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ORIGINAL ARTICLE

Pediatric tracheostomy tube change

Cambio de cánula de traqueostomía en pediatría

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What do we know about the subject matter of this study?

In some health centers, only medical staff is trained to perform tracheostomy tube changes. However, more and more parents are managing their tracheostomized children, with few reports detailing their involvement in this procedure.

What does this study contribute to what is already known?

Routine tracheostomy tube changes performed by trained health professionals and family members are safe. However, changing to a larger diameter cannula is risky and should be done only by health professionals.

Abstract

Changing the tracheostomy tube in children is a key procedure, however, some of its aspects remain unclear. **Objective:** To characterize the tracheostomy tube change in children from a long-stay health institution. **Patients and Method**: Retrospective observational analytical study based on the 2-year clinical record of hospitalized children who underwent tracheostomy. The variables evaluated were the reason for tracheostomy tube change, size and brand of the tube, operator and participants (assistants/spectators) of the procedure, complications, and education. **Results:** We analyzed 630 tracheostomy tube changes. The most frequent operators were relatives (33.7%). The main reason for the change was routine (83.3%). 10.7% of the changes presented some complications, where the most frequent was peristomal bleeding (47.37%) and the first failed attempt (34.21%). There was no association between the presence of balloon and complications ($p = 0.24$), nor with the use of Mechanical Ventilation ($p = 0.8$) or the operator ($p = 0.74$). **Conclusion:** The routine change of the tracheostomy tube in children with prolonged artificial airway use is a safe procedure, which can be performed by both health professionals and properly trained family members.

Keywords:
Tracheostomy;
Tube;
Intensive Care;
Long-Term Hospital;
Stay;
Airway;
Caregiver

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Introduction

In the United States, 6.6% of children who recieve mechanical ventilation (MV) in PICUS require a tracheostomy, a number that has increased in recent decades[1,2]. Different consensuses agree that the appropriate management of the tracheostomy tube is essential, both in the daily care such as collar fixation, heated humidification, and cleaning of secretions, as well as in its replacement[3]. There are several indications for the latter procedure, including change of diameter, dysfunction of any of its parts, therapeutic alternative and routine[4-6]. The right moment to perform it is variable, being the most frequent the weekly or monthly change, depending on the institution, material, and/or risk of obstruction, among other factors[3,6-8].

Complications during tracheostomy tube change include the creation of false passages, bleeding at the stoma site, and discomfort[4]. There will be risks during any change, therefore the risk-benefit balance must be understood and known by all participants[4]. In some health centers, only medical staff is trained for this procedure, even recommending that it should be performed only in the hospital setting[4,7]. However, there is an increasing population of tracheostomized children managed at home by their parents and/or informal caregivers, who were trained in different procedures before hospital discharge, including tracheostomy change[6,9,10]. Despite this, few reports detail the change of tracheostomy tube, the reasons for changing, operators, and most frequent complications. This report aims to describe the tracheostomy tube changes in children from a long-stay hospital institution in Chile.

Patients and Method

Design and patients

Observational retrospective study that included tracheostomized children, with a complete and readable historical record of tracheostomy tube change procedures during their hospitalization. The study was conducted at the Josefina Martínez Hospital, a long-stay center in Chile, which is part of the Josefina Martínez de Ferrari Foundation.

Measurements

Two years of follow-up were considered (August 2014-2016). During this period, each patient provided several data since the procedure was performed monthly according to institutional standards, patient's needs, and/or indications from the treating health team. The variables of interest and their respective responses (table 1) were recorded by clinical staff in a historical form, designed for this purpose, attached to each patient's medical record.

Statistical analysis

Descriptive statistics were used to characterize the sample, using mean, standard deviation, and percentage measures. The prevalence of the events of interest was calculated based on the total changes registered. We used the variance homogeneity test and the T-test to determine the degree of association. Odds Ratio were also calculated as risk measure. All the analyses were made using the statistical software Stata version 12® (Texas, United States).

Ethical aspects

The study was approved by the Scientific Ethical Committee of the Eastern Metropolitan Health Service in Santiago, Chile, on October 25, 2016. The authors reported no conflict of interest.

Results

39 of the 42 hospitalized children met the inclusion criteria. 760 cannula changes were recorded, of which 130 were excluded due to incomplete and/or illegible information, resulting in 630 procedures considered in the final analysis. The age of the participants at the time of change was 41.3 ± 31.3 months, and most of the patients were male (27/39, 69.2%).

