Retrosternal Goitre: What Options?

Ann. Ital. Chir., 2026 97, 1: 18–25
https://doi.org/10.62713/aic.3949

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AIM: Goitre is a multifactorial disease whose development is influenced by both genetic and environmental factors. The literature presents no univocal definition of retrosternal goitre. There are more than ten different definitions, making actual classification non-homogeneous. There is no clear consensus concerning the proportion of the gland that must be located in a retrosternal position, nor the depth to which it must descend into the thoracic cavity to be classified as a retrosternal goitre. The therapeutic choice depends on the size of the goitre, the symptomatology, the patient's age, and other patient characteristics. A multidisciplinary evaluation is essential to choosing the best therapeutic approach. Most retrosternal goitres can be safely resected through a cervical approach; however, up to 2% of cases may require a combined cervicothoracic approach. The purpose of this study is to analyze the different surgical approaches used in cases of cervico-mediastinal goitre with real sinking into the thorax, which required a joint surgical procedure with surgeons from the thoracic surgery unit.
CASE PRESENTATION: From June 2022 to February 2024, 449 patients underwent surgery for thyroid disease at the general surgery unit of the University Hospital of Parma. Of these patients, we analysed the cases of cervico-mediastinal goitre with real sinking into the thorax, which required a joint surgical procedure with colleagues from the thoracic surgery unit due to the goitre's size and location. We identified a series of 5 cases of thoracic goitre, for an incidence rate of 1.1% of the treated patients. In all 5 cases, there was preoperative tracheal compression or dislocation. Of our cases, we found that 2 patients were treated with Kocher cervicotomy, 2 were treated with cervicotomy associated with thoracoscopy (in 1 case, a concomitant mini-thoracotomy at the IV intercostal space was performed), and 1 was treated with cervicotomy associated with manubriotomy. In 2 cases, total thyroidectomy was performed; in 2 cases, two-stage thyroidectomy was performed; and in 1 case, left lobectomy was performed.
RESULTS: Although thoracic goitre is a low-incidence disease, the risks and complications are significantly higher than those of cervical thyroidectomy. Preoperative imaging enables the evaluation of morphology, extension, relationships, and vascularisation, which facilitates preoperative multidisciplinary planning of surgical procedures. Advances in surgical techniques reduce procedure invasiveness by using minimally invasive techniques, which in turn reduce the impact of surgical access, perioperative complications, hospitalisation times, and postoperative recovery.
CONCLUSIONS: In our experience, a multidisciplinary approach—in particular, collaboration with thoracic surgeons—is fundamental to improving surgical outcomes.

Keywords: retrosternal goitre; surgery; multidisciplinary approach; case series

Introduction

Depending on the studies considered, goitre can be defined as an enlargement of the thyroid gland by more than two or three standard deviations compared to normal glandular volume, for a glandular volume greater then 18–19 mL in women and 25 mL in men [1]. There is no univocal definition of retrosternal goitre in the literature. The first definition dates to 1749, when Haller anatomically described retrosternal goitre as an extension of the thyroid at the thoracic inlet [2]. According to Kocher, a retrosternal goitre can be defined as the part of the gland that remained permanently retrosternal [3], while for Goldenberg and Lindskog [4], an enlargement of the goitre up to or below the transverse process of the fourth thoracic vertebra on radiographic examination, or again, according to the guidelines of the American Thyroid Association, a retrosternal goitre is defined as the presence of the thyroid gland below the sternal notch or below the clavicle in a physical or radiological examination conducted in the supine position with a small extension of the neck [5]. Similarly, there is no consensus on the proportion of the gland that must be located in a retrosternal position, nor on the depth to which it must

Submitted: 7 January 2025 Revised: 8 February 2025 Accepted: 20 February 2025 Published: 12 November 2025
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Editor: Francesca Gaino

descend into the thoracic cavity [6]. The most common and widely accepted definition is a goitre that extends below the level of the thoracic inlet or which has more than 50% of its mass below the sternal notch [7].

