randomized Trial of Endoscopic Biliary Sphincterotomy Using Pure-Cut Versus Combined Cut and Coagulation Waveforms. Clinical Gastroenterology and Hepatology. 2005; 3:1029-1033.
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22. Perini, Rafael. Post-sphincterotomy bleeding after microprocessor-controlled electrosurgery. Gastrointestinal Endoscopy. 2005.
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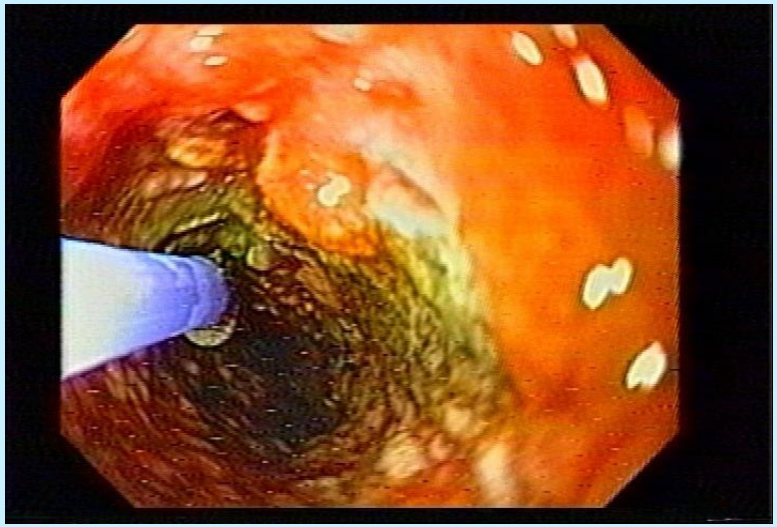
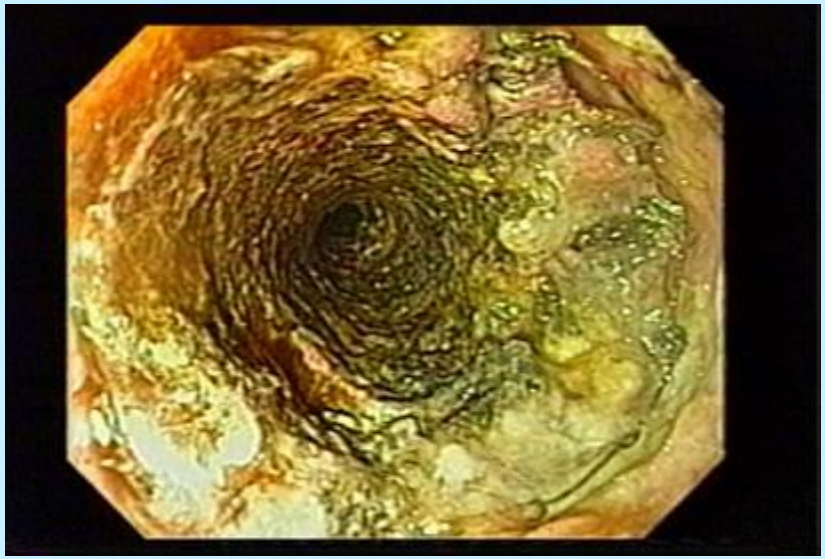
29. Vargo, John. Clinical Applications of APC. Gastrointestinal Endoscopy, 2004.
30. Zlatanic, J, et al. Large sessile colonic adenomas: use of argon plasma coagulator to supplement piecemeal snare polypectomy. Gastrointestinal Endoscopy; 1999: Vol. 49, No. 6.

