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MAIN ARTICLE

Endoscopy findings affect subjective smell rehabilitation in post-laryngectomy patients using the nasal airflow-inducing manoeuvre

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Abstract

Objective: To evaluate the characteristics of post-laryngectomy patients, including nasal endoscopy findings, that affect subjective smell improvement in the post-surgical period.

Methods: Thirty patients who had undergone total laryngectomy participated in at least three sessions of a smell rehabilitation programme involving the nasal airflow-inducing manoeuvre, under the supervision of a speech-language pathologist. Patient characteristics and nasal endoscopy findings were evaluated.

Results: Participants experienced a mean improvement in sense of smell of 61 per cent ($p < 0.001$) and a significant improvement in appetite ($p = 0.002$). Male patients and patients with a nasal discharge had a significantly better outcome.

Conclusion: The nasal airflow-inducing manoeuvre is an effective method for improving smell perception and appetite in laryngectomy patients. There was no relationship between nasal endoscopy findings and outcome of the nasal airflow-inducing manoeuvre rehabilitation programme in our case series.

Key words: Laryngectomy; Endoscopy; Sense of Smell; Yawning

Introduction

Laryngeal cancer is a common head and neck cancer. Despite the widespread use of organ preservation methods in laryngeal cancer treatment, total laryngectomy is common. Patient quality of life after surgery is the major concern of most surgeons. The most common factor affecting post-operative quality of life is voice loss.[1,2] However, recent studies have revealed the importance of loss of smell in post-laryngectomy life satisfaction.[2–5]

Separation of the airway passage from the nose prevents odorous particles reaching the olfactory cleft, leading to deterioration in the sense of smell and taste.[1–8] Olfactory epithelial damage is also reported to be a consequence of laryngectomy,[1,3,6,7,9] although this is controversial.[10] Much effort has been put into overcoming this problem,[4,5,11] but most attempts have been unsuccessful.[12] In 2000, Hilgers *et al*. reported a nasal airflow-inducing manoeuvre that aimed to solve this problem, and had a noticeable success rate.[9] Since then, other researchers have adopted the nasal airflow-inducing manoeuvre, with varying success.[11,13–15]

Despite the efficiency of this technique in improving patient quality of life after laryngectomy, the effect of different nasal variables on the outcome of this procedure and on outcome stability are unclear.[16] However, nasal endoscopy findings such as non-use rhinitis can be considered probable effective factors.[1,6] Changes in appetite and taste perception after rehabilitation manoeuvres were also considered. These outcomes have not been adequately addressed in previous studies.

Methods

Participants

The study was conducted in Imam Khomeini Complex Hospital, Tehran, between March 2008 and June 2010. Thirty patients who had undergone total laryngectomy, had a normal sense of smell before surgery and agreed to participate in the rehabilitation programme were recruited at least six months after completion of treatment. Exclusion criteria were a history of head trauma or psychological problems, and no or frequent use of drugs that interfere with the sense of smell. Three patients did not take part in the rehabilitation

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programme: one because of recurrence, one because of general health issues (congenital anosmia) and one because of lack of motivation.

Ethical approval

The study protocol was approved by the Institutional Review Board of Tehran University of Medical Sciences. All participants gave written informed consent. The study was conducted in accordance with the Declaration of Helsinki.

Tests and outcome evaluation

Demographic data, the date of total laryngectomy surgery, and history of radiotherapy or other adjuvant treatment were recorded. Nasal endoscopy characteristics of all participants were evaluated by the same method before the start of the smell rehabilitation programme. Data were collected through patient interviews and from patient records by a single researcher using a similar method.

All nasal endoscopies were performed using a 30° rigid endoscope (Karl Störz, Tuttlingen, Germany) with a 4 mm diameter. Before nasal endoscopy, cotton pledgets soaked in 10 per cent lidocaine and 0.5 per cent phenylephrine were placed in the nose for 10 minutes to anaesthetise and shrink the tissues.

Patients were divided into three groups according to their nasal mucosa status: hypertrophic, polypoid or atrophic. Nasal septum deviation or other anatomical variations were documented, and the presence of discharge or secretion was recorded. Furthermore, smell, gustatory and appetite status and associated symptoms were evaluated before treatment and after three sessions of the nasal airflow-inducing manoeuvre. These were classified into four categories by comparing pre- and post-operative self-assessed status: 1 = no change; 2 = mild change; 3 = moderate change; and 4 = severe change. To provide a better assessment, patients scored their sense of smell before intervention and at the end of the smell rehabilitation programme using a visual analogue scale (VAS), in which 0 = complete anosmia and 100 = normal sense of smell.

