



## Do patients prescribed short-burst oxygen therapy meet criteria for ambulatory oxygen?

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### SUMMARY

The aim of this study was to determine whether patients ( $n = 40$ ) with chronic obstructive pulmonary disease (COPD) currently receiving short-burst oxygen therapy meet existing criteria for ambulatory oxygen. A prospective randomised balanced double-blind crossover design was used. Criterion (i) for ambulatory oxygen (desaturation by 4% to below 90% on the practice walk) was met in 21 patients; 15 of these 21 patients also met criterion (ii) (10% improvement in distance and/or breathlessness score with

oxygen). Despite no evidence of desaturation in 19/40 patients, 9/19 improved their distance and/or breathlessness score with oxygen. This study has shown that many patients on short-burst oxygen meet existing criteria for ambulatory oxygen and may have been receiving suboptimal therapy. It supports recent proposals for the development of comprehensive assessment services which incorporate assessment for all categories of oxygen.

**Keywords:** Oxygen therapy; COPD

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### INTRODUCTION

Organisational models of health care delivery for oxygen therapy services differ from country to country, and there are incongruous recommendations regarding the prescription of ambulatory and short-burst oxygen therapy for chronic obstructive pulmonary disease (COPD) (1–5). Short-burst oxygen therapy is the use of oxygen for relief of breathlessness at rest, before exercise or after exercise (1). There is very little evidence to justify any recommendations for short-burst oxygen, or the associated widespread and costly prescription of it in some countries (6–8). In contrast, there is clear evidence to support the short-term benefit of ambulatory oxygen (oxygen during exercise and activity) (9). Patients prescribed short-burst oxygen may receive a suboptimal therapeutic benefit if in fact the appropriate prescription was ambulatory oxygen, and many of these patients may meet existing criteria for ambulatory oxygen (1). In some countries, access to ambulatory oxygen equipment has been limited, but these systems, e.g. liquid oxygen, are now more readily available, and if oxygen assessment services such as those proposed for England and Wales are to be developed then appropriate categorisation of oxygen therapy is essential (10). It has been suggested that the Royal College of Physicians (RCP)

guidelines provide a comprehensive assessment process for different categories of oxygen therapy (2).

The aim of this study was to determine whether patients with COPD prescribed short-burst oxygen therapy meet the RCP criteria for ambulatory oxygen (1).

### METHODS

#### Subjects

Forty patients currently receiving short-burst oxygen therapy were assessed using the RCP guidelines for prescription of ambulatory oxygen (Table 1) (1). The sample size was based on a power calculation where a sample size of 36 is sufficient to detect a difference of 10% in distance between two treatments in a randomised crossover trial with 80% power, based on a standard deviation for difference scores of 25.4, an alpha value of 0.05 and a one-tailed test. To allow for potential dropouts, we recruited 40 patients.

Patients were included if they had a diagnosis of COPD (11), were clinically stable for at least 4 weeks and had been prescribed short-burst oxygen (oxygen before or after exercise/activity or at rest) for at least the previous 3 months. Patients were excluded if they met the criteria for long-term oxygen therapy (LTOT), if SaO<sub>2</sub> was less than 92% or if they were unable to perform an exercise test.

The study period was March 2002 to May 2004. The study was approved by the University of Ulster Research Ethics Committee, and all patients gave written voluntary informed consent.

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**Table 1** Royal College of Physicians guidelines for assessment for ambulatory oxygen therapy

Criteria which can be used to ascertain if ambulatory oxygen is indicated include

- (i) a fall in SaO<sub>2</sub> of at least 4% to reach a reading below 90% during a baseline walking test while breathing air and
- (ii) an improvement of at least 10% in walking distance and/or breathlessness score when walking with supplemental O<sub>2</sub> compared with an air cylinder.

The level of oxygen prescribed should be adequate to maintain SaO<sub>2</sub> > 90%

### Procedure

Patients attended on two occasions at least one day apart. On the first day, patients attended for two practice walks on room air; on the second day, a prospective randomised balanced double-blind crossover design was used to compare an oxygen and placebo walk. The rest period between tests was 30 min. The study was double-blinded by concealing the oxygen and air tank from both the patient and assistant (AMcK) with a fitted cover. Gas was delivered at a flow rate of 4 l/min via nasal cannulae. As there was no placebo ambulatory system available, equivalent size E air and oxygen cylinders were used which were wheeled along by the assistant. The order of gas delivery was randomised and balanced to ensure that equal numbers of patients used oxygen first or placebo first. The codes for randomisation were held in sealed envelopes which were unopened until the patient agreed to participate in the study and had completed the practice walks.

