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Research Article

Substernal Goiter at a Burundian National Referral Hospital: Clinical Presentation, Diagnostic Work-up, and Operative Management in a Retrospective Surgical Case Series

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Abstract

Background: Substernal goiter can complicate airway assessment, mediastinal anatomical characterization, and operative planning. Evidence describing its clinical presentation, diagnostic work-up, and surgical management in resource-constrained African referral hospitals remains limited.

Methods: We conducted an exhaustive retrospective surgical case series at the Centre Hospitalo-Universitaire de Kamenge, Burundi, from 1 January 2022 through 31 December 2024. Patients were included when clinical assessment and ultrasound and/or computed tomography (CT) documented substernal goiter and the record was sufficiently complete. Data were abstracted using a pre-established KoboCollect form, exported to Microsoft Excel 2019, and analyzed descriptively in Epi Info.

Results: Among 81 patients consulting for goiter, 69 were excluded, and 12 comprised the cohort. All 12 presented with a cervical mass; dysphagia occurred in 6/12 (50.0%), dyspnea in 5/12 (41.7%), and dysphonia in 2/12 (16.7%). The inferior thyroid pole was non-palpable in 12/12. Ultrasound showed nodules in 11/12 (91.7%) and lobe hypertrophy in 8/12 (66.7%). Chest radiography was performed in 3/12 (25.0%) and CT in 4/12 (33.3%); mediastinal extension and tracheal compression were each recorded in 4/4 CT-imaged patients. Seven patients underwent total thyroidectomy and five underwent lobectomy-isthmectomy; cervical access was used in 12/12. Histopathology, postoperative morbidity, hospital outcomes, and longitudinal follow-up were not collected.

Conclusion: This series documents symptomatic substernal goiter, heterogeneous anatomical characterization, and cervical operative access at a Burundian national referral hospital. The data do not establish diagnostic accuracy, the appropriateness of selective CT, operative safety, or long-term effectiveness. Prospective standardized clinical, imaging, operative, pathology, and outcome documentation is required.

Keywords: Substernal goiter; Thyroidectomy; Computed tomography; Burundi; Surgical case series

1.Introduction

Substernal goiter is clinically important because extension below the thoracic inlet can alter airway assessment, obscure the inferior extent and mediastinal relationships of the gland, and complicate operative exposure. Definitions and classification systems vary, but the clinically relevant problem is consistent: cervical assessment alone may not establish the depth, compartment, or airway and vascular relationships of intrathoracic thyroid tissue [1-3]. Clinical examination and cervical ultrasound characterize cervical thyroid morphology, whereas cross-sectional imaging can add information about tracheal displacement or compression, mediastinal depth, and relationships that may influence perioperative planning and operative access [4-8].

The capacity to characterize and treat substernal goiter is also shaped by the surrounding surgical system. Global evidence documents major inequalities in access to timely, safe surgical and anaesthesia care, while African thyroid-surgery studies show heterogeneous diagnostic resources, case mix, operative capacity, and outcome reporting [9-12]. These differences should not be presumed to indicate inadequate local practice, but they limit comparison across settings. Evidence remains particularly sparse on how patients with substernal goiter are identified, anatomically characterized, and surgically managed in Burundi.

This study aimed to describe the clinical presentation, documented diagnostic work-up, and operative management of patients with substernal goiter treated at the Centre Hospitalo-Universitaire de Kamenge (CHUK) between 2022 and 2024.

2. Methods

2.1 Study design, Setting, and Reporting Framework

This retrospective descriptive surgical case series was conducted in the Department of Otorhinolaryngology-Head and Neck Surgery at CHUK, a national referral and teaching hospital in the Ntahangwa health zone of Bujumbura, Burundi. The study period was 1 January 2022 through 31 December 2024. CHUK receives patients with thyroid and other head-and-neck conditions from urban and rural areas throughout the country. Reporting was informed by PROCESS and STROCSS guidance for surgical observational studies, with complementary use of STROBE and RECORD principles for routinely collected health data and JBI methodological guidance on case-series bias [13-17].

2.2 Participants, exhaustive case ascertainment, and study definition

The screening population comprised all patients consulting for goiter in the CHUK Otorhinolaryngology service during the study period. An exhaustive sampling approach was used to identify all recorded cases of substernal goiter. Eighty-one patients were screened.

