ENERGY SOURCES IN LAPAROSCOPY

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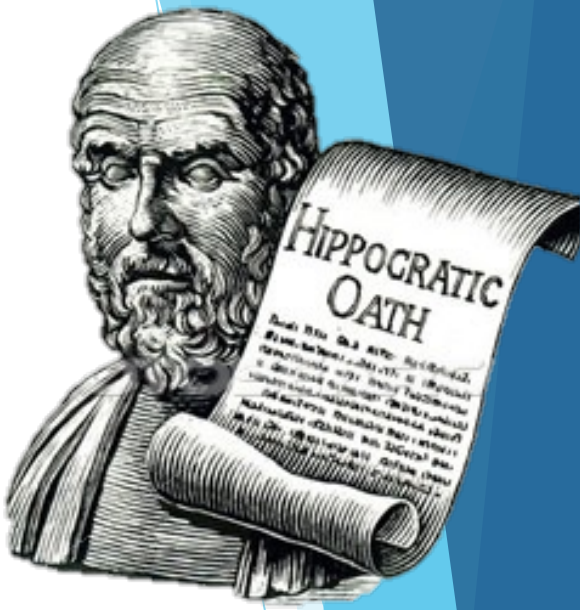
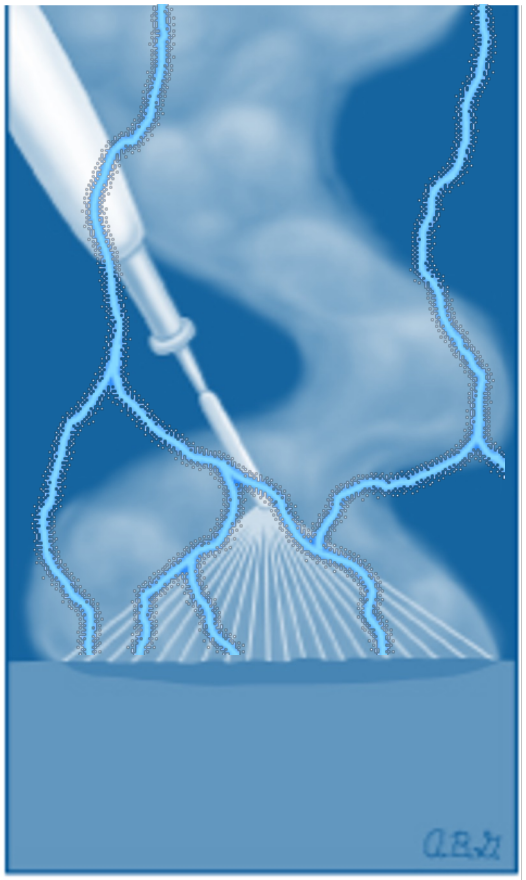
HISTORY

- The use of cautery is described in ancient medicine.
- Hippocrates used cautery to treat Hemorrhoids,



- Albucasis, the father of modern surgery popularized the use of cautery in surgery all over Europe.

LIGHTNING



Fulguration

FULGURATION

Latin word for lightning

Walter de Keating-Hart 1907 used fulguration from the Latin word for lightning

Dessication

DESICCATION

William Clark in 1914.

He described the effect to be between hyperaemia and carbonization with just enough heat to destroy the tissue.

FACT SHOULD KNOW FIRST

WHY THIS **PRESENTATION?**

- Proper use and knowledge of energy sources is a must for performing a laparoscopic surgery.

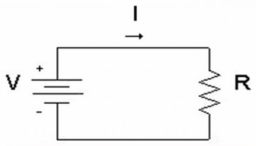
- A thorough knowledge and understanding the basics of energy uses will improve the quality of surgery as well as prevent complications due to improper usage.

BASIC PRINCIPLES IN ELECTRICITY

OHM'S LAW

Georg Simon Ohm

Electronics and You



Basic Electrical Circuit

$$I = \frac{V}{R}$$

Ohm's Law

CURRENT (I)

The electrical current is the flow of electrons.

The source of current is an electrosurgical unit.

IMPEDANCE /RESISTANCE (R)

Impedance is the opposition of the flow to the current.

During surgery the impedance source is the tissue.

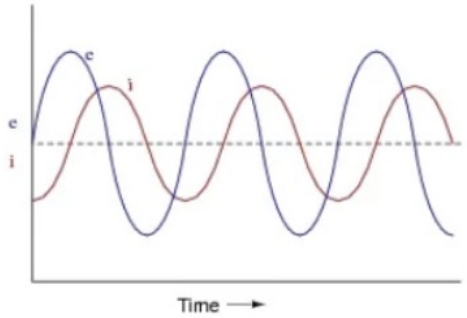
The type of tissue to which the current is applied differs in impedance.

VOLTAGE (V)

Voltage is **the the electric force that causes electrons to flow.**

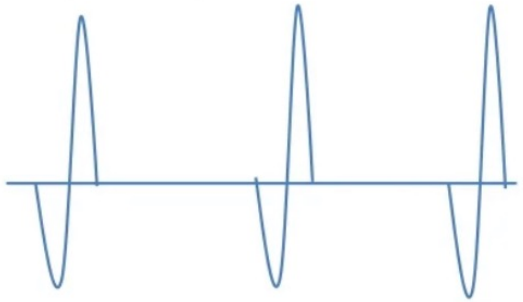
Cut

- Low Voltage + Long Time



Coag

- High Voltage + Short Time



BASIC PRINCIPLES IN COAGULATING

.

- Water from the tissue evaporates and cells dry up.
- A process of tissue desiccation, protein denaturation
- This seals the vessels and haemostasis is achieved.
- Carbon is formed on continued application of current which results in tissue blackening.

FACTORS MODIFYING THE TISSUE EFFECTS

- 1. Size of active electrode
- 2. Cut or Coagulation mode
- 3. Power setting
- 4 Duration of exposure
- 5. Tissue Impedance

