

Impact of Midline Sternotomy on Surgical Outcome for Treatment of Retrosternal Goitre

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Abstract Retrosternal goitre is defined as goitre with a portion of its mass more than 50% located in the mediastinum. Surgical removal is the treatment of choice and in most cases; the goitre can be removed via cervical approach. This work aimed to evaluate the impact, value and safety of midline sternotomy on the treatment of retrosternal goitre. In the surgical department, Assiut University Hospital between March 2009 and December 2014, 1228 patient underwent thyroidectomy. Only 43 patients (3.5%) of them had retrosternal extension, 27 (62.7%) females and 16 (37.3%) males and the mean age of the patients: 54 years (range 35-75). History, clinical examination, preoperative investigation in the form of plain x-ray chest, neck ultrasonography, CT scan of the neck and chest, thyroid scanning were done when needed. All the removed glands were examined histopathologically. Intraoperative and postoperative complications were recoded. All patients followed for 6 months. The study included 43 patients; the most recorded symptoms were the dyspnea (63.3%), dysphagia (23.3%) and SVC obstruction (13.3%). All patients were presented with cervical mass (30 patients were symptomatic, 13 patients were asymptomatic). CT scan revealed the goitres were right sided in 23 (53.4%), left sided in 15 (34.8%) and bilateral in 5 (11.6%) of the patients. Thirty two patients (74.4%) were treated via cervical approach, 10 of them (31.2%) presented CT evidence of descend below the aortic arch. Eleven patients (25.5%) undergone sternotomy in which the C.T scan showed evidence of the goitre reached to the carina of the trachea. postoperative complications occurred in 8 (18.6%) patients (7 (16.2%) in the cervical group and one (2.3%) in the sternotomy group). Sternotomy is generally accepted for the removal of retrosternal goitres in the anterior mediastinum. It is safe procedure and able to dominate retrosternal goitre especially its vascular pedicle without complication.

Keywords: *Thyroid, goitre, Retrosternal, Sternotomy, Surgical Outcome*

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1. Introduction

Retrosternal goitre (RG) was first described by Albrecht von Haller in 1749, as the extension of the thyroid tissue below the upper opening of the chest [1]. The most commonly accepted definition of RG describes a goitre as substernal or retrosternal when a $\geq 50\%$ portion of the mass is located in the mediastinum [2]. The incidence of RG is documented in (2.19%) of all thyroidectomies [3]. Diagnosis of RG is most frequently made in the fifth or sixth decade of life, with a female to male ratio of 4:1. RG can be classified as either primary or secondary. Primary intrathoracic goitre arises from aberrant thyroid tissue which ectopically located in the mediastinum, receives their blood supply from mediastinal vessels and is not connected to the cervical thyroid. They are rare, representing less than 1% of all RGs [4]. Secondary RGs develop from the thyroid located in its normal cervical site. Down word migration of the thyroid

into the mediastinum is facilitated by negative intrathoracic pressure, gravity, traction forces during swallowing and the presence of anatomical barriers preventing enlargement in other directions (thyroid cartilage, vertebral bodies, strap muscles, especially in patients with a short, large neck). About 20-40% of RG are discovered as an incidental finding on radiographic examination [5]. The majority of patients in addition to neck swelling, present with shortness of breath or asthma like symptoms. Other symptoms are hoarsness of voice, dysphagia, stridor and about 50% of patients may be asymptomatic [6]. Thyrotoxic symptoms were reported in less than 10% of cases [7]. Less commonly, signs of superior vena cave obstruction and Horner's syndrome (compression of sympathetic chain). The diagnosis of RG depends on clinical history, examinations and imaging findings [8]. Computed Tomography (CT) is considered to be the most useful in evaluation the extent of goitre and defining its relationships to adjacent structures [9]. Magnetic Resonance Imaging (MRI) adds little additional information to that obtained with CT and is not routinely

used [10]. There is general agreement that surgical removal is the treatment of choice of RG, even in the absence of clinical symptoms [11]. Most RGs can be removed through a cervical approach, while a partial or total sternotomy should be performed in some cases, ranging between 1-11 % [12]. The aim of the present work was to evaluate the impact, value and safety of midline sternotomy on the treatment of retrosternal goitre.

2. Patients and Methods

Out of 1228 patients underwent thyroidectomies, at surgical department, Assiut university Hospital between March 2009 and December 2014, only 43 (3.5%) of them had retrosternal goitre (27 (62.7%) females and 16 (37.2%) males). Mean age 54 years; range: 35-75). The study was approved by the medical research ethics committee of the faculty of medicine, Assiut University, Egypt and informed consent was taken from all patients.

History and clinical examination were taken for all patients. The preoperative investigation included, plain x-ray chest, neck ultrasonography. CT scan of the neck and chest, thyroid function tests, serum ca level, and pulmonary function tests in patients with dyspnea. The records of these patients were analyzed with regards to clinical symptoms, presence of tracheal deviation or tracheal compression (defined as a reduction in size of the tracheal lumen), site of mediastinal extension (anterior or posterior in relation to the center of the trachea), type of surgical approach, either cervical or cervical with median sternotomy. All patients underwent thyroidectomy using the standard surgical approach with minor changes. After ligation and division of the middle thyroid veins, devascularisation of the upper thyroid pole was done.

