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ORIGINAL

Long-term tracheostomy complications

Complicaciones tardías de traqueostomía

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ABSTRACT

Introduction: prolonged tracheostomy is associated with chronic complications that affect respiratory, phonatory, and swallowing functions, particularly in institutionalized patients with multiple comorbidities. Evidence from long-term care settings remains limited, highlighting the need for locally generated data.
Method: a retrospective, cross-sectional, observational study was conducted in a chronic care facility in Buenos Aires in 2024. A total of 87 adult patients with a tracheostomy in place for ≥3 months were included. clinical, functional, and structural variables were collected and analyzed using descriptive statistics, correlation tests, and logistic regression.
Results: all patients exhibited phonatory and/or swallowing dysfunction, and 64,3 % developed multiple complications. The most frequent complications were granulation tissue formation (21,8 %), recurrent respiratory infections (20,7 %), and tracheal stenosis or tracheomalacia (18,4 %). cannulation time was an independent predictor of multiple complications (OR = 1,18; $p < 0,01$), as was prolonged invasive mechanical ventilation ($p < 0,05$). functional impairment was substantial: 44,8 % of patients had total dependency and 24,1 % had severe dependency according to the Barthel Index.
Conclusion: long-term complications are highly prevalent among chronically tracheostomized patients and are associated with significant functional deterioration. These findings underscore the importance of structured follow-up protocols, periodic endoscopic assessment, and interdisciplinary rehabilitation, as well as the need for multicenter prospective studies to inform the development of national clinical guidelines.

KEYWORDS

Tracheostomy; Chronic Complications; Long-Term Care.

RESUMEN

Introducción: la traqueostomía prolongada se asocia con complicaciones crónicas que afectan la función respiratoria, fonatoria y deglutoria, especialmente en pacientes institucionalizados con múltiples comorbilidades. la evidencia en contextos de cuidados crónicos es limitada, lo que justifica la necesidad de estudios locales.
Método: estudio observacional, retrospectivo y transversal realizado en una unidad de cuidados crónicos de Buenos Aires durante 2024. se incluyeron 87 adultos con traqueostomía ≥ 3 meses. se recopilaron variables clínicas, funcionales y estructurales, analizándose mediante estadística descriptiva, correlacional y regresión logística.
Resultados: todos los pacientes presentaron disfunción fonatoria y/o deglutoria, y el 64,3 % múltiples complicaciones. las más frecuentes fueron formación de tejido de granulación (21,8 %), infecciones respiratorias recurrentes (20,7 %) y estenosis/traqueomalacia (18,4 %). el tiempo de canulación fue predictor independiente de complicaciones múltiples (OR = 1,18; $p < 0,01$), al igual que la ventilación mecánica invasiva prolongada ($p < 0,05$). la dependencia funcional fue elevada: 44,8 % total y 24,1 % severa según el índice de Barthel.

Conclusión: las complicaciones tardías son altamente prevalentes en pacientes con traqueostomía crónica y se asocian con deterioro funcional significativo. estos hallazgos refuerzan la necesidad de protocolos de seguimiento estructurado, evaluación endoscópica periódica y rehabilitación interdisciplinaria, además de estudios multicéntricos que consoliden guías clínicas nacionales.

PALABRAS CLAVE

Traqueostomía; Complicaciones Crónicas; Cuidados Prolongados.

INTRODUCTION

Tracheostomy is a widely used procedure in critically ill patients requiring prolonged mechanical ventilation, secretion management, or relief of upper airway obstruction. Its use has increased in recent decades due to population aging, improved survival of critically ill patients, and advances in intensive care. It is estimated that between 10 % and 20 % of mechanically ventilated patients in intensive care units (ICUs) require a tracheostomy, with similar figures reported in Argentina.[1]

Although tracheostomy provides clinical benefits during the acute phase, prolonged use may lead to long-term complications, defined as those occurring more than 30 days after the procedure. In this study, we analyzed complications arising beyond three months post-tracheostomy in a clinically complex population that has been scarcely addressed in the literature but is of high public health relevance. These complications may compromise respiratory, phonatory, or swallowing functions, and include tracheal stenosis, granulation tissue formation, recurrent respiratory infections, tracheoesophageal fistulas, and vocal or swallowing dysfunction.[2,3,4]

Despite the widespread use of tracheostomy in critically ill patients, most studies focus on variables related to the acute phase of the procedure and on ICU populations.[5,6] In contrast, there is little systematized evidence on chronic complications in patients with prolonged tracheostomy admitted to subacute or long-term care units.[7] This population presents important clinical particularities, such as longer cannulation times, high comorbidity burden, functional deterioration, and dependence on prolonged ventilatory support,[8,9] factors that increase their vulnerability to adverse events and complicate long-term follow-up.

