The hazards of airway surgery

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Abstract

Airway surgery provides a unique challenge in that the airway is shared between the anaesthetist and surgeon. Patients may experience airway obstruction, often at extremes of age, following aspiration of a foreign body by the young or tumour-related impediments in the elderly which are complicated by smoking-related heart and lung disease. The threat of hypoxia, retained carbon dioxide and complete airway obstruction is present pre-, intra- and postoperatively.

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Introduction

Surgery is usually performed for some type of airway obstruction that may be outside the airway (tumours, abscesses, an enlarged thyroid or lymph nodes), in the wall of the airway (tumours or infective papillomata), or in the lumen of the airway itself (a foreign body). If the lesion is in the larynx, it will be managed by an ear, nose and throat surgeon, while lesions below the larynx are operated on by a thoracic surgeon. In an emergency, patients present with stridor due to the causes above, with the added challenge of a full stomach in a dyspnoeic, hypoxic patient, with no time for special investigations.

Co-existing medical problems usually relate to smoking (heart and lung disease, especially coughing) or tumours (wasting and an altered anatomy, especially following radiation therapy). Many patients will return repeatedly for further surgery.

Anaesthetic techniques

These procedures require that the airway is shared between the surgeon and the anaesthetist. The surgeon needs the patient to be still, especially during microscopic surgery, but also often requires a spontaneously breathing patient so that the function of the vocal cords can be assessed. Various techniques and combinations are used by the surgeon and anaesthetist. Often, a requirement is that an array of equipment needs to be available.

Techniques that may be may be used include volatile anaesthetic, total intravenous anaesthetic, sedation and local anaesthesia.

Volatile anaesthetic

Inhalational agents are selected to keep the patient anaesthetised. The advantage of this technique is that the patient keeps breathing. Disadvantages are that the gases need to be administered by a tube or mask which may obstruct the surgeon's vision, and that it can be difficult to maintain anaesthesia as the gases are diluted before reaching the trachea. Also, the anaesthetic agent may need to be sucked out by the surgeon, while older agents are flammable and the high concentrations of gas might be inhaled by the surgeon.

Total intravenous anaesthetic

The major advantage of a total intravenous anaesthetic (TIVA) is that anaesthesia can be maintained using a route other than the airway. Apnoea is a disadvantage.

Sedation

Sedation, combined with topical local anaesthesia, is poorly tolerated.

Local anaesthesia

Local anaesthesia is often added to the above techniques to prevent coughing and to allow manipulation of the vocal cords without laryngospasm.

Airway management techniques

Endotracheal tubes (ETT) are not the mainstay of airway management as they obstruct the view of the larynx, or can't fit through the obstruction.

Intermittent apnoea (“drunken sailor”)

Control of the airway is shared between the surgeon and anaesthetist. The anaesthetist allows the patient to breathe anaesthetic gases through a face mask until deeply anaesthetised, then the surgeon works until the patient becomes light or desaturates, after which the anaesthetist resumes control once more, using a face mask.

Nasopharyngeal airway

A tube is inserted through the nose into the back of the pharynx, maintaining a patent airway without interfering in the surgeon’s field.

Microlaryngoscopy endotracheal tube

A microlaryngoscopy ETT (MLT) is used if it does not obstruct the operative view. Specific laryngoscopy tubes are different to cuffed paediatric tubes as they have large cuffs on small bore tubes so they can occlude an adult trachea. Normal anaesthesia can be given with intermittent positive pressure ventilation.

Laryngeal mask airways

Laryngeal mask airways (LMA) are occasionally used to maintain the airway while fibre-optic bronchoscopy is performed through the LMA. Elbow connectors with a removable plug are needed for the scope.

Bronchoscope

Inhaled anaesthesia is given through a side port on the bronchoscope for tracheal and bronchial procedures.

Jet ventilation

High-pressure gas is delivered via a bronchoscope or narrow cannula directly to the vocal cords or down the trachea. This is a simple technique, but it has a number of problems, namely barotrauma and pneumothorax. Because of the high pressure, adequacy of ventilation can’t be measured, volatile anaesthetic can’t be used, TIVA is required and gastric insufflation may occur if the jet is above the vocal cords, while high flows of gas may dry out the airways.

Specific surgical procedures

Direct laryngoscopy and microdirect laryngoscopy

Vocal cords are visualised and operated on using a rigid laryngoscope (a microscope may be used). The patient needs to be breathing to assess vocal cord function. There is a high degree of sympathetic stimulation when the vocal cords are operated on.

