



St. Paul's Hospital Millennium Medical College
Department of Surgery

Surgical Outcome of Retrosternal Goiter: A 5-year Retrospective Study

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Addis Ababa, Ethiopia

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Abstract

Background

Retrosternal goiter refers to any thyroid enlargement in which over 50% of the thyroid permanently located under the thoracic inlet or the lower pole of thyroid is not palpable with the neck in hyperextended position(1).

Retrosternal goiter occurs in 2-26% of thyroidectomies, with a female preponderance and a familial component in up to 30% of cases. Surgery is the best treatment for retrosternal goiters due to thyroid growth and malignancy. Cervical incision is commonly used, but some cases require extracervical approach like sternotomy or thoracotomy(2). There are only case reports on retrosternal goiter in Ethiopia.

Objective

To Assess clinical presentation, options of surgical management and outcome of patients surgically treated for retrosternal goiters in SPHMMC from January 2017 to December 2022 GC.

Methodology

A retrospective review of patients' medical records over a five-year period, Jan, 2017 to Dec, 2022, was carried out. OR log books, and individual patient medical record was used for review. Data was cleaned and analyzed using SPSS version 23 for windows. Means, standard deviations and percentages were calculated.

Results: A total of 1621 patients had thyroidectomy in a five-year period. Of these, 60 were cases of retrosternal goiter making a prevalence of 3.7%. About 44(73.3%) of the patients were females whereas 16(26.7%) were males with F: M ratio of 2.8:1. The mean age at diagnosis was 52 with a range of 19-75 and duration of illness ranged from 7 months to 40 years with mean of 4.7 years.

The most common mode of clinical presentations were cervical mass (93.3%), dyspnea (61.7%), dysphagia (16.7%), chest pain (8.3%), hoarseness of voice (5%) and SVC syndrome (1.7%).

Functionally, 23 patients (38.3%) were hyperthyroid whereas 37 (61.7%) were euthyroid. FNAC test revealed that (3.3%) were malignant and (96.7%) were benign. Twenty-eight individuals had CT scan; 21(75%), 5(17.9%) and 2(7.1%) of the patients displayed Grade 1, Grade 2 and Grade 3 respectively according to CSI classification. Hence 45% of the cases were diagnosed intraoperative as cases of RSG.

Thyroidectomy was achieved in 96.7% of the patients via cervicotomy and 3.3% had sternotomy.

Wound hematoma 13.3%, transient hypocalcaemia 10 %, loss of high pitched voice 5%, and pneumonia (1.7%) were the commonest complications. One patient (1.7%) who presented with SVC syndrome had an ICU admission for close monitoring and was discharged from ICU after 2 days.

All patients were found to have post-operative follow-up and all had improvement. No postoperative mortality.

Conclusion

Retrosternal goiters may exist in absence of symptoms or signs. Majority of retrosternal goiter cases are benign. Hyperthyroidism make significant proportion of the patients. Nearly all the retrosternal goiter patients can be approached via cervicotomy. Morbidity and mortality rates are comparable to the literature.

Key Words: Retrosternal goiter, Sternotomy, Cervicotomy

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Acronyms and Abbreviations

DC: Data Collectors

DS: Data Supervisors

FNAC: Fine Needle Aspiration Cytology

PI: Principal Investigator

RSG: Retrosternal Goiter

SPHMMC: St. Paul's Hospital Millennium Medical College

SPSS: Statistical Package of Social Science

1 Introduction

1.1 Background

Retrosternal goiter refers to any thyroid enlargement in which over 50% of the thyroid permanently located under the thoracic inlet or the lower pole of thyroid is not palpable with the neck in hyperextended position(1).

Retrosternal occurs in 2–26% of thyroidectomies depending on how they are classified(3). There is a female preponderance in cases of RSG with a ratio of 3:1 and have a familial component in up to 30% of cases(2).

The actual etiology of retrosternal goiter is unknown. It would seem to be a combination of a low-lying larynx, enlargement of the inferior pole of a goiter, perhaps enhanced by gravity and negative intrathoracic pressure, as well as the cephalic and caudal movement of the larynx with swallowing (however, many of these factors are present in every person, whether they have a goiter or not)(4).

The most common symptoms were cervical mass (69 percent), dysphagia (33 percent), and dyspnea (28 percent); 13 percent were asymptomatic(5).

