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IP Journal of Otorhinolaryngology and Allied Science

Journal homepage: <https://www.joas.co.in/>

## Original Research Article

## Retrosternal goitre and its management

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## ARTICLE INFO

## Article history:

Received 31-05-2021

Accepted 21-07-2021

Available online 04-08-2021

## Keywords:

Retrosternal goitre

Surgery

Thyroidectomy

Sternotomy

## ABSTRACT

**Background and Objective:** Retrosternal goiter (RSG) is a term that has been used to describe a goiter that extends beyond the thoracic inlet. Retrosternal goitre is defined as a goitre with a portion of its mass  $\geq$  50% located in the mediastinum. Surgical removal is the treatment of choice and, in most cases, the goitre can be removed via a cervical approach. Aim of this retrospective study was to analyse personal experience in the surgical management of retrosternal goitres, defining, in particular, the features requiring sternotomy.

**Setting and Design:** Retrospective study, teaching hospital-based.

**Materials and Methods:** Retrospective analysis of 687 thyroidectomies performed between 2008 and 2019. The 47 (6.84 %) patients with RSG were analyzed further, with regard to demographics, presentation, indications, and outcome of surgical treatment.

**Results:** There were 47 patients (6.84 %) with RSG, [ 34 females (72.34%), 13 males (27.66%)] (mean age: 52 years, range: 34-76), out of 687 thyroidectomies, in a 14 -year period. The most common presentation was neck swelling (68%), followed by respiratory symptoms (46.8%) and the surgical procedure predominantly used was total thyroidectomy. The RSGs were removed by collar incision in 43 (91.5 %) of the cases, only 4 cases (8.5 %) required sternotomy. (residual thyroid in mediastinum after cervical approach in one case and due to very large thyroid reaching the main bronchial bifurcation in the other three). The final histological diagnosis revealed malignancy in 8.5 % of the thyroid specimens. There was no mortality and minor complications occurred in nine patients (19.1%).

**Conclusions:** The presence of an RSG is an indication for surgery owing to the lack of effective medical treatment, the higher incidence of symptoms related to compression, low surgical morbidity, and the risk of malignancy. Surgical removal of a retrosternal goitre is a challenging procedure; it can be performed safely, in most cases, via a cervical approach, with a complication rate slightly higher than the average rate for cervical goitre thyroidectomy, especially concerning hypoparathyroidism and post-operative bleeding. The most significant criteria for selecting patients requiring sternotomy are computed tomography features, in particular the presence of an ectopic goitre, the extent of the goitre to or below the tracheae carina. If retrosternal goitre thyroidectomy is performed by a skilled surgical team, familiar with its unique pitfalls, the assistance of a thoracic surgeon may be required only in a few selected cases

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## 1. Background

Goiter is a term derived from the Latin tumidum gutter, meaning swollen throat, and is defined as a thyroid gland that is twice the normal size or over 40 g.<sup>1</sup> Retrosternal,

substernal, intrathoracic or mediastinal are terms that have been used to describe a goiter that extends beyond the thoracic inlet. Retrosternal goitre (RSG) was first described by Albrecht von Haller in 1749, as the extension of the thyroid tissue below the upper opening of the chest . Since then RSG has always been considered a challenge