Procedures

All patients participated in three sessions of the nasal airflow-inducing manoeuvre procedure under the supervision of a speech-language pathologist.

The aim of the nasal airflow-inducing manoeuvre is to create reverse airflow through the nose by relaxing the oral cavity and oropharynx (i.e. an extended 'polite yawning' technique). To achieve this, patients were instructed to perform an extended yawn while simultaneously decreasing the pressure in the oral cavity and oropharynx to allow the airflow to reach the post-nasal area and olfactory cleft.[9,13] Biofeedback via a water manometer or similar apparatus was not used in this study. Each session lasted for at least 1 hour and continued until the patient could perform the manoeuvre efficiently.

Statistical analysis

Data were analysed using SPSS version 11.5 for Windows (SPSS Inc., Chicago, Illinois, USA). The chi-square test was used to compare ratios, and ANOVA and the Student's *t*-test were used to compare mean values. The Spearman coefficient was used to evaluate correlations among variables. The sample effect size was calculated to be 30 patients based on Cronbach's $\alpha = 0.05$, Cohen's $d = 1.12$, and $p = 0.87$. Values were calculated using descriptive statistical methods and presented as mean ± standard deviation. Statistical significance was set at $p < 0.05$.

Results

Of the 30 patients recruited, 3 (10 per cent) were female and 27 (90 per cent) were male. The mean age was 63.5 ± 9 years and the mean interval between laryngectomy and the start of the rehabilitation programme was 14.2 ± 3.6 months. In addition, 18 (60 per cent) patients had a history of radiotherapy in the course of their cancer treatment, with a mean period after radiotherapy of 22 ± 7.8 months.

Mean VAS scores for smell perception were 39.6 ± 29.4 and 63.8 ± 20.8 before and after the intervention, respectively, which represents a significant change (*t*-test, $p < 0.001$). Group analysis revealed that sense of smell and appetite status changed significantly after the intervention. However, the same was not true for taste. Pre- and post-intervention scores for smell, taste and appetite are shown in Table I. Analysis of the change in smell perception before and after intervention demonstrated that patients with a severe sense of smell disturbance benefited most from

TABLE I
PRE- AND POST-INTERVENTION VAS SCORES FOR SMELL, TASTE AND APPETITE

Variable	Evaluation time	Patient evaluation (*n* (%))				*p* value
		No change	Mild change	Moderate change	Severe change	
Sense of smell	Before intervention	1 (3.3)	10 (33.3)	5 (16.7)	14 (46.7)	<0.001*
	After intervention	5 (16.7)	16 (54.3)	9 (30.0)	–	
Sense of taste	Before intervention	8 (26.7)	8 (26.7)	7 (23.3)	4 (13.3)	0.15
	After intervention	13 (43.3)	10 (33.3)	5 (16.7)	2 (6.7)	
Appetite	Before intervention	16 (53.3)	2 (6.7)	8 (26.7)	4 (13.3)	0.002*
	After intervention	15 (50)	12 (40)	3 (10.0)	–	

*Statistically significant. VAS = visual analogue scale

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TABLE II
CHANGES IN SMELL AND TASTE ACCORDING TO PRE-INTERVENTION VAS EVALUATION

Variable	Pre-intervention evaluation	Mean change	*p* value
Smell	No change	0	0.003*
	Mild change	12.7 ± 10	
	Moderate change	10 ± 5	
	Severe change	35.4 ± 17.6	
Taste	No change	12.5 ± 9.6	0.308
	Mild change	19.3 ± 12.4	
	Moderate change	27.8 ± 20.4	
	Severe change	33.3 ± 25	

*Statistically significant. VAS = visual analogue scale

the nasal airflow-inducing manoeuvre (ANOVA test; summarised in Table II).

We next aimed to define factors that could influence the outcome of the nasal airflow-inducing manoeuvre in our study population. First, we noted a significant difference in the average sense of smell improvement between males and females (25.7 ± 19.1 and 13.3 ± 5.8, respectively; *t*-test, $p = 0.04$). However, only three female patients were included in this study. In contrast, there was no significant effect of age (Spearman rank-order correlation coefficient, $\rho = 0.068$, $p = 0.77$). Evaluation of patient symptoms before the study showed that those with a history of rhinorrhoea had a significantly better sense of smell outcome. The average improvement in rhinorrhoea and non-rhinorrhoea groups was 32.9 ± 13 and 18.7 ± 12.9, respectively (*t*-test, $p = 0.045$). All patients also underwent nasal endoscopy (findings summarised in Table III). However, none of these factors had a significant effect on smell improvement after nasal airflow-inducing manoeuvre rehabilitation (by *t*-test). Sense of smell changes in patients with polyps and anatomical abnormalities are shown in Table IV.

