

Cautery Fires in the Operating Room

Sonya P. Mehta, M.D.

A healthy 25-year-old woman underwent excision of a cyst from her face at an ambulatory surgery center under monitored anesthesia care (MAC). The patient was sedated with midazolam 4mg and fentanyl 200mcg, with 100% oxygen administered at 4 L/min via nasal prongs. The surgical area was prepped with an alcohol-based solution and then surgical drapes were applied. When the surgeon used the electrocautery, a massive fire erupted in the drapes and melted the nasal prongs. The patient sustained burns to her nose and face. She required surgery and grafting and was left with permanent disfigurement. The case was settled for \$80,000.

Even with the attention given by the Anesthesia Patient Safety Foundation (APSF),¹ American Society of Anesthesiologists (ASA) Practice Advisory for the Prevention and Management of Operating Room Fires,² and the American College of Surgeons,³ many anesthesiologists and surgeons are still unaware of fire risks in the operating room. In October 2011, the Food & Drug Administration (FDA) also launched a new patient safety initiative in order to prevent operating room fires.⁴ This FDA initiative led to television segments featured on the “Today” show on NBC in November 2011 and one on MSNBC in December 2011, pointing out that the number of fires in the operating room are on the rise each year, even though they are 100 percent preventable.⁴⁻⁷

Cautery Fire in the Operating Room

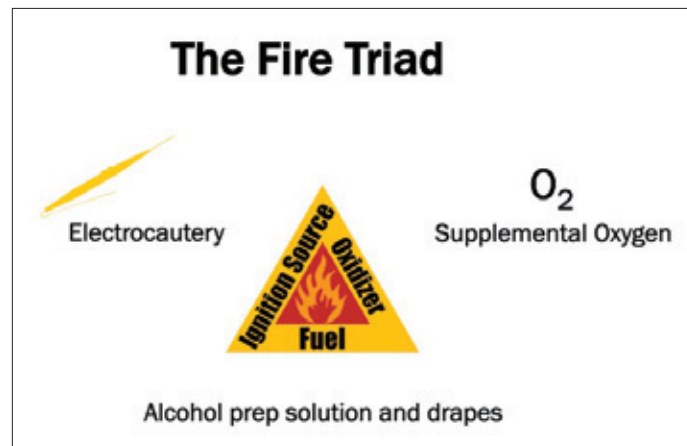
In 2001, Barker reported a case of cautery-induced fire during a procedure for bilateral parietal burr holes to

evacuate a subdural hematoma in a 73-year-old under MAC.⁷ The anesthesia team introduced an oxidizer source consisting of oxygen at 6 L/min via a loosely-fitted oxygen mask. Possible fuels included an alcohol-based skin prep, plastic oxygen mask, paper surgical drapes over the head, neck and chest, the patient’s hair and the surgical towels. The ignition source was provided by the electrocautery. Upon activation of the monopolar cautery to incise the pericranium, the head was fully engulfed in flames as the drapes were removed.⁷ The oxygen-enriched environment was critical for igniting the fire.

The Fire Triad

Fire requires the presence of three components, known as the “fire triad”: 1) an oxidizer, 2) an ignition source and 3) fuel (Figure 1).² Oxidizers typically used in the O.R. include oxygen and/or nitrous oxide.² Both of these agents increase the likelihood and intensity of combustion in the surgical field in a concentration-related manner. Although the electrocautery is most often the ignition source, other sources include lasers, argon beam coagulators, heated probes, drills and burrs, fiberoptic light cables, and defibrillator paddles or pads.² Fuel sources include, but are also not limited to, endotracheal tubes, sponges, drapes, gauze, alcohol-containing prep solutions, solutions containing other volatile compounds such as ether or acetone, oxygen masks, nasal cannula, the patient’s hair, dressings, ointments, surgical gowns, gastrointestinal tract gases, blankets, suction catheters, flexible

Figure 1: The Fire Triad



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Table: Prevention of Operating Room Fires²

General Guidelines – Fire Triad	Specific Recommendations
Minimize an oxidizer-enriched atmosphere	<ul style="list-style-type: none"> ■ Replace oxygen with compressed air or discontinue supplemental oxygen for a period of time (3-5 minutes) prior to use of the electrocautery. ■ If supplemental oxygen is required during deep sedation, consider use of an endotracheal tube or laryngeal mask airway. ■ If oxygen is necessary, consider blending oxygen with air.
Safely manage ignition sources	<ul style="list-style-type: none"> ■ Communicate with the surgeon regarding the timing and use of cautery before the start of a procedure. ■ The surgeon must warn the anesthesiologist 3-5 minutes prior to use of electrocautery.
Safely manage fuels	<ul style="list-style-type: none"> ■ Prevent oxygen buildup by configuring the surgical drapes to allow for adequate venting of oxygen. ■ Allow sufficient drying time after application of alcohol-based skin-prepping agents and before applying drapes to the prepped area. ■ Reduce flammability of sponges, cottonoids or packing material by using them wet rather than dry. ■ For airway surgery, use cuffed endotracheal tubes to prevent oxidizer leaks.