In Argentina, it is estimated that there are approximately 2 000 adult ICU beds, with tracheostomy performed in 10–20 % of mechanically ventilated patients.[1] Among this group, 40–60 % remain cannulated beyond three months, constituting a condition of chronic tracheostomy, which is associated with a high risk of structural and functional complication.[2] However, national evidence regarding clinical trajectories and outcomes in this population remains limited, reinforcing the need for studies that characterize this issue in the local context.

Although some studies have described complications and long-term outcomes in tracheostomized patients, such as those by Stark et al. in long-term care settings [15] and by Engoren et al. in ICU populations,[16] few have specifically focused on institutionalized patients with prolonged tracheostomy, nor integrated the simultaneous analysis of functional, clinical, and structural variables through multivariate approaches.

The present study, conducted in an Argentine chronic care setting, aims to complement existing evidence by providing relevant data on factors associated with long-term tracheostomy complications, patient functionality, and ventilatory support requirements in a clinically complex cohort. The primary objective was to identify and characterize chronic complications related to tracheostomy in adult patients admitted to a specialized chronic critical care facility in Buenos Aires, Argentina, between January and December 2024, and to correlate these events with clinical, functional, and structural variables.

METHOD

Study design:

An observational, retrospective, descriptive, and cross-sectional study with an exploratory approach was conducted to analyze clinical and procedural variables associated with long-term tracheostomy complications in adult patients. The research was based on the review of medical records from a chronic care center, using institutional databases and standardized protocols to ensure data reliability.

Population and inclusion criteria:

The study population consisted of adult patients (≥18 years) with a tracheostomy in place for at least three months, who were admitted to the chronic critical care facility during the 2024 calendar year. A total of 94 medical records were reviewed. After applying the eligibility criteria, seven cases were excluded due to a tracheostomy duration

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of less than three months or incomplete clinical documentation, resulting in a final sample of 87 patients.

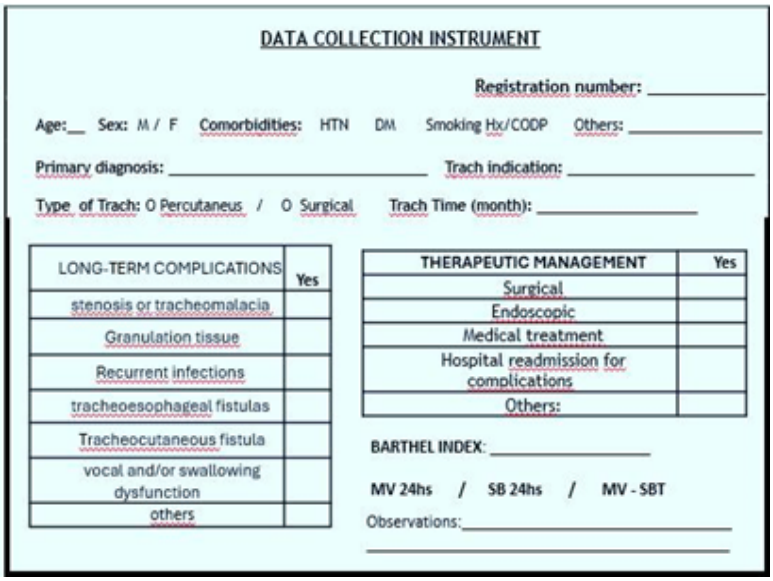
Inclusion criteria:
Included adult patients (≥18 years) admitted to the chronic critical care facility during 2024, with a tracheostomy in place for at least three months and complete medical records containing sufficient clinical, functional, and procedural data.

