Short burst oxygen therapy in chronic obstructive pulmonary disease: a patient survey and cost analysis

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SUMMARY

The prescription of home oxygen cylinders is substantial. This study aimed to establish patient’s current use of short burst oxygen therapy in chronic obstructive pulmonary disease (COPD) and to examine potential cost savings if cylinder use had been replaced by a concentrator. An interviewer-administered questionnaire was completed by 100 patients currently receiving short burst oxygen therapy. Patients reported that they used their oxygen before exercise/activity (26%), during exercise (19%), after exercise/activity (87%) and at rest (46%) and mostly for the relief of symptomatic breathlessness. The length of time [mean (SD)] patients had oxygen at home was 27.42 (29.31) months. Of those patients using cylinders, savings could have been made by transferring from cylinders to concentrators. While withdrawal of oxygen may be difficult, an oxygen assessment service could ensure that future prescription is aimed at those who benefit and is delivered by the most cost-effective method.

Keywords: Short burst oxygen

INTRODUCTION

While the organisational models of health care delivery and oxygen therapy services vary considerably from region to region and country to country, it is recognised that oxygen therapy represents a significant component of the economic burden of chronic obstructive pulmonary disease (COPD) (1–3). Terminology is not consistent, and in contrast to long-term oxygen therapy (LTOT), there is limited information regarding the use and prescription of short burst oxygen therapy. Short burst oxygen therapy is mostly prescribed for patients with COPD and is usually delivered via oxygen cylinder (4). While there is little evidence that short burst oxygen therapy is of benefit, UK figures show that the prescription of home oxygen cylinders is substantial (5–9). In a 12-month period during 2002/2003, about £8,596,515.24 was spent in England and £444,862 in Northern Ireland on the ingredient cost of cylinder oxygen alone (8,9). This figure is an underestimate of the total service delivery cost that would include prescription charges, pharmacy distribution costs, flow head rental and disposable delivery interfaces (10).

It is not clear when or why patients use short burst oxygen therapy. There is also evidence that the delivery of short burst oxygen by cylinder may not always be cost effective (10). The aim of this study was to establish patient’s current use of short burst oxygen therapy in COPD and to examine potential cost savings if cylinder use had been replaced by a concentrator.

METHODS

Stage 1 – the Development and Administration of the Questionnaire

The questionnaire was developed after a review of relevant literature and consultation with patients, physiotherapists and respiratory physicians. Response cards and pictures/diagrams of oxygen apparatus were compiled for use with relevant questions. The questionnaire was administered to three patients with COPD to ensure clarity. The questionnaire was assessed for test–retest reliability (n = 10), and any question or question component that demonstrated poor reliability (weighted kappa <0.6 or intraclass correlation coefficient <0.6) was re-examined and amended by the authors (11). Questions related to reasons for oxygen use, perceived benefits, method of oxygen delivery, flow rate and length of time using oxygen.

The interviewer-administered questionnaire (available from jm.bradley@ulster.ac.uk) was completed by 100 patients with COPD who were currently receiving short burst oxygen therapy. The interview was conducted at Belfast City Hospital or in the patients’ home. Only patients using short burst oxygen (oxygen for episodic breathlessness particularly before or after exercise or for breathlessness at rest) for at least the previous 3
months were included, and patients who met the criteria for LTOT were excluded. The study period was February 2002 to September 2003. Data from the questionnaires were analysed using the SPSS (version 9.0) statistical package.

Stage 2 – Cost Minimisation Analysis

Previous cost minimisation analysis had estimated savings associated with transfer from cylinders to concentrators (10). These estimates were based on hypothetical cases rather than actual data. In this study, data on actual use of oxygen was obtained. This allowed us to calculate actual oxygen use among cylinder users and compare the cost of delivering oxygen via cylinders with that of concentrators. Cost data included fixed and variable components. Fixed costs refer to those elements that are independent of oxygen consumption, e.g. installation costs. Variable costs refer to those elements that vary with oxygen consumption, e.g. electricity costs (Table 1). Concentrator costs included installation, back-up cylinder, rental, servicing and electricity. Cylinder costs included installation, ingredient cost, dispensing fee, delivery and flow head rental. Cylinder costs were based on an assumed flow rate of 2 l/min and cylinder size of 1360 l as this was the most common method of delivery reported in the questionnaire. Cost calculations were based on utilisation levels – number of cylinders consumed per week and the average length of time patients had used oxygen as reported in the patient questionnaire. Four levels of utilisation were identified among cylinder users: G1, those who consumed less than one cylinder per week (assumed to equate to three per month); G2, those who consumed one cylinder per week (assumed to equate to four per month); G3, those who consumed two per week (assumed to equate to eight per month) and G4, those who consumed more than three per week (assumed to equate to 12 per month). Costs of cylinder use were estimated for each of the four levels and compared with the equivalent costs of delivery had concentrators been used instead.

