

AST Standards of Practice for Use of Electrosurgery

Introduction

The following Standards of Practice were researched and written by the AST Education and Professional Standards Committee and have been approved by the AST Board of Directors. They are effective April 16, 2012.

AST developed the following Standards of Practice to support healthcare facilities (HCF) reinforce best practices related to electrosurgery safety in the perioperative setting. The purpose of the Standards is to provide an outline that surgical team members can use to develop and implement policies and procedures for electrosurgery safety. The Standards are presented with the understanding that it is the responsibility of the HCF to develop, approve and establish policies and procedures for electrosurgery safety, according to established HCF protocols.

Rationale

The following are Standards of Practice related to electrosurgery safety in the perioperative setting. It is recommended that electrosurgery safety practices be meticulously followed by all surgical personnel, who are involved in the use of the various types of electrosurgery in order to protect themselves and the patient. Risk factors identified with the use of electrosurgery include fire, patient burns, surgical personnel injuries and biological hazards, such as plume, which are addressed by safety standards. Several organizations have been involved in the development of standards related to the use of electrosurgery, including the Association for the Advancement of Medical Instrumentation (AAMI), American National Standards Institute (ANSI), American College of Surgeons (ACS), US Department of Health and Human Services, ECRI, National Fire Protection Association (NFPA), National Institute for Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), Pennsylvania Patient Safety Authority, The Joint Commission as well as the Canadian Centre for Occupational Health and Safety (CCOHS). Surgical personnel should be familiar with the safety standards of these organizations, including implementation of safety practices. The following Recommended Standards of Practice are broad based and not intended to replace the electrosurgery standards established by the previously mentioned organizations; rather, these Recommended Standards serve to reinforce the industry-established standards with a focus on the role of the surgical technologist and reference those documents that address electrosurgery safety in the surgical environment. All members of the surgical team should be involved in the process of developing and implementing HCF policies and procedures for electrosurgery safety.

Standard of Practice I

A representative of each surgical team profession (surgeon, anesthesia provider, Certified Surgical Technologist (CST), and registered nurse (RN), should be involved in the evaluation and purchase of electrosurgical units (ESU) and accessory items.

1. The ESU and accessory items (active electrode, patient return electrode (PRE), foot pedal) should be evaluated for purchase by applying the patient and surgical personnel safety standards as established by AAMI.⁴
 - A. The evaluation should include ensuring all currently recommended equipment safety features are incorporated into the technology of the equipment to prevent patient and surgical personnel injury.
 - (1) The ESU and accessory items should be evaluated to confirm that all current technologies that prevent capacitive failure, direct coupling and insulation failure are incorporated.⁴ This includes evaluation of the activation tone control.
2. When evaluating the ESU and accessory items to purchase, the surgical team should recommend that the same model of ESU and accessory items be purchased to be used throughout the HCF in order to standardize the equipment.²⁸
 - A. Standardization of equipment improves the ability of biomedical technicians to calibrate and repair the equipment; contributes to improved training and continuing education of surgical personnel on one ESU model; surgical personnel develop in-depth knowledge of and apply consistent skills on a daily basis on the use of one ESU model to decrease the risk of user error.

Standard of Practice II

Surgical technologists should complete continuing education to further their knowledge and skills in the proper use of the ESU and accessories.

1. CSTs should complete continuing education to demonstrate to peers, other healthcare providers and the public the individual's commitment to providing a high level of quality surgical patient care.⁶
 - A. CSTs should have comprehensive knowledge of the principles of electrosurgery including patient and personnel safety measures in order to reduce the risks associated with the intraoperative use of ESU.
 - (1) CSTs should complete instruction on the proper care, handling and operation of the ESU and accessories items prior to use.⁴³
 - (2) The CST should remain current in their knowledge through completion of continuing education on the role and duties of the CST during an adverse event such as an intraoperative fire or patient burn caused by the use of the ESU, and the intraoperative actions to take to quickly resolve the situation. This includes knowing the HCF reporting procedure for an adverse event.

- (3) If various models of ESU equipment and accessory items are used in the surgery department, the CST should complete training on each model of ESU.²⁸
 - (4) The continuing education should include updates on new technology as it is developed, made available and used in the OR.²⁸
 - (5) The CST should complete training when the HCF purchases new ESU equipment and accessory items or the equipment is updated.
2. CSTs should be evaluated annually on the safe use, handling and operation of the ESU equipment and accessory items.
 - A. The competency of the CST should be documented by the HCF including any remedial training.

Standard of Practice III

When the surgical procedure demands the use of monopolar electrosurgery, the CST should follow the safety principles for the proper placement of a PRE to reduce the patient's risk for perioperative injuries.

1. The PRE should be verified as being a brand/model that can be used with the ESU generator.
 - A. The recommendations by the manufacturer of the ESU generator and PRE should be followed when purchasing the PRE.
2. Prior to placement of the PRE, the patient's skin where the PRE will be placed should be inspected and the condition of the skin documented. Additionally, the amount of hair present should be evaluated and the determination made if it should be removed.^{20,24}
 - A. If the skin presents with cuts, lesions, scars or other types of skin disorders, an alternative site for PRE placement should be selected.
 - B. The skin should be free of skin lotion, blood, prep solution and debris prior to applying the PRE. The PRE must be applied to skin that is dry and clean to assure complete contact with the skin.^{20,43}
 - C. Hair should be removed from the PRE site of placement if it is determined it will interfere with full contact with the skin of the patient.⁵² The hair should be removed according to the *AST Recommended Standards of Practice for Skin Prep of the Surgical Patient*.¹⁰
3. The correct size (neonate, infant, pediatric and adult) of PRE should be selected.
 - A. In some instances, the size of the patient may dictate the PRE size, eg small adult patient may require a pediatric sized PRE.
 - B. The PRE should not be cut or folded in order to change the size.
 - C. Using the correct size promotes complete contact of the PRE with the patient's skin in order to complete the circuit and decreases the size of the current.
4. It is recommended that a single-use PRE be used for all surgical procedures in which monopolar electrosurgery will be employed.
 - A. The single-use PRE should only be used once and properly discarded.