CURRENT DENSITY VS TISSUE IMPEDANCE

TYPES OF **ENERGY SOURCES**

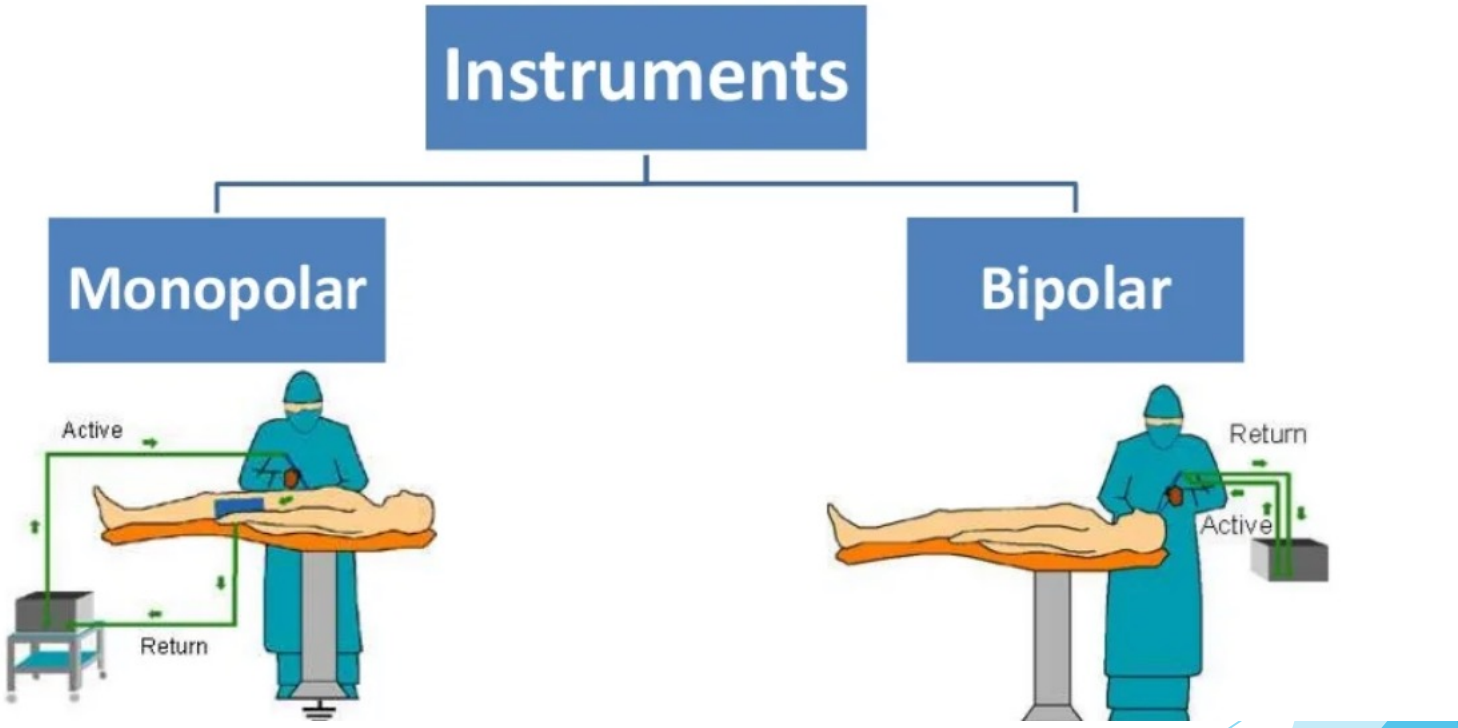
TYPES OF ENERGY SOURCES Mainly 3 types of energy sources are there

1. Electrical
2. Ultrasonic
3. Argon beam

All other sources are basically modifications of one of these sources.

ELECTRO SURGICAL INSTRUMENTS

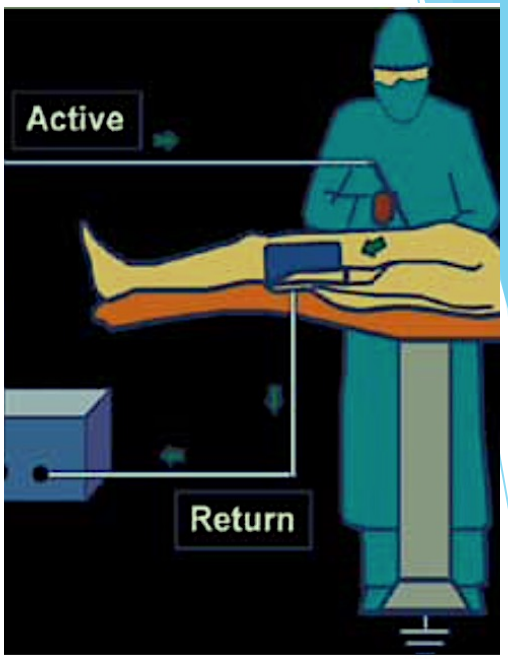
INSTRUMENTS

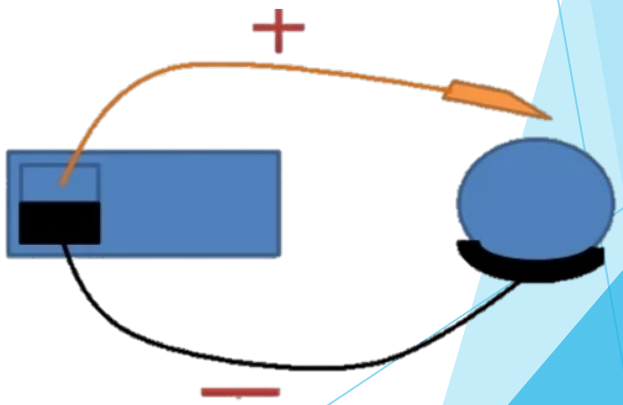


MONOPOLAR INSTRUMENTS

ELECTRICAL CURRENT FLOWS FROM

- the generator to the electrode through the target tissue,
- to the patient return pad and
- back to the generator.





MONOPOLAR INSTRUMENTS

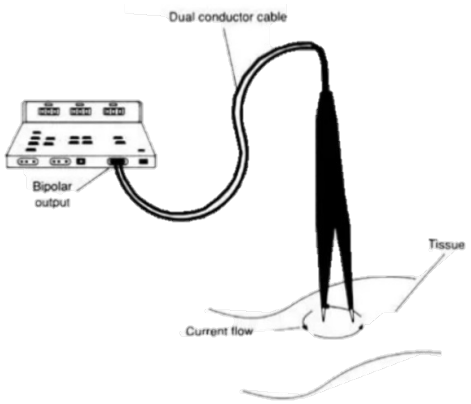
Advantages

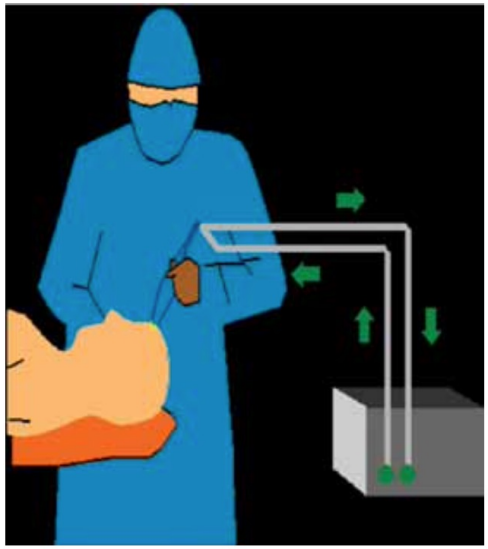
- Easy to use
- Inexpensive
- Best method for making simple incisions on the skin

Disadvantages

- Interference with pacemakers and other equipment's during surgery.
- Higher temperatures at the tool tip and longer cool down times to a safer temperature compared
- Large thermal spread.

BIPOLAR INSTRUMENTS





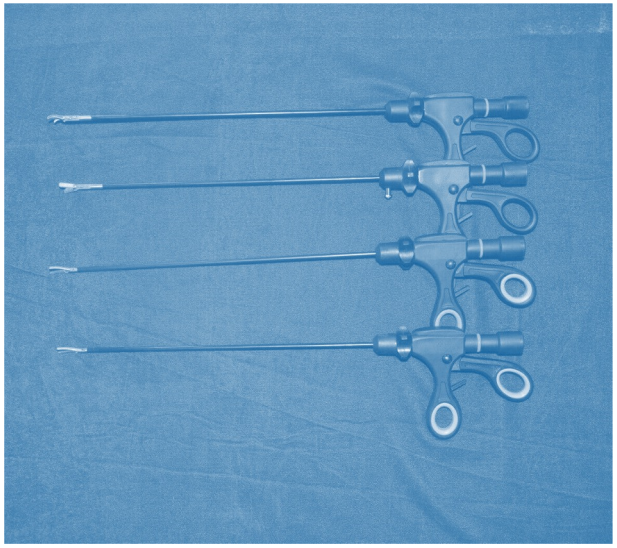
- electrons flow between two adjacent electrodes. The tissue between the two electrodes is heated and desiccated.
- Less chances of Cutting
- Best for coagulation, so mainly for small vessel coagulation without thermal injury.

