Management principles

Hypoxaemia is damaging to tissues and if uncorrected, fatal. Rapid reversal of hypoxaemia is obviously critical. Hypoxemia should be treated by oxygen supplementation while the pathophysiological cause is determined and specific therapy instituted. Note that the risk of oxygen induced hypoventilation in hypercarbic patients with an acute exacerbation of chronic obstructive pulmonary disease is low.

Oxygen Supplementation

A number of different methods to deliver supplemental oxygen have been developed. The ability of the device to match the patient's instantaneous inspiratory flow determines how much room air must be entrained by the patient during each breath. Methods that supply a relatively constant oxygen concentration to the lungs are called fixed performance devices. Variable performance devices provide variable concentrations depending on the patient's respiratory rate and inspiratory flow pattern.

Nasal Cannula

This is a variable performance device. The maximal tracheal FiO_2 is not likely to exceed 0.4. Higher flow rates have a drying and irritating effect on nasal mucosa. The nasal cannula, is comfortable and well tolerated at low flows, but does not allow precise control of FiO_2.

Air-Entrainment Masks (Venturi Masks)

Air-entrainment masks are designed to deliver constant concentrations of oxygen from a FiO_2 of 0.24 to 0.50 regardless of the patient's inspiratory flow pattern and respiratory rate. This is achieved by delivering a very high total gas flow. These masks are most useful when it is necessary to control the FiO_2 or to know the FiO_2.

Reservoir Face Masks

The reservoir face mask consists of a mask with valves and a reservoir bag. The reservoir bag is filled from the 100% oxygen supply source. The delivered oxygen flow rate is adjusted so that the bag remains distended throughout the respiratory cycle. During inspiration oxygen is inspired from both the oxygen source and the reservoir. The delivery of oxygen can therefore be maximized. The mask is not tightly sealed and therefore some air is entrained with the result that it is not a true fixed performance device. The FiO_2 at an oxygen flow rate of 15 l/min is approximately 0.7.

Bag valve resuscitator

When the mask is held firmly over the face, air entrainment is largely excluded. If the oxygen flow to the bag is kept high ($\geq$15 L/min), a high oxygen concentration is provided. The addition of a reservoir bag increases the ability of the system to provide 100% oxygen. PEEP valves can be added to provide even better oxygenation capacity (see *Mechanical ventilation - basics*). The resuscitation bag need not be compressed to supply oxygen as the valve system also allows spontaneous breathing. It is a closed, high-oxygen, high-flow device.

Treating the cause of respiratory failure

As always it is vital to diagnose and treat the underlying cause.

Mechanical ventilation

In some cases the decision to ventilate a patient is very straightforward. The patient who is hypoxic despite high inspired oxygen concentrations, or is unconscious due to hypercapnia clearly requires mechanical ventilation. Patients who require intubation for airway protection are usually ventilated, at least temporarily. In many cases, however the decision is a complex one in which a number of factors need to be taken into account. Factors that commonly need to be considered include the following:

- Severity of respiratory failure.
- Cardiopulmonary reserve. Patients with less reserve should be ventilated earlier.
- Adequacy of compensation. Patients who are failing to compensate require earlier ventilation. In addition the ventilatory demand should also be considered. Patients with a high ventilatory requirement (eg severe sepsis, severe metabolic acidosis) are more likely to develop respiratory muscle fatigue and therefore fail to meet their ventilatory requirement without support.
- Expected speed of response to treatment of the underlying condition. Patients who respond quickly are more likely to cope with respiratory failure without ventilatory support. Any estimate of speed of response should be based on knowledge of underlying disease and the therapy that has already been given.
- Risks of complications associated with ventilation. Certain conditions (eg asthma) are associated with higher risk of ventilator-associated complications.
- Need for mechanical ventilation for non-respiratory reasons eg intubation to secure the airway, mechanical ventilation for surgery.

When considering mechanical ventilation it is important to consider whether it is necessary to intubate the patient or whether the patient can be ventilated non-invasively (see *Mechanical ventilation – common modes*).

Airway management & airway obstruction

Airway emergencies require an urgent response as patients may deteriorate very rapidly. It is therefore essential to not only train to manage these situations but to be adequately prepared. When starting work in an unfamiliar environment always check the availability and proper functioning of emergency airway management equipment, including the location and contents of the difficult airway “kit”.

As a minimum emergency airway equipment should include:

- plentiful oxygen supply
- **M**ask
- **A**irways (oral and nasal)
- **L**aryngoscopes
- **E**ndotracheal tubes
- **M**onitoring (pulse oximetry and ECG)
- **E**mergency drugs
- **S**elf inflating bag valve resuscitator
- **S**uction

In ideal circumstances an end-tidal CO_2 monitor, mechanical ventilator, fiberoptic bronchoscopes or laryngoscopes, laryngeal mask airways and equipment necessary for a surgical airway (cricothyroidotomy set, tracheostomy tray) should also be available.

