MORBIDITY AND MORTALITY OF THYROIDECTOMY FOR SUBSTERNAL GOITER

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Abstract: Background. Our objective was to evaluate morbidity and mortality of thyroidectomy in substernal goiters and identify patients at risk for these events.

Methods. The medical records of 127 patients with substernal goiters were retrospectively reviewed.

Results. The most common preoperative symptom was shortness of breath (48%). 13% of the 127 patients were asymptomatic. Preoperative imaging identified tracheal deviation in 69% and tracheal compression in 41% of the cases. Substernal goiters were resected via a cervical approach in 100% of the cases. Six patients (5%) had postoperative hoarseness, 1 had permanent vocal cord paralysis, and 19 (15%) had transient postoperative hypocalcemia. The mortality and permanent hypoparathyroidism were null. Patients with postoperative complications had larger goiters and were more likely to have tracheal compression.

Conclusions. Thyroid resection via a cervical approach for substernal goiters is associated with low rate of morbidity and no mortality. Patients with large tumors and tracheal compression are more likely to develop postoperative complications. © 2009 Wiley Periodicals, Inc. Head Neck 32: 744–749, 2010

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The definition of substernal goiter is not unanimous. Most studies include only cases with 50% or more of the gland situated within the thorax, whereas other studies include patients with any part of the gland extending through the thoracic inlet. Substernal goiters are documented in 3% to 20% of all operations for goiter.1–12 The vast majority of substernal goiters develop from enlarging thyroid tissue that grows into the mediastinum. Less than 1% of substernal goiters involve aberrant thyroid tissue located ectopically in the mediastinum.1 Patients with substernal goiter may be seen with dyspnea, dysphagia, or hoarseness. In advanced cases, patients can have profound respiratory distress. Less commonly, patients are seen with a superior vena caval obstruction (positive Pemberton sign or superior vena cava syndrome).13 Five percent to 50% of the patients with substernal goiters are asymptomatic, and the goiters are
discovered either on physical examination or as an incidental finding on a chest radiograph or CT scan.1–5

Surgery for substernal goiter is indicated for the management of compression symptoms, potential airway compromise, and for the treatment of thyroid malignancy. Thyroidectomy for a substernal goiter can be safely performed via cervical incision in the vast majority of cases. In the cases in which the gland cannot be removed safely through a cervical incision, a median sternotomy may be used to gain additional access to the gland.1–17 Some authors state unequivocally that the presence of substernal goiter alone, with or without symptoms, is an indication for surgery. Others advocate surgery when there are significant symptoms, radiographic evidence of tracheal deviation or compression, or progressive enlargement of the goiter despite treatment with thyroid hormone for thyrotropin suppression.1–5

Whether postoperative morbidity and mortality are more common in patients undergoing substernal goiter resection than in patients undergoing thyroidectomy for benign cervical thyroid disease is not yet fully answered.18–23 This paper aims to evaluate morbidity and mortality of thyroidectomy for substernal goiter and to identify patients at risk for these events.

MATERIALS AND METHODS

Study Population. This retrospective study was undertaken to evaluate morbidity and mortality of thyroidectomy in patients with substernal goiters. According to the authors’ department policy, a goiter is considered substernal if any part of the gland extends through the thoracic inlet. All the medical records in which thyroidectomy was performed between January 1996 and December 2007 at our institution were included. The local hospital ethical committee approved database review. An informed consent was obtained from all the patients to review their medical files to be included in the study. The following parameters were recorded for all patients: age, sex, preoperative symptoms and diagnosis, thyroid hormonal status, substernal extension of goiter, preoperative and postoperative calcium, phosphorous values, operative time, postoperative complications, hospital stay, and final histology.

Surgical Technique. All operations were performed by a single surgeon (B.A.). Iodine-free solutions (chlorhexidine) were used to swab the operative field. All thyroidectomies were attempted via a transverse cervicotomy under general anesthesia. The thyroidectomies were all performed in a similar fashion with careful dissection along the thyroid capsule attempting to identify and preserve the parathyroid glands along with their vascular supply, as well as the recurrent laryngeal nerves. We perform early ligation of the middle thyroid vein branches and the superior pole vessels flush with the capsule of the gland. This allows rotation of the cervical portion of the gland from lateral to medial and greatly facilitates a gentle, blunt finger dissection on the surface of the capsule through areolar planes around all borders of the goiter. This enables superior retraction and delivery of the substernal component into the neck. Bleeding is minimized, and there is optimal visibility to identify the recurrent nerve and parathyroid glands.