Patients were included when the record documented a diagnosis of substernal goiter based on clinical assessment and radiological findings on ultrasound and/or CT and contained sufficient information for analysis. Patients with cervical goiter without evidence of mediastinal extension and records missing data essential for analysis were excluded. The study protocol did not specify a uniform anatomical landmark, percentage of intrathoracic thyroid volume, or CT-based classification for substernal extension. CT was not required for inclusion.

2.3 Data Collection and Study Variables

Data were abstracted retrospectively from medical records using a pre-established collection form implemented in KoboCollect on a smartphone. Records were transferred to the KoboToolbox server and exported to Microsoft Excel 2019 before analysis.

Reported demographic variables were age, sex, residence, and educational level. Clinical variables included cervical mass, dysphagia, dyspnea, cervical pain, dysphonia, thyroid consistency, mobility, palpable nodularity, palpability of the inferior thyroid pole, and thyroid-function category. Diagnostic variables included the recorded ultrasound impression of substernal goiter, thyroid nodules, lobe hypertrophy, chest radiography findings, and CT findings. Therapeutic variables were the type of thyroid operation and cervical or sternotomy access.

Histopathology, early postoperative complications, length of stay, reoperation, readmission, and mortality were not included in the study data-collection instrument. Longitudinal follow-up and recurrence were not collected. These domains were therefore not analyzed as study outcomes.

2.4 Diagnostic and Operative Variables

Ultrasound variables were limited to the recorded impression or sign of substernal goiter, thyroid nodularity, and lobe hypertrophy. A defined anatomical threshold did not standardize the ultrasound criterion used to label a substernal sign. Chest-radiography variables were a visible endothoracic component and tracheal deviation. CT variables were mediastinal extension and tracheal compression. Imaging findings were analyzed only among patients who underwent the relevant examination.Operative procedures were categorized as total thyroidectomy or lobectomy-isthmectomy according to the operation recorded. Access was categorized as cervical when surgery was completed through a cervical incision and as sternotomy when a sternal incision was recorded. No retrospective decision rule for CT use, procedure selection, or operative access was imposed.

2.5 Missing data and Statistical Analysis

Analysis was performed in Epi Info and was strictly descriptive. Categorical variables are reported as n/N (%) when the denominator was known. Age is reported as mean and range. No hypothesis testing, regression modeling, diagnostic-accuracy analysis, or comparative-effect estimation was performed. Imaging findings use examination-specific denominators; CT findings therefore describe the four CT-imaged patients and not the full cohort. Records that were incomplete or missing data essential for analysis were excluded, while "not specified" was retained as a category where reported within the included cohort.

2.6 Ethics

The study was conducted in accordance with the principles of the Declaration of Helsinki and received authorization from the CHUK Ethics Committee for the use of anonymized medical data. Patient names and direct identifiers were not recorded in the study database, and confidentiality was maintained during collection, analysis, and reporting.

3. Results

3.1 Case ascertainment and cohort composition

Eighty-one patients consulting for goiter were screened. Sixty-nine were excluded: 63 had cervical goiter without documented mediastinal extension, and six had incomplete or non-analyzable records. The final cohort comprised 12 patients with substernal goiter and sufficiently complete records (Figure 1).

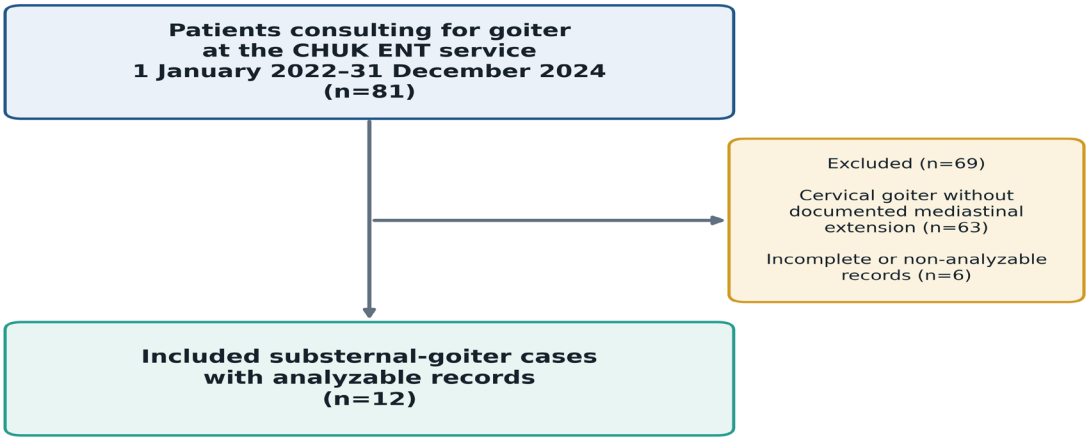


Figure 1. Case-ascertainment flow diagram showing patients screened, exclusions with reasons, and the final retrospective surgical case series.

