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Chapter

Surgery for Sleep-Disordered Breathing

Ken-ichi Hisamatsu, Hiroumi Matsuzaki, Itsuhiro Kudou and Kiyoshi Makiyama

Abstract

We evaluated the outcomes of nasal surgery for sleep-disordered breathing, including obstructive sleep apnea syndrome (OSAS), respiratory effort-related arousal, and snoring. To reduce pharyngeal negative pressure during sleep, the nasal parasympathetic nerve was resected, and the nasal cavity was enlarged by submucosal inferior turbinectomy and septoplasty if necessary. Of the 45 severe OSAS patients, symptoms were significantly ameliorated in 67%. This low-invasiveness nasal operation effectively reduced excessive daytime sleepiness and bothersome snoring without any pharyngeal operation. In addition, no side effects have been reported to be associated with this treatment regimen.

Keywords: nasal surgery, sleep-disordered breathing, snoring, hypersomnia, obstructive sleep apnea syndrome

1. Introduction

Sleep-disordered breathing (SDB) includes mild-to-severe obstructive apnea syndrome (OSAS), respiratory effort-related arousal (RERA), other hypersomnia, and socially unacceptable snoring. The pathophysiology of SDB involves nocturnal pharyngeal negative pressur, collapsibility of the soft palate, and an increased inspired air volume due to obesity, a narrow upper airway, and an oropharyngeal shape with a wide pillar and long uvula.

A number of patients suffer from excessive daytime sleepiness, bothersome snoring, and apnea pointed out by a member of their family or bed partner. Hypersomnia can cause traffic accidents and similar dangerous incidents, so this disorder should be managed quickly when it is noted. Furthermore, snoring affects the quality of life (QOL), especially in people who work in group settings, such as firefighters and police officers.

Septoplasty was reported to improve the QOL [1]. Nasal surgery can enlarge the nasal cavity, resulting in a reduction in the nasal resistance and subsequent amelioration of SDB. Generally, OSAS is managed with CPAP therapy. However, other SDBs are typically not managed this way either for financial reasons or due to the fact that they are not covered for CPAP by the Japanese National Insurance System.

At our institution, we use nasal surgery to reduce nocturnal nasal resistance.

The aim of this study was to clarify the efficacy of nasal surgery for resolving SDB.

2. Material and methods

Active anterior rhinomanometry was performed using a Spirometer HI-801 (Chest Co., Tokyo, Japan). PSG was performed using a PSG amplifier (Embla N7000; Natus Company, Pleasanton, CA, USA). OSAS was diagnosed according to the report of the American Academy of Sleep Medicine Task Force [2].

The nasal surgery comprised conventional septoplasty and bilateral submucosal inferior turbinectomy with posterior nasal neurectomy [3] and was performed under local anesthesia. Indications of this operation were unilateral and/or bilateral high nasal resistance (>0.35 Pa/cm^3/s), marked septal deviation, and marked protrusion of the inferior turbinate and hypertrophic mucosa. To protect the mucosal from damage, between a gauze coated with kichin (Beschitin®F; Nipro Co., Osaka, Japan), sandwiched bet pieces of gelatin sponge, was packed into the nasal cavity for 2 days.

The judging criteria were selected according to the findings of our previous report [4]. Daytime sleepiness was assessed by the Epworth sleepiness scale [5].

The study protocol was reviewed and approved by the ethics committees of Nihon University Hospital. This original retrospective study on the outcomes of nasal surgery for SDB was registered at the University Hospital Medical Information Network Clinical Trial Registry (identifier: UMIN 000011997; trial name: Effect of nasal surgery on sleep-disordered breathing).

3. Statistical analyses

The data were analyzed by using Wilcoxon matched-pair signed rank test, and a p value of <0.05 was considered to be significant.

4. Results

4.1 Subjects

The present study enrolled 52 patients with severe OSAS, 33 with moderate OSAS, 19 with mild OSAS, 45 with RERA, and 41 snorers. Patients' background details are shown in **Table 1**. All patients provided their informed consent before undergoing the nasal surgery.

