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Early management of the critically ill patient

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Without an adequate supply of oxygen, cell mechanisms fail and the patient dies. The priority in the early management of a sick patient is therefore to ensure adequate levels of cellular oxygenation. Although many disorders can account for an acute deterioration in a patient's status, the early management principles are similar and revolve around the basics of supporting the patient's airway, breathing and circulation.

Airway management

The first priority in managing an acutely sick patient is to ensure patency of the patient's airway and to give the patient oxygen (Table 1)[1]. The aims of airway management are to maintain adequate oxygenation and to prevent aspiration of gastric contents into the tracheobronchial tree. These aims can best be achieved by giving oxygen with an appropriate device (Table 2) while maintaining patency of the airway. This may be relatively simple, merely requiring support of the jaw, or more complex, necessitating tracheal intubation.

The airway can be intact, partially obstructed or completely occluded. Even if the airway is open, loss of the normal protective reflexes can leave the patient susceptible to aspiration of gastric secretions. Although loss of the gag or cough reflexes is usually obvious, they should be considered inadequate if the Glasgow Coma Scale score is less than eight. Complete obstruction of the airway is usually self-evident, but partial obstruction is not always so easy to diagnose. Partial obstruction presents as inspiratory stridor, or 'snoring' if the obstruction is due to a loss of pharyngeal tone, or as expiratory wheeze if the obstruction is below the larynx. In the presence of spontaneous breathing, partial obstruction can present as paradoxical movements of the chest and abdomen.

When the patency of the airway is compromised, it should be treated with utmost urgency. The basis for the steps taken is that the genioglossus muscle attaches the tongue to the mandible and thus techniques that displace the

Key Points

Early appropriate treatment of acutely ill patients is vital in order to maintain adequate cellular oxygenation and to prevent a decline into organ failure and death

When the patency of the airway is compromised, it should be treated with utmost urgency. This includes simple manoeuvres of the jaw up to and including endotracheal intubation

Appropriate amounts of oxygen must be delivered to tissues. This can be achieved with a variety of delivery devices. Effectiveness can be assessed by arterial blood gas measurement or peripheral oxygen saturation

Circulatory resuscitation is imperative in shocked patients to allow adequate delivery of oxygen to the vital organs. Oxygen delivery has three main components – oxygen saturation, haemoglobin concentration and cardiac output – all three of which must be adequate for optimal resuscitation

KEY WORDS: CPD, airway, breathing, cardiac output, circulation, delivery, mask, oxygen, saturation, ventilation

Table 1. American College of Chest Physicians and National Heart Lung and Blood Institute recommendations for commencing oxygen therapy.

- Cardiac or respiratory arrest
- Hypoxaemia, as defined by PaO_2 <7.8 or SaO_2 <90%
- Hypotension, as defined by systolic BP <100 mmHg
- Metabolic acidosis (bicarbonate <18 mmol/l)
- Tachypnoea (respiratory rate >24 breaths/min)

Table 2. Equipment for the delivery of oxygen in spontaneously breathing patients.

Device	Flow of oxygen through device (litres)	Inspired oxygen concentration (%)
Nasal cannula	0.5–5	21–40
Face mask	5–10	35–50
Venturi face mask	4–15	24–60
Face mask with reservoir bag	4–15	35–90
Tight fitting anaesthetic mask	10–15	100

mandible forward will pull the tongue off the posterior pharyngeal wall and so open the airway. A series of simple progressive steps can be taken to correct this problem. First, the mouth should be inspected for the presence of a foreign body or excessive secretions that could be simply removed. The airway can then be opened by flexing the neck, whilst at the same time extending the head on the neck. If this does not alleviate the problem, the chin can be pulled forward or the jaw thrust forward with a finger placed proximal to the angle of the mandible. If none of these techniques is adequate, an oral or nasopharyngeal airway should be inserted and then, if necessary, the trachea intubated with an endotracheal tube.

