

Clinical Update on Managing the Obstructed Airway

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Abstract

The upper airway can obstruct due to soft tissues, blood, secretions and infections. In patients who are sedated, anaesthetised or unconscious, the commonest cause is due to loss of airway muscle tone. The usual site of obstruction is the soft palate followed by the epiglottis and occasionally the tongue. To relieve the obstruction, a head tilt, chin lift jaw thrust and open mouth manoeuvre should be performed. This will tense the muscles in the floor of the mouth causing the hyoid and larynx to be lifted away from the posterior pharyngeal wall. Oral and nasal airways are useful adjuncts to improve airway patency. In patients who are unconscious or adequately anaesthetised, the laryngeal mask or Combitube® could be used especially in the difficult airway situation. As there is a significant decline in performance with time, it is important to maintain airway skills through regular practice and evaluation.

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Maintaining a patent upper airway is the first principle in resuscitation and acute care. This is usually carried out by anaesthesiologists, emergency medicine physicians and intensivists. However, there are occasions when less experienced personnel are required to relieve an obstructed airway in an emergency situation. An understanding of the mechanisms of obstruction and the techniques used to relieve it is vital in reducing patient morbidity and mortality. Lower airway obstruction has different mechanisms and therapy and will not be discussed.

Why Does the Airway Obstruct?

The upper airway is controlled by a complex arrangement of muscles. The pharyngeal constrictors and muscles that insert into the tongue and hyoid bone maintain patency. They exhibit phasic activity to prevent airway collapse during inspiration when a negative pressure is generated. Afferent activity arising from receptors in the lung and airways and consciousness provides the sensory input to maintain this muscle tone. When there is lack of arousal (e.g. sleep, anaesthesia or coma), this phasic activity is reduced. The upper airway diameter is reduced and resistance increases. Snoring or grunting can be heard.

When there is airway obstruction, it is usually due to the soft tissue of the pharynx. It is often assumed that this is a result of the posterior displacement of the tongue producing

obstruction at the oropharyngeal level.¹ Recent studies have showed that the most consistent site of obstruction is the nasopharynx where the soft palate approximates the posterior pharynx.² Air can move either through the oral or pharyngeal cavity during inspiration and the soft palate does not cause obstruction. Obstruction occurs mainly during expiration, especially when the mouth and lips are closed. This is present in patients with obstructive sleep apnoea. The epiglottis and supralaryngeal tissue may also contribute to the narrowing.³ The lax upper airway muscles allow the laryngeal complex to appose the posterior pharyngeal wall. The tongue is usually not the site of narrowing. The narrowing is worsened when negative pressure is applied during inspiration against an obstructed airway. Other causes of pharyngeal obstruction include enlarging space-occupying lesions or foreign substances like secretions or tumours.

Obstruction at the larynx is usually due to laryngospasm. There are two mechanisms causing this. The intrinsic laryngeal muscles (especially the interarythenoid and cricothyroid muscles) contract and cause the vocal cord to close. The extrinsic muscles of the larynx, particularly the infrahyoid group of strap muscles, can cause the hyoid to be drawn towards the thyroid cartilage. This causes the airway column from hyoid to cricoid to shorten. At the same time, the mucosal folds also become apposed. The

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result is a shortened and closed airway. Laryngospasm can occur due to airway stimulants, like secretions, blood or vomitus, inhalational anaesthetic agents or instrumentation of an airway under inadequate anaesthesia. Life-threatening desaturation due to laryngospasm was reported in 2 awake patients during attempted fiberoptic intubations. This was probably due to inadequate topicalisation of the airway and inappropriate sedation. They could not be ventilated and emergency cricothyrotomy and tracheostomy had to be performed.⁴ Other causes of life-threatening laryngeal obstruction include tumours and infections e.g. epiglottitis.

How to Recognise Airway Obstruction?

Partial airway obstruction is characterised by noisy breathing. Snoring is typical of hypopharynx obstruction and is generally heard during expiration. Stridor is best heard during inspiration when there is laryngeal obstruction or laryngospasm. Total airway obstruction is silent as there is no movement of air. The patient uses the accessory muscles for respiration. There is a paradoxical breathing pattern and may become agitated from hypoxia. Oxygen desaturation resulting from unrelieved obstruction can be detected using a pulse oximeter. Cyanosis should not be used as an early sign of obstruction as this usually occurs late and is difficult to detect.

