Acta Medica Okayama

Volume 60, *Issue* 3 2006 *Article* 7

JUNE 2006

Continuous positive airway pressure ameliorated severe pulmonary hypertension associated with obstructive sleep apnea.

Aiko Ogawa[*] Tetsuro Emori[†] Wakako Sumita[‡]

Atsuyuki Watanabe[**] Hideki Fujio[††]

Katsumasa Miyaji[‡‡] Tohru Ohe[§]

[*]Okayama University,

[†]Okayama University,

[‡]Okayama University,

[**]Okayama University,

[††]Okayama University,

[‡‡]Okayama University,

[§]Okayama University,

Continuous positive airway pressure ameliorated severe pulmonary hypertension associated with obstructive sleep apnea.*

Aiko Ogawa, Tetsuro Emori, Wakako Sumita, Atsuyuki Watanabe, Hideki Fujio, Katsumasa Miyaji, and Tohru Ohe

Abstract

A 52-year-old obese woman was admitted to our institution for evaluation of dyspnea and pulmonary hypertension (PH). Polysomnography revealed severe obstructive sleep apnea (OSA) with an apnea hypopnea index of 99.8. Treatment with nocturnal continuous positive airway pressure (CPAP) resulted in correction of daytime hypoxemia, hypercapnia, and near-normalization of pulmonary artery pressure. To our knowledge, this is the most severe case of OSA-associated PH (approximately70 mmHg) reported to date, and it was successfully treated with nocturnal CPAP. This case demonstrates that OSA should be considered and polysomnography performed in all patients with PH, irrespective of severity, and that nocturnal CPAP has therapeutic effects on both OSA and daytime PH.

KEYWORDS: continuous positive airway pressure, polysomnography, secondary pulmonary hypertension, sleep apnea syndrome

---

*PMID: 16838048 [PubMed - indexed for MEDLINE]

Acta Med. Okayama, 2006
Vol. 60, No. 3, pp. 191–195

Acta Medica Okayama
http://www.lib.okayama-u.ac.jp/www/acta/

Case Report

Continuous Positive Airway Pressure Ameliorated Severe Pulmonary Hypertension Associated with Obstructive Sleep Apnea

Aiko Ogawa[a]*, Tetsuro Emori[a,b], Wakako Sumita[a], Atsuyuki Watanabe[a], Hideki Fujio[a], Katsumasa Miyaji[a], and Tohru Ohe[a]

[a]Department of Cardiovascular Medicine, Okayama University Graduate School of Medicine, Dentistry and Pharmaceutical Sciences, Okayama 700–8558, Japan, and
[b]Emori CV Clinic, Okayama 703–8243, Japan

A 52-year-old obese woman was admitted to our institution for evaluation of dyspnea and pulmonary hypertension (PH). Polysomnography revealed severe obstructive sleep apnea (OSA) with an apnea hypopnea index of 99.8. Treatment with nocturnal continuous positive airway pressure (CPAP) resulted in correction of daytime hypoxemia, hypercapnia, and near-normalization of pulmonary artery pressure. To our knowledge, this is the most severe case of OSA-associated PH (~70 mmHg) reported to date, and it was successfully treated with nocturnal CPAP. This case demonstrates that OSA should be considered and polysomnography performed in all patients with PH, irrespective of severity, and that nocturnal CPAP has therapeutic effects on both OSA and daytime PH.

Key words: continuous positive airway pressure, polysomnography, secondary pulmonary hypertension, sleep apnea syndrome

There is a close link between obstructive sleep apnea (OSA) and cardiovascular diseases [1]. In most patients, OSA is suspected based on clinical features such as witnessed apneas or excessive daytime somnolence, but in others, the sleep-related breathing disorder is not associated with any symptoms or signs. In such cases, presentation with systemic hypertension or pulmonary hypertension (PH) may be an important clue to underlying OSA. Patients with dyspnea and PH sometimes suffer from severe OSA, and all-night polysomnography should be performed in such cases. Approximately 20% of patients with OSA manifest mild PH [2, 3]. Patients confirmed to have OSA are treated with nocturnal continuous positive airway pressure (CPAP), and CPAP has been shown to ameliorate OSA associated with mild PH [3–5].

We experienced a patient with OSA and severe PH, both of which were dramatically ameliorated by nocturnal CPAP. Treatment resulted in a significant reduction of daytime hypoxemia and hypercapnia, and normalization of pulmonary artery pressure. We report this case to highlight the fact that even severe PH can be caused solely by OSA and can be treated with CPAP alone.