BI-POLAR CAUTERY

THE BI-POLAR CURRENT IS

- to be used with the lowest settings
- to be applied in short bursts.
- Applying the current continuously is less effective, causes more lateral spread of current and results in charring of tissues.

BIPOLAR INSTRUMENTS



it is more ideally used for those procedures where tissues can be easily grabbed on both sides by the forceps electrode.

BIPOLAR INSTRUMENTS

Advantages

- Better control over the area being targeted, and helps prevent damage to other sensitive tissues.
- The risk of patient burns is reduced significantly.
- It can be used in patients with implants.

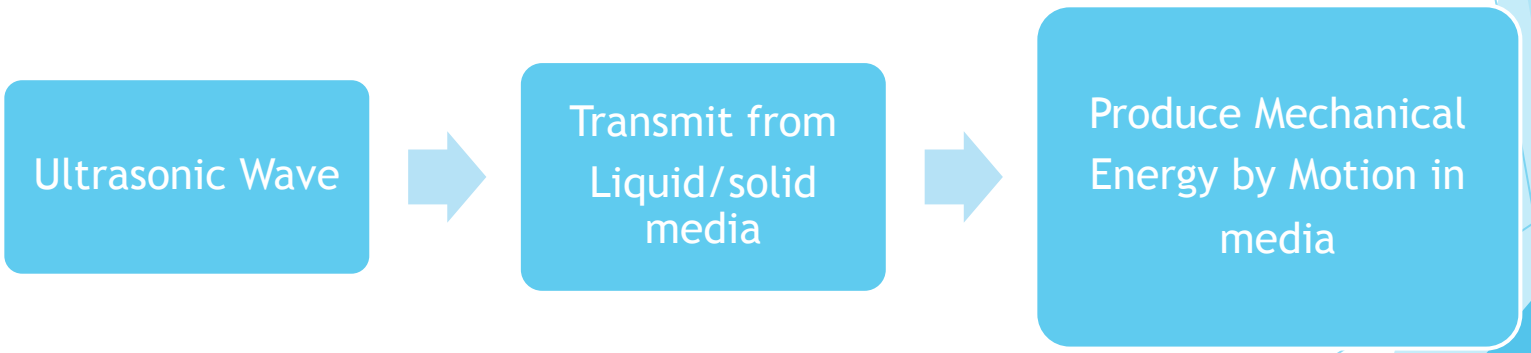
Disadvantages

- Operational time is usually longer than monopolar electrosurgery
- Not as effective on small blood vessels.

ULTRASONIC GENERATOR

ULTRASONIC WAVE

- Infrasonic < 20 Hz
- Audible wave = 20- 20,000 Hz
- Ultrasonic > 20,000 Hz

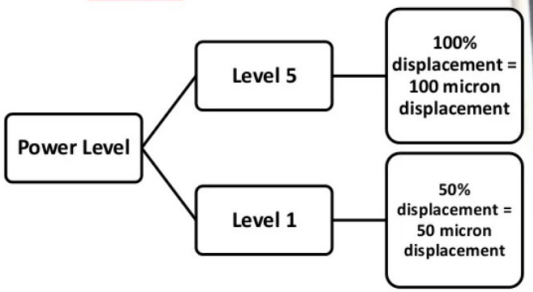


- The Harmonic Scalpel uses sound energy at 55000 Cycles per second (Hz).
- (This is done by a piezoelectric ceramic element that expands and contracts rapidly)

- Sound energy is transmitted through silicon rings in the element which amplify the waves.
- This makes the blade vibrate.
- Heat is produced due to friction
- Coagulation and cutting is thus obtained according to low or high-power setting on the foot pedal.

POWER SETTING

- **We can set power level 1 To 5**



The settings on the processor are set to

- 2 or 3 for coagulating
- 5 for cutting

Cutting VS Coagulation Modes

More tissue tension		♦ Faster cutting ♦ Less homeostasis
Less tissue tension		■ Slower cutting ■ More homeostasis

TISSUE EFFECTS

- **Cutting**
- **Coagulation**
- **Cavitations :** Motion of blade create Vaporization.

