A SURGEON'S GUIDE TO ELECTROSURGERY

Bovie®

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INTRODUCTION

Electrosurgery refers to the application of a high-frequency electrical current to biological tissue in order to cut, coagulate, or desiccate the tissue. It has been common in hospitals for over 60 years. Today over 80% of all surgical procedures involve electrosurgery and the US Centers for Disease Control and Prevention estimates that electrosurgical devices are used in over 41 million procedures per year. Now, health professionals around the world are adopting these valuable time-saving tools http://www.cdc.gov/nchs/fastats/hospital.htm.

Electrosurgery allows surgeons to operate efficiently and with great precision. By providing the ability to cut tissue and control bleeding with a single hand-held device, the method can reduce blood loss, procedural time, and minimize the patient's time under anesthesia.

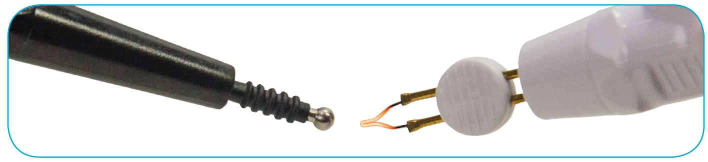
This educational guide explains the technology behind electrosurgery and some of the key features of electrosurgical devices.

ELECTROCAUTERY VS. ELECTROSURGERY

Although incorrect, the term "electrocautery" is often used to describe all electrosurgical procedures. But while electrosurgery involves the application of electrical current through tissue to create the desired effect, electrocautery involves heating a wire or instrument via electrical energy.

During electrocautery the hot wire or instrument is then applied to the tissue, transferring the heat, helping to achieve the desired tissue effect. Current never enters the tissue or body and electrocautery techniques are only used for coagulation of small bleeding vessels. In contrast, electrosurgery generates heat by transmitting electrical energy through the tissue itself and offers a broad range of applications.

Today it is very common to hear the term "Bovie®" used to describe a monopolar pencil or the application of electrosurgical energy to tissue (e.g. "Bovie this.") This practice dates back to 1926 and invokes memories of Dr. William T. Bovie, a PhD from Harvard University, who is credited as the inventor of the electrosurgical generator.



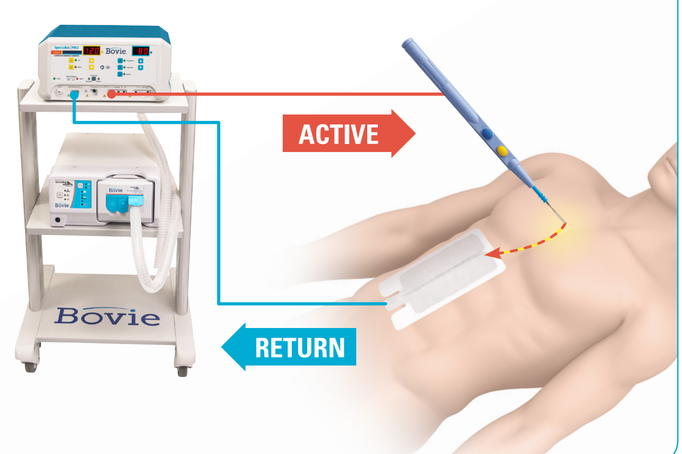
Despite the common vernacular, in this document we will refer to the use of electrosurgical devices by the term "electrosurgery."

ELECTROSURGERY: AN OVERVIEW

The principle underlying electrosurgery is simple: a highly controlled electrical current is passed through tissue in the patient's body. The tissue becomes part of the electrical circuit acting as a resistor that generates localized heat. Depending on the resulting energy profile or temperature, the tissue is cut, coagulated, ablated, or dissected.

The electrical current is powered by an Electrosurgery Generator Unit commonly called an ESU or generator. The ESU provides different electrical waveforms to create different effects in the tissue.

