



# Surgical Diathermy Machine

DIAGNOSTIC AND THERAPEUTIC EQUIPMENT

UNIT – 2



# Surgical Diathermy Machine

1. What do you mean by Electrosurgery? What is Surgical Diathermy Machine?
2. Explain Monopolar Electrosurgery Technique with block diagram. Where it is used?
3. Explain Bipolar Electrosurgery Technique with block diagram. Where it is used?
4. Explain Active and Passive electrodes of ESU.
5. Describe different effects on body tissue during Electrosurgery.



# Electrosurgery

- **Electrosurgery** is a simple method of making surgical incisions, controlling bleeding and destroying unwanted tissue cells by the use of a high frequency “electrosurgical current”.
- Its benefits include the ability to make precise cuts with limited blood loss.
- Electrosurgical devices (**Surgical Diathermy Machine**) are frequently used during surgical operations helping to prevent blood loss in hospital operating rooms or in outpatient procedures.

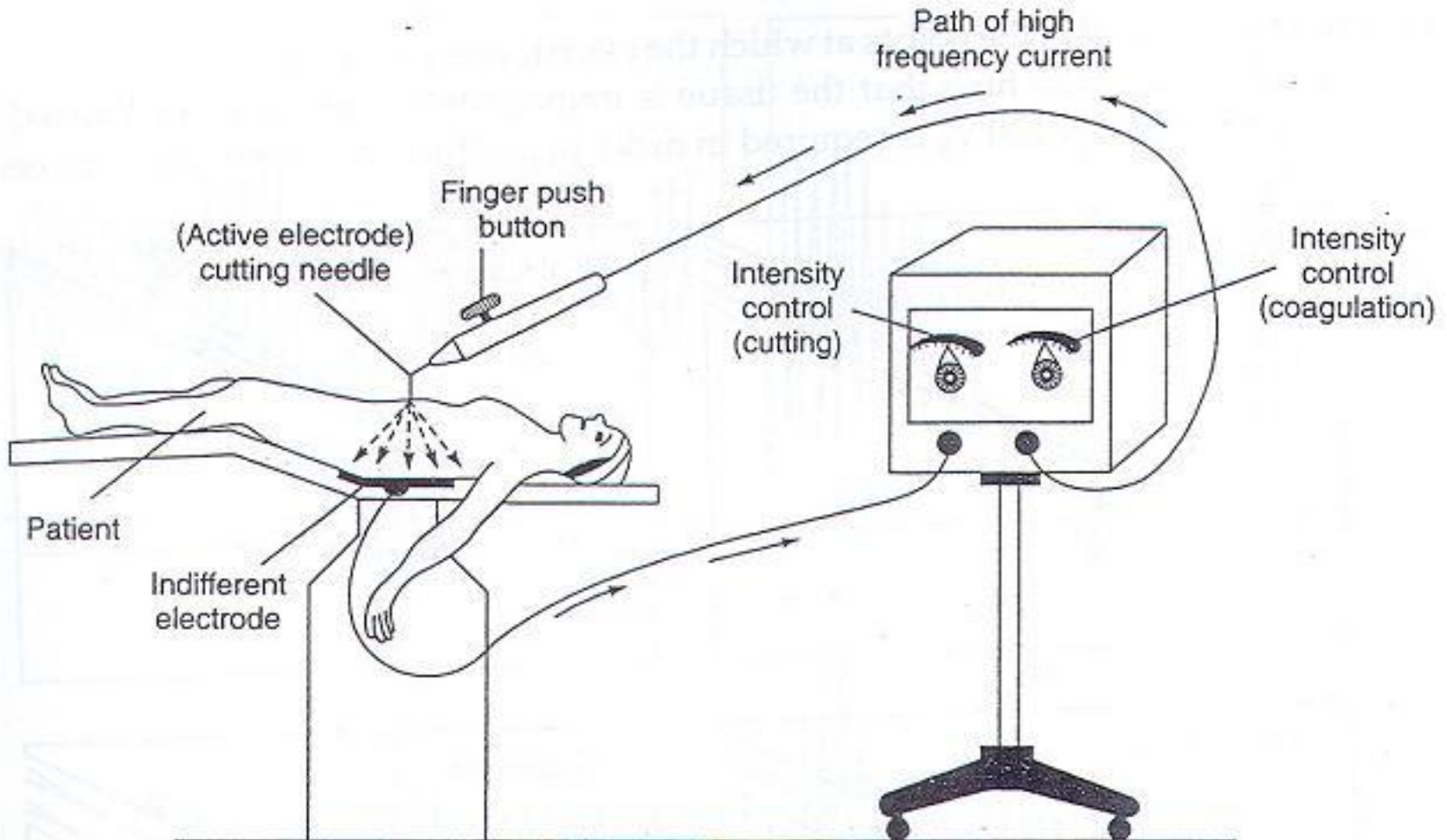


# Surgical Diathermy Machine

- It is a dedicated medical therapeutic equipment used by surgical departmental doctors for the purpose of cut, coagulate, desiccate, or fulgurate tissue.
- Two modes are used as desired by Doctors–
  - (i) Monopolar
  - (ii) Bipolar



