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AN EVALUATION OF THE EFFECTIVENESS OF COMBINED CARDIAC AND THYROID SURGERY OF PATIENTS WITH A HIGH PERIOPERATIVE RISK

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SUMMARY

Background:

The simultaneous manifestation of heart disease and thyroid problems is a fairly common phenomenon. In the case of the simultaneous appearance of these complications at an advanced level of development there is the need to conduct joint endocrine surgery and a cardiac surgical operation. This is only possible in specialist units with a high level of various medical specialisations. The aim of our research is to conduct the first assessment in Poland of the effects of a simultaneously conducted operations of thyroid resection and open-heart surgery, including mainly an analysis of the post-operational complications. This is, at the same time, the most extensive publication to date of patients of this type to appear in English-language subject literature.

Material/ Methods:

Eleven patients (four males and seven females) with an average age of 66.27 years (ages ranging from 37 to 80) underwent combined thyroidectomy and cardiac surgery at the Clinical Department of Cardiovascular Surgery and Transplantology of the John Paul II Hospital in Krakow for the period from 2006 to 2014. The research employed a retrospective analysis of the hospitalization documentation as well as the results of the control tests conducted. Cases were reviewed for demographic data and past medical history, cardiac and thyroid pathology (including pathologist reports), the type of combined surgeries, heart rate, blood pressure and temperature during the operation, postoperative laboratory examinations (cardiac enzymes and thyroid function markers). With the aim of evaluating complications a specialist questionnaire – The Complication Evaluation Questionnaire – was used on patients following a hybrid operation of the goitre and heart.

Results:

It was found that all patients survived and relatively few complications were noticed – one right recurrent laryngeal nerve palsy and one suppuration of the postoperative thoracic wound. No other complications as described in the relevant subject literature were observed, also none of the patients needed to be reoperated on. Eight patients required packed Red Blood Cells or Fresh Frozen Plasma transfusions due to extensive blood loss while only five patients needed vasoactive drug support.

Conclusions:

As a result of the research conducted it has been noted that the cumulative risk is less in the combined operation in comparison with that of a two-stage operations, with any ensuing complications being minor. The research conducted, as with that appearing in the relevant subject literature, shows that a single-stage procedure is safe, efficient and effective, with a good outcome.

Key words: thyroidectomy, goiter, cardiac surgery

INTRODUCTION

Hyper- and hypothyroidism both have a negative influence on the heart. Hyperthyroidism can lead to cardiac tachyarrhythmias, increased consumption of oxygen in tissues and hyperthermia, as well as possibly producing in severe cases the life-threatening condition known as thyroid storm. Hypothyroidism causes bradycardia, decreased cardiac contractility, prolongation of the QT interval or diastolic hypertension (Klein & Danzi 2000). Thus, hyperthyroidism co-existing with any heart abnormality can cause severe consequences, including hemodynamic instability and myocardial infarction.

The prevalence of thyroid disease in the general population varies from 9% to 15% in adult females, with lower percentages reported for adult males (Klein & Danzi 2000; Canaris et al., 2000). The prevalence of thyroid disease in patients with cardiac disease is estimated to be 11.2% (Jones et al., 1994).

Coexisting diseases are usually treated in a two stage approach, with cardiac surgery preceding a thyroid gland operation (thyroidectomy) (Lithmathe et al., 2005). Two-stage surgery is cursed with a higher perioperative risk – if a thyroidectomy is performed before cardiac surgery, one must be aware of any possible unstable cardiac function and myocardial infarction, especially because the diseased heart has lower reserves and is especially threatened due to the hormones released from the thyroid gland to the bloodstream during its resection. On the other hand, cardiac surgery prior to thyroidectomy is associated with a risk of thyrotoxicosis (Matsuyama et al., 1999). A staged approach also inevitably prolongs the time to the next operation; something that could be critical under certain circumstances. Furthermore, there are serious side effects to the cardiac surgery with a cardio-pulmonary bypass in patients with malignant thyroid disease – the immunosuppression following the cardiac operation may favor the growth and dissemination of the malignant tumor (Finlayson & Birkmayer 1998; Hill et al., 1997). Regardless of the order of procedures, every anesthesia is associated with possible complications, and the cumulative risk of anesthesia during two operations is higher than in a single anesthetic procedure. From that point of view, it can be required to perform both surgeries simultaneously under the same anesthesia, especially, when the patient is diagnosed with retrosternal goiter. In such a situation, tumor (goiter) could constitute an obstacle for a cardiologist. Besides, the resection of large mediastinal goiter masses is facilitated by the sternotomy, which is still required for most of the procedures performed on the heart (Banker et al., 2004).

The aim of the research is the very first attempt in Poland to evaluate the effects of a simultaneous operation on the thyroid in combination with open heart surgery, including an analysis of any post-operation complications. This is at the same time the biggest hitherto published compilation of patients of this type to appear in English-language subject literature.