Received August 1, 2005; accepted December 2, 2005.
*Corresponding author. Phone: +81-86-235-7351; Fax: +81-86-235-7353
E-mail: aiko-oky@umin.ac.jp (A. Ogawa)

Case Report

A 52-year-old obese woman visited our hospital in August 2003 with a chief complaint of dyspnea on exertion. She had been followed up for hypertension, hyperlipidemia and hypothyroidism for about 9 years. She was treated with metoprolol (60 mg/day), imidapril hydrochloride (5 mg/day), pravastatin (10 mg/day), and levothyroxine sodium (60 μg/day) and was under good control. The past history included right total mastectomy for breast cancer with no relapse over the 15 postoperative years. One month before the current presentation, she developed shortness of breath on exertion with pretibial edema, which progressively worsened. Twelve-lead electrocardiography revealed normal sinus rhythm with negative T wave in V1 through V3. Echocardiography displayed right atrial and ventricular dilatation and pericardial effusion, which had not been documented previously (Fig. 1). Pulmonary artery pressure was estimated at about 70 mmHg. Physical findings including obesity were suggestive of pulmonary thromboembolism.

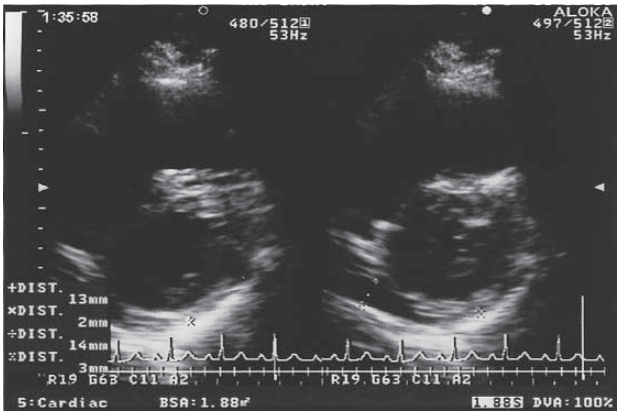

Fig. 1 Echocardiography on admission.

She was admitted to the hospital for further evaluation of dyspnea and PH. At the time of admission, her height was 153 cm, her body weight was 100 kg and her body mass index was 42.7 kg/m^2. Physical examination revealed an arterial blood pressure of 138/96 mmHg and heart rate of 92 beats/min. Arterial blood gas analysis revealed a carbon dioxide partial pressure ($PaCO_2$) of 55.6 torr, oxygen partial