# Block Diagram of Surgical Diathermy





# Electro –Surgery Techniques

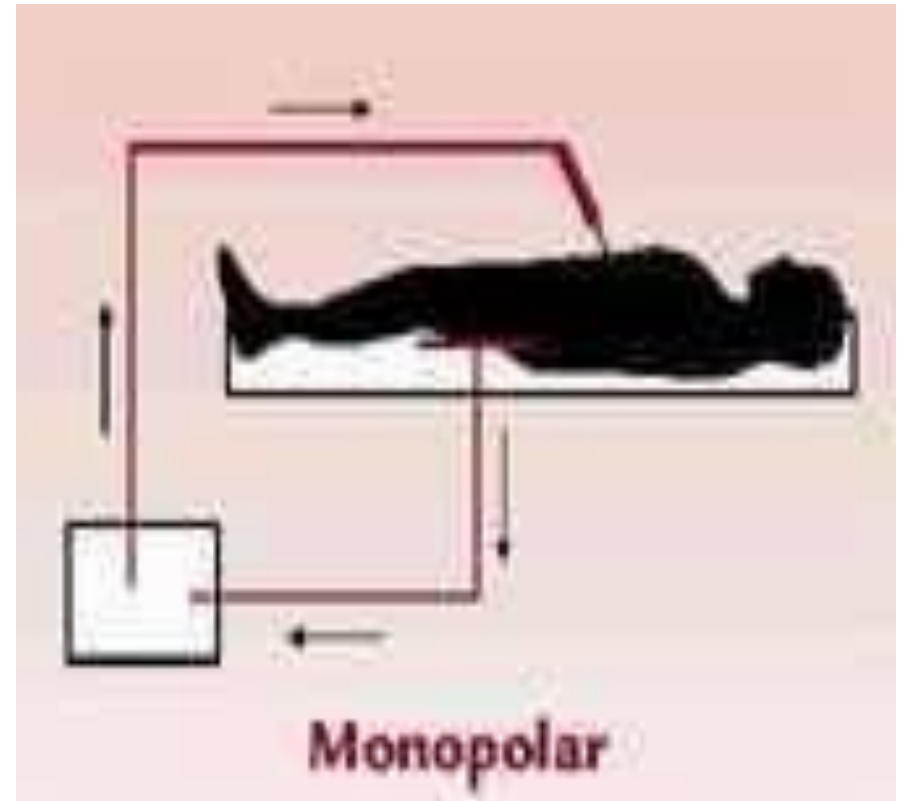
- ▶ Mono–polar technique
- ▶ Bi–polar technique





# Monopolar electro surgery

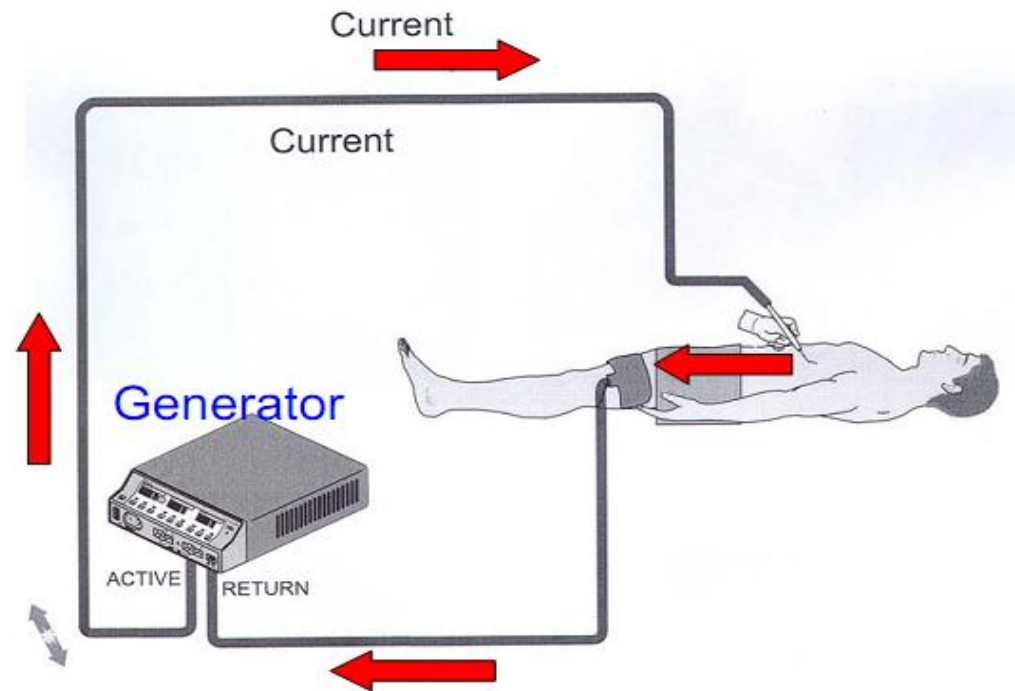
- ▶ Monopolar electro surgery is the admittance of the HFAC from the diathermy machine via an active electrode through the patient body tissues and then returned back to the diathermy machine via a dispersive electrode (patient return pad)





