patients with COPD and to reduce the amount of health care needed (Griffiths et al., 2000).

**CONTROLLED OXYGEN THERAPY**

Relief of life-threatening hypoxia is clearly the first priority; this can usually be achieved by administering supplemental oxygen and optimizing cardiac output. It is important to appreciate, however, that administration of oxygen is nearly always associated with a rise in \( P_{\text{aCO}} \) due to:

- a fall in minute ventilation (Calverley, 2000), caused by suppression of the hypoxic drive to breathe which is mediated by the carotid chemoreceptors;
- reversal of hypoxic pulmonary vasoconstriction, with worsening V/Q mismatch and an increased physiological dead space;
- the Haldane effect (i.e. carbon dioxide dissociates from haemoglobin).

In most cases this rise in \( P_{\text{aCO}} \) is of no consequence, but in those with severe COPD, long-standing hypercarbia and a 'hypoxic' drive to respiration, oxygen therapy may significantly decrease alveolar ventilation and precipitate severe carbon dioxide retention. Because these patients are hypoxic they are operating on the steep portion of their oxyhaemoglobin dissociation curve and small increases in \( P_{\text{aO}} \), not sufficient to cause significant carbon dioxide retention, will lead to useful increases in arterial oxygen content (\( \text{CMO}_2 \)). Oxygen saturation values of 90–92% should be targeted. This forms the basis for controlled oxygen therapy (Campbell, 1960a) using fixed-performance masks (Ventimask) delivering 24%, 28% or 34% oxygen. Alternatively nasal cannulae can be used to administer a low flow of oxygen. Careful monitoring is essential with frequent blood gas analysis to achieve the optimal effect. Although small increases in \( P_{\text{aCO}} \) can be tolerated, the pH should not be allowed to fall below 7.25. If significant carbon dioxide retention does occur it is important not to deprive the patient of supplemental oxygen since, because of the respiratory depression and the increase in \( P_{\text{aCO}} \), \( P_{\text{aO}} \) is likely to fall to a level lower than that on admission. Evidence suggests that, provided oxygen therapy is carefully controlled, hypoxaemia can be corrected with a low risk of \( \text{CO}_2 \) retention, indicating that hypercapnic ventilatory drive is preserved in most patients. Generally those who develop clinically important \( \text{CO}_2 \) retention are more severely hypercapnic on presentation (Moloney et al., 2001).

Inhalation of nitric oxide (see below) may worsen, rather than improve, gas exchange in COPD (Barberà et al., 1996).

**MECHANICAL VENTILATION**

If the patient continues to deteriorate despite these measures, institution of mechanical ventilation should be considered. This decision is primarily clinical (see above) and intervention is often prompted by deteriorating mental status, ineffective cough or apnoea.

**Selection of patients for mechanical ventilation.** In general it is prudent to be cautious about embarking on mechanical ventilation in those with severe chronic respiratory failure because they are particularly susceptible to complications and in a proportion of cases weaning will prove to be difficult or very occasionally impossible. Selection of suitable patients is based largely on an assessment of the severity and nature of the underlying chronic pulmonary disease. The patient’s previous exercise tolerance and ability to lead an independent existence are perhaps the most important considerations. Those who were severely incapacitated (e.g. able to walk only a few metres on the flat) before the acute episode will be extremely difficult to wean from the ventilator. Conversely, if the patient was previously leading a full and active life an aggressive approach to treatment should be adopted. It is also important to enquire about previous admissions to hospital with respiratory failure and whether the patient has required mechanical ventilation in the past. If possible, the duration of any previous intensive care admissions and details of the weaning process should be ascertained. Polycythaemia and cor pulmonale suggest that the patient has been hypoxic for some time, whereas an elevated bicarbonate concentration indicates that hypercarbia has been present for at least a few days. In general, success is most likely in patients with a clearly reversible component to their lung pathology (e.g. superadded infection and/or reversible Airways obstruction), whereas those with end-stage lung disease associated with unresponsive airflow limitation are less likely to benefit from mechanical ventilation. Clearly if there is any doubt, as is frequently the case, the patient should be intubated and ventilated.

The principles underlying the selection of the most appropriate mode and pattern of ventilation for a patient with COPD are similar to those described earlier for patients with severe asthma. There is some evidence that the application of an external PEEP at a level close to that of the intrinsic PEEP can significantly reduce work of breathing in mechanically ventilated COPD patients (Guerin et al., 2000). In one study values for static intrinsic PEEP averaged 13 ± 2.9 cm H₂O in ventilator-dependent, tracheostomized COPD patients (Purro et al., 1998). Non-invasive mechanical ventilation may be useful as a means of avoiding endotracheal intubation and has been associated with improved outcomes in patients with exacerbations of COPD (see Chapter 7).

**GENERAL MEASURES**

Mechanically ventilated patients with COPD require prophylaxis against thromboembolism and adequate nutritional support (usually via the enteral route). Hypophosphataemia, which can impair respiratory muscle function (Aubier et al., 1985), is extremely common and may be related to an intracellular shift of phosphate secondary to correction of respiratory acidosis (Laaban et al., 1989). Phosphate administration is indicated in those with severe hypophosphataemia, those with symptoms related to low phosphate levels, when there is pre-existing hypophosphataemia and in alcoholics. The benefits of phosphate administration in those with lesser