# Operating Room Fires

## *A Closed Claims Analysis*

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## ABSTRACT

**Background:** To assess patterns of injury and liability associated with operating room (OR) fires, closed malpractice claims in the American Society of Anesthesiologists Closed Claims Database since 1985 were reviewed.

**Methods:** All claims related to fires in the OR were compared with nonfire-related surgical anesthesia claims. An analysis of fire-related claims was performed to identify causative factors.

**Results:** There were 103 OR fire claims (1.9% of 5,297 surgical claims). Electrocautery was the ignition source in 90% of fire claims. OR fire claims more frequently involved older outpatients compared with other surgical anesthesia claims ($P < 0.01$). Payments to patients were more often made in fire claims ($P < 0.01$), but payment amounts were lower (median $120,166) compared to nonfire surgical claims (median $250,000, $P < 0.01$). Electrocautery-induced fires (n = 93) increased over time ($P < 0.01$) to 4.4% claims between 2000 and 2009. Most (85%) electrocautery fires occurred during head, neck, or upper chest procedures (high-fire-risk procedures). Oxygen served as the oxidizer in 95% of electrocautery-induced OR fires (84% with open delivery system). Most electrocautery-induced fires (n = 75, 81%) occurred during monitored anesthesia care. Oxygen was administered via an open delivery system in all high-risk procedures during monitored anesthesia care. In contrast, alcohol-containing prep solutions and volatile compounds were present in only 15% of OR fires during monitored anesthesia care.

**Conclusions:** Electrocautery-induced fires during monitored anesthesia care were the most common cause of OR fires claims. Recognition of the fire triad (oxidizer, fuel, and ignition source), particularly the critical role of supplemental oxygen by an open delivery system during use of the electrocautery, is crucial to prevent OR fires. Continuing education and communication among OR personnel along with fire prevention protocols in high-fire-risk procedures may reduce the occurrence of OR fires.

### What We Know about This Topic

- The relative importance of factors contributing to operating room fires remains unclear

### What This Article Tells Us That Is New

- In evaluation of the Closed Claims database, electrocautery was responsible for 90% of the fire claims
- Most fire claims occurred in patients who had monitored anesthesia care with open oxygen delivery for upper chest, neck, and head procedures

FIRES and explosions in the operating room (OR) have been described since the development of flammable volatile anesthetics. In 1937, a committee appointed by the American Society of Anesthesiologists (ASA) investigated 230 incidents of fire/explosion in the OR[1] and described the hazards of using electrocautery in the presence of oxidizer and fuel.[2]

Many anesthesiologists and surgeons remain unaware of fire risks in the OR, despite recent recommendations of the ASA Practice Advisory for the Prevention and Management of Operating Room Fires[3] and the Anesthesia Patient Safety Foundation.[4]‖ The Food and Drug Administration recently launched a new patient safety initiative to prevent OR fires.# The Anesthesia Patient Safety Foundation recently emphasized that prevention of OR fires may require more cautious use of supplemental oxygen via an

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‖ Anesthesia Patient Safety Foundation. Fire Safety Video. Available at: http://www.apsf.org/resources_video_commentary.php?id=1. Accessed October 20, 2011.

\# FDA Safety Communication: Preventing Surgical Fires: Date issued October 13, 2011. Available at: http://www.fda.gov/MedicalDevices/Safety/AlertsandNotices/ucm275189.htm. Accessed October 20, 2011.

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open delivery system.[4] The Emergency Care Research Institute, after extrapolating data published by the Pennsylvania Patient Safety Authority, estimated that 550–650 surgical fires occurred nationally each year,[5] an instance comparable to that of wrong-site surgery. We therefore used the ASA Closed Claims Project database, a structured evaluation of closed malpractice claims from 35 professional liability insurance companies, to analyze clinical details associated with OR fire claims. We tested the hypothesis that OR fires as a source of claims increased over time. We also analyzed the clinical characteristics of OR fires during monitored anesthesia care (MAC) and regional anesthesia (RA) compared to fires during general anesthesia (GA), particularly concerning the role of supplemental oxygen administered via an open delivery system.

