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Research Article

Emergency Tracheotomy for Tumor-Related Upper-Airway Obstruction in a Tertiary ENT Service in Burundi: Clinical Profile, Postoperative Morbidity, and Health-Systems Implications

Lionel Horugavye[1]*, Gordien Ngendakuriyo[1], Sixte Nderagakura[1], Octave Murisho[1], Josue Ndayishemeze[1], Bernard Niyondavyi[1]

[1]Department of Otorhinolaryngology–Head and Neck Surgery, Centre Hospitalo-Universitaire de Kamenge, University of Burundi, Bujumbura, Burundi

***Corresponding Author:** Lionel Horugavye, Department of Otorhinolaryngology–Head and Neck Surgery, Centre Hospitalo- Universitaire de Kamenge, University of Burundi, Bujumbura, Burundi. Email: lionel.horugavye@ub.edu.bi

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Abstract

Background: In high-income settings, adult tracheostomy is now predominantly associated with prolonged ventilation and critical-care pathways. In many low-resource settings, however, tracheotomy remains closely linked to advanced upper-airway obstruction and head and neck disease. We evaluated tracheotomy practice in a tertiary otorhinolaryngology service in Burundi as both a clinical airway intervention and a potential service-level signal of delayed access to airway-oncology care.

Methods: We conducted a retrospective observational study of all patients who underwent tracheotomy in the ENT department of the Centre Hospitalo-Universitaire de Kamenge between 1 January 2021 and 30 April 2025. This was an exhaustive institutional census of eligible cases during the study period. Twenty-three records were identified, two were excluded because of unusable data, and 21 analyzable cases were included. Data were abstracted from archived clinical records using a standardized collection form. Primary outcomes were the distribution of final diagnoses, the proportion of emergency procedures, and the frequency of postoperative complications. Descriptive statistics are presented as counts, percentages, means, ranges, and exact binomial 95% confidence intervals (CIs).

Results: Twenty-one tracheotomies were analyzed, representing 0.86% of 2415 ENT surgical procedures and a mean annual volume of 4.2 cases. The mean age was 50.4 years (range 2–77 years), and 18/21 patients were male (85.7%, 95% CI 63.7%–97.0%). Laryngeal dyspnea was the leading presentation (19/21, 90.5%, 95% CI 69.6%–98.8%), and stage III–IV dyspnea was documented in 15/19 symptomatic patients. Laryngeal tumor was the predominant final diagnosis (16/21, 76.2%, 95% CI 52.8%–91.8%). Emergency tracheotomy was performed in 16/21 cases (76.2%, 95% CI 52.8%–91.8%). Postoperative complications occurred in 14/21 patients (66.7%, 95% CI 43.0%–85.4%), most commonly mucus-plug obstruction (10/21, 47.6%, 95% CI 25.7%–70.2%).

Conclusion: In this tertiary Burundian ENT service, tracheotomy was predominantly an emergency procedure for tumor-related upper-airway obstruction and was followed by substantial postoperative morbidity. Clinically, the cohort defines a late-presenting airway-oncology phenotype. At the systems level, the same burden is consistent with delayed diagnosis, referral inefficiency, and postoperative care-process fragility, although these mechanisms were not directly measured. Earlier red-flag airway-oncology evaluation and a standardized postoperative tracheotomy care pathway should therefore be considered immediate quality-improvement priorities.

Keywords: Tracheotomy, Tracheostomy, Airway obstruction, Laryngeal neoplasms, Postoperative complications, health systems, Burundi.

Introduction

Tracheotomy remains a core airway procedure in otorhinolaryngology, but its epidemiology varies substantially across health systems. In high-income settings, adult tracheostomy has shifted toward prolonged ventilation, critical-care practice, and protocolized multidisciplinary management. Outcome optimization increasingly depends on standardized safety pathways rather than on operative technique alone [1–4].

The broader oncologic context is equally relevant. Global cancer burden remains substantial, and laryngeal cancer continues to contribute materially to morbidity and mortality. Across Africa, head and neck cancers are frequently encountered at advanced clinical stages, and delayed recognition, together with constrained specialist access, often shapes both severity at presentation and treatment opportunities [5–8].

In this context, tracheotomy in a tertiary ENT service in Burundi may represent more than an isolated operative event. It may function simultaneously as an airway-rescue procedure, an endpoint of advanced upper-airway disease, and a service-level signal of how effectively the health system identifies, routes, and stabilizes patients at risk of airway compromise.

