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Does drug-induced sleep endoscopy predict surgical success of limited palatal muscle resection in patients with obstructive sleep apnea?

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ABSTRACT

Objective: The aims of this study were to determine the associated factors affecting the success rate of limited palatal muscle resection (LPMR), and to investigate whether drug-induced sleep endoscopy (DISE) could predict the therapeutic response to LPMR in patients with obstructive sleep apnea obstructive sleep apnea (OSA).

Methods: Twenty-one consecutive OSA patients underwent LPMR were enrolled. All patients received routine ENT examination, preoperative DISE, and polysomnography (PSG). Clinical, polysomnographic, cephalometric variables, and DISE findings were evaluated. The measurements were related to the success or failure of LPMR based on the results of preoperative and postoperative PSG.

Results: The overall success rate of LPMR was 66.6%. Postoperative AHI and minimal oxygen saturation were significantly decreased after LPMR ($p < 0.001$). Comparison between success and failure groups revealed no significant differences in BMI, Friedman stage, preoperative AHI, minimal oxygen saturation, and all cephalometric parameters. However, the success of LPMR was significantly correlated with site, degree, and configuration of obstruction in DISE. In the velopharynx, complete obstruction ($p = 0.006$) with anterolateral or concentric pattern ($p = 0.044$) had significantly better success rate than partial obstruction with lateral pattern.

Conclusion: DISE was only predictive method for identifying the success in OSA patients undergoing LPMR. Patients with anteroposterior or concentric total obstruction in the velopharynx might be suitable candidate for LPMR.

1. Introduction

Obstructive sleep apnea (OSA) is characterized by a repeated episodes of complete or partial upper airway obstruction during sleep, narrowing the pathway for airflow and causing periods with reduction or cessation of airflow causing decreased oxygen saturation, sleep fragmentation, and

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excessive daytime sleepiness [1,2]. This breathing disorder is a result of abnormal anatomy superimposed on physiological or excessive reduction of muscle tone during sleep [3]. Although positive airway pressure (PAP) is the preferred treatment for patients with OSA, numerous patients cannot or are unwilling to use long-term PAP therapy and, therefore, seek surgical treatment to alleviate the symptoms of OSA [4].

TThe ultimate goal of surgical treatment for OSA is to improve symptoms and decrease cardiovascular morbidity and mortality by correcting anatomic obstruction and decreasing pharyngeal collapsibility [5]. Although uvulopalatopharyngoplasty (UPPP) is the most common surgical treatment [6], the long-term success rate of UPPP is <50% [7,8]. Furthermore, UPPP has been associated with complications such as velopharyngeal insufficiency and nasopharyngeal stenosis [9]. Therefore, many modifications of UPPP have been proposed to contend with anatomical variations of the pharynx and minimize morbidities [10–14]. In a recent study, limited palatal muscle resection (LPMR), a modified technique of UPPP, showed significant improvement regardless of tonsil size in subjective and objective outcomes of OSA patients with normal postoperative pharyngeal function [15].

Identification of precise upper airway obstruction site is vital to attain site-specific treatment and thus better surgical treatment outcomes. Drug-induced sleep endoscopy (DISE) is a reliable method for identifying the sites of obstruction in patients with OSA. The validity and reliability of this technique have been reported in several studies [16–19]. However, there are little data in regard to the clinical, polysomnographic, and DISE parameters that could affect the efficacy and outcome of LPMR.

Therefore, the aims of this study were to determine the associated factors affecting the success rate of LPMR, and to investigate whether DISE findings could predict the therapeutic response to LPMR in patients with OSA.

2. Subjects and methods

2.1. Patient selection

This prospective, non-randomized study was conducted from March 2016 to June 2016 with the approval of the Institutional Review Board of Pusan National University Hospital.

2.1.1. Inclusion criteria

They must have experienced one or more of the following clinical symptoms of snoring, morning headaches, tiredness, daytime sleepiness attributed to OSA, and an apnea–hypopnea index (AHI) score greater than 5 events per hour. Full-night PSG (Embla N7000, Embla Systems, Broomfield, CO) was performed in all patients before and at six months after operation. All patients failed to respond to conservative treatments, such as weight loss, diet, physical exercise, positional therapy, avoidance of sedatives, and were either intolerant or unwilling to use PAP.

2.1.2. Exclusion criteria

Subjects older than 65 years, morbid obesity [body mass index (BMI) >35 kg/m^2], gross maxillary and mandibular deformities (mainly retrognathia) by the lateral cephalometry, macroglossia, and suggested presence of hypopharyngeal narrowing during midazolam-induced sleep endoscopy were excluded. Macroglossia was determined by the Friedman tongue position IV allowing the visualization of the hard palate only, and hypopharyngeal narrowing was defined by complete obstruction of the hypopharynx and a portion of the oropharynx posterior to the tongue.

2.2. Cephalometric analysis

The patients were seated in the natural head position at the end-expiration phase and were instructed not to swallow. The landmarks and reference lines for conventional cephalometric analysis have been defined previously [20]. Variables analyzed included the distance between the posterior nasal spine and the tip of the soft palate (PNS-P), the space between the base of the tongue and the posterior pharyngeal wall (PAS), and the distance from mandibular plane to the hyoid bone (MP-H).

2.3. DISE

DISE was performed by the same ENT surgeon in a semi-dark and silent operating room with each patient lying supine. Sleep was induced by intravenous administration of midazolam with respiratory monitoring.

The anesthesiologist titrated the drug slowly to 0.07 mg/kg per patient; boluses of 1–2.5 mg were given (to a maximum of 7.5 mg per patient) using a target-controlled infusion system. Once the patient was deeply asleep (sufficiently to snore, show obstructions, and respond sluggishly to a light glabella or loud auditory stimulus: Ramsay's level of sedation scale 5) [21], a 4 mm-diameter flexible video laryngoscope was introduced gently through the nose. Video images of all DISE procedures were later evaluated by a single otolaryngologist (S.K.), blinded to patient identity, to minimize inter-rater variation and the bias of similar scoring due to case familiarity [22]. The DISE findings were characterized using the VOTE classification for sites, degree, and configuration of the obstruction [23].

2.4. LPMR

We have previously described the LPMR procedure [15]. Briefly, the patient was placed in the supine position and operative exposure was obtained with a Dingman mouth gag (Pilling Instrument CO., Philadelphia, PA). The LPMR was initiated with a bilateral tonsillectomy in patients with tonsil size 2 and 3. Tonsillectomy was not performed in patients with tonsil size 1. The areas to be surgically excised were injected with small amounts of epinephrine (1:100,000) solutions. Oval shaped incision was designed using the monopolar electrocautery with a fine needle tip. The boundaries of resection were as follows: superior margin was 2 cm posterior to the hard–soft palate junction, inferior margin was the base of the uvula, and lateral margin was the superior extension of an imaginary line

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