MATERIAL AND METHODS

Eleven patients (four males and seven females) with an average age of 66.27 years (ages ranging from 37 to 80) underwent combined thyroidectomy and cardiac surgery at the Clinical Department of Cardiovascular Surgery and Transplantation, The John Paul II Hospital in Krakow, for the period 2006 – 2014. All of the subjects were operated on urgently, scheduled for such an operation because of the sudden exacerbation of their state (e.g. cardiac arrest) or because of the very high perioperative risk connected with both pathologies.

The research employed a retrospective analysis of hospitalisation documentation as well as the results of the control tests conducted. Cases were reviewed for demographic data and past medical history, cardiac and thyroid pathology (including pathologist reports), type of combined surgeries, heart rate, blood pressure and temperature during the operation, postoperative laboratory examinations (cardiac enzymes and thyroid function markers). With the aim of evaluating any complications employed was a specially devised questionnaire – The Complication Evaluation Questionnaire (Pačhalska et al., 2014) devised for those patients having undergone a hybrid goitre operation and treatment for heart disease, based on the data from case series published in English (Lithmathe et al., 2005; Testini et al., 2010; Abboud et al., 2003).

Underlying cardiac conditions included two coronary artery diseases, five aortic stenoses, one aortic regurgitation and one mitral insufficiency (as a result of rheumatic fever), furthermore two patients suffered from aneurysms of the ascending aorta. Important concomitant cardiovascular diseases: stenosis of the left subclavian artery (case No. 1) and atrial fibrillation (case No. 9) were also noted. All of the patients suffered from goiter - in five cases. Four patients displayed tracheal obstruction, in one case combined with right vocal cord paralysis preoperatively (case No. 10). In the postoperative histopathological examination two patients were diagnosed with thyroid cancer - Hurtle cell tumor (case No. 3) and papillary carcinoma (case No. 8). All the clinical characteristics of our patients are summarized in Table 1.

Methods of operations

All patients underwent strumectomy prior to heart surgery. The surgical access to the thyroid gland was achieved by means of a cervical collar incision, in the case of retrosternal goiter the surgical field was enlarged by extending the median sternotomy to the neck. In ten patients a resection of the thyroid was conducted, while in one - subtotal thyroidectomy (total right lobe and subtotal left lobe resection) was performed (case No. 8). Cardiac procedures were performed on a cardiopulmonary bypass pump in hypothermia (25-30 degrees Celsius) or in normothermia (case No. 8).

Cardiac surgeries assumed three Bentall procedures (case Nos. 4, 8, 9) and five other aortal valves replacements (case Nos. 3, 5, 6, 10, 11). Five artificial and three biological valves were implanted. In addition, one mitral valve replace-

Table 1. Clinical characteristics of the reported patients

	Age	Sex	ICU [days]	Cardiac disease	Thyroid disease	Related symptoms	Operations
1	72	F	7	CAD	MG	TC	TT + CABG (Svg-Dg, LAD)
2	65	F	2	CAD, cardiac arrest	MG retrosternal	none	TT + CABG (Svg-RPD, Mg)
3	67	M	3	AV stenosis, calcified bicuspid AV	MG, left lobe tumor	none	TT + AV replacement bio.
4	65	M	2	AV regurgitation	MG toxic	none	TT + Bentall procedure (bio. AV)
5	78	F	4	AV stenosis	MG retrosternal	TC	TT + AV replacement art.
6	80	F	5	AV stenosis	MG	none	TT + AV replacement art.
7	69	F	2	Rheumatic MV regurgitation	MG	none	TT + MV replacement
8	37	M	1	AAAsc	MG, right lobe tumor	none	Subtotal thyroidectomy + Bentall procedure (art. AV)
9	53	M	1	AV regurgitation, AAAsc	MG	none	TT + Bentall procedure (art. AV)
10	68	F	3	AV stenosis, calcified	MG toxic	TC, right vocal cord palsy	TT + AV replacement art.
11	75	F	5	AV stenosis, calcified	MG retrosternal	TC	TT + AV replacement bio.
Summary	Mean: 66.27	4M, 7F	Mean: 3.18	8 AV diseases, in two instances additionally associated with AAAsc, 1 MV disease, 2 CAD	MG in all patients, in five retrosternal, in two toxic, and in another two malignant	compression symptoms in 4 patients	TT in 10 patients, in 1 subtotal; 3 bio. AV and 5 art. AV replacements - in 3 cases associated with Bentall procedure; 1 MV replacement; 2 CABG

AAAsc - Ascending Aortic Aneurysm

AV - Aortic Valve

art. – artificial

bio. – biological

F – Female

M – Male

MG – Multinodular Goiter

MV - Mitral Valve

Svg - Saphenous Vein Graft

TC – Tracheal Compression

TT – Total Thyroidectomy

For other abbreviations see text.

ment (case No. 7) and two coronary artery bypass grafting (CABG) were performed (case Nos. 1, 2). In both CABG cases saphenous vein grafts were used. All patients were admitted post-operatively to the Cardiovascular Intensive Care Unit (ICU).