When at least 1 parathyroid gland was identified during the operation, further thorough dissection to search for missing glands was avoided. Inadvertently removed parathyroid glands during dissection and/or unequivocally devascularized parathyroid glands were removed and immediately autotransplanted into a pocket fashioned in the ipsilateral sternocleidomastoid muscle. The transplantation site was closed with permanent silk sutures. The cervical wound was closed without drain tubes. In cases in which the substernal gland cannot safely be removed through a cervical incision, a median sternotomy may be used to gain additional access to the gland.

Postoperative Period and Follow-up. Monitoring of the cervical wound was assessed closely in the postoperative period. Postoperative complications, mainly vocal cord paralysis and temporary or permanent hypocalcemia, were noted. The presence and the type of hypocalcemia signs were recorded by a surgeon or by a nurse, together with the evaluation of the Chvostek’s sign. Biochemical hypocalcemia was defined as serum calcium concentrations less than 2.0 mmol/L on a least 1 postoperative measurement. Postoperative hypocalcemia was defined as patients requiring medications to maintain normocalcemia when they were discharged from the hospital. They were considered as having transient
hypocalcemia if they were normocalcemic at least 2 weeks after stopping all medications during follow-up. Postoperative hypocalcemia requiring treatment to maintain normocalcemia associated with a low parathyroid hormone level (normal: 9–55 pg/mL) more than 1 year postoperatively was considered as permanent. Discharge from the hospital occurred when the patient was asymptomatic or when the serum calcium level rose above 2 mmol/L. The patients were instructed to contact their physician if symptoms of hypocalcemia developed. Clinical follow-up ranged from 6 to 120 months.

**Statistical Analysis.** Results were expressed as frequencies and percentages for qualitative data and as mean (range) or mean ± SD. The t test and the Mann-Whitney's U tests were used as appropriate (non-normal distribution) to compare continuous data, and chi-square statistic was used to compare qualitative data, corrected by the Fischer's exact test as appropriate. A multivariate logistic regression model was used to control for univariate analysis and to identify independent risk factors for postoperative complications. All tests were 2-sided, and a p value less than .05 was considered statistically significant. All computations were done using SPSS v13 (Chicago, IL) statistical software.

**RESULTS**

From January 1996 to December 2007, 980 patients underwent thyroidectomy in our department. Substernal thyroid extension was found in 127 patients (13%). Female patients numbered 84 (66%), and 43 were men (34%). The mean age of the patients was 57 (range, 23–81 years). A total of 54% of patients were aged between 51 and 70 years old. The most common preoperative symptom was shortness of breath and dyspnea encountered in 61 patients (48%). Dysphagia was found in 14 patients (11%), and “voice changes” in 11 patients (9%). Preoperative laryngeal exam, performed in 6 patients with “voice changes,” showed an ipsilateral vocal fold paresis in 2 patients and was normal in 4 patients. Association of more than 1 symptom (dysphagia + dyspnea) was seen in 24 patients (19%). Seventeen patients (13%) were asymptomatic. The mean duration of symptoms was 6.3 (range, 0.2–15) years. Physical examination in the office revealed a positive Pemberton sign in 4 patients (3%), superior vena cava syndrome at rest was seen in 6 patients (5%).

All patients underwent at least 1 of the following preoperative imaging studies: chest radiography, CT scanning, or MRI (Figure 1). The extent of substernal extension above and to or below the aortic arch was shown in 59% and 41% of the cases, respectively. Large posterior extension of the substernal goiter was shown in 18% of the cases. Tracheal deviation was seen in 87 patients (69%); tracheal compression was seen in 52 patients (41%), of whom 31 patients presented a tracheal lumen narrowing of 65% to 85%. Twenty-three patients underwent radioiodine scanning prior to referral for surgery, which revealed multinodular goiter in 16 patients, cold nodule in 5 patients, and normal uptake in 2 patients. Age was similar between both sexes (p = .571). The thyroid function was normal in 105 patients (83%). Hyperthyroidism was exhibited by 19 patients (15%), and 3 patients (2%) were hypothyroid. All patients with hyperthyroidism were treated with methimazole and β-blocker drugs. All had normal thyroid function before the operation.

