Retrosternal goiter: The need for thoracic approach based on CT findings: Surgeon’s view

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Thyroid gland

Abstract  Background and purpose: The incidence of retrosternal goiter (RSG) varies from 2% to 26% of all thyroidectomies, depending on the defining criteria. There are no clear guidelines to identify patients that require an intrathoracic approach. So, we tried to correlate, between the size and/or anatomical site of the RSG based on preoperative CT findings and the surgical approaches used, aiming at defining those patients with RSG who are in need for thoracic approach.

Patients and methods: Out of 1481 patients underwent thyroidectomy at the National Cancer Institute (NCI), Cairo University, between January 2000 and December 2009, only 73 (4.93%) of them had retrosternal extension. Demographic, clinical, operative, anatomical, and pathological data of patients with RSG were recorded and analyzed.

Results: The intraoperative extension of the goiter correlated with the extension seen in the CT in all except two patients. Laterality and longitudinal extension found in preoperative CT, correlated well with the surgical findings. The approach used was cervical in 66 cases (90.4%); combined approach in six patients (8.2%). Pure thoracic (full sternotomy) was used alone in one case (1.4%). Extension of the RSG down to or below the arch was associated with an increased risk of using a thoracic approach \( p < 0.0001 \).

Conclusion: Preoperative CT, can be used effectively to guide the indications for using a thoracic approach. Reaching the aortic arch or beyond and loss of fat planes in CT, recurrent and malignant disease, are significant risk factors for using a thoracic approach.

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Introduction

Retrosternal goiter (RSG) is a vague term that have no uniform definition, to date. The most commonly accepted definitions describe a retrosternal goiter as one that have descended below the plane of the thoracic inlet [1] or have more than 50% of its mass lying inferior to the thoracic inlet [2].
Although it is estimated that < 5% of the world population have goiters, the incidence of retrosternal goiter (RSG) varies considerably, ranging from 2% to 26% of all thyroidectomies, depending on the defining criteria [3].

The significant variability found in the literature regarding the clinical presentation and the surgical management of RSG can – at least in part – be explained by the different definitions employed. So, no standards for communicating the findings and results between clinicians as well as assist in preoperative planning.

Computed tomography scanning of the neck and chest permits identification of tissue planes of intrathoracic goitrous components and is the best proven diagnostic modality. Michel and Bradpiece reported 100% sensitivity with computed tomography scanning, 77% with thyroid scanning, and 59% with chest radiography. Because most substernal thyroid tissue does not take up radioiodine, 131I thyroid scan rarely alters management and often fails to define the intrathoracic mass [4,5].

Fine-needle aspiration cytology to exclude the presence of carcinoma is not recommended because intrathoracic goiters are not easily accessible and the procedure may lead to life-threatening complications [6].

The surgical approach used to gain access to RSG is commonly based on intraoperative findings. The use of CT scanning to aid in this decision has always been limited, but now, it is gaining popularity among many surgeons. Several have emphasized on the importance of CT in preoperative planning of surgery for RSG. Extension to the level of the aortic arch and beyond was found to greatly influence the need for a thoracic approach [7,8].

In this work we tried to correlate, preoperatively between the size and/or anatomical site of the RSG based on the CT findings and the surgical approaches used, aiming at defining those patients with RSG who are in need for thoracic approach.

Patients and methods

We retrospectively reviewed the medical records of patients who underwent thyroidectomy in the department of surgery at the National Cancer Institute (NCI), Cairo University, from January 2000 to December 2009. Only patients with retrosternal component were included; we defined RSG as goiter with at least 50% of the mass residing within the thorax [9].

Patients’ records were revised and data including full history, the presenting symptoms and signs and all the preoperative investigations done for each patient, were recorded in a data sheet. Contrast enhanced CT of the neck and chest was considered the primary radiological tool in this group of patients. Magnetic resonance imaging and fiberoptic bronchoscopy were done whenever indicated. Preoperative thyroid function test revealed 66 patients were euthyroid (90.4%), three had hyperfunction (4.1%) and 4 (5.5%) had below normal levels of thyroid hormones but none were clinically hypothyroid.