The incidence rate of retrosternal goitre varies widely according to different studies: 0.2 to 45% according to Raffaelli *et al*. [8], or 2 to 14% according to Katlic *et al*. [9]. The most frequently encountered symptoms are respiratory difficulties (in 42–96% of cases), dysphagia (26–60%), and airway obstruction and dysphonia (1–5%) [10]. Less frequent but clinically significant conditions include thyrotoxicosis, tracheomalacia, superior vena cava syndrome, pulmonary atelectasis, laryngopharyngeal reflux, and Obstructive Sleep Apnea Syndrome (OSAS). Respiratory symptoms are the most frequently reported indications and occur due to progressive compression and deviation of the airways [11]. Dyspnea occurs when the diameter of the trachea is <8 mm; stridor and wheezing occur when the diameter is <5 mm [12]. Acute symptoms related to airway obstruction may not occur until the tracheal lumen is obstructed by up to 75% [13].

The therapeutic choice depends on the size of the goitre, the symptomatology, the patient's age, and other patient characteristics. A multidisciplinary evaluation is essential to choosing the best therapeutic approach.

Most retrosternal goitres can be safely resected through a cervical approach; however, up to 2% of cases may require a combined cervicothoracic approach [14].

The purpose of this study is to analyze the different surgical approaches used in the cases of cervico-mediastinal goitre with real sinking into the thorax, which required joint surgical procedures with surgeons from the thoracic surgery unit.

Case Series

From June 2022 to February 2024, 449 patients were operated on at the General Surgery Clinic of the University Hospital of Parma. We analyzed the cases of cervico-mediastinal goitre with real sinking into the thorax, which required a joint surgical procedure with the colleagues from the thoracic surgery unit due to the goitre's size and location. We selected a series of 5 cases of thoracic goitre, for an incidence rate of 1.1% (Table 1). All patients signed informed consent for anonymous data collection.

Case 1: R.A. (Female, 66 Years Old)

The patient presented with ultrasound evidence of thoracic goitre with right lobe measuring 26 × 29 × 66 mm and left lobe measuring 34 × 32 × 60 mm. Multiple nodules, mostly cystic, were observed. Initial hyperfunction was seen, with thyroid-stimulating hormone (TSH) values of 0.55 µU/mL. The patient complained of dysphagia for liquids. The neck-thorax computed tomography (CT) documented a voluminous thyroid goitre with mediastinal extension of the right lobe (cranio-caudal extension on the right approximately 16.7 cm, on the left approximately 9.5 cm) along with tracheal compression and deviation to the left side (maximum caliber of the trachea at the level of the mid-thoracic tract approximately 8–9 mm) (Fig. 1).

Normal cord motility was observed at the preoperative ear, nose, and throat (ENT) evaluation. Preoperative parathyroid hormone (PTH) and calcemia values were 47 pg/mL and 9.5 mg/dL, respectively.

Cervicotomy was performed with access to the right thyroid lobe, and a gland deeply extended in the posterior me-

Fig. 1. Computed tomography (CT) of Case 1.

Fig. 2. CT of Case 2 (coronal). L, left.

Table 1. Summary of the reported cases.

	Case 1	Case 2	Case 3	Case 4	Case 5
Sex	F	M	F	F	F
Age (year)	66	74	73	57	84
Comorbidities	Arterial hypertension, osteoporosis	Arterial hypertension, BPH	Hypertension, glaucoma	Ulcerative colitis, tachyarrhythmia, GERD, jugular compression thrombosis	Allergic asthma, arterial hypertension, previous thrombosis of the right brachial and axillary veins
Pathology	Retrosternal goitre (larger on the right side)	Retrosternal goitre (larger on the left side)	Retrosternal goitre (larger on the left side)	Retrosternal goitre (larger on the left side)	Retrosternal goitre (larger on the left side)
Surgery	Right lobectomy+VATS	Left lobectomy+sternotomy	Left lobectomy	Left lobectomy+VATS	Total Thyroidectomy

VATS, video assisted thoracic surgery; BPH, Benign Prostatic Hyperplasia; GERD, Gastroesophageal Reflux Disease; M, male; F, female.

diastinum which was partially dislocated was found. Due to unclear vascular control, the team decided to proceed with a thoracoscopic approach. Selective tracheal intubation was performed, and the patient was positioned in the left lateral decubitus position; right video assisted thoracic surgery (VATS) was performed with an incision of the pleura up to the apex and its mobilization with cervical enucleation. The patient was repositioned, and the gland was extracted through the cervical access. The team decided to perform a two-stage thyroidectomy for an unsatisfactory post-operative electromyographic signal, despite the presence of an anatomically intact nerve. One drain was positioned in the neck, and one in the thorax; the thoracic drain was removed on the second postoperative day, and the cervical one was removed on the third day. The patient was discharged after 72 hours.

