

HISTOLOGICAL AND RADIOLOGICAL EFFECTS OF TOTAL LARYNGECTOMY ON UPPER AIRWAY

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SUMMARY : *In this study it was investigated whether abolished nasal airflow effected the nasal mucosal structure or paranasal sinuses in laryngectomised patients. At first, nasal mucosal biopsies were taken from 10 subjects preoperatively, and 17 subjects postoperativeley in succession and secondly paranasal sinuses were examined using plain x - ray films in occipitomenal (or Water's) and occipitofrontal (or Caldwell) projections on 12 patients.*

All histological parameters except fibrosis and inflammatory cell reaction significantly differed between preoperative and postoperative specimens, and there appeared to be an obvious negative correlation between the duration after operation and number of layers of pseudostratification (NLPS), and a very high correlation between NLPS and number of capillary vessels (NCV).

In radiological evaluation of the paranasal sinuses, no important changes were ascertained.

Therefore, it is concluded that abolished nasal air current has a role on histologic patterns of masal mucosa and this effect becomes more apparent in time. But, these changes are not so drastic to create pathological conditions.

Key Words : *Total Laryngectomy, Nasal Mucosa*

INTRODUCTION

The respiratory membrane of the nose consists of a pseudo-stratified columnar epithelium resting on a basement membrane which seperates it from the underlying submucosa or lamina propria. The epithelium consists of ciliated columnar cells, non-ciliated columnar cells, goblet cells and basal cells. Goblet cells constitute the glandular element of the epithelial layer. These are unicellular mucous glands with a basal nucleus. All the columnar cells are covered by a sort of finger - like projections on

their superficial surfaces called microvilli. The main components of the submucosa-which is a fairly loose connective tissue with some collagen and very few elastic fibrils-include various glands, serous and seromucinous glands, and blood vessels. Additionally, mast cells and the numerous extravascular cells, which have important immunological functions are found among all layers of the submucosa (Brain, 1989).

Normal breathing occurs through the nose, which has the task of filtering, warming and humi-

difying the inspired air, which is later delivered to the lungs in an optimal state. Nasal breathing has a marked effect on the lining mucous membrane of the respiratory region of the nose (Brain, 1989). Therefore, the alterations of the nasal airflow effects histological structure of the mucosal lining of the respiratory region. A series of studies had proved this effect. Bende (1983) reported that the nasal functions were discontinued, with abolished air current; and because of the decrease in nasal blood flow, morphological changes occurred after total laryngectomy. Havas (1987) demonstrated the alterations in nasal cycle after laryngectomy. Hilding and Hilding (1970) studied rabbits which were subjected to closure of one nostril, and pointed out that an increase in ciliogenesis and goblet cell population occurred.

In this study, firstly, we investigated the respiratory epithelium of the nose in patients that have undergone total laryngectomy in order to show whether the duration of the nasal airflow absence effects the histologic structure or the radiological appearance of the paranasal sinuses.

MATERIALS AND METHODS

Seventeen subjects (16 male and 1 female) aged 34-65 (mean 45.1) years who have undergone total laryngectomy between 1989 and 1990, were investigated in the first study. They were all heavy smokers (more than 20-30 cigarettes per day, for at least 20 years).

Nasal mucosa surface characteristics were studied in biopsies obtained just before total laryngectomy and neck dissection and 2-24 months after laryngectomy. The biopsies taken for pathological examination were fixed in 10 % formalin and then were embedded in paraffin. The blocks were cut in 5 microns and subsequently stained with hematoxylen & eosin. The slides were evaluated in terms of number of layers of pseudostratified epithelium (NLPS), goblet cells (NGC) and capillaries (NCV). The number of goblet cells and capillaries were counted per 10 high - power fields (x 450) and an average of these figures was obtained. The biopsies were also evaluated for the presence of fibrosis and inflammatory reaction and arbitrarily categorised into nil, slight, moderate or severe.

For the first study the specimens were allocated into 3 groups, preoperative ones (Group A), the specimens obtained in 2 - 6 months (Group B) and the ones obtained later than 7 months (Group C), postoperatively (Table 1). The averages of the parameters were statistically analysed between these groups by Student's t- test, and additionally, the correlation of the parameters was investigated, using Microstat (1984 by Echosoftware, Inc) statistical analysis program.