Fluid vapor expansion causes layers to separate

which enhance Plane of dissection

- **Drilling**

CUTTING

COAGULATION

CAVITATIONS

DRILLING

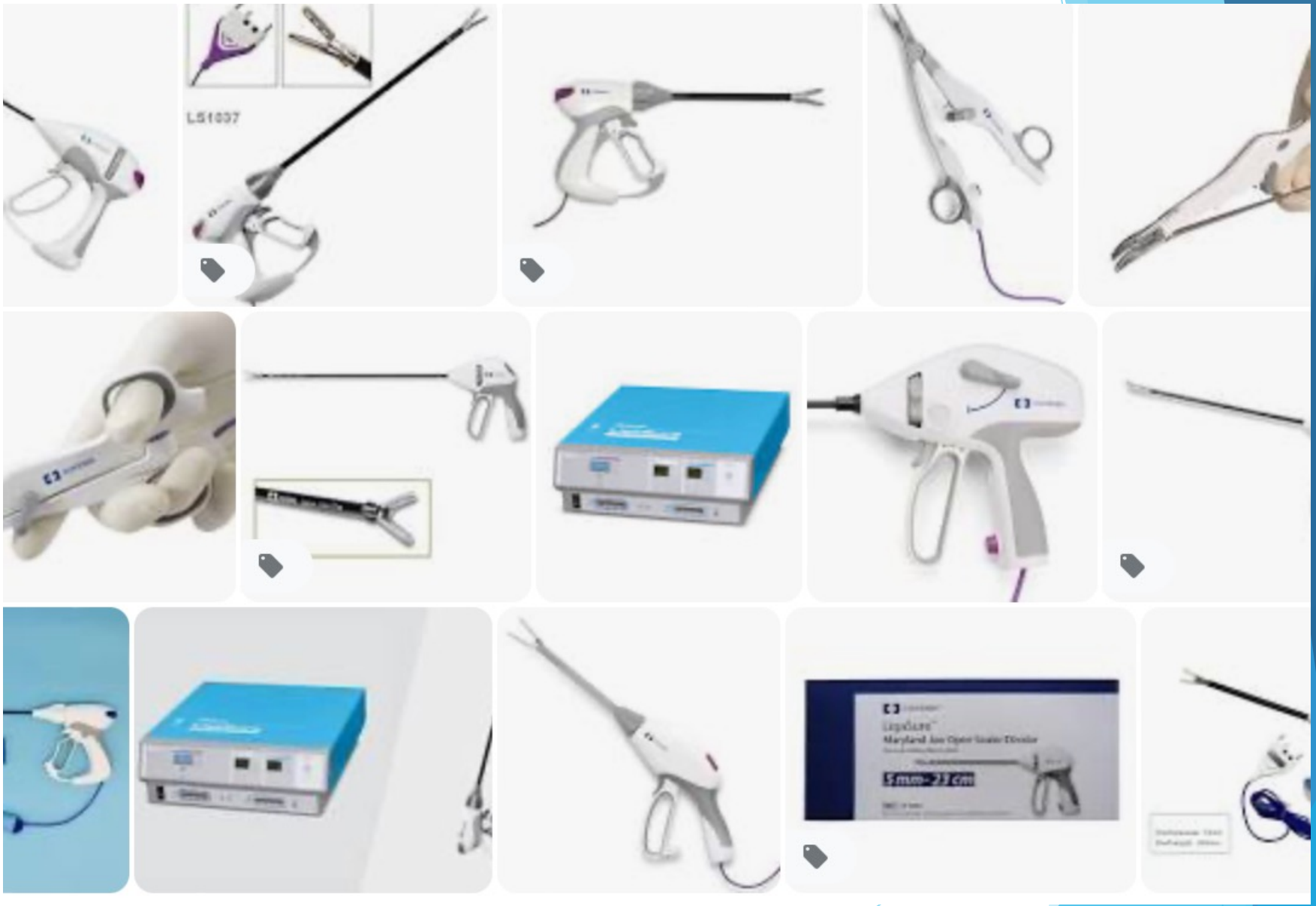
Advantages

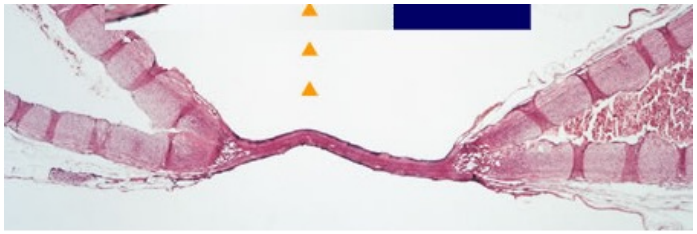
- Produces less heat compared to other energy devices (less than 80° C compared to 100 C for electro surgery) thereby reducing the risk of thermal injury.
- Does not transmit active current in the tissues and thereby eliminate any risk of electric shock.

Disadvantages

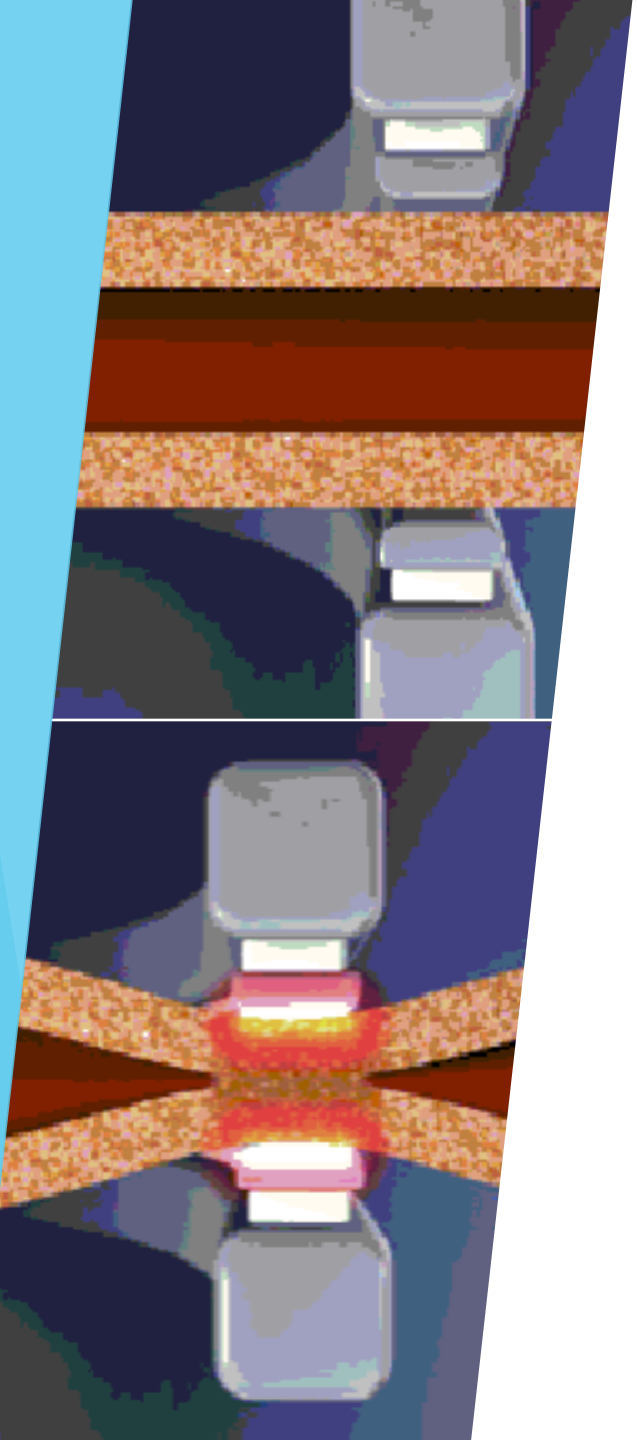
- slower coagulation compared to electrosurgery
- not as efficient in sealing medium to large sized blood vessels. Not reliable in sealing vessels larger than 3mm.

LIGASURE


LS1037
5 mm - 23 cm



- LigaSure vessel sealing technology works by **bipolar energy with pressure** to **fuse the collagen and elastin in the vessel walls.**
- It effectively seals vessels 1 to 7 mm in diameter with minimal sticking, charring, or thermal spread.



THE LIGASURE

- The ligasure is a dedicated bipolar with pressure and works at a pressure of upto 250 mm Hg.
- There is no lateral spread beyond the jaws.
- These are available as 10 and 5 mm probes. The 10 mm probe is more useful as it is more sturdy.
- Ligasure gives a audio signal when coagulation is completed, after which the inbuilt cutter can be used to cut the tissue.
- The ligasure is excellent for taking bulky pedicles Upto 7 mm vessels