Airway management

The objectives of emergency airway management are to:

- ensure airway patency
- ensure ventilation of the lungs
- protect the lungs from soiling

Clearly airway patency must be achieved much more urgently than airway protection.

Airway management should always start with a check for airway patency followed, if necessary, by basic airway manoeuvres to restore patency ± bag-mask ventilation. **If airway patency and ventilation cannot be restored rapidly and easily call for help early.** In most cases simple measures will be sufficient in themselves or will buy time for more advanced procedures.

The choice of a particular advanced technique (table 1) will depend on the:

- skills of the operator
- anticipated difficulty in carrying out the procedure
- objective
- potential complications

Difficult intubations may be expected in 1-3% of patients presenting for general anaesthesia, and the incidence is likely to be considerably higher in ICU patients.

Intubation difficulty can be predicted by the following, although the sensitivity and specificity of individual features is low.

- Patients with structural upper airway obstruction

- Severe traumatic facial injury
- Anatomical/disease related features of difficult intubation in subjects who otherwise appear normal:
    - short neck, obese or muscular (thyro-mental distance < 6 cm)
    - limited neck and jaw movements (arthritis, ankylosing spondylitis, trismus, perioral scarring)
    - protruding teeth, small mouth, long high curved palate, or receding lower jaw
    - obstructing lesions in the oropharynx and larynx

Only doctors who are highly skilled in advanced airway techniques should use these methods in patients with an anticipated difficult airway.

Technique	*Airway protection?*	*Level of skill & training required*
Laryngeal mask airway	No	+
Intubating laryngeal mask	Yes	++
Direct laryngoscopy & intubation	Yes	+++++
Fibreoptic intubation	Yes	+++++
Cricothyrotomy	No	+++

Table 1. Advanced airway techniques

Other factors to consider when choosing a technique are the timely availability of experienced help and accessibility of equipment. Note that even very skilled and experienced operators benefit from the help of a skilled assistant.

Always provide an appropriate explanation to conscious patients to minimize anxiety.

Basic airway techniques

A variety of airway manoeuvres lift the tongue and pharyngeal tissues anteriorly and open the airway.

- The head tilt is easy and effective. A hand firmly placed on the forehead tilts the head backward on the atlanto-occipital joint.
- The head tilt - chin lift is completed by placing the fingers of the other hand under the bony part of the lower jaw and lifting the chin forward.
- The triple airway manoeuvre is used when other methods have failed to open the airway. The head is tilted back in extension and the fingers of both hands grasp the ramus of the mandible which is displaced forward and upward. Both thumbs are then used to open the lower lips (figure 1).

