

FIRES IN THE OPERATING THEATRE

There have been a number of recent reports in Victoria of fires within the operating theatre, resulting in some cases in serious morbidity. Some of these have involved the use of diathermy. Because the hazards associated with volatile anaesthetic agents have largely disappeared there now may be a tendency to ignore the risks associated with use of electrical equipment in the operating environment.

In view of recent adverse events, the Consultative Council believes it is important that procedures for preventing and managing such incidents be reviewed by all staff in operating theatres. It is strongly recommended that there be reference to and consideration of the Health Care Safety Alert produced by the Massachusetts Department of Public Health in March 2002. The full document can be viewed at www.state.ma.us/dph/dhcq/pdfs/orfires.pdf. As indicated in the 'Acknowledgements' section of this document, most of the recommendations are those put forth by ECRI (formerly the Emergency Care Research Institute, which is an independent nonprofit health services research agency) in their Health Devices Safety Reports. ECRI's Medical Device Safety Reports can be viewed at www.mdsr.ecri.org.

The three elements necessary for the production of a fire are the heat source, the combustible substance and the oxidiser, usually oxygen or nitrous oxide. The temperature at the end of a diathermy point is said to reach up to 1500 degrees F and virtually all foreign materials in contact with the patient are combustible. Thus, serious burns can occur if immediate management is not instituted. This is summarised by the following table taken from ECRI.

**ECRI's Table of Typical Coexisting Ingredients that Could Cause an OR Fire
(Excluding flammable anaesthetics)**

Oxidisers	Ignition Sources	Combustible Substances
Oxygen	Electrosurgical units	Patient (hair, GI tract gases)
Nitrous oxide	Electrocautery units (both battery and line operated)	Prepping agents/Degreasers: ether, acetone. Freon is nonflammable.
	Surgical lasers	Aerosol adhesives
	Fibreoptic light sources	Alcohol (also present when spilled from gut suture packets during opening)
	Incandescent spark	Tinctures (Hibitane [chlorhexidine digluconate] Merthiolate [thimerosal])
	Static discharge spark	Linens (drapes [nonwoven, woven and adherent]); gowns; masks; hoods; caps)
		Dressings (gauze, sponges, adhesive tape [cloth, plastic])
		Ointments (Collodion; Petrolatum [petroleum jelly]; Tincture of benzoin; aerosols [e.g., Aeroplast ®]; paraffin; white wax)
		Plastic/rubber products (blood pressure and tourniquet cuffs, gloves, stethoscope tubing)
		Anaesthesia components (breathing circuits, masks, airways, endotracheal tubes)

Particular risks are associated with operations about the head and neck where there may be an oxygen-enriched atmosphere under the drapes. The use of diathermy in association with tracheostomy also constitutes a particular hazard. In this procedure diathermy is best avoided although it is recognised that on occasion it is difficult to arrest haemorrhage by ligation. On the other hand, many such patients require high-inspired oxygen and are intubated with a cuffed endotracheal tube, which can be combustible. In view of a recent accident under such circumstances the recommendations of the British Association of Otorhinolaryngologists (www.orl-baohns.org) are a timely reminder of the necessary precautions.

PREVENTION AND MANAGEMENT OF AIRWAY FIRE DURING TRACHEOSTOMY

RECOMMENDATIONS FOR PREVENTION:

1. All theatre staff should be aware that an airway fire may occur during tracheostomy. Have a bowl of saline and drapes available on the surgical instrument trolley at all times. Have a fire extinguisher immediately available. In practice, a carbon dioxide fire extinguisher will be the usual choice.
2. Have a self-inflating ventilation bag (e.g. Ambu bag) available in case it becomes necessary to ventilate the patient with room air.
3. The use of nitrous oxide is relatively contra-indicated during the higher risk part of the procedure, as more heat is produced in nitrous oxide mixtures.
4. Use a single-lumen endotracheal tube, which is long enough to allow the tip to be advanced to the carina (the carina is approximately 24-25 cm from the teeth in an average male). Positioning with a bronchoscope may be useful.
5. Use saline to inflate the endotracheal cuff. Make sure there is no leak of anaesthetic gases past the endotracheal cuff.
6. Use the lowest safe FIO₂ in air/oxygen mixture.
7. If the tracheostomy wound is significantly deep (example, in an obese patient), use a suction device to clear any build up of diathermy products from within the wound.
8. Before the trachea is opened, advance the endotracheal tube down the trachea so the tip is close to the carina in order to minimise the likelihood of damage to the cuff when the trachea is incised.
9. Control all bleeding points and obtain a meticulously dry operative field. Incise the trachea using either a scalpel, scissors or a harmonic knife. Never use diathermy to cut through the trachea.
10. Once the trachea has been opened and the surgeon is ready to insert the tracheostomy tube, stop ventilating, deflate the endotracheal tube cuff and withdraw the endotracheal tube carefully under direct vision until the tip is just above the tracheal hole (do not remove the tube completely at this stage). Be prepared to push the endotracheal tube back down the trachea to secure the airway if there are any difficulties, either while inserting the tracheostomy, or during the initial ventilation through the tracheostomy.

11. If bleeding occurs once the trachea has been incised, first ensure that the airway is secured with either a tracheostomy or endotracheal tube with the cuff inflated. If there is cuff leak from the trachea, then temporarily stop ventilation and ligate or suture the bleeding point. If bleeding persists use bipolar diathermy while using suction to clear oxygen and products from the wound. Consider pushing damp swabs into the wound to occlude any air leak.
12. Once the tracheostomy tube is secure in the trachea, inflate the tracheostomy cuff and suck out the tube using a suction catheter, checking that the suction tube passes easily through the whole length of the tube. If this is satisfactory, then commence ventilation through the tracheostomy.

MANAGEMENT OF AIRWAY FIRE

1. Extinguish the fire.
2. In the event of fire, immediately disconnect the patient from the anaesthetic machine, switch off the anaesthetic gas flow, disconnect the gas pipelines and ventilate with room air using a self-inflating bag.
3. Use an airway filter if there is smoke in the theatre.
4. Consider flushing saline down the endotracheal tube to extinguish any intraluminal fire.
5. Consider removing or changing the tube to minimise the inhalation of toxic products of combustion and spread of fire into the tracheo-bronchial tree. However, changing the tube may be more risky than leaving it in if the patient was previously difficult to intubate or the airway has become oedematous. If tube removal deemed necessary use ventilating exchange bougie.