Electrosurgical Burn at the Site of an Esophageal Temperature Probe

EDSON O. PARKER III, M.D.*

The electrosurgical unit (ESU) has been used throughout operating rooms in the United States for almost 60 years.1 The hazards of stray radiofrequency (RF) current causing burns or other problems have been described.1-3 Electrical burns, not electrocution or fire, constitute the most common electrical hazard in operating rooms.4 Most ESU-associated burns occur at the attachment site of electrocardiogram (EKG) electrodes.3,4 Although a burn involving a rectal temperature probe has been reported,2 the internal nasal, oral, and rectal temperature monitors have not been reported as causes of electrical burns when used with the ESU. I describe a serious RF electrical burn at the site of an esophageal temperature probe.

REPORT OF A CASE

A 22-year-old man in good health was scheduled for right knee reconstruction under general anesthesia. After starting an IV infusion, monitors were placed, including the Ohio® 2100 Adult/Pediatric automated blood pressure monitor, the Physio-Control VSM 1/ESF Monitor®† (for EKG monitoring), and a precordial stethoscope. Before preoxygenation, an uneventful induction of anesthesia and endotracheal intubation were performed, followed by the atrumatic insertion of an almost new (used less than 10 times) YSI® 702A Thermilinear Esophageal/Rectal Temperature Probe® (connected to the VSM 1/ESF monitor) through the nares, its full length, into the esophagus. Since electrocautery was to be used, the ESU dispersive electrode (Valley Lab Cohesive Dual Return Electrode®§), compatible with the Valley Lab SSE2L ESU®, was properly applied to the patient's left thigh.

The operation, lasting slightly over 4 h, was devoid of any unusual anesthetic or surgical events. There were no arrhythmias, and the esophageal temperature ranged between 35.5 and 35.9°C. However, the temperature probe, after removal, was noted to have several smooth dark brown and black areas of discoloration on the white surface not noted prior to its insertion. After a routine emergence and extubation of the trachea in the operating room, the patient was admitted to the recovery room in a drowsy, easily arousable, stable condition, with blood pressure 150/80 mmHg, heart rate 84 beats/min, and respiratory rate 20 breaths/min while receiving 40% humidified oxygen via face mask.

In the recovery room, approximately 1 h after admission, the patient began spitting up copious amounts of blood-tinged saliva. Auscultation of the lungs revealed generalized congestion. An immediate chest radiograph revealed right hilar opacification. Vital signs remained

---

* Chief, Anesthesia and Operative Service, Martin Army Community Hospital, Fort Benning, Georgia 31905. Accepted for publication December 5, 1983.

† Physio-Control Corporation, Redmond, Washington 98052.

‡ Yellow Springs Instruments Co., Inc., Yellow Springs, Ohio 45387.

§ Valley Lab, Boulder, Colorado 80301.
stable at blood pressure 150/80 mmHg, heart rate 90 beats/min, and respiratory rate 20 breaths/min, without dyspnea or ectopy. An elective awake left nasotracheal intubation was performed because of increasing hemoptysis. Approximately 2 h later, copious amounts of frothy red sputum were suctioned. The patient breathed 10 l/min oxygen via a T-tube, arterial blood gases revealing a pH 7.27, PaO\textsubscript{2} 302 mmHg, PacO\textsubscript{2} 50.7 mmHg, and BE -4.4 mEq/l. A general surgeon then performed esophagoscopy and flexible bronchoscopy. Bronchoscopy revealed frothy, bloody fluid from the right main stem bronchus with the posterior tracheal wall blistered and red. Esophagoscopy revealed the probable site of primary burn as the middle of esophagus with whitened (linear) burns. The patient then was sedated, treated with steroids and antibiotics, and ventilation controlled. He made a rapid and uneventful recovery with no apparent permanent adverse sequel.

