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Combined Thyroid and Cardiovascular Surgery in an Endemic Goiter Area

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Abstract

Objective: Thyroid nodules are prevalent in southern Italy, with specific regions identified as endemic for goiter. This issue is frequently observed in patients requiring cardiovascular surgery. The study evaluates the feasibility and safety of combined interventions involving thyroid and cardiovascular surgeries. **Methods:** A retrospective study of 4843 cardiac operations conducted between 2010 and 2021 identified ten cases of thyroid surgery performed alongside cardiac or vascular procedures. These procedures encompassed coronary artery bypass grafting, valvular surgeries, and carotidectomy. The patients' medical records were examined, focusing on demographic and surgical data, including age, sex, pre-operative diagnoses, cardiovascular condition, surgical approaches, post-operative stay, complications, and histological findings. **Results:** Seven males and three females underwent surgeries for coronary artery disease, valvular disorders, or both, along with carotidectomy and thyroid-related interventions. Anticoagulation with intravenous heparin was administered both perioperatively and postoperatively. No cases of neck bleeding occurred during these periods, but two out of ten patients developed wound infections. Histological examination revealed benign thyroid disease in eight patients, while two were diagnosed with papillary microcarcinoma. **Conclusion:** The study demonstrates that combined thyroid and cardiovascular surgeries are both feasible and safe. However, thyroid surgery should be reserved for cases involving intra-thoracic goiter or toxic goiter, as these conditions could exacerbate post-operative cardiac complications.

Keywords

Cardiovascular Surgery, Thyroidectomy, Goiter, Combined Surgery, Multidisciplinary Approach

1. Introduction

The intricate relationship between cardiovascular disease and thyroid function has been well documented in scientific literature [1]-[3]. Un-treated hyperthyroidism often leads to significant cardiac dysfunction, as frequently observed in multinodular toxic goiter in the elderly [4]. Conversely, inadequate iodine intake is a key contributor to thyroid goiter in endemic areas of southern Italy. Despite the introduction of a nationwide salt iodization program in 2005 (Law n. 55/2005), goiter remains endemic, albeit with a reduced prevalence compared to prior levels [5]. Cardiothoracic and thyroid/parathyroid surgery each carries both advantages and disadvantages. Among the most important benefits we find reduced cumulative risk, single anesthesia exposure, shorter overall recovery, and avoidance of a second operation with sternotomy [6]-[11], especially for low-risk patients with coexisting conditions. Equally, on the disadvantages side, we have prolonged operative and anaesthesia time, increased procedural complexity, increased post-operative haemorrhage risk, and elevated risk in patients with compromised cardiac function [11].

This retrospective study aims to provide a framework for cardiac/vascular and endocrine surgeons on determining the optimal timing for both procedures and assessing the associated risks of performing them concurrently [6]-[11].

2. Methods

A retrospective analysis of 4843 cardiac and vascular procedures conducted at Gemelli Molise Hospital in Campobasso, Italy, between January 1, 2010, and December 2021, identified ten patients who underwent concurrent thyroid surgery combined with cardiac interventions. These included coronary artery bypass grafting (CABG), valvular surgery, carotid endo-arterectomy, or combinations thereof.

During the same period, a dedicated surgeon within the Division of Surgical Oncology and general surgery performed more than 1300 thyroidectomies, as in a medium volume specialized centre. The medical records of the ten selected patients were systematically reviewed, focusing on demographic and surgical parameters such as age, sex, pre-operative thyroid disease, cardiovascular disease, surgery, post-operative stay, complications, and final histological findings.

The criteria for choosing 10 out of 4843 patients for the study came after a detailed documentation and analysis regarding diagnosis, treatment, and medical history for each one of them, and as a main criterion, the presence of goiter with intrathoracic component, which could benefit from a sternotomy procedure.

Cardiac and thyroid diseases were thoroughly evaluated before surgery, with

elective hospital admission scheduled to optimize outcomes. All patients had a documented history of goiter, with one previously confirmed as benign, and were deemed suitable candidates for dual procedures. Indications for thyroid surgery according to the guidelines [12] included cervico-thoracic or giant goiters, potentially complicated cardiovascular procedures due to obstructive symptoms. The indication for cardiovascular surgery determined patient eligibility for cardiac or vascular procedures based on the most current and relevant guidelines applicable to the surgery period [13]-[16].

The combined surgical process involved a coordinated two-stage approach in the same operating theatre. Initially, thyroidectomy was performed by specialized endocrine surgeons via a large cervicotomy. This technique facilitated gland access following neck hyperextension, allowing precise identification and preservation of the parathyroids and recurrent laryngeal nerve, as described in previous literature [12]. Subsequently, cardiac surgery procedures, including sternotomy, were conducted by cardiac or vascular surgeons. For cases involving intrathoracic goiters, careful hemostasis and placement of surgical drains ensured optimal post-operative outcomes. For some patients, to optimize surgical planning and minimize risks, a collegial decision was made to perform cardiac surgery before thyroidectomy due to the severity of the cardiac disease. In cases requiring carotid endo-arterectomy, the vascular surgeon extended the neck incision laterally after the thyroidectomy to complete the procedure.

