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CASE REPORT

Complete transthoracic resection of giant posterior mediastinal goiter: A case report and review of the surgical approaches

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Abstract

Intrathoracic goiter (IG) is commonly located in the anterior mediastinum. Here, we report the case of a 54-year-old Chinese woman with successful removal of an intrathoracic goiter and improvement of dyspnea by a right posterolateral thoracotomy approach. Conclusion: Posterior mediastinal thyroid goiter with mediastinal compressive symptoms is an indication for surgery.

Key words: intrathoracic goiter (IG); posterior mediastinum goiter (PMG); thoracotomy

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Abbreviations: IG: intrathoracic goiter; ITGs: intrathoracic thyroid goiters; PMGs: posterior mediastinal goiters; CT: computed tomography; PIG: primary intrathoracic goiter; SIG: secondary intrathoracic goiter; VATS: video-assisted thoracoscopy

Intrathoracic goiter (IG) is defined as a goiter that is located partially or totally in the anterior or posterior mediastinum, and its incidence is associated with multinodular goiter; therefore, it is more frequent in areas with endemic iodine deficiency [1–2]. Generally, the incidence of intrathoracic thyroid goiters (ITGs) is approximately 10%–15% of all mediastinal masses, and of these, the majority (75%–95%) are located in the anterior superior mediastinal compartment [3], whereas approximately 10%–15% are located in the posterior mediastinum. Posterior mediastinal goiters (PMGs), either retrotracheal or retroesophageal, are rare, comprising 4% of all mediastinal goiters [4]. They are commonly of neural origin and develop into isolated thyroid tumors within the mediastinum or descend into the retrosternal loose tissue space of the neck, which may cause various compressive symptoms when they reach a certain size. Most anterior mediastinal goiters can be removed by a transcervical approach, but those that extend into posterior mediastinal goiters may require additional extracervical incisions [5].

Case presentation

A 54-year-old Chinese woman was admitted to our hospital (The Affiliated Qingdao Hiser Medical Center of Qingdao University Medical College, China) with a chief complaint of chest tightness and shortness of breath after activities for more than 3 weeks without hemoptysis or dysphagia. Physical examinations showed a heart rate of 80 beats/min, sinus rhythm Qi, regular rate and rhythm with no murmurs or bruits, blood pressure of 140/85 mmHg, and no obvious mass in the neck. Hematological examination showed normal thyroid function. Computed tomography (CT) of the neck and chest showed a goiter of low density in the right thyroid and a giant cystic nodule on the back of the right thyroid, which grew into the right posterior superior mediastinum (Fig. 1a). The tumor was located between the spine and the dorsal part of the trachea and esophagus, and its lower edge extended beyond the aortic arch and compressed the trachea to the left (Fig. 1b–1d). Thyroid $^{99}Tc^{m}O_4$-tracer static imaging showed a normally positioned but indistinct thyroid gland. The right lobe of the thyroid was enlarged. The tracer showed uneven distribution within the futaba

