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Management of Retrosternal Goiter without Sternotomy: A Case Report

Sherly Tandililing,[1] Edwin Z. Sipayung[2]

[1]Division of Head Neck Surgery, Department of Surgery, Faculty of Medicine, Universitas Sam Ratulangi - Prof. Dr. R. D. Kandou Hospital, Manado, Indonesia
[2]Departement of Surgery, Faculty of Medicine, Universitas Sam Ratulangi, Manado, Indonesia
Email: edwinzaofery_sipayung@yahoo.com
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Abstract: Retrosternal goiter (RG) is a thyroid enlargement that extends into the chest, often causing compression of nearby structures such as trachea and esophagus. Thyroidectomy for RG is a complex procedure, with the choice of surgical approach depending on the goiter's size and position. A cervical approach is typically preferred, though sternotomy may be required in some cases. We reported a 57-year-old female presented with a 20-year history of a progressively enlarging neck lump, which extended from the right to the left side, neck vein enlargement, and radiating pain. Laboratory tests were within normal limit. Pathology biopsy revealed a follicular thyroid nodule with a Bethesda II classification and imaging revealed a multinodular goiter causing compression of the trachea. This case was classified as type A with a pyramidal shape, apex pointing downward, type I with location in the anterior mediastinum, and Grade I with location above the aortic arch (at the level of T4); so, sternotomy was not required, considering the potential complications associated with sternotomy. The patient was then diagnosed with toxic retrosternal goiter in the euthyroid phase and underwent a total thyroidectomy without sternotomy. Postoperative care included fluids, antibiotics, H2 blocker, and analgesics. The patient showed good recovery, with no complications or symptoms of thyrotoxicosis at the two-week follow-up. In conclusion, in this case surgical intervention is focused on releasing decompression, and a total thyroidectomy was performed without sternotomy. An important technique that can be shared is to remove surgically the superior pole first, releasing it from Berry's ligament on one of the lobes and should always free the tissue as close to the goiter tissue as possible to avoid damage to the surrounding structures. The successful outcomes in studies emphasize that with careful assessment, retrosternal goiter can be safely treated with minimal complications.
Keywords: retrosternal goiter; non-sternotomy procedure

INTRODUCTION

Retrosternal goiter (RG) is a condition where the thyroid gland enlarges and extends into the chest, particularly the superior mediastinum. It typically develops gradually due to gravity, negative intrathoracic pressure, and swallowing motion, and remains asymptomatic in early stages.[1] As RG progresses, it can compress nearby structures such as the trachea, oesophagus, or blood vessels, leading to symptoms like neck swelling, hoarseness, difficulty breathing or swallowing, and visible neck veins.[2] Although RG accounts for 1–15% of all goiter cases and is often detectable through physical examination, its growth within the chest faces less resistance, which may allow for considerable enlargement. Risk factors include thyroid disorders, radiation exposure, and previous thyroid conditions. In some cases, fatal complications like intra-cystic haemorrhage may occur.[3,4]

Surgical management of RG, especially total thyroidectomy, is complex due to the intricate and sometimes distorted anatomy of the neck. Challenges include preserving vital structures such as the recurrent laryngeal nerve and parathyroid glands, particularly when the goitre extends into the thoracic inlet or mediastinum.[5,6] Most thyroidectomies are successfully done through a cervical approach, but a small percentage of large or deeply extended RGs may require a more invasive sternotomy, which carries greater risks and longer recovery.[7] Advanced imaging helps determine the goiter's classification and surgical planning.[8] While the cervical approach is preferred, limitations in access for large or posteriorly located RGs can necessitate conversion to sternotomy, potentially increasing complications.[9,10] The case report aims to explore the feasibility and success of managing such a case without resorting to sternotomy.