At the ENT check-up after 7 days, hypomotility of the right vocal cord was documented; consequently, speech therapy was performed, with confirmation at 30 days and 180 days of hypomotility of the right cord with contralateral compensation. The final histological examination documented thyroid adenomatous hyperplasia.

Case 2: S.L. (Male, 74 Years Old)

The patient presented with ultrasound evidence of an enlarged thyroid gland (right lobe Anterior-Posterior (A-P) diameter 25 mm, isthmus 5 mm, left lobe 24 mm as far as explorable). The caudal end of the left lower pole in the thoracic inlet could not be assessed well. Preoperative TSH values were 1.12 pg/mL. The neck-thorax CT highlighted an enlarged thyroid gland, with a left thyroid lobe extending into the mediastinum up to the subcarinal site with maximum dimensions of 73 × 109 mm, and a cranio-caudal diameter of 180 mm. The goitre caused a caliber reduction and right lateral deviation of the trachea (minimum A-P diameter 9 mm in the middle third), with compression and right lateral deviation of the oesophagus (Figs. 2,3).

Kocher cervicotomy was performed with access to the left thyroid lobe, and a voluminous multinodular goitre which deepened into the mediastinum was found without the possibility of evaluating the lower vascular limit. The left upper lobe was isolated. The parenchyma appeared easily friable with intense bleeding; in the absence of a sure vascular control, the team decided to proceed with the sectioning of the sternal manubrium. The isolation of the lobe was difficult due to its voluminous dimensions and the isolation of the innominate artery and vein (Figs. 4,5).

Fig. 3. CT of Case 2 (sagittal).

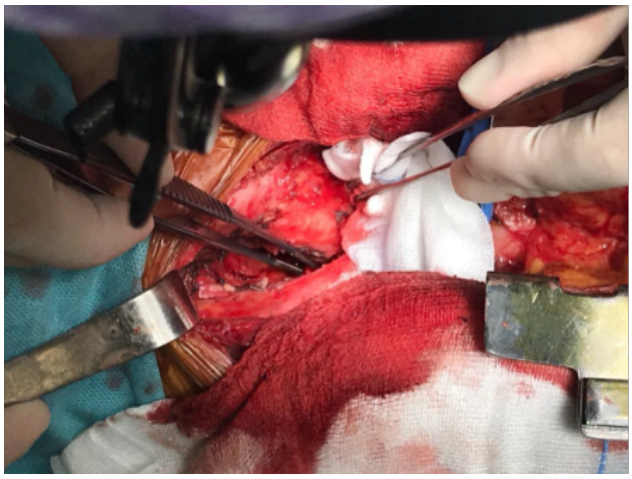

Fig. 4. Manubriotomy of Case 2.

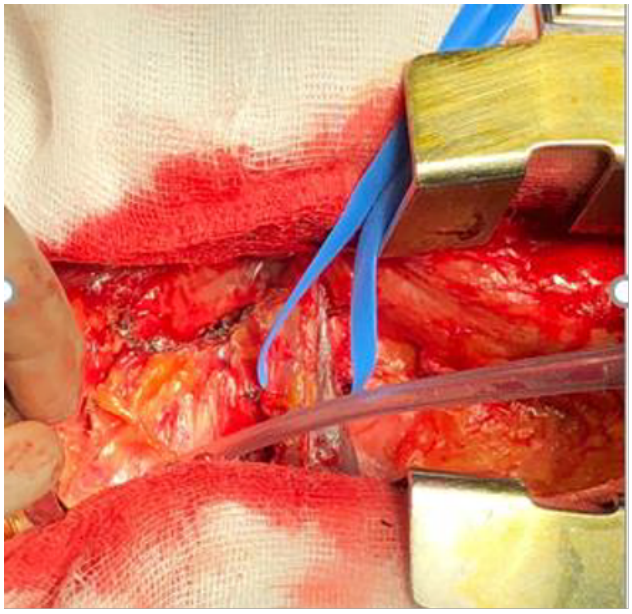

Fig. 5. Anonimous vein and artery.

