Severe nocturnal hypoxaemia in geriatric inpatients

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Abstract

Background: oxygen levels are decreased in older people especially in the supine position, and during sleep. Geriatric inpatients often suffer from stroke and heart disease. Respiratory control may be substantially affected.

Objective: the aim of this study was to examine oxygen levels during night in inpatients on geriatric medical wards to find out if they needed nocturnal oxygen therapy.

Design: prospective observational study.

Setting/Participants: we consecutively examined 133 patients with SpO2 ≥ 92% in sitting position by an overnight -8-h pulse oximetry. Patients with severe obesity, dementia or pulmonary disease were excluded. The test was performed at least 4 days after the event in stroke cases.

Outcome Variables: ninety two patients, m/f 43/49, with mean age 78.3 ± 6.9 SD completed the test. Sixty six patients suffered from stroke; 34 left-sided and 19 right-sided stroke. Nine patients suffered from a heart disease only, and 17 patients suffered from other diseases.

Results: according to the guidelines for long-term oxygen therapy recommendations for nocturnal oxygen therapy, we found that 26% of the patients fulfilled the criteria of SpO2 ≤ 90% for ≥ 30% of the time. There was a significant positive correlation between age and the amount of time with SpO2 between 80 and 84% (0.215, P < 0.05). Diagnosis or severeness of disease did not significantly affect nocturnal SpO2 %.

Conclusion: nearly 30% of the inpatients in geriatric medical wards suffered from severe oxygen-requiring nocturnal hypoxaemia irrespective of diagnosis.

Keywords: pulse oximetry, geriatric, stroke, nocturnal hypoxaemic, elderly

Introduction

Older people have lower oxygen retention in the supine position during sleep. The reason is hypventilation due to age-related reduced lung elasticity, depressed respiratory regulation caused by autonomic dysfunction as well as underventilation due to cardiac, lung and brain diseases [1–7].

Sleep-disordered breathing (SDB) is characterised by frequent apnoeas and/or hypopnoeas with oxygen desaturation during sleep. Intermittent hypoxaemia may be an important risk factor for the development of atherosclerosis [8]. The symptoms of SDB is disturbed sleep with short periods of deep sleep, episodes of night-time awakening and increased daytime sleepiness [1]. This impaired daytime functioning can lead to cognitive impairment with difficulties in memory, attention and concentration. Hypnotics for insomnia on a regular basis will increase SDB in the elderly [9]. Increased morbidity due to hypertension, cardiac arrhythmias, myocardial infarction and stroke have been associated with SDB. The mortality rate is higher in patients with severe SDB [3, 10–12].

The highest prevalence of sleep-related apnoeas related to age is found in the 40–60 years age-group [13]. But sleep disorders are estimated to affect nearly 50% of older persons [2]. Several investigations have demonstrated significant correlations with cardiac and lung diseases [7, 14, 15]. Hypoxia is a major problem early after a stroke and oxygen supplementation is included in the recommendations for stroke management [12]. Prevalence of nocturnal oxygen desaturations in the elderly has been studied. Even though the prevalence is high, the clinical implications and effect of therapeutic interventions have so far not been studied [3, 16].

SDB can be uncovered by polysomnography, but it is expensive and troublesome for older patients, especially those with a stroke. Nocturnal pulse oximetry has been
used in several studies both in hospitals, nursing homes and at home, and both in patients with chronic obstructive pulmonary disease (COPD), heart failure, stroke and with Cheyne-Stokes respiration. Pulse oximetry has shown a high sensitivity but a low specificity and does not show if the patient is asleep or not. Therefore it is necessary to go further with a polysomnography to diagnose obstructive sleep apnea syndrome (OSAS). There may also be some under diagnosing of OSAS. In COPD patients, nocturnal oxygen saturation may vary a lot and registration of more than one night is necessary [17, 18]. It is important to diagnose OSAS in middle aged and younger elderly people because treatment with continuous positive airway pressure (CPAP) will probably reduce the risk of developing hypertension, ischaemic heart disease, stroke and diabetes mellitus. Older patients with sleep-apnoea syndrome or nocturnal hypoxaemia have so far been overlooked and undiagnosed. Why then examine the oldest diseased elderly? We know that severe hypoxaemia may lead to cognitive impairment in COPD patients [19]. The indication for nocturnal oxygen therapy in COPD patients are SpO2 ≤ 90% for ≥ 30% of the night [19]. The purpose of this study was to assess this level of nocturnal hypoxaemia monitored by a single overnight pulse oximetry in inpatients on geriatric medical wards.