Exclusion criteria
Comprised patients with a tracheostomy duration shorter than three months, incomplete or missing clinical documentation, or those transferred from other institutions with insufficient follow-up data.

Exit criteria:
Were defined as patient death or transfer to another institution before completing the follow-up period, and withdrawal of consent for data use when applicable under institutional policy.

Setting:
The study was conducted in a private tertiary care facility specializing in the management of patients with complex chronic conditions. The institution functions as a referral center for other healthcare units, admitting patients requiring prolonged ventilatory support, advanced tracheostomy management, weaning from mechanical ventilation, as well as specialized motor and respiratory rehabilitation.

Data sources and collection methods:
No direct interventions were performed on patients. Data were obtained through an exhaustive review of medical records, bronchoscopy reports, nursing notes, interdisciplinary medical evaluations, and functional documentation. A data collection instrument (figure 1) was designed ad hoc to systematize clinical, functional, and structural information for each case.


DATA COLLECTION INSTRUMENT

Registration number: _____

Age:__ Sex: M / F Comorbidities: HTN DM Smoking Hx/COPD Others: _____

Primary diagnosis: _____ Trach indication: _____

Type of Trach: O Percutaneus / O Surgical Trach Time (month): _____

LONG-TERM COMPLICATIONS	Yes
stenosis or tracheomalacia	
Granulation tissue	
Recurrent infections	
tracheoesophageal fistulas	
Tracheocutaneous fistula	
vocal and/or swallowing dysfunction	
others	

THERAPEUTIC MANAGEMENT	Yes
Surgical	
Endoscopic	
Medical treatment	
Hospital readmission for complications	
Others:	

BARTHEL INDEX: _____

MV 24hs / SB 24hs / MV - SBT

Observations: _____

Figure 1. Data collection instrument

Ad hoc form designed to systematize clinical, functional, and structural information for each patient, including demographic variables, comorbidities, complications, and ventilatory support.

Variables:
The variables analyzed included demographic data (age and sex); clinical information (primary diagnosis and relevant comorbidities); tracheostomy-related factors such as type of procedure (surgical or percutaneous), indication, date, and duration of cannulation; and long-term complications, including granulation tissue, tracheal stenosis or tracheomalacia, recurrent respiratory infections, tracheoesophageal fistulas, and vocal and/or swallowing dysfunction. Therapeutic management was recorded according to the type of intervention (medical, endoscopic, or surgical). Functional status was assessed using the Barthel Index, and ventilatory support was categorized as continuous invasive mechanical ventilation, spontaneous breathing trials, or permanent spontaneous breathing.

Statistical analysis:
Data were analyzed using IBM SPSS Statistics, version 27.0. Qualitative variables were expressed as absolute and relative frequencies (%), while quantitative variables were expressed as means with standard deviation or medians with interquartile ranges, according to distribution. Associations between categorical variables were assessed using the Chi-square test or Fisher's exact test. For quantitative variables, Student's t-test or the Mann-Whitney U test was applied depending on distribution normality. Odds ratios (OR) with 95 % confidence intervals (CI) were calculated to estimate the strength of association between clinical variables and the occurrence of complications. Binary logistic regression was performed to identify independent predictors of multiple complications. A p-value <0,05 was considered statistically significant.

Ethical considerations:
The research protocol was approved by the institution's Teaching and Research Committee and Ethics Committee. As this was a retrospective study, data confidentiality was ensured without the need for individual informed consent, in accordance with current regulations.

RESULTS

The study cohort included 87 tracheostomized patients, with a balanced sex distribution (52,9 % male and 47,1 % female) and a mean age of 65,4 years. The median and mode were both 71 years, indicating a predominantly older adult population. The age range was broad (19 to 93 years), reflecting substantial heterogeneity in the clinical profile and suggesting the need for individualized approaches in the management and follow-up of this population. From a clinical perspective, a high comorbidity burden was observed: 62,1 % of patients had two or more chronic conditions. The most prevalent were arterial hypertension (32,2 %), COPD or a history of smoking (25,3 %), and obesity (14,9 %). Cases of diabetes mellitus (10,3 %), heart failure (10,3 %), and acute renal failure (5,7 %) were also recorded. This clinical profile highlights the vulnerability of tracheostomized patients, who face an increased risk of complications, prolonged critical care needs, and the requirement for interdisciplinary follow-up (figure 2).

