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The evaluation of pattern and quality of sleep in patients with chronic rhinosinusitis with nasal polyps

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ABSTRACT

Objective: The goal of this study is to evaluate the impact of chronic rhinosinusitis with nasal polyps (CRSwNP) on sleep pattern and sleep quality before and after functional endoscopic sinus surgery using subjective and objective parameters.
Methods: Twenty-two patients with CRSwNP were evaluated. All subjects underwent assessment by nasal endoscopy, rhinomanometry and computed tomography. Sleep pattern and sleep quality were evaluated by Pittsburgh sleep quality index (PSQI) and polysomnography (PSG). All patients were reassessed 6 months after surgery.
Results: Nasal resistance decreased after the surgery ($p < 0.001$). Postoperative PSQI scores were significantly lower than preoperative scores ($p < 0.001$). The preoperative mean values of total apnea index and apnea-hypopnea index were 25.4 and 13.3, respectively. After surgery, the total apnea and apnea-hypopnea index had decreased significantly to 7.8 and 11.2, respectively ($p = 0.009$ and 0.019, respectively).
Conclusion: In patients with CRSwNP, functional endoscopic sinus surgery significantly ameliorates sleep pattern and sleep quality. CRSwNP may be a predisposing factor for sleep related respiratory disorders.

1. Introduction

Chronic rhinosinusitis with nasal polyps (CRSwNP) is a recurrent disease resulting in chronic inflammation of the nasal and paranasal sinus mucosa. Although a diagnosis of CRSwNP is made in 0.5–4% of the population [1,2], the etiology and pathogenesis of this disease remain unclear, and the protocol for treatment of patients with CRSwNP has not yet been precisely defined [3]. It is thus very important to investigate the effectiveness and effects of different treatment modalities on a patient's quality of life as there are as yet many unknown factors. The choice of patient-specific treatment may affect the quality of life and quality of sleep of patients with CRSwNP.

Obstructive sleep apnea syndrome (OSAS) is characterized by recurrent events of upper airway obstruction during sleep, resulting in hypoxemia, apnea and sleep fragmentation [4]. OSAS is mostly caused by functional and anatomic factors. Collapse of the pharynx is the most important functional factor, and the key anatomical feature is a reduction in diameter of the naso-oro-hypopharyngeal section [5]. The relationship between nasal obstruction and OSAS has not yet been fully defined. If a given patient has a nasal obstruction, then they have to employ oral breathing which narrows the upper airway and makes it more collapsible to inspiratory

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negative pressure [6]. Also, patients with CRSwNP have a two-fold higher risk of suffering sleep disturbance compared with controls [7]. Poor sleep quality has been observed in patients with chronic rhinosinusitis and was improved after sinus surgery [8]; however, sinus surgery did not improve polysomnographic findings in patients with CRSwNP but increased their score on the Epworth Sleepiness Scale (ESS) [9]. On the other hand, there is no report in the literature which simultaneously evaluates both polysomnography (PSG) and Pittsburgh Sleep Quality Index (PSQI) in patients with CRSwNP.

This study was conducted to evaluate the parameters of PSG and quality of sleep in patients with CRSwNP, to observe the changes in these parameters after functional endoscopic sinus surgery (FESS), and to discuss the possible pathophysiological effects on quality of sleep. To the best of our knowledge, this is the first study to evaluate the efficacy of FESS in patients with CRSwNP using subjective and objective parameters such as the PSQI and PSG.

2. Materials and methods

Between January 2009 and July 2011, 22 patients who were recently diagnosed with CRSwNP and who fulfilled the inclusion criteria were offered to participate in this study. All subjects gave their informed consent to participate. The study was performed according to the principles of the Declaration of Helsinki.

Adult patients aged between 20 and 60 years with a recent diagnosis of symptomatic bilateral nasal polyps having at least two of the following symptoms were eligible to participate: nasal obstruction (for a period not longer than 3 years), rhinorrhea with anterior or posterior nasal drip, hyposmia or anosmia. The diagnosis of CRSwNP was established by direct visualization via nasal endoscopy and confirmed by paranasal CT scanning.

The following criteria were used to exclude patients from this study: a history of severe systemic diseases such as asthma or diabetes, aspirin intolerance, previous sinonasal surgery, severe septal deviation, obesity, tongue base hypertrophy, or a Mallampati score of 3 or 4.

