Al-Mustaqbal University

Biomedical Engineering Department

Class: 5th

Subject: Biomedical Instrumentation Lab

Lecturer: M.SC. ZAINAB SATTAR JABBAR

1st term – Lect. 5: Electrosurgical Machine

Email: zainab.sattar.jabbar@uomus.edu.iq

Electrosurgical Machine

Use Of Electrosurgical Machine

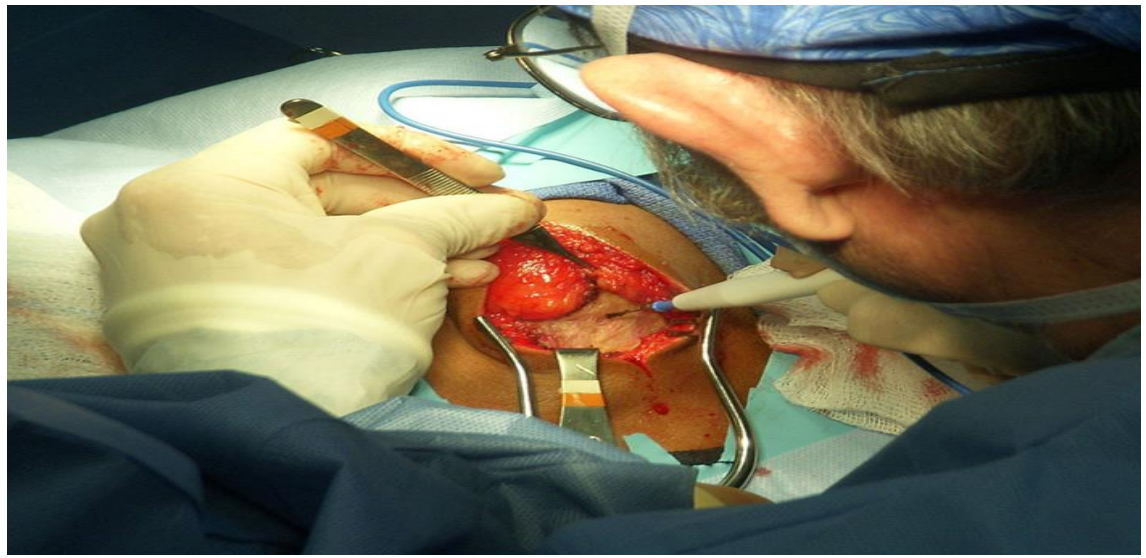
- Electro surgery is an alternative approach to cutting a patient. Typically, it is used as an alternative to a scalpel.
- Electro surgery can cut like a scalpel, but can also coagulate the blood in small vessels so the surgical field is bloodless.

Electro surgery allows the surgeons to work faster as they do not have to tie off (close) every vessel they cut. The patient recovers better as there is less blood loss and there is more rapid healing.

An Electrosurgical machine is also known as an: ESU = Electro Surgical Unit

Scientific Principles of Electrosurgical Machine

- Electro surgery is accomplished by converting high frequency electrical current into heat, caused by the tissue resistance to the passage of electrical current
- As current must pass through the body, at least two electrical connections must be made between the patient and the machine. The power needed is up to 400 watts.