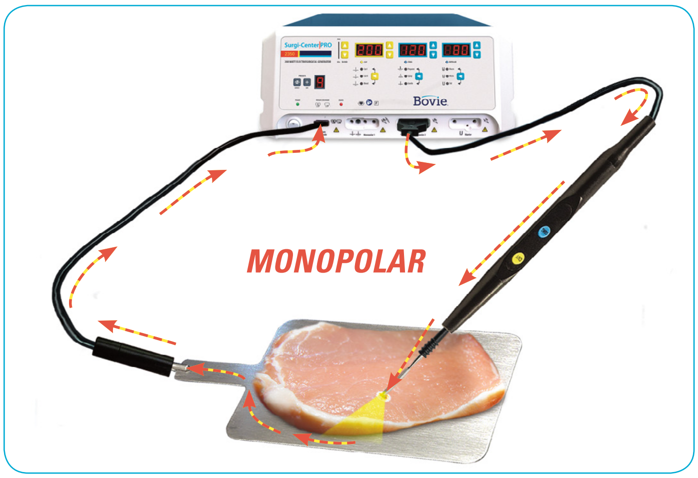
Electrical current flows from the Electrosurgical Generator Unit (ESU) to the handpiece, through the patient and to the return electrode pad. Current then returns from the pad back to the ESU.

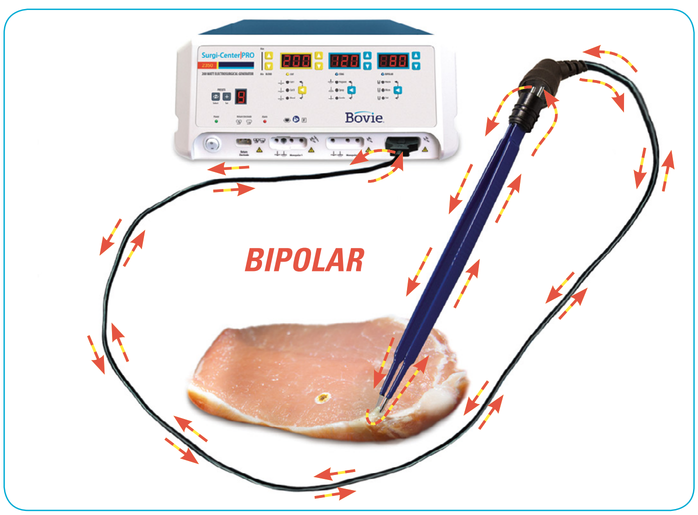


Electrosurgical systems come in two configurations: monopolar and bipolar. Monopolar and bipolar modes differ in the pathway that the electrical current takes through the tissue and are suitable for different types of surgeries.

MONOPOLAR ELECTROSURGERY

Monopolar electrosurgery is the most commonly used modality. It offers three main advantages: ease of use, efficient cutting, and ability to coagulate larger vessels. In monopolar electrosurgery current flows from the generator into the active electrode on the end of the handheld 'pencil' and then into the tissue. It exits the patient via the grounding plate which is an electrode that's placed on the patient's body to complete the circuit. The current then returns to the generator.





BIPOLAR ELECTROSURGERY

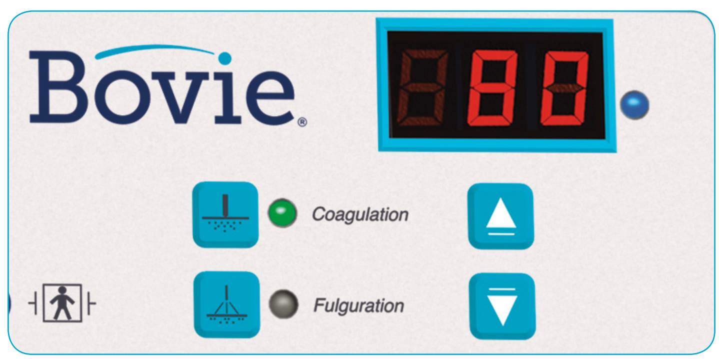
Bipolar electrosurgery is commonly used by neurosurgeons for extremely delicate procedures such as operations around the eyes or on the eyelids. In bipolar electrosurgery the current flows from the electrode on one prong of the tweezer-like handheld device then across the tissue's surface to the electrode on the other side of the handpiece. These electrodes are often as simple as the metal tips of a pair of forceps or scissors. Here, no electrical current flows through the patient so there's no need for a grounding pad. Rather, the current flows along the tissue between the prongs of the handpiece. This makes it a valuable tool for exacting work on a tissue surface.