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for the surgeons, because of the difficulties that may be encountered during surgical removal. The definition of RSG is still not uniform, and varies between the different authors. However, the most commonly accepted definition of RSG describes a goitre as substernal or retrosternal when a  $\geq 50\%$  portion of the mass is located in the mediastinum. As described by Candela in 2007, any goitre that descends below the plane of the thoracic inlet or grows into the anterior mediastinum for more than 2 cm is considered retrosternal. In endemic goitre areas, 20% of the population over 70 will have retrosternal goiter. Diagnosis of RSG is most frequently made in the fifth or sixth decade of life, with a female/male rate of 4:1. Advancing age is associated with increased medical co-morbidity, implying that operation at an earlier stage of goitre development may be associated with reduced complications related to co-existing disease. RSGs can be classified as either primary or secondary. Primary intra-thoracic goitres arise from aberrant thyroid tissue which is ectopically located in the mediastinum, receive their blood supply from mediastinal vessels and are not connected to the cervical thyroid. They are rare, representing less than 1% of all RSGs. Secondary RSGs develop from the thyroid located in its normal cervical site. Downward migration of the thyroid into the mediastinum is facilitated by negative intra-thoracic pressure, gravity, traction forces during swallowing and the presence of anatomical barriers preventing the enlargement in other directions (thyroid cartilage, vertebral bodies, strap muscles, especially in patients with a short, large neck). These secondary RSGs are, characteristically, in continuity with the cervical portion of the gland and receive their blood supply, depending on cervical vessels, almost always through branches of the inferior thyroid artery.<sup>2</sup>RSGs show, in most cases, a slow-growing enlargement, which usually remain asymptomatic for many years; about 20-40% of RSGs are discovered as an incidental finding on a radiographic examination.<sup>3</sup> Retrosternal goitres are more likely to be left sided. Very rarely a left sided cervical goitre descends into the right side of the chest this is called a "crossed substernal goitre". The most common symptoms are related to compression of the airways and the oesophagus, and are represented by dyspnoea, choking, inability to sleep comfortably, dysphagia and hoarseness. Less commonly, signs of compression of vascular and nervous structures are present, such as superior vena cava obstruction (superior vena cava syndrome) and/or Horner's syndrome (compression of sympathetic chain). The diagnosis of RSG is based upon clinical history, clinical examinations, and imaging findings. Computed tomography (CT) scanning is, at present the most exhaustive examination for assessment of the extent of the goitre and compression effects on adjacent anatomical structures. Magnetic resonance imaging (MRI) adds little additional information to that obtained with CT and is not routinely

used.<sup>2</sup>Surgery plays an important role in the treatment of these patients, but whether all or selective patients with retrosternal goiter (RSG) should undergo the operation remains controversial.<sup>4</sup> There are numerous reasons for performing surgery in such cases:

1. Non-surgical treatment of RSG with thyroid hormone or radioactive iodine ablation is very rarely successful.<sup>5</sup>
2. RSG can become a life-threatening emergency if there is a sudden enlargement of the goitre, secondary to hemorrhage, cystic degeneration or malignant change, and asphyxiation, which can be life threatening.<sup>6</sup>
3. A diagnosis of malignancy, reported in 3-21% of RSGs<sup>7</sup>, could be missed, considering the difficulties and potential dangers in performing fine-needle aspiration cytology in the mediastinal portion of a RSG.

Differences in the recommendations for the treatment of cervical goitre and of retrosternal goitre seem paradoxical as the latter is not a biologically distinct entity but simply a variant (of nodular goitre) by virtue of its anatomy. Most RSGs can be removed through a cervical approach, while an extra cervical approach (either manubriotomy, sternotomy (partial or total) or thoracotomy) should be performed only in a minority of patients, ranging between 1- 20%.<sup>2,3</sup> In this retrospective study, a review has been made of personal experience in patients who had undergone thyroidectomy for RSG over the past fourteen years. As local data are lacking, we present our experience with the surgical management of RSG, defining the characteristic findings of our patients with role of surgery in its treatment.

## 2. Materials and Methods

Over a 10-year period (2008-2018), 687 patients underwent thyroidectomy. In all those patients with clinical suspicion of retrosternal extension of the goiter (lower pole of the cervical goitre not palpable) or with findings of tracheal deviation or a mediastinal mass upon chest X-ray, a CT scan was performed before surgery. Overall, 47 patients (6.84%), [34 females (72.34%), 13 males (27.66%)] (mean age: 52 years, range: 34 – 76), underwent total thyroidectomy on account of a RSG. The goitre was considered retrosternal when extending at least 3 cm below the cervico-thoracic isthmus, upon CT examination, performed with hyperextension of the neck. All patients with a minor mediastinal extension of the goitre were excluded from this study. The records of these patients were analysed with regard to: clinical symptoms, history of previous thyroidectomy, presence of tracheal deviation (defined as displacement of the trachea from the normal midline position) or tracheal compression (defined as a reduction in size of the tracheal lumen), site of mediastinal extension (anterior or posterior in relation to the centre

of the trachea in the antero-posterior plane), type of surgical approach (only cervical or cervical with median sternotomy), histological findings of thyroid, and post-operative complications.

