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Surgical Management of Goiter with Intrathoracic Extension at the Philippine General Hospital Department of Otolaryngology Head and Neck Surgery

ABSTRACT

Objective: To describe the demographic and clinical characteristics of patients diagnosed with intrathoracic thyroid masses managed surgically in our institution, determine associated factors affecting eventual operative approaches for these patients, and assess postoperative outcomes and complications associated with surgical intervention.

Methods:

Design: Retrospective descriptive case series
Setting: Tertiary National University Hospital
Participants: 24 patients

Results: The mean age of patients diagnosed with intrathoracic goiters was 55.71 years old, with a 1:1.4 male to female ratio; with most having an intrathoracic extent of Huins Grade 1 (67%) compared to others having Huins Grade 2-3. Majority of patients pre-operatively had a Fine Needle Aspiration (FNA) Bethesda Thyroid Nodule Classification of Category II (benign); 79% of total patients underwent excision of thyroid mass utilizing a transcervical approach alone. As Intrathoracic Extension (ITE) grade increased, additional transthoracic approaches were performed; duration of operation, average estimated blood loss, length of hospital stay was also noted to increase. Majority of post-operative surgical histopathology results revealed malignant thyroid masses, in contrast to pre-operative FNA. Post-operative transient hypocalcemia was the most reported immediate complication.

Conclusion: Management of intrathoracic goiter is often multidisciplinary. Referral to the thoracic vascular service is warranted for access to the thoracic inlet. Classification by grade of intrathoracic goiters is helpful to determine the most appropriate operative approach and may be predictive of intraoperative and postoperative outcomes. Postoperative histopathology across all ITE grades mostly yield malignant results; hence, preoperative FNA results should be used with caution.

Keywords: *thyroid diseases; thyroid neoplasms; goiter, intrathoracic; goiter, substernal; goiter, retrosternal; thyroid, surgery; thyroidectomy, complications; sternum; manubrium*

Thyroid masses that extend into the thoracic inlet are referred to as *intrathoracic goiters* (also called *retrosternal, substernal, or mediastinal* goiters), and may be defined as a "thyroid gland that, on neck examination without being in hyperextension, has a portion that remains permanently retrosternal."[1] Other definitions use landmarks such as distance from the sternal manubrium

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landmark,[2] fourth thoracic vertebrae,[3] aortic arch,[4] or constant positions such as the clinical definition with neck in hyperextension.[5] Huins *et al*., in a systematic review looking into practices in the management of retrosternal goiters,[6] attempts to classify intrathoracic extension from Grade 1 to 3, with respective surgical recommendations depending on extent. *Figure 1* demonstrates this grading system, with physical exam images and their CT scan extent.

Local literature on the incidence and operational approaches to intrathoracic goiter are scant and limited to a small case series and case report.[7,8] Villaluna and Desales[7] reviewed experiences at the Lung Center of the Philippines in a cross-sectional study of 14 patients wherein 42% of patients with intrathoracic goiter underwent excision with a neck collar incision without a sternotomy. At the 1,500-bed Philippine General Hospital, goiter serves as the top reason for admission at the Department of ORL-HNS Ward.[9] To the best of our knowledge, based on a search of HERDIN Plus, the ASEAN Citation Index (ACI), the Western Pacific Region Index Medicus (WPRIM), MEDLINE (PubMed and PubMed Central), and Google Scholar, using the search terms "goiter" OR "thyroid," AND "intrathoracic" OR "retrosternal" OR "substernal," AND "Philippines," there are no other studies describing intrathoracic goiter in the Philippines.