## Materials and Methods

The ASA Closed Claims Project methodology has been well described.[6] Briefly, closed claim files, typically consisting of the hospital and medical records, narrative statements from involved healthcare personnel, expert and peer reviews, deposition summaries, outcome reports, and the cost of settlement or jury awards, were reviewed onsite at the professional liability company by practicing board-certified anesthesiologists. The onsite reviewer completed a standardized form for each claim with information on patient characteristics, surgical procedures, sequence and location of events, critical incidents and injuries, severity of injury, standard of care, outcome, and payments. Each claim was assigned an injury severity score using the insurance industry's 10-point severity scale that ranges from 0 (no injury) to 9 (death). Injuries were grouped into one of three categories: temporary or nondisabling (scores 0–5), permanent and disabling (scores 6–8), and death (score 9). The injury-causing event was determined by the onsite reviewer and later confirmed by the Closed Claims Committee. Based on reasonable and prudent practice at the time of injury, the onsite reviewer also judged whether the anesthesia care met standards (appropriate), was substandard, or was impossible to judge. Previously published studies have found the reliability of reviewer judgments to be acceptable.[7] Finally, the onsite reviewer wrote a detailed claim summary narrative of the sequence of medical events to describe and explain the circumstances and outcomes of each claim. Claims for dental damage were not included in the database.

OR fires, occurring from 1985 to 2009, were included in the current study, from a total database of 9,536 claims. OR fire claims were compared to nonfire surgical anesthesia claims from the same time period (obstetric, acute pain, and chronic pain claims not included).

### *Study Variables Classifications*

The following variables were classified from the data forms and claim summaries by two authors (SPM and KBD), with discrepancies resolved by a third author (KP). The location of the surgical procedure was categorized as head, neck or upper chest, oral or tracheal, and other procedure locations to identify procedures at high risk of fires. According to the ASA Practice Advisory for Operating Room Fires, a high-fire-risk procedure was defined as one in which an ignition source (*e.g.*, electrocautery) may come in proximity to an oxidizer-enriched atmosphere (*e.g.*, supplemental oxygen or nitrous oxide).[3]

If the surgical procedure required the use of an airway device, this was further classified as nasal cannula, face mask, endotracheal tube, and other type of device. Alcohol-containing prep solutions and other fuels containing volatile compounds (Lacri-lube, hair spray or gel, colloidin, alcohol-soaked sponges, etc.) were categorized. Oxidizer sources were determined according to the presence of supplemental oxygen or nitrous oxide. Burn locations were categorized as skin, mouth, and airway. For the purpose of this study, we defined skin as any part of the epithelium on the body excluding the lips. Mouth was defined as the area from the lips to inside of the oral cavity through the uvula. Airway was defined as the posterior pharynx, larynx, and trachea. The ignition sources were classified as electrocautery, lasers, and miscellaneous devices. For cases involving MAC, the type of sedation, if known, was categorized as follows: propofol alone; propofol plus other agents (*e.g.*, benzodiazepines, opioids, other, etc.); benzodiazepine–opioid combinations (any of the types)—this category included any benzodiazepine and any opioids, but excluded propofol and other agents; hypnotic alone and with other agents; and other alone (*e.g.*, ketamine, droperidol, diphenhydramine, ketorolac, dexmedetomidine).

### *Statistical Methods*

OR fire claims were compared to nonfire surgical anesthesia claims using Fisher exact test for ASA physical status, age groups, outpatient *versus* inpatient procedure, type of anesthesia (MAC/RA [neuraxial or peripheral] *vs.* GA), severity of injury, standard of care, and claim payments. Payments to the plaintiff were adjusted to 2011 dollar amounts using the Consumer Price Index and were presented as median and interquartile range. Payment amounts (excluding $0 and missing data) were compared for differences in the distribution using the Mann–Whitney U test with Monte Carlo significance calculated from 10,000 random tables.

For cautery-induced fire claims, patient's age, ASA physical status, type of procedure, airway device used, and burn location were compared between fires during MAC/RA *versus* GA with Fisher exact test with statistical significance derived from Monte Carlo simulation with 10,000 replications. Cautery fires were compared with all nonfire surgical claims for trends over time (and trends over time within MAC claims) by logistic regression of cautery fire on year. Year was the only factor analyzed. The years 2006–2009 were combined in this analysis due to the small number of claims during these years. Logistic regression was conducted in R 2.14.0 (The R Foundation for Statistical Computing, Vienna, Austria). All other statistical tests were conducted with PASW Statistics 18.0.3 (IBM Corporation, Somus, NY). All tests were two-tailed with the threshold of statistical significance set at $P < 0.05$.