3.2 Clinical presentation and preoperative profile

The mean age was 54.1 years (range, 40-67 years); 9/12 patients (75.0%) were women and 8/12 (66.7%) had rural residence (Table 1).

Domain	Variable	n/N	%
Age	Mean, years (range)	54.1 (40-67)	-
Age group	40-49 years	4/12	33.3
	50-59 years	3/12	25.0
	≥60 years	5/12	41.7
Sex	Female	9/12	75.0
	Male	3/12	25.0

Residence	Rural	8/12	66.7
	Urban	4/12	33.3

Table 1. Demographic profile of the cohort (N = 12).

All 12 patients presented with a cervical mass. Symptoms were not mutually exclusive: dysphagia was documented in 6/12 (50.0%), dyspnea in 5/12 (41.7%), cervical pain in 3/12 (25.0%), and dysphonia in 2/12 (16.7%) (Figure 2A).

The inferior thyroid pole was non-palpable in 12/12 patients, palpable nodularity was documented in 9/12 (75.0%), the gland was mobile in 8/12 (66.7%), and it was fixed in 4/12 (33.3%) (Figure 2B). Thyroid-function status was euthyroid in 7/12 (58.3%), hyperthyroid in 3/12 (25.0%), hypothyroid in 1/12 (8.3%), and not specified in 1/12 (8.3%) (Figure 2C). Detailed educational-level and thyroid-consistency data are reported in Supplementary Table S1.