APC GI Clinical Applications

Palliative Management for Esophageal Tumors



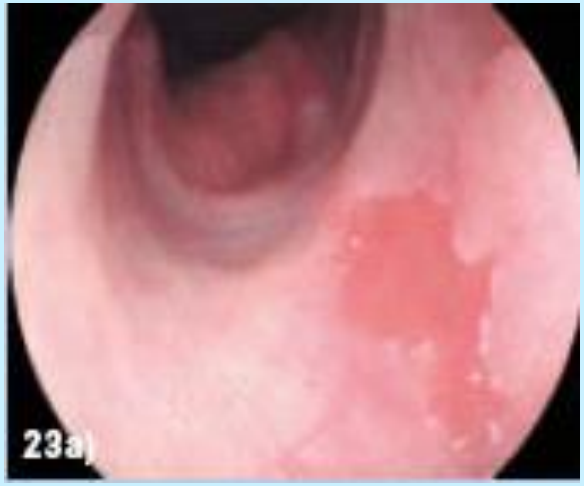
Before



Post APC

APC GI Clinical Applications

Barrett's Esophagus



before ablation

after ablation with APC

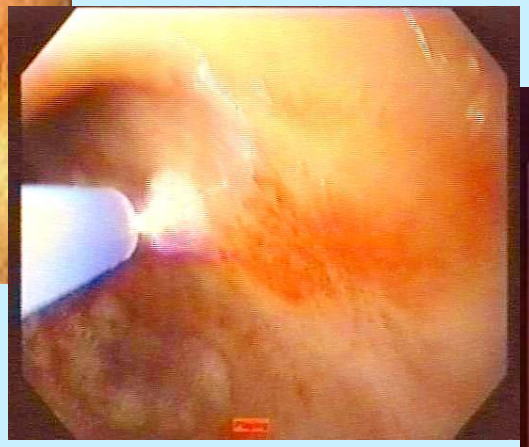
- The purpose of endoscopic thermal devitilization is to remove premalignant columnar epithelium so that it can be replaced by normal squamous epithelium, thus reducing the risk of malignant transformation.

Note: The use of APC technology for the eradication of Barrett's epithelium is currently under investigation.

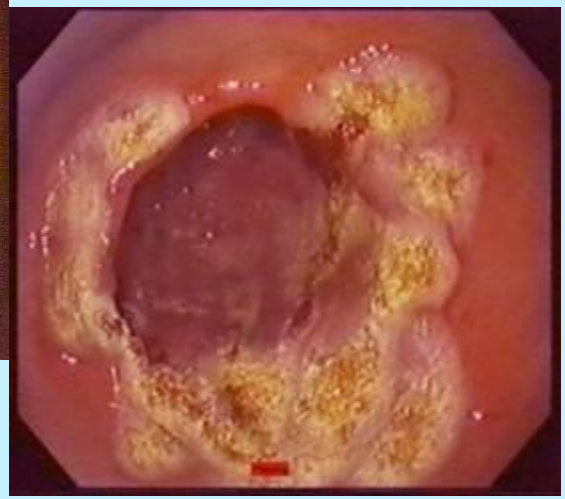
APC GI Clinical Applications

APC for Watermelon Stomach –
Gastric Antral Vascular Ectasia (GAVE)

Before



During APC



Post APC

APC GI Clinical Applications

APC for Radiation Proctopathy

Before

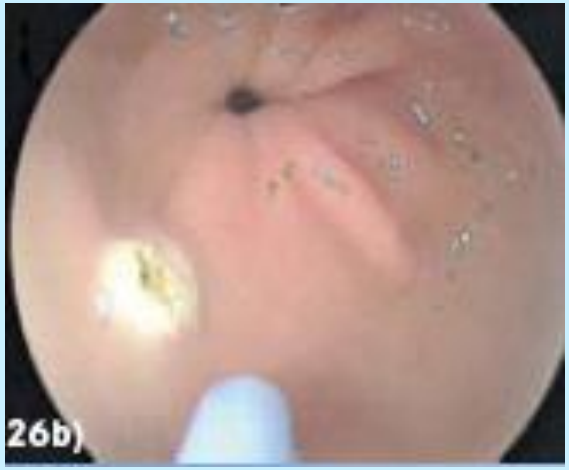
- *Before – Patient was on regular blood transfusions*
- *POST – No transfusions were required for 6 months*

