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Relationship between nasal obstruction and pulmonary ventilation in laryngectomized patients

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SUMMARY

Respiratory gases (P_{O_2} and P_{CO_2}) in arterial blood were determined in 19 laryngectomized patients (47 to 77 years of age) following nasal obstruction. P_{O_2} values were somewhat elevated, but the difference was statistically insignificant, while P_{CO_2} value remained the same. These results to a certain extent correlate with the findings of Cave et al. on dogs, but with a minor correction which we explain by the effect of the second reflex arch of the trigeminal – phrenic and intercostal nerves. Respiration (rate, tidal volume and minute volume) was also tested and the results agreed with the findings of respiratory gases.

INTRODUCTION

Ogura et al. (1964, 1970, 1973) observed from their experimental and clinical data that nasal obstruction increases pulmonary resistance (R_A) and reduces compliance. Their findings provided new insights into surgical interventions in the septum and nasal pyramid. Cook and Komorn (1975) observed hypoxemia with hypercapnia in 20 patients with anterior and posterior nasal packing. Six patients with chronic obstructive pulmonary disease (COPD) had more marked changes in their blood gases with nasal packing than the 14 patients without a history of COPD. Krajina et al. (1977) found minor changes in the blood gases of children following nasal packing. Cavo et al. (1975) noted a significant depression in P_{O_2} and an elevation of P_{CO_2} following nasal packing in dogs. These blood changes disappeared dramatically after packing was removed. None of the above-mentioned changes in blood were recorded after packing in six dogs subjected to total laryngectomy.

For our investigations of the effect of nasal obstruction on P_{O_2} and P_{CO_2} values in arterial blood after the removal of the larynx, we examined patients who

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have had laryngectomies for one or more years. We wanted to test Cavo et al.'s experimental results with dogs and study the role of the reflexogenic zone in the laryngeal mucosa.

MATERIAL AND METHODS

Nineteen laryngectomized patients between 47 an 77 years of age were included in this study. The time lapse between surgery and our investigations ranged between 20 days to 19 years. Neither anamnestic data nor objective examinations indicated any severe disturbances of the upper respiratory tract, or chronic changes of the nasal mucosa, except for its paleblue tint, which is generally common in such patients.

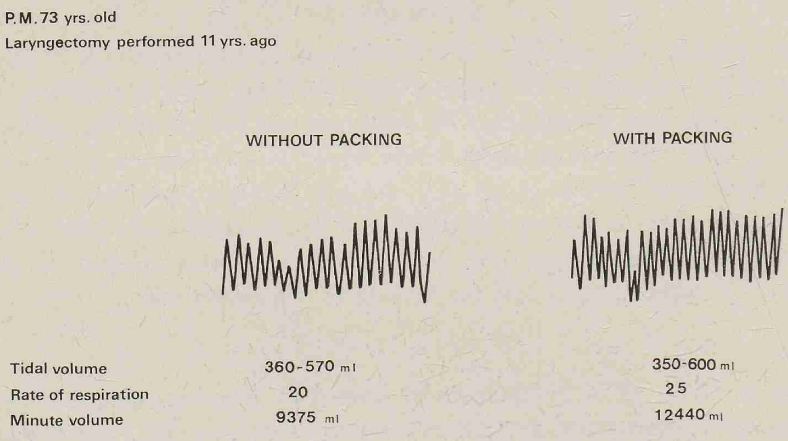

Figure 1. Alteration of respiration in laryngectomized patients following anterior nasal packing (tidal volume, rate of respiration and minute volume).

Bilateral anterior nasal packing was always performed and respiratory blood gases were determined 5 or 24 hours later. We analyzed P_{O_2} and P_{CO_2} values in arterial blood drawn from the cubital artery. These values were measured before and after nasal packing, using the Blood Gas Analyser 613. In addition to blood gas analyses, some patients underwent pulmonary ventilation tests (tidal volume, rate of respiration and minute volume) before and after bilateral nasal obstruction (Figure 1). Pulmonary ventilation was measured with the expirograph (Godart).