Although ultrasonography is the primary imaging modality in the evaluation of multinodular goiter, cross-sectional imaging methods such as computed tomography (CT) and/or magnetic resonance imaging (MRI) are the basic imaging methods in determining the most appropriate surgical approach in retrosternal goiter. These imaging methods could also contribute significantly to the determination of the strategy for anesthesia and intubation(2).

In most of studies, CT is defined as the gold standard method in the preoperative evaluation of patients with RSG and is used more frequently(6).

A CSI classification system defined RSG in the cranio- caudal dimension as: grade 1 (above aortic arch), grade 2 (level of aortic arch), and grade 3 (below aortic arch); in the anteroposterior dimension as type A (prevascular), type B s(retrovascular-paratracheal), and type C (retrotracheal); in the latero-lateral dimension as: monolateral or bilateral(1).

Surgery is accepted as the treatment of choice for a retrosternal goiter, even in asymptomatic patients, because of continued thyroid growth and the risk of malignancy. There is general agreement that a retrosternal goiter can be approached by cervical incision; however, some cases may require an extracervical approach such as a sternotomy or thoracotomy(1).

1.2 Statement of the Problem

The incidence of retrosternal goiter (RSG) varies from 2% to 26% of all thyroidectomies, depending on the defining criteria. There are no clear guidelines to identify *patients* that require an intrathoracic approach.

Although retrosternal goiter is treated surgically in our country, there is a gap in evidence collected on surgical outcome of RSG.

There is paucity on data with regard to the surgical outcome of RSG patients in Ethiopia.

1.3 Significance of the study

There are only a handful of published case reports on RSG in Ethiopia. To the best of the authors' knowledge, a national or hospital-based study on RSG has not previously been performed in Ethiopia. Knowledge of the approach and surgical outcome in patients that were surgically managed for RSG will input into our future practice by improving our preoperative evaluation, optimization, and patient operation selection. Additionally, this study will provide as a reference point for future RSG research within our setting.

2 Literature Review

Retrosternal goiter refers to any thyroid enlargement in which over 50% of the thyroid permanently located under the thoracic inlet or the lower pole of thyroid is not palpable with the neck in hyperextended position(1).

Retrosternal goiter occurrence exists in about 2-19% of patients undergoing thyroidectomy(7).

Eighty patients at the Massachusetts General Hospital that underwent resection of retrosternal goiter in the years 1976 to 1982 were reviewed and the outcome was that, the most common symptoms were cervical mass 69%, dysphagia 33%, and dyspnea 28%; 13 % were asymptomatic. On examination, cervical mass was present in most 90% but not all patients, 51% were obese, and more than one third had tracheal deviation. Fifty-one of 52 patients tested were euthyroid and one was mildly hypothyroid. Chest radiographs showed tracheal deviation in 79% and soft tissue mass in 56 percent(4).

Another study done by Mercante G. et al to identify risk factors for surgical extracervical approach in patients with retrosternal goiter by using a novel classification system based on CT scan cross-sectional imaging (CSI) reconstruction reviewed medical records of 4297 patients with thyroid disease operated. A CSI classification system defined RSG in the cranio-caudal dimension as: grade I (above aortic arch), grade II (level of aortic arch), and grade III (below aortic arch); in the anteroposterior dimension as type A (prevascular), type B (retrovascular-paratracheal), and type C (retrotracheal); in the latero-lateral dimension as: monolateral or bilateral. In their study, the prevalence of RSG was 222 of 4297 cases (5.1%). Fifteen of 222 cases (6.7%) required an extracervical approach due to grade ≥ 2 and/or type C RSG (14 of 15 cases). They reached a conclusion that CT-CSI classification system allows us to identify risk factors for extracervical surgical approach in retrosternal goiter(8).

During the course of 872 thyroidectomies performed at the University of Michigan Medical Center between 1972 and 1982, 5.7% of the patients were found to have retrosternal goiters, 42 of which were benign and eight malignant. All but one operation was performed through a cervical incision. There were no intraoperative deaths. The most common complications in order of occurrence were atrial fibrillation, transient hypocalcaemia, pneumonia, and wound hematoma(9).