The electrical circuit of the operating room in which the case occurred and all electrical equipment involved were taken out of use and evaluated for electrical safety by the hospital's biomedical technicians. No defects were found in the Physio-Control Monitor, Valley Labs ESU or Gridding Pad, or temperature probe. Representatives from the Physio-Control Corporation also personally examined the VSM 1/ESU Monitor with the temperature probe and stated no malfunctions were found. A Physio-Control representative stated that the YSI 700 Series temperature probes are grounded and can readily accept RF current. A YSI Company representative did not examine the probe but informed this author that the temperature probes are an electrical hazard, that the YSI Company makes no claims for them blocking RF current, and that the probes should be considered "bare wires." He also indicated that adding insulation to them would defeat their function.

Furthermore, the instruction pamphlet for the YSI temperature probe states, "In medical use, remove the probe from patient contact before activating electrosurgical apparatus or other direct-coupled RF energy source."

**DISCUSSION**

Electrical burns occurring to the patient when electrocautery is used are due to the existence of an alternate return pathway of RF current from the electrode tip through a point of high current density, rather than the appropriate ESU low current density dispersive electrode ("ground plate").\textsuperscript{1,4} These fortuitous points at which burns have been reported to occur are most common at the site of the grounded reference lead ECG electrode.\textsuperscript{2-4} but also include signal ECG electrodes,\textsuperscript{3} EEG electrodes,\textsuperscript{4} skin temperature probes,\textsuperscript{6} and rectal temperature probes.\textsuperscript{2} Theoretically, any item touching the patient’s body which has a low impedance, i.e., ground point, will accept stray RF current, and is thus a potential burn site. Even if not causing a burn, stray RF current can interfere with electrical equipment, e.g., EKG, pacemakers.\textsuperscript{2} The most common explanation for such electrical burns has been the inadequacy of the primary ESU grounding plate,\textsuperscript{1,5} with or without failure of the grounding circuit alarm system to sound and/or deactivate the unit.\textsuperscript{1}

The problem in this case is that an electrical burn occurred when all electrical equipment was being used in an unaltered, routine manner, with all safety circuits and alarms intact and operational, a situation we, as consumers, assume will not lead to unexpected morbidity. However, this problem is not unprecedented; temperature probes have produced rectal burns with the patient ground plates properly positioned and cables intact.\textsuperscript{3} The problem with internal temperature probes is apparently not widely recognized despite their widespread use with electrocautery.\textsuperscript{2} Yet a major manufacturer of temperature probes, the Yellow Springs Instrument Co., in its instruction brochure for the series 700 thermilinear temperature probes, specifically warns against the use of the probe in conjunction with electrocautery or any other RF energy source. In this author's opinion, the currently used internal temperature probes should be viewed with no less concern for safety than the now defunct EKG needle electrodes.

Recommendations for rendering the temperature probe, or any other monitoring device for that matter, safe for use in the presence of RF energy include, of course, insuring the ESU equipment is grounded and functioning properly; positioning the ESU ground plate as close as possible to the operative site;\textsuperscript{1,9} activating the ESU electrode the minimum time necessary; using the largest possible monitoring electrodes; "isolating" the circuit from ground\textsuperscript{1,2,8} (battery-operated, insulated case); and providing RF current limiting inductors (fuses or "chokes") in the monitoring leads.\textsuperscript{1,8,10}

However, the often-recommended and followed practice of isolating monitors, e.g., battery-operated temperature monitoring box, is apparently not sufficient. Patients may suffer burns at the electrode sites even if the EKG cable is disconnected from the EKG monitor. The RF current flowing through the electrodes and cable due to capacitive coupling losses may be sufficient to cause burns.\textsuperscript{10} There is no reason to believe an internal temperature probe will react any differently, i.e., disconnecting it from the monitor intermittently (while electrocautery is in use) will not diminish the danger of burns at the probe site.