Finally, there was no significant correlation between outcome and history of radiotherapy or length of the interval between surgery or radiotherapy and taking part in the smell rehabilitation programme.

Discussion

Removal of the larynx, which forms a standard part of laryngectomy, and subsequent re-direction of the airway may not only cause voice loss but may also affect the sense of smell.[1] There have been many attempts to improve patients' ability to speak after laryngectomy. However, researchers are now aiming to improve the sense of smell because of its impact on quality of life.[3] Attempts to solve this problem had varying success rates[4,5] before the introduction of the nasal airflow-inducing manoeuvre by Hilgers *et al.*[9] This technique has now been widely adopted. However, the effect of patient characteristics on nasal airflow-inducing manoeuvre outcome is unclear. In particular, nasal endoscopy findings of non-use rhinitis and other nasal endoscopy characteristics can be considered probable effective factors.[1,6]

TABLE III
NASAL ENDOSCOPY FINDINGS

Endoscopy finding	Patients (*n* (%))
Polypoid tissue	4 (13.3)
Mucosal hypertrophy	6 (20)
Mucosal atrophy	11 (36.7)
Anatomical abnormality	2 (6.7)

TABLE IV
SMELL IMPROVEMENT IN PATIENTS WITH POLYPS AND ANATOMICAL ABNORMALITIES

Type of abnormality	Smell improvement (VAS score)		*p* value
	With abnormality	Without abnormality	
Polypoid tissue	28.7 ± 11.7	23 ± 18.2	0.60
Anatomical	27.5 ± 21.8	23.9 ± 17.9	0.79

VAS = visual analogue scale

In our case series, patients experienced an average overall improvement of 24.2 ± 18.1, representing a 61 per cent improvement over the pre-intervention status. These results are comparable with other case series, suggesting that sense of smell deficits after laryngectomy are reversible and that the nasal airflow-inducing manoeuvre can benefit many patients.[13,15,17] The non-surgical rehabilitation method used in this case series, performed under the supervision of a speech pathologist, was considered by Ward *et al.* to be the most effective method.[13] However, unlike Hilgers *et al.*, we did not use biofeedback with a water manometer or a similar apparatus.[9] Instead, our patients participated in three rehabilitation sessions.

Similar to other case series, demographic characteristics (except for sex) had no significant effect on rehabilitation outcome.[18] The reason that male participants achieved better results in nasal airflow-inducing manoeuvre may be related to our small sample size and the small number of female participants. In addition, despite the destructive effect of radiotherapy on the olfactory system and the widespread use of this modality as an adjuvant treatment, it had no significant effect on rehabilitation outcome. Furthermore, patients experienced improved appetite after rehabilitation, which can be explained by the smell of food acting as an appetite stimulant. However, changes in gustatory function were not significant ($p = 0.308$). Hilgers *et al.* suggested that most patients use the retronasal route for tasting and, therefore, that the nasal airflow-inducing manoeuvre may have little effect on this sensation.[9]

The only symptom that significantly affected the outcome of the nasal airflow-inducing manoeuvre was rhinorrhoea, possibly because rhinorrhoea is a common finding in the early post-laryngectomy period.[19] Considering that olfactory epithelial damage

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is likely to impede smell rehabilitation,[7] this symptom may be a prognostic factor for success.

- **The nasal airflow-inducing manoeuvre is an effective tool for smell rehabilitation in laryngectomy patients**
- **It has a beneficial effect on appetite**
- **Rhinorrhoea is a good predictor of a positive response**

We also observed a significantly greater improvement in smell perception in patients who had a poorer sense of smell in the pre-intervention evaluation. Fuji and colleagues made the same observation in their study, and concluded that some laryngectomy patients achieve a better sense of smell through adopting retronasal smelling. Therefore, patients who have completely lost their sense of smell may benefit more from the nasal airflow-inducing manoeuvre.[8,10] However, we did not find a significant relationship between the smell rehabilitation programme outcome and other nasal endoscopy findings. This could result from our small sample size or from differences in endoscopy findings for non-use rhinitis and neuroepithelial changes to the olfactory cleft, as claimed by Miani *et al*.[6] Further studies with larger sample sizes are therefore needed to identify the effective elements of the nasal airflow-inducing manoeuvre.

Conclusion

The nasal airflow-inducing manoeuvre technique is a user-friendly method for improving the sense of smell, and consequently the appetite, of laryngectomy patients. We found no significant relationship between different nasal endoscopy characteristics and nasal airflow-inducing manoeuvre outcome in our case series.

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