RESULTS

Table 2 presents the postoperative complications in relation to particular patients. It was found that during the operation no unexpected life-threatening blood pressure, heart rate or temperature changes were observed. One right recurrent laryngeal nerve palsy was found and one suppuration of the postoperative wound was observed. Eight patients required packed red blood cells transfusions

Table 2. Postoperative complications in the reported patients

	ICU [days]	Recurrent laryngeal nerve damage	Postoperative wound infections	Hypocalcemia	Bypass occlusion	pRBC transfusion [units]	FFP transfusion [units]	Presors
1	7	none	none	none	n/a	2	0	ADR, DB
2	2	none	none	none	n/a	0	0	none
3	3	none	none	none	n/a	1	0	none
4	2	right recurrent laryngeal nerve palsy	none	none	n/a	4	7	none
5	4	none	none	none	n/a	1	1	ADR, DB
6	5	none	none	none	n/a	2	4	none
7	2	none	none	none	n/a	2	0	none
8	1	none	none	none	n/a	2	0	none
9	1	none	none	none	n/a	0	0	DB
10	3	none	none	none	n/a	0	0	DB
11	5	none	Suppuration of the postoperative thoracic wound	none	n/a	2	0	ADR, DB
Summary	Mean: 3,18	1	1	0	0	8 patients, Mean: 2 units	3 patient, Mean: 4 units	5 patients

n/a – not applied
 ADR – Adrenaline
 DB – Dobutamine
 FFP – Fresh Frozen Plasma
 pRBC - packed Red Blood Cells

(mostly two units), three of them received also fresh frozen plasma (averagely 4 units) due to extensive intraoperative blood loss. Five patients needed vasoactive drug support immediately after surgery with gradually decreasing doses. The mean stay at the ICU was 3.18 days (the range being from 1 to 7 days). Despite the severe condition and expansive surgical exploration, all operations were successful and in each single case the benefits brought to the patient from the surgery clearly outweighed any complications.

It was found that in our group all the patients survived and relatively few complications were noticed. Only one patients experienced right recurrent laryngeal nerve palsy and in one suppuration of the postoperative thoracic wound occurred. No other complications as described in the relevant subject literature were observed, also none of the patients needed to be reoperated on. Eight patients required packed Red Blood Cells or Fresh Frozen Plasma transfusions due to extensive blood loss while only five patients needed vasoactive drug support.

DISCUSSION

Thyroid hormones play a very important role within the cardiovascular system and a malfunctioning thyroid gland can lead to changes in peripheral resistance or myocardial contractility, cardiac output, and myocardial oxygen consumption, which can result in myocardial infarction (Klein & Danzi 2000; Jones et al., 1994).

Current data suggests that the combination of cardiac surgery and thyroidectomy is safe, regardless of the order of the procedures. Recently, a systematic review by De Silva and Dignan (2015) aimed to answer the clinical question as to whether thyroidectomy of a large retrosternal goiter in an adult patient requiring cardiac surgery can be performed with an acceptable outcome. They included and analyzed three retrospective case series (level of evidence: 4) and 13 case reports (level 5) that provided the best answer to the question and found that existing subject literature supports the use of combined surgery, as it is a 'safe, efficient and effective procedure with good outcomes'. A direct comparison with the staged approach was, however, not possible due to the lack of reported outcome data and we also have failed to identify such reports. Our research also confirmed that the application of hybrid procedures (thyroidectomy + cardiac surgery) is safe, efficient and effective. In a group of eleven patients of a collectively raised risk value both mid- and post-operation there was not noted a fatality or any life-threatening complication. Similar results were obtained by Abbout et al. (2003) where in a group of six patients operated on with the same indications all survived. Similarly Testini et al. (2010) were successful post-operationally in a group of 10 patients operated on. In turn, Lithmathe et al. (2005) confirmed in a group of three operated on patients the death of only one.

The basic premise behind our work was equally not to incorporate descriptions of individual cases, of which we found a dozen or so, for we considered these to be encumbered with too high a level of error given that no one describes an operation which has failed or has ended only in partial success – as we have

written in the initial version: 'In order to estimate the complication rate from current evidence we used exclusively data from case series published in English, since the identified single-case reports reported virtually no complications, which suggests a publication bias towards successful cases only.'

The mean stay at the ICU was 3.5 days as equally for our patients as for those described in the relevant subject literature (Lithmathe et al., 2005; Banker et al., 2005). The exception being the patient group described by Testini et al. (2010), where there was a mean hospital stay of 8.4 days.

The timetabling for the goiter resection (hemi-thyroidectomy, subtotal and total thyroidectomy) is close to that documented in the world subject literature (Lithmathe et al., 2005; Abboud et al., 2003). Similarly, the types of