Caring for patients receiving oxygen therapy

Abstract

Although respiratory disease can occur at any age, older people are more likely to suffer both acute and chronic respiratory disease. Without sufficient oxygen, cells fail and die, and extensive cell death causes body systems to fail. This article considers the principles of short-term oxygen therapy and offers guidance to nurses who may be required to administer such treatment in their work with older people.

Oxygen is vital for life. In health, body cells produce the energy they need to function by metabolising glucose in the presence of oxygen. Without sufficient oxygen, body cells die. Extensive cell death causes organ or system failure which may be fatal. Air contains 21 per cent oxygen, which in health is sufficient for life, but ill-health may necessitate giving supplementary oxygen to ensure cells receive sufficient oxygen to function and survive.

Acute diseases may only need short-term oxygen therapy (the focus of this article), but chronic respiratory disease may necessitate long-term oxygen therapy (LTOT). Staff in hospitals and in the community need to know how to care for patients receiving oxygen, and many principles of acute oxygen therapy can be transferred to long-term care.

**Respiratory failure**

Many diseases can cause respiratory failure, but respiratory failure can be classified into two groups: type 1 and type 2 (Table 1). Type 1 respiratory failure is where blood oxygen levels are low but carbon dioxide levels are normal (oxygenation failure). Type 1 respiratory failure is usually caused by diseases that impair oxygen transfer into the blood, such as pulmonary oedema.

With type 2 respiratory failure oxygen is low, but in addition carbon dioxide is raised. Type 2 respiratory failure is caused by ventilatory failure. Type 2 respiratory failure may be acute or chronic. Acute causes of lack of air reaching alveoli include bradypnoea (low respiratory rate) and shallow breathing. Chronic type 2 failure is from severe chronic obstructive pulmonary disease (COPD), and may be caused by lack of air reaching alveoli (from chronic bronchitis), or failure to exchange gases in severely damaged alveoli (emphysema).

**Table 1. Respiratory failure**

<table>
<thead>
<tr>
<th>Type 1</th>
<th>Type 2</th>
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<tr>
<td>↓ oxygen</td>
<td>↓ oxygen</td>
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<tr>
<td>normal carbon dioxide</td>
<td>↑ carbon dioxide</td>
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<tr>
<td>eg from pulmonary oedema</td>
<td>eg from chronic obstructive pulmonary disease (COPD)</td>
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Respiratory failure can occur at any age, but age-related decline in function (see Richardson et al 2004 or Herbert 2005) significantly increases risks of acute respiratory disease in later life (Behrendt 2000). Cumulative damage to airways during life makes older people more likely to experience chronic respiratory disease. Respiratory disease causes one quarter of medical hospital admissions and about half of these diseases are chronic (MacNee 2003). Respiratory observations, not discussed in this article, are an important part of nursing care.

Oxygen is a drug requiring a prescription, which may include a patient group direction (PGD). Oxygen may be given through a:

- face mask
- nasal cannulae, or
- artificial airway (such as a tracheostomy,

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not described here). Oxygen is a useful treatment for both types of respiratory failure, although other treatments (such as bronchodilators and steroids) are also often needed.

**Nasal oxygen**

Most people needing supplementary oxygen find nasal delivery more comfortable than face masks. Unlike face masks, nasal oxygen does not get in the way of eating, drinking and talking, and is less likely to be claustrophobic.

Nasal oxygen percentages are unpredictable, varying between 24 per cent and 44 per cent (Jevon and Ewens 2001), according to individual breathing patterns. Oxygen tubing delivers 100 per cent oxygen, around which the person breathes air (21 per cent oxygen). Large breath volumes therefore dilute the 100 per cent with more 21 per cent, while shallow breathing dilutes 100 per cent with less (unmeasured) 21 per cent. Breathless people receiving oxygen usually breathe shallowly, so higher percentages are more likely to be received. Nasal oxygen should therefore be recorded by the litre flow, rather than estimated percentage. As a rough guide, on average each litre adds approximately 4 per cent oxygen (Charlebois et al 2004). As air contains 21 per cent oxygen, this makes:

- one litre/minute approximately 25 per cent
- two litres/minute approximately 29 per cent
- three litres/minute approximately 33 per cent.