Left lobectomy was performed. The lobe extended beyond the carina, causing significant compression and tracheal deviation. Due to significant intraoperative blood loss (approximately 1800 mL), as well as due to the impossibility of using intraoperative neuromonitoring (IONM) since the patient had been curarised, the team decided after the left lobectomy not to proceed with the completion of the thyroidectomy. A cervical drain was placed.

Postoperative hospitalisation was regular, and the patient was discharged on the fifth postoperative day. No postoperative dysphonia occurred. The final histological examination documented thyroid adenomatous hyperplasia.

Case 3: B.P.G. (Female, 73 Years Old)

The patient presented with an enlarged thyroid gland (right lobe 33 × 34 mm A-P and Latero-Lateral (L-L) diameter, and left lobe of 43 × 50 mm) with several

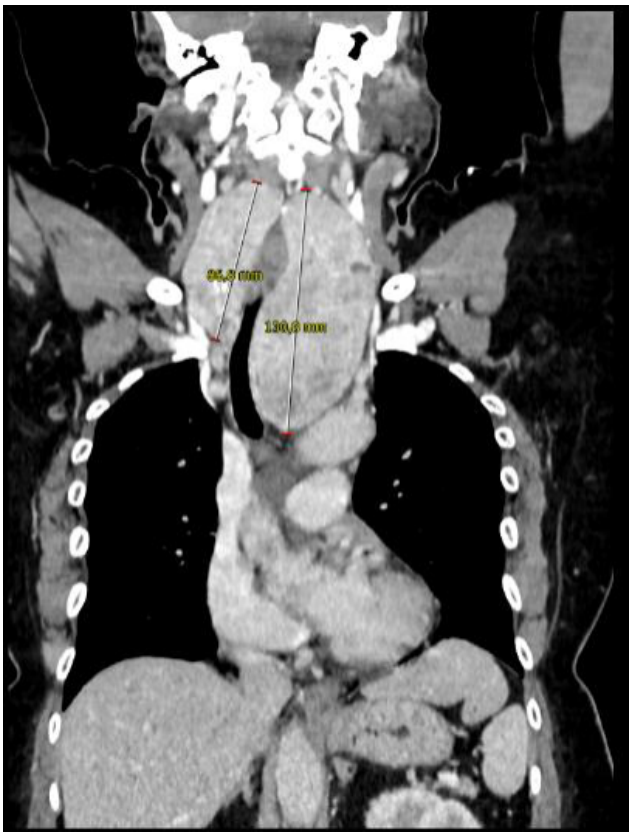

Fig. 6. CT of Case 3.

Fig. 7. Specimen of Case 3.

Fig. 8. CT of Case 4.

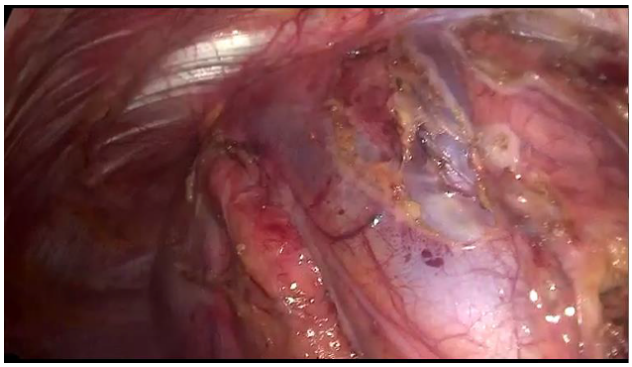

Fig. 9. Thoracoscopic image of Case 4.

mixed/spongiform nodules. Longitudinal diameters were not estimable. The neck-thorax CT documented a bulky multinodular thyroid goitre, mainly affecting the left lobe (cranio-caudal diameter on the left approximately 13 cm, on the right approximately 8 cm), which extended into the posterior mediastinum and caused a marked deviation to the right as well as compression of the upper trachea (wrapped for approximately 180°, with residual air lumen caliber of approximately 7–8 mm) and the upper thoracic oesophagus (Fig. 6).

