Retrosternal Goiter: 30-Day Morbidity and Mortality in the Transcervical and Transthoracic Approaches

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Abstract

Objective. Retrosternal goiters pose a significant challenge in determining the indications and appropriate approach for surgical removal while limiting postoperative morbidity and mortality. The objective of this study is to use the National Surgical Quality Improvement Program (NSQIP) database to compare outcomes of transcervical and transthoracic approaches for retrosternal goiter removal and to review the literature regarding the varying indications for the 2 surgical approaches.

Study Design. Administrative database analysis.

Setting. NSQIP database.

Subjects and Methods. The NSQIP database was queried for all cases of retrosternal thyroid: 2716 patients were included, which represents one of the largest data reviews of patients with retrosternal thyroid pathology who underwent surgery. Data were analyzed to examine morbidity and mortality of the cervical and transthoracic approaches.

Results. Patient demographics and preoperative comorbidities were similar between groups. Patients undergoing a transthoracic approach experienced increased rates of unplanned intubations and need for transfusion and length of stay postoperatively.

Conclusions. A transthoracic approach is associated with increased rates of several critical postoperative morbidities, and the data indicate the potential of increased overall mortality. Given equivalent retrosternal extension, a transcervical approach should be attempted whenever anatomically possible, regardless of pathology.

Keywords

substernal goiter, thyroid neoplasm, thyroid disease, thyroid nodule, thyroidectomy

Historically, thyroid surgery was viewed as a high-risk surgical procedure but more recently is considered a common ambulatory surgery associated with low complication rates. The incidence of palpable thyroid nodules in the general population ranges from 4% to 7%.1 Prior studies have estimated the incidence of thyroid nodules to be up to 50% of the population at autopsy, the majority of which are undetected.2 Benign palpable thyroid goiters may still warrant a surgical removal to relieve symptoms, such as dysphagia or dyspnea, depending on the size of the nodules, severity of symptoms, and the willingness of the patient to accept the risks of the surgery.

Despite these indications, removal of large multinodular goiters is not without surgical risk. A prior study conducted by Testini et al3 reported an increased rate of unilateral and bilateral transient and permanent recurrent laryngeal nerve palsy in patients undergoing surgery for retrosternal goiter versus cervical goiter. In a separate study, Testini et al4 found an overall increased rate of malignancy, hypoparathyroidism, recurrent laryngeal nerve palsy, and hematoma in cases of retrosternal goiter, regardless of approach. Additional studies found an increase in the rate of complications associated with the size of thyroid goiter and the degree of tracheal compression preoperatively when retrosternal goiter excision is performed.5,6

Retrosternal thyroid is defined as an anatomic position of the thyroid below the level of the thoracic inlet. This can be estimated on radiographic imaging; however, there may be some difference between the position of the thyroid during imaging procedures—as in computed tomography chest

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when patients are positioned supine with arms extended overhead—as compared with the extended operative position. This may overestimate the retrosternal portion of the thyroid and, therefore, the indications for a transthoracic approach. While most historical case series and studies have reported transcervical approaches for retrosternal goiter, sternal split is sometimes necessary.

Landerholm et al posed the question of whether asymptomatic patients with retrosternal goiter should be operated on at all.11 Previous studies advocated for aggressive surgical approaches to all retrosternal goiter due to the possibility of malignancy, with some estimating malignancy rates as high as 17%.12,13 However, a recent systematic review by White et al found no increased incidence of malignancy when comparing retrosternal with multinodular goiter.14

Given the controversy surrounding the need for surgery in asymptomatic goiter and the use of a cervical approach versus a thoracic approach for symptomatic disease, this study aims to evaluate 30-day morbidity and mortality related to retrosternal goiter excision via the different approaches. Delineating the risks of the various approaches will help in the decision of whether to operate or not and the risks and benefits of a transthoracic approach. To our knowledge, this study represents one of the largest series of retrosternal goiters in the literature.

Materials and Methods

Study Design and Sample

A retrospective cohort study was conducted through the American College of Surgeons National Surgical Quality Improvement Program (NSQIP) database. The NSQIP is a well-validated observational cohort of patients undergoing surgical procedures in 525 medical centers. It is representative of participating hospitals in 46 of the 50 states and 43 international hospitals. Patients were identified through Current Procedural Terminology codes 60270 and 60271: retrosternal goiter excision by a sternal split or transthoracic approach (60270) or by a cervical approach (60271). This analysis is exempt from Institutional Review Board review at the Mount Sinai Medical Center given that the NSQIP database contains de-identified patient information.