When adding bipolar capability, you will need the correct footswitch, cable, and forceps *. Bipolar forceps are a reusable product, unlike the disposable monopolar electrode tips.

** Other bipolar forcep styles available.*

VARIABLES IMPACTING TISSUE EFFECT

The surgeon selects the waveform of the current and the power level generated by the ESU. These factors determine how the current interacts with the tissue.



Example of Electrosurgery Generator Unit display panel

Cut mode: When set to cut mode, the ESU generates a standard radio-frequency (RF) current waveform. The steady current is concentrated to a very focused path thus localizing the energy to a point in the tissue. It effectively vaporizes the tissue ahead of the electrode with a constant flow of electricity. The low voltage, high current waveform can be used to cut a wide variety of tissues while providing a small level of hemostasis.

Coagulation mode: When set to coagulate mode, the ESU generates a waveform with interrupted segments of RF current. The high voltage, low current setting desiccates the tissue and seals the bleeding vessels. This is best used when targeting specific bleeding vessels.

Blend mode: When set to blend mode, the ESU combines waveforms suited to each of cutting and coagulation. This allows the surgeon to cut the tissue while imposing hemostasis as desired. A higher-end ESU may have multiple blend settings: one extreme may favor coagulation while the other favors cutting. That can be helpful in situations with higher tendencies for bleeding such as removing a tumor.

Using a ball electrode to coagulate bleeding vessels

Fulguration: When set to fulguration mode, the ESU takes the coagulation mode to an extremely high voltage to arc the energy from the electrode to the patient. That allows surgeons to achieve hemostasis quickly over a large area. Fulguration, often referred to as spray, can be thought of as non-contact coagulation.

OTHER VARIABLES

Other variables that impact the electrosurgery outcome include the type and size of the electrode, activation time, tissue type, and user techniques such as hand speed. Electrodes are disposable and certain specialties (e.g. ob-gyn or dermatology) may benefit from different electrode choices.

Geometry of electrode tip: The most commonly used electrode is the blade. However, other electrodes can be more efficient or better suited for specific procedures. Options include fine-tipped needles, balls, loops, hooks, and insulated/jacketed blades or needles. Electrodes are single-use, disposable products.

Both blade and needle electrodes can be modified into an insulated option such that energy is only delivered through the very tip of the electrode. The modified electrodes are ideal for working in cavities or other procedures where the surgeon requires extreme precision around delicate tissues.

Blade electrodes are the most common type of electrode. They can be used to create the initial incision, excise tissue, and target and coagulate bleeding in a wide variety of tissues. Applying the side of the blade can affect a broader tissue area than just using the edge of the electrode.

Example of a blade electrode

Needle electrodes deliver precise, concentrated energy through a thin needle tip. Like blade electrodes, needles can be used for incision, excision, and pinpoint coagulation. The thin shape of the electrode is easy to maneuver and minimizes thermal damage giving the surgeon more control when operating in complex geometries. A wide range of sharp, blunt, and angled needles are available; particularly for dermatology and ambulatory surgery procedures. J- and L-shaped hooks are also available and are often used in laparoscopic procedures.

Example of a needle electrode

The modified electrode is insulated around the sides such that energy is only delivered through the very tip of the electrode.

Example of a modified electrode

Ball electrodes are used strictly for coagulation and fulguration. The larger surface area of the ball tip (typically 5mm or 3mm) is commonly used to quickly fulgurate, or ‘spray’, large surface areas.