Most patients will not tolerate flows above three litres/minute.

Nasal oxygen should not be used if people are breathing through the mouth. This sounds obvious but in the rush to try to ease breathlessness may be overlooked. Nasal oxygen cannot be humidified, so hydration should be maintained through drinks and other means (see below). Plastic oxygen tubing can also cause skin damage, so should be fitted with sufficient slack to avoid unnecessary pressure.

Areas where tubing touches skin, especially around the ears, should be checked frequently. Frequency will vary according to individual risk factors, such as the person’s skin, their ability to relieve any pressure, and any external pressure (such as tubing being between their skin and a pillow). In hospital staff should check the person at least each shift; in the community the person should be checked each visit, and if at high risk of skin damage, carers should also be advised to check the tubing. Gauze or cotton wool can cushion skin from damage (Porter-Jones 2002).

**Nasal cannulae** (Figure 1) usually have two prongs, one of which should be placed in each nostril. These prongs can easily dislodge, reducing oxygen therapy by half, with the other half jetting upwards, often into the eye. Being a dry gas, oxygen can damage the delicate cornea (eye surface), potentially causing corneal ulcers that may never heal, and which could necessitate corneal transplant. Tubing of nasal cannulae usually includes a sliding adjustment to give the person sufficient but not excessive slack in tubing before the nostril prongs. Tubing should be loose enough so that it does not indent into skin or leave marks on the face, but tight enough so that prongs are supported safely in the nostril. With short-term use, tubing may need fixing onto the face with hypoallergenic tape. With long-term use, even hypoallergenic tape can cause skin damage, especially in patients who have friable skin, a common side effect of steroid therapy.

**Nasal sponges** (Figure 2) are similar to nasal cannulae, except that they are only inserted in one nostril and the tip is protected by sponge. Choice will usually be dictated by what is available, although most healthcare providers purchase cannulae rather than sponges. Sponges have the advantage of being more obviously in, or not in, the right place. Some patients find nasal sponges more comfortable than traditional cannulae, while others find them less comfortable. They have a tendency to fall out, so may be best taped to clothing or to the patient’s skin.

**Face masks**

Face masks can be variable performance or fixed performance (Figure 3). Like nasal oxygen, variable performance masks deliver a set number of litres/minute of 100 per cent oxygen, to which a variable amount of air is added, depending on depth of breathing. Although variable performance masks supply a guide to average percentages, these are only approximations.

Fixed performance masks supply accurate per-
percentages of oxygen, provided the correct flow of oxygen is used. This accuracy is achieved using a Venturi system – a fine jet of oxygen that draws air in, rather as the wake of a speedboat draws in water. Air inlets in the nozzle allow a fixed amount of air to enter, diluting the oxygen to a large volume with a precise concentration. The large volume ensures that practically the entire breath is from this accurate mixture.

Where absolute accuracy of percentage oxygen is desirable, fixed performance masks should be used. This is likely to be for relatively long-term (more than one day) use, or with patients who have chronic respiratory disease. Variable performance masks are cheaper, and where oxygen therapy is likely to be limited to a few hours, or where absolute accuracy is not essential, with therapy being adjusted according to frequently monitored saturation, their use is usually justified. However, low flow rates of variable performance masks can cause carbon dioxide accumulation in the masks (Beaumont 2000), worsening carbon dioxide retention in chronic respiratory disease. Many wards consider, justifiably, that stocking two different types of masks creates a clinical risk, so limit stock to one type. If only one type is stocked, fixed performance masks are recommended.

Fixed-performance nozzles are colour-coded:
- blue (24 per cent with two litres O₂ flow)
- white (28 per cent with four litres O₂ flow)
- orange (31 per cent with six litres O₂ flow)
- yellow (35 per cent with eight litres O₂ flow)
- red (40 per cent with ten litres O₂ flow)
- green (60 per cent with 15 litres O₂ flow)
(Figure 4).

Thirty-one per cent oxygen (orange) is almost never needed, so very few areas stock these nozzles. The large gap between 60 per cent and 40 per cent is potentially problematic – reducing oxygen delivery from 60 per cent currently necessitates reducing oxygen concentration by one third. Some manufacturers are therefore considering developing a 50 per cent nozzle.