Preoperative Variables

Demographic variables examined were age, sex, race, ethnicity, and presence of malignant disease. Race is reported as white, black or African American, Asian, Native Hawaiian or Pacific Islander, American Indian or Alaska Native, and unknown/not reported.

Body mass index (BMI) was calculated for each patient. Preoperative comorbidities included in this analysis are diabetes mellitus, current smoker, alcohol use, ventilator dependence, chronic obstructive pulmonary disorder, congestive heart failure, hypertension, dialysis, steroid use, open wound/wound infection, weight loss >10% in the past 6 months, and bleeding disorders.

Postoperative/Outcome Variables

Complication data included surgical site infection, pneumonia, unplanned intubation, ventilator use for >48 hours, deep venous thrombosis or pulmonary embolism (DVT/PE), urinary tract infection, cardiac arrest, bleeding transfusion, and sepsis/septic shock.

The NSQIP employs the Centers for Disease Control and Prevention’s definitions for wound infections.15 Wound complications were collapsed into a single “surgical site infection” variable for the purposes of this study. Other outcomes of interest included mortality and return to the operating room within 30 days of surgical admission and total postoperative length of stay.

Data Analyses

Bivariate analysis was performed to compare demographics and preoperative comorbidities between study groups. A binomial logistic regression model was designed to conduct an analysis for all outcome measures, given that all were dichotomous. Chi-square or Fisher’s exact test was used to compare categorical variables, and Mann-Whitney U or t test was used to compare continuous variables. To control for baseline differences in the patient population, logistic regression analysis controlling for patient age and sex was performed to calculate odds ratios for all outcome variables. P < .05 was considered significant. All statistical analyses were performed with SPSS 22 (IBM Corporation, Armonk, New York).

Results

A total of 2716 patients were found in the NSQIP database to have surgical management of a thyroid with retrosternal component. The majority of patients were treated with a cervical approach (n = 2342, 86.2%). The mean age for both surgical approaches was 58 years. The majority of patients were female, and white patients made up the major race category. Hispanics represented a significantly greater proportion of patients undergoing transthoracic approaches (4.4% vs 7.9%, P < .05); 346 patients (12.7%) were diagnosed with a thyroid malignancy. Of these, 292 (84.4%) were treated with a transcervical approach, while 54 (15.6%) required a transthoracic approach (Table 1).

Preoperative comorbidities included mean BMI, diabetes mellitus, current smokers (defined as smoking within 1 year of surgery), alcohol use >2 drinks per day, chronic obstructive pulmonary disorder, congestive heart failure, hypertension, current dialysis, and bleeding disorders. There was no statistically significant difference in medical comorbidities between groups. The average BMI was 32.2 for the transcervical approach and 31.6 for the transthoracic approach (Table 2).

Multiple outcomes were analyzed to evaluate 30-day morbidity and mortality. These included return to operating room, surgical site infection, pneumonia, unplanned intubation after surgery, ventilator dependence for >48 hours
after surgery, DVT/PE, urinary tract infection, cardiac arrest, need for transfusion, sepsis or septic shock, or mortality. Odds ratios (ORs) and \( P \) values were calculated for each variable (Table 3).

Regarding thyroidectomy for retrosternal disease, 7 (0.3%) patients undergoing a transcervical approach died within 30 days of surgery, while 4 (1.9%) undergoing a transthoracic approach died within 30 days (\( P = .07 \)). Unplanned intubation was necessary in 18 (0.8%) patients undergoing a transcervical approach and in 8 (2.1%) undergoing a transthoracic approach (\( P < .05; \ OR = 2.7 \)). Of patients undergoing a transcervical approach, 12 (0.5%) required a transfusion, as compared with 10 (2.7%) for those undergoing a transthoracic approach (\( P < .05; \ OR = 5.56 \)). Patients undergoing a transcervical approach required ventilator support for >48 hours in 21 (0.9%) cases, while 7 (1.9%) with a transthoracic approach required prolonged ventilator support (\( P = .08 \)). Five patients (0.2%) experienced DVT/PE after a transcervical approach, while 3 (0.8%) undergoing a transthoracic approach experienced these same postoperative complications (\( P = .08 \)). Pneumonia, surgical site infection, sepsis/septic shock, urinary tract infections, and cardiac arrest were experienced by a relatively small proportion of patients, and incidence rates did not differ significantly between approaches.

