A breath of fresh air: a new UK guideline for emergency oxygen therapy

Any junior doctor who has rotated between acute medicine, emergency medicine, respiratory medicine and intensive care will have seen oxygen used in very different ways in these departments. Trainees are likely to have received very different advice in each of these areas, even if the rotation was within a single hospital. Some trainers will have emphasized the risks of hypoxaemia and reassured trainees that the reported hazards of oxygen therapy in chronic obstructive pulmonary disease (COPD) and some other 'high risk' conditions were somewhat exaggerated whereas other trainers may have emphasized the risks of high-dose oxygen therapy in vulnerable patients and not given sufficient attention to the risks of hypoxaemia in other cases. Some trainees may have wondered if the consultants in these specialties ever spoke to each other.

Why does this matter?

Inconsistencies in clinical practice might not matter very much if the drug in question was rarely used or if there were no important consequences of under- or overuse. However, patients may die from undertreated hypoxaemia and others are at risk from respiratory acidosis if excessive amounts of oxygen are given (Plant et al, 2000).

Oxygen is probably the most widely used drug in medical emergencies. A recent audit in north-west England found that 34% of patients brought by emergency ambulance to the majors section of a hospital emergency department were given oxygen in the ambulance and almost half had this discontinued in the emergency department (Hale et al, 2008). Of 1022 patients audited, 17% had an oxygen saturation below 94% at some time during the ambulance journey and 7% had saturation below 90% (33% of COPD patients and 5.5% of non-COPD patients had a saturation below 90%).

How well is oxygen prescribed at present?

Another curious thing about oxygen is that it is rarely prescribed in hospitals. A patient in hospital would never be given paracetamol, amoxycillin or insulin by nursing staff without a valid prescription but oxygen is given freely on the basis of the word 'oxygen' being written in the case notes or, in many instances, with no written instruction whatsoever.

Audit of oxygen prescribing has shown that proper prescription of oxygen in hospitals is the exception rather than the rule (Boyle and Wong, 2006; Hickey, 2007). Oxygen is often given without a prescription and, if prescribed, there is little correlation between the prescription and what the patient actually receives. This is partly a result of the complexity of oxygen prescriptions because of the range of devices and flow rates that are available. In serious emergencies, oxygen should be given first and documented later (like adrenaline or atropine) but, like other medicines, it should be prescribed in all other situations.

Are there existing guidelines?

Before October 2008 there was only one publication describing the north west oxygen guidelines (Murphy et al, 2001). These very brief guidelines were developed when a group of respiratory physicians, intensivists and emergency physicians in north-west England sat down together, reviewed the existing evidence and came up with a very short document with agreed principles for emergency oxygen therapy.

A major step forward has occurred in 2008 with the publication of the first national guideline for the emergency use of oxygen in adults. This aims to simplify oxygen delivery and better protect acutely ill patients. The guideline was developed by a multidisciplinary working party, commissioned by the British Thoracic Society and endorsed by 21 other societies and colleges (O'Driscoll et al, 2008).

This guideline aims to correct the lack of consistency between departments and between institutions, striking a sensible balance between the risk of hypoxaemia for some patients and the risk of hypercapnic acidotic respiratory failure in others.

What differences will the new guideline make?

- Oxygen therapy will be adjusted to achieve target saturations rather than giving a fixed dose to all patients with the same disease
- The target saturation is 94–98% for most patients
- The target saturation is 88–92% for patients with significant COPD and other patients who may be at risk of hypercapnic respiratory failure
- Nurses and physiotherapists will make these adjustments without needing a change to the prescription each time
- Most oxygen therapy will be from nasal cannulae rather than masks
- Oxygen will not be given to patients who are not hypoxaemic (except during critical illness)
- Pulse oximetry must be available wherever emergency oxygen therapy is used
- Oxygen will be prescribed in all situations except for the immediate management of critical illness.

Why is oxygen given?

Most patients and most health-care professionals think that oxygen relieves breathlessness. There have been few studies of the effects of oxygen on acutely ill hypoxaemic patients but there is a lot of evidence that oxygen does not relieve breathlessness in non-hypoxaemic patients (O'Driscoll, 2008). Furthermore, pure hypoxaemia in the absence of illness or exercise causes altered consciousness followed by loss of consciousness but does not actually cause breathlessness (Hoffman et al, 1946).