All patients were post-operatively admitted to a dedicated intensive care unit. Parathyroid function was monitored via calcium and i-PTH (intact Parathyroid Hormone) measurements on the first day post-operatively, to prevent severe hypocalcemic complications, transient hypocalcemia was defined as measured blood calcium level below 8.0 mg/dL within 6 months after surgery, with or without a subnormal serum parathyroid hormone level (less than 15.0 pg/mL) or the need for continuous use of calcium or vitamin D supplements. Levothyroxine therapy was introduced from the third post-operative day to prevent hypothyroidism in such kind of patients. Thyroid function tests (TSH, FT3, FT4) were regularly monitored 30 to 45 days after surgery. Cervical wounds were inspected by an endocrine surgeon to check for neck bleeding or infections, while a cardiothoracic surgeon assessed the sternotomy sites. Following discharge from the cardiovascular surgery unit, patients were transferred to a rehabilitation unit for approximately 15 days. Upon final discharge, patients have been sent to referral outpatient ambulatory care for endocrinology and cardiology check-ups.

3. Results

From January 2010 to December 2021, a total of ten patients: 7 males and 3 females, underwent combined surgery for coronary artery disease, cardiac valvular disease, and carotid significant stenosis alongside thyroidectomy.

Detailed patient characteristics, surgical indications, and procedures are well shown in **Table 1**.

Table 1. Patients' characteristics with indications for surgery and the surgical procedure.

Patients	age	Cardiac/vascular disease	Thyroid disease	Symptoms	Surgical procedure
1	64	Multivasal coronaropathy + 80% stenosis Left Internal carotid artery	Thyroid nodule	Compression	Endoarterectomy left carotid + left thyroid lobectomy+myocardial revascularization with extracorporeal circulation
2	69	Multivasal coronaropathy + 80% stenosis Right Internal carotid artery	Toxic goiter	Hyperthyroidism	CABG + Endoarterectomy right internal carotid + Total Thyroidectomy
3	68	Multivasal coronaropathy	Intrathoracic Goiter	Compression	CABG + Total Thyroidectomy
4	46	Multivasal coronaropathy	Toxic goiter	Hyperthyroidism	CABG + Total Thyroidectomy
5	70	Multivasal coronaropathy	Toxic goiter	Hyperthyroidism	CABG + Total Thyroidectomy
6	68	multivasal coronaropathy + 80% stenosis Right Carotid artery	Intrathoracic Goiter	Compression	CABG + Endoarterectomy right carotid artery + Total Thyroidectomy
7	70	mitralic insufficiency + multivasal coronaropathy	Intrathoracic Goiter	Compression	CABG + Mitral valve subs + Total Thyroidectomy
8	73	80% stenosis Right carotid artery	Intrathoracic Goiter	Compression	Endoarterectomy RIGHT carotid + total thyroidectomy
9	67	Aortic valve stenosis	Intrathoracic Goiter	Compression	Aortic Valve replacement + Total Thyroidectomy +
10	75	80% stenosis right Carotid artery	Thyroid follicular thyroid nodule TIR-3 in goiter	Compression	Endoarterectomy carotid artery + total thyroidectomy + central neck Lymphadenectomy

The patients' ages ranged from 46 to 75, with a mean age of 67 ± 8 (SD). The preoperative diagnoses were: benign multinodular non-toxic goiter (5 cases), benign multinodular toxic goiter (3 cases), benign uninodular goiter (1 case), and multinodular goiter with a low suspicion of follicular neoplasm (1 case). Intrathoracic goiter extension was observed in 8 out of the 10 patients.

Hormonal assessment prior to surgery was normal in all cases. Of the 10 patients, three hyperthyroid patients were well-controlled with medical therapy, one hypothyroid patient had normalized thyroid levels with levothyroxine, and six patients displayed normal thyroid hormone levels. Cardiac and vascular indications and the surgical procedures are detailed in Table 1.

Thyroid surgery was performed as the initial procedure in seven cases, while in three cases, it was deferred until after cardiac or vascular surgery. The surgical procedures consisted of a total thyroidectomy in eight cases, thyroid lobectomy in one case, and total thyroidectomy with central neck lymph node dissection in one case due to intraoperative evidence of lymph node involvement. In this latter case, ECC (Extra Corporeal Circulation) was avoided to minimize the risk of tumor cells micro-dissemination.

The mean operative time was 413.5 ± 130.7 minutes (SD), with the majority of this time dedicated to addressing cardiac and/or vascular conditions. Post-opera-

tive complications included transient hypocalcemia in eight patients and transient recurrent laryngeal nerve palsy in one case (out of 19 nerves at risk). Definitive hypoparathyroidism and definitive recurrent laryngeal palsy were each observed in one patient.

No patient experienced bleeding in the neck, neither intra- nor post-operatively. However, two cases of wound infection were documented. The final histological evaluation of thyroid specimens revealed a variety of findings: four cases of non-toxic nodular struma, three cases of nodular struma displaying signs of thyroid hyperfunction, one case of colloido-cystic struma, and two cases of papillary thyroid microcarcinoma: pT1a in one case and a pT1a N1a in the other.

