A Veterinarian’s Guide to ELECTROSURGERY
INTRODUCTION

Today’s electrosurgery generators allow a Veterinarian to be so much more efficient whether it’s a simple removal of a growth or advanced surgical procedures.

Electrosurgery has been commonly used in surgical procedures for over 60 years, and today it is used in over 80% of all human surgical procedures, in almost all surgical specialties. It is estimated that electrosurgery energy devices are being used in over 41 million procedures per year.

http://www.cdc.gov/nchs/fastats/hospital.htm

Because of the benefits associated with the use of electrosurgical devices, this tried and true technology is being adopted by more and more animal health professionals around the world. Electrosurgery generators and accessories are valuable time-saving tools that can enhance any veterinary professional facility.

These devices are used so commonly because they allow for faster and more efficient procedures and provide some unique capabilities for Veterinarians. These capabilities include the ability to cut, coagulate, ablate, and dissect tissue with a single device, which can reduce operative times, blood loss, and reduce the time under anesthesia both intra- and post-operatively.

In this educational guide, we will be explaining the technology behind electrosurgery and highlighting some of the key benefits of these products.

ELECTROCAUTERY VS. ELECTROSURGERY

While incorrect, the term "electrocautery" is often used to describe all electrosurgical devices. It is important to recognize the differences between these two terms. Electrosurgery involves the application of electrical current through tissue to create the desired effect. Electrocautery devices use electrical energy to heat up a wire or instrument. The hot wire or instrument is then applied to the tissue, which transfers the heat and helps achieve the desired tissue effect. When electrocautery is used, there is no current entering the animal’s tissue or body. Electrocautery techniques are only used for general coagulation of small bleeding vessels.

Today, it is very common to hear the term "Bovie®" being 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 relates to Dr. William T. Bovie, a PhD from Harvard University, who is credited as being the inventor of the electrosurgical generator. Despite the common vernacular, throughout this document, we will refer to the usage of electrosurgical devices by using the term "electrosurgery."

ELECTROSURGERY: AN OVERVIEW

Electrosurgery involves the application of high frequency electrical current through the animal’s tissue or body. When electrical current is applied through the tissue, there is resistance. This resistance is what causes localized heat. The heat is then used to create the cutting, coagulation, ablative, or dissection effect.

The electrical current is created by an Electrosurgery Generator Unit, commonly called an ESU or generator. The ESU provides different electrical waveforms to create different effects to the tissue.
The two main types of electrosurgery systems are monopolar electrosurgery and bipolar electrosurgery. These systems differ in the pathway of the flow of electrical current.

**MONOPOLAR ELECTROSURGERY**

Monopolar electrosurgery is the most commonly used electrosurgical modality due to its versatility and clinical effectiveness. In monopolar electrosurgery, the current flows from the handpiece through the animal, and returns via the grounding plate, and back to the generator.

**BIPOLAR ELECTROSURGERY**

In bipolar electrosurgery, the current flows from the electrode on one side of the handpiece to the electrode on the other side of the handpiece. These electrodes are often the tip of a pair of forceps or scissors. With bipolar use, no electrical current is flowing through the animal, so no grounding plate is necessary. Bipolar electrosurgery is commonly used by neurosurgeons and for procedures around the eyes or on the eyelids.

When wanting to add bipolar capability, you will need the correct footswitch, cable and forceps of choice.*

* Other bipolar forcep styles available.

**VARIABLES IMPACTING TISSUE EFFECT**

The ESU has the ability to change the waveform of the current and the power wattage, which changes the effect on tissue. The modalities include the ability to cut, blend, coagulate and fulgurate.

**Cut mode** is a general cutting modality that has a standard radio-frequency (RF) waveform with a constant stream of electricity. In cut mode, the energy is highly concentrated to allow for a very focal energy path. This creates the greatest amount of localized energy in a short time, which in effect vaporizes the tissue ahead of where the electrode is being applied. Cut mode can be used on a wide variety of tissues while providing a small level of hemostasis.

**Blend mode** is a cutting modality that uses a combination of cutting and coagulation waveforms. This mode allows the Veterinarian to cut using greater hemostasis when desired. A higher-end ESU may have multiple blend settings that can be helpful when working in conditions with higher tendencies for bleeders, such as tumors. A higher blend mode adds more coagulation effect to the waveform. Different electrosurgery generators may have a different number of blend settings.

**Coagulation mode** is a power setting on the ESU of high voltage and low current that is used to coagulate bleeding and dehydrate the tissue. In this mode, the tissue dries out and forms a coagulum rather than vaporizing, like when using a cut mode. This is the mode that should be used when targeting specific bleeding vessels.
Fulguration is an electrosurgical output which coagulates and seals tissue over a wide area. Fulguration, often referred to as spray, can be defined as non-contact coagulation. Fulguration uses a higher voltage output to arc the energy from the electrode to the animal. This allows Veterinarians to achieve hemostasis quickly over a large area.

OTHER VARIABLES

Other variables that impact the tissue effect include the type of electrode used, the size of the electrode used, activation time, tissue type, and user techniques such as hand speed.

