Electrocautery in the Operating Room

Cautery is a part of everyday life in an operating room. Some of us may remember the original Bovie machine. Today, we take electrosurgical cautery for granted because we do not know life without it, yet there is still so much to learn about it. The cautery machines of today have their own computer brains to help control electricity. It has spread from our operating rooms to emergency rooms and clinics where patients no longer have to come to the O.R. for cautery or small procedures.

Cauterization in medicine means the use of special instruments to destroy tissue with a caustic electrical current to fuse small areas of body tissue, destroy cells, prevent the spread of infection, or seal tiny blood vessels to minimize blood loss. This takes place mostly in surgery, but some small bleeds may be cauterized in the emergency room. A hot iron and freezing can also cauterize.

Electrocautery has been widely used for over sixty years. There are many complications and advantages to using conventional electrosurgery in common surgical procedure. Electrocautery is the delivery of radio frequency (RF) energy to tissue for a desired clinical effect, such as cutting or coagulation.

The History:

Humans throughout time have used fire to heat some type of tool to stop bleeding. As we evolved, we also started using heat to stop the spread of certain disease. William Bovie, reportedly an eccentric inventor with a doctorate in plant physiology, receives most of the credit for creating an electrosurgical unit in 1920. William Bovie created this machine that uses high frequency current to control bleeding for neurosurgeon Harvey Cushing (1869-1939). William Bovie first used his newly created Bovie for neurosurgeon Harvey Cushing in September
28, 1926. The first hospital to use the Bovie machine was Peter Brent Brigham Hospital in Boston, Massachusetts October 1, 1926.

Before William Bovie’s invention, there was another documented use of spark treatment on a hand ulcer was by Joseph A. Riviere. Riviere discovered that touching one of the wires of a device he was using produced a spark which he used as treatment for an ulcer. Riviere reported his results at the first international congress of medical Electrology and Radiology in Paris in 1900. The Journal of American Medical Association (JAMA) talks of how other events similar to this one lead to this invention.

Dr. Bugbee, who many of us remember through the use of the Bugbee electrode today; in 1917 at the sixteen Annual Meeting of the American Urological Association reported he had used a high frequency spark in treating median bar obstruction. These types of reporting have showed everyone that different fields were using high frequency to treat patients. ScienceDirect goes into greater detail about each one of the people involved in this great discovery.

**What is high frequency?**

High frequency is the range of frequencies in the radio spectrum between 3 and 30 megahertz with a wavelength of 100km to 1 mm. Radio transmissions frequencies range from 15,000 to 10 to the 11th hertz. Radio frequency (RF) energy can also be used in coagulation and ablation. This range of electromagnetic radiation constitutes the Radio Spectrum and corresponds to the frequency of alternating current. Electro surgical units utilize these currents to cut, coagulate, and destroy tissue through specialized instruments. Electricity is also the power behind radiofrequency electrosurgery. The important thing to remember about electricity is it always follows the path of least resistance and it always returns to ground.
Electrical current:

Electrical current (EC) is the flow of electrons during a period of time, measured in amperes. Electrons orbit the nuclei of atoms. Current is created when electrons flow from one atom to the orbit of another atom. Remember, the more concentrated the current, the greater the potential for a burn. It is also important to remember that there are two types of electrical current in use today. The two currents are 1) Direct Current (DC) and 2) Alternating Current (AC). Direct current has a current that does not vary or varies slightly, and always flows in the same constant direction. Batteries are an example of DC. Alternating (electrical) current reverses direction at regular intervals, having a magnitude that varies continuously in a sinusoidal (parallel spaced at regular intervals) manner. The frequency of these alterations is measured in cycles per second or Hertz (HZ). One hertz is equal to one second. Household current is around 60 cycles per second and so is most electrical equipment that is used in an OR and 60 Hz can cause tissue injury.

There must be a complete circuit for electrocautery EC units to work correctly and this allows the electrons to flow. A circuit is a pathway for the uninterrupted flow of electrons. The original source of these electrons is the actual “Ground” to which they always try to return to (earth) ground. Any grounding object can and will complete the circuit.

OR Nurses language:

An electrocautery machine is commonly called a “Bovie” no matter what company it comes from. Examples of electrocautery machines are Bovie medical (Aaron medical) which purchased the Bovie’s rights. Another well-known company is Valley Lab, although there are many others. Today, for each type of machine that
we use, there are several companies who are now involved in producing electrocautery equipment and accessories.

**Electrocautery (EC) Machines:**

Other terms we need to recognize when we are talking about these machines are:

Resistance, which is the opposition to the flow of electrical current, this is measured in **OHMS** (impedance=resistance). In the OR the patient is what creates the resistance. All patient tissues have different **OHMS** of resistance. In the OR the Patient is the “Obstacle” to the flow of current.

**Voltage** is the force that causes one amp to flow through one ohm of resistance. In other words, **voltage** is the force pushing current through the resistance. This process is measured in volts (V). Depending on the type, and how a surgical generator is used, the voltages can range from 2,000 to 10,000 volts of electricity. **Power** is the energy produced and it is measured in watts (W).

According to Webster, a **Watt** is the SI unit of power, equivalent to one Joule per second and equal to the power in a circuit in which a current on one ampere flows across a potential difference of one volt.

A **Joule** is the SI unit of work or energy, equal to the work done by a force of one Newton when its point of application moves through a distance of one meter in the direction of the force.

For EC machines, a current must flow through a completed circuit with voltage impedance and resistance being components to make the generator function.

Safety issue: never bypass an electrocautery safety system. Know and use equipment properly.
Electrosurgical Machines:

There are many electrosurgical machines on the market. Many of which are directed to different types of surgical or procedural settings. Smaller machines have been designed to work from the clinical setting, while larger machines are typically used for major surgical cases. These machines have different settings to accommodate the different types of cases. These settings utilize different waveforms to create a specific effect for the different types of tissue.

The different types of setting are:

The “Cutting” setting uses a continuous waveform, which vaporizes tissue to create a clean tissue cut. As the tip cuts through tissue, it can also coagulate the bleeders as it passes through tissue if the tip is in contact with tissue. Each machine has a range for the **cut** setting and each surgeon will decide the setting for each case. Always make sure to confirm with the surgeon before starting the case, where to put the settings. **Blend** on the EC machine is a function which affects the **cut** setting. Adjusting the **blend** setting changes how coagulation integrates with the cutting process and affects how they work together.

The “**Coag**” setting is an interrupted waveform which heats the tissue to create hemostasis. The tip of the instrument does not have to be in direct contact with tissue to heat the tissue. Sparks given off the tip can coagulate the tissue. Fulguration can also be adjusted on different machines if there is a need.

**Cutting** and **coag** are the two main settings that the surgeon uses in most cases.

Bipolar is also used off most EC units in the OR. When using Bipolar, the electrical current leaves the machine and returns to the machine. Bipolar forceps are used to complete the bipolar process and it uses positive and negative poles which is
low voltage. The current never flows through the patient; therefore the patient does not need to be grounded. Grounding the patient (no they are not in trouble) will be the next step addressed after completing machine settings. Bipolar is regarded as a safe type of electrosurgery, but may not be as effective on large bleeders.

Monopolar is a term referring to the electrical current that starts in the machine then travels to the patient by the cautery tip. The current then travels through the patient starting at the entry wound either by cut or Coag process to a grounding pad which most nurses still call a “Bovie” pad or the bed “Bovie” pad which is also plugged into the EC machine. When charting the electrocautery machine, typically an OR nurse will usually have to pick monopolar or bipolar when addressing how to use the EC Machine.

No one at this time should be using Ground-referenced generators. These machines have been around a very long time and those that have been in the OR for a while will have used these machines. Occasionally there is a possibility they might still be in the storage room.

Patient safety is very important when dealing with patients and electricity. One of the most important components of electrosurgery is the Grounding pad which returns current back to the machine. This prevents patients’ unwanted burns and, in extreme cases, patient death by current going to the path of least resistance and going to ground. When positioning a patient, be very aware to protect them from touching any metal, electricity can pass through metal to ground causing a major burn. Also, wait to place grounding pad till after positioning so no kinks, bends, tears or peeling occurs with the pad. Placing the pad once positioning is complete helps to insure pad integrity.
Resistance is an obstacle to the flow of current which is measured in ohms (impedance=resistance). In the case of the Operating room, the obstacle is the patient and the different tissues types are the resistance.

When using a monopolar electrosurgery the current starts in the generator and is delivered to the patient. This can happen in a few different ways.

**Fulguration:** The coagulation mode on the generator. Coagulation allows the tissue to be heated with spikes in the waveform, with a cooling down cycle to allow coagulation to happen at the cellular level. It helps to hold the electrode tip slightly above the tissue to be coagulated and let the spark from the tip to work.

**Blend:** is a choice on the machine to allow the cut setting to be modified to dampen the waveform to allow some hemostasis during the cutting process. There are several blend settings that vary on need and the manufacturer.

**Cut:** is the current from the generator that is a continuous waveform, with a lower voltage creates tissue vaporization. When the tip is just held over the area to be cut it vaporizes the cells to create a clean tissue cut. The tip can be held directly on tissue and this mode can also coagulate tissue.

With these settings, you must use a patient return electrode. Today there are several different types on the market. The one used the most would be a grounding pad. There are several considerations for the Circulating nurse as well as nurses now in other areas who are using electrocautery.

Be sure to ask the patient if they have any implants. If so, ask where they are located, if possible, try not to place a grounding pad over that area. If a limb without an implant can be used, this side would be preferred. Make sure the appropriate pad for the size of your patient is used. Use adult grounding pads for adults, and infant grounding pads for infants. It is important to make sure the pad surface is in contact with the patient. The greater the surface area covered, the
better it is for grounding purposes. The most grounding pads are usually pre-gelled and disposable; however, there are many different kinds. You as the nurse applying the pad may need to remove hair to get the pad to stick. If the pad still does not stick, you may need to clean the area and let it dry to get the pad to stick. If the pad still will not stick notify the surgeon immediately.

Today, there are also grounding pads that the patients lie on instead of the pads being placed on the patient. In this case, you may not need to remove hair to get the pad to stick and more surface area may come in contact with the patient. These new pads may also give the patient more cushions to help against pressure sores. This, however, may not work for all surgeries. You must pay attention to the expiration date on these pads and be aware to change them out if they are past their expiration date. Also, with these electrocautery pads, the cautery machine does not always turn green when the pad is attached; usually the light does not come on. For the table pads this is normal. If the surgeon feels he is not getting the power necessary, you may need to change to a disposable pad.

**Bipolar:** In this case, the circuit is completed by using forceps which are parallel poles located at the tip of the forceps (tines) which are close to one another. The tips of the forceps have one positive pole and one negative pole, so the flow of the current is restricted. Since the poles are so close, low voltage is used to cut the tissue. No return electrode is need when using bipolar since the current never flows through the patient’s body. Bipolar is much safer to use, although bipolar does not spark and may not coagulate large bleeders.

**Electrosurgical accessories:** are also available for the cautery machine and pencils. Enclosed, several examples can be found from the Bovie Medical, Valleylab(Covidien) and Medline websites.

Cautery Pencils or suction irrigators should always be returned to their holsters. This is a patient safety issue. Do not use suction irrigators as retractors and avoid
tissue contact when not in use. If the cautery is returned to the holster the patient should not have a chance of being burned if accidentally turned on while laying on the drape. With Radio Frequency, there is current leakage, so it is very important to connect the pencil cord to the holster and not to a metal instrument; a metal instrument with the leakage could cause a burn. A cautery scraper can be placed anywhere, however, it is usually placed on a holster so it can be cleaned prior to being put back in to holster so it’s ready for use.

There are many cautery tips available for the many different types of Tumor cases. One example is the loop tip, which can be used to cut slices of a tumor off and coagulate as the tissue is removed. It is important to keep loops clean to work correctly, thus keeping excess tissue off.

**Laparoscopic Procedures:** Today, we have many laparoscopic instruments available which meet the surgical needs. Most of these instruments can be hooked up to our generators for electrosurgical benefits. There is a special connector for those who desire a pre-sterile insulated wire to allow each instrument to be switched and connected to the machine. This allows laparoscopic surgery to go faster with less bleeding.

**GI Procedures:** There is also cautery available to use during GI procedures which may save some patients from having to go to the OR for a bigger procedure. This allows for biopsies to be done and bleeding to be controlled through scopes with the help of cautery in many outpatient settings.

**Warnings:** Be sure to use extreme caution when using cautery around oxygen. There is a fire/explosion hazard if there is an oxygen leak. Make sure endotracheal tubes are properly sealed to avoid oxygen leaks.
Oxygen enriched environments may result in fires and burns to the patient or the surgical team. These incidents increase with the use of alcohol based skin preps, and tinctures.

**Cautions:** Do not use red rubber catheters or plastic materials to cover surgical tips as a sheath as they may ignite. The smoke generated from the electrocautery is one potential danger. Studies have shown that the smoke can be harmful to patients as well as the surgical team. The studies recommend adequate ventilation and using a smoke evacuator is best. You can also use the suction to help remove smoke from the field, even though there is no filter.

There have been cases in which the removal of genital (Venereal) warts also known as human papillomavirus (HPV), where the smoke carries the virus to the staff through the nares.

**Burns:** Have also been known to happen in pediatric patients. This can happen to pediatric patients when the settings were not set to the lowest output setting to still achieve the desired surgical affect. The higher the current flow and the longer the current is applied, the greater the possibility of an unintended thermal damage to tissue, especially during use on small appendages according to Valleylab.

**Documenting Burns:** Upon undraping, everyone on the team should be assessing the patient for pressure areas and burns. When the grounding pad is removed, closely assess for burns. If a burn is discovered, document in the charting the complication in appropriate area. Also fill out the facilities “unusual reporting
form” with all information. Information should include a size that is measured, a picture when possible and rate the type of burn.

Example: 1\textsuperscript{st} degree burn which is a superficial burn with redness, tenderness and mild pain.

2\textsuperscript{nd} degree burns are Painful, form blisters, and wounds that may heal with a scar. 3\textsuperscript{rd} degree leaves skin with pale, brown, grey, or blackened appearance. This burn is painless because the nerves are destroyed in the skin. Scar formation and contractures are likely complications.

4\textsuperscript{th} degree includes full thickness of skin, fat, muscles, tendons and into the underlying bone. These burns are best managed at burn centers.

Once established that there is a burn, red tag and quarantine all equipment used with this patient. This includes all cautery pieces, cords, grounding pad, and the machine. This must go to Biomed/company to be checked out to find the problem.

It is still an AORN recommendation to remove all patient jewelry and this recommendation according to AORN should be maintained.
Electrosurgical pencils and Accessories:

Footswitches

Bonie
Disposable Regular Cautery Tips

Needle Tips

Ball Tips
Reusable Cautery Tips

Blade Tips

Needle Tips

Ball Tips

Special Tips
Tungsten Loops: used for tumor removal

Specialty needle electrodes

modified fine needle with Heatshrink, sterile - 5/box
Disposable and Reusable loops/squares tips

Arthroscopic cautery tips

actual length is 6.5"
Suction Coagulators
Two functions, one instrument

Valleylab suction coagulators offer increased efficiency during procedures requiring controlled fluid evacuation with precise electrosurgical coagulation. Suction and coagulation can be performed independently or simultaneously.
Example of Endoscopic Cautery Application
**Green Safety Ring** disperses electrosurgical RF current more uniformly over the pad's entire surface. This allows the pad to be smaller and easier to place, and to meet the same thermal performance standard as traditional pads that are up to 33% larger in conductive surface area.

**Excellent pad-to-skin contact:**  
Water-based hydrophilic conductive adhesive provides exceptional pad-to-skin contact, flowing uniformly into skin crevices.

**Helps reduce chance of skin stripping:**  
For patients with fragile skin, our non-aggressive border adhesive reduces possibility of skin stripping.

**Medline's Tranthermal Backing permits heat to escape faster:**  
Older grounding pad technology uses foam as the backing material of choice. Unfortunately, foam locks in heat. The Medline Universal Pad employs a tranthermal backing material similar to that of surgical drapes, letting heat escape 25% faster than foam and reducing risk of unsafe temperature rise.

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**Medline Electrosurgical Pencils**  
Designed exclusively for the surgeon who requires the traditional "feel" they are accustomed to.

Featuring soft buttons, soft cords and high quality plugs. All pencils are manufactured to the highest degree of quality and are guaranteed.

All pencils are latex free, sterile and packaged with a safety holster.

