



The use of oxygen in the palliation of breathlessness. A report of the expert working group of the scientific committee of the association of palliative medicine

Sara Booth^{a,*}, Heather Anderson^b, Maelie Swannick^c, Rosemary Wade^d, Suzanne Kite^e, Miriam Johnson^f

^aOncology Centre, Box 193, Addenbrooke's Hospital, Hills Road, Cambridge CB2 2QQ, UK

^bWythenshawe Hospital, Southmore Road, Manchester M23 9LT, UK

^cNightingale McMillan Unit, 117A London Road, Derby DE1 2QS, UK

^dWest Suffolk Hospital, Hardwick Lane, Bury St. Edmunds IP33 2QY, UK

^eLeeds General Infirmary, Great George Street, Leeds LS1 3EX, UK

^fSt. Catherine's Hospice, Scarborough, YO12 6TB, UK

Accepted 21 August 2003

KEYWORDS

Dyspnoea;
Cancer;
Heart failure;
COPD;
Palliation;
Oxygen

Summary Dyspnoea is a common, distressing symptom and difficult to control with medical treatment. The role of oxygen in reducing the severity of the symptoms and improving quality of life is still unclear. A working party of the Association of Palliative Medicine Science Committee set out to examine the evidence concerning the use of oxygen for the palliation of breathlessness in COPD, advanced cancer and chronic heart failure and to make recommendations for clinicians working in palliative care. There were very few randomised controlled trials available for any of these conditions. There was no evidence available for heart failure, very little for advanced cancer and although there were a number of trials on the use of oxygen in COPD very few, until recently, used reduction of breathlessness as an outcome measure. Recommendations are made on the basis of the evidence available and expert opinion such as the Royal College of Physicians report on the use of domiciliary oxygen. Oxygen use has to be tailored to the individual and a formal assessment made of its efficacy for reducing breathlessness and improving quality of life for that person.

© 2003 Elsevier Ltd. All rights reserved.

Introduction

Breathlessness remains an enigma.¹ It is a dominant symptom in the advanced stages of many disorders including cancer, cardio-respiratory and neurological disease. Clinicians are often unable to control

breathlessness effectively² in contrast with malignant pain management where it is now possible to offer relief for most patients with oral pharmacological therapy alone even in advanced disease. In their last year of life as many as 94% patients with chronic lung disease, 78% of those with lung cancer³ and more than 50% of patients with heart disease⁴ will experience breathlessness. Its prevalence is increasing in the population as a whole for a

*Corresponding author.

E-mail address: sara.booth@addenbrookes.nhs.uk (S. Booth).

number of reasons, paradoxically, for example, because of the success of the secondary prevention of the complications of myocardial infarction⁵ which delay but do not prevent the onset of heart failure and breathlessness. Breathlessness is a problem that is reaching epidemic proportions.^{6,7}

It is clear that a unitary theory of the causation of breathlessness is inadequate—it is not simply a disorder of the heart and lungs either singly or in combination. It is a complex multisystem disorder with evidence of neurohormonal abnormalities, peripheral and respiratory muscle dysfunction; and a whole host of other changes outside the cardio-respiratory system.

There is continuing controversy about the place of oxygen in palliative care. In the early palliative care literature, it is generally stated that oxygen therapy can do more harm than good if the equipment comes between patient and family in the late stages of an illness. There was, and remains, a concern that patients can become dependent on oxygen, not wishing it to be removed even when they are clearly dying and when pharmacological therapy could offer some relief in the form of sedation.

Domiciliary oxygen is expensive.⁸ In the Cambridgeshire area alone (population 775,000) nearly 14 million pounds was spent on oxygen concentrators in 2000, a rise from 11 million in 1996. It is important that clinicians are able to target this drug at the right patients as oxygen can have adverse effects (Appendix A) as well as benefits for patients' and families' quality of life.

This working party set out to examine the evidence available for the use of oxygen in the palliation of breathlessness in chronic obstructive pulmonary disease (COPD), advanced cancer and cardiac failure. We did not consider neurological disease, interstitial lung disease or acute exacerbations of heart failure or COPD. Oxygen is one part of a complete palliative care treatment strategy—other appropriate medical and surgical interventions, the management of psychological and social concerns and support of the family and other carers are also essential to produce the best symptom relief possible. These aspects of care are not further mentioned as the remit of this group was to assess the evidence available on the use of oxygen in the palliation of breathlessness and make recommendations (even where good evidence was scarce) to guide palliative care clinicians in the use of oxygen for the palliation of breathlessness.

We were asked to consider only randomised controlled trials (RCT)⁹ and the search strategy used is set out in each section. The evidence for

each patient group is summarised and then general clinical recommendations are made from our findings and expert clinical opinion.^{10,11}

Definitions¹⁰

Short-burst oxygen therapy: Intermittent use of oxygen for relief of breathlessness, before exercise or for recovery after exercise.

Ambulatory oxygen therapy: Provision of oxygen therapy during exercise and/or the activities of daily living.

Long-term oxygen therapy (LTOT): Provision of oxygen therapy at home on a continuous and long-term basis, ideally for at least 15 h daily, including time spent asleep. In COPD, it is prescribed within specific guidelines to prolong survival.

Background

Participants with COPD in trials of oxygen use can be divided into four groups: those with acute exacerbations, at rest, during exercise or on long-term oxygen therapy. The British Thoracic Society (BTS) guidelines recommend the use of long-term oxygen therapy in specific patients to improve survival rather than palliation, as it reduces secondary polycythemia, prevents progression of pulmonary hypertension and improves neuropsychological health. At rest the BTS COPD guidelines¹¹ state "Short bursts of oxygen from a cylinder via a facemask are widely prescribed to relieve breathlessness. There are no data to support or refute this practice..." The guidelines also state that good evidence to support the use of ambulatory oxygen is also lacking.

