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Research

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Effectiveness of Bronchodilator Therapy on Dyspnoea After Total Laryngectomy

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SUMMARY

Dyspnoea is an important symptom affecting quality of life in the laryngectomy. In these patients, it is useful to conduct spirometry and provide appropriate drug therapy when a bronchial obstruction is present.

ABSTRACT

Objective: The aim of this study was to evaluate the effects of long-term bronchodilators (six months of treatment) by performing a functional assessment and determining the degree of breathlessness in a group of laryngectomies.
Materials and Methods: We evaluated 93 outpatient laryngectomies by means of spirometry (extra-tracheal device); the mMRC scale was administered to determine the degree of dyspnoea. When appropriate, we began treatment with bronchodilators according to measured bronchial obstruction and repeated the test after six months of therapy.
Results: Patients undergoing total laryngectomy very often develop clinically evident bronchoconstriction and severe dyspnoea over the long term. In laryngectomies, the prevalence of airway obstruction is high (about 60%) and the incidence of dyspnoea is also very high (51 out of 62).
Conclusion: Bronchodilator therapy improved pulmonary function and dyspnoea within 180 days of treatment. The possibility of evaluating and quantifying the degree of obstruction allows optimization of drug therapy.

KEYWORDS: Dyspnoea; Lung function; Laryngectomy; Chronic Obstructive Pulmonary Disease (COPD).

INTRODUCTION

Patients undergoing total laryngectomy experience a series of physiological changes in breathing pattern caused by the separation of the lower airways from the upper airway, because the air enters through the tracheostoma bypassing the upper respiratory tract, thus eliminating the functions of the nose on the air inhaled, such as heating, humidification, and filtration.[1] At the level of the lower airways, this anatomical disruption produces irritation and dryness of tracheo-bronchial mucosa, crusting at the level of the stoma and cough.[1]

In laryngectomies, in the first two months after a tracheostomy, an increase occurs in the efficiency of the mucociliary clearance. This is probably due to a reactive bronchial hypersecretion, which protects the respiratory mucosa by direct contact with the airflow, which is no longer filtered and conditioned by nasal mucosa. As a result of the absence of air, irritants and infectious organisms contained in the inspired air are no longer stimulated.[2] In later stages, atrophy of the mucosa and a reduction in intranasal temperature occur, which increases the time of mucociliary clearance and, therefore, result in conditions that aid in the development of chronic infections by saprophytic bacterial flora.[3] Therefore, a few months after surgery, the permanent tracheostoma leads to a decrease in mucociliary function, resulting in exclusion of the upper

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airways, because of viral and bacterial infectious episodes that are repeated over time.

It is important to consider that patients who develop laryngeal cancer are heavy smokers, in almost all cases: laryngeal cancer and Chronic Obstructive Pulmonary Disease (COPD) often coexist.[4,5] After the risk of developing a second cancer, the second leading cause of morbidity and mortality in these patients is the progressive deterioration of lung function[6] until respiratory failure occurs.

OBJECTIVE OF THE STUDY

Our main objective of this study was to examine the effects of bronchodilators (six months of treatment), with respect to functional and clinical data. Indication for therapy was obtained by assessment of lung function (by spirometry) in the patients who had undergone total laryngectomy surgery.

MATERIALS AND METHODS

The Monaldi Hospital (Naples, Italy) Institutional Review Board (IRB) has approved this study. We evaluated 93 consecutive patients who had undergone total laryngectomy (Table 1) in our Respiratory Department from January 2012 to April 2013. Patients included had undergone total laryngectomy surgery for laryngeal carcinoma between 1981 and 2008, and their age ranged between 44 and 83 years (mean age 65 years), 82 patients were male and 11 women, 89 were smokers (96%). The patients had no history of asthma and had never been treated with bronchodilator therapy. They underwent clinical examination and spirometry; in addition, their dyspnoea was assessed according to the modified Medical Research Council (mMRC) scale. The mMRC breathlessness scale comprises five statements that describe the range of respiratory disability from none (Grade 0) to almost complete incapacity (Grade 4).

Patients (n=93)		
Sex, m/f	82/11	
Age, year	65.6 +/- 10	
Pulmonary Function		
FVC, L	2,2 +/- 0,8	
FVC, % pred	65,6 +/- 20,9	
SVC, L	2,5 +/- 0,8	
SVC, % pred	72 +/- 0,2	
FEV1, L	1,7 +/- 0,7	
FEV1, % pred	61 +/- 0,2	
FEV1/FVC, % pred	69,8 +/- 12,9	
MMRC Grade of Dyspnea		
Average value	1,6 +/- 1,6	
Grade 0	42/93	45%
Grade 1	01/93	1%
Grade 2	19/93	21%
Grade 3	16/93	17%
Grade 4	15/93	16%

Table 1: Baseline characteristic of patients.