CASE REPORT

A 57-year-old female patient presented to the surgery department with a complaint of a lump in the right side of her neck for the past 20 years. Initially, the lump appeared on the right side of her neck, about the size of a marble, and gradually increased in size over the last 15 years, eventually extending to the left side of her neck. Sometimes, patients complain of pain, numbness, and tingling in the shoulder, arm, and hand, especially after activities such as raising their arms. The patient reports that their face becomes easily flushed or red after light to moderate physical activity. There were no changes in voice, shortness of breath, dysphagia, odynophagia, or pain around the lump. The patient reported a history of palpitations, but there were no tremors in her hands or hyperhidrosis. Geographically, she resides in an area near the coast. There was no history of headache or jaundice. A family history of similar conditions was denied. The patient has never had a general check-up for the lump in her neck.

On general examination, the patient was in fair condition with full consciousness. In the neck region, lumps were found on both the right and left anterior sides. The lump on the right lobe measured 15x10 cm, while the one on the left lobe measured 5x4 cm. The lumps had a firm consistency, smooth edges, were fixed in place, and their colour matched the surrounding skin. Venous dilation and facial flushing were observed when the patient raised both arms above the head and held the position for 30 seconds. The lumps moved during swallowing, and there was no tenderness upon palpation. Simple physical examination tests such as the elevated arm stress test, upper limb tension test, and hyperabduction test elicited pain after several positional maneuvers. Examination of the head, thorax, and abdomen revealed no abnormalities. Laboratory tests showed normal results for routine haematology, kidney function, liver function, serum electrolytes, and thyroid function. A subsequent pathology biopsy revealed a follicular thyroid nodule with a Bethesda II classification, predominantly composed of colloid and adenomatoid cells. Imaging studies were performed to assess the anatomical boundaries of the goiter's extension. Chest X-ray interpretation revealed cardiomegaly with a right mediastinal mass at the level of thoracic vertebrae 1-4, suspicious for extension of the right thyroid causing compression of the trachea to the left. A contrast-enhanced neck CT scan showed a predominant multinodular goiter in the right thyroid lobe, with a combined size of 11x7.5x13 cm, causing displacement of the thyroid to the left and

extending into the superior thoracic aperture, as well as spreading into the upper mediastinum. Additionally, there was evidence of lymphadenopathy in the right neck region.

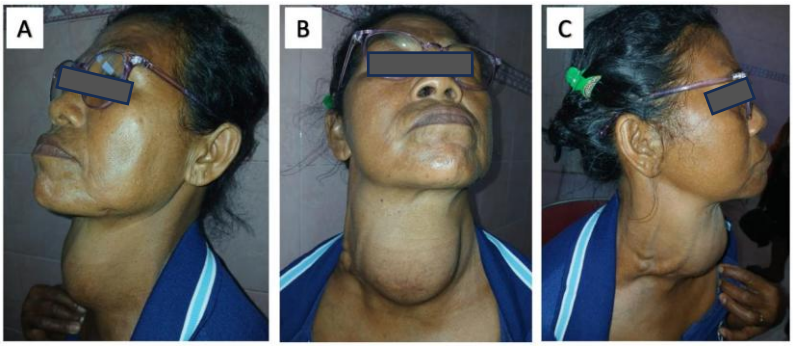

Figure 1. A. Left view, enlargement of the thyroid gland measuring 5x4 cm, with a firm consistency, smooth edges, fixed position, and no redness. No jugular vein distension was seen; B. Front view, bilobar enlargement of the thyroid gland with dominance on the right side, facial flushing, and partial distension of the right jugular vein; C. Right view, enlargement of the thyroid gland measuring 15x10 cm, with a firm consistency, smooth edges, fixed position, and no redness. Jugular vein distension was noted, with a height of 5+6-7 cm H2O.