4. Discussion

Concomitant thyroid and cardiac or vascular surgery is rarely reported in the literature, with only a few studies addressing this topic [6]-[11], encompassing a total of 41 patients to date. Thyroid disease represents a common morbidity in the cardiovascular patient population, reaching up to 12% of cases [15].

A key consideration when planning such interventions is determining the optimal timing for surgery. Generally, cardiac or vascular procedures take precedence over benign conditions, particularly as treatment recommendations have evolved in line with contemporary guidelines from the referral society [12]-[15].

While the simultaneous execution of both procedures remains a topic of debate, there is consensus among surgeons that the cardiovascular risks associated with endocrine surgery are too significant to justify performing thyroid surgery before cardiac surgery. Accordingly, most surgeons advocate postponing thyroid surgery until after the cardiovascular procedures, allowing for better optimization of the cardiovascular condition, despite the potential risks associated with having two distinct procedures [16].

In our view, the thyroid procedure can be safely performed after optimization of cardiovascular disease, though in specific cases such as intrathoracic goiter or giant goiter, both surgical procedures can be conducted concurrently. The operation is meticulously planned and performed in a center with expert surgeons skilled in handling such complex cases.

The same operative field aids in performing both surgical procedures, ensuring only a minimal increase in operative time. After the three initial cases, we refined the incision technique for combined cervicotomy and sternotomy. This adjustment was implemented following two instances of infection at the junction between the sternotomy and cervical incision, identified as the source of the complication. Therefore, we modified the incision approach, as illustrated in **Figure 1**, leaving a small bridge of skin at the junction to reduce the risk of infection.

A distinctive feature of our series, despite the small number of patients, is the relatively high frequency of carotid endarterectomy performed in nearly 50% of patients, combined with cardiac surgery, and associated with low morbidity, as previously reported [17]. Among the four out of five patients, this procedure was

correlated with cardiac surgery (valvular disease and/or coronary disease), leveraging the same operative field used for thyroidectomy. This combined approach has been associated with a low incidence of complications in a cohort of 386 patients. In one of these five cases, thyroidectomy was combined with carotid endarterectomy due to a large, giant goiter (**Figure 2**) complicates the direct access to the vascular surgical field.

Figure 1. Operative field at the end of the procedure (cardiac and thyroid surgery).

Figure 2. Giant goiter and pre-operative incisional line drawing in a patient who needed total thyroidectomy and right endocarotidectomy.

These results may help explain the duration of the surgical procedure, which involved 3 distinct surgeries. Matsuyama *et al.* [18] reported a case of emergency for toxic goiter unresponsive to therapy, along with valvular replacement and coronary artery bypass. The post-operative course was favorable, with no complications and definitive resolution of hyperthyroidism.

However, this case differs from our series, as all surgeries at our centre were elective, undertaken with comprehensive preoperative planning and optimization of anesthesiological risks, ensuring a more controlled and planned approach to

the combined surgical procedures. Abboud *et al.* [7] reported six patients who underwent both procedures; hyperthyroidism was present in four cases, while two had intrathoracic goiter, all with a low incidence of complications. This series aligns with ours in terms of pre-operative diagnosis and surgical approach. Both procedures were safely feasible, despite only 0.23% of the patients undergoing cardiovascular surgery. In our series, only 0.21% of patients were eligible for both procedures after a thorough pre-operative assessment of hormonal status, ultrasound, CT scan, all followed by a collegial multidisciplinary evaluation. Each patient was pre-operatively studied as outpatient, alongside assessments by anestesiologists, cardiologists, endocrinologists, or endocrine surgeons. Medical therapy was administered to hyperthyroid patients to normalize serum hormonal levels before surgery.

Recurrent laryngeal nerve injury, characterized by reduced or absent vocal cord mobility, whether transient or permanent (lasting less or more than six months), has been reported as a complication of both procedures. Hence, we emphasize the necessity of a careful dissection of the nerve by both endocrine and cardiovascular surgeons throughout the entire course of the procedures. We agree with Testini *et al.*, who reported that sternotomy provides better visualization of the recurrent laryngeal nerve, as the operative field allows for a more extensive visual exposition of the nerve's course [10]. Final histology of these patients revealed benign nodular goiter in eight patients, with only two cases of malignant microcarcinoma.

Previous published studies [6]-[11], [18]-[23] reported benign disease with hyperfunction as the primary indication for combined surgery, aimed at mitigating the theoretical risk of tumor cell micro-dissemination. However, previous reports showed no evidence of a real risk for thyroid cancer [24].

As De Silva and coll. pointed out, it is difficult to compare combined procedures with two-stage surgical approaches, as highlighted in the literature [25].

In conclusion, this study underscores the feasibility and safety of combined cardiovascular and thyroid surgery. Indications for this combined approach should be limited to cases involving toxic or cervico-thoracic goiters. While our results are encouraging and consistent with the literature, they are based on a small cohort of patients. Larger patients' samples in future studies could enhance the value of this retrospective study and help strengthen the integration of combined surgical techniques across specialties.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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