All participants had a complete otorhinolaryngological examination. Inspiratory nasal airway resistance was measured by rhinomanometry (Rhinometrics SRE 2000; Rhinometrics, Lynge, Denmark) at a pressure of 150 Pa for objective evaluation of nasal obstruction. All subjects also had PSQI evaluation on enrollment. PSQI is one of the most frequently used questionnaires to evaluate general sleep quality. The questionnaire is simple, validated, and reasonably quick and easy to administer. The self-administered questionnaire has nineteen individual items which are used to generate seven composite scores, to assess subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication and daytime dysfunction. In general, scores of greater than 5 represent "poor quality sleep" [10]. All subjects had a preoperative sleep study using polysomnography (PSG). Sleep parameters were recorded on a 32-channel PSG system (Embla N700; Flaga-Medcare, Reykjavik, Iceland) and included four electroencephalography channels (C3, C4, O1 and O2), electrooculogram, a chin electromyogram, electrocardiogram, oronasal airflow, finger pulse oximetry, tibialis anterior muscle activity and strain gauges for thoracoabdominal movements. PSGs were scored manually and blinded using criteria for sleep stages [11].

All patients with CRSwNP were treated medically for 6 months then operated. Subjects were given nasal lavage with saline and intranasal steroids (momethasone furoate 200 μg/day), starting at the time of diagnosis. All patients underwent FESS by the same procedure under general anesthesia. A microdebrider polypectomy (Xomed, Jacksonville, FL, USA) was followed by Messerklinger's technique. Patients continued to use momethasone furoate (200 μg/day) for 1 week after surgery. The preoperative evaluations (PSQI and PSG) on the patients were performed 1 week before surgery and repeated 6 months after surgery.

Statistical analyses were performed using SPSS v19.0 software for Mac (SPSS, Inc., Chicago, IL, USA). Parametric values were analysed using the paired samples *t*-test, and the Wilcoxon test was used for non-parametric values. Spearman's correlation test was used to analyze the correlations between two variables. Values of $p < 0.05$ were considered statistically significant.

3. Results

The data were collected from 22 patients (15 male 68%, 7 female 32%) with CRSwNP. Their mean age was 43.9 ± 13.9 years and mean BMI was 24.9 ± 1.65 (BMI_{min}: 21.7, BMI_{max}: 27.7) kg/m^2. Mean inspiratory nasal airway resistance at 150 Pa, measured by rhinomanometry, was 0.45 ± 0.03 Pa/cm^3/s preoperatively, and after surgery, this had decreased significantly to 0.31 ± 0.02 Pa/cm^3/s ($p < 0.001$) (Table 1).

The PSQI scores were significantly higher in patients before surgery (5.55 ± 3.07) than in patients 6 months after surgery (3.18 ± 2.97) ($p < 0.001$). Additionally, PSQI subdomains such as daytime dysfunction, sleep disturbance and sleep quality scores improved significantly after FESS ($p = 0.003$, $p = 0.001$, $p < 0.001$, respectively). Mean Apnea/Hypopnea Index (AHI) scores decreased significantly ($p = 0.019$) in the postoperative period (preoperatively, 13.32 ± 14.96; postoperatively 11.21 ± 15.66). The total number of preoperative apnea episodes was 25.41 ± 69.49, and the postoperative value decreased to 7.77 ± 13.88 ($p = 0.009$). However, the total number of hypopnea episodes did not change postoperatively (preoperative: 60.14 ± 54.36, postoperative: 67.09 ± 98.07, $p = 0.673$). Minimum oxygen (O_2) saturation improved significantly ($p = 0.007$) from $86.77 \pm 5.65\%$ to $89.05 \pm 5.76\%$ after surgery. N1, N2, N3 and REM sleep stages, and total sleep time, shown in Table 1, did not differ significantly between pre- and postoperative values ($p = 0.783$, $p = 0.069$, $p = 0.079$, $p = 0.119$, $p = 0.306$ respectively). On the other hand, an increase in the ratios of N3 and REM sleep stages was noted ($45.98 \pm 15.11\% \rightarrow 52.7 \pm 9.52\%$; $14.91 \pm 6.73\% \rightarrow 17 \pm 7.40\%$, respectively). There was a significant and strong correlation between pre- and postopera-

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