Preoperative TSH values indicated initial mild hyperthyroidism, with TSH values of 0.209 µU/mL, PTH values of

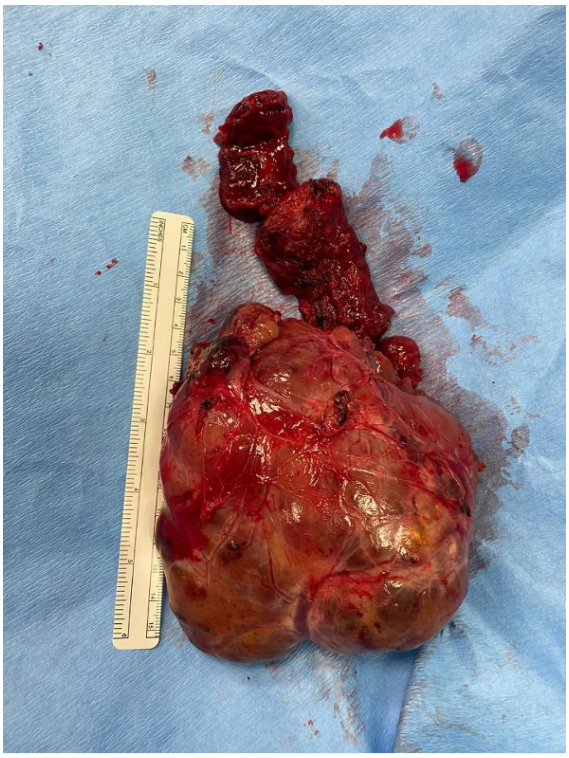

Fig. 10. Specimen of Case 4.

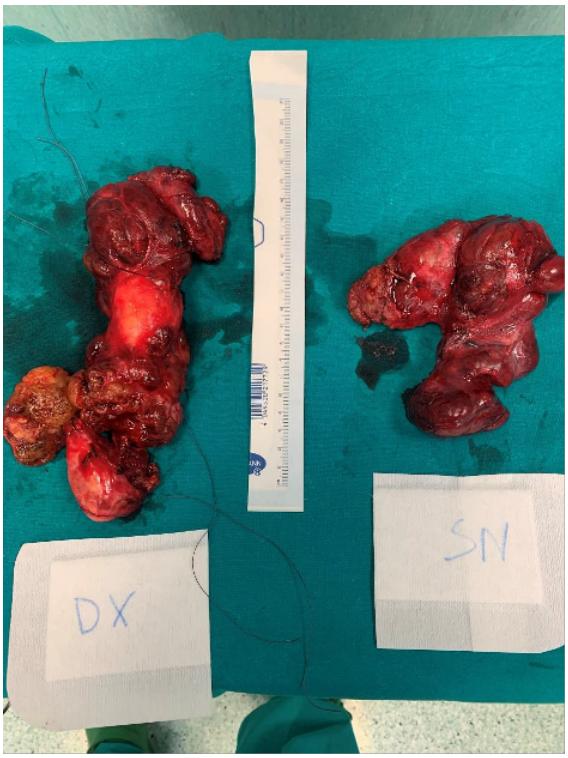

Fig. 11. Specimen of Case 5.

approximately 135 pg/mL, and calcemia and ionised calcium values of 11.3 mg/dL and 1.3 mmol/L, respectively. The left vocal cord was found to be fixed at the preoperative ENT evaluation.

On suspicion of hyperparathyroidism, scintigraphy with methoxyisobutyl isonitrile (MIBI) and Positron Emission Tomography (PET) with choline were performed without evidence of hyperfunctioning parathyroid tissue. We proceeded with a cervicotomy with wide separation of the flaps; isolation of the left lobe presented friable and bleeding parenchyma. IONM did not show an electromyographic signal of the left vagus nerve, compatible with the known fixity of the vocal cord. Given the fixity of the left vocal cord, we opted for a left lobectomy without sternotomy (Fig. 7).

No postoperative complications occurred, and the patient was discharged after 2 days. The final histological examination documented a multinodular colloid cystic goitre.