In 44 patients (35%), the primary indication for operation was the presence of symptoms of
airway compromise (dyspnea or shortness of breath), superior vena caval obstruction (Pemberton sign or superior vena cava syndrome), or dysphagia. Progressive enlargement of the goiter despite medical therapy was an indication for operation in 34 patients (27%). In 42 patients (33%), the primary indication for operation was the radiologic finding of either tracheal deviation or compression. Four patients (3%) underwent surgery because of testing positive for carcinoma or suspicious fine-needle aspiration biopsy specimen from a nodule in the cervical component of the goiter. In 3 patients (2%), the reason for the operation was cosmetic; these patients had both cervical and substernal thyroid enlargement but were asymptomatic.

All patients in this series underwent a thyroidectomy for a substernal goiter via a cervical approach (n = 127; 100%) and none (0%) required a median sternotomy. The operations performed included total (n = 85; 68%) or near total (n = 36; 28%) thyroidectomy in 122 patients (96%) and lobectomy in 5 patients (4%). Of the 122 total or near-total thyroidectomies, both recurrent laryngeal nerves were identified in 100 cases (82%) and 1 recurrent laryngeal nerve in 18 cases (15%); neither recurrent laryngeal nerve was identified in 4 cases (3%). The recurrent laryngeal nerve was identified in the ipsilateral neck in 4 (80%) of the lobectomies and was not identified in 1 lobectomy (20%). The number of parathyroid glands identified were 4 in 102 patients (80%), 3 in 22 patients (17%), 2 in 2 patients (2%), and 1 in 1 patient (1%). The pathologic diagnoses of the resected tumors included 103 benign multinodular goiters (81%), 15 follicular adenomas (12%), 1 Hürthle cell adenoma (1%), 8 malignant thyroid neoplasms (6%, 7 of them being papillary carcinomas), and 1 anaplastic carcinoma (1%). The weight of thyroid tissue varied from 53 g to 644 g, with a mean of 83 g.

After surgery, patients who underwent total or near-total thyroidectomies received prophylactic calcium (calcium carbonate, 1.5 to 3 g daily) and 1-25 dihydroxyvitamin D3 (Rocaltrol, Roche S.A., Basel, Switzerland, 0.5 to 1 g daily). Calcium supplement and vitamin D analogue were gradually decreased and discontinued in the presence of normocalcemia in 2 to 4 weeks. Nineteen patients (15%) had transient postoperative hypocalcemia (serum calcium level <8 mg/dL [2 mmol/L]) that resolved within 6 months of the operation. There were no cases of permanent hypoparathyroidism. Six patients (5%) had transient postoperative hoarseness (unilateral vocal cord paresia at laryngoscopy) that resolved within 2 months of the operation; 1 had permanent vocal cord paralysis (0.8%; unilateral paralysis at laryngoscopy performed 1 year after operation). None of the patients had a postoperative neck hematoma requiring immediate reoperation. All patients were successfully extubated in the postoperative period. None required a tracheostomy. Of the 110 patients with preoperative symptoms, 92 (84%) reported improvement of their symptoms after thyroidectomy. None of the patients had serious postoperative airway complications or tracheomalacia.

The postoperative length of stay was 1 day (n = 117 patients; 92%), 2 days (n = 6 patients; 5%), and more than 2 days (n = 4 patients; 3%). Asymptomatic patients with hypocalcemia were discharged from the hospital the next day after operation. Mean duration of hospitalization for patients with hypocalcemia was 3 days (range, 2–5 days). During follow-up, no patients exhibited clinical symptoms of hypocalcemia and the blood calcium was normal in all patients at 6 months postoperatively. The incidence of permanent hypoparathyroidism was 0% as certified from blood calcium levels measured at 6 months postoperatively.