Post APC

APC GI Clinical Applications

AVM's (Arterial / Venous Malformations)

Gastric AVM before APC



After APC

- *APC is used in all areas of the GI tract to treat AVM's*
- *Low power applications and superficial APC mode selection helps to minimize the risk of perforation in thin walled areas (cecum, small bowel) where angiodysplasias often occur*

APC GI Clinical Applications

Snare Adenoma of Cecum APC Polyp Bed Ablation

1. Adenoma of Cecum

2. Adenoma Injected

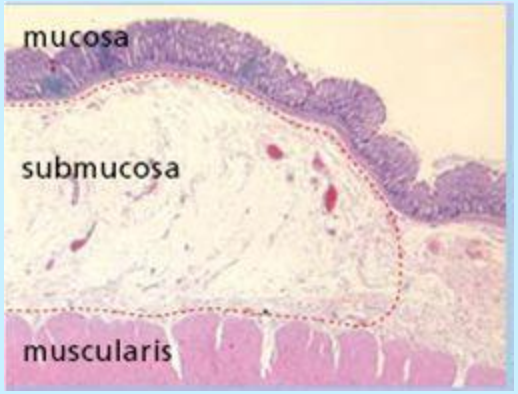
3. Adenoma Snared (piecemeal)

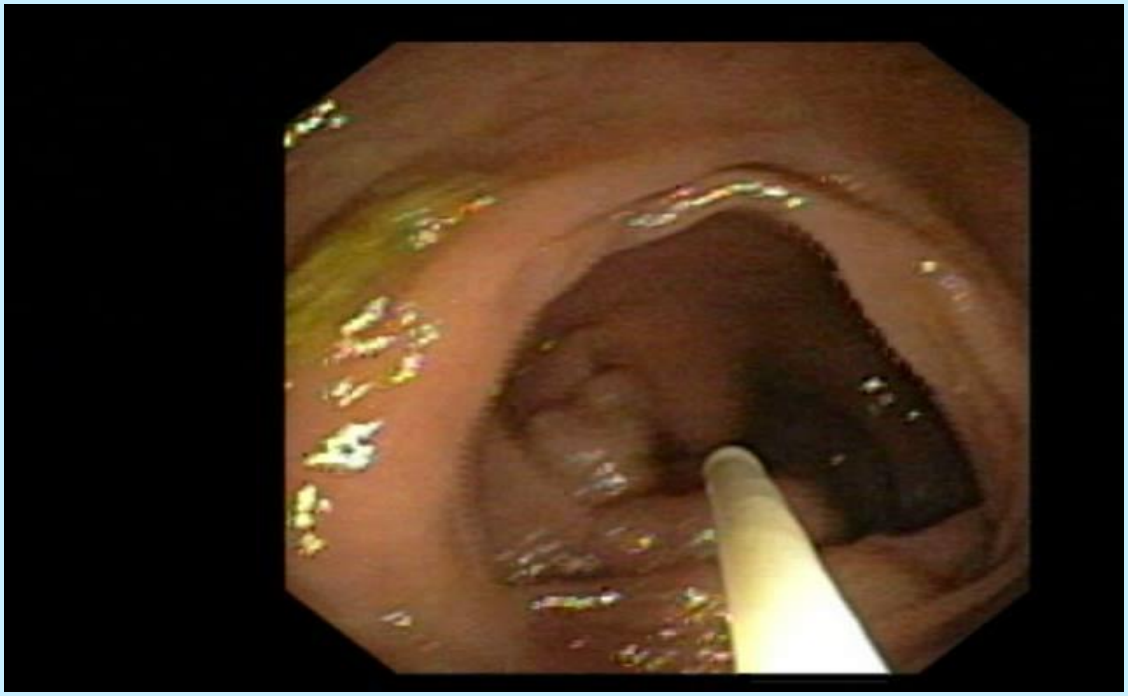
4. Ablation of Bed with APC

Long term clinical study results show 50% reduction in re-growth.