The study was approved by the University of Ulster Research Ethics Committee, and all patients gave voluntary informed consent to take part.

RESULTS

One hundred patients completed the questionnaire (44 males). The mean (SD) age was 72 (9) years. Oxygen was used before exercise/activity (26%), during exercise (19%), after exercise/activity (87%) and at rest (46%). The majority of patients (90%) reported that they obtained benefit from their oxygen; the main benefit was reduced shortness of breath.

The length of time [mean (SD)] patients had oxygen at home was 27.42 (29.31) months (Table 2). Most patients had size F cylinders (capacity 1360 l) (75%) or a concentrator (25%). Most patients used a flow rate of 2 l/min (65%) or 4 l/min (23%). Of those using cylinders, 37/75 used less than one per week (G1), 11/75 used one per week (G2), 14/75 used two per week (G3), 13/75 used more than three per week (G4). In all four groups, savings could have been made by transferring patients from cylinders to concentrators (Table 3).

DISCUSSION

This study confirms that most patients with COPD used short burst oxygen therapy for relief of symptomatic breathlessness. Oxygen was used mostly after exercise despite limited evidence of benefit (5–7). It seems likely that the symptomatic relief reported after exercise may be provided by the cessation of exercise, rather than the oxygen itself. While

| Table 1 | Fixed and variable costs for the provision of oxygen by concentrator and cylinder at current costs |
|---------|--------------------------------------------------------------------------------------------------|
| **Costs concentrator** | **Rate (£)** |
| Fixed | |
| Installation | 48.21 |
| Back-up cylinder | 3.37 |
| Variable | |
| Rental (per month) | 17.08 |
| Servicing (per quarter) | 18.24 |
| Electricity (per hour) | 0.04 |
| **Costs cylinder (1360 l)** | |
| Service installation | 10.20 |
| Ingredient | 7.48 |
| Dispensing fee (per 3 cylinders) | 9.14 |
| Delivery allowance per delivery | 9.38 |
| Flow head rental per month | 1.99 |

All costs were effective from April 2003 and were before VAT.

| Table 2 | The mean (SD) length of time patients had oxygen at home |
|---------|-------------------------------------------------------|
| Whole group (n = 100) | 27.42 (29.31) |
| Concentrator users (n = 25) | 24.46 (15.00) |
| Group 1: <1 cylinder per week used (n = 37) | 29.31 (33.89) |
| Group 2: 1 cylinder per week used (n = 11) | 20.50 (14.25) |
| Group 3: 2 cylinders per week used (n = 14) | 33.57 (37.27) |
| Group 4: >3 cylinders per week used (n = 13) | 26.92 (18.08) |

Mean (SD) length of time in months 27.42 (29.31) 24.46 (15.00) 29.31 (33.89) 20.50 (14.25) 33.57 (37.27) 26.92 (18.08) 95% confidence interval 21.60–33.23 13.06–35.85 18.01–40.61 10.92–30.08 12.05–55.09 16.00–37.85

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there is evidence of the benefit of oxygen during exercise and activity (ambulatory oxygen) in COPD, few patients indicated this option (12–15).

Nonetheless, the withdrawal of inappropriately prescribed short burst oxygen therapy may be difficult. In these circumstances, the use of oxygen concentrators rather than cylinder oxygen is likely to be more cost effective in many patients who use as little as three cylinders per month.

Inappropriate short burst oxygen therapy is expensive, and we believe an oxygen assessment service could best determine which patients benefit from short burst oxygen therapy and determine the most appropriate prescription and the most cost-effective method of delivery (16). The establishment and delivery of this service may be cost neutral due to the savings relating to reduction of inappropriate prescription and more cost-effective delivery.

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*Per patient over the mean time period oxygen was used by the respective groups.

Table 3 Estimated savings* that could have been made by transferring from cylinders to concentrators

|                | Group 1 (£) | Group 2 (£) | Group 3 (£) | Group 4 (£) |
|----------------|------------|------------|------------|------------|
| Concentrator   | 768.00     | 556.87     | 954.68     | 805.10     |
| Cylinder       | 1298.73    | 1198.90    | 3797.77    | 4487.64    |
| Saving (concentrator vs. cylinder) | 530.73 | 642.03 | 2843.09 | 3682.54 |

*Per patient over the mean time period oxygen was used by the respective groups.

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