Example of a ball electrode

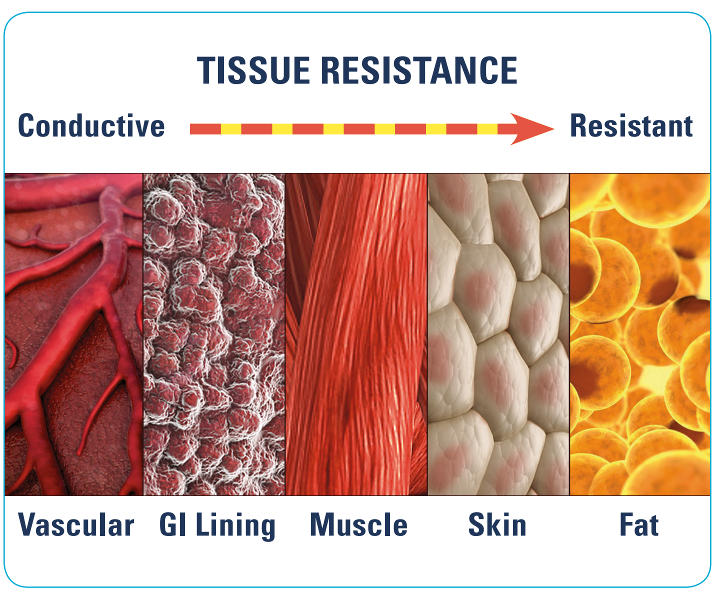
Loop electrodes are used to quickly and easily excise lesions or diseased tissue. They come in a variety of sizes and shapes selected to suit the area and the type of tissue. Common in ob-gyn procedures such as colposcopy and dermatology procedures.

Examples of loop electrodes.
Note the difference in wire diameters.

Size of electrode tip: For a given power setting, a smaller electrode leads to higher energy density and stronger heating in a tissue sample due to the energy density of the different electrodes. Similar effects can be achieved using either smaller electrodes at lower power settings or larger electrodes at higher power settings.

Activation time: Activation time, or the duration over which current flows from the generator, impacts tissue effect. The surgeon presses the cut or coagulation button or foot pedal to activate the generator. A longer activation time produces more heat and therefore has a stronger effect on the tissue.

Type of tissue: Tissues vary greatly in terms of density and perfusion. Highly vascular tissues are more conductive and react differently to electrosurgery than lower vascular tissues.



Techniques: The surgeon's techniques while performing electrosurgery can dramatically affect the outcome of his or her efforts.

GENERAL TECHNIQUES

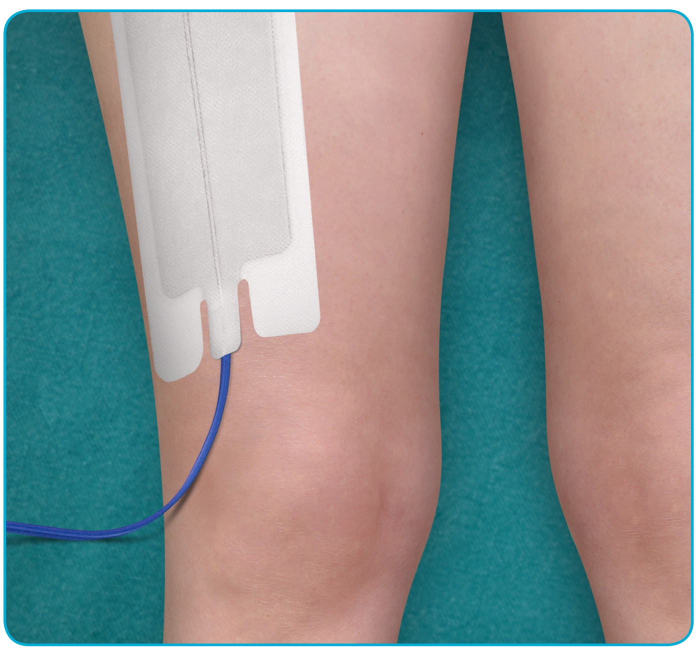
Most surgeons consider electrosurgical devices easy to use and simple to learn. There is no mandated training. However, some basic techniques should be followed.