- B. If a single-use PRE must be repositioned, a new single-use PRE must be used.
 - (1) Some of the adhesive backing on the original single-use PRE will be missing, thus not allowing the single-use PRE to properly adhere to the skin of the patient and significantly increasing the risk for a burn to occur.
 - (2) Removal of the original single-use PRE allows the CST to re-inspect the skin to possibly determine the reason for non-adherence and take corrective actions. (**Note:** For purposes of clarity and simplicity, when the abbreviation PRE is used throughout this document, it will be in reference to single-use PRE, and the term single-use will not be repeated).
- 5. Prior to placement of the PRE, the CST should check the expiration date printed on the packaging. If the PRE is outdated, it should be disposed.²⁰
- 6. The PRE package should be opened and applied once the patient is placed in the surgical position.
 - A. The PRE package should be opened when ready for immediate placement on the patient to prevent drying of the adhesive.⁴³
 - B. Upon opening the package, the CST should inspect the PRE for damage, and cracks and dryness in the adhesive.^{18,20,28} If the adhesive is dry, additional conductive gel should never be added by hand to the PRE. Additionally, the cable should be inspected for damage including its connection to the PRE. If a defect is discovered, the PRE should be disposed and a new one obtained.
 - C. Placement of the PRE prior to positioning of the patient can cause dislodgement, gaps or tunnelling effect allowing moisture to collect under the PRE as well as contribute to patient burns due to lack of complete contact with the skin.^{43,49,52}
 - (1) If the patient is repositioned intraoperatively, it is recommended the PRE should be replaced even if visualization seems to confirm complete contact with the patient's skin. Inner non-contact that cannot be visualized could occur upon movement of the patient resulting in increasing the risk for burn.^{18,20,28}
- 7. The CST must follow the patient safety considerations when placing the PRE to avoid patient injuries and burns.
 - A. The PRE should be placed over a large muscle with adequate blood supply on the same side of surgery and as close to the surgery site as possible. Placement of the PRE over bony prominences should be avoided if possible.
 - (1) Water is a good conductor of electricity and most of the body's water is found in muscle (lean mass); adipose tissue which contains little water is a poor conductor of electricity and actually impedes the flow of electricity.¹¹
 - (2) The best site available should be chosen for patients who are suffering from cachexia or other wasting disorders; this may

involve placing the PRE at a distance from the surgical site as well as on the opposite side.

- (3) The normal physiological changes of the skin and muscle mass due to aging must be taken into consideration when choosing a site for the placement of the PRE. Elderly patients often exhibit a loss of skin elasticity and subcutaneous fat and therefore are more prone to skin damage due to pressure.³³
 - (4) Placement of the PRE close to the surgery site allows the electrical current to travel the least amount of distance as possible as well as reduces the risk of the current exiting through an alternative pathway.
- B. The PRE should not be placed distal to tourniquets. Tourniquets close off the blood supply to the extremity which can impede the flow of electricity as well as compromise the skin under the PRE which, upon removal, could injure the skin.
- C. The PRE should not be placed over or near a metal prosthesis, eg total hip prosthesis.
- (1) Scar tissue which forms over and around a prosthesis is a poor conductor of electricity.
 - (2) There are no adverse event reports that have been submitted to the US Food and Drug Administration (FDA) or other state or federal departments as related to skin or deep tissue burns due to heating of the implant. However, it is considered a risk factor that in theory should be avoided by not placing the PRE over or near a metal prosthesis.
- D. When positioning the patient, the CST should assist the surgical team in confirming there is no contact between the patient and metal, eg metal parts of OR bed, metal poles of stirrups, metal on safety straps, and if gown is left in place, the metal snaps on gowns.⁵⁴
- (1) Metal devices can provide an alternate pathway for the electrical current and be responsible for patient burns.
- E. The patient monitoring electrodes, such as ECG electrodes, should be placed as far apart from the surgical site as feasible.⁴³
- (1) Current division is a phenomena when the electrical current divides and follows a path of least resistance in order to complete the circuit. The surgical environment provides many alternate pathways for the electrical circuit, one is patient monitoring electrodes. Instances of burns have been reported at the sites of the electrodes when a grounded ESU has been used.¹⁷ Additionally, due to the focused current concentration, the burns tend to be serious.
- F. The patient's metal jewelry, including body piercings, should be removed in the patient's ward room and safely secured by the HCF.
- (1) Metal jewelry is a risk for patient burns in three ways: direct contact between the active electrode and metal; heat from the surrounding tissue is transferred causing the metal to become hot