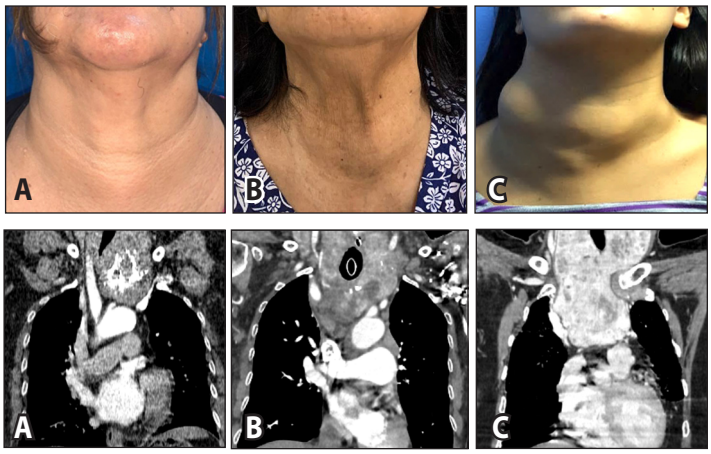

Figure 1. Representative Physical Exam Images and Contrast CT Scans illustrating Intrathoracic Extent across Huins Grades: **A.** Grade 1 (aboveaortic arch / T4); **B.** Grade 2 (aortic arch to pericardium); and **C.** Grade 3 (below right atrium)

Our study aims to report the demographic and clinical characteristics of patients diagnosed with intrathoracic thyroid masses managed surgically in our institution, determine associated factors affecting eventual operative approaches for these patients, and assess post-operative outcomes and complications associated with surgical intervention.

METHODS

With approval from the University of the Philippines Manila Research Ethics Board (UPM-REB 2020-0664-01), this retrospective series considered all patients diagnosed to have intrathoracic goiter who underwent thyroidectomy under the Department of Otolaryngology – Head and Neck Surgery of the Philippine General Hospital over five years from January 1, 2015 to December 31, 2019, for inclusion.

Inclusion criteria were patients with pre-operative diagnosis of "intrathoracic goiter" with: (1) clinical definition (a thyroid gland that, on neck examination without being in hyperextension, has a portion that remains permanently retrosternal) diagnosed by a board-certified otolaryngologist-head and neck surgeon; and (2) radiographic diagnosis on Computerized Tomography (CT) scan of the neck officially read by a board-certified radiologist. Included patients should have subsequently undergone surgical excision of the thyroid mass. Excluded were patients whose records were incomplete or non-retrievable.

The initial physical chart review included the Patient Case Record (age, sex, region of residence, length of admission, duration of mass, reported signs/symptoms of patient at time of admission, co-morbidities); Operation and Anesthesia Record (operation performed, intraoperative findings, blood loss, total operation time); Doctor's Order sheet (pre-operative medications, pre-operative risk assessment by General Medicine service, entries from co-managing services): Laboratory reports (thyroid function test levels; post-operative serum calcium values); Surgical Pathology report (pre-operative FNA Bethesda classification results, final post-operative histopathology as officially reported by a board-certified pathologist); Radiology report (inferior most intrathoracic extent as officially reported by a board-certified radiologist). Records were considered incomplete if at least one of these was missing or could not be retrieved.

Data was encoded using Microsoft Excel for Mac 2016 Version 14.0.0 (Microsoft Corporation, Redmond, WA, USA). Collected data were tabulated according to socio-demographic, preoperative clinical characteristics. Stratification of patients were done based on intrathoracic extent (ITE) grade as outlined by Huins[6]: **Grade 1** (above the aortic arch/thoracic vertebrae 4), **Grade 2** (aortic arch to the pericardium); and **Grade 3** (below the right atrium). Intraoperative surgical approach characteristics, and post-operative characteristics and complications were described. Pre-operative fine-needle aspiration (FNA) biopsy classifications using the Bethesda System for reporting thyroid cytopathology versus final thyroid histopathology reports were also compared.

Descriptive summary measures for continuous variables were presented through means ± standard deviations (if relevant) and categorical variables were presented using frequency counts and proportions. Microsoft Excel for Mac 2016 Version 14.0.0 (Microsoft Corporation, Redmond, WA, USA) was also used for statistical analyses.

RESULTS

Of the 60 patients with diagnoses of "intrathoracic" or "retrosternal" and "goiter" or "thyroid," during the study period, 24 patients (40%) met inclusion and exclusion criteria. The mean age of patients diagnosed

with intrathoracic goiters was 55.71 years old (range 33 to 73 years old). There were 10 males and 14 females, with a 1:1.4 male to female ratio. On average, patients had their thyroid masses for 8.9 years prior to operation. Twenty two (22) were new cases, while two were recurrences of previously excised thyroid masses.