Burundi-specific tracheotomy data remain scarce, and the existing procedural literature rarely frames emergency tracheotomy through both clinical and health-systems lenses. We therefore aimed to describe the epidemiological profile, indications, procedural characteristics, and postoperative outcomes of tracheotomy at the Centre Hospitalo-Universitaire de Kamenge (CHUK), while interpreting the observed burden as both an airway-oncology endpoint and a marker of pathway performance in a resource-limited tertiary setting.

Materials and Methods

Study design and reporting framework

We conducted a retrospective observational study in the ENT department of CHUK, Bujumbura, Burundi, covering the period from 1 January 2021 to 30 April 2025. Reporting was aligned with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement [9].

Study setting

CHUK is a tertiary teaching hospital and national referral center that receives patients from Bujumbura and multiple provinces across Burundi. The ENT department manages upper-airway emergencies, obstructive laryngeal disease, selected head-and-neck oncology cases, and postoperative tracheotomy care. In this setting, tracheotomy is performed both as a rescue airway procedure and as an adjunct to definitive disease management.

Participants and case ascertainment

All patients who underwent tracheotomy in the CHUK ENT service during the study period were screened for eligibility. Inclusion criteria were tracheotomy performed within the department during the study interval and the availability of a usable medical record. Files judged incomplete or unusable were excluded. Twenty-three records were identified, two were excluded on this basis, and 21 were retained for analysis.

Because the study included all eligible cases during the study period, it was designed as an exhaustive institutional census rather than a sampled cohort. No formal sample-size calculation was therefore performed. Participant selection is summarized in Figure 1.

Figure 1. Study flow diagram

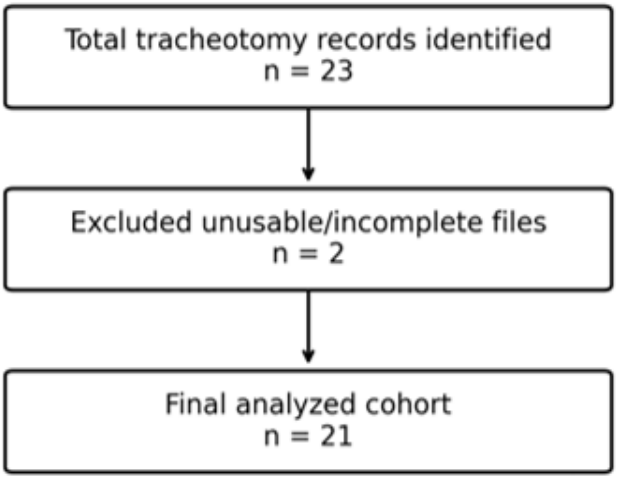

Figure 1. Selection of tracheotomy cases in the CHUK ENT department, January 2021–April 2025.

Variables, definitions, and data collection

Data were extracted from archived clinical records using a standardized collection form. Recorded variables included age, sex, occupation, provenance, alcohol and tobacco exposure, relevant clinical history, presenting symptoms, onset and severity of dyspnea, endoscopic and imaging findings, final diagnosis, urgency of tracheotomy, anesthesia type, postoperative complications, and duration of cannulation.

For consistency, this manuscript uses the term tracheotomy

for the index procedure and tracheostomy when referring to the wider literature. Emergency tracheotomy was defined as a non-elective procedure undertaken to secure the airway in the setting of clinically significant respiratory compromise. Definitive tracheotomy referred to a cannulation strategy expected to remain in place because the underlying lesion was not immediately reversible. Temporary tracheotomy refers to planned later decannulation after clinical resolution or subsequent definitive treatment. Early and late complications were classified according to the timing recorded in the clinical chart.

Outcomes

The primary descriptive outcomes were the distribution of final diagnoses, the proportion of emergency procedures, and the frequency of postoperative complications. Secondary outcomes included demographic profile, exposure profile, presenting symptoms, anesthesia type, and the proportion of definitive versus temporary tracheotomy.

Statistical analysis

Continuous variables are presented as means with ranges. Categorical variables are reported as counts and percentages. Exact binomial 95% confidence intervals were calculated for key proportions. Given the small sample size, sparse data structure, and absence of a comparator group, no multivariable modeling was attempted. Missing data were handled by available-case reporting, with no imputation.

Bias and interpretive framework

We attempted to reduce selection bias by including all eligible tracheotomy cases recorded during the study period. However, because the analysis depended on archived clinical files, documentation-dependent misclassification remained possible. The study population was also restricted to patients who reached tertiary ENT care and underwent tracheotomy, which constrains external validity and prevents capture of patients managed elsewhere, referred too late, or never referred. The analysis was therefore descriptive and hypothesis-generating rather than causal.