Identification of the correct plane, superiorly and posteriorly were done. The index finger passed downward almost sliding in a convex surface of the gland. If the lower pole was palpable intraoperatively, the intrathoracic part was gently manipulated by the index finger to free any adhesions and the lobe was pulled up and delivered. If the lower pole was not palpable or difficult to be delivered, sternotomy was decided to deliver the gland. Good haemostasis was achieved and preservation of recurrent laryngeal nerve and parathyroid glands were done. Histopathological findings and post-operative complications were recorded. All patients were followed up for 6 months for hypocalcaemia and recurrent laryngeal nerve palsy. Statistical calculation of non-parametric data was done using chi-square test to compare signs and symptoms and analyzed using SPSS for Windows version 16.0, and $p < 0.05$ considered significant.

3. Results

In 32 out of 43 (74.4%) patients, thyroidectomy was performed through a cervical incision, while in 11 patients (25.5%), a median sternotomy had to be performed (Figure 1). Thyroidectomy was done in collaboration with cardiothoracic surgeon to achieve safe removal of the goitre. Thirty patients out of 43 (69.7%) operated for RG were symptomatic, while 13 (30.2%) were asymptomatic except for presence of a cervical mass. The recorded symptoms commonly were respiratory in the form of dyspnea which was reported in 19 patients (63.3%); 7 patients complained of dysphagia (23.3%), whereas signs of vena cave obstruction were present in 4 (13.3%) patients. (Table 1)

Table 1. Clinical presentation of RG in the studied patients

Clinical presentation	Symptomatic		Non symptomatic	
	Number n = 30	69.7 %	Number n = 13	30.2 %
Cervical mass	30	69.7%	-	-
Dyspnoea	19	63.3%	-	-
Dysphagia	7	23.3%	-	-
SVC obstruction	4	13.3%	-	-
Total	30	69.7%	13	30.2%

Table 2. Patients characteristics in the C.T scanning

Characteristics	All patients		Cervical		Sternotomy	
	Number n=43	%	Number n=32	%	Number n=11	%
Tracheal deviation/compression	29	76.4	18	26	11	37.9%
Mediastinal extension:						
- Below aortic arch	10	23.2	10	23.2	-	-
- Reaching to the carina of the trachea	11	25.5	-	-	11	25.5
Side of descend:						
- RT	23	53.4	19	82.6	4	21
- LT	15	34.8	10	66.6	5	33.3
- Bilateral	5	11.6	3	60	2	40

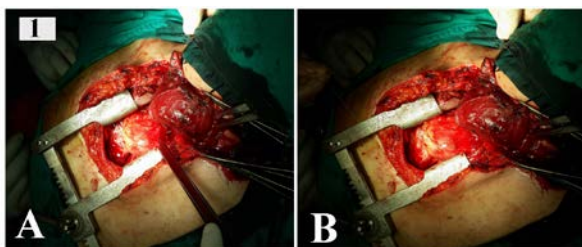


Figure 1. A: low collar incision with midline sternotomy and the two parts of the thyroid gland (cervical and mediastinal parts) **B:** Dissection of the mediastinal part of the gland after retraction of the sternum

Overall, 29 patients out of 43 (67.4%) (18 patients in the cervical group (62%) and 11 patients in the sternotomy group (37.9%)), presented CT evidence of tracheal compression or deviation. Table 2 shows that, goitre was anterior to the trachea at C.T scan in 33 out of 43 patients (76.7%), posterior in 7 patients (16.2%). Whereas in 3 patients (9%), complex spreading of the thyroid mass anteriorly and posteriorly. The mediastinal extension of the goitres was common on the right side in 23 patients (53.4%), on the left side in 15 patients (34.8%) and bilateral in 5 patients (11.6%). As regard the depth of the mediastinal extent of the goitres 10 patients (23.2%)

presented CT evidence of descent below the aortic arch. In all these patients, thyroidectomy was performed through a cervical approach. In the sternotomy group (11 patients), CT scan showed evidence of the goitre reaching the carina of the trachea so that sternotomy was required for all these patients. (Table 2 & Figure 1- Figure 3).



Figure 2. Constricting ring between cervical and retrosternal parts with complete devascularization of the mediastinal part of the gland



Figure 3. The gland after excision with its two parts

The mean operative time was 105 minutes (Range: 42-220) in cases treated via cervical approach and 185 minutes (Range: 90-250) in cases treated by sternotomy. Post-operative histopathological study revealed the presences of thyroid carcinoma in 5 patients (11.6%), 4 of them were papillary carcinoma and one was follicular carcinoma. The remaining 38 patients were benign in the form of colloid goitre, follicular adenoma and thyroiditis.

Post-operative complications occurred in 8 patients (18.6%), 7 patients in the cervical group (16.2%) and one patient in the sternotomy group (2.3%).