A retrospective review of a surgical database was performed by Coskun A. et al between 1995 and 2013 for 220 goiter patients. Comparisons were made between patients who had an RSG and patients who had a cervical goiter with particular focus on those who required sternotomy. Results of the 220 patients, 127 patients (58%) had RSG, of whom 7 (5.5%) required sternotomy(10).

A total of 34 papers totaling 2426 of RSG patients were reviewed. Eighty-four percent of patients operated on for RSG were achieved via a cervical approach, with the remainder also requiring manubriectomy (3.1%), full sternotomy (6.6%) or thoracotomy (4%). Tracheomalacia occurred in 1% of patients and Superior Vena Cava syndrome (SVC) in 3.2%. There was a clear and highly significant association between the extent and definition of RSG and reported complications, as well as the approach used, with the incidence of tracheomalacia, SVC and need for intrathoracic approach increasing more than 10-fold in cases of RSG reaching the aortic arch(11).

Tabchouri N, et al retrospectively reviewed 70 patients who underwent total thyroidectomy for retrosternal goiter for postoperative complications of thyroidectomy in their center between 2007 and 2016. They concluded that related complications were seen more with sternotomy patients compared to cervical approach(12).

Between 1968 and 1991, Torre G and colleagues analyzed 237 patients who underwent thyroidectomy for retrosternal goiter and analysis of their data indicates that, retrosternal goiter arose in elderly patients more than a decade later than cervical goiter; goiters with a 'complex' endothoracic development had an increased rate of short and long term complications; cancer occurred in a significant number of patients, without any specific symptoms of malignancy; The group of patients with hyperthyroidism was characterized by a significantly longer clinical history than euthyroid patients; Nearly all retrosternal goiters could be approached through a cervical collar incision; The morbidity and mortality were low also after sternotomy. The absence of alternative treatment, the relatively high incidence of malignancy, and the threat of acute airway obstruction should induce the early removal of all retrosternal goiters(13).

In a study carried out by A. Agha ET. Al revealed that the most common postoperative complications were persistent (5.1%) or temporary (3.4%) paresis of the recurrent laryngeal

nerve, transient hypocalcaemia (3.4%), and hematoma (3.4%) and a tracheostomy was required in one patient with bilateral vocal cord paresis (1.7%)(14).

In a review done by Oo et al in 2016, 72% of the patients had a computerized tomography scan of the neck and upper chest done. Overall, 98% of the retrosternal goiters were secondary while 2% of the patients had primary retrosternal goiter which was an autopsy finding. The inferior extent of the goiter was predominantly in the anterior mediastinum in 80% patients, while 16% patients had posterior mediastinal extension of retrosternal goiter; extension into both anterior and posterior mediastinum was seen in 14% patients. In 56% patients, the goiter extended to the angle of Louis inferiorly; while in 18% patients the goiter reached the aortic arch and in 11% patients it extended to the trachea bifurcation. The extension beyond the trachea bifurcation occurred in 16% patients(7).

A retrospective study done on managing retrosternal goiter in Ibadan, Nigeria between January 2001 and December 2015 reviewed a total of 652 thyroidectomies performed in the center, of those 6.9% patients had retrosternal goiter. In their study, 76% were female and 24% were male with a female/male ratio of 3:1(7).

El Hammoumi, M and colleagues carried out a retrospective study from January 2004 to December 2012 in Morocco, reviewing 93 cases of RSG operated in their department, with the aim of describing epidemiological and clinical data and discussing the surgical challenges. The most common presentations in sequence were cervical mass, dysphagia, dyspnea, hoarseness and partial vena cava syndrome. Cervicotomy and sternotomy were performed in 95.7% and 4.3% of the patients respectively, hence their experience demonstrates that cervicotomy frequently enables removal of goiter with mediastinal extension. In 9 instances, 3.2% of hypoparathyroidism, and 4.3% of recurrent nerve damage, postoperative sequelae were found. No postoperative death occurred(15).

In a study done by Sakkary M. A et al at the National Cancer Institute (NCI), Cairo University, between January 2000 and December 2009 on the need for thoracic approach based on CT scan findings. Out of 1481 patients underwent thyroidectomy, 4.93% (73) had RSG. CT findings were consistent with intraoperative findings except in 2 patients. The approach used was cervical in 90.4%; combined approach in 8.2%. Sternotomy was used alone in one case (1.4%). The study

concluded that Preoperative CT, can be used effectively to guide the indications for using a thoracic approach(16).