- and cause tissue damage; metal can serve as an alternate pathway for electrical current.⁴⁴
- G. When the intraoperative use of needle monitoring electrodes is necessary, bipolar electrosurgery or laser should be used.²⁸
 - (1) Needle monitoring electrodes provide an alternate pathway for the electrical current placing the patient at risk for burns.²⁸
 - H. Tape of any type (eg, paper, silk, cloth, foam elastic) should not be used to anchor the PRE in place. If the PRE dislodges, the surgeon should be notified, the ESU turned off and a new PRE applied to the patient.
 - (1) Tape cannot fully keep the PRE in place and guarantee complete contact of the PRE with the skin.⁵¹
 - I. It is recommended that the PRE not be placed near or over a tattoo, since the tattoo inks contain metals.³⁶
 - (1) There are no adverse event reports that have been submitted to the US Food and Drug Administration (FDA) or other state or federal departments as related to skin or deep tissue burns due to placing the PRE over a tattoo. However, it is considered a risk factor that in theory should be avoided since there have been reported adverse events of superheating of tattooed tissue during magnetic resonance imaging procedures.^{32,46}
 - J. When the CST has applied the PRE, a final visual inspection should be made to confirm full contact of the PRE with the skin. Items to rule out include tunneling, gaps, and pooling of liquids, which can contribute to patient injuries.⁵⁴
8. Patient's who have received preoperative medications are still sensitive to what is occurring in the OR. Since the temperature of the OR is cool, the PRE can be cold. If the patient is receiving general anesthesia, it is recommended that the PRE be applied after he/she is anesthetized. If he/she is receiving local anesthesia, the CST should communicate to the patient that he/she is going to be applying a cold pad so as to reduce the "startle" effect of the patient.³³
 9. PREs should be stored in a dry area of the OR away from liquids to prevent damage.
 10. Liquids, such as skin prep solutions, must not be allowed to pool around or leak under the PRE. The solutions can cause the PRE to fail to completely adhere to the patient's skin, burn the patient's skin due to lengthy contact, and can ignite when exposed to a spark from the active electrode.^{18,33,54}
 11. The PRE should be placed as far away from a hyper/hypothermia device as possible. The cold or heat of the device can affect the adherence of the PRE to the patient's skin.⁵⁴
 12. There are instances of more than one ESU being used at the same time during a surgical procedure. The manufacturer of the ESU should be contacted to confirm the compatibility of the ESUs.
 - A. A PRE should be used for each ESU. The PREs should be placed separately and as close to each separate surgical site as possible to prevent their edges from overlapping.
 13. When removing the PRE, the CST should do so slowly and carefully.

- A. The CST should place gentle opposite traction on the skin at either end of the PRE to smooth out the skin.
- B. The PRE should be slowly removed and not quickly pulled off to minimize skin irritation or tears due to the adhesive.²⁹ This is particularly important for patients with dry, fragile skin.²⁹

Standard of Practice IV

The CST should follow the safety principles for the proper care and handling of the electrosurgical unit (ESU) to reduce the patient's risk for perioperative injuries.

1. The CST should read and be familiar with the information provided in the manufacturer's equipment manual in order to safely operate the ESU.^{4,43}
 - A. The HCF should have the manufacturer's equipment manual easily accessible to all surgery personnel; it is recommended the manual be placed in a waterproof cover and attached to the ESU.⁴³
2. The ESU should be secured on a cart or a shelf.
 - A. A cart should be a solid structure that weighs more than the ESU and large enough that the edges of the ESU do not hang over the sides to prevent leaning or falling over.
 - B. A shelf should be a solid structure that does not bend when the ESU is placed on it and large enough that the edges of the ESU do not hang over the sides.
3. The ESU must be protected from liquids in order to prevent equipment malfunction or electrical hazard.⁴³
 - A. The first scrub CST should not use the ESU as a table for opening his/her sterile gown and gloves. After performing the surgical scrub and when grasping the gown, water from the arm could drip onto the ESU causing it to malfunction.
 - B. Liquids should not be placed near or on top of the ESU.
4. When not in use, the foot pedals with cords should be placed in a secure area to prevent damage. When in use, the foot pedals should be placed inside a waterproof, transparent, disposable cover to protect against body fluids and irrigating solution spills.
5. The ESU should be inspected and tested before use according to the manufacturer's instructions.²⁰
 - A. The warning alarm should be tested. It will activate when a PRE is not connected to the ESU.
6. Warning alarms and activation tone control should be audible at all times during use of the ESU.
 - A. Warning alarms alert the surgical team to possible malfunctioning of the ESU or electrical circuit.³⁴
 - B. The ESU activation tone control alerts the surgical team that the active electrode is in use. The tone also alerts the team to the inadvertent activation of the active electrode (eg member of the sterile team leans on active electrode, heavy surgical instrument is placed on the active electrode) in order to prevent injury to the patient and/or sterile team member or drapes from catching fire.

- C. When performing surgery on a conscious patient, the various noises they may hear in the OR should be explained to the patient, including the ESU activation tone control to prevent the patient from being startled.
 - D. If music is played during the surgical procedure, it should not be so loud as to prevent hearing the ESU audible alarms and activation tone control.
 - E. AAMI, the International Electrotechnical Commission (IEC) and AST support the use of a low-volume limit on the ESU activation tone control.
7. The cut and coagulation power settings will be requested by the surgeon and should be confirmed prior to the skin incision.
 - A. The lowest possible ESU power settings appropriate to the surgery should be used.²² This decreases the risk for capacitive coupling and arcing.³⁷
 - B. When a surgeon repeatedly requests for an increase in the power settings, this can be an indicator of an ESU malfunction or impedance of the electrical circuit.^{22,43}
 - (1) The surgeon should be alerted to the possibility of malfunction, and use of the ESU should discontinue until the situation is resolved.
 - (2) All electrode cord connections should be checked including examining the cords for damage.
 - (3) The PRE should be checked to confirm complete contact with the patient's skin and no impedance is occurring.
 - (4) The type of electrolyte irrigation solution and amount used should be confirmed with the surgeon. The surgeon may request a change in the type of solution in order to decrease the impedance of the electrical circuit.³⁷
 - (5) If the troubleshooting does not resolve the situation, the ESU should be removed from the OR and immediately replaced. A new PRE should be placed on the patient, and the active electrode replaced with a new one.
 8. An improperly working ESU should be immediately removed from the surgery department and transferred to the Healthcare Technology Management Department (formerly the Biomedical Department) for repair.²²
 9. Injuries and deaths related to the use of a medical device, such as the ESU must be reported by the HCF to the FDA that has established processes for reporting adverse events.⁵⁵
 10. The ESU should be cleaned at the end of every surgical procedure according to manufacturer's instructions.
 11. A schedule should be established by the Healthcare Technology Management Department for the periodic inspection and preventive maintenance of all ESU's used in the Surgery Department.
 - A. Each ESU should be assigned a HCF identification number that is recorded by the Healthcare Technology Management Department. Additionally, the serial number should be recorded. The numbers allow the Healthcare Technology Management technicians to record when preventive maintenance was completed on each ESU and description of the maintenance, as well as keep a record and description of repairs.