The brain is the most vulnerable organ in extreme hypoxic conditions but other organs such as the liver and kidneys can also be harmed by severe hypoxaemia. Thus the main indication for oxygen therapy is to protect the organs from the harmful consequences of hypoxaemia, although it may also provide some relief from breathlessness in patients who are hypoxaemic.

In the past, it was believed that oxygen therapy would increase oxygen delivery to

organs such as the heart and brain during emergencies such as heart attacks and strokes. However, hyperoxaemia causes vasoconstriction in the cardiac circulation and elsewhere. Giving oxygen to a non-hypoxaemic patient with chest pain may increase the oxygen saturation from 98% to 100% but the coronary artery blood flow may be reduced by about 18%, thus reducing the amount of oxygen actually delivered to the cardiac tissues (Beasley et al, 2007).

The only randomized study of oxygen in non-hypoxaemic patients with myocardial infarction (Rawles and Kenmure, 1976) found a statistically significant increase in cardiac enzyme levels in the blood, suggesting increased myocardial damage, in the group given oxygen and there was a non-significant increase in mortality. It is both surprising and worrying that oxygen continued to be given to most patients with heart attacks for the next 32 years without any further clinical trials. A quasi-randomized trial of oxygen therapy in non-hypoxaemic stroke patients showed no difference in outcomes in severe strokes but, for those with mild or moderate strokes, the 1-year mortality was 18% for those given oxygen and 9% in those randomized to air (P=0.023) (Ronning and Guldvog, 1999). Therefore, the new guideline aims to achieve normal oxygen levels for patients with chest pain and strokes but it is not necessary to give oxygen to those whose oxygen saturation is normal.

Is precautionary oxygen beneficial?

Oxygen was often given for precautionary reasons on the basis that it would be protective if a patient deteriorated. This may have saved lives before oximetry was widely available, but the high oxygen level recorded by oximetry in such a patient nowadays would delay recognition that the patient was deteriorating and might delay life-saving interventions (Downs, 2003; Fu et al, 2004).

Furthermore, a patient with desaturation while breathing air can be given oxygen while emergency assessment is being arranged but there are fewer therapeutic options for a patient who desaturates while breathing high-dose oxygen. The clinical deterioration might have been detected and treated earlier (and the patient might have been transferred to an intensive care unit at an earlier stage) if the oxygen saturation had been monitored while breathing air.

What type of oxygen delivery systems are recommended?

Critically ill patients will be treated with high concentration oxygen from a reservoir mask and patients with COPD and other vulnerable patients will be treated with a Venturi mask (usually with 28% oxygen). However, most patients who are treated with oxygen require medium concentration oxygen therapy and this is usually delivered by simple face masks. Clinical trials have shown that nasal cannulae are as effective as simple face masks, are preferred by patients, and there is no risk of re-breathing or of increasing the resistance to respiration. Therefore the guideline recommends that nasal cannulae are used in preference to face masks for most patients who require emergency oxygen therapy.

How important is clinical assessment?

The guideline emphasizes the importance of adequate clinical assessment of seriously ill patients and the need to seek a senior opinion urgently in such cases, with early referral to critical care teams where necessary. Oximetry is now available at low cost and must be available in all settings where emergency oxygen is used. In addition to oximetry, the guideline emphasizes the importance of physiological 'track and trigger' systems such as the Early Warning Scoring system.

How will the new guideline be implemented?

The guideline emphasizes the importance of training for all staff who administer oxygen. There are lots of educational materials including lectures for doctors, nurses and other health-care professionals on the British Thoracic Society website (www.brit-thoracic.org.uk). Most acute hospital NHS trusts and some other trusts have got 'oxygen champions' in place to supervise the implementation of the guideline locally. The champions will introduce changes to the prescription sheets and bedside monitoring charts in every acute trust in the UK to ensure that oxygen is delivered in accordance with the new guideline. This will enhance patient care and safety.

Conclusions

The new British Thoracic Society emergency oxygen guideline is an exciting step forward for patient care and patient safety. This is the world's first national guideline for emergency oxygen use and it is hoped that it will save many lives. **BJHM**

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KEY POINTS

- There is a new national guideline for emergency oxygen use which is approved by 22 societies and colleges.
- The guideline is based on oximetry measurements.
- The target saturation for most acutely ill patients is 94–98%.
- The target saturation is 88–92% for patients at risk of hypercapnic respiratory failure.