Type of electrode tip: The most commonly used electrode is the blade electrode. However, other electrodes can be more efficient and maximize your procedures. Other types of electrodes include fine tip needle, ball, loop, and modified insulated/jacketed blades or needles.

It is important to note that electrodes are available in both reusable and disposable types. Generally electrodes with a black base can be autoclaved and reused and electrodes with a blue base are designed to be used for one procedure and discarded.

Blade electrodes are the most common type of electrode used. They allow for general application over a wide variety of tissues for cutting, dissection, and coagulation. They can be used to create the initial incisions, excise tissue and target and coagulate bleeding vessels or tissue. The larger surface area of the side of the blade can apply more energy to a broader tissue area than just using the edge of the electrode.

Needle electrodes offer precise, concentrated energy through a thin needle tip. The concentration of energy allows more precision in the delivery of the energy. Like blade electrodes, needles can be used for incision, excision, pinpoint coagulation. The thin shape of the electrode is easy to maneuver and minimizes thermal damage, giving the Veterinarian more control when making turns while dissecting.

Both blade and needle electrodes are offered as modified electrodes. These electrodes are insulated so that electrosurgical 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 Veterinarian requires extreme precision around delicate tissues.

Ball electrodes are used strictly for coagulation and fulguration. The larger surface area of the ball tip is excellent for coagulation of bleeding tissues. Ball electrodes are commonly used to quickly fulgurate large surface areas.
**Loop electrodes** are used for quick and easy excision of lesions or diseased tissue. They come in a variety of sizes and shapes depending on the area and the type of tissue being excised.

![Examples of loop electrodes. Note the difference in wire diameters.](image)

**Size of electrode tip:** The size of the electrode is an important factor in determining the tissue effect. For a given power setting, the smaller the electrode, the higher the energy density and the greater the effect. Similar tissue effects can be achieved using either smaller electrodes at lower power settings or larger electrodes at higher power settings. This is due to the energy density of the different electrodes.

**Activation time:** Activation time is defined as the amount of time that the cut or coag button or foot pedal is pressed. The length of activation time also impacts the tissue effect. The longer the activation time, the more heat is produced, and therefore the greater the tissue effect.

**Type of tissue:** Tissues vary greatly in terms of density and perfusion. More vascular tissues are more conductive, and therefore react differently to the same type of energy (compared to) than lower vascular tissues.

**Techniques:** The techniques used when using electrosurgery can dramatically affect the amount of current concentration and therefore has a large impact on the tissue effect. The general techniques to use will be described in the next section.

**GENERAL TECHNIQUES TO USE**

Most Veterinarians would consider electrosurgical devices to be easy to use and to have a short learning curve. There is no mandated training necessary. However, there are some basic techniques that should be followed when using electrosurgical devices.

- Always start at a lower power setting and work your way up until you have the desired tissue effect.
- Power level should be set based on the type of tissue being operated on. The more delicate or thinner the tissue, the lower the setting. Conversely, denser or more highly perfused organs may require higher power settings in order to achieve the desired effect.
- General guidance with electrosurgery would be to have the power set as low as possible but as high as necessary so the cut can be done without a lot of drag of the tip through the tissue.
  - If the setting is too low, there will be a lot of drag of the electrode through the tissue. When this occurs it is recommended to increase the power in small increments until the drag disappears.
  - If the setting is too high, there will be a discoloration or excessive char of the tissue or the generation of sparks. If this occurs reduce the power until you can make an effective cut without causing excessive discoloring of the tissue.
- Activate the energy just before contacting the tissue. This will ensure the most consistent effect from start to stop.
- Different power settings allow Veterinarians to move their hand at the rate that they want. This means that a Veterinarian can increase or decrease the power level based on how quickly or slowly they want to achieve the desired effect.
- As mentioned earlier in this guide, a monopolar pencil is the most common type of electrosurgical instrument used. However, it is possible to create a bipolar type effect with a monopolar pencil. This is often referred to as "buzzing the hemostat" and is performed using the follow steps:
  - The target tissue, usually a small vessel, is grasped with forceps or a hemostat.
Using the coag button on the monopolar device, touch the forceps or hemostat and activate until the desired tissue effect (usually hemostasis) is achieved.

This technique is effective because this energy is transmitted from the pencil 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, the energy is still being used in monopolar mode. Electricity will still be transmitted through the body and to the grounding plate.

Caution should be exercised when working around your instruments so that you do not accidentally couple to an instrument causing an undesired tissue effect.

GROUNDING PLATE USAGE

A grounding plate is a common name for a return electrode. A stainless steel grounding plate is used most often in the Veterinary application and, normally, does not require the animal to be shaved. Proper use of the grounding plate is essential to avoid any inadvertent burns to the animal. It is important that at least 85-95% of the plate is in contact with the animal to ensure sufficient surface area so that the current is diffused enough to avoid inadvertent burns. If the animal is smaller than the plate it is important to have the animal in contact with as much of the plate as possible.