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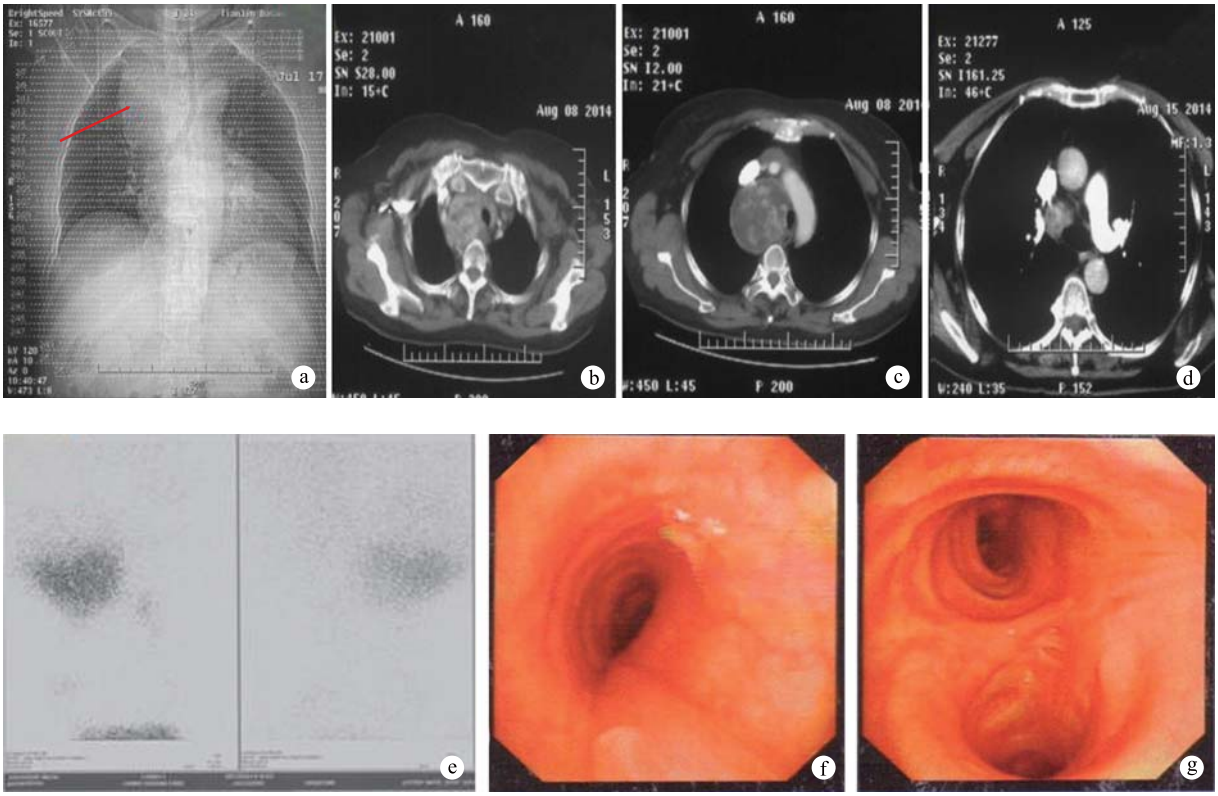

Fig. 1 CT scan of a giant thyroid goiter in the posterior mediastinum. (a) Enhanced CT scan reveals the right thyroid lobe (arrow) with a small cyst and a giant low-density goiter on the posterior aspect of the right lobe. (b) Enhanced CT clavicle cross section reveals the giant goiter located in the posterior mediastinum, compressing the trachea and esophagus. (c) CT of the chest reveals that the goiter is well beyond the aortic arch and compresses the superior vena cava. (d) CT of the chest reveals that the lower edge of the goiter reaches the carina of the trachea. (e) Thyroid $^{99}Tc^{m}O_4$-tracer static imaging shows a normally positioned but indistinct thyroid gland. The right lobe of the thyroid is enlarged. The tracer uneven distribution within the futaba thyroid. An abnormal concentration of tracer is visible in the lower right lobe, and the tracer distribution is significantly sparse in the upper pole of the right lobe and the left lobe of the thyroid. (f) Bronchoscopy shows obvious stenosis in the right side of the airway due to the external goiter. (g) The carina is sharp