Case 4: P.B. (Female, 57 Years Old)

The patient presented with a large goitre. The neck-thorax CT documented a large thyroid goitre starting from the left lobe and extending into the antero-superior mediastinum (maximum diameter on the axial plane 110 × 113 mm, and a cranio-caudal extension of 117 mm). Due to the goitre volume, compression of the superior vena cava was found, with multiple superficial collateral circulations of the anterior thoracic wall, at the base of the neck, and in the adipose tissue of the anterior mediastinum. A right lateral deviation of the trachea ran along its entire course, with an associated reduction in calibre (Fig. 8).

A cervicotomy was performed with access to the left thyroid lobe. A thyroid goiter deeply extended into the mediastinum was found, with compression and displacement of the trachea. The gland was friable and bled easily at touch. We proceeded to VATS, with identification of the left lobe descending into the right hemithorax. The thyroid capsule, the azygos vein, superior cava, and innominate vein were isolated, and the ipsilateral recurrent laryngeal nerve (RLN) was identified (Fig. 9). In the end, the nerve was intact along its entire path in the thyroid lobe, but the electromyographic signal to IONM stimulation was absent. Left hemithyroidectomy was performed (Fig. 10).

Mild postoperative dysphonia, absence of dysphagia were observed. Left vocal cord paralysis at 48 hours with ENT control was found. The patient was discharged after 7 days. Definitive histological examination documented adenomatous hyperplasia.

The patient was discharged after 7 days. Definitive histological examination documented adenomatous hyperplasia.

Case 5: D.A. (Female, 84 Years Old)

The patient presented with ultrasound evidence of an enlarged thyroid, with multiple nodules extending into the mediastinum. The A-P and L-L diameters were 5 cm and 5 cm. On CT scans, the thyroid gland appeared markedly enlarged and diffusely inhomogeneous. The right lobe was larger in size and deepened into the mediastinum, surrounding the trachea and reaching the carina. At the level of the upper mediastinal aditus, the trachea was compressed and deformed by the goitre. The right thyroid lobe caused compression of the superior vena cava and confluence between the subclavian and internal jugular veins, with the development of superficial collateral venous circulations in correspondence with the neck and the right anterior thoracic wall.

Surgery was performed and a goitre was found that was causing significant tracheal compression. The upper pole was found to be in a cranial position and multiple nodules and mediastinal extension were also found. The nerves at the end appeared intact and there was an electromyographic signal. Double suction drainage was positioned (Fig. 11).

The postoperative course was regular, with postoperative calcemia values of 7.4 mg/dL and PTH values of 30 pg/mL. The patient was discharged after 3 days. Definitive histological examination documented multinodular colloid cystic goitre.

Discussion

The treatment goal for substernal goitres is to relieve the obstructive symptoms; for patients with asymptomatic retrosternal goitre, the aim is to prevent the growth of the goitre and the subsequent development of obstructive symptoms.

Surgery for retrosternal goitres is associated with higher complication rates than surgery for cervical goiters [15]. Compared to a few years ago, present-day options vary, depending on the substernal extension of the thoracic goitre. Cervicothoracic CT scan is the investigation of choice for studying the relationship between the goitre and the vessels [16,17]. The vast majority of retrosternal goitres can be safely resected via cervical incision, although a combined cervical–thoracic approach has been reported to be necessary in up to 2% of cases [14,18]; the latter patients may require transthoracic surgical excision under the care of experienced, high-volume surgeons [19].

Currently, there are no clear guidelines for substernal thyroid goitres, which may require a transthoracic approach. In our experience, with complex retrosternal goitres, a combined work-up and collaboration with thoracic surgeons is fundamental to optimised surgery planning for patients. A collaborative approach with the anaesthesiology team is also essential to airway management—specifically to deciding the anesthesia pattern, the use of opioids, the use of paralytic agents and their impact on neural monitoring, and the plan for postoperative care (such as an eventual intensive care unit hospitalisation) [20].

Nerve dissection over long segments could cause injury resulting from potential devascularisation or physical trauma. A massive mediastinal lesion has a greater potential to distort normal anatomy. In a recent Italian study, Testini *et al.* [21] showed a statistically significant increase in the rates of both transient and permanent RLN palsy when a substernal goitre is approached extracervically via manubri-

otomy, compared to the rates with a transcervical approach. In surgeries for advanced cancer, revision procedures, and large goitres with substernal involvement, IONM has been shown to decrease the rate of RLN injury [22].

