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Sufficient indication of nocturnal oxygen saturation and breathing pattern in COPD patients, from a single night's study

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Introduction

Overnight studies in patients with chronic obstructive pulmonary disease (COPD) and daytime hypoxia are performed to record the degree of nocturnal hypoxaemia and to prescribe the proper flow of oxygen supplementation needed for maintaining normoxia (0·5–5·0 l min^{-1}). Nocturnal studies are also performed in COPD patients with daytime normoxia who are suspected to have nocturnal hypoxaemia, e.g. because of the presence of secondary polycythaemia or pulmonary hypertension.

It is quite common to perform duplicate studies since a first-night effect in EEG variables has been shown in normal subjects (1–4). However, little is known about the impact of this first-night effect on nocturnal oxygen saturation (SaO_2) and breathing in COPD patients (5,6).

The aim of the present study is to determine if the study of a single night is representative and sufficient for clinical purposes.

Patients and Methods

Thirty-one COPD patients (24 males, seven females) with a mean age of 64 years (range 41–78 years) participated in this study. Mean FEV_1 value was 29% of predicted (range 18–52%), and body weight was below 125% ideal weight. Mean daytime PaO_2 was 8·2 kPa and mean $PaCO_2$ was 6·1 kPa. In 15 patients, studies were performed on 2 consecutive nights (Group 1). The other 16 patients were studied on 2 non-consecutive nights separated by 1 week (Group 2).

Oxygen saturation, thoraco-abdominal movement, oro-nasal airflow, electromyogram of the intercostal muscles and electro-oculogram were measured.

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Questions about sleep quality, sleep latency and number of awakenings were scored on a three-step scale.

Desaturation, central and obstructive apnoea/hypoventilation were defined according to standard criteria. Results were tested for significance using either the paired *t*-test or the Wilcoxon signed rank test, with $P<0·05$ used as the level for significance.

Results

OXYGEN SATURATION

In Group 1, mean nocturnal SaO_2 was 89% (SD, 5·6%) on the first night and 89% (SD, 4·9%) on the second night. The lowest SaO_2 values were 80% (SD, 11%) and 80% (SD, 12%) for the 2 consecutive nights (n.s.). In Group 2, mean nocturnal SaO_2 was 86% (SD, 4·3%) on the first night and 87% (SD, 3·1%) on the second night. The lowest SaO_2 values were 75% (SD, 5·5%) and 73% (SD, 6·6%) for the 2 non-consecutive nights (n.s.).

Limited individual variations in mean nocturnal SaO_2 were observed and these are shown in Table 1.

BREATHING

Twenty-six patients (84%) developed nocturnal oxygen desaturation. In 24 of these patients (92%), most desaturations (8–91%) were accompanied by central hypoventilation on both nights in both groups. Two patients had obstructive apnoeas/hypopnoeas (OA/H), varying from 7–9 OA/H h^{-1} (patient number 9) and from 61–59 OA/H h^{-1} (patient number 14) on the first and second night respectively.

SUBJECTIVE PARAMETERS

The subjective sleep quality, sleep latency and number of awakenings did not differ significantly between the 2 consecutive nights. Of the patients who

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Table 1 Individual mean nocturnal saturation data. Patients 1–15 slept on 2 consecutive nights and patients 16–33 slept on 2 non-consecutive nights

No.	Mean SaO_2	No.	Mean SaO_2	No.	Mean SaO_2	No.	Mean SaO_2
1	93·6 (1·1)	9	90·6 (6·3)	16	85·5 (2·7)	24	85·2 (2·7)
1	92·9 (1·0)	9	88·5 (5·1)	16	83·1 (3·8)	24	85·3 (6·2)
2	87·5 (2·5)	10	85·2 (1·5)	17	78·2 (3·8)	25	89·1 (2·1)
2	88·8 (2·7)	10	86·7 (1·2)	17	83·1 (3·9)	25	90·1 (2·1)
3	90·7 (2·0)	11	91·0 (1·7)	18	91·8 (2·0)	26	88·3 (2·3)
3	90·8 (1·3)	11	88·5 (1·9)	18	92·6 (2·1)	26	87·9 (2·3)
4	86·2 (2·7)	12	88·8 (2·7)	19	86·4 (4·7)	27	88·7 (2·8)
4	85·7 (3·0)	12	89·3 (1·9)	19	85·2 (4·3)	27	89·1 (3·0)
5	90·7 (2·3)	13	88·5 (2·3)	20	89·8 (4·5)	28	88·5 (2·0)
5	91·9 (1·9)	13	87·3 (2·5)	20	88·1 (3·0)	28	89·1 (2·0)
6	91·4 (1·3)	14	70·9 (8·2)	21	86·7 (3·3)	29	84·4 (2·2)
6	91·3 (1·2)	14	73·5 (9·6)	21	88·5 (3·3)	29	85·3 (3·2)
7	94·1 (0·9)	15	93·7 (1·2)	22	86·9 (2·8)	30	86·9 (2·4)
7	94·5 (1·1)	15	92·2 (1·6)	22	86·2 (3·0)	30	86·9 (2·6)
8	91·5 (1·5)			23	91·5 (2·6)	31	83·5 (2·9)
8	90·5 (2·0)			23	91·2 (3·2)	31	82·5 (3·9)

Numbers in parentheses denote SD.

were studied on 2 non-consecutive nights, eight patients reported that they had more difficulties falling asleep on the second night.

Discussion

In this study, mean and lowest nocturnal oxygen saturation of the groups showed no significant difference between 2 consecutive or 2 non-consecutive nights. For the individual patient, a small variability could be shown. However, these night-to-night differences could occur in either direction and moreover, the individual variation of 2 consecutive nights was comparable to that of 2 non-consecutive nights. Therefore, we conclude that there is no reason to consider the second night more appropriate to characterize the oxygen saturation pattern in COPD patients. Furthermore, the variation appeared to be quite small. The largest change was seen in one patient with a baseline SaO_2 on the steep part of the oxygen haemoglobin dissociation curve, indicating that the change in PaO_2 was probably no larger than that of others (patient number 17).

No significant variation was found in disordered breathing between the first and second night in either situation.

It is concluded that to characterize the nocturnal oxygen saturation and breathing patterns, a single night's recording in COPD patients is sufficient.

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