# Mono-polar technique

- **Generator** → **Active Electrode** → **Patient** → **Patient Return Electrode** → **Generator**







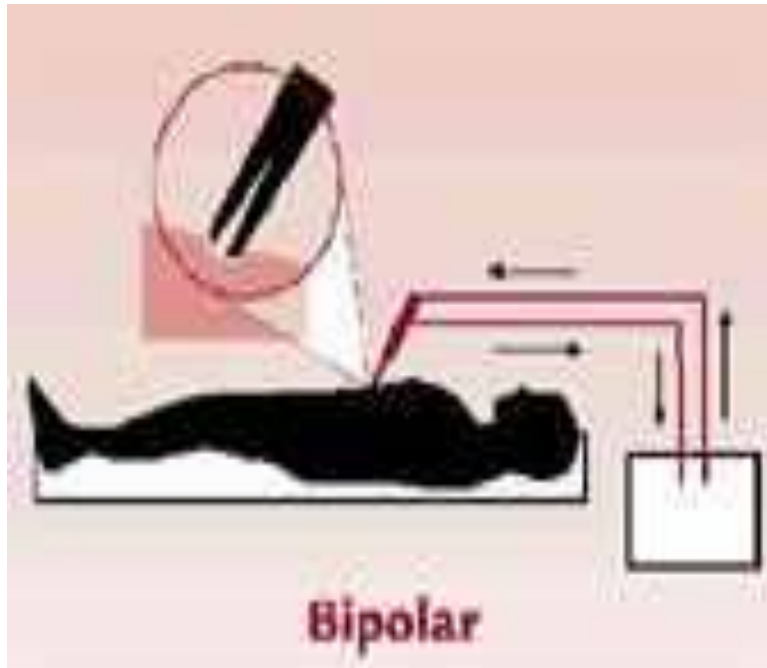
# Some Basics of Monopolar Surgery



- Diathermy currents (HFAC) may be generated by transistor circuits and may include a range of protection.
- The frequencies used are typically in the range 0.5 to 3 MHz.
- Most versions have power output up to a few hundred watts.
- Higher power necessary for urology applications where the surgery often takes place under water (in the bladder).
- Low power versions exist, sometimes called hyphenators, for excision of warts, polyps, and skin flaps.