A case report in Ethiopia by Irabor, D. O. in 2003 on operative experience for a 53-year-old female with giant retrosternal goiter with severe tracheal compression and superior vena cava syndrome reported that from the initiation of the neck incision, mobilization of the gland and performing the subtotal excisions there was troublesome bleeding; Pneumothorax resulting after delivery of the massive retrosternal portion was managed with an underwater-seal drainage tube(17).

3 Objectives

3.1 General Objective

- To Assess clinical presentation, options of surgical management and outcome of patients surgically treated for retrosternal goiters in SPHMMC.

3.2 Specific Objectives

- To Assess various clinical presentation of retrosternal goiter patients
- To Assess surgical approach for retrosternal goiter
- To Assess the complications following surgical management for retrosternal goiter
- To identify factors associated with morbidity and mortality following surgical management of retrosternal goiter

4 Methodology

4.1 Study Design

There was a single-center retrospective cross-sectional study design utilized.

4.2 Study Area and Study Period

The study was conducted in the surgical department of St. Paul's Hospital Millennium Medical College; it serves as a medical hub for a population of more than 5 million. The hospital treats 1,200 patients with a variety of problems on a daily average across a number of specialties and subspecialties. Cardiothoracic and endocrine surgeons with training perform surgeries at this hospital. The period covered by the retrospective study was from January 2017 to December 2022.

4.3 Study population

- All patients that had surgery for retrosternal goiter at SPHMMC from January 2017 to December 2022.

4.4 Inclusion Criteria

- All patients, who underwent surgery for RSG during the research period at SPHMMC from January 2017 to December 2022.

4.5 Exclusion Criteria

- Incomplete Charts

4.6 Sample Size

- $$n = \frac{P(1-P) Z_{\alpha/2}^2}{d^2}$$
- Desired confidence interval: 95%, Z:1.96
- **P:** Prevalence of RSG = 5.1
- **D:** margin of error:5%

- N: 74.37
- Total sample size = $N + 10\%(7.437) = 81.807$

4.7 Sampling Method

Non-probability convenience sampling technique was used to compute the sample

4.8 Study Variables

Dependent Variables

- RLN injury
- Hypothyroidism
- Hypocalcaemia
- Troublesome Bleeding
- Pneumothorax
- Pneumonia
- ICU admission

Independent Variables

- Age
- Sex
- Dysphagia
- Cervical mass
- Dyspnea
- Duration of illness
- Type of surgical procedure

4.9 Data Collection Procedure and Data Quality Management

Data was collected from July to Dec 2023. A data collection checklist prepared in English language and adapted from literatures reviewed for this study was used. Records of patients with RSG who have undergone surgical management from January 2017 to December 2022 were

taken for this study from operation theater registry and ward log books and used to retrieve individual patient card from record room.

Training was given to data collectors on the components of the checklist and how to fill the data into a computer. Records of the study population were assessed for completeness before data entry and the entered data was checked by the data supervisor on a daily basis for any incompleteness and/or inconsistency.

4.10 Data Analysis

The Statistical Package of Social Sciences (SPSS) version 23.0 for Microsoft Windows was used to analyze the data. Calculations were made for means, standard deviations, and percentages. Charts and graphs were created using Microsoft word 2019 software. The relationship between each dependent and independent variable was assessed using binary logistic regression and multivariate regression, a p-value of 0.05 considered significant.

4.11 Ethical Consideration

The Institutional Review Board of St. Paul's Hospital Millennium Medical College provided ethical clearance before authorization to conduct the study was requested from the Department of Research Directive. A standardized checklist was used to gather the data for each subject. The information gathered was solely used for this specific study and was kept private.

4.12 Dissemination of Results

As part of the requirements for a specialty certificate in General Surgery, the results of this study were shared with the Department of Surgery and Public Health, St. Paul's Hospital Millennium Medical College.

4.13 Operational Definitions

- **Incomplete Charts:** Charts without attached imaging results, operation notes, pathology reports or discharge summaries.
- **Management outcome:** Results related to surgical procedure or underlying disease process in patients who have undergone surgical management for RSG.

