

## Cervical Approach for Retro-Sternal Goiter Reaching the Arch of the Aorta. Should be Always your First Option

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### Abstract

**Background:** Although the retrosternal goiters (RSG) 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 (RSG) is 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.

**Aim of Study:** This study was to assess the feasibility of total thyroidectomy through cervical incision in (RSG) reaching to the arch of aorta.

**Patients and Methods:** Our study is a multicentric proof of concept included fourteen cases of huge thyroid goiter with retrosternal extension reaching up to the aortic arch as confirmed on neck computed tomography (CT) scan. The cases were retrospectively collected from both East Jeddah Hospital in Saudi Arabia and University Oncology Center of Mansoura University in Egypt, during the period between November 2016 to January 2020. All cases underwent total thyroidectomy using the cervical approach.

**Results:** Cases include 10 women and 4 men with a median age of 55.5 years (range, 34-78 years). RSG status has been clinically and Radiologically diagnosed in all cases using both Neck US and enhanced computerized tomography (CT) of the neck, the latter confirmed a retro-sternal extension down to aortic arch (Level-II). All patients underwent thyroidectomy transcervically without the need for median sternotomy. A Thoracic surgeon was stand-by in three cases for the possible need for sternotomy incision.

Postoperatively, malignant entity was histopathologically proven in six patients (42.8%). Hypocalcaemia was transient in one patient (7.1%). No permanent hypocalcemia has been encountered in any of the cases. Regarding postoperative complication, no tracheomalacia, vocal cord paralysis, postoperative hematoma nor patient death was reported.

**Conclusion:** The cervical approach for patients with RSG extending to the aortic arch is an optimum, feasible and less invasive surgical approach that can be considered the appropriate

choice in such cases and can be performed successfully by experienced specialized surgeons. Thoracic surgeon standby is required in a few selected cases which carry a chance that sternotomy might be needed.

**Key Words:** Retrosternal goiter – Cervical incision – Papillary thyroid cancer.

### Introduction

**RETRO-STERNAL** goiter (RSG) refers to the descent of a portion of thyroid mass into the thoracic cavity. It has a 3 to 1 female predominance. Other names include substernal, cervicothoracic, intrathoracic, mediastinal or endothoracic goitres. Those goiters are usually enlarged and presented clinically with symptoms associated with the close proximity of the retrosternal part of the gland to the surrounding visceral and vascular tissues [1,2].

There are many classifications of (RSG) as an attempt to predict whether or not transcervical resection will be needed and to anticipate the need of sternotomy. These classifications are based on computed tomography (CT) scan imaging measuring the depth of the goitre, the anteroposterior dimension, the lateral dimension or the anatomical location [3].

(RSG) should be resected and non-surgical treatment is not recommended even if asymptomatic; as sudden enlargement could be life-threatening. In addition, the difficulty of fine-needle aspiration biopsy to the retrosternal part may miss malignancy [4].

The cervical approach is the most used approach for retrosternal goiter, however, some cases will need a sternotomy.

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The aim of this study is to assess the feasibility of total thyroidectomy through cervical incision in (RSG) up to the level of arch of aorta.

### **Patients and Methods**

Research ethics committee at both East Jeddah Hospital (EJH) and Oncology centre of Mansoura University (OCMU) had approved the research work as a retrospective designed study. Data of all patients with underlying (RSG) who underwent total thyroidectomy through a cervical incision were collected from the database of the General Surgery Department at East Jeddah General Hospital as well as Mansoura University Oncology Center. 121 cases of (RSG) sought surgical consultation have been found between the period of November 2016 and January 2020. As a standard of practice in both institutions, neck CT with IV contrast is routinely requested for any patients identified on clinical and/or ultra-sonographic level to have a retrosternal extension. Out of those cases, 117 patients were fit and agreed to proceed with CT scan, only 16 cases of which were reported on CT to have a retrosternal extension reaching the arch of the aorta. All CT reports used the term (abutting/touching the arch) or (reaching the arch), no cases reported as (encasing the arch) nor (displacing the arch). Tracheal narrowing and deviation to the contralateral side were reported in all cases.

