ORIGINAL ARTICLE

Chronic Adherence to Heat and Moisture Exchanger Use in Laryngectomized Patients

Gabriel Pedemonte-Sarrias,* Juan Carlos Villatoro-Sologaistoa, Paulina Ale-Inostroza, Montserrat López-Vilas, Xavier León-Vintró, Miquel Quer-Agustí

Servicio de Otorrinolaringología, Hospital de Sant Pau, Barcelona, Spain

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KEYWORDS
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Abstract

Introduction and objective: Total laryngectomy leads to pulmonary problems such as excessive sputum production, forced expectoration and increased coughing. The use of a heat and moisture exchanger (Provox® HME) reduces these symptoms. The aim of this study was to quantify chronic adherence to HME use in laryngectomized patients.

Methods: A prospective study of 115 patients laryngectomized at our centre during 2005–2011 was performed.

Results: Of the 115 patients, 90 (78.2%) used the HME consistently and 25 (21.8%) abandoned its use. The most common causes of desertion were adhesion problems due to mucus and skin irritation. Of the 30 patients with voice prostheses, 90% of them used the HME system regularly. Voice prosthesis use (P=.05) and early indication in postoperative laryngectomy (P=.001) were factors significantly associated with chronic HME use.

Conclusions: There is high adherence (78.2%) to heat and moisture exchanger (Provox® HME) use in laryngectomized patients. Chronic HME use was higher in patients with voice prosthesis and the ones with early indication in postoperative laryngectomy. The major causes of abandonment were related to problems with the adhesive.

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* Corresponding author.
E-mail addresses: gpedemonte@santpau.cat, gabrielpedemonte@gmail.com (G. Pedemonte-Sarrias).
Introduction

The upper respiratory tract has a well known effect on the physiology of breathing: humidification of inhaled air; retention of moisture from exhaled air, heating of the air that reaches the lower respiratory tract, and filtering of particles and microorganisms.1-3

After a total laryngectomy, the upper and lower respiratory tract are permanently disconnected and the patient breathes through a tracheostoma. This causes alterations in lung function, such as a decrease in the mucociliary activity of the tracheobronchial tree,4 irritation, dryness of the mucosa and a greater production of secretions. In turn, these alterations provoke an increase in coughing and forced expectoration, as well as excessive sputum production,5 which get worse in the first 6–12 months after surgery, stabilising afterwards.4

Together with the loss of laryngeal phonation and cervical tracheostoma, the increase of lung symptoms participates in reducing the quality of life for these patients.5,7

The heat and moisture exchanger (HME) is used to compensate for the functions of the upper respiratory tract suppressed after a laryngectomy is performed. Its main characteristic, the exchange of heat and moisture, aims to restore the physiological function corresponding to the upper respiratory tract6,8; and this is responsible, together with the increase in respiratory resistances and particle filtering, for the improvement of the lung symptoms in laryngectomized patients.10

For laryngectomized patients that do not use a tracheostoma, the HME system is composed of an adhesive plaster that hooks around the tracheal stoma, over which a filter is placed (Fig. 1). In patients with a cannula, there are filters that can adapt to the tracheostomy cannula.

The main objective of this study was to assess quantitatively adherence to chronic use of the tracheostoma humidifier in the laryngectomized patients in our centre.

Patients and Methods

We carried out a prospective study in 115 patients laryngectomized at the Otorhinolaryngology Service of the Hospital de la Santa Creu i de Sant Pau in Barcelona during the period from May 2005 to March 2011. The mean patient age was 64, with a range between 42 and 85 years. Of these, 107 patients were male (93%) and 8 were female (7%). None of the patients included in the study were users of tracheostomy cannula. Thirty-seven patients (32.2%) used voice prostheses. In the rest of the patients, voice rehabilitation consisted of oesophageal speech training.

The HME system used in our centre was the Provox® HME system (Atos Medical, Hörby, Sweden; http://www.atosmedical.com), funded by the public health system nationally since February 2007. The most common indication was for Provox® round FlexiDerm® adhesive plasters with Provox® HME normal cassette humidifiers. None of the patients had had previous experience with the HME system. Mean patient follow-up was 17 months. Time from the total laryngectomy and commencement of using the HME varied from 6 days up to 27 years, with a mean of 3 years.

