A 76-year-old female, with a history of asthma and tracheal bronchitis, presented with a non-ST elevation, myocardial infarction. Chest x-ray on admission showed a widened mediastinum, which was further evaluated with a computed tomography (CT) scan. It disclosed a giant substernal goiter compressing the trachea and the ascending aorta. Cardiac catheterization showed significant coronary disease unsuitable for percutaneous intervention; thus, the patient was scheduled for coronary artery bypass grafting. Single stage thyroidectomy immediately followed by coronary artery bypass was performed. After surgery, her upper airway symptoms were improved, and no cardiac events were noted. Collaboration between otolaryngology and thoracic surgery teams contributed to good outcomes for this patient with substernal goiter and severe cardiac disease.

**Keyword:** coronary artery disease, thyroid disease, goiter, surgery

**Introduction**

A large substernal goiter may compress the trachea and cause upper airway symptoms.\(^1\) Persistent upper airway obstruction due to substernal goiter may increase stress to the cardiovascular system and also increase the risk of the coronary artery disease (CAD).\(^2\) For a goiter located in the mediastinum, sternotomy is sometimes required to access the entire mass rather than approaching from the neck alone.\(^1\) Here, we report a patient who presented with acute myocardial infarction (MI) and was found to have a giant substernal goiter with compressive symptoms. The patient underwent single-stage surgery combining thyroidectomy and coronary artery bypass grafting (CABG).

**Case Presentation**

A 76-year-old female with a past medical history of hypertension, hyperlipidemia, diabetes, obesity, asthma, and chronic tracheobronchitis presented to the emergency department complaining of shortness of breath and wheezing. She was unable to lie flat due to severe shortness of breath and stridor. Steroid treatment was started for symptomatic upper airway obstruction. The initial workup revealed a non-ST elevation MI. Subsequent cardiac catheterization showed complex CAD (severe proximal stenosis on the left anterior descending artery and bifurcating lesion on the diagonal artery), which was not suitable for percutaneous catheter intervention, and poor left ventricular function (ejection fraction 29%). Chest x-ray on admission showed a widened mediastinum (**Fig. 1A**). CT scan revealed a giant substernal goiter compressing the trachea and aorta (**Fig. 1B and 1C**). The tracheal diameter was 4 mm at the level of T1-T2. Thyroid function tests...
cheal collapse during the surgery, we preserved a site for the emergent tracheostomy and planned to made two separate incisions at the neck and sternum (Fig. 2A). The otolaryngology team performed a curvilinear collar incision to the neck in order to gain access to the upper portion of the goiter. The right hemi-thyroid, which appeared to be larger than the left, was dissected first. The subternal component of the goiter was unable to be delivered despite transecting the right strap muscles and ligating the middle pole vessels. The cardiothoracic team performed a median sternotomy, which allowed access to the lower portion of the goiter. (Fig. 2B). The thyroid tissue was carefully dissected from the thymic remnant and underlying vasculature. The right hemi-thyroid was removed after ligating the inferior pole vessels and transecting the isthmus (Fig. 2C). The left hemi-thyroid and pyramidal lobe were then dissected and delivered in a similar fashion. The parathyroid glands and recurrent laryngeal nerves were preserved. The neck incision was packed with sponges.

The cardiothoracic team then harvested the left internal mammary artery (LIMA) and a saphenous vein graft. Heparin was given before cardiopulmonary bypass. CABG with a LIMA graft to the left anterior descending artery and a saphenous vein graft to the first diagonal artery were performed. Cardiopulmonary bypass was weaned off and protamine was then given to the patient. After completion of the CABG, the neck was examined for hemostasis and 2 Jackson-Pratt drains were placed within the thyroid bed. These were placed to high wall suction and removed by postoperative day 3.

Pathology showed the large thyroid mass consisted of the right lobe, 14 × 8 × 4 cm, left lobe 5.5 × 5 × 2.2 cm, and isthmus 4.5 × 4.2 × 2.2 cm (Fig. 3). Multinodular areas were identified with multiple foci of firm tan-white calcification. Histopathology of the specimen was consistent with multinodular goiter.

On postoperative day 1, the patient was electively extubated with otolaryngology and anestesia backup present. No stridor or wheezing was observed after extubation. She did not experience hoarseness or difficulty of swallowing after surgery. On postoperative day 9, the patient was discharged home in stable condition with close follow-up with cardiology, otolaryngology, endocrinology and speech pathology. At 2 weeks after discharge from the hospital, laryngoscopy was repeated and revealed normal vocal fold motion. At 6 weeks after discharge from the hospital, she denied any upper airway obstruction symptoms, was free from cardiac events, and returned to her previous activities.
rowed more than 50% from the normal size. Stridor at rest is a sign of severe upper airway obstruction, indicating the airway is narrower than 3 mm in diameter. The chest CT from our patient showed a 4 mm tracheal narrowing. The respiratory symptoms in our patient may have been worsened by her large body habitus and presence of acute MI. She did have CAD risk factors; however, the presence of chronic upper airway obstruction by the giant substernal goiter may have further contributed to accelerating CAD, hypertension, and ventricular dysfunction.

