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Surgical Fire During Organ Procurement

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Abstract

Fire remains a dire complication in anesthesiology despite numerous advisories and education. Here, a case of fire occurring during organ procurement is described. Root cause analysis revealed that lack of communication and using an electrocautery in the presence of an alcohol-moisten sponges triggered fire. It resulted in a total loss of breathing circuit and 2 degree burns to the organ donor. The origin of fire is discussed with special emphasis on the role of communication between operating team members.

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INTRODUCTION

Surgical fires occur weekly and with possible catastrophic outcome. Approximately 100 surgical fires happen each year in the United States.[1] Operating room fires resulting in patient burn injuries accounted for 17% of closed malpractice claims for monitored anesthetic care in the American Society of Anesthesiologists Closed Claims database since 1990.[2] Eighty percent of operating room fires are classified as minor with little or no injury. Ten to 20% are classified as serious and are associated with injury. One to two patients die annually from fires.[3] A heat source, a fuel source, and an oxidizer each comprise the three sides of the fire triangle.[4,5] Each member of the operating room team controls a specific side of the fire triangle. Surgeons control the heat source, which include electrocautery devices or lasers. Nurses and technicians control the fuel, which include alcohol-containing disinfectants and petroleum-based ointments. Anesthesiologists control oxidizers, which include both oxygen and nitrous oxide. Each member of the operating room team can help avoid the risk of fire by managing both their technique and part of the triangle. Information exchange between members of the operating room team is one of the key elements to preventing fires.

We present a case report of a surgical fire that occurred during organ procurement. This case report illustrates the need for education of all staff and better communication between team members. We also detail post-event procedural changes instituted to prevent future fires.

CASE REPORT

A19-year-old man suffered severe head trauma and multiple injuries in a motor vehicle accident. Following a 3 week hospital course complicated by sepsis, respiratory failure, tracheostomy, and MRSA pneumonia, he was declared brain dead at Shands Hospital at the University of Florida. The family wished to donate his organs for transplantation and signed informed written consent for procurement. The organ donor was maintained on a ventilator in the surgical intensive care unit until transplant harvest teams arrived from outside hospitals. Following transport to the operating room, the donor was ventilated with a 32% oxygen/air mixture. The donor's oxygen saturation (SpO_2) was 100%. A transplant surgeon from an outside hospital cleaned the thorax and abdomen with alcohol. Purulent discharge around the tracheostomy site was also removed with alcohol. The surgeon then wrapped a soaked, gauze sponge around the tracheostomy tube and left it in place. The donor was then aseptically prepared from sternal notch to pelvis with iodine povacrylex (0.7% available iodine) and isopropyl alcohol (74% w/w; DuraPrep™, 3M™ Healthcare, St Paul, MN), which dried before finally draping with cloth towels and paper drapes.

Approximately 15 min after incision using an electrocautery device, the surgeon exclaimed that the donor was on fire. The anesthesiologist immediately disconnected the breathing circuit from the anesthesia machine and turned off all gases. Orange flames engulfed the towel that was used by the surgeon in an attempt to smother the flames, and the fire spread quickly to the drapes. The circulating nurse left the room to find water or a fire extinguisher. The anesthesiologist disconnected a bag of intravenous fluid from the donor and extinguished the fire as the scrub technician threw pieces of ice, which were in a bin to cool the soon to be removed organs, toward the fire from across the room. The anesthesiologist immediately removed the charred breathing circuit, oral temperature probe and the tracheostomy tube. Of note, the tracheostomy cuff was still inflated and the inner cannula was intact. The fire melted 2 of 3 lumens of the subclavian central venous line. The fire left a 10-by-5 inch area of sooting and singed skin on the right neck and shoulder where the breathing circuit had been. The donor's chin and face were reddened, and eyebrows, eyelashes and facial hair were singed. The anesthesiologist placed a 7.5 mm cuffed endotracheal tube in the tracheostomy and ventilated the donor using room air. SpO_2 remained in the 70s on room air and improved to 99% using an FiO_2 of 1.0. The anesthesiologist reduced the FiO_2 to 0.75 and the donor's SpO_2 remained at 94%. The donor was again aseptically prepared, draped and the organs procured successfully. A dopamine infusion of 20 mcg · kg-1 · min-1 kept the systolic blood pressure in the 90s. Later, the surgeon speculated he started the fire after placing the electrocautery device next to the alcohol-soaked sponge, which he had wrapped around the donor's tracheostomy.

