MedStar Georgetown University Hospital

Department of Anesthesia	
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Anesthesia Laser Safety	9253
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POLICY:

Departmental guidelines for laser safety are to be followed to protect both patient and staff from the potential hazards, such as ocular injury, cutaneous burns or operating room/surgical fires.

PROCEDURES:

1. PREOPERATIVE EVALUATION

Perform appropriate preoperative evaluation of the patient and obtain informed consent.

Besides regular preoperative evaluation, one must search for and examine:
a) The degree of airway compromise of the patient
b) Patient's general health

The surgeon must make available for the anesthesiologist to review if necessary, the results of:

- Indirect or prior fiberoptic examinations
- Neck X-rays
- CXR, MRI scans of the larynx and/or neck
- Tomograms of the larynx
- Spirometry and flow volume curves
- Prior cardiac consultation
- Prior cardiac work-up

Seller's has classified preoperative airway obstruction into three types:

TYPE 1: Unobstructed airway at rest, and small lesion

TYPE 2: Mild degree of airway obstruction at rest. These patients may show a moderate degree of airway obstruction and distress on exertion

TYPE 3: Severe obstruction, severe respiratory distress at rest

2. PRE-MEDICATION

The premedication is guided by

a) The patient's general physical state
b) The state of the airway

Premedication drugs like barbiturates, narcotics, tranquilizers and diazepam promote:

a) Tongue and jaw relaxation
b) Respiratory depression

For premedication, avoid or use these drugs judiciously in patients with compromised airways.

Use atropine or glycopyrollate unless contraindicated; either give an intramuscular dose appropriate for age 30 minutes before the procedure, OR give an intravenous dose appropriate for age prior to induction.

3. INTRAOPERATIVE MANAGEMENT

Obtain necessary equipment and drugs in the operating room.

The necessary equipment includes:

a) Air-oxygen anesthesia machine equipped with a full air tank and a calibrated oxygen analyzer
b) A full oxygen tank with an ambu bag in the room
c) A fully stocked Laser, fiber optic endoscopy cart

The necessary drugs include:

a) An LTA kit
b) Tearsol eye drops bottle or equivalent ocular lubricant(1)
c) .25% neosynephrine nose drop (1 bottle)
d) 4% cocaine (1 bottle)
e) 1% IV xylocaine 5 cc (1 bristoget)
f) 4% xylocaine 5 cc (vial)
h) Albuterol inhaler (Ventolin)
I) Dexamethasone 10 mgs (2 vials)
j) Methylene blue 10 cc (1 vial)
k) Heparin (1 bottle)

Anesthesia monitoring

a) Standard: EKG, BP, precordial stethoscope, axillary or rectal temperature
b) Continuous oxygen saturation and capnography
c) Neuromuscular monitoring
d) Spot ABG's as necessary

The following standard anesthesia technique will be used, unless the pathologic lesion or the patient's age warrants a change in the anesthesia technique.

Anesthesia induction

In patients with no airway obstruction, a regular anesthesia induction will be used. This includes the following:

Adults

a) Alfentanil 10-20 ug/kg or Fentanyl 1-2 ug/kg, to suppress intubation response
b) Precurarize
c) Preoxygenation
d) Propofol 1.5 - 2 mg/kg
e) Succinylcholine 1-1.5 mg/kg for intubation
f) Xylocaine 1.5 -2 mg/kg, 2-4% spray to the posterior tongue, epiglottis, uvula, pharynx, trachea and cords
g) Intubate trachea with a size 5 or 6 mm laser pre-wrapped red rubber tube. (Sheridan®, Laser-Trach®)
h) Inflate the cuff with 1% xylocaine, colored by methylene blue
I) Tape tube loosely
j) Lubricate eyes with tearsol eye drops. Cover the eyes with wet eye patches.

Children

a) Inhalation induction with N_2O/O_2 or O_2 and Sevoflurane
b) Intravenous or intramuscular atropine in a dose appropriate for age
c) Atracurium 0.3-0.4 mg/kg or other muscle relaxants of your choice for intubation
d) Xylocaine spray to oropharynx, cords, epiglottis and trachea 1.5 -2 mg/kg, 2-4%.
e) Intubate trachea with a red rubber tube, laser pre-wrapped
f) Tape tube loosely
g) Lubricate eyes with Tearsol eye drops. Cover eyes with wet eye patches.

