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Original Article

APPROACH TO OBSTRUCTIVE SLEEP APNEA SYNDROME AT TOKYO DENTAL COLLEGE
ICHIKAWA GENERAL HOSPITAL

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Abstract

In this communication, we report the current status of OSAS (Obstructive Sleep Apnea Syndrome) in the southern region of Higashikatsushika around Ichikawa City, our effort to improve patient QOL as well as to establish diagnostic and therapeutic methods, and the results of a comparison of therapeutic options with the focus on improvement of compliance by using nCPAP (nasal continuous positive airway pressure). We examined 112 patients who visited the Otolaryngology Department at Tokyo Dental College, Ichikawa General Hospital, with the chief complaint of nocturnal snoring or sleep apnea from January 2001 to April 2003 and underwent all-night PSG (polysomnography). Based upon the results of these all-night PSGs, 89 and 23 patients were diagnosed as having OSAS and simple snoring, respectively. Using the AHI classification of severity, 58 and 31 patients were assessed as having severe OSAS and mild OSAS, respectively. (1) nCPAP was tried in 61 patients, and 39 patients (63%) were able to continue it. After the introduction of nCPAP, surgery was performed in 18 patients (30%). As a result, weaning from nCPAP was successfully achieved in 10 cases, compliance with nCPAP was improved in six cases, alleviation of symptoms (decreased pressure) was seen in one case, and aggravation was noted in one case. In addition, four patients (7%) unilaterally discontinued nCPAP. (2) Surgery was performed in 34 patients, and 18 of them had surgery after nCPAP was tried. (3) We asked the dental department to make OAs (oral appliances) for 31 patients but seven of them did not attend the department, so a total of 24 patients used OAs. Fourteen patients (58%) were able to tolerate an OA for 3 months or more. Based on these results, we are hoping to achieve a better control of OSAS by combining nCPAP and other modalities.

Key words: Obstructive sleep apnea syndrome — nCPAP —
Uvulo-palato-pharyngoplasty (UPPP) — Nasal obstruction —
Oral appliance (OA) — Endonasal sinus surgery (ESS)
INTRODUCTION

Obstructive sleep apnea syndrome (OSAS), which was first reported by Guilleminault et al. in 1976, has suddenly become the focus of attention in Japan not only as a medical problem but also a social problem, since a dozing bullet train operator was detected in March of 2003. The number of potential patients with OSAS is estimated to be approximately 1–2% of the total population. In Ichikawa City, the population is 450,000, so there may be 4,500–9,000 patients with OSAS, while the neighboring four cities (Matsudo City, Funabashi City, Urayasu City, and Kamagaya City) are considered to have 12,000–25,000 patients in total.

In this communication, we report the current status of OSAS in the southern region of Higashikatsushika around Ichikawa City, our effort to improve patient QOL as well as to establish diagnostic and therapeutic methods, and the results of a comparison of therapeutic options with the focus on improvement of compliance by using nCPAP.

MATERIALS AND METHODS

Patients: We examined 112 patients who visited the Otolaryngology Department at Tokyo Dental College, Ichikawa General Hospital with the chief complaint of nocturnal snoring or sleep apnea from January 2001 to April 2003 and underwent all-night polysomnography (PSG). The patient population included 101 male and 11 female patients whose ages ranged from 2 to 72 years, with a mean of 44.9 years (Fig. 1).

Methods: We performed PSG using a Somnostar Alpha® (manufactured by Sensor Medics Inc.). We examined the sleep electroencephalogram (C3/A2, C4/A1, O1/A2, O2/A1), eye movements, electromyogram (mentalis and anterior cervical muscles), electrocardiogram, air flow through the nose and mouth detected by a thermistor, thoracoabdominal movements, snoring sounds, percutaneous arterial oxygen saturation (detected by an oximeter), and body position. Sleep stages were determined by naked-eye observation according to the international criteria of Rechtschaffen and Kales13). With respect to respiratory events, apnea was defined as no air flow for 10 sec or more, and hypopnea was defined as diminished respiratory flow for 10 sec or more plus desaturation of at least 3% or an arousal response.

Assessment: Severity was classified simple snoring (AHI < 5 times/hr), mild OSAS (AHI from 5 to <20 times/hr), and severe OSAS (AHI ≥20 times/hr) from the results of the PSG, and treatments were chosen according to the classification (Table 1).

In our treatment strategy, nasal continuous positive airway pressure (nCPAP) was the first choice for severe OSAS, and an oral appliance (OA) was the main therapy for mild OSAS (Fig. 2).

