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Non-continuous home oxygen therapy: utilization, symptomatic effect and prognosis. Data from a national register on home oxygen therapy

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Abstract About half of all patients on home oxygen therapy receive non-continuous oxygen therapy (less than 15 h daily) (NCOT). The goal of NCOT is to improve well-being during daily activities and to improve sleep quality. The aim of this study was to evaluate the effect of NCOT on pulmonary symptoms and sleep quality, and to determine whether patients with a subjective beneficial effect differed from those without effect in terms of patients' characteristics, utilization of oxygen, hospitalization and survival. Furthermore, the relationship between the reported beneficial effect of NCOT on dyspnoea and physical activity during domestic activities was examined. During the period November 1994 to July 1995, 254 Danish patients were prescribed oxygen less than 12 h daily or 'on demand'. Of these patients, 142 (55·9%) answered a questionnaire on hours spent with oxygen and symptomatic effect of oxygen treatment. While on oxygen, 76·3% of the patients reported improved dyspnoea score (0–10) more than 0·5 points, 78·3% had improved quality of life, 59·5% improved sleep, 48·5% increased physical activity, 49·3% felt less tired and 40·0% reported improved thinking. Fifty-seven (43·2%) patients reported both improved dyspnoea and physical activity, whereas seven (5·3%) patients reported that oxygen had no effect on dyspnoea but a beneficial effect on physical activity. Only 11 (7·7%) patients reported no subjective improvement on oxygen. The subjective effect of NCOT was not significantly associated to hours spent with oxygen, the underlying disease, gender, hospitalization or survival. During daily activity and regardless of daily number of hours spent with oxygen, NCOT improved well-being in nearly all patients. The most pronounced improvement was reported on dyspnoea, sleep and quality of life. Very few patients sensed improved physical activity without relief in breathlessness.

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Keywords COPD; respiratory failure; oxygen; home care; symptoms.

INTRODUCTION

About half of all patients on home oxygen therapy in U.K. receive NCOT and this figure is probably even higher in U.S.A. (1,2). Although the criteria for long-term oxygen therapy (LTOT) are well established, the criteria for short-term oxygen therapy (NCOT) are less clear (3–5). NCOT is not aimed on improving survival, but prescribed in order to decrease dyspnoea, increase exercise capacity and tolerance, and prevent nocturnal desaturations (3–6). However, the effects of this therapy are questioned (6–16). Some studies have found that supplemental oxygen significantly improves exercise tolerance without affecting the dyspnoea (14,16), whereas other studies found the opposite pattern (9–12). Studies on NCOT mainly describe the effect during controlled circumstances, for example during a treadmill test, and only one small study has evaluated the effect of NCOT during normal daily activity (17). However, in this study the beneficial effect was not further specified. In the present study of patients on NCOT, we evaluated the effect of therapy on different symptoms and investigated whether patients with beneficial effect differed from those without subjective effect in terms of patients' characteristics, utilization of oxygen, hospitalization and survival. Furthermore, we examined the relationship between the reported beneficial effect of NCOT on dyspnoea and physical activity during domestic activities.

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MATERIALS AND METHODS

Collection of information

The Danish Oxygen Register was established in November 1994 and covers 98% of the Danish population. From the patients' hospital files and GP files, we achieved information on the cause of hypoxaemia and smoking status (current smoker, ex-smoker and never smoker).

During the period, 01.11.94 to 31.07.95, 1591 adult patients started home oxygen therapy due to cardiopulmonary disease or dyspnoea due to extra-thoracic disease. Although NCOT is not recommended in Denmark, 254 (16%) patients initiated NCOT, defined as oxygen prescribed less than 12 h daily or 'on demand' (Table 1).

Within 1 month after initiation of NCOT patients received a questionnaire by mail on the use of oxygen (number of hours daily), smoking status (current smoker, ex-smoker, and never smoker), and on the symptomatic effect of oxygen therapy (Fig. 1). In addition we assessed breathlessness with and without supplemental oxygen using standard 10 cm visual analogue scale score (VAS), rating breathlessness from 'no breathlessness' (zero) to 'extreme breathlessness' (10 cm).