## Results

### *OR Fire Claims* versus *Nonfire Surgical Claims*

There were 103 OR fire claims and 5194 nonfire surgical claims, with the electrocautery serving as the ignition source in the vast majority of fire claims (n = 93, 90%). Patients in fire claims were older and more often had elective procedures under MAC or RA compared to patients with nonfire surgical claims ($P < 0.01$, table 1). The severity of injury was lower in fire claims (81% *vs.* 47% temporary or nondisabling, $P < 0.01$) and anesthesia care was more often judged as substandard (51% *vs.* 39%, $P = 0.035$, table 1). Although payments to patients were more often made in fire claims (78% *vs.* 51% in nonfire claims, $P < 0.01$), the payment amounts were lower in fire claims (median $120,166) compared to nonfire surgical claims (median $250,000, $P < 0.001$, table 1).

### *Electrocautery-induced Fires*

Electrocautery-induced fires increased over time, ranging from less than 1% of all surgical claims in 1985–1994 to 4.4% of all surgical claims between the years 2000 and 2009 ($P < 0.01$) (fig. 1). Electrocautery-induced fires increased to 31% of MAC claims in 2000–2009 ($P < 0.01$, fig. 2). Oxygen was the oxidizer source in 95% of all electrocautery fires (table 2). In three low-fire-risk procedures, the electrocautery ignited flammable fuels, including colloidin (n = 1, GA) alcohol prep (n = 1, MAC), and an alcohol-soaked sponge (n = 1, GA) without a supplemental oxidizer. Alcohol-containing prep solutions (n = 10), hair spray or gel (n = 2), alcohol-soaked sutures (n = 1), and Lacri-lube (n = 1) served as fuels in the presence of supplemental oxygen in 15% of electrocautery-induced fires (table 2).

**Burn Injuries during MAC/RA.** Most electrocautery-induced fires (n = 77, 83%) occurred during MAC (n = 75) and sedation for RA (n = 2, both epidural). Electrocautery fires during MAC increased from 6% of MAC claims during 1985–1989 to almost one-third of MAC claims during 2000–2009 ($P < 0.01$, fig. 2). Nearly all claims for electrocautery-induced fires during MAC/RA involved high-fire-risk procedures (99%) with use of supplemental oxygen (99%, table 2). Plastic surgery procedures on the face accounted for 64% of MAC/RA fire claims. Other common high-fire-risk MAC/RA procedures included temporal artery biopsy (8%), carotid endarterectomy (3%), or other neck procedures (12%), and procedures on the upper chest such as pacemaker or central venous catheter placement (6%). The most common airway devices used to administer supplemental oxygen were open delivery systems including nasal cannula (53%) and face

**Table 1.** Patients in Fires *versus* Other Claims

| Characteristics | Fire Claims n = 103 | Nonfire Surgical Claims n = 5,194 | *P* Value |
|---|---|---|---|
| Female* | 64 (62%) | 2,627 (51%) | 0.028 |
| Patient age, yr* | | | <0.01 |
| ≤16 yr | 8 (8%) | 364 (7%) | |
| 17–55 yr | 40 (39%) | 2,930 (58%) | |
| ≥56 yr | 55 (53%) | 1,788 (35%) | |
| ASA physical status 1–2* | 52 (55%) | 2,439 (56%) | 0.917 |
| ASA E* | 3 (3%) | 798 (17%) | <0.01 |
| Outpatient* | 74 (78%) | 1,407 (30%) | <0.01 |
| Anesthesia type | | | <0.01 |
| GA or GA/RA | 25 (24%) | 4,052 (78%) | |
| MAC or RA | 78 (76%) | 974 (19%) | |
| Severity of injury* | | | <0.01 |
| Temporary or nondisabling | 83 (81%) | 2,419 (47%) | |
| Permanent and disabling | 14 (14%) | 1,110 (21%) | |
| Death | 6 (6%) | 1,663 (32%) | |
| Substandard anesthesia care* | 44 (51%) | 1,755 (39%) | 0.035 |
| Payment made | 80 (78%) | 2,657 (51%) | <0.01 |
| Payment in 2011$† | | | 0.001 |
| Median | $120,166 | $250,000 | |
| Interquartile range | $43,861–$280,000 | $62,400–$758,500 | |

*P* values by chi-square or Fisher exact test for proportions and Mann–Whitney U test for payment amount using Monte Carlo significance based on 10,000 random tables.