**VEGA SERIES:**  
Blue Silk™  
ESPC6062

Check out all the Electrosurgery products Medline has to offer at [www.medline.com](http://www.medline.com)
Megadyne Patient Return Electrodes go on the OR table not on the patient. They also can be pressure reducing to the patient.
<table>
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<tr>
<th>High-Temperature Cauterizes</th>
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<table>
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<tr>
<th>Item</th>
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<tbody>
<tr>
<td>0007</td>
<td>Aron Replacement drill bit - y/j/box</td>
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*Produce cover cap included for storage and safe disposal.*
Operating Room Safety Precautions

- "The ESU should not be used in the presence of flammable agents (i.e., alcohol and/or tincture-based agents)."
  AORN Recommended Practices for Electrosurgery 2003

- Avoid oxygen enriched environments

- Use of a nonconductive holster is recommended by:
  - ECRI, Los Angeles Fire Marshal, AORN
  - "Cutting Your Legal Risks of Electrosurgery" in OBG Management

"The active electrode(s) should be placed in a clean, dry, well-insulated safety holster, when not in use."
AORN Recommended Practices for Electrosurgery 2003

- Do not use red rubber catheters or other materials as a sheath on active electrodes
  - Red rubber and other plastic materials may ignite with high power settings and in the presence of an oxygen enriched environment

- Use manufacturer approved insulated tips

Radiofrequency is not always confined by insulation. Current leakage does occur.

- It is recommended that:
  - Cords not be wrapped around metal instruments
  - Cords not be bundled together
Surgical Smoke Evacuation

When performing surgical procedures with electrosurgical units, a smoke byproduct called “smoke plume” is created. This plume is created when tissue is heated and cellular fluid is vaporized. Plume is a wisp or puff of smoke that may rise from the surgical field. Electrocautery is used to cut, coagulate or destroy tissue. From this process, plumes are created. Surgical plumes may contain carbon monoxide, benzene, hydrogen cyanide, and formaldehyde and among other potentially toxic gases or vapors.

Along with these dangerous gases, plume can also contain Viral DNA, bacteria, carcinogens, live and dead cellular material (including blood fragments) and irritants. At high concentrations, the smoke causes ocular and upper respiratory tract irritation in health care professionals.

Plume can also create visual problems for the surgeon. Not only can smoke have unpleasant odors, it has been shown to have mutagenic potential according to the CDC.

NIOSH research has shown airborne contaminants generated by these surgical devises can be effectively controlled. Two methods are recommended by the NIOSH and CDC are: 1) ventilation and 2) work practices.

Ventilation techniques include a combination of general room and local exhaust ventilation (LEV). General room ventilation is not sufficient to capture contaminants generated at the source. Two major LEV approaches used to reduce surgical smoke levels are room suction systems and portable smoke evacuators.
Smoke evacuators contain a suction (vacuum) pump, filter hose and inlet nozzle.

Smoke evacuators should have a high efficiency in airborne particle reduction and should be used in accordance with manufacturer’s recommendations to achieve maximum efficiency. A capture velocity of 100 to 150 feet per minute at the inlet nozzle is generally recommended by NIOSH. A high efficiency particulate air (HEPA) filter or equivalent is recommended for trapping particulates.

Room suction systems can pull at a much lower rate and were designed primarily to capture liquid rather than particulates or gases. If these systems are used to capture generated smoke, users must install appropriate filters in the line. Insure the line is cleared and filters are disposed of properly. This system is not generally as effective to control generated smoke properly from the surgical field.

**Work Practices:** The smoke evacuator or room suction hose nozzle inlet must be kept within 2 inches of the surgical site to effectively capture airborne contaminants generated by these surgical devices. There are many commercially-available smoke evacuator systems to select from. All of these LEV systems must be inspected and maintained correctly to prevent possible leaks. Users must utilize control measures such as “universal precautions”, as required by OSHA Blood-Borne Pathogen standard.

Additional respiratory protection from particulate exposure could be the N95 respirator. The amount of control of exposure reduction is much greater with an N95 face mask than with a surgical mask. Surgical masks are very loose fitting and protect the wearer mainly from splashes and spray.
Smoke evacuators come in different sizes now to accommodate the different types of surgical settings. These settings include operating rooms, labor and delivery surgery rooms, same day surgery rooms, doctor’s offices, procedure rooms and even in the emergency rooms, or wherever coagulation use may take place.

Smoke evacuators should be on (activated) at all times when airborne particles are produced during all surgical or other procedures.

Remember, per NIOSH and the CDC, the various filters and absorbers used in smoke evacuators require monitoring and replacement on a regular basis and are considered a possible biohazard requiring proper disposal.

Included is a surgical smoke module from the CDC created in March, 2008 to increase awareness of surgical smoke exposure.

Also included are examples of different kinds of smoke evacuator machines.
Different types of Smoke Evacuators

Bovie Medical Corporation

Products: Smoke Shark™
effective smoke & particle removal

Typical Setups

Electrosurgery
SE01 - Smoke Shark Unit with pneumatic footswitch (FSSEP)
SF18 - Long Life 18-hour Filter
786T - 7/8" x 6' Tube (Case of 24)
- or -
SETW 7/8" x 6' Tube w/Wand (Case of 24)
SEAS - Arm Stand

OBGYN
SE01 - Smoke Shark Unit with pneumatic footswitch (FSSEP)
SF18 - Long Life 18-hour Filter
788T - 7/8" x 6' Tube (Case of 24)
- or -
SETW 7/8" x 6' Tube w/Wand (Case of 24)

Laser
SE01 - Smoke Shark Unit with pneumatic footswitch (FSSEP)
SF18 - Long Life 18-hour Filter
788T - 7/8" x 6' Tube (Case of 24)
- and -
SETW 7/8" x 6' Tube w/Wand (Case of 24)
SEAS - Arm Stand
Different types of Smoke Evacuators cont:

Valleylab

Smoke Evacuation Systems
Valleylab smoke evacuation systems are designed to effectively capture and filter surgical smoke. NEW!
Introducing the RapidVac™ Smoke Evacuator ...more

Smoke Evacuation Systems

Valleylab's new RapidVac™ smoke evacuation system is designed to effectively capture and filter surgical smoke to remove odor, particulates, and other potentially hazardous byproducts of electrosurgery procedures.

RapidVac™ is Easy, Effective, Economical and Quiet.

Our smoke evacuation product line includes the RapidVac™ Smoke Evacuator, the pencil-mounted AccuVac™ smoke evacuation attachment and a full range of tubing and accessories to meet your needs.

COVIDIEN
Different types of Smoke Evacuators cont:

**Mega Vac** Smoke Evacuation Product Line

Research studies have confirmed the hazards of electrosurgical smoke plume in high concentrations to health care personnel and surgeons. The Mega Vac Smoke Evacuation System now offers an easy-to-use solution to this problem in the Operating Room.

Protecting you and your patient from the hazards of electrosurgical smoke plumes is easy, quiet and comfortable with the Mega Vac smoke evacuator system.

- **Variable Levels of Suction**—turning on and off when the surgeon activates and deactivates the electrosurgical pencil based upon the surgeon's discretion.

- **Life-Time Monitoring**—saving filter expense by letting the user know precisely when to change the filter.

- Create effective suction with less noise during electrosurgical procedures.

- **Ultra Vac Pencil** and **Attacha Vac Pencil Shroud** allow surgeons to easily capture smoke while comfortably performing surgery.
Ligasure

Ligasure was introduced to the market in 1998, and is a devise than can be used to sense the depth of the tissue, usually being an isolated artery or a vein and lymphatics up to 7mm in diameter. Ligaure can also be used on tissue bundles and produces permanent fusion. Ligasure is used in Laparoscopic and surgical specialties including Gynecology, Colorectal, and Urology as well as other surgical specialties.

The generators used for Ligasure is an isolated output electrosurgical generator that allows electrical power to seal the vessels and also bipolar surgery. The instruments used in this process have tines which allow for bipolar and macrobipolar modes. The pressure of the tines brought together for a controlled amount of time aid in achieving permanent fusion of tissue and vessel lumens.

There are two bipolar modes available:

Regular Bipolar mode is used for most applications, utilizing the low voltage to keep from preventing sparking. This helps to reduce sticking, charring and thermal spread to adjacent tissue.

The Maximum voltage output is controlled to reduce sparking and tissue damage.

Macrobipolar may be used for bipolar cutting or rapid coagulation, since the voltage is higher and more power than bipolar.

These instruments plug into the Ligasure machines, the electrical energy goes to the instrument and then back to the machine. The instruments can be controlled by either hand switch or footswitch
activation. This also allows for the system to deliver an exact amount of energy and electrode pressure to vessels to permanently fuse the lumen.

Always make sure the activation tone volume is high enough to hear. The regrasping indicator will alert you if the tines have shorted out, if maximum seal cycle time is reached, or if tissue impedance is out of range.

Ligasure generators automatically sense tissue resistance and it adjusts the output voltage to maintain a consistent effect across different tissue density. Adjustments are based on the tissue resistance and power settings. Most machines have the ability to adjust the power settings manually. Most settings cannot be adjusted during use. An additional safety feature is a standby mode until you are ready for surgery.

There are many different Ligasure machines. Most are touch screen with receptacles to receive the plugin part of the cord from the instruments. It is very important to connect instruments correctly. While connecting, inspect to make sure no metal is exposed. Especially inspect reusable instruments for breaks, cracks, nicks, or other damage before use. Another important safety issue: never connect a wet instrument to the energy platform. These issues may result in injury or electrical shock to patient or surgical team.

When you turn on the machine, make sure it completes a start-up self-test before connecting the instrument. Make sure to connect instruments into the proper receptacle to avoid inadvertent instrument activation or other potentially hazardous conditions.
Other things to keep in mind: when using the foot control, make sure to be plugged in to the correct instrument receptacle that has the footswitch plugged in the back of the machine. Example: Ligasure 1 matches ligasure 1 on the back for the footswitch plug.

Make sure when plugging in the machine to use a grounded wall receptacle.

There are usually alerts on the machine, one might be “check instrument”. In this case you may need to:

• **Regrasp thicker tissue**, thin tissue may not allow ligasure to work.

• **Reinsert electrodes** they may have become dislodged.

• **Clean electrode tips** with a wet gauze to allow tips to work correctly.

• **Remove excess fluids**, pooled fluids around tip may not allow instrument to work correctly.

“End point not reached” means maximum seal cycle time has been reached, **but** the system needs more time and energy to complete the seal. Usually you can reactivate without removing or repositioning the instrument.

At the end of surgery make sure to turn off the machine and then disconnect the instrument. If using disposable instruments, dispose of them according to your facilities policies. If using reusable instruments, wipe all surfaces with a cleaning agent and a damp cloth. It is recommended by some companies to soak in an enzymatic cleaning agent, examples being klenzine or Enzol according to manufacturer’s
instruction. Then, sterilize the instrument to be ready for the next case.
Ligasure equipment

LigaSure™
Vessel Sealing System
• LigaSure™ Generator
• Laparoscopic Instruments
• Open Instruments

COVIDIEN
**Ligasure equipment cont.**

**Ligasure V - 5mm instrument for laparoscopic procedures**

**Ligasure Atlas 20 cm for open procedures**

**Ligasure Lap - 5 mm instrument with curved jaws for fine dissection**
Ablation

Today ablation can be used for many different applications in surgery as well as the clinic setting. Ablation per Taber’s is removal of a part, Pathway, or function by surgery, Chemical destruction, electrosurgery, or radiofrequency. The types of ablation we will discuss are electrosurgery and radiofrequency. Covidien has also introduced MV ablation system which is considered Microwave ablation.

Ablation by electrosurgery is usually accomplished by using a high-powered “rollerball” which is used to destroy the uterine endometrium and 2-3 cm of myometrium. This is done by a cautery Machine usually set to a higher level to create a burning effect.

Ablation by radiofrequency is by an electrode which delivers a low-voltage, high-frequency current to cauterize and destroy abnormal tissue.

Vallelylab announced May 8, 2006 that the FDA cleared them for their new Cool-Tip RF ablation system for use for non-resectable liver tumors. Interventional Oncologists have been ablating liver tumors since the mid-90’s with the Cool-Tip RF ablation system. This system combines a radiofrequency generator with a 17 gauge internally cooled needle electrode to deliver therapeutic energy at the needle tip to heat and destroy the tumor from the inside out. The electrode is guided to the tumor using Imaging such as CT or ultrasound, and then using radio waves creates energy at the needle tip to heat and destroy the tumor. This procedure maximizes the amount of energy that can possibly be delivered and creates the largest ablation possible in a minimal amount of time. Because ablation with the cool tip ablation system is minimally-invasive, the procedure can be repeated until the liver tumor is ablated.
The New Cool-tip system allows the physicians up to three electrodes with RF switching controller to larger ablations.

Using pulsed radiofrequency current quickly heats and ablates large volumes of tissue, destroying in minimal time. This procedure is performed open surgery, percutaneously, or laparoscopically depending on the Doctors decision.

Another form of ablation is EVIDENT MV Ablation system which uses microwave ablation. Microwave uses the rotation of water molecules to create friction heat and this results in an ablation zone. Evident MV ablation system uses 915 MHZ frequency, and can create ablations with 10 minutes at 45 W with the application of one, two or three antennas simultaneously. This will produce individual lesions at each antenna or one combined lesion when antennas are spaced 1.5-2cm apart per Valleylab nomenclature.

With microwave ablation there is no current that flows through a patient and this eliminates the need for a return pad. The microwave antenna radiates an energetic field into the tissue, which reaches an active zone of heating rather than relying on thermal conduction and current flow.

This system is made for soft tissue. This system also automatically shuts off when the set ablation time is reached. Use image guidance to verify that the ablation zone has been achieved. There is much more information available of the Valleylab web site www.valleylab.com.
Another company offering an ablation system is AngioDynamics, which acquired Rita Medical Systems in January, 2007. This gave AngioDynamics immediate access to an interventional oncology market through RITA’s specialized sales. Rita Generators ensure predictable controlled ablations. Rita Model 1500x generator can offer three flexible serial ports and delivers 250 watts. It is able to offer control because of the automatic temperature control. This RF generator is also compatible with the latest StarBurst and Habib electrosurgical devices for ablations and soft tissue coagulations ranging from 1-7cm. The Rita model 1500x offers the new Habib mode.

Rita has base software in its machines which allows users to visually monitor tissue temperatures in real time. Rita also has an Intelliflow Pump which is used in conjunction with the 1500x. This pump is used to deliver a precise amount of infused saline. This eliminates the need for syringes.

New thermo pads allow the physician to monitor the temperature of the return pad site during the ablation process. The pads’ adhesive had a thermocouple device which returns data automatically to the generator. This monitoring pad can have the power shut off if pad temperatures reach unsafe levels.

The Starburst soft and hard tissue access system makes it possible to locate the target area prior to using the starburst RFA device. The tip of the introducer is detectable with ultrasound, CT and Fluoroscopy.

The Habib 4x bipolar resection device has four bipolar electrodes and uses radiofrequency (RF) energy to coagulate tissue. The Habib can coagulate organs’ parenchyma and vessels in seconds. When the 1500xm generator is fully used in Habib mode with automatic RF shut
off and remote, it has foot control pedals available. Its applications are for renal and hepatic. It not only reduces the chances for blood transfusions, but spares functional portions of cirrhotic liver.

The renal benefits from Habib are that it assists in performing open partial nephrectomies without hilar clamping. Also, it reduces blood loss and facilitates operative time in nephron-sparing surgery. Habib also has a laparoscopic device.
Introducing the Evident™ MW Ablation System

Interactive microwave ablation uses rotation of water molecules to create frictional heat, which results in an ablation zone. The Evident™ MW Ablation System, which uses a 915 MHz frequency, can create ablations within 10 minutes at 45 W with the application of one, two or three antennas simultaneously. This will produce individual lesions at each antenna or one combined lesion when antennas are spaced 1.5 – 2 cm apart.

With microwave ablation, there's no current flow through the patient, eliminating the need for a patient return pad. The microwave ablation antenna radiates an energetic field into tissue, which creates an active zone of heating, rather than relying on thermal conduction and current flow.

The Evident™ MW Ablation System is an entire system that is matched for soft tissue. Anticipated ablation results in tissue are achieved by inserting the entire radiating section of the antenna into the target tissue and turning on the power. The system automatically shuts off when the set ablation time is reached. Use image guidance to verify that the ablation zone has been achieved.

- Evident™ MW Ablation System is the fastest ablation system for soft tissue coagulation
- One of the fastest systems available; ablation procedure duration is up to 60 percent quicker than other radiofrequency ablation products*
- Evident™ MW Ablation System is the only microwave ablation system available in select countries worldwide that has received U.S. Food and Drug Administration clearance for the partial or complete ablation of nonresectable liver tumors
- Easy to set up
- Creates a larger zone of active heating** and is not directly affected by impedance***

*vs. traditional radiofrequency ablation systems
**vs. current microwave ablation systems
***vs. current microwave ablation systems
Ablation Systems

Valleylab Offers You a Treatment Alternative for Inoperable Lesions

Using pulsed radiofrequency current, the Valleylab Cool-tip™ RF ablation system quickly heats and ablates large volumes of tissue, destroying it in minimal time.

RF ablation procedures can be performed in open surgery, percutaneously, or laparoscopically, depending on the physician’s discretion.

Ablation Master’s Course

FDA Clears Valleylab’s Cool-Tip™ RF Ablation System for Use in Abalizing Non-Resectable Liver Tumors

Valleylab regarded as the only radiofrequency ablation company cleared to market device to physicians. Read more...

Cool-tip™ System for Non-Resectable Liver Lesions

Valleylab’s Cool-tip™ system is intended to treat patients where complete surgical resection is not an option. Read more...

