Olfactory function after total laryngectomy

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Objective
The aim of this study was to assess the olfactory function in patients who underwent total laryngectomy.
Patients and methods
Olfactory function assessment using the Scandinavian Odor Identification Test was carried out in 32 patients who had undergone total laryngectomy and were being followed up in Kasr El Aini ENT Outpatient Clinic.
Results
The studied cases included both men (59%) and women (41%). Their ages ranged from 50 to 70 years. The duration between operation and olfactory assessment ranged from 4.5 to 15.5 months. Results showed 75% incidence for anosmia and 25% incidence for hyposmia. Both age and sex did not correlate with either pattern of olfactory loss. The mean duration between operation and olfactory assessment was statistically significantly different between those who developed hyposmia and those who developed anosmia, being longer in the latter group. There was also a linear relation between the number of odors that could be smelled and postoperative duration. The longer the duration, the fewer the number of odors that could be smelled. The study reviewed similar studies and discussed suggested explanations.
Conclusion
The study also recommended preoperative olfactory assessment as well as postoperative olfactory rehabilitation for such patients.

Keywords:
anosmia, hyposmia, olfactory function, Scandinavian Odor Identification Test, total laryngectomy

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Introduction

Sense of smell provides people with valuable input from the surrounding environment, which is important for their food, drink, and security needs [1]. Smell disorders can affect their food and fluid intake, which may cause weight loss, dehydration, and overconsumption of salty or sweet food items, aggravating, hypertension, and diabetes mellitus. Inhalation of toxic fumes or ingestion of spoiled food can be life threatening [2]. Olfactory disorders are quantitative, such as anosmia, hyposmia, and hyperosmia, or qualitative, such as cacosmia and phantosmia [1]. Common causes for olfactory disorders are very similar to those causing conductive and sensorineural deafness [3]. Many recent studies reported post-total laryngectomy olfactory disorders to be common. Van Dam *et al.*[4] and Welge-Luessen *et al.*[5] recorded 67 and 72% incidence for anosmia. The suggested explanations included decreased air volume because of discontinuation of upper and lower air columns following total laryngectomy, thus reducing the number of odor molecules transported to the olfactory epithelium [6]. Epithelial degeneration of olfactory mucosa that commonly follows the operation could also be a major cause of olfactory loss in such patients [7].

Materials and methods

Thirty-two patients who underwent total laryngectomy were recruited into this study. Patients were randomly selected from Kasr Al Aini ENT Outpatient Clinic from March to June 2014. The study was approved by the committee of ethics and research related to the Otolaryngology Head and Neck Surgery Department in Cairo University. Informed consent was taken from each patient after a detailed explanation about the study had been given and patient data confidentiality had been assured. All patients were subjected to history taking with emphasis on time of operation and preoperative olfactory state. Only those with normal preoperative olfaction were recruited for the study. Anterior rhinoscopy and nasal endoscopy were performed on all patients to assess the patency of the nasal airway to ensure that the airflow access to the olfactory neuroepithelium was adequate.

Assessment of olfaction

Olfaction was tested with the Scandinavian Odor Identification Test, which includes 16 odors. The Scandinavian Odor Identification Test odors are pine-needle, peppermint, juniper berry, violet, anise, clove, vanilla, almond (bitter), orange, cinnamon, lemon, lilac, vinegar, tar, ammonia, and apple, with no time limit for answering. These 16 odorous test stimuli were relatively identifiable, familiar, strong in intensity, and pleasant according to healthy participants. The odors used in this study consisted of 5 ml of odor stimulus placed in a glass jar. Each 5 ml of the stimulus (odor) was placed in an amber glass jar and presented 1–2 cm under the participant's nose for as long as required to accomplish the set of tasks. The patient was asked to name each odor and responses were collected for the 16 odors. There was a 30-s interstimulus interval to limit the effects of adaptation/habituation. The stimuli were presented in a well-ventilated room at room temperature. The test has age-related and sex-related cutoff scores. According to the results of the test as well as the age, patients were categorized as having normosmia, hyposmia, or anosmia, as shown in Table 1[8].

Statistical analysis

Data were described in terms of mean ± SD and frequencies. Comparison of numerical variables between the two study groups was performed using the Student *t*-test for independent samples when the data were normally distributed and the Mann–Whitney *U*-test for independent samples when the data were not normally distributed. The χ^2-test was performed for comparing two sets of categorical data. The exact test was used when the expected frequency was less than 5. *P* values less than 0.05 were considered statistically significant. All statistical calculations were performed using statistical package for the social sciences (SPSS, version 15 for Microsoft Windows; SPSS Inc., Chicago, Illinois, USA).