Brooker J, Saunders B, et al. Treatment with argon plasma coagulation reduces recurrence after piecemeal resection of large sessile colonic polyps: A randomized trial and recommendations. *Gastrointestinal Endoscopy* 2002; 55:371-375.

Submucosal Injection





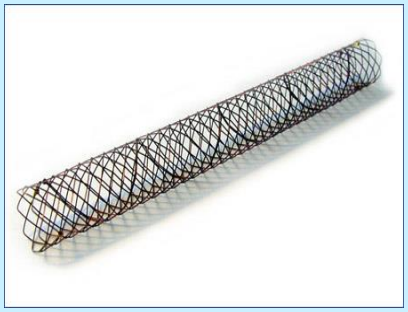
Clinical Video: Needle-free submucosal injection

Submucosal injection provides an additional cushion to protect the muscularis and also aids in dispersing electrosurgical current during electrosurgical procedures, including APC.

Norton ID, Wang LN, Levine SA, Bugart LJ, Hofmeister EK, Yacavo RF, et al. In vivo characterization of colonic thermal injury caused by argon plasma coagulation. GastrointestEndosc 2002;55:631-6.

APC GI *Reported* Clinical Applications

Stent Shortening ("Trimming")

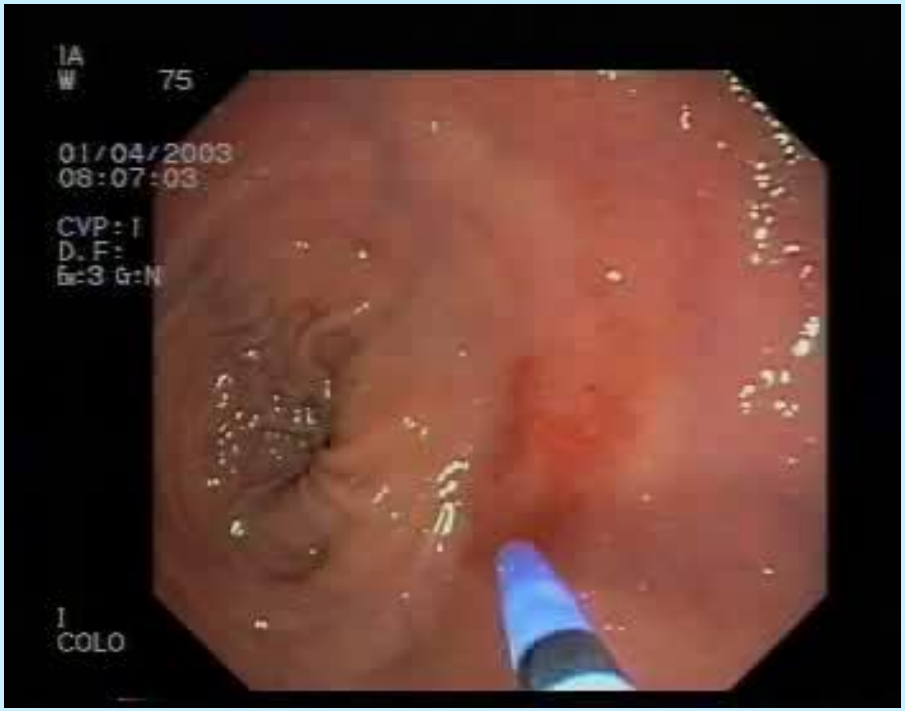


- Self-expanding metal stents may become displaced causing bleeding or ulceration
- Although this is an *off-label* use, the projecting ends of the metal stent have been shortened ("trimmed") using APC with short activations

Note: Literature reported during ex-vivo testing, with long activations of APC trimming Permalume (silicone) covered Wallstents, flaming of the Permalume was noted.