How to Relieve the Obstruction?

1. Simple Airway Manoeuvre

The simplest manoeuvre is the head tilt. The head is tilted on the atlanto-occipital joint by the chin or neck lift. This tenses the muscles in the mentum-genohyoid-hyoid-thyroid axis, causing the hyoid to be lifted away from the pharynx. The hyoid in turn elevates the epiglottis via the hyo-epiglottic ligament (Fig. 1). This could be further improved by placing the occiput 5 to 7 cm above the level of the shoulders, known commonly as the sniffing position.

In young children, the upper cervical spine is very flexible and can bow forward when the head is tilted. The posterior pharyngeal wall is forced forward against the tongue and larynx, worsening the obstruction. It may be better to leave the child's head in a more neutral position. In older patients with stiff cervical spine, elevating the head also elevates the larynx, leaving the airway unchanged and obstruction unrelieved.

The jaw thrust directly lifts the hyoid bone and tongue away from the posterior pharyngeal wall by sublaxating the mandible forward. Placing an oral airway when lifting angle of the jaw forward makes it easier to sublaxate the mandible. In some patients, the soft palate occludes the nasopharynx, impeding expiration if the mouth is closed. An airway opens the mouth and allows exhalation.

The triple manoeuvre, head tilt/chin lift, jaw thrust and open mouth done together is the most reliable method to maintain a patent upper airway.⁵

2. Artificial Airway

Oropharyngeal Airway

An oropharyngeal airway can be used either as a bite block or a patent airway. The standard design has a straight bite section with a flange and a distal curved section to displace the tongue anteriorly. Before an oral airway can be inserted, the patient should be comatose or adequately anaesthetised, otherwise biting and coughing can occur. The airway can either be inserted backwards, with the convex side towards the tongue and then rotated 180° or directly with the help of a tongue blade. In whichever method, it is essential that the correct size be used. If it is too short, it may not lift the tongue forward to push the larynx away from the posterior pharyngeal wall. If it is too long, the tip of the airway may touch the epiglottis, stimulating coughing or laryngospasm. Using an incorrect technique, the tongue may be pushed backwards, worsening the obstruction. The length of the oral airway should extend from the angle of the mouth (flange) to the angle of the mandible (tip).

The Cuff Oropharyngeal Airway or COPA has been recently introduced into clinical practice. It is a modification of the oral airway. It has a balloon which can be inflated, causing the airway to be displaced anteriorly, thus relieving the obstruction more effectively.

Nasopharyngeal Airway

The nasopharyngeal airway is another device to relieve airway obstruction (Fig. 2). They are made of soft rubber or plastic materials of variable diameter and length and have a flange to prevent overinsertion. The main advantage is that they are better tolerated in awake, semi-comatose or lightly-anaesthetised patients. However, it may be difficult to pass, can cause bleeding due to mucosal tears, avulsion of the turbinates or submucosal tunnelling. A small nasopharyngeal tube should be used to reduce trauma but could be too short to relieve the obstruction. An endotracheal tube may be an alternative if it is too short. The larger nares should be chosen and a vasoconstrictor (oxymetazoline or cocaine) applied if time permits. The airway is lubricated and passed with the concave side parallel to the palate under the inferior turbinate. Resistance will be felt as the airway meets the posterior nasopharynx. The airway can be rotated or a suction catheter passed through to serve as a guide. This will allow the airway negotiate the angle into the oropharynx. Epistaxis can occur after removal of the nasal airway due to the loss of the tamponade effect. It is usually self-limiting. Bleeding from the anterior plexus is

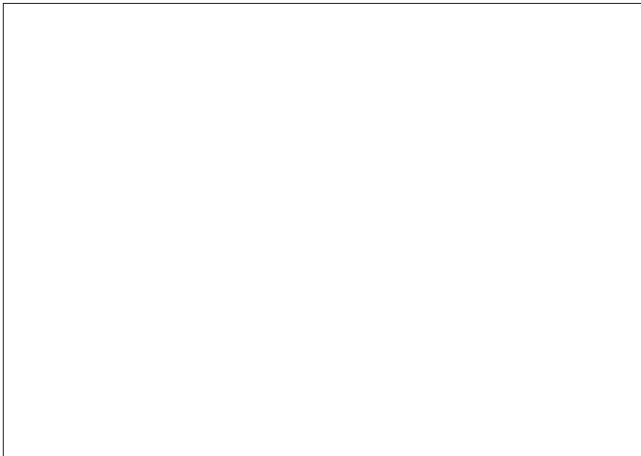


Fig. 1. The effect of the triple airway manoeuvre aided by an oral pharyngeal airway.

