paralysis exists, full return of function should occur prior to performance of surgery on the contralateral side.

REFERENCES


Anesthesiology
66:697-698, 1987

Fire Following Use of Electrocautery during Emergency Percutaneous Transtracheal Ventilation

T. ANDREW BOWDLE, M.D., PH.D.,* MICHAEL GLENN, M.D.,† HOWARD COLSTON, M.D.,‡ DAVID EISELE, M.D.§

Fires can occur intraoperatively, despite the use of "nonflammable" anesthetics. Usually electrocautery is the source of ignition for a variety of flammable materials, including enteric gas and surgical drapes.1-3 Recently, the surgical laser has been the ignition source for several endotracheal tube fires.4 Administration of oxygen or nitrous oxide/oxygen mixtures serve to enhance combustion. Percutaneous transtracheal ventilation allows oxygenation and ventilation of the patient when attempts at ventilation, both via a mask and bag apparatus and endotracheal intubation, fail.4-6 This case illustrates the fire hazard associated with percutaneous transtracheal ventilation performed during an emergency tracheostomy at which electrocautery was used.

REPORT OF A CASE

A 60-yr-old male underwent panendoscopy for staging of a 3 by 3 cm mass of the left neck. The trachea was intubated for that procedure with a 6.5 mm endotracheal tube with a stylet and a Mac 3 laryngoscope blade. The glottis was not well seen due to an "anterior" larynx, but intubation was performed easily on the first attempt. Panendoscopy was normal, and the patient was scheduled for biopsy of the neck mass and probable left neck dissection.

Four days later, when the patient presented for his second procedure, he was asymptomatic, except for a mild sore throat. There was no stridor or hoarse voice. After placement of monitors, including an arterial line and a pulse oximeter, anesthesia was induced iv, succinylcholine was administered, ventilation was controlled without difficulty, and endotracheal intubation was attempted. The glottis could not be visualized, and the epiglottis was noted to be edematous during the initial intubation attempt. Despite several attempts with curved and straight laryngoscope blades, small endotracheal tubes, and an Echmann stylet, intubation could not be performed. Ventilation was maintained via a mask and bag between intubation attempts, and oxygen saturation was well maintained. However, ventilation was becoming distinctly more difficult after each attempt. Because there appeared to be a progressive obstruction of the airway, the etiology of which was unknown, it was decided to establish percutaneous transtracheal ventilation and perform a tracheostomy. A 14-gauge iv catheter was inserted through the cricothyroid membrane, secured with a suture, and ventilation was begun with 100% oxygen at 50 psi. Analysis of arterial blood gases confirmed effective oxygenation and ventilation: pH 7.42, PaO₂ 54 mmHg, PaCO₂ 22 mmHg. Oxygen saturation, as measured by pulse oximetry, remained >95% throughout the procedure.

Betadine solution, which contains no volatile materials, such as alcohol, was used to prep the skin. The patient was draped for tracheostomy with the anesthesiologist holding onto the cricothyroid catheter, just under the drape. Anesthesia was maintained with intermittent doses of thiopental and succinylcholine. The procedure proceeded uneventfully until the surgeon divided the thyroid isthmus with the cautery. A flash of light was observed in the field which appeared to travel under the drapes in a cephalad direction. A moment later, the anesthesiologist noted that his middle finger felt extremely hot. Upon withdrawing his hand from under the drape, a plastic glove covering his hand was burning. The glove was removed and the patient's head was uncovered. Two cloth drapes next to the right side of the patient's neck were in flames. These were removed and extinguished. The tracheostomy was completed without further difficulty, and the left neck dissection was also performed. The anesthesiologist suffered a deep second degree burn of his middle finger, and the patient suffered a superficial second degree burn of the right side of his neck. Both burns are now well healed. Panendoscopy was performed following completion of the neck dissection. There were no burns of the airway. Severe, diffuse edema of the larynx was noted, and the cords were very difficult to visualize, accounting for the difficulty in attempting to intubate the trachea.

DISCUSSION

Prior to 1955, the most common fuel for operating room fires was flammable anesthetics. In the 15-yr period...
from 1959–1974, a total of 36 fires or explosions were reported, but only a third involved a flammable anesthetic. The majority of fires involved plastic, rubber, paper, fabric, and disposable items (28%), enteric gas (22%), and volatile prep solutions (8%). The source of ignition was electrocautery in 53% of the cases. Electrocautery works by emitting a radio frequency current which produces heat within the tissue. Hemostasis is achieved by occlusion of vessels with coagulated blood and tissue. When used in the “cutting” mode, the heat produced is even greater than that produced by the “coagulation” mode. The cutting current “produces intense heat, which explodes the cellular water into steam at the cautery tip.” Thus, electrocautery may cause fire by “local ignition” of a flammable material, which occurs when a small amount of material is heated to the ignition temperature. Electrocautery may also cause combustion by producing a spark. A spark passing through a volume of air equal to 1 mm³, can develop a temperature of 1000° C in 1 msec, adequate to ignite a flammable material.

In addition to a fuel and a source of ignition, oxygen is necessary to produce combustion, and, in general, combustion is enhanced by both higher ambient pressures (as encountered in a hyperbaric chamber) and higher concentrations of oxygen. Dilution of oxygen by nitrogen tends to reduce combustibility, while nitrous oxide actually enhances combustion. In our case, large amounts of oxygen were exhaled from the patient’s mouth during percutaneous transtracheal ventilation with 100% oxygen. Since the patient’s head was entirely covered with drapes, the oxygen was probably held in place, resulting in a very high oxygen concentration near the surgical field. The ignition source was electrocautery, and the fuel was cloth drapes and a plastic glove.

Percutaneous transtracheal ventilation can be a very useful, even lifesaving, technique and was quite efficacious in this case. Among the possible complications, fire has not been previously reported. We would make two specific suggestions to reduce the chance of fire in this setting. First, the drapes should not be allowed to cover the face, so that the exhaled oxygen will be dissipated into the room air and not accumulate under the drapes. Second, electrocautery, especially for cutting, should be avoided if at all possible when the surgical field is immediately adjacent to the oxygen source, as in this case of emergency tracheostomy.

REFERENCES


Neostigmine Antagonism of Vecuronium Paralysis during Fentanyl, Halothane, Isoflurane, and Enflurane Anesthesia

B. DERNOVOI, M.D.,* S. AGOSTON, M.D., PH.D. (NETH),† L. BARVAIS, M.D.,‡ M. BAURAIN, M.D.,‡ R. LEBFLORE, M.D.,* A. D’HOLLANDER, M.D., PH.D. (BEL)$

The neuromuscular blocking properties of non-depolarizing muscle are enhanced by volatile anesthetics. Recently, Deslile and Bevan found that enfurane (ENFL) interfered with neostigmine antagonism of a pancuronium neuromuscular blockade. The aim of our study was to compare, with a standard dose of neostigmine, the antag-

Groeningen State University Hospital, Groeningen, The Netherlands. Accepted for publication December 18, 1986. Supported by the Ministère de la Politique Scientifique Belge (Actions concertées).

Address reprint requests to Dr. d’Hollander: Service d’Anesthesiologie, Hopital Erasme, Route de Lennick, 808, B-1070 Bruxelles, Belgium.