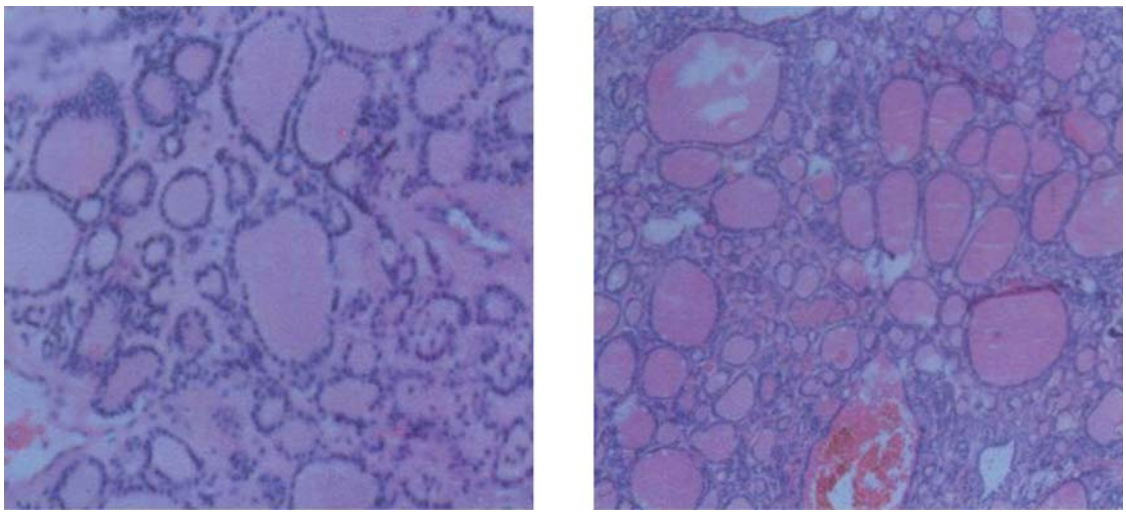

Fig. 2 Pathology revealed a fully encapsulated mass measuring 10.5 cm × 7.2 cm × 4.5 cm. The cystic solitary mass was hypervascular. Located in the right posterior mediastinum, the nodular goiter was considered to be derived from ectopic thyroid (hematoxylin-eosin, original magnification × 20)

thyroid. An abnormal concentration of tracer was visible in the lower right lobe, and the tracer distribution was significantly sparse in the upper pole of the right lobe and the left lobe of the thyroid (Fig. 1e). Bronchoscopy revealed clear tracheal rings, sharp carina, and an obvious stenosis of the right of airway due to external pressure (Fig. 1f–1g). In August 2014, surgery was performed by right posterolateral thoracotomy of the fourth intercostal space. A posterior mediastinal tumor consistent with the location on CT was identified, and the right lobe was not excised. Pathology revealed a fully encapsulated mass measuring 10.5 cm × 7.2 cm × 4.5 cm. The cystic solitary mass was hypervascular. Located in the right posterior mediastinum, the nodular goiter was considered to be derived from ectopic thyroid tissue (Fig. 2). The final diagnosis was a secondary giant thyroid goiter in the posterior mediastinum. In October 2014, the latest follow-up showed that patient had no symptoms after activity, and had no thyroid dysfunction.

Discussion

Haller first described intrathoracic goiter (IG) in 1749 and, since then, some have defined it as a goiter that is totally or partially located in the mediastinum and that, when the neck is in an over-extended position, has a lower edge at least 3 cm below the manubrium of the sternum. Other authors define it as a thyroid gland that has grown to double its normal size and has 50% of its tissue below the suprasternal notch [1]. According to the origin of thyroid tissue, IG can be divided into primary intrathoracic goiter (PIG) and secondary intrathoracic goiter (SIG). The majority of IGs are secondary ones that arise from the lower part of one lobe or both lobes of the cervical thyroid or isthmus and grow inferiorly through the thoracic inlet. PIG only accounts for 0.2%–1% of all IGs, and it affects female patients more often (male:female = 1:3 or 1:4) [6]. During the embryonic development of the thyroid gland, part or all of the thyroid blastoma leaves the primordium and is pulled into the thoracic cavity by the descendent heart and great vessels, then continues to develop in the thoracic cavity, forming the final PIG. Because of different origins, secondary posterior mediastinal goiter is often contiguous with the cervical thyroid gland, with a blood supply from the inferior thyroid artery and its branches, whereas primary posterior mediastinal goiter maintains little or no connection with the cervical thyroid gland, and has a blood supply derived from intrathoracic arteries [7].

