Predictors of Airway Complications After Thyroidectomy for Substernal Goiter

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Hypothesis: Airway complications after thyroidectomy for substernal goiter can be predicted by preoperative symptom profiles, radiologic findings, or other factors.

Design: Retrospective review.

Settings: A university tertiary care center and a veterans' hospital.


Main Outcome Measures: Symptoms, preoperative radiologic findings, extent of thyroid resection, tumor size, and postoperative complications.

Results: Dysphagia was the most common preoperative symptom (n = 26), followed by dyspnea (n = 21), orthopnea (n = 13), and hoarseness (n = 6); 18 patients (30%) had superior vena caval obstruction. Thirteen patients (22%) were asymptomatic. Preoperative imaging identified tracheal deviation or compression in 45 patients (75%). Substernal goiter was resected via a cervical approach in 59 patients (98%). Of 47 patients with preoperative symptoms, 41 (87%) reported improvement postoperatively. Seven patients (12%) had postoperative airway complications: 1 developed a neck hematoma requiring reoperation, and 6 could not be immediately extubated; all 6 were successfully extubated after 1 to 10 days. Patients with airway complications were older (mean ± SEM, 70.3 ± 3.6 years vs 61.5 ± 2.2 years), had larger goiters (mean ± SEM, 210.7 ± 37.0 g vs 112.2 ± 7.7 g), and were more likely to have tracheal compression on preoperative imaging than those who did not have complications (P < .05).

Conclusions: Most patients with substernal goiters underwent thyroid resection via a cervical approach with an improvement in symptoms. The few patients who developed postoperative airway complications were older, had larger goiters, and were more likely to have tracheal compression on preoperative imaging than those without airway complications.

Arch Surg. 2004;138:656-660

ORIGINAL ARTICLE

From the Department of Surgery, University of California, San Francisco.

SUBSTERNAL GOITER is defined as a goiter with more than 50% of the thyroid tissue located below the sternal notch.1,2 Although the overall incidence of goiter in the United States has decreased during the last century with the widespread use of iodine supplementation, large goiters are still commonly encountered; substernal goiters are documented in 3% to 20% of all operations for goiter.1,2 The vast majority of substernal goiters develop from enlarging thyroid tissue that grows into the mediastinum. A combination of negative intrathoracic pressure, gravity, and the large potential space of the mediastinum facilitates the downward migration of the goiter. Fewer than 1% of substernal goiters involve aberrant thyroid tissue that is ectopically located in the mediastinum.1

Patients with substernal goiters can present with a variety of symptoms and signs related to compression of the airway, esophagus, vascular structures, and nerves.3-12 Most patients have symptoms of airway compression (dyspnea, orthopnea, or stridor); in advanced cases patients can have profound respiratory distress. Less commonly, patients will have indications of superior vena caval obstruction (positive Pemberton sign or superior vena cava syndrome). Other initial complaints include dysphagia, hoarseness, and metabolic signs and symptoms of hyperthyroidism or thyrotoxicosis. Five percent to 40% of 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 computed tomographic (CT) scan.1,2

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Nonsurgical treatment of 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. Some authors state unequivocally that ports and recorded the following data: the extent of thyroid 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.

We reviewed our experience with patients who underwent thyroidectomy for substernal goiter during the past decade. Our specific aim was to examine the incidence of airway complications and to identify any preoperative factors that might help predict which patients would be most likely to have these complications. We hypothesized that patients with larger goiters, more symptoms, longer duration of symptoms, tracheal deviation or compression on preoperative imaging, and those who underwent total thyroidectomy as opposed to lobectomy would be more likely to have postoperative airway complications.

RESULTS

Sixty patients underwent thyroidectomy for substernal goiter between 1993 and 2002. Thirty-four patients were women (57%), and 26 were men (43%). The mean age of the patients was 62.6±1.9 years. The most common preoperative symptom was dysphagia (26 patients [43%]). Shortness of breath was found in 22 patients (37%), orthopnea in 13 patients (22%), and hoarseness in 6 patients (10%). The mean duration of symptoms was 4.7±4.0 years. Thirteen patients (22%) were asymptomatic. Physical examination in the office revealed a positive Pemberton sign in 15 patients (25%); superior vena cava syndrome at rest was seen in 3 patients (5%).