# Bipolar electro surgery

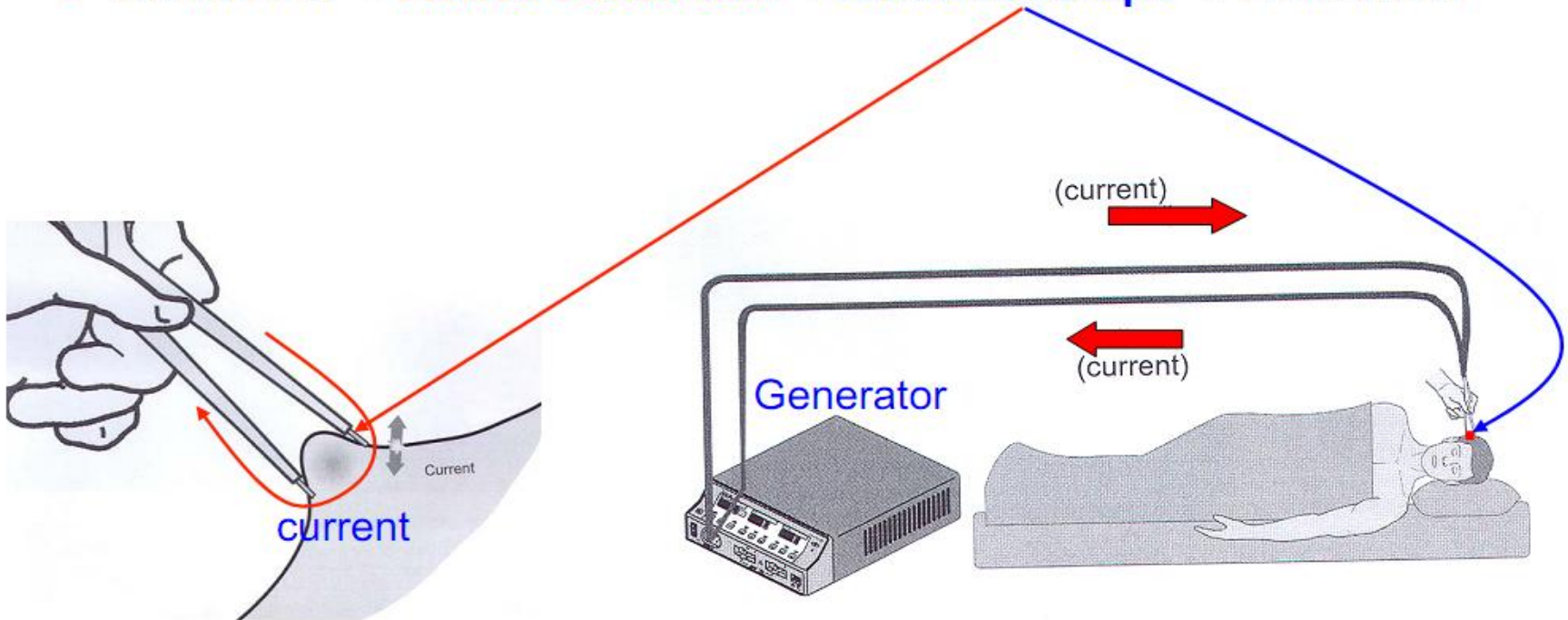


- ▶ Bipolar electro surgery is the admittance of the HFAC from the diathermy machine down one prong of a bipolar forceps through the tissue that has been placed between the forceps tips and returned to the diathermy machine via the second prong.
- ▶ Bipolar diathermy does not require a dispersive electrode (patient return pad).



# Bi-polar technique

➤ Generator → **Active Electrode** → **Electrodes tips** → Generator





# Some Basics of Bipolar Surgery

- ▶ Diathermy currents may be generated by valve or transistor circuits and may include a range of protection and monitoring systems.
- ▶ The frequencies used are typically in the range 0.5 to 3 MHz.
- ▶ Bipolar systems are available in which the heating currents only flow between the two tips of special forceps.
- ▶ Bipolar systems are useful for fine work and when the patient has a pacemaker which might malfunction in the presence of the very large circulating high-frequency current.



# Electro–Surgery Unit (ESU)

- ▶ An ESU consists of basically a high frequency power oscillator:
- ▶ **Spark–gap oscillator:** Generates damped high frequency current which is specifically suitable for the coagulation of all kinds of tissues.
- ▶ **Solid–state oscillator:** Generates un–damped high frequency current which is suitable for making clean cutting.



# Solid-State ESU



- ▶ The heart of solid-state ESU is the logic and control part which produce the basic signal and provides various timing signals for the cutting, coagulation and haemostatic modes of operation.
- ▶ In the cutting it delivers 400 W in 500  $\Omega$  load at 2000V.
- ▶ In the coagulation it delivers 150W.
- ▶ The output circuit in ESU is generally isolated and carefully insulated from low frequency primary and secondary voltage by means of capacitors.





