Assessment of Electrosurgery Burns in Cardiac Surgery

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Abstract

Background: Monopolar surgery is applied mostly in major operations, while bipolar is used in delicate ones. Attention must be paid in electrosurgery application to avoid electrical burns.

Objectives: We aimed to assess factors associated with electrosurgery burns in cardiac surgery operating rooms.

Patients and Methods: This was a case-control study in which two groups of 150 patients undergoing cardiac surgery in Imam Khomeini Hospital were recruited. Several factors like gender, age, operation duration, smoking, diseases, infection, atopia, immunosuppressive drugs use, hepatic cirrhosis, and pulmonary diseases were compared between the two groups. Patients were observed for 24 hours for development of any burn related to the operation. Data was analyzed using SPSS v.11.5, by Chi square and T-test.

Results: Patients in the two groups were similar except for two factors. DM and pulmonary diseases which showed significant differences (P = 0.005 and P = 0.002 respectively). Seventy-five patients from controls and 35 from the study group developed burns, which was significant (P < 0.0001).

Conclusions: None of the factors were significantly related to developing burns. The differences between the two groups highlights the importance of systems modifications to lessen the incidence of burns.

Keywords: Electrosurgery, Burn, Electrocautery

1. Background

Electrosurgery dates back to 1920 when a physician named Bovie William invented an electrical device to stop bleeding. Harvey Cushin the neurosurgeon of Harvard University used the device invented by Bovie for excision of brain tumors (1-4). Some devices are still named Bovie. Electrosurgery, which is called HF surgery or RF surgery can destroy malignant lesions, control bleeding and cut tissues (5-7). The advantage of this kind of surgery is the possibility of making accurate cuts with less bleeding. Some of the probable complications of ESU include burning at the site of the dispersive electrode, unintentional activation of the active electrode and contact with the body surface, combustion in operation room because of high concentration of oxygen, electromagnetics effects on other devices in operation room and more important on patients with pacemakers; fumes produced by evaporation of tissue liquids, can be potentially harmful for staff and patients and gas emboli in case of using Argon. Some of the advantages of electrical knife over mechanical knife in surgeries include the possibility of coagulation (8, 9).

2. Objectives

We aimed to assess factors associated with electrosurgery burns in cardiac surgery operating rooms.

3. Patients and Methods

A total of 300 patients admitted to Imam Khomeini Hospital undergoing cardiac surgery were recruited. Informed written consents were obtained before the study from all patients. Patients were allocated to two groups. One-hundred fifty patients in the control group were chosen in spring before any engineering modifications of the system and 150 patients in the case group were chosen in summer after the engineering modifications of the system. Patients were observed after 24 hours of the operation to assess any probable burns caused by electrosurgery.

3.1. Modifications

First, the earth well and its accessories were tested regarding its soil resistivity; the previous well had a resistance about 13.5 ohms, which decreased to less than 2
ohms. Second, the isolated power system was repaired and fixed. Third, the electrical resistance of the operation room antistatic and conductive rubber flooring was tested and changed if was higher than the ISO standards. Moreover, this was performed for the operating rooms bed coats. Fourth, all the equipment in the operation room such as bed, monitoring, anesthetics tools, pumps, and electrocautery were tested regarding calibration and leakage; and the leakage currents were removed as much as possible. Fifth, the circumstances under which the operation was done like body moisture and the way in which equipment was used were assessed; finally, some less important factors such as climate changes, staff training, etc., were assessed.

4. Results

Control group patients were gender-matched to the case with a P value of 0.525 (69.3% were male in case and 72.7% in controls), which did not have a significant difference between the two groups. In analysis of other factors except for two, no significant differences were detected. DM (Diabetes Mellitus) showed a significant difference between the two groups with a P value of 0.005 (12% in case and 24.2% in control). Moreover, pulmonary diseases in case group with a P value of 0.002, were significant (0.7% in control group and 12% in case). Analysis of other factors including smoking (P value = 0.075), infection, diseases, immunosuppressive drug usage, location of dispersive plate did not show any significant differences between the two groups. Analysis of burn incidence between the two groups showed significant differences. Seventy-five of 150 patients in the control group and 35 of 150 patients in case group developed burns with a P value below 0.0001. Burns were more common in controls compared to the case group. Altogether, 110 patients developed burns. The results did not show significant effects of risk factors on developing burns.