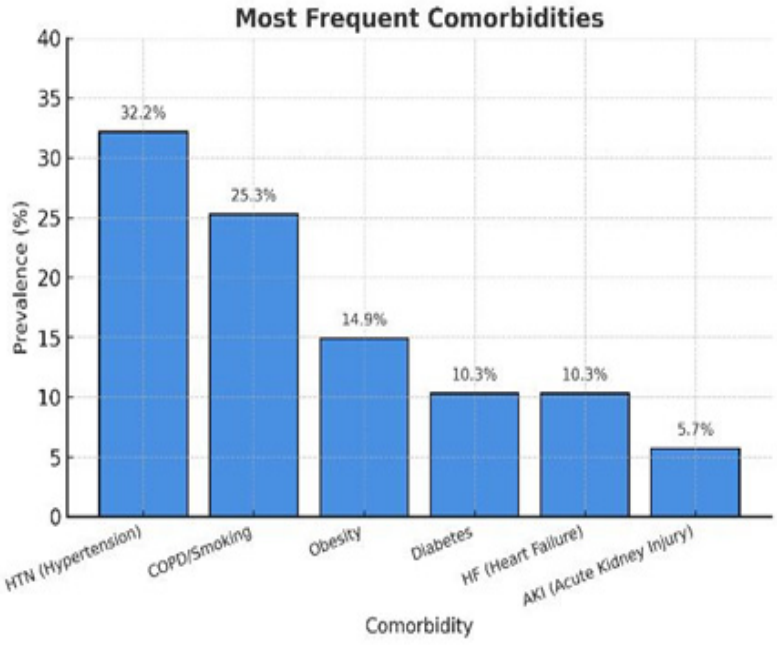


Figure 2. Comorbidities

Percentages of relevant comorbidities in the cohort (n=87). Arterial hypertension (32,2 %), COPD/smoking history (25,3 %), and obesity (14,9 %) were the most prevalent. HTN = hypertension; COPD = chronic obstructive pulmonary disease.
Regarding primary diagnoses, the most frequent was hemorrhagic stroke, with a prevalence of 23 %. This was followed by COPD exacerbation (14,9 %) and ischemic stroke (13,8 %), underscoring the impact of neurological and respiratory diseases in this population. Less frequent conditions included severe traumatic brain injury, Guillain-Barré syndrome, septic shock, and cardiogenic shock, each accounting for 6,9 %, as well as other critical causes of lower incidence (figure 3).

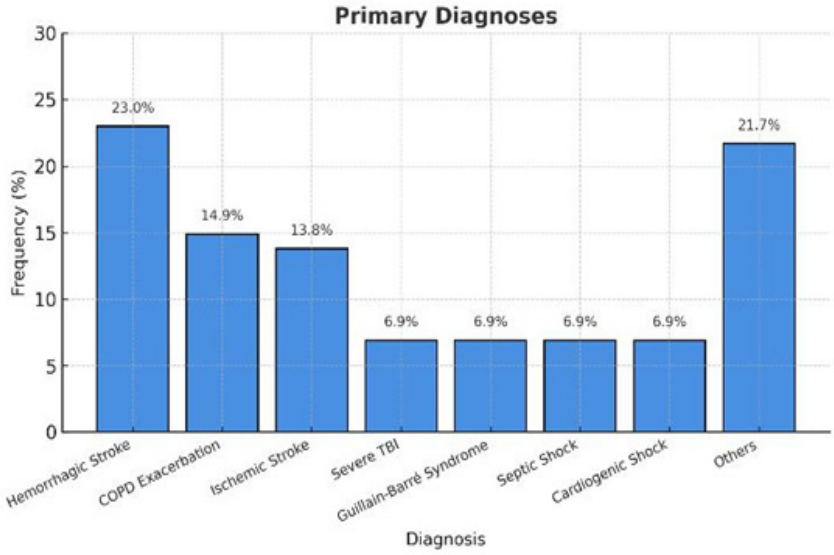


Figure 3. Primary admission diagnosis

Frequency of diagnoses leading to admission in the cohort. Hemorrhagic stroke (23 %) and COPD exacerbation (14,9 %) were the most frequent causes.