Dyspnoea is a common symptom in patients with advanced cancer and generally has a mixed aetiology.¹² Oxygen is commonly used in the palliation of breathlessness without clear evidence of its efficacy.

The mechanisms behind the sensation of breathlessness in chronic heart failure (CHF) are not clear and are thought to be multifactorial. In addition to a variable amount of pulmonary oedema, there is an abnormal ventilatory response to exercise and carbon dioxide production resulting in an increased ventilatory dead space. Other factors may include increased arterial chemoreceptor sensitivity and abnormal skeletal muscle with enhanced muscle ergoreflex activity that further stimulates ventilation and sympathetic activity.

Method

Search strategies

A search was undertaken focused on Medline, EMBASE and the Cochrane Library limited to human studies from 1966 (1975 for heart failure). For subjects with COPD the keywords of oxygen, oxygen therapy, COPD, chronic obstructive airways disease, breathlessness and dyspnoea were searched in various combinations. The references of relevant papers were then hand searched together with Chest, Thorax and The American Journal of Respiratory and Critical Care Medicine from 1970. For subjects with cancer the keywords of oxygen, oxygen therapy, cancer, neoplasm and breathlessness/dyspnoea were searched in various combinations. The references of relevant papers were then hand searched. For subjects with heart failure the search words were CHF, oxygen therapy and breathlessness. All studies, which recorded when breathlessness was cited as a reason to stop an exercise regimen, were also reviewed.

Outcome measures

A reduction in breathlessness as measured with a specific tool or scale. In the studies found, these were often simple visual analogue scales (VASs) or the Borg scale.¹³

Results

Patients with COPD

There were no large RCTs found. The trials included in this review were small controlled trials either single or double blind. A crossover design was used in all trials except those of long-term oxygen. Many studies¹⁴ measured physiological variables and endurance whilst using oxygen but did not assess dyspnoea. The results are shown in table form divided into three categories of trial participants —at rest, exercise and long-term oxygen therapy at rest.

Oxygen therapy at rest: Only five papers were found where oxygen therapy was given to patients with COPD at rest and these are summarised in Table 1.

Oxygen therapy and exercise (ambulatory and short-burst oxygen): Exercise tests used included treadmill, cycle, 6 min or endurance walks; often two types of exercise were used in each study. Oxygen therapy is given during exercise unless

Table 1 Summary of studies using oxygen therapy for breathlessness in patients with COPD at rest.

Study	Methods	No.	Mean baseline oxygen levels	Intervention	Comparison	Outcome	Main effect
Liss and Grant ¹⁵	Single blind crossover trial	8	PaO ₂ 7.07 kPa	2 and 4 l/min oxygen with or without Lidocaine	2 and 4 l/min compressed air all via nasal cannulae	Change in VAS	No significant difference. Lidocaine increases dyspnoea
Kollef and Johnson ¹⁶	Single blind crossover trial	9	PaO ₂ 6.67 kPa	Transtracheal oxygen at 2 and 4 l/min with and without Lidocaine	Transtracheal air at 2 and 4 l/min	Change in VAS	Significantly more breathless on high flow oxygen and air. With Lidocaine no difference
Swinburn et al. ¹⁷	Double blind randomised crossover trial	12	PaO ₂ 6.71 kPa and SaO ₂ 85%	28% oxygen via mask	Compressed air via mask	Change in VAS	Significant improvement on oxygen
Booth et al. ¹⁸	Single blind crossover trial	13	Range 80–99% SaO ₂	Oxygen at 4 l/min via nasal cannulae	Air at 4 l/min via nasal cannulae	Change in VAS and Borg scale	Improvement on air and oxygen and no significant difference between the two gases
O'Donnell et al. ¹⁹	Baseline test pre-exercise trial	11	PaO ₂ 6.93 kPa	60% oxygen using mouth piece	21% oxygen using mouth piece	Change in Borg	No difference in reported dyspnoea

Table 2 Summary of studies using oxygen therapy for breathlessness in patients with COPD before, during and after exercise.

Study	Methods	No.	Mean baseline oxygen	Intervention	Comparison	Outcome	Main effect
Woodcock et al. ²⁰	Double blind RCT	10	PaO ₂ rest 9.65 kPa and exercise 8.19 KPa	Oxygen carried by subject or assistant	Compressed air both via nasal cannulae	Change in VAS	Slower increase in dyspnoea and increased endurance
Waterhouse and Howard ²¹	Single blind RCT	20	PaO ₂ on exercise 8.9 kPa	Oxygen 2 and 4 l/min via nasal cannulae	Compressed air via nasal cannulae and room air	Change in VAS	Reduced dyspnoea on oxygen
Swinburn et al. ²²	Double blind RCT	5	SaO ₂ 93% rest and 86% on exercise	Oxygen 60% via mouth piece	Room air via mouth piece	Change in VAS	Increased endurance, same dyspnoea
Evans et al. ²³	Single blind RCT	19	PaO ₂ rest 8.05 kPa	Oxygen <i>after</i> exercise via mask	Compressed air via mask and room air	Change in VAS	Shorter recovery time with oxygen
Davidson et al. ²⁴	Double blind RCT	17	PaO ₂ 8.60 KPa, SaO ₂ 94% at rest and 87.5% on exercise	Oxygen subjects choice of mask/ nasal cannulae	Compressed air given as oxygen	Change in VAS	Slower increase in dyspnoea and increased endurance
Lane et al. ²⁵	Single blind non-randomized crossover trial	9	PaO ₂ 8.92 kPa at rest	Oxygen to maintain oxygen saturation via mouth piece	Room air via mouth piece	Change in VAS	Reduced dyspnoea on oxygen
McKeon et al. ²⁶	Double blind RCT	21	PaO ₂ 8.85 kPa and SaO ₂ 92% rest and 83% exercise	Portable oxygen at 4 l/min via nasal cannulae	Compressed air via nasal cannulae and room air	Change in VAS	Slower increase in dyspnoea on oxygen
McKeon et al. ²⁷	Double blind RCT	20	PaO ₂ 7.73 kPa and SaO ₂ 91% rest and 83% <i>after</i> exercise	Oxygen <i>before</i> exercise via nasal cannulae	Compressed air <i>before</i> exercise via nasal cannulae	Change in VAS	No difference
Leach et al. ²⁸	Single blind RCT	20	PaO ₂ 8.74 kPa at rest and 7.82 KPa after exercise	Oxygen at 2, 4 and 6 l/min via mask	Compressed air 4 l via mask	Change in VAS	Reduced dyspnoea on oxygen
Dean et al. ²⁹	Double blind RCT	12	PaO ₂ 9.47 kPa at rest and 8.4 kPa <i>after</i> exercise	40% oxygen via mouth piece	Compressed air via mouth piece	Change in Borg scale	Increased endurance until limited by the same dyspnoea
Dewan and Bell ³⁰	Single blind RCT	10	SaO ₂ maintained at	High and low flow transtracheal	High and low flow air through nasal	Change in Borg scale	High flow greater dyspnoea and increased endurance