Results

The studied cases ranged between 50 and 75 years of age, with a mean ± SD of 58.84 ± 6.37. Men constituted 59% and women 41% of the sample. The duration (months) between operation and olfactory assessment ranged from 4 to 15 months, with a mean ± SD of 10.9 ± 2.9. Olfactory assessment of the sample showed 75% incidence for anosmia and 25% for hyposmia. Using the Fisher exact test it was found that sex had no significant influence on the pattern of olfactory dysfunction ($P=0.68$). Similarly, age of the patients was not statistically related to the pattern of olfactory dysfunction on using the unpaired sample *t*-test.

The duration after surgery had a significant role in the frequency of pattern of olfactory loss. Hyposmia was more common at an earlier period after the operation and anosmia was more prevalent at longer periods. The impact of postoperative time on olfactory loss pattern was evident upon assessment of the linear relation between the time since the operation (months) versus the number of odors that could be smelled using the Pearson correlation coefficient ($P=0.001$; $r=-0.948$). The assessment revealed statistically significant evidence that the number of odors that could be smelled decreased with the passage of time after surgery, as shown in Fig. 1.

Table 1 Scandinavian Odor Identification Test age and sex cutoff scores

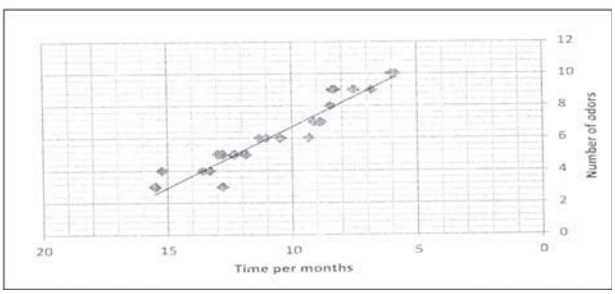
Age (years)	Normosmia	Hyposmia	Anosmia
15–34	13–16	10–12	<9
35–54	12–16	9–11/10–11[a]	<8/<9[a]
55–74	11–16	8–10	≤7

[a]Men/women.

Discussion

Olfactory loss following total laryngectomy was evident in this study, reporting an incidence of 75% for anosmia and 25% for hyposmia. Welge-Luessen *et al.*[5] reported 72% incidence for anosmia and 28% for hyposmia, whereas Risberg-Berlin *et al.*[9] reported 58 and 17% incidence, respectively. Another important finding in our study revealed that the longer the time after total laryngectomy the greater the olfaction impairment ($P<0.001$). Sinkiewicz *et al.* [10] studied 59 postlaryngectomized patients and reported a similar finding. Jin *et al.*[11] reported in their study including 60 patients that longer time after total laryngectomy leads to less remaining olfaction.

Figure 1



Scatter plot. *X* axis, number of odors smelled; *Y* axis, time after operation.

The explanation postulated was that total laryngectomy results in disconnection between the upper and lower airways with breathing taking place through the permanent tracheostome and consequently the natural orthonasal airflow will be considerably decreased or totally missing [7], and as the olfactory acuity is regarded a function of the nasal airflow the reduction in nasal airflow is considered a key contributing factor to impaired olfaction following total laryngectomy [12]. Such a theory is supported by the fact that when nasal airflow, resembling natural breathing and sniffing, is re-established using puffs of air from squeeze bottles [13] or prosthetic devices such as larynx bypass that reconnects the nose and lungs [14], improvement in olfactory acuity is evident. However, examination of the olfactory mucosa in laryngectomized patients has shown various degrees of epithelial degeneration. Therefore, Miani *et al.*[7] concluded that it is the combination of loss of nasal airflow and degeneration of the epithelium that leads to olfactory loss in patients after total laryngectomy.

The literature reported many methods to restore olfaction after total laryngectomy, including prosthetic devices such as nipple tube described by Bosone [15], oral tracheal breathing tube introduced by Knudson and Williams [16], and larynx bypass introduced by Schwartz *et al.* [14]. All of these maneuvers aim to bypass the larynx to re-establish orthonasal airflow between the nose and the tracheal tree. The polite yawning technique developed by Hilgers *et al.*[17] as a rehabilitation technique creates a negative pressure in the oral cavity and oropharynx to induce orthonasal airflow, thus enabling odorous substances to reach the olfactory epithelium.

Conclusion

The study confirms the prevalence of olfactory loss following total laryngectomy and recommends preoperative olfactory assessment and postoperative olfactory rehabilitation for such patients to restore their sense of smell. Olfaction worsens as more time passes after total laryngectomy.

Conflicts of interest

None declared.

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