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Experience of 1003 tracheostomy tube changes in a chronic pediatric intensive care unit

Abstract

Objective: To analyze how frequently tracheostomy tubes are replaced due to material-related issues and, secondarily, to describe the general reasons for tracheostomy tubes replacements in a public chronic pediatric inpatient unit from Buenos Aires, Argentina.

Study design: A retrospective observational study was conducted, analyzing the medical records of patients under 16 years of age who were admitted with tracheostomy tubes to our unit. A list of reasons for tracheostomy tubes replacement was established.

Results: A total of 30 patients with tracheostomy tubes were admitted. The median age was 21.5 months (range: 3 months to 16 years), and 20 patients (66.6%) were male. A total of 1,003 tracheostomy tube changes were performed for various reasons. The majority (78.2%) were routine, time-based changes (every 15 days). Regarding material defects, failures were more frequent in patients who had tracheostomy tubes with cuffs compared to those who had exclusively without cuffs ($p = 0.002$).

Conclusion: Our data analysis shows that performing tracheostomy tubes changes every 15 days and reusing them resulted in a 5.68% failure rate for certain tube components, with cuffed tubes experiencing the highest failure rates.

Keywords: tracheostomy, pediatrics, trachea, intensive care, long-term hospital, airway

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Introduction

Tracheostomy is an increasingly common procedure in pediatric intensive care units, allowing the survival of complex, technology-dependent patients.[1,2] Proper management of the tracheostomy tube is essential for patient comfort, and routine care includes periodic replacement.[3,4] This procedure is necessary to prevent infections, the formation of granulation tissue around the tracheal stoma, and occlusion caused by secretions.[5] In general, the frequency of tube replacement described in the literature varies from one week to three months.[3,6–9] It has been suggested that replacements performed every one to two weeks are associated with fewer complications from granulation tissue formation.[3,6,7,10,11] However, recommendations from manufacturers vary depending on the material, typically suggesting replacement every 28 to 30 days after insertion.[9] The reasons for indicating tracheostomy tube changes include the need to increase or decrease the tube diameter, malfunction due to a component breakage, the need for a specialized tracheostomy tube or simply routine changes.[3,12,13] In the chronic pediatric inpatient unit of the Instituto de Rehabilitación Psicofísica (IREP) routine changes every 15 days have been standardized since its opening in 2017. These procedures are performed by respiratory therapists, and a list of replacement indications has been established for subsequent analysis.

Objective

To analyze how frequently tracheostomy tubes are replaced due to material-related issues and, secondarily, to describe the general reasons for tracheostomy tubes replacements in our institution.

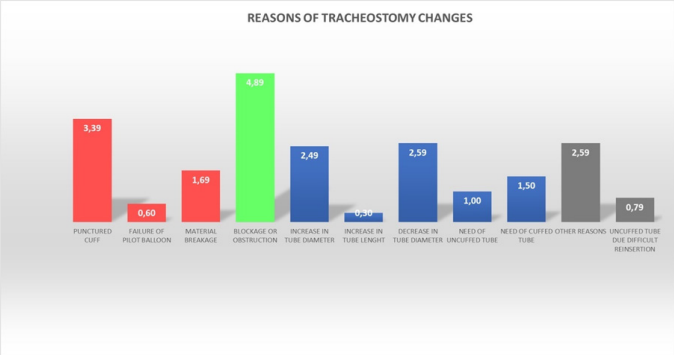
Material and Methods

A retrospective observational study was conducted, analyzing the medical records of patients under 16 years of age who were admitted with tracheostomy tubes to the Chronic Pediatric Intensive Care Unit at IREP, Ciudad Autónoma de Buenos Aires (CABA), between May 2017 and April 2024. The following reasons for tracheostomy tubes replacement were stablished in the unit: routine changes, punctured cuff, increase or decrease in tube diameter, need for a cuffed tube, blockage or obstruction, failure of the pilot balloon, material breakage, increase in tube length, need for an uncuffed tube, other reasons (e.g., suspected issues that were not confirmed or team-recommended replacements outside the standard classification), and the need for an uncuffed tube due to difficulties inserting a cuffed one. Additional variables considered included age, gender, days with tracheostomy tubes in the Chronic Pediatric Intensive Care Unit, performance of fibrobronchoscopy, type of lesion (granuloma, stenosis, or tracheomalacia), lesion location, and the percentage of tracheal lumen occlusion.

In our service, the hygiene and reuse of tracheostomy tubes followed the recommendations of the Consensus for the Care of Children with tracheostomy tubes by the Argentine Society of Pediatrics, using an enzymatic detergent for decontamination.[7,14] The reuse of tracheostomy tubes through cleaning and disinfection protocols is a regular and safe practice in tracheostomized pediatric patients and reduce costs. Specifically, tubes are gently washed with hot water and a pipe cleaner inside and outside till no mucus is observed and then they are soaked in hot water and enzymatic detergent (Bonzyme) for 15 minutes (dilution ratio: 7.5ml for 1liter of water). Finally, they are air dried completely and stored. Ethical committee clearance was obtained for performing this study and a written informed consent was obtained from the parents of all the children. Continuous variables were reported as mean and standard deviation (SD) or median and interquartile range (IQR), as appropriate. Categorical variables were presented as absolute counts and percentages (n; %). The Shapiro-Wilk test was used to assess the distribution of numerical variables. Statistical analysis was performed using the Infostat software.

