Oxygen and the airways

Richard Wood-Baker

The best things carried to excess are wrong (Charles Churchill (satirist) 1731–1764)

The use of oxygen for the management of patients with acute breathlessness, irrespective of cause, is well established in medical practice. The perception of benefit, even in the absence of measurement of oxygenation, and concerns over adverse outcomes from severe hypoxaemia have driven the use of high-concentration oxygen therapy over many years with little regard to possible harmful effects. While there have been many advocates for the cautious use of oxygen in chronic obstructive pulmonary disease (COPD) as a result of its propensity to promote hypercapnia, liberal use in asthma appears universal. This approach pervades student teaching through medical texts, even when there is significant respiratory input into the publication and extends to recent evidence-based guidelines on both asthma management and oxygen usage. The recently published British Thoracic Society/Scottish Intercollegiate Guidelines Network (BTS/SIGN) guidelines recommend administration of oxygen for acute exacerbations of asthma, stating ‘Many patients with acute severe asthma are hypoxaemic. Supplementary oxygen should be given urgently to hypoxaemic patients, using a face mask, Venturi mask or nasal cannulae with flow rates adjusted as necessary to maintain SpO₂ of 94–98%’, advice that is allocated a moderate to low level of evidence. Furthermore, they emphasise the use of oxygen therapy even in the absence of information on oxygenation, recommending that the ‘Lack of pulse oximetry should not prevent the use of oxygen’. Use of oxygen according to these recommendations is likely to result in a high fractional inspired oxygen, as ‘In hospital, ambulance and primary care, nebulised β₂ agonist bronchodilators should preferably be driven by oxygen’, noting ‘A flow rate of 6 l/min is required to drive most nebulisers’. The recently published BTS guidelines on emergency oxygen use are more circumspect on use without measurement of oxygenation, stating that there is no benefit from oxygen administration in non-hypoxic patients and emphasising that administration should be based on, and monitored by, objective measures.

The relationship between oxygen concentrations and airway diseases, particularly the impact on ventilatory responses, has been of interest for many years. As early as 1979, investigations were being carried out on the impact of hyperoxia in asthma, by measuring specific airway conductance during exercise-induced bronchoconstriction and comparing patients with asthma who had bilateral carotid body resection with those having intact carotid bodies. Oxygen breathing during exercise markedly attenuated the post-exercise bronchospasm in patients with asthma who had intact carotid bodies, but had no significant effect in those without carotid bodies, unrelated to changes in end-tidal partial pressure of carbon dioxide. The authors concluded that oxygen attenuates exercise-induced bronchospasm in patients with asthma through its action on the carotid bodies.

Further reassurance on the safety of oxygen for acute exacerbations of asthma was reported. Seventy-four patients were randomised to receive 28% or 100% oxygen for 20 min. The administration of 100% oxygen significantly increased arterial carbon dioxide pressure (PaCO₂) compared with 28% oxygen, especially in those with PaCO₂ greater than 40 mm Hg before oxygen treatment. Supporting these observations, in this issue of the journal, Perrin et al report on findings that provide high-level evidence based on which recommendations have been made for oxygen administration in acute asthma. They report a randomised study comparing the effect of high-concentration oxygen delivered at 8 l/min via a face mask with oxygen titrated to achieve oxygen saturations of 93–95% in acute exacerbations of asthma presenting to an emergency department. Transcutaneous CO₂ pressure (PtCO₂) was used to measure the effect of the interventions, with the proportion of patients having a rise in PtCO₂ =4 mm Hg at 60 min being significantly greater in the high concentration oxygen group when compared with the titrated group. The investigators concluded that

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Oxygen use is a rising tide that threatens the practice of all medical disciplines.     This is not a call to restrict its availability, but a reminder that the evidence for using it is not without significant reservations. If we are to improve the management of asthma, we should be more cautious of the oxygen we administer, even in those with the most hypoxaemic features.
Who will benefit from tracheostomy ventilation in motor neuron disease?

John M Shneerson

The decision when to recommend tracheostomy ventilation in motor neuron disease (amyotrophic lateral sclerosis) has always been difficult. At one extreme is the view that when spontaneous ventilation or non-invasive ventilation is inadequate, a tracheostomy will save the patient’s life and lead to prolonged survival. This view has been more widely held in the USA than elsewhere. In the UK, a common position is the opposite, with a nihilistic attitude towards invasive respiratory treatment. The rationale behind this is that it is too intrusive, both for the patient and for the family and carers, and that once a tracheostomy is needed, palliative care is more appropriate.

Not surprisingly, there has been a wide geographical variation in the proportion of patients who proceed to a tracheostomy, and the review by Sancho et al is timely. The authors describe a 9-year experience in a specialist respiratory care unit where the issues surrounding tracheostomy ventilation were openly discussed with each patient who might benefit from it. Out of 76 subjects 38 refused. Unfortunately, no further data are provided about these patients to compare their outcomes in terms of quality of life with the 38 who underwent a tracheostomy but their mean survival was only 0.83 months.

Interestingly, over half of those who underwent a tracheostomy did so during an acute severe chest infection in which non-invasive ventilation was either ineffective or not indicated. These patients were transferred from entotraheal intubation to tracheostomy ventilation. The indications were otherwise untreatable ventilatory failure or the need for access to tracheobronchial secretions during and after the infection. The mean survival after tracheostomy was 10.76 months, which was similar to the mean survival when tracheostomy was carried out electively.

As has also been reported in a recent study, some of these patients eventually did not require continuous ventilatory support, but there is no mention of whether any could be weaned onto non-invasive ventilation once they recovered from their acute illness. Another report, however, suggests that almost half of those who undergo tracheostomy ventilation in this situation can eventually be weaned onto non-invasive support. Their survival is as good as those who still require tracheostomy ventilation but they are more likely to be able to return home.

These encouraging findings suggest that there is a need for a re-appraisal of the management of severe chest infections in motor neuron disease. A much more active approach needs to be taken by intensivists, neurologists and respiratory physicians involved in their care than has been the standard practice in the past.

The indications for elective tracheostomy ventilation were either an inability to provide adequate ventilatory support...