Ethics statement

Administrative authorization for access to hospital records was obtained from the General Directorate of CHUK before data collection. Data were retrospectively extracted from routine clinical files and anonymized before analysis. No directly identifying patient information is reported in this manuscript.

Results

Case accrual and procedural volume

During the study period, 21 tracheotomies were performed among 2415 ENT surgical procedures, corresponding to a procedural frequency of 0.86% and a mean annual volume of 4.2 cases. Annual counts were 5 in 2021, 4 in 2022, 1 in 2023, 7 in 2024, and 4 during January–April 2025. Annual case distribution is shown in Figure 2.

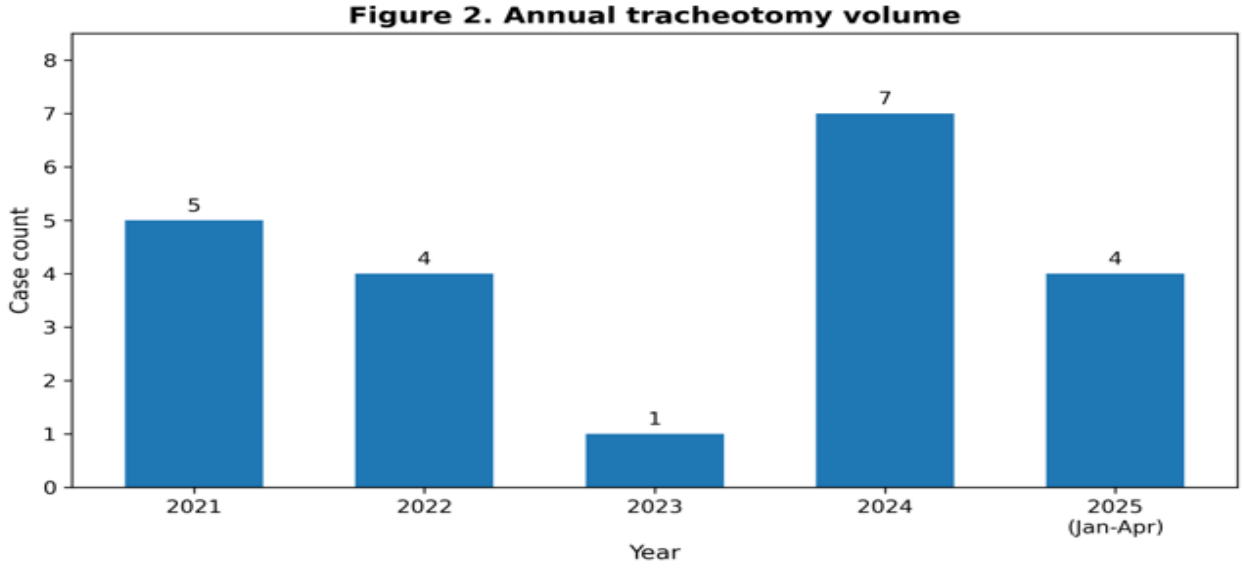

Figure 2. Annual number of tracheotomy procedures in the CHUK ENT service from 2021 to April 2025.

Baseline characteristics

Baseline patient characteristics are summarized in Table 1. The mean age was 50.43 years (range 2–77 years), and 14/21 patients (66.7%) were older than 50 years. Male patients accounted for 18/21 cases (85.7%, 95% CI 63.7%–97.0%). Fourteen of 21 patients (66.7%) were referred from outside Bujumbura. Combined alcohol and tobacco exposure was reported in 10/21 cases (47.6%, 95% CI 25.7%–70.2%), whereas 7/21 patients (33.3%) reported neither exposure.

Characteristic	n/N	%
Male sex	18/21	85.7
Age > 50 years	14/21	66.7
No formal occupation	10/21	47.6
Farmer	8/21	38.1
Referred from outside Bujumbura	14/21	66.7
Combined alcohol and tobacco exposure	10/21	47.6
Neither alcohol nor tobacco exposure	7/21	33.3

Data are presented as counts and percentages. Exact binomial 95% confidence intervals are reported in the main text for key proportions
Table 1. Baseline characteristics of patients undergoing tracheotomy at CHUK

Clinical presentation and diagnostic profile

Clinical and diagnostic characteristics are summarized in Table 2. Laryngeal dyspnea was the dominant presenting complaint, occurring in 19/21 patients (90.5%, 95% CI 69.6%–98.8%). Dysphonia was documented in 14/21 patients (66.7%). Dyspnea onset was progressive in 18/21 patients (85.7%). Among the 19 symptomatic patients with dyspnea, 15 presented with stage III or IV dyspnea.