Standard of Practice V

The ESU electrical cord and plug should be maintained in optimal condition in order to reduce the risk of damage to the equipment and injury to patient and surgical personnel.

1. To prevent harm to the surgical patient and personnel, the ESU electrical cord and plug must be properly handled by the CST.
 - A. The grounding of electrical equipment is critical to preventing patient and personnel injury. The ESU must come equipped with an electrical cord that has a three-pronged plug. The third prong is the ground; it must never be removed in order to make the plug fit into a non-grounded outlet.^{5,33}
 - B. The plug should only be handled when inserting or removing from electrical outlet. The cord should not be pulled on to remove the plug from the electrical outlet as this places tension on the cord possibly causing damage and generate sparks.
 - C. An extension cord should never be used with the ESU electrical cord.⁵
 - (1) The ESU electrical cord should be of sufficient length to reach the electrical outlet without placing tension on the cord and/or having the cord elevated from the floor. Tension can damage the cord as well as increase the risk for surgical team members to fall from tripping on the cord.
 - D. The ESU electrical cord and plug should be inspected and tested prior to use.
 - (1) It should be confirmed that all three prongs are present on the plug and not bent. If a prong is bent, it should not be bent back into place as this may loosen the prong; the ESU should be removed from the OR, sent to Healthcare Technology Management Department and replaced in the OR.
 - (2) The outer insulation of the electrical cord should be inspected for fraying, cracks or cuts that expose the inner wiring. If the electrical cord is damaged, the ESU should be removed from the OR, sent to Healthcare Technology Management Department and replaced in the OR.
 - (3) The electrical cord should not have knots or stress kinks/bends that could damage the outer insulation or cause leakage or build-up of electrical current. The build-up of electrical current can also cause a breakdown of the inner wiring and outer insulation due to the accumulation of heat.
 - (4) Testing the ESU prior to use will also determine whether if the electrical cord and plug are working properly.
 - E. The ESU electrical cord and plug must be kept dry.
 - (1) Fluids should not be stored or placed near the electrical outlet.
 - (2) Fluids on the floor that are near or around the electrical cord and ESU must be immediately removed by the circulating person to prevent an electrical shortage of the circuit.

- F. The ESU electrical cord should be cleaned according to manufacturer's instructions.
 - (1) Isopropyl or ethyl alcohol should not be used to clean the electrical cord since the solution can dry out the outer insulation which can lead to cracks.³³

Standard of Practice VI

The CST should follow the safety principles for the proper care and handling of the monopolar active electrode to reduce the risk of perioperative injuries to the patient and surgical team members.

- 1. The first scrub CST should inspect the active electrode, cord and tip(s) when setting up the sterile field to confirm the items are intact including the outside insulation of the cord.¹³ Damaged active electrodes should be immediately passed off the sterile field and replaced.
- 2. The CST and surgeon should use the active electrode tips according to the manufacturer's instructions. Surgical fires have resulted due to the improper use of the tips.^{24,25}
 - A. The CST should place the tip fully into place on the end of the active electrode handpiece to ensure it is not loose. During the surgical procedure, the CST should occasionally check the tip for looseness.
 - B. The tip should not be modified by bending as this can damage the tip and reduce its function.
 - C. Small pieces of latex rubber catheters, such as a Robinson, should never be placed over the tip to extend the insulation. The material is actually flammable and patient injuries have occurred.²⁵
 - D. It is the responsibility of the CST to help the surgeon keep the tip clean of eschar. The buildup of eschar impedes the flow of the electrical current, and it can serve as an ignitable fuel.²⁵
 - (1) The heat on the tip causes small pieces of tissue to adhere to the surface of the tip. The tissue can become superheated and become an ignition and fuel source.⁴⁴
 - (2) Since the eschar can impede the flow of electrical current, the resistive heating of the tip will also increase.²⁵
 - (3) Provide continuing education to surgical personnel to make them aware that the build-up of eschar poses a risk as a fire hazard and the risk for fire is significantly increased in locations of elevated oxygen concentration such as the throat and mouth.²⁵
 - E. The CST should have a method for cleaning the tip available for the surgeon at the sterile field.
 - (1) An abrasive scratch pad can be used for removing eschar from the tip. The pad should be placed in a convenient location for the surgeon, but not close to the surgical wound to prevent it from entering, if it becomes loose.
 - (2) If a nonstick tip is being used, a wet sponge should be utilized to clean the tip since the abrasive pad will ruin the Teflon® or silicone nonstick surface.