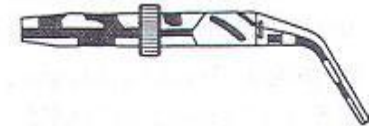
# ESU Electrodes



(a) Needle electrode



(b) Angulated lancet electrode



(c) Wire loop electrode



(d) Angulated band loop electrode



(e) Straight lancet electrode





# Types of ESU Electrodes

- ▶ Active Electrode
- ▶ Passive Electrode

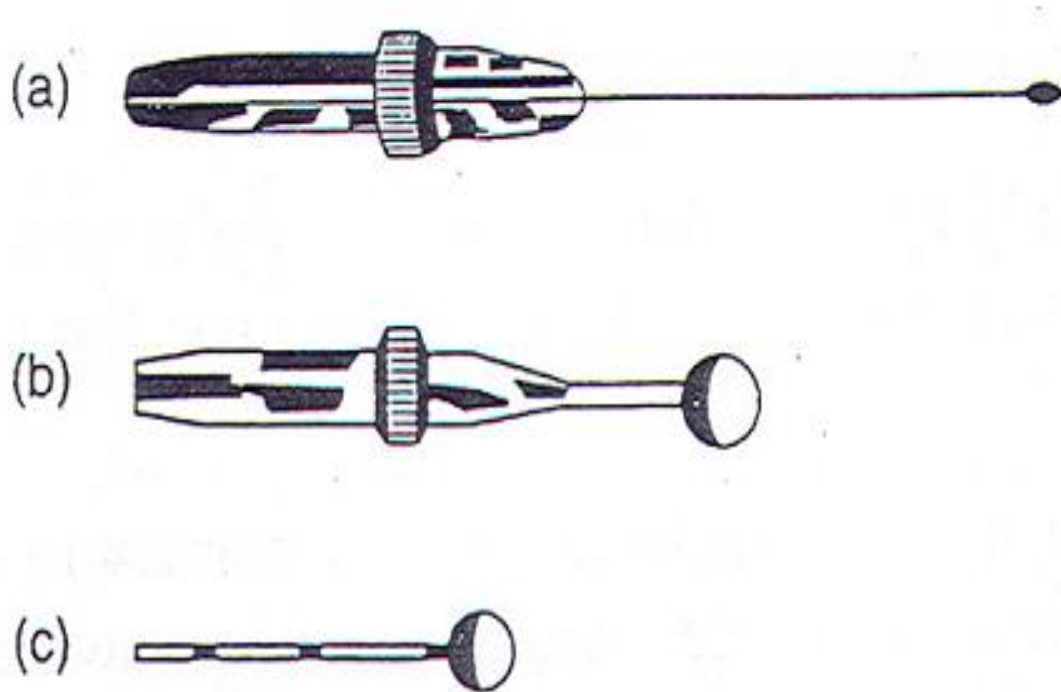


# Active Electrodes

- ▶ Electrodes are connected to the RF power generator.
- ▶ Switching on the high frequency current can be done with a finger-tip switch in the electrode or a foot switch.
- ▶ Small size (thickness in mm (1mm) and wideness till 10 mm).



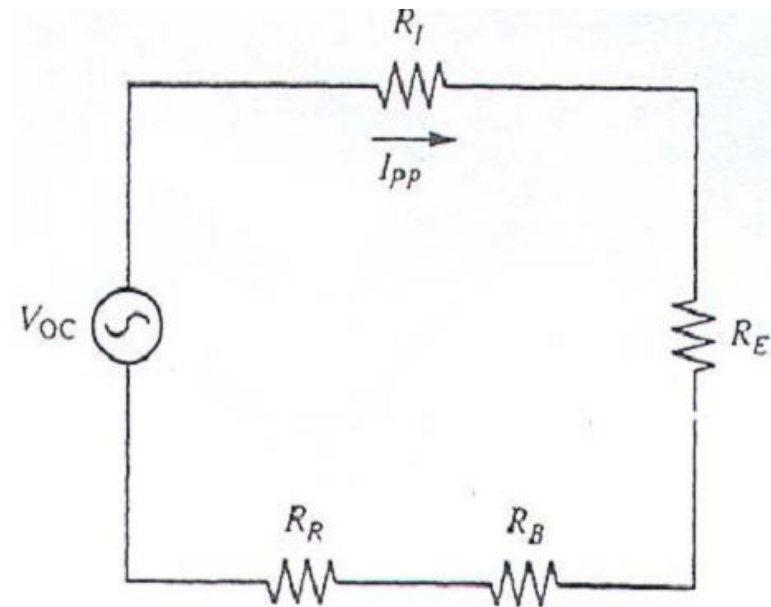
# Active electrode for coagulation





# Active Electrode Resistance

- ▶ The amount of power delivered to the tissue for a given ESU voltage depends on the active electrode-to-skin resistance  $R_E$ .
- ▶  $R_I$ : Internal resistance of active electrode
- ▶  $R_E$ : active electrode-to-skin resistance
- ▶  $R_B$ : Body resistance
- ▶  $R_R$ : Return electrode resistance