All patients underwent at least 1 of the following preoperative imaging studies: chest radiography, CT scanning, or MRI. Tracheal deviation was seen in 42 patients (70%); tracheal compression was seen in 21 patients (35%). Sixteen patients underwent radioiodine scanning prior to referral for surgery, which revealed multinodular goiter in 6 patients, cold nodule in 6 patients, and normal uptake in 4 patients.

The reasons for operation were categorized based on patient presentation, clinical and radiologic findings, and patient preferences. In 20 patients (33%) the primary reason for operation was the presence of symptoms of airway compromise (dyspnea or orthopnea) or superior vena cava obstruction (Pemberton sign or superior vena cava syndrome). Progressive enlargement of goiter despite medical therapy was the reason for operation in 18 patients (30%). In 17 patients (28%) the primary reason for operation was the radiologic finding of either tracheal deviation or compression. Four patients (7%) underwent an operation because of testing positive for carcinoma or suspicious fine-needle aspiration biopsy specimen from a nodule in the cervical component of the goiter. Lastly, in 1 patient (2%) the reason for the operation was cosmetic; this patient had both cervical and substernal thyroid enlargement but was asymptomatic.

All patients in this series underwent thyroidectomy for substernal goiter. One patient (2%) with superior vena cava syndrome and severe airway obstruction required median sternotomy, whereas the remainder (98%) underwent thyroidectomy via a cervical approach. The operations performed included total or near-total thyroidectomy in 31 patients (52%) and lobectomy in 29 patients (48%). Of the 31 total or near-total...

METHODS

With the approval of our institutional review board, we retrospectively reviewed the medical records of 60 patients who underwent thyroidectomy for substernal goiter between 1993 and 2002. Substernal goiter was defined as a goiter with more than 50% of the thyroid tissue located below the sternal notch. The operations were performed by 1 of 3 endocrine surgeons (E.K., Q.-Y.D., and O.H.C.) at either a university tertiary care center (University of California, San Francisco, or University of California, San Francisco/Mt Zion Medical Center) or at a veterans’ hospital (San Francisco Veterans Affairs Medical Center).

Preoperative and postsurgical symptom profiles were obtained by questionnaire during the patients’ office visits. Preoperative physical examination in the office noted the presence or absence of the Pemberton sign, defined as venous engorgement in the face or neck when the patient’s arms are raised above his or her head; superior vena cava syndrome was defined as venous engorgement in the face or neck at rest. All patients underwent preoperative chest radiography, CT scanning, or magnetic resonance imaging (MRI); the presence of tracheal deviation or compression was determined by reviewing the radiologists’ dictated reports. Tracheal deviation was defined by displacement of the trachea from its normal midline position, and tracheal compression was defined by a reduction in the size of the tracheal lumen.

All patients underwent partial or total thyroidectomy for their substernal goiters. We reviewed the patients’ operative reports and recorded the following data: the extent of thyroid resection, identification of parathyroid glands and/or recurrent laryngeal nerves, and requirement for median sternotomy. In addition, any difficult intubations or intraoperative airway problems were noted.

Postoperative outcome measures included length of hospital stay, serum calcium levels, tumor size and pathological diagnoses, postoperative complications, and postoperative symptom profiles. Postoperative airway complications included hematomas requiring reoperation and intubation lasting longer than 6 hours postoperatively. The follow-up period ranged from 4 months to 10 years.

Statistical significance was determined using the t test and the Fisher exact test. P<.05 was considered significant. All data are presented as the means±SEM, unless otherwise noted.
Complications

- One patient (2%) had transient postoperative hoarseness that resolved within 2 months of the operation.
- Seven patients (12%) had transient postoperative hypocalcemia (serum calcium level range, 3-10 days).
- Fifty patients (87%) reported improvement of their symptoms after thyroidectomy; none had permanent vocal cord paralysis.