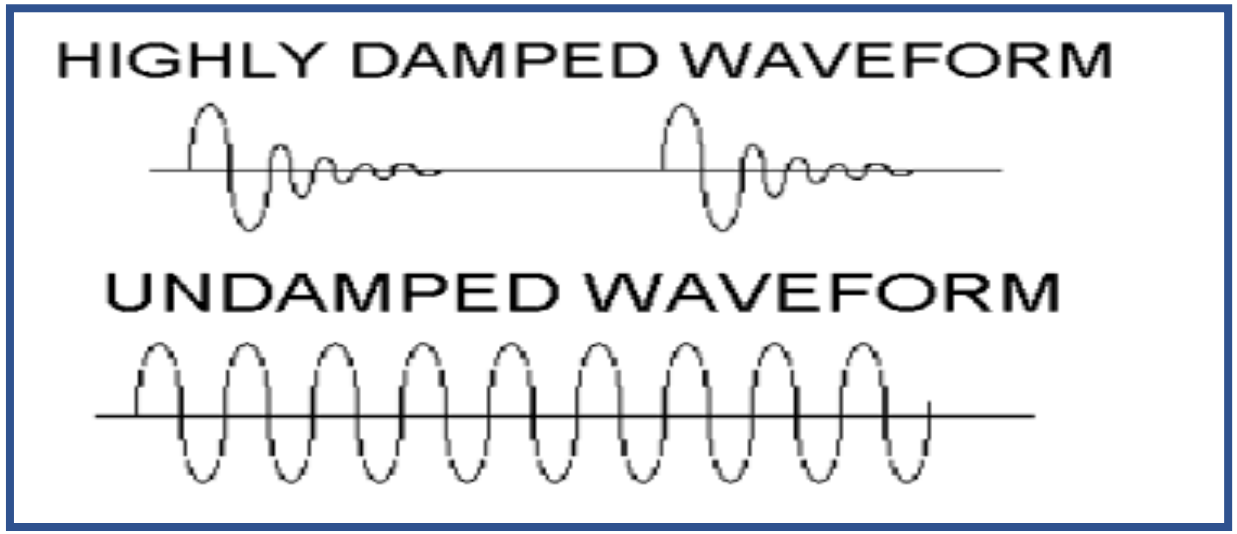


high frequency electrical current is used to avoid exciting the body cells electrically.

Scientific Principles of Electrosurgical Machine

- If the waveform is damped it will coagulate blood and stop bleeding (coag setting).

- If the waveform is undamped the tissue is ablated (vaporizing the water content) leaving a void or cut or incision (cut setting).



Electrosurgical machine: four common techniques

1. **electro-dessication**
   a highly damped waveform is supplied to the contact point, active electrode, a ball, needle or blade which is placed on the tissue before energizing and produces coagulation around the site.
2. **electro-fulguration**
   a highly damped waveform is used but the active electrode is held 1 to 2 mm above the tissue and - when energized - sparks spray the area drying it out and leaving some burning of cell edges.
3. **electro-section**
   an undamped waveform is applied to the active electrode, which is placed on the tissue surface creating an incision.
4. **electro-coagulation**
   a damped waveform is delivered to the patient to stop bleeding without doing any additional cutting.