Surgical treatment of an obstructing lesion was indicated when a patient refused nCPAP or failed to show any benefit from it, when we aimed to improve compliance with nCPAP, and when patients had snoring (Fig. 2). We employed uvulo-palato-pharyngoplasty (UPPP) and adenoidectomy for the tonsils and pharynx and performed endonasal sinus surgery (ESS) including septoplasty and conchotomy for the nose and paranasal sinuses.
On the other hand, for the treatment of simple snoring, we chose OA or UPPP based on the patient’s wishes, and we performed septoplasty plus intranasal surgery (mainly conchotomy) for the treatment of nasal obstructions (Fig. 2).

RESULTS

From the results of all-night polysomnography (PSG), 89 and 23 patients were diagnosed as having OSAS and simple snoring, respectively. Based on the classification of severity using the apnea-hypopnea index (AHI), 58 and 31 patients were assessed as having severe OSAS (AHI ≥ 20 times/hr) and mild OSAS (AHI from 5 to <20 times/hr), respectively (Fig. 3).

Treatment was provided according to the above-mentioned strategy based on the severity of each case.

1) nCPAP was tried in 61 patients, and 39 patients (63%) were able to continue it (Fig. 4). After the introduction of nCPAP, surgery was performed in 18 patients (30%) who had difficulty in wearing the apparatus because of nasal pain or discomfort. As a result, weaning from nCPAP was successfully achieved in 10 cases, compli-
ance with nCPAP was improved in six cases, alleviation of symptoms (decreased pressure) was seen in one case, and aggravation was noted in one case (Figs. 5, 6, Table 2). In addition, four patients (7%) unilaterally discontinued nCPAP because they felt that the apparatus did not fit well (Fig. 4).

2) Surgery was performed in 34 patients, and 18 of them had surgery after nCPAP was tried (shown in parentheses). The operations performed were UPPP in two cases, septoplasty plus conchotomy plus UPPP in 23 (12) cases, septoplasty plus conchotomy plus UPPP plus adenoidectomy in one (one) case, septoplasty plus conchotomy in five (three) cases, and septoplasty plus ESS in three (two) cases.

3) We asked the dental department to make OAs for 31 patients but seven of them did not attend the department, so a total of 24 patients used OAs. Fourteen patients (58%) were able to tolerate an OA for 3 months or more.

**DISCUSSION**

More than 110 patients underwent PSG over the last 28 months at our department. About half of these patients had severe OSAS (AHI ≥ 20 times/hr), and 80% of all patients had OSAS, including mild cases, while the remaining 20% had simple snoring. The American Academy of Sleep Medicine (AASM) judges the severity of respiratory disturbance caused by OSAS according to the respiratory disturbance index (RDI)\(^1\). Since the RDI is calculated as AHI + RERA (respiratory effort related arousal), it assesses arousal responses resulting from respiratory effort as well as hypopnea. Severe OSAS is defined as a RDI of 30 times/hr or more. On the other hand, because of the lack of such criteria, the indication for health insurance to cover the use of nCPAP to treat OSAS in Japan is an AHI of 20 times/hr or more. Additionally, He et al. reported that patients with an apnea index (AI) of 20 times/hr or more had a worse prog-

![Fig. 5 Patients who had surgery after the introduction of nCPAP](image)

![Fig. 6 AHI of 10 patients weaning from nCPAP after surgery](image)

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<tr>
<td>1</td>
<td>38</td>
<td>8.8</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>44</td>
<td>5.9</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>73.3</td>
<td>18</td>
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</tr>
<tr>
<td>4</td>
<td>26.2</td>
<td>4.6</td>
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</tr>
<tr>
<td>5</td>
<td>66.7</td>
<td>11.3</td>
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<td>6</td>
<td>40.9</td>
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<td>9</td>
<td>44.1</td>
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<tr>
<td>10</td>
<td>86.1</td>
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nosis than those with an AI of less than 20
times/hr\(^3\). Thus, we clinically diagnose a
patient with an AHI \(\geq 20\) times/hr as having
severe OSAS.

We tried nCPAP for all the severe cases, and
we also instructed the patients to lose weight
or educated them about nutrition if necessary.
Even if the AHI was less than 20 times/hr,
we recommended nCPAP for some patients
with certain complications (cerebrovascular
disease, circulatory disorders, \textit{etc.}) or an
extremely low \(\text{SpO}_2\). Because its effect is
immediate and definite, nCPAP is the first-
line treatment for OSAS. With respect to com-
pliance, however, it often raises problems in
terms of physical status, living environment,
and level of consciousness. Especially when
impaired nasal breathing (nasal obstruction
due to the shape of the nasal cavity or nasal
diseases) is observed, careful examination is
important. Without appropriate care, symp-
toms such as intranasal pain, intranasal dry-
ness, and nasal bleeding may occur, or nCPAP
may become impossible because of the devel-
opment of mouth breathing\(^3,11,14\). Likewise,
mouth breathing easily develops in the pres-
ence of enlarged tonsils, and this may lead to
failure of nCPAP because the full effect
cannot be obtained. We tried nCPAP in 61
patients, and 39 patients (63\%) were able to
continue it. When nCPAP was poorly toler-
ated, we performed surgery in 18 out of 61
patients (30\%) (Fig. 4). The compliance rate
with nCPAP is generally considered to be
about 50\%, ranging from 40 to 80\% in previ-
ous reports\(^8,10\). The compliance rate at our
department was 63\%, which is comparable
with that at other facilities. However, our insti-
tution is characterized by the ability to per-
form surgical treatment, evaluate applicability
for OA equipment, and provide treatment in
patients in whom nCPAP is not indicated.