Laryngeal tumor was the principal final diagnosis, identified in 16/21 patients (76.2%, 95% CI 52.8%–91.8%). Other diagnoses included laryngeal stenosis in 2/21 patients (9.5%), cervicofacial cellulitis in 1/21 patient (4.8%), closed laryngeal trauma in 1/21 patient (4.8%), and hypopharyngeal tumor in 1/21 patient (4.8%). The diagnostic distribution is illustrated in Figure 3.

Characteristic	n/N	%
Laryngeal dyspnea	19/21	90.5
Dysphonia	14/21	66.7
Progressive dyspnea onset	18/21	85.7
Stage III–IV dyspnea among dyspneic patients	15/19	78.9
Laryngeal tumor as the final diagnosis	16/21	76.2
Emergency tracheotomy	16/21	76.2
General anesthesia	20/21	95.2
Definitive tracheotomy	19/21	90.5

CHUK = Centre Hospitalo-Universitaire de Kamenge.
Table 2. Clinical presentation and procedural profile

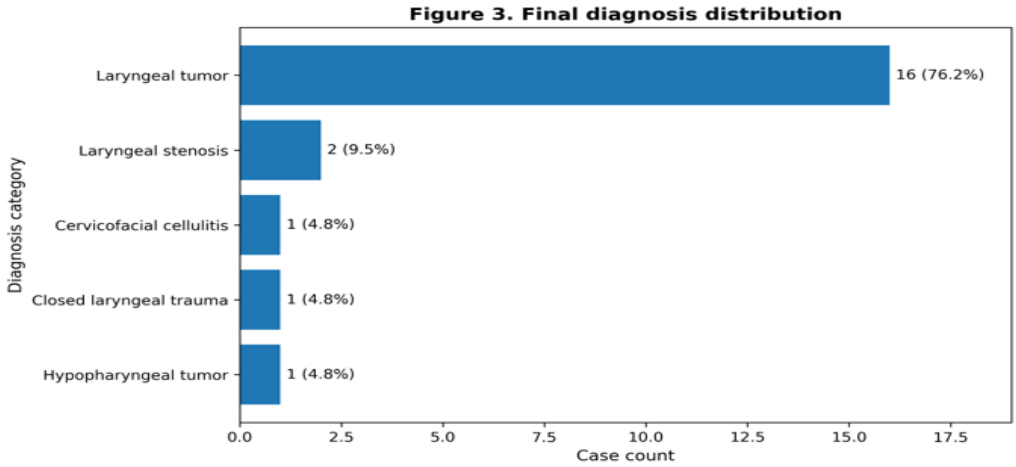

Figure 3. Final diagnoses leading to tracheotomy at CHUK.

Procedural characteristics

Emergency tracheotomy was performed in 16/21 cases (76.2%, 95% CI 52.8%–91.8%). General anesthesia was used in 20 of 21 procedures (95.2%). Tracheotomy was definitive in 19/21 patients (90.5%, 95% CI 69.6%–98.8%) and temporary in 2/21 patients (9.5%). In the temporary subgroup, cannulation duration ranged from 7 to 32 days, with a mean of 19.5 days.

Postoperative outcomes

Postoperative outcomes are summarized in Table 3. Only 7/21 patients (33.3%, 95% CI 14.6%–57.0%) had an uncomplicated postoperative course. Postoperative complications occurred in 14/21 patients (66.7%, 95% CI 43.0%–85.4%). The most frequent complication was mucus-plug obstruction, affecting 10/21 patients (47.6%, 95% CI 25.7%–70.2%). Other early complications included tracheobronchial infection in 2/21 patients (9.5%), accidental decannulation in 2/21 patients (9.5%), and stoma infection in 2/21 patients (9.5%). Late complications included late hemorrhage, cannula-related stenosis, bronchopulmonary infection, and late accidental decannulation, each occurring in 1/21 patient (4.8%). The postoperative complication profile is illustrated in Figure 4.

Outcome	n/N	%
Any postoperative complication	14/21	66.7
Uncomplicated postoperative course	7/21	33.3
Mucus-plug obstruction	10/21	47.6
Tracheobronchial infection	2/21	9.5
Accidental decannulation, early	2/21	9.5
Stoma infection	2/21	9.5
Late hemorrhage	1/21	4.8
Cannula-related stenosis	1/21	4.8
Bronchopulmonary infection	1/21	4.8
Accidental decannulation, late	1/21	4.8

Complication categories are reported as documented in the available clinical records.

