



## FIRE TRAIT: KEEPING THE LEGS APART

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**ABSTRACT** Fires in the Operating Room are more of a danger today as it was in past where cyclopropane or ether was used because we now routinely use electrosurgical cautery in presence of fuel rich sources and oxidizers (air, oxygen and nitrous oxide). Now, with laser surgeries reaching more rapidly to our intuition this risk is getting even larger. The effect of endotracheal tube being ignited while being ventilated by Oxygen and Nitrous oxide which essentially emit a blow torch is catastrophic. Although laparoscopic surgeries are done with carbon dioxide insufflation which doesn't support combustion, nitrous oxide diffuses intraabdominally and it gets easily mixed with bowel gases (methane and hydrogen) which can be ignited by cautery. These are a few examples of numerous sources of fires in our OR.

**KEYWORDS :** Fire, Fire Prevention, Operating Room Hazard

### Why to revisit fire safety?

Electrosurgical units and lasers in presence of rich fuel supply and ample oxygen and nitrous oxide, the incidence of fires in OT are still happening besides many precautions and measures. Some headlines from newspapers from recent year:

- Fire breaks out in west Delhi Hospital.
- Fire breaks out at Operation theatre in AIIMS Trauma Centre.
- Fire breaks out inside Man's Chest during heart surgery (Australia)

### Fire Problem:

- Estimates suggest: 550-650 fires each year (5-10% associated with serious injuries).<sup>1</sup>
- Most common locations: Patient's Airway (34% head or 28% face)
- Oxygen enriched atmospheres was a contributing factor in 74% of the cases.

### Hospital Fires: What are the hazards?



### The Fire Triangle<sup>[2]</sup>

#### Ignition Sources in Ot's

- Electro surgical units: 68% of fires
- Lasers: 13% of fires
- High Intensity Fibre-optic Light Sources
- Drills
- External Defibrillators
- Incandescent sparking
- Static discharge spark
- Loose boards & electrical circuits

#### Oxidizers:

- Oxygen and Nitrous Oxide function equally well as oxidizers.
- Combination of 50% oxygen and 50% nitrous oxide would avidly support combustion, as would 100%.
- All materials burn in the presence of an oxygen-enriched environment.
- The higher the concentration of oxygen, the more readily the material could be set on fire. In 50% and 95% O<sub>2</sub>, all the materials burned.

- In the case of the cotton, the time to ignition in 21% O<sub>2</sub> was a mean of 12 seconds. The same material ignited in 0.1 seconds in 95% O<sub>2</sub>.



### Common sources of Fuel in OT



"Prep" agents  
Alcohol  
Degreasers (acetone, ether)  
Adhesives (tincture of benzoin, Aeroplast)  
Chlorhexidine digluconate (Hibitane)  
Iodophor (Dura-Prep)  
Drapes and covers  
Patient drapes (paper, plastic, cloth)  
Equipment drapes (paper, plastic, cloth)  
Blankets and sheets  
Pillows, mattresses, and padding  
Gowns  
Masks  
Shoe covers  
Gloves (latex, nonlatex)  
Clothing  
Compression (antiembolism) stockings  
Patient  
Hair  
Alimentary tract gases (methane, hydrogen)  
Desiccated tissue  
Dressings  
Gauze and sponges  
Petrolatum-impregnated dressings  
Xeroform  
Adhesive tape (cloth, plastic, paper)  
Elastic bandages  
Stockinettes  
Sutures  
Steri-strips  
Colloidion  
Ointments  
Petrolatum  
Antibiotics (bacitracin, neomycin, polymyxin B)

Nitropaste (Nitro-Bid)  
EMLA  
Up balms  
Anesthesia equipment  
Breathing circuit hoses  
Masks  
Endotracheal tubes  
Oral and nasal airways  
Laryngeal mask airways  
Nasogastric tubes  
Suction catheters and tubing  
Scavenger hoses  
Volatile anesthetics  
CO<sub>2</sub> absorbers  
Intravenous tubing  
Pressure monitor tubing and plastic transducers  
Other equipment  
Charts and records  
Cardboard, wooden, and particleboard boxes and cabinets  
Packing materials (cardboard, expanded polystyrene [Styrofoam])  
Fiberoptic cable covers  
Wire covers and insulation  
Fiberoptic endoscope coverings  
Sphygmomanometer cuffs and tubing  
Pneumatic tourniquet cuffs and tubing  
Stethoscope tubing  
Vascular shunts (Gore-Tex, Dacron)  
Dialysis and extracorporeal circulation circuits  
Wound drains and collection systems  
Mops and brooms  
Textbooks and instruction manuals