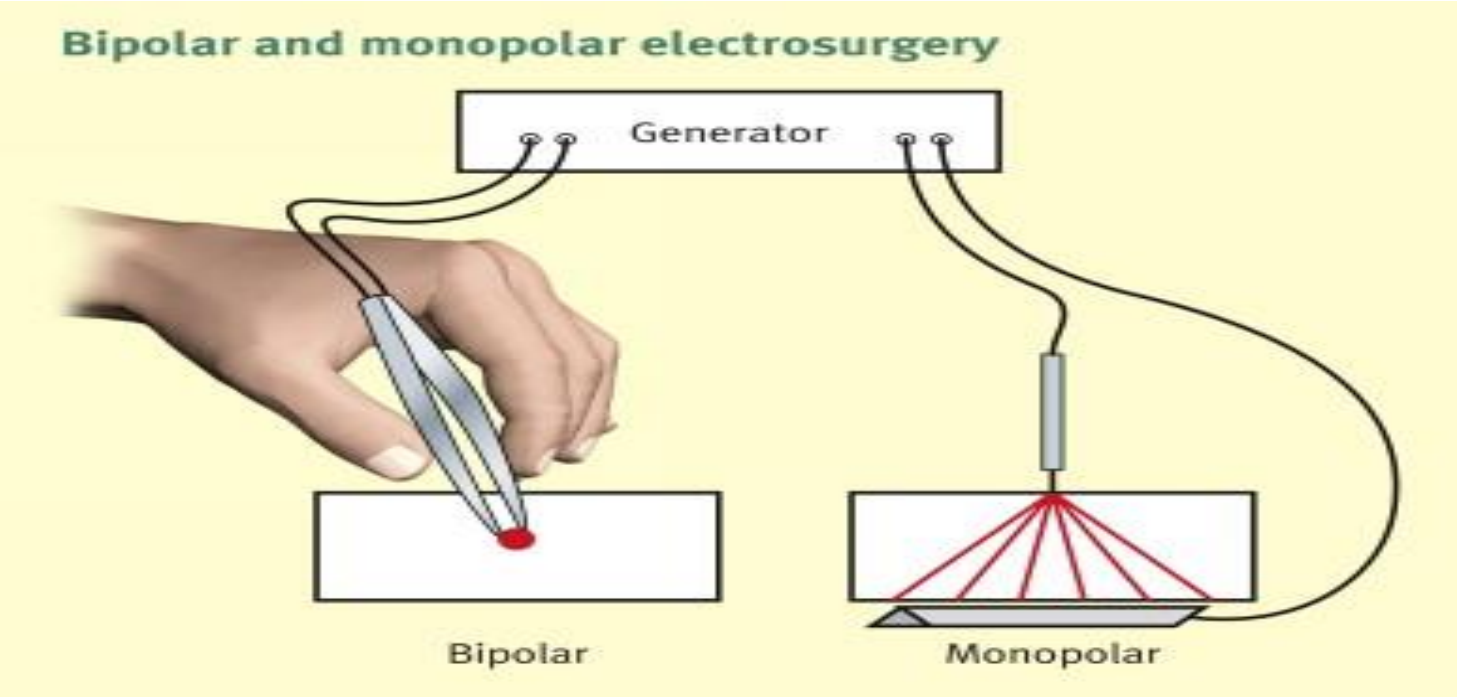
Component of Electrosurgical Machine

An electrosurgical unit (ESU) consists of :

- High frequency power producing generator with monitoring function.
- Hand piece with electrodes to apply the energy to the surgical site.
- Connecting cables.
- Foot switch to control output.

