Surgical management of mediastinal goiter in the elderly

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Aim: Mediastinal goiter (MG) is characterized by compression symptoms such as choking, dyspnea, sleeping apnea and dysphagia. It is significantly observed in elderly patients who due to comorbidity are associated to increased surgical risk. Total thyroidectomy is indicated to treat tracheal compression. Cervicotomy is the most used surgical access. Aim of the study was the evaluation of the role of surgery in the treatment of MG in the elderly.

Methods: A retrospective analysis of twenty-eight-years on 1721 cases of MG in a referral center for endocrine surgery was carried out. CT was used as a standard in the preoperative study. Surgery was performed by an experienced surgical team with standard technique via cervical approach or in selected cases via sternotomy or thoracotomy. Clinical records were examined.

Results: Patients were divided into two groups: older and younger than 80-years-old. Total thyroidectomy was performed in all cases and via a cervical approach in almost 99% of patients. Tracheal dislocation and tracheomalacia were prevalent in elderly patients and were treated conservatively. Benign struma was observed in 1463 patients and a carcinoma in 258. Larger thyroid weight was observed in the elderly. The rate of complications was similar between groups.

Conclusion: Total thyroidectomy via cervical approach is the treatment of choice for MG in the elderly. It should be treated only in referral centers with adequate caution for elderly patients to achieve complete cure with limited complications.

1. Introduction

Intrathoracic thyroid masses account for 5.8% of all mediastinal masses [1]. The definition of mediastinal goiter (MG) generally refers to a struma with a location for at least 50% of its volume in substernal position [2]. For embryologic reasons, MG are mostly located in the anterior and middle mediastinum, and rarely in the posterior mediastinum. Up to 40% of MG are asymptomatic and they are diagnosed incidentally [3]. When clinically manifest MG is usually associated to compressive symptoms which mainly determine effects on surrounding structures, especially on the trachea with consequent dislocation producing choking, dyspnea and sleeping apnea or on the esophagus with dysphagia. Less frequently are observed compressive effects on cervical and mediastinal neurovascular structures with rare cases of superior vena cava syndrome due to venous compression and thrombosis and even of Horner’s syndrome for chronic compression on the sympathetic chain [3,4].

Total thyroidectomy with en bloc removal of the intrathoracic portion of the thyroid, is the treatment of choice. Usually a cervical approach is appropriate in most of the cases being the mediastinal portion easily externalized by traction and digital maneuvers. In selected cases a partial or complete median sternotomy or a thoracotomy are required to achieve radical excision without hemorrhagic complications. Since MG shows a prevalence in a population of old patients with large goiters, progressively descending in the mediastinum, specific considerations must be faced in this group. Aim of the study was the analysis of a large experience of a referral center for endocrine surgery in the...
treatment of MG focusing on the surgical issues observed in elderly patients.

2. Materials and methods

Over a twenty-eight years period (1986–2013), 1721 (13%) cases of MG were observed and treated among 12,824 patients underwent thyroidectomy in the Unit for Endocrine Surgery, Terni University Hospital, Perugia University, Italy. All MG patients underwent a functional study with dosage of FT3, FT4, TSH, thyroglobulin, antibody against thyroperoxidase and thyroglobulin and parathyroid hormone (PTH). Neck and Chest computed tomography (CT) for preoperative surgical planning was performed in all cases. In selected cases endoscopy was used. Preoperative therapy with lugol solution and beta-blockers was adopted when indicated. Surgery was performed by an experienced surgical team including skilled endocrine surgeons supported if required by thoracic surgeons. Surgical technique is standardized based on the large experience in ordinary thyroidectomy[4–7]. On a technical point of view, thyroidectomy started from the smaller lobe gaining complete mobilization of the contralateral one with removal of the thyroidal mass. The dissection was operated aiming preliminary superior and inferior laryngeal nerves identification, the inferior was followed completely till the larynx when technically feasible. Careful dissection of the parathyroids was operated as in ordinary thyroidectomy. In all patients a Jackson Pratt drainage was used and removed according to the clinical course. A serum dosage of calcium and PTH was performed in all operated patients according to the standard protocol in use in our Department as previously reported[4–7]. The clinical records of MG patients were analyzed for: history of previous thyroid pathology and incomplete surgery with residual intrathoracic goiter, symptoms, presence of tracheal deviation and/or compression, surgical approach (cervical or cervical combined to median sternotomy, sternotomy, thoracotomy), histology, post-operative complications.

