ABC of Major Trauma

Management of the Upper Airway

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First vital minutes

All severely injured patients have hypoxaemia in varying degrees. As soon as medical help arrives the first priority must be to ensure that the patient's airway is free and ventilation is unimpaired. Immediate administration of supplementary oxygen to the unobstructed airway is of paramount importance. Remember that in the first vital minutes the cervical spine of any patient with trauma should be considered broken until proved otherwise. The neck must be kept stabilised without traction (for example by using a spine board, sand bags, or a hard collar) at all times until the possibility of neck injury is excluded.

In an unconscious patient any obstruction to the airway must be removed under direct vision. The laryngeal and pharyngeal reflexes should then be assessed and respiratory performance examined. If protective reflexes are adequate - for example, the patient is coughing -retracting the tongue forward by employing the chin lift or jaw thrust manoeuvre or inserting an anaesthetic type airway or nasopharyngeal tube may suffice. If the reflexes are depressed or absent - that is, there is no gag reflex when oropharyngeal suction is attempted in an unconscious patient - the airway must be secured at the earliest opportunity by intubation with an appropriately sized endotracheal tube with a low pressure cuff.

Patients with hypoxia or apnoea must be ventilated and oxygenated before intubation is attempted. Ventilation can be achieved with a mouth-to-face mask or bag-valve-face mask. Studies suggest that ventilation techniques with a bag-valve-face-mask are less effective when performed by one person rather than two people, when one of the pair can use both hands to assure a good seal. When only one person is present to provide ventilation the method employing the mouth-to-face mask is preferred. During such manoeuvres the neck must be kept immobilised.

If intubation is performed a large bore gastric tube should also be passed. Nasal passage of a gastric tube is contraindicated in patients with suspected basal skull fractures or injury to the cribriform plate.

Tracheostomy is rarely necessary as an emergency procedure. Severe distorting injury to the structures above or at the level of the larynx can render endotracheal intubation impossible, but cricothyroidotomy - for example, with a large bore intravenous cannula - is preferred to emergency tracheostomy in such circumstances.

In patients with fractured ribs with or without a pneumothorax chest drainage on the side of the fractures is mandatory before artificial ventilation is undertaken. A tension pneumothorax should always be suspected when a patient with a recent crush injury has obvious respiratory distress or cyanosis. In patients with a chest injury complicated by pneumothorax an apical chest drain should be inserted through the space between the fifth and sixth ribs, just anterior to the midaxillary line. If there is blood in the pleural cavity an additional basal drain may be required.

An open pneumothorax should be managed initially by occluding the open wound with a petroleum jelly gauze or other non-porous dressing. A chest tube is also inserted to relieve any accumulated air and prevent the development of a tension pneumothorax.

Box: Indications for securing an airway with an endotracheal tube

➤ Apnoea

➤ Obstruction of upper airway

➤ Protection of lower airway from soiling with blood or vomitus

➤ Respiratory insufficiency

➤ Impending or potential compromise of airway (prophylactic intubation) - for example, after facial burns or continuous seizures after intravenous diazepam

➤ Raised intracranial pressure requiring hyperventilation.

Indications for oxygenation and ventilation

Once the airway is secured the adequacy of the exchange of respiratory gases must be evaluated. The respiratory rate can be counted and respiratory effort assessed. Measurements of blood gas tensions should be undertaken as soon as is practicable.

Artificial ventilation in patients without respiratory failure must also be considered when there is coincidental head injury. Hypercapnia and hypoxaemia from asphyxia or inadequate ventilation with fluctuations in arterial blood pressure cause considerable deterioration in cerebral function. This is probably secondary to alterations in cerebral blood flow that adversely affect intracranial pressure.

Box: Indications for oxygenation and ventilation

➤ Ventilatory assistance is required when there is excessive respiratory work or obvious ventilatory insufficiency

➤ Failure of adequate oxygenation ($PaO_2 < 9$ kPa) when the patient is breathing a high inspired oxygen concentration (6 L/min O_2 by facemask) demands endotracheal intubation and assisted positive pressure ventilation.

Hospital management

An anaesthetist experienced in caring for victims of trauma should be available to examine the patient immediately on arrival at hospital. Evaluation of the patient's airway must proceed simultaneously with treatment. If the airway is satisfactory treatment may consist simply of increased oxygen delivery. If the airway is comprised or the patient needs ventilatory support a secure intratracheal airway, if not already in place, is required. Patients with hypoxia or apnoea must be ventilated and oxygenated before intubation is attempted.

The route of choice for securing the airway depends on several factors. Blunt trauma of the head and face is associated with an incidence of fractures of the cervical spine of 5 to 10%. Patients with trauma should be assumed to have a cervical fracture until proved otherwise; manipulation of the neck is strictly contraindicated. Doctors in the UK generally accept that laryngoscopy and orotracheal intubation after induction of anaesthesia and muscle paralysis can be performed by a competent operator with minimal changes in the position of the cervical vertebrae while an assistant holds the patient's head. Although optimum exposure of the larynx is not achievable under such conditions, experienced anaesthetists can intubate patients without clearly visualizing the vocal cords. This may require aids such as the gum elastic bougie. Pressure on the cricoid must be provided by a skilled assistant to protect the patient from aspirating gastric contents. The stomach may already have been emptied as much as possible by the passage of a nasogastric tube with the neck immobilised.