Table 2 (continued)

Study	Methods	No.	Mean baseline oxygen	Intervention	Comparison	Outcome	Main effect
Roberts et al. ³¹	Non-blind RCT	15	92% and 98% PaO ₂ 6.98 kPa and lowest SaO ₂ 74.6%	oxygen therapy On demand oxygen delivery system using nasal cannulae	cannulae Continuous oxygen via nasal cannulae and room air	Change in VAS	Less dyspnoea on both methods of giving oxygen
O'Donnell et al. ³²	Double blind RCT	11	PaO ₂ 9.87 kPa and SaO ₂ 90%	Oxygen 60% via mouth piece	21% oxygen via mouth piece	Change in Borg scale	No change in dyspnoea but increased endurance
Marques-Magallanes et al. ³³	Single blind RCT	18	PaO ₂ 6.8 kPa	Oxygen 40% <i>after</i> exercise via mask	Compressed air via mask and room air	Change in VAS	No reduction in dyspnoea
Revoll et al. ³⁴	Single blind RCT	10	SaO ₂ 92% at rest and 80% on exercise	Oxygen 2 l/min via nasal cannulae	Sham oxygen via nasal cannulae and room air	Change in Borg scale	No change in dyspnoea but increased endurance
Killen and Corris ³⁵	Single blind RCT	18	SaO ₂ 94% at rest and < 90% on exercise	Oxygen 2 l/min via face mask <i>before</i> and <i>after</i> exercise	Compressed air via face mask	Change in VAS	Reduced dyspnoea on oxygen
Knebel et al. ³⁶	Double blind RCT	31	SaO ₂ 97% at rest and 90% on exercise	Oxygen at 4 l/min via nasal cannulae	Compressed air via nasal cannulae and room air	Change in VAS	No reduction in dyspnoea
Somfay et al. ³⁷	Single blind RCT	10	SaO ₂ 95.7% at rest and 92% on exercise	Oxygen at 30%, 50%, 75% and 100% via mouth piece	Compressed air via mouth piece	Change in modified Borg	Oxygen dose-dependent reduction in dyspnoea
Jolly et al. ³⁸	Double blind RCT	20	PaO ₂ > 8 kPa at rest and on exercise two groups SaO ₂ < 90% and > 90%	Oxygen 6, 9 and 12 l/min via nasal cannulae	Compressed air via nasal cannulae	Change in Borg scale	Oxygen reduced dyspnoea in desaturation and non-desaturation groups
Maltais et al. ³⁹	Double blind RCT	14	PaO ₂ 11.3 kPa at rest and 9.33 kPa on exercise	Oxygen via mouth piece (FIO ₂ = 0.75)	Room air via mouth piece	Change in Borg scale	Reduced dyspnoea on oxygen
O'Donnell et al. ¹⁹	Double blind RCT	11	PaO ₂ 6.93 kPa at rest and 6.13 kPa after exercise	Oxygen 60% via mouth piece	Oxygen 21% via mouth piece	Change in Borg scale	Increased endurance until limited by the same dyspnoea
Eaton et al. ⁴⁰	Double blind RCT over 12 weeks	50	At rest PaO ₂ 9.2 kPa and SaO ₂ 94% and	Oxygen 4 l/min during exercise via nasal cannulae	Compressed air 4 l/min during exercise via nasal cannulae	Change in chronic respiratory	Reduced dyspnoea on oxygen

Table 3 Summary of studies using oxygen therapy in the long term for breathlessness in patients with COPD.

Study	Methods	No.	Mean baseline oxygen	Intervention	Comparison	Outcome	Main effects
McDonald et al. ⁴¹	Single blind randomised crossover trial over 12 weeks	26	PaO ₂ 9.2 kPa and SaO ₂ 94%	Oxygen 4 l/min via nasal cannulae	Compressed air via nasal cannulae during exercise	Change in Borg	No significant change in dyspnoea
Rooyackers et al. ⁴²	Randomised controlled trial over 10 weeks not blind	24	PaO ₂ 10 kPa at rest and 7.3 kPa at peak exercise	Oxygen 4 l/min during exercise	Room air during exercise 10 weeks	Change in Borg and chronic respiratory disease questionnaire	Rehabilitation programme improved dyspnoea, no increased benefit from supplemental oxygen
Garrod et al. ⁴³	Single blind randomised controlled trial over 6 weeks	22	At rest PaO ₂ 8.5 kPa and SaO ₂ 92.3%, SaO ₂ 82% on exercise	Oxygen 4 l/min during exercise via nasal cannulae	Compressed air 6 weeks during exercise via nasal cannulae	Change in Borg	Small decrease in dyspnoea
Eaton et al. ⁴⁰	Double blind RCT over 12 weeks	50	At rest PaO ₂ 9.2 kPa and SaO ₂ 94% and SaO ₂ 82% after exercise	Oxygen 4 l/min during exercise via nasal cannulae	Compressed air 4 l/min during exercise via nasal cannulae	Change in chronic respiratory disease questionnaire	Small decrease in dyspnoea

Table 4 Summary of studies using oxygen therapy for breathlessness in patients with advanced cancer.