The most frequent indication for tracheostomy was the need for prolonged mechanical ventilation (PMV) due to pulmonary or neurological causes (27/39, 69.2%), and critical airway obstruction (10/39, 26%). 13/39 (32%) used partial MV (only at night), while most patients used continuous MV (26/39, 66%).

A large proportion of the children (14/39, 36%) are patients with Neuromuscular Disease (NMD) or Chronic Lung Disease (CLD) (table 2).

Among health personnel and/or family members, 2095 were the participants involved in the 630 cannula changes. Most of them were nurses (34.9%), kinesiologists (21.8%), or family members (14.9%). In contrast, the most frequent operator of the change were family members (33.7%), followed by nurses, kinesiologists, and physicians (table 3).

Of the total relatives performing the tracheostomy change, 90.5% were child`s parents, being the mother the most frequentoperator (73.3%).

The main reason for changing is routine (83.3%),

Table 1. Study variables

Interest variables	Response variables
Tracheostomy change reasons	Routine Emergency Tracheostomy obstruction Therapeutic alternative
Tacheostomy size and brand	Size number previous to change Size number posterior to change Portex Rush Other
Operator and participants in the procedure (auxiliary/assistant)	Physician Nurse kinesiologist Auxiliary Nurse Care Giver: mother, father, brother, sister, grandparents, other
Complications	Bleeding Stoma closing First failed change attempt Need of guide Failed change
Education	It´s an educational instance? (Yes/No) Who is being educated (Physician, Relatives, Nurse, Kinesiologist, Auxiliary nurse)

followed by emergency (7%), and as a therapeutic alternative (6%). The emergencies were mostly cases of critical lumen obstruction of the TQT cannula. Most of the procedures did not modify the cannula's diameter (93.3%).

59.1% of the procedures performed played an additional educational role, mostly directed at family members (71.71%).

6% of tracheostomy changes had some complications. The main ones were bleeding at the stoma site (47.37%) and first failed change attempt (34.21%). There were no serious events or complications such as recannulation failure and/or death.

Most of the cannulas were Portex® and RUSH® brand, with 60% and 36.51% respectively, most of them without balloon (69.9%).

There was no association between any type of complication during the TQT cannula change procedure and the presence of the balloon, use of MV, operator, or educational context where the procedure was performed. However, the increase and decrease in internal diameter (ID) were associated with greater complications development. Additionally, the odds ratio was 5.12 for changes to a larger ID and 4.37 for changes to a smaller one (table 4).

Table 2. General characterization

Included children (n = 39)		
Age (months, mean, standard deviation)	41. 31 ± 31.3	
Male (n/%)	27/69.2	
Tracheostomy indication (n/%)	PMV need PMV caused by UAO UAO	27/69 5/5 10/26
MV use (n/%)	Continuous Night only No	26/66 13/32 1/2
Comorbidities (n/%)	NMD CLD UAO CNSD	14/36 11/28 8/21 6/15
Change reason (%)	Routine Emergency Obstruction Therapeutic alternative	83.3 7 3.7 6
Cuffed cannula (%)	Yes	30.1

VMP: Ventilación mecánica prolongada. OVAS: Obstrucción de vía aérea superior. ENM: Enfermedad neuromuscular. DPC: Daño pulmonar crónico, SNC: Alteración en sistema nervioso central.

Table 3. Tracheostomy change characterization

Perfomed tracheostomy changes (n = 630)		
Interest variables	Response variables	%
Participants	Physician	6.2
	Nurse	34.9
	Kinesiologist	21.8
	Auxiliary Nurse	14.9
	Family member	14.9
	Student (Any discipline)	7.3
Change operators	Physician	10.2
	Nurse	29.2
	Kinesiologist	12.9
	Auxiliary Nurse	8.3
	Family member	33.7
	Student (Any discipline)	5.7
Complications	Bleeding	47.4
	Stoma closing	7.9
	First failed change attempt	34.2
	Need of guide	7.9
	Failed change	2.6

Table 4. Association between complications and interest variables

Interest variables	OR	CI, 95%	p-value
Cuffed cannula	1.52	0.7 - 3.19	0.2358
MV use	0.77	0.10 - 33.6	0.7994
Operator	1.12	0.54 - 2.39	0.7426
Educational context	1.36	0.65 - 2.95	0.3833
ID size increase	5.12	1.39 - 15.6	0.0008
ID size decrease	4.37	1.6 - 10.7	0.0002

OR: Odds Ratio. MV: Mechanical ventilation. ID: Inner diameter. CI: Confidence interval.