### 3. Results

In 43/47 RSG patients (91.5%), thyroidectomy was performed through a cervical incision, while in 4 patients (8.5%), a median sternotomy had to be performed, in collaboration with cardio-thoracic surgeons, in order to achieve safe removal of the goitre. Overall, 32/47 patients (68%) operated for RSG were pre-operatively symptomatic, while 15 (32%) were asymptomatic except for complaints of a cervical mass. The symptoms most commonly reported were respiratory: various degree of dyspnoea, cough, choking, etc, and were present in 22 patients (46.8%); 4 (8.5%) patients complained of dysphagia, whereas signs of vena cava syndrome (venous engorgement in the face or neck at rest) were present in 1 patient (2.12%) [Figure 4]. In the sternotomy group, all patients were symptomatic, while 3 patients complained of dyspnoea, in one patient associated with dysphagia and in another with vena cava syndrome. [Table 1] Overall, 35 patients (74.4%) (32 patients in the cervical group, i.e., 74.4%, and 3 patients in the sternotomy group, i.e., 75%), presented CT evidence of tracheal compression or deviation. Goitre was anterior to the trachea, on CT scan, in 44 patients (93.6%), posterior in 3 patients (6.4%). The mediastinal extension of the goitres was predominant on the right side in 23 patients (49%), on the left side in 18 patients (38.3%), and bilateral in 6 patients (12.7%). As per the depth of the mediastinal extent of the goitres, 6 patients (12.7%) presented CT evidence of descent below the aortic arch in all of these cases, thyroidectomy was performed through a cervical approach. In 3 patients (6.4%), CT scan showed evidence of the goiter reaching the carina tracheae; in all of these patients, sternotomy was required. All patients were euthyroid except one patient who had a toxic goiter, which was controlled preoperatively. There was no significant comorbidity and all the patients were offered surgery. Median sternotomy was needed in only four patients (8.5%) and in 91.5% of the patients, cervical collar incision was adequate for the removal of these masses. The patients' characteristics are summarized in [Table 2]. There were no perioperative deaths and morbidities were minimal, as minor complications occurred in nine patients (19.1%); most of them resolved completely [Table 3].

Histology showed the presence of thyroid carcinoma in 4 patients (8.5%), two follicular carcinoma and two papillary carcinoma, all four patients were operated upon via a cervical approach, while in the remaining 43 patients (91.5%) a benign lesion (goitre, follicular adenoma, etc.) was discovered. All malignancies were detected only after the final histology. No formal neck dissection was

performed, but lymph nodes in zones 6 and 7 were removed along with the retrosternal part of the goiter.

Post-operative complications occurred in 9 patients (19.1%), 7 patients in the cervical group (16.3%), and 2 patients in the sternotomy group (50%). The most common complication after thyroidectomy, for RSG, was transient hypoparathyroidism which occurred in 7 patients (14.9%), 4 (9.3%) of them in the cervicotomy group and 3 in the sternotomy group (75%). Post-operative bleeding requiring immediate re-operation occurred in 1 patient (2.12%) only, in the sternotomy group (25%). Permanent hypoparathyroidism occurred in 2 patients (4.25%), both in the cervicotomy group. Two patients (4.25%) had post-operative airway complications, requiring, a temporary tracheostomy due to airway oedema. Post-operative temporary vocal cord paralysis occurred in 3 cases (6.4%); two patients (4.25%) had permanent unilateral (right side) recurrent laryngeal nerve paralysis. No patients died. All patients received the thyroid stimulating hormone (TSH)-suppressive treatment with the thyroid hormone postoperatively. There was no recurrence during an average follow-up period of two years (range three months to seven years). Data concerning post-operative complications are outlined in Table 3.

### 4. Discussion

Retrosternal goiter was first described by Haller in 1749. The incidence of RSG is reported to range from 3 to 20% of the patients undergoing thyroid surgery.<sup>2,3</sup> This wide range in the incidence is mainly due to the variation in the definition of RSG.