Fibre-optic bronchoscopy

Fibre-optic scope visualisation of the vocal cords is a diagnostic procedure only, as no surgery is possible on the vocal cords through the fibre-optic scope. Often, it is carried out under local anaesthesia, with or without sedation. A technique in which the scope is passed through an LMA under general anaesthesia is becoming more popular.

Rigid bronchoscopy

A large, rigid metal scope is passed into the trachea during deep general anaesthesia by a thoracic surgeon for the purpose of foreign body removal, tumour resection and dilation in the trachea and lung. Various anaesthetic techniques are used, such as TIVA, and gas and muscle relaxation with insufflation down the bronchoscope to ventilate the patient.

Tracheal surgery

Tracheal surgery is usually performed in specialised units under general anaesthesia with full invasive monitoring, a double-lumen tube and intensive care postoperatively.

Tracheostomy and percutaneous tracheostomy

This constitutes placement of a surgical airway in the trachea in the case of upper airway obstruction or long-term, intensive care unit ventilation. Critical airway compromise is carried out under local anaesthesia while patients who are already intubated are operating upon while under general anaesthesia.

Laser surgery

Laser surgery is usually performed in combination with direct laryngoscopy or rigid bronchoscopy. It presents a host of unique problems:

- *Airway fire:* Airway fire is the most feared complication of laser surgery and occurs because of swabs in the airway or when the ETT catches alight. Safety policies to prevent and handle fire include wetting any swabs that are placed in the operative field, not using an ETT or using laser-safe tubes in the airway, decreasing oxygen supply to 21% without nitrous oxide (these support combustion), and having a bucket of water and water-filled syringes available to douse a fire.
- *Damage to healthy tissue:* Swabs are placed around the lesion to avoid damage to the normal tissue. These should be wet to prevent ignition.
- *Hypoxia:* This is a problem because of the delivery of 21% oxygen.
- *Injury to staff:* Laser eye damage can be avoided by wearing safety glasses. Masks should be worn to prevent aerosolised particles of papilloma being inhaled.

Postoperative care

Surgery on the airway does not mean that the problem has been resolved postoperatively. These patients continue to be at risk in both the recovery room and ward. Postoperative complications include airway obstruction because of oedema or bleeding, laryngospasm, aspiration, apnoea and pneumothorax. Equipment must be available to manage and secure the airway. In addition, a difficult intubation trolley should be in theatre. Dexamethazone and adrenaline nebulisation may be needed to treat stridor and to reduce swelling.

Difficult airway in recovery

The difficult airway in recovery is no different to the difficult airway in theatre, except it is always more of a challenge. The same rules and algorithms apply as those in theatre except the patient is usually not fully anaesthetised, staff don't anticipate the problem, the anaesthetist is in a foreign environment, staff are not used to handling a difficult airway, equipment is not readily accessible, drugs are not available, the anaesthetist wants to return to theatre to start on the next case, and often, there are no other personnel around.

In their fourth national audit, The Royal College of Anaesthetists and the Difficult Airway Society found that 30% of serious airway complications were associated with extubation or removal of a LMA at the end of anaesthesia.

Preferably, extubation of a patient with a known difficult airway should be carried out in theatre with all the staff and difficult airway equipment available. Preparation to reintubate the patient should take place before extubation. The patient should be awake, breathing spontaneously and positioned in an optimal position that is dependent on the cause of his or her difficult airway (sitting, or on his or her side). Techniques such as extubation over a tube exchanger have been suggested.

A difficult intubation trolley should contain the following:

- *Laryngoscope and blades:* Various types and sizes of laryngoscopes and blades, including Mackintosh, Miller, Polio and McCoy.
- Video-assisted laryngoscope and introducer.
- *Endotracheal tubes:* All sizes of endotracheal tubes from 4-8 (uncut), including reinforced sizes 6-8.
- *LMA and intubating LMAs:* Sizes 3, 4 and 5.
- *Oropharyngeal airways:* All sizes.
- Bougies and introducers: Gum-elastic bougies, introducers of different sizes and a tube exchanger.
- *Cricothyroidotomy kit:* Adult and paediatric.
- *Retrograde intubation kit:* "J"-tipped guide wire, size-22 fixed scalpel blade, curved artery forceps and swabs.
- *Nasopharyngeal airways:* Sizes 6-8, with Cobb's type connector.
- Fibre-optic bronchoscope.

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