Box: Intubation of patients with head injuries

➤ Assume the patient has a cervical fracture
➤ An anaesthetist performs laryngoscopy while an assistant holds the patient's head
➤ Pressure on the cricoid must be provided to prevent aspiration of gastric contents.

Tracheostomy may be necessary for patients who cannot be intubated either nasally or orally. Often these patients have massive facial trauma. Although surgical cricothyroidotomy can be performed through a small midline incision in the cricothyroid membrane, life saving oxygenation can also be provided by needle cricothyroidotomy with a cannula connected to an anaesthetic circuit for assisted ventilation. Spontaneous respiration after needle cricothyroidotomy, however, can be extremely difficult, requiring high pressures in the airway and considerable ventilatory effort. Assisted ventilation with sedation and muscle paralysis is therefore necessary.

Anaesthetic considerations

Anaesthetists caring for patients who are critically ill reduce the doses of all anaesthetics because hypovolaemia and hypotension alter the distribution and pharmacokinetics of drugs, thereby exaggerating their clinical effects. Opiates and barbiturates are therefore given in smaller doses to avoid cardiovascular depression. Ketamine and halogenated hydrocarbons such as halothane raise intracranial pressure and are contraindicated in trauma of the head. Ketamine (1

to 2 mg/kg) and partial opiate agonists such as nalbuphine, however, are useful in trauma that is complicated by haemorrhagic shock. Muscle relaxants given to facilitate intubation include suxamethonium (1.0 mg/kg), pancuronium (0.1 to 0.2 mg/kg), vecuronium (0.1 to 0.2 mg/kg) or atracurium (0.4 mg/kg). Often patients have taken drugs such as opiates, cocaine, and marijuana before suffering trauma. These may interact with anaesthetics. Ethanol enhances the effect of anaesthetics and sedatives and reduces the minimum alveolar concentration of volatile general anaesthetics required.

Box: Drugs contraindicated in trauma

Head injuries

➤ Ketamine increases intracranial pressure
➤ Halothane and enflurane increase intracranial pressure

Burns and spinal cord injuries

➤ Suxamethonium is safe during the first 24 hours but subsequently it can cause potentially lethal hyperkalaemia

Eye injuries

➤ Suxamethonium is relatively contraindicated as it raises intraocular pressure.

Before embarking on intubation an anaesthetist will check the equipment, including the suction and oxygen delivery apparatus. Anaesthetics should be ready in labelled syringes, and duplicate ampoules should be easily accessible. Vasoactive drugs such as atropine should also be ready in syringes in case untoward bradycardia complicates extended laryngoscopy. A skilled assistant must be at hand to apply pressure on the cricoid. The neck must be kept stabilised. Secure venous access is mandatory.

Box: Essential equipment for endotracheal intubation

➤ Laryngoscope
➤ Endotracheal tube
➤ Connections
➤ Inflating bag (such as Ambu bag)
➤ 10 mL syringe for cuff inflation
➤ Suction apparatus
➤ Bougie or introducer catheter
➤ Magill curved forceps.

Anaesthesia is induced only after administration of oxygen with the best possible monitoring available. Pressure on the cricoid is maintained by the assistant. Neuromuscular blockade is produced by suxamethonium, and intubation proceeds with the onset of paralysis and relaxation of the jaw.

Although deeply unconscious patients without protective reflexes may be intubated without receiving drugs, patients with responsive airway reflexes require induction of anaesthesia and muscle paralysis for the airway to be secured by either an oral or a nasotracheal route. Nasotracheal intubation should not be undertaken if fractures of the base of the skull or of the cribriform plate are suspected.

Intubation technique

The anaesthetist takes the laryngoscope in his or her left hand and inserts it into the right hand side of the patient's mouth, thereby moving the tongue to the left. While carefully observing the back of the tongue he or she advances the curved blade of the laryngoscope until the epiglottis comes into view.

The tip of the blade is moved anterior to the epiglottis and the whole lower jaw lifted upwards, taking care not to move the neck. This should expose the arytenoid cartilages and vocal cords. The tracheal rings should be visible beyond. Under direct vision the anaesthetist advances a 60 cm gum elastic bougie or the endotracheal tube, aiming for the left vocal cord. If a gum elastic bougie is used a cut cuffed endotracheal tube of the appropriate size is subsequently "rail roaded" into the trachea. A size 8 tube is usually suitable for women and a size nine for men. The cuff of the endotracheal tube is then inflated with air from a syringe until an airtight seal is secured. The chest should be auscultated in both axillae to exclude intubation of the right main bronchus or oesophagus. Pressure on the cricoid can only now be released and the tube secured with tapes.

After intubation ventilation should proceed with a tidal volume of about 10 mL/kg at a rate of about 10 breaths each minute. Analysis of arterial blood gases should be undertaken at the first opportunity to reassess oxygenation and the adequacy of ventilation. Radiography of the chest should also be performed routinely after endotracheal intubation to catalogue the position of the endotracheal tube in the bronchial tree.

In conclusion, providing oxygen and ventilatory support as early as possible are prerequisites for successful resuscitation in victims of major trauma. Otherwise, as Haldane observed, hypoxia not only stops the machine but wrecks the machinery.