The most common symptom in our series was respiratory, occurring in 46.8% of the cases, which resulted from compression of the trachea or the esophagus or both. This complication was caused by the progressive nature of the disease, combined with the narrow passage of the inlet. A classical chest X-ray finding of the RSG included a mediastinal mass with tracheal deviation and compression, and visualization of the smooth or nodular outline of the tumor [Figure 1] However, 30% of these patients may have a completely normal chest X-ray (to be consistent, chest X-ray or radiograph). In our series, 20% of chest X-rays were normal. All patients had an ultrasound as part of the routine evaluation of goiters, which suspected the retrosternal extension in some patients; however, the ultrasound could not provide detailed information about the RSG. A CT scan shows the relationship of the goiter with the trachea, the esophagus, and great vessels, as well as how deeply into the chest the gland descends [Figure 2]. In this series, a CT scan was performed routinely for all patients.<sup>8,9</sup> On CT films, intrathoracic goiter usually manifests as a clear boundary mass, its density varies due to the amount of iodine contained: when the amount of iodine in the mass is low, its density is close to the soft

**Table 1:** Symptoms / signs in patients with RSG (n = 47)

Sympton / Sign	Number	Percentage
Neck Swelling	44	93.6%
Respiratory {Dyspnea/ Cough/Choking}	22	46.8%
Dysphagia	04	8.5%
Neck discomfort	04	8.5%
Hoarsness of voice	01	2.12%
Sup. Vena cava syndrome	01	2.12%
Asymptomatic	15	31.9%

**Table 2:** Patient characteristics RSG (n = 47)

	All Patients (n=47)	Cervical (n=43)	Extra cervical / Sternotomy (n=04)
<b>Mean Age (Years)</b>	52 {range 34 -76 }	51 {range 34 -68 }	56 {range 51 -76 }
Male : Female ratio	1.0 : 2.6	1.0: 2.7	1.0:1.0
Clinical Presentation	Asymptomatic	15 (34.9%)	-
	Symptomatic	32 (68.1%)	04 (100%)
<b>Tracheal deviation/compression</b>	35 (74.4%)	32 (74.4%)	03 (75%)
Location of retrosternal component of goitre	Left	18 (38.3%)	-
	Right	23 (49%)	01 (25%)
Mediastinal extension	Bilateral/ Midline	06 (12.7%)	03 (75%)
	Below Aortic Arch	06 (12.7%)	•
Surgical Procedure	Upto Carina Trachea	03 (06.4%)	03 (75%)
	Total Thyroidectomy	24 (51.06%)	20 (46.5%)
Surgical Procedure	Near Total Thyroidectomy	10 (21.28%)	10 (23.25%)
	Sub Total Thyroidectomy	06 (12.76%)	06 (13.95%)
	Hemi Thyroidectomy	07 (14.9%)	07 (16.3%)
Histopathological diagnostics	Benign	43 (91.5%)	39(90.7%)
	Malignant	4 (8.5%) {02 Papillary, 02 Follicular }	04 (09.3%)

**Table 3:** Postoperative complications in 09 patients (19.1%) operated on for RSG

Complication	Number	Percentage
Transient symptomatic hypoparathyroidism	07	14.9%
Permanent hypothyroidism	02	04.25%
Hematoma	02	04.25%
Wound infection	02	04.25%
Pneumonia	01	02.12%
Post operative bleeding (re-operation)	01	02.12%
Transient Recurrent Laryngeal nerve paresis	03	06.4%
Permanent unilateral (right) Recurrent Laryngeal nerve paresis	02	04.25%

tissue of chest wall, and when the amount of iodine is high, its density could be greatly higher than soft tissue. In addition, its density can be uneven due to colloid cysts and calcified plaque. Magnetic resonance imaging adds little information, to that obtained with CT, and is not routinely used. Nuclear imaging with Iodine-131 or Technetium-99 scan is not considered essential in the preoperative evaluation of known RSG; moreover, not all RSGs are radioiodine avid.<sup>4-24</sup> Some of our patients underwent MRI. [Figure 3]

An FNA biopsy of an RSG may be helpful when a large cervical component exists, but this is not usually recommended, because it is technically difficult, may be dangerous to perform, and can miss the true pathology. The majority of our patients presented with a multinodular goiter (MNG). An MNG adversely affects the preoperative diagnosis of thyroid cancer with FNA, as it is particularly impossible to evaluate all of the nodules. Thyroid cancer is frequently an incidental postoperative finding originating from one of the numerous nodules, although the FNA biopsy

result is reported as benign. The reported incidence of hyperthyroidism in patients with RSG varies widely from 0 to 50%.<sup>6</sup>