Length of postoperative hospital stay was also analyzed for the varying approaches (Table 4). The mean length of hospital stay for patients undergoing a transcervical approach was 1.5 days, while patients undergoing a transthoracic approach had a mean length of stay of 2.4 days (\( P < .05 \)).

An analysis was also conducted to evaluate patients with retrosternal malignancies: 346 patients were diagnosed with

### Table 1. Characteristics of Patients Undergoing Substernal Thyroidectomy by Surgical Approach.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Cervical Approach (n = 2342)</th>
<th>Transthoracic Approach (n = 374)</th>
<th>( P ) Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median</td>
<td>59</td>
<td>57</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>58</td>
<td>58</td>
<td></td>
</tr>
<tr>
<td>Interquartile range</td>
<td>48-69</td>
<td>48-67</td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>17-90</td>
<td>23-90</td>
<td></td>
</tr>
<tr>
<td>Female, %</td>
<td>73.4</td>
<td>70.5</td>
<td>.258</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td>.050</td>
</tr>
<tr>
<td>White</td>
<td>63.3</td>
<td>58.0</td>
<td></td>
</tr>
<tr>
<td>Black / African American</td>
<td>26.2</td>
<td>26.5</td>
<td></td>
</tr>
<tr>
<td>Asian / Pacific Islander</td>
<td>2.9</td>
<td>5.1</td>
<td></td>
</tr>
<tr>
<td>American Indian / Alaska Native</td>
<td>0.4</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>Unknown / not reported</td>
<td>7.3</td>
<td>9.9</td>
<td></td>
</tr>
<tr>
<td>Hispanic ethnicity, %</td>
<td>4.4</td>
<td>7.9</td>
<td>.006(^a)</td>
</tr>
<tr>
<td>Malignant disease, %</td>
<td>12.5</td>
<td>14.4</td>
<td>.279</td>
</tr>
</tbody>
</table>

\(^a\)Statistical significance.

### Table 2. Preoperative Comorbidities of Patients Undergoing Substernal Thyroidectomy by Surgical Approach.

<table>
<thead>
<tr>
<th>Variable</th>
<th>n</th>
<th>Cervical Approach (n = 2342)</th>
<th>Median Sternotomy (n = 374)</th>
<th>( P ) Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean BMI</td>
<td>—</td>
<td>32.2</td>
<td>31.6</td>
<td>.197</td>
</tr>
<tr>
<td>Diabetes mellitus requiring treatment</td>
<td>489</td>
<td>18.2</td>
<td>16.8</td>
<td>.563</td>
</tr>
<tr>
<td>Current smoker within 1 y</td>
<td>398</td>
<td>14.7</td>
<td>14.4</td>
<td>.937</td>
</tr>
<tr>
<td>Alcohol use &gt;2 drinks/d</td>
<td>23</td>
<td>0.8</td>
<td>1.3</td>
<td>.234</td>
</tr>
<tr>
<td>Ventilator dependent</td>
<td>19</td>
<td>0.6</td>
<td>1.1</td>
<td>.320</td>
</tr>
<tr>
<td>History of severe COPD</td>
<td>94</td>
<td>3.5</td>
<td>3.5</td>
<td>.999</td>
</tr>
<tr>
<td>CHF in 30 d before surgery</td>
<td>16</td>
<td>0.6</td>
<td>0.8</td>
<td>.475</td>
</tr>
<tr>
<td>Hypertension requiring medication</td>
<td>1465</td>
<td>54.1</td>
<td>53.2</td>
<td>.780</td>
</tr>
<tr>
<td>Currently on dialysis</td>
<td>20</td>
<td>0.6</td>
<td>1.3</td>
<td>.181</td>
</tr>
<tr>
<td>Steroid use for chronic condition</td>
<td>51</td>
<td>2.0</td>
<td>1.3</td>
<td>.539</td>
</tr>
<tr>
<td>Open wound/wound infection</td>
<td>21</td>
<td>0.7</td>
<td>1.3</td>
<td>.196</td>
</tr>
<tr>
<td>Weight loss &gt;10% in past 6 mo</td>
<td>24</td>
<td>0.9</td>
<td>1.1</td>
<td>.563</td>
</tr>
<tr>
<td>Bleeding disorders</td>
<td>62</td>
<td>2.3</td>
<td>2.4</td>
<td>.852</td>
</tr>
</tbody>
</table>

Abbreviations: BMI, body mass index; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disorder.

\(^{a}\)Values in percentages unless noted otherwise.
Comparison of Length of Postoperative Stay by Surgical Approach.

