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Changes occurring in mucosal contractility of the inferior turbinate and mucociliary clearance following total laryngectomy: A prospective clinical trial

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ABSTRACT

Objective: In this study, changes occurring in the contractility capacity of the inferior turbinate and mucociliary clearance time due to the interruption of nasal air flow were examined.
Material & methods: A total of 23 patients undergone total laryngectomy between June 2010 and June 2012 were included in the study. Acoustic rhinometry test was performed in the patients before and after 0.05% oxymetazoline nasal topical decongestant administration. In addition, saccharin test was applied in order to measure mucociliary clearance. The same measurements were repeated at the postoperative months 1, 6 and 12 and the data obtained were statistically compared.
Results: In evaluation of the patients' contractility capacity at MCA-1 and MCA-2, contractility capacity was found to be significantly decreased from the postoperative first month compared to the preoperative values. The contractility capacity at the postoperative 6th month was significantly lower than that of the postoperative first month. The contractility capacity at the postoperative 12th month was significantly lower than that of the postoperative 6th month.

Mucociliary clearance time did not change significantly at the postoperative first month compared to the preoperative value, while this value was significantly decreased at the postoperative 6th month. No statistically significant difference was observed in mucociliary clearance between the postoperative 6th and 12th months.
Conclusion: Contractility capacity of the inferior turbinate decrease over time in patients undergoing total laryngectomy. This indicates that the dysfunction developing in the nasal mucosal structure in the chronical absence of nasal air flow may be resulted from the decreased choncal contractility.

1. Introduction

Patients undergoing laryngectomy because of larynx and hypopharynx cancers develop great physical and emotional changes. Total laryngectomy leads to the impairment of the nasopharyngeal and respiratory airway integrity. Therefore, the nose in these patients losses its functions such as breathing air, moisturizing, heating and sense of smell [1].

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The complete interruption of nasal air flow results in physiological, histological and cytological changes in the nasal mucosa. Patients who have undergone laryngectomy are proper models for the studies of totally interrupted nasal air flow [2]. In the literature, patients undergoing total laryngectomy have been widely included in the studies evaluating mucosal structural changes, nasal cycle and mucociliary transport that develop as a result of the complete interruption of nasal air flow, as they are proper models for these studies [2].

After total laryngectomy, nasal mucosa (atrophy) becomes thinner and color paling occurs over time due to the nasal obstruction or decreased air flow [3]. In addition, following the interruption of nasal air flow, blood flow in the nasal mucosa decreases, senses of smell and taste impair and mucociliary transport and nasal flora become disrupted [3]. In addition to nasal physiology, nasal cytology also changes following laryngectomy with the ciliated columnar epithelium transforming to squamous epithelium in the nasal cavity due to the aspiration of irritating agents in the absence of nasal air flow [4]. Again cellular elements are decreased in the nasal mucosa from the six month with atropies observed in the epithelium [5].

Mucociliary clearance is an important defence mechanism of respiratory tract. Mucociliary clearance provides the cleaning of foreign particles from the respiratory system mucosa and allows to keep the mucosal surface moist and clean. This combined effect of the mucus and ciliary system can be evaluated through measuring mucociliary clearance. Mucociliary clearance can be estimated by measuring the elimination time of aerosols inhaled [6] Saccharin test is among the methods using for the measurement of mucociliary clearance [7].

Acoustic rhinometry is one of the objective methods using for the evaluation of nasal congestion. In addition, this method is also used for measuring of the congestional changes in the nasal mucosa. Acoustic rhinometry gives information about the anatomy of the nasal cavity through 2 dimensional views [8].

The inferior turbinate has mucosal contractility feature owing its sensorial and vascular nature. It features the regulation of nasal air flow, moisturizing and heating air through its mucosal contractility property [9]. Functional disruptions may occur in the mucosa of the inferior turbinate after total laryngectomy due to the interruption of nasal air flow.

The primary objective of this study is to examine the change occurring in the contractility capacity of the nasal mucosa because of the interruption of nasal air flow after laryngectomy. The secondary objective is to investigate effect of the possible changes that may occur in the contractility capacity of the inferior turbinate on mucociliary function.

2. Material and methods

The study was initiated after receiving approval from the clinical research local ethics committee of our university. A total of 23 patients undergone total laryngectomy between June 2010 and June 2012 were included in the study. All the participants were smokers. Patients with sinonasal pathologies (allergic rhinitis, chronic sinusitis, nasal polyps, sinonasal tumor etc.), systemic disease, those have received radiotherapy and patients with previous nasal surgery were excluded from the study. Patients preoperatively received anterior rhinoscopy and nasal endoscopy in order to confirm absence of any pathology. Patients were informed about the procedure to be performed and gave verbal and written consents. After the patients were acclimatized to the setting for 20 min, first nasal mucociliary time was measured with saccharin test. Then acoustic rhinometric evaluation was performed. Acoustic rhinometry and mucociliary clearance measurements were carried out preoperation and at postoperative months 1, 6 and 12.

2.1. Acoustic rhinometry

Acoustic rhinometry (Acoustic Rhinometer A1; GM Instruments Ltd., Kilwinning, Scotland) was performed in accordance with the standards described and recommended by the standardization committee [8].

The anatomic nasal adaptor for AR was then applied to the patient's nose. When necessary, an ultrasound gel was also applied to prevent leakage. The patients were asked to hold their breath during the measurements. The mean value of three measurement curves was calculated. Acoustic rhinometric measurements of patients were performed before and 15 min after 0.05% oxymetazoline nasal topical decongestant application (2 puffs in each nostril). The minimal cross-sectional area (MCA1) within the first 2 cm from the portal of the nose (MCA1) and the minimal cross-sectional area between 2 cm and 5 cm (MCA2) measured. MCA data were recorded and 0.05% oxymetazoline spray was applied as in each nostril as two puffs. Acoustic rhinometry was repeated at 15 min after 0.05% oxymetazoline spray application. MCA data were recorded. The same procedures were performed in each patients at the postoperative months 1, 6 and 12 and the results were compared.

2.2. Contractility capacity of the mucosa

Nasal mucosal contractility capacity is the measurement of change between before and after decongectant administration. In this study, a formula was created in order to evaluate the contractility capacity through acoustic rhinometry which is an objective rhinologic measurement methods. This formula is based on the percentage change between the parameters measured before and after decongestant.

$$\text{Acoustic Rhinometry Contractility Index}(\%) = \left\{\frac{\text{Value} - \text{Dec}(+)}{\text{Value} - \text{Dec}(-)} \times 100\right\} - 100$$

2.3. Mucociliary clearance

Mucociliary clearance was measured at room temperature. First, secretions of the patients were aspirated. A 1/4 tablet of saccharin (1 × 1 × 1 mm) was put on the medial surface at 1 cm posterior of the head of the inferior turbinate of patients with head upright position and time was kept. The patients were asked not to sneeze, sniffle, blow theirs noses or tilt their heads. Patients were told to gulp once in 15 s and the time was stopped

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