Laser airway fire: management

The ASA came out with updated guidelines regarding the prevention and management of airway fires in 2013 and to the best of my knowledge, they have not been updated since then. A fire requires 3 things:

-An **oxidizer**, such as oxygen and nitrous oxide
-An **ignition source** such as a laser, defibrillator pads, or electrocautery
-A source of **fuel**: such as an endotracheal tube, throat packing, or drapes

Given that the keyword is management, we will skip prevention and assume an airway fire has already been identified. The **first step is to remove the endotracheal tube.** This may seem counterintuitive in someone who just sustained a thermal injury to the airway and will likely require reintubation, however, in an airway fire it must be assumed that the source of oxidizer, the anesthesia circuit, is continuing to flow creating a functional jet of fire emerging from the end of the tube. Getting that out of the patient as quickly as possible is paramount. **Immediately following, stop all gas flows** on the anesthesia machine. Some advocate for these two steps to occur simultaneously, but the 2013 task force recognized that this is difficult to do when administering anesthesia solo and so they are sequentially ordered, “as fast as possible”. Next, **remove all flammable and burning material** from the patient, keeping in mind that certain fuels can burn with an apparent invisible flame in the brightly lit OR. **Saline or water should then be poured into the airway**.

Now that the fire is (hopefully) out, it is time to support the patient and assess the damage. **Reestablish mask ventilation** without nitrous oxide and as low an FiO_2 as possible. Next, **airway devices should be examined for intactness** as any missing fragments will need to be accounted for. **Bronchoscopy (rigid or flexible) should be considered** to find missingr breathing apparatus fragments, removal of debris, and injury assessment. A plan must then be developed for ongoing care of the patient.

If the initial steps did not extinguish the fire a **carbon dioxide extinguisher** should be used. These are safe to use on the patient as there is no particulate like seen with standard extinguishers.

Further Reading: Apfelbaum JL, Caplan RA, Barker SJ, Connis RT, Cowles C, Ehrenwerth J, Nickinovich DG, Pritchard D, Roberson DW, Caplan RA, Barker SJ, Connis RT, Cowles C, de Richemond AL, Ehrenwerth J, Nickinovich DG, Pritchard D, Roberson DW, Wolf GL; American Society of Anesthesiologists Task Force on Operating Room Fires. Practice advisory for the prevention and management of operating room fires: an updated report by the American Society of Anesthesiologists Task Force on Operating Room Fires. Anesthesiology. 2013 Feb;118(2):271-90. doi: 10.1097/ALN.0b013e31827773d2. PMID: 23287706.

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OPERATING ROOM FIRES ALGORITHM

Fire Prevention:

- Avoid using ignition sources [1] in proximity to an oxidizer-enriched atmosphere [2]
- Configure surgical drapes to minimize the accumulation of oxidizers
- Allow sufficient drying time for flammable skin prepping solutions
- Moisten sponges and gauze when used in proximity to ignition sources

Is this a High-Risk Procedure?
An ignition source will be used in proximity to an oxidizer-enriched atmosphere

YES →

- Agree upon a team plan and team roles for preventing and managing a fire
- Notify the surgeon of the presence of, or an increase in, an oxidizer-enriched atmosphere
- Use cuffed tracheal tubes for surgery in the airway; appropriately prepare laser-resistant tracheal tubes
- Consider a tracheal tube or laryngeal mask for monitored anesthesia care (MAC) with moderate to deep sedation and/or oxygen-dependent patients who undergo surgery of the head, neck, or face.
- *Before* an ignition source is activated:
  - *Announce* the intent to use an ignition source
  - *Reduce* the oxygen concentration to the minimum required to avoid hypoxia[3]
  - *Stop* the use of nitrous oxide[4]

No →

Fire Management:

Early Warning Signs of Fire[5]

HALT PROCEDURE
Call for Evaluation

Fire is not present; Continue procedure

FIRE IS PRESENT

AIRWAY [6] ***FIRE:***

IMMEDIATELY, without waiting

- Remove tracheal tube
- Stop the flow of all airway gases
- Remove sponges and any other flammable material from airway
- Pour saline into airway

NON-AIRWAY FIRE:

IMMEDIATELY, without waiting

- Stop the flow of all airway gases
- Remove drapes and all burning and flammable materials
- Extinguish burning materials by pouring saline or other means

If Fire is Not Extinguished on First Attempt
Use a CO_2 fire extinguisher [7]
If FIRE PERSISTS: activate fire alarm, evacuate patient, close OR door, and turn off gas supply to room

Fire out

- Re-establish ventilation
- Avoid oxidizer-enriched atmosphere if clinically appropriate
- Examine tracheal tube to see if fragments may be left behind in airway
- Consider bronchoscopy

Fire out

- Maintain ventilation
- Assess for inhalation injury if the patient is not intubated

Assess patient status and devise plan for management

[1] Ignition sources include but are not limited to electrosurgery or electrocautery units and lasers.
[2] An oxidizer-enriched atmosphere occurs when there is any increase in oxygen concentration above room air level, and/or the presence of any concentration of nitrous oxide.
[3] After minimizing delivered oxygen, wait a period of time (*e.g.,* 1-3 min) before using an ignition source. For oxygen dependent patients, *reduce* supplemental oxygen delivery to the minimum required to avoid hypoxia. Monitor oxygenation with pulse oximetry, and if feasible, inspired, exhaled, and/or delivered oxygen concentration.
[4] After stopping the delivery of nitrous oxide, wait a period of time (*e.g.,* 1-3 min) before using an ignition source.
[5] Unexpected flash, flame, smoke or heat, unusual sounds (*e.g.,* a "pop," snap or "foomp") or odors, unexpected movement of drapes, discoloration of drapes or breathing circuit, unexpected patient movement or complaint.
[6] In this algorithm, airway fire refers to a fire in the airway or breathing circuit.
[7] A CO_2 fire extinguisher may be used on the patient if necessary.