Surgical removal of RSG can be performed by a cervical approach in the majority of patients. It has been reported that skilled head and neck surgeons, with good thyroid surgery experience, need to perform an extra-cervical approach in 2-5% of thyroidectomies for RSG.<sup>10</sup> but some authors have reported an incidence of sternotomy in 29% of patients.<sup>11</sup> This variability could be correlated with the lack of uniformity in definition of RSG. Initially a goitre was generically considered as retro-sternal when extended below the thoracic inlet.<sup>12</sup> Later, RSG was defined by de Souza and Smith — as a goitre with a portion of its mass  $\geq 50\%$  situated in the mediastinum. However, this definition lacks anatomic precision and can be interpreted unspecifically. More precise definitions of RSG have been suggested, namely: a goiter lying two finger breadths below the thoracic inlet with the patient in a supine position,<sup>13</sup> a goitre reaching the aortic arch,<sup>14</sup> or the carina tracheae,<sup>15</sup> a goitre with its inferior pole passing through the cervico-thoracic isthmus below the subclavian vessels.<sup>16</sup> Several classification systems have also been developed in order to better classify RSG. Cohen and Cho divide goitres into four grades, depending on the percentage of goitre mass located in the mediastinum.<sup>17</sup> Huins et al. proposed a classification of RSG based on the relationship of goitre with anatomical structures of the mediastinum: they defined three grades of goitre depending upon mediastinal extension, namely, to the level of the aortic arch, to the level of the pericardium or below the level of the right atrium.<sup>18</sup>

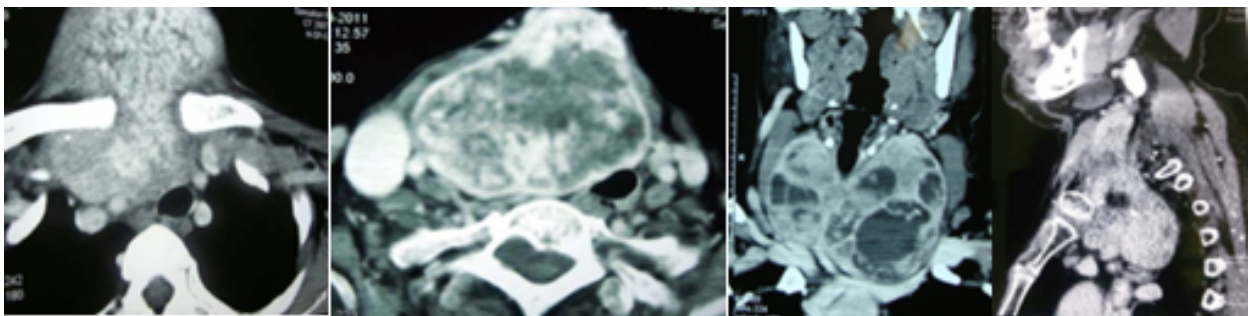
In our study, in agreement with de Perrot et al.<sup>19</sup>, we considered as retro-sternal those goitres showing an extension of at least 3 cm below the cervico-thoracic isthmus, at CT scan, performed with hyper-extended neck, excluding from the study all the many other goitres showing a less mediastinal extension. At present, many different treatment modalities have been described for the management of goiters. In our series, RSG could be removed, using a standard cervical approach, in 43/47 patients, despite the large size and depth of the mediastinal extension of the goitres.[Figure 5] Indeed, 6/43 patients showed an extension of the goitre below the aortic arch at CT scan, in these cases, access to the goitre was facilitated by the vertical extension of the cervical incision downward, towards the sternal manubrium. In this way, the inferior pole of the thyroid could be reached, and using digital dissection safely separated from the mediastinal tissues and gently retracted into the neck. The major risk of this manoeuvre depends on the poor access to the vascular structures, which complicates ligation of the vascular thyroid supply, with, in turn, a higher risk of bleeding. Nevertheless, the risk of rupture of the veins is considerably reduced by the cervical origin of the vessels, which usually descend in

the mediastinum, behind the mediastinal extension of the goitre, thus allowing the digital dissection of the thyroid and its cervical dislocation before ligation or coagulation of the vessels. The ultrasonic instruments, like Harmonic scalpel, can be very useful in the coagulation and resection of small thyroid vessels in the mediastinum. In all patients, the recurrent laryngeal nerves could be identified and the parathyroid glands preserved. It is well known that post-operative morbidity is more common in patients undergoing RSG resection than in patients undergoing thyroidectomy for cervical thyroid disease.,<sup>20</sup> the total complication rate following RSG resection via a cervical approach. No intra- or peri-operative deaths occurred.