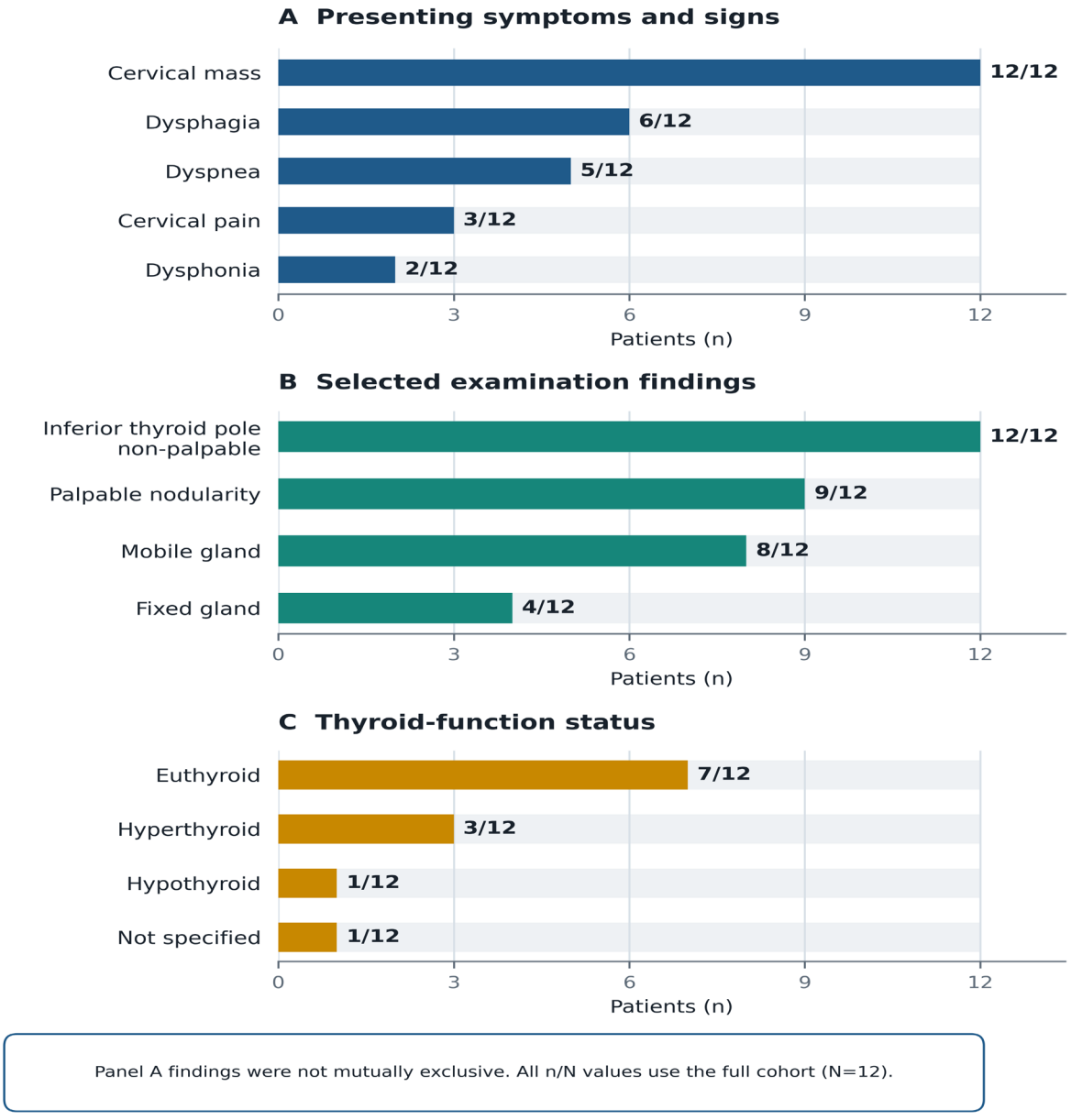


Figure 2. Clinical presentation and preoperative profile. (A) Presenting symptoms and signs; symptoms were not mutually exclusive. (B) Selected examination findings. (C) Thyroid-function status. Values are patient counts with full-cohort denominators (n/12).

3.3 Diagnostic work-up and anatomical characterization

Ultrasound findings were available for 12/12 patients, chest radiography was performed in 3/12 (25.0%), and CT was performed in 4/12 (33.3%) (Figure 3A). An ultrasound impression or sign of substernal goiter was recorded in 12/12, thyroid nodules in 11/12 (91.7%), and lobe hypertrophy in 8/12 (66.7%).

Within the three-patient radiography subgroup, a visible endothoracic component was recorded in 2/3 and tracheal deviation in 1/3. Within the four-patient CT subgroup, mediastinal extension and tracheal compression were each recorded in 4/4 patients (Figure 3B). These conditional findings describe only the patients who underwent each examination and are not full-cohort prevalence estimates. Denominator-level imaging data are provided in Supplementary Table S2.

3.4 Operative management and evidence continuity

Total thyroidectomy was performed in 7/12 patients (58.3%) and lobectomy-isthmectomy in 5/12 (41.7%). Cervical access was used in 12/12; no sternotomy was recorded. These data describe the procedures and access used; they do not establish operative safety or the absence of an indication for extracervical access in other anatomical presentations.

Histopathology, early postoperative complications, length of stay, reoperation, readmission, mortality, longitudinal follow-up, and recurrence were not included in the data-collection instrument. These domains were therefore uncollected rather than assessed with missing values, and no event rates or outcome denominators can be reported (Figure 3C).