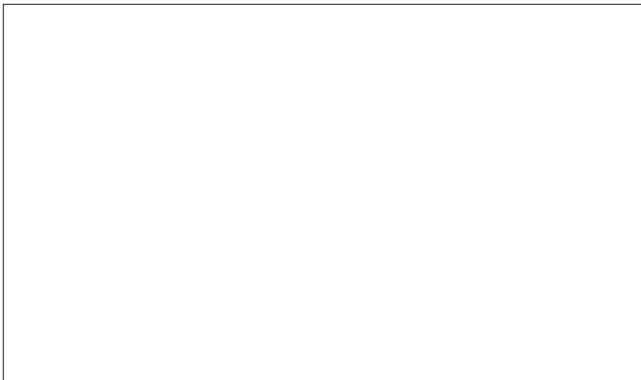


Fig. 2. Common airway devices. From top: oral pharyngeal, nasal, laryngeal mask and Combitube airways.

controlled with direct pressure. Occasionally, posterior plexus bleed may have to be treated with a posterior nasal pack or even intubation to prevent soilage of the trachea.

Laryngeal Mask Airway

The laryngeal mask airway has established itself as an essential tool in anaesthesia practice (Fig. 2). It is used in elective surgeries and as a rescue airway in difficult intubation or ventilation situations. It is a recommended alternative airway to maintain ventilation in the American Society of Anesthesiologists' Difficult Airway Algorithm. It can also serve as a conduit for intubation with an endotracheal tube using a tube exchanger or an intubating fibrescope. The technique of inserting the laryngeal mask is easily learnt. Using the index finger, the mask is pressed against the hard palate and passed into the pharynx till resistance is felt. The finger is then removed and the cuff inflated. No other equipment is needed. Volunteers, who were taught laryngeal mask airway insertion, were able to achieve a high success rate compared to learning endotracheal intubation (94% versus 51%)⁶ or bag and mask with a Guedal airway (87% versus 43%).⁷ The

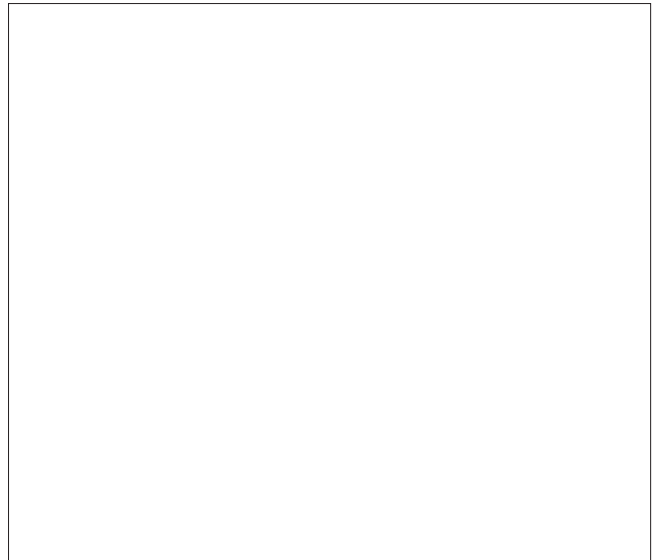


Fig. 3. Changes in arterial saturation with time after a) reduction of alveolar ventilation from 4 L/min to 2 L/min; b) central apnoea; c) obstructed apnoea; and d) obstructed apnoea in hypoxic patient.¹

laryngeal mask airway has been used successfully by paramedical personnel in pre-hospital settings to maintain oxygenation. The other advantages compared with tracheal intubation are more stable haemodynamics during insertion, minimal increase in intra-ocular pressure and less sore throat. However, the laryngeal mask airway does not protect against aspiration of gastric content. Unpleasant airway reflexes, like coughing, swallowing and laryngospasm, can occur when the laryngeal mask airway is inserted under inadequate depth of anaesthesia.