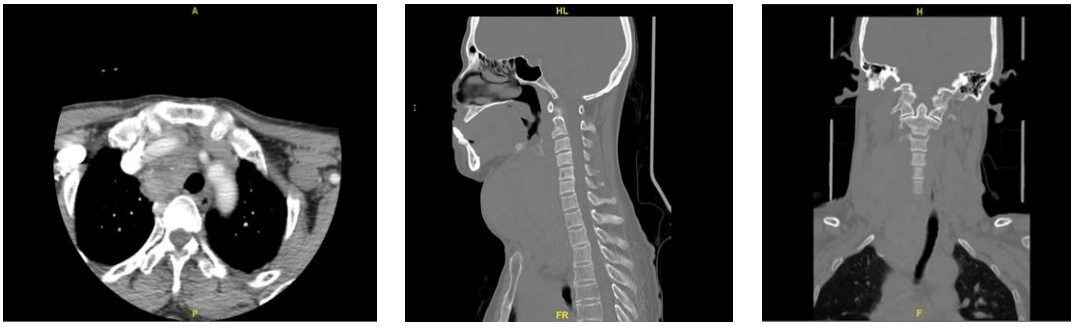

Figure 2. CT scan neck axial, sagital and coronal plane

The patient was diagnosed with toxic retrosternal goiter in the euthyroid phase due to mass enlargement at the level of the sternum, presenting with thyrotoxicosis symptoms without an imbalance in TSH or FT4 levels. The patient underwent invasive management with total thyroidectomy without sternotomy.

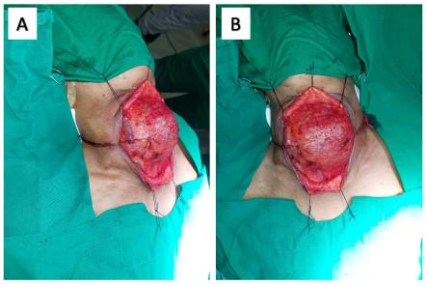

Figure 3. Intraoperative management with total thyroidectomy procedure. Skin dissection to expose the entire goiter tissue, localized within the capsule, with cross-sections. A, lateral and B, front.

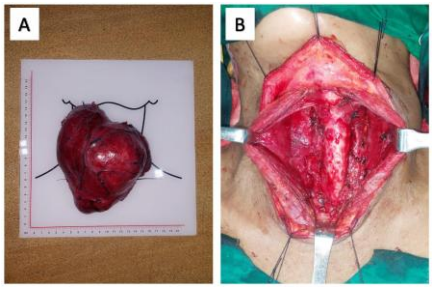

Figure 4. A, post-operative goiter specimen with bilobar characteristics, encapsulated, smooth edges, firm texture, no neovascularization observed, measuring 15x10 cm with the apex pointing downwards; B, front view: total thyroidectomy with a cervical surgical approach was performed, and the surgery was successful with complete dissection of the entire goiter tissue without damaging the surrounding structures. The trachea, esophagus, and surrounding blood vessels appeared intact

Postoperative care included the administration of crystalloid fluids, broad-spectrum antibiotics to prevent secondary infection, H2 blockers to prevent excessive gastric acid production, and injectable analgesics. The patient received care for three days post-surgery and was then continued with outpatient care, including the administration of analgesics and follow-up antibiotics. Two weeks post-operation, the surgical wound showed improvement without signs of secondary infection, and no symptoms of thyrotoxicosis or any signs of obstruction in the retrosternal area.

DISCUSSION

Retrosternal goiter can be defined as any enlargement of the thyroid gland with the largest mass located below the thoracic inlet. This goiter is also known by terms such as subclavicular, retroclavicular, substernal, or mediastinal goiter, among others. Retrosternal goiters are frequently located in the anterior mediastinum (80–90% of all retrosternal goiters), which is the most common location, or in the posterior mediastinum, posterior to the trachea (10–15%) or esophagus (less frequent). Retrosternal goiters are usually classified as primary or secondary. Primary goiters are truly substernal and account for 1–2% of all retrosternal goiters. These goiters are congenital and unrelated to the cervical thyroid gland, as they originate from embryonic foregut endoderm ectopic thyroid cells that descend into the thorax via the aortic arch. Secondary or acquired retrosternal goiters are much more common and arise from the cervical thyroid gland, growing from the gland into the thorax.[11]