Table 1. Patients on home oxygen therapy categorized according to prescribed and used oxygen. Those marked with bold characters are defined as short-term oxygen therapy

	n = 1591 (100%)
Prescribed oxygen	
15–24 h day^{-1}	817 (51·4%)
12–14 h day^{-1}	58 (3·6%)
< 12 h day^{-1}	**82 (5·2%)**
'As needed'	**92 (5·8%)**
Prescription is missing	
Patients were using oxygen < 12 h day^{-1}	**80 (5·0%)**
Patients were using oxygen 12–24 h day^{-1}	62 (3·9%)
Both prescribed and used oxygen according to the patient are missing	400 (25·1%)

The non-responders (44·1%) differed from the responders by having a higher frequency of lung cancer (52·7% vs. 23·4%) and a higher 3-month mortality rate (53·2% vs. 11·8%). The study group comprised 142 responders with NCOT. Using the answers from questions 3–8 (Fig. 1), and the value 1 for 'yes—improvement', 0 for 'don't know', 'no improvement' or no answer, a score of

Questions to the patients on NCOT

1. How many hours per day do you spent with oxygen?
2. Do you smoke tobacco— "Yes or No"?
3. Do you have less dyspnoea with oxygen therapy— "Yes, No or Don't know"?
4. Does oxygen therapy improve physical activities— "Yes , No or Don't know"?
5. Does oxygen therapy help you to think clear— "Yes, No or Don't know"?
6. Does oxygen therapy make you less tired— "Yes, No or Don't know"?
7. Does oxygen therapy improve your sleep— "Yes, No or Don't know"?
8. Does oxygen therapy improve your quality of life — "Yes, No or Don't know"?
9. Mark on the vertical line (10 cm) the degree of breathlessness without oxygen theraphy

   Extreme breathlessness — No breathlessness

   10 — 0

10. Mark on the vertical line (10 cm) the degree of breathlessness with oxygen theraphy

    Extreme breathlessness — No breathlessness

    10 — 0

Fig. 1. Questions to the patients on NCOT.

the effect of NCOT on symptoms was calculated. Depending on the symptomatic effect of NCOT, patients were divided into three groups: (1) scores 4–6 (very good effect), (2) scores 2 or 3 (good effect), (3) scores 0 or 1 (no or some effect).

Data on oxygen systems delivered was obtained from the oxygen suppliers. Mobile oxygen was defined if patients had cylinders of 2–5 l — if necessary on a stroller. Liquid oxygen was not available before August 1995.

Vital status was ascertained by the National Health Services Central Register up to 31.10.98. During follow-up, 96 (67·6%) deaths were identified. The National Board of Health provided information on hospital admissions up to 31.12.96. Nineteen patients stopped oxygen therapy before 31.12.96 without a hospitalization. Time until stopped therapy was included. Concerning hospitalization, the mean follow-up period was 197 days. During this period, 107 (75·4%) patients had at least one admission to hospital. The regional Ethical Committees and the Data Inspection Board have approved the study.

There are no Danish guidelines for selecting suitable patients. However, it is most likely that Danish doctors are adopting guidelines from U.S.A., U.K. and Australia, recommending NCOT to patients with symptoms related to exercise-induced or nocturnal hypoxaemia and to patients with symptomatic terminal cardio-pulmonary disease without continuous hypoxaemia (7,18,19). Documentation of a beneficial effect of oxygen exceeding a placebo effect is not routine in Denmark before starting the NCOT.

Statistics

Data analysis and descriptive statistics were performed using with the Statistical Package for Social Sciences (SPSS) version 9.0 (SPSS Inc., Chicago, U.S.A.). The Kaplan–Meier estimate was used to produce survival and admission rates (time until first admission), and the log rank test to test differences between COPD and cancer patients. The chi-squared, two sample *t*-tests and Mann–Whitney *U*-tests were used as appropriate to compare differences between the groups. A two-sided *P*-value of $<0·05$ was considered significant.