5. Discussion

Awareness of cautery burns and alarm signs to diagnosis and promptly treat them may be of great importance for surgeons. By knowing the factors involved in developing burns, they can be modified or avoided to decrease the incidence of this complication. Analysis of burns incidence showed significant differences between the two groups with a P value of 0.0001 (12% in case and 24.2% in control). Moreover, pulmonary diseases in case group with a P value of 0.002, were significant (0.7% in control group and 12% in case). Analysis of other factors including smoking (P value = 0.075), infection, diseases, immunosuppressive drug usage, location of dispersive plate did not show any significant differences between the two groups. Analysis of burn incidence between the two groups showed significant differences. Seventy-five of 150 patients in the control group and 35 of 150 patients in case group developed burns with a P value below 0.0001. Burns were more common in controls compared to the case group. Altogether, 110 patients developed burns. The results did not show significant effects of risk factors on developing burns.

References

1. Odell RC. Surgical complications specific to monopolar electrosurgical energy: engineering changes that have made electrosurgery safer. J Minim Invasive Gynecol. 2011;20(3):288–98.
2. Galloro G, Magno I, Ruggiero S, Livino P, Formisano C, Cortese L, et al. Comparison between tungsten and steel polypectomy snare: evaluation of depth of colonic thermal wall injury in a pig model. Endoscopy. 2011;43(2):121–6.
3. Saaiq M, Zaib S, Ahmad S. Electrocautery burns: experience with three cases and review of literature. Ann Burns Fire Disasters. 2012;25(4):203–6.
4. Tucker RD, Voyles CR. Laparoscopic electrosurgical complications and their prevention. AORN J. 1995;62(2):589–91.
5. Vatin R. Skin Surge: a practical guide. St. Iovis: Mosby; 1998.
6. Hainer BL. Fundamentals of electrosurgery. J Am Board Fam Pract. 1991;4(6):419–26.
7. Sawchuk WS, Weber PJ, Lowy DR, Dzubow LM. Infectious papillo-
mavirus in the vapor of warts treated with carbon dioxide laser or electrosurgical: detection and protection. J Am Acad Dermatol. 1989;21(1):41–9.

8. Reilly JP. Scales of reaction to electric shock. Thresholds and biophysical mechanisms. Ann N Y Acad Sci. 1994;720:21–37.

9. Lee TW, Chen TM, Cheng TY, Chen SC, Chen SL, Chou TD, et al. Skin injury in the operating room. Injury. 1998;29(5):345–7.

10. Sheridan RL, Wilson NC, O’Connell MF, Fabri JA. Noncontact electrosurgical grounding is useful in burn surgery. J Burn Care Rehabil. 2003;24(6):400–1.

11. Tucker RD, Kramolowsky EV, Stasz P. Direct-current potentials created by arcing during monopolar radiofrequency electrosurgery. Biomed Instrum Technol. 1990;24(3):212–6.

12. Tuncel U, Ozgenel GY. Thermal injury due to electrosurgery. Ulus Travma Acil Cerrahi Derg. 2005;11(1):76–7.

13. Tucker RD. Laparoscopic electrosurgical injuries: survey results and their implications. Surg Laparosc Endosc. 1995;5(4):311–7.

14. Bieber EJ, Redwine DB, Tucker RD, Mittendorf R. An In-Vivo Evaluation of the Correlation Between Histologic and Visually Estimated Zones of Tissue Injury Created with Monopolar Electrosurgery. J Am Assoc Gynecol Laparosc. 1994;4(4, Part 2):53–4.

15. Tucker RD, Sievert CE, Kramolowsky EV, Vennes JA, Silvis SE. The interaction between electrosurgical generators, endoscopic electrodes, and tissue. Gastrointest Endosc. 1992;38(2):318–22.

16. Tucker RD, Ferguson S. Do surgical gloves protect staff during electrosurgical procedures? Surgery. 1991;110(5):892–5.

17. Hainer BL. Electrosurgery for the skin. Am Fam Physic. 2002;66(7):1259–66.

18. Demir E, O’Dey DM, Pallua N. Accidental burns during surgery. J Burn Care Res. 2006;27(6):395–900.

19. Tucker RD, Hollenhorst MJ. Bipolar electrosurgical devices. Endosc Surg Allied Technol. 1993;1(2):110–3.