<table>
<thead>
<tr>
<th></th>
<th>Length of Postoperative Stay, d</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total (n = 2716)</td>
<td>Cervical Approach (n = 2342)</td>
<td>Sternotomy (n = 374)</td>
</tr>
<tr>
<td>Median</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Mean</td>
<td>1.6</td>
<td>1.5</td>
<td>2.4</td>
</tr>
<tr>
<td>Interquartile range</td>
<td>1.1</td>
<td>1.1</td>
<td>1.3</td>
</tr>
<tr>
<td>Range</td>
<td>0.39</td>
<td>0.39</td>
<td>0.30</td>
</tr>
</tbody>
</table>

*p < .001.

Discussion

Thyroid enlargement with a retrosternal component requires careful preoperative analysis to predict the need for a thoracic approach. Many studies have described indications for a transthoracic approach, such as large descending goiters that cannot be retracted from a cervical approach, primary intrathoracic goiter, and intrathoracic malignancy. A study by Coskun et al expanded on the indication for transthoracic approach with more specific characteristics, such as extension of goiter below the aortic arch or extending toward the tracheal bifurcation. A review study by McKenzie et al describes the risk factors for sternal split to include history of goiter with retrosternal extension beyond 160 months, thyroid tissue density, posterior mediastinal location, and subcardinal extension. However, some studies argue that intrathoracic extension in itself is rarely an indication for a sternal split, and many have advocated for a cervical approach unless there is suspected or confirmed malignant nodes in the mediastinum. Additional criteria vary from ectopic thyroid tissue in the mediastinum and previous cervical thyroidectomy to invasive carcinoma. However, prior studies have described removal of ectopic thyroid as well as retrosternal thyroid malignancy through a cervical approach. In light of these data, the argument may be made that the selected surgical approach for a retrosternal thyroid may be somewhat subjective and guided to a certain degree by the level of experience of the surgical team, as no definitive criteria exist.

Even the decision to operate at all is controversial. Landerholm et al argued against operating on asymptomatic retrosternal goiter. This argument was based on the increased risk of morbidity and mortality in patients undergoing any surgical approach for a retrosternal goiter as compared with observation, as well as on the fact that the risks were similar regardless of whether the patient was symptomatic. Others have argued for operating on all retrosternal goiters due to an observed increased incidence of thyroid malignancy in prior studies. However, in a systematic review, White et al found no increase in the incidence of thyroid malignancy between retrosternal and multinodular goiter.

The current analysis found a statistically significant increase in the incidence of postoperative unplanned intubations in patients undergoing a transthoracic approach compared with patients undergoing a transcervical approach. Our data indicated an OR of 2.7 of unplanned intubation, which can be interpreted as an almost 3-fold increase in the risk for unplanned intubation postoperatively. A prior study by Shen et al found that airway issues after thyroidectomy were correlated with older age, larger goiters, and a greater degree of tracheal compression on preoperative imaging. We found no significant difference in the mean age of a malignancy. Of these, 292 had a total thyroidectomy through a transcervical approach, while 54 required a trans-thoracic approach. Three patients (1.0%) undergoing a transcervical approach required transfusion, while 3 (5.6%) undergoing a transthoracic approach also required transfusion (P < .05; OR = 5.34; Table 5).

Table 3. Odds of Postoperative Complications in Sternotomy vs Cervical Approach.

<table>
<thead>
<tr>
<th></th>
<th>OR</th>
<th>95% CI</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unplanned intubation</td>
<td>2.70</td>
<td>1.17-6.25</td>
<td>.020a</td>
</tr>
<tr>
<td>Bleeding transfusion</td>
<td>5.56</td>
<td>2.38-13.0</td>
<td>&lt;.001a</td>
</tr>
<tr>
<td>Return to operating room</td>
<td>0.76</td>
<td>0.35-1.69</td>
<td>.508</td>
</tr>
<tr>
<td>30-d mortality</td>
<td>3.11</td>
<td>0.91-10.6</td>
<td>.070</td>
</tr>
<tr>
<td>Surgical site infection</td>
<td>1.52</td>
<td>0.32-7.21</td>
<td>.597</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>1.55</td>
<td>0.43-5.53</td>
<td>.501</td>
</tr>
<tr>
<td>Ventilator for &gt;48 h</td>
<td>2.22</td>
<td>0.93-5.30</td>
<td>.073</td>
</tr>
<tr>
<td>PE/DVT</td>
<td>3.89</td>
<td>0.91-16.5</td>
<td>.666</td>
</tr>
<tr>
<td>Urinary tract infection</td>
<td>1.81</td>
<td>0.37-8.75</td>
<td>.460</td>
</tr>
<tr>
<td>Cardiac arrest</td>
<td>1.55</td>
<td>0.33-7.32</td>
<td>.583</td>
</tr>
<tr>
<td>Sepsis/septic shock</td>
<td>0.94</td>
<td>0.21-4.21</td>
<td>.938</td>
</tr>
</tbody>
</table>