* Claims with missing data excluded. † Payments adjusted to 2011 dollar amounts using Consumer Price Index; claims with no payment or missing data excluded.

ASA = American Society of Anesthesiologists; E = emergency; GA = general anesthesia; MAC = monitored anesthesia care; RA = regional anesthesia.

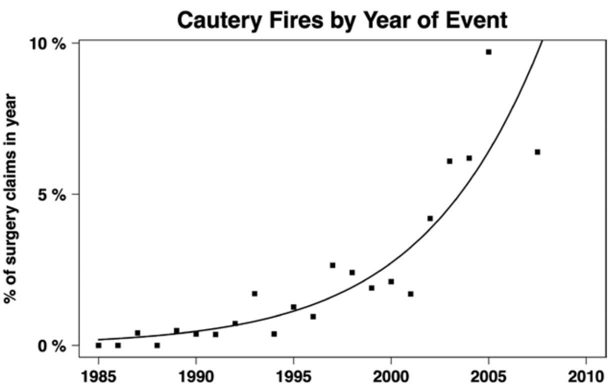


**Fig 1.** The percentage of cautery fires have increased over time from approximately <1% of all surgical claims during 1985–1989 to 4.4% of all surgical claims between the years 2000 and 2009 ($P$ < 0.001 by logistic regression of cautery fire on year). The markers show cautery fires as a percent of nonfire surgical claims during each year, with the years 2006–2009 combined and indicated at the average year of 2007.5. The *line* represents the fitted logistic regression curve of cautery fire on year.

masks (34%). Dioxide flow rates, where known, were above 4 l/min in approximately half of the cases (table 2). Alcohol-containing prep solutions or volatile compounds were used in less than a fifth (14%, n = 11) of electrocautery-induced fires during MAC/RA (oxygen used in all but one of these claims). Most burns during MAC/RA were confined to the skin (86%) or skin and mouth region (10%, table 2). Propofol (with or without any type of additional drugs including benzodiazepine or opioid sedation) was used in nearly half (43%, n = 33) and benzodiazepine or opioid with or without additional drugs, but excluding propofol, in approximately one-third of MAC/RA electrocautery-induced fire claims (35%, n = 27).

**Burn Injuries during GA.** Seventeen percent (n = 16) of electrocautery-induced fires occurred during GA, with years of injury from 1991 to 2009. The majority occurred during tonsillectomy (n = 4) or tracheostomy (n = 6) surgeries using an endotracheal tube, mostly from cuff leaks or ruptures (table 2). Fires occurred during administration of oxygen by mask in three high-fire-risk procedures. Nitrous oxide/oxygen was used in two cases and volatile compounds (hair spray, colloidin, alcohol-soaked sponge) in three cases (table 2). Nearly half (44%) of the burns during GA involved the airway, with the remainder of burns limited to the skin (44%) or mouth/lips (13%, $P$ < 0.01 *vs.* MAC/RA, table 2).

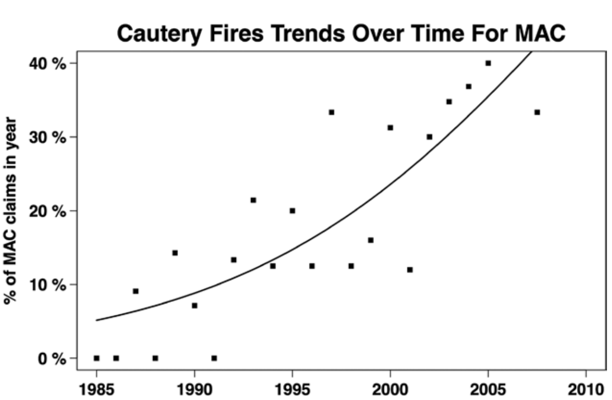


**Fig 2.** Cautery fires during monitored anesthesia care (MAC) increased from 6% of MAC claims during 1985–1989 to 31% of MAC claims during 2000–2009 ($P$ < 0.001 by logistic regression of MAC cautery fires on year). The markers show cautery fires during MAC as a percent of nonfire MAC surgery claims during each year, with the years 2006–2009 combined and indicated at the average year of 2007.5. The *line* represents the fitted logistic regression curve of cautery fire on year.