3. Statistical analysis

The Student’s t test for analysis of variance between groups and p < 0.05 was considered statistically significant. All of the data were analyzed using XLSTAT (Addinsoft, New York, NY, USA).

4. Results

Our series included 1721 patients, 1153 females, 568 males, mean age: 60 years, (range: 55–88). Patients were divided into two groups: group A including patients older than 80-years-old (n = 390, 22.6%) and group B with patients less than 80-years-old (n = 1331, 77.4%).

Previous history of thyroid pathology and incomplete surgery was present in 78 (4% of all cases) patients whose 56 (71.7%) belonged to group A. Considering the different groups residual goiter was significantly prevalent in elderly patients (p = 0.034). In 688 patients (39.9%) compressive symptoms were present and were the cause of first access to medical care with no significant difference between groups. Comorbidity was prevalent in group A (66% vs 34%). Goiter was located in the anterior mediastinum in 92% of patients. In 165 patients MG was incidentally discovered during radiological investigations undertaken for other conditions. Prevalence of occult MG, incidentally diagnosed, was significant in group A (p = 0.049). Tracheal dislocation was evident at CT study in 638 patients (37%) with a significant prevalence in group A vs B (p = 0.044) and symptomatic in 8% of cases with no significant difference comparing group A vs B. In 11 patients, all located in group B, emergency surgery was considered for sudden increase of thyroid volume mainly due to parenchymal hemorrhage. In all patients with tracheal compression, intubation was performed with the aid of a fiberoptic bronchoscope, available in the operating room for cases of difficult intubation. We observed a secondary tracheomalacia in 37 cases (2.1%) with prevalence for the 23 patients of group A (62.1%), in all cases we maintained intubation for few days post-operatively with stenting function. We didn’t perform tracheostomy for tracheomalacia in any patient. Total thyroidectomy was performed in all cases. Surgery was performed via a cervical approach in 1696 patients (98.5%), a subtotal sternotomy was necessary in 21 patients (1.2%), due to a large thyroid reaching the main bronchial bifurcation, in 4 cases a thoracotomy (3 antero-lateral and 1 posterolateral) was performed to improve safety in the dissection. The mean surgical time was 110 min (range: 50–240), 101 min (range: 50–205) for surgery via the cervical approach with significant difference (p < 0.039) compared to 165 min (range: 115–240) in cases submitted to sternotomy and thoracotomy. No statistical differences were observed comparing groups. At pathological examination gross specimens presented mean weight of 910 g (range: 490–1730). Significant higher thyroid mean weight was observed in group A vs B (p < 0.044). Histology demonstrated a benign struma in 1463 patients (diffuse in 1106, unilobar in 31, adenoma in 15 and Base- dow syndrome in 16) and a carcinoma in 258 (15%). Incidence of malignancy was not significantly different in the two groups and it was recurrent in 23 patients and in 97 cases it was diagnosed preoperatively by FNB and by radiological features of suspicion. Post-operative bleeding, requiring a reoperation occurred in 0.5% of cases and was controlled via the cervical approach in all patients. Permanent monolateral recurrent laryngeal nerve palsy occurred in 1.3% of patients, bilateral palsy requiring a tracheotomy due to severe respiratory complications in 0.6%. Incidence of transient and permanent hypoparathyroidism was 14% and 4.1% respectively. No difference in the incidence of surgical post-operative complications was observed between group A and B. Patients were discharged in 3rd or 4th post-operative day with the exception of isolated cases. Symptoms control was successful in all patients over a period of 90 days after surgery. Dysphagia was the hardest disorder to recover. Hyperthyroidism was successfully controlled in all symptomatic patients.