Patients and methods

One hundred and thirty three consecutive inpatients in the geriatric division were examined by one overnight — 8 h pulse oximetry. Registrations shorter than 6 h were excluded. Nocturnal pulse oximetry took place at least 4 days after the event in stroke cases. Patients with severe lung disease or confusion unable to cooperate were excluded. The patients characteristics were age, sex and diagnosis. The study subjects had a resting SpO2 in the sitting position above 92% and considered as not being oxygen requiring. A Nonin pulse oximeter with memory function and finger probe was used. The patients were grouped according to oxygen level during night. Group I (hypoxaemic) had a nocturnal SpO2 ≤ 90% for ≥ 30% of the time recorded [19]. Group II (normoxaemic) had a nocturnal SpO2 ≥ 90% for ≥ 70% of the time recorded. The study was approved by the Regional Ethics Committee.

Statistical analysis

Values are given as mean ± standard deviation (SD). The results were normally distributed. Between the groups, Students t-test for unpaired data with equal variance was used. All P values reported are two-tailed. Statistically significant differences were defined as P < 0.05. Correlations were tested by using the Pearson correlation coefficient.

Results

Sixty nine per cent of the patients had a complete registration (mean 8.2 h ± 1.25 SD, range 4.5–10). Data from 92 patients were analysed. Two of the included patients were monitored 4.5 h only as severe oxygen-requiring hypoxaemia was detected. Forty one patients were excluded due to disruptions of registration. The sex, diagnoses and number using sedatives were similar in the two groups. There was an insignificant age difference between the groups (P ≤ 0.10). Patient characteristics are listed in Table 1. In a random sample of 50 patients number of days in hospital were insignificantly different between the groups (41 days ± 45 for group I versus 48 ± 27 for group II (NS), respectively). Mean and min SpO2% were significantly lower in group I (P < 0.001). Mean and max heart rate (HR) were significantly higher in group I (P < 0.01 and 0.001, respectively) (Table 2). There was a significantly positive correlation between age and percent of the time with SpO2 below 85% (0.215; P < 0.05). The mortality rate after 1 and 2 years was 25 and 29% in group I and 16 and 23% in group II, respectively.

Discussion

We found that 26% of the geriatric inpatients on geriatric medical wards suffered from severe oxygen-requiring nocturnal hypoxaemia irrespective of diagnosis. There have been studies of hypoxaemia at night, but none have reported a prevalence at this level. We found a significant correlation between age and percent of the time with very severe desaturation. This is in agreement with previous knowledge. Diagnoses and seriousness of disease did not significantly affect the severity of nocturnal hypoxaemia.

Sixty nine per cent fulfilled the overnight -8 h test at the first trial. This showed that it was possible to discover the majority of the nocturnal oxygen-requiring patients by a single overnight pulse oximetry. Therefore it seems reasonable that geriatric divisions should examine the patients by pulse oximetry at night and give oxygen supplementation during sleep to the patients with nocturnal respiratory failure.

As there are no current criteria for nocturnal oxygen therapy in this group, we selected the definition used for patients with COPD [19]. Pulse oximetry gives some underestimation of OSAS, therefore polysomnography will identify more patients in need of therapy. Previous studies have shown that compliance with CPAP is good for patients with heart failure [10]. However, in this study few patients had pure heart failure.