Iodine deficiency is widely acknowledged as a significant environmental factor contributing to the increased occurrence of thyroid nodularity. In regions with mild and moderate iodine deficiency, such as plateau areas, thyroid enlargement was observed in 15.0% and 22.6% of ultrasonographic examinations, respectively. Thyroid nodules were found in 30% of the examinations in both areas, but the nodules were larger and more frequently palpable in regions with moderate iodine deficiency. Palpable goiters were seen in 9.8% of individuals in areas with mild deficiency and 14.6% in those with moderate deficiency.[12] In contrast, in coastal regions where significant iodine deficiency is not a concern, the most common causes of goiter are nodular goiter, Hashimoto's thyroiditis, and Graves' disease. Various environmental and genetic factors contribute to thyroid growth, including mutations in genes encoding the thyroid-stimulating hormone receptor, sex steroid hormones, insulin, and glucocorticoids. The epidermal growth factor has also been associated with thyroid cell proliferation. These findings suggest that goiter development is a multifactorial process, explaining why goiters can occur even in regions with sufficient iodine intake.[13] In this particular case, no significant risk factors for goiter were identified, as the patient resides in a coastal area where iodine deficiency is not an issue, and goiters are sporadic. The likely etiology in this patient is genetic, with a potential hormonal change, especially involving steroid hormones in postmenopausal women.[12,13]

An anatomical classification is based on the shape and extent of the goiter. According to Cvasiuc (2014),[14] the classification of cervicothoracic goiter is divided into four types based on their extent. Type A is a pyramidal goiter with the apex pointing downward. Even if the apex extends well into the mediastinum, the goiter is always removed through a neck operation. Type B is a pyramidal goiter with the apex pointing upward. The wide base below the clavicles can make it more challenging to remove via a cervical approach. Depending on the width and depth of the base into the mediastinum, the surgeon should be prepared to perform a manubriotomy or sternotomy. These goiters may extend to the opposite side. Type C has a bilobal shape with a narrow neck or a pedicle between the cervical and mediastinal parts. The mediastinal portion is more difficult to deliver than in type B. If the pedicle between the two parts is thin and unrecognized, the mediastinal part may be mistakenly left behind. Type D is an uncommon goiter, which may be an ectopic thyroid unconnected to the thyroid in the neck, or a mediastinal remnant of an inadequately resected type C goiter. In this case, it is likely anatomically categorized as a cervicothoracic goiter due to its location in the superior mediastinum, and it fits type B, with the goiter originating from the thyroid gland and extensively extending into the superior mediastinum with its apex pointing up.

Retrosternal goiters with mediastinal extension are classified into different types. Type I goiters extend into the anterior mediastinum, descending in front of the subclavian and innominate vessels while maintaining the normal anatomical position of the recurrent laryngeal nerve (RLN), which remains deep to the thyroid gland. In contrast, type II goiters extend into the posterior mediastinum, pushing the trachea anteriorly and displacing the great vessels. This displacement alters the normal positioning of the RLN, shifting it ventral to the thyroid, which increases the risk of RLN injury, particularly during surgical removal. Studies suggest that sternotomy helps reduce the risk of RLN injury compared to a purely cervical approach. Posterior mediastinal goiters are further divided into yype IIA, which remains on the same side as the enlarged thyroid lobe, and type IIB, which crosses to the opposite side of the thoracic cavity, either behind (IIB1) or between (IIB2) the trachea and oesophagus. Right-sided extensions are more common due to the anatomical barrier created by the aortic arch on the left side. Furthermore, ectopic mediastinal goiters, which are not connected to the cervical thyroid, obtain their blood supply from mediastinal arteries like the aorta or subclavian artery, making their surgical management more complex. Another challenging variant is the dumbbell-shaped goiter, where a narrow thyroid tissue band connects the cervical and substernal components, often requiring sternotomy for complete removal. While anterior mediastinal goiters are often managed through a cervical approach, posterior, ectopic, or dumbbell-shaped goiters typically require sternotomy to ensure safe and complete excision.[5] According to this classification, this case is classified as type I substernal goiter, as it extends into the anterior mediastinum at the level of T1-T4 without invading the great vessels, such as the subclavian or brachiocephalic arteries. Therefore, the intervention performed was limited to a total thyroidectomy without the need for sternotomy.[14]