THUNDER BEAT

THUNDER BEAT

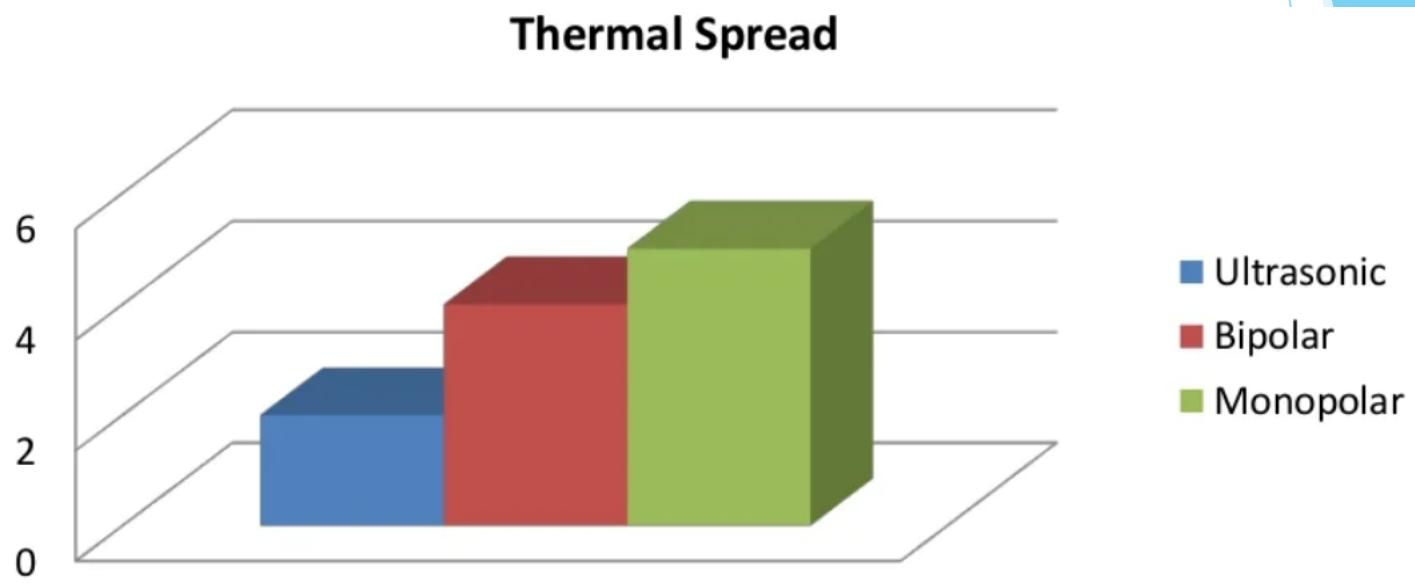
HYBRID DEVICES

The THUNDERBEAT (TB) is **a relatively novel energy device that is used in laparoscopic resection which integrates both ultrasonic and bipolar energy.**

allowing a surgeon to simultaneously seal and cut vessels up to and including 7 mm in size with minimal thermal spread.

COMPARISION

COMPARISION



COMPARISION

	Ultrasonic	Bipolar	Monopolar
Coagulation	Yes	Yes	Yes
Small vessel coagulatn	Yes	No	?
Large vessel coagulatn	No	Yes	?
Cutting	Yes	No	Yes
Lateral Thermal Effect	Lowest	Medium	Highest
Thermal Injuries	Lowest	Medium	Highest

- **When considering thermal damage**

  Max - monopolar electro-surgery

  Min - ultrasonic energy.

- **In terms of their performance**

  highest seal strength in smaller vessels - ultrasonic devices

  highest seal strength in larger vessels - Ligasule

- **most effective hemostasis on irregular surfaces**

  Argon beam coagulation (however, it also leads to gas embolism.)

ELECTRO SURGICAL ACCIDENTS

ELECTROSURGICAL ACCIDENTS

- I have not seen one !!!!!
- They are very rare !!!!!
- Seen only in textbooks!!!!!

Is it true ??

ELECTRO SURGICAL **ACCIDENTS**

According to AORN journal

(AORN - Association of perioperative Registered Nurses)

- Around **40,000** pts. burned by faulty Electro-Surgical Unit every year.
- **70%** of them are undiagnosed at the time of surgery.

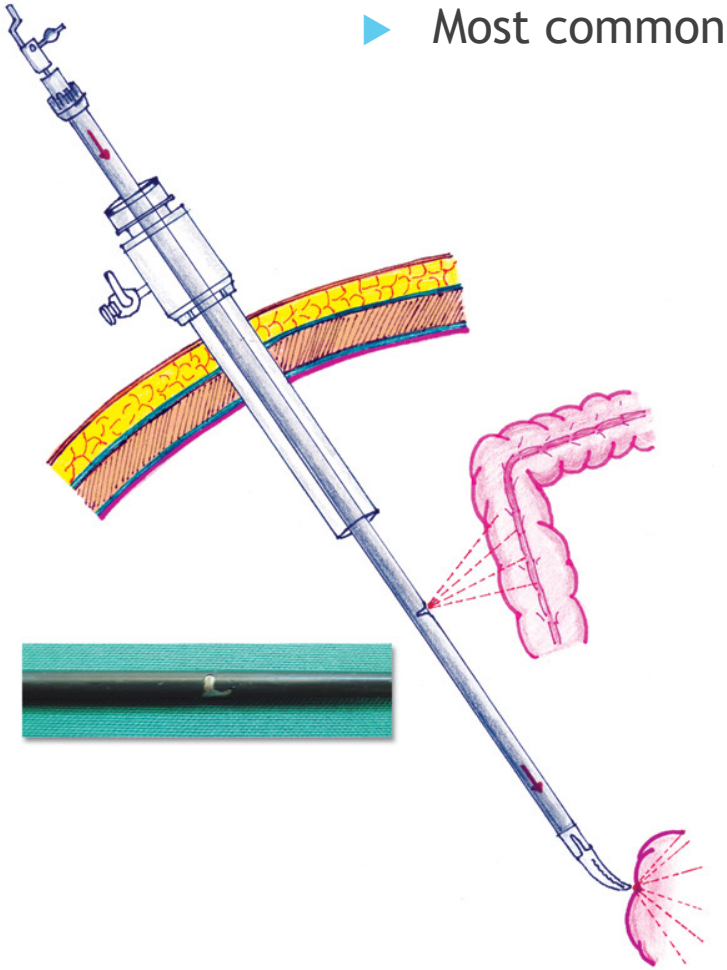
ELECTROSURGICAL INJURIES DURING LAPAROSCOPY

- Electro surgical injuries are not always due to 'Pilot' error.

