Electro surgery Burns: A Word of Caution for the Operating Surgeon

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Abstract- Electro surgery is a safe surgical technique for achieving hemostasis, however its use carries the risk of burns to the operating surgeon. The aim of our report is to spread awareness among surgeons and operating room staff about hazardous consequences of electro surgery and appropriate measures to prevent them.

Introduction

Electro surgery is a commonly used surgical technique to achieve hemostasis and is usually considered safe and effective. Despite recent advances in electrosurgical technology, its use carries some risks and dangers, which must be fully known to the healthcare team to ensure general safety of the operating team and prevent untoward incidents in the operation suite. As it uses electrical current to generate heat to be delivered to biological tissues, both current and heat can pose damage not only to the patient but to the operator too, including risk of minor and major burns. We present a case report where use of electro surgery induced burn in the operating surgeon.

Case

A 56 year old male with avascular necrosis of left hip was taken for total hip arthoplasty with the procedure lasting for about 2 hours. During the procedure, operating surgeon experienced superficial burn in distal phalanx of left index finger, size of lesion being 5 x 5 mm. It was dry, red and tender to touch and movement with intact sensation. Capillary refill time was within two seconds. It was managed conservatively with silver sulfadiazine dressing as advised by plastic surgeon and healed within 2 weeks.

Discussion

Harvey Cushing and William T. Bovie developed electrosurgery device that utilized electricity to control bleeding. It has become a crucial auxiliary for surgical specialties. Given its efficiency in achieving hemostasis with lesser patient discomfort and reduced risk of scarring, it has gained prominence over the past century for performing skin incisions as well. To reduce the risk of electrical shocks, a diathermy machine transforms electricity from the main supply into high frequency current (>100,000 Hz)[1]. In monopolar mode, active electrode serves as the entry point for diathermy current, which exits through grounding pad applied on patient's body. Without much flow through the patient, current in bipolar mode travels between the electrode prongs.

Iatrogenic cautery burns can be caused by any of the following mechanisms: (i) direct contact burns from active electrode on patient's skin; (ii) burns at the site of grounding electrode; (iii) burns caused by electrode heating pooled solutions like spirit; and (iv) burns that take place outside the operative field as a result of circuits created between active electrode and alternate grounding source.

Functioning Of an Electrosurgical Unit

Electrosurgical unit comprises of a generator and a handpiece with one or more electrodes. The return electrode or ground electrode is linked to the patient and device is operated by a foot switch or a switch on the handpiece. Different electrical waveforms can be generated by electrosurgical generators which can have varied effects on body tissues. The electrical circuit is completed when charge passes from generator into the patient through the active electrode and back to the generator via the return electrode. Current is transformed into thermal energy as it travels through the active electrode. The tissue is dessicated as a result of heat-induced tissue cell disintegration.[2] The amperage of the electrical current, diameter of electrode tip, and duration for which generator is activated determine the effect on tissues. As we know, current takes the path of least resistance, unfortunately, sometimes hand of the operating surgeon/assistant becomes the path for flow of current.

Figure 1. Bipolar electrosurgery

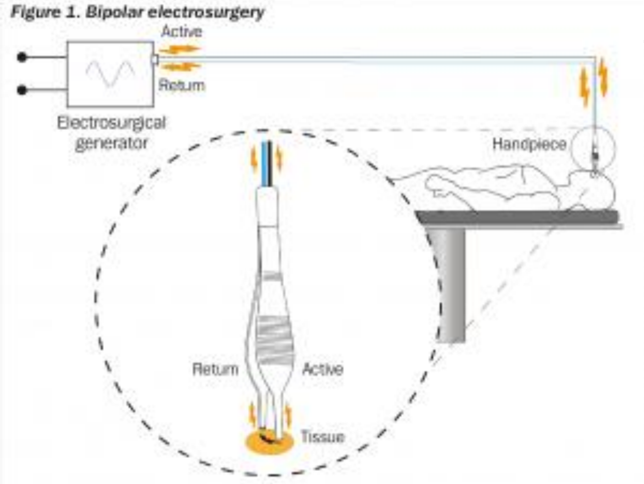
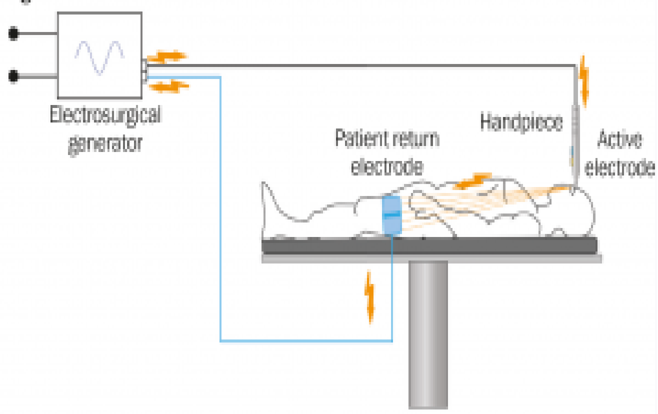