Study	Methods	No.	Mean baseline oxygen	Intervention	Comparison	Outcome	Main effect
Bruera et al. ⁴⁴	N of 1 double blind crossover trial	1	SaO ₂ 84%	Oxygen at 5 l/min for 5 min at rest via mask	Compressed air at 5 l/min via mask	Change in VAS	Less breathless on oxygen
Bruera et al. ⁴⁵	Double blind crossover trial	14	< 90% SaO ₂	Oxygen at 5 l/min for 5 min at rest via mask	Compressed air at 5 l/min via mask	Change in VAS	Less breathless on oxygen
Booth et al. ¹⁸	Single blind crossover trial	38	Between 80% and 99% SaO ₂	Oxygen at 4 l/min for 15 min at rest via nasal cannulae	Compressed air at 4 l/min via nasal cannulae	Change in VAS and Borg scale	Improvement with air and oxygen and no significant difference between the two gases

Table 5 Summary of the available evidence on the use of oxygen in chronic heart failure.

Study	Method	No./ NYHA grade	Comparison	Outcome	Main effect
Moore et al. ⁴⁶	Double blind RT Bicycle ergometer exercise test	7/II 5/III	21%, 30% and 50% oxygen via a mouthpiece	Change perceived exertion (Borg scale) and dyspnoea (VAS)	Mean SaO ₂ unchanged during exercise on air Dyspnoea reduced with 50% oxygen
Restrict et al. ⁴⁷	Double blind RT 6 min walks, oxygen carried by subject or assistant. Endurance walks, oxygen carried by subject	12/III	Air and oxygen at 2 and 4 l/min via nasal cannulae	Change in breathlessness as rated on a modified Borg scale and VAS	Mean SaO ₂ fell on exercise on air No change in distance walked or Borg or VAS scores with oxygen
Russell et al. ⁴⁸	Double blind RT. Bicycle ergometer exercise test	16/II–III	21% and 60% oxygen via a mouthpiece	Stated reason for stopping exercise	Mean SaO ₂ unchanged during exercise on air 13 subjects stopped exercising complaining of fatigue and three because of dyspnoea

otherwise stated. Twenty-two papers were found and the results are summarised in [Table 2](#).

Long-term oxygen therapy (LTOT): Trials of LTOT tend to use quality of life measures as opposed to measurements of breathlessness and only three have been included using our criteria. The aim of LTOT is to prolong survival not to palliate dyspnoea but where dyspnoea was assessed it was important to see the effect. The trials are summarised in [Table 3](#).

Patients with cancer

There were no large RCTs found. Two of the trials included in this review were small controlled trials with a crossover design and one an 'N of 1' study. The results for patients with advanced cancer are shown in [Table 4](#). The patients in the trials had advanced cancer with either primary or secondary disease in the thorax. Most, but not all had lung cancer.

Patients with heart failure

There were no large randomised controlled studies found. There were no studies specifically looking at *the effects of oxygen on reducing the sensation of breathlessness* in severe heart failure.

There were two small studies which included VAS score and/or Borg scale for breathlessness as one of the study end-points and one study recorded dyspnoea as a reason patients gave for stopping exercise schedules. The studies are discussed below and summarised in Table 5.

Moore et al.⁴⁶ found that during bicycle ergometer exercise testing with oxygen-enriched air, there was a significant increase in arterial oxygen saturation. In addition, total exercise duration was prolonged, carbon dioxide production was reduced. When breathing 50% oxygen, perceived exertion rated (Borg score) was significantly reduced and subjective dyspnoea scores rated lower on a VAS. Inhaling 30% oxygen produced values intermediate between air and 50% oxygen. Restricker et al.⁴⁷ and Russell et al.⁴⁸ did not confirm this. Restricker, in a double-blind study of 12 subjects with heart failure (New York Heart Association (NYHA) class III) found that although 2 and 4 l/min ambulatory oxygen increased resting arterial oxygen saturation compared with air, there was no significant difference in distance walked or perceived breathlessness on a Borg or VAS. In this study, patients were required to carry their own portable oxygen cylinders: this would have increased workload in compromised patients. Russell et al. failed to show any reduction in minute ventilation or functional benefit with higher oxygen concentrations. The study unfortunately did not look at the subjective assessment of breathlessness although the authors did comment on the number of patients who stopped due to breathlessness or fatigue. All patients had the same reason for stopping during exercise tests, breathing either concentration of oxygen. In both Moore and Russell's studies, the mean arterial oxygen saturation did not fall during exercise on air in contrast to Restricker's study where the mean oxygen saturation fell significantly. In response to Russell's study, Abinader and Sharif⁴⁹ noted that the effect of increased oxygen concentration in patients with heart failure is variable. They commented that the concentration of 60% inspired oxygen was probably too high leading to an increase in systemic vascular resistance and also suggested that the exercise programme may have been too strenuous for those with severe heart failure. They also raised the point that none of Russell's subjects desaturated on exercise and suggested that it is those patients with heart failure who desaturate on exercise that benefit most from oxygen.