Valleylab Introduces New Cool-tip™ RF Switching Controller

Allows physicians to use up to three electrodes simultaneously; maximizes energy delivery for larger ablations. Read more...
Ablation Devices

**AngioDynamics**

**RITA® Model 1500X Generator**

Now with smart card technology that facilitates upgrades without additional capital investments, the RITA Model 1500X radio-frequency (RF) generator ensures predictable, controllable ablations, time after time.

The 1500X has three flexible serial ports and delivers 200 watts of power. It has multiple temperature displays and an intuitive panel design for the utmost simplicity. To ensure predictable, controllable ablations, the 1500X also provides automatic temperature control.

This RF generator is compatible with the latest Starburst® and Hash® electrosurgical devices for ablation and soft tissue coagulation ranging from 1-7 cm.

**Features:**
- Now Habib mode
- Ranomized paddle control
- Automated ablation algorithm
- Expanded memory capacity
- Fully-automated generator recognizes when device is plugged in and will automatically load the paddle protocol.

**RITA IntelliFlow Pump**

The IntelliFlow peristaltic infusion pump is used in conjunction with the 1500X radio-frequency generator for the coagulation and ablation of soft tissue. The IntelliFlow offers the ultimate in ease of use, while delivering a precise amount of infused saline. The pump is specifically designed to be used with current and future RITA electrosurgical devices.

**Features:**
- Peristaltic pump eliminates the need for syringes
- Automatic communication with 1500X generator
- Integrated IV pole
- No battery to recharge
- No pre-settings required
- Easy loading and securing of tubing
- Storage drawer for accessories
- Tubing set attached to Starburst family of infusion devices
- Occlusion pump provides use of tubing irrigation

**Thermo Pads**

New temperature monitoring thermo pads help the physician monitor the temperature of the return pad site during the ablation process. AngioDynamics' pads feature continuous temperature monitoring at the pad adhesion site through the incorporation of a thermocouple device located at the pad-leading edge. These pads are designed to meet the needs of clinicians using AngioDynamics latest generation of high-power, inflation based radiofrequency electrosurgery. The thermocouple returns data automatically to the 1500X RF generator, monitoring pad temperature throughout the procedure, and shutting off power when unsafe pad temperatures are detected. Thermo pads will work with any existing 1500X System.
Ablation Devices

AngioDynamics

UniBlate™

Scalability Means Flexibility

The UniBlate radiofrequency ablation (RFA) electrode provides linearly scalable ablations from 1 to 3 cm in length and 1 to 2.5 cm in diameter. This device enables physicians to change the ablation volume during the procedure without the need to open additional devices.

Designed for flexibility, the UniBlate RFA electrode design is fully compatible with the RITA® 15000i RF generator and eliminates the need to stock multiple electrodes for multiple ablation volumes allowing for lower inventory costs by using fewer devices.

Features:
- Designed for CT-gantry compatibility
- Added safety near critical structures
- Built-in thermocouple provides temperature feedback
- Cool-down cycle and full-tank ablation capability
- Allows user to “dial in” the desired length of active electrode

StarBurst™ Talon

The StarBurst Talon RFA Device offers clinicians 4 cm ablations in a side-deployment device specifically designed for applications in lesions that may be mobile in soft tissue or adjacent to critical structures.

The Talon RFA device may be used in laparoscopic, percutaneous and intraoperative procedures. It is part of AngioDynamics’ RITA® Infusion System family of products, which uses the Infiltflow pump to deliver precise amounts of normal saline to the ablation zone.

Features:
- Fast 4 cm spherical ablation using the RITA Infusion System and Infiltflow pump
- A unique tapered cutting tip center electrode to make it easier to penetrate solid tumors
- Easy to position for both surface and difficult-to-reach dome lesions
- Proprietary, real-time temperature feedback from all four electrode lines ensures controlled ablation
Ablation Devices

StarBurst Talon Semi-Flex RFA Device

The Starburst Talon Semi-Flex RFA device encompasses all of the features of its parent device with the addition of a precise and bendable delivery shaft to secure access to nearly any part of the body.

Important Risk Information

INDICATION FOR USE: The Starburst Talon Electrosurgical Device is a tool for transcatheter, monopolar RF/infusion energy (provided by the RTA® RF Generator) in conjunction with the InfiltroFlow Infusion Pump. It is indicated for use in percutaneous, laparoscopic, or open procedures to ablate or ablate and resect bony tissue, including the partial or complete ablation of non-removable tumor, post-trauma, or postoperative cauterization and ablation of soft tissue, including the partial or complete ablation of non-removable tumor, post-trauma, or postoperative cauterization and ablation of soft tissue.

CAUTION: Federal (USA) law restricts these devices to sale by or on the order of a physician.

CONTRAINDICATIONS: None known.

WARNINGS AND PRECAUTIONS: For single use only. Do not bend or twist the trocar or the needles or exert forceful pressure on the device while it is deployed in the tissue, do not use sharp objects (e.g., clamps, scissors) on the device, or use metal introducers that do not have insulation; interference with the device may result. To ensure safe and effective use, follow the manufacturer’s directions and recommendations for the preparation, placement, surveillance, removal, and use of the dispersive electrode. To achieve the desired ablation, follow the manufacturer’s guidelines of ablation time and temperature. Ensure that the device is placed at least 1 cm away from structures not intended for ablation. In laparoscopic procedures, care must be taken to avoid a gas embolism, and activation of the device when not in contact with target tissue may cause capacitive coupling. In some cases, a liver lesion will only be partially destroyed, the first determination of the success of lesion destruction can only be made by imaging studies. Following the procedure and during the postoperative follow-up period, a potential complication is the presence of a residual lesion. Pathologic fracture is more prevalent in the extremity, while the lesion is not in the bone. If the lesion is not in bone, MRI safe. Please refer to the package insert for complete list of warnings and contraindications.

POTENTIAL COMPLICATIONS: Published reports on the use of RFA systems indicate low overall complication rates, these include bleeding, abscesses, and, in cases involving the treatment of bone tumors, fractures and nerve damage.

Indications, contraindications, warnings, and instructions for use can be found in the instructions for use supplied with each device. Failure to do so may result in patient complications.
Ablation Devices

**StarBurst® XLI-enhanced**

*Scalability Means Flexibility*

The "scalable" StarBurst XLI-enhanced radiofrequency ablation device is designed to create soft tissue ablation sizes of 4-7 cm with a single device placement. The device can be used for percutaneous, laparoscopic, or minimally invasive procedures.

*Because Temperature Matters*

The XLI-enhanced RFA device, with patented inflation-based technology, ensures consistent stabilized target temperatures and enables the predictable ablation of predictable volumes of tissue. The StarBurst XLI-enhanced RFA Device reduces the time required to perform procedures and in many cases, enables patients to resume normal activity within days.

**StarBurst XLI-enhanced Semi-Flex RFA Device**

*Designed for Versatility*

The Semi-Flex radiofrequency ablation device provides the same scalability and performance of its parent device, however; it is designed with a lower that bends in all directions up to 90 degrees to easily clear the CT gantry.

**Important Risk Information**

INDICATION FOR USE: The StarBurst XLI-enhanced Electrosurgical Device is a tool to transmit monopolar radiofrequency energy (provided by the RITA RF Generator). It is indicated for use in percutaneous, laparoscopic, or minimally invasive coagulation and ablation of soft tissue including the partial or complete ablation of non-resectable liver lesions and palliation of pain associated with metastatic lesions involving bone in patients who have failed or are not candidates for standard therapy. **CAUTION:** Federal (USA) law restricts these devices to sale by or on the order of a physician. **CONTRAINDICATIONS:** None known. **WARNINGS AND PRECAUTIONS:** For single use only. Do not bend or flex the trocar or the needles or exert torsional strain on the Device while it is deployed in soft tissue. Do not attach any lead (i.e., clips, etc.) to the Device, or use metal instruments that do not have insulation, as inadvertent patient injury may result. To ensure safe and effective use follow the manufacturer’s directions and recommended practices for the preparation, placement, surveillance, removal, and use of the dispersive electrode. To achieve the desired ablation follow the manufacturer’s guidelines of ablation time and temperature. Ensure that the device is placed at least 1 cm away from structures not intended for ablation. In laparoscopic procedures, care must be taken to avoid a gas embolus, and aspiration of the device when not in contact with target tissue may cause capacitive coupling. In some cases, a liver lesion will only be partially destroyed; the final determination of the success of lesion destruction can only be made by imaging studies following the procedure and during regular long-term follow-up. For ablation of painful bone metastases, do not perform RF ablation in weight-bearing bone with evidence of impending fracture. Pathologic fracture is more prevalent and serious in long bone. Please see package insert for complete list of warnings and precautions. **POTENTIAL COMPLICATIONS:** Published reports on the use of the RFA system indicate few overall complication rates. These include bleeding, abscesses, and, in cases involving the treatment of bone tumors, fractures and nerve damage.

Indications, contraindications, warnings and instructions for use can be found in the instructions for use supplied with each device. Observe all instructions prior to use. Failure to do so may result in patient complications.
Ablation Devices

Starburst® MRI/MRI w/ cable RFA Devices

The preferred choice of radiologists, the new Starburst MRI RFA Device makes it possible to use radiofrequency ablation safely and effectively in an MRI environment. The Starburst MRI's compatibility relates to magnetic field transitional attraction, torque, RF heating, induced currents and limited arichost.

Like the Starburst XL RFA device, the Starburst MRI RFA device is capable of creating spherical ablations in soft tissue from 3-3 cm in diameter, yet is also compatible for use with magnetic resonance imaging (MRI) during device placement.

The Starburst MRI RFA device also is available with a pre-attached main cable for improved ease of use.

Important Risk Information

INDICATION FOR USE: The Starburst® MRI and SDE Electrophysical Devices when used monopolar radiofrequency energy (provided by the RTA® 1500 or 1500K RF Generators) and are indicated for use in percutaneous, laparoscopic, or intraoperative coagulation and ablation of soft tissue including the partial or complete ablation of non-resectable liver lesions and palliation of pain associated with metastatic lesions involving bone in patients who have failed or are not candidates for standard path therapy. CAUTION: Focused (USA) law restricts the sales of this device by or on the order of a physician.

CONTRAINDICATIONS: None known. WARNINGS AND PRECAUTIONS: For single use only. Do not freeze or expose to the sun. Do not use with anything (e.g., clamps, etc.) to the device, or use metal introducers that do not have insulation. Accidental patient injury may result. To ensure safe and effective use follow the manufacturer’s directions and recommended practices for the sterilization, placement, surveillance, removal and use of the depopulation electrode. To acquire the desired ablation the manufacturer’s guidelines of ablation time and temperature. Ensure that the device is placed at least 1 cm away from significant and not intended for ablation. In laparoscopic procedures, care must be taken to avoid gas embolism, and activation of the device when not in contact with tissue may cause capacitive coupling. In some cases, a liver lesion may only be partially destroyed; the final determination of the success of lesion destruction can only be made by imaging studies following the procedure and during regular long-term follow-up. For ablation of painful bone metastasis, do not perform RF ablation in weight bearing bone with evidence of impending fracture. Pathologic fracture is more prevalent and common in long bones. Please see package insert for complete list of warnings and precautions.

POTENTIAL COMPLICATIONS: Published reports on the use of the RFA system indicate low overall complication rates. These include bleeding, abscesses and, in cases involving the treatment of bone, tumors, fractures and nerve damage.

Indications, contraindications, warnings and precautions for use can be found in the instructions for use supplied with each device. Observe all instructions prior to use. Failure to do so may result in patient complications.
Ablation Devices

Starburst® XL RFA Device

Because Temperature Matters

The Starburst XL RFA device creates 1-5 cm ablations, and the active tip can also be used to create small ablation to prevent complications. The device has nine active electrodes and five thermocouples positioned throughout the array that provide real-time temperature feedback.

By monitoring the temperatures at the margins of the ablation zone, physicians can ensure that the ablation is successful in destroying targeted tissue. Electrodes within the array configuration are well-distributed and are engineered with a “space-heeling” design.

Scalability Means Flexibility

With its variable array size, the Starburst XL makes it easy for physicians to create spherical zones of ablation from 3-5 cm with a single needle placement.

The Starburst XL RFA electrode also is available with a pre-attached main cable for improved ease of use.

Starburst® Semi-Flex RFA Device

The Starburst Semi-Flex RFA device offers the same benefits of its parent device with the addition of a trocar that allows it in all directions (up to 90 degrees), the Starburst Semi-Flex gives physicians the ability to properly guide the device and then clear C7 anomalies during image-guided percutaneous RF procedures.

Important Risk Information

INDICATION FOR USE: The Starburst XL Electrosurgical Device is a tool to transmit monopolar radiofrequency energy (provided by the RITA® 1500 or 1500X RF Generator) and is indicated for use in percutaneous, laparoscopic, or transperitoneal coagulation and ablation of soft tissue including the partial or complete ablation of non-recurrent liver lesions and palliation of pain associated with metastatic lesions involving bone in patients who have failed or are not candidates for standard pain therapy. CAUTION: Federal (USA) law restricts these devices to sale by or on the order of a physician. CONTRAINDICATIONS: None known. WARNINGS AND PRECAUTIONS: For single use only. Do not bend or kink the trocar or the needle; do not attach anything (i.e., clamps, etc.) to the device, or lateral introduction of needles do not have insulation, inadvertent patient injury may result. To ensure safe and effective use follow the manufacturer’s directions and recommendations. To achieve the desired ablation follow the manufacturer’s guidelines of ablation rate and temperature. Ensure that the device is placed at least 1 cm away from structures not intended for ablation. In laparoscopic procedures, care must be taken to avoid a gas embolism, and aspiration of the cavity when not in contact with target tissue may cause capillary rupture. In some cases, a liver lesion will only be partially destroyed; the final determination of the success of lesion destruction can only be made by imaging studies following the procedure and during regular long-term follow-up. For ablation of painful bone metastases, do not perform RF ablation in weight-bearing bone with evidence of impending fracture. Pathologic fracture is more prevalent and serious in long bone. Please see package insert for complete list of warnings and precautions. POTENTIAL COMPLICATIONS: Published reports on the use of this RFA system indicate low overall complication rates. These include bleeding, abscesses and, in cases involving the treatment of bone tumors, fractures and nerve damage. Indications, contraindications, warnings and instructions for use can be found in the manufacturer's user-supplied instructions and precautions. Obtain all instructions prior to use. Failure to do so may result in patient complications.
Habib® 4X
Bipolar Resection Device

**Features**
- compatible with PAA TC generator
- step electrode bipolar resection device
- connects to proper cable (requires cable for different generators)
- uses 180W energy for tissue coagulation
- devices available in two electrode lengths: 6 cm and 10 cm
- packaged in a 6 in 2 manner, 4 pack "packout" and

**Benefits**
- designed to:
  - significantly reduce bleeding
  - significantly reduce chances for blood coagulation
  - saves functional portions of esophageal lining
  - eliminates the need for cauterizing (proximal or distal)
  - segmented coagulation
  - leaves the esophagus of true tissue & does not coagulate a stalk of blood but resection and functional tissue sparing
  - significantly decreases operating room time
  - reduces ICU and overall hospital stay
  - decreases the overall costs of the procedure

**Wedge Resection**
A. Resection with Wedge "C"
B. Sutural ligation over the resected edge
C. Completed Wedge Resection

**Segmental Resection**
A. First 2 row: Segmental Resection with Wedge "C"
B. Resected tumor - Mobilization and Extraction
C. Extracted Carcinoma Tumor
Ablation Devices

Habib® 4X Bipolar Resection Device

The Habib 4X bipolar resection device is designed to reduce blood loss, shorten OR time, and shorten ICU and overall hospital stays, as well as offer the ability to perform non-clamping surgery and avoid warm ischemia side effects. Based on clinical data, the average time for an individual ablation is eight seconds using the Habib 4X bipolar resection device.

Features:
- Four-electrode bipolar resection device
- Uses radiofrequency (RF) energy for tissue coagulation
- Coagulates organs' parenchyma and vessels in seconds
- Used with 1500W generator – fully automated Habib mode
- With automatic RF shut-off and remote foot pedal control available

The Habib 4X bipolar resection device has hepatic and renal applications.

Hepatic Benefits:
- Significantly reduces chances for blood transfusions
- Sparing functional portions of cirrhotic liver
- Lowers the occurrence of liver failure & bile leakage as a result of blood loss reduction
- Functionally spares tissue

Renal Benefits:
- Assists in performing open partial nephrectomies without hilar clamping*
- Expands available time for the collecting system reconstruction and/or repair*
- Reduces blood loss and facilitates faster operative time in nephron sparing surgery*

* Based on Labay Clinic ALA Poster study and the Tennessee clinical study by Wesley M. White et al., Journal of Urology, December 2009.