These pathologies were reflected in the clinical indications for tracheostomy. The primary indication was prolonged mechanical ventilation (39,1 %), followed by impaired consciousness with loss of protective airway reflexes (36,8 %), and failed weaning attempts (24,1 %). These findings are consistent with the literature, which describes critically ill patients with neurological or respiratory diseases as the main candidates for prolonged tracheostomy.

With respect to technique, 73,5 % of procedures were performed percutaneously, while 26,4 % were performed using the conventional surgical approach. This distribution aligns with current critical care trends favoring the percutaneous technique due to its lower complexity and feasibility at the bedside. Nonetheless, the surgical approach remains preferred in patients with anatomical abnormalities, hemodynamic instability, or previous complications (23).

In the analyzed cohort, cannulation time showed a heterogeneous distribution: 28,7 % of patients remained cannulated for three months, 37,9 % between 4 and 6 months, 18,4 % between 7 and 12 months, 6,9 % between 13 and 24 months, and 8 % for more than two years (figure 4). This prolonged cannulation highlights a significant burden of chronic tracheostomies, implying greater challenges in rehabilitation, follow up, and discharge planning.

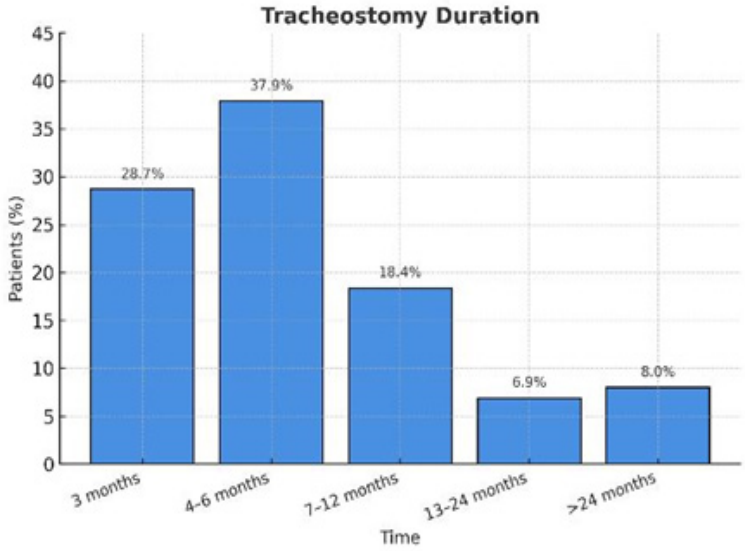


Figure 4. Duration of tracheostomy

Proportion of patients according to time with cannula in place. More than one-third remained cannulated between 4 and 6 months, and 8 % exceeded two years.

From a functional perspective, the Barthel Index revealed that 44,8 % of patients had total dependency, 24,1 % severe dependency, and 31,0 % moderate dependency. No patients were classified as independent or with mild dependency. This functional profile reflects marked disability with important prognostic implications. Previous studies have demonstrated that low Barthel Index scores predict hospital complications, readmissions, longer length of stay, and increased mortality (1,2,3).

Correlation analysis showed weak but clinically relevant associations. A positive correlation was observed between age and tracheostomy duration (r = 0,17), suggesting that older patients tend to remain cannulated longer. In contrast, a negative correlation was found with the Barthel Index (r = –0,10), indicating that greater functional independence was associated with shorter cannulation time. Furthermore, the surgical approach was associated with a longer mean cannulation duration (11,6 months) compared to the percutaneous approach (7,3 months), although without reaching statistical significance (p = 0,071). This trend may be related to greater case complexity in surgical patients (figures 5 and 6).