The most common complication was the transient hypoparathyroidism which occurred in 5 patients (11.6%), all of them occurred in the cervical group. Post-operative bleeding requiring reoperation occurred in 2 patients (4.6%), one in the cervical group and one in the sternotomy group. One patient (2.3%) had post-operative stridor due to vocal cord oedema requiring temporary tracheostomy (operated via cervical approach). No patient

had permanent recurrent laryngeal nerve paralysis and no patients died (Table 3).

Table 3. Post-operative complications

Complications	All patients n=43		Cervical n=32		Sternotomy n=11	
	Number	%	Number	%	Number	%
Transient hypoparathyroidism	5	11.6	5	11.6	-	-
Post-operative bleeding	2	4.6	1	2.3	1	2.3
Post-operative stridor	1	2.3	1	2.3	-	-

4. Discussion

In the majority of patients, RG can be performed by a cervical approach. Skilled surgeons with good experience need to perform sternotomy in 2-5% of thyroidectomies for RG [13]. Some Authors have reported an incidence of sternotomy in 29% of patients [14]. Initially the goitre considered RG when extended below the thoracic inlet [15]. Later on, RG defined as goitre with a portion of its mass $\geq 50\%$ situated in the mediastinum. More precise definitions of RG have been suggested, namely: a goitre lying two finger breadths below the thoracic inlet with the patient in supine position [16], a goitre reaching the aortic arch [17], or the carina trachea [18], a goitre with its inferior pole passing through the cervico-thoracic isthmus below the subclavian vessels. Huins et al [19] proposed a classification of RG based on the relationship of goitre with the anatomical structures of the mediastinum: they defined three grades of goitre namely, grade I to the level of the aortic arch, grade II to the level of the pericardium and grade III below the level of the right atrium. In our study, RG removed via cervical approach in 32 patients out of 43 patients, in spite of 10 patients (23.2%) of them descended below the level of aortic arch at C.T scan. This was in agreement with Maruotti et al [20], who recorded in his series, 42 (77%) patients out of 52 patient of RG treated via cervical approach while (10) patients need sternotomy (23%). The most common symptom in our study was dyspnea (63.3%), cervical mass in (69.7%), S.V.C syndrome in (13.3%), and dysphagia (23.3%) while Deperrot et al. [21], mentioned in this study that the clinical presentation of RG was mainly dyspnea (37%), palpation of a cervical mass (65%), S.V.C syndrome (12%), dysphagia (19%). In this study C.T scan proved to be, the RG was anterior in (76.7%), posterior in (16.2%) and mixed in (9%), this was in agreement with Flati et al., in 2009 [22], who mentioned that the RG most commonly presented anteriorly (70%) and less commonly posteriorly (12%) and mixed in (18%) and also he mentioned that sternotomic approach as inevitable in the presence of iceberg shaped RG with $>70\%$ of the mass lying in the mediastinum. In our series 10 patients (23.2%) of a cervical group descended below the level of aortic arch treated without sternotomy. This was similar to the study done by White et al 2008 [23] who mentioned that 14 patients out of 40 (35%) of RG reached to the level of aortic arch and treated without sternotomy so that he suggested that sternotomy is more likely to be performed only in the presence of a primary RG or a mass larger than the thoracic inlet.

In our study, II patients (sternotomy group), the CT scan showed evidence of the goitre reached to the carina of the trachea so that, sternotomy was done for all these patients. This was in agreement with Fabrizio et al., [24] who mentioned that the main advantage of sternotomy in the possibility to properly dominate mediastinal masses, especially their vascular pedicles, through a wide operative field. Also He mentioned, the ectopic goitres have a proper vascularization and this must always be kept in mind, as mediastinal bleeding may be difficult to treat. Also Per Malvemyr et al., [25] proved in his study that, retrosternal goiter extension below the aortic arch concavity was confirmed as a significant risk factor for sternotomy. In this our study, post operative complications occurred 8 patients (18.6%), the most common complication were transient hypoparathyroidism (5 patients) (11.6%), post operative bleeding in 2 patients (4.6%), respiratory complications in the form of strider due to vocal cord oedema in one patient (2.3%) this was similar to the study of the Coskun et al [26] who mentioned in his series as 42 patients had substernal goitre and were included in this study, 38 patients (90-5%) treated by a cervical approach and 4 (9.5%) by full median sternotomy. All surgeries were successful with no major postoperative complications. Minor postoperative complications of transient hypocalcaemia and transient paralysis of the recurrent laryngeal nerve occurred in 5 (11.9%) and 2 (4.7%) cases respectively. Gamal et al [27] reported in his study that, the postoperative morbidity was minimal, temporary hypoparathyroidism was the most common (15.4%) complication. Faruque et al. [28] reported that although the majority of reterosternal goitres are amenable to transcervical thyroidectomy, in a minority of patients, sternotomy is required (17 patients out of 80 of reterosternal goitre)

In conclusion, the ability to predict the need for sternotomy before operation would allow to safer surgery with very low postoperative complications as well as improved logistical efficiency in coordination with thoracic surgeons in required. The most important indications for sternotomy were posterior mediastinal extension, extension below the carina, and a conical goitre in which the thoracic inlet becomes a ring of constriction.

Conflict of Interest/Funding

None.

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