Important Risk Information

INDICATION FOR USE: The Habib 4X device is used to transmit bipolar radiofrequency energy (provided by the RITA 1500X RF Generator) and is designed to be used in conjunction with a bipolar bioprobe to ablate tissue at the site of incision, surgeons may incorrectly set the system to the ON position, or the system may have been activated without the devices being correctly connected. RISK OF BURN: For single use only. Do not bend loop the needle arrays or attempt anything (i.e., clamps, etc.) to the device. Inadvertent patient injury may result. Do not use needle-monitoring or dispersive electrodes. This may interfere with the operation of other equipment. Improper placement of electrodes on or near the patient may lead to burns. Please see package insert for complete list of warnings and precautions and observe all instructions prior to use. POTENTIAL COMPLICATIONS: Possible complications include, but are not limited to, general anesthesia, bleeding, liver abscess, bile leak, liver failure, subphrenic abscess, postoperative heart failure, chest infection, wound dehiscence, wound infection or intestinal hernia.

Indications, contraindications, warnings and instructions for use can be found in the instructions for use supplied with each device. Observe all instructions prior to use. Failure to do so may result in patient complications.
Introducing

The Next Generation NovaSure

More Comfort.
NovaSure

What can I expect from the NovaSure procedure?

More women are choosing NovaSure because it has been shown to be safe, simple, and successful. Find a physician in your area who offers NovaSure.

NovaSure uses radio frequency (RF) energy to permanently remove the lining (endometrium) of the uterus, which reduces, or eliminates, future bleeding. Here's a look at what happens during the procedure to help you know what to expect:

1. Your doctor will slightly dilate the cervix and insert a slender wand through the cervix into the uterus.

2. The doctor then extends the triangular mesh array through the wand where it expands to conform to the dimensions of the uterine cavity.

3. RF energy is then delivered into the uterus for approximately 90 seconds.

4. The triangular mesh array slowly retracts and the wand is gently removed from the uterus.

Want to know more? Request a brochure!
SureSound Uterine Cavity Measuring Device

Simplify NovaSure® procedures with the SureSound®
Uterine Cavity Measuring Device

Safe, Simple, and Accurate

SureSound's safe and accurate design simplifies the measurement process during standard GYN procedures, including the NovaSure procedure.

SureSound's single use, non-latex, uterine and cervical canal length measurement device allows you to simply and accurately assess uterine size required for the NovaSure procedure:

1/2 cm Markings
Enable accurate measurement
of the cervical canal and
uterine cavity length.

NovaSure Disposable Device
NovaSure RF Controller

Get an accurate uterine cavity measurement with
the SureSound device and enter the cavity length on the
NovaSure Disposable Device and the NovaSure RF Controller
for a customized ablation for every patient.

- Flexible internal sound allows safe measurement in severely anteverted or retroverted uterus
- Single-use device, which may reduce contamination risk compared to traditional sound
Coblation® Tonsillectomy

Author – Mr Michael Timms, FRCS
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Procedure Overview
The EVac™ 70 Plasma Wand™ can be used either for tonsillectomy or for tonsillotony. These two techniques involve Coblation, a unique non-heat driven process of molecular disintegration, resulting in precise ablation of tissue. Both ablation methods result in less bleeding and less post-operative pain than in traditional tonsillectomies.

Coblator® II Equipment Set-up
1. **Turn on the power switch on the Controller. Attach the Flow Control Valve Unit to an IV pole by placing the Clamp onto the shaft of the pole. Hang a 500-ml or 1000-ml bag of normal saline solution on the IV pole.**
2. **Plug one end of the Flow Control Cable into the rear of the Flow Control Valve Unit and one end into the front of the Controller. Press the Valve switch up toward the green dot to open the pinch valve. Spike the saline bag with IV tubing extension and thread the IV tubing behind the pinch valve. Press activation switch down to close the valve.**
3. **Connect Patient Cable to the EVac Wand at the end labeled Connect to ArthroWand®, aligning arrow and dot on Cable and Wand. Connect Patient Cable to Controller, aligning arrow and dot on Cable and Controller. Connect suction tubing and IV tubing to the EVac Wand.**
4. **Open the roller clamp fully on the Wand and the giving set. Make sure that you get maximum saline flow when pressing the ablation or Coag pedal. Additionally, make sure that you have strong and efficient suction.**
5. **Set Controller power between set points 6-9, depending upon surgeon preference and based on rate of tissue ablation.**

*NOTE: Saline should ONLY flow when pressing the steps on the ablation or coagulation Foot Pedal.*

Procedure Preparation
1. **Position the patient as for routine tonsillectomy with shoulder roll, neck extension, and head support.**
2. **Intubate using a cuffed oro-tracheal tube. For small children, a non-cuffed tube can be used.**
3. **Useful tools: Boyle-Davis mouth gag, a pillar retractor and Luc’s non-traumatic forceps.**
4. **Prep and drape the patient as for routine tonsillectomy. Use the Boyle-Davis mouth gag to access the oropharynx and to hide the tracheal tube.**
5. **To avoid unintended tissue ablation, DO NOT activate the Wand while in contact with other structures in the oral cavity.**

Follow normal guidelines when choosing anesthetic method, optimal surgical field is achieved by oral intubation and if a Boyle-Davis mouth gag is used to hide the tracheal tube.
Tonsillectomy Procedure

An operating microscope with 300 mm lens will help you to visualise structures and vessels well and in addition a useful tool for training and documentation, however a microscope, is not mandatory.

1. Grasp the tonsil using a non-traumatic (e.g. Luc’s) forceps and pull it towards the midline and up.
2. Hold the Wand perpendicular to the anterior tonsil parenchyma.
3. While retracting the tonsil medially, begin dissection by depressing the left (yellow) foot pedal in short bursts. If you have good visibility of the lower lobe, start the dissection at the lower lobe. Otherwise, start dissection at the upper lobe. Paint the tissue with VERY LIGHT pressure – applying too much pressure may cause too deep penetration resulting in bleeding and clogging of the suction channel. Keep the dissection to the peri-tonsillar space and avoid penetrating the tonsil capsule. Penetration capsule or the muscle layer may cause excessive bleeding.
4. If a bleeding vessel is encountered, place the Wand directly on the vessel and depress the coagulation Foot Pedal for approximately 1 second to achieve haemostasis (prolonged coagulation is not effective). Deal with bleeders as they are encountered rather than waiting as this makes for a cleaner field and more accurate haemostasis.
5. The suction/irrigation system keeps the area free of blood to allow accurate application of coagulation. Remember to use maximum flow rate (roller clamp fully open) controlled by the flow control unit.

Tonsillotomy Procedure

As an alternative to the technique described above, you can do a tonsillotomy by ablatting the tonsil. Once the anterior pillar is retracted, brush the Wand across the tonsil surface with light pressure to remove tissue layer by layer until the muscles are visible through the tonsil capsule. Again, it may be easier to differentiate tonsil tissue from the tonsillar capsule if the operating microscope is used, although this is not essential, only easier.

Post-operative Instructions

Follow local guidelines.

Guidelines at the Blackburn Royal Infirmary:

1. Normal diet and discharge from hospital the same day, with a minimum post-op stay of 4 hours.
2. No antibiotics.
3. Paracetamol or ibuprofen elixir on a p.r.n. basis in children and paracetamol/codeine preparations, +/- diclofenac in adults. Patients have been found to use fewer analgesics than after conventional tonsillectomy.

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Snoring and Sleep Surgery

Coblation snoring and sleep surgery procedures involve the reduction or removal of soft tissue, such as those found in the soft palate, uvula, or tongue base, to treat patients with socially disruptive snoring and/or obstructive sleep apnea (OSA).

Coblation procedures can be performed on an individual basis, including:

- **Soft palate channeling**
- **Uvulopalatoplasty**
- **Base of tongue channeling**
- **Partial glossectomy**
- **Lingual tonsillectomy**

Coblation can also be used as part of a multistage treatment concept such as Coblation Assisted Upper-Airway Procedures, which allows you to choose one or more steps to treat your patient depending on clinical need.

**Coblation Assisted Upper-Airway Procedures (CAUP)**

CAUP for the treatment of snoring and mild obstructive sleep apnea (OSA) is a multistage treatment concept which may include turbinate reduction, palate incision, volume reduction by upwards palatal channeling and uvular resection and channeling, pillar reduction by downwards channeling (anterior and posterior), tonsil channeling and tongue base reduction. The **ReFlex® SP Plasma Wand** can be used for all steps of the procedures, and CAUP has shown to be a very favorable procedure in the treatment of snoring and mild OSA.

**Clinical Information**

Procedure Overview

CAUP (Coblation® Assisted Upper-Airway Procedures) is a multistage treatment concept where you can choose one, several or all steps to treat your patient depending on clinical need. ReFlex Ultra™ 55 Wand can be used for all steps.

CAUP

- Turbinates
- Palate
  - Incision
  - Volume reduction by:
    - Upwards palatal channeling
    - Uvular resection & channeling
- Pillar reduction
- Downwards channeling (anterior & posterior)
- Tonsillar channeling
- Tongue base reduction

Patient Preparation

1. For patient comfort, apply Xylocain Gel 2%, 5 - 10 ml into the patient’s mouth for 15 - 20 minutes. This is to reduce the gag reflex during surgery.
2. A mixture of Xylocain/Adrenalin 2% and 0.5 ml Solu-Cortef or other steroid solution is prepared in a 5 ml syringe with thin needle and injected into the soft palate in 3 - 4 injections on each side of the mid-line.
3. Wait for 5 minutes.

Equipment Preparation

1. Insert the ReFlex Ultra 55 Wand into the connector end of the Patient Cable. Align the raised dot on the Wand handle with the black dot on the Patient Cable.
2. Set the Controller power level to 5 or 6, depending on the surgeon preference as judged by resistance during channeling (ablation) in the soft palate.

Coblation-Channeling™ Technique

Before each insertion, dip the Wand tip in saline solution to ensure formation of the plasma field. The intracellular fluid within the tissue will be sufficient to maintain the plasma field during channeling. Space out multiple channels to avoid creating overlapping lesions.

Palate Incision

1. The patient is best seated in an upright position in an ENT examination chair, opposite the surgeon.
2. Put an emesis basin in the patient hand, and in the other hand a bent tongue depressor (spatula). Patients often feel more comfortable if they are able to regulate the pressure on the tongue.
3. Using the Ablation pedal, activate the ReFlex Ultra 55 Wand tip to create an incision 1 - 2 cm long, made at approximately 45 degrees upward angle at the lateral rim of the soft palate (Figure 1). The dissection is obtained by gentle strokes of the Wand tip while stabilizing the soft palatal rim by using a surgical forceps. It is of great importance to dissect through the posterior pillar, thus leaving as wide of a transversal opening as possible. By just making one incision, a maximum of untouched mucosal lining is left undamaged, thus reducing the tendency for retraction and mucosal scarring as well as salivary gland damage that can cause mouth dryness.

Figure 1

www.arthrocareENT.com
# Coblation Procedures

Coblation® procedures employ radiofrequency (RF) energy to remove tissue and often provide a gentler alternative to other types of surgery. Coblation procedures gently break down tissues resulting in less damage to the surrounding tissue and virtually no bleeding.

Coblation procedures include: tonsillectomy, adenoidectomy, turbinate reduction, sinus surgery, and treatment of snoring. More information can be found by clicking the links in the table below.

<table>
<thead>
<tr>
<th>Procedure</th>
<th>EVac® Plasma Wands</th>
<th>ReFlex Ultra® Wands</th>
<th>PROcise™ Plasma Wands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adenoidectomy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nasal Surgery</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment of Snoring and OSA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tonsillectomy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sinus Surgery</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laryngeal and Head &amp; Neck Surgery</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Coblation

Procedures Supported by Interventional Therapies

Soft Tissue Removal (within the Spine)

The Cavity SpineWand® medical device creates a space in a malignant lesion in the spine. Using patented plasma technology (Coblation - or controlled ablation). This device can be used with a full line of vertebral body access tools. There are two sizes available: 11G and 8G (the difference is the offset of the device as well as length).

These devices also work with the Parallax family of products and the Arthrocare System 2000 controller (using saline as the conductive medium for tissue removal).

Results to Date:

- Used in over 1,000 tumor treatment procedures
- Minimally invasive
  - Typically adds on 10 minutes to a secondary procedure
  - General or local anesthesia is utilized
  - May require an overnight hospital stay depending on patient's co-morbidities

Procedures

Plasma Disc Decompression

Plasma Disc Decompression (PDD) is a minimally invasive procedure for patients with symptoms associated with a contained disc herniation who have failed conservative care and are not yet candidates for major surgery. PDD is performed with SpineWand® surgical devices, which use ArthroCare's patented Coblation® (controlled ablation) technology.

About Us

Since ArthroCare® Spine introduced its first spine system in 1995, we have been advancing the science of treating spine-related conditions by pioneering minimally invasive procedures for symptoms caused by vertebral compression fractures and contained disc herniation. Procedures such as percutaneous vertebroplasty and plasma disc decompression have helped hundreds of thousands of patients return to active and productive lives.

Substantial clinical data has been compiled demonstrating and validating the benefits of ArthroCare Spine's procedures and products. We invite you to explore our website to learn more.

Customer Service
- Tel: 800.797.6320
- Fax: 888.994.2782

Corporate Compliance
- ArthroCare Code of Business Conduct & Ethics
- Advamed Code of Ethics Effective July 1, 2009
- Ethics Helpline
COBLATION® Technology
What Is COBLATION Technology?

COBLATION® technology was designed and patented by the ArthroCare Corporation. The term "COBLATION" is a registered trademark of ArthroCare. The term "COBLATION" means "controlled ablation" and refers to the process of surgically dissolving tissue using a plasma-based radiofrequency device.

To date, COBLATION technology has been successfully deployed in millions of procedures within arthroscopy, spine and neurology, otolaryngology, urology, gynecology, and laparoscopy/general surgery. Some of the most common procedures in which it is used include those shown in the table below.

This technology has applications across several surgical fields, and many more are being explored. The primary ways in which the ArthroCare COBLATION technology works include:

- **Tissue ablation:** the removal of a defined volume of tissue in a surgical procedure.
- **Tissue shrinkage:** the volumetric or length reduction of tissue using thermal energy in a surgical procedure.
- **Hemostasis:** the coagulation or cauterization of tissue in order to stop bleeding or hemorrhage.

<table>
<thead>
<tr>
<th>ENT</th>
<th>Sports Medicine</th>
<th>Spine/Interventional Therapies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tonsillectomy and Tonsillectomy</td>
<td>Subacromial Decompression</td>
<td>Disc Decompression</td>
</tr>
<tr>
<td>Adenoidectomy</td>
<td>Meniscectomy</td>
<td>Microdiscectomy</td>
</tr>
<tr>
<td>Turbinate Reduction</td>
<td>Articular Cartilage Debridement</td>
<td>Creating a cavity in a malignant lesion</td>
</tr>
<tr>
<td>Partial Glossectomy</td>
<td>Tendon Microdebridement</td>
<td></td>
</tr>
<tr>
<td>Uvulopharyngoplatoplasty</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polypectomy</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
An ArthroCare system has the capability to perform tissue ablation (i.e. tissue removal), tissue shrinkage, and hemostasis. In medical devices operating in saline type environments, the electrical excitation can range from low-voltage, non-plasma-forming tissue-heating conditions (causing tissue coagulation, for example) to higher voltage plasma-forming conditions that can cut or excise tissue rapidly with minimal necrosis of untargeted tissue. Radiofrequency excitation frequencies used for COBLATION devices most commonly range from 100 to 500 kHz. Plasma-forming, or COBLATION, radiofrequency controller settings are used for removing tissue in a defined area, while non-plasma-forming settings are used for performing procedures in which tissue shrinkage or tissue coagulation is the goal.

**Non-Plasma Settings**

At the lower voltages, typically below about 65-125 volts root mean square (rms), the saline solution is merely heated by joule dissipation of the electrolyte ions moving in the solution in response to the imposed electric fields. This heated fluid can interact with nearby tissue. The tissue can also be heated directly by the electrical currents if the tissue is sufficiently electrically conducting (usually through the presence of naturally-occurring ions such as sodium, potassium, chloride, and the like). Tissue containing collagen fibrils (a major non-cellular component of many soft tissues) may shrink as a result of the heating, which sometimes is a desired surgical procedure. Collagen shrinking is a shortening of the collagen fibers through a thermally induced change of the molecular structure. Blood vessels within the tissue may also be coagulated, thereby stopping their bleeding during the surgical procedure. With COBLATION products, coagulation occurs at a much lower temperature than with conventional electrocautery: it is obtained through a shrinkage of the vessel fibers, reducing the diameter of the lumen, and also through a coagulation of the proteins contained in the plasma (blood).