5 Results and Discussion

5.1 Results

■ Socio-demographic characteristics

During study period, 1621 patients had thyroidectomy and 60 of them were cases of retrosternal goiter making prevalence of 3.7%. About 44(73.3%) patients were females whereas 16(26.7%) were males with F: M ratio of 2.8:1. Most of the patients were in their 5th and 6th decade of life (table 1). The duration of illness ranged from 7 months to 40 years with mean of 4.7 years.

Table 1: Socio-demographic characteristics in the surgical management of retrosternal goiter at St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia, 2023(n=60)

Variable	Category	Frequency	Percentage
Age	18-24	2	3.3%
	25-34	2	3.3%
	45-54	11	18.3%
	55-64	18	30%
	Above 65	27	45%
Sex	Female	44	73.3%
	Male	16	26.7%

■ Presenting symptoms, preoperative laboratory and imaging data

The most common mode of clinical presentations were cervical mass (93.3%), dyspnea (61.7%), dysphagia (16.7%), chest pain (8.3%), hoarseness of voice (5%) and SVC syndrome (1.7%).

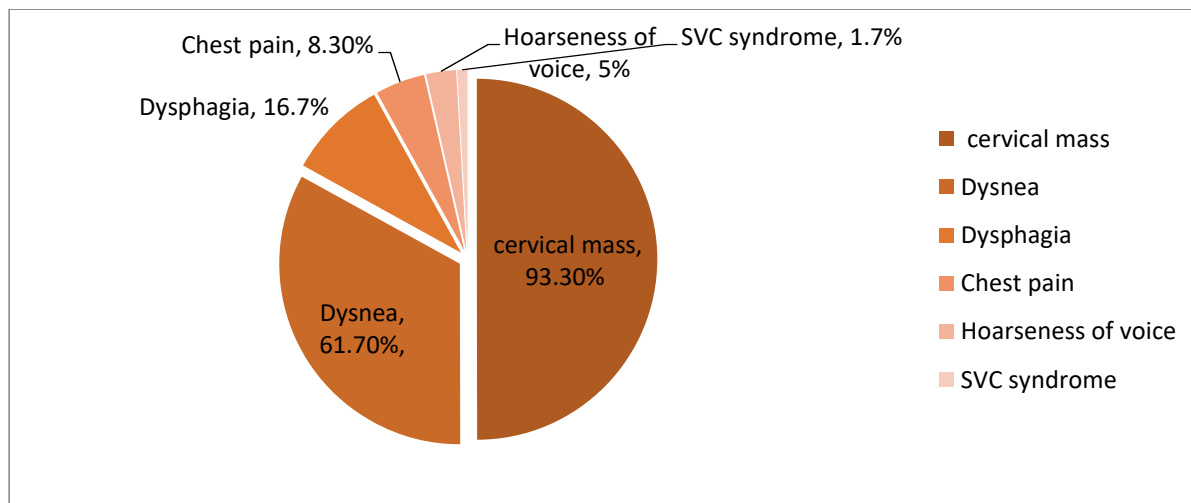


Figure 1: Clinical Presentation of patients

Functionally, 23 patients (38.3%) were hyperthyroid whereas 37 (61.7%) were euthyroid. FNAC test revealed that (3.3%) were malignant and (96.7%) were benign. Twenty-eight individuals had CT scan; 21(75%), 5(17.9%) and 2(7.1%) of the patients displayed Grade 1, Grade 2 and Grade 3 respectively according to CSI classification.

Surgical Approach, Postoperative complications and Mortality

Of the patients operated, 27 (45%) were diagnosed intraoperative as cases of retrosternal goiter and 33(55%) were preoperative diagnosis. Thyroidectomy was achieved in 96.7% of the patients via cervicotomy and 3.3% had sternotomy. While undergoing surgery 4 (6.7%) patients required intra-operative transfusion. Wound hematoma 13.3%, transient hypocalcaemia 10 %, loss of high pitched voice 5%, and pneumonia (1.7%) were the commonest complications. Other post-operative complications were temporary hoarseness of voice and tracheomalacia accounting for 1(1.7) and 1(1.7%) respectively. Two patients (3.3%) required re-exploration for indication of hematoma and both patients showed improvement after the re-exploration. One patient (1.7%) who presented with SVC syndrome had an ICU admission for close monitoring and was discharged from ICU after 2 days. The mean length of stay of patients who underwent surgery was 3 days with a range of 2-14 days. Upon assessing persistent complications, 1(1.7%) patient was found to have permanent hypocalcaemia.