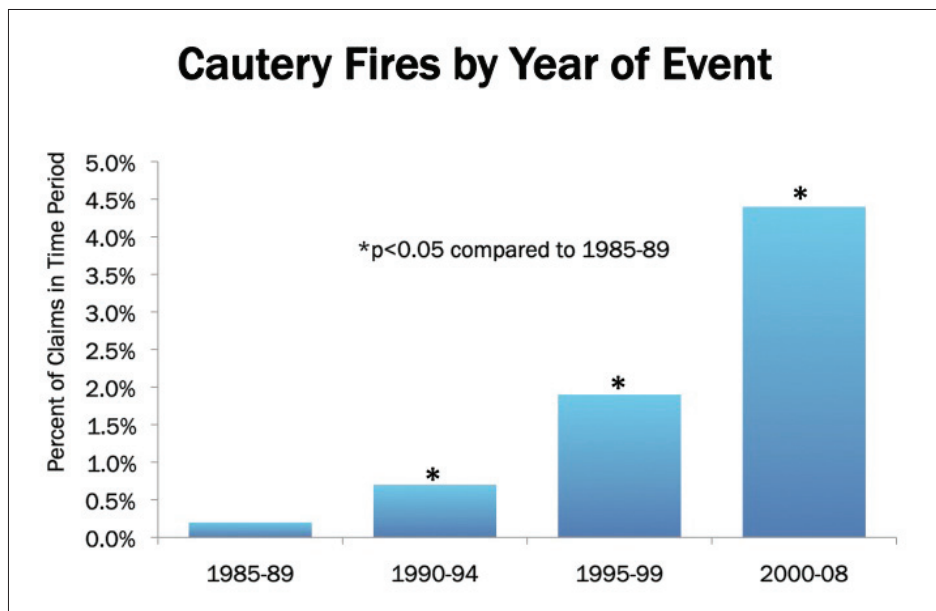
endoscopes, fiberoptic cable coverings, gloves and packaging materials.² Pooling of alcohol-containing prep solutions in the drapes has been implicated in a number of cautery-induced fires. However, use of supplemental oxygen is the predominant cause in most fires, as combustion is markedly enhanced in an oxygen-enriched environment.

Cautery Fire Trends in the ASA Closed Claims Project

We used the ASA Closed Claims database to review adverse complications from the use of electrocautery resulting in O.R. fires. The percentage of cautery fires increased over time from less than 1 percent of all surgical anesthesia claims in 1985-

94 to 4.4 percent of all surgical anesthesia claims between the years 2000-08 (Figure 2, $p < 0.05$).⁸ This trend was especially pronounced among claims for MAC. Almost 85 percent of the fires occurred during sedation for head and neck surgery with use of supplemental oxygen. Oxygen delivery devices (e.g., face masks, nasal cannulae) and surgical drapes typically served as fuel sources, and the electrocautery served as the ignition source. Alcohol-containing prep solutions that pooled into the drapes were important factors in only a minority of claims.⁸ The remainder of fires (16 percent) occurred during general anesthesia, most often with a cuff rupture or cuff leak, during oral, pharyngeal or tracheal surgery.⁸

Figure 2: Cautery Fire by Year of Event



Prevention

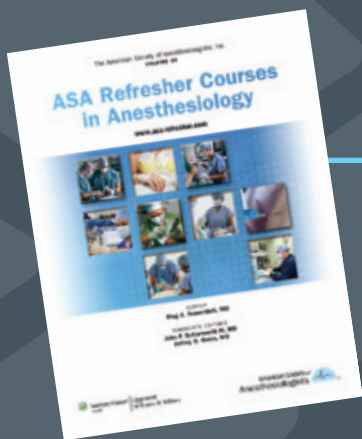
Cautery-induced fires can be easily prevented.^{1,2,4} Anesthesiologists and surgeons must be very aware of the fire triad and use techniques to minimize an oxidizer-enriched atmosphere, to safely manage ignition sources and to safely manage fuels (Table). Not all patients require supplemental oxygen during sedation. If heavy sedation with supplemental oxygen is required to preserve SpO₂, the ASA advisory recommends consideration of use of a sealed delivery device (e.g., an endotracheal tube or laryngeal mask airway).² Oxygen build-up should be prevented by allowing adequate venting

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of drapes and by shutting off oxygen three to five minutes prior to use of the electrocautery. Good communication between surgeon and anesthesiologist regarding the timing of use of the electrocautery is key for allowing adequate time for the oxygen to be eliminated from the surgical field. A standard checklist should be available or added to existing operating room checklists and should be implemented prior to the start of the case to discuss strategies for reducing potential fire hazards during high-risk surgery (i.e., proximity of an ignition source and an oxidizer-enriched atmosphere).³

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