In our series, a sternotomy was required in 4/47 patients (8.5%), (due to a residual thyroid tissue in mediastinum after cervical approach in one patient, and large thyroid reaching the main bronchial bifurcation in the remaining 3 patients).[Figure 6] For surgeons performing thyroidectomy, it is essential to pre-operatively identify patients requiring sternotomy, in order to plan the presence of a multi-disciplinary team, involving also the thoracic surgeon, when necessary, and to correctly inform the patient about the approach which it may be necessary to adopt. Many attempts have been made to specifically define the factors increasing the likelihood of sternotomy, but a general consensus has still not been reached. Flati et al., in 2005, defined the sternotomic approach as “inevitable” in the presence of an iceberg shaped RSG with  $>70\%$  of the mass lying in the mediastinum.<sup>21</sup> Later, de Perrot et al., in 2007, highlighted the need to perform a sternotomy in goiters  $> 10$  cm, in patients previously submitted to cervical thyroidectomy, and in the presence of invasive carcinoma or ectopic goitre.<sup>19</sup> More recently, Cohen identified four factors significantly increasing the need to perform sternotomy: 1. the presence of malignancy, 2. involvement of the posterior mediastinum, 3. extension of the goitre below the aortic arch and 4. the presence of ectopic goitre.<sup>22</sup> Prospective studies document the incidence of carcinoma development in goitres at 1.3–3.7 new cases per 1000 patients. A recent review of evidence-based management of substernal goitres concluded the incidence of malignant transformation is equivalent in retrosternal goitres to those residing entirely in the neck.<sup>23</sup> The possible correlation between the presence of malignancy and the need of sternotomy does not appear to be confirmed by our results, since the 4 patients, in whom a thyroid carcinoma was found, at histological examination, were successfully submitted to thyroidectomy through a cervical incision. Nevertheless, we still consider malignant neoplasms as a high risk of sternotomy procedure due to the chance of extra-thyroidal extension of the tumour and/or the need to perform dissection of mediastinal lymph nodes.



**Fig. 1:** Chest X.ray of a patient showing a large retrosternal goiter

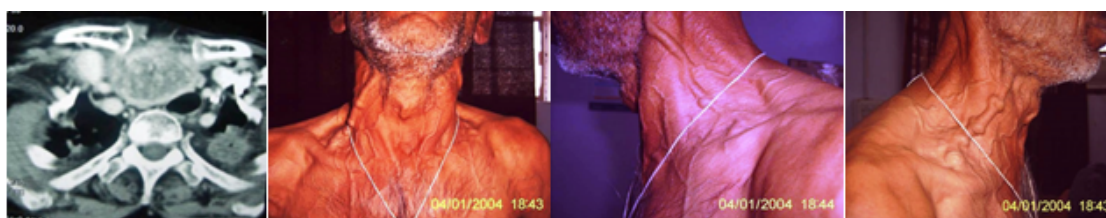


**Fig. 2:** CT scan (axial/coronal/sagittal) of the neck and chest showing the relationship of the goitre with the trachea and the mediastinum