Table 3. Postoperative outcomes

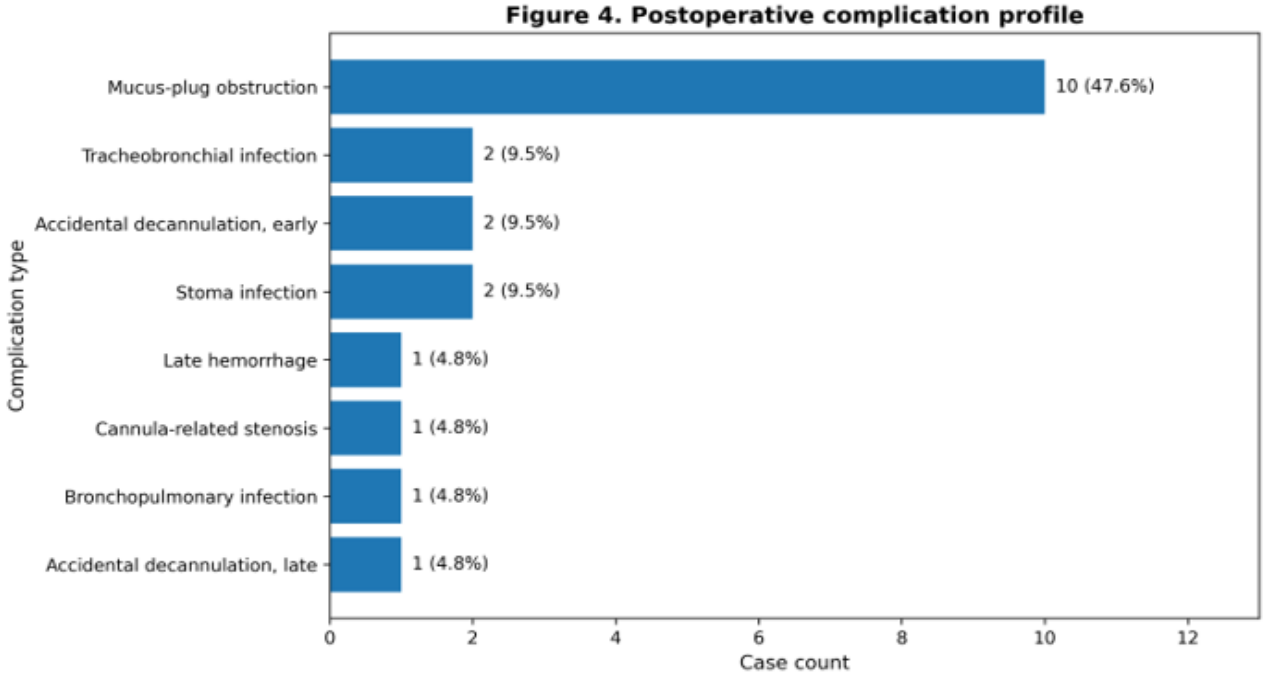

Figure 4. Frequency of documented postoperative complications following tracheotomy.

Discussion

Principal findings

This study identifies a distinctive tracheotomy profile in a Burundian tertiary ENT service: low procedural volume, high clinical acuity, overwhelming tumor predominance, frequent emergency indication, and substantial postoperative morbidity. Two linked messages emerge. Clinically, the cohort is dominated by tumor-related upper-airway obstruction. At the systems level, the same operative burden is consistent with delayed access to specialist airway care and vulnerability in postoperative care processes.

Clinical interpretation

The predominance of tumor-related emergency tracheotomy in the CHUK cohort is clinically coherent and aligns with a wider international pattern in which advanced laryngeal and head-and-neck malignancy remains strongly associated with late airway compromise. Huang et al. in 2024, using global cancer registry data, showed that laryngeal cancer continues to cluster around modifiable exposures and still presents with major cross-regional inequities in burden and care access [6]. Zhou et al. in 2025 extended that observation by showing that global laryngeal cancer trends remain shaped by persistent risk gradients and uneven disease control across settings [7]. Read against those global analyses, the CHUK finding that 76.2% of tracheotomies were performed for laryngeal tumors is not an isolated institutional anomaly; rather, it is consistent with the persistence of late obstructive laryngeal disease in settings where patients often enter specialist care late.

The regional comparison is equally important. Seedat et al. in 2023, in a scoping review of head-and-neck cancer in Africa, reported that delayed presentation and advanced-stage disease remain defining features across the continent [8]. Nteyumwete et al. in 2024, studying head-and-neck cancer diagnosis in Rwanda, identified patient-level, provider-level, and pathway-level delays as major contributors to late diagnosis [10]. The present cohort is concordant with that regional evidence: the combination of persistent dysphonia, progressive dyspnea, advanced airway compromise, and emergency tracheotomy suggests a late-presenting airway-oncology phenotype rather than a mixed general tracheostomy population. At the same time, the CHUK series is more narrowly concentrated around airway-threatening laryngeal disease than broader oncology datasets, which is plausibly explained by the case mix of a tertiary ENT referral service and by the fact that the cohort captures only patients who progressed to operative airway intervention.

