

Intraoperative burn from a grounding pad of electrosurgical device during breast surgery

A CARE-compliant case report

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Abstract

Rational: Burns at the site of the return electrode (i.e., grounding pad) are possible effects of electrosurgery. Despite this knowledge, however, ignorance or negligence with regards to proper handling of the grounding pads still often occurs. Burn injuries can be easily prevented by taking the necessary precautions; thus, during plastic surgery, careful attention should to be paid.

Patient Concerns: A 38-year-old female patient was admitted to our ward to be performed augmentation mammoplasty. Before the start of the procedure, the grounding pad was placed on the surgical table and the left calf of the patient was placed on the grounding pad. Before using the endoscope, we found a burn on patient's left calf, where the grounding pad had been placed.

Diagnosis: It was a 3-cm-by-3-cm-sized full thickness burn. The surrounding areas had no painful sensation with noninfectious sign.

Intervention: Debridement and direct closure was performed with elliptical incision of eschar.

Outcomes: The patient did not require additional surgical procedure anymore and satisfied with the scar.

Lessons: Through this case, we present the appropriate management of electrical burns from a grounding pad, and emphasize the understanding of the mechanism of burn because of electrosurgery, and how to use the grounding pad optimally to minimize the patient's risk.

Abbreviations: i.e. = in a sentence, et al. = and others, Co. = company, NY = New York, W= watt, Fig. = Figure, no. = Number.

Keywords: intraoperative burn, electrosurgical unit, mechanism of grounding pad

1. Introduction

According to the history of electrosurgery by Massarweh et al,^[1] electrosurgical devices are the most effective and most-relied-upon instruments within the field of general surgery. The history of the electrosurgical method goes back to prehistoric times, when ancestors used heated stones for hemostasis. Many scientists have made advances in the use of electricity in surgery since the sixth century Before Christ when they started using conductive heating of tissue. In the 19th century, Morton and William Clark found the level of permissible currents in the human body without inducing pain, or burn. In 1926, Bovie synthesized these concepts and developed early version of the

electrosurgical devices. Bovie's device is a diathermy device that transfers a high frequency current. The current is passed from the probe to the grounding pad. It has been useful for cutting and coagulation. As Bovie's development of an electrosurgical unit, surgical procedures involving communication between an electronic system and the human body were considered to be increasingly safe and effective.^[1,2]

Although the use of electricity in surgery is highly useful and effective, it is not without possible complications. From the 1970 s through the 1990s, the reported incidence of electrosurgical injuries has remained at roughly 2 to 5 per 1000.^[3-5]

As of now, 82% of associated complication events occur intraoperatively.^[6] Furthermore, about 0.5% of the general problems related to the surgical equipment are caused by the electrosurgical unit.^[7]

Among them, complications related to the grounding pads are often reported. The grounding pad is usually attached by interns or nurses, and ignorance or negligence often occurs in relation to the proper placement of the grounding pad.^[8] Electrosurgical grounding pad problems can be extremely aggravating, leading to local skin reactions ranging from blisters to burns. Unfortunately, a few doctors understand the electrosurgical circuit and especially the mechanism of the grounding pad. Many also lack an understanding of the mechanism and complications of the device, because of a lack of awareness of the need for sufficient contact area for the grounding pad.

Burn injuries related to the grounding pad can be easily prevented with an adequate level of caution, and thus, during plastic surgery—especially aesthetic operations—careful attention is necessary to be paid. Here, we report an encounter with a

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Figure 1. IDS-300 AARON Bovie electrocautery generator and a 7 cm by 10 cm grounding pad made of metal. Grounding pads that do not bend easily are more often used, because of their cheap costs.

rare case of a burn related with the grounding pad. Through this case, we take a look at the mechanism of grounding pad, and the risk and prevention of its adverse effects.

2. Case report

A 38-year-old female patient visited our hospital with what she felt were small breasts, and an augmentation mammoplasty was performed. Before the start of the procedure, the grounding pad was placed on the surgical table and the left calf of the patient was placed on the grounding pad. Surgery was performed with general anesthesia. After administration of the general anesthesia, we checked again to see if the left calf was properly situated on the grounding pad; no problems were observed. The operation was then started with an approach through the transaxillary incision. We used a 300-watt IDS-300 AARON Bovie (Bovie Medical Co., Purchase, NY) electrocautery generator with a power setting of 50 W, in spray mode (Fig. 1). However, before using the endoscope, we found a burn on patient's left calf, where the grounding pad had been placed. The wound was observed to be of dermal depth, with a circular and hyperemic lesion of about 1 cm in width in the outer margin, and subcutaneous tissue in the inner space. It was a 3-cm-by-3-cm-sized full thickness burn. The surrounding areas had no painful sensation with noninfectious sign (Fig. 2). The total

operation time was one hour. Conservative management was completed when waiting for the demarcation of the necrotic wound. After 14 days, debridement included a fat layer, and direct closure was completed with elliptical incision of eschar. The following picture was taken 1 month after the operation (Fig. 3). This study was approved by the institutional review board of Seoul National University Boramae Hospital (no. 16-2017-24), and complies with the principles of the Declaration of Helsinki.