Preoperative work up, included in all patients a thyroid function test and an US-guided fine-needle aspiration cytology (FNAC) which targeted the enlarged thyroid lobe in general, and the most appreciated dominant or suspicious nodule in specific (if present). Our connection/track for two patients from OCMU were lost after they did not return for surgery (likely sought management in an other health institution).

All remaining 14 cases were pre-operatively evaluated and cleared by the anesthesia team and were consented for the surgery.

### **Results**

Fourteen cases with (RSG) reaching the arch of the aorta had total thyroidectomy through a cervical incision.

The cases includes ten women and four male patients, with a median age of 55.5 years (range,

34-78 years). Retro-sternal goiter has been confirmed with both Neck US and enhanced computerized tomography (CT) of the neck with a median size of the prominent enlarged lobe/a dominant nodule of 5.8 x 3.5cm, accompanied by a retro-sternal extension down to aortic arch causing tracheal narrowing and deviation to the contralateral side in almost all cases. (Fig. 1).

Preoperative laboratory investigation shows that all patients were euthyroid except one case showed sub-clinical hypothyroidism. US-guided FNAC has been done for all cases from the most suspicious thyroid nodule apart from 3 cases where FNA was taken from the diffuse enlarged thyroid lobe.

Pre-operative vocal cords bilateral mobility was confirmed using fiberoptic naso-laryngoscopy. Endotracheal intubation after anesthetic induction using a fibro-optic laryngoscope for all cases.

Intraoperative full visualization of recurrent laryngeal nerve on both sides as well as parathyroid glands has been done. (Fig. 2).

All cases were performed utilizing the cervical approach only without the need for median sternotomy, although the thoracic surgeon was stand-by in three cases.

Total thyroidectomy has been done successfully through the cervical incision in all cases. (Fig. 3).

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. All patients were put on replacement levothyroxine (1.7 X Body weight in Kg) starting from the first postoperative day.

Final histopathological assessment of the excised specimens for all cases were obtained, with malignant component in 6 cases. On outpatient follow-up, all patients showed satisfactory outcomes with concomitance to their replacement therapies.

Patient characteristics are summarized in Table (1).

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 (<0.5cm)	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 1cm	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 <1cm	- 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 retrosternal 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
Case 11	54 Yrs.	Female	- Hugely enlarged gland, reaching infraclavicular 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 7x10cm 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 3.8x1.4 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