Abbreviations: 95% CI, 95% confidence interval; DVT, deep venous thrombosis; OR, odds ratio; PE, pulmonary embolism.

*Statistical significance.

Table 5. Odds of Postoperative Complication in Sternotomy Compared with a Cervical Approach in Malignancy.

<table>
<thead>
<tr>
<th></th>
<th>OR</th>
<th>95% CI</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bleeding transfusion</td>
<td>5.34</td>
<td>1.02-28.0</td>
<td>.047a</td>
</tr>
<tr>
<td>Return to operating room</td>
<td>1.41</td>
<td>0.38-5.20</td>
<td>.604</td>
</tr>
<tr>
<td>30-d mortality</td>
<td>4.99</td>
<td>0.62-40.4</td>
<td>.132</td>
</tr>
<tr>
<td>Surgical site infection</td>
<td>1.44</td>
<td>0.16-13.4</td>
<td>.748</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>5.18</td>
<td>0.65-41.2</td>
<td>.120</td>
</tr>
<tr>
<td>Unplanned intubation</td>
<td>5.11</td>
<td>0.93-28.0</td>
<td>.060</td>
</tr>
<tr>
<td>Ventilator for &gt;48 h</td>
<td>3.02</td>
<td>0.64-14.2</td>
<td>.161</td>
</tr>
<tr>
<td>DVT/PE</td>
<td>1.27</td>
<td>0.11-14.2</td>
<td>.848</td>
</tr>
<tr>
<td>Sepsis/septic shock</td>
<td>1.21</td>
<td>0.12-12.2</td>
<td>.870</td>
</tr>
</tbody>
</table>

Abbreviations: 95% CI, 95% confidence interval; DVT, deep venous thrombosis; OR, odds ratio; PE, pulmonary embolism.

*Statistical significance.
patients experiencing the need for postoperative reintubation. However, the exact size of the goiter and the degree of tracheal compression were not available in the database. Given that the group requiring more unplanned intubations was also the group requiring a transthoracic approach, it could be argued that this group may have contained the greater degree of larger goiters and experienced more tracheal compression; however, this is unclear based on the available NSQIP data.

Prior studies have argued that a transthoracic approach, when appropriate, will not only allow for improved surgical exposure and facilitate hemostasis but also prevent excessive blood loss in cases where there might otherwise be uncontrollable bleeding in the mediastinum. However, we observed a significant difference in the need for transfusion. Patients undergoing a transthoracic approach had a postoperative transfusion rate of 2.7%, while patients undergoing a transcervical approach required a transfusion in only 0.5% of cases ($P < .05$). The OR of 5.6 indicated a >5-fold increase in the risk for necessity of transfusion when patients undergo a transthoracic approach. The argument can be made that performing a transthoracic approach carries with it a greater associated amount of blood loss. However, this group may have been affected by selection bias as having larger goiters, which may have necessitated a transthoracic approach and so put them at greater risk for life-threatening bleeding. Also, a surgeon may be more willing to accept greater blood loss while avoiding what could be life-threatening blood loss with limited access.

There have been cases reported in the literature describing postobstructive pulmonary edema after total thyroidectomy due to rapid relief of significant tracheal compression. In addition, many studies have documented an increased risk of recurrent laryngeal nerve palsy following thyroidectomy for large retrosternal goiter. Prolonged intubation may predispose these patients to developing DVT/PE, with increased rates being seen in patients with a transthoracic approach. The need for prolonged ventilator support (>48 hours after surgery) and the incidence of DVT/PE were analyzed by each approach.

Our statistical analysis found a greater proportion of Hispanic patients undergoing transthoracic approaches (4.4% vs 7.9%, $P < .05$). Without further patient-specific information, it would be difficult to make any inferences regarding the reason for this. However, future studies could focus on possible socioeconomic or patient-specific variables that may affect the choice of approach within this cohort.