Table 1 shows the socio-demographic and clinical characteristics of patients with intrathoracic goiter fulfilling the inclusion criteria. Region of residence and comorbidities were listed in the table as well. Patient preoperative clinical symptoms were also noted; dyspnea (four patients; 17%), dysphagia (three patients; 13%), were noted to be the most frequent reported signs/symptoms. For 12 patients (50%), the surgeon-in-charge ordered pre-operative antibiotics; less frequently, Tranexamic Acid and calcium supplementation were ordered pre-operatively. Nineteen patients (79%) had normal FT4 and TSH values prior to operation. Pre-operative risk assessment made by the co-managing Internal Medicine service stratified 20 patients (83%) at low risk for perioperative complications prior to procedure. Based on their official CT scan radiographic official reading, they were classified according to intrathoracic extent (ITE) grade: Sixteen patients (67%) were Grade 1 (above the aortic arch/T4 vertebrae), six patients (25%) were Grade 2 (aortic arch to pericardium) and two patients (8%) were Grade 3 (below the right atrium).

Twenty two patients (92%) underwent total thyroidectomy, with two patients undergoing completion thyroidectomy from previous excision of the contralateral lobe. Nineteen (19) patients from all grades (79%) underwent excision of thyroid mass utilizing a transcervical approach alone; 16 of total patients (67%) were classified under ITE Grade 1. Four patients with ITE Grade 2 required additional transthoracic approaches (2 manubriotomies, 1 median sternotomy, 1 posterolateral thoracotomy) in addition to the transcervical incision. For the two patients with ITE Grade 3, one underwent a transcervical approach alone while one needed a posterolateral thoracotomy. Neck dissection was performed for patients with pre-operative suspicion for malignancy– five patients for ITE Grade 1, one patient for ITE Grade 2, and one patient for ITE Grade 3.

Table 2 outlines the duration of operation, hospital stay, blood loss, blood transfusion, and pre-operative to post-operative calcium levels and corresponding level differences. The duration of surgery and average estimated blood loss were noted to increase as ITE grade increased. Furthermore, there was an increase in average packed RBC units transfused intraoperatively as ITE grade increased. Duration of length of hospital stay (from date of admission to date of discharge) were significantly prolonged as thoracic grade extent increased, with a mean of 15.2 days for Grade 1, 31.3 days for Grade 2, and 54 days for Grade 3. Serum calcium levels from pre-operative to post-operative period were noted to be consistently decreased 24 hours post-operatively per patient group, with an average of 0.36 mmol/L difference across all ITE Grades (Grade 1 at 0.37, Grade 2 at 0.32, and Grade 3 0.37 mmol/L).

Table 1. Socio-demographic and pre-operative clinical characteristics of Patients

Characteristic	Total	
	n	%
Total	24	100%
Age		
(Mean: 55.7 y/o; SD: 13.5)		
< 55 years old	9	38%
≥ 55 years old	15	63%
Sex		
Male	10	42%
Female	14	58%
Region		
Region IV-A CALABARZON	11	46%
National Capital Region	5	21%
Region III Central Luzon	3	13%
Region IX Zamboanga Peninsula	2	8%
Cordillera Administrative Region	1	4%
Region VIII MIMAROPA	1	4%
Region XIII CARAGA	1	4%
New/Recurrence		
New	22	92%
Recurrence	2	8%
Duration of neck mass prior to consult		
(Mean: 8.9 years; SD: 8.2)		
0-10 years	17	71%
11-20 years	5	21%
≥ 20 years	2	8%
Co-morbidities		
Hypertension	4	17%
Dyslipidemia	2	8%
Metabolic syndrome	2	8%
Signs and symptoms		
Palpable anterior neck mass	24	100%
Dyspnea	4	17%
Dysphagia	3	13%
Hoarseness	3	13%
Weight loss	2	8%
Neck pain	1	4%
Heat/Cold intolerance	1	4%
Tremors	1	4%
Use of Pre-operative Medications		
Antibiotics	12	50%
Tranexamic Acid	7	29%
Calcium Supplementation	3	13%
Pre-operative Risk Assessment		
Low	20	83%
Medium	3	13%
High	1	4%