Pathological Diagnoses

- The pathological diagnoses of the resected tumors included 47 benign multinodular goiters (78%), 7 follicular adenomas (12%), 3 microscopic papillary cancers (5%), 2 Hurthle cell adenomas (3%), and 1 follicular carcinoma (2%). The mean weight of the pathological specimens was 125.4 ± 11.2 g.

Demographic Characteristics

- Forty-seven patients (78%) were discharged from the hospital on the first postoperative day, 8 patients (13%) were discharged on the second postoperative day, and 5 patients (8%) were hospitalized for longer than 2 days (range, 3-10 days).

Comparison of Patients With and Without Airway Complications

<table>
<thead>
<tr>
<th>Finding</th>
<th>Airway Complications (n = 7)</th>
<th>No Airway Complications (n = 53)</th>
<th>P Value†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean ± SEM, y</td>
<td>70.3 ± 3.6</td>
<td>61.5 ± 2.2</td>
<td>.03</td>
</tr>
<tr>
<td>Duration of symptoms,</td>
<td>8.0 ± 1.9</td>
<td>4.1 ± 0.5</td>
<td>.11</td>
</tr>
<tr>
<td>mean ± SEM, y</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of symptoms,</td>
<td>1.9 ± 1.3</td>
<td>1.3 ± 1.2</td>
<td>.30</td>
</tr>
<tr>
<td>mean ± SEM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dysphagia</td>
<td>2 (29)</td>
<td>24 (45)</td>
<td>.23</td>
</tr>
<tr>
<td>Dyspnea</td>
<td>3 (43)</td>
<td>19 (36)</td>
<td>.29</td>
</tr>
<tr>
<td>Orthopenia</td>
<td>3 (43)</td>
<td>10 (19)</td>
<td>.13</td>
</tr>
<tr>
<td>Hoarseness</td>
<td>0 (0)</td>
<td>6 (11)</td>
<td>.46</td>
</tr>
<tr>
<td>Pemberton sign</td>
<td>3 (43)</td>
<td>12 (23)</td>
<td>.18</td>
</tr>
<tr>
<td>Tracheal compression</td>
<td>6 (86)</td>
<td>15 (28)</td>
<td>.006</td>
</tr>
<tr>
<td>Total thyroidectomy</td>
<td>5 (71)</td>
<td>26 (49)</td>
<td>.18</td>
</tr>
<tr>
<td>Goiter size, mean ± SEM,</td>
<td>210.7 ± 37.0</td>
<td>112.2 ± 7.7</td>
<td>.02</td>
</tr>
<tr>
<td>g</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goiter &gt; 200 g</td>
<td>4 (57)</td>
<td>4 (8)</td>
<td>.004</td>
</tr>
</tbody>
</table>

Abbreviation: SVC, superior vena cava.
†Boldface type indicates that the P value is statistically significant.

Airway complications did not occur more frequently in the earlier years of this series. There was no difference in rates of airway complications at the 3 hospitals in which the operations took place.

Comment

The vast majority of patients in this report underwent thyroidectomy for substernal goiter through a cervical incision with an overnight hospital stay, had improvement in symptoms, and there was no morbidity. Seven patients, however, had postoperative airway complications. We retrospectively reviewed data from these patients with the goal of identifying factors that would help predict postoperative airway complications. There were significant differences in age and tumor size between the patients who suffered airway complications and those who did not; patients with airway complications were on average 9 years older and had goiters that were nearly 100 g heavier. In addition, patients with goiters larger than 200 g were more likely to have airway complications (P = .004; Fisher exact test). There were no significant differences between the 2 groups in the number of preoperative symptoms (P = .30), duration of symptoms (P = .11), radiologic finding of tracheal deviation (P = .07), or extent of thyroid resection (P = .18). The percentages of patients with dysphagia (P = .23), dyspnea (P = .29), orthopenia (P = .13), hoarseness (P = .46), and Pemberton sign (P = .18) were not different between the 2 groups. Airway complications did not occur more frequently in the earlier years of this series. There was no difference in rates of airway complications at the 3 hospitals in which the operations took place.
vena cava syndrome differed significantly between the 2 groups; however, the total number of patients with superior vena cava syndrome in this series was small (3 of 60 patients), so a firm conclusion regarding this finding cannot be made.