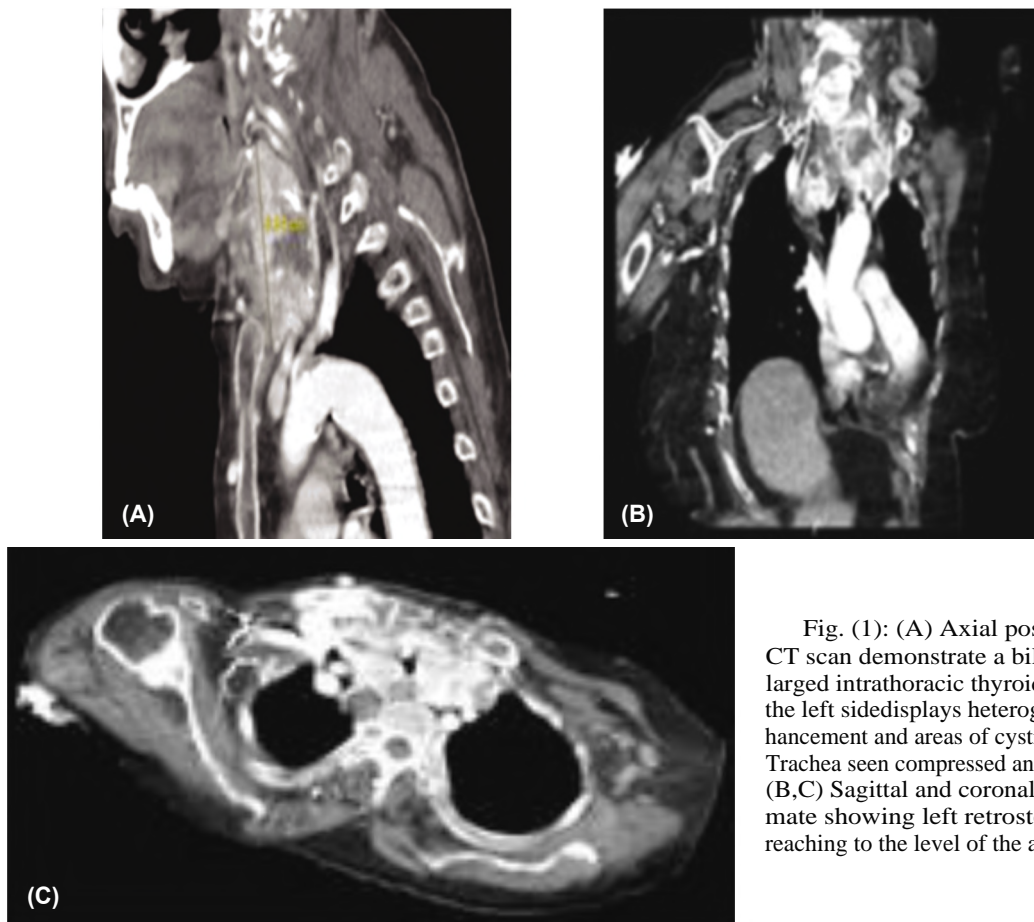


Fig. (1): (A) Axial post contrast CT scan demonstrate a bilateral enlarged intrathoracic thyroid, more on the left side displays heterogenous enhancement and areas of cystic changes. Trachea seen compressed and deviated. (B,C) Sagittal and coronal CT reformate showing left retrosternal lobe reaching to the level of the aortic arch.

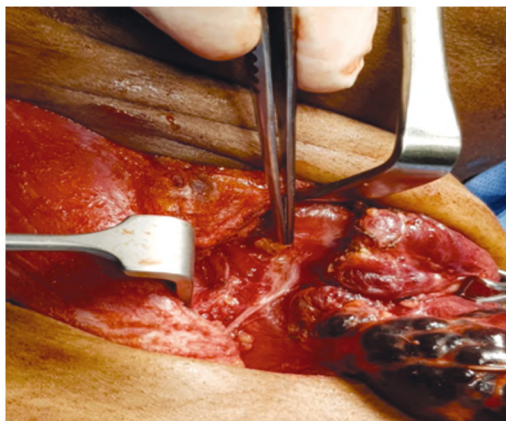


Fig. (2): Identification of right recurrent laryngeal nerve.



Fig. (3): Total excision of the thyroid gland.

### Discussion

(RSG) is clinically and/or radiologically defined as thyroid tissue extension below the sternal notch when the patient is in a supine position [3].

Two entities can be distinguished in RSG: 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]. This is in agree with our study were percentage of RSG reaching the arch were 11.5% of total cases (121) initially diagnosed with RSG, further more 85% had anterior extension, 15% posterior extension with Oesophageal compression manifestation, while 78.5% had tracheal compression manifestation.

The (RSG) 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]. In our study, 57.1% of cases were in 5<sup>th</sup> and 6<sup>th</sup> decade in agreed to above literatures.

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]. In our study, all cases were initially diagnosed clinically to have retrosternal goiter and confirmed by US, then a CT scan was requested as a standard of practice for accurate assessment of retrosternal extension level. A couple of cases initially diagnosed with RSG were not able to receive I.V contrast injection due to high creatinine level and MRI was requested instead, however MRI images were impacted by respiratory movement, accurate extension could not be confirmed, therefore they were excluded from our study, this is in agree with the literature that 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% to 20% [11,12]. In our study, we had 42.8% malignant cases, 21.4% papillary cancer types.

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]. In our study, all cases had a preoperative FNAC, in 13 cases a needle targeted a dominant nodule or the most US suspicious nodule, while in 3 cases FNAC was done targeted the diffusely heterogenous gland, avoiding the necrotic parts. The preoperative FNAC result were useful and this alter our surgical plan/management in such way in 3 cases by performing central neck dissection.

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 (RSG) 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].

Limitation of our study includes the small sample size, therefore another multicentered study with larger number of cases to confirm our results would be valuable. Another point to highlight is that all cases have been operated by 10-15 years experienced surgeons, some are subspecialized in thyroid surgeries, having said that, we believe that assessing the feasibility of this surgical technique with less experienced surgeons is not of such importance given that the vast majority of such patients diagnosed with a (RSG) extension reaching the aortic arch are assigned or referred to an experienced surgeon.

