Part II: Respiratory Failure

Chapter 20: Acute Upper Respiratory Tract Obstruction

P D Cameron

Acute progressive upper respiratory tract obstruction is a life threatening emergency. Possible causes of airway obstruction in an emergency room or Intensive Care setting are many. Diagnosis must be made quickly and therapy immediately directed towards securing a patent airway.

Aetiology

The upper airway commences at the nose and lips, and continues through the oral and nasal pharynx, larynx, carina, and main stem bronchi to the origin of the major divisions. Functional and mechanical causes for obstruction may occur from within the lumen, in the wall, or extrinsic to the wall of an anatomical or artificial airway.

Table 1 lists some clinical conditions which may be associated with acute upper airway obstruction. Adult epiglottitis has been recognized with increasing frequency in recent years and appears to carry a greater mortality than the childhood variant. Some chronic conditions may progress rapidly to an acute phase, ie, tumour haemorrhage, tissue oedema, and altered conscious state.

Diagnosis

The opportunity to diagnose the cause of an acute obstruction, by taking a careful history and making a physical examination, occurs only infrequently. Undue attention must not be directed towards establishing a cause, away from the more urgent need of establishing a clear airway.

Clinical Presentation

Early symptoms and signs of airway obstruction may be few; dyspnoea only becoming evident on impairment of gas flow during episodes of exercise-induced tachypnoea. Late signs of obstruction and respiratory decompensation may be brief in onset, and soon progress to complete obstruction, when extreme anxiety and agitation are usually marked in conscious patients. Gasping inspirations, dysphagia, persistent cough, use of respiratory accessory muscles, nasal flaring, suprasternal and intercostal tissue retraction, cervical ecchymosis and subcutaneous emphysema, absence of the thyroid cartilage prominence, paradoxical chest wall movements and easily audible stridor may all be indicators of partial airway obstruction. If phonation and cough are lost, the patient may use the international distress sign and clutch his throat between thumb and index finger to signal his distress. Cyanosis, diminishing stridor, protective posturing, diaphoresis, acidosis, and loss of consciousness are very late signs of hypoxaemia and hypercarbia, and often herald the onset of terminal cardiac dysrhythmias.

The clinical setting fo the patients may give some guide to the aetiology of an obstruction (Table 1). Patients can progress to acute obstruction following certain therapeutic

modalities, ie, postoperative haemorrhage and oedema, and drug- or food-induced angio-oedema.

Physical examination should include an inspection of the oral cavity (in unconscious patients particularly, but avoid instrumentation in suspected epiglottitis) and auscultation over the larynx, trachea, and lung fields. It is important to exclude tension pneumothorax and flail chest, which may mimic some features of obstruction. In a subacute setting, use of accessory muscles, the ability to phonate and cough, and the degree and nature of stridor should be regularly checked, to detect clinical deterioration and increase in the work of breathing. Stridor may be inspiratory (denoting supraglottic obstruction), expiratory (obstruction below the glottis), or both, and in adults usually signifies an airway diameter of 5 mm or less. Hypertension and tachycardia may reflect hypercarbia, hypoxaemia, and acidosis. Partially obstructed patients should not be sent unaccompanied for additional diagnostic tests (ie, to a radiology department). Recumbency may precipitate complete obstruction.

Special Investigations

A more exact localization and characterization of the obstruction may be made with special tests. If time permits, a diagnostic workup should include neck and chest X-rays (anteroposterior and lateral views), airway tomography, CT scans, arterial blood gas estimation, pulmonary function testing, and bronchoscopy. Clinical features of respiratory failure from small airway obstruction (ie, asthma) may mimic some aspects of upper aiway obstruction. Time should not be wasted in making the sometimes difficult differentiation between the two (by evaluation of flow-volume loops) before management principles are enacted.

Management

Although a diagnosis may be incomplete, general principles of resuscitation should be directed towards relieving the obstruction and increasing the available inspired oxygen. Early surgical consultation is advisable. Specific management options will depend on the particular cause and severity of obstruction and the location of the patient. In any case, the patient should be continuously observed.

1. Unconscious Patient

The presence of a pulse and spontaneous respiratory efforts is determined; if absent, cardiopulmonary resuscitation is started. Lingual obstruction is relieved by anterior displacement of the mandible and extension of the head on the neck (if no cervical spine injury is suspected). Any oropharyngeal debris is evacuated, and the patient is positioned slightly head-down and semi-prone. Oropharyngeal or nasopharyngeal artificial airways may be needed. Endotracheal intubation may follow on a semi-elective basis. An intravenous line should be established, and ECG monitoring commenced.

2. Oxygen

Oxygen is given by facemask, and positive pressure ventilatory assistance by a self-inflating bag-valve device (ie, Air Viva or Laerdal resuscitators) may be required. Humidification is desirable in order to avoid the accumulation of dried secretions.

3. Complete Obstruction

The Heimlich manoeuvre may be applied if an aspirated foreign body (mostly radiolucent) is markedly compromising the airway of a conscious or unconscious patient (ie, "Cafe Coronary" syndrome). Repeated upper abdominal thrusts are alternated with interscapular back blows and, if necessary, mouth-to-mouth ventilation. Digital evacuation of a proximally dislodged obstruction from the oral cavity may be successful in restoring the airway. This manoeuvre is not performed in a patient who can still breathe; if improperly performed, the procedure may be hazardous (ie, in children or pregnancy).

(a) *Tracheostomy* as an emergency means of securing an airway, is rarely required.

(b) *Cricothyrotomy* ("minitracheostomy") is a safer procedure by non-surgeons, until a formal tracheostomy can be completed to bypass a glottic or supraglottic obstruction. A small diameter endotracheal tube (ie, Portex "Mini Trach") can be inserted through a midline incision in the relatively avascular cricothyroid membrane.