All patients had post-operative follow-up and all had improvement. No postoperative mortality.

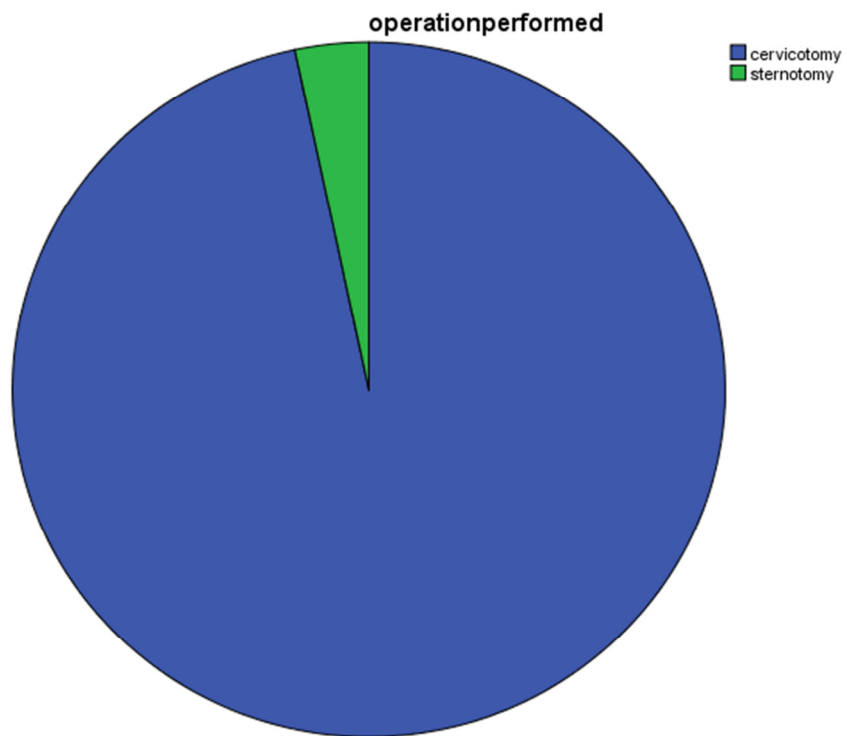


Figure 2: Types of procedure performed among operated patients

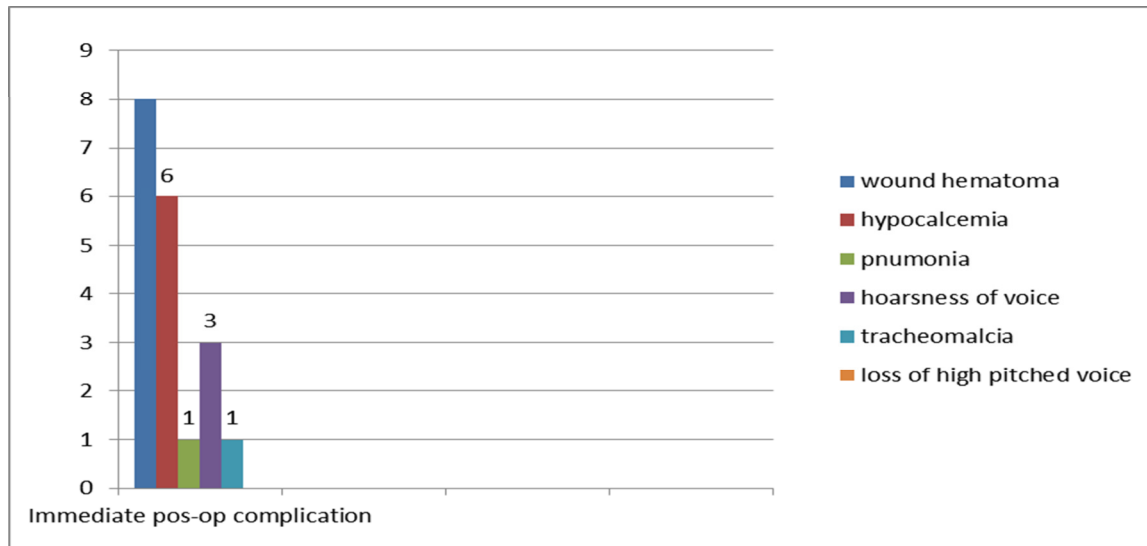


Figure 3: Graph showing immediate post-operative complications among operated patients