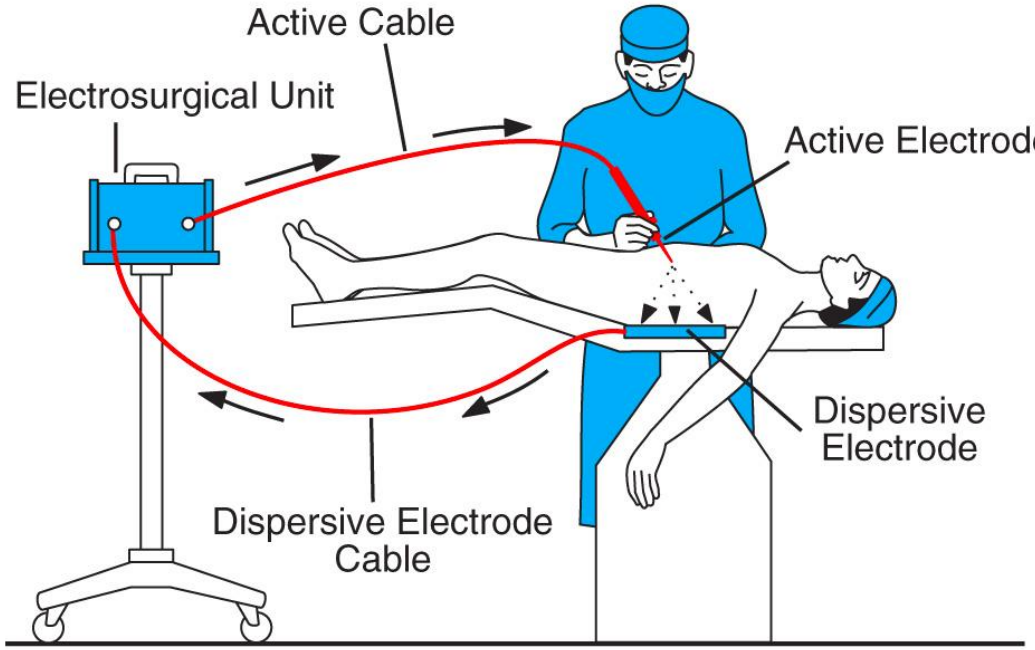
Types of Electrodes

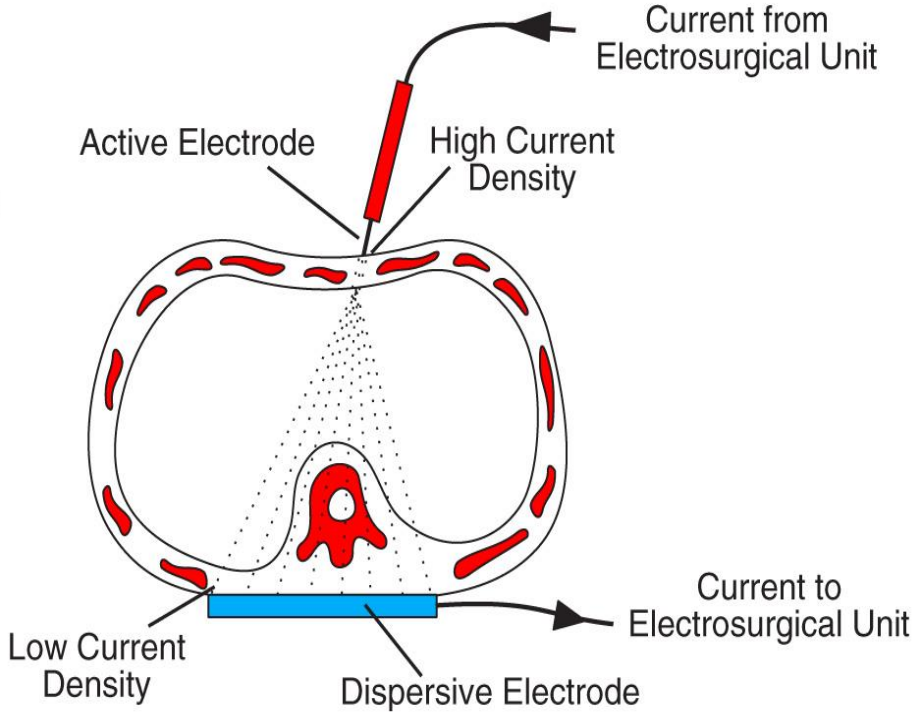
- Monopolar electro-surgery
- Bipolar electro-surgery