GROUP	A	B	C
n	10	10	7
NLPS	10.20	4.85	2.43
NCV	12.80	6.80	5.07
NGC	4.58	2.45	1.32

Table - 1 : Results of the parameters investigated in three groups (Group A, Preoperative biopsies; Group B and C, biopsies 2-6 months and later than 7 months after laryngectomy, respectively; n, number of the biopsies; NLPS, number of layers of pseudostratification; NCV, number of capillary vessels, NGC, number of goblet cells).

In the second study we investigated the radiological appearance of the paranasal sinus of laryngectomised patients. Paranasal sinus x - rays in occipitotomental (or Water's) view and occipitofrontal (or Caldwell) view were obtained from 12 preoperative subjects and 9 more than 3 months postoperatively. All x - rays were evaluated twice in order to prevent personal errors.

RESULTS

In table 1, NLPS, NCV and NGC values are given in three groups. These values were significantly different for each parameter between all the groups (Table 2), and there appeared to be an obvious negative correlation between the duration after operation and NLPS, and a very high correlation between NLPS and NCV (Table 3). Additionally, significant correlation were present between other parameters, except the one between NGC and time elapsed after operation (TEAO). In the biopsies of both groups no fibrosis and inflammatory reaction were revealed, compared to the control group. In each of the 3 groups mucosal specimens showed nil or slight mononuclear inflammatory cell reaction except for 2 patients who had had maxillary sinusitis preoperatively. Moderate mononuclear inflammatory cell reaction was found in those 2 patients (Fig 1).

In 2 of 12 patients, x-rays taken preoperatively revealed bilateral maxillary sinusitis and one of them also had bilateral ethmoidal sinusitis. There was a mucosal retention cyst in the left maxillary sinus and bilateral ethmoidal sinusitis in a third patient.

		MEAN	SD	T	n
NLPS	A	9.80	1.93	5.98 *	20
	B	4.85	1.77		
	A	9.80	1.93	7.82 *	17
	C	2.29	1.98		
	B	4.85	1.77	2.81 *	17
	C	2.29	1.98		
NCV	A	12.8	3.23	5.50 *	20
	B	7.0	0.85		
	A	12.8	3.23	5.88 *	17
	C	5.1	1.47		
	B	7.0	0.85	3.43 *	17
	C	5.1	1.47		
NGC	A	4.58	1.00	5.35 *	20
	B	2.45	0.76		
	A	4.58	1.00	6.19 *	17
	C	1.49	1.03		
	B	2.45	0.76	2.23 **	17
	C	1.49	1.03		

Table - 2 : Statistical analysis of the parameters between three groups (T, Student's t - test; Group A, Preoperative biopsies; Group B and C, biopsies 2-6 months and later than 7 months after laryngectomy, respectively; SD, standart deviation; n, number of the biopsies; NLPS, number of layers of pseudostratification; NCV, number of capillary vessels; NGC, number of goblet cells; *, < 0.01; **, < 0.05).

	TEAO	NLPS	NCV	NGC
TEAO	1			
NLPS	-0.76	1		
NCV	-0.66	0.88	1	
NGC	-0.053	0.66	0.66	1

Table - 3 : The correlation analysis of the parameters (TEAO, time elapsed after operation; NLPS, number of layers of pseudostratification; NCV, number of capillary vessels; NGC- number of goblet cells).

tient. Therefore, the paranasal sinus x-rays of these 3 subjects were not investigated postoperatively. Since 3 of the rest had unilateral maxillary retention cysts, their postoperative x-rays were evaluated for the healthy sinuses, and none of the postoperative x-rays showed any abnormal changes in maxillary, frontal or ethmoidal sinuses except for a retention cyst in the right maxillary sinus of a laryngectomised patient after 6 months.

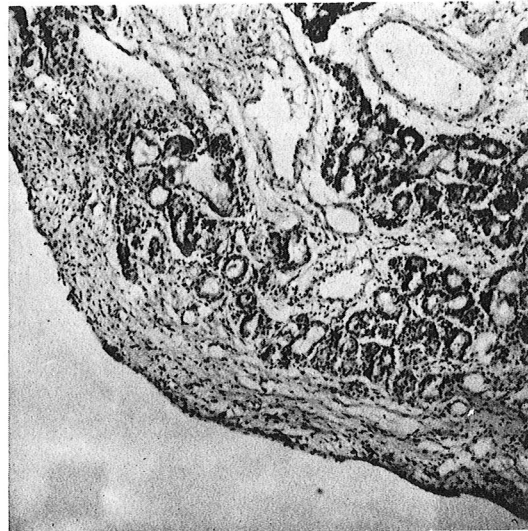


Fig . 1 : A nasal mucosal biopsy obtained two years after the laryngectomy. Note the reduced number of goblet cells, capillaries and the one - layered surface epithelium.