The operative procedures whether; cervical alone, cervicothoracic or pure thoracic, as well as any intraoperative complications were all recorded. The post operative complications were also recorded, trying to correlate these complications with the type of surgical approach used. Pre operatively, informed patient’s consent including the possibility of thoracic approach was taken.

Data was analyzed using statistical package of social science (SPSS) version 15. Numerical data were expressed as mean, standard deviation and range. Qualitative data were expressed as frequency and percentage. Chi-square test or Fisher’s Exact test was used to examine the relation between qualitative variables. For quantitative data, comparison between two groups was done using Mann–Whitney test (nonparametric t-test) for variables not normally distributed. P-value < 0.05 were considered significant. All statistical tests are two tailed.

Results

Over the past 10 years a total of 1481 patients underwent thyroidectomy, 73 (4.93%) of them had retrosternal extension. There were 54 female patients (74%) and 19 male patients (26%). The mean age was 55.4 years.

Cervical mass and dyspnea were the most frequent symptoms in our series. On examination all patients except one had a palpable neck mass (98.6%), 69 patients had nodular mass on palpation and only 3 had a smooth surface. Five patients had palpable lymphadenopathy (6.8%).

Preoperative chest X-ray showed RSG as a mediastinal shadow in 58 patients (78.8%), tracheal shift was found in 46 cases (63.5%). Thoracic extension was not detected in seven patients, giving the CXR accuracy in detection of RSG of 90.4%.

Fine needle aspiration cytology (FNAC) was performed in 55 patients. Benign cytology was obtained in 26 patients and correlated 100% with the final pathology. Malignant cytology correlated in 75% only, 25% were falsely diagnosed as malignant goiters. It was inconclusive in 13 cases. None of the patients suffered any complications related to the procedure.

CT scan was by far the most accurate diagnostic tool where RSG was detected in 100% of our cases with the following results (Table 1). Vertical extension at or below the level of aortic arch, loss of tissue planes and the presence of mediastinal lymph nodes was considered the most important CT findings raising the possibility of thoracic approach.

Clear tissue planes were absent in four patients (5.5%), three had malignant goiters (two medullary carcinomas and one follicular thyroid cancer) and one had recurrent colloid goiter. Lymphadenopathy was seen in six patients by CT scan, raising suspicion of malignancy, five of them had mediastinal lymphadenopathy at surgery. Five out of the six cases had malignant goiters (83.3%) and only one had a colloid goiter (16.7%).

Primary RSG or ectopic goiter with no connection to the neck was found in only one patient (1.4%), which was a recurrent nodular goiter. The remaining 72 cases were diagnosed with secondary RSG based on detection of an attachment to the thyroid gland or cervical component.

Retrosternal extension was found intraoperatively to be anterior in 53 patients [pretracheal in 47 (88.7%) and prevascular in 6 (11.3%) patients], forming the majority of cases (72.6%). Posterior mediastinal goiters were found in 20 patients (27.4%) (Table 2). This was more common on the right and was found in 12 of the 20 patients (60.0%). Retrotracheal
extension was found on the left side in four patients and bilateral in another four patients.

The approach used for removal of the RSG was cervical in 66 cases (90.4%); a combined approach was used in six patients (8.2%) (five partial sternotomies and one full sternotomy). Pure thoracic (full sternotomy) was used alone in one case (1.4%).

Of the 59 goiters lying above the arch; a thoracic approach was used in only one patient (1.7%). A thoracic approach was used in five of the 13 patients (38.5%) extending to the arch; three partial sternotomies, and one complete sternotomy were combined with the cervical incision. A full sternotomy was used alone, for the fifth case, a recurrent ectopic colloid goiter. Extension beyond the arch was encountered in only one case and a partial sternotomy was added for proper exposure and assessment. The patient had a right sided posterior mediastinal medullary carcinoma that was irersectable.