RESULTS

Characteristics of patients

In general, patients were elderly and a little more than half (51·1%) of them had COPD (Table 2). The average flow of oxygen was 1·7 l min^{-1} and only 12·1% of the patients were prescribed more than 2 l min^{-1}. Hypoxaemia, while patients were resting, was documented in 36 (25·4%) patients, whereas a $PaO_2 > 7·3$ was recorded in 13 (9·2%). Among the remaining 93 (65·5%) patients, blood gases were not checked before starting NCOT. As PaO_2 status had no influence on the symptomatic effect of NCOT, in subsequent analyses all patients were analysed as one group, regardless of presence or absence of hypoxaemia.

Table 2. Characteristics of patients on non-continuous oxygen therapy

	All patients ($n=142$)
Age, years ($n=142$)	68·9 (9·9)
Female, % ($n=142$)	44·4
Diagnosis, % ($n=141$)	
COPD	51·1
Cancer	23·4
Cardiac disease	9·9
Kyphoscoliosis/neuromuscular disease	5·0
Lung fibrosis	3·5
Sequelae from lung tuberculosis	3·5
Other	3·5
Started by a GP, % ($n=142$)	34·5
Oxygen flow, l min^{-1} ($n=141$)	1·7 (1·3)
Mobile system, % ($n=142$)	21·8
Current smoker, % ($n=141$)	27·0

GP: General Practitioner.
Age and oxygen flow are presented as mean (SD).

Utilization of oxygen, hospitalization and survival

On average, patients spent 5·1 h daily with oxygen. Nine patients used oxygen on demand. Very few (5·1%) patients stated to use oxygen at least 15 h daily. The most common use of oxygen was less than 5 h daily (55·3%).

The median time until the first hospitalization was 125, 157 and 84 days for all patients, for COPD patients and cancer patients, respectively. Admission rates were equal for COPD and cancer patients ($P = 0·63$).

The 12-month mortality rates were 39·4%, 20·8% and 78·8% for all patients, for COPD patients and cancer patients, respectively. The mortality rates were significantly higher among cancer patients compared with COPD patients ($P < 0·001$).

Symptomatic effect of NCOT

Decreased dyspnoea and improved quality of life were the most pronounced symptomatic effects of NCOT (Fig. 2). Degree of dyspnoea expressed by VAS showed that the majority (89·3%) scored at least five points without oxygen. On oxygen this proportion of patients

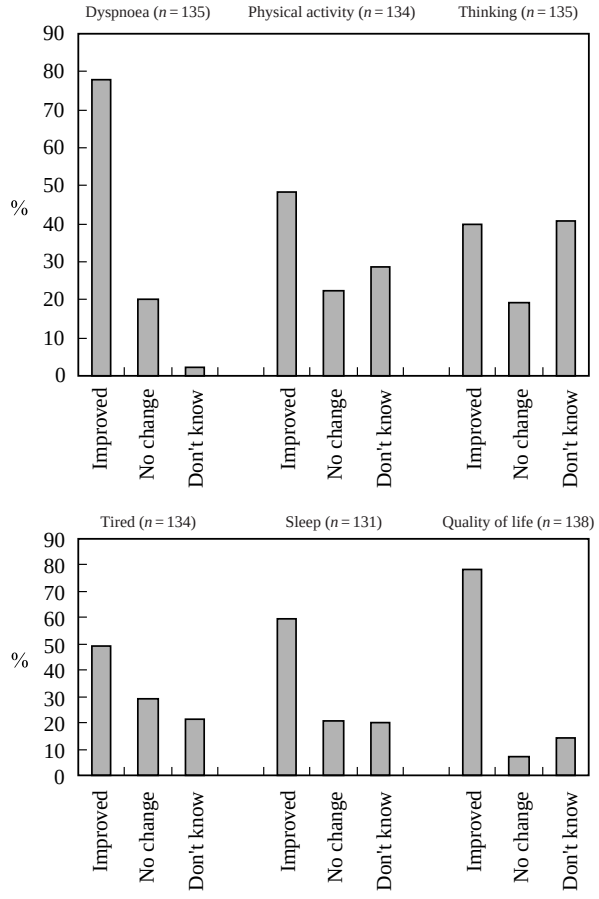

Fig. 2. Effect of short-term oxygen therapy on different symptoms. Answers to question 3–8 (listed in Fig. 1). *N*=number of patients with data.