- (3) A knife blade should never be used to clean the tip. The blade can excessively scratch the tip reducing its functionality and presents as a risk for a sharps accident.
- F. Since the tip(s) is/are inserted into the active electrode handpiece and can become dislodged, it should be included as part of the sharps count.⁹
- G. The tip(s) are considered a sharp and should be properly handled.
 - (1) If the surgeon requires the active electrode to be passed to him/her, the CST should place the active electrode in the neutral zone and indicate such to the surgeon.⁹
 - (2) The tip(s) should be removed from the active electrode and properly disposed in a designated sharps container that has the biohazard symbol on the outside.⁹
- 3. The CST should control the active electrode when not in use to prevent inadvertent activation in order to avoid burns to the patient and surgical team, and ignition or puncture of the drapes. Additionally, contamination of the active electrode is avoided, when it is properly controlled.
 - A. The active electrode should always be placed in a dry, well-insulated safety holster when not in use to prevent inadvertent activation or contamination by falling down the side of the OR table.^{19,37,44,56}
 - B. The safety holster should be attached to the sterile field using an atraumatic clamp, preferably non-metal.^{8,44}
 - (1) The safety holster should be placed in a location on the sterile field according to the surgical procedure that facilitates easy retrieval by the surgeon.
 - (2) Endoscopic active electrodes are longer than normal and usually do not fit inside the safety holster. In this instance, the active electrode should be placed on the Mayo stand.^{13,19,44} If the surgeon maintains that the active electrode be placed on the drapes, this should be recorded in the operative record.⁸
 - C. The CST should prevent the active electrode cord from becoming knotted or extremely bent at the sterile field.
 - (1) The cord should not be placed/strung through the handles of a clamp that has been attached to the drapes.
 - (2) Preventing knotting and bending of the cord reduces the risks for current leakage and overheating of the insulation due to current accumulation which can cause stray currents and capacitive coupling.
- 4. Immediately prior to the skin incision, a final check should be made so that the active electrode cord is connected into the correct jacks of the ESU. The CST should quickly activate the active electrode to test.
- 5. Only the operator of the active electrode should activate it by hand or foot pedal to prevent injury to sterile team members.³⁰
- 6. The surgical team should follow local, state and federal fire safety precautions when using the ESU.

- A. Flammable agents (eg skin prep agents, tinctures, polymethylmethacrylate) should be allowed to dry before the active electrode is activated in order to avoid a surgical fire.⁴³
- (1) Skin prep agents that contain alcohol must be allowed to completely dry; while drying, the vapors are also flammable. This includes allowing the hair to dry since the solution can soak the patient's hair.⁴⁵
 - (2) Prior to draping the patient, the solution should be completely dry to avoid vapors from becoming trapped and surrounding the surgical site. The ESU could ignite the alcohol vapors causing a fire and/or burn.
 - (3) When using flammable agents, the surgical team should follow the NFPA standards.⁴³
 - (4) When possible, non-flammable agents should be used.
 - (5) Although a rare occurrence, there have been reports of fire from the ignition of polymethylmethacrylate.⁴⁴ An enclosed bone cement mixing device that suctions the fumes should be used in order to avoid ignition by the ESU.
 - (6) Provide continuing education to surgical personnel to make them aware of the risks of using alcohol and alcohol-based prep solutions, and the potential risk of ignition of polymethylmethacrylate when electrosurgery is used.
- B. The CST should dispose of suture packets that contain alcohol when setting up the sterile field. However, the suture packets should be disposed of in the sterile-paper disposal bag that is set up on the sterile backtable. The packets should not be handed off to the circulating person. By placing in the sterile-paper disposal bag, the packets are isolated from the ESU and active electrode.
- C. The use of the ESU during airway surgery presents particular risks that the surgical team should recognize in order to prevent electrosurgical airway fires.²¹
- (1) As stated by the ECRI, the ESU is initially considered responsible for an electrosurgical airway fire, but the true cause is typically misuse of the ESU in an oxygen-enriched atmosphere (OEA).²¹ OEA is defined as an atmosphere that contains more than 23% of oxygen which is commonly found in the oropharynx.
 - (2) Anesthesia providers often use a combination of oxygen and nitrous oxide during airway surgery; both gases support combustion. Additionally, during airway surgery these gases can leak around the endotracheal tube and its cuff creating an OEA in the oropharynx.^{21,37}
 - (3) In 2009, ECRI published the *Clinical Guide to Surgical Fire Prevention*. A key change is the recommendation that the traditional practice of open delivery of 100% oxygen be discontinued during head, neck and chest procedures.²⁷ If

supplemental oxygen is needed, the anesthesia provider should intubate the patient or use a laryngeal mask to prevent oxygen and nitrous oxide (oxidizers) from collecting under the surgical drapes.²⁷

- (4) Other recommendations to prevent airway fires include:
 - Not using the ESU to cut the tracheal rings to enter the airway. The CST should provide the knife handle or scissors to the surgeon
 - Sponges should be applied wet and kept wet. However, this applies to all surgical procedures when the ESU will be used. Fires have resulted from the ignition of dry sponges placed around the surgical site or within the surgical wound.^{21,30,44}
 - Provide continuing education to surgical personnel so they recognize the risks for electrosurgical airway fires.
- D. When using electrosurgery, the lowest possible oxygen supply that will maintain adequate saturation for the patient should be used.^{2,30} Reducing the level minimizes the buildup of oxygen under the surgical drapes and decreases the risk of sparking and nearby fuel ignition in the OEA.^{2,30}
- E. The ESU should not be used when the gastrointestinal (GI) tract is entered, such as during a colon resection. The GI tract contains flammable gases, such as methane that can be ignited causing a fire if the ESU were used.^{2,30}
- F. Surgical personnel should complete training in order to be prepared to properly respond to a surgical fire.
 - (1) Personnel should be trained on the use of fire extinguishers.
 - (2) The training should include scenarios that address the various types of surgical fires that can occur and how to respond.
 - (3) Personnel should be familiar with the Surgery Department policies and procedures for response to surgical fires.
- G. The CST is responsible for ensuring items that can be used to put out a surgical fire are on the sterile backtable (eg wet towels, sterile saline or water).³⁰
7. When the surgeon uses a battery-powered disposable active electrode, the CST should remove the batteries at the end of the surgical procedure while breaking down the sterile backtable and Mayo stand and then dispose the active electrode. There have been reported incidences of trash fires when the active electrode was improperly disposed.²³

Standard of Practice VII

The CST should follow the safety principles for applying the active electrode to a clamp for purposes of hemostasis to reduce the risk of intraoperative injuries to the patient.