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 airway complications. Specifically, symptoms and signs such as dysphagia, dyspnea, orthopnea, Pemberton sign, and hoarseness do not appear to correlate with complications; neither does the radiologic finding of tracheal deviation. Patients undergoing total thyroidectomy appear to have airway complications at the same rate as those undergoing lobectomy. We understand that our study population is relatively small and the overall incidence of airway 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 awake fiberoptic intubation if necessary. Older patients, patients with large tumors (>200 g), and those with tracheal compression on preoperative imaging may be more likely to have postoperative airway complications.

Accepted for publication April 15, 2003.

This study was presented at the 74th Annual Meeting of the Pacific Coast Surgical Association; February 17, 2003, Monterey, Calif; and is published after peer review and revision. The discussion is based on the originally submitted manuscript and not the revised manuscript.

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REFERENCES

tomy? (3) Was transient hypocalcemia only seen in patients who underwent total thyroidectomy, and therefore actually found in 7 (24%) of 31 of these patients? (4) What are your current indications for operation in patients with substernal goiter?

Perhaps the final conclusion of the paper should be rephrased to include the inexperience of the anesthesiology team as a major contributor to postoperative airway complications.

Theodore X. O’Connell, MD, Los Angeles, Calif: I just have a quick question regarding the major complication, which is prolonged intubation postoperatively. I wonder, what are your criteria for extubating the patient, because you can’t use the regular criteria as far as lung function, tidal volume, MIF, etc, because the lungs are fine and the potential problem is above the end of the tube. I wonder if it is not just a self-fulfilling prophecy that if you have a bigger lesion, an older patient, a difficult intubation, etc, you are just afraid to take the tube out, so you leave it in longer because it is very, very difficult to judge when the tube really should come out.

Dr Duh: I want to congratulate Dr Shen for an excellent presentation and thank Dr Byrd for an excellent discussion. We agreed with his comments, specifically regarding the importance of the help by good anesthesiologists. We also find pulmonologists to be very useful.

Regarding preoperative symptoms that may predict intubation difficulties, we find the patients who are orthopneic frequently require awake fiberoptic intubation. We also make sure that the CT scans or the MRI printouts are available in the operating room. We also agree with early dissection of the upper pole followed by blunt finger dissection of the substernal component. This makes the operation less bloody and possible through a cervical approach.

The patient who required median sternotomy was preoperatively identified as a poor candidate for transcervical approach because of severe SVC syndrome and very large substernal goiter. Dr Jablon, a thoracic surgeon, was present and started the operation.

Regarding lobectomy, almost half of our patients had a lobectomy instead of total thyroidectomy. All patients with substernal goiter have multinodular goiter, so many of them had prior operations for their goiter, especially on the contralateral side. This accounted for some of the lobectomies. A few patients have a small contralateral lobe that we did not resect. There has not been any recurrence in these patients.

Regarding the risk of hypoparathyroidism, there is probably a slightly higher risk in patients with substernal goiter, although all of our patients with transient hypoparathyroidism have recovered. The lower parathyroid gland, which tends to be along the thyrothymic ligament, is at risk. Frequently one cannot identify it until the dissection is finished so it can be devascularized.

In terms of indication for operation for patients with substernal goiter, Drs Allo and Thompson recommended that the presence of substernal goiter by itself is an indication for operation. However, we don’t know the real risk for these patients if the thyroid is not removed. The issue may be similar to inguinal hernia, where the traditional teaching is the presence of hernia is an indication for hernia repair, but there are many patients with asymptomatic hernias who do not have a hernia repair. Three fourths of our patients were symptomatic. The ones who were not symptomatic had impressive chest x-rays or CT scan findings. So recommending an operation for them has not been a practical problem. If we have a truly asymptomatic patient with a substernal goiter, we sometimes use pulmonary studies and flow volume loop to help us decide the severity of the physiologic problem. What we have shown in this series is that subjective symptoms may not be good predictors of how severe the disease is anatomically and physiologically.

Regarding Dr O’Connell’s comments, it is true that delay in extubation can be a self-fulfilling prophecy. However, several of these patients were extubated and required reintubation. We have not found tracheomalacia to be a problem in any of our patients.