	N	Sex	N	Age, mean(SD), year	BMI, (SD), kg/m^2
Severe OSAS	52	M	44	46.22 ± 10.85	26.37 ± 4.47
		F	8	47.5 ± 7.93	25.74 ± 2.79
Moderate OSAS	33	M	26	39.54 ± 11.29	24.31 ± 3.94
		F	7	46.43 ± 5.4	24.2 ± 5.09
Mild OSAS	19	M	13	44.23 ± 8.89	24.52 ± 2.74
		F	6	45.67 ± 8.21	24.88 ± 8.21
RERA	45	M	24	38.63 ± 10.99	23.35 ± 3.56
		F	21	36.81 ± 11.89	22.99 ± 4.46
Snorer	41	M	26	39.03 ± 12.76	24.53 ± 3.16
		F	15	47.4 ± 10.19	20.82 ± 2.61

Table 1.
Patient's background.

			OSAS		
			Highly effective	**Effective**	**Ineffective**
		Sex			
Severe OSAS	40	M	1	27(70%)	12
	5	F		4	1
Moderate OSAS	10	M		8	2
	5	F		4	1
Mild OSAS	3	M		2	1
	0	F		0	0

Table 2.
Effect of NS on sleep-disordered breathing.

4.2 Operative details

The outcomes of surgery are shown in **Tables 2** and **3**. Severe OSAS was ameliorated in 28 of the 40 male patients (70%) and 4 of the 5 female patients (80%) by nasal operation without any pharyngeal intervention. Moderate OSAS was ameliorated in 8 of the 10 male patients (80%) and 4 of the 5 female patients (80%) by nasal operation without any pharyngeal intervention (**Table 2**). The improvement rate of hypersomnia was particularly high in RERA patients (23 of 24 male patients [95.8%] and all 20 female patients [100%]), although the results of many studies remain unclear, and the snoring symptoms substantially improved 127/151 (84.1%) (**Table 3**). The improvement rate of all SDB was 111/140 (79.2%) for hypersomnia and 127/151 (84.1%) for snoring.

4.3 Findings of polysomnography

The preoperative and postoperative values of apnea index (AI), apnea hypopnea index (AHI), and SpO_2 < 90% were analyzed, with results shown in **Table 4**.

		Hypersomnia		**Snore**		**Allergic rhinitis**
		Effective	**Obscure**	**Effective**	**Ineffective**	**Improved**
	Sex					
Severe OSAS	M	30	19	31	6	6
	F	3	5	5	0	1
Moderate OSAS	M	13	1	18	4	2
	F	6	0	5	5	2
Mild OSAS	M	6	2	6	3	2
	F	0	1	4	0	1
RERA	M	23	1	17	0	
	F	20	0	9	1	1
Snorer	M	5	0	22	2	4
	F	5	0	10	3	2
	Total	111	29	127	24	

Table 3.
Global assessment.

	N	AI	N	AHI	N	$SpO_2 < 90\%$
Severe OSAS		Mean ± SD				
Preop	20	31.42 ± 16.34	20	57.49 ± 21.85	20	8.01 ± 7.01
Postop	20	16.68 ± 14.17	20	31.89 ± 26.02	20	2.61 ± 23.83
Moderate OSAS						
Preop	10	10.04 ± 4.77	10	3.69 ± 4.13	10	14.92 ± 10.24
Postop	10	20.2 ± 6.08	10	6.73 ± 5.33	10	2.27 ± 2.93
Mild OSAS						
Preop	3	10.1 ± 6.88	3	2.43 ± 3.44	3	8.47 ± 5.83
Postop	3	17.63 ± 5.60	3	2.73 ± 2.27	3	2.67 ± 4.44

Table 4.
Effect of NS on PSG parameters in patients with OSAS.

In the 20 severe OSAS patients the AI, AHI and $SpO_2 < 90\%$ were significantly improved ($p = 0.0002$, $p = 0.0124$, and $p = 0.0015$, respectively). In the 10 moderate OSAS patients, the AI and $SpO_2 < 90\%$ were significantly improved ($p = 0.0051$ and $p = 0.0125$, respectively); however, the AHI was not significantly changed ($p = 0.1394$). In the 3 mild OSAS patients, the AI and $SpO_2 < 90\%$ were significantly improved ($p = 0.0051$ and $p = 0.0125$, respectively); however, the AHI was not significantly changed ($p = 0.1394$).

