A Minimally-Invasive Approach to Substernal Goiter and Posterior Mediastinal Mass

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Background
A female patient presented with a massive goiter with bilateral substernal extension and a mass in the right posterior mediastinum.

Summary
Our patient is a 65-year-old woman who presented with a large multinodular goiter, voice weakness, and dysphagia with solid food, but no symptoms of hyper- or hypothyroidism. Imaging found a dominant right thyroid with bilateral substernal extension, as well as a left posterior mediastinal mass that was separated from the goiter by a tissue plane. The mediastinal mass (82 g) was first excised through robotic-assisted thoracoscopic resection and found to be benign thyroid tissue. Near-total thyroidectomy (218 g) was then performed through a cervical incision. This report details the unusual finding of an ectopic posterior mediastinal goiter, without connection to substernal goiter, raising the possibility of a rare primary intrathoracic goiter. We review the evidence for diagnosis and management of intrathoracic goiter.

Conclusion
Most intrathoracic goiters extend from cervical goiters. We present the case of a possible primary intrathoracic goiter, successfully treated with a two-stage operation involving robotic-assisted thoracoscopic resection and a near-total thyroidectomy through a cervical incision.

Keywords
Posterior mediastinal mass, substernal goiter, robotic-assisted thoracoscopy

Disclosure:
The authors have no conflicts of interest to disclose.

Case Description

Our patient is a 65-year-old woman who presented with a large multinodular goiter. This goiter had been expanding for many years. The patient experienced a change in voice and vocal weakness. However, laryngoscopy showed normal vocal cord movement. She also had dysphagia with solid food. She had no family history of thyroid cancer and no history of radiation exposure. She had no symptoms of hyper- or hypothyroidism. Her TSH was low, at 0.385, with a normal free T4 level. FNA of two nodules within the goiter showed benign thyroid nodules with areas of cystic degeneration.

The patient’s initial computed tomography (CT) scan of the neck (Figure 1) showed a dominant left thyroid beginning below the left mandible, causing tracheal deviation to the right and compression of the esophagus. The left thyroid extended into the mediastinum down to the level of the aortic arch. The right thyroid extended into the right mediastinum. Further imaging revealed a secondary mass in the right paratracheal mediastinum which was separated from the thyroid by a tissue plane. The mediastinal mass had no uptake with radioiodine scan, which showed large nodules in the left and right lobes with decreased activity with possible surrounding areas of increased activity.

The patient first underwent a robotic-assisted resection of her mediastinal mass, accessed through right thoracoscopy. Flexible bronchoscopy was performed preoperatively to ensure there were no endobronchial lesions. Final pathology revealed benign thyroid tissue. The specimen was 5.5 x 4.5 x 3.0 cm and 82 g. The patient then had a subtotal thyroidectomy via a 6 cm cervical incision after a two-month interval. Neuromonitoring of the recurrent laryngeal nerve was used. The specimen was 218 g and consisted of left thyroid, isthmus, and much of the right with substernal extension (Figure 2). The right superior lobe was preserved. A left superior parathyroid gland was implanted into the left sternocleidomastoid muscle.

The patient recovered very well from both operations, which were overnight stays. Her voice recovered fully to normal strength. She had a normal calcium level and normal TSH and T4 on 50 mcg of levothyroxine.

Discussion

Goiter is an enlarged thyroid gland with multiple definitions, including twice normal size or greater than 40 g.\(^1\) There are also many definitions of substernal or intrathoracic goiter. The American Thyroid Association defines substernal goiter as “thyroid extension past the sternal notch with the patient in the supine position, detected either radiologically or clinically.”\(^2\) This case features both massive substernal goiter and intrathoracic goiter without clear connection found on imaging or during resection. Intrathoracic goiters can be categorized based on origin of the thyroid tissue and location within the mediastinum. Primary intrathoracic goiters represent a separation of thyroid blastoma from the thyroid primordium, which is pulled into the thoracic cavity by descent of the heart.

![Figure 1. Preoperative CT scan showing right posterior mediastinal mass and deviation of trachea due to left-side dominant goiter](image1)

![Figure 2. Surgical specimen of substernal goiter weighing 218 g](image2)
and great vessels. These types of goiters are rare, representing only 0.2 to 1 percent of intrathoracic goiters, and they have a female predominance of 3–4:1. In contrast, secondary intrathoracic goiters are thought to result from enlarging cervical goiters following the path of least resistance through the thoracic aperture into the thoracic cavity. Growth in inferior direction is encouraged by negative intrathoracic pressure, swallowing, and gravity. Primary intrathoracic goiters receive blood supply from intrathoracic arterial branches, while secondary intrathoracic goiters connect with the superior and inferior thyroid arteries.

Intrathoracic goiter can also be categorized by location in the anterior or posterior mediastinum. The incidence of posterior mediastinal goiter is commonly cited as 10 to 15 percent, with 90 percent being right-sided due to the bulk of the aortic arch, subclavian artery, and carotid artery on the left. In a more recent series of 88 patients with intrathoracic goiter, 30.7 percent of patients had a posterior mediastinal goiter, with 10.2 percent prevascular and 20.5 percent retrovesical.