Note: Wrapping with reflective adhesive backed aluminum tape:
Wrap the red rubber tube fresh prior to the induction of anesthesia. In children the wrapping starts at the tip of the tube. The wrapping should be done circumferentially, and the tape should cover the previous turn by more than a half. The wrapping should continue till all the tube has been wrapped. Do not use a fragmented tape. The whole wrap of the aluminum should be one single piece. Bend the tube after the tube is wrapped to make sure that the underlying rubber is not exposed. The surgeon should also inspect the wrapping, and the wrapped tube should be tested prior to induction by the laser, on a wooden block.

Induction in patients with compromised airways:

a) In patients with Type 3 airway obstruction, an emergency tracheostomy with local anesthesia is the method of choice.
b) A surgeon must be present in case emergent tracheostomy is needed.
c) In patients able to cooperate, good topical anesthesia and awake intubation

with visualization of the cords is done OR a fiberoptic intubation is done. (blind intubation runs the risk of trauma to the lesions, bleeding and increased amounts of secretions which can convert a partial obstruction into a complete obstruction and is best avoided).

d) In children and in some patients unable to cooperate, an inhalation induction using sevoflurane with oxygen with maintenance of spontaneous breathing and laryngoscopy and intubation under deep anesthesia is the technique of choice.

Anesthesia maintenance

a) Air-oxygen mixture with inhalation agent. Use the lowest concentration of oxygen possible (25%-40%) to maintain an oxygen saturation of 90% and above.
b) Muscle relaxation using muscle relaxants of your choice.

Anesthesia checklist of the nurses and the surgeons

a) Saline saturated cottonoids used by the surgeon to protect the cuff of the endotracheal tube, and soaked intermittently to prevent drying.
b) Cover the eye, the face, the endotracheal tube and the anesthesia hoses with wet soaked towels after the suspension of the larynx by the suspension laryngoscope
c) Adequate smoke and plume evacuation by the surgeon
d) The power density and the radiant exposure used by the surgeon. To reduce fire hazards, minimum wattage should be used by the surgeon, and a pulsed mode rather than a continuous mode should be encouraged.
e) The ENT equipment for laser surgery should be the coated laser surgery equipment

In some pathologic lesions and in some pediatric patients, the endotracheal tube may be too bulky and may occupy a significant portion of the airway obstructing the surgeon's view. Two options are available in this situation, which must be agreed upon between the anesthesiologist and the surgeon prior to induction of anesthesia.

1) Insufflation technique and
2) Venturi jet ventilation technique:
    a. Supraglottic
    b. Infraglottic

With both these techniques, first the supraglottic and the easily visualized lesions are resected with the endotracheal tube in place, the laryngeal opening is made wider, then switch to the above techniques.

Insufflation technique

a) Maintain anesthesia by air-oxygen and sevoflurane
b) Maintain deep levels of anesthesia and spontaneous breathing
c) Spray the oropharynx-epiglottis, trachea and the cords with 1.5-2 mg/kg

xylocaine, 2-4%.

d) Insufflate air-oxygen and sevoflurane at a flow of 2.5-3 times the minute ventilation of the child, through a metal Andrews anterior commissure retractor positioned by the surgeon. The gases are directed at the laryngeal inlet.
e) The surgeon should evacuate smoke, plume and the anesthetic gases.
f) The depth of anesthesia is controlled by the inspired concentration of sevoflurane.
g) At the end of surgery, patient may be intubated with a regular tube for a secure airway prior to emergence.

Venturi jet ventilation technique

a) Attach the pressure regulated jet injector to either 100% oxygen or an air oxygen blender with an air compressor. Use the lowest oxygen concentration possible to maintain the oxygen saturation at 90% or above. Remember the principle of the jet ventilation. Air will be entrained and the oxygen concentration will be diluted. Do not ventilate with a hypoxic mixture.
b) Use IV agents to maintain anesthesia
   - Propofol infusions or methohexital
   - Alfentanil 10-30 ug/kg or Fentanyl 1-3 ug/kg
   - For muscle relaxation, use muscle relaxants of your choice.
c) 1% aqueous xylocaine is used by surgeon intermittently to keep the mucosa moist.

Supraglottic jet ventilation

a) The surgeon should align the axis of the laryngoscope as close to the axis of the trachea as possible.
b) The tip of the suspension laryngoscope should be as close to the vocal cords as possible.
c) The needle mounted on the clamp should be in line with the laryngoscope, the larynx and the trachea.

