Cervical approach for retro-sternal goiter reaching the arch of aorta

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Abstract

Background: Although the retrosternal goiters are characterized by the protrusion of at least 50% of the thyroid tissue below the level of the thoracic inlet, their definite definition is still controversial. Total thyroidectomy for retrosternal goiter has a great challenge and mostly requires an experienced thyroid surgeon. Excision could be possible through a cervical incision in most cases, though Sternotomy remains an option.

Patients and Methods: We report fourteen patients who presented to our academic medical center between 2016 and 2019 with large thyroid goiters and retrosternal extension proven by computerized tomography scan of the neck, presented in both Mansoura University Oncology Center, Egypt and East Jeddah Hospital, Saudi Arabia from 2016 to 2019.

Results: Fourteen cases with retrosternal goiter been undergone total thyroidectomy through a cervical incision without the need for median sternotomy, although the thoracic surgeon was stand-by in three cases. Six patients were found to have a malignancy in the post-operative histopathological assessment.

CONCLUSION: Surgical procedures for most all retrosternal goiters can be completed successfully using a cervical approach; however, a sternotomy is required in a small number of such patients.

Introduction

Substernal goiter refers to the descend of a portion of thyroid mass into the thoracic cavity. Those goiters are usually enlarged and presented clinically with symptoms associated with the close proximity of the substernal part of the gland to the surrounding visceral and vascular tissues. (1, 2). We present fourteen patients diagnosed with a retrosternal goiter who underwent total thyroidectomy using a cervical approach. Six of the patients were discovered to have a malignancy on histopathological assessment these malignancies included: papillary thyroid cancer, follicular thyroid cancer, chondrosarcoma, and non-Hodgkin lymphoma.

Patients & Methods

A retrospective review was undertaken of all patients with underlying retrosternal goiter who had undergone total thyroidectomy through a cervical incision at the general surgery department at East Jeddah General Hospital and Mansoura University Oncology Center.

Retro-sternal goiter was diagnosed using both neck ultrasound and CT neck with IV contrast. All patients underwent thyroid function test and US-guided fine-needle aspiration cytology from the prominent suspicious nodule;

A Thoracic surgeon was stand-by in three cases for the possible need for sternotomy incision. All cases were pre-operatively evaluated and cleared by the anesthesia team and were consented for the surgery.

Results

Fourteen cases with retrosternal goiter been undergone total thyroidectomy through a cervical incision without the need for median sternotomy; although the thoracic surgeon was stand-by in three cases.

All patients were women except for four male patients, with a median age of 55.5 years (range, 34 - 78 years). Retro-sternal goiter has been confirmed with both US neck and enhanced computerized tomography (CT) neck with a median size of the prominent enlarged nodule of 5.8 x 3.5 cm, accompanied by a retro-sternal extension down to aortic arch (Level-II) causing tracheal narrowing and deviation to the contralateral side in all cases.

All patients were euthyroid except one case showed sub-clinical hypothyroidism. US-guided FNA has been done for four cases from the most suspicious thyroid nodule and revealed benign finding (DC-II) (According to the Bethesda system reporting for cytology). For the fifth case, US-guided FNA was done from the suspicious right cervical lymph node which came back as non-conclusive and an excisional biopsy had to be performed and confirmed papillary thyroid carcinoma.

Pre-operative vocal cords bilateral mobility was confirmed using fiberoptic naso-laryngoscopy. Endotracheal intubation after anesthetic induction using a fibro-optic laryngoscope for two cases. Total thyroidectomy has been done successfully through the cervical incision in all cases. In the fifth case, we extended the incision to form half apron for lateral neck dissection.

Complete visualization of recurrent laryngeal nerve on both sides has been done.

All cases did not experience any intra-operative or post-operative complications, except one case showed a temporary post-operative hypocalcemia which was recovered in two weeks. Histopathological assessment of the excised specimens for all cases showed multifocal papillary carcinoma in 3 cases, with the need for radioactive iodine ablation for two of them. On outpatient follow-up, all patients showed satisfactory outcomes with concomitance to their replacement therapies.

Patient characteristics are summarized in Table one and two representative cases are described below:

Case Study 1

This case pertains to a 69-year-old lad, who was admitted to the orthopedic surgical ward for a traumatic fracture right femur neck after falling down at home. She is known to have rheumatoid arthritis and non-compliant on her medications, with an inability to fully extend her very short neck.