The insertion of 3.3 millihenry Ferrite-core RF current limiting inductors between ECG electrodes and the cable should prevent patient burns.\textsuperscript{3,10} However, a representative of the YSI Co. informed this author that any further insulation of the temperature probes would render them less effective. Thus, due to the complication reported herein, the inherent dangers of using monitoring probes and electrocautery concurrently, and the temperature probe manufacturer's own warning, this author stopped using internal temperature probes in the operating room in the presence of electrocautery. Skin temperature strips or dots are now used instead on every patient; their shortcomings notwithstanding, they do give trends that are valuable, especially for detecting hyperthermia.
In summary, all electrically operated patient monitoring devices present the hazard of electrical burns when used in the presence of electrocautery. This electrical hazard can be minimized by following straightforward safety procedures and avoiding the use of monitoring devices that are not designed to specifically inhibit the reception of radiofrequency current. Yellow Springs Instrument Company temperature probes are not so designed, and in compliance with the YSI Company’s own literature, should not be used in the presence of electrocautery.

REFERENCES

Severe Histamine-mediated Reaction to Rectally Administered Methohexitol

LETTY M. P. LIU, M.D.,* PHILIP L. LIU, M.D.,* JONATHAN MOSS, M.D., PH.D.†

Preanesthetic medication of children with rectally administered methohexitol eliminates the pain of parenteral drug administration and reduces anxiety for both the child and parents when they are separated from each other. In essence, the child can fall asleep in the parent’s arms before being taken to the operating room. Clinically effective doses and sleep times have been established for this technique. Although hypersensitivity reactions to methohexitol are rare, we describe a case of a severe histamine-mediated reaction to rectally administered methohexitol. Histamine, norepinephrine, and epinephrine levels were obtained in close proximity to the acute event.

REPORT OF A CASE

An extremely apprehensive healthy 7-year-old (24 kg) female child with recurrent urinary tract infections was admitted for a cystoscopy.

* Assistant Professor of Anaesthesia, Harvard Medical School.
† Associate Professor of Anaesthesia, Harvard Medical School.
Received from the Anaesthesia Services of the Massachusetts General Hospital and the Department of Anaesthesia, Harvard Medical School, Boston, Massachusetts. Accepted for publication December 6, 1985.
Address reprint requests to Dr. Liu: Department of Anaesthesia, Massachusetts General Hospital, Boston, Massachusetts 02114.

Key words: Anesthetics, intravenous; methohexitol. Anesthetic techniques: rectal. Histamine.

Her past medical history was unremarkable except for an episode of otitis media and allergic reactions to a number of drugs. The child’s first drug reaction occurred two years prior to admission when she developed a rash after receiving Gantrisin® (sulfisoxazole) (Roche, Nutley, New Jersey) for 10 days. A year later she complained of pruritis, developed hives, and became somnolent after receiving Robitussin® (guaifenesin) (A. H. Robins Co., Richmond, Virginia), Dimetapp® (brompheniramine, phenylephrine, phenylpropanolamine) (Robins), and aspirin for a respiratory infection. Following both occasions, the child received Benadryl® (diphenhydramine) and was admitted to the hospital for overnight observation. One month prior to the present admission, the patient had another drug-related reaction. Her lips became edematous and she complained of pruritis after receiving Ipecac® (ipecac, ammonium chloride) (Key Company, Miami, Florida). She again was treated with diphenhydramine. Neither her parents nor her two siblings have a history of drug allergies. However, the patient’s paternal grandmother was allergic to several drugs.

The preanesthetic physical examination was normal. Her systolic blood pressure was 100 mmHg, and her heart rate 136 beats/min and regular. Preanesthetic medication consisted of rectally administered methohexitol (720 mg). Seven min after receiving the drug, the child fell asleep. Concurrent with the onset of sleep, her face became flushed and she began coughing. Her heart rate and arterial blood pressure remained unchanged. After suctioning secretions from her airway, anesthesia was induced via a mask with halothane, nitrous oxide, and oxygen. Two minutes later (15 min following methohexitol administration) coughing ceased, and the skin of her face, chest, and neck became bright red. Arterial blood pressure, heart rate, electrocardiogram, and temperature remained unchanged. Five minutes later the skin of her entire body became erythematous and edematous. Approximately 2 min later (22 min after methohexitol administration),