Figure 2



Problems Associated With Electro surgery

Despite numerous security measures and years of experience with the use of electrosurgery, risks like burns, intraoperative fire, interference with monitoring equipment, pacemakers and other cardiac devices, temperature sensors, deep brain stimulation electrodes, and pulse oximeter probes continues to exist. Electrical shock or burn to the operating surgeon/assistant from surgical gloves is a major issue. Usually pre-existing glove punctures are a cause of burn to the surgeon's hand, but not always. [3] Three potential ways have been described in literature responsible for a potential shock or burn to the surgeon:

(i) DC Conduction – Usually impedance of surgical gloves is low enough to allow current to pass through. However, extended period of use, exposure to blood and body fluids, or perspiration inside the glove can impair its impedance or resistance qualities[4], impairing its barrier ability and allowing current to flow more readily leading to hazardous consequences for the surgeon. Regular changing of gloves before use of electrosurgery can avoid this. Surgeons wearing low resistance hydrated gloves during electrosurgery should try to maximize their contact area with metal hemostats or other metal surgical equipment which gives the current a larger area to flow, and thus, decreases the current density. Adding another layer of glove can increase the DC resistance and slow hydration effects.

(ii) RF Capacitive Coupling - The operating surgeon's perspiring electrically conductive skin and patient's tissue act as capacitors separated by an insulator (glove). When alternating current is supplied to patient from the active electrode, surgeon's hand also acquires an electrical charge. Thinner the intervening glove, more effective is the current transmission from patient to the surgeon's hand.[5]According to literature, all gloves, whether intact or not, are capable of significant RF transmission. Therefore, using thicker or double gloves can provide better insulation.

(iii) High-voltage Dielectric Breakdown- High voltage from generators may puncture the glove resulting in a burn. Commonly when surgeon uses a hemostatic device and active electrode to cauterize the bleeder, complete hemostatic instrument receives voltage from the generator. If this voltage is sufficiently high, it will destroy the glove leading to burn. Higher the voltage and longer the activation time, more likely is the occurrence. Should the surgeon sense heat in the hand holding the metal instrument, the RF current flow should be discontinued immediately. Generator should never be energized with active electrode in air and not in contact with the tissue. Maintaining a firm grip on the active electrode to ensure contact with the hemostat before energizing reduces the chance of glove breakdown. The surgeon or assistant holding the hemostat should also grip the hemostat firmly over a large area to avoid concentration of charge or voltage in a small area.[4]

In our case, there was no pre existing puncture in the glove used by the surgeon. However, long duration of surgery and glove hydration could have been possible causes impairing its barrier ability resulting in a burn. It is extremely important to raise awareness among the surgical staff about the possible dangerous consequences of electrosurgical techniques to encourage a proactive approach on their side for its prevention and ensure preparedness to tackle unfortunate circumstances.

Conclusion

Electrosurgery unit is a crucial part of the contemporary operating room and poses a risk for not only the patient but the surgical staff too. Despite being made of non-conducting material, surgical gloves may lose their insulating properties after coming in contact with moisture no longer shielding the surgeon from electrical short circuit impact. Proper surgical instrument handling technique, re-gloving before use of electrosurgery, use of thicker, good quality gloves and double gloves can prevent complications to the operating staff and surgeon.

References

1. Ramachandran M, Aronson JK. John Marshall's first description of surgical electrocautery. J R Soc Med. 2011;104:355-60.
2. Miller JM, et al. Permeability of surgical rubber gloves. Am J Surg. July 1972; 124:57-9.
3. Cordero I. Electrosurgical units - how they work and how to use them safely. Community Eye Health.2015;28(89):15-6.
4. Tucker RD, Ferguson S. Do surgical gloves protect staff during electrosurgical procedures? Surgery. 1991Nov;110(5):892-5.
5. Miller JM, et al. Permeability of surgical rubber gloves. Am J Surg. July 1972; 124:57-9.