DISCUSSION

Dixon (1949) reported that mucosal changes in the nasal cavity appeared in the third month after operation Basterra and Martorell (1983) pointed out that these changes appeared in 2 months-2 years postoperatively. In our first study nasal mucosa was investigated in 2 months - 2 years period and structural differences were shown after laryngectomy.

Nieto (1972) emphasized that mucosal changes were closely related to the postoperative period. In our study, significant differences between group B (2-6 months) and C (after 7 months), together with high negative correlation between all the parameters and duration after laryngectomy supported the finding that the mucosal changes become more apparent in the period after operation. Basterra and Martorell (1983) pointed out that glands became atrophied and mucosal fibrosis appeared postoperatively, but we could not ascertain mucosal fibrosis in any group which were operated upon. Contradictorily, some authors reported glandular hyperplasia (Dixon et al. 1949; Puskas, 1970)).

Bende (1983) emphasized that mucosal blood flow became decreased after laryngectomy and all of the structural changes depended on mucosal blood flow. Our results support this relation, as there was a positive correlation between the number of capillary vessels and other structural changes.

Dixon (1949) and Nieto (1972) showed that aging had an important role on histological changes and vascular pattern of the nasal mucosa, did not find a difference between old healthy subjects and laryngectomised ones, but showed a significant difference between 2-3 months postoperative group and the group that was followed for more than 4 months. In this study we compared the results of preoperative biopsies of the same patients in addition to 2 postoperative groups, and there was no significant age difference between preoperative and postoperative ones. Therefore, it is thought that abolished nasal air current has a role on histologic patterns of nasal mucosa and this effect becomes more apparent in the course of time.

Havas (1987) emphasized that loss of the nasal cycle was the first physiological alteration to take place after laryngectomy and suggested that further investigation was required to clearly delineate the connection between loss of the nasal cycle and other changes that were manifestations of the gross alteration in nasal physiology following laryngectomy. But we found no changes in paranasal sinuses after total laryngectomy. Therefore, although we could not evaluate nasal airflow and ciliary activity, we propose that the changes in these functions are not so serious to create pathological conditions. Further investigations are necessary to delineate whether these alterations causing no nasal and paranasal diseases will effect the treatment or not.

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REFERENCES

1. Basterra J, Martorell M : Estudio Histologica comparativo de la mucosa nasal traqueal en laringectomizados. *Ann. Otolaryngol. Iber. Amer.* (abs) 10 : 459-467, 1983
2. Bende M : Blood flow in human nasal mucosa after total laryngectomy. *Acta Otolaryngol* 96 : 529-531, 1983
3. Brain DJ : Anatomy, physiology and ultrastructure of the nose, In : Rhinitis, ed. I. Mackay (Royal Society of Medicine Services Limited, Suffolk). 1989, pp. 11-32
4. Dixon FN, Hoerr NL, McCall JW : The nasal mucosa in the laryngectomised patients. *Ann Otol Rhinol Laryngol* 58 : 535-547, 1949
5. Havas TE, Cole P, Gullane P, Kassel R : Alterations in nasal physiology after laryngectomy : the nasal cycle. *Otolaryngol* 16 : 149-153, 1987
6. Hilding DA, Hilding AC : Electron microscopic observations of nasal epithelium after experimental alteration of airflow. *Ann Otol Rhinol Laryngol* 79 : 451-460, 1970
7. Nieto CJM : Alteraciones histofuncionales de la mucosa nasal en los laringectomizados. *Acta Otolaryngol Iber - Amer.* (abs) 23 : 300-319, 1972
8. Puskas F : Morphologische, funktionelle und bakteriologische untersuchung der norenschleimhaut nach laryngectomie. *Z. Laryngol Rhinol* (abs) 49 : 176-184, 1970