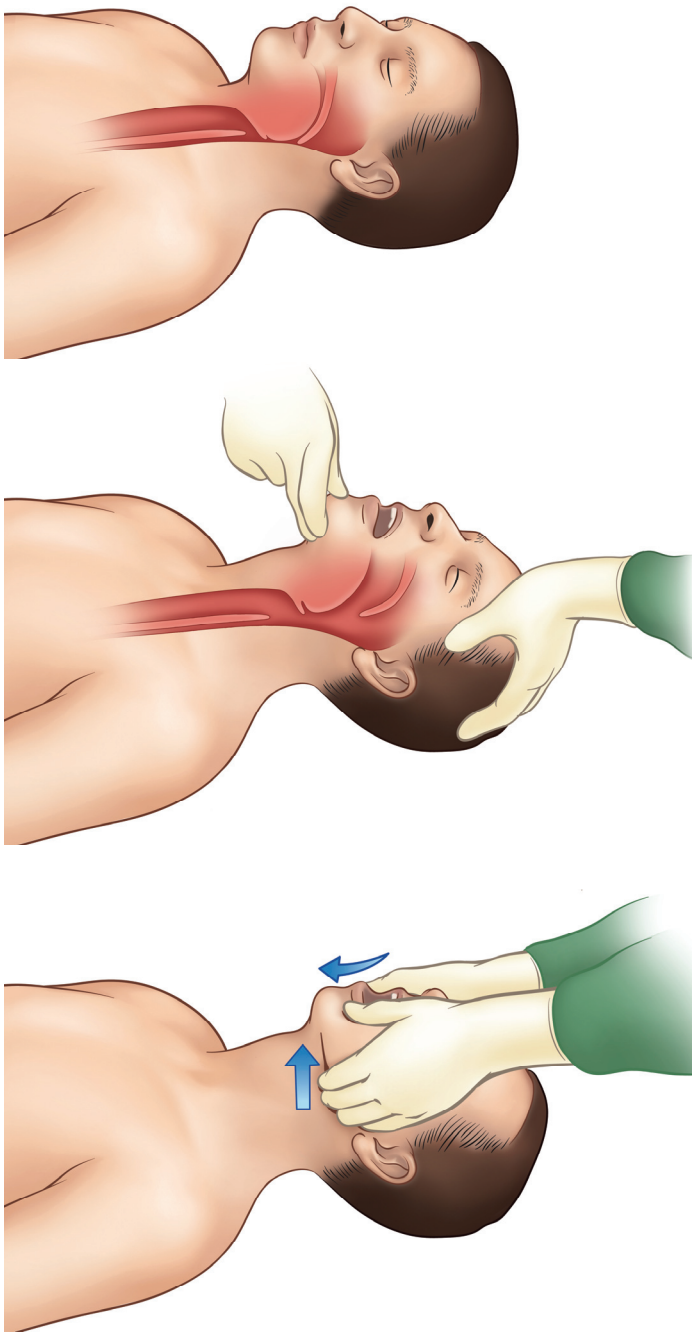

Figure 1. Triple manoeuvre

- The modified jaw thrust excludes the head tilt and is useful in the presence of cervical spine instability (figure 2).

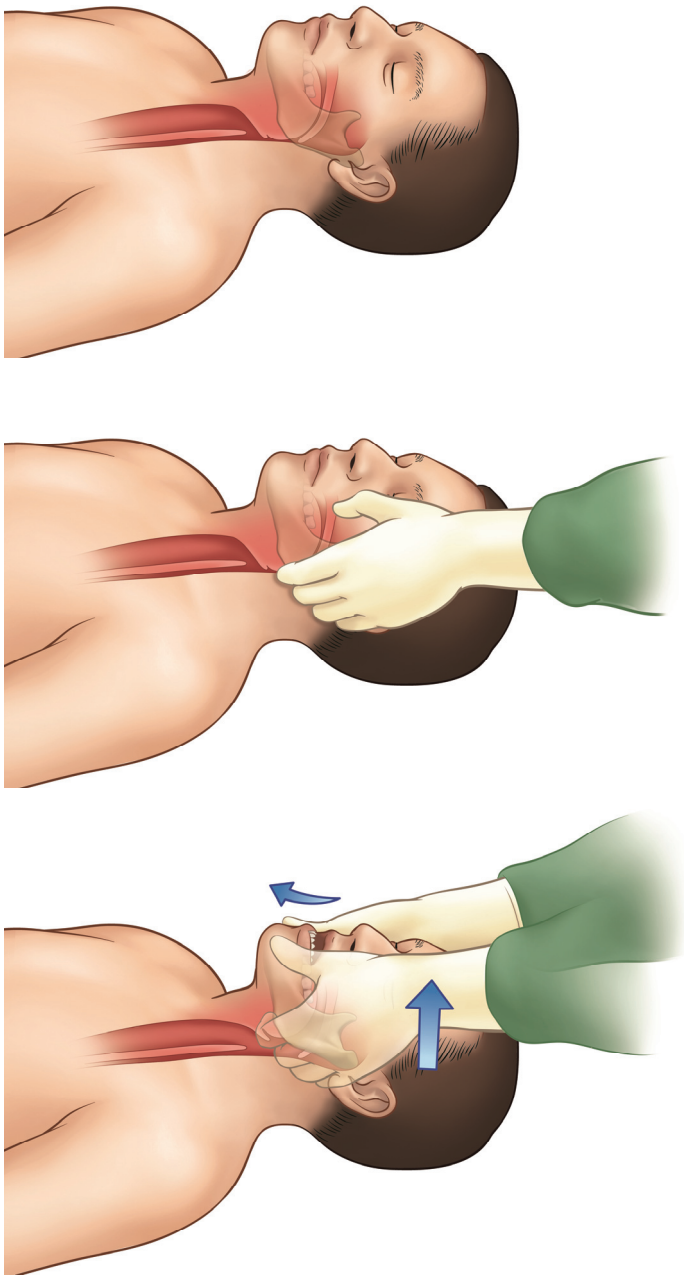

Figure 2. Modified jaw thrust

Oro/naso-pharyngeal airways

Placement of an oropharyngeal airway or nasopharyngeal airway may be useful to prevent soft tissues from obstructing the airway in the unconscious patient at the levels of the soft palate, epiglottis and base of tongue.

An oropharyngeal airway may establish an adequate airway for spontaneous or bag-mask ventilation when proper head and jaw positioning is insufficient. It is inserted with the concavity facing the palate and then rotated 180° into the proper position as it is advanced (figure 3).