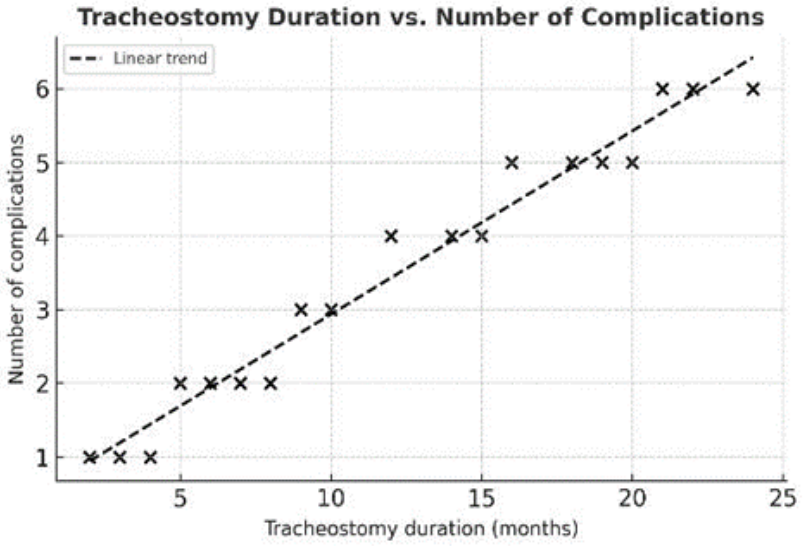


Figure 5. Scatter plot of tracheostomy duration vs. number of complications

Scatter plot showing the association between cannulation duration and the number of chronic complications recorded. A positive correlation was observed (r = 0,34), indicating that patients with longer tracheostomy duration presented a higher number of structural and functional complications.

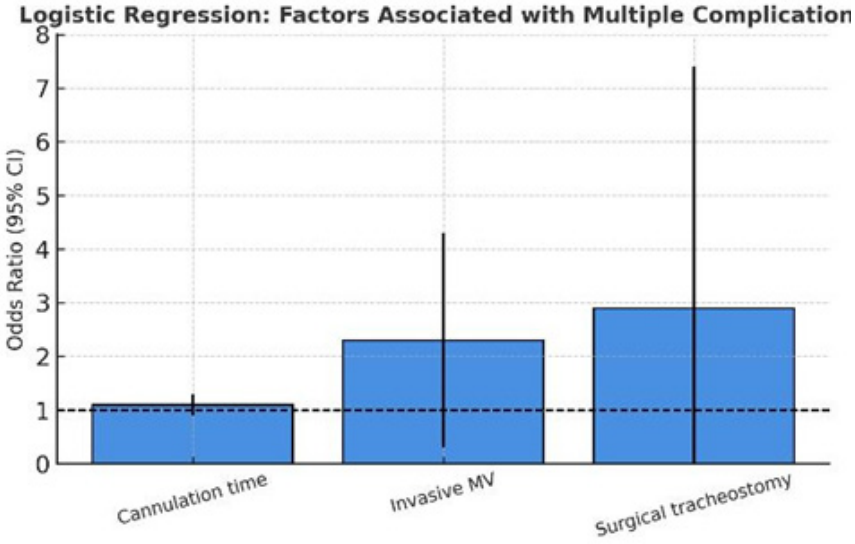


Figure 6. Forest plot showing odds ratios (OR) with 95 % confidence intervals (CI)

Forest plot displaying the association between surgical vs. percutaneous tracheostomy and specific complications.

The surgical approach was associated with higher risk of granulation tissue formation, recurrent respiratory infections, and tracheal stenosis/tracheomalacia. OR = odds ratio; CI = confidence interval.

A particularly significant association was observed between tracheostomy duration and the presence of multiple chronic complications (r = 0,34). This finding supports the hypothesis that prolonged cannulation increases the risk of structural and functional complications, such as stenosis, tracheomalacia, infections, fistulas, and phonatory and/or swallowing dysfunction. In this context, the importance of establishing periodic endoscopic follow-up protocols and preventive strategies in long-term care facilities is emphasized.

Regarding mechanical ventilation (MV) requirements, 40,2 % of patients remained on continuous MV, 32,2 % underwent spontaneous breathing trials (SBT/MV), and 27,6 % maintained permanent spontaneous breathing. This classification of ventilatory support showed a statistically significant association with the presence of multiple complications (p = 0,012), which were more frequent in patients requiring continuous mechanical ventilation.