Cold water humidifiers (connected to ‘elephant’ tubing) have Venturi valves, making them fixed performance systems.

Standard face masks can only deliver up to 60 per cent oxygen. For acute, severe oxygen need, a ‘reservoir’ bag mask (Figure 5) delivers nearly 100 per cent oxygen. These are useful in emergency situations (such as cardiac arrest), but should not be used for long periods (more than a few hours at most), as high concentrations (more than 60 per cent for longer than 24 hours) can be toxic.

Inaccurate settings of oxygen flow will cause inaccurate delivery. With all types of mask, it is important to check the litres set on the oxygen flow metre (or cylinder). Oxygen flow should be read from the centre of the float.

**Chronic respiratory disease**

Breathing is stimulated by three chemicals in blood:
- (high) carbon dioxide
- (low) oxygen
- acid (pH <7.35).

In health, all three stimulate breathing, but because chronic respiratory disease often causes chronically high levels of carbon dioxide (hypercapnia) and acids, people with chronic respiratory disease may breathe solely in response to low oxygen levels (hypoxia). In people with chronic respiratory disease, giving supplementary oxygen can remove the stimulus to breathe. This has created the mistaken but widespread belief that people with chronic respiratory disease should never be given more than 28 per cent oxygen.

Bateman and Leach’s classic medical review (1998) suggests that only 10 to 15 per cent of people with chronic respiratory disease are at risk of respiratory depression if given more than 28 per cent oxygen. So 85 to 90 per cent of people with chronic respiratory disease are potentially denied sufficient oxygen to protect 10 to 15 per cent of their population. Political manifestos advocating this balance would be untenable, yet every day health care applies these odds to people with chronic respiratory disease. Oxygen is vital for life. If people need more than 28 per cent oxygen, they should be given what they need.

In emergency situations (such as cardiac arrest),
patients should be given as much oxygen as possible (preferably 100 per cent). In non-emergency situations, British Thoracic Society (1997) guidelines advise that 60 minutes after commencing, 28 per cent oxygen arterial blood gases should be measured before giving higher percentages. Apnoea caused by excessive blood concentrations (hyperoxia) can usually be reversed by removing oxygen, although an arrest call should always be made, and occasionally some patients will require intubation and artificial ventilation.

In community settings, oxygen should therefore normally be limited to 28 per cent until medical investigations can be initiated. However, for transfer to hospital, patients with acute exacerbations of COPD should be commenced on 40 per cent oxygen, with percentage titrated upwards if saturations fall below 90 per cent, and titrated downwards if patients become drowsy or saturations exceed 93 to 94 per cent (British Thoracic Society 2004, National Institute for Health and Clinical Excellence (NICE) 2004). Anyone known to suffer respiratory depression from hyperoxia should be advised to wear a ‘medialert’ bracelet.

Humidification

Oxygen is a dry gas, so will collect moisture from any moist surface. At 20°C (average room temperature in the UK), air is 50 per cent saturated (Ballard et al 1992). This means that it can hold as much moisture again as it already contains. Warmer air can hold more water. Normally, by the time air reaches the bronchi, it has been warmed to body temperature, and fully saturated. So even fully saturated air entering the body will collect additional moisture from airways.

People with respiratory disease are often breathless. Breathlessness often discourages people from drinking adequately, making their bodies, including their airways, dehydrated. Paradoxically, their fast respiratory rates (tachypnoea) cause even more drying of the airways. This makes sputum more sticky (viscous), and more difficult to expectorate, and can cause an irritating, unproductive (‘dry’) cough. Supplementary (dry) oxygen causes even more drying of airways, increasing risks (or duration) of chest infections.

If patients are well hydrated, the respiratory tract adequately humidifies flows of up to four litres of oxygen (Bateman and Leach 1998), and for short-term (up to a few hours) use, unhumidified oxygen is not usually a problem. But for hospital use beyond a few hours, especially with patients who have chronic respiratory disease, facemask oxygen should always be humidified. In community settings, where nasal oxygen is usually used, people should be encouraged to drink sufficiently to maintain systemic hydration.