RESULTS

P_{O_2} and P_{CO_2} values before and after nasal packing are shown in Table 1. We noted that P_{O_2} values after nasal obstruction were somewhat elevated in 14 cases. These changes in the majority of patients were statistically insigni-

Table 1.

no.	age (years)	laryngectomy performed (years ago)	without packing		with packing	
			P_{O_2}	P_{CO_2}	P_{O_2}	P_{CO_2}
1	53	1	83	39,4	84	40,8
2	49	1	67	37,5	75	35,3
3	58	2	77	32,9	82	34,9
4	52	2	74	35,9	76	35,9
5	68	2	78	43,4	81	44
6	49	9	77	35,2	80	40,0
7	68	12	62	34,1	59	36,3
8	52	2	88	36,5	81	41,5
9	49	20 d	87	38,6	84	39,6
10	62	6	80	33,6	87	31,3
11	47	9	77	37,7	79	38,1
12	73	12	79	35,8	81	32,6
13	52	4 m	73	36,4	77	36,2
14	48	6 m	74	35,2	76	37,2
15	68	2	81	37,9	79	37,3
16	74	20 d	91	38,2	89	38,1
17	73	12	68	36,7	73	32,2
18	77	11	69	39,6	72	38,9
19	74	19	73	33,4	74	34,2

ficant (Table 2). The P_{CO_2} analysis revealed five reduced, ten elevated and four with no changes. The statistical differences in P_{CO_2} values before and after obstruction were insignificant. *T* statistic for P_{CO_2} was 0,6 as compared to 2,05 for P_{O_2}.

In some patients following nasal packing, tidal volume or rate of respiration increased, which meant an increase in minute volume. This mechanism can explain to a certain extent the P_{O_2} variations before and after nasal obstruction in the laryngectomized patients.

Table 2. Blood gas alteration in laryngectomized patients following anterior nasal packing.

	number of patients	mean value		*T* (statistic)	*Df*	*T* (from table)
		without packing	with packing			
P_{O_2}	19	76,73±7,26	78,36±7,36	2,05	18	2,10
P_{CO_2}	19	36,21±2,48	36,91±3,98	0,6	18	2,10

DISCUSSION

We are faced with the question whether our investigations on laryngectomized patients correlate with Cavo et al. 's findings (1975) in six laryngectomized dogs. Before answering this question, it is necessary to explain the

reflex relationship between the nose and lower respiratory tract and thorax which function as a unit. A number of authors have made significant contributions to this problem (Kratchmer, 1966; Voltolini, 1951; Šercer, 1930; Ogura et al., 1964, 1970; Angell-James and Daley, 1972; and others).

Mechanical, chemical or thermal stimulation of the nasal mucosa stimulates the external intercostal muscles and diaphragma, as well as the tracheobroncial muscles, which in turn affect the volume and rate of respiration. These reflexes are a reaction of the trigeminal -phrenic and intercostal nerves on one side and the trigeminal-vagus nerves on the other. Krajina (1976) has shown that vegetative system plays an important role in this reflex mechanism. During vasomotor rhinitis, whether provoked experimentally or in patients, we observed that reflexes increased as a result of parasympathomimetic reaction. This suggests that these nasopulmonary and nasothoracic reflexes have a physiological role in respiration, but can in certain cases cause pathological inversions because of a low sensation threshold or a strong reaction of the effector. In the same way, the immunologie mechanisms have a protective function in man, but they can also be dangerous in allergy.

The nasal reflex through the reflex region of the larynx, especially in the supraglottic area, stimulates a powerful reaction in the tracheobronchial tree. In a healthy person, the bronchial pressure during coughing is 100–160 mm Hg and in the intratracheal spase 256–384 mm Hg, which corresponds with the difference between the laryngeal and bronchial muscle force. If the laryngeal relationship is severed by laryngectomy, this effect is absent, while the intercostal muscle and diaphragma reflex remains. From this, we can see changes in respiration and variations in P_{O_2} in arterial blood of laryngectomized patients, which differs from the findings of Cavo et al.

A task in the future for rhinologists would be to investigate the reason for reflex differences in the upper and lower respiratory tract and which is a critical area for this pathological reflexes.

CONCLUSIONS

P_{O_2} and P_{CO_2} values in arterial blood were determined in 19 laryngectomized patients following nasal obstruction. P_{O_2} values were somewhat elevated in 14 patients, while no differences were recorded in P_{CO_2} values. These results to a certain extent correlate with the findings of Cavo et al. on dogs, but with a minor correction which we explain by the effect of the second reflex arch of the trigeminal – phrenic and intercostal nerves.

RÉSUMÉ

Le gaz respiratoire (P_{O_2} et P_{CO_2}) dans le sang arteriel était detérminé chez 19 malades laryngectomisés (47–77 agés) après l'obstruction nasale. La valeur de

P_{O_2} était quelque chose élevée, mais la valeur de P_{CO_2} restait la même. Ces resultats jusqu'au certain dégré corresponds avec les constatations de Cavo et col. chez les chiens, mais avec une petite correction quelle nous pouvons expliquer avec la réflexion secondaire de nerves trijumeau – phrenic et intercostales. Les respiration était aussi analysée et les resultats s'accordaient avec les constatations des gaz respiratoires.

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