Chua et al.⁵⁰ investigated the contribution of the peripheral chemoreceptors to ventilation and also the effects of their suppression on exercise tolerance in patients with mild to moderate heart failure. In the course of this study, an increase in exercise tolerance and a decrease in dyspnoea was noted when the participants were breathing 100% oxygen—but as a descriptive study this was not included in our review of evidence.

Summary of evidence in patients with COPD

- (1) There is evidence for and against using oxygen for palliation of breathlessness at rest.
- (2) The majority of studies using oxygen during exercise show that patients experience *less breathlessness* at equivalent level of exercise when compared to air.
- (3) There is no evidence that pre-oxygenation reduces breathlessness during exercise.
- (4) There is recent evidence that using oxygen may speed recovery from breathlessness, given before or after exercise.³⁵
- (5) A recent study suggests that the effect of ambulatory oxygen on quality of life over a longer-term cannot be predicted from patients' baseline characteristics or their acute/short-term response to oxygen therapy.⁴⁰ Even when they experienced acute/short-term response to oxygen therapy, a significant proportion of patients will not continue to use ambulatory oxygen at home because of poor tolerability.

It is important to note that all these trials had small numbers of subjects. In most papers the investigators remark on the markedly different responses from one patient to another.

Summary of evidence in patients with cancer

Oxygen may be helpful for the palliation of breathlessness in some patients with advanced cancer but at the present time there is little evidence to enable clinicians to *predict* which patients will obtain benefit. Some form of formal clinical assessment like an 'N of 1' trial, is necessary to determine its usefulness for each individual.

Summary of evidence in patients with heart failure

There is insufficient evidence currently available for the use of oxygen for breathlessness in these patients. Most patients included in the reviewed

studies had stable mild to moderate heart failure (NYHA II–III) and it is difficult to extrapolate these results to patients with severe (NYHA IV) CHF, or to those with unstable disease.

Conclusion

It is clear both from the work of this group and the RCP working party,¹⁰ that further research is needed to enable *palliative care clinicians* to prescribe this potentially useful therapeutic tool more effectively. This paper reviews the evidence concerning oxygen treatment alone. In the trials presented here patients were stable and receiving other standard treatments. Oxygen therapy is not a complete answer to the palliation of breathlessness in these groups of patients.

When the literature as a whole is reviewed, there is evidence that oxygen can have a useful role in the palliation of this symptom^{18,45} in selected patients with advanced cancer and COPD.⁴³ In CHF the absolute lack of evidence is a barrier to any certainty. The clinical recommendations for the use of oxygen in palliative care below are based on the findings of our review in conjunction with the wider body of expert clinical opinion.^{10,11,51}

Key recommendations

Basic principles of oxygen therapy in palliative care

- Oxygen therapy may be one part of the palliative or supportive care of patients with cancer, COPD and chronic cardiac failure, never a complete treatment in itself.
- The adverse effects of oxygen therapy need to be part of the assessment for oxygen therapy for each individual (set out in Appendix A).
- Oxygen therapy in palliative care is more complex than the simple correction of hypoxaemia.
- Only in exceptional circumstances should oxygen be instigated as a *long-term option for continuous use*, by a physician, without some formal assessment of its efficacy for breathlessness, or quality of life, for that patient. Such assessment is probably most usefully done in the home over a pre-determined period of time.
- The assessment method used before an individual is prescribed oxygen therapy needs to be tailored for each person and the way in which oxygen is to be used. Formal exercise testing (as set out in Appendix C) may not be the

most appropriate or most accurate way of assessing the need for oxygen for a particular patient. Clinical judgement and consultation with the patient are the foundations of palliative care as improved quality of life is the central aim.

- The treatment strategy, including the use of oxygen, may change quite rapidly in advanced cancer and needs frequent reassessment and adjustment as necessary.
- LTOT for chronic respiratory illness should only be instigated by a respiratory physician.

Recommendations for clinical practice

Oxygen therapy at rest

Patients with COPD and advanced cancer

Oxygen therapy at rest should only be prescribed as a long-term option for use during most hours of the day after careful assessment of the severity of breathlessness and quality of life over a predetermined time by patients using simple diaries and appropriate scoring systems. An 'n of 1' trial, using the principles described by Bruera,⁴⁴ may be the simplest way of doing this (see Appendix B). Patients who benefit from oxygen and compressed air should be given whichever gas is most appropriate.

Patients with chronic heart failure

There is no evidence to suggest that the use of oxygen therapy at rest is useful in patients with CHF. An individual trial may be indicated if the patient is hypoxaemic.

Short-burst oxygen therapy

Short-burst oxygen therapy and short-term oxygen therapy *is recommended* for patients with advanced cancer for the relief of breathlessness. The RCP working party stated that "despite extensive prescription of short-burst oxygen therapy, there is no adequate evidence available for firm recommendations...it may be prescribed for episodic breathlessness not relieved by other treatments in patients with severe COPD...heart failure and in palliative care".

There is some evidence from Booth et al.¹⁸ that oxygen and air can help to relieve breathlessness at rest and whilst this study did not demonstrate a significant difference between oxygen and air the improvements in dyspnoea were greater with oxygen than with air. The work of Killen and

Corris³⁵ indicates that short-burst oxygen therapy *before or after exertion* in patients with COPD can reduce the severity of dyspnoea on exertion. Patients with advanced cancer, who are breathless without a remediable cause, have a short prognosis (months rather than years). Most are treated in oncology outpatients or hospice units where it may be difficult to do formal exercise testing as a routine. Whilst there is a clear need for more research evidence, it is acceptable to provide short-burst oxygen therapy for patients with breathlessness on exertion after a formal, but simple test of its efficacy in that individual.⁵²