For many years, median sternotomy has been the classic approach to an anterior mediastinal mass. This procedure presents some risks of complications, including deep space wound infections, dehiscence, sternal instability, and arrhythmias. In our experience, hemiclamshell can also be considered a safe procedure for treating mediastinal goitre and enabling a good exposure of subclavian vessels and mediastinal nodes.

In recent years, several alternative minimally invasive techniques have been employed as part of an extracervical approach [23]. VATS is an excellent option, as a less morbid extra-cervical approach than median sternotomy. Patients who undergo VATS for anterior mediastinal masses experience less blood loss, less pain, shorter duration of chest drains, and shorter length of hospital stay than those with median sternotomy [24]. VATS thyroidectomies are often successful, with only 8% requiring conversion to open surgery [25]. VATS—and, more recently, robotic-assisted thoracoscopic surgery (RATS)—have been associated with reduced length of hospital stay, improved pain, and quicker recovery compared to open approaches [26,27].

The possibility of being able to follow the course of the nerve and to evaluate its function with IONM enables us to choose how to proceed after the removal of the major lobe (which normally causes stenosis and tracheal deviation), as well as to opt for two-stage thyroidectomy in case of signal loss so as to avoid the risk of bilateral nerve dysphonia—which, together with the risk of tracheomalacia, would make breathing and functional recovery difficult [28].

Resection of a retrosternal goitre is more commonly performed via cervical collar incision with mandatory availability of sternotomy. Radiological measurement of the craniocaudal length may predict the need for sternotomy [29]. Indications for an extracervical approach vary across studies; generally, an extracervical approach should be considered in goitres with diameters exceeding that of the thoracic inlet or in conditions such as recurrent goitres, intrathoracic thyroid cancer, and thyroid tissue invading the retrotracheal or retroesophageal space, which usually require a sternotomy. Anatomy of the thyroid gland and the chest should be considered before operating. According to some studies, the tracheal diameter-to-thoracic inlet ratio is important: a wide trachea with a narrow inlet usually requires an extracervical approach, while a narrow trachea with a wide inlet requires a transcervical one [30]. In a retrospective single-centre review by Linhares *et al*. [19], only the substernal component of the thyroid goitre extending beyond the sternal notch into the mediastinum was statistically significant in predicting sternotomy, and mediastinal extension of $\geq$5 cm beyond the sternal notch showed a sensitivity of 94% and a specificity of 86.5% with respect to predicting need for sternotomy.

Patients must be informed about the adverse events associated with surgery, not only of the thyroidectomy but also of any additional surgical options which may be decided intraoperatively [31].

In the upcoming years, we hope to implement our case series in order to increase our experience in the various therapeutic approaches to retrosternal goitres, as we think that the main limitation of this article is the limited number of cases in our series.

Conclusions

Although thoracic goitre is a low-incidence disease, the risks and complications are significantly higher than those of cervical thyroidectomy. Preoperative imaging enables the evaluation of morphology, extension, relationships, and vascularisation, which facilitates preoperative multidisciplinary planning of surgical procedures. Advances in surgical techniques reduce procedure invasiveness by using minimally invasive techniques, which in turn reduce the impact of surgical access, perioperative complications, hospitalisation times, and postoperative recovery. In our experience, a multidisciplinary approach—in particular, collaboration with thoracic surgeons—is fundamental to improving surgical outcomes.

Availability of Data and Materials

All data generated or analyzed during this study are included in this article, and no further underlying data are necessary to reproduce the results.

Author Contributions

TL: Data curation, Formal analysis, Investigation, Visualization, Writing-original draft, Writing-review & editing. EB: Data curation, Investigation. DB: Data curation, Formal analysis. LA: Conceptualization, Resources. PDR: Conceptualization, Resources, Project administration, Supervision. All authors contributed to important editorial changes in the manuscript. All authors read and approved the final manuscript. All authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

Since it is a case series, no ethical approval is needed. Patients signed an informed consent before surgery. The study conformed to the provisions of the Declaration of Helsinki.

Acknowledgment

Not applicable.

Funding

This research received no external funding.

Conflict of Interest

The authors declare no conflict of interest.

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