An ESU electrical equivalent circuit



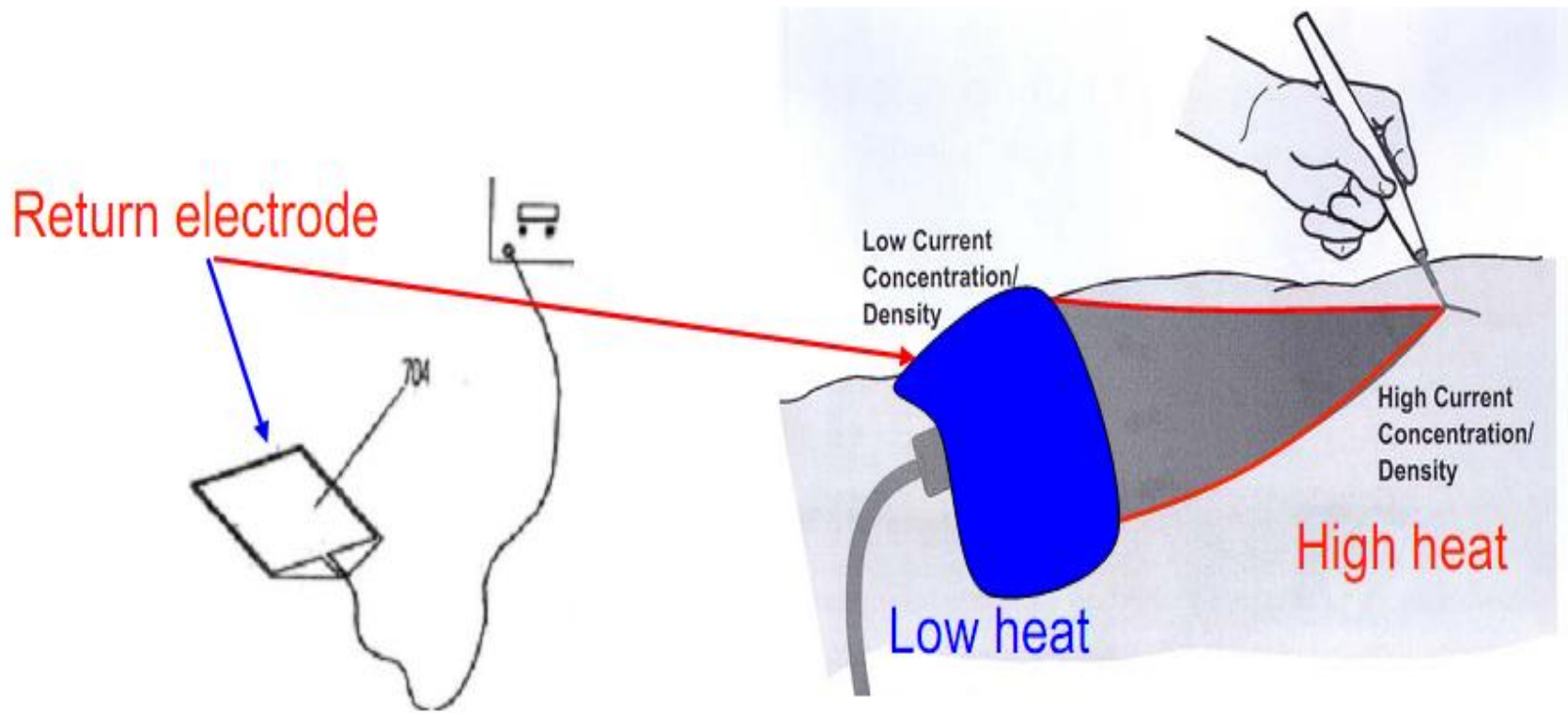
# Passive (Neutral, Return) Electrode

- ▶ The function of the patient return electrode is to remove current from the patient safely.
- ▶ A return electrode burn occurs when the heat produced, over time, is not safely dissipated by the size or conductivity of the patient return electrode.
- ▶ Two points are of practical importance:
  - (i) Sufficiently large contact area.
  - (ii) High electrical conductivity between the body and electrode.





# Passive (Neutral, Return) Electrode





# Effects on Body Tissue

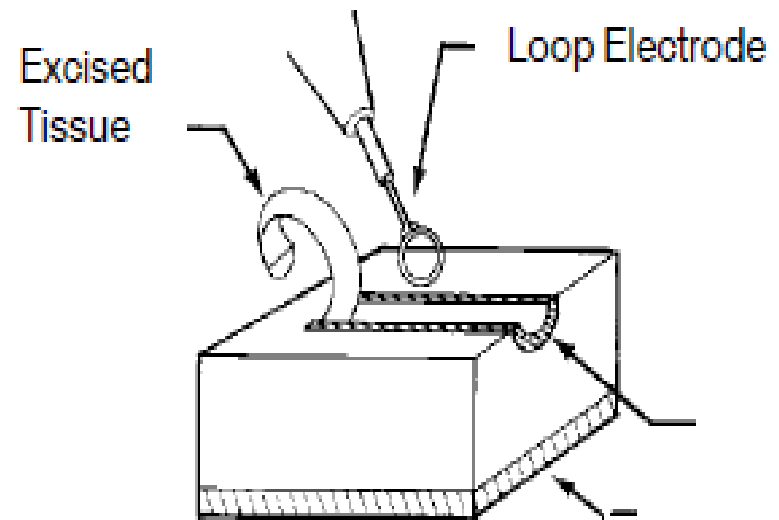
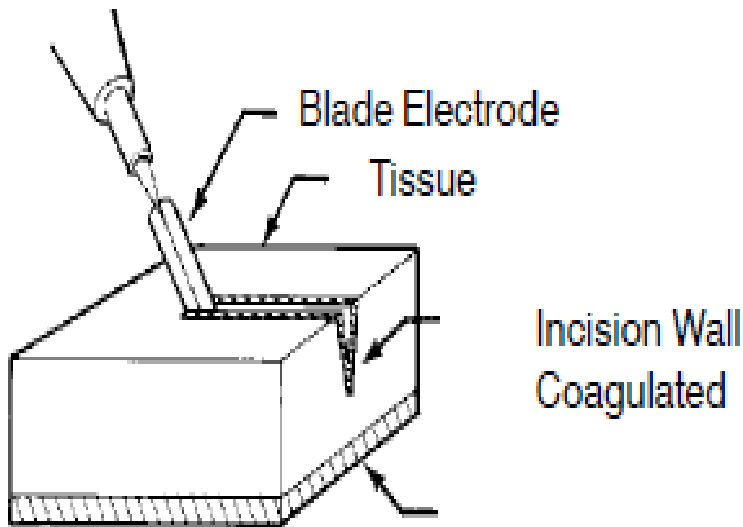
- ▶ Cutting
- ▶ Coagulation
- ▶ Fulguration
- ▶ Desiccation