Health-systems interpretation

The health-systems interpretation is more inferential, but it remains important. For patients to reach tertiary ENT care only when airway obstruction is already critical, delay must often accumulate upstream through patient symptom appraisal, first-contact recognition, referral procedures, transport, diagnostic access, and specialist review. The present study did not directly measure referral interval, stage at first assessment, or pathology turnaround. It therefore cannot establish causal delay. However, the observed pattern is more consistent with pathway compression and delayed access than with isolated operative urgency alone.

This distinction matters because it changes how the procedure is interpreted. In this setting, tracheotomy appears not only as an emergency airway intervention but also as the distal expression of a broader care pathway that may be failing to identify high-risk laryngeal disease early enough for planned evaluation and elective airway decision-making.

Postoperative morbidity and implementation relevance

The postoperative burden observed at CHUK is substantial and aligns with findings from recent low-resource and implementation-oriented tracheostomy literature. In a prospective cohort from Uganda, Nyanzi et al. in 2023 reported that tracheostomy in low-resource settings remained strongly associated with airway-compromise indications and with a meaningful burden of early postoperative complications [11]. Selekwa et al. in 2023, in a scoping review focused specifically on tracheostomy care quality improvement in low- and middle-income countries, concluded that postoperative safety problems remain common while structured improvement interventions remain sparse and under-evaluated [12]. Sandler et al. in 2020 similarly showed that improving tracheostomy care in resource-limited settings requires adaptation of care pathways to local staffing, equipment, and workflow realities rather than simple transplantation of high-resource models [13].

The current series is concordant with that literature in one important respect: the dominant complications were not rare surgical catastrophes but process-sensitive events, especially mucus-plug obstruction, decannulation, and infection. That pattern strengthens the implementation relevance of the findings. It suggests that the main preventable burden at CHUK likely lies in bedside reliability, humidification, suction readiness, secretion clearance, tube-security practice, emergency preparedness, and escalation speed, rather than in operative technique alone. The CHUK complication profile may appear more heavily weighted toward secretion-related obstruction than some broader cohorts, but this difference is plausibly explained by the small sample size, the predominance of definitive cannulation for advanced upper-airway disease, and the constraints of a tertiary ward environment in which postoperative care processes may be more decisive than intraoperative factors.

Comparative positioning and service redesign

The CHUK cohort is broadly consistent with published tracheostomy data from low-resource settings, but it also shows a more concentrated airway-oncology profile. The literature on tracheostomy quality improvement helps explain why this matters operationally. Bedwell et al. in 2019 highlighted the role of multidisciplinary collaboratives in organizing safer tracheostomy care [14]. Ninan et al. in 2023 found in a systematic review that interprofessional tracheostomy teams improve several clinically meaningful outcomes [15]. Pandian et al. in 2023 likewise emphasized that timing, technique, and teamwork should be integrated through interprofessional care models [16]. At the institutional level, McGrath et al. in 2020 showed that guided quality-improvement programs can improve tracheostomy care processes across diverse hospitals [17], while Rubin et al. in 2020 reported reduced complications through multidisciplinary standardization [18].

The postoperative burden observed in the present cohort is also compatible with contemporary complication-focused studies. Murray et al. in 2022 and Erickson et al. in 2024 showed that acute post-tracheostomy adverse events remain clinically important even in better-resourced settings when surveillance, secretion management, and emergency response processes are inconsistent [19,20]. The current findings should therefore not be interpreted as evidence of uniquely poor local performance. Rather, they suggest that CHUK is facing a well-recognized safety problem under more constrained conditions. Because the dominant complications in this series are process-sensitive, a context-adapted tracheotomy bundle focused on humidification, suction availability, routine patency checks, tube security, bedside emergency equipment, and staff training is directly supported by the comparative literature [14-20].

Strengths and limitations

The main risks of bias in this study relate to selection, documentation-dependent misclassification, missing data, and limited external validity. Because the analysis includes only patients who reached a tertiary ENT service and underwent tracheotomy, it cannot capture patients managed elsewhere, referred too late, or never referred. In addition, several clinically important variables, including formal tumor stage, symptom interval, histopathologic distribution, long-term decannulation status, and survival, were not consistently documented in archived records. These constraints limit causal inference.