Discussion

In this study, we described 630 procedures of TQT change, among which only 6% presented some complications. Such events were not associated with the type of operator who performed the procedure, which could be a family member or a health professional. Therefore, one of the main findings of this study is that, in children who use prolonged MV, the routine TQT change made either by health professionals or family members properly trained and qualified, is a safe procedure. However, we should take into account aspects regarding procedures involving the ID change of the TQT cannula.

It is expected that the greatest development of complications in patients with ID change will occur when trying to install a larger ID cannula (as a therapeutic alternative or as the child grows) which are 5 times more frequent in this context, making it a risky procedure. It is recommended that this procedure be done only by health personnel with proper training, which may be a physician along with nurses and/or kinesiologists, who may also run the procedure according to their experience, but always in the presence of the team leader. In contrast, and within the context of complications, it should be considered to cannulate with a smaller diameter that facilitates admission through the tracheostomy opening in case of an initial failed attempt with the ID of the cannula in use, a therapeutic resource mentioned by some authors[7,11]. Complications associated with the prolonged use of TQT are generally described ranging from 24 to 100%; however, reports detailing complications specifically during TQT change are scarce. Early complications associated with the first TQT change or TQT insertion have been described more frequently in the literature[12-14].

Regarding the indication for tracheostomy, it seems logical that the proportion of children tracheostomized due to PMV is equal to that of children using MV continuously, however, there is a 3% difference between them. This may because the initial indication was the need for PMV, which may be partial and/or intermittent as the patient has evolved favorably or her/his condition allows it, and should not necessarily be interpreted as the use of continuous MV.

The difference in the proportion between participants and operators who change the cannula is large since parents are encouraged to receive more training before discharge. In the same way, it is expected that the highest proportion of participants are nurses since a large part of this group educates family members and other health professionals, a similar phenomenon occurs regarding the participation of the Kinesiology team.

Occlusion is one of the most frequent complications in children with a tracheostomy, reaching 72% in newborns and 14% in 1-year children or older, while in our study it is close to 7%, which is the emergency change. However, it should be noted that in the mentioned studies, occlusion is treated as a general complication, without specifying its subsequent management[2,15]. In our study, there was a 3.7% non-critical tracheostomy occlusion, that is, given the difficulties to get artificial airway patency, we changed it preventively to avoid total occlusion. The lower frequency of complications reported in our study could be explained by the routine review of the artificial airway as a standard of care for each hospitalized children. Our patients undergo daily for at least 2 reviews of the tracheostomy

by the nursing team. Many of these procedures are performed with the respiratory kinesiology team, who help to clear the airway from secretions as needed.

Routine tracheostomy changes are made to avoid the formation of granulation tissue around it, development of infections, and occlusion by excessive secretions or to avoid material wear and eventual dysfunction, which according to Johansson et al would be considerable from its third month of use[16]. However, the recommendation among manufacturers of cannulas varies according to the material, and they should be replaced by a new one between 28 and 30 days after insertion[17]. At the other extreme, the recommendation for weekly change is also frequent and may narrow the tracheostomy stoma, especially in users of cuffed cannulas[18]. This event was not observed in this series of patients with monthly tracheostomy changes, appearing to be a safe practice not associated with complications increase.

Limitations of this study are the subjectivity of who records the characteristics of the procedure and the occurrence of it, which may represent a reporting bias typical of this type of studies based on clinical records, affecting the representativeness of the sample. Another aspect also related to design is the impossibility of making temporary associations and establishing risks. In addition, since it is a reference center specialized in the management of patients with artificial airway, our results may be conditioned by the experience of the health team, affecting its external validity. Despite this, the recommendations regarding the procedure for changing the cannula should not be affected.

Conclusions

Routine tracheostomy tube change performed by trained and qualified health professionals and family members is a safe procedure for children using an artificial airway for a long time. Unlike the above, switching tracheostomy tube to a bigger ID is a higher risk procedure that should only be performed by trained health professionals and in a multidisciplinary setting that includes more than 2 participants.

Ethical Responsibilities

Human Beings and animals protection: Disclosure the authors state that the procedures were followed according to the Declaration of Helsinki and the World Medical Association regarding human experimentation developed for the medical community.

Data confidentiality: The authors state that they have followed the protocols of their Center and Local regulations on the publication of patient data.

Rights to privacy and informed consent: The authors have obtained the informed consent of the patients and/or subjects referred to in the article. This document is in the possession of the correspondence author.

Conflicts of Interest

Authors declare no conflict of interest regarding the present study.

Financial Disclosure

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