The presentation of intrathoracic goiter can vary. One series of 132 patients with intrathoracic goiter included 43.2 percent who were completely asymptomatic; in this case series, it was noted that the diagnosis is increasingly found incidentally on chest imaging. Symptoms tend to be caused by compressive effects of the goiter. Intrathoracic goiters can compress the trachea, causing dyspnea, and the esophagus, causing dysphagia. A series of 59 patients with intrathoracic goiter found that 49 percent presented with dyspnea and 13.6 percent presented with dysphagia. Dysphonia or hoarseness, which was seen in the subject of this case report, is also commonly seen due to compression of the recurrent or superior laryngeal nerve. More rare presentations include jugular vein thrombosis, Horner syndrome, superior vena cava syndrome, and acute hemorrhage into the goiter, causing tracheal obstruction.

CT is a valuable tool in preoperative evaluation. It allows for evaluation of compression of the trachea and esophagus, relation to blood vessels, and extension within the mediastinum. A review of seven retrospective studies argues that CT can predict the need for a thoracoscopic approach. Features that predicted the need for thoracotomy included extension below the aortic arch, location within the posterior mediastinum, dumbbell shape, and a thoracic component wider than the thoracic inlet. Appearance of the goiter on CT varies with iodine content. Goiters with low amounts of iodine show attenuation similar to the soft tissue of the chest wall, while goiters with high amounts of iodine appear similar to normal thyroid.

Radioiodine scans can be useful to define areas of autonomous function, but are limited by interference from the sternum, clavicles, mediastinum, and blood. Fine needle aspiration and thyroid ultrasound are less useful due to inaccessibility of the goiter. Thyroid function tests have low sensitivity in predicting goiter, as only 10 to 15 percent of patients with goiter have hypothyroxinemia. In this case, preoperative bronchoscopy was used to rule out endobronchial lesions, as the most common posterior mediastinal masses in adults include lymphoma, schwannoma, and thymic neoplasm.

Resection of intrathoracic goiters can cause significant morbidity and mortality, and one paper argued that the risks of operation may outweigh the benefits for asymptomatic tumors, especially because the natural history of the disease is not well defined. A large series of 33,930 patients undergoing thyroidectomy, of which 1,153 had substernal extension, showed that substernal thyroidec- tomy was associated with a higher risk of recurrent laryngeal nerve injury, postoperative bleeding, deep vein thrombosis (DVT), respiratory failure, and transfusion, as well as an increased hospital length-of-stay, and increased mortality. Additionally, another series of 110,889 patients undergoing thyroidectomy (of which 5,525 underwent substernal thyroidectomy), showed that substernal thyroidectomy was associated with significantly higher rates of bleeding, respiratory failure, pulmonary embolism, hypoparathyroidism, hypocalcemia, pneumothorax, bacteremia, and mortality.

Resection of intrathoracic goiters can be approached in a variety of ways. The majority can be resected with a cervical incision, but certain factors can make this approach difficult or impossible. In addition to the CT findings noted above, a series of 88 patients found that risk factors for requiring an extra-cervical approach include primary mediastinal goiter, posterior mediastinal goiter, and the presence of an aberrant adenoma. A review of 220 patients with large (>110 g) thyroids or substernal goiter found that patients with symptoms of chest pressure and voice changes were also more likely to undergo sternotomy. Other indications include a large secondary mediastinal goiter that cannot be retracted and malignant mediastinal lymph nodes.
Although goiters within the anterior mediastinum can be accessed through a sternotomy, this is less helpful for posterior mediastinal goiters, as the heart and great vessels are still anterior to the goiter. For this reason, many authors have reported use of a lateral or posterolateral thoracotomy. One approach involves mobilizing the thyroid through a cervical incision and then proceeding to complete extraction through lateral thoracotomy. Another case first mobilized the intrathoracic section and then withdrew the goiter through the cervical incision.

Thoracotomy can be avoided with the use of robotic surgery for which there is mounting evidence of quicker recovery and decreased morbidity compared with open thoracic surgery. The largest series that details the viability of this technique for posterior mediastinal masses includes 75 patients, although none were for goiter. Two case reports on robotic surgery for posterior mediastinal goiters noted that the 3D visualization, wrist movement, and delicate dissection afforded by the robotic technique was ideally suited for the narrow confines of the posterior mediastinal space and was far superior compared with conventional video-assisted thoracoscopic surgery.

Among intrathoracic goiters, our case was unique, in that there was no obvious connection between the cervical goiter and the intrathoracic portion. It was decided to approach the thoracic resection first due to the possibility of malignancy. As mentioned previously, we agree that the posterior mediastinal space is best approached with robot-assisted thoracoscopic surgery, as it offers improved dissection accessibility through a sternotomy, this is less helpful for posterior mediastinal masses: Report of two cases and literature review. Scand J Surg. 2008;393(5):751–757. doi:10.1177/1457496914523411