Patients with obstructive syndrome were evaluated for the degree of dyspnoea according to the mMRC scale: 1) short of breath when hurrying or walking up a slight hill, 2) walk slower than contemporaries on level ground because of breathlessness, or had to stop to breathe when walking at own pace, 3) had to stop to breathe after about 100 metres or after a few minutes on a level surface; 4) too breathless to leave the house or breathless when dressing or undressing.

To conduct the pulmonary function test, a Spirometer (Medical International Research) MIR III was used, which quantified the following parameters in each patient: SVC (Slow Vital Capacity), FVC (Forced Vital Capacity), FEV1 (Forced Expiratory Volume in 1 second), FEV1/FVC.

The extra-tracheal device was set up with a silicone adapter mounted on a cardboard mouthpiece and a filter (Figure 1). The specific adapter silicone was well tolerated by the patient. The appropriate adapter was used to perform spirometry in patients with alterations in the margins of the stoma skin, with an irregular diameter and not only adhering to the cardboard mouthpiece.

Figure 1: The extra-tracheal device.

The nozzle of the spirometer was connected to the tracheostoma by means of the extra-tracheal device, exerting slight pressure to avoid air leaks.

Spirometry testing was performed according to the following procedure:

1 -Patients were informed about spirometry and how the test would be conducted;

2 -the cannula, if present, is extracted from the trachea and tracheobronchial secretions are removed;

3 -the extra-tracheal spirometry device is connected to the tracheostoma;

4 -spirometryis executed according to ATS/ERS criteria (2005).[7]

5 -spirometryis interpreted according to ATS/ERS criteria (2005).[8]

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After pulmonary function testing, the skin was examined for irritation or allergic reactions to the silicone adapter. The patients were asked to rate comfort and acceptance of the device, and adverse skin reactions were also evaluated. Patients who had a variable degree of obstruction were treated according to the Global initiative for chronic Obstructive Lung Disease (GOLD) guidelines (2014).[9]

After six months of treatment, the patients underwent another spirometry test, and the degree of dyspnoea was re-evaluated. Statistical analysis was performed with the Biostat Calculator.

RESULTS

The patients reported good compliance to the method and reported no cases of adverse skin reactions. The results showed that 26 patients had no alteration in pulmonary function; 64 patients had obstructive syndrome (11 patients had mild obstructive syndrome, 32 patients a moderate obstruction, 21 patients a severe obstruction), and finally, spirometry was not reproducible in five patients. Among patients with obstructive syndrome, 16 had a reversible obstruction treated with a β-adrenergic agonist.

According to the mMRC evaluation the results shows ten patients had no dyspnoea except on strenuous exercise, one had a degree of dyspnoea of 1, 20 had a degree of dyspnoea of 2, sixteen reported a level of dyspnoea of 3, finally, 15 patients had a degree of dyspnoea of 4.

Fifty-two of the sixty-two patients with obstructive syndrome received bronchodilator treatment according to the GOLD guidelines. Ten patients were excluded: one patient had lung cancer and nine asymptomatic patients had a mild degree of obstruction. After six months of therapy, lung function and the degree of dyspnoea in the study patients were evaluated: five of 52 patients receiving bronchodilator therapy were lost to follow-up. Forty-seven patients were reassessed after undergoing bronchodilator treatment (Table 2) and had a reduction in the level of dyspnoea: six patients had a reduction in dyspnoea from grade 2 to 1;17 had a reduction from grade 3 to between grades 2 and 1;13 had a reduction from grade 4 to between grades 3 and 2; finally, 11 subjects had a reduction from grade 5 before bronchodilator treatment to between 4 and 2 after treatment. After the revaluation, a significant improvement in Forced Expiratory Volume (FEV) 1 was noted with a *p value* <0.0005 (Figure 2) and the parameter dyspnoea improved with a *p value* <0.01 (Figure 3).

