

## Learning From Others: A Case Report from the Anesthesia Incident Reporting System

### CASE 2021-06: Up in Flames

A 78-year-old male with a history of malignant pleural mesothelioma underwent scheduled right thoracotomy with extended pleurectomy and decortication. Induction, intubation, arterial line placement, and flexible bronchoscopic examination by the surgeon were uneventful. The single lumen tube was then changed to a L-sided double lumen tube and the patient turned to left lateral position. The operative (right) lung was deflated, and the procedure begun.

Over the next four hours, the anesthetic was uncomplicated. The patient was maintained with sevoflurane in 60% oxygen and tolerated one-lung ventilation well. However, surgical debulking was extremely difficult. To facilitate identification of the visceral pleura, the surgeon requested that the operative lung be reinflated. The R (tracheal) lumen was unclamped, and the anesthesiologist attempted to deliver a manual breath.

However, a large right lung parenchymal leak was encountered, and the lung could not be adequately inflated. The anesthesiologist refilled the bag with the O<sub>2</sub> flush valve, and after several manual breaths partially reinflated the lung. At that point, the surgeon was able to identify the correct tissue plane and began to dissect the visceral pleura. When electrocautery was used, however, a gauze sponge in the thoracic cavity caught on fire. The fire was quickly doused, and the operative lung deflated. No tissue damage occurred, the case was completed uneventfully, the patient was successfully extubated and discharged from the hospital on POD#7.

The event was classified as an OR fire and reported to The Joint Commission as a sentinel event. The likely mechanism of the fire was electrocautery-induced ignition of surgical gauze in a high FiO<sub>2</sub> environment caused by leakage of oxygen-enriched airway gas into the chest cavity. During the root cause analysis (RCA), several factors were identified that may have increased the risk of an airway fire. Because pleurectomy for mesothelioma was infrequently performed at this institution (10-15 cases per year), anesthesia and nursing staff were relatively unfamiliar with the procedure, the need for periodic lung re-inflation to facilitate identification of the visceral pleura, and the high likelihood of leak during re-inflation. In addition, because high oxygen concentrations were often used to combat shunt during prolonged one-lung ventilation, the risk of airway gas with a high oxygen concentration leaking into the chest cavity was greater. That an airway fire of this

type had not occurred previously in institutional memory led to a decreased awareness of the risk of high FiO<sub>2</sub> gas coming into close proximity to electrocautery. Communication between the surgeon and anesthesiologist with respect to electrocautery use during the period of lung inflation was not protocolized for this procedure due to lack of recognition regarding the possibility of fire. Finally, although protocol existed to deploy a second ventilator to re-inflate the operative lung independently at a controlled FiO<sub>2</sub>, it was infrequently used due to perceived lack of need, technical challenges, and delays in bringing the machine in a timely fashion.

At the RCA, participants also reviewed the definition of surgical fire versus controlled electrocautery. The 2015 Joint Commission Sentinel Event policy defines a fire as “fire, flame or unanticipated smoke, heat or flashes occurring during an episode of patient care” and notes that a spark or flame from equipment not required for patient care or a spark from equipment plugged into an outlet would not be considered a sentinel event unless patient harm occurred (asamonitor.pub/3tckicc). In this case, similarity between routine electrocautery-induced burning and several seconds of burning surgical gauze in the chest cavity caused the event to not be reported for several days afterward.

### Countermeasures

To develop possible countermeasures, a literature review was conducted that included the 2013 ASA Practice Advisory for the Prevention and Management of Operating Room Fires (*Anesthesiology* 2013;118:271-90). Although likely underreported, such events are estimated to occur in one per 360,000 procedures in the U.S. (*BJA Educ* 2019;19:261-6). All fires require an ignition source (most often cautery), fuel (surgical drapes, gauze, alcohol-containing prep solutions), and an oxidizer (either oxygen or nitrous oxide) (*Anesthesiology* 2013;118:271-90). Most occurrences are during face, neck or upper chest surgery in sedated patients (with supplemental oxygen) (*Anesthesiology* 2013;118:1133-9) or during airway surgery in the presence of high inspired oxygen concentrations (*Ann R Coll Surg Engl* 2001;83:376-80; *Eur J Anaesthesiol* 2000;17:204-7). Countermeasures include use of low FiO<sub>2</sub> concentrations when possible, explicit communication regarding electrocautery use, allowing skin prep to dry