The association between the dependent and independent variables was analyzed using the logistic regression analysis. In the binary logistic regression analysis, variables with a p-value of less than 0.25 were selected for multivariate logistic regression analysis. On the binary logistic regression, dysphagia was found to be a significant association with hematoma. Duration of illness was associated with the need for postoperative transfusion and grade of RSG was found to be significantly associated with transient hypocalcaemia. Using the multivariate logistic regression analysis, it was found that none of the independent variables were significantly associated with any of the dependent variables.

5.2 Discussion

During study period, 1621 patients had thyroidectomy and 60 of them were cases of retrosternal goiter making a prevalence of 3.7%. The prevalence is slightly lower compared to studies done in University of Michigan medical center 5.7%(9), Nigeria 6.9 %(7) and Egypt 4.9%(16). This could be due to the reason that nearly half of our patients were diagnosed intraoperative as cases of RSG and poor documentation might have contributed.

About 44(73.3%) patients were female whereas 16(26.7%) were male with F: M ratio of 2.8:1. This is comparable to a study done in Ibadan, Nigeria in which 76% were female and 24% were male with a female/male ratio of 3:1(7).

Our study revealed that, the most common mode of clinical presentations were cervical mass (93.3%), dyspnea (61.7%), dysphagia (16.7%), chest pain (8.3%), hoarseness of voice (5%) and SVC syndrome (1.7%) whereas a study done in Morocco showed a comparable results with the most common presentations in sequence as cervical mass, dysphagia, dyspnea, hoarseness and partial vena cava syndrome(15). Dyspnea was the second most common presentation in the former unlike the latter due to the fact that most of the patients presented with huge goiters after decades of illness.

Functionally, 23 patients (38.3%) were hyperthyroid whereas 37 (61.7%) were euthyroid which has a marked difference with a research carried out at the Massachusetts General Hospital in which 98% of the patients tested were euthyroid and 2% were mildly hypothyroid(4). This can be explained by fact that most of our patients presented after a long period of clinical history. This finding is also supported by a review done for 34 papers by Huins CT, Georgalas C. and colleagues which revealed that a group of patients with hyperthyroidism was characterized by a significantly longer clinical history than euthyroid patients (11). FNAC test revealed that 2 (3.3%) were malignant and 58 (96.7%) were benign which shows slight discrepancy in research done in University of Michigan Medical Center where 84% of which were benign and 16% malignant(9).

Our research outcome showed that, 45% of the cases were intraoperative diagnosis which is not the case with the reviewed literatures. This could be attributed to cost availability as some patients could not afford standard imaging modality.

Thyroidectomy was achieved in 96.7% of the patients via cervicotomy and 3.3% had sternotomy which is comparable to studies done by Coskun A. et al 94.5% underwent cervicotomy and 5.5% required sternotomy(10). And also comparable to a research done in Morocco where Cervicotomy and sternotomy were performed in 95.7% and 4.3% of the patients respectively(16).

In this study, Wound hematoma 13.3%, transient hypocalcaemia 10 %, loss of high pitched voice 5%, and pneumonia (1.7%) were the commonest complications. One patient (1.7%) who presented with SVC syndrome had an ICU admission for close monitoring and was discharged from ICU after 2 days. The complications are relatively comparable to other studies (14, 9). Wound hematoma was seen in majority of the patients that had complications unlike other studies. This could be due to patients' late presentation with huge goiters. No RLN injury, this can be explained by the virtue that such operations are being performed by experienced general surgeons or endocrine surgeons.

Due to rarity of retrosternal goiter, there is paucity in data in Ethiopia. Currently, there are no published researches on this matter and this shall be the first hospital based study.

5.3 Conclusion

Retrosternal goiters may exist in absence of symptoms or signs. Majority of retrosternal goiter cases are benign. Our study showed that nearly half of the patients were hyperthyroid. Nearly all the retrosternal goiter patients could be approached via cervicotomy. Morbidity and mortality rates are comparable to the literature.

5.4 Recommendation

Our study found a gap in preoperative workup, most of the patients were diagnosed intraoperative as cases of retrosternal goiter. Patients with longstanding goiters should be imaged.