Insulation Failure
Direct Coupling
Capacitive Coupling

INSULATION FAILURE

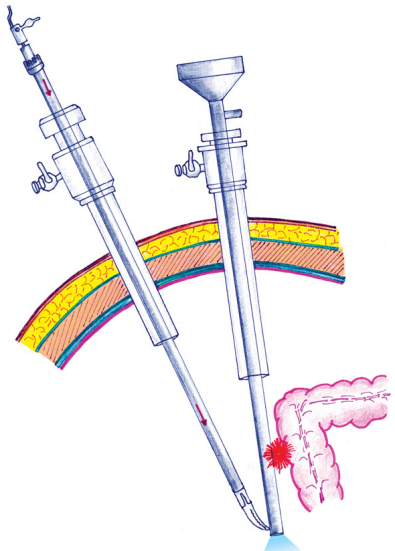
- Most common reason

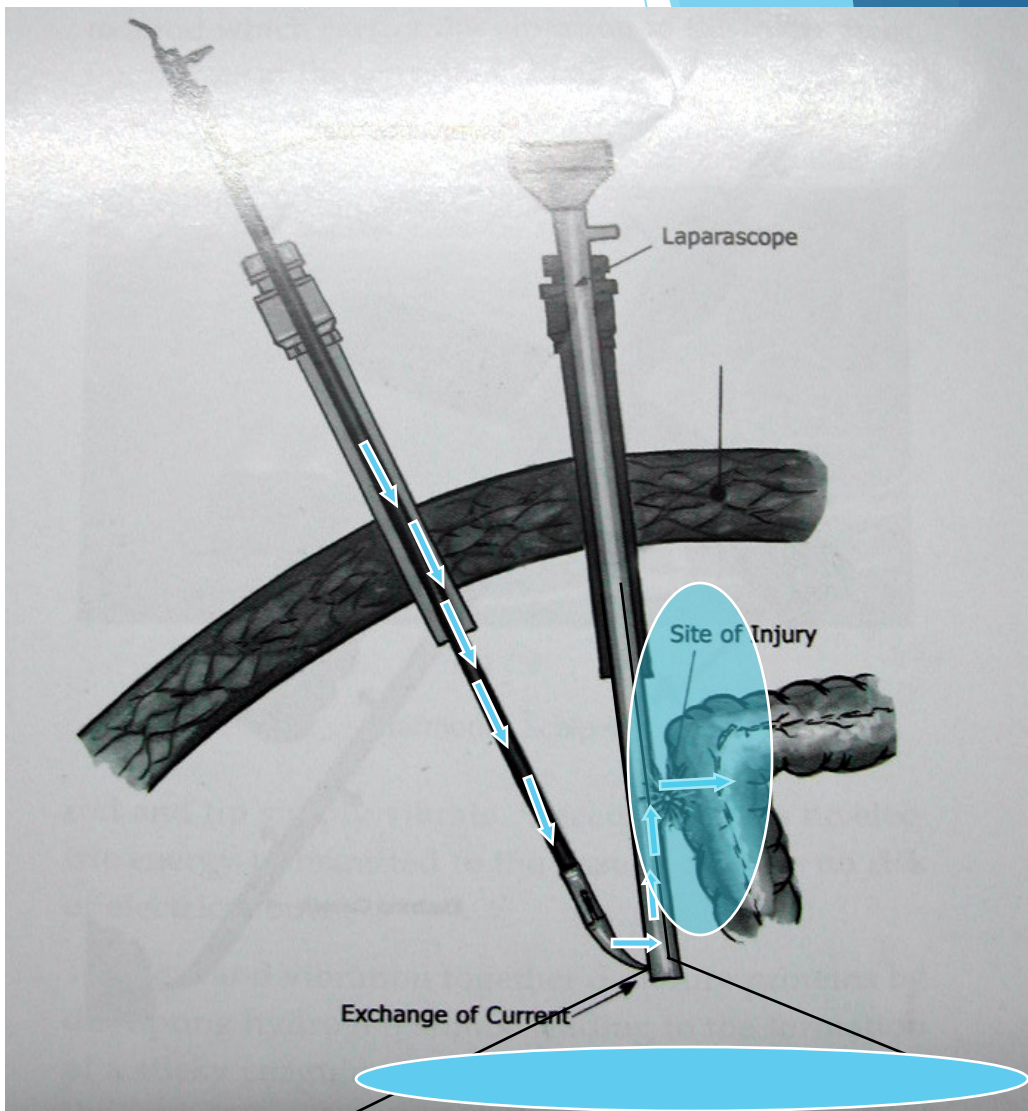


DIRECT COUPLING

Instruments touching other areas

Instrument in contact with other instruments





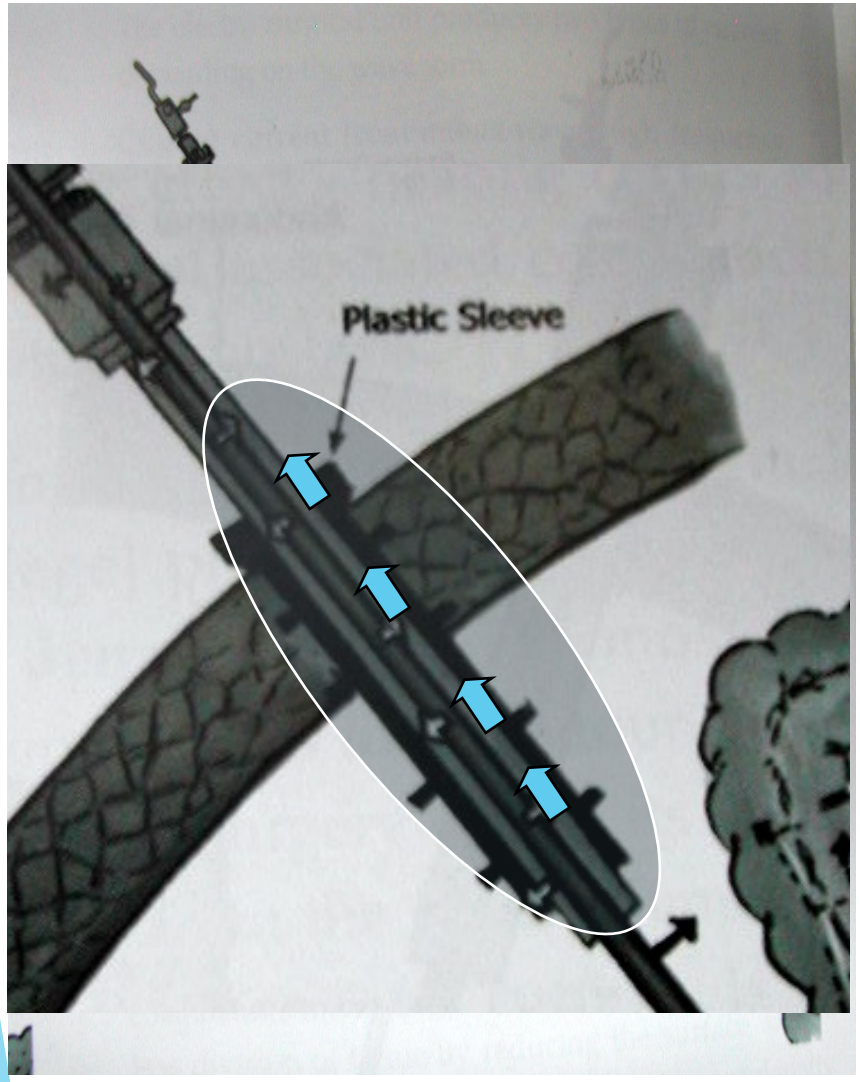
CAPACITANCE COUPLING

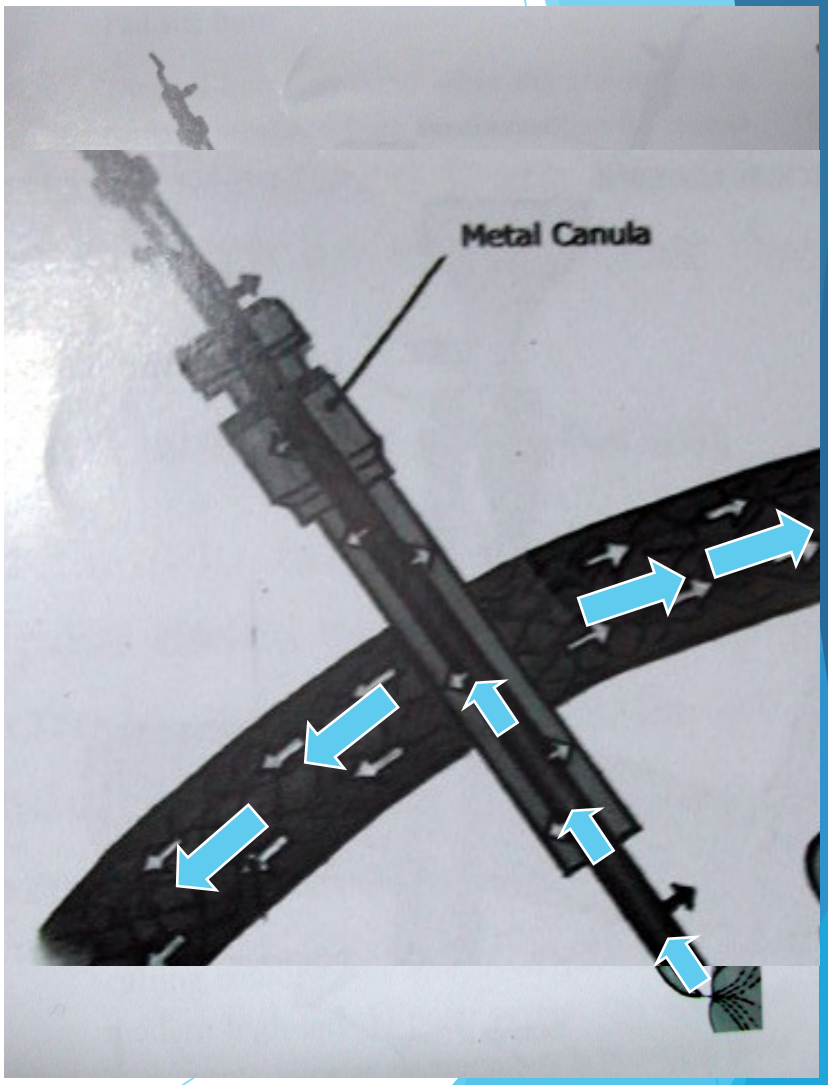
2 conductors separated by insulator + air gap

Energy gets stored

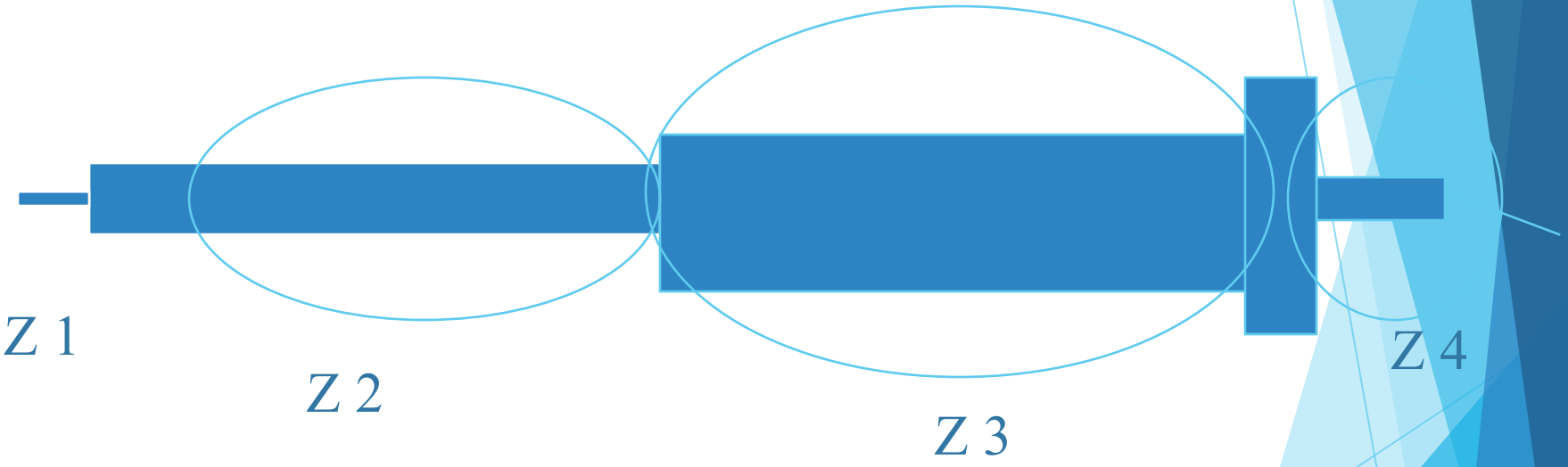
Accumulated energy discharges through the point of contact between cannula and instrument

CAPACITANCE COUPLING





INSULATION FAILURE ZONES



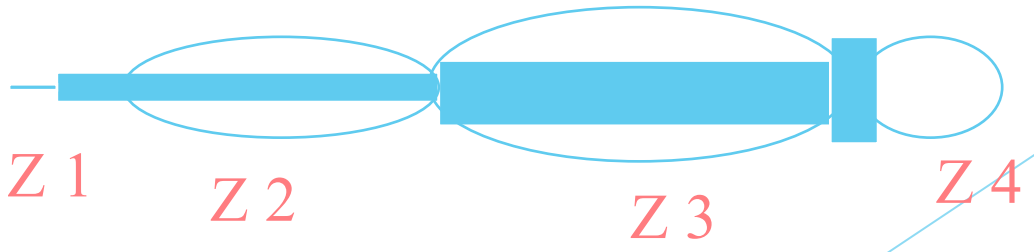
ZONE I – WITHIN THE VIEW