**Plasma Setting**

COBLATION technology works by generating an electric field between a single or cluster of active electrodes located on the tip of a radiofrequency device and a return electrode located more proximally on the same bipolar device. Current flows through an electrically conductive solution, such as saline. With COBLATION settings, a voltage (150-350V) is introduced across the electrodes on a wand. This electrical field interacts with underlying fluid, such as saline, to excite electrolytes and molecules in the fluid and create a high-density energy field called plasma. The plasma field contains energized particles with sufficient energy to break soft tissue molecular bonds, thus producing conditions that are effective in dissolving tissue at relatively low temperatures. The formation of a gas layer is an important process leading to the plasma-forming conditions. Gas formation at the electrode is the result of an electrochemical process at the surface of the electrodes. In addition, when the local joule heating of the saline induced by the electric field and current density near the energized electrodes exceeds the heat of vaporization of the fluid (e.g., water) and the rate at which the heat dissipates due to thermal conduction, localized vaporization can develop. As a very thick vapor layer forms (on the order of 100µm) and high impedance of the vapor layer as compared with the saline occurs, the electric field across this area, which is localized in thin regions around the electrode(s), increases dramatically (300V across 100µm is 30,000 V/cm), ionizing and fragmenting the water molecules in the vapor layer and forming the plasma field.
The Plasma Field
The plasma field is an ionized gas consisting of free electrons, ions and excited radicals. Though the electrons contained in the plasma field are relatively energetic, the ions and neutral particles in the plasma remain relatively cool, and many of the fragments are chemically reactive. In contact with biological tissue, these plasma particles are sufficiently (re)active to disintegrate organic molecular within the tissue into elementary molecules. In this manner, the target tissue is effectively dissolved or volatilized in a gentle fashion (at low temperature) inducing minimal or no damage to surrounding healthy tissue.

Research has shown that electrical discharges formed around electrodes submerged in isotonic saline produces strong optical emissions from the sodium D-lines as well as from excited hydroxyl (OH) and atomic hydrogen (H) radicals. The sodium D-line emission is usually dominant and is responsible for the characteristic yellow glow associated with these discharges, as shown in Figure 1.

Figure 1.
The yellow glow emitted by a COBLATION device functioning in a saline environment shows the plasma field.
Transition between Non-Plasma and Plasma Settings:
The performance of ArthroCare wands can be illustrated using a power curve (see Figure 2). With the ArthroCare system, the transition between non-plasma and plasma controller settings for each particular ArthroCare wand is defined by current density. Current density is principally modulated by:

1) Voltage (controller setting)
2) Electrode configuration of the wand, and
3) Impedance (impedance is mainly determined by the surface area of the electrode, electrode composition, composition of the fluid or gas around the electrodes and to a much lesser extent tissue composition).

Voltage corresponds to controller setting. Transition between non-plasma and plasma activities usually occurs between 125 and 250 V-rms (controller settings 2 to 7), but depends on wand design. Peak thermal power dissipation is also usually achieved within this voltage range. Once the wand is in plasma mode, thermal power is reduced while the plasma ablative effectiveness is elevated due to increased chemical activity driven by the elevated electron energy. The increased electron energy is a result of electron acceleration (i.e. movement) induced by the higher electric field in the plasma. NOTE: Controller (voltage) settings are not linearly related to dissipated power.

Figure 2. Example of an ArthroCare device power curve.
HOW DOES COBLATION TECHNOLOGY COMPARE TO OTHER TYPES OF RADIOFREQUENCY-BASED TECHNOLOGIES SUCH AS ELECTROCAUTERY AND OTHER ELECTROSURGICAL DEVICES?

The practice of electrocautery which dates back to Hippocrates, is a crudely effective technology, useful for hemostasis, but lacking the ability to selectively target a precise area. Electrocautery effectively kills and removes the target tissue by essentially burning it.

Electrosurgery, first invented over 100 years ago, is more precise than electrocautery allowing the surgeon to target a specific area of tissue. The electric current passes through the tissue, causing the tissue to heat up, but not as dramatically as in electrocautery. There is demonstrated difference among varying types of radiofrequency-based devices. The size of the electrode, the type of current, the power setting and the amount of time the device is in contact with the tissue all affect the end clinical result.

Although COBLATION is a form of electrosurgery, it does not require current to flow through tissue to operate. In fact, during most common COBLATION procedures, only a very small amount of current passes through tissue. Tissue ablation is obtained through the chemical etching action of the plasma. When used in coagulation mode, localized heating of tissue is achieved by a larger amount of current passes it and by the direct heating of the fluid in contact with the tip of the COBLATION wand.

The ArthroCare electrosurgical generator and other electrosurgical power sources have unique differences from both electrocautery and conventional electrosurgical systems. While all of the generators are radiofrequency generators, the ArthroCare generator is voltage-regulated; other generators are generally power-regulated. To better understand the difference between these two modes of operation, it is important to appreciate the concept of electrical power. Electrical power is defined as the product of current (I) and voltage (V). Based on Ohm's Law, current is defined as the ratio of the voltage to the resistance (R); hence, Power (P) = VI = V²/R.

When a voltage is applied to an area of tissue to be treated, the resistance (R) increases over time. Therefore in this situation, for power-controlled systems, the voltage is constantly changed (increased) to ensure that the power (P) remains constant as the resistance increases. For an ArthroCare generator, the voltage at each controller set point is fixed. Therefore, as the resistance increases during a tissue treatment, the power (i.e. thermal effect) is significantly higher during the first when the device is activated (less than a 10th of a second) and then rapidly decreases, limiting the thermal effects generated over time.

ADVANTAGES OF COBLATION TECHNOLOGY

• COBLATION technology functions at cooler temperatures than other radiofrequency-based technologies, generating tissue temperatures of 40°C to 70°C versus other technologies such as electrocautery that generate tissue temperatures of 400-600°C.

• COBLATION technology is more precise than other radiofrequency-based technologies, allowing the surgeon to ablate the tissue in a specific area with minimal effect to the surrounding tissue. Plasma is only 100-200μm thick around the active electrode.

• COBLATION technology preserves tissue quality, since the tissue is dissolved or volatilized at the molecular level, and not burned or otherwise mechanically abraded.
Q. The COBLATION Wand tip is glowing. Am I burning the tissue?

A. No. The glow signals that the wand is working correctly; it is not a heat indicator. A yellow color indicates the presence of excited sodium (Na) atoms from the NaCl-based saline solution used to generate the plasma (Figure 3A). The glow color will change in a different medium; for instance, in a potassium chloride (KCl) based medium, the tip will have a pinkish-blue glow, which is characteristic of excited potassium (K) atoms (Figure 3B).

Figure 3.

Q. Does the saline around the COBLATION Wand tip get hot?

A. Only minimally. Energy from the generator is used to vaporize and ionize the saline in a very thin layer around certain regions of the active electrode(s) to create the plasma. Much of the saline near the wand tip remains below approximately 40 - 70 °C.

Q. If the COBLATION Wand is not heat driven, why does soft tissue sometimes turn brown while ablating?

A. The tissue turns brown due to oxidation, similar to an apple core exposed to air after the apple has been eaten.

Q. I noticed charred tissue on the tip of the device, what does this mean?

A. Since as discussed above the COBLATION process is plasma driven, much of the removed tissue is dissolved or volatilized into vapor bubbles that dissipate or are actively pumped away by suction devices. However, sometimes small amounts of nonvolatile residue of the ablated tissue can stick to the tip of the device after it is removed from the targeted ablation site. This occurrence is not unusual and it usually doesn’t pose problems for these single-use devices.
Q. How much cell necrosis occurs in tissue not targeted for treatment when a COBLATION device is used?

A. There is a very thin layer of cell necrosis adjacent to the treated area, which is to be expected since some heat is generated during the process as a by-product. When used for articular cartilage and intervertebral disc applications, the COBLATION process has been shown to be associated with approximately 100 – 200 microns of tissue necrosis (Figure 4).

Figure 4. Confocal microscopy indicates that depth of cell necrosis at the treatment site ranges from 100 to 250 μm with use of a COBLATION device used at a plasma setting [Amiel et al., 2002]. Study of metabolic activity in the treated tissue samples was not significantly affected when compared to untreated tissue.
REFERENCES

4. Pilitsis, The Role of Vertebroplasty in Metastatic Spinal Disease, Neurosurg Focus 11(6), 2001

GLOSSARY OF TERMS

COBLATION: A registered trademark of ArthroCare that means "controlled ablation."

Electrocautery: The process of cauterizing or removing tissue with a device consisting of a hot piece of metal heated by a high-voltage, DC or high-frequency alternating current passed through an electrode. The device may produce very high temperatures and scald or burn tissue on contact.

Electrosurgery: The process of using an electrical device powered with high-frequency current instead of a scalpel in order to cauterize or dissolve or otherwise remove tissue.

Plasma field: A highly ionized gaseous state of matter, consisting of free electrons, ions and excited radicals.

Voltage (V): A voltage is a measure of the potential difference between two points, and it can drive the flow of electrons and ions, constituting a current. An ArthroCare controller unit applies a voltage waveform to the wand in the form of a 100-kilohertz square-wave with a zero time average voltage. Thus, the total period of a single wave period is 10 microseconds—half of this period (5 microseconds) is driven at a positive voltage level and the other half is driven at a negative voltage level. This voltage waveform is applied to the wand through the cable supplied with the controller. The controller setting indicates the amplitude of the square-wave, usually expressed in terms of a root mean square value. For example, the "C" setting ("C" stands for coagulation) provides a nominal 65-volt root mean square amplitude signal to the wand. A setting of 1 on the controller provides a nominal 100-volt root mean square amplitude signal to the wand and each higher setting provides incrementally 25 volts more to the wand. The voltage drives an electrical current (see below) through the saline solution surrounding the wand—the combined action of the voltage and current dissipates energy, which, depending on the controller setting generates either a) a coagulation condition ("coag") or b) a COBLATION mode.

Current (I): Current is a flow of electrons or ions between two points, driven by the potential difference (voltage) between them. In ArthroCare devices, the active tip of the wand, the saline solution surrounding the wand, the nearby tissue, the return electrode incorporated into the body of the wand, and the cable connecting the wand to the controller constitute an electrical circuit through which electrical current flows as it is driven by the applied voltage from the controller. The current, expressed in "amperes," is a measure of the charge per unit time (1 ampere = 1 coulomb of charge per second) flowing in the circuit—it is related to the voltage through a mathematical relationship known as "Ohm's Law," which states that there is a linear relationship between the voltage and current and the constant of proportionality is called the resistance (or impedance, see below). The electrical current may pass either 'in series' or 'in parallel' through the circuit elements, depending on a number of factors related to the geometrical and electrical properties of the circuit elements.

Current Density: Current density refers to the charge per unit time flowing across a surface area. It is expressed in ampere per unit area. Since the current flowing in the circuit flows through different cross sectional areas depending on the location in the circuit, the current density may vary widely through the circuit. For example, the current density at the active tips of the wand is relatively large due to the small surface area of the active electrodes. The current density then decreases significantly as the current flows.
through the surrounding saline solution and the current density at the return electrode is relatively small due to the large surface area of the return electrode. Regions of high current density frequently are where the greatest effects of electrosurgical devices are developed.

**Impedance:** Impedance refers to the electrical resistance (R) in the circuit elements, or of the entire circuit, depending on the context in which it is used. Sometimes impedance is synonymous with "resistance." In either case, impedance or resistance is expressed in ohms—it is the constant of proportionality found in Ohm’s Law, discussed above. Circuit elements with high impedance cause a diminution of current flow, while elements with low impedance can allow large current flows. The overall impedance of a circuit containing both parallel and series elements can be obtained by a suitable mathematical manipulation and application of Ohm’s Law.

**Tissue Impedance:** Tissue impedance refers to the electrical resistance of the particular type of tissue being treated by the surgeon. Tissue impedance is a function of the type of tissue, its geometrical shape, its temperature and the frequency of the electrical signal being applied. The impedance of the tissue is inversely related to the "conductivity" of the tissue, which is a more fundamental property of each type of tissue. Since some of the current flowing in an electrosurgical system flows outside the tissue on its way back to the current return electrode, it is of limited utility for many practitioners. Many studies of tissue conductivity have been conducted and the results are generally available online or in textbooks on electrosurgery or electromagnetic interactions with tissue.

**Electric Field:** An electric field develops between two points when a voltage difference is applied. Electrical field intensity is measured in Volts per unit of distance; example: Volt/cm. In electrostatic situations, the applied potential difference causes the charges to rearrange themselves until an equilibrium is attained and the local electric field is a measure of the local charge imbalance. In the case when current is flowing, an electric field may also develop in a circuit element, in which case its magnitude is related to the current density and the conductivity of the medium through which the current is flowing. Again, Ohm’s law (or variations of it) can be used to determine the electric field in tissue or other elements in the circuit if the conductivity of the medium is known and the current density is known. Since this is not the case in many electrosurgical situations, it is difficult to determine with great precision the electric field in most tissues during the treatment.

**Ohm’s Law:** In its simplest form, this law defines the relationship between current (I) and voltage (V) or potential difference – the current flowing through a conductor is directly proportional to the potential difference between its ends: I = V/R; where R is the resistance of the conductor (e.g., piece of tissue).

**Power (P):** Power is the amount of energy delivered per unit of time; it is expressed in Watts. 1 Watt is one Joule delivered in 1 second. Power can be calculated by the product of voltage and current (P = IV); using Ohm’s Law, power can also be represented as P = V^2/R, or FR.
ArthroCare

**CAPSure**
- Catalog Number: A 1730-01
- Procedures: Knee Arthroscopy, Shoulder Arthroscopy

**CAPSure 30**
- Catalog Number: A 1830-01
- Procedures: Knee Arthroscopy, Shoulder Arthroscopy

**CAPSure 30 ICW**
- Catalog Number: AC 1830-01
- Procedures: Knee Arthroscopy, Shoulder Arthroscopy

**BendIng Tool**
- Catalog Number: H 2000-20
- Procedures: Knee Arthroscopy, Shoulder Arthroscopy

For use with CAPSure™, CAPSure ICW™, and MicroCAPS™

**TOPAZ™ Family**

**TOPAZ ICW**
- Catalog Number: AC 4040-01
- Procedures: Tendon and Fascia

**TOPAZ EFP Microdebrider 48**
- Catalog Number: Q6002-01
- Procedures: Tendon and Fascia

The TOPAZ EFP Microdebrider features a 45° tip angle to facilitate an arthroscopic surgical approach to fascia in the foot.

**Slicer**
- Catalog Number: A 4330-01
- Procedures: Knee Arthroscopy, Lateral Release, Shoulder Arthroscopy

**Slicer 30**
- Catalog Number: A 4330-01
- Procedures: Knee Arthroscopy, Lateral Release, Shoulder Arthroscopy

**Slicer 30 ICW**
- Catalog Number: AC 4330-01
- Procedures: Knee Arthroscopy, Lateral Release, Shoulder Arthroscopy

**Curexor™ 20 ICW**
- Catalog Number: AC 4540-01
- Procedures: Knee Arthroscopy, Shoulder Arthroscopy

**Curexor™ ICW**
- Catalog Number: AC 4540-01
- Procedures: Knee Arthroscopy, Shoulder Arthroscopy
<table>
<thead>
<tr>
<th>Product Name</th>
<th>Catalog Number</th>
<th>Procedures</th>
<th>Views</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right Angle 90° 8.9mm</td>
<td>A 1305-01</td>
<td>Knee Arthroscopy, Shoulder Arthroscopy</td>
<td></td>
</tr>
<tr>
<td>Right Angle 90° 8.9mm</td>
<td>A 1335-01</td>
<td>Knee Arthroscopy, Shoulder Arthroscopy, Glenoid Labral Repair</td>
<td></td>
</tr>
<tr>
<td>LePue 76°</td>
<td>A 1336-01</td>
<td>Knee Arthroscopy, Shoulder Arthroscopy, Subscapularis Debridement</td>
<td></td>
</tr>
<tr>
<td>LePue 45°</td>
<td>AC 1306-01</td>
<td>Knee Arthroscopy, Shoulder Arthroscopy, Subscapularis Debridement</td>
<td></td>
</tr>
<tr>
<td>Right Angle 45°</td>
<td>AC 1340-01</td>
<td>Knee Arthroscopy, Shoulder Arthroscopy, Subscapularis Debridement</td>
<td></td>
</tr>
<tr>
<td>Equivator 88°</td>
<td>A 1345-01</td>
<td>Knee Arthroscopy, Shoulder Arthroscopy, Subscapularis Debridement</td>
<td></td>
</tr>
<tr>
<td>Bovie</td>
<td>A 3525-01</td>
<td>Knee Arthroscopy, Multicision</td>
<td></td>
</tr>
<tr>
<td>Bovie 45° 8.9mm</td>
<td>AC 3520-01</td>
<td>Knee Arthroscopy, Shoulder Arthroscopy, Lateral Release</td>
<td></td>
</tr>
<tr>
<td>Bovie 45° 8.8mm</td>
<td>A 3520-01</td>
<td>Knee Arthroscopy, Shoulder Arthroscopy, Lateral Release</td>
<td></td>
</tr>
<tr>
<td>Bovie 30° Lumen</td>
<td>A 3525-01</td>
<td>Knee Arthroscopy, Multicision</td>
<td></td>
</tr>
</tbody>
</table>
ArthroCare

Knees

ArthroWand

RF Wand

Featured Products

Section

Bose® TurboVan® 95, IRS
Catalog Number: ASH 4200-01
Procedures: Knee Arthroscopy, Cruciate Reconstruction, Meniscectomy

For Quantum only
Our popular SuperTurboVan® Wand is now available with integrated Finger Switches built into the Wand handle.

Super MultiVac® 50, IRS
Catalog Number: ASH 4650-01
Procedures: Knee Arthroscopy, Cruciate Reconstruction, Meniscectomy

For Quantum only
The SuperMultiVac® 50 ArthroWand, designed for ACL and meniscal debridement, is now available with finger switches built into the handle.