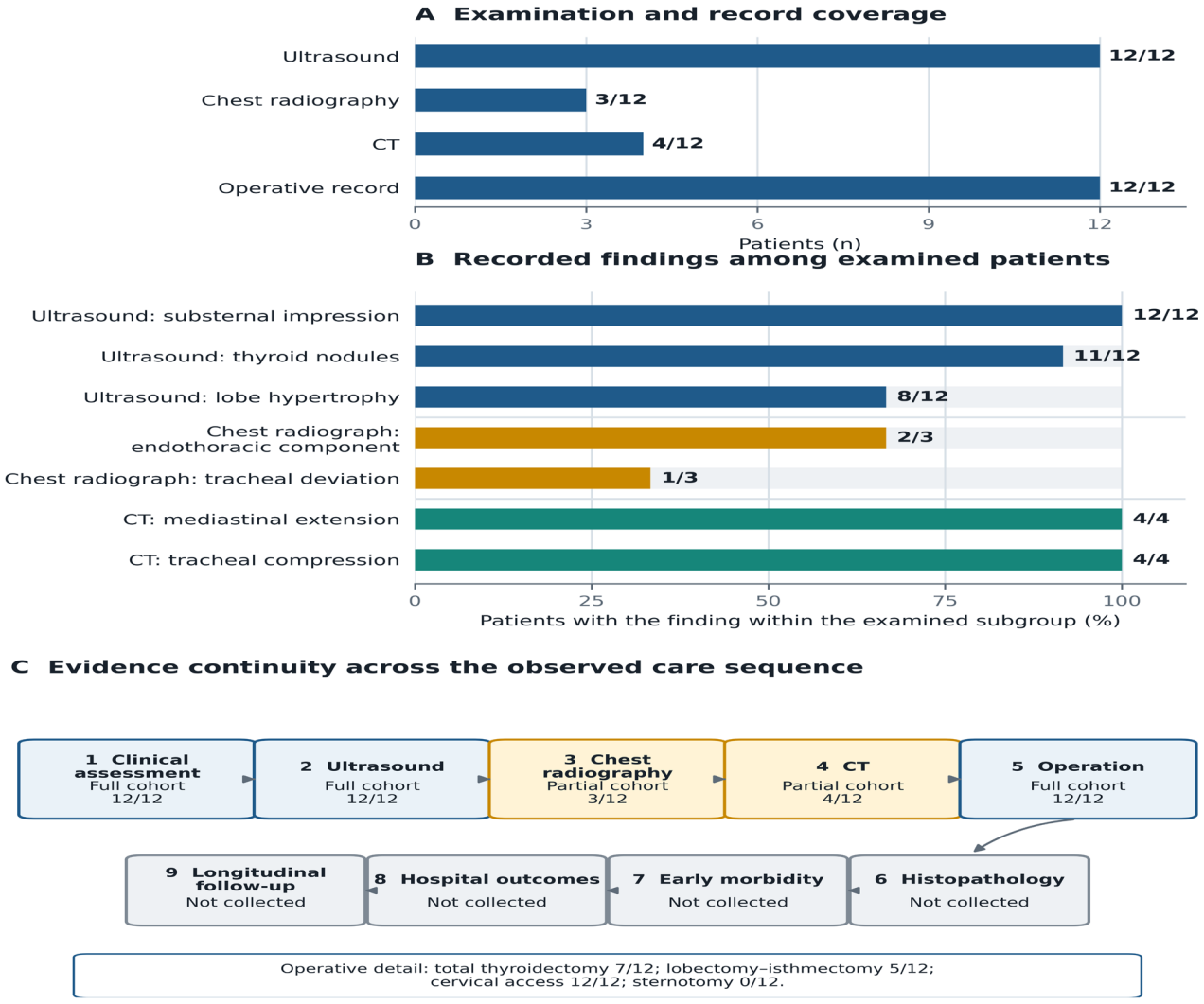


Figure 3. Diagnostic work-up, recorded findings, operative management, and evidence continuity. (A) Examination and operative-record coverage in the full cohort. (B) Findings among patients who underwent each examination; denominators are ultrasound, N = 12; chest radiography, N = 3; and CT, N = 4. Conditional percentages are not full-cohort prevalence estimates. (C) Evidence continuity across the

observed care sequence. Full-cohort stage coverage indicates that a clinical, ultrasound, or operative record was available for all 12 patients; it does not imply complete capture of every variable. Histopathology and outcome domains were not collected and must not be interpreted as zero events or assessed-but-missing outcomes.

Supplementary Material

Domain	Variable	n/N	%
Educational level	No formal education	2/12	16.7
	Primary	2/12	16.7
	Secondary	5/12	41.7
	Higher	3/12	25.0
Thyroid consistency	Soft	5/12	41.7
	Firm	3/12	25.0
	Hard	2/12	16.7
	Elastic	1/12	8.3
	Not specified	1/12	8.3

Supplementary Table S1. Additional demographic and examination details (N = 12)

