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

AUTHORS:
Kevin A. Chen, MD; Gabrielle Perrotti, BS; Nathaniel R. Evans, MD, FACS, FCCP; Alliric I. Willis, MD, FACS

CORRESPONDENCE AUTHOR:
Kevin Chen, MD
1000 Walnut St. #906
Philadelphia, PA 19107
Phone: (626) 678-0585
Email: kac022@jefferson.edu

AUTHOR AFFILIATIONS:
Thomas Jefferson University
Department of Surgery
Philadelphia, PA 19107

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

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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.

Figure 1. Preoperative CT scan showing right posterior mediastinal mass and deviation of trachea due to left-side dominant goiter

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.

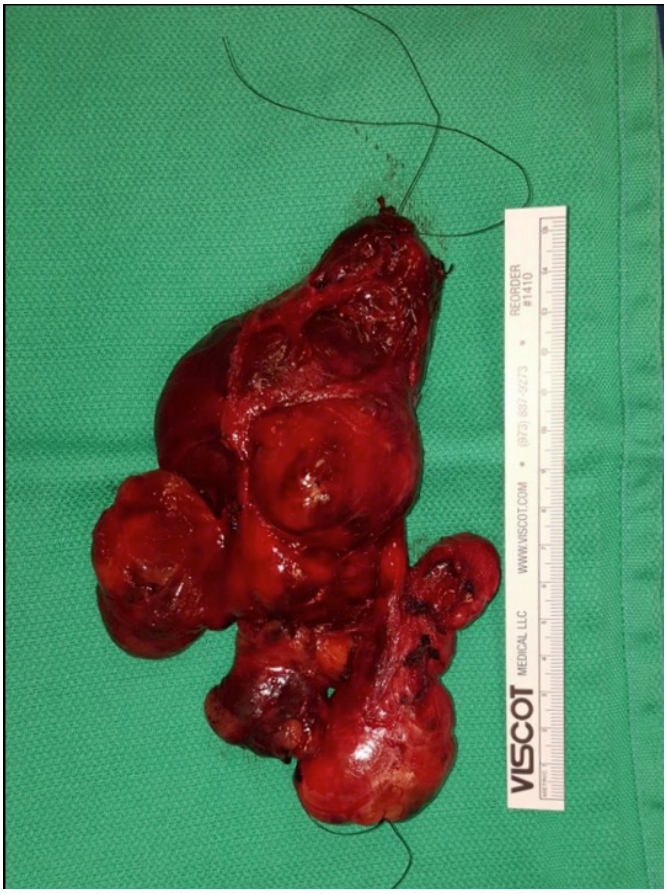

Figure 2. Surgical specimen of substernal goiter weighing 218 g

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

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.[3] 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.[4]

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.[4] 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 previsceral and 20.5 percent retrovisceral.[5]

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.[6] 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.[7] 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.[8,9,10,11]

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 thoracic 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.[12] 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.[13]

Radioiodine scans can be useful to define areas of autonomous function, but are limited by interference from the sternum, clavicles, mediastinum, and blood.[14] 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.[13] 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.[15]

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.[6] A large series of 33,930 patients undergoing thyroidectomy, of which 1,153 had substernal extension, showed that substernal thyroidectomy 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.[16] 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.[17]

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.[5] 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.[18] Other indications include a large secondary mediastinal goiter that cannot be retracted and malignant mediastinal lymph nodes.[10]

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.[19] Another case first mobilized the intrathoracic section and then withdrew the goiter through the cervical incision.[20]

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.[21] The largest series that details the viability of this technique for posterior mediastinal masses includes 75 patients, although none were for goiter.[22] 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.[23,24]

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 robotic-assisted thoracoscopy, as it offers improved dissection compared with VATS, and it also offers reduced complications and faster recovery compared with thoracotomy.[25] This particular dissection was especially challenging due to adjacency of the lesion to the superior vena cava (SVC), esophagus, and trachea. The delicate maneuvers afforded by the robot allowed us to complete the dissection without damage to these structures. However, a thoracotomy may be employed if the mass is too large to be extracted through a thoracoscopic port site. The two-stage resection allowed us to have a full pathologic examination of the posterior mediastinal mass before proceeding with the cervical resection. Once we confirmed the benign nature of the posterior mediastinal mass, we completed the cervical goiter excision.

Conclusion

This case report demonstrates that a minimally-invasive approach, involving a robotic thoracoscopic surgery and a cervical incision, is a safe and effective treatment for large cervical goiter in conjunction with posterior mediastinal goiter.

Lessons Learned

The differential diagnosis for posterior mediastinal masses is broad, but includes goiter. Posterior mediastinal goiter presenting with large substernal goiters can be safely resected using a dual robotic-assisted thoracoscopic and cervical approach.