Adult

a) Use a 14 G needle
b) Position the needle tip approximately 6cms from the tip of the adult laryngoscope.
c) Start with a 0psi driving pressure and the pressure regulator knob in off position. Allow enough time for exhalation. Adjust the driving pressure until one is satisfied with good chest movement. Ventilate at a rate of 10-20 times a minute. Monitor the adequacy of ventilation by taking ABG's as necessary, or use a transcutaneous O_2/CO_2 monitor. If the ventilation cannot be maintained, the technique may have to be abandoned.

Children

a) Use a 16 G needle
b) Position the needle tip approximately 4-5cms from the laryngoscope tip.

c) Start with a 0psi driving pressure and the pressure regulator knob in the off position. Allow enough time for exhalation. Adjust the driving pressure to maintain adequate chest movements. Ventilate at a rate of 20-30 times a minute. Monitor the adequacy of ventilation by AGB's as necessary.

Infraglottic jet ventilation

a) Use a Hunsakar Mon-jet tube for intubation.
b) Start with 0psi driving pressure and the pressure regulator knob in the off potion. Adjust the driving pressure to maintain adequate chest movements
Ventilate at rate of 10-20 times a minute. Allow enough time for exhalation. Monitor the adequacy of ventilation by ABG's as necessary.
c) If wet cottonoids are inserted into the glottis to prevent retrograde vocal cord movement and to prevent aspiration of blood and secretions, lower the driving pressure to prevent barotrauma and hyperventilation of the patient.
d) At the end of the surgery change to a regular endotracheal tube prior to extubation of the trachea.

Jet ventilation through a copper metal tube (pediatric or adult) or HunsakerMon-Jet tube (adults only)

a) Place copper metal tube or Hunsaker Mon-Jet tube below the cords.
b) Start with 0psi driving pressure and the pressure regulator knob in the off position. Ventilate at rate of 10-20 times a minute. Allow enough time for exhalation. Adjust the driving pressure to maintain adequate chest movements. Monitor the adequacy of ventilation by $ETCO_2$ or AGB's as necessary.
c) At the end of the surgery change to a regular endotracheal tube prior to extubation of the trachea.
d) Caution: Lumen of upper copper tube is extremely small, do not pack tightly around tube and allow for exhalation of gas.

Emergence from anesthesia

a) Consider intubating the patient at end of surgery when jet ventilation has been used.
b) Reverse muscle relaxants as necessary.
c) Extubate the patient when the patient is awake, has regained adequate muscle power, ventilation is adequate and the patient has adequate recovery reflexes.

4. POSTOPERATIVE MANAGEMENT

a) Give humidified oxygen by a mask in the recovery room.
b) Alert the recovery room nurses to watch for early post-operative laryngeal edema, stridor or croup.

5. STEPS IN MANAGEMENT OF AN AIRWAY FIRE OR EXPLOSION

Primary emergency care

a) Simultaneously stop ventilation, disconnect oxygen, and remove endotracheal tube.
b) Put out the fire with water.
c) Place oral airway and ventilate with an anesthesia mask and 100% oxygen.

Secondary emergency care

a) Reintubate with small, cuffed or uncuffed endotracheal tube, or a ventilating bronchoscope.
b) Perform rigid bronchoscopy to remove large foreign bodies, carbon debris and lavage trachea.
c) By flexible bronchoscopy, visualize small airways, remove small distal foreign bodies and lavage distal airways.
d) Repeat rigid bronchoscopy with rod telescope to evaluate the tracheobronchial tree.
e) Use direct laryngoscopy and pharyngoscope to evaluate airway and to remove fragmented mucosa or papilloma.
f) If necessary, perform tracheostomy, preferably below third tracheal ring; use low pressure cuff.

Tertiary emergency are:

a) Administer antibiotics and steroids short-term only.
b) Provide a high-humidity environment and positive end expiratory pressure ventilation.

Subsequent early management

a) Place patient in reverse isolation.
b) Culture trachea daily.
c) Perform endoscopy 3-5 days post burn to evaluate the extent of injury.
d) Perform ventilation perfusion studies.
e) Perform tomography of the tracheobronchial tree.
f) If early extubation is not possible, place a T-tube.

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