### *Burn Injuries from Nonelectrocautery Devices*

Causes of nonelectrocautery fires included lasers (n = 9) and a defibrillator (n = 1), occurring between 1989 and 2003. Laser fires during GA (n = 8) occurred with inspired oxygen concentrations greater than 30% and resulted in burns to the trachea and larynx. One laser fire during MAC resulted in burns to the nose, lips, and chest. A single defibrillator fire, which occurred during GA, resulted in burns to the wrist. In all nonelectrocautery fires, the principal source of fuel was airway equipment (*e.g.*, nasal cannula and endotracheal tubes).

## Discussion

Claims for electrocautery-induced OR fires during MAC increased dramatically over time, representing almost a third of claims related to MACs in the 2000s, despite the fact that fires are largely preventable. The majority were during high-fire-risk procedures with supplemental oxygen by open delivery systems. Oxygen served as the oxidizer in 95% of electrocautery-induced OR fires and in all of the fires ignited by other ignition sources. In contrast, alcohol-containing skin preparation solutions served as fuels in a minority of OR fires.

### *Fire Triad*

Generation of fire requires the presence of three components, known as the "fire triad": (1) an oxidizer, (2) an ignition source, and (3) fuel.[3] Oxidizers used in the OR are oxygen or nitrous oxide.[3] Both of these agents increase the likelihood and intensity of combustion in the surgical field in a concentration-related manner. Although electrocautery is most often the primary ignition source, other sources include lasers, argon beam coagulators, heated probes, drills and burrs, fiberoptic light cables, and defibrillator paddles or pads.[3] 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, and blankets.[3] Wet alcohol-containing prep solutions have been implicated in a number of cautery-induced fires.[3] However, use of supplemental oxygen is the predominant cause in most OR fires we reviewed, as combustion is markedly enhanced in an oxygen-enriched environment. Relatively few fires in this series were fueled by alcohol skin

**Table 2.** Electrocautery-ignited Fire Details by Anesthetic Technique

| | MAC/RA n = 77 | GA n = 16 | Total n = 93 | *P* Value |
|---|---|---|---|---|
| Patient age, yr | | | | 0.007 |
| ≤16 yr | 3 (4%) | 5 (31%) | 8 (9%) | |
| 17–55 yr | 30 (39%) | 4 (25%) | 34 (37%) | |
| ≥56 yr | 44 (57%) | 7 (44%) | 51 (55%) | |
| ASA physical status 1–2* | 40 (56%) | 6 (43%) | 46 (54%) | 0.392 |
| ASA E* | 1 (1%) | 2 (13%) | 3 (3%) | 0.074 |
| Procedure | | | | <0.01 |
| Head, neck, or upper chest | 75 (97%) | 4 (25%) | 79 (85%) | |
| Oral or tracheotomy | 1 (1%) | 10 (63%) | 11 (12%) | |
| Other—all low fire risk | 1 (1%) | 2 (13%) | 3 (3%) | |
| Airway device (three low-risk procedures excluded)† | | | | <0.01 |
| Nasal cannula | 40 (53%) | 0 | 40 (44%) | |
| Face mask | 26 (34%) | 3 (21%) | 29 (32%) | |
| ET tube | 0 | 10 (71%) | 10 (11%) | |
| Other‡ | 10 (13%) | 1 (7%) | 11 (12%) | |
| Fuel/oxidizer | | | | |
| Alcohol-containing prep | 11 (14%) | 0 (0%) | 11 (12%) | |
| Other volatile compounds§ | 3 (4%) | 3 (19%) | 6 (6%) | |
| Oxygen as oxidizer | 76 (99%) | 12 (75%) | 88 (95%) | |
| Nitrous oxide and oxygen as oxidizer | 0 | 2 (13%) | 2 (2%) | |
| Burn location‖ | | | | <0.01 |
| Skin | 66 (86%) | 7 (44%) | 73 (78%) | |
| Airway | 3 (4%) | 7 (44%) | 10 (11%) | |
| Mouth/lips | 8 (10%) | 2 (13%) | 10 (11%) | |

Percentages may sum to >100% due to rounding. *P* values by Fisher exact test with Monte Carlo *P* values based on 10,000 sampled tables.