Ambulatory oxygen therapy

Patients with COPD and advanced cancer

Ambulatory oxygen therapy is appropriate for many patients with COPD and breathlessness who *desaturate on exercise*, and this condition should be actively sought using simple exercise testing and oximetry. In the RCP report, ambulatory oxygen is recommended¹⁰ for patients who, desaturate at least 4% below 90% on a baseline walk breathing air and/or there is an improvement of 10% in walking distance or breathlessness scores with supplemental oxygen or experience a sustained improvement in their breathlessness on using it. Assessing the impact of oxygen over a period of time on a patient's quality of life at home, by means of simple standardised tools may give a more accurate picture of its importance to an individual as a recent study by Eaton et al. demonstrated. Although some patients gained acute (measured by an exercise test) and short-term (assessed by the Chronic Respiratory questionnaire) benefit from oxygen therapy this was not necessarily sustained over a 12 week period. In addition, 14(41%) of acute or short-term responders did not want to continue oxygen after the trial—11 of these citing poor acceptability. It is not possible to determine which patients will benefit from oxygen from their baseline characteristics. Some sort of formal assessment is needed. A recent retrospective study in patients with COPD suggested that a baseline resting arterial oxygen saturation below 95% may predict the need for ambulatory oxygen⁵³ but the results of this study need further careful prospective research. At the moment, for patients with *advanced cancer* a documented improvement in breathlessness on exertion when using oxygen or a simple 'N of 1' trial would give sufficient evidence for the prescription of ambulatory oxygen in this group.

Patients with chronic heart failure

There is little evidence to support any recommendations for patients with CHF but patients who are troubled by breathlessness and who are willing to use oxygen should have a formal trial of its efficacy at rest and on exercise. The RCP report does not recommend ambulatory oxygen therapy for patients with CHF.

Appendix A. Adverse effects of oxygen therapy

- (1) Restriction of activities.
- (2) Oxygen apparatus is cumbersome and for an already disabled patient may act as a disincentive to going out and living as normally as possible.
- (3) Impaired communication between patient and family.
- (4) If patients become psychologically dependent on oxygen they may attend too much on the mechanics of having their oxygen therapy. Some will not even remove their mask for even a minute and conversation with is impeded. They may even become frightened when there is any interruption in the oxygen supply and refuse to go out without a continuous supply from a cylinder. This may have a deleterious impact on quality of life.
- (5) Fire hazard: Oxygen promotes combustion. Patients who smoke during oxygen therapy are in great danger of facial burns and some fatalities have been reported.
- (6) Hypercapnic respiratory failure: The dangers of oxygen therapy in those patients with Type II respiratory failure are well known.
- (7) Withdrawing oxygen: Once oxygen has been given to a patient it is often difficult to stop its use even when it is on longer relieving breathlessness or being used appropriately.
- (8) The cost of oxygen: Oxygen is not cheap and should be used appropriately rather than universally.
- (9) Humidification of oxygen in LTOT is usually unnecessary as this is done adequately by the patient's own upper respiratory tract. Humidifiers tend to be noisy, bulky and often ineffective but may be necessary for a specific problem.

Appendix B. Formal testing to assess patients for oxygen at rest

- (1) At present there is no agreed testing procedure.
- (2) Formal assessment of fan or oxygen should include rating scales to assess breathlessness before and after the intervention.

- (3) Formal assessment of oxygen therapy should include the use of oximetry to establish for each individual whether there is a link between hypoxaemia and breathlessness.
- (4) Formal assessment of oxygen therapy should establish whether there is a difference for an individual between the response to oxygen at rest and on exercise.
- (5) The rating scale should be appropriate both to the patient group and the parameter tested. For example, VASs are useful for breathlessness in any condition but can only assess the symptom itself at a particular period of time, rather than its impact on quality of life. *It may be more appropriate to measure quality of life if assessing the benefits of oxygen for a patient at home—they can then choose to use it most appropriately for their circumstances.*
- (6) An 'N of 1' trial may be helpful.⁴⁴

Appendix C. Formal exercise testing to assess patients for ambulatory oxygen testing

- (1) Choose a validated exercise test such as the shuttle walking test.⁵¹
- (2) The patient should have at least one formal practice test, as there is a learning effect.
- (3) Just before starting the test, measure the patient's SaO₂ whilst they breathe room air and ask the patient to assess their current level of breathlessness using a VAS.
- (4) Carry out the test with oxygen or air (the patient should not know which they are receiving) and measure saturation and breathlessness on a VAS as soon after the patient stops as you can. It is possible to measure saturation and pulse rate continuously with some oximeters.
- (5) Repeat the test after a rest period (2 h plus) or on another day using oxygen or air from a portable cylinder carried by the patient. The oxygen and air administration should be carried out as a double-blind procedure and the patient should not be told their saturation results until after both have been completed.

References

1. The enigma of breathlessness. *Lancet* 1986;1(8486): 891–2.
2. Higginson I, McCarthy M. Measuring symptoms in terminal cancer: are pain and dyspnoea controlled? *J R Soc Med* 1989; 82(5):264–7.