Combitube

The Combitube is a combination of an oesophageal obturator and an endotracheal tube (Fig. 2). The tube can either be inserted into the tracheal or oesophagus without using a laryngoscope. In either case, this double lumen tube can be used to ventilate the lungs directly through a distal tracheal lumen or via a series of perforation at the pharyngeal portion of the tube. Its usefulness as an emergency airway has been recognised and is a recommended method of oxygenation in the difficult airway. It is simple to insert and easily learnt. Paramedics have used it in the pre-hospital settings with good results.⁸ The complications from the Combitube are minor which include trauma and unwanted airway reflexes.

3. Mask Ventilation

At times, even with a patent airway, ventilation may not be adequate. Ventilation must then be assisted by other means like mouth-to-mouth or mouth-to-nose. When available, the bag and mask technique is most appropriate due to concerns of cross infections. This requires an airtight

seal with a face mask. It is estimated that difficult ventilation can occur in 5% of the population. This would mean poor chest movement, oxygen saturation of <92% with 100% oxygen and fresh gas flow of >15 L/min or having a significant gas leak. They are usually patients above 55 years old, with body mass index >26 kg/m², having a beard, edentulous or has a history of snoring.⁹

In edentulous patients, inserting an oral airway will restore the vertical height to the face and improve the seal. Alternatively, the dentures could be left in the mouth. In patients with a full beard, smearing a water-soluble gel, or using a diathermy pad with a hole for the mouth can improve the seal. Any form of resuscitation bags could then be used for ventilation.

In situations where there is excess soft tissue in the pharynx, e.g. large tonsils, a continuous positive pressure can relieve the obstruction. In a study using video endoscopy, 24 children with adenotonsillar hyperplasia underwent general anaesthesia. It was found that when chin lift or jaw thrust was applied, the epiglottis was lifted off the posterior pharyngeal wall. When this was combined with continuous positive airway pressure (10 cmH₂O), there was significant displacement of the tonsils and reduction of stridor.

4. Improving Oxygenation

When managing an obstructed airway, the most important task is to provide for a clear airway as quickly as possible. Desaturation occurs faster in a patient breathing against an obstruction than one that is apnoeic (Fig. 3).¹⁰ The simplest manoeuvre is the head tilt, chin lift, jaw thrust and open mouth. When this fails, an oral airway is inserted. If the obstruction is not relieve despite correct positioning and size of the oral airway, a nasal airway would be useful. Additional help in repositioning the patient or the airway may be helpful. At this point, an alternative airway like the laryngeal mask or Combitube could be used. These are useful equipment in cases of difficult ventilation. Supplementary oxygen should always be given. This will improve oxygenation as well as flow characteristics.

The viscosities of common anaesthetic gases are fairly similar but their densities differ greatly. When the airway is narrowed, flow becomes turbulent and the density of a gas takes greater significance. The density of oxygen is quite close to air, but the density of 70% nitrous oxide in oxygen is 60% higher while that of 80% helium in oxygen is only 30% that of air. During an airway obstruction, the use of heliox (80% helium, 20% oxygen) improves flow as turbulence is reduced. This improved flow can be 1.73 times greater than air or 100% oxygen. In a child with acute epiglottitis, inhalational induction with helium-oxygen

mixture is a recommended technique. If helium is not available, using 100% oxygen is also more advantageous than nitrous oxide-oxygen mixture as there will be less turbulence. Gas flow is increased and the higher oxygen concentration also provides better oxygenation.

If the cause of the obstruction or desaturation cannot be reversed, there will be a need to secure a definitive airway via tracheal intubation or even surgery. Whatever the choice, it is essential to maintain oxygenation at all times. Skilled help is vital in determining a successful outcome in these situations.

Conclusion

Airway management remains an essential skill for all personnel involve in patient care. An understanding of the anatomy, devices available and techniques for overcoming an obstruction will enable us to provide quality medical care in challenging situations. While it is not difficult to acquire the skill, it is essential to have periodic practice combined with feedback to maintain performance.¹¹ Without this, there is a significant loss of airway management skills to the detriment of our patients.

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