Chen Y, Jakribettuu, V, et al. Safety and Efficacy of Argon Plasma Coagulation Trimming of Malpostioned and Migrated Biliary Metal Stents: A Controlled Study in the Porcine Model. *American Journal of Gastroenterology.* 2006.

APC GI Clinical Applications



Clinical Video: Telangiectasia
APC Pulsed Effect 2

APC GI Clinical Applications

Clinical Video: GAVE
APC Pulsed Effect 2

APC Pulmonary Clinical Applications

Pulmonary Uses found in Clinical Literature

- Granulation Tissue
- Bleeding / Hemoptysis
- Exophytic Tumors
- Stent Over-growth/In-growth

References:

1. Bergler, Wolfgang, Treatment of recurrent respiratory papillomatosis with argon Plasma coagulation. Journal of Laryngology and Otology. 1997.
2. Bolligner, CT, et al. Therapeutic bronchoscopy with immediate effect: laser, electrocautery, argon plasma coagulation and stents. European Respirartory Journal. 2006: 27:1258-1271.
3. Capaccio, P, et al. Flexible Argon Coagulation Treatment of Obstructive Tracheal Metastatic Melanoma. American Journal of Otolarynogology. 2002: Vol 23, No 4.
4. Crosta, C et al. Endoscopic argon plasma for palliative treatment of malignant airway obstructions: early results in 47 cases. Lung Cancer. 2001: 33: 75-80.
5. Lee, P, et al. Advances in Bronchoscopy-Therapeutic Bronchoscopy. JAPI. 2004: Vol 52.
6. Morice, Roldofo. Endobronchial Argon Plasma Coagulation for Treatment of Hemoptysis and Neoplastic Airway Obstruction. Chest. 2001.
7. Orino, K, et al. Bronchoscopic Treatment with Argon Plasma Coagulation for Recurrent Typical Carcinoids: Report of a Case. Anticancer Research. 2004: 24:4073-4078.
8. Sheski, F. Endobronchial Electrosurgery. Seminars in Respiratory and Critical Care Medicine. 2004: Vol, 25, No 4.
9. Sohrab, S. Management of Central Airway Obstruction. Clinical Lung Cancer. 2007.
10. Sutedja, G. Endobronchial Electrocautery and Argon Plasma Coagulation. Prog Respir. 2000: Vol 30.
11. Tremblay, A. Endobronchial electrocautery and Argon Plasma Coagulation: A Practical Approach. Can Respir. 2004.