3. Edmonds P, Karlsen S, Khan S, Addington-Hall J. A comparison of the palliative care needs of patients dying from chronic respiratory diseases and lung cancer. *Palliative Med* 2001;15(4):287–95.
4. McCarthy M, Lay M, Addington-Hall J. Dying from heart disease. *J R Collog Phys Lond* 1996;30(4):325–8.
5. Cleland JG. Are symptoms the most important target for therapy in chronic heart failure? (Review, 26 Refs). *Prog Cardiovasc Dis* 1998;41(1, Suppl. 1):59–64.
6. Garg R, Packer M, Pitt B, Yusuf S. Heart failure in the 1990s: evolution of a major public health problem in cardiovascular medicine. *J Am Collog Cardiol* 1993;22(Suppl A): 3A–5A.
7. Kelly D. Our future society: a global challenge. *Circulation* 1997;95:2459–64.
8. Leach RM, Bateman NT. Domiciliary oxygen therapy (Review, 33 Refs). *Br J Hosp Med* 1994;51(1–2):47–54.
9. Sackett DL. Rules of evidence and clinical recommendations on the use of antithrombotic agents. *Chest* 1986;89(Suppl. 2): 2S–3S.
10. Wedzicha JA. Domiciliary oxygen therapy services: clinical guidelines and advice for prescribers. Summary of a report of the Royal College of Physicians. *J R Collog Phys Lond* 1999;33(5):445–7 (Ref Type: Report.).
11. COPD Guidelines Group of the Standards of Care Committee of the BTS. BTS guidelines for the management of chronic obstructive pulmonary disease. *Thorax* 1997;52(Suppl. 2): S1–28.
12. Escalante CP, Martin CG, Elting LS, Cantor SB, Harle TS, Price KJ, et al. Dyspnea in cancer patients. Etiology, resource utilization, and survival-implications in a managed care world. *Cancer* 1996;78(6):1314–9.
13. Borg GA. Psychophysical bases of perceived exertion. *Med Sci Sports Exercise* 1982;14(5):377–81.
14. Wesmiller SW, Hoffman LA, Sciruba FC, Ferson PF, Johnson JT, Dauber JH. Exercise tolerance during nasal cannula and transtracheal oxygen delivery. *Am Rev Respir Dis* 1990; 141(3):789–91.
15. Liss HP, Grant BJ. The effect of nasal flow on breathlessness in patients with chronic obstructive pulmonary disease. *Am Rev Respir Dis* 1988;137(6):1285–8.
16. Kollef MH, Johnson RC. Transtracheal gas administration and the perception of dyspnea. *Respir Care* 1990;35(8):791–9.
17. Swinburn CR, Mould H, Stone TN, Corris PA, Gibson GJ. Symptomatic benefit of supplemental oxygen in hypoxemic patients with chronic lung disease. *Am Rev Respir Dis* 1991; 143(5, Part 1):913–5.
18. Booth S, Kelly MJ, Cox NP, Adams L, Guz A. Does oxygen help dyspnea in patients with cancer? *Am J Respir Crit Care Med* 1996;153(5):1515–8.
19. O'Donnell DE, D'Arsigny C, Webb KA. Effects of hyperoxia on ventilatory limitation during exercise in advanced chronic obstructive pulmonary disease. *Am J Respir Crit Care Med* 2001;163(4):892–8.
20. Woodcock AA, Gross ER, Geddes DM. Oxygen relieves breathlessness in "pink puffers". *Lancet* 1981;1(8226):907–9.
21. Waterhouse JC, Howard P. Breathlessness and portable oxygen in chronic obstructive airways disease. *Thorax* 1983;38(4):302–6.
22. Swinburn CR, Wakefield JM, Jones PW. Relationship between ventilation and breathlessness during exercise in chronic obstructive airways disease is not altered by prevention of hypoxaemia. *Clin Sci* 1984;67(5):515–9.
23. Evans TW, Waterhouse JC, Carter A, Nicholl JF, Howard P. Short burst oxygen treatment for breathlessness in chronic obstructive airways disease. *Thorax* 1986;41(8):611–5.