Binary logistic regression analysis identified tracheostomy duration as a significant predictor of multiple complications (OR = 1,175; p = 0,008), indicating that each additional month of cannulation increased the risk of developing more than one complication by 17,5 %. Age and functional independence level showed similar trends, although without reaching statistical significance.

Finally, analysis by tracheostomy type revealed a significant association between the surgical approach and certain specific complications. Surgical procedures carried a higher risk of granulation tissue formation (OR = 2,68; 95 % CI: 1,08–6,69; p = 0,032), recurrent respiratory infections (OR = 3,45; 95 % CI: 1,27–9,41; p = 0,015), and tracheal stenosis/tracheomalacia (OR = 2,88; 95 % CI: 1,09–7,60; p = 0,031) (figure 7). No significant differences were found in the occurrence of fistulas. These results underscore the need for specialized follow-up in patients with surgical tracheostomy, given their higher structural risk.

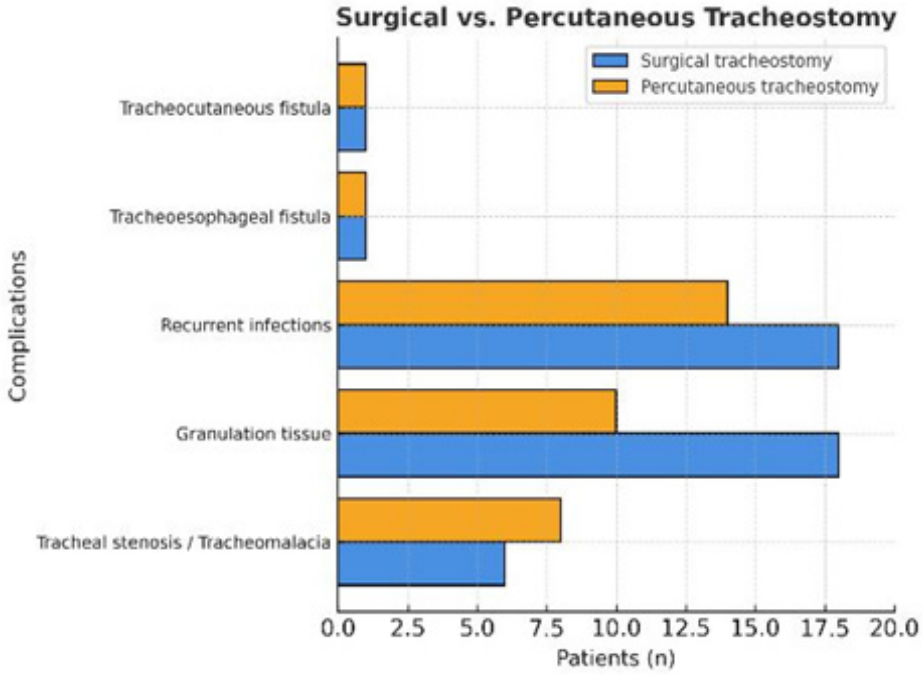


Figure 7. Tracheostomy types and their association with complications

Comparison of the proportion of patients with ≥1 complication according to tracheostomy type. The surgical approach was associated with a higher frequency of complications compared to the percutaneous technique.

DISCUSSION

The findings of this study demonstrate a high burden of morbidity among chronically tracheostomized patients admitted to long-term care facilities. The high prevalence of complications, particularly phonatory and swallowing dysfunction, reflects the functional fragility of this population and the sustained impact of tracheostomy on communication, nutrition, and quality of life.[19,20,21]

Research involving chronically tracheostomized patients presents notable methodological challenges, both in defining representative populations and in performing multivariable analyses of their complex clinical profiles. Currently, no standardized global statistics describe the prevalence or outcomes of patients with prolonged

cannulation beyond three months. A recent Japanese study of over 750 adult tracheostomized patients reported decannulation rates of 40,8 % at three months, 63,9 % at one year, and 65,0 % at two years of follow-up, indicating that a considerable subset remains tracheostomized beyond the early post-procedural period, requiring prolonged care and specialized follow-up.[22]

The relative rarity of such cases, their dispersion across institutions, and their marked clinical heterogeneity complicate data collection and limit comparability across studies. Moreover, the absence of standardized diagnostic, follow-up, and documentation criteria, together with the interdependence of multiple variables—such as tracheostomy type and indication, cannulation time, degree of functional dependence, and mechanical ventilation—makes it difficult to produce robust and generalizable evidence.