Figure 1

Figure 1: Charred breathing circuit (left) and burn to organ donor (right).

The donor's family was immediately informed of the fire. The family's main concern was whether the organs were still viable. The family expressed relief knowing the organs were viable for transplantation. A root cause analysis of the incident was conducted and the case findings were submitted to the hospital safety case management committee for further assessment.

DISCUSSION

With the advent of non-flammable anesthetics, the issue of operating room fires was put on the back burner and rules and regulations to prevent fires were largely laid to rest. Electrical hazards and shock were the new operating problems brought to the forefront. However, the use of alcohol-based cleansers (e.g. chlorhexidine, DuraPrep™ and Prevail-FX™ [Cardinal Health, Inc., Dublin, OH]) and use of supplemental oxygen during sedation has reignited the debate over operating room fire prevention. Occasional case reports of surgical fires have been written, especially in the setting of high oxygen concentrations.[6,7,8,9]

In June 2003, the Joint Commission on Accreditation of Health Care Organizations (JCAHO) released a Sentinel Event Alert outlining strategies to prevent surgical fires.[10,11,14] Electrosurgical equipment sparks the most fires (68%), followed by lasers (13%).[1] The airway is the most common location of fire (34%), followed by face and head (28%), and elsewhere inside or outside the patient (38%); an oxygen-enriched atmosphere contributes to 78% of all cases.[1]

National Patient Safety Goals for 2007 established by the JCAHO include reduction for risk of fire through the education of practitioners and anesthesia providers.[15] This education includes how to control heat sources, how to manage fuels with enough time for surgical preparation of the patient, and the establishment of guidelines to minimize oxygen concentration under surgical drapes.[5, 10, 12,13, 15]

This case described illustrates several key points regarding intraoperative fires and their prevention. Some members of the team were apparently not aware of their role in preventing fires. The scrub technician, also from an outside hospital, did not have control over flammable liquids. The surgeon left an alcohol-soaked gauze sponge on the patient primarily out of his concern for preventing contamination of the surgical field and harvested organs. Later, the surgeon placed his electrocautery device in close proximity to a known fuel source, sparking the fire. Furthermore, the team had never worked together before and communication was lacking. The anesthesiologist observed the surgeon place the gauze around the tracheostomy and mistakenly presumed it was soaked in saline rather than alcohol. While both ECRI and JCAHO suggests soaked sponges be used around airways, common sense would dictate that they be soaked with saline or water and not alcohol. Finally, the operating room did not have water readily available to extinguish the flames.

All staff members working in the operating room, including faculty, residents, nurses, and technicians, at our institution are required to have annual fire education. This education provides information about intraoperative fires and their prevention, the role and responsibility of each team member, as well as the use and location of fire extinguishers, gas pipeline shut off valves, emergency equipment, and fire alarms. Since this event, our institution revised its fire safety protocol and initiated several new steps to minimize recurrence of surgical fire. In addition to the previous guidelines, these new steps address the safe use of flammable surgical preparation solutions and first response to fire. Specifically, alcohol-soaked sponges are not allowed on the surgical field. Pooled prep solutions and any prep-soiled products must be removed and the patient dry prior to any draping. During oropharyngeal surgery, sponges, gauze, and pledgets are to be moistened with water (not alcohol) to make them ignition resistant. For head and neck surgery, water-based Betadine® (Purdue Pharma L.P., Stamford, CT), not DuraPrep®, is used. Water or saline must be present at all times in the operating room for use in case of fire. Response to fire now specifically includes smothering, dousing it with water, and removal of oxygen and fuel sources by whoever is closest to the fire, rather than having just one individual responsible for extinguishing the fire.

Education, prevention, and preparation remain the mainstays of avoiding operating room fires. With each member of the surgical team knowing the three sides of the fire triangle and their role in managing their side, surgical fires can be minimized and potentially avoided.

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