In this study, seriousness of nocturnal hypoxaemia correlated negatively with age and not with diagnose or seriousness of the disease. Unexpectedly we found a high proportion of the patients in need of oxygen during the night. Retrospectively, we found an insignificantly poorer 1 year survival in the hypoxaemic group. Even though we know the mortality rate is higher in patients with SDB, the effect of oxygen therapy at night on survival among the oldest elderly has not been studied yet. We know, however, that oxygen therapy reduces the increased respiratory effort due to hypoxaemia.
Table 1. Patient characteristics

<table>
<thead>
<tr>
<th></th>
<th>All patients</th>
<th>Group I</th>
<th>Group II</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>92 (100%)</td>
<td>24 (25.5%)</td>
<td>68 (74.5%)</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>78.3 ± 6.9</td>
<td>80.5 ± 6.9</td>
<td>77.9 ± 6.6</td>
<td>NS</td>
</tr>
<tr>
<td>Sex m/f</td>
<td>43/49</td>
<td>11/13</td>
<td>32/36</td>
<td></td>
</tr>
<tr>
<td>Diagnosis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All with stroke</td>
<td>66</td>
<td>17</td>
<td>49</td>
<td></td>
</tr>
<tr>
<td>Left sided stroke</td>
<td>34</td>
<td>10</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>Right sided stroke</td>
<td>19</td>
<td>4</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Heart disease</td>
<td>9</td>
<td>3</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>17</td>
<td>4</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>No using sedatives</td>
<td>11</td>
<td>2</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Patients SpO₂% and HR during the night

<table>
<thead>
<tr>
<th></th>
<th>All patients</th>
<th>Group I</th>
<th>Group II</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean SpO₂%</td>
<td>91 ± 7</td>
<td>82 ± 10</td>
<td>94 ± 2</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Max SpO₂%</td>
<td>97 ± 6</td>
<td>97 ± 3</td>
<td>97 ± 7</td>
<td>NS</td>
</tr>
<tr>
<td>Min SpO₂%</td>
<td>73 ± 16</td>
<td>62 ± 19</td>
<td>76 ± 13</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Mean HR</td>
<td>69 ± 12</td>
<td>75 ± 15</td>
<td>67 ± 10</td>
<td>0.01</td>
</tr>
<tr>
<td>Max HR</td>
<td>112 ± 41</td>
<td>144 ± 68</td>
<td>101 ± 16</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Min HR</td>
<td>42 ± 11</td>
<td>42 ± 12</td>
<td>42 ± 10</td>
<td>NS</td>
</tr>
</tbody>
</table>

HR, heart rate.

Arterial blood gas measurement is a more correct method, but pulse oximetry is easier, cheap, sensitive and of no discomfort for the elderly patients. The study only uses a single overnight monitor, more nights would be required to be sure of findings. Seventy per cent of patients were able to be monitored, although patients with confusion and pulmonary disease were excluded. Thirty per cent of patients with normal oxygen saturations in day time had overnight desaturations—the clinical implications of this are currently unclear. Whether patients who desaturate at night in hospital do so after discharge is also unclear. According to previous reports sleep disorders are frequent in the older population [2]. However, how many of them will be in need of extra oxygen supplementation are so far unknown.

In this study, patients were hospitalised for a week to several months. The duration of stay depended on the need of rehabilitation and nursing. Therefore, the degree of hypoxaemia had no influence on length of stay.

Most patients in this study suffered from stroke. It is therefore reasonable to think that the brain function improvement during the rehabilitation process of some of the patients might have been better if they had been treated with nocturnal oxygen therapy for a longer period of time than the routinely 4 days and nights as part of the acute stroke management [20]. The Mini-Mental Status (MMS) tests of cognitive function were not reported because of the substantial portion of missing data in patients with stroke. However, in a prospective, randomised nocturnal oxygen therapy study, a selected battery of neuropsychological tests may have uncovered an improvement difference.

Only 11 patients used sedatives, and we found no sedative effect on the SpO₂ level.

Conclusion

We found that nearly 30% of the inpatients in geriatric medical wards suffered from severe oxygen-requiring nocturnal hypoxaemia irrespective of diagnosis. In patients with chronic respiratory failure for any reason age is no contraindication for palliative oxygen therapy. Effects of nocturnal oxygen therapy on survival and cognitive function in elderly with severe hypoxaemia at night needs to be further studied.

Acknowledgements

The authors would like to thank the staff at the geriatric division for skillful technical assistance.

Key points

- A single overnight pulse oximetry uncovered that 30% of the inpatients in geriatric medical wards suffered from severe oxygen-requiring nocturnal hypoxaemia irrespective of diagnosis.
- Effects of nocturnal oxygen therapy on survival and cognitive function in elderly with severe hypoxaemia at night needs to be further studied.

Conflict of interest

None

References

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