Results

A total of 30 patients with tracheostomy tubes were admitted. The median age was 21.5 months (range: 3 months to 16 years), and 20 patients (66.6%) were male. A total of 1,003 tracheostomy tube changes were performed for various reasons. Most of the tube change reasons (78.2%) were routine, i.e. time-based changes (every 15 days). Other reasons included blockage (4.89%), punctured cuff (3.39%), reduction in tube diameter (2.59%), increase in tube diameter (2.49%), material breakage (1.69%), and pilot balloon valve failure (0.6%). Taking out the routine reasons, the rest of tube changes might be grouped in four practical categories as "failure of the tracheostomy material" (red bars); "humidification problems" (green bar); "therapeutic interventions", i.e. in order to decannulate a patient or adapt the tracheostomy to the worsening of the chronic illness of the patient (blue bars); and "unclear reasons" (grey bars) shown in Figure. As it is shown in Figure, most of the tube changes are therapeutic decisions (7.88%), i.e. controlled tube change situations; but obstructions (4.89%) and tracheostomy material failures (5.68%) are emergency changes.



Each patient underwent a median of 18 tube changes (range: 0 to 136) during their tracheostomized period (median: 252 days, range: 9 to 1,822 days), with a median use of 14.87 days per tracheostomy tube (IQR: 13.62–16.73). Regarding material defects, failures were more frequent in patients who had tracheostomy tubes with cuffs compared to those who had exclusively without cuffs ($p = 0.002$) (9 patients only use cuffed tubes and 13 patients used uncuffed tubes throughout their entire stay at the institution). Fibrobronchoscopies were performed on only five patients, revealing granulomas and/or stenosis in all cases. In three patients, these lesions occupied more than 50% of the tracheal lumen. Most of the tracheostomy tubes provided by our institution's pharmacy were from the Shiley brand. However, other brands such as Well-lead, Portex, Aurinco, Tracoe, and Rusch were also used, depending on the unit's availability or the patient's referring institution. All of them have high-volume and low-pressure cuffs.

Discussion

There is limited evidence regarding the optimal timing for replacing long-term tracheostomy tubes in the pediatric population.[5,15] Practices vary widely across institutions and countries.[16–18] In our study, we observed that routine replacement every 15 days accounted for most changes (78.2%). It is known that PVC tubes are flexible but become rigid and prone to cracks or splits after 3–4 months of use.[16,19] In daily practice, the use of multiple tracheostomy tubes is often alternated, with deterioration typically noted after 6 months to 1 year. Nonetheless, there is no consensus about cleaning techniques (brush use or not, type of detergent, time of soaking, etc.) and tube reuse practices.[20,21] It is essential to inspect all tubes before use.[6] Despite intensive use and the drying effects of enzymatic detergents, only 5.68% of the replacements in our study were due to material failure.

Jalil et al.[9] studied a series of patients at a Chilean hospital, where tracheostomy tube changes occurred every 30 days, reporting 630 procedures. They classified replacements into routine changes, emergencies (mostly due to critical lumen obstructions, 7%), occlusions, and therapeutic alternatives. Similar to our findings, routine changes were the most frequent reason (83.3%).[9] If we equate emergency changes to what we classify as blockage, our protocol of changing tubes every 15 days yields similar percentages to monthly protocols.

Although studies with longer intervals between changes report similar rates of blockages, one study described complications over a 3-month interval. A tertiary pediatric medical center in Thailand reported an average interval of 87 days between replacements without a significant increase in complications (6.48%). They cited one case of granulation tissue development at the distal tip of the tracheostomy tube, leading to adjustments to a 2–4-week replacement interval. Even with more frequent replacements, the formation of granulation tissue persisted, suggesting that shorter intervals may not prevent this complication.[22]

Given these findings, extending the time frame between routine changes appears to be a safe alternative for future consideration. However, our study did not aim to analyze complications, so we did not record airway infections, peri-stomal bleeding, stoma closure, dilation requirements, or guide use during replacements.[23] Nevertheless, among the 1,003 documented changes, only one event of airway loss occurred, requiring orotracheal intubation. Additionally, we did not document accidental decannulations, which were observed in infants during activities such as play, bathing, or clothing changes.

Limitations include the absence of data on the number of times each tracheostomy tube was reused, which may be associated with material failure. Another limitation is the potential subjectivity of those recording the procedure details and reasons for replacement, which may introduce reporting bias. Finally, strengths include the analysis of over 1,000 procedures in a pediatric population, a group that is typically less studied in this context. Although, it is still necessary to have more randomized controlled trials that compare methods of cleaning and disinfection tracheostomies to preserve the integrity of the tube and, also that compare different timings of tracheostomy tube changes and analyze their complications.

Conclusion

Our data analysis shows that performing tracheostomy tubes changes every 15 days and reusing them resulted in a 5.68% failure rate for certain tube components, with cuffed tubes experiencing the highest failure rates. Although manufacturers recommend routine replacements approximately every 30 days, this practice is not commonly followed in the daily management of pediatric tracheostomized patients. Most tube changes were scheduled based on time.

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None.

Conflicts of interest

The author declares there is no conflict of interest.

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