24. Davidson AC, Leach R, George RJD, Geddes DM. Supplemental oxygen and exercise ability in chronic obstructive airways disease. *Thorax* 1988;**43**(12):965–71.
25. Lane R, Cockcroft A, Adams L, Guz A. Arterial oxygen saturation and breathlessness in patients with chronic obstructive airways disease. *Clin Sci* 1987;**72**(6):693–8.
26. McKeon JL, Tomlinson JC, Tarrant EP, Mitchell CA. Portable oxygen in patients with severe chronic obstructive pulmonary disease. *Aust N Z J Med* 1988;**18**(2):125–9.
27. McKeon JL, Murree-Allen K, Saunders NA. Effects of breathing supplemental oxygen before progressive exercise in patients with chronic obstructive lung disease. *Thorax* 1988;**43**(1):53–6.
28. Leach RM, Davidson AC, Chinn S, Twort CH, Cameron IR, Bateman NT. Portable liquid oxygen and exercise ability in severe respiratory disability (erratum appears in *Thorax* 1993;**48**(2):192). *Thorax* 1992;**47**(10):781–9.
29. Dean NC, Brown JK, Himelman RB, Doherty JJ, Gold WM, Stulbarg MS. Oxygen may improve dyspnea and endurance in patients with chronic obstructive pulmonary disease and only mild hypoxemia. *Am Rev Respir Dis* 1992;**146**(4):941–5.
30. Dewan NA, Bell CW. Effect of low flow and high flow oxygen delivery on exercise tolerance and sensation of dyspnea. A study comparing the transtracheal catheter and nasal prongs. *Chest* 1994;**105**(4):1061–5.
31. Roberts CM, Bell J, Wedzicha JA. Comparison of the efficacy of a demand oxygen delivery system with continuous low flow oxygen in subjects with stable COPD and severe oxygen desaturation on walking. *Thorax* 1996;**51**(8):831–4.
32. O'Donnell DE, Bain DJ, Webb KA. Factors contributing to relief of exertional breathlessness during hyperoxia in chronic airflow limitation. *Am J Respir Crit Care Med* 1997;**155**(2):530–5.
33. Marques-Magallanes JA, Storer TW, Cooper CB. Treadmill exercise duration and dyspnea recovery time in chronic obstructive pulmonary disease: effects of oxygen breathing and repeated testing (see comments). *Respir Med* 1998;**92**(5):735–8.
34. Revill SM, Singh SJ, Morgan MD. Randomized controlled trial of ambulatory oxygen and an ambulatory ventilator on endurance exercise in COPD. *Respir Med* 2000;**94**(8):778–83.
35. Killen JW, Corris PA. A pragmatic assessment of the placement of oxygen when given for exercise induced dyspnoea. *Thorax* 2000;**55**(7):544–6.
36. Knebel AR, Bentz E, Barnes P. Dyspnea management in alpha-1 antitrypsin deficiency: effect of oxygen administration. *Nurs Res* 2000;**49**(6):333–8.
37. Somfay A, Porszasz J, Lee SM, Casaburi R. Dose-response effect of oxygen on hyperinflation and exercise endurance in nonhypoxaemic COPD patients. *Eur Respir J* 2001;**18**(1):77–84.
38. Jolly EC, Di BV, Aguirre L, Luna CM, Berensztein S, Gene RJ. Effects of supplemental oxygen during activity in patients with advanced COPD without severe resting hypoxemia. *Chest* 2001;**120**(2):437–43.
39. Maltais F, Simon M, Jobin J, Desmeules M, Sullivan MJ, Belanger M, et al. Effects of oxygen on lower limb blood flow and O₂ uptake during exercise in COPD. *Med Sci Sports Exercise* 2001;**33**(6):916–22.
40. Eaton T, Garrett JE, Young P, Fergusson W, Kolbe J, Rudkin S, et al. Ambulatory oxygen improves quality of life of COPD patients: a randomised controlled study. *Eur Respir J* 2002;**20**(2):306–12.
41. McDonald CF, Blyth CM, Lazarus MD, Marschner I, Barter CE. Exertional oxygen of limited benefit in patients with chronic obstructive pulmonary disease and mild hypoxemia. *Am J Respir Crit Care Med* 1995;**152**(5 Part 1):1616–9.
42. Rooyackers JM, Dekhuijzen PN, Van Herwaarden CL, Folgering HT. Training with supplemental oxygen in patients with COPD and hypoxaemia at peak exercise. *Eur Respir J* 1997;**10**(6):1278–84.
43. Garrod R, Paul EA, Wedzicha JA. Supplemental oxygen during pulmonary rehabilitation in patients with COPD with exercise hypoxaemia (see comments). *Thorax* 2000;**55**(7):539–43.
44. Bruera E, Schoeller T, MacEachern T. Symptomatic benefit of supplemental oxygen in hypoxemic patients with terminal cancer: the use of the N of 1 randomized controlled trial. *J Pain Symptom Manage* 1992;**7**(6):365–8.
45. Bruera E, de Stoutz N, Velasco-Leiva A, Schoeller T, Hanson J. Effects of oxygen on dyspnoea in hypoxaemic terminal-cancer patients. *Lancet* 1993;**342**(8862):13–4.
46. Moore DP, Weston AR, Hughes JMR. Effects of increased inspired oxygen concentrations on exercise performance in chronic heart failure. *Lancet* 1992;**339**:850–3.
47. Restrck LJ, Davies SW, Noone L. Ambulatory oxygen in chronic heart failure. *Lancet* 1992;**340**:1192–3.
48. Russell SD, Koshkarian GM, Medinger AE, Carson PE, Higginbotham MB. Lack of effect of increased inspired oxygen concentrations on maximal exercise capacity or ventilation in stable heart failure (see comments). *Am J Cardiol* 1999;**84**(12):1412–6.
49. Abinader EG, Sharif D. Effect of increased inspired oxygen concentrations on exercise capacity in stable heart failure. *Am J Cardiol* 2000;**85**(8):1043–4 (letter; comment).
50. Chua TP, Ponikowski PP, Harrington D, Chambers J, Coats AJ. Contribution of peripheral chemoreceptors to ventilation and the effects of their suppression on exercise tolerance in chronic heart failure. *Heart* 1996;**76**(6):483–9.
51. Ram FS, Wedzicha JA. Ambulatory oxygen for chronic obstructive pulmonary disease (Review, 29 Refs). *Cochrane Database Syst Rev* 2002;**2**:CD000238.
52. Booth S, Adams L. The shuttle walking test: a reproducible method for evaluating the impact of shortness of breath on functional capacity in patients with advanced cancer. *Thorax* 2001;**56**(2):146–50.
53. Knowler MT, Dunagan DP, Adair NE, Chin Jr R. Baseline oxygen saturation predicts exercise desaturation below prescription threshold in patients with chronic obstructive pulmonary disease. *Arch Intern Med* 2001;**161**(5):732–6.

Update

Respiratory Medicine

Volume 98, Issue 5, May 2004, Page 476

DOI: <https://doi.org/10.1016/j.rmed.2004.01.001>



ERRATUM

**Erratum to the “The use of oxygen in the palliation of breathlessness. A report of the expert working group of the scientific committee of the association of palliative medicine”
[Respiratory Medicine 98(1) 66–77] ☆**

**Sara Booth^a, Rosemary Wade^b, Miriam Johnson^c, Suzanne Kite^d,
Maelie Swanwick^e, Heather Anderson^f**

^a*Oncology Centre, Addenbrooke’s Hospital, Box 193, Hills Road, Cambridge CB2 2QQ, UK*

^b*West Suffolk Hospital, Hardwick Lane, Bury St. Edmunds IP33 2QY, UK*

^c*St. Catherine’s Hospice, Scarborough, YO12 6TB, UK*

^d*Leeds General Infirmary, Great George, Street, Leeds LS1 3EX, UK*

^e*Nightingale Macmillan Unit, 117A, London Road, Derby DE1 2QS, UK*

^f*Wythenshawe Hospital, Southmore, Road, Manchester M23 9LT, UK*

The publisher regrets that when the above article was printed, the names of the authors were published in the wrong order. The names and affiliations should read as shown above.

Also in the abstract of the article, the word “trial” was spelt “trail” twice.

☆ PII of original article S0954-6111(03)00300-7.

E-mail address: sara.booth@addenbrookes.nhs.uk (S. Booth).