Photo courtesy of the Anesthesia Patient Safety Foundation.

before beginning surgery, use of moistened gauze and surgical sponges, and use of suction for scavenging high-FiO<sub>2</sub> gases (*Anesthesiology* 2013;118:271-90; *BJA Educ* 2019;19:261-6).

Unfortunately, few countermeasures are described in prevention guidelines for fires that occur during thoracic surgery. No such cases are described in the ASA 2013 Closed Claims analysis (*Anesthesiology* 2013;118:271-90), highlighting their rarity. However, a similar case was reported in 2005 along with author recommendations to insufflate the operative lung independently with air to reduce the O<sub>2</sub> concentration in the chest (*Anesth Analg* 2005;101:612). In addition, a 2018 report described a fire during video-assisted thoracoscopy for resection of pulmonary bullae and recommended less use of electrocautery and high FiO<sub>2</sub> (*J Thorac Dis* 2018;10:E549-51). Intrathoracic fires have also been described during right lower lobe resection when CPAP was used to augment oxygenation (*Anaesth Intensive Care* 2001;29:301-3). A 2010 report of fire during coronary artery bypass grafting with left internal mammary dissection suggested wetting surgical sponges to limit the amount of ignitable fuel (*J Cardiothorac Surg* 2010;5:10).

Independent ventilation of the operative lung, either via use of a second ventilator or insufflated air (*Anesth Analg* 2005;101:612; *Ann Transl Med*

2017;5:246) was considered. However, it was felt that in this case the sizeable leak would have caused the second ventilator to alarm constantly. In this case, an air flowmeter had been available in the dedicated thoracic OR for this purpose, but due to an emergency case in that room, the procedure was scheduled in a non-thoracic OR without an air flowmeter.

To address these issues, the case was presented at Anesthesia Quality Improvement meetings both before and after the RCA to raise departmental awareness of this rare but potentially dangerous complication and the availability of second ventilators and air flowmeters in thoracic ORs. In addition, protocols for communication during pleurectomy were reviewed, and use of saline-based bipolar electrocautery devices were prioritized for this procedure by surgical and nursing staff.

Most surgical fires occur during airway surgery or surface procedures on the face, neck, or upper chest with open use of supplemental oxygen. However, intraoperative fires have been described in the chest cavity during thoracic surgery where leakage of airway gas with high oxygen concentrations may occur. Since such occurrences do not involve open oxygen administration or airway surgery, they “fly under the cognitive radar,” and awareness of the potential for intrathoracic fire is lower. Because parenchymal lung damage is almost always present, re-inflation of the operative lung is likely to introduce high oxygen concentrations into the thoracic cavity and increase the likelihood of fire. Frequent use of high FiO<sub>2</sub> concentrations and positive airway pressure to maintain oxygenation during one-lung ventilation also increase risk. Careful communication between the surgeon and anesthesiologist regarding the presence of leak and use of electrocautery, independent ventilation of the operative lung via a dedicated air flowmeter or second ventilator, use of saline-based electrocautery, and wet surgical gauze and sponges may reduce the likelihood of fire. ■

Review of unusual patient care experiences is a cornerstone of medical education. Each month, the AQI-AIRS Steering Committee abstracts a patient history submitted to the Anesthesia Incident Reporting System (AIRS) and authors a discussion of the safety and human factors challenges involved. Real-life case histories often include multiple clinical decisions, only some of which can be discussed in the space available. Absence of commentary should not be construed as agreement with the clinical decisions described. Feedback regarding this article can be sent by email to [airs@asahq.org](mailto:airs@asahq.org). Report incidents or download the AIRS mobile app at [www.aqiairs.org](http://www.aqiairs.org).