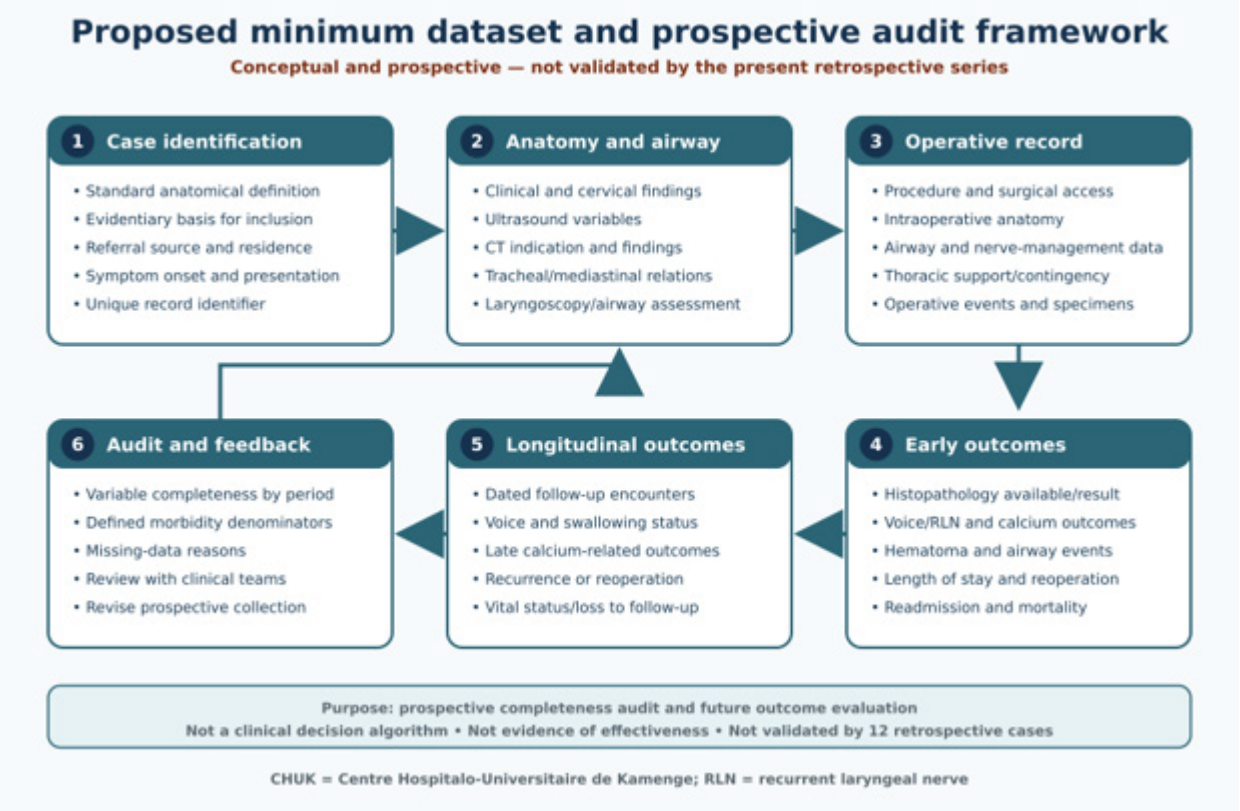
Educational level is presented descriptively; no association with access, delay, diagnostic work-up, or outcome was assessed.

Domain	Measure or finding	Denominator basis	n/N	%
Ultrasound	Findings available	Full cohort	12/12	100
	Recorded impression/sign of substernal goiter	Full cohort	12/12	100
	Thyroid nodules	Full cohort	11/12	91.7
	Lobe hypertrophy	Full cohort	8/12	66.7
Chest radiography	Examination performed	Full cohort	3/12	25.0
	Visible endothoracic component	Radiography subgroup	2/3	66.7
	Tracheal deviation	Radiography subgroup	1/3	33.3
CT	Examination performed	Full cohort	4/12	33.3
	Mediastinal extension	CT subgroup	4/4	100
	Tracheal compression	CT subgroup	4/4	100
Thyroid procedure	Total thyroidectomy	Full cohort	7/12	58.3
	Lobectomy-isthmectomy	Full cohort	5/12	41.7
Operative access	Cervical	Full cohort	12/12	100
	Sternotomy	Full cohort	0/12	0

Supplementary Table S2. Denominator-level diagnostic and operative data

Percentages for chest-radiography and CT findings use the examined subgroup, not the full cohort. Imaging variables reflect recorded findings and do not constitute a diagnostic-accuracy assessment.

Supplementary Figure S1



Supplementary Figure S1. Proposed minimum dataset and prospective audit framework for substernal-goiter documentation at CHUK. This conceptual framework is a future research recommendation and has not been validated by the present retrospective case series.

Discussion

4.1 Principal findings and Central Contribution

Three observations define this case series. First, symptomatic structural thyroid disease reached tertiary surgical care: all patients had a cervical mass, and dysphagia, dyspnea, or dysphonia was documented in several cases. Second, the inferior thyroid pole was non-palpable, and an ultrasound impression of substernal extension was recorded in every included patient, but CT-based anatomical characterization was available for only four. Third, every recorded operation used cervical access, yet histopathology, postoperative morbidity, hospital outcomes, and longitudinal follow-up were outside the data-collection instrument. The most consequential finding is therefore not a demonstrated management advantage, but a mismatch between documented operative activity and the evidence required to judge anatomical comparability, pathology, safety, or durability.