Extension of the RSG down to or below the arch intraoperatively was associated with an increased risk of using a thoracic approach \( p < 0.0001 \), it was also a significant risk factor if found on CT \( p = 0.003 \). There was no significant difference in the approach needed between anterior and posterior RSGs \( p = 0.668 \) or the laterality of the extension. The need of a thoracic incision was more common with malignant goiters \( p = 0.018 \). Patients younger than the age of 60 were more likely to need a thoracic approach than their counterparts \( p = 0.016 \).

Resection was not possible in two patients (2.7%), due to extensive invasion of the trachea and esophagus. A total thyroideectomy was done in 26 (35.6%), subtotal in 16 (21.9%), near total in one (1.4%), hemithyroidectomy in 10 (13.7%) and a completion thyroideectomy in 18 (24.7%). Mediastinal lymphadenectomy was done in two patients.

The incidence of malignancy in RSGs in this study was 28.8% (21/73). Eighteen patients had recurrent goiters (24.7%). The disease free interval ranged from 1 month to 30 years. Four recurrent goiters were excised using a thoracic approach (22.2%). Recurrent RSG had an increased likelihood of a thoracic approach \( p = 0.036 \), but without significant increase of morbidity \( p = 0.305 \).

The intraoperative extension of the goiter correlated with the extension seen in the CT in all except two patients who had been noted to reach the arch but in fact lay above the arch during surgery. Laterality of RSG and the longitudinal extension found in preoperative CT, correlated well with the surgical findings (Fig. 1).

In our series, the thoracic approach was associated with a 71.4% morbidity (5/7 patients), versus a 36.4% in the cervical group (24/66 patients), however the difference was not statistically significant \( p = 0.106 \). Visceral injury occurred in two patients, the first had left posterior mediastinal follicular carcinoma developed pharyngeal injury after difficult cervical delivery. This was primarily repaired and nasogastric tube feeding was imposed for 7 days. The second developed tracheo-esophageal fistula during completion thyroidecetomy using the cervical approach for recurrent colloid goiter extending retrotracheal to the level of the arch and carina. These were repaired, and a tracheostomy and nasogastric feeding tube were placed. The patient died 16 days after surgery following mediastinitis and acute respiratory distress syndrome (ARDS). Better exposures using the appropriate thoracic incision avoid the occurrence of such complications (Table 3).

There were two mortalities (2.7%), one from mediastinitis, and the other from pneumonia secondary to thoracotomy for reactionary hemorrhage after cervical delivery of medullary carcinoma above the arch.

The mean hospital stay was 4.6 days ranging from 1 to 32 days. Thoracic approach was a significant factor for increasing hospital stay \( p \) value of 0.008). Other factors associated with prolonged hospital stay were; Age \( p \) value = 0.024), malignancy \( p = 0.002 \) and the development of post operative complications \( p < 0.0001 \).

### Discussion

Substernal goiter was first described by Haller in 1749 [10]. From that time, there were controversies concerning the definition of retrosternal goiters. The most common definition was proposed by deSouza and Smith [9], as that in which >50% of the total bulk of thyroid tissue resides below the thoracic inlet. In our series, RSG were found in 4.93% of thyroidecetomy, and most patients are symptomatic and only a minority (2.7%) were asymptomatic. Some authors had re-

### Table 2

<table>
<thead>
<tr>
<th>Vertical extension</th>
<th>Number of patients (%)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Right</td>
<td>Left</td>
</tr>
<tr>
<td>Above the arch</td>
<td>19</td>
<td>26</td>
</tr>
<tr>
<td>At the arch</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>Below the arch</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>37</td>
<td>52</td>
</tr>
</tbody>
</table>