Outcome measures included distance walked on the Incremental Shuttle Walk Test (ISWT), and BORG breathlessness score and oxygen saturation (Minolta Pulsox-3 oximeter) at the start and end of the exercise test and after a 2-min rest (12,13). All measurements were recorded using a standardised format by an investigator (BO'N) who was not involved in conducting the exercise test. Additionally, patients were asked about the use and perceived benefit of their short-burst oxygen at home.

### Data Analysis

Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS version 11.0). Data was assessed to determine whether patients met the RCP criteria for ambulatory oxygen. A confidence interval (CI) for the number of patients likely to be found to require oxygen from a screening population of 100 was calculated assuming the proportion of such patients to follow a binomial distribution.

### RESULTS

Forty (22 male) patients were recruited, and all patients completed the study. All patients were using their oxygen according to the current definition of short-burst oxygen therapy and hence are likely to be representative of the patients currently prescribed short-burst oxygen. Thirty-eight out of forty patients perceived some benefit from their

oxygen. Patients had moderate or severe COPD, were non-hypoxic at rest and had reduced exercise capacity (Table 2).

Criterion (i) for ambulatory oxygen (desaturation by 4% to below 90% on the practice walk) was met in 21 patients; 15 of these 21 patients also met criterion (ii) (10% improvement in distance and/or breathlessness score with oxygen) [mean (SD) improvement in distance is 24 (27)%; mean (SD) reduction in breathlessness is 18 (35)%] (Figure 1).

In 13 of the 15 patients who met both criteria, the flow rate of 4 l/min was sufficient to maintain the SpO<sub>2</sub> > 90%; in two of the 15 patients, reassessment would have been necessary at a higher flow rate to maintain a SpO<sub>2</sub> > 90%. In the six out of 21 patients who desaturated but did not improve distance and/or breathlessness with oxygen compared with air, SpO<sub>2</sub> > 90% was maintained in five patients, and in 1 patient, reassessment would have been necessary at a higher flow rate to maintain a SpO<sub>2</sub> > 90%.

Criterion (i) for ambulatory oxygen (desaturation by 4% to below 90% on the practice walk) was not met in 19 patients; nine of these 19 patients met criterion (ii) (10% improvement in distance and/or breathlessness score with oxygen) (Figure 1).