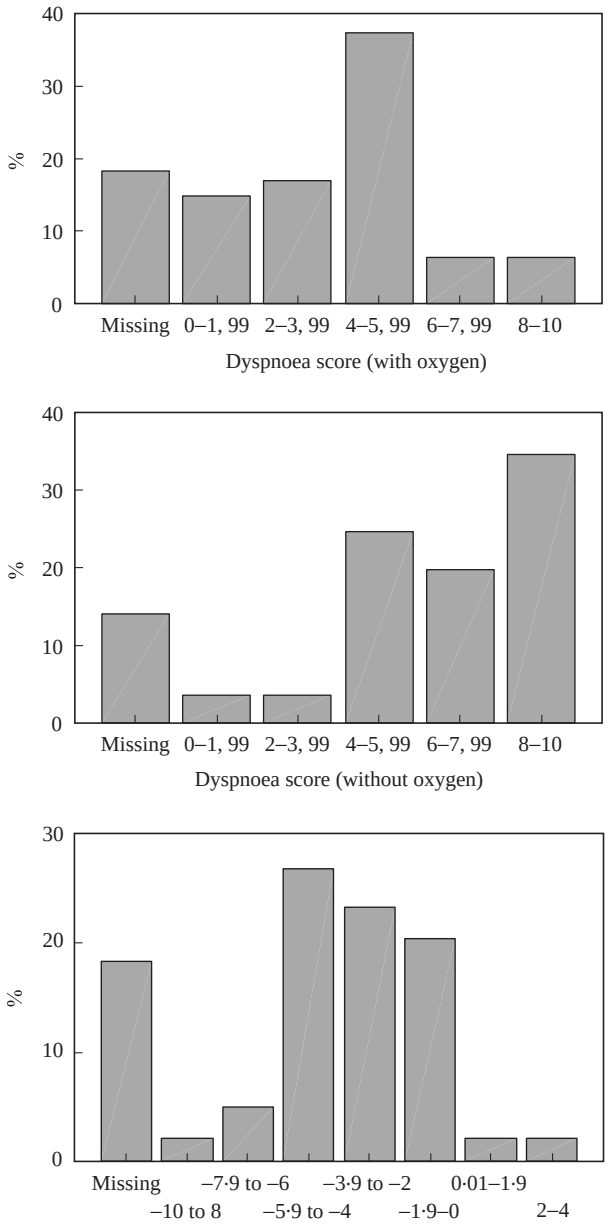

Fig. 3. Dyspnoea score without oxygen, with oxygen and difference between dyspnoea score (with–without oxygen) according to a visual analogue scale (0–10).

was reduced to 50% (Fig. 3). Thus, 76·3% of the patients improved their dyspnoea score more than 0·5 points, which is considered as clinically relevant (20).

On oxygen therapy, 57 (43·2%) of the patients reported both improvements in dyspnoea and physical activity, whereas 43 (32·6%) patients reported beneficial effect on dyspnoea without an improvement in physical activity. Only seven (5·3%) patients reported improved physical activity without any beneficial effect on breathlessness. Twenty-five (18·9%) patients reported no effect on either breathlessness or physical activity and the remaining 10 patients had not answered both questions.

Improved sleep was reported in 78 (59·5%) of the patients. A utilization of oxygen at least 7 h daily was more common among these patients compared to patients without improved sleep (71% vs. 52%; P=0·03).

Only 11 (7·7%) patients had no subjective effect and 23 (16·2%) had 'some or no effect' (group 3), 44 (31·0%) had 'good effect' (group 2) and 75 (52·8%) had 'very good effect' (group 1) of oxygen therapy.

Comparison between patients with very good effect (group 1) and those with some or no effect of NCOT (group 3)

Patients with no or some effect of NCOT (group 3) had, as compared with patients with very good effect of NCOT (group 1), a significantly lower dyspnoea score (without oxygen) [mean difference: 1·4 (95% CI: 0·2–2·6)]. Also, both groups did not differ in terms of age, gender, diagnosis, delivered mobile oxygen, prescribed oxygen flow, spent hours with oxygen, median time until hospitalization, 12- and 24-month

mortality rates, and smoking, although there was a trend towards a higher proportion of current smokers in group 3 (40·9%) compared with group 1 (27·0%) ($P = 0·2$).