(c) *Transtracheal ventilation* via cricothyroid membrane puncture using a large bore intravenous cannula, 3 mL syringe, and an endotracheal tube adaptor connected to an anaesthesia bag or oxygen source, is also a satisfactory emergency technique. However, this technique should only be used if adequate expiration is judged feasible.

4. Endotracheal Intubation

Except in an absolute emergency, endotracheal tube placement should only be attempted by a skilled clinician under optimum conditions. A review of the patient's case notes may reveal useful information concerning previous intubation. Adequate suction, skilled assistance, a range of endotracheal tube sizes, and resuscitation equipment must be available. The procedure should preferably be undertaken in an operating room with an experienced surgeon prepared to perform immediate tracheostomy. A prudent approach is to intubate the patient awake, unpremedicated, and fasted, using a fibreoptic intubating laryngoscopy or bronchoscope, following pre-oxygenation, topical anaesthesia (including by nebulization) and cricoid pressure. However, the patient may be too restless, and awake intubation may not be possible.

An inhalation induction of anaesthesia with nearly 100% oxygen (or helium/oxygen) is then preferable to the of intravenous hypnotics and muscle relaxants, in order to maintain a spontaneously breathing patient with some airway protective reflexes. In this way, direct visualization of the airway may also be possible, with additional guidance gained from the origin of airway secretion bubbles in the vicinity of oedematous mucosa and a distorted epiglottis. This is particularly so for laryngotracheal disruption, epiglottitis, airway oedema or burns, and tumours. Use of a translaryngeal bougie, fibreoptic stylet or percutaneous

retrograde (cricothyroid) guide wire may permit intubation in the presence of proximal visual obstruction.

In difficult cases, epiglottic contact and suspension by a straight bladed laryngoscope or rigid bronchoscope may be indicated, although this carries some risk of haemorrhage or epiglottic fragmentation. Continuous oxygen insufflation into the hypopharynx may provide a lesser risk of hypoxia during instrumentation. Monitoring oxyhaemoglobin saturation with pulse oximetry is highly desirable.

Once endotracheal intubation is safely accomplished, a tracheostomy may then be performed if considered necessary. Secure fixation of the endotracheal tube is mandatory. The upper limbs of the patient may need to be secured if necessary, to avoid self-extubation. Extubation should be undertaken when the patient is awake, capable of competent laryngeal reflexes and an air leak exists around the tube with the cuff deflated. Facilities for emergency reintubation should be immediately available.

5. Bronchoscopy

Fibreoptic bronchoscopes have reduced some of the risks of emergency intubation, and have facilitated making an early diagnosis. Rigid bronchoscopes are, however, preferred for the removal of foreign bodies.

6. Pharmacological Adjuncts

Drug therapy may be required in certain clinical situations of upper aiway obstruction (Table 2).

7. Helium-Oxygen Mixtures

Helium-oxygen mixtures with a density less than air, may improve gas flow past airway obstruction and decrease the work of breathing. Helium (40%) with oxygen can substantially improve arterial blood gases.

8. Extra-corporeal Membrane Oxygenation

Extra-corporeal membrane oxygenation (ECMO) has been used in the emergency and perioperative support of airway-obstructed patients requiring major surgery on the trachea and mainstem bronchi. Preoperatively, following heparinization, perfusion catheters are peripherally inserted into the vena cava and aorta.

Additional Considerations in the ICU

1. Elderly, debilitated, or obtunded patients have diminished airway protective reflexes and may require parenteral rehydration and nutrition.

2. It is safer to change tracheostomy tubes over steriles suction catheters, to avoid the creation of false passages.

3. Blunt trauma to the larynx and trachea is frequently overlooked in the presence of more obvious injuries. A cause must be found for cervical and thoracic subcutaneous emphysema. Cervical spine injury is not infrequently found in association with tracheal/laryngeal injury.

4. Endobronchial intubation may isolate a healthy lung from intrapulmonary haemorrhage and obstructive clot formation.

5. Usually benign tracheal stenosis may be exacerbated by intercurrent infection-induced mucosal oedema.

6. Pulmonary oedema may follow maximum inspiratory efforts against an obstructed airway, particularly in children, or may follow the relief of epiglottitis.

7. patients with airway burns should be intubated sooner rather than later, as mucosal oedema may progress over 24 hours. Tracheostomy in these patients is associated with a 50% mortality (due to sepsis).

8. Wire cutters should be at the bedside of a patient with interdental wiring to facilitate rapid opening of the mouth, should postoperative airway obstruction occur.

9. Laryngoscopy may rupture a tonsillar or retropharyngeal abscess and cause pulmonary soiling. Drainage under local anaesthesia in an awake patient, properly positioned, is preferable.

10. Although a chronic problem, obstructive sleep apnoea is sometimes monitored in the ICU. Nasopharyngeal airways commonly employing continuous positive airway pressure, may provide temporary relief until more definitive diagnosis and therapy can be undertaken.

11. Early airway protection in adult epiglottitis is advisable, particulary if bacteraemia is evident. Antibiotic therapy is directed against the most likely pathogens (*Haemophilus influenzae* and *parainfluenzae, Streptococcus pneumoniae, Staphylococcus aureus* and *haemolytic streptococci*). Systematically administered steroids may ameliorate associated mucosal oedema.

12. More specific therapies for paediatric problems and anaesthesia related problems, are best sought from an appropriate text.

Summary

Failure to diagnose and adequately treat acute airway obstruction makes other resuscitative therapies futile. A better prognosis may be expected by rapidly instituting first aid measures (positioning and oxygenation) for a compromised airway. It is then generally safer to await skilled assistance rather than embark on any unfamiliar procedure which may prove more hazardous for the patient.