Table 3 shows post-operative histopathologic and clinical characteristics of patients included in the study. On post-operative assessment of histopathologic results, most of the patients were diagnosed to have histologically malignant thyroid masses (16 patients, 66%). For ITE Grade 1, majority of patients (12 patients, 66%) were diagnosed post-operatively as malignant; for ITE Grade 2, majority (five patients, 71.5%) had benign colloid goiter; and for Grade 3, all patients

Table 2. Duration of operation, hospital stay, blood loss, transfusion, laboratory values

Characteristic	Total			ITE Grade 1 above aortic arch / T4		ITE Grade 2 aortic arch to pericardium		ITE Grade 3 below right atrium	
	Unit	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Duration of Operation	hours	6.0	3.3	4.7	2.3	8.0	4.0	10.3	0.1
Length of hospital stay	days	22.6	22.6	15.2	12.2	31.3	25.6	54.0	53.7
Operation Date to Discharge Date Duration	days	12.5	15.3	7.3	7.1	20.7	20.1	29.5	34.6
Estimated Blood Loss	mL	917.7	1238.5	484.1	479.5	1746.7	2087.4	1900.0	989.9
Packed RBC Blood Transfused	350 cc standard packed RBC units	1.1	1.6	0.5	0.9	1.7	1.5	4.0	2.8
Laboratory Values									
Pre-op Calcium Level	mmol/L	2.2	0.1	2.2	0.1	2.2	0.1	2.1	0.2
Post-op Calcium Level	mmol/L	1.8	0.2	1.8	0.3	1.9	0.2	1.7	0.0
Pre-op and Post-op Calcium Difference	mmol/L	0.4	0.2	0.4	0.3	0.3	0.2	0.4	0.2

Table 3. Post-operative histopathologic and clinical characteristics of patients

Characteristic	Total		ITE Grade I above aortic arch / T4		ITE Grade II aortic arch to pericardium		ITE Grade III below right atrium	
	n	%	n	%	n	%	n	%
Post-operative Histopathology								
Benign Colloid Goiter	10	42	6	38	4	84	-	-
Benign Colloid Goiter with Thymic Tissues Malignant	1	4	-	-	1	17	-	-
Papillary Carcinoma	11	46	7	44	2	33	2	100
Follicular Carcinoma	2	8	2	13	-	-	-	-
Medullary Carcinoma	1	4	1	6	-	-	-	-
Hurthle Cell/Oncocytic Carcinoma	1	4	1	6	-	-	-	-
Lymphoma	1	4	1	6	-	-	-	-
Complications								
Hypocalcemia	15	63	10	63	3	50	2	100
Infection Blood	2	8	-	-	2	33	-	-
Sputum	5	21	2	8	3	50	-	-
Other (stool, urine)	2	8	-	-	1	17	1	50
Surgical site	0	0	-	-	-	-	-	-
Psychiatric	5	21	2	13	3	50	-	-
Mechanical ventilation	4	17	-	-	3	50	1	50
Nerve palsy	4	17	-	-	4	67	-	-
Cardiac dysrhythmia	2	8	1	6	1	17	-	-
Wound dehiscence	1	4	1	6	-	-	-	-

included in the study (two patients, 100%) had papillary thyroid carcinoma.