### Table 3

<table>
<thead>
<tr>
<th>Complication</th>
<th>Cervical group</th>
<th>Combined/thoracic group</th>
<th>Number (%) – all patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>RLN injury</td>
<td>8</td>
<td>10</td>
<td>13 (17.7%)</td>
</tr>
<tr>
<td>Hypocalcaemia</td>
<td>20</td>
<td>22</td>
<td>22 (30.1%)</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>6</td>
<td>8</td>
<td>8 (11%)</td>
</tr>
<tr>
<td>Hemorrhage</td>
<td>1</td>
<td>2</td>
<td>3 (4.1%)</td>
</tr>
<tr>
<td>Visceral injury</td>
<td>2</td>
<td>2</td>
<td>4 (5.5%)</td>
</tr>
<tr>
<td>Chylous fistula</td>
<td>1</td>
<td>1</td>
<td>2 (2.7%)</td>
</tr>
<tr>
<td>Sternal wound</td>
<td>–</td>
<td>1</td>
<td>1 (1.4%)</td>
</tr>
<tr>
<td>Dehiscence</td>
<td></td>
<td></td>
<td>1 (1.4%)</td>
</tr>
</tbody>
</table>

Some patients suffered more than 1 complication.
ported a much higher percentage of asymptomatic patients. Patel and co-workers, noted that patients may not present with symptoms in 20–35% of cases [11]. CT scanning has become the gold-standard pre-operative radiological investigation for assessment of retrosternal extension and its relation to adjacent structures, and also can be used in determining the group of patients likely requiring thoracic approach [7]. Extension to the level of the arch and beyond was found to greatly influence the need for a thoracic approach with a \( p = 0.003 \) in this series. This concurs with Huins et al., [8], whose findings led them to classify RSG into three levels related to the aortic arch, where RSG reaching this level and below were at a higher risk of needing an intrathoracic approach.

In our series, CT imaging was able to accurately diagnose RSG in 100% of patients and found to be correlated well with the surgical findings in all of our cases as regard laterality of RSG and the longitudinal extension. However, CT lacks accuracy in 4% of our patients regarding the depth of invasion but this is more likely due to patient positioning during the examination rather than to failure of detection. The standard patient position, when doing a chest CT scan, is with the arms raised above the head, these results in an apparently increased descent of the goiter within the mediastinum. Therefore any CT performed for patients with RSG should be done with the patient’s arms by their sides (12). Determination of the exact orientation requires multilayer images of the mediastinum, therefore, a 64-slice spiral post-contrast CT is recommended, typically conducted using 5 mm cuts from the cranial base to the hilums of the lungs [7,12].

Loss of clear planes between the RSG and the surrounding structures in CT scan can be used as a strong predictor for a thoracic approach [13]. Four of our patients had lost tissue planes in CT, three of them were malignant and the fourth was a recurrent goiter. This agrees with Cohen [14], where malignancy was not found to mandate a thoracic approach but such an approach should be considered in the absence of clear tissue planes.

FNAC had 86.7% specificity and 100% sensitivity for malignancy in this study. This falls within the reported sensitivity and specificity of FNAC found in literature [15]. Percutaneous transthoracic aspiration biopsy (PTAB) was performed in one patient with 100% accuracy, this is a small sample but its accuracy has been reported to be between 70% and 100%. The controversy regarding FNAC and PTAB lies within the fear of consequent complications and unsatisfactory results. The use of FNAC in RSG with a cervical component seems to be of little value. Results in this study did not alter the management of these patients and the risks of the procedure can be avoided.

On the other hand, PTAB of primary ectopic RSG should be performed to differentiate ectopic goiters from other mediastinal masses, and possible complications are negligible [16].

The presence of compressive symptoms is a risk factor for the development of complications [17]. Most of our patients that developed complications had long standing symptoms, therefore we agree with Rios et al. [18], who recommend early treatment of patients with compressive symptoms, especially those with airway manifestations, because of the high risk of acute respiratory insufficiency and even death.