- Always start at a low power setting and gradually increase the settings until the desired tissue effect is achieved.
- Power level should be set based on the type of tissue. Thinner tissues require lower power while denser or highly perfused organs may require higher power to achieve the desired effect.
- Generally, the power should be set as low as possible but as high as necessary to achieve the cut without dragging the electrode tip through the tissue.
    - If the setting is too low, the electrode will drag as it moves through the tissue. The power should be increased in small increments until the drag disappears.
    - If the setting is too high, the tissue will become discolored or charred. Sparks may also be generated. The power should be reduced until you can make an effective cut without causing excessive tissue discoloration.
    - Control the rate needed for moving the electrode across the tissue by increasing or decreasing power (if you prefer to move slowly, select a lower power to avoid overheating the tissue).
- A monopolar electrosurgery pencil is the most common type of electrosurgical instrument. However, it is possible to create a bipolar electrosurgery effect with a monopolar pencil. This is often referred to as "buzzing the hemostat" and is performed as follows:
    - Activate the ESU just before contacting the tissue.
    - Grasp the target tissue, usually a small blood vessel, with forceps or a hemostat.
    - While pressing the 'coagulate' button on the pencil touch the forceps or hemostat to the monopolar pencil and activate until the desired tissue effect (usually hemostasis) is achieved.

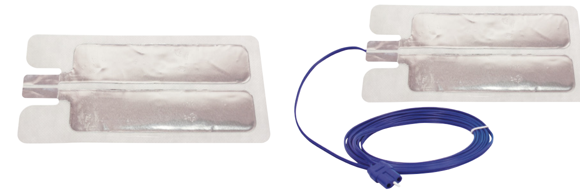
- This technique works as energy is transmitted from the electrode through the forceps or hemostat and to the tissue in between the tines/jaws.
- Remember when using this technique that while the effect will be localized between the jaws of the grasping instrument energy is still transmitted in monopolar mode. Electricity will travel through the body and to the grounding plate.
- Take care to avoid accidentally coupling the electrode to another instrument that would carry current into another part of the patient.

GROUNDING PAD USAGE

A grounding pad is the common name for a return electrode that's placed on the patient to direct the current out of the body. The dispersive electrode diffuses the return current over the area of the pad to avoid burns. A disposable, single-use grounding pad manufactured with a super adhesive hydrogel is most common in surgical applications. Advancements have developed the ability to sense tissue impedance so the ESU will discontinue the current if the pad is not applied correctly (Bovie NEM Neutral Electrode Monitoring).



Note: Do not use alcohol between the grounding pad and the patient. Alcohol is flammable and may catch fire when the electrosurgical device is activated.



Split adult return electrodes

Solid adult return electrodes

CONSIDERATIONS WHEN CHOOSING ELECTROSURGICAL DEVICES

A modern, quality generator offers better control over settings than older devices. It should produce a high quality, consistent power profile. Bovie® offers a variety of generators with different power levels, modalities, and accessories to suit different surgical needs.

The generator should provide a clear display power setting, visible from across the room, so the surgeon can easily check the settings from a distance and instruct the technician if changes are needed.

Most surgeons prefer a hand-held pencil equipped with buttons to switch between cut and coagulate modes. This minimizes the need to break the sterile field or have an additional technician standing by to switch between different functions. But selecting the right (disposable) electrode tip and pencil combination is important for individual comfort. Pencils come in both reusable and disposable options.

Also remember to consider the availability of disposable and reusable components when investing in an electrosurgical system.

Many electrosurgical generators accept both laparoscopic and open surgery instruments but not all systems can. Be sure to purchase the appropriate system depending on your anticipated needs. A surgeon should also consider purchasing a foot pedal control for switching between waveform modes.

In summary, it is important to select an electrosurgical generator and an accessory that are cost effective and have the available settings and accessories that can be adapted as procedures and skills develop over time.

ELECTROSURGERY SAFETY

Modern electrosurgery generators are extremely safe. However, precautions must be followed to ensure the best surgical outcomes with minimal risks to the patient and the surgical staff.

Before use, staff responsible for the operation of the ESU should read the user manual for full instruction on safety and precautions. Bovie® offers manufacturer representatives who will train the entire surgical staff on the setup and operation of the new ESU.