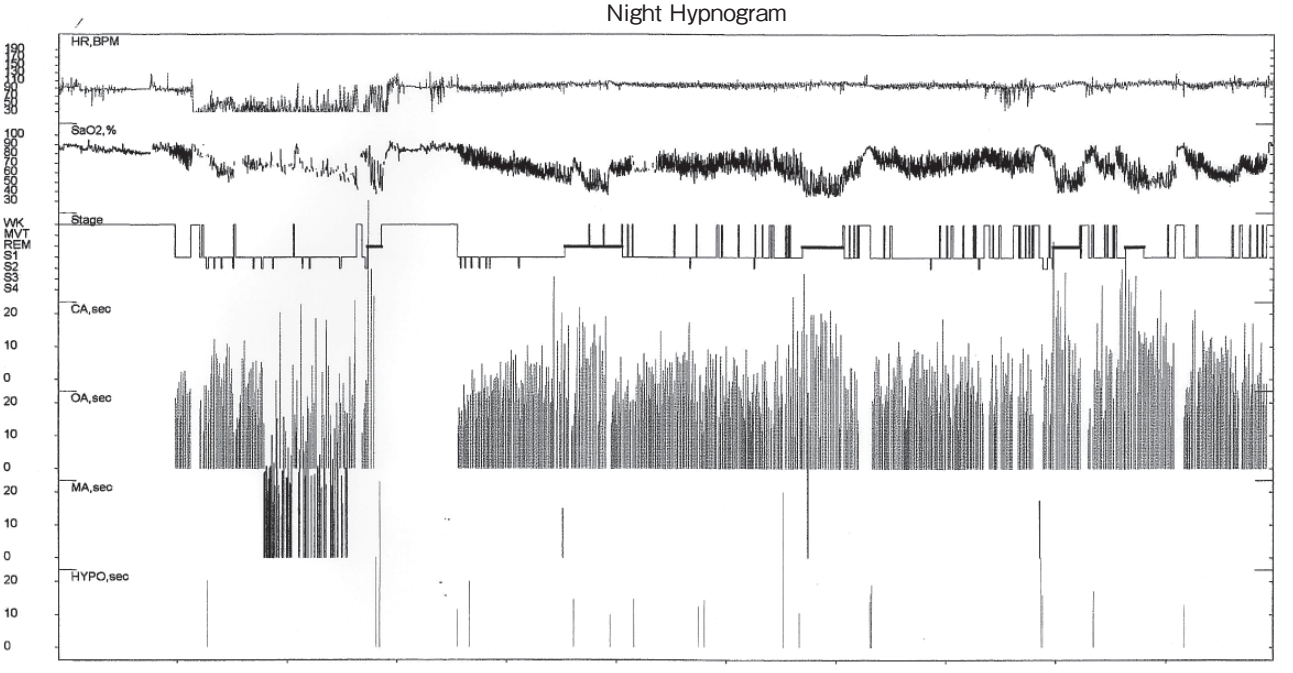

Fig. 2 Polysomnography: An overnight summary demonstrating the presence of OSA. HR, heart rate; SaO_2, atrial oxygen saturation by pulse oximetry; Stage, sleep stage; WKMVT, movement when awake; REM, rapid eye movement; S1–4, non-rapid eye movement sleep; CA, central apnea; OA, obstructive apnea; MA, mixed apnea; HYPO, hypopnea.

pressure (PaO_2) of 45.9 torr, and oxygen saturation (SaO_2) of 82.8%. There was no cyanosis or finger clubbing. Jugular venous pressure could not be assessed because of obesity. No abnormal sounds were heard on cardiac or lung auscultation. Abdominal examination revealed no hepatomegaly or ascites.

A chest radiograph showed cardiomegaly with a cardiothoracic ratio of 62% and no abnormality of either lung field. Multislice CT scan with contrast enhancement revealed no evidence of pulmonary embolism, deep vein thrombosis or other abnormalities. Lung ventilation-perfusion scintigraphy did not yield any findings supporting a diagnosis of pulmonary embolism. As she was a non-smoker and her lung function tests were normal, chronic obstructive pulmonary disease was ruled out.

During the examination of echocardiography, the patient fell asleep, and snoring and repetitive apneas were observed. Obstructive sleep apnea (OSA) was then suspected. A diagnostic full-night polysomnography was performed (Alice 4 Sleep Diagnostic System; Respironics, Inc., PA, USA) (Fig. 2). The apnea hypopnea index was 99.8 per hour. The longest apnea lasted for 82 sec (Fig. 3). The mean SaO_2 was 69% and the minimum SaO_2 was as low as 34%. Most of the apneic episodes were obstructive (91.0%), while 0.3% were central and 2.5% were scored as hypopneas. She had predominantly OSA. She was subsequently treated with nocturnal continuous positive airway pressure (CPAP; REMstar Auto; Respironics Inc., Murrysville, PA, USA). Following the application of CPAP, she immediately felt more alert during the daytime. She was able to read books again, something she had previously been unable to do for more than a few minutes without