1. During a surgical procedure, a hemostatic clamp may be placed on a vessel to stop the bleeding. The surgeon will request the CST to either hold the clamp while he/she applies the active electrode to the clamp to cauterize the vessel

(referred to as buzzing) or request the CST buzz the clamp while the surgeon holds it.

- A. When holding the clamp, the CST should hold it upright and confirm with the surgeon that the clamp is not touching any other untargeted tissue, in particular, the wound skin edges.⁴⁴
- B. When buzzing a clamp, the CST should follow these principles:
 - (1) Normally, the surgeon's glove functions as an insulator protecting the fingers from the current moving down the hemostat. However, if the glove is thin and provides little resistance, the current may travel through the glove and cause the surgeon to sustain a painful burn. Also, dielectric breakdown occurs when electrical current breaks down the insulating material such as sterile gloves. The material in the gloves is unable to withstand the leakage of ESU current, producing a hole in the glove and causing the surgeon to sustain a burn.³³ Therefore, the CST should place the tip of the active electrode below the fingers of the surgeon to prevent burns.³³
 - (2) The CST should activate the active electrode only when the tip has made full contact with the clamp, and the CST can fully visualize the contact to avoid arcing of the electrical current.
- C. The glove of the surgeon and CST should be dry when buzzing.

Standard of Practice VIII

The CST should follow the safety principles for the proper care and handling of the bipolar active electrode to reduce the risk of perioperative injuries to the patient and surgical team members.

- 1. The CST should apply the same principles for setting up the bipolar active electrode and cord on the sterile field as those for the monopolar active electrode (see Standard of Practice VI).
- 2. Bipolar active electrodes and cords are usually non-disposable. The CST should inspect the bipolar active electrode and cord to confirm both items are intact while setting up the sterile field. The CST should also inspect the tips to make sure they are properly aligned and not bent.
- 3. Misconnection of the bipolar active electrode to the monopolar jacks on the ESU must be avoided.⁴
 - A. The misconnection results in the inadvertent activation of the ESU's monopolar mode which produces a dramatically higher output than the bipolar mode which can lead to damage to the patient's tissues.²⁶
 - B. Recommendations by ECRI to avoid misconnections include the following:²⁶
 - (1) Provide and document continuing education of surgical personnel on the risks of misconnection of bipolar electrodes to monopolar jacks. This includes documenting the competency of surgical personnel in the use of bipolar electrosurgery.

- (2) Before each use or after reconnection of electrodes (eg electrodes accidentally disconnected), it should be verified and documented that the electrodes are connected to the proper ESU jacks.
 - (3) Flexible bipolar electrode cables should be replaced with cables designed to prevent misconnection to the monopolar jacks, such as plugs mounted on rigid connector blocks.
 - (4) The PRE should not be placed on the patient when bipolar electrosurgery will be used.
 - (a) If the surgeon requests the use of monopolar and bipolar electrosurgery, the PRE can be applied but the PRE electrode cable should only be plugged into place when the surgeon is ready to use, and the bipolar electrode cable unplugged and vice-versa.
 - (5) All unused ESU operating modes should be set at zero (0) or lowest setting possible.
 - (6) The activation tone control must be clearly audible to all members of the surgical team during the entire surgical procedure.
4. The foot pedal should be positioned where the surgeon can easily access it.
- A. The foot pedal cord should be inspected prior to use for cracks or breaks in the outer insulation. If the cord is damaged, the ESU should be removed from the OR, sent to Healthcare Technology Management Department for repairs, and a replacement brought into the OR.
 - B. The CST should communicate to the surgeon the location of the foot pedal prior to the skin incision.
 - C. When not in use the foot pedals with cords should be placed in a secure area to prevent damage. When in use, the foot pedals should be placed inside a waterproof, transparent, disposable cover to protect against body fluids, irrigating solution spills, and fluids on the floor.

Standard of Practice IX

It is recommended that coblation technology be used for purposes of hemostasis when the patient presents with an implanted electrical device (IED).

1. The monopolar ESU is a type of radio frequency (RF) device that operates at frequencies (200 kHz – 3.3 MHz) that can significantly interfere with IEDs in the OR.⁵⁶
 - A. The following list of IEDs includes, but is not limited to: permanent pacemakers, ventricular assist devices (VADs), deep-brain stimulators (DBSs), vagal nerve stimulation (VNS), ventricular shunt, cochlear implant, implanted bone conductor stimulator, implantable and semi-implantable hearing aids, auditory brainstem implants, implanted fusion pump, and osteogenic stimulators.
 - B. It is recommended that monopolar and bipolar electrosurgery are not used in the presence of IEDs, and coblation is used.^{3,12,56}
 - (1) If electrosurgery must be used, the O. team should refer to the manual of the manufacturer of the IED for contraindications as

well as contact the IED manufacturer to inquire if IED will be affected by electrosurgery and their recommendations.⁵⁶ If the manufacturer cannot be contacted, the surgical team should apply their knowledge as a team to exercise the safest patient practices.

- (2) If coblation is not available, the next best recommendation is the use of bipolar electrosurgery. When activated, it should be kept more than ½ inch (1 cm) from the IED.^{3,14,56}

Standard of Practice X

The CST should follow the safety principles for the use of argon-enhanced electrosurgery (AEE) to reduce the risk of perioperative injuries to the patient and surgical team members.