Ultrasound gel should be applied between the animal and the grounding plate as an extra precaution, assuring good contact between the animal and the plate. This measure will ensure a more efficient flow of current from the animal to the plate and back to the ESU, and will minimize any risk of grounding plate burns.

Additionally, it is important to make sure the plate is properly repositioned every time an animal is moved during a procedure. The animal should always have maximum contact with the grounding plate. A stainless steel table can transmit the current from the ESU. Therefore, if a stainless steel table is used during a procedure, care should be taken to ensure that it does not come in contact with the animal or the grounding plate.

If using a stainless steel table, it is recommended that a rubber mat be placed between the table and the animal to ensure the table does not conduct the electrosurgical energy. This will minimize risk of inadvertent burns.

When the grounding plate is properly used and connected, there is minimal risk of grounding plate burns.

CONSIDERATIONS WHEN CHOOSING ELECTROSURGICAL DEVICES

The electrosurgical generator should provide a high quality, consistent power profile. A modern, quality generator allows the Veterinarian to use a variety of general techniques that older, lower quality devices will not allow.

The generator should provide clear visibility of the power settings from across the room. This allows the Veterinarian to quickly determine the power setting from a distance and more easily instruct the technician if setting changes are needed. Selecting the right pencil and electrode combination for your specific use is critical. Most Veterinarians select and prefer a reusable pencil that has a cut and coag button so the Veterinarian does not have to leave the sterile field to quickly switch between these two modes. This minimizes the need to break the sterile field, or have an additional tech standing by when needing to switch between different functions.

The available selection of reusable or disposable pencils, electrodes, and other accessories should be considered when adopting the use of electrosurgery in one’s practice.
Electrosurgical generators have the ability to accept both laparoscopic and open surgery instruments and some only accept open instrumentation. Be sure to purchase the appropriate system depending on your anticipated needs and usage. A Veterinarian should also consider purchasing a foot pedal for use when needed for either monopolar or bipolar modes.

In summary, it is important to select an electrosurgical system (generator and accessories) that is cost effective, and has the available settings and accessories that can be used for all Veterinarian’s needs as procedures and skills are developed.

**ELECTROSURGERY SAFETY**

Modern electrosurgery generators are extremely safe. However, there are precautions that must be followed to ensure the best possible outcomes with minimal risks to the animal and the surgical staff working on the animal.

Prior to use, staff responsible for the operation of the ESU should read the user manual for full instruction on safety and precautions. Bovie Animal Health offers manufacturer representatives who will train the entire veterinary 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 animal, inhalation of noxious surgical smoke, and in extremely rare cases, the potential to cause a fire.

In an effort to prevent inadvertent burns, the Veterinarian should acknowledge that the longer the button is held down, the more heat is generated on the tissue. There is no reason to hold down the button when the handpiece is not being used.

Surgical smoke is created by all energy devices including electrosurgery, lasers, and harmonic scalpels. The plumes are, at minimum, an annoyance and may impair visualization of the surgical site. They can also pose a health hazard to the animal, Veterinarian, and surgical staff. It is estimated that over 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, as well as reducing the strong odor.

On very rare occasions, a fire can occur if electrical sparks ignite flammable gases or solutions. Because of this, when performing oral surgery a Veterinarian should always shut off or reduce the concentration of oxygen before using electrosurgery. Inadvertent activation on sponges or drapes can also result in a fire. Caution should always be exercised when using electrosurgical and other energy devices around flammable materials.

**CONSIDERATIONS DURING MIS:**

Electrosurgical devices are also available in configurations that can be used for minimally invasive surgeries (MIS). When used in MIS, there are some important safety concerns to consider such as direct coupling.

**DIRECT COUPLING:**

Direct coupling occurs when the user inadvertently touches an energized electrode to another metal instrument. This secondary instrument will then become energized and could cause thermal damage to any tissue to which it is in contact. This is similar to the purposeful technique “Buzzing the Hemostat” of direct coupling to stop small bleeders, as described in the "General Techniques To Use" section.

The secondary instrument will become energized. This energy will seek a pathway to complete the circuit to the animal grounding plate. If this occurs there is potential for an unanticipated burn or injury to the animal. The surgical technique of “Buzzing the Hemostat,” described above, is a purposeful and safe application of direct coupling as long as the Veterinarian is aware of all tissue that may be touching the secondary instrument.
CONCLUSION

The use of electrosurgery is safe and effective for all cases when using basic recommended techniques. These devices allow the Veterinarian to cut and coagulate tissue, significantly minimize bleeding, and improve visibility at the surgical site. Veterinarians save time on procedures due to the decrease in time spent controlling bleeding and the use of electrosurgery allows many Veterinarians to perform more complex procedures.

To view videos of electrosurgical products being used in a variety of surgical procedures, to include tumor resection, cutting and coagulation, visit Bovie Animal Health’s video library here – BovieVet.com.

ABOUT BOVIE ANIMAL HEALTH

Bovie Animal Health 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 BovieVet@BovieMed.com or by phone at 1 800 537 2790.