Monopolar electro-surgery

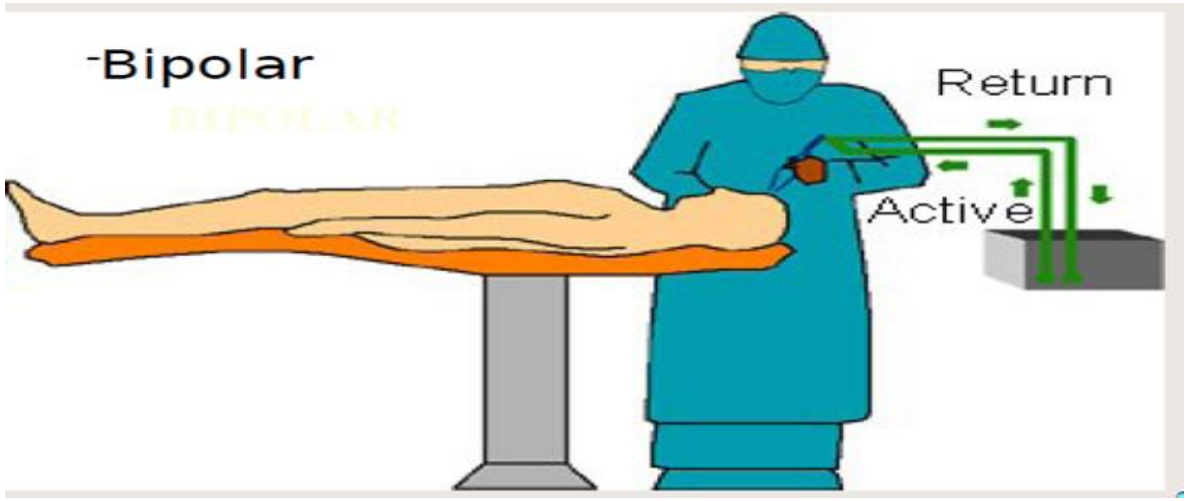
- All electrosurgery techniques require two connections to the patient, the active electrode (or pen, or bovie pen) and the reference electrode (or dispersive or ground electrode).
- For **monopola**r electro-surgery, the reference electrode is placed under the patient and the active electrode is held in the surgeon's hand.





Bipolar electrosurgery

- For bipolar electrosurgery, the reference and active electrodes are both held by the surgeon in one combined pen.
- Electrosurgical current in the patient is restricted to a small volume of tissue in the immediate region of application of the forceps.
- Bipolar is most commonly used with small vessels and for precise tissue destruction.

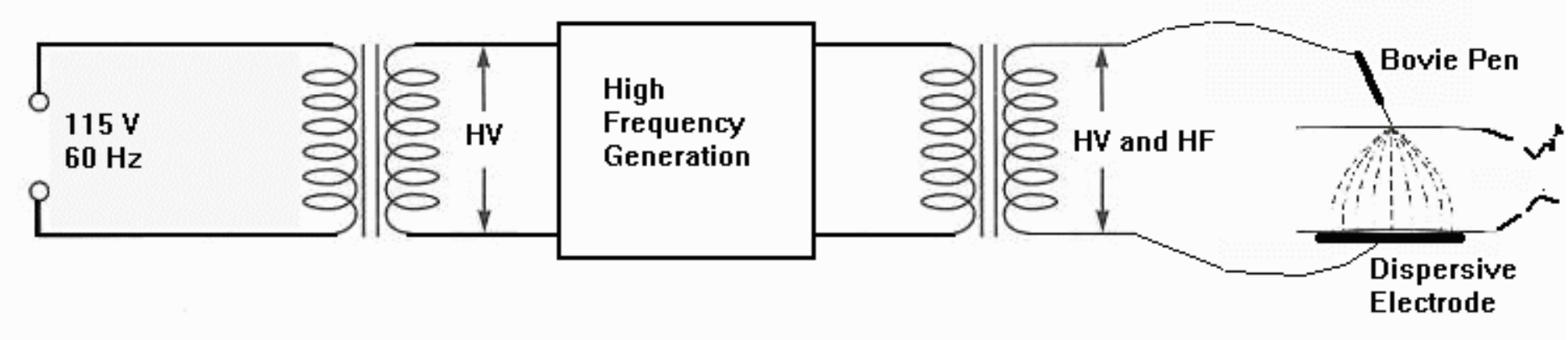


Electrosurgical machine: use

- The Bovie pen (or ESU pen) is held on the patient by the surgeon.
- The dispersive electrode can be a metal plate covered with a conductive gel or saline soaked cloths.
- Many are now using single use dispersive electrodes. Single use devices are often pre-gelled, conductive adhesive pads that include multiple connections to the machine. The multiple connections are used to allow the device to constantly check for a good contact between the patient and the dispersive electrode.
- Poor contact with the dispersive electrode is the most common cause of unintentional patient burns. In modern ESU machines, the dispersive electrode must touch the patient to prevent an alarm.