Indications for performing total thyroidectomy with sternotomy include: 1) goiter extending below the aortic arch or carina; 2) goiter located in the posterior mediastinum; 3) loss of tissue planes between the retrosternal goiter and surrounding tissues; 4) goiters with additional blood supply originating from the mediastinal vessels; 5) intrathoracic goiter connected via a fibrous stalk to the cervical component and beyond easy reach from the transcervical approach; and 6) isolated thoracic goiter.[15] The simplified classification proposed by Huins in 2008 divides retrosternal goiters into three grades, relevant to surgical management: grade 1 (above the aortic arch/thoracic vertebrae 4); grade 2 (from the aortic arch to the pericardium), and grade 3 (below the right atrium).[16] According to this classification, this case is categorized as grade I, with the location above the aortic arch/thoracic vertebrae 4.

A retrospective study by Veerabhadraiah et al[9] analyzed 21 patients with RG who underwent thyroidectomy using a cervical approach without sternotomy. The most common presentation was neck swelling (76.19%), followed by neck discomfort (23.80%), and dyspnea (9.52%). The results showed that all patients successfully underwent surgery without the need for sternotomy, with the majority of cases (80.95%) showing benign histopathological results. A total of 76% of all patients successfully overcame postoperative symptoms without any complications and achieved recovery through medicinal follow-up. Study of Landerholm and Järhult[10] involving 132 patients who underwent surgery for RG. Sternotomy was required in only four patients (3%), while the remaining cases were successfully operated on using the cervical approach. However, postoperative morbidity and mortality rates were higher in patients with compressive symptoms who underwent sternotomy compared to those without symptoms.

In this case, the retrosternal goiter was classified as type B on the coronal CT scan image, but it was classified as grade I on the sagittal image. The basal part of the goiter extended up to the level of T4, but there was no invasion into major blood vessels such as the subclavian artery or the aortic arch. The chest X-ray image was simplified and classified as grade I, with the basal location was still above the aortic arch. Based on histopathology examination, according to the Bethesda classification, this case was classified as Bethesda II, indicating a benign goiter type. Surgical management is the gold standard to remove the cause without causing complications. There are three approaches to eliminate the goiter: transcervical, manubriotomy, or minimal

sternotomy. According to Cvasiuc et al,[14] a type B goiter should be managed with manubriotomy or minimal sternotomy. However, in this case, there was still room to perform the procedure via a transcervical approach. There are several reasons for performing total thyroidectomy via transcervical access: 1) the extent of the goiter is still above the aortic arch and does not involve major blood vessels, 2) post-operative considerations, as the transcervical approach offers better post-operative comfort, whereas sternotomy is often associated with post-operative complications, and 3) consideration of the surgeon's expertise in identifying the relationship between the goiter and the recurrent laryngeal nerve.[14]

There are several steps involved in performing a total thyroidectomy in cases of substernal goiter, with modifications of a functional neck dissection, followed by additional procedural techniques. The patient is placed under general anesthesia with orotracheal intubation, positioned in a beach chair setup with cervical extension, and muscle relaxants are used to aid exposure, as laryngeal nerve monitoring is not utilized.[15] A 6 to 10 cm transverse Kocher incision is made above the sternal notch, followed by elevation of subplatysmal flaps and midline separation of strap muscles to expose the thyroid lobes, with careful protection of the anterior jugular veins and possible division of the thin sternothyroid muscles.[17]