1. The safety risks for monopolar electrosurgery apply since monopolar alternating current is used to deliver the argon gas from a portable tank that is attached to a specialized ESU.³³
 - A. Since the electrical current passes through the patient a PRE must be placed on the patient (see Standard of Practice III).
2. Before use and after intraoperative delays in use, the air should be purged from the argon gas line and electrode before activation by the surgeon.
 - A. Purging the argon gas before use reduces the risk of venous gas embolism, a primary concern with the use of AEE.^{16,35,47}
 - B. The manufacturer's instructions for purging the argon gas line and electrode should be followed.
3. During open abdominal and laparoscopic procedures, the abdominal cavity should be flushed with CO₂ between activation periods to reduce the risk of venous gas embolism.¹⁶
4. The argon gas flow should be set at the lowest level that will still provide the surgeon with the desired clinical effect.¹⁶
5. The risk of venous gas embolism is increased during laparoscopic procedures because of intra-abdominal over-pressurization and displacement of CO₂ by the argon gas.¹⁶ However, this risk is also present during open abdominal procedures.
 - A. The active electrode tip should never come into contact with the tissue. It should never be held less than several millimeters from the tissue. The tip should be held at an oblique angle to the tissue, and the handpiece moved away from the tissue after each activation.¹⁶
 - B. The endoscopic CO₂ insufflator should have audible and visual abdominal over-pressurization alarms that cannot be turned off.³⁵
6. Surgical personnel should be knowledgeable of the signs, symptoms and emergency treatment of venous gas embolism.
 - A. Patient monitoring by the anesthesia provider should include end-tidal CO₂ to aid in the early detection of venous gas emboli.

Standard of Practice XI

The CST should follow the safety principles for the use of the harmonic scalpel to reduce the risk of perioperative injuries to the patient and surgical team members.

1. The harmonic scalpel uses ultrasonic energy rather than electricity to cut and coagulate tissue.³³ Therefore, a PRE is not necessary.
2. Use of the harmonic scalpel produces a vaporized tissue plume that can contain harmful chemical and biological byproducts. Smoke evacuator system and wall suction with an in-line ultra low penetration (ULPA) filter should be used to reduce the level of the surgical team's exposure to the plume.³³ See Standard of Practice XIII for additional details as related to vaporized tissue plume.

Standard of Practice XII

Unique risk factors exist when electrosurgery is used during minimally invasive surgical (MIS) procedures. The CST should work with the surgical team to implement the safety principles to reduce perioperative injuries to the patient and personnel.

In order to understand the Recommended Standards for electrosurgery used during MIS, the terminology must be understood. The following is a brief explanation of the unique risk factors that can occur: capacitive coupling, direct coupling and insulation failure.

Capacitive coupling occurs when an electrical current from an active electrode transfers through the insulation to an adjacent conductor. For example, during laparoscopic surgery, when electrical current travels through an active electrode, the current can travel from the active electrode through intact insulation and produce an electrical charge within an adjacent metal trocar sheath.⁴⁰ The trocar becomes heated and, if touching, tissue can burn the untargeted tissue. The surgical team may not see the accidental burns that are produced during the incident and capacitive coupling cannot be controlled by the surgeon. However, the Recommended Standards of Practice provide methods of prevention.

Direct coupling occurs during laparoscopic surgery when an active electrode is placed too close to or touches a non-insulated metal instrument or device, such as a sheath, laparoscope or suction tube.⁴⁰ The electrical current travels from the active electrode to the metal item, thus heating it and burning the untargeted tissue. This is surgeon's error since it is within his/her control to avoid the incident. Again, Recommended Standards of Practice provide methods of prevention.

Insulation failure is now considered the primary cause of laparoscopic electrosurgical injuries.³¹ If the insulation is compromised such as a crack or hole, the electrical current can escape at the point and burn untargeted tissue. A decrease in power at the tissue target site will not occur even with the escape of electrical current.⁴⁰ Escaped electrical currents can quickly cause extensive tissue death due to their extremely high temperature. The burns may not be seen by the surgical team and often do not cause symptoms in the patient for several postoperative days. Complications from these types of burns include life-threatening organ perforations and peritonitis.

1. Insulated instruments and electrodes should be inspected in the Central Supply Department (CSSD) prior to sterilizing. The following is a five-step recommended method for inspecting the insulation in the CSSD.³⁸

- A. Visually inspect the insulation prior to completing the cleaning process. Instruments and electrodes with cracks or holes in the insulation should be removed from service and sent for re-insulation repair.
 - B. Instrument or electrode should be cleaned with a soft brush and non-abrasive cleaning agent, and rinsed.
 - C. A microscope should be used to visualize the integrity of the insulation of each item.
 - D. An insulation scanner should be used to detect the release of stray electrical energy along the length of the insulation.²⁸
 - (1) Cost-effective, user-friendly insulation scanners are commercially available that can be used to test the insulation on reusable and disposable electrosurgical instruments. When the instrument is scanned, a full-thickness break in the insulation will activate an audible and visible alarm.⁴⁰
 - E. Instruments and electrodes are securely packaged for sterilization.
 - (1) The items should be packaged in such a manner as to minimize movement during handling in order to prevent damage to the insulation.
2. The first scrub CST should be responsible for the next inspection of the insulation which should be completed while setting up the sterile field.
- A. The CST should be familiar with the manufacturer's instructions on how to use the sterile insulation scanner. The CST should inspect the insulation on all the instruments and electrodes.
 - (1) The insulation may have passed inspection in the CSSD, but the high temperature of the steam sterilization process could cause a hole or break in the insulation. Sterilizing chemicals can also break down the insulation.^{28,40,57,58}
 - (2) If a faulty instrument is discovered, it should be immediately removed from the sterile field and sent out for re-insulation repair. The HCF should keep an accurate inventory of single-use or sterilized instruments and electrodes as replacements. The CST should scan the replacement instrument(s).
 - B. Before the surgery is completed, the instruments and electrodes should be scanned one last time by the first scrub CST.
 - (1) If the insulation on an instrument is found to be defective, the surgeon should be informed and may decide to inspect the abdominal cavity as well as order postoperative X-rays.
3. Other methods that are recommended for detecting compromises of the insulation include active electrode monitoring devices and two-level insulation surface.²⁸
- A. Active electrode monitoring devices continuously monitor the laparoscopic instruments and actively shield against stray electrosurgical current.⁵⁸ The device reduces the risks of capacitive coupling and insulation failure.
 - B. Two-level insulation surface involves color coding. When a break in the outer black-color insulation occurs, the inner brightly colored layer can be seen in order to warn the CST or surgeon not to use the instrument.⁴⁰