Posterior mediastinal goiters constitute only 4% of all posterior mediastinal masses and 10%–25% of all IGs. Most PMGs are found in the right mediastinum, irrespective of the thyroid lobe of origin. Anatomically, PMGs in the right mediastinum generally grow to a position of relatively lower resistance than in the left posterior mediastinum, and this helps right posterior mediastinum goiters to form. Because the thymus (which may atrophy), left and right brachiocephalic veins, and superior vena cava are anterior, and the aortic arch and its three branches (phrenic nerve and vagus nerve have smaller resistance) are in the middle left of the retrosternal space, tumor growth will be constricted there. According to most authors, goiters are generally asymptomatic in 20%–30% of cases when the goiter is small, and many cases are only found incidentally by chest radiographic examination or autopsy. Patients experience symptoms after many years of evolution, due to the slow growth of this lesion. As the goiter increases in size, the most commonly reported symptom is a cervical mass (in 40%–50% of cases). There may be secondary symptoms caused by compression of intrathoracic structures, including dyspnea, stridor, and shortness of breath, all caused by airway compression. In some series it is reported that 50% of patients with IGs had these symptoms. Other compressive symptoms are dysphagia, seen in approximately 30%–40% of cases (more frequent in PMG), rhonchus in 13%, and other more infrequent symptoms caused by vascular compression that cause esophageal varices with digestive hemorrhages, superior vena cava syndrome, transient ischemic events, and cerebral edema. In 80%–90% of these patients, a palpable cervical mass, among other symptoms, is observed. Pemberton's sign and tracheal deviation can also be observed [6, 8–10].

Radiographic imaging is the most effective and necessary diagnostic method for IGs. Chest X-ray shows a mediastinal mass or a thickening of the upper mediastinum, as well as tracheal deviation from the midline and different degrees of compression. Computed tomography (CT) provides precise information on the relationship between intrathoracic organs and the goiter, and is very useful to the surgeon when planning the type of approach. On CT films, IG usually manifests as a clear boundary mass, and its density varies due to the amount of iodine it contains: when the amount of iodine in the mass is low, its density is close to the soft tissue of the chest wall, and when the amount of iodine is high, its density could be significantly higher than that of soft tissue. In addition, its density can be uneven due to colloid cysts and calcified plaques. Radionuclide scan is also a common diagnostic method, but it is not as effective when compared with its usage in thyroid goiters of other regions, because ITGs do not always uptake iodine. A definitive diagnosis is made using either radiologically guided fine needle aspiration cytology or surgical procedures such as video-assisted thoracoscopic-guided biopsy.

Once a diagnosis is made, IGs should be treated surgically for several reasons: (1) they do not respond to medical treatment; (2) in order to establish a tissue

diagnosis when malignancy is suspected and for threatening potential malignancy; and (3) to prevent potential acute airway compromise [11]. Surgical removal can be performed by an inferior cervical collar incision in the majority of SIGs. A review of the literature shows that experienced surgeons need to perform an extracervical approach in 2%–3% of cases [12]. In particular, PMGs that extend beyond the aortic arch may require additional extracervical incisions. The type and extent of surgery are subjects of controversy. Partial resection is recommended since it minimizes the surgical risk of damage to the parathyroid glands and recurrent nerves; however, a significant proportion of patients (12%–20%) suffer a relapse of the lesion 20–30 years later. Therefore, total thyroidectomy is the technique of choice, especially in those patients with a life expectancy greater than 10 years [1].