Ambient™ Super MultiVac® 50 IRS
Catalog Number: ASH 4830-01
Procedures: Knee Arthroscopy, Cruciate Reconstruction, Meniscectomy

For use with Quantum 2 System ONLY.
The Ambient® Super MultiVac® 50 IRS, designed for ACL and meniscal debridement, provides accurate, real-time temperature measurements of the surgical environment. Available with integrated Finger Switches built into the wand handle.

StarVac™ 50 ICM
Catalog Number: ASC 4251-01
Procedures: Knee Arthroscopy, Shoulder Arthroscopy, Subacromial Decompression

The newest 90° suction Wand combines aggressive ablation speed with powerful suction. Now available as an integrated Cello Wand.

Ambient™ CoVac™ 750
Catalog Number: ASH 4571-01
Procedures: Knee Arthroscopy, Meniscectomy

Accurate, real-time measurements of the arthroscopic irrigating fluid in the joint. Temperature Feedback for Intelligent Arthroscopy

Paragon™ T2™ ICM
Catalog Number: AC 5531-01
Procedures: Knee Arthroscopy, Shoulder Arthroscopy, Frozen Shoulder

The Paragon T2 ArthroWand precisely smooths and ablates cartilage.

TOPAZ® Family

TOPAZ XL ICM
Catalog Number: AC 4048-01
Procedures: Shoulder Arthroscopy, Frozen Shoulder

The TOPAZ XL ArthroWand is the only bipolar RF device specifically designed to treat the rotator cuff tendon.

Harpoon & Faucet Cassettes

Harpoon ICM
Catalog Number: AS 5609-01
Procedures: Knee Arthroscopy, Meniscectomy

Meniscal ICM
Catalog Number: ASC 5536-01
Procedures: Knee Arthroscopy, Meniscectomy

Razor 5.4 ICM
Catalog Number: A 5520-01
Procedures: Knee Arthroscopy, Meniscectomy

Razor 3.6 ICM
Catalog Number: AC 5520-01
Procedures: Knee Arthroscopy, Meniscectomy
ArthroCare

RF Controllers and Accessories

Featured Product Sets

Controller and Accessories

Guamut™ System (Includes Controller, Wired Foot Control, Power Cord, and User’s Manual)
Catalog Number: H 4200-01
Procedures: Knee Arthroscopy, Cruciate Reconstruction, Chondroplasty; Lateral Release, Meniscectomy, Shoulder Arthroscopy, Subacromial Decompression, Foot and Ankle Arthroscopy, Tendon and Tissue, Hip Arthroscopy, Knee Arthroscopy, Elbow Arthroscopy

Catalog Number: H 3000-00
Procedures: Knee arthroscopy, Cruciate Reconstruction, Chondroplasty, Lateral Release, Meniscectomy, Shoulder Arthroscopy, Subacromial Decompression, Foot and Ankle Arthroscopy, Tendon and Tissue, Hip Arthroscopy, Knee Arthroscopy, Elbow Arthroscopy

The Atlas platform enhances bipolar Coagulation technology and maximizes performance in arthroscopic procedures.

ArthroCare Dilute & Protecting Cups
Catalog Number: H 0979-02
Procedures: Knee Arthroscopy, Cruciate Reconstruction, Chondroplasty, Lateral Release, Meniscectomy, Shoulder Arthroscopy, Subacromial Decompression, Foot and Ankle Arthroscopy, Tendon and Tissue, Hip Arthroscopy

Power Cord
Catalog Number: D 3349-00
Procedures: Knee Arthroscopy, Cruciate Reconstruction, Chondroplasty, Lateral Release, Meniscectomy, Shoulder Arthroscopy, Subacromial Decompression, Foot and Ankle Arthroscopy, Tendon and Tissue, Hip Arthroscopy, Valve Arthroscopy, Tissue Arthroscopy

Thinner
Catalog Number: H 2000-01
Procedures: Tendon and Tissue

Atlas systems accessory

Post-Care
Catalog Number: EA 8800-63
Procedures: Knee arthroscopy, Cruciate Reconstruction, Chondroplasty, Lateral Release, Meniscectomy, Shoulder Arthroscopy, Subacromial Decompression, Foot and Ankle Arthroscopy, Tendon and Tissue, Hip Arthroscopy, Valve Arthroscopy, Tissue Arthroscopy
Harmonic Scalpel

The Harmonic Scalpel is a highly advanced piece of equipment used in a growing number of surgeries, and can be added to an arsenal of laparoscopic surgical instruments to increase a surgeon’s efficiency and a patient’s recovery. The Harmonic Scalpel is actually an entire system that consists of a generator, foot pedal and hand switch, a hand-held ultrasonic transducer, and a cutting instrument.

The Harmonic Scalpel is a cutting instrument used during surgical procedures to simultaneously cut and coagulate tissue. The instrument is similar to a Bovie, but it can cut through tissue, create less smoke, and may offer greater precision. However, the Harmonic Scalpel is not as easily maneuverable as the Bovie, and takes longer to cut and coagulate tissue. Additionally, while a Bovie can be used to coagulate bleeding tissue at any time, the Harmonic Scalpel only coagulates as it cuts.

The Harmonic Scalpel causes less lateral thermal damage than the Bovie. Whereas a Bovie performs its action via an electrical current (and production of heat), the Harmonic Scalpel cuts via vibration. The scalpel surface itself cuts through tissue by vibrating in the range of 20,000 Hz. The vibration cuts through the tissue and seals it using protein denaturization, rather than heat. A good analogy is whisking an egg white; denaturation of the protein by vibration rather than heat.

The Harmonic Scalpel can be used for both open and endoscopic surgical procedures. The innovative design requires fewer instrument exchanges during a procedure than other options. Additionally, there is no electricity running to the patient. Finally, the Harmonic Scalpel allows for greater precision to avoid damaging vital structures of the body.

Because the Harmonic Scalpel can be used in multiple configurations, it is a great tool for a number of procedures. It has applications in dental, ophthalmic, and other types of surgery.

Harmonic Scalpel bullet points

- It is not bipolar nor monopolar. It is Ultrasonic technology (pure mechanical motion in which no electricity goes to the patient at all).
- The Harmonic generator and handpiece convert electrical energy into pure mechanical motion
- The blade cycles 55,000 cycles per second
- The vibration, along with the compression, breaks down the Hydrogen bonds and denatures protein creating sticky coagulum, which seals vessels
- The Harmonic shears can seal up to and including 5mm vessels and lymphatics
Experience the Advantages of Harmonic® Technology

Harmonic® instruments are powered by ultrasonic energy, a form of mechanical motion.

- Blade vibrates longitudinally 55,500 times per second.
- Soft tissue is coagulated to form a sticky coagulum and is then transected.
- Clamp force coapt blood vessels (≤5 mm); coagulum forms a reliable hemostatic seal.

Factors that drive performance and efficiency:

- Better hemostasis: Decrease TISSUE COMPRESSION, TISSUE TENSION, POWER LEVEL, BLADE SHARPNESS
- Faster cutting: Increase
Experience the Advantages of Harmonic® Technology

- Blade vibrates longitudinally 55,500 times per second.
- Soft tissue is denatured to form a sticky coagulum and is then transected.
- Clamp force coaps blood vessels (≤5 mm); coagulum forms a reliable hemostatic seal.

Factors that drive performance and efficiency:

- **Tissue Compression**
- **Tissue Tension**
- **Power Level**
- **Blade Sharpness**

Better hemostasis, decrease, increase, faster cutting.
Minimal Lateral Tissue Damage

**Harmonic**

- **technology**
- **Electrosurgery**

<table>
<thead>
<tr>
<th></th>
<th>Harmonic</th>
<th>Electrosurgery</th>
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</thead>
<tbody>
<tr>
<td>Protein coagulation</td>
<td>✓</td>
<td>×</td>
</tr>
<tr>
<td>Tissue desiccation</td>
<td>✓</td>
<td>×</td>
</tr>
<tr>
<td>Eschar (oxidation)</td>
<td>✓</td>
<td>×</td>
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*Harmonic technology offers numerous surgical benefits*

*If you have to perform a very skilled or detailed surgery, such as a laparoscopic radical hysterectomy, you want to make sure you are using an instrument that is safe near vital structures.*

*Advancing Smooth Surgery*

*Harmonic ACE*
<table>
<thead>
<tr>
<th>Minimal Lateral Tissue Damage</th>
<th>Harmonic</th>
<th>Harmonic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proximal, medial, and lateral spread and tissue damage</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Tissue desiccation</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Minimal lateral spread and tissue damage</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>No electricity passes into or through the patient</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>No current-related neurovascular stimulation</td>
<td>✔️</td>
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</table>
Harmonic ACE® Curved Shears—Created With Surgeons, for Surgeons

Developed with input from hundreds of surgeons to produce the ultimate surgical instrument

"It can be used as a dissector, it can be used as a grasper, and it can coagulate and cut...so you don't have to exchange instruments."

- Intuitive controls: Minimal index finger repositioning; soft molding maximizes grip
- Handle and hook trigger: Contoured with an open design for comfort, balance and control
- Audible and tactile feedback: Trigger clicks when jaws are fully compressed and again when released

Terence Hallam, MD
Assistant Professor
University of Maryland
Cleft and Craniofacial Surgery
Harmonic ACE® Curved Shears—Created With Surgeons, for Surgeons

It can be used as a dissector, it can be used as a grasper, and it can coagulate and cut. So you don’t have to exchange instruments.

- Tactile control
- Manual(idex finger positioning, soft/tightly instrument
- Thum-like and hook triggers
- Contoured with an open design for comfort, balance and control
- Audible and tactile feedback: fringe indicators are fully compressed and again when released
Multiple Blade Surfaces, Optimal Performance

Clamping surface
for cutting, coagulating and grasping

Blunt nose
for spot coagulation and fine dissection

Cutting edge
for tissue scoring or backcutting

Flat back
for broad coagulation

Curved blade
for precise dissection and blade tip visibility

"You're able to have one instrument that can clamp, cut and tie. Essentially... It saves you time...especially when you're deep down in the pelvis."

Ray Bledsoe, MD
New Haven Hospital
Education and Surgery

Advancing Smooth Surgery

Harmonic ACE
Multiple Blade Surfaces, Optimal Performance

- Flat back for broad coagulation
- Curved blade for precise dissection and blade transfer
- Clamping surface for cutting, coagulating and grasping
- Blunt jaws for spot coagulation and head separation
- Cutting edges for tissue severance and dissection

Advancing Smooth Surgery

Harmonic ACE
Harmonic ACE® Curved Shears—Feeling Is Believing

Versatile: Cuts, coagulates, grasps and dissects without exchanging instruments

Precise: Few lateral thermal tissue damage for safer dissection near vital structures

Reliable: Confidently seals vessels ≤5 mm, as well as lymphatics

Efficient: Moves through tissue quickly while maintaining hemostasis

Tightly-fit: Intuitive controls maximize comfort and balance

Harmonic® technology is the proven leader in advanced energy with more than 9.5 million procedures worldwide.
**Harmonic ACE® Curved Shears—Feeling Is Believing**

Extensively engineered to intuitively blend into your surgical flow

<table>
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<tr>
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<th>Cuts, coagulates, grasps and dissects without exchanging instruments</th>
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<tr>
<td>Efficient</td>
<td>Moves through tissue quickly while maintaining hemostasis</td>
</tr>
<tr>
<td>Ergonomic</td>
<td>Intuitive controls maximize comfort and balance</td>
</tr>
</tbody>
</table>

**Harmonic® technology is the proven leader in advanced energy with more than 6.5 million procedures worldwide.**
The Harmonic ACE® Curved Shears Surgical System

Innovative technology offers dependability and versatility

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Product Code</th>
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<tbody>
<tr>
<td>Harmonic ACE® curved shears with ergonomic handle and hand control (23 cm)</td>
<td>ACE23E</td>
</tr>
<tr>
<td>Harmonic ACE® curved shears with ergonomic handle and hand control (36 cm)</td>
<td>ACE36E</td>
</tr>
<tr>
<td>Harmonic ACE® curved shears with ergonomic handle and hand control (45 cm)</td>
<td>ACE45E</td>
</tr>
</tbody>
</table>

Ordering Information

"You can use it not just for taking vessels, but making enterotomies, which you have to do in laparoscopic bariatric surgery."

- Oscar Smith, M.D.
- Advanced Obesity Surgery for Bariatric Surgery

Advancing Smooth Surgery
The Harmonic ACE® Curved Shears Surgical System

Innovative technology offers durability and versatility.

Generator 300 (Gen300)

Hand piece (posa)
Harmonic ACE® curved shears

45 cm lap for extra reach
36 cm long
23 cm tips

Ordering Information

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<td>ACE36E</td>
</tr>
<tr>
<td>Harmonic ACE® curved shears with ergonomic handle and hand control (45 cm)</td>
<td>ACE45E</td>
</tr>
</tbody>
</table>

You can use it not just for taking vessels, but making enterotomies, which you have to do in laparoscopic bariatric surgery.

Melton, St. Louis, MO 63118

Harmonic ACE

Advancing Smooth Surgery
Harmonic ACE® Curved Shears—Feeling Is Believing
Maximizing performance and comfort for an incomparable surgical experience

For more information, contact your local EES representative, call 1-800-USE-ENDO or visit www.harmonic.com.
Argon Beam Coagulation

Argon Beam Coagulation (ABC) was developed to more effectively control bleeding in surgery. While standard electrosurgical coagulation applied radio frequency electrical current to cauterize tissue and thereby control bleeding, argon coagulation delivers current to the tissue in a directed beam of ionized argon gas.

The flow of gas blows away blood and debris from the surgical field and produced a coagulated surface that is more uniform and shallower than that produced in standard electrosurgical coagulation, according to manufacturers. As a result, surgeons are able to coagulate bleeding tissue faster with reduced blood loss and less tissue damage. Argon coagulation has also been found to produce less smoke than conventional electrosurgery.

The ABC system achieves the unsurpassed coagulation and enhanced clinical effectiveness by focusing RF energy into a directional, non-contact, cooler beam of argon gas. The electrosurgical current follows a tight path along the argon gas flow from the hand piece electrode to the tissue. The delivered RF energy forms a reticulum of arc tunnels as before, but with the ABC units, tunnels are smaller, more numerous, more uniform in diameter and depth, and distributed evenly on the tissue. This results in faster hemostasis, a more homogenous eschar, and less tissue damage. The flow of argon gas also serves to clear the surgical site of fluids to allow coagulation directly on the tissue, reducing carbonization. Clearing the fluids from the path of the beam and creating the arc tunnel reticulum directly on the target tissue prevents the formation of a floating eschar, thereby producing:

- More rapid coagulation
- Less tendency to fracture
- Improved healing time
- Improved eschar integrity
- Reduced possibility of rebleeding

The depth of penetration of the coagulum is dependent upon both power and duration of application, as well as the electrical characteristics of the tissue. With ABC coagulation, the depth is not only uniform, but also quite shallow. This minimal tissue destruction means less necrotic tissue, reduced chance of sloughing, and post-op bleeding and enhanced healing.
There are many benefits to using Argon Beam Coagulation.

- Reduced blood loss
- Enhanced clinical effectiveness
- Less tissue damage
- Reduced risk of infection
- Reduced OR procedure time
- Enhanced healing
- Minimal smoke plume and odor
- Enhanced safety
Argon Beam Coagulator
System 7500 & 7550 Reference Card***

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Power Settings (Watts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endometriosis</td>
<td>60-80 (40-60 near Ureter &amp; Bladder)</td>
</tr>
<tr>
<td>LAVH</td>
<td>100 (40 near Bladder)</td>
</tr>
<tr>
<td>Hysterectomy</td>
<td>80-100</td>
</tr>
<tr>
<td>Myomectomy</td>
<td>100-120</td>
</tr>
<tr>
<td>Gallbladder</td>
<td>100-120</td>
</tr>
<tr>
<td>Breast Tissue</td>
<td>95</td>
</tr>
<tr>
<td>Bone</td>
<td>100-150</td>
</tr>
<tr>
<td>Delicate Tissues</td>
<td>40</td>
</tr>
<tr>
<td>Liver/Kidney/Spleen</td>
<td>120-150</td>
</tr>
<tr>
<td>Lung</td>
<td>50-60</td>
</tr>
<tr>
<td>Mesentery Vessels</td>
<td>40-80</td>
</tr>
<tr>
<td>Muscle</td>
<td>80-100</td>
</tr>
<tr>
<td>Pancreas</td>
<td>80</td>
</tr>
<tr>
<td>Skin Flap</td>
<td>70</td>
</tr>
<tr>
<td>Sternum</td>
<td>130-140</td>
</tr>
<tr>
<td>Tonsillectomy</td>
<td>45-55</td>
</tr>
<tr>
<td>Vessel Surfaces</td>
<td>40-80</td>
</tr>
</tbody>
</table>

***These settings are based upon what other surgeons have used in the past, but actual settings depend upon surgical circumstances and the discretion of the surgeon.