In cases of large goiters, addressing the superior thyroid artery early in the dissection can be beneficial, as the vessel is often elongated and more easily visualized with minimal strap muscle dissection. Careful isolation of the superior thyroid vessels while protecting the external branch of the superior laryngeal nerve improves gland mobility, reduces vascularity, and facilitates removal of the thyroid from its bed.[17] Once the superior pole is mobilized, the remaining thyroid gland is carefully dissected from the strap muscles and delivered into the wound by separating the avascular areolar plane anterior to the common carotid artery. The middle thyroid vein is isolated and divided, and the gland is progressively advanced, sometimes using Lahey clamps or a spoon to aid in carefully detaching the substernal component and bringing it into the neck.[17]

Once the goiter is delivered into the field and retracted by the assistant, exposing the common carotid artery and lateral trachea, the surgeon must be cautious as the recurrent laryngeal nerve (RLN) may be located more anteriorly than expected when the goiter and trachea are rotated. The RLN is identified low in the neck, allowing it to be traced upwards towards the thyroid. The remaining vascular and soft-tissue attachments are then divided, and the inferior parathyroid gland, though difficult to locate, is biopsied into the sternocleidomastoid muscle. The RLN is followed upwards to its insertion into the larynx, and the superior parathyroid gland is preserved by carefully managing the small branches from the inferior thyroid artery. As the nerve approaches the thyroid capsule, dissection continues, and the remaining thyro-tracheal attachments are divided.[17]

After the dissection of the thyroid pedicle, a 2-0 silk ligature is placed around it, and the enlarged thyroid lobe is detached. The contralateral side is removed similarly, with better exposure due to increased space. A 7-French silastic drain is placed in both thyroid beds, and if the strap muscles were divided, they are reapproximated with figure-of-eight 3-0 Vicryl sutures. The platysma is closed with interrupted sutures, and the skin is closed with a running 4-0 subcuticular Vicryl suture. The wound is secured with Steri-strips and a loose bandage, with careful attention to leaving an inferior opening for subcutaneous decompression in case of postoperative haemorrhage.[17]

There is still room to perform thyroidectomy through a cervical incision, especially for type A, B, and C on the coronal CT scan images, by removing it through a neck approach. The technique used is similar to the one described by Cvasiuc et al,[14] where a cervical incision through the neck is made, dividing transversely to expose the upper pole of the thyroid and the thyroid isthmus. The thyroid is gradually removed from the chest area after concomitant medial and lateral dissection until reaching the thyroid lobes. Identification of the recurrent laryngeal nerve is crucial, with the "toboggan" technique being used to promote early division of the isthmus from the tracheal attachments and mobilize the superior pole, which facilitates the removal of the retrosternal goiter component (or inferior pole) from the mediastinum, with early identification and preservation of the reccurent laryngeal nerve. It is important to define the lower aspect of the goiter, the shape on

coronal CT images, and correlate it with transversal or sagittal CT images to determine which mediastinal compartment is involved (anterior or posterior). The resected goiter can be compared to the CT scan to minimize the risk of leaving part of it in the mediastinum.[14] We successfully performed total thyroidectomy on this patient using the same method, resulting in several post-operative benefits and good follow-up outcomes without any further complications.

An important technique that researchers can share is to surgically remove the superior pole first, releasing it from Berry's ligament on one of the lobes and should always free the tissue as close to the goiter tissue as possible to avoid damage to the surrounding structures.

CONCLUSION

In this case surgical intervention focused on release decompression, and a total thyroidectomy was performed without requiring sternotomy. With the current retrosternal goiter classification system on CT-scan can help guide surgical decisions based on the extent and exact location of the goiter especially those that are benign and accompanied by appropriate operative techniques can often be managed with a cervical approach, reducing the need for more invasive procedures such as sternotomy or manubriotomy. An important technique that researchers can share is to surgically remove the superior pole first, releasing it from Berry's ligament on one of the lobes and should always free the tissue as close to the goiter tissue as possible to avoid damage to the surrounding structures. The successful outcomes in studies emphasize that with careful assessment, retrosternal goiters can be safely treated with minimal complications.

Conflict of Interest

The authors affirm no conflict of interest in this study.

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