# Cutting

## Cutting/Vaporization:

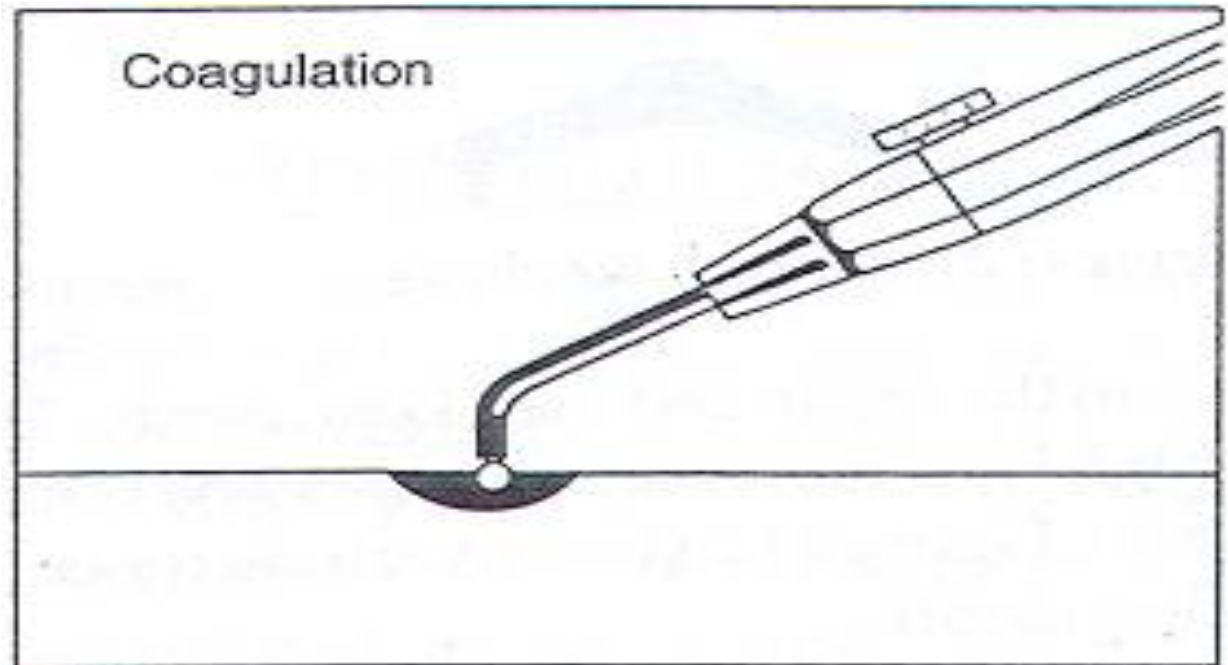
- High current concentration at active electrode causes intense heat in tissue (above 100c).