These limitations do not eliminate the value of the dataset. The study appears to capture the complete consecutive tracheotomy experience of a tertiary ENT department over more than four years, with only two files excluded for incompleteness. In a low-volume but high-acuity procedure, such an institutional census remains clinically meaningful because it defines the local indication profile, quantifies the postoperative safety burden, and identifies practical targets for service redesign. The manuscript should therefore be read as a descriptive, hypothesis-generating service evaluation with appropriately bounded claims regarding causality and generalizability.

What this adds and next steps

This study adds a Burundi-based tertiary-service perspective to the limited LMIC literature on tracheotomy. It shows that, in this setting, emergency tracheotomy remains closely tied to advanced obstructive laryngeal disease and that the postoperative burden is dominated by complications that are plausibly preventable through better ward-process reliability. Two practical priorities follow directly from these findings. First, tertiary and referring facilities should adopt an airway-oncology red-flag pathway for patients with persistent dysphonia, progressive laryngeal dyspnea, stridor, unexplained neck mass, or other features suggesting impending upper-airway compromise. Second, the ENT ward should standardize postoperative tracheotomy care through a bundle that is auditable, low-cost, and feasible within routine practice. Figure 5 presents a pragmatic conceptual model linking symptom recognition, referral efficiency, specialist airway assessment, emergency tracheotomy burden, and postoperative pathway reliability in this setting.

Future research should move beyond retrospective description toward a prospective multicenter registry linking symptom onset, referral trajectory, diagnostic timing, tumor characterization, cannulation duration, decannulation success, and patient outcomes. Such a design would allow tracheotomy burden to be examined more explicitly as both a clinical endpoint and a health-systems performance metric. The core postoperative safety measures proposed for implementation are summarized in Figure 6.

Figure 5. Proposed care pathway schematic

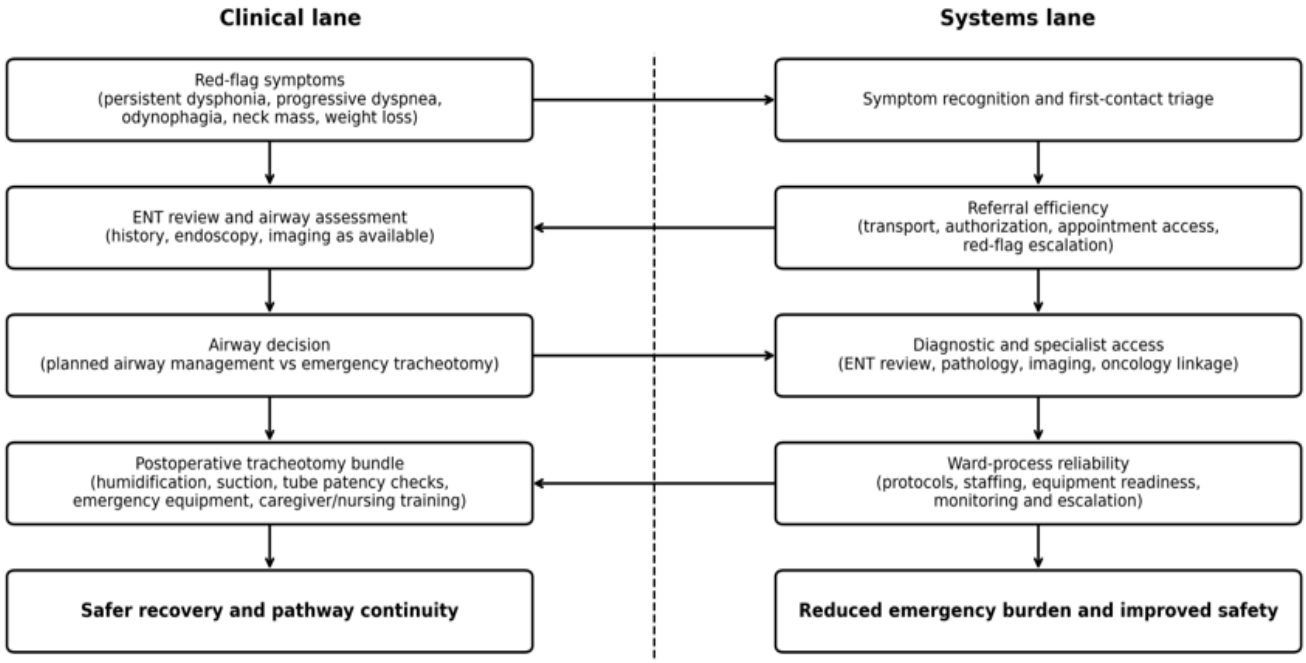

Figure 5. Conceptual model linking red-flag symptoms, referral delay, emergency tracheotomy, and postoperative pathway reliability.