There are a variety of surgeries, and the choice of operation depends on the location, size, and relationship of the mass to vital mediastinal structures. This information is obtained from imaging tests. The most common surgical approach is through a collar incision, since more than 90% of all goiters with an intrathoracic component can be extracted by this technique [10]. It is necessary to use a cervicothoracic approach, especially in those patients with primary goiters and those located in the posterior mediastinum. Different approaches are used to resect certain IGs, including partial or total median sternotomy, thoracotomy, and thoracoscopy. Median sternotomy is the preferred route and is indicated in very large IGs with a blood flow derived from intrathoracic vessels, goiters in the posterior mediastinum that displace or compresse the aortic arch associated with superior vena cava syndrome, recurrent goiters, and malignant substernal goiters with lymph node metastasis. Thoracotomy may be appropriate for IGs located in the middle or posterior mediastinum. A high thoracotomy incision provides a wide operating field and allows monitoring and direct visualization of the large vessels and the posterior mediastinum. In recent years, due to its many advantages, minimally invasive surgery is becoming increasingly popular. For example, in 2008, there were two cases of resection of posterior mediastinal goiters with minimally invasive surgery using the Da Vinci robot, but this technique is very difficult and is probably only appropriate for very small goiters. One study reported a 45% complication rate and a 3.6% mortality rate with thoracotomies compared with a 28% complication rate and a 0% mortality rate associated with video-assisted thoracoscopy (VATS) [13]. VATS has been used for resection of retrosternal goiters; however, we currently avoid it due to the lack of evidence supporting its application in retrotracheal goiter surgery. In conclusion, minimally invasive surgical techniques (Da Vinci robot, VATS, etc.) should be evaluated with further studies. The surgical complications include post-operative tracheal collapse, prolongation of mechanical ventilation, hypocalcaemia, damage of the recurrent nerves, hematoma and hemorrhage, surgical wound infections, and others. However, these complications are very rare; a prospective study of 201 thyroidectomies for multinodular goiter found only 1% with definitive complications. Furthermore, that study identified hyperthyroidism and goiter size as risk factors for these complications. Briefly, the main current approaches for thyroid surgery are cervical incision, cervicothoracic incision, thoracotomy approach, and thoracoscopy technology, each of which

Table 1 Thyroid surgical approaches

Surgical approach	Advantages & Disadvantages
Cervical incision	Most retrosternal goiters can be resected through a cervical approach. This neck incision is small, and patient trauma is minimal with a short postoperative hospitalization time. However, poor access can increase the risk of surgery and provide bad exposure to the surgical visual field. For giant goiters, this surgical approach usually does not enable complete resection and can increase the risk of uncontrolled bleeding, damage to the recurrent laryngeal nerves, etc.
Thoracotomy approach	This approach provides a wide operative field and can remove the mass more completely. However, it is associated with a long hospitalization time and a significant injury to the patient, with frequent complications, for example, postoperative atelectasis and hypoxia. It is usually used to resect recurrent goiter, ectopic goiter, invasive goiter, malignant goiter, and retrovascular goiter.
Cervicothoracic incision	This approach is a quick, reliable, and excellent surgical method that can easily control any vascular injury and avoid catastrophic results. It provides a wide exposure, facilitating complete removal of the mass from both the cervical region and mediastinum. However, this approach causes more trauma to the patient than does a cervical incision. It has a good effect for acute upper airway obstruction and retrosternal goiters, for instance those extending beyond the aortic arch into the posterior mediastinum.
Thoracoscopy technology	Video-assisted thoracoscopic surgery is a minimally invasive approach. It is associated with quicker recovery, less morbidity, less early postoperative pain, fewer chest tube days, shorter hospital stay, and faster return to work than open surgery. It is also a diagnosis modality and reduces the dose of required anesthetic. However, it also has some drawbacks such as the inability to control massive hemorrhage and other emergent cases. Overall, it is better for the resection of small goiters and primary intrathoracic goiters. It is a complex technology that requires professional training and needs to be evaluated with further studies.

has advantages and disadvantages (Table 1). Determining the optimal surgical approach depends on the patient's condition.