DISCUSSION

NCOT is widely prescribed in Denmark, comprising 16–41% of all initiated home treatments with oxygen, and most patients are treated with oxygen for at least 1 year. NCOT is aimed on improving well-being, and in our study all but 11 patients (92·3%) had at least some subjective effect. This is in line with the results of a previous study finding beneficial effect of oxygen in 44 of 45 patients on NCOT (17). A little more than half of our patients (52·8%) reported an effect on several subjective parameters, particularly decreased breathlessness and increased quality of life. This marked beneficial effect of NCOT is surprising because oxygen therapy is encumbered with several disadvantages. In a study from The Netherlands, inconvenience during LTOT was reported from 95% of the patients (21). An explanation might be that they have studied patients on LTOT where restricted autonomy, noise from oxygen concentrators and nose complaints are more likely to occur than in our patients on NCOT. In addition, patients on NCOT are probably selected due to the symptomatic effect of oxygen and are probably highly motivated for this treatment. Another disadvantage of oxygen therapy is the weight of mobile oxygen cylinders. If the patient has to carry the gas cylinder, the exercise tolerance decreases by about 10% and dyspnoea score increases by 10–20% (8,15,22). Supporting a beneficial effect of oxygen, despite carrying the oxygen cylinder, two studies suggest that the effect of placebo counterbalances the burden of carrying the gas cylinder (10,11,14), and oxygen improves exercise tolerance and symptoms additionally (15,22).

Calverley has recently suggested that some patients with supplemental oxygen choose to exercise to the same level of breathlessness as previously but, because they are either fitter or less distressed, they cover a greater physical activity. Alternatively, they keep the same exercise activity but experience less breathlessness (1). Our data, focusing on daily activity, showed that the latter explanation was common (32·6% of the patients), and that very few (5·3%) patients report a greater physical activity but no improvement on breathlessness while on NCOT.

The subjective effect of oxygen therapy found in our study could well be attributed to a placebo effect. There is growing evidence that placebo (sham oxygen) relieves dyspnoea (12–14,23–25) and improves exercise performance (12,14,23). However, most studies have found oxygen superior to placebo in decreasing dyspnoea and increasing exercise tolerance (9,12,14–16,22,23,26,27).

The majority of our patients had sleep disturbances that affected quality of life. This is in line with the IPPB and NOTT studies of COPD patients finding a very high score (impairment) for these domains (28,29). Nearly 60% of our patients reported improvement in sleep quality. Whether supplemental oxygen improves quality of sleep is not clear (30–32). In patients with nocturnal hypoxaemia supplemental oxygen reduces or alleviates hypoxaemia, but does not modify the evolution of pulmonary haemodynamics and seems not to improve survival (6).

About 40% of our patients reported improved mental activity. This improvement may be attributed to a placebo effect, because a placebo controlled study of hypoxaemic COPD patients failed to find a beneficial effect of oxygen on a short-term basis (33). On the other hand, continuous oxygen therapy seems to improve mental activity (34,35).

Fatigue is a prominent symptom associated with severe lung disease. Half of our patients felt less tired on NCOT. Whether this is due to oxygen therapy or placebo is unclear, because so far, no placebo-controlled studies have examined the effect of oxygen on tiredness, fatigue or exhaustion.

In our study, no association was found between the subjective effect and the utilization of oxygen. The explanation might be that NCOT is not always used to treat continuous symptoms, for example some patients use oxygen to treat nocturnal desaturations, while others only use oxygen during exercise or during attacks of breathlessness.

The goal of NCOT is to improve well-being during daily activity. Judging by the patients' own reports, this goal was met by 92% of our patients who were prescribed NCOT. However, the benefit seemed not to be affected by either time spent with oxygen, the underlying disease or gender. Therefore, randomized, placebo-controlled studies are warranted in well-defined patient groups in order to separate the effect of oxygen from the effect of placebo during daily activities.

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