Surgical treatment was indicated when a
patient refused nCPAP or failed to get any
benefit from it, when we aimed to improve
compliance with nCPAP, or when patients
had snoring. Surgical treatment generally
involved a combination of UPPP and intrana-
sal surgery.

UPPP is the most common surgical proce-
dure for OSAS; it aims at correcting obstruc-
tion due to the soft palate or enlarged tonsils,
both of which can cause sleep apnea. UPPP
can alleviate obstruction, but can seldom
eliminate it, and its efficacy rate is reported to
be about 50\%\(^5\). However, it is suggested that
the rate may be higher if the procedure is
performed after the site of obstruction in the
upper respiratory tract is meticulously iden-
tified\(^16\). In a review of our 20 UPPP cases and
6 UPPP cases treated at related hospitals, a
comparison of the effective group (\(n=11:
42.3\%\)) and other patients (\(n=15: 57.7\%\))
showed a significant effect when patients were
aged 42 years or younger and when the facial
axis (Fx) (Fig. 7), which indicates the extent
of opisthognathia relative to the skull base,
was at least 84 degrees\(^2\). We postulate that
UPPP is not likely to work when a patient has
a small jaw and opisthognathia, so that the Fx,
is less than 84 degrees. On the other hand,
with regard to other parameters (MP-H, ANB,
PAS, PNS-P) including AHI, age, or BMI
before treatment, we found no significant dif-
fences. In the cephalometric analysis of the
maxillofacial contour, Fx assesses the length
of the face and opisthognathia at the same
time. It is established that there is a racial difference between Caucasians and Japanese with respect to Fx, which is an average of about 90 degrees in Caucasians and about 86 degrees in Japanese\textsuperscript{9}. On the other hand, there is no difference in the prevalence of OSAS between the USA and Japan, despite the fact that obese people (a BMI of 30 kg/m\textsuperscript{2} or more) account for about 20% and about 2% of the populations in the USA and Japan, respectively\textsuperscript{17}. Therefore, opisthognathia may be an aggravating factor for OSAS, as is obesity, so that cephalometric analysis of the maxillofacial contour is important for this disorder.

Although intranasal surgery does not treat the causative lesion, it can prevent the development of mouth breathing, improve nasal breathing, and thereby increase compliance with therapy. We performed surgery in 18 out of the 61 patients using nCPAP and found improved compliance with use in six cases and a decrease of the pressure in one case (Figs. 4, 5). Moreover, 10 of the 18 patients could be weaned from nCPAP by combining UPPP, intranasal surgery and OA (Fig. 6, Table 2). From these findings, intranasal surgery for nasal diseases seems to have an important role if weaning of nCPAP is set as the final goal.

We employed an OA or surgical treatment for mild OSAS. Although the effectiveness of OAs is recognized\textsuperscript{12}, this is not the first-line treatment, because their therapeutic effect is smaller than that of nCPAP. In addition, the indications for the use of OA to treat OSAS are not definitely established, so the OA is generally indicated for mild or moderate OSAS under current medical circumstances. Therefore, opisthognathia may be an aggravating factor for OSAS, so that use of an OA to push the mandible forward or hold the tongue anteriorly is considered a reasonable treatment for this disorder. A review of compliance with OA use in 43 patients with OSAS who were referred to the dental department from February of 1999 to July of 2000 showed that 12 patients were unable to tolerate the apparatus (due to discomfort, temporomandibular joint pain, etc.)\textsuperscript{15}. In 15 patients who underwent PSG and wore an OA, the average AHI was 36.5 times/hr (AHI from 12.5 to 76.5 times/hr) before wearing and fell to 18.4 times/hr after wearing (p<0.05), but AHI was reduced to less than five times/hr in only five patients. These findings indicate that apnea was not eliminated. However, the OA is definitely a promising treatment modality because it is convenient and cheap. There were no clear differences related to the shape of the OA (one piece type, two piece type). In fact, the shape and indications for OA use still differ from hospital to hospital at present.

Based on these results, we hope to achieve better control of OSAS by combining nCPAP and other modalities. We are also eager to explore the possibility of treatments that enhance QOL and allow patients to be eventually weaned from nCPAP by surgical treatment of hard tissues in the maxillofacial region as well as of soft tissues such as the tonsils, the soft palate, and the root of the tongue.

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