On preoperative preparation, the anesthesia team noticed enlarged and engorged neck veins over the anterior chest wall with no other symptoms of respiratory compromise. The orthopedic surgery was postponed as instructed by the Anaesthesia team and we received a consultation for the assessment of this patient.

Laboratory exams including thyroid function tests were within normal limits. CT chest with IV contrast was done and revealed; left thyroid lobe measured 8 x 4 x 4 cm with central necrosis and extension down to the level of the aortic arch, while the right lobe measured 3 x 7 x 4 cm, extending from the level of vocal cords down to the right paratracheal area at the level of T6, with noticed moderate luminal tracheal narrowing with deviation to the right side (Figure 1).

After written consent, the patient was admitted for surgery, which was done under general anesthesia with endotracheal intubation via flexible fiber optic bronchoscope.

With thoracic surgeon, standby for the possible need for sternotomy. Surgery was started with cervical incision and management has been done to deliver both lobes and get a clear visualization of right and left recurrent laryngeal nerves and all parathyroid glands (Figures 2).

Removal of the thyroid gland was done through a cervical incision without the need for sternotomy (Figure 3).

The patient was shifted to the surgical ward after successful extubation. The patient passed the postoperative period safely and was discharged from surgery side in a good condition. In the same admission, the patient went for her orthopedic surgery for fixation.

Histopathological examination of the excised thyroid gland revealed multifocal papillary thyroid carcinoma (3 foci each less than 0.5 cm) in background of multinodular goiter with hyperplastic nodules.

Thyroid hormone replacement therapy started immediately on the next day of surgery (1.7 x kg body weight). The patient is following in the general surgery clinic.

Table 1: Total patient characteristics according to age, gender, US/CT findings, Post-operative histological assessment and complications.

	Age	Gender	US/CT	Histopathological assessment	Complications
Case 1	69 Yrs.	Female	Enlarged bilateral thyroid lobe with the largest in the left lobe 8 x 4 x 4 cm with extension to aortic arch.	Multi-focal papillary carcinoma < 0.5 cm)	None
Case 2	52 Yrs.	Male	Enlarged the left thyroid lobe with a nodule measuring 8 x 5.7 x 9 cm with a retrosternal extension.	Multi-focal papillary thyroid carcinoma of 1 cm	None
Case 3	35 Yrs.	Female	Enlarged left thyroid lobe and isthmus with nodule measuring 6.5 x 7.5 x 8.5 cm with a retrosternal extension.	Multi-nodular goiter with no malignancy detected	None
Case 4	56 Yrs.	Female	Bilateral enlarged thyroid nodules with extension of the right lobe through retrosternal space.	Multi-nodular goiter with no malignancy detected	None
Case 5	42 Yrs.	Female	Enlarged bilateral thyroid nodule with the largest in the right lobe measuring 5.2 x 1.3 x 1.7 cm with an enlarged right cervical lymph nodes extending as a chain down to the retrosternal space	Multi-focal papillary carcinoma < 1 cm	Temporary hypocalcemia
Case 6	78 Yrs.	Female	Right thyroid swelling measuring about 10.2 x 4.6 x 6.1 cm, contacting strap muscles anteriorly and prevertebral muscles posteriorly with compression of the airway to the left side, extending inferiorly to the superior mediastinum abutting the brachiocephalic vessels.	Thyroid chondrosarcoma	None
Case 7	55 Yrs.	Females	Bilateral enlarged thyroid nodules, largest on the right side 5 cm, with extension to the mediastinum.	Recurrent MNG	None
Case 8	34 Yrs.	Male	Multiple bilateral isoechoic solid nodules with cystic changes, with a complete halo sign around most nodules, largest measuring 3.3 x 2.2 cm on right side and 5.2 x 4 cm on left side. In addition to an evidence retro-sternal extension of left lobe.	Colloid nodular goiter	Temporary hypocalcemia
Case 9	75 Yrs.	Male	Large single nodule 10 x 8 cm, extending down to level of major vessels of superior mediastinum.	Follicular carcinoma (widely invasive variant)	None
Case 10	64 Yrs.	Male	Enlarged left thyroid lobe with huge solid isoechoic thyroid nodule with areas of cystic degeneration and foci of calcifications measuring 4.7 x 3.1 x 5.8 cm. Detected retrosternal extension of the left thyroid lobe, reaching the aortic arch.	Colloid nodular goiter with secondary changes	None