Post-operative transient hypocalcemia was noted to be the most reported immediate complication of surgical operations involving intrathoracic goiters, at 63% across ITE groups. Infections during hospital in-patient admission were also noted (five patients, 21%) and were most frequent with ITE Grade 2, with those having bacteriologically proven infections on sputum specimen. The most common isolates were *Kleibsiella pneumoniae* (three patients), *Pseudomonas aeruginosa* (one patient) and *Staphylococcus aureus* (one patient). Psychiatric complications were also noted as post-surgical complications for five patients (21%). These patients were diagnosed with delirium associated with prolonged operative anesthesia time or sepsis. Being committed to mechanical ventilation post-operatively was increased in patients

Table 4. Distribution of pre-operative FNA bethesda classification with post-operative histopathology

Pre-operative FNA Bethesda Classification												
	Total		II		III		IV		V		VI	
Post-operative Histopathology	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Total*	26	100	19	100	1	100	1	100	4	100	1	100
Benign Colloid Goiter	10	39	8	42	0	0	1	100	1	25	0	0
Malignant Papillary	11	42	8	42	1	100	0	0	1	25	1	100
Follicular	2	8	1	5	0	0	0	0	1	25	0	0
Medullary	1	4	1	5	0	0	0	0	0	0	0	0
Hurthle Cell/Oncocytic Carcinoma	1	4	1	5	0	0	0	0	0	0	0	0
Lymphoma	1	4	0	0	0	0	0	0	1	25	0	0

* Note that there are 26 histopathology-based post-operative histopathology results from 24 patients because two patients have mixed type results.

with ITE Grade 2 (three patients, 50%) and Grade 3 (one patient, 50%); all were extubated after.

Table 4 shows the preoperative FNA classification tabulated side-by-side with post-operative surgical histopathology. Only 42% of Bethesda Category II pre-operative FNA specimens had consistent benign colloid goiter results on post-operative histopathology. Fifty seven percent (57%) of the time, Bethesda Category II results yielded a malignant post-operative histopathologic diagnosis, which were mostly papillary thyroid carcinomas (42%). It is important to note that the abovementioned findings contrast with the pre-operative FNA findings that showed the majority (18 patients; 75%) as benign.

DISCUSSION

Benign and malignant thyroid masses comprised the top 1 and 3 diagnoses, respectively, at the Philippine General Hospital Department of Otolaryngology-Head and Neck Surgery (ORL-HNS), and thyroidectomies comprised the top 1 of all surgical procedures, with an average of around 250 cases per year.[9] The Philippine Thyroid Diseases Study (PhilTiDes 1) estimated the prevalence of goiters in the Philippines to be at 8.9% among the total Filipino adult population in 2014, 56% of which had diffuse enlargement and the rest (44%) had nodular goiter.[10] However, those with intrathoracic extent had not yet been explored by the institution prior to this study and national prevalence data show no distinction about this patient subset.

Most patients in our study had a mean age of 55.7 years old at time of diagnosis, with higher prevalence of females versus males, and with most coming in from geographical regions near the institution. This is in comparison with the characteristics of the sample population with goiter in general in the Philippine National prevalence study,[10] where the mean age of patients diagnosed with goiter disorders was around 43.9-47.9 years old (SD 1.4-2.7), with more females than males having larger grade thyroid sizes.[10]

All our patients had a reportedly palpable anterior neck mass, which was the chief complaint for most of the consults. Obstructive symptoms such as dyspnea, dysphagia were present as the top reported associated symptoms, but not to the same extent as reported in the local study by Villaluna and Desales[7] where 64% had dyspnea and 14% had dysphagia that was more frequent in Grade 2-3 patients as size increased. The results of our study were more consistent with Unlu's findings that "about 69–97% of the patients present with cervical mass, 42–96% respiratory symptoms, 26–60% dysphagia, and 1–5% acute airway obstruction."[11]

Pre-operative medications were also used, mostly concentrated on antibiotics, Tranexamic Acid, and calcium supplementation to prevent complications. As a clean surgery, antibiotic use is not routinely recommended in thyroid surgery as long as the surgical procedure was performed aseptically and postoperative care done appropriately.[13] Furthermore, antibiotic prophylaxis in thyroid and parathyroid surgery produce similar surgical site infection (SSI) rates as those without perioperative antibiotics.[14] A previous study in our institution found that, in patients undergoing transcervical thyroidectomies, there was no significant difference between presence and absence of postoperative antibiotics in relation to SSI.[15] To our knowledge, there are no official guidelines for perioperative antibiotic use in non-cardiac thoracic surgery; however in some studies there is strong evidence that supports use of perioperative antibiotics, especially Cefazolin[16] in thoracic surgeries.