Patients operated from the year 2007 (n=61) were systematically offered the possibility of using the tracheostoma humidifier, normally after the immediate postoperative period in patients not candidates for adjuvant treatment with radiotherapy, or once such treatment ended (primary HME). Patients operated before 2007 (n=54) were offered the use of the HME device during one of the follow-up visits (secondary HME).
In the consultation, the patients received an explanation of how the HME system was used and of the potential benefits associated with its chronic use. Patients were instructed in plaster management and filter cleaning, as well as in the advantages of changing the stoma filters daily.

Patient adherence to the tracheostoma humidifier was evaluated using a questionnaire. The information collected in this questionnaire was demographic data, if the patients used a voice prosthesis, if they used the HME system, the type of use (continual or partial) and, in the case of abandonment, its cause.

The data obtained were analysed with the SPSS® statistics program version 19.0 (SPSS®, Inc., Chicago, IL, USA).

**Results**

A total of 115 patients were included in the prospective study on the adherence to chronic use of the tracheostoma humidifier. Of these, 90 patients (78.2%) were habitual users of the HME system, while 25 (21.8%) abandoned it. Of these 90 users of the HME system, 84 (93.3%) made complete use of the plasters and filters, while the rest used them partially only during the day (2.2%) or non-continuously (4.4%).

For the 25 patients that abandoned the HME system during the study period, the mean time lapse between the prescription of the plasters and filters and their abandonment was 2.5 months (range: 9 days to 13 months).

Table 1 details the causes of abandonment. In 72% of the occasions, the cause for abandonment that the patients indicated was for problems related to the plaster (mainly for lack of adhesiveness due to tracheobronchial secretions) or for dermatological problems associated with the use of the adhesive plasters.

A total of 37 of the laryngectomized patients included in the study (32.2%) used voice prostheses. Adherence to chronic treatment with the tracheostoma humidifier in this group of patients was 89.2%. For the rest of patients that were non-users of voice prostheses (n=78), the percent of use was 73.1%. There were differences in the limit of statistical significance in the percentage of chronic HME system use, based on the use of a voice prosthesis (chi-square, $P=.05$).

For the patients operated before 2007 (n=54), for whom the indication for HME use was secondary, adherence to chronic use was 63.0%. However, for the patients operated after that date, for whom the indication for HME use was primary in the immediate postoperative period or once the therapy sequence ended, the percentage of adherence reached 91.8%. There were significant differences in the percentage of HME system use depending on its primary or secondary indication (chi-square, $P=.0001$).

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Reasons for Abandoning the Use of the HME System.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problems with the adhesive</td>
<td>18 (72%)</td>
</tr>
<tr>
<td>No adherence due to excessive mucus</td>
<td>9 (36%)</td>
</tr>
<tr>
<td>Dermatological problems</td>
<td>8 (32%)</td>
</tr>
<tr>
<td>Anatomical alterations</td>
<td>1 (4%)</td>
</tr>
<tr>
<td>Abundant secretions</td>
<td>3 (12%)</td>
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<tr>
<td>Sensation of dyspnoea</td>
<td>3 (12%)</td>
</tr>
<tr>
<td>Subjective discomfort</td>
<td>1 (4%)</td>
</tr>
</tbody>
</table>

**Figure 1** Placement of the Provox® HME system of plasters and filters.
Discussion

Using a tracheostoma humidifier is becoming the treatment of choice for pulmonary symptoms after a total laryngectomy. Various studies have shown its positive effects in decreasing coughing, expectoration, cleaning the stoma, favouring pulmonary rehabilitation and improving the quality of life of the patients.\textsuperscript{11-18}

The HME system offers 3 main advantages: the capacity of exchanging heat and moisture, the creation of an increase in respiratory resistances and the particle filtration. As the action is simultaneous, it is difficult to determine the individual impact of each of these advantages separately on the changes produced in respiratory physiology.\textsuperscript{10} Although the HME conditions the air less effectively than that achieved physiologically by the upper airway, the heating and humidification of the inhaled air seem to be the most important elements in the benefit obtained from habitual HME system use after a total laryngectomy.\textsuperscript{6,16,19}

Increasing respiratory resistance would not lead to a significant improvement in pulmonary oxygenation.\textsuperscript{6,10,21}

Although the implementation of heat and moisture exchange systems at the level of the stoma was described many years ago, their use in Spain in laryngectomized patients became general after the public health system began to fund the Provox\textsuperscript{®} HME system in 2007.

