ELECTROSURGERY

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Electrosurgery, Electrocoagulation, Electrodesiccation, Electrofulguration, Diathermy? Electrocautery
ELECTROCONFUSION
19th century, medical uses for electricity.

Franz Nagelschmidt, in 1897, discovered that patients with articular and circulatory ailments benefited from the application of electrical currents. He coined the term diathermy to describe the heating effect discovered by d'Arsonval 6 years earlier.

Joseph Rivere, treated an insomniac patient with electricity produced by a generator similar to Nagelschmidt's, noted that a spark arcing from an electrode coagulated an area of his skin. He subsequently used this arcing current to treat a carcinomatous ulcer on the hand of a patient. This event has been cited as the first true use of electricity in surgery.

Simon Pozzi used high-frequency, high-voltage, low-amperage currents to treat skin cancers, a technique he termed fulguration.
HISTORY

- 1910, William Clark: Under the microscope, he observed that tissues subjected to this current shrunk from dehydration. In 1914, he used the term dessication.

- Bovie: Constructed a diathermy unit that produced high-frequency current delivered by a “cutting loop” to be used for cutting, coagulation, and dessication. The first use of his apparatus in an operating room in Boston.
ELECTROSURGERY

ETYMOLOGY: GK, ELEKTRON + CHEIOURGOS, SURGEON

- The surgical division of tissues by high frequency **electrical current** applied locally with a metal instrument or needle i.e. Cutting

- The surgical use of **high-frequency** electric current for cutting or destroying tissue i.e. electrocauterization.

- This is accomplished by converting the electrical energy into **heat** through tissue resistance to the passage of the electrical current.
PROPERTIES OF ELECTRICITY

• CURRENT = Flow of electrons during a period of time, measured in amperes

• CIRCUIT = Pathway for the uninterrupted flow of electrons

• VOLTAGE = Force pushing current through the resistance, measured in volts

• RESISTANCE = Obstacle to the flow of current, measured in ohms
  (impedance = resistance)
Hyfrecator
ELECTROSURGERY

Isolated generator circuit.
The transformation of electrical energy into heat occurs in accordance with Joules Law and can be expressed by the following formula:

\[
\text{Energy} = \left(\frac{\text{current}}{\text{cross-sectional area}}\right)^2 \times \text{resistance} \times \text{time}
\]
AC CURRENT

- 60 Hz: Household Appliances
- 100 kHz: Muscle and Nerve Stimulation
- 550-1550 kHz: AM Radio
- 54-880 MHz: Television

Electrosurgery: 200 kHz - 3.3 MHz
CUTTING VERSUS COAGULATION

- Different waveforms create different tissue effects
- Cutting current
  - Constant waveform
  - Heat produced quickly – vaporisation of tissue
  - Lower voltage
- Coagulation current
  - Intermittent waveform allows dispersion of heat
  - Less heat produced – coagulum rather than vaporisation
  - Higher voltage
CUTTING VERSUS COAGULATION

- Different waveforms create different tissue effects

- Cutting/fulguration/dessication
  - Cutting – producing maximal current density vaporising tissue
  - Fulguration – sparking with coagulation waveform, char and coagulum over wide area
  - Dessication – contact with tissue. Current density reduced – cell drying
CUTTING VERSUS COAGULATION

• Different waveforms create different tissue effects
• Blends
  • Modification of on/off time
  • Blend 1 50/50 (on/off)
  • Blend 2 40/60
  • Blend 3 25/75
  • Coagulation 6/94
ELECTROSURGERY

Cut
- Pure
- Blend

Coagulation
- Fulguration
- Dessication
Pure cut  Blend  Fulguration/non contact coag
ELECTROSURGERY COMPLICATIONS

- Relatively common, occurring in 2 to 5 per 1000 procedures.

- Severe burns can occur if the dispersive electrode pad becomes partially detached from the patient. Increased current density on the smaller surface area of the skin. (return electrode monitoring system)

- Patients with electrical implants require special precautions, especially when using monopolar devices.

- Cautery Smoke – irritating and dangerous
PATIENTS & ELECTRODES
SMOKE PLUME

- The smoke plume contains potentially toxic substances.
- In high concentrations, these substances can irritate the eyes and respiratory tract.
- Can transmit viruses.
- For this reason, smoke should be captured and evacuated using suction and smoke evacuation devices.
PATIENT RETURN ELECTRODES

- Position plate as close to surgical site as possible
- Poor patient plate contact
  - bony prominences.
  - fluid invasion,
  - adhesive failure.
  - scar tissue
  - Excessive Hair at return electrode plate
- Break in the return cable
- Detached return cable
- Ignition of flammable material on pt’s skin
- Abnormally high power setting
Electrosurgery and Implantable Electronic Devices

- Cardiac Pacemakers
- Implantable Cardioverter Defibrillators
- Cochlear Implants
- Deep Brain Stimulators
- Vagal Nerve Stimulators
- Sacral Nerve Stimulators
- Phrenic Nerve Stimulators
- Spinal Cord Stimulators
- Gastric Pacemaker

Electrosurgery and Implantable Electronic Devices: Review and Implications for Office-Based Procedures 
Dermatol Surg 2011;37:889–899
ELECTROSURGERY AND IMPLANTABLE ELECTRONIC DEVICES

Consultation with a cardiology or pacemaker service
GENERAL ADVICE

• Use lowest effective possible power setting
• Use a low voltage waveform (cut)
• Use brief, intermittent activation
• Do not activate in close proximity or direct contact with another instrument
• Use bipolar electrosurgery where appropriate
• Use a return electrode monitoring system
• The disappearance of water vapor is a good guide for deciding when to stop the application of bipolar electrosurgical energy