### DISCUSSION

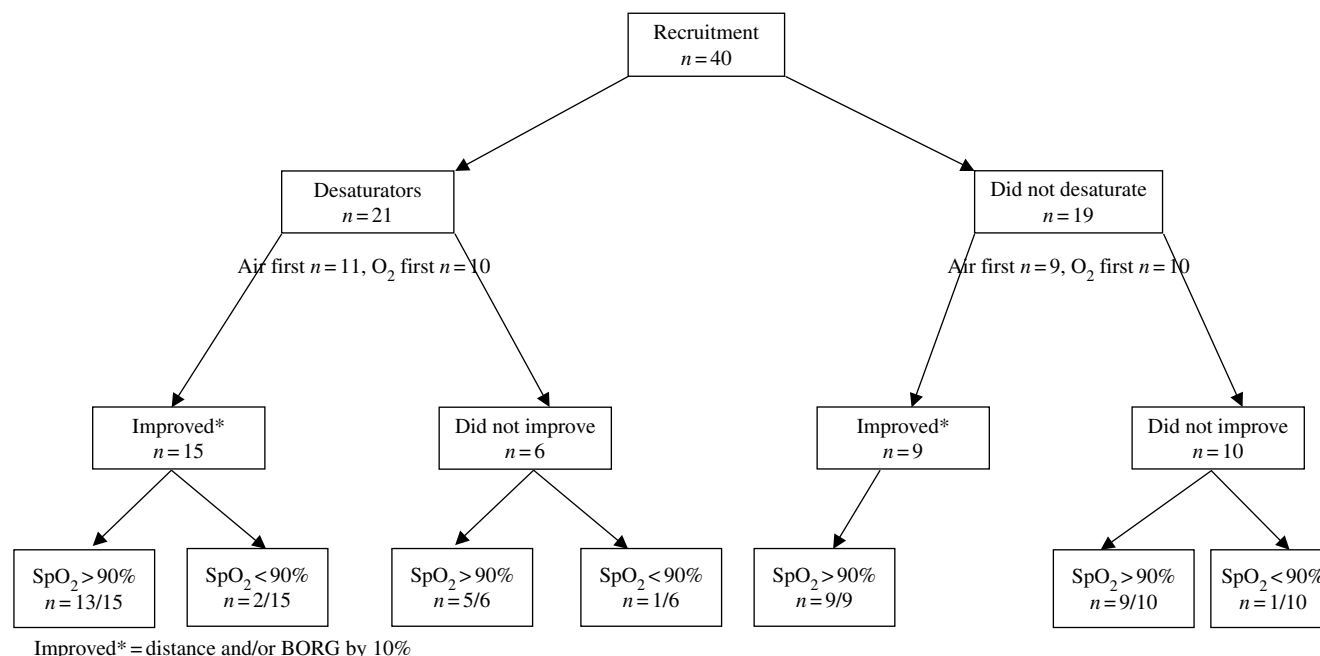
This study assessed whether patients with COPD prescribed short-burst oxygen therapy met the RCP criteria for ambulatory oxygen. Based on our results, we have estimated that out of a screening population of 100 patients on short-burst oxygen, 38 (95% CI 29.85–45.15) patients would meet the RCP criteria for ambulatory oxygen.

This study provides rationale for the need to carefully assess patients for each category of oxygen therapy. The proposed mechanisms for improvements with ambulatory oxygen may include a reduction of ventilation and respiratory rate,

**Table 2** Patient characteristics (*n* = 40)

	Mean (SD)
Age – years	68.7 (9.5)
FEV <sub>1</sub> – litres	0.76 (0.41)
FEV <sub>1</sub> –%predicted	33.74 (14,36)
FVC – litres	1.75 (0.76)
SaO <sub>2</sub> –%	94.36 (2.68)
ISWT (room air) – metres	107.38 (80.63)

FEV<sub>1</sub>, forced expiration in 1 second; FVC, forced vital capacity; SaO<sub>2</sub>, oxygen saturation; ISWT, incremental shuttle walk test.



**Figure 1** Patient categorisation according to the Royal College of Physicians (RCPs) guidelines

reduced  $\text{VO}_2$ , decreased lactic acid production, improved oxygen uptake by peripheral muscles, a reduction in dynamic hyperinflation and decreased carotid chemoreceptor stimulation (14–16). The RCP assessment criteria only consider improvement in distance and breathlessness; future assessment criteria may need to include other additional measurements relevant to these mechanisms, as well as an indication of the potential adherence to oxygen by patients with severe COPD (10).

Apart from those patients who satisfied the full RCP criteria, a further group with no evidence of desaturation improved symptomatically with oxygen. The inclusion of exercise-induced desaturation as part of the assessment for ambulatory oxygen is recommended in several countries, and this warrants further research (1,5). Studies in patients with COPD without significant exercise-induced hypoxia ( $\text{SaO}_2 > 88\%$  during exercise) and in healthy subjects who do not desaturate have demonstrated improved exercise capacity and reduced breathlessness with supplemental oxygen (16–18). Mechanisms for these improvements may be similar whether patients desaturate or not (16–18).

It is unclear whether the large proportion (62%) of patients who did not meet the RCP criteria for ambulatory oxygen require the continued prescription of short-burst oxygen and health care professionals require advice regarding any future prescription of short-burst oxygen therapy. There is a need for a systematic review of existing research on short-burst oxygen therapy and an international consensus on whether this category of oxygen should continue to be prescribed or not.

This study has shown that many patients on short-burst oxygen meet the RCP criteria for ambulatory oxygen and may have been receiving suboptimal therapy. It supports recent

proposals for the development of comprehensive oxygen assessment services which incorporate assessment for all categories of oxygen.

#### ACKNOWLEDGEMENTS

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