**Preparation**

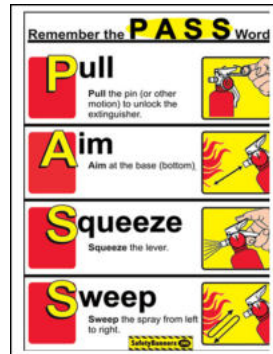
- Trained personnel in operating room fire management
- Fire drills
- Assure that fire management equipment is readily available.
- Determine if a high-risk situation exists.
- Each person assigned a task in case of fire.
- OTs should be equipped with Water sprinkling system & smoke alarm, checked and serviced regularly.
- Fire Extinguisher should be available and staff should be trained to use them.
- AMBU bag should be available in all Ot's

**Prevention**

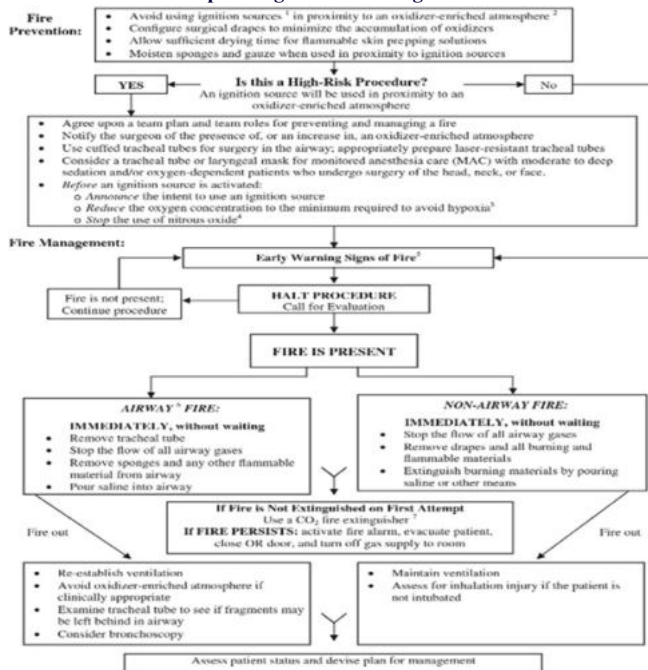
 <p><b>DO'S</b></p>	 <p><b>DON'TS</b></p>
<ul style="list-style-type: none"> <li>• Keep Electro cautery tip in the holster when Not in Use.</li> <li>• Surgical drapes configuration should not accumulate oxidizers.</li> <li>• Allow flammable skin preparations to Dry before draping.</li> <li>• Keep O<sub>2</sub>, N<sub>2</sub>O concentration as low as possible.</li> <li>• Maintain the relative humidity above 50%.</li> <li>• Shave hair of patient near operative site.</li> <li>• Install over-current protection on electrical devices.</li> <li>• Use Non-inflammatory Cuffed ET tubes and Inflate cuff of ET with NS in case of airway laser surgery or if cautery has to be used.</li> </ul>	<ul style="list-style-type: none"> <li>• Patients should be advised not to use petroleum-based creams/jelly.</li> <li>• Disposable drapes should not be used: More flammable.</li> <li>• Don't use ESU to control bleeding from trachea.</li> <li>• Avoid use ESU on oral surgeries.</li> <li>• Don't use diathermy near a distended bowel.</li> <li>• Avoid using nitrous oxide for surgeries of bowel.</li> <li>• Don't switch on high intensity light sources, when not in use.</li> </ul>

**Fire: Every Second Counts... R.A.C.E.!!**

- Rescue the Patient**
- General OT Fire Safety
  - Airway Fires
  - Drape Fires
  - Equipment Fires
- Activate Building Fire Alarm System**
- Fire Detection Devices
  - Phone Call to 101 or Security
- Confine**
- Compartmentalization by closed doors
  - HVAC Issues
  - Gas Shut off
- Extinguish**
- Saline Solution
  - Fire Extinguishers: P.A.S.S.
- Evacuate**
- Staff Responsibilities & Considerations:
  - Both own and patient safety.
  - Brining the table to "wheels" if power is lost.
  - Narrow corridors & doorways.
  - Items blocking the evacuation routes.
  - Forgetting to unplug ALL equipment before evacuation.
  - Knowing your receiving site.
  - Limited plugs and outlets at receiving sites.



**Operating Room Fire Algorithm<sup>[1]</sup>**



<sup>1</sup> Ignition sources include but are not limited to electrosurgery or electrocautery units and lasers.  
<sup>2</sup> 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.  
<sup>3</sup> 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.  
<sup>4</sup> After stopping the delivery of nitrous oxide, wait a period of time (e.g., 1-3 min) before using an ignition source.  
<sup>5</sup> 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.  
<sup>6</sup> In this algorithm, airway fire refers to a fire in the airway or breathing circuit.  
<sup>7</sup> A CO<sub>2</sub> fire extinguisher may be used on the patient if necessary.

**Take Away Message:**

In addition to fire extinguishers and the updated guidelines; only through awareness, education, training and communication; we can keep prevent and mitigate the risk of Operating Room fire.

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