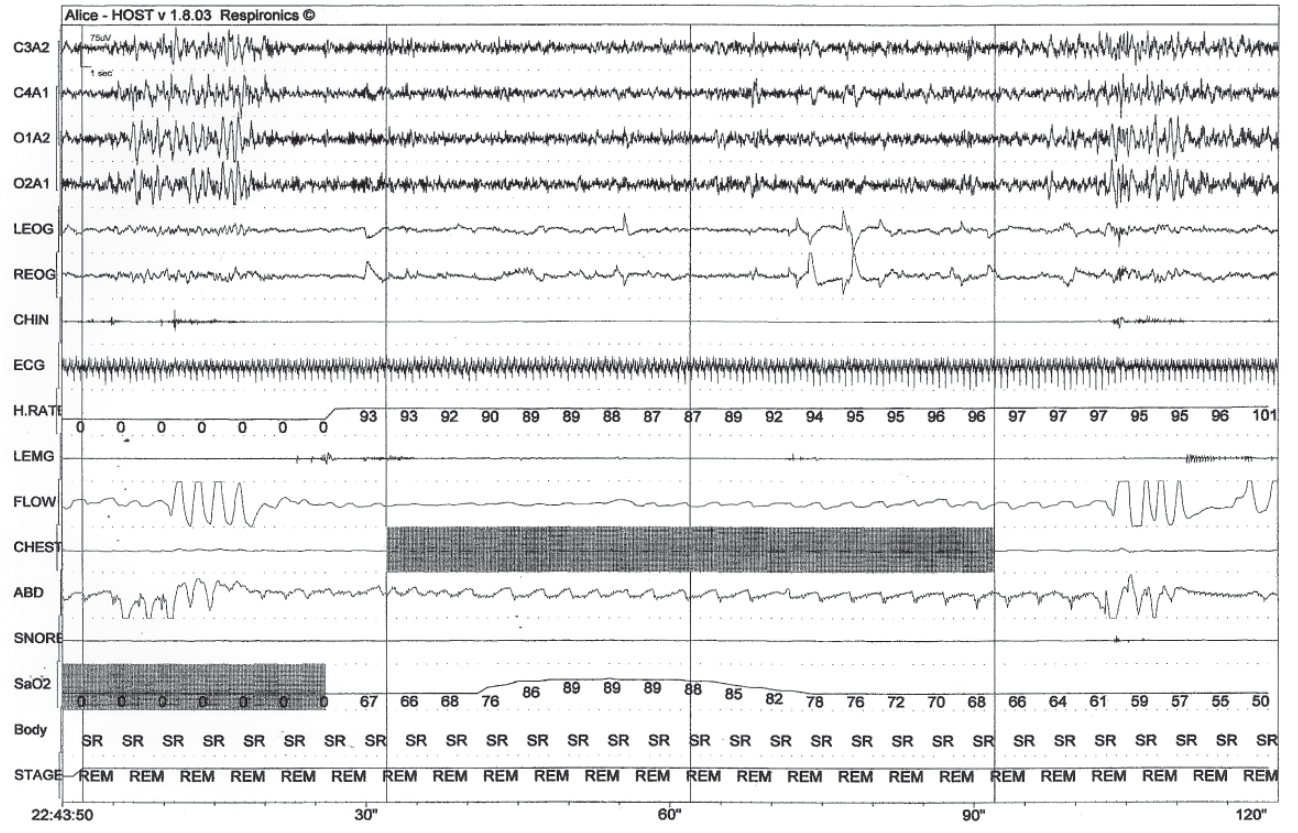

Fig. 3 Polysomnographic record demonstrating the longest OSA lasting 82 sec. C3, C4, O1 and O2: the 4 channels of the electroencephalogram; LEOG and REOG, the 2 channels of the electrooculogram; CHIN, chin muscle electromyogram; ECG, electrocardiogram; H.RATE, heart rate; LEMG, leg muscle electromyogram; FLOW, oronasal airflow; CHEST and ABD, motion of the chest and abdominal wall; SNORE, snoring sound; SaO_2, atrial oxygen saturation by pulse oximetry; Body, body position; STAGE, sleep stage.

falling asleep.

Treatment with nocturnal CPAP resulted in improvement of daytime dyspnea and PH. Six days after starting CPAP, daytime arterial blood gas analysis revealed $PaCO_2$ of 46.9 torr, PaO_2 of 73.5 torr, and SaO_2 of 95.3% on room air breathing. Echocardiography showed a normal size right atrium and slightly dilated ventricle, and the pericardial effusion had disappeared. Pulmonary artery pressure was estimated at 37 mmHg. With a mean airway pressure of 7.4 cm H_2O, the apnea hypopnea index diminished to 5.2 per hour. After discharge from the hospital, she continued to use nocturnal CPAP. She has been followed for over 2 years, and dyspnea and PH have not recurred.

Discussion

Several studies have examined the relation between sleep-disordered breathing and cardiovascular risk [1]. OSA is the most common form of sleep-disordered breathing and plays a role in the pathogenesis in systemic hypertension, congestive heart failure, arrhythmias, and atherosclerosis. It also correlates with PH. It is reported that approximately 20% of OSA patients without any other lung or heart disease develop mild PH [2, 3]. Alchanatis *et al.* reported that the emergence of PH is related to old age, greater body mass index and low PaO_2 during wakefulness [3]. In the present case, the patient was 52 years old, had a body mass index of 43 kg/m^2, and manifested severe daytime hypoxemia on admission. According to the criteria of Alchanatis *et al.*, she was thus highly susceptible to severe OSA with PH. Moreover, the case presentation corresponded with Pickwickian syndrome, which is characterized by severe obesity, daytime sleepiness, hypercapnia, and severe OSA [2].