Breathing-respiratory failure

The aims of supporting the ventilatory status of the patient are to ensure adequate oxygenation of blood and excretion of carbon dioxide. Respiratory failure can present in a number of ways, acute, chronic and acute-on-chronic, and be due to a number of causes (Table 3)[2]. The treatment of respiratory insufficiency must therefore be appropriate to the underlying disturbance. Hypoxaemia has to be treated by increasing the inspired oxygen concentration (FiO_2) and by manoeuvres aimed at increasing the mean airway pressure. Hypercarbia, on the other hand, necessitates either decreasing the total dead space or increasing the minute ventilation.

Simple, logical, progressive steps in management can best achieve these aims. Appropriate amounts of oxygen must be given to start with and titrated to the desired effect as assessed by measuring either arterial blood gas concentration or peripheral oxygen saturation. If the patient remains hypoxaemic despite increasing the FiO_2, continuous positive airways pressure may be considered. This will increase the mean airways pressure and should increase blood oxygenation. The underlying condition must be treated or therapy initiated. Minute ventilation can then be increased with either invasive or non-invasive techniques, as appropriate. Whichever technique is utilised, regular assessment of arterial blood gas concentration is essential to ensure appropriate levels of therapy.

Table 3. Causes of respiratory failure.

Increased metabolic requirements (especially in patients with borderline respiratory function)	Fever Hyperthyroidism Agitation Excess carbohydrate load
Central depression	Central nervous system disease Drug overdose Anaesthesia Metabolic alkalosis Obstructive sleep apnoea syndrome Central fatigue
Reduced respiratory muscle strength	Neuromuscular disease Malnutrition Electrolyte abnormalities (especially hypophosphataemia) Steroids Thoracic deformities Peripheral fatigue
Ventilation perfusion inequality	Increased shunt (eg ARDS) Increased dead space (eg chronic obstructive airways disease)
Abnormal mechanical load	Elastic load (eg pneumonia, ARDS) Resistive load (eg asthma)

ARDS= acute respiratory distress syndrome.

Circulatory support

The main function of the cardiovascular system is to ensure both adequate delivery of oxygen (DO_2) to the tissues and an adequate perfusion pressure for the vital organs to function. When this fails, the patient is 'shocked'. It is imperative, therefore, that acutely ill patients are resuscitated to levels of DO_2 and mean arterial blood pressure appropriate for their needs. The result of such therapies can be assessed clinically (end-organ perfusion), biochemically (lactic acidosis) and mechanically

(invasive haemodynamic monitoring).

The prime determinants of DO_2 to the tissues are the arterial haemoglobin oxygen saturation (SaO_2), the haemoglobin level and the cardiac output. The SaO_2 should be 95–100%. The DO_2 then depends on the amount of haemoglobin and the cardiac output. Cardiac output is best maintained, first, by ensuring that the circulatory volume is adequate by giving infusions of either crystalloids or colloids. It is unclear which of these is most effective[3]. When circulating volume has been restored, vasoactive drugs can be given to increase either flow or pressure, as required.

Recent advances in resuscitation of the circulation

Improving DO_2 is effectively the only action we are able to take when resuscitating a patient. However, beyond this there is evidence that in some patient groups outcome may be improved by targeting therapy towards specific goals. The absolute level of DO_2 that should be achieved in individual patients is controversial[4]. Fewer patients undergoing high-risk surgery will die if DO_2 is maintained above 600 ml/min/m^2. This has been achieved with the use of fluids and dopexamine, titrated to effect with the use of a pulmonary artery catheter[5,6,7]. In patients with septic shock treated in the accident and emergency department, mortality has been reduced by giving treatment to achieve near normal end-points of blood lactate level and central venous SaO_2, which provide surrogate markers for DO_2[8].

Conclusions

The early management of critically ill patients revolves around the basic principle of ensuring that adequate amounts of oxygen are transported around the body to the tissues. The management steps involved with ensuring this process are simple but can often be overlooked[9]. If the principles described are adhered to, both morbidity and mortality can be reduced.

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