References

1. White ML, Doherty GM, Gauger PG. Evidence-based surgical management of substernal goiter. *World J Surg*. 2008;32(7):1285–1300. doi:10.1007/s00268-008-9466-3
2. Chen AY, Bernet VJ, Carty SE, et al. American Thyroid Association Statement on Optimal Surgical Management of Goiter. *Thyroid*. 2014;24(2):181–189. doi:10.1089/thy.2013.0291
3. Oueriachi F El, Hammoumi MM El, Arsalane A, Slaoui O, Diouri H, Kabiri EH. Primary mediastinal goiters. *Springerplus*. 2014;3:503. doi:10.1186/2193-1801-3-503
4. Mack E. Management of patients with substernal goiters. *Surg Clin North Am*. 1995;75(3):377–394. http://www.ncbi.nlm.nih.gov/pubmed/7747247. Accessed September 12, 2017.
5. Cichoń S, Anielski R, Konturek A, Baczyński M, Cichoń W, Orlicki P. Surgical management of mediastinal goiter: Risk factors for sternotomy. *Langenbeck's Arch Surg*. 2008;393(5):751–757. doi:10.1007/s00423-008-0338-y
6. Landerholm K, Järhult J. Should asymptomatic retrosternal goitre be left untreated? A prospective single-centre study. *Scand J Surg*. 2014:92–95. doi:10.1177/1457496914523411
7. Agha A, Glockzin G, Ghali N, Iesalnieks I, Schlitt HJ. Surgical treatment of substernal goiter: An analysis of 59 patients. *Surg Today*. 2008;38(6):505–511. doi:10.1007/s00595-007-3659-5
8. Samokhvalova A, Loberantb N, Makhoula N. Posterior mediastinal goiters: Report of two cases and literature review. *Respir Med Case Reports*. 2012;5(1):65–68. doi:10.1016/j.rmedc.2011.07.008
9. Torres A, Arroyo J, Kastanos N. Acute respiratory failure and tracheal obstruction in patients with intrathoracic goiter. *Crit Care Med*. 1983;11(265):6.

10. Rolighed L, Rønning H, Christiansen P. Sternotomy for substernal goiter: retrospective study of 52 operations. *Langenbeck's Arch Surg*. 2015;400(3):301–306. doi:10.1007/s00423-015-1288-9
11. Tsakiridis K, Visouli AN, Zarogoulidis P, et al. Resection of a giant bilateral retrovascular intrathoracic goiter causing severe upper airway obstruction, 2 years after subtotal thyroidectomy: A case report and review of the literature. *J Thorac Dis*. 2012;4(20):41–48. doi:10.3978/j.issn.2072-1439.2012.s004
12. Qureishi A, Garas G, Tolley N, Palazzo F, Athanasiou T, Zacharakis E. Can pre-operative computed tomography predict the need for a thoracic approach for removal of retrosternal goitre? *Int J Surg*. 2013;11(3):203–208. doi:10.1016/j.ijsu.2013.01.006
13. Chen X, Xu H, Ni Y, Sun K, Li W. Complete excision of a giant thyroid goiter in posterior mediastinum. *J Cardiothorac Surg*. 2013;8(1):207. doi:10.1186/1749-8090-8-207
14. Shahian DM, Rossi RL. Posterior Mediastinal Goiter. *Chest*. 1988;94(3):599–602. doi:10.1378/chest.94.3.599
15. Laurent F, Latrabe V, Lecesne R, et al. Mediastinal masses : diagnostic approach. *Eur Radiol*. 1998;1159(8):1148–1159.
16. Pieracci FM, Fahey TJ. Substernal Thyroidectomy is Associated with Increased Morbidity and Mortality as Compared with Conventional Cervical Thyroidectomy. *J Am Coll Surg*. 2007;205(1):1–7. doi:10.1016/j.jamcollsurg.2007.03.010
17. Moten AS, Thibault DP, Willis AW, Willis AI. Demographics, disparities, and outcomes in substernal goiters in the United States. *Am J Surg*. 2016;211(4):703–709. doi:10.1016/j.amjsurg.2015.11.022
18. 1Nankee L, Chen H, Schneider DF, Sippel RS, Elfenbein DM. Substernal goiter: when is a sternotomy required? *J Surg Res*. 2015;199(1):121–125. doi:10.1016/j.jss.2015.04.045
19. Ojanguren A, Baena J, Ros S, Santamaría M, Ojanguren I, Olsina J. Best approach for posterior mediastinal goiter removal: transcervical incision and lateral thoracotomy. *Arch Bronconeumol*. 2014;50(6):255–257. doi:10.1016/j.arbres.2013.09.009
20. MacHado NO, Grant CS, Sharma AK, Al Sabti HA, Kolidyan S V. Large posterior mediastinal retrosternal goiter managed by a transcervical and lateral thoracotomy approach. *Gen Thorac Cardiovasc Surg*. 2011;59(7):507–511. doi:10.1007/s11748-010-0712-x
21. Farivar AS, Cerfolio RJ, Vallières E, et al. Comparing Robotic Lung Resection With Thoracotomy and Video-Assisted Thoracoscopic Surgery Cases Entered Into The Society of Thoracic Surgeons Database. *Innov Technol Tech Cardiothorac Vasc Surg*. 2014;9(1):10–15. doi:10.1097/IMI.0000000000000043
22. Cerfolio RJ, Bryant AS, Minnich DJ. Operative techniques in robotic thoracic surgery for inferior or posterior mediastinal pathology. *J Thorac Cardiovasc Surg*. 2012;143(5):1138–1143. doi:10.1016/j.jtcvs.2011.12.021
23. Approach ACC. C ASE R EPORT A Novel Robot-Assisted Technique for Excision of a Posterior Mediastinal Thyroid Goiter. 2009;4(4):225–228.
24. Al-Mufarrej F, Margolis M, Tempesta B, Strother E, Gharagozloo F. Novel thoracoscopic approach to difficult posterior mediastinal tumors. *Gen Thorac Cardiovasc Surg*. 2010;58(12):636–639. doi:10.1186/1749-8090-3-55
25. Paul S, Sedrakyan A, Chiub Y lin, et al. Outcomes after lobectomy using thoracoscopy vs thoracotomy: A comparative effectiveness analysis utilizing the Nationwide Inpatient Sample database. *Eur J Cardio-thoracic Surg*. 2013;43(4):813–817. doi:10.1093/ejcts/ezs428