4. Conductive trocar cannulas are recommended for use during laparoscopy procedures.
 - A. Conductive trocar cannulas allow the electrosurgical current to safely travel between the cannula and abdominal tissue in order to prevent the heating and burning of non-target tissue.^{28,57,58}
 - B. Combination plastic and metal trocars and cannulas should not be used. The combination allows the electrical current to travel between the two items causing capacitive coupling.⁵⁸
5. The lowest power settings for cut and coagulating should be selected that still allows the surgeon to achieve the desired clinical results.
 - A. The low power settings decrease the risks of capacitive coupling and insulation failure. The low settings also contribute to minimizing the tissue damage when direct coupling occurs.
6. The surgeon should not activate the active electrode until it is close to the target tissue.⁵⁸ Activation when close to the tissue reduces the risk of arcing, capacitive coupling, and touching non-target tissue.

Standard of Practice XIII

Electrosurgical plume evacuation and filtering should be performed during a surgical procedure when the monopolar ESU is used including the harmonic scalpel.

1. Research consistently confirms the presence of harmful chemicals and biological byproducts in the vaporized tissue plume that present the possibility of being mutagenic and carcinogenic. Refer to the bibliography for a comprehensive listing of journal articles publishing research results over a span of several years.
2. Vaporized tissue plume should be evacuated for all procedures, open and laparoscopic, when the ESU is used.
3. The smoke evacuation system should be appropriate to the amount of plume that may be produced during the surgical procedure. The CST should be familiar with the manufacturer's instructions for the operation of the system.
 - A. If small amounts of plume are anticipated, the use of an inline suction filter is recommended that is positioned between the suction canister and wall or ceiling connection.¹ The inline filter should be replaced according to manufacturer's instructions.
 - B. If a large amount of plume is anticipated, an individual smoke evacuator unit with a ULPA filter should be used.
4. It is recommended that high-efficiency particulate air (HEPA) or ULPA be used to capture the plume.
5. The CST should hold the smoke evacuator wand less than 1 centimeter from the active electrode-tissue contact site to remove as much of the plume as possible.⁴² Holding the evacuator wand farther away from the surgical site allows the smoke to build-up and obstruct the view of the surgeon.¹
6. If a smoke evacuator foot pedal is used, it should be activated by the surgical technologist or surgeon.
7. Only trained surgical personnel should change the smoke evacuator filters.
 - A. Manufacturer's instructions should be followed for changing filters, including how often they should be changed.

- B. Surgical personnel who change the filter should wear personal protective equipment (eg, high-filtration mask and gloves).
 - C. The used filter, tubing, and evacuator wand should be placed in a bag marked with the biohazard symbol and disposed of according to HCF policy.¹
8. High-filtration masks should be worn by all surgical team members when the ESU will be used.
- A. High-filtration masks with filtering capability of particulate matter 0.1 micron and larger should be worn by the surgical team members.
 - (1) Regular surgical masks should not be worn due to filtering capability of 5 microns or higher.
 - B. Double masking should not be allowed, since it does not provide proper protection against particulate matter in the plume.
 - C. The high-filtration mask should be worn properly covering the nose and mouth as well as conforming to the face.

Standard of Practice XIV

Surgery Department electrosurgery policies and procedures should be reviewed at regular, designated intervals and easily accessible to all surgery personnel.

1. The review and revision of policies and procedures should involve representation of all professions from the Surgery Department, ie surgeon, anesthesia provider, CST and RN.
 - A. The policies and procedures should include, but are not limited to the following:
 - (1) Testing of ESU and accessories prior to the start of a surgical procedure.
 - (2) Perioperative assessment of the patient.
 - (3) Perioperative safety measures.
 - (4) Completion of the ESU checklist prior to the start of a surgical procedure.
 - (5) Reporting of and delivery of malfunctioning equipment to the Healthcare Technology Management Department.
 - (6) Reporting of patient and surgical personnel injuries.
 - (7) Schedule for preventative maintenance of ESUs.
2. Adverse events such as patient and surgical personnel injuries should be reported according to FDA, state and local regulations.⁵⁵
3. Equipment malfunctions should be reported according to federal, state and local regulations.

Competency Statements

Competency Statement	Measurable Criteria
<p>1. CSTs are knowledgeable of the risks, patient and surgical personnel hazards and safety principles associated with the use of ESU and accessory items.</p> <p>2. The CST is qualified to perform the patient care concepts as related to the use of the ESU based upon completed training (eg, applying the PRE, connecting electrodes to the ESU).</p> <p>3. The CST is qualified to operate the ESU based upon completed training.</p> <p>4. The CST has the knowledge and skills to assist the surgeon as related to the technical aspects of the use of electrosurgery (eg buzzing a clamp, use of surgical smoke wand, implementing MIS safety principles such as the use of the insulation scanner).</p>	<p>1. Educational standards as established by the <i>Core Curriculum for Surgical Technology</i>.¹⁵</p> <p>2. The subject area of electrosurgery and safety principles is included in the didactic studies of a surgical technology student.</p> <p>3. Surgical technology students demonstrate knowledge and skills of electrosurgery in the lab (mock OR) and surgery during surgical rotation under the supervision of instructors and preceptors.</p> <p>4. CSTs complete continuing education to remain current in their knowledge of electrosurgery including safety principles.</p> <p>5. CSTs complete technical duties and provide patient care as related to the use of the ESU and accessory items.</p>

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