Figure 6. Proposed postoperative tracheotomy safety bundle

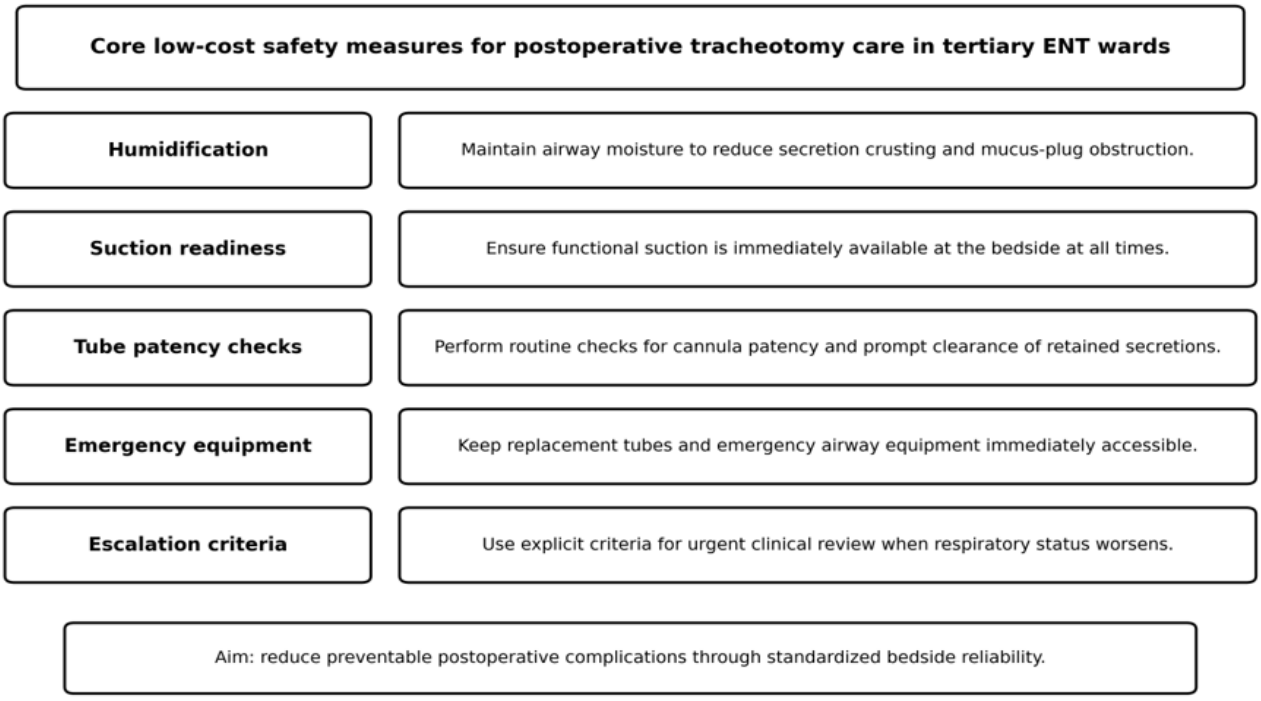

Figure 6. Proposed postoperative tracheotomy safety bundle listing humidification, suction readiness, tube patency checks, emergency equipment availability, and clear escalation criteria.

Conclusion

In this tertiary Burundian ENT referral service, tracheotomy was predominantly an emergency procedure performed for tumor-related upper-airway obstruction and followed by substantial postoperative morbidity, especially mucus-plug obstruction. The clinical message is clear: the case mix is dominated by a late-presenting airway-oncology profile. The health-systems message is equally important: the same burden is consistent with delayed diagnosis, referral inefficiency, and postoperative care-process fragility. Earlier airway-oncology evaluation and a standardized postoperative tracheotomy safety pathway should therefore be considered immediate quality-improvement priorities.

Ethics Statement

Administrative authorization for record access was obtained from CHUK. Formal ethics committee approval details should be inserted before submission if available. Because the study used retrospective anonymized clinical data, individual consent for participation was not applicable under the described data-collection process.

Author Contributions

LH: conceptualization, study design, data curation, analysis, manuscript drafting, editing, and supervision.
GN: methodological oversight, clinical validation, and critical manuscript review.
SN: conceptualization, data extraction, and supervision.
OM and JN: case verification, quality control of clinical definitions, literature review, and figure interpretation.
BN: data extraction and data synthesis.
All authors read and approved the final manuscript.

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Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Data Availability Statement

De-identified data may be made available by the corresponding author upon reasonable request and subject to institutional authorization.

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