APC Pulmonary Clinical Applications

APC for Malignant Stenoses in the Pulmonary Tract

Stenosing Tumor

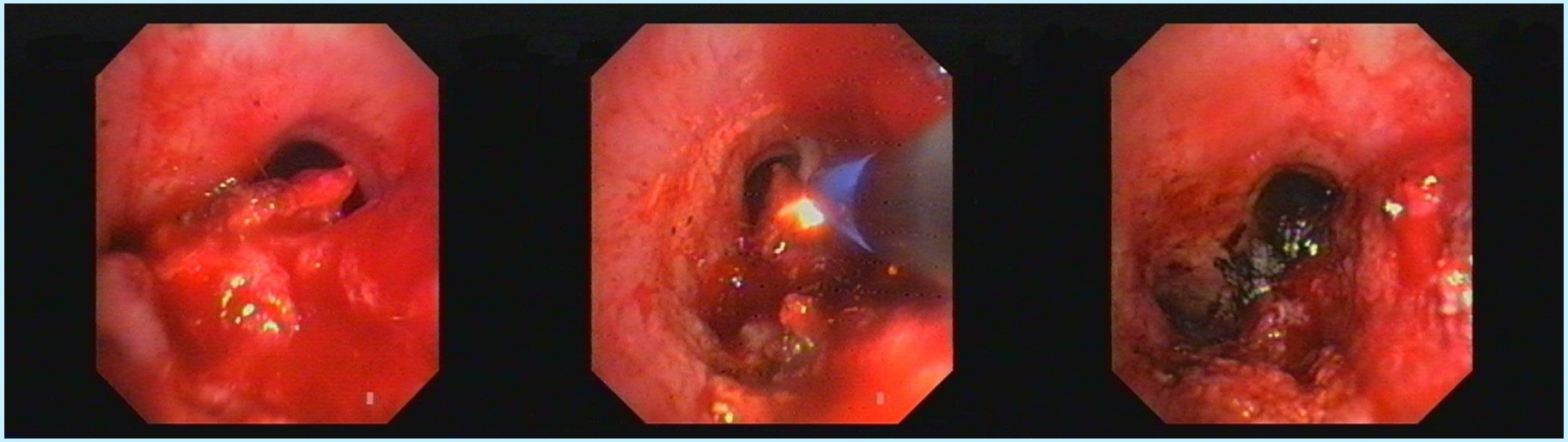
Recanalization using APC

Reopened Bronchus

- APC For tumor ablation, offers palliative improvement of life-threatening stenoses
- Subsequent therapy may consist of radiotherapy and/or chemotherapy, stent implantation or surgery
- Eschar is often removed by forceps or cryotherapy probe

APC Pulmonary Clinical Applications

Hemostasis



Before During Post APC therapy

APC may be used for hemostasis of bleeding tumors, and after biopsies are taken in the pulmonary tract

APC Pulmonary Clinical Applications

Stent In-growth and Over-growth

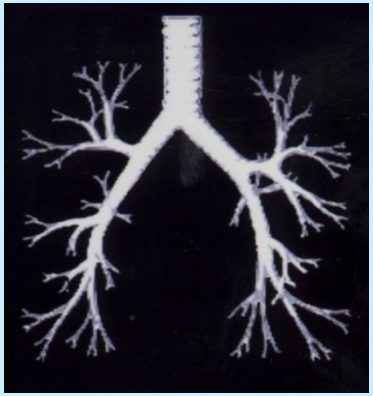
Tumor in-growth

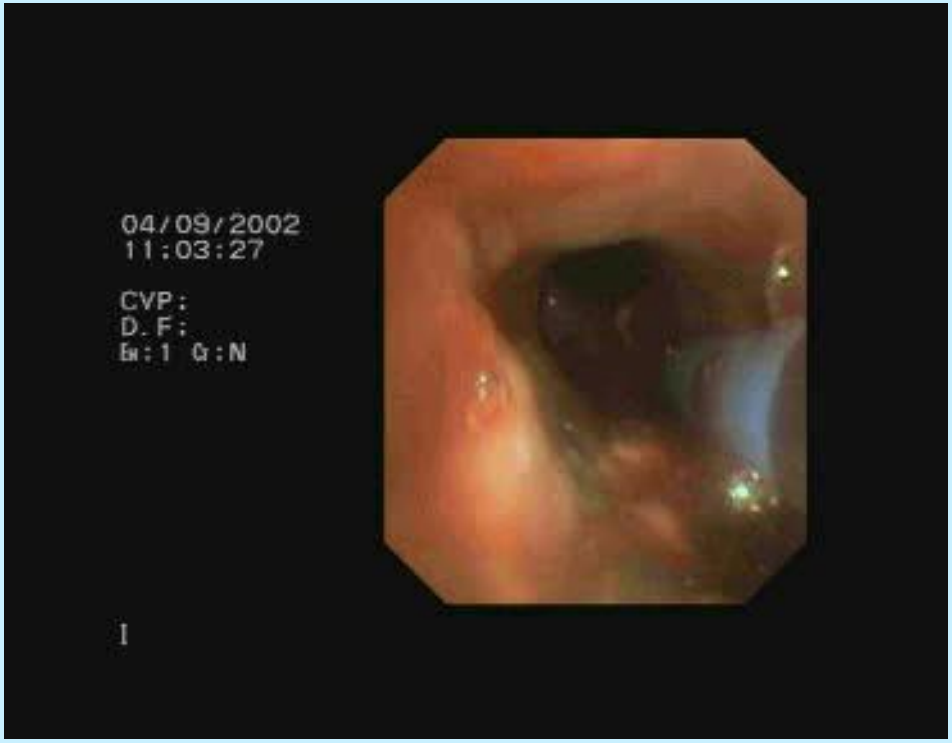
Treatment with APC

Post APC Treatment

- Tumor in-growth/over-growth - short activations allow tissue to cool and shrink, helping to manage transfer of thermal energy to the stent
- APC may be used to treat stenoses, making subsequent stent placement easier