Our study also documents use of other preoperative medications such as Tranexamic Acid and Calcium supplementation, which seems to be dependent on physician preference, as we know of no local guidelines on their preoperative use. The degree by which the use of Tranexamic Acid may prevent bleeding and hypocalcemia for thyroidectomy may be investigated in future studies. Overall, most of the operative risk assessments of our thyroidectomy patients were low risk, as these patients were admitted on elective basis and co-morbidities were ideally controlled first by co-managing medical services prior to scheduled operation.

The systematic review of Huins *et al.* proposed a classification to the

approach to the retrosternal goiter relevant to surgical management: **Grade 1** (above the aortic arch/thoracic vertebrae 4); **Grade 2** (aortic arch to the pericardium), and **Grade 3** (below the right atrium).[6] A majority (71.9% of 2426 patients) included in their study were Grade 1, with decreasing number of patients on higher Huins grades.[6] The data from our study showed the same trend: majority were Grade 1 (16 patients; 67%), followed by Grade 2 (six patients; 25%) and Grade 3 (two patients; 8%). Patients in our study mostly underwent a transcervical approach only (79%), similar to the study of Huins *et al.* where only 3.1% required additional manubriotomy, 6.6% required sternotomy, and 4% requiring thoracotomy[6] versus 8%, 4%, 8%, respectively, in our study. This is also similar to the local study by Villaluna and Desales[7] where most patients with intrathoracic goiter required only a cervical incision to approach the mass without a sternotomy. Thyroidectomies with intrathoracic extent requiring neck dissection due to malignant neck nodes mostly involved central neck dissection of level VI (21% of patients), followed by neck node levels II, V, III and IV, which are draining sites of thyroid carcinoma neck node metastasis. This is consistent with the NCCN (2023) recommendation[18] that clinically positive and/or biopsy-proven nodal metastases be treated with formal compartmental resection in the central neck with unilateral or bilateral level VI dissection, and in the lateral compartment, a formal modified radical neck dissection including levels II, III, IV, and V.

For intraoperative duration of operation, we note that as ITE Grade increases, so does the mean intraoperative time. For thyroid masses classified as ITE Grade 1, in which all masses were approached through the transcervical route only, the mean duration of operation was 4.7 hours. For ITE Grade 2, the mean duration increased to 8.0 hours, and for ITE Grade 3, the estimated mean OR time was 10.3 hours. This is consistent with literature that tumor size is associated with greater operative time.[17] These figures may provide surgeons and anesthesiologists with an objective data-based estimate of operative time, especially in a setting where surgical time slots and rooms are limited. However, we must also take into account other procedures that may affect total operative time such as thoraco-cardiovascular access procedures to release intrathoracic extension (sternotomy, manubriotomy, thoracotomy) and neck dissection, as only total operative time was noted in the operative technique documentation. Estimated blood loss and amount of packed red blood cells (RBC) units transfused were also seen to increase as ITE Grade increase. With this data, surgeons may be able to rationally anticipate and prepare standby units of blood products for possible transfusion.