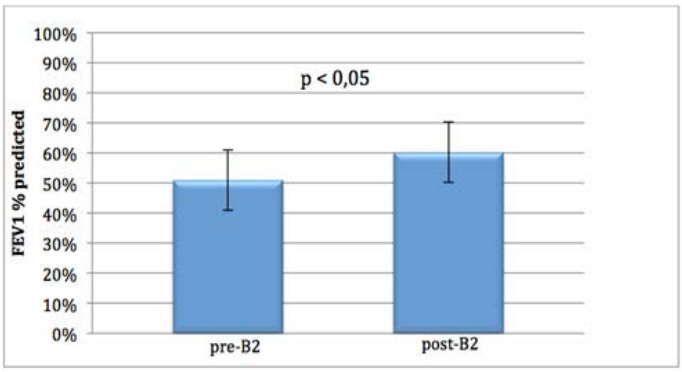

Figure 2: Improvement in FEV1% predicted after 6 months of pharmacological therapy.

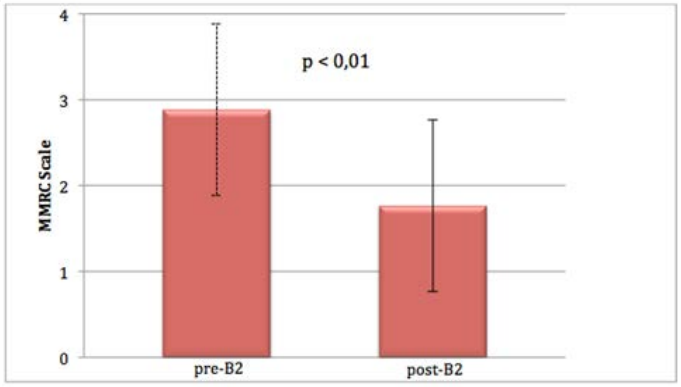

Figure 3: Reduction of dyspnoea after 6 months of pharmacological therapy.

Patients (n= 47)				
	Sex, m/f	42/5		
	Age, year	65.9 +/- 8,8		
		before	**after**	**P-value**
Pulmonary Function				
	FVC, L	1,96+/- 0,7	2,09+/- 0,8	p 0,018
	FVC, % pred	61,1 +/- 0,19	66 +/- 0,2	p 0,030
	FEV1, L	1,37+/- 0,6	1,52 +/- 0,6	p<0,0005
	FEV1, % pred	51,84 +/- 17,2	58,50 +/- 18,4	p<0,0005
	FEV1/FVC, % pred	61,26 +/- 10,3	64,08 +/- 11,8	p 0,054
MMRC Grade of Dyspnea				
	Average value	2,9 +/- 0,8	1,8 +/- 0,9	p<0,01

Table 2: Changes in pulmonary function and dyspnoea after pharmacological therapy.

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DISCUSSION

It is well known that exposure to cigarette smoke and anatomic and functional alterations after surgery predispose individuals to the development of respiratory problems. Pulmonary function tests are rarely performed in patients with total laryngectomy due to the absence of an appropriate extra-tracheal device; however, laryngectomies are generally smokers (in our group 94% of patients) and, in addition, the anatomical changes that occur after surgery contribute to the development of chronic inflammation of the airways. For all study patients, it was possible to make an assessment of lung function with the help of a simple device. The extra-tracheal device allowed connection of the patient to the spirometer, without air leaks during spirometry. The ability to perform spirometry has made it possible to conduct a uniform assessment of patients.

Of the 93 patients examined, 62 (67%) had a variable degree of obstruction, and 52 (56%) had dyspnoea during exercise. Patients in need of drug treatment began therapy and were re-evaluated after six months, at which time functional improvement and a significant decrease in the dyspnoea index were noted. The mMRC scale does not measure breathlessness itself, but the disability caused by breathlessness.[10] This remains the issue of greater importance, because the appropriate treatment has an impact on patients' quality of life. The capacity to assess and quantify the degree of obstruction and to provide the appropriate therapy for each patient can help to improve quality of life. Therefore, in the follow-up of patients with total laryngectomy, it is also necessary periodically to perform a study of lung function by spirometry.[11] Even patients with normal lung function prior to total laryngectomy, show a progressive obstructive ventilatory defect, within one year of follow-up; however, patients who undergo conservative intervention have no significant reduction of the breathing parameters.[12]

CONCLUSION

In conclusion, baseline lung function should be assessed early in all patients with total laryngectomy. Further studies should also be dedicated to broader populations, because most of these patients are smokers and often treated with the wrong therapy, without reference to the functional data, with frequent exacerbations, with a decidedly negative impact on quality of life.

CONFLICTS OF INTEREST: None.

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CONSENT STATEMENT

The patient has provided written permission for publication of the case details.

ETHICAL STANDARDS

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional guidelines on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

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