Conclusion

Most mediastinal tumors are benign lesions. IGs represent a small percentage of these tumors. IGs have a poor response to thyroxine treatment, and iodine treatment is possible in high-risk patients. Therefore, surgery is the treatment of choice. Most retrosternal goiters can be resected through a transcervical approach, but those that extend beyond the aortic arch into the posterior mediastinum are better managed by sternotomy or lateral thoracotomy. For optimal surgical exposure, we recommend the use of transthoracic approaches, such as median sternotomy and thoracotomy, for retrosternal goiters and for large goiters situated in the mediastinum causing tracheal compression. A posterior mediastinal goiter with mediastinal compressive symptoms is an indication for surgery. Lateral thoracotomy is an alternative approach for IGs that extend into the posterior mediastinum, and care must be taken to avoid injury to surrounding structures. This requires a combined surgical approach by both general surgeons and cardiothoracic surgeons once the diagnosis is confirmed. Finally, the choice of surgical type depends on the location, size, and relationship of the mass to vital mediastinal structures.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images.

Conflicts of interest

The authors indicated no potential conflicts of interest.

Authors' contributions

Gaoyang Lin write this case report and analyzed all data, as well collects literature for this paper. The other authors and Gaoyang Lin together to complete the operation. Yingyi Lv and Zhenbo Liu together to correct the article modifications. Zhenbo Liu provides financial support for article's writted and published. All authors read and approved the final manuscript.

References

1. de Aguiar-Quevedo K, Cerón-Navarro J, Jordá-Aragón C, *et al*. Intrathoracic goitre: a literature review. Cir Esp (Spanish), 2010, 88: 142–145.
2. Pieracci FM, Fahey TJ 3rd. Substernal thyroidectomy is associated with increased morbidity and mortality as compared with conventional cervical thyroidectomy. J Am Coll Surg, 2007, 205: 1–7.
3. Chong CF, Cheah WK, Sin FL, *et al*. Posterior mediastinal goiter. Asian Cardiovasc Thorac Ann, 2004, 12: 263–265.
4. Huins CT, Georgalas C, Mehrzad H, *et al*. A new classification system for retrosternal goitre based on a systematic review of its complications and management. Int J Surg, 2008, 6: 71–76.
5. Kilic D, Findikcioglu A, Ekici Y, *et al*. When is transthoracic approach indicated in retroesternal goiters? Ann Thorac Cardiovasc Surg, 2011, 17: 250–253.
6. Foroulis CN, Rammos KS, Sileli MN, *et al*. Primary intrathoracic goiter: a rare and potentially serious entity. Thyroid, 2009, 19: 213–218.
7. Cichon S, Anielski R, Konturek A, *et al*. Surgical management of mediastinal goiter: risk factors for sternotomy. Langenbecks Arch Surg, 2008, 393: 751–757.
8. Torre G, Borgonovo G, Amato A, *et al*. Surgical management of substernal goiter: analysis of 237 patients. Am Surg, 1995, 61: 826–831.
9. Ríos A, Rodríguez JM, Canteras M, *et al*. Surgical management of multinodular goiter with compression symptoms. Arch Surg, 2005, 140: 49–53.
10. Ríos A, Rodríguez JM, Galindo PJ, *et al*. Results of surgical treatment in multinodular goiter with an intrathoracic component. Surg Today, 2008,38: 487–494.
11. Ket S, Ozbudak O, Ozdemir T, *et al*. Acute respiratory failure and tracheal obstruction in patients with posterior giant mediastinal (intrathoracic) goiter. Interact Cardiovasc Thorac Surg, 2004, 3: 174–175.
12. Ojanguren Arranz A, Baena Fustegueras JA, Ros López S, *et al*. Best approach for posterior mediastinal goiter removal: transcervical incision and lateral thoracotomy. Arch Bronconeumol, 2014, 50: 255–257.
13. Cattaneo SM, Park BJ, Wilton AS, *et al*. Use of video-assisted thoracic surgery for lobectomy in the elderly results in fewer complications. Ann Thorac Surg, 2008, 85: 231–235.

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