3. Discussion

According to d'Arsonval in 1891, electric waves passing through the human body increase the temperature around the surrounding tissue. This thermal effect is the process by which electrical energy is transferred.^[9] This concept has appeared in the medical field through the invention of Bovie knife, which was commonly used for cauterizing and cutting tissue by adjusting the electrical current. The use of thermal ablation during an electrocautery procedure was first reported by Rossi et al^[10] and by McGahan et al^[11] in hepatocarcinoma. Even now, electrocautery instruments are widely used in surgery in all surgical departments. When integrating the patient's body with high frequency electrical circuitry, modern electrocautery devices selectively cauterize and volatilize tissue by allowing for currents to dissipate



Figure 2. Photograph of the burn site postprocedure on the day of surgery.



Figure 3. The burn site 1 month after primary closure.

as they leave the patient's body, resulting in an avoidance of unintended thermal injury.^[12]

Electrosurgical instruments form a circuit. They have their own roles in each location. The electrode probe acts as the cathode of an electrical circuit, which is ultimately closed by the application of dispersing grounding pads, primarily placed on the patient's thighs.

It is known that a problem can arise in any one of the components that make up the circuit, in an unfavorable situation. Munding et al^[12] reported that intraoperative burn can be seen in several situations. Direct contact burn can occur because of both operator ignorance and inexperience. Problems with the surrounding environment may also cause thermal injury when the pooled solution is around.

Complications related with grounding pads rarely occur. The exact incidence is not yet reported, but they have only been reported sporadically in literature.^[13-15] In addition to causing obvious morbidity to the patient, burns also leads to medicolegal, economic, physical, financial, and psychological implications on patients and their families. The grounding pad is an output site where the electric current goes out. Because of the small cross-sectional area of the probe tip, there is a very high energy flux around the grounding pad. The smaller the area of the grounding pad is, the larger the amount of current is, and this increases the chances of burn injury.^[16] Currently, there are several types of grounding pads on the market. Depending on the material, there are 2 types of grounding pads available: neutral plate and rubber plate. The grounding pad is responsible for safely returning current to the electrosurgical generator, and provides a path of low resistance and low current density^[17] For this reason, metals are used as conductors in grounding pads. In aesthetic clinics, 7 cm by 10 cm Bovie plates made of metal that do not bend easily are often used, because of cheap costs. The small size of these plates is already an issue, but when it is not fully attached to the patient, the contact area becomes even smaller, which results in a higher chance of burn injury.^[3,14] Recently, noncontact grounding pads were also developed.^[18] With these pads, the patient

simply lies on top of them to achieve electrical contact without direct contact. Noncontact grounding pads may useful in burn surgery to prevent further aggravation to sensitive skin, and may be effective in preventing burns that occur because of improper placement of traditional grounding pads.^[19,20] Noncontact grounding pads can also reduce operation time by simultaneously serving as 2 radiofrequency hand pieces. These pads are environmentally friendly and reusable; however, they remain only narrowly used for economic reasons.^[18]

It is known that certain procedures, such as tumor ablations^[13] or arthroscopy,^[14] in which long activation times or high currents are needed, are more likely to result in electrosurgical burns. There is no recommendation for the appropriate use time of an electrosurgical circuit connected with a grounding pad. Samuel SM et al^[14] said that one way to lessen possible adverse effects would be to set and keep a duty cycle. They suggested that if the electrosurgical circuit was activated for 10seconds, then in 30 seconds, it should be turned off to prevent burns. It is considered a good idea to consider these standards further.

If the grounding pad temperature goes up 45⁰C, it is more likely that burns may occur.^[1,21] Temperatures below 45⁰C is important because damaged tissues are revisable. If the temperatures are above 45⁰C, the proteins in the tissue will be denatured and the structural integrity disappears.

The risk of burn is also increased when contact quality between the patient and the grounding pad is poor. This can occur if the grounding pad is placed against an unshaven area, an area covered with moisturizers, a bony prominence, scar tissue, or an area with little soft-tissue mass or a large amount of fat.^[22] To reduce the risk of this complication, grounding pads should ideally be positioned over dry, shaven and well-vascularized tissue surfaces, to maximize the contact area of the return electrode and reduce the heat of the underlying tissues.^[23]

Above all, it should be recalled that we have to deal with the electrosurgical circuit with care. Doctors should use this system only with a clear understanding of the mechanism by which electrosurgical circuits work. Based on this rare case, we suggest the recommendation of using a grounding pad that is bigger in size and bendable, to prevent burn injury during electrosurgery.

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