5. Discussion

A low-invasiveness technique is ideal for surgery. In the present study, the nasal operation showed high efficacy in ameliorating OSAS, hypersomnia, and snoring. A number of patients suffering from hypersomnia and snoring cannot undergo nasal CPAP either for financial reasons or due to the fact that this treatment for CPAP is not covered by the Japanese National Health Insurance System. Our low-invasiveness nasal operation is useful for reducing nocturnal pharyngeal negative pressure, thereby resulting in the amelioration of hypersomnia and/or socially unacceptable snoring.

To our knowledge, this is the first report regarding SDB, including OSAS, in which the nasal resistance was measured in consideration of its pathophysiological importance. Recent studies have found that nasal operations were effective in relieving snoring [6] and ameliorating nasal obstruction, which has consequently increased CPAP tolerance and compliance [7]. The degree of nasal resistance before starting CPAP treatment has a significant effect on the acceptance of CPAP by patients, as a high nasal resistance disturbs CPAP performance [8]. The improvement of the Epworth Sleepiness Scale (ESS) was more significant in the operated group than in the CPAP group [9], although CPAP was observed to ameliorates daytime sleepiness. Robust evidence supports the efficacy of nasal surgery on improving snoring, the subjective sleep quality, daytime sleepiness, sleep-related QOL measures, and other important OSAS outcomes [10]. In patients with chronic rhinosinusitis with polyps, functional endoscopic sinus surgery was shown to significantly ameliorate the sleep pattern and sleep quality [11]. Both the AHI and ESS significantly improved after isolated nasal surgery, but the improvement in the AHI was slightly more significant [12]. Nasal surgery can also effectively improve

the subjective symptoms of patients with simple snoring accompanied by nasal blockage as well as those of patients with OSAS [13]. Surgical treatment of nasal obstruction has been shown to improve SDB as well as CPAP. CPAP is considered to be the first line of therapy, but long-term compliance is only about 40%, often because of problems associated with nasal obstruction [14]. Therefore, nasal surgery to reduce nasal resistance during sleep is desirable before starting CPAP. Nasal surgery improved the OSAS severity as measured by PSG, subjective complaints, and three-dimensional reconstructed computed tomography scans [15]. This operation is a cost-effective strategy for improving CPAP compliance in OSAS patients with nasal obstruction [16], although the optimum operative techniques have not been studied. Nasal dilators have shown efficacy in improving nasal breathing but not in improving obstructive sleep apnea outcomes [17], suggesting a need for nasal surgery.

Nasal septum deviation should be investigated in patients with sleep disorders [18]. The most frequent cause of impaired nasal patency was nasal septal deviation, which was found in 82.5% of the patients, including 45% with unilateral impaired patency and 37.5% with bilateral nasal patency [19]. According to our previous study on nasal resistance, even unilateral high resistance affects SDB [4]. Our nasal operation involves septoplasty, submucosal inferior turbinectomy and posterior nasal neurectomy. Measurement of the nasal resistance has proven useful for the treatment of OSAS [20], although the technique used in the cited study was different from that used in ours. Chronic rhinosinusitis (CRS) patients have been shown to have a high prevalence of OSAS, and OSAS symptoms are worse in CRS patients than in others [21].

Nasal surgery alone was partially effective in improving the sleep quality and snoring, but it had no effect on obstructive apnea in patients with OSAS and nasal obstruction [22].

The present study underscored the utility of nasal surgery consisted of septoplasty, submucosal inferior turbinectomy to enlarge the nasal cavity, and nasal parasympathetic nerve resection to achieve a nocturnal low nasal resistance for the amelioration of SDB.

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Conflict of interest

No conflicts of interest and no financial support.

Abbreviation

CPAP	transnasal continuous positive airpressure
SDB	sleep disordered breathing
PSG	polysomnography
ESS	Epworth Sleepiness Scale

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Author details

Ken-ichi Hisamatsu[1*], Hiroumi Matsuzaki[2], Itsuhiro Kudou[2] and Kiyoshi Makiyama[2]

1 Tsuchiura Snoring and Sleep-Disordered Breathing Center, Tsuchiura City, Ibaraki Prefecture, Japan

2 Department of Otorhinolaryngology, Head and Neck Surgery, Nihon University Hospital, Chiyoda-ku, Tokyo, Japan

*Address all correspondence to: kenhisam@jcom.home.ne.jp

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