We reviewed the demographic characteristics, symptom profiles, radiologic findings, and pathology reports of the patients who had postoperative complications and compared them with the patients who did not have complications. The patients who developed postoperative complications were older (72.3 ± 20.6 years vs 60.3 ± 24.1 years, p = .043) and had larger goiters (more than 200 g) than those who did not have complications (p = .001). Patients with goiters larger than 200 g were more likely to have postoperative hoarseness (p = .047). In addition, patients with tracheal compression on preoperative imaging were more likely to have postoperative complications (p = .008). On multivariate analysis, only larger goiter and tracheal compression remained statistically significant (p = .036 and .021, respectively). There were no significant differences between the 2 groups in the number of preoperative symptoms (p = .435), duration of symptoms (p = .724), radiologic finding of tracheal deviation (p = .201), or extent of thyroid resection (p = .782). The percentages of patients with dysphagia, dyspnea, orthopnea,
hoarseness, and Pemberton sign were not different between the 2 groups.

DISCUSSION
The vast majority of patients in this report underwent thyroidectomy for substernal goiter through a cervical incision with an overnight hospital stay and had improvement in symptoms; there was no mortality and minimal morbidity. Six patients, however, had postoperative hoarseness. We retrospectively reviewed data from these patients with the goal of identifying factors that would help predict postoperative complications. There were significant differences in tumor size between the patients who experienced postoperative complications and those who did not; patients with recurrent palsy had heavier goiters. In addition, patients with goiters larger than 200 g and those with tracheal compression on preoperative imaging were more likely to have hoarseness. Although advanced age was found statistically significant on univariate analysis, its effect disappeared on multivariate control. In contrast, there were no significant differences in the number of preoperative symptoms, duration of symptoms, presence of tracheal deviation, and extent of thyroid resection between the 2 groups. We conclude from this study that patients with substernal goiters typically present with a spectrum of clinical findings, and it can be difficult to use these factors to predict postoperative complications. Radiologic findings of tracheal deviation do not appear to correlate with complications. Patients undergoing total thyroidectomy appear to have complications at the same rate as those undergoing lobectomy. The prevalence of clinically significant carcinoma in the specimen is rare in this series (6%).

Nonsurgical treatment of a substernal goiter with thyroid hormone or radioactive iodine ablation is almost always unsuccessful; in addition, attempted radioactive ablation can sometimes precipitate respiratory distress, especially in elderly patients. Thyroidectomy is the treatment of choice in patients who are medically fit to undergo an operation. A cervical approach would be adequate for 94% to 98% of these goiters.1,14,16,25 Unfortunately, there are no solid criteria for selecting patients who would likely require a median sternotomy. Various factors are thought to increase the likelihood of a median sternotomy, including involvement of the posterior mediastinum, recurrent goiter, superior vena caval obstruction, malignancy with local involvement, and emergent airway obstruction. In addition, inability to palpate the lowermost extent of the gland also is considered to be an indication for median sternotomy.1–17 A CT and MRI are considered to be the most useful in evaluating the extent of the goiter and defining its relationships to adjacent structures.24–26 Hence, despite the clinical and radiologic features that suggest the likelihood of needing a median sternotomy, a cervical approach would suffice in a large number of patients. For some authors, gland extension beyond the aortic knuckle on the CT scan is a strong indication for median sternotomy after a preliminary attempt at cervical delivery.16

Morbidity rates for substernal goiter resection range from 4% to 12% in the literature and include recurrent laryngeal nerve injury, hypoparathyroidism, and airway complications such as neck hematoma and prolonged intubation.1,26–29 Some authors suggested that more liberal use of a median sternotomy may prevent some postoperative complications, including injury to the recurrent laryngeal nerve, parathyroid glands, adjacent organ injury, and hemorrhage caused by excessive traction through a cervical incision. The decision to employ a median sternotomy is usually made at operation.1,25 For some authors, substernal goiter was associated with high mortality and morbidity.22,23 In our series and in others,18–21 there was no mortality and the rate of morbidity was similar to thyroidectomy for simple goiter.

CONCLUSION
In conclusion, we understand that our study population is relatively small and the overall incidence of complications in patients with substernal goiter is low in most series. Nevertheless, this review of our experience with substernal goiter confirms that thyroidectomy in these patients can be performed safely through a cervical incision with minimal morbidity in most cases, despite the presence of preoperative symptoms or tracheal deviation. An experienced anesthesiologist should be notified of the patient prior to operation and should be prepared to perform fiber-optic intubation while the patient is awake, if necessary. Close communication between the surgeon and anesthesiologist
renders the difficult intubation uncommon. Patients with large tumors (>200 g) and those with tracheal compression on preoperative imaging may be more likely to have postoperative complications, especially hoarseness.

REFERENCES