Cervical approach was achieved in 90.4% (66/73) of our cases without the need for any additional incisions, and the thoracic approach was used in 9.6% (7/73). This coincides with that reported by others [14]. Most surgeons recommend a cervical approach and consider it sufficient to deliver the goiter into the neck in up to 98% of cases and without any significant morbidity [19].

In this series 19.2% (14/73) of our cases had RSG extending to (13/14) or beyond (1/14) the arch, of which 6 needed a thoracic approach (42.9%), so we agree that extension to the arch or beyond was a very significant risk factor for using a thoracic incision \( p < 0.0001 \), this was also correlated with CT findings and showed the same significance \( p = 0.003 \) [7,8].

Posterior mediastinal goiters are more commonly found on the right side than on the left and this was explained by the presence of the aortic arch and descending aorta posteriorly on the left side. Many believe posterior extension to be an increased risk for a thoracic approach [4]. Cervical delivery was possible in 85% (17/20) of our cases and the retrotracheal location showed no significance in determining a thoracic approach. An even higher incidence of cervical delivery (95%) of posterior RSG was reported by de Andrade [20].

Our results did not show any significant increase in risk of complications \( p > 0.05 \) between total and less than total resections. The percentage of recurrent goiters in our series is 24.7%; this is higher than the reported incidence of recurrent RSG, 5–10% [17]. We think this was because total thyroideectomy has not yet gained favor over other types by most surgeons.

Figure 1 Agreement between CT and surgery regarding laterality, vertical and longitudinal extension.
Surgery for recurrence did have higher rates of RLN injury (22.2%) as opposed to primary thyroidectomies (13.2%). Development of hypocalcaemia between the two groups was comparable, 27.8% in recurrent RSG and 32.1% in primary surgery; this is in agreement with that reported by others [21, 22].

Recurrent goiters and malignancy are possibly the most challenging of all RSG without the added risk of deep extension into the thorax [8, 14]. We found that both recurrence and malignancy were significant risk factors in patients that needed a thoracic approach; p value 0.036 and 0.018, respectively.

Malignancy in RSG has been reported to range between 9–13% [23], although some have reported higher rates [24]. The NCI is the largest cancer referral center in Egypt and this explains our higher rate of malignancy, 29.1%. Cohen [14], states that malignancy does not in itself mandate a thoracic approach. He reported 20% of malignant cases (1/13) needed a thoracic approach. Five of our 21 malignant RSG needed thoracic approach (24%). We also agree that malignancy on its own does not command a combined approach.

Ectopic or Primary RSG represents 0.2–1% of all RSG (1712), our incidence was 1.4%. There is no debate on whether ectopic RSG should be approached via the thorax.

It is generally agreed that surgery for RSG is associated with a higher rate of complications [25]. Arici et al. [26] report complication rate following surgery that reach 30%.

Overall, we had a 44% rate of morbidity; RLN injury and hypocalcaemia were reported in 13.7% and 30.1%, respectively in this study. This high rate can be explained by our higher incidence of malignancy and recurrent RSG in our series.

Age was found to be a significant factor in the development of non surgery related complications especially postoperative chest infection, where patients above the age of 70 were found to be at a greater risk of pneumonia than their younger counterparts and overall non surgery related complications [27]. Age was found to be a risk factor in the development of complications in this series also (p = 0.017).

Cichoń et al. [28] had no mortalities in their study as opposed to our rate of 2.7% (2/73). They also reported a much higher rate of thoracotomies (30.7%); ours was only 9.6%, which were mainly due to recurrent and posterior mediastinal RSG. This explains our higher rate of mortality where both cases were recurrent goiters and one was a posterior RSG which could have been avoided if a thoracic approach was applied.

Conclusion

Based on our review data, preoperative CT can be used effectively to guide the indications for using a thoracic approach. Vertical extension at or below the level of aortic arch, loss of tissue planes and the presence of mediastinal lymph nodes and recurrent and malignant RSGs was considered the most important CT findings raising the possibility of thoracic approach. However, cervical delivery should be first attempted in all cases.

References