Potential complications associated with the use of electrosurgical devices may include inadvertent burns to the patient and inhalation of noxious surgical smoke. In extremely rare cases the device may cause a fire.

To prevent inadvertent burns the surgeon should acknowledge that the longer the device remains active (by holding the button on the pencil), the more heat it generates on the tissue. Only activate the device during use.

All energy-based surgery devices generate surgical smoke including electrosurgical devices, lasers, and harmonic scalpels. Smoke plumes present an annoyance and may impair visualization of the surgical site. They can also pose a health hazard to the patient, surgeon, and surgical staff. Some 500,000 persons are exposed to surgical smoke each year. Implementing a smoke evacuation system, such as the Bovie Smoke Shark™ II Smoke Evacuator, significantly reduces the risk of surgical smoke exposure while also reducing the strong odor.

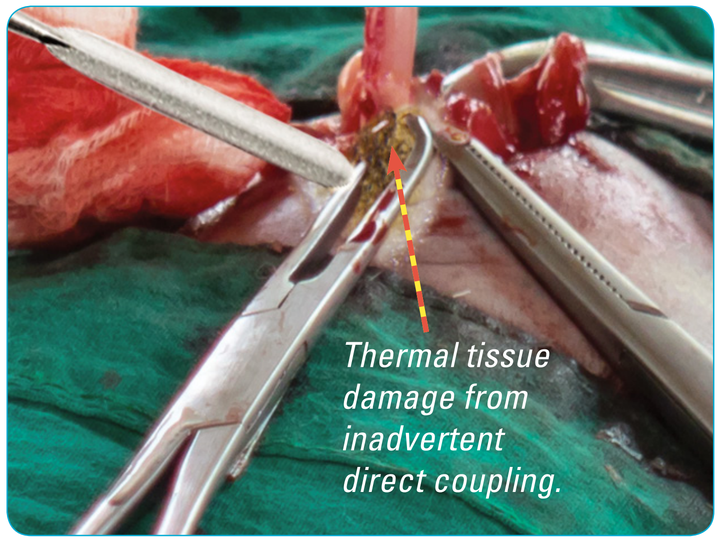
On very rare occasions, electrical sparks from the generator can ignite flammable gases or solutions and cause a fire. To reduce this risk always shut off or reduce the concentration of oxygen before using electrosurgical devices for oral surgery. Inadvertent activation on sponges or drapes can also result in a fire. Always exercise caution when using electrosurgical and other energy devices around flammable materials.

CONSIDERATIONS DURING MIS:

Electrosurgical devices are also available in configurations specifically for minimally invasive surgeries (MIS). When used in MIS, important safety concerns include inadvertent direct coupling.

DIRECT COUPLING:

Direct coupling occurs when the user inadvertently touches an energized electrode to another metal instrument. This secondary instrument conducts the current away from the electrode and could cause thermal damage to any tissue it contacts.


Thermal tissue damage from inadvertent direct coupling.

The secondary instrument becomes a part of the electrical circuit. This energy will seek a pathway to complete the circuit to the patient grounding plate potentially burning or injuring the patient. The surgical technique of "Buzzing the Hemostat," described above, employs direct coupling in a purposeful and safe application as long as the surgeon is aware of all tissue that may be in contact with the secondary instrument.

CONCLUSION

Electrosurgery is safe and effective when basic protocol is followed. State-of-the-art devices allow surgeons to cut and coagulate tissue, significantly minimize bleeding, and improve visibility at the surgical site. Surgeons save time on procedures by efficiently controlling bleeding even during the most complex procedures.

To view videos of electrosurgical products in a variety of surgical procedures including tumor resection, cutting and coagulation, **visit www.youtube.com/user/boviemed.**

ABOUT BOVIE® MEDICAL

Bovie Medical provides current customers and potential buyers with product support and education on all of our products from electrosurgical generators and accessories to smoke evacuation. We have an experienced team of sales professionals covering the entire country and they are available for hands-on product demonstrations and in-servicing or for any of your ESU training needs.

To schedule a meeting with one of our sales professionals contact us via email at Sales@BovieMed.com or by phone at 1 800 537 2790.

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