APC Pulmonary Clinical Applications





Clinical Video: Endobronchial Tumor Ablation
Pulsed APC Effect 2

Nursing Considerations for Clinical Safety

Clinical Safety: Argon Plasma Coagulation

Emphysemas, Embolisms and Perforations:

- ALWAYS verbally confirm settings prior to activation and document confirmation.
- Avoid probe contact with the tissue
- Keep 1-5 mm distance between probe and tissue during activations
- Activation in static applications should be short (1-2 sec)
- Output settings, mode, and application durations should be based on clinical indications, anatomical location and wall thickness

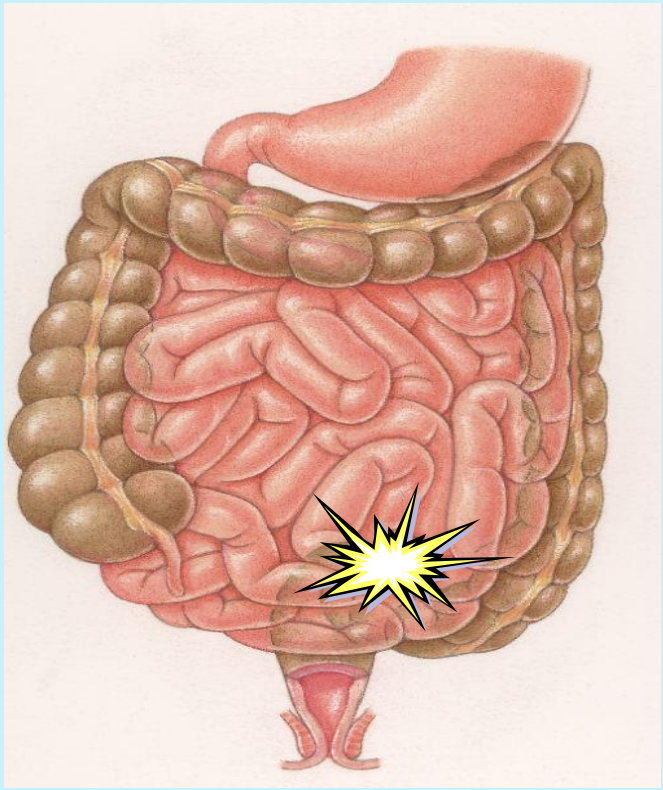
Clinical Safety: Argon Plasma Coagulation

Emphysemas, Embolisms and Perforations:

- Use the lowest possible settings and gas flow rates
- Avoid activating an APC probe near a metal clip or metal stent
- Avoid over-distention of the GI Tract through brief and repeated aspiration of gas
- Avoid aiming the probe directly at large, open vessels

Clinical Safety: Bowel Preps

What nurses should know about preps:



- Incomplete Preps or enema-only preps for Flexible Sigmoidoscopy increases the risk for bowel explosions
- Bowel explosions can occur with ANY monopolar electrosurgery (e.g. snare, APC, hot biopsy) when combined with hydrogen and methane gases in a dirty colon
- Patients should be fully prepped

Clinical Safety: Oxygen Management

Preventative measures to avoid combustion

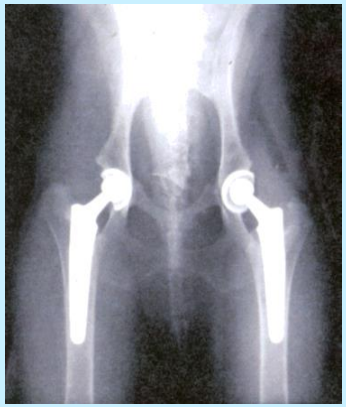
Oxygen Management:

Maintain oxygen concentration at a safe level

- ***Conscious Sedation Patient***
  Supplemental nasal cannula
  O^2 at 3 L/M or LOWER
  Mask delivery is considered high risk
- ***Intubated Vent Patient***
  Supplemental O^2 Concentration should be reduced to 40% or less
- ***Activation***
  Activate APC during the patient's exhalation phase, or during apnea

Combustion requires heat source, fuel, and oxygen

Dispersive Electrodes



The Dispersive Electrode Should NOT Be Placed Over:

- Boney prominences
- Scar tissue – including Tattoos
- Skin/Scars over an implanted metal prosthesis
- Hairy surfaces – clip if necessary
- Lotions or oils on skin

Dispersive Electrodes

Mono Pads bypass the pad safety systems of generators…

MONO Foil or Single pad:

Performs only completion of the electrical circuit.

- The current density of the pad edges is not measured
- The correct orientation of the pad is not measured

Dispersive Electrodes

A Dual Foil or Split Pad:

- Completes the electrical circuit
- Disperses the current density
- Engages the safety system of the unit

Dispersive Electrodes

Why did this patient receive a pad site burn?

Dispersive Electrodes

FDA Data Update: MAUDE

LATERAL HIP SHOWN

(Manufacturer And User Facility Device Experience)

- *Hospital Reports of Burns, accessory damage causing injury, staff injuries, fires, and jewelry injury.*

Accounts of PREVENTABLE accidents

.www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfMAUDE/search.cfm

Alternate Site Burns

Electricity Always Seeks Ground….

- Observe skin touching conductive objects - IV poles, metal bed rail parts
- Watch for fingers, toes, ankles, and elbows touching metal
- Check for arms over bedrails and hands grasping handrails
- Separate all wires, including heart monitor wires from active cords and dispersive electrode cords

Clinical Safety: Jewelry

Navel and genital jewelry can be in the circuit, increasing risk of burns

Tongue studs can damage scopes and impede intubation in an emergency

Jewelry Removal:

- ESU Manufacturers and clinical guidelines recommend removing ALL pierced and non-pierced jewelry, if within the clinical circuit
- Removal helps to:
  - Avoid Burns
  - Avoid accidental injury
  - Lower staff liability

Clinical Safety – Additional Challenges

Body modifications require special attention for maintenance of the patients skin integrity…

Trans-dermal/micro-dermal implants

Sub-dermal implants

Additional risks are posed due to:
- Patient positioning
- Patient transfers
- Electrosurgery use and pad placement

Clinical Safety: Pacemakers, ICDs, IEDs

Advance Preparation:

- Physician offices and/or Pre-Admission phone calls MUST collect information
- Patient Pacemaker ID card
- Pacemaker, ICD, IED policy and decision tree

Clinical Safety: Pacemakers, ICDs, IEDs

Basic Safety:

- Use Bipolar when possible
- Keep 15 cm between the active electrode and any EKG electrode
- Have resuscitation equipment at the ready – DOCUMENT
- Have the device clinical support line available
- Contact the IED manufacturer for specific deactivation recommendations

Clinical Safety: Pacemakers, ICDs, IEDs

If the physician must use Monopolar current:

- Place pad on opposite lower extremity
- Use the lowest setting possible
- Use the shortest activations possible
- If the ICD is deactivated, re-establish integrity of the device post-procedure*

* IMPORTANT FOR RISK MANAGEMENT

Neuromuscular Stimulation

Unintentional electrical stimulation of the patient's nerves and muscles caused by demodulation of the electrical current

- Loose wires
- Broken wire bundles
- Defective/broken adapters

In Conclusion

Thank you for allowing me to share this information with you today.

May your devotion and knowledge serve your patients well.

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