The main objective of this study was to perform a quantitative assessment of adherence to chronic HME system treatment in laryngectomized patients. The results obtained in our centre indicate that 78% of the patients to whom HME use was indicated adhered to the treatment. These results are similar to those obtained in other studies.\textsuperscript{11,16-18}

The possibility of using different adhesive plasters in different forms depending on the morphological characteristics of the stoma and the cervical area, and different filters with variable respiratory resistances, helped to improve the results obtained with the use of this type of systems.\textsuperscript{10,14,15}

One of the objectives in our centre with laryngectomized patients is to achieve wide tracheal stomas that do not require the use of tracheostomy cannulas, which facilitates treatment with HME systems. To do so, we feel it is important to perform careful suturing of the tracheal stoma to the cervical skin flap, carrying out primary tracheoplasty at the time of the laryngectomy when necessary. By doing this, we make it possible for the patients to become HME users in the immediate postoperative period, favouring respiratory rehabilitation. A total of 92% of the patients to whom HME treatment was a primary indication after the postoperative laryngectomy period adhered to the treatment in a chronic manner.

For patients with sternal insertions of prominent sternocleidomastoid muscles that make adapting the adhesive plaster difficult, primary sectioning of the cone-shaped tendon of this muscle at the time of the laryngectomy, or secondarily with local anaesthesia, is a manoeuvre than can help to regularise the cervical area and facilitate the adaptation of the adhesive plaster. Another surgical modification that can make adaptation easier is creating a tracheal stoma independent from the cervical incision used for performing the total laryngectomy and extirpation of the cervical lymph nodes (Fig. 2).

In addition, offering the patient information and giving instruction in the use of the HME system appears to be a key element in achieving adherence to the treatment.\textsuperscript{12,14,19}

In our study, the most important cause of abandonment consisted of dermatological problems and problems with adhesion of the adhesive plaster. Taken together, these
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were responsible for treatment abandonment in 72% of the patients that rejected habitual HME use.

Ackerstaff et al.10 reported the dermatological problems derived from the use of the adhesive as the most frequent reason for abandoning the HME system. Half of the dermatological complications caused by plaster irritation were solved alternating different types of adhesives, applying a skin protector before sticking on the plaster or using a cannula (LaryTube®) in which the Provox® HME filter can be applied directly without using adhesive.

Chronic use of the HME system implies a decrease in pulmonary symptoms.11–13 However, some patients report greater production of mucus with the HME system when it is initially used. This could be explained by the retention of moisture in the lower respiratory tract, making expectoration more fluid.16

Based on our results, adherence to treatment with the HME system was significantly greater in the group of patients using voice prostheses. The HME system has a valve that permits airtight closure of the tracheostoma, which favours its occlusion and the passage of air towards the voice prosthesis and the pharynx.17 In turn, this achieves greater quality of the prosthetic voice in relation to manual occlusion of the tracheal stoma. Various studies18,19 that assessed the benefits derived from using the HME system in laryngectomized patients with a voice prosthesis observed an improvement with respect to digital occlusion in maximum phonation time and in dynamic range in up to 75% of the patients, which favours greater intelligibility, fluency and phonation ease. Herranz González-Botás et al.19 observed that HME use led to an improvement in the vocal parameters in the patients that used voice prostheses, with a decrease in the force needed to achieve stoma closure, greater fluency in phonation and an increase in intelligibility.

Finally, there is an additional benefit that is difficult to measure: the self-image of the laryngectomized patient. The HME system makes hygienic occlusion of the tracheal stoma possible, without being unpleasant from the aesthetic point of view. This improves the self-esteem of laryngectomized patients and their social and family integration.

Conclusions

The results of this study show high adherence (78%) to chronic treatment with heat and moisture systems for the tracheostoma in laryngectomized patients. In the group of patients with voice prostheses, treatment adherence was superior thanks to the valve system that favours prosthesis use. The main causes of abandonment were for problems with the adhesive, with lack of adhesiveness from mucus and dermatological problems being the motives most frequently reported by the patients.

Conflict of Interests

The authors have no conflict of interest to declare.

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