Surgery for substernal goiter with significant CAD should be planned carefully. Hemodynamic monitoring should be performed before anesthesia induction. The risk of thyrotoxicosis during thyroidectomy is low as long as the patient remains euthyroid or hypothyroid before surgery, although thyrotoxicosis can be observed in euthyroid patients. The anesthesiology team must be alerted if severe tracheal narrowing exists in a patient with substernal goiter. Fiberoptic and rigid bronchoscopes, as well as instruments for emergency tracheostomy, should be made available and opened before anesthesia induction. In a patient with a history of recent acute MI or severe CAD.

**Fig. 2** Incision plan of this patient (A). A giant substernal goiter is visible from sternotomy incision (B). The right hemithyroid is delivered from neck incision after additional dissection from the sternal incision (C).

**Fig. 3** Pathology specimen of the giant goiter. A large right hemithyroid (A) and smaller left hemithyroid (B).

**Comments**

The presence of symptomatic airway obstruction in patient with substernal goiter is an indication for thyroidectomy in patients with substernal goiter. The upper airway symptoms may be masked for years due to slow growth of the goiter. The symptoms occasionally mimic tracheobronchitis or asthma, as was the case with our patient’s previous diagnosis. Substernal giant goiter is easily diagnosed by CT scan. Patients may complain of respiratory symptoms if their tracheal diameter is narrowed more than 50% from the normal size. Stridor at rest is a sign of severe upper airway obstruction, indicating the airway is narrower than 3 mm in diameter. The chest CT from our patient showed a 4 mm tracheal narrowing. The respiratory symptoms in our patient may have been worsened by her large body habitus and presence of acute MI. She did have CAD risk factors; however, the presence of chronic upper airway obstruction by the giant substernal goiter may have further contributed to accelerating CAD, hypertension, and ventricular dysfunction.

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(as in this case), desaturation from a difficult airway or catecholamine surge from thyroid disease may increase the risk of perioperative acute MI. Thus, surgery was performed through the collaboration of otolaryngology, cardiac surgery and anesthesia teams.

Concomitant surgery for substernal giant goiter and CAD has only been reported by a few researchers in the English literature as far as we know. In all cases, including ours, thyroidectomy was performed first with a combination of collar incision and median sternotomy. Dissection of the substernal goiter is often difficult due to the compression to the adjacent mediastinal structures and hemorrhagic degeneration of the goiter. Thus, the thyroidectomy should be done before anticoagulation for CABG to minimize the risk of bleeding. We left the neck wound open during the CABG to monitor for unexpected bleeding from anticoagulation.

Current standards of care for the patient undergoing non-cardiac surgery with severe CAD is to delay the non-cardiac surgery until coronary revascularization because of the risk of perioperative MI. As in our patient, the risk of MI is high in patients with recent MI and/or poor ventricular dysfunction.

A two-stage procedure, thyroidectomy after CABG would be difficult to do in a patient such as the one presented herein due to the presence of extensive thyroid tissue in the retrosternal space. Since the entire substernal goiter was unable to be removed through the neck incision without the use of sternotomy access, if we had performed a two-stage procedure (thyroidectomy after CABG) the patient would have required re-do sternotomy, which carries a substantial risk for injury to cardiac structures and/or grafts. The risk of MI is as high as 40% if the grafts are injured at the time of sternal re-entry. Moreover, with the second sternotomy for CABG there is increased scar formation from the previous sternotomy, which can make dissection of the goiter from other mediastinal structures more difficult than would be with a primary thyroidectomy. Another consideration is sudden swelling of the goiter. Cagli reported a patient with an asymptomatic substernal goiter who had developed acute upper airway obstruction and required emergent thyroidectomy after elective CABG. Tracheal obstruction clearly occurred after CABG. Cagli speculated that a systemic inflammatory response from cardiopulmonary bypass during CABG may have contributed to substantial swelling of the substernal goiter, which resulted in compression of the upper airway followed by acute respiratory failure; thus a two-staged procedure is discouraged.

By combining a thyroidectomy and CABG, the surgical team can take advantage of the proximity of these two organs. That is, if both surgical sites are within the same operating field, they can be accessed at any time during procedure in case of cardiac or respiratory complications. This single-stage surgery by multiple specialty surgical teams can be a significant advantage to patient care.

References