#### *Conclusion:*

The cervical approach for patients with (RSG) reaching the Aortic arch is a feasible surgical technique for total thyroidectomy in such cases, carries the advantage of being less invasive surgery compared with sternotomy, and overall it can be considered the most appropriate option for an experienced thyroid surgeon. Though, the need for a standby thoracic surgeon in a few selected cases

which carry a higher chance that a sternotomy may still be required.

*Declarations:*

*i- Funding:*

The authors declare that this research was self-funded without any supported funding body.

*ii- Conflicts of interest:*

The authors declare that they have no competing interests; in addition, they declare they have no conflicts of interests.

*iii- Ethics approval:*

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

*iv- Consent to participate:*

All patients were consented for both the surgery and the publication of their data for the scientific research and the supporting materials are available upon request.

*v- Consent for publication:*

The authors declare that this research to be published.

*vi- Availability of data and material:*

All patients were consented for both the surgery and the publication of their data for the scientific research and the supporting materials are available upon request.

*vii- Code availability:*

Not Applicable.

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## استئصال الغدة الدرقية المتضخمة خلف القفص الصدري التي تصل إلى قوس الشريان الأورطي عن طريق الرقبة. هل يجب أن يكون دائماً خيارك الأول

على الرغم من أن تضخم الغدة الدرقية خلف القفص الصدري تتميز ببيروز ٥٠٪ على الأقل من أنسجة الغدة الدرقية تحت مستوى المدخل الصدري، إلا أن تعريفها المحدد لا يزال مثيراً للجدل. يمثل استئصال الغدة الدرقية الكلى في هذه الحالات تحدياً كبيراً ويتطلب في الغالب جراحاً متخصصاً في الغدة الدرقية. يمكن أن يكون الاستئصال ممكناً من خلال الجرح المعتاد في الرقبة في معظم الحالات، على الرغم من أن شق القفص الصدري يبقى خياراً.

كان الهدف من هذا العمل البحثي هو تقييم جدوى استئصال الغدة الدرقية الكلى من خلال جرح الرقبة المعتاد.

دراستنا شملت أربعة عشر حالة من تضخم الغدة الدرقية الضخم مع امتداد خلفي للقص يصل إلى قوس الأبهر كما تم تأكيده في التصوير المقطعي المحوسب للرقبة (CT). تم جمع الحالات بأثر رجعي من كل من مستشفى شرق جدة في المملكة العربية السعودية ومركز الأورام الجامعي بجامعة المنصورة في مصر، خلال الفترة من نوفمبر ٢٠١٦ إلى يناير ٢٠٢٠. وخضعت جميع الحالات لاستئصال الغدة الدرقية الكلى باستخدام الجرح المعتاد بالرقبة.

النتائج: تشمل الحالات نساء ورجال بمتوسط عمر سنة المدى سنة. تم تشخيص حالة سريريّاً وإشعاعياً في جميع الحالات والتصوير المقطعي المحوسب المحسن للرقبة، وقد أكد الأخير امتداداً للقص القصي وصولاً إلى القوس الأبهر المستوى الثاني خضع جميع المرضى لاستئصال الغدة الدرقية عن طريق الرقبة. كان جراح الصدر على أهبة الاستعداد في ثلاث حالات لاحتمال الحاجة إلى شق القص.

بعد العملية الجراحية، تم إثبات وجود كيان خبيث تشريحياً في ستة مرضى (٤٢.٨٪) كان نقص كالسيوم الدم عابراً في مريض واحد (٧.١٪). فيما يتعلق بمضاعفات ما بعد الجراحة، لم يتم الإبلاغ عن شلل الحبل الصوتي أو ورم دموي بعد العملية الجراحية ولا وفاة المريض.

الخلاصة: إن استئصال الغدة الدرقية للمرضى الذين يعانون من RSG الممتد إلى القوس الأبهرى هو نهج جراحى مثالى ومناسب وأقل تدخلاً يمكن اعتباره الخيار المناسب في مثل هذه الحالات ويمكن إجراؤه بنجاح بواسطة جراحين متخصصين ذوي خبرة. مطلوب استعداد جراح الصدر في عدد قليل من الحالات المختارة التي تنطوي على فرصة أن تكون هناك حاجة إلى بضع القص.