* Claims with missing data excluded. † $O_2$ flow rates for open delivery systems were available for 46 of 77 MAC/RA claims. Of the 46 claims, 25 (54%) had $O_2$ flow rates of >4 l/min and 21 (46%) had $O_2$ flow rates of ≤4 l/min. ‡ Other airway equipment included blow by oxygen (n = 4), cut suction catheters taped to a patient's face (n = 2), tracheostomy mask (n = 1), face tent (n = 1), misplaced $O_2$ cannula from preop (pt had LMA during procedure) and unknown oxygen devices (n = 2). § Other volatile compounds included Lacri-lube, hair spray, colloidin, hair gel, alcohol-soaked sutures, and alcohol-soaked sponge (n = 1 each). ‖ Location of burn: For purposes of analysis, airway may include mouth, lips, or skin; mouth/lips may include skin but excludes any airway involvement; skin excludes any involvement of airway, mouth or lips.

ASA = American Society of Anesthesiologists; E = emergency; ET = endotracheal; GA = general anesthesia; MAC = monitored anesthesia care; RA = regional anesthesia.

preparation or fluids, or volatile compounds, whereas oxygen was nearly always used (Table 2).

### Electrocautery-induced OR Fires during MAC/RA

Previous case reports of OR fires under MAC mostly had oxygen as the oxidizing source.[8–10] In a previous report of closed claims related to MAC, electrocautery was the ignition source in the presence of supplemental oxygen using a facemask or nasal cannula for initiating all fires during MAC.[11] Almost all MAC cases in the current analysis (which includes the 20 cases in the previous report)[11] used supplemental oxygen administered by an open delivery system. Oxygen is one of the most frequently administered drugs from the pharmacopoeia. It is often administered at flow rates or concentrations that are higher than needed to maintain acceptable $Sp_{O_2}$ and this practice can lead to fires in high-fire-risk procedures.

Fires are easily ignited with a sustained flame with 100% oxygen administered at high flow rates. The time for ignition of a drape by both electrocautery[12,13] and laser[14] decreases with increasing oxygen concentrations, resulting in more rapid and severe fires. Using a raw chicken meat model to simulate oropharyngeal fires, the electrocautery ignited a sustained flame in 15–30 s in the presence of 100% oxygen delivered at 15 l/min. In contrast, with 50% oxygen, ignition with sustained flame occurred in 2–3 min, and the cautery did not cause ignition in this model with the oxygen concentration less than 45%.[12]

Several studies measured oxygen content near nasal prongs or beneath drapes.[15–19] Oxygen concentrations may be markedly higher than expected when administered via open delivery systems at high oxygen flow rates.[16] With low flow rates (<4 l/min) administered by nasal prongs oxygen concentrations rarely exceeded 26%.[18] Higher oxygen concentrations were observed with higher oxygen flow rates (6 l/min), ranging from 30 to 35% oxygen near the lips,[18] with even higher oxygen concentrations (60–70%) near the end of the nasal cannula observed in some studies.[17,19] Closed face draping increased the oxygen concentration under surgical drapes (>40%), whereas oxygen concentrations remained close to room air with open face draping.[15] Cessation of supplemental oxygen at 3 l/min reduced the oxygen concentration below drapes to room air in 60 s, whereas a longer duration was required for higher flow rates.[15] Use of alternate supplemental oxygen delivery systems such as a nasopharyngeal system (where cut ends of a nasal cannula are placed into a nasopharyngeal airway),[17,19] a scavenger system under the drapes along with low oxygen flow rates,[16] or sub-100% oxygen gas mixtures,[20] reduce observed oxygen concentrations.

Our closed claims review found that the majority of MAC cases used sedation with both propofol and other agents. In some cases, communication by the surgeon requesting "heavy sedation" often resulted in the use of higher oxygen flow rates because of patient desaturations. In contrast to the importance of supplemental oxygen, only a minority of the MAC claims in our analysis involved the use of volatile skin-prepping agents as synergistic fuels.