Despite these challenges, the present study provides valuable local data on an underrepresented and clinically complex population. A total of 64,3 % of patients developed two or more chronic complications, the most frequent being granulation tissue formation (21,8 %) and recurrent respiratory infections (20,7 %), consistent with previous reports on prolonged tracheostomy.[5,6] Although most complications were clinically manageable, more than half of the cohort required endoscopic or surgical interventions, increasing treatment complexity, length of stay, and overall morbidity.[7]

Invasive mechanical ventilation was the only variable significantly associated with multiple complications ($p = 0,012$), confirming this subgroup's higher clinical complexity. Although tracheostomy type did not reach statistical significance ($p = 0,06$), surgical procedures showed a higher complication rate (74 %) compared with percutaneous techniques (59 %), consistent with previously described trends. No associations were found between sex or functional dependence and complication frequency; however, patients with longer cannulation times and lower Barthel Index scores tended to experience more adverse events, suggesting a potential prognostic role that warrants confirmation in larger samples.

Limitations

This study has several limitations. Its retrospective and single-center design may restrict the generalizability of findings to other healthcare settings. Although representative of the institutional caseload, the sample size was relatively small, which may have reduced the statistical power to detect associations of modest magnitude. The reliance on medical records could have introduced information bias due to incomplete documentation. Additionally, the cross-sectional approach precluded assessment of temporal or causal relationships between variables. Finally, the lack of standardized diagnostic and follow-up criteria across institutions limits comparability with other studies. Despite these constraints, this research provides exploratory evidence that improves understanding of long-term tracheostomy outcomes and highlights the need for larger, multicenter, prospective studies.

These findings underscore the importance of implementing structured follow-up strategies for patients with chronic tracheostomy, particularly those with prolonged mechanical ventilation, surgical tracheostomy, or extended cannulation time. Periodic endoscopic surveillance, interdisciplinary management, and functional rehabilitation should constitute key pillars of care. Such measures may guide the development of institutional protocols and health policies aimed at improving longitudinal follow-up and reducing complication rates in this vulnerable population. Incorporating these strategies into national clinical guidelines is essential given the growing demand for long-term care and the need for efficient resource allocation.

CONCLUSIONS

Long-term tracheostomy complications were highly prevalent in this cohort of adult patients admitted to a chronic care unit, representing a significant burden of morbidity. Phonatory and swallowing dysfunctions were universal, and over 60 % of patients developed multiple complications, most commonly granulation tissue formation, recurrent respiratory infections, and airway structural alterations such as stenosis and tracheomalacia. These findings emphasize the profound functional and prognostic impact of tracheostomy in clinically fragile patients.

Cannulation time was identified as an independent predictor of multiple complications, and prolonged invasive mechanical ventilation was significantly associated with an increased risk of adverse outcomes. Although tracheostomy type was not statistically associated with overall complication rates, surgical procedures were linked to a higher incidence of structural complications. These results highlight the importance of integrating clinical and technical variables when planning long-term management and rehabilitation strategies.

Structured monitoring programs, including regular endoscopic assessments, functional follow-up using validated tools, and interdisciplinary rehabilitation focused on communication, swallowing, and autonomy, should be prioritized. Standardizing institutional protocols and incorporating these practices into national clinical guidelines could improve patient outcomes and optimize healthcare resource utilization in long-term care settings.

As this was a retrospective, single-center study, the findings should be interpreted with caution and not directly generalized to other contexts. Nevertheless, the contribution of local data from an underrepresented population

adds value to the current evidence base. Future prospective, multicenter studies are warranted to validate these results, identify additional predictors, and support the development of standardized protocols and public health policies for the comprehensive management of chronically tracheostomized patients.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

AUTHORSHIP CONTRIBUTION

Conceptualization: Angel Vasquez Oropeza.
Drafting – original draft: Angel Vasquez Oropeza.
Writing – proofreading and editing: Angel Vasquez Oropeza.