For an international readership, the study adds a transparent account from a national referral hospital in a region underrepresented in substernal-goiter literature. It shows what could be established from routine records and, equally importantly, where inference must stop. The data neither validate an imaging algorithm nor evaluate a cervical-first strategy; they define a baseline from which a prospectively auditable service can be built.

4.2 Diagnostic Certainty and Imaging in Context

Substernal goiter is not a uniform anatomical entity. Published definitions variously use the thoracic inlet, sternal landmarks, a proportion of intrathoracic thyroid volume, or inferior mediastinal boundaries [1-3]. The pragmatic case label in this series relied on the documented clinical diagnosis and ultrasound and/or CT findings without a uniform anatomical threshold. Non-palpability of the inferior pole and an ultrasound impression of downward extension are clinically informative, but they do not establish mediastinal depth, anterior or posterior compartment, continuity with the cervical gland, or relationships to the trachea and great vessels. Misclassification and anatomical heterogeneity therefore remain

plausible. Ultrasound remains central to cervical thyroid and nodule assessment [8], but the thoracic inlet limits mediastinal mapping. CT-based studies show that the depth and inferior extent of a goiter and its relation to mediastinal structures can inform anticipation of extracervical access [18-19]. Systematic reviews similarly identify cross-sectional anatomy as central to operative planning while showing substantial variation in definitions and reported approaches [20-21]. In one surgical series, extension below the aortic arch and posterior mediastinal location were associated with sternotomy [22]; such predictors are useful for planning but cannot be extrapolated to patients whose corresponding CT features were not measured.

In the CHUK series, mediastinal extension and tracheal compression were recorded in all four CT-imaged patients. These findings describe a selected third of the cohort, not the prevalence of those features among all 12 patients. The study did not collect indications for CT, so the observed pattern could reflect clinical concern, examination findings, clinician preference, access, or other unmeasured factors. Selective CT may therefore have produced spectrum and verification effects: patients imaged with CT may have differed systematically from those who were not. The appropriate inference is that CT-based certainty was incomplete, not that selective CT was either appropriate or inappropriate.

4.3 Operative Access and Limits of Surgical Inference

The literature consistently reports that most substernal goiters are removed through a cervical incision, with extracervical access required in a minority selected by anatomy and operative circumstances [5-7,20-22]. The 12 cervical operations at CHUK are consistent with that broad pattern, but the sample contains no extracervical comparator and incompletely characterized anatomy. The finding establishes what surgeons did; it cannot establish that sternotomy was unnecessary, that cervical access was technically optimal, or that a cervical-first strategy is transferable to other patients.

Operative feasibility also cannot establish safety. Large multicenter observational studies have reported higher rates of selected complications when thyroidectomy involves mediastinal or retrosternal goiter rather than cervical goiter [23-24]. Other contemporary studies emphasize that recurrent laryngeal nerve injury, hypocalcemia or hypoparathyroidism, bleeding, airway events, and other morbidity require active and standardized ascertainment [25,26]. A recent Tanzanian tertiary-hospital cohort illustrates that thyroidectomy outcomes can be measured in an African referral setting, but differences in case mix and definitions preclude direct benchmarking against the present series [27]. Post-thyroidectomy hematoma is additionally a time-critical event for which structured recognition and response are recommended [28].

None of those outcomes can be estimated here. Histopathology, early complications, length of stay, reoperation, readmission, and mortality were not variables in the data-collection instrument, and longitudinal follow-up was not collected. This is stronger than ordinary item-level missingness: the domains were unmeasured. Accordingly, an apparently completed operation or the absence of a complication entry in this dataset must not be interpreted as an uncomplicated recovery. Pathology distribution, safety, symptom resolution, late complications, recurrence, and long-term effectiveness are not assessable.

4.4 Strengths, Limitations, and Interpretive Boundaries

The study's principal strengths are its focus on an underrepresented national referral setting, exhaustive screening of recorded goiter consultations across a defined three-year period, transparent accounting of exclusions, and denominator-specific reporting for selectively performed imaging. Its descriptive scope is also explicit: no inferential analysis was imposed on 12 cases, and uncollected outcomes were not converted into negative findings.