Gas Flow Settings

**Endo Mode:** This mode limits the gas flow to < 4 SLPMs, and it should be used for all laparoscopic procedures. Also, when using the ABC during laparoscopic procedures, be sure to monitor the pneumatic pressure and vent a trocar when the ABC is activated.

**Automatic Mode:** This mode automatically adjusts the argon gas flow, and will increase to a maximum of 10 SLPMs if needed. This mode should be used for open procedures.

**Manual Mode:** This mode allows the surgeons and staff to automatically adjust the gas flow without relation to the wattage. This can be used as needed, but do not increase the gas flow above 4 SLPMs during laparoscopic procedures.

Other Tips

**Depth of Penetration:** The depth of penetration with the Argon Beam Coagulator is related to the power setting, the distance from the tip of the electrode to the tissue, and the duration that the argon beam coagulator is held in one place. Surgeons use their own discretion with regard to these variables to achieve the desired clinical effect.

**Turning Gas On & Off:** Be sure to turn the gas on when setting up the generator, and turn it off when the procedure is completed. If a tank is not turned off, the gas can leak out slowly. Turning off the gas prevents the tank from being empty during emergencies.
Argon Beam Coagulation: Patient Benefits and Safety
Learning Objectives

• Explain the scientific principles supporting ABC
• Identify the properties of argon gas
• Describe the tissue effects related to ABC
• Differentiate patient benefits of using ABC from conventional electrosurgery
• Discuss considerations important to safe patient care during ABC
Full-Function Generator with an Advanced Argon Beam Coagulator
Argon Beam Coagulation is a gas-assisted coagulation method involving the transfer of electrical energy in a gas stream from an electrode to the tissue.
achieve.
Impossible or difficult to
cogulation was previously
allows for coagulation where
directly on the tissue. This
that energy can be applied
ABC clears blood from the tissue so
Cost savings
Reduced surgical time
Reduced tissue carbonization
Reduced surgical plume
Rapid hemostasis
Hemorrhage
Reduced risk of secondary hemorrhage
Reduced blood loss
Decreased healing time
Reduced thermal penetration
Superficial coagulation
Secure pliable eschar
Improved visibility of tissues

Advantages of ABC
ABC Blows Away Fluids

- Decreases healing time
- Adjacent tissues
- Reduces thermal penetration to
- Thin layer of eschar securely anchored
- Rapid hemostasis
- Better visibility of targeted tissue
and risk for adjacent thermal damage.

Lower temperatures reduce thermal spread.

ES Coag = 220°C

ABC = 110°C

Temperature at Application
Argon is readily available.

Argon is inexpensive.

Argon is readily purged from the body.

Argon is easily ionized.

The tissue and reduces smoke plume.

Which reduces carbonization of field.

Argon from the immediate surgical.

Argon is inert, therefore it displaced.

Argon Gas
ABC Technology
Procedural Advantages

- ABC proved to be advantageous for liver transplant, trauma, thoracic, and head and neck surgeries
- In head and neck cases,
  - Blood loss was reduced by 50%
  - Operative time was reduced by 33%
    (particularly beneficial for older patients)
ABC Technology

Procedural Advantages

Partial nephrectomies showed:

- Reduced procedure time by 53%
- Reduced blood loss by 51%
- Reduced tissue damage by 62%
Superior Hemostatic Agent: ABC

- For these 14 cases, ABC was then used and application in 14 of 15 cases achieved hemostasis in less than 1 minute.
- Other modalities (lasers, sutures, and topical agents) failed to coagulate after 3 minutes of application in 15 of 15 cases.
- ABC coagulated 18 of 18 splenic lacerations in less than 1 minute.
- ABC coagulated hepatic lacerations in 25 of 25 cases.
ABTechnique

- Do not allow the nozzle to glow red quickly.
- Don’t jerk or move backwards.
- Don’t drag the tissue.
- Do not touch the tissue.

Pass forward-moving target site with one steady side-to-side sweeping motion.

Try to coagulate the area at ~45° angle.

Use a slow and steady side-to-side motion.

Keep the nozzle ~1 cm from tissue.
Awareness of Patient Safety During Application of ABC

- Institute all safety activities associated with monopolar energy
- Be sure to use an appropriate size dispersive electrode
- Follow AORN Recommended Guidelines for dispersive electrode applications
Monitor pneumoperitoneum pressures

Always:

- Actively vent during laparoscopic procedures
- Actively vent during laparoscopic procedures

Laparoscopy

Use more than 4 slip of argon during

Bury the nozzle in tissues

Use the nozzle to probe tissues

Never:

3 mm or for use in the uterine cavity

Not recommended for vessels larger than

Safety Measures
Use a Holster
Purge the system before use.
Deactivate the ICD before using ESU.
Available
Have a pacemaker programmer unit
Have a defibrillator in the room
Provide continuous ECG monitoring
Consider bipolar electrocautery
Interscintig the pacemaker or leads
Avoid electrical energy from contact pacemaker manufacturer
Pacemaker and ICD Patients
PK Plasmakinetics

PK is short for Plasmakinetics. “Plasma” in the name Plasmakinetics pertains to the plasma that is formed on the dedicated resection loop for turps, or for removal of bladder tumors. Plasma forms on the loop because of the use of saline, which is conductive, and is heated to very high temperatures. The plasma is localized on the loop, which does the transaction and cauterization of tissue. It is important to note that the saline in the prostate or in the bladder does not become hot.

In regards to PK devices used for open general surgery cases i.e.: cholectomies and GYN cases i.e.: TAH’s (Total Abdominal Hysterectomies), or urology for open prostatectomy’s or open hand assist nephrectomies, there are many devices. Most devices are commonly used in laparoscopic GYN procedures such as LAVH’s, LSH’s and LTH’s.

The PK energy in the Gyrus generators works using a low voltage with a maximum peak voltage on coag of 170 volts. The plasma Gyrus PK electrical cutting instrument operates at a minimum of 380 volts. An example of these instruments are the Omni, Plasma J, PK needle and Plasma spatula and the Plasmasord morcellator device.

What is the significance of a VP setting? VP stands for vapor pulse. PK is advanced pulsed bipolar electrosurgery. The energy is delivered to the tissue and then the generator shuts down to allow the tissue to cool and form what is called “vapor pockets”. The tissue is re-read by the generator and another prevent of energy is delivered followed by another shut off period. This happens very quickly. The result of cooling and re-reading the tissue allows the surgeon to apply just enough energy to be hemostatic but not enough that would cause excess burning of tissue.

PK technology provides surgeons with unique RF energy to seal, transect, coagulate, dissect, and mobilize tissue. All with precision and control from a single workstation. PK technology delivers a proprietary RF energy waveform to create a broad range of tissue effects for a multitude of surgical applications. PK provides advanced coag and cutting with superior hemostasis, delivering minimal amounts of energy to achieve the desired
tissue effect. PK delivers the desired result with minimal thermal spread and virtually no sticking or charring.
Three Uniquely Designed PlasmaCision Instruments for all your Surgical Needs

**PKS™ OMNI™**
- Advanced bipolar coagulation and cutting reduces OR time
- True bipolar cutting for fast, precise tissue transection
- Dual action jaws facilitate mechanical dispersion
- Improved tip design for spot coagulation and improved grasping
- For laparoscopic and open procedures

---

**PLASMA J-HOOK™**
- Provides rapid hemostatic cutting
- Simultaneously cuts and coagulates
- Excellent for dissection and mobilization
- For laparoscopic and open procedures

---

**PLASMAPATULA™**
- Provides rapid, controlled cutting
- Excellent for spot coagulation
- For laparoscopic and open procedures

---

The Only Techno Simultaneous Co
PlasmaCision™ the latest advancement in tissue coagulation and cutting.
Compared to the speed, safety and
True Bipolar Cutting
PlasmaCision™ utilizes unique bipolar technology.
Versatility
PlasmaCision™ offers unmatched versatility designed for all your surgical needs. It is surgeon optimal control.

Seven Instruments
PK Technology

**PKS CUTTING FORCEPS**
- Offers precise tissue transection with minimal risk of tissue damage
- Universal use for various surgical procedures

**PKS NEEDLE**
- Provides secure needle control and retraction

**PKS LIONS™ DISSECTING FORCEPS**
- Unique design for secure grasping and dissection
- Ideal for delicate tissue manipulation
VEssel SelAing Using (PK) Plasmakinetic Pulsed Bipolar System

PK Open Forceps  Study Results

Default Setting Used  VP2 60

One Energy Application

Type of Tissue—Porcine Carotid Arteries, Femoral, Iliac, Axillary and Renal Arteries.

Number of Vessels Sealed—116

Criteria for Success; 300 MM HG for 10 Seconds

Vessel Size; See Table One  4MM, 5MM, 6MM, 7MM 8MM, 10MM.

Success Rate: 95.5%

Maximum burst pressure testing on sixteen vessels ranging in size 5MM, and 6MM. End point burst pressure ranged from 565 to 1934MM HG.

Thermal spread  0.4MM to 2.3MM away from the closure sites
Introduction

Recently, Gyrus Medical improved their Plasmakinetic™ (PK) generator for its Saline TUR system. The system enables a traditional TURP to be done with saline irrigation as opposed to glycine. This report describes an overview of the capabilities of the improved system.

Patient History

A 73 year old male with a long history of obstructive voiding symptoms was reluctant to have surgery, and had been on multiple trials of several alpha blockers over the past several years. The patient also had a history of recurrent bladder stones which were treated with electrohydraulic lithotripsy in the past. The patient was now seen in urinary retention after failing a voiding trial. The patient was also noted to have several large bladder stones present. Digital rectal exam revealed a prostate of approximately 40 grams. Pre-operative cystoscopy revealed tri-lobar hypertrophy with prostatic length of 4-5cm and several moderately sized bladder stones.

Materials and Methods

The patient underwent a resection utilizing the PK w/SuperPulse System. The system consisted of a new generator, a Gyrus resectoscope, and a Gyrus PK Super-Loop. The system uses bipolar technology to create a plasma corona around the loop which vaporizes tissue it comes in contact with. The bipolar technology is what allows the entire procedure to be done using saline as an irrigant. The generator recognizes the vaporization device via its "plug and play" programming. Once connected, the generator automatically goes to preprogrammed settings (160 watts in cutting and 80 watts for coagulation). These also can be altered by the physician if desired. Resection is performed exactly the same way that a traditional TURP is performed. Resection time was 100 minutes with negligible blood loss. The patient was placed on continuous bladder irrigation overnight. This, and the catheter were discontinued in the morning, the patient voided, and was discharged.
Results

The patient is voiding well one month after the procedure. His AUA symptom score is 4. He has had no complications and is quite satisfied with his outcome.

Discussion

Over the past decade there has been a rapid rise in the number of "minimally invasive procedures" for the treatment of benign prostatic hyperplasia (BPH). These have all sought to improve voiding with less complications than a traditional TURP, the original minimally invasive treatment for BPH. Although each has had some success, as yet, none have been able to match the efficacy of the TURP, which remains the "gold standard". However, these studies have increased the awareness of the potential complications of TURP. The 2 most severe of these complications are bleeding and absorption of the irritant glycine leading to the aptly named "TUR syndrome". Although these complications are rare, as the number of TURPs done in training decreases the potential for prolonged resection time increase, thereby increasing the complication risks.

With this in mind we investigated the use of the Gyrus Saline TURP in a residency training program. The original Gyrus generator was used, and it proved several things. First, good hemostasis was provided, and second, that there was no change in serum electrolytes despite prolonged resection times.

The original Gyrus PK generator system for TURP was hampered by a delay seen between stepping on the foot pedal and generation of current at the loop to resect tissue, which led to a learning curve. The new PK w/SuperPulse generator seems to have solved these problems. In the last three TURPs done with the new generator, resection time decreased and there was no "kick-off" delay identified, with immediate response of the loop to foot pedal activation. Saline was not warmed and the bladder neck could be easily resected similar to the traditional loop. The learning curve that was needed for the older system was no longer necessary and therefore the ability to transfer from the traditional TURP to the saline TURP is now seamless.

With this in mind, I have begun using the PK w/SuperPulse for Saline TUR system to resect bladder tumors, allowing for complete conversion to the Gyrus system allaying the cost of the need for several resection systems.
Clinical Case Report

Saline Transurethral Resection of the Prostate (TURP) for BPH Utilizing the Gyrus PlasmaKinetic Tissue Management System with SuperPulse
Rodney U. Anderson, MD FACS Professor of Urology Stanford University School of Medicine

Introduction

While transurethral resection of the prostate has represented the gold standard of surgical management for lower urinary tract symptoms due to benign prostatic hypertrophy for many years, little advance in technique has been introduced until recently. While the optics and instruments have been refined, the actual tissue resection has relied on monopolar resection with current conducted through the body. The Gyrus PlasmaKinetic™ (PK) Tissue Management System with SuperPulse was developed to take advantage of the physicochemical properties of saline solution when superheated. Using bipolar electrical current, an ionized plasma corona of energy is created which instantly vaporizes tissue entering its margins of active force. The low thermal mass of the plasma contains the spread of tissue desiccation and coagulation creating a precise, clean resected plane. This Saline TUR system also provides rapid simultaneous hemostasis of small vessels as the tissue is removed, limiting the interference of view and blood loss, providing a faster, safer procedure.

Case Reports

Two gentlemen with BPH and consequent urinary retention are presented to describe the usefulness of the latest generation of Gyrus technology, including a new generator system and loop configuration.

Patient #1

Patient CP was a 72-year-old male who had been experiencing lower urinary tract dysfunction relatively recent with urgency, voiding every hour, and dribbling flow. His serum creatinine was 1.0 and PSA was 1.2. He had GERD with Barrett’s esophagus and noted worsening symptoms taking terazosin 2-5 mg. The patient had aortic stenosis, DJD, hypertension, and was recently diagnosed with laryngeal carcinoma requiring local radiation. At the onset of radiation treatments the patient took some Alka-Seltzer with pseudoephedrine component and developed urinary retention. He was seen in the emergency department and found to have 1700 cc in the bladder. This suggested that he had suffered progressive dilation of the bladder and gradual urinary retention. Multiple attempts at removing the catheter over several weeks with voiding trials failed. During this time he was also noted to have urinary tract infection symptoms and bacteriuria consisting of Stentotrophomonas maltophilia growing at >105/cc.

A urodynamic study was performed to help assess his lower urinary tract physiologic status. Ultrasound revealed a 63 gram prostate that measured 5.7 cm in the transverse dimension, 3.8 cm in the anterior-posterior dimension and 5.2 cm cranio-caudal dimension. The patient had first sensation of bladder filling at 293 cc and was urgent at 384 cc. He was unable to recruit a detrusor contraction and unable to void with valsalva. The decision was made to reduce the prostate resistance to its minimum (radical transurethral resection of the prostate) to offer him the best opportunity to valsea or Crede’ void with his underactive bladder function.
The patient was taken to the operating room and, under regional anesthesia, the TURP was performed. The complete resection of the prostate was enhanced by the Gyrus system because of the compact size of the loop, excellent coagulation, and the ability to carefully resect the apical tissue and remove all tissue to the capsule because of the enhanced firing using the new generator. The patient lost less than 100 cc of blood during the procedure and the catheter was removed the next day. Unfortunately, because of his aortic bladder and our reluctance to allow him to perform forceful valsalva he was unable to void. Therefore the catheter was left in place 10 days. When the patient returned to clinic he was filled with 280 mls and was able to void 280 mls with a comfortable valsalva maneuver. There was no urinary incontinence.

Patient #2

This healthy 63-year-old man was referred to the urology clinic in December 2002 because of lower urinary tract symptoms (LUTS) consisting primarily of urgency, frequency and nocturia. He noted these symptoms for the past year. Serum PSA was 1.7. The gland was enlarged by DRE. His AUA symptom score was only 11. The patient had been tried on terazosin alpha blocking agent, but had adverse side effects and was changed to tamsulosin. He had no improvement in his symptoms after 30 days of drug. We performed uroflowmetry that demonstrated voiding of 289 mls, a peak rate of 15 mls/sec, and a post-void residual urine volume detected by bladder ultrasound scan of 110 mls. It was thought he may have overactive bladder with detrusor instability secondary to outlet obstruction and a urodynamics study was ordered.

The patient was not studied until 3 months later and was complaining of nocturia 5 to 6 times at night and urgency/frequency during the day. He was noted to have stable filling with first sensation at 290 cc and a cystometric capacity of 345 cc. Upon the command to void he had a maximum detrusor pressure of 70 cm H2O and voided at a peak rate of 10 cc/sec to completion. Because of his irritable bladder symptoms he was treated with low-dose oxybutynin at 2.5 mg tid and scheduled for follow-up evaluation. The patient converted medication to 5.0 mg bid and complained of dry mouth and no improvement in symptoms. A repeat post-void residual urine check by bladder scan ultrasound showed a persistent 169 cc residual. In July of 2003 cystoscopy was performed and bilobal hypertrophy was noted as well as 2+ trabeculation of the bladder wall. TURP was discussed as well as intermediate therapy using radiofrequency thermal needle ablation. It was felt that this man's irritative symptoms were a result of high-pressure voiding and secondary hypertrophy of smooth muscle with incomplete bladder emptying. The objective was to completely eliminate any prostate resistance. Using the accuracy of the Gyrus PK Tissue Management System with SuperPulse and room temperature saline, a complete resection was accomplished with essentially no blood loss. The catheter was removed and patient discharged the next day with good flow. Follow-up urodynamics and symptom survey is planned at 3 months.