We have identified a gap with regard to local data on retrosternal goiter, therefore we recommend wider hospital based or nationwide studies to improve our practice as well as avail adequate data.

Preventive measures such as iodine supplementation and health education on the disease may encourage early presentation of the patients and reduction in the disease burden.

5.5 Limitations of the Study

- The data source is secondary and pages of the charts might have been lost
- Since the study was institution based, it may not reflect the overall status of the problem in Ethiopia

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7 Annexes

7.1 Annex I Data Collection Format

Patients demographic data, presenting symptoms, preoperative laboratory and imaging data			
MRN	Age	Sex Male ☐ Female ☐	
Address	Region City	Occupation	
Referred from	Regional ☐ Zonal ☐	Private Hospital ☐ Others	
Diagnosis	Age at diagnosis	Grade of RSG I ☐ II ☐ III ☐ Not Applicable ☐	
Presenting Symptoms	Cervical mass Yes ☐ No ☐	Dyspnea Yes ☐ No ☐	Dysphagia yes ☐ No ☐

	Chest pain Yes ☐ No ☐		
	Others		
Duration of illness	 (In months)	Previous treatment Yes ☐ No ☐ If yes specify	
Comorbid conditions	DM Yes ☐ No ☐	RVI Yes ☐ No ☐	Unknown ☐
	HTN Yes ☐ No ☐	Others	
ASA Class	I ☐ II ☐ III ☐ IV ☐		
Preoperative Lab	Euthyroid ☐ Hypothyroid ☐ Hyperthyroid ☐		
FNAC	Benign ☐	Suspicious for malignancy ☐	Malignant ☐
Imaging findings	Ultrasound	Yes ☐ No ☐	Comment
	x-ray	Yes ☐ No ☐	Comment
	CT scan	Yes ☐ No ☐	Comment
	Others		Comment

Surgical Approach, postoperative complications and mortality			
Intraoperative Diagnosis	Changed ☐ Unchanged ☐ If changed, specify		
Operation performed	Cervicotomy ☐	Sternotomy ☐	Others
Duration of procedure	In minutes	Intraoperative Transfusion	Yes ☐ No ☐ If yes, No. of units
Intaop surgical complication	Troublesome bleeding Yes ☐ No ☐	Pneumothorax Yes ☐ No ☐	Others
Intraop anesthesia complication	Yes ☐ No ☐	If yes, specify	

ICU admission	Yes ☐ No ☐	If yes, length of ICU stay..... (in days)	
Tracheostomy	Yes ☐ No ☐	If yes, Temporary ☐ Permanent ☐	
Postoperative complications	Wound Hematoma Yes ☐ No ☐	Transient Hypocalcaemia Yes ☐ No ☐	Others
	RLN Injury Yes ☐ No ☐ If yes, Specify.....	Pneumonia Yes ☐ No ☐	
Postoperative transfusion	Yes ☐ No ☐	If yes, No. of units.....	
Re-exploration	Yes ☐ No ☐	If yes, why? Outcome	
Total hospital stay	 (In days)	Died in hospital yes ☐ No ☐ If yes, cause of death.....	
Condition on discharge	Improved ☐ Same ☐ Worsened ☐		
Readmission	Yes ☐ No ☐	If yes, why?	
Follow-up visit	Yes ☐ No ☐	If yes, improved ☐ same ☐ worsened ☐	
Persistent complications	Airway obstruction Yes ☐ No ☐	Hypothyroidism Yes ☐ No ☐	Others
	Hypocalcaemia Yes ☐ No ☐		

7.2 Annex II Assurance of Investigator

I the undersigned resident agree to accept all responsibilities for the scientific, ethical and technical conduct of the research project and for provision of required progress reports as per terms and conditions of the Research and Publication Directorate and /or Department of Public Health of St. Paul's Hospital Millennium Medical College.

Name of the Resident: Dr. Arop Garang Maluach

Signature: _____

Date: _____

Approval of Advisors

Name of Clinical Advisor: Dr. Yishak Suga

Signature: _____

Date: _____

Name of Clinical Advisor: Dr. Mekdim Tadesse

Signature: _____

Date: _____

Name of Clinical Advisor: Dr. Petros Jirata

Signature: _____

Date: _____