Each limitation changes what can be concluded. The 12-case sample yields no stable comparative estimates and cannot support prediction or subgroup inference. The absence of a uniform anatomical threshold creates potential case misclassification and limits comparability with CT-defined international cohorts. Excluding six incomplete records may have introduced selection bias; its direction is unknowable because the excluded patients were not characterized beyond record completeness. Selective CT prevents estimation of full-cohort CT-defined anatomical prevalence and may preferentially represent clinically concerning cases. Retrospective abstraction permits documentation and information bias, while unrecorded CT indications and operative decision rationales prevent evaluation of clinical decision-making. Because histopathology and postoperative outcomes were uncollected, pathological spectrum and operative safety are not merely uncertain but unassessable. Absent longitudinal follow-up precludes inference about late morbidity, recurrence, and durability. Finally, the referral cohort represents patients who reached CHUK; it cannot estimate population burden, national prevalence, or outcomes in patients managed elsewhere.

4.5 Clinical Implications and Future Research

Current Practice Implication

The immediate clinical implication is documentary rather than prescriptive. Cervical thyroid morphology, substernal anatomical mapping, airway assessment, operative planning, and postoperative outcome surveillance should be treated as distinct information domains. A record that establishes nodularity does not necessarily map the mediastinum; a record that establishes cervical access does not establish safety. The present data do not define an institutional CT al-

gorithm or referral threshold. Rural residence was common, but no presentation interval, travel burden, or referral delay was measured; it is therefore only a signal for future access research.

At the institutional level, the highest-yield intervention is a minimum dataset embedded in routine surgical documentation, coupled with clear responsibility for capturing imaging indications, operative findings, pathology, early morbidity, and follow-up. This is consistent with the wider global-surgery emphasis on measuring access, capacity, and outcomes rather than inferring performance from procedural volume alone [9].

African thyroid-surgery evidence likewise supports context-specific outcome surveillance, but this small series cannot determine which equipment, staffing, or referral investment would produce the greatest benefit at CHUK [10-12,27].

Research Implication

A prospective registry is the first research priority. It should use a standardized anatomical definition and record the evidentiary basis for inclusion; symptom onset and referral dates; airway and voice assessment; ultrasound, radiography, and CT availability, indication, and findings; operative procedure, access, and intraoperative anatomy; histopathology; recurrent laryngeal nerve and voice outcomes; calcium-related outcomes; hematoma and airway events; length of stay; reoperation; readmission; mortality; and dated longitudinal follow-up.

A multicenter extension could then define national referral patterns and improve precision. Only after complete prospective ascertainment should comparative questions about imaging strategies, access, cost, safety, or effectiveness be tested. Supplementary Figure S1 presents a conceptual minimum dataset for prospective audit; it is not a management pathway validated by this series.

5. Conclusion

This exhaustive retrospective surgical case series describes the presentation, diagnostic work-up, and operative management of 12 patients with substernal goiter treated at CHUK. It documents compressive symptoms, non-palpability of the inferior thyroid pole, CT-based anatomical information in only four patients, and cervical access in all recorded operations. It does not establish diagnostic accuracy, the appropriateness of selective CT, the safety or superiority of cervical access, pathology distribution, or long-term effectiveness because pathology and postoperative and longitudinal outcomes were not collected.

The single most important next step is prospective standardized documentation of anatomical characterization, operative details, histopathology, postoperative morbidity, and dated follow-up.

Declarations

Ethics Approval

The study was conducted in accordance with the Declaration of Helsinki and received authorization from the CHUK Ethics Committee for the use of anonymized medical data. Patient names and direct identifiers were not recorded, and confidentiality was maintained throughout data collection, analysis, and reporting.

Data Availability

The de-identified dataset is not publicly available because of patient confidentiality and institutional-governance requirements. Access may be considered on reasonable request to the corresponding author and subject to CHUK approval.

Competing Interests

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

Author Contributions

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

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Use of Artificial Intelligence

ChatGPT (OpenAI) was used for language editing, clarity, and manuscript organization. All AI-assisted content was reviewed and verified by the authors, who retain full responsibility for the accuracy, integrity, and final content of the manuscript.

Abbreviations

CHUK, Centre Hospitalo-Universitaire de Kamenge; CT, computed tomography; PROCESS, Preferred Reporting Of CasE Series in Surgery; RECORD, REporting of studies Conducted using Observational Routinely-collected health Data; STROBE, Strengthening the Reporting of Observa-

tional Studies in Epidemiology; STROCSS, Strengthening the Reporting of Cohort, Cross-sectional and Case-control Studies in Surgery.

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