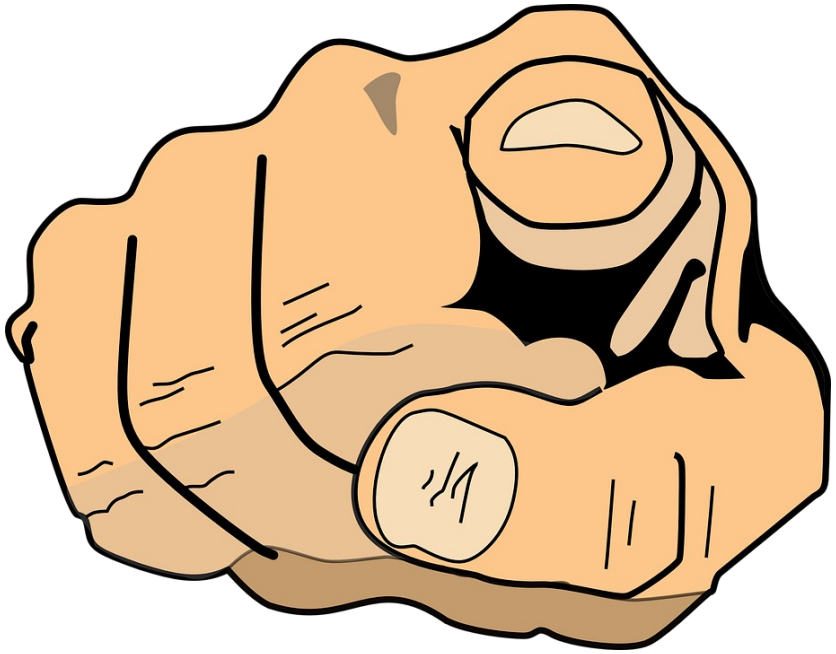
Repeated trauma (insertion, withdrawal)

Repeated heating, poor handling

Sterilisation defect

Manufacturing defect





It's your responsibility to avoid electrosurgery injury

CHALLENGES IN LAP

- Limited access, Limited field of vision,
- Presence of insufflating gas
- Low heating capacity,
- Instruments may not cool rapidly
- Combustion - N20
- Use of Cannulas - Capacitance coupling

WAY TO THE **SAFE SURGERY?**

AVOID

Activation of cautery :

- When tissues & instrument are not in contact
- Outside the visual field
- Near metallic objects

(clip, staple, scope, metal instruments)

Metal Cannulas with plastic sleeves

Use of the un-insulated instrument

WHICH IS THE BEST?!