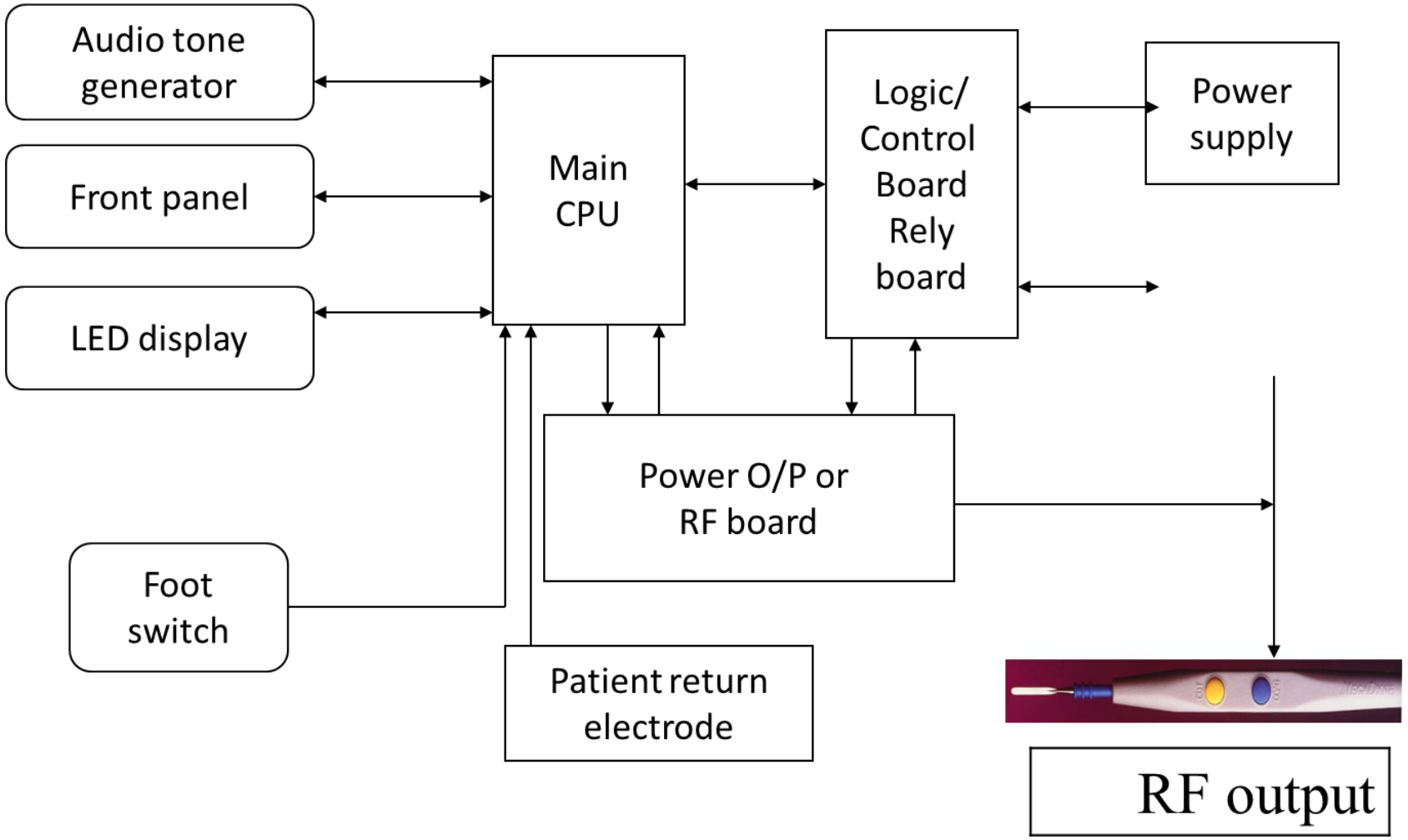
Electrosurgical machine: Construction

The generating unit itself is often called a **Bovie**. It is generally a solid state device that can produce 300 to 3000 kilo Hertz. Most machines produce 25-200 Watts. Conceptually, the Bovie breaks up the 50 Hz from the wall into many shorter pulses, then uses a transformer to generate the high voltage required.