The patient's pulmonary artery pressure was estimated as 70 mmHg, and we were initially skeptical that OSA alone could have induced such severe PH. Patients with OSA generally have mild PH. In the 42 pulmonary hypertensive patients investigated by Laks *et al.*, pulmonary artery pressure ranged from 20 to 52 mmHg and the average value was only 29 mmHg [6]. Similarly, in the 37 pulmonary hypertensive patients reported by Chaouat *et al.*, pulmonary artery pressure ranged from 20 to 44 mmHg with an average of 26 mmHg [7]. Because OSA is the only disease known to cause daytime hypoxemia and PH, we finally concluded that the severe PH in this patient was a complication of OSA. This is the first reported case of OSA associated with PH of this severity.

In patients with OSA, the combination of marked nocturnal hypoxemia with mild to moderate daytime hypoxemia could explain the development of PH. The mechanisms by which alveolar hypoxia leads to PH are thought to be both pulmonary vasoconstriction and remodeling of the pulmonary vascular bed [7]. Obesity-related hypoventilation may also play a role in the emergence of mild daytime hypoxemia and subsequently of mild PH [3].

When patients are diagnosed with OSA, the standard treatment is nocturnal nasal CPAP [3–5]. The effect of CPAP treatment on pulmonary hemodynamics and gas exchange in OSA has been thoroughly investigated. Sajkov *et al.* reported a decrease in pulmonary artery pressure and pulmonary vascular resistance in patients treated with CPAP [4]. They also assessed the hypothesis that CPAP could reduce hypoxic pulmonary vascular reactivity, which is the propensity of the pulmonary circulation to constrict in response to a hypoxic stimulus. In our case, daytime hypoxemia, hypercapnia, and PH improved markedly following treatment with CPAP, indicating that intermittent nocturnal hypoxemia associated with OSA causes pulmonary constriction, which is reversible with abolition of OSA by CPAP.

Conclusion. In this case, administration of nocturnal CPAP significantly improved not only OSA but also daytime hypoxemia, hypercapnia, and severe PH. This suggests that OSA was the only cause of severe PH. Obese patients who present with dyspnea, hypoxemia or PH, even if it is severe PH, should be suspected of having OSA and full-night polysomnography should be performed. Moreover, treatment of such patients with CPAP will result in the disappearance of symptoms and normalization of pulmonary artery pressure.

References

1. Lattimore JD, Celermajer DS and Wilcox I: Obstructive sleep apnea and cardiovascular disease. J Am Coll Cardiol (2003) 41: 1429–1437.

2. Kessler R, Chaouat A, Weitzenblum E, Oswald M, Ehrhart M, Apprill M and Krieger J: Pulmonary hypertension in the obstructive sleep apnoea syndrome: prevalence, causes and therapeutic consequences. Eur Respir J (1996) 9: 787–794.
3. Alchanatis M, Tourkohoriti G, Kakouros S, Kosmas E, Podaras S and Jordanoglou JB: Daytime pulmonary hypertension in patients with obstructive sleep apnea: the effect of continuous positive airway pressure on pulmonary hemodynamics. Respiration (2001) 68: 566–572.
4. Sajkov D, Wang T, Saunders NA, Bune AJ and Mcevoy RD: Continuous positive airway pressure treatment improves pulmonary hemodynamics in patients with obstructive sleep apnea. Am J Respir Crit Care Med (2002) 165: 152–158.
5. Chaouat A, Weitzenblum E, Kessler R, Oswald M, Sforza E, Liegeon MN and Krieger J: Five-year effects of nasal continuous positive airway pressure in obstructive sleep apnoea syndrome. Eur Respir J (1997) 10: 2578–2582.
6. Laks L, Lehrhaft B, Grunstein RR and Sullivan CE: Pulmonary hypertension in obstructive sleep apnea. Eur Respir J (1995) 8: 537–541.
7. Chaouat A, Weitzenblum E, Krieger J, Oswald M and Kessler R: Pulmonary hemodynamics in the obstructive sleep apnea syndrome. Results in 220 consecutive patients. Chest (1996) 109: 380–386.