	Age	Gender	US/CT	Histopathological assessment	Complications
Case 11	54 Yrs.	Female	Hugely enlarged gland, reaching infra-clavicular region with marked retrosternal extension with multiple nodules, largest on the right about 4.1 x 2.5 cm & on the left about 2.9 x 1.4 cm.	Colloid nodular goiter	None
Case 12	59 Yrs.	Female	Enlarged thyroid gland with large right thyroid lobe 7 x 10 cm with contralateral shift of trachea & retro sternal extension reaching aortic arch.	NHL (diffuse large cell type)	None
Case 13	56 Yrs.	Female	Multinodular goiter with a retrosternal extension on the left side with tracheal deviation, largest left nodules about 3.8 x 1.4 cm.	Amyloid goiter	None
Case 14	53 Yrs.	Female	Right lobe : multiple nodules largest measured about 4.1 x 2.6 x 3.2 cm with calcification with left shift of the trachea with retrosternal extension.	Colloid nodular goiter	None

Case Study 2

This patient This patient is a 42-year-old woman, who presented to the outpatient clinic with a complaint of progressive swelling of the right-sided of her neck; she reported no other associated symptoms. Upon examination; a palpable large right cervical lymph node masse at level II & III about 4 x 4 cm with stretching of the nearby sternomastoid was noticed. While the thyroid gland was normal in its size and site.

Neck U/S showed multiple nodules in both thyroid lobes, with multiple bilateral cervical modules, the largest seen in the right cervical side measures 4.3 x 3 cm. CT scan of the neck with IV contrast confirmed the multiple nodules in the right cervical region as a chain down to the retrocaval, anterior and upper mediastinal region (Figure 4).

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As a result, Total thyroidectomy with central and right lateral neck dissection was planned, and after the patient's consent and clearance from the anesthesia side, surgery has been undergone through a cervical half apron incision, starting with the delivery of the retro-sternal enlarged central compartment lymph nodes successfully through the performed incision without the need for the sternotomy after blunt dissection of the mass from the aortic arch (Figure 5).

Followed by delivery of each lobe after complete visualization of the recurrent laryngeal nerve on each side, especially the right recurrent laryngeal nerve (Figure 6) which was encroached by the tumor mass along its whole cervical length before the complete excision has been completed.

Finalizing the procedure by lateral neck dissection for the lymph nodes at level II, III and IV, and all the specimens (Figure 7) were sent for the pathologist.

The patient has passed the post-operative period uneventfully apart from temporary hypocalcemia to which oral calcium carbonate was administered, and was discharged on post-operative day 3

The histopathological assessment of the excised specimen showed multifocal papillary Carcinoma < 1 cm with a lymphocytic thyroiditis in the background. In addition to the metastasis to the amalgamated lymph nodes at the levels II, III, IV and VI.

On follow-up at the outpatient clinic, the patient was satisfied with the outcome and she was referred for radio-iodine ablation.

Discussion

Substernal goiter (SSG) is clinically and/or radiologically defined as thyroid tissue extension below the sternal fork when the patient is in a supine position. (3)

Two entities can be distinguished in SSG: cervico-thoracic goiter (CTG) and intrathoracic goiter (ITG), the former shows exclusively thyroid vascularization; while the ITG featuring with the development of ectopic thoracic thyroid tissue, without continuity with the cervical tissue. In addition to being rare (< 1% of goiters), it shows specifically thoracic vascularization (internal thoracic artery, aorta, etc.) (4), and thus comes within the field of thoracic surgery, with specific approaches. (5)

Thoracic extension in CTG is progressive into regions of lower anatomic resistance behind and anterior to the supra-aortic vessels. Anterior extension is the most familiar at about 75% of CTGs. (4) It shows a rapidly compressive manifestations, hindered in its inferior development by the brachiocephalic artery. CTGs with posterior development may be quite large, without clinical impact or symptoms, because there is a large space behind the brachiocephalic artery. (4)

The retrosternal goiter shows a slowly progressive growth course, that leads to its presentation in the fifth or sixth decade of life.(6) In some series of patients with retrosternal goiters, acute problems occur with an incidence of between 5–11%.(7, 8)

The diagnosis of RG is mainly based upon history, clinical examinations, and imaging findings (7). Computed tomography (CT) of the neck is the examination of choice for assessment of the extent of the goiter and compression effects on adjacent anatomical structures(9). Magnetic resonance imaging (MRI) adds a little additional information to that obtained with CT and is not routinely used(10).