Overall 30-day mortality was evaluated comparing transcervical and transthoracic approaches. While 30-day mortality did not reach statistical significance between the 2 approaches ($P = .07$), there was a trend toward a greater mortality rate among patients undergoing a transthoracic approach. This may have reached statistical significance had the sample size been larger.

Evaluation revealed a statistically significant increase in the mean length of stay associated with a transthoracic approach, as expected, with patients undergoing sternal split requiring 2.4 days in the hospital versus 1.5 days for patients undergoing a transcervical approach. This is predictable with the additional surgical complexity and the necessity of closer monitoring for complications associated with the thoracic approach, such as pneumothorax, pneumomediastinum, and mediastinitis.

Many investigators have advocated for a transthoracic approach when retrosternal malignancy is diagnosed. Some have argued for a transthoracic approach for wide exposure and control of bleeding in cases of retrosternal malignancy. Others have argued for total thyroidectomy even in cases of asymptomatic retrosternal goiter due to an increased observed rate of malignancy in retrosternal goiter. This study found of 346 malignancies diagnosed, 292 were able to be removed through a transcervical approach. There was a statistically significant increase in postoperative rates of transfusion between a transthoracic approach and a transcervical approach. This may be subject to selection bias and may reflect the increase in size of malignant goiters necessitating a transthoracic approach and requiring transfusion. However, given the significantly increased average length of hospital stay associated with transthoracic approaches, the argument could be made that, based on approximately equivalent retrosternal extension, all efforts should be made to excise malignancies through a transcervical approach to avoid the increased healing time associated with a sternal incision and that malignancy by itself may not be a criterion for a transthoracic approach, as previously advocated.

The data in this study indicate an increase in rates of unplanned intubation and the need for transfusion with the transthoracic approach versus the transcervical approach. Also, the mean length of hospital stay was significantly longer when patients underwent a transthoracic approach. An adequate assessment of preoperative tracheal compression may help predict an increased risk of postoperative prolonged intubation and the need for weaning trials rather than immediate extubation and unplanned reintubation. Surgeons performing transthoracic approach should be prepared for greater blood loss and the need for transfusion. Given the increased morbidity and possible mortality seen in the data, we advocate that all efforts be made to attempt to excise a retrosternal goiter through a transcervical approach before converting to a transthoracic approach if necessary. While some may advocate for the transthoracic approach to prevent excessive blood loss and control hemorrhage, our study found that the transthoracic approach required a significantly higher number of blood transfusions and is associated with more blood loss overall when compared with the transcervical approach. Given the longer recovery period associated with transthoracic approaches, patients are more susceptible to complications such as DVT/PE. Regardless, the primary surgeon should have the services of a thoracic surgeon on hold, lest an intraoperative decision is made that a transthoracic approach is necessary.

Some limitations should be noted. Registry-based data in general are subject to informational biases: without access...
to the original clinical records, accuracy of the data is wholly dependent on the registration/codification process. Data for other postoperative complications, such as recurrent laryngeal nerve palsy and hypocalcemia, were not available. The success rates of individual centers could not be calculated and comparisons could not be made between high volume and low volume centers. Finally, there are limitations to retrospective studies in general, including all data being subject to selection biases.

**Conclusion**

Patients with retrosternal extension of thyroid goiter pose a significant challenge due to the difficulty in determining the appropriate time to operate and the appropriate surgical approach. The transthoracic approach has traditionally proven to be a significantly riskier procedure, with an increase in the rates of several postoperative complications. Despite the comparable rates of many postoperative morbidities, with an increase in length of stay, unplanned intubation, need for transfusion, and the possible increase in mortality, the data would argue for an attempt at transcervical removal of all retrosternal thyroid disease regardless of thyroid pathology, with the conversion to transthoracic approach only in the event that the transcervical excision fails.

**Author Contributions**

Mohammed N. Khan, conception and design of work, data acquisition, analysis, drafting, revising, final approval, accountability for all aspects of the work; Erden Goljo, design of work, data analysis, drafting, revising, final approval, accountability for all aspects of the work; Randall Owen, conception of work, data acquisition, revising, final approval, accountability for all aspects of the work; Richard Chan Woo Park, conception of work, data analysis, drafting, revising, final approval, accountability for all aspects of the work; Mike Yao, design of work, interpretation of data, drafting, revising, final approval, accountability for all aspects of the work; Brett A. Miles, conception and design of work, data acquisition, analysis, drafting, revising, final approval, accountability for all aspects of the work.

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**References**