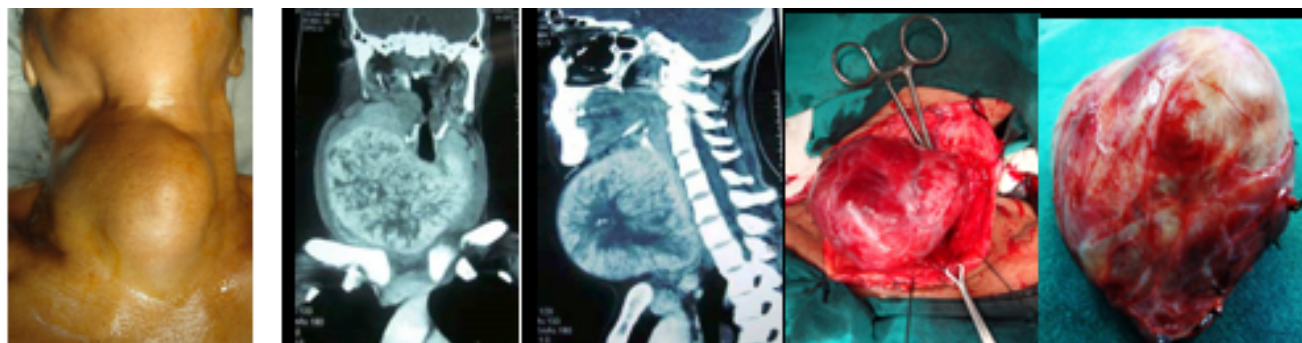


**Fig. 3:** MRI of the Neck & chest showing the relationship of the goitre with the trachea and the mediastinum

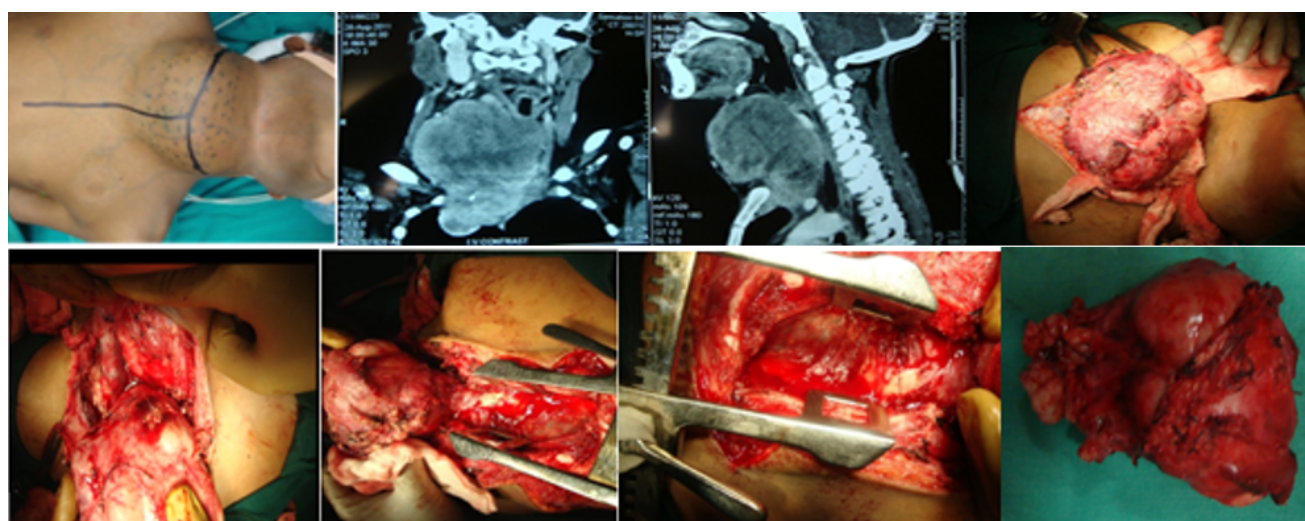




**Fig. 4:** RSG case with engorged neck veins (Superior venacaval syndrome) and Tracheal deviation



**Fig. 5:** RSG removed by cervical approach



**Fig. 6:** RSG removed by Extra- cervical / sternotomy approach

## 5. Conclusion

Removal of a RSG is a challenging surgical procedure, presenting a slightly higher risk of complications, especially hypoparathyroidism and post-operative bleeding. An attempt to remove the goitre through the cervical incision should always be made, using all the techniques available, on account of less risk of surgical and aesthetic damage obtained with this approach. The most significant criteria for selecting patients requiring sternotomy are CT scan features, in particular presence of an ectopic goitre, thyroid gland volume and extension of the goitre to or below the

tracheae carina. Therefore, the CT scan should always be included in the pre-operative diagnostic workup, when RSG is suspected. However, the final decision as to whether to perform sternotomy can be made only intra-operatively, and the choice is related to the experience of the surgeon. In conclusion, if retrosternal goiter thyroidectomy is performed by a skilled surgical team, familiar with its unique pitfalls, the assistance of a thoracic surgeon may be required only in a few selected cases. Thyroidectomy for retrosternal goitres should be performed by surgeons with a specific interest and experience in thyroid surgery to ensure that complications are minimised and a cervical approach is

successful in the maximum number of cases.

## 6. Source of Funding

None.

## 7. Conflict of Interest

None.

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## Author biography

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**Cite this article:** Varshney S. Retrosternal goitre and its management. *IP J Otorhinolaryngol Allied Sci* 2021;4(2):38–45.