The papillary thyroid carcinoma is the most common histopathologic subtypes, which may be detected in the retrosternal goiter, with overall malignancy rate between 0–20%. (11, 12)

Thyroidectomy should be performed in all patients with retrosternal goiter, when there are no medical contraindications for the surgery. The recommendation was based on the increased risk of thyroid cancer and later respiratory problems. (1)

Preoperative FNA is an excellent tool for the evaluation of patients with a solitary, cervical thyroid nodule, but its value is still debatable in patients with multiple nodules and substernal goiters. (13, 14).

The collar incision is the standard access for retrosternal goiter, except for around 2% who may need for either manubriotomy, sternotomy or thoracotomy. (1) Most RGs can be totally removed through a cervical approach, while a partial or total sternotomy should be performed only in a minority of patients, ranging between 1–11% (1).

When performing a thyroidectomy for a retrosternal goiter, an experience with a specific interest in thyroid surgery is needed. (1)

Although most retrosternal goiter can be safely resected through a cervical incision, the combined cervical–thoracic approach has been reported to be necessary in up to 2% of cases. (11, 12, 15). An agreement has been reached that sternotomy is not to the routine recommendations, as a collar incision is sufficient in most situations. (1)

In conclusion:

Thyroidectomy should be performed in all patients with retrosternal goiter who do not have medical comorbidity excluding them from surgery.

The majority of retrosternal goiter could be totally resected through a cervical incision avoiding the morbidities of additional thoracic approach. An attempt to remove the goiter through the cervical incision should always be made, using all the available techniques.

Thyroidectomy for a retrosternal goiter should be carried out by a skillful surgical team that is familiar with its unique pitfalls. The need for thoracic surgeons may only be required in a few selected cases.

Declarations

- **Ethics approval and consent to participate:**

The authors declare that this research was approved by the Institutional Research Board from Mansurah University / Egypt with proposal number R.20.12.1120. In addition, the approval from Ethical Committee of Scientific Research at Dictorate of Health Affairs in Jeddah / Saudi Arabia with proposal number 20-591E.

- **Consent for publication:**

All patients were consented for both the surgery and the publication of their data for the scientific research.

- **Availability of data and materials:** All the supporting materials are available upon request.
- **Competing interests:**

The authors declare that they have no competing interests.

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- **Authors' contributions:**

Name	Role
Mohamed T. Hafez	The Idea and revision of the research paper, performing and supervising thyroid surgeries in Oncology Center Mansoura University / Egypt and East Jeddah Hospital / Saudi Arabia and the contributing author.
Mostafa M. Abdelmaksoud	Writing and organizing the research paper and the operating surgeon in East Jeddah Hospital / Saudi Arabia.
Shadi Awni	Writing the research paper and the operating surgeon in Oncology Center Mansoura University / Egypt.
Alaa Jamjoom	The operating Surgeon in East Jeddah Hospital / Saudi Arabia.
Abdullah Mashat	Collecting of patient's data in East Jeddah Hospital / Saudi Arabia.
Khaled Abdelwahab	Collecting the patient's data in Oncology Center Mansoura University / Egypt.
Merit ElMaadawy	Editing, revision and comment of all radiology images

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Figures

Figure 1

Case study-1, CT neck with IV contrast.

Figure 2

Case study-1, right recurrent laryngeal nerve.

Figure 3

Case study-1, total excision of the thyroid gland.

Figure 4

Case study-2, CT neck with IV contrast.

Figure 5

Case study-2, delivery of the enlarged lymph node.

Figure 6

Case study-2, identification of right recurrent laryngeal nerve.

Figure 7

Case study-2, the excised specimen including thyroid gland and cervical lymph nodes at level II, III, IV & VI.