### OR Fires during GA

Fire risk with use of electrocautery during airway surgery has been described in numerous case reports, especially during tracheostomy[21–24] and tonsillectomy.[25–27] The majority of the 16 OR fires during GA in our analysis occurred during these procedures. An oxygen leak into the surgical field is always present during tracheostomy once the trachea is incised. Cauterizing a bleeding vessel or performing further dissection using the electrocautery increases the risk of fire at this surgical stage. Tonsillectomy presents a risk of fire when the electrocautery contacts a flammable substance (*e.g.*, fat, soft tissue, and plastic tubing) in an oxidizer-rich environment (*e.g.*, oxygen or nitrous oxide). An uncuffed endotracheal tube, or any leak around a cuffed endotracheal tube due to inadequate inflation or cuff rupture, may allow for a significant retrograde flow of oxygen into the oropharynx, as described in case reports[25,26] and in three of our cases. A recent survey of otolaryngologists reported that the electrocautery was the most common ignition source in OR fires (59% of fires) and the most common fuel was the endotracheal tube (31%).[28]

### Limitations of Closed Claims Analysis

The limitations of analyzing and interpreting data gathered from the ASA Closed Claims Project Database have been previously described.[6,11] Briefly, the database does not have data on the total number of OR fires (the numerator) or the total number of anesthetics performed during this period (the denominator). Hence, we cannot provide any estimate of the incidence/risks of fire in the OR. In addition, only a small proportion of adverse events result in a malpractice claim.[29] Since we do not have access to all the insurance carriers in the United States, we cannot report on all OR fire-related claims. The data are collected in a nonrandom, retrospective manner from direct participants. Also, the database has only that information which the closed claims reviewer could obtain from the insurance company files. Closed claims analysis is weaker than prospectively collected data due to gaps in detailed information regarding the sequence of events leading to the injury. In almost half of the MAC/RA cases, the flow rates of supplemental oxygen were unknown. The majority of cases in this series occurred before the publication of the ASA Practice Advisory for the Prevention and Management of Operating Room Fires[3] so we cannot assess the impact of the advisory. However, recent Anesthesia Patient Safety Foundation,[4‖] and Food and Drug Administration# warnings emphasize that electrocautery-induced OR fires oxidized by supplemental oxygen remain a serious problem. With regard to the MAC cases, we were unable to determine the depth of sedation that was used during these surgical procedures and whether it would have been more appropriate to use a sealed airway delivery device (*e.g.*, endotracheal tube or laryngeal mask airway).

### Conclusions and Clinical Recommendations

The risk of OR fires can presumably be reduced by following the recommendations of the ASA Practice Advisory,[3] the Anesthesia Patient Safety Foundation,[4‖] and the recent initiative surgical fire prevention program by the Food and Drug Administration# to promote safer practices and share fire prevention resources. The approach involves all the members of the surgical team—surgeons, anesthesia providers, nursing, and technical staff. Team communication of fire risk and prevention is important during the presurgical checklist, as well as intraoperatively regarding timing of the use of electrocautery with discontinuing supplemental oxygen. The role of the anesthesia team is to keep oxidizer concentrations to a minimum during use of the electrocautery, as is evident by the important role of oxygen in this review of OR fire claims. The ASA Practice Advisory suggests several methods in addition to team communication to minimize oxygen delivery during electrocautery use in high-fire-risk procedures.[3] These recommendations include avoiding supplemental oxygen where possible during MAC cases, use of the lowest possible $F_{IO_2}$ to maintain oxygen saturation at an acceptable range, using a sealed gas delivery device such as an endotracheal tube or laryngeal mask airway if deep sedation is required, and preventing oxygen from collecting under the drapes by creating a venting system using IV poles or other attachments to tent the drapes.[3] Another key recommendation to prevent fires during GA is to ensure that there are no leaks around the endotracheal tube.[3]

In summary, OR fires are an increasing source of liability for anesthesiologists, with cautery fires representing greater than 4% of surgical anesthesia claims during 2000–2009 and 31% of claims associated with MAC during this time period. Electrocautery in the presence of supplemental oxygen during MAC was a predominant mechanism of OR fires. Recognition of the fire triad, particularly the critical role of supplemental oxygen by an open delivery system during electrocautery use, is crucial to prevent OR fires. Continuing education and communication among OR personnel along with fire prevention protocols in high-fire-risk procedures may reduce the occurrence of OR fires.

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