- Easy to handle
- Reliable
- Efficient
- Cost Effective

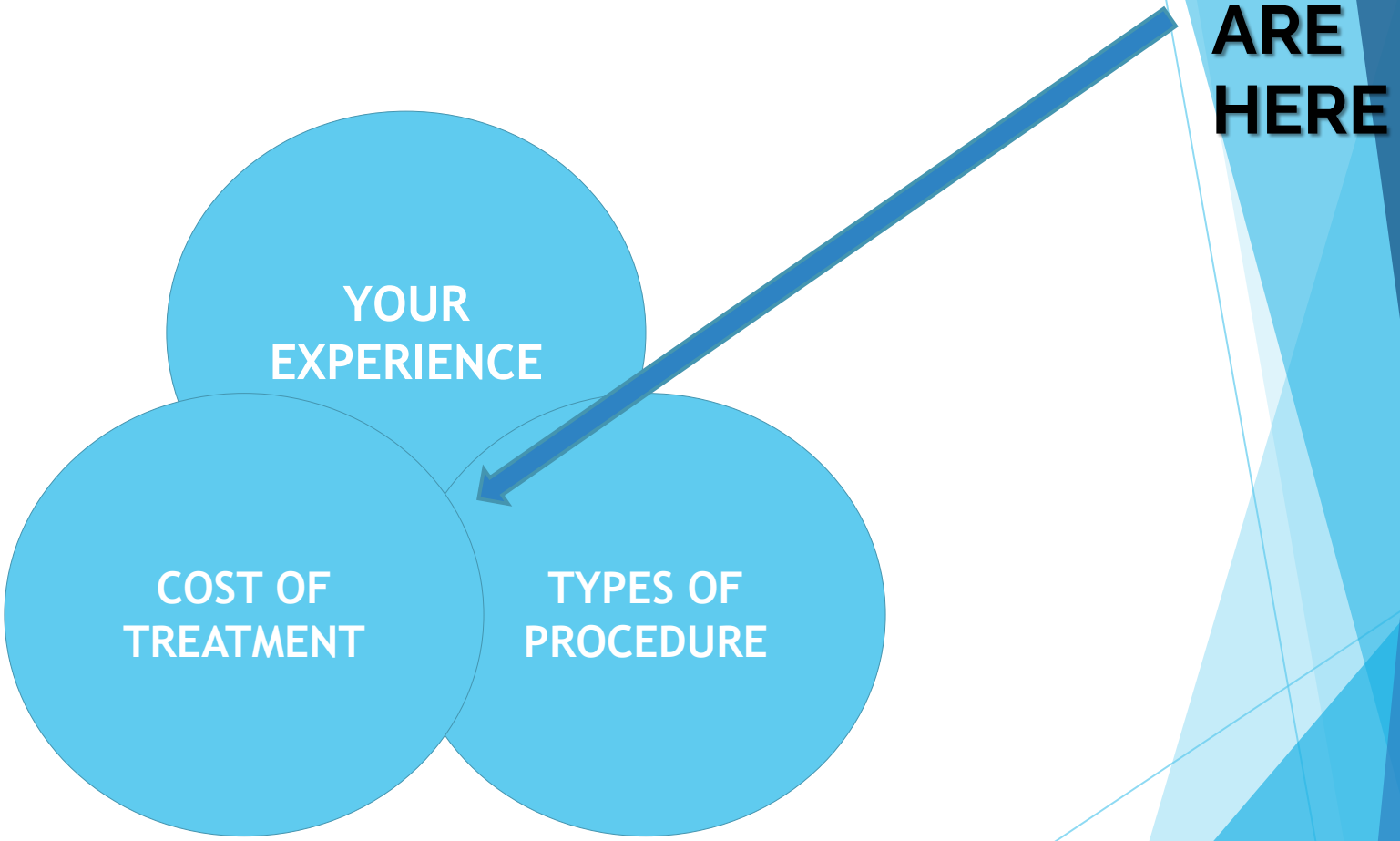
Features

- Maximum vessel burst Pressure
- Least thermal spread.
- Least amount of smoke production.
- Fastest sealing time

HOW TO SELECT THE INSTRUMENT FOR PURCHASE


CHOOSE
DECIDE
PICK
SELECT

RIGHT SELECTION



JUST LIKE SELECTION OF CAR












TAKE HOME MESSAGE

HOW TO SELECT -CHOICE

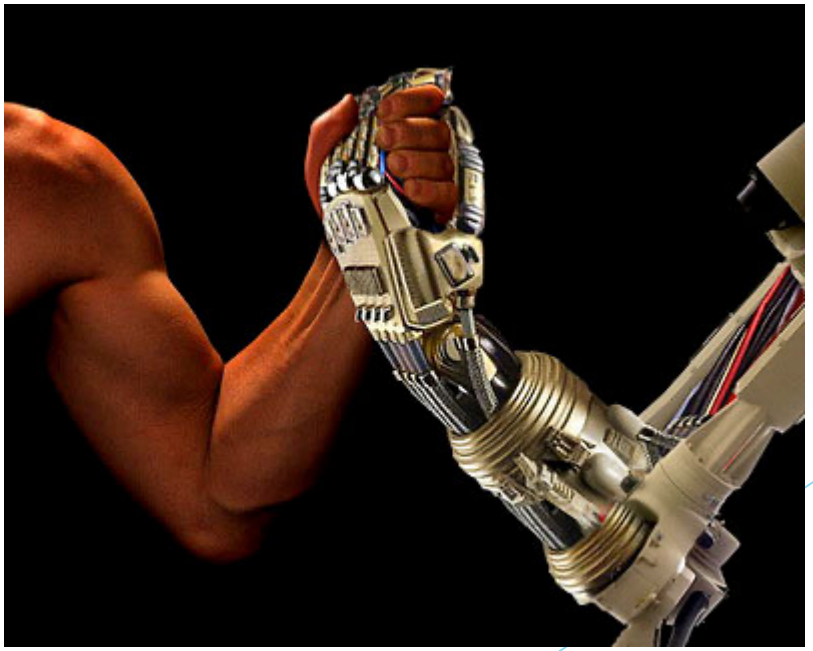
- If you are capable you can do any surgery by any equipment.

IN LAPAROSCOPY

- CUTTING : Tip of the hook
  High density current
- COAGULATION :Blunt side of hook
  Low density current
- FULGURATION :Blunt side, kept at a short distance
  Low density, shallow coagulation

SURGEON SHOULD BE MASTER FOR ALL MACHINES

MACHINES ARE THE SLAVES FOR SURGEON



JUST RIDE THE TECHNOLOGY


Thank
you