Discussion

The number of transurethral resections of the prostate has dropped dramatically in the last decade because of medical therapy and less invasive technology to reduce bladder outlet resistance due to BPH. The patient perception of cutting out prostate tissue with consequent blood loss, possible sphincter damage with urinary incontinence, and possible impotence has driven the medical therapy in the direction of less invasive tissue ablation. Thermal therapy, prostatic stents and trials of ethanol ablation are examples of these attempts to reduce symptoms. While the outcomes of this minimally invasive therapy are respectable, duration of benefit is unknown and the ability to eliminate post-void residual urine volumes is marginal in the patient with inadequate detrusor function. This phenomenon applies to a large percentage of the older male patients suffering from BPH symptoms.

Because of the favorable advantages of the Saline TURP I have converted from monopolar technique. The bipolar saline TURP reduces intraoperative and postoperative blood loss by 50% and the excellent visualization produced allows our junior residents to have more confidence in performing the procedure. The technology allows a safer, more accurate resection due to less blood loss. We have less conduction of current into the obturator nerve and less concern for the TUR absorption syndrome because we are using saline. The recent introduction of the PK w/ SuperPulse generator system provides rapid-firing of the corona and less need to heat the saline or reduce irrigation flow for efficiency of resection. Internal software programming eliminates any hesitancy of the loop to fire. A wider loop configuration with alloy enhancement provides a stronger wire for large glands and provides a wider coagulation surface to target any bleeding vessels. These benefits have reduced hospital stay from an average of 2 days to 1 day with 24-hour catheter removal, and many patients could easily be discharged from the operating room as outpatients after the surgery.
Introduction

The key to safe and effective laparoscopic surgery is the ability to hemostatically dissect and divide tissue in a consistent, controlled manner. The objective of every laparoscopic surgeon is to use a system that provides the greatest level of safety, efficiency and cost-effectiveness. Since the introduction of operative laparoscopy, various energy sources have been examined and utilized, resulting in varying degrees of success. Gyrus Medical, Inc. has developed the PlasmaKinetic® (PK) Tissue Management System that utilizes time-honored safe bipolar electrical energy with "plug and play" programming. The Gyrus PK System technology and instrument designs offer surgeons the ability to best meet their surgical needs with the safety, efficiency, and cost-effectiveness they have come to expect.

1. PK Zip L-Hook dissecting tissue

2. PK Cutting Forceps approaching vascular pedicle

Patient History

The patient is a 31-year-old caucasian female who was evaluated for surgical management of her morbid obesity, with an excess of 100 pounds over her ideal body weight for more than 8 years. She had tried multiple weight loss programs, both supervised and unsupervised, without long-term success. As is commonly seen, this patient was able to lose some of her weight through these programs, but would rapidly gain the weight back. At 5'3" and 240 lbs, her calculated body mass index was 43. She had hypertension as a major co-morbid condition. Her past history was significant only for a previous laparoscopic cholecystectomy and tubal ligation. With the obvious importance of weight control for health reasons, the patient presented for gastric bypass surgery. Upon evaluation and counseling, it was determined that she fully understood the implications of the surgery and its potential risks and associated complications. This patient was an excellent candidate for a laparoscopic Roux-en-Y Gastric Bypass, which was conducted in May 2003.

Materials and Methods

The patient was approached utilizing a modified procedure as described by Wittgrove and Clark. All energy-based dissection and transection of tissues was performed using the Gyrus PlasmaKinetic Tissue Management System.
No other energy source was required for the case, further contributing to efficiency and cost-effectiveness. Given that the formation of the gastric pouch tends to be the most difficult portion of the procedure, the pouch was created first. All fine dissection and gaining access to tissue planes were performed using a 45cm length, 5mm shaft, PK Zip L-Hook™ Probe, a bipolar hook device that dissects, hemostatically coagulates and divides tissues, irrigates and has suction.\(^{(1)}\) Larger vascular tissue pedicles were coagulated and transected using a 45cm length, 5mm shaft, PK Cutting Forceps, another multifunctional device that grasps, dissects, coagulates, transects, and retracts tissues.\(^{(2)}\) Since the PK System is bipolar and maintains controlled and precise delivery of the electrical current, lateral thermal spread is minimized and injury from stray current is virtually eliminated. The devices were used safely to coagulate and divide tissues directly adjacent to the bowel and stomach. Bleeding staplines were easily controlled using the L-Hook.\(^{(3)}\) After the development of the gastric pouch, the Roux limb was constructed and passed in a retro-colic, retro-gastric fashion. The gastro-jejunostomy was created using the technique described by Wittgrove and Clark.

### Results

The procedure took approximately two hours to complete, with an estimated blood loss of about 100cc. The patient underwent a routine post-operative course and was discharged the morning of the third post-operative day, returning to work within 10 days. Her post-operative UGI series demonstrated a pouch of approximately 10cc with no evidence of leak or obstruction.

### Discussion

The Gyrus PK Tissue Management System, with automatic impedance monitoring, and the PK Zip L-Hook Probe and PK Cutting Forceps were used in this procedure. A variety of other Gyrus instrument designs may also be used with the system, based on the operative preference of the surgeon. The pre-programmed, pulsed delivery of energy offers safe coagulation of tissues with minimal lateral thermal spread, sticking, and coagulum formation. Precise delivery through the instrument tip design allows the surgeon to use it in close proximity to heat-sensitive structures. The PK L-Hook is an ideal instrument for fine dissection, gaining access to the lesser sac, creating openings into the bowel, and hemostatically controlling stapleline bleeding. The PK Cutting Forceps performs very well in dividing the vascular pedicles as well as transecting the mesentery. As normal saline enhances the flow of current, the Gyrus PK System can be used in a “wet” environment, which is especially useful when using irrigation to find small bleeding points.\(^{(4)}\) The Gyrus system maintains all the benefits of electrosurgery without unintentional tissue damage and other safety issues seen with monopolar electrosurgery. Since the Gyrus PK System is complete and no other energy source is required, the utilization of this system can significantly contribute to reducing overall surgical costs.


PlasmakinetiC is a registered trademark. Zip L-Hook is a trademark of Gyrus Group PLC. All patents pending.
Glossary

A

Ablation: removal of a part, pathway, or function by surgery, chemical destruction, electrocautery, or radiofrequency.

Active electrode: An electrosurgical instrument or accessory that concentrates the electric (therapeutic) current at the surgical site.

Adapter: a connector between incompatible plugs (connectors) and jacks (receptacles) that allows correct connection and completion of the electric circuit.

Alternate burn site: An electrosurgical burn at a site on a patient, other than the intended surgical site or the patient return electrode, caused by current division. Mishandling of an active electrode can also cause an alternate site burn.

Alternating Current (AC): A flow of electrons that reverses direction at regular intervals.

Ampere (A): the unit of measurement for electric current. One ampere (A) equals $6.242 \times 10^{18}$ electrons per second.

Amplitude: The peak to peak movement of the end of the vibrating tip of an ultrasonic surgical aspirator.

Aspiration: The removal, by vacuum, of fragmented tissue and irrigation solution from the surgical site.
Autobipolar: A mode that a user can select to allow automatic start and/or stop of the bipolar current bases on the impedance of the tissue between the tines of the bipolar instrument.

B

Bipolar electrosurgery: an electrosurgical procedure in which current flows between two electrodes (tines) that are positioned around tissue to create a specific surgical effect. Current passes from one electrode, through the desired tissue, to the other electrode, thus completing the circuit without entering any other part of the patient’s body.

Bipolar instrument: An electrosurgical instrument or an accessory that incorporates both active output and patient return functions at the surgical site.

Blend: A waveform that combines features of cut and coag waveforms; current that cuts tissue with varying degrees of hemostasis.

Buzzing the hemostat: A surgical technique for coagulating a bleeding vessel; the active electrode is touched to a hemostat which in turn delivers the current through the hemostat to the
target tissue. This is not a recommended technique.

C

Capacitance: The property of an electrical circuit that enables it to transfer an electrical charge from one conductor to another even when separated by an insulator.

Capacitive Coupling: The condition that occurs when an electrical charge is transferred from one conductor (the active electrode), through intact insulation, into adjacent conductive materials (tissue, trocars, wires, etc.)

Capacitive pad: A patient return electrode that contains a nonconductor that allows the displacement of electric charges however does not allow the flow of electric current.

Cavitation: The sudden formation and collapse of low pressure bubbles in liquids by mechanical forces; example those that are formed by a boat (marine) propeller.

CEM System: The CUSA Electrosurgical Module accessory
nosecone in combination with a Force FX generator. This system provides electrosurgical current to the ultrasonic tip.

Circuit: The path along which electricity flows.

Coag (coag mode): A high voltage, intermittent waveform optimized for electrosurgical fulguration, desiccation, or both.

Coagulation: The clotting of blood or destruction of tissue with no cutting effect; electrosurgical fulguration, desiccation, or both.

Coblation: A registered trademark of Arthrocare that means “Controlled ablation”.

Conductor: A substance that carries electricity.

Crest factor: The ratio of the peak voltage of a waveform to the root mean square (rms) voltage; an indication of the degree of fulguration provided by the waveform. Waveforms generally with high crest factors provide a high degree of fulguration with minimal cutting effect.

Cross coupling: The transfer of power between two adjacent circuits.

Current: The number of electrons or ions past a given point per second and between two points, measured in amperes (amps, A).

Current density: The amount of current flow per unit of surface area; It is expressed in amperes per unit area. Current density is directly proportional to the amount of heat generated.

Cut: A low voltage, continuous waveform optimized for
electrosurgical cutting (vaporization of tissue).

Cutting: Is the electrosurgical effect that results from high current density in the tissue causing cellular fluid to turn to steam, this in turn bursts the cell walls and disrupts the structure. Voltage is low and the current flow is high.

**D**

Default (default setting): A mode or power setting automatically selected when you turn the system on.

Desiccation: The electrosurgical effect of tissue dehydration and protein denaturation caused by direct contact between the electrosurgical electrode and tissue. Desiccation involves lower current density than cutting.

Direct Coupling: The condition that occurs when one electrical conductor (the active electrode) comes into direct contact with another secondary conductor (scopes, graspers). Electrical current will flow from the first conductor into the secondary one and energize it.

Direct Current: A flow of electrons in one direction only; for example, the flow of electrons from one battery terminal to another.
Duty cycle: The service required under conditions of load and rest; typically expressed as on time and off time.

Electric Field: An electric field develops between two points when a voltage difference is applied. Ohms law can be used to determine the electric field in tissue.

Electrocautery: The process of cauterizing or removing tissue with a device consisting of a hot piece of metal heated by a high-voltage, DC or high-frequency alternating current passed through an electrode. The devices may produce very high temperatures and scald or burn tissue on contact.

Electrode: A conductor that transmits or receives electrosurgical current.

Electron: A negatively charged subatomic particle.

Electrosurgery: The passage of high frequency electrical current through tissue to create a desired surgical effect. The process uses an electrical device powered with high-frequency alternating current passed through an electrode. The devices may produce very high temperatures and scald or burn tissue on contact. This will cauterize or dissolve or otherwise remove tissue.

Electrosurgical burn: Tissue destruction caused by the concentration of high frequency electric current, including the
surgical effect by usually referring to accidental injury.

Electrosurgical circuit: The path traveled by the therapeutic current from the generator to the active electrode, through body tissue, to the return electrode, and back to the generator.

Electrosurgical Current: See radio frequency (RF).

Electrosurgical unit (ESU): The electrosurgical generator.

Endoscope: A fiber-optic tube used to examine body cavities or organs.

F

Frequency: The rate at which a cycle repeats itself; with reference to electrosurgery, the number of cycles per second that current alternates; with reference to ultrasonic surgery, the number of cycles per second that the tip vibrates.

Fulguration: Using electrical arcs (sparks) to coagulate tissue. The sparks jump from the electrode across an air gap to the tissue.

G

Generator: The machine that converts low frequency alternating current to high frequency electrosurgical current (electrosurgical generator, ESU).

Ground: The universal conductor and common return point for
electric circuits (earth ground).

Hemostasis: Coagulation; in electrosurgery, heat produced by the electrosurgical current applied to a transected blood vessel to close the vessel and stop bleeding.

Hemostat: An instrument used to clamp a bleeding vessel to stop blood flow.

Hertz (HZ): The unit of measurement for frequency, equal to one cycle per second.

Holster: An insulated receptacle used on the sterile field for storing electrosurgical active electrodes when not in use.

Impedance: Resistance to the flow of alternating current, including simple direct current resistance and the resistance produced by capacitance or inductance. The resistance of a material is its tendency, measured in ohms, to oppose the flow of electric current or, viewed another way, the material's tendency not to conduct the current.

Insufflation: The introduction of a gas into a body cavity (e.g. carbon dioxide in to the abdominal cavity during laparoscopic procedures).
Insulation failure: The condition that occurs when the insulation barrier about an electrical conductor is breached. As a result, current may travel outside the intended circuit.

Insulator: A substance that does not conduct electrical current.

Isolated output: The output on an electrosurgical generator that is not referenced to earth ground.

L

Laparoscopy: The examination of the contents of the peritoneum with a laparoscopic (scope) instrument.

Laparoscopic mode (lap mode): Mode used during laparoscopic procedures.

Leakage current: Current that flows along an undesirable path, usually to ground; in isolated electrosurgery, radio frequency (RF) current that regains its ground reference.

LLetz/Leap: Loop electrosurgical excision procedure for the removal of the transformation zone of the cervix.

Load: The source of electrical impedance in a circuit that uses electrical energy for some purpose; in electrosurgery, the body tissue involved in the electrosurgical circuit.
Macrobipolar: An electrosurgical waveform used in bipolar surgery, with higher voltage and power that standard bipolar electrosurgical waveforms. It is intended for bipolar cutting or rapid coagulation.

Microbipolar: A low voltage bipolar waveform intended for precise desiccation.

Monopolar electrosurgery: A surgical procedure in which only the active electrode is in the surgical wound; electrosurgery that directs current through the patient's body and requires the use of a patient's return electrode.

Monopolar instrument: An electrosurgical instrument or accessory that delivers Monopolar current to target tissue to achieve a desired surgical effect.

Monopolar output: Grounded or isolated output of an electrosurgical generator that directs current through the patient to a patient return electrode.

Necrosis: Localized tissue death in response to disease or injury.
Ohm (Ω): The unit of measurement for electrical resistance; volts per ampere.

Ohm's law: Defines the relationship between current (I) and Voltage (V) or the potential difference.

Output: The current, voltage, or power produced by an electrical device, such as an electrosurgical generator (ESU).

Pad site burn: An electrosurgical burn caused by excessive current concentration, over time, at the patient return electrode.

Patient return electrode: A conductive plate or pad (dispersive electrode) that recovers the therapeutic current from the patient during electrosurgery, disperses it over a wide surface area, and returns it to the electrosurgical generator. Plates are usually rigid and consist of metal or foil covered cardboard; pads are usually flexible. Pads may also lie on the bed and patients lay on the pad.

Peak Voltage: The maximum voltage of a waveform measured from its maximum positive value.

Power: The amount of energy used per (per unit of time) second, expressed in watts. One watt is one Joule delivered in one second. Power can be calculated by the product of voltage and current.
Radio Frequency (RF): The high frequency current used in electrosurgery; which is above 100 kHz.

Resistance: The lack of conductivity or the opposition to the flow of electric current, measured in ohms.

RMS voltage: root mean square voltage; the effective average voltage (the amount of voltage present at any instance) of a waveform.

Self-limiting power: A performance feature of generators that limits power output to certain tissue resistance levels.

Short circuit: The status of an electrosurgical circuit when the generator is activated and the active electrode directly touches the return electrode; an electric circuit with no load and essentially has no resistance.

Spark: A discharge of electric current across an air gap which is essential to electrosurgical cutting and fulguration.

Spray: A Coag mode that affords optimum fulguration; using a spark gap technique with superficial tissue penetration over a wide area.
Suction coagulator: An instrument that incorporates an active electrode and suction to provide coagulation and evacuation of blood either independently or simultaneously.

T

Tissue strength: The ability of tissue with greater qualities of collagen, elastin, or both to resist fragmentation.

Tissue Impedance: Tissue refers to the electrical resistance of the particular type of tissue being treated by the surgeon. The impedance of the tissue is inversely related to the “conductivity” of the tissue, which is a more fundamental property of each type of tissue.

Transformer: In electrosurgical generators, electrical circuitry that changes the ratios of current to voltage, converting low voltage, high current waveforms to high voltage, low current waveforms.

U

V

Volt (V): The unit of measurement for electric potential (voltage).

Voltage: The force that pushes electric current through resistance; electromotive force or potential difference expressed in volts.
Watt (W): The unit of measure of power; work per second.

Waveform: A graphic depiction of electrical activity that can show how voltage varies over time as current alternates.