Activation of the electrosurgery is done by the surgeon using either a hand switch on the bovie pen or by stepping on a foot switch. Both have two contacts one labelled **CUT** for electro-section and the other **COAG** for electro-dessication or electrofulguration.

Electrosurgical machine: Construction



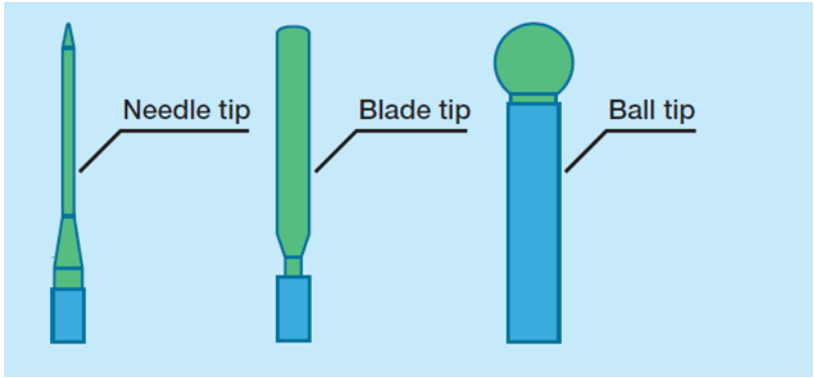
Troubleshooting

- The most common problems in electrosurgery are:
  - burns, excessive tissue damage, damage to alternate
  - fires
  - interference with other devices.
- Skin burns are the most frequently reported of these problems, usually occurring at the return electrode site. Partial or complete detachment of the electrode pad from the patient is the most common cause.
- The dispersive electrode should always be placed on an area of the body that has good blood flow and is not subject to high weight concentration. The side of the thigh is a very common location.
- If the **tip is dirty**, there can be little, or no, current passing through the patient.
- In addition to problems with dirty tips, the wires become broken with reuse. They are simple wires which can be re-soldered for repairs.
- In older machines, the lack of contact with the electrode may not be detected by the system. The effect can be patient burns where the electrical current finds an alternative path to ground. In newer machines, the generator has two connections to the dispersive electrode. When connected to the patient, a small current is passed between the two halves of the dispersive electrodes. When not properly connected to the patient, the current cannot pass and an alarm will sound.

Preventive maintenance

- The most important action in preventive maintenance is to keeping the inside and outside of the machine **clean**. Check the plate electrode, the leads, and the instruments.

- If the physician wishes a different tip for a monopolar electrosurgery unit, it is sufficient to connect any metal tip to the existing tip. Insure that the connection is electrically and mechanically sound to the existing tip and pen.



Safety considerations

The ESU is inherently a potentially **dangerous** device. All members of the surgical team using an ESU must be fully aware of the hazards, understand the principles of operation and safe handling, and be familiar with the abilities and limitations of their particular unit.

The main risks associated with electrical surgery

- **Burns**
- **Electrical interference** with the **heart muscle**
- **Explosion/fire** caused by sparks and
- Electrical interference with **pacemaker** and other medical equipment.

Performance monitoring

- The performance and safety of electrosurgical devices must be verified every 3-6 months.
- A typical test procedure can consist of the following test steps:
  1. Visual inspection
  2. Low-frequency electrical safety test.
  3. Verification of the **contact quality monitoring** circuit (Return Electrode Monitoring)
  4. Testing for high frequency leakage
  5. Check output power at certain loads in relation to the function and waveform selection.

THANK YOU!