In addition to humidifying oxygen, all patients receiving oxygen should be adequately hydrated. If able to do so. However, breathless patients may need supplementary fluids prescribed intravenously and/or subcutaneously.

Mouth and lip care

Oxygen dries mucous membranes (mouth, lips, nose). Patients who are nil-by-mouth, or who have dry or infected mouths, should be offered frequent mouthwashes. White petroleum jelly or yellow soft paraffin help prevent lips drying and cracking (Bowsner et al 1999) and, contrary to popular myth, do not cause explosions or burns (Winslow and Jacobson 1998), as can be demonstrated by attempting to light them with a match. Water-based gels such as Aquagel may also be useful, although being water-based are likely to dry more quickly, so need more frequent applications.

Nasal mucosa may similarly be dried by nasal oxygen. Although not usually a significant problem in acute settings, in community settings people with long-term oxygen therapy may need similar nasal lubricants. They should be asked about nasal discomfort, and the condition of their nasal mucosa should be checked. Most people receiving LTOT will be able to apply lubricants themselves, but some may need help from carers.

Psychological care

Good psychological care is desirable for humanitarian reasons, yet in busy environments may be perceived as unachievable. Distress causes a stress response, which (through increased release of adrenaline and other hormones) increases respiratory rate and causes other problems that delay recovery. Adverse effects of distress on breathing may be seen most vividly during asthma attacks. People with breathing difficulty are likely to be fearful and will also sleep poorly.

Distress and poor sleep increase risks of delirium, delay recovery and increase mortality (McCusker et al 2002, Adamson et al 2005). Taking time to provide psychological care is therefore a worthwhile investment in preventing or minimising further deterioration.

Reducing distress can help people breathe more effectively and recover from disease. Nurses have much to do and little time to do it in. But if staff can appear confident and competent, patients are more likely to be as relaxed as possible. Providing explanations and (honest) reassurance can
reduce distress. Family and friends can also provide valuable emotional support (Bergbom and Askwall 2000). Relaxation techniques, such as use of background music, can also reduce distress (Cooke et al 2005).

As with many treatments, some people become psychologically dependent on oxygen therapy, and removing or reducing it may make them fearful of whether they will be able to cope, or live, without it. Plans should be discussed with the individual who should be offered the opportunity to voice any fears and ask any questions. If distress seems likely, increasing periods of oxygen-free breaks when others are around can enable the person to gain confidence in their own ability to breathe adequately.

**Long-term oxygen therapy**

Although this article focuses on acute care, some patients with chronic respiratory failure need oxygen at home. LTOT is the only treatment of proven benefit in chronic severe hypoxia from COPD (British Thoracic Society 1997). Local support services such as the community respiratory team should be aware of patients’ needs to ensure adequate supplies. The home should be checked for risk factors such as faulty electrical wiring, which could ignite combustion. Most burns from LTOT are caused by smoking (Chang et al 2001), so the importance of not smoking, or using any naked flames, in the presence of oxygen should be emphasised. The person, and carers, should be shown how to operate cylinders and store them safely.

**Conclusion**

Breathing is a fundamental activity of living. It provides the oxygen needed for body cells to function. Although respiratory disease can occur at any age, older people are more likely to suffer both acute and chronic respiratory disease. Without sufficient oxygen, cells fail and die. Extensive cell death causes body systems to fail.

Oxygen is vital, so patients receiving supplementary oxygen should be closely monitored. This should include respiratory observations, not discussed in this article, such as rate and depth of breathing, appearance and oxygen saturation. The amount of oxygen given should be recorded on observation charts and in relevant notes. Flow rate of oxygen and position of nasal cannulae should be frequently checked.

Good respiratory care can be life saving. The sooner breathing problems are identified, and the more effectively they are treated, the sooner patients are likely to recover from acute diseases and be able to cope with chronic limitations.

Oxygen can dry airways, so if used for more than a few hours should always be humidified. Patients should also be offered frequent drinks, or mouth care if nil-by-mouth. Lips should be kept moist with a lubricant. Good psychological care helps people to breathe more easily and effectively.

**References**


Bateman NT, Leach RM (1998) Acute ventilated patients. *Intensive and Critical Care Nursing* 14, 1, 7-10