Complications may arise from surgical management of intrathoracic goiters that may come intrinsically from the thyroidectomy itself to associated procedures in providing access to the intrathoracic component. These include almost similar complications to those of thyroidectomy - recurrent laryngeal nerve injury, post-operative transient hypocalcemia, and hemorrhage. In thoracic surgeries, additional possible complications include mediastinitis, post-thoracotomy chronic pain, and post-operative surgical site infections.[1] In our study, the most documented complication was post-operative transient hypocalcemia, with 63% of patients showing low serum calcium values. In a study exploring prolonged duration of thyroid surgeries, the risk of hypocalcemia due to hypoparathyroidism after total thyroidectomy was noted to be high, with one of the independent predictors of the acute complications being duration of surgery extending greater than 120 minutes.[17] The mean operating room time of at least 4.7 hours for those with Grade 1 ITE, puts our patient group at high risk for post-operative hypocalcemia. Infections during admission were also noted. Our study did not report post-operative wound-related infections as a complication; however, incidences of post-surgery infections with proven positive results elsewhere– on blood or sputum specimen, were reported to have prolonged hospitalization. This is in comparison with retrospective study by Fassas *et al*. analyzing post-operative complications after thyroidectomy; although overall complication rates were low at 3.28% for 161,534 patients included in their study, 53% of overall complications were due to pneumonia during hospitalization.[26] Hence, it may also be worthwhile in future studies to investigate the degree by which preoperative antibiotic use can help prevent infections in patients with intrathoracic extent that may prolong hospital stay in the local setting. Psychiatric complications were also noted as a post-surgical complication. Patients experiencing post-operative delirium from thyroidectomy are rare, limited to case reports.[18,25] Other documented complications from local literature include postoperative hemorrhage, and respiratory failure.[7]

The local study of Villaluna and Desales showed that the histopathologic results of intrathoracic goiters were mostly multinodular adenomatous goiters (50%) and follicular adenomas (7%) [7]. This in contrast to the results of our study where a majority of intrathoracic goiters with Category II results on initial pre-operative FNA yield malignant results on final histopathology (papillary thyroid carcinoma at 46% and follicular carcinoma at 8%). Our results also differ from the reported risk of malignancy in the original article introducing the Bethesda System by Cibas *et al.*,[22] which reported a malignancy risk of 0-3% risk for Category II FNA findings. Pre-operative FNA Bethesda classification and final surgical histopathological findings yielding different results for the same patient may be explained by findings that, in patients with large thyroid nodules, FNA results are highly inaccurate and may misclassify patients with reportedly benign lesions.[23] There might be a need to revisit the way pre-operative FNA is done in the institution, especially in cases of intrathoracic goiter in order to have better sample yields that are more representative and reflective of post-operative histopathology. Furthermore, additional modalities such as ultrasound-guided FNA may improve diagnostic accuracy than manual palpation-guided FNA in diagnosing malignancy in thyroid nodules of increased sizes.[24]

Our study only included 40% of patients with a diagnosis of thyroid mass or goiter with intrathoracic extension from our hospital five-

year census, or only 24 out of 60 patients, which is a major limitation of our study. The significant number of incomplete records may also be related to most reports and results being in physical printed and handwritten paper forms that are prone to data loss. It is our hope that the transition of the hospital to digital documentation can help minimize the amount of missing data for inclusion in future studies. Our study also used measurements based on official radiologic CT imaging readings made by various radiologists; most CT scan imaging plates and Digital Imaging and Communications in Medicine (DICOM) raw files were no longer retrievable. It would be ideal that all CT scans be read by a single radiologist (or several independent radiologists) applying the same standard. A prospective study where CT scan DICOM files can also be confirmed by a single radiologist (or several independent radiologists applying the same standards) can be recommended for future researchers. As possible take-off points for future studies, we also recommend a standardized way of measuring masses clinically pre-operatively, as well as post-operatively in retrieved specimens– so these can also be compared with other metrics such as radiologic measurements of the mass. Radiologic CT reports can also be standardized for intrathoracic goiters, to include the inferior-most point of the mass, measurement from the thoracic inlet, and Intrathoracic Extension Grade as outlined by Huins *et al.*, which can help the surgeon plan the surgical approach especially if it would need an additional thoracic approach.

In summary, this study described the demographic and clinical profile of patients with intrathoracic goiters and provided an overview of how our institution manages intrathoracic goiters. The management of intrathoracic goiters is often multidisciplinary. Referral to the thoracic vascular service is warranted if access to the thoracic inlet may be needed. Classification by grade of intrathoracic goiters is helpful in determining the most appropriate operative approach and may be predictive of intraoperative and postoperative outcomes. The study also provided an objective pre-operative estimate regarding hospital stay, anticipated blood loss and blood transfusion needs which increases as thoracic grade increases. Postoperative histopathology across all ITE grades mostly yield malignant results; hence, preoperative FNA results should be used with caution.

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