# Coagulation

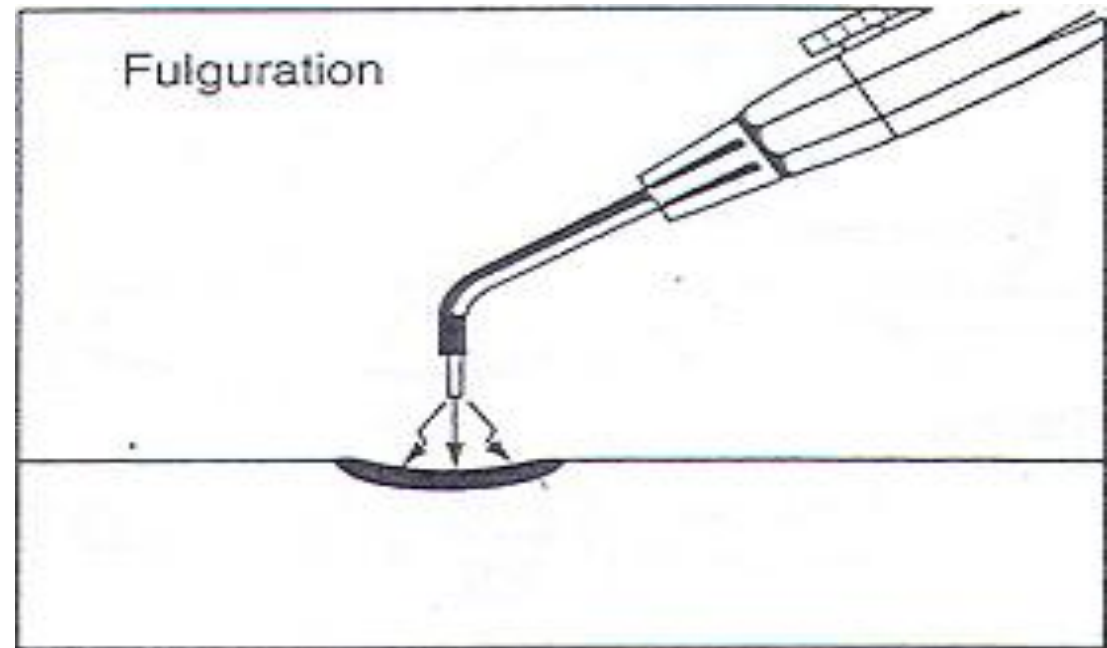
- ▶ **Coagulation** is the process by which blood forms clots. Every damaged blood vessel wall is covered by a platelet and fibrin-containing clot to stop bleeding and begin repair of the damaged vessel.





# Fulguration

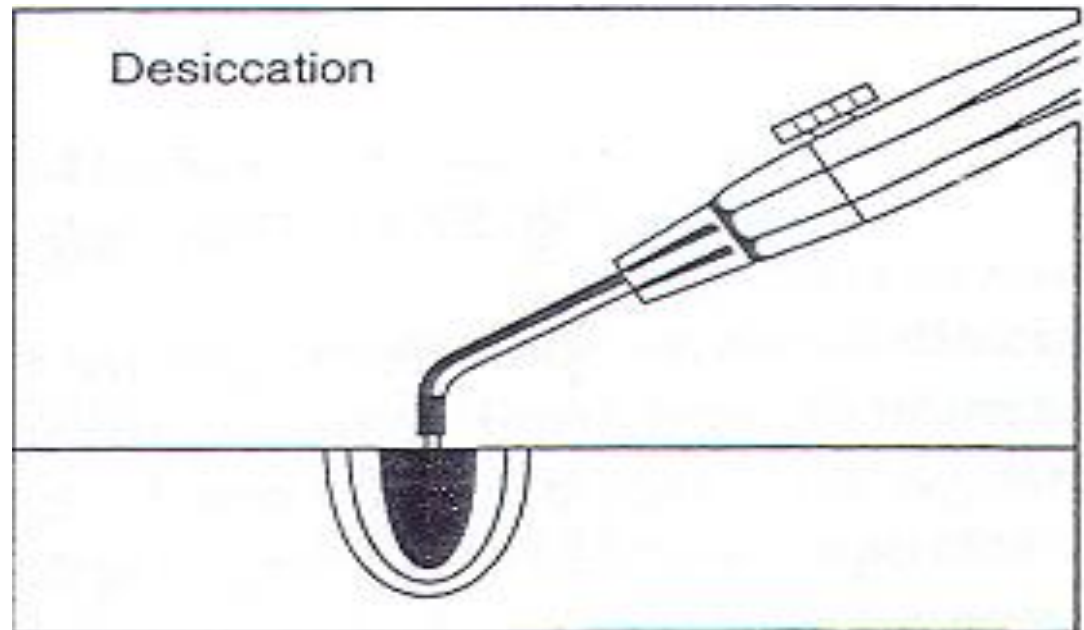
- ▶ **Fulguration**, also called **electrofulguration**, is a procedure to destroy tissue (such as a malignant tumor) using a high-frequency electric current applied with a needlelike electrode.





# Desiccation

- ▶ **Desiccation** is the state of extreme dryness, or the process of extreme drying. A desiccant is a hygroscopic (attracts and holds water) substance that induces or sustains such a state in its local vicinity in a moderately sealed container.







# Safety aspects in electro-surgical unit

- ▶ Burns: caused by excess current density
- ▶ High frequency current hazard
- ▶ Explosion hazards: sparks with ether, alcohol, explosive anesthetic gas, etc.