5. Discussion

Treatment of a real MG is not synonymous of ordinary thyroidectomy. It must be referred to specialized center because it might be challenging even for skilled endocrine surgeons. Treatment of MG in the elderly is characterized by more potential problems due to the characteristics of a longstanding goiter with associated implications for tracheal compression, increased morbidity of patients, determining sometimes different surgical strategies compared to ordinary patients. In presence of MG a safe surgical thyroidectomy in most cases can be performed via a cervical approach whereas partial or total sternotomy in selected patients is the first choice approach or might be required intraoperatively especially in case of uncontrolled bleeding via a classical cervicotomia. Some authors reported an incidence of sternotomy up to 29% [8]. Most retrosternal goiters are situated in the anterior mediastinal compartment, but according to the literature, 10–15% are located in the posterior mediastinum [8]. In our series this rate is of 8% and all patients belonged to group B. Although most of the anterior mediastinal goiters can be removed by a transcervical approach, posterior mediastinal goiters may require additional extra-cervical incisions [8].

In our series we confirmed, on a large group of patients, that total thyroidectomy for MG via a cervical approach is feasible and
safe and that it might represent the gold standard of treatment. Standard sternotomy of principle must be proscribed because it is not founded on anatomical and technical reasons [1]. In fact the majority of MGs is secondary to the growth of the struma from the lower part of one or both lobes of cervical thyroid or isthmus through the thoracic inlet. Swallowing, gravity and thoracic negative pressure help the growth of the goiter from the anterior superior mediastinum between trachea and sternum direct into the chest cavity. Left and right brachiocephalic veins, superior vena cava, aortic arch and its three branches arrest the progression of this growth in the mediastinum. Differently the primary MG is defined as all or part of the thyroid blastoma that during the embryonic developmental period is pulled into the thoracic cavity by the descendent heart and great vessels and then continues to develop in the mediastinum. It accounts only for 0.2–1% of all the MGs [9]. The normal thyroid gland develops with the parathyroids and thymus from the primordial pharynx and its pouches during the first and second weeks of intrauterine life. When the median thyroid anlage comes in contact with the aortic sac it is pulled ventrocaudally as the sac descends. Following descent of the median thyroid anlage, its pharyngeal connection elongates as the thyroglossal duct. The thyroglossal duct normally disappears by the fifth to sixth week but the separated fragments of ectopic thyroid tissue may eventually reside anywhere in the midline along the embryologic pathway from the root of the tongue to the diaphragm [10].

The blood supply in secondary MG comes from the inferior thyroid artery and its branches while primary posterior mediastinal goiter maintains little or no connection with the cervical thyroid gland and has a vascularization derived from intrathoracic arteries [11]. These anatomical bases suggest that at least in the secondary MG located in the anterior mediastinum a complete control of the arterial supply (inferior thyroid arteries) is possible and safe via a cervical approach. In a thyroidectomy for primary MG, vascular control is possible only directly in the mediastinum. These differences are part of the evaluation for a proper surgical access [12].

The criteria for selecting patients requiring sternotomy or thoracotomy based on CT features, are usually the volume of the thyroid gland and the extent of the goiter from its isthmus to the cervical part of the gland and the extent of the goiter to or below the tracheal bifurcation, vascular connections, specific risk of bleeding and associated lymphadenopathy in case of suspicious malignancy [13–15]. We could not compare the radiological volume of the goiter and specimen weight as a criteria for prevalent extra-cervical option in the surgical approach, being the cervicotomy vs sternotomy plus thoracotomy groups not statistically comparable. Nevertheless large volume might be even considered as an option for additional access. Although the largest goiters were present in patients of group A, none of them received an extra-cervical approach, whereas few goiters of very large volume in group B were approached with additional access. We observed an incidence of malignancy of 15% which was almost similar in the two groups. It is not irrelevant when considering the correct approach, if difficult en block thyroidectomy is evident preoperatively in case of suspicious cancer. Nevertheless, as previously reported [1], we observed that even thoracotomy is usually limited to isolated cases and in our experience it was not necessary in patients who showed a thyroid cancer. Therefore it would seem inappropriate to perform a full sternotomy for retrosternal goiters that do not reach to the level of the aortic arch. However, extension to and below the aortic arch and to the level of the pericardium cannot be reached safely via a cervical approach alone, requiring some degree of intrathoracic approach to gain adequate exposure and allow delivery of the intact gland.

Many authors reported several combinations of surgical approaches ranging from videothoracoscopy to mediastinoscopy and robotic procedures to increase safety in the dissection of mediastinal structures, limiting comorbidity of classical thoracotomy and sternotomy [16–18].

Computed tomography (CT) is part of a standard protocol of evaluation in all cases in order to define preoperatively the indication to the cervical or sternotomic approach or a combination of both and the technical issues related to each singular patient [9].

On CT images, MG usually appears 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 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 [9].

MG is a challenging condition also on an anesthesiological point of view. A large goiter located in the mediastinum can compress the carina and if the patient needs to be changed to lateral position after induction of anesthesia, the risk of mediastinal syndrome with compression of heart or great vessels is increased because it might determine extreme hypoxia or heart arrest when cardiac output decreases and blood pressure drops. With increased age, cardiovascular comorbidity is effectively high being most of the patients affected by chronic heart insufficiency, high blood pressure and general low resistance to hemodynamic stress. In our series as naturally expected the elderly patients in group A were those in which the anesthesiological assessment was more challenging. Nevertheless the benefit coming from thyroidectomy in large MGs with reassessment of both endocrine status in hyperthyroidism and compressive effects on airways, was so relevant to balance the increased risk of surgery in these elderly patients. In high risk patients of all ages sometimes for acute respiratory and/or cardio-vascular insufficiency a cardiopulmonary bypass (CPB) via femoral vessels can be kept ready before induction of anesthesia so that oxygenation can be maintained if irreversible airway obstruction occurs [9].

We didn’t experienced the use of CPB mostly depending on the limited recourse to extra-cervical approach with accurate selection of patients. Elderly patients received instead adequate medical care and pharmacologic treatments in order to safely face the operation with non need for invasive procedures as above. Safe control of the airways is as well a fundamental step of perioperative management of patients with MG who can present difficult intubation. In our operating room is always available a flexible bronchoscopy which can be useful preoperatively to evaluate the grade of tracheal compression, the risk of tracheomalacia and to exclude an invasion of the tracheal wall by a suspicious neoplasm. It can also be considered for fiberoptic bronchoscope guided tracheal intubation when required at the induction of anesthesia. In our series a significant prevalence of tracheal compression was evident in group A but it was not relevant on the clinical course of these patients. All these elderly patients were anesthetized successfully with fiberoptic assisted intubation.

The severity of respiratory symptoms depends on the degree of compression. Intrathoracic goiters may cause more severe constrictive symptoms than the cervical goiters, due to the limited space of the thoracic inlet and cage. Airway obstruction (presenting with stridor) can be life-threatening, particularly if suddenly precipitated by spontaneous or traumatic intraparenchymal bleeding of the MG or by tracheal infection. In these cases tracheal decompression has been recommended, particularly in symptomatic patients. Acute airway distress may require intubation or semi-emergent surgery [19]. All patients of both groups underwent a total thyroidectomy and all the patients in group A were operated via a cervical approach. More extended thoracic accesses were avoided of principle and they were not required during operation. This approach reduced severe potential increase of general post-
operative complications. Sometimes in clinical practice the piece-meal resection with morcellation is used if anatomical radical dissection is complex or the experience and skills of surgeon not adequate for this kind of procedure [19]. This approach must be proscribed because it determines high risk of goiter recurrence for persistence of vascularized thyroid tissue, possible neoplastic spilling and bleeding [20]. In fact en block thyroidectomy, at least radical lobo-isthmectomy plus contralateral lobectomy possibly without disruption of the thyroid capsule is the gold standard technique. This standard approach avoids the problem of the “forgotten” goiter which is defined as a mediastinal thyroid mass found after total thyroidectomy, rare condition whose incidence might increase after surgery for MG, if it is not performed according to the above criteria. In fact the “forgotten goiter” is usually the consequence of the incomplete removal of a plunging goiter, and moreover, sometimes it may be attributed to a concomitant, un-recognized mediastinal goiter which is not connected to the thyroid [21–24]. This condition requires reoperative thyroid surgery which is related with higher risk of complications, including temporary or permanent recurrent laryngeal nerve palsy and hypoparathyroidism [19]. In our series most of the forgotten goiters belonged to group A. Other specific complications observed in MG may be related to tracheomalacia associated to chronic compression of an MG on the trachea. It is due to the atrophy and/or reduction of tracheal elastic fibers of the tracheal wall or interruption of the integrity of tracheal cartilage. Methods for the treatment of severe tracheomalacia in adults are limited and there is no uniform standard. Surgical treatments, including stent implantation, tracheostomy, tube insertion and external tracheal stabilization which were shown to have several therapeutic effects especially in primary tracheomalacia; however, their use requires careful consideration on an individual basis and is generally restricted to patients with localized disease [25–27]. Surgical correction of tracheomalacia as reported above is not generally recommended in a tracheomalacia associated to MG. In our experience maintenance of the oro-tracheal tube and positive pressure ventilation for few days after surgery is a safe and effective method to induce self-sclerosing healing of the peritracheal tissue, coming after thyroidectomy, which stabilizes the tracheal structures. There was a significant prevalence of tracheomalacia in group A of our series but it did not modified the clinical course of these patients. All these patients were treated conservatively for tracheomalacia as described in the intensive care unit, with no mortality or major complications.

Post-operative complication rate is slightly higher for MG than the average rate for cervical goiter thyroidectomy, especially concerning hypoparathyroidism and post-operative bleeding. In the largest retrospective study conducted in Italy over 10 years (with the participation of our institution plus other six academic departments of general and endocrine surgery) out of 19,662 patients, 1055 with MG, were treated with total thyroidectomy mostly via a cervical approach. A split-sternal approach was required in 6.5% of cases of MG. Malignancy was significantly more frequent in MG treated by cervicotomy or manubriotomy (respectively 22.4% and 36.2%) than in cervical ones (10.4%). Overall morbidity was significantly higher in both MG undergone sternotomy (53.5%) and those operated via a cervical approach (34.4%) compared to cervical goiter undergone standard cervical thyroidectomy (23.7%) [28]. As well we already observed statistically significant increases of complications in terms of transient hypocalcemia, permanent hypocalcemia, transient and permanent recurrent laryngeal nerve palsy, phrenic nerve palsy, seroma/hematoma and rarer complications comparing outcome of MG operated patients compared to those operated for cervical goiter [26]. This evidence supports that the cervical access, if not contraindicated, contains morbidity following thyroidectomy for MG. In our observation age of patients did not affect the rate of surgical post-operative complications and this confirms indication to this approach for MG even in elderly patients. Among rarer complications, lesions of the cervical thoracic duct can complicate the post-operative course in patients undergone surgery for thyroid disease. In our experience it was observed in four cases, whose two had an intraoperative detection with immediate ligature. In the other two, observed post-operatively, conservative treatment was preferred considering the low-flow of the fistula [29].

We experienced on a large series that in the management of MG, correct indications and accurate surgical technique by a proper approach, gain a successful control of symptoms in all patients in a period ranging from few days to weeks. Only dysphagic patients sometimes only partially recovered in longer time. Usually patients with history of dysphagia lasting less than 6 months gain full-recover, no improvement was instead observed in those with longer lasting disorder due probably to irreversible damage on the superior oesophageal sphincter or to lesions of the superior laryngeal nerve. Hyperthyroidism is usually successfully controlled in all symptomatic patients with immediate resolution of the hormonal dysfunction. Although the limits of a retrospective analysis, such a prevalence of clinical success after total thyroidectomy via a cervical approach for MG, clearly supports the efficacy of the procedure that is associated to limited rate of complications which although higher than in thyroidectomy for ordinary cervical goiter, might be considered acceptable for the extreme complexity of the disease. This approach is safe and effective also in elderly patients with specific caution to comorbidity and limiting aggressiveness of surgery and associated procedures.

6. Conclusion

In our experience total thyroidectomy via a cervical approach is the technique of choice for the treatment of MG in the elderly. These patients require specific care in order to contain the increased comorbidity. Tracheal compression and tracheomalacia are well managed in elderly with no need for aggressive approach. Ordinary complications are similar to what observed in younger patients and therefore the benefit of treatment balance the increased risk of surgery.

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Author contribution

Andrea Polistena: Participated substantially in conception, design, and execution of the study and in the analysis and interpretation of data; also the drafted and editing of the manuscript.

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Roberta Lucchini: Participated substantially in conception, design, and execution of the study and in the analysis and interpretation of data.

Roberta Triola: Participated substantially in conception, design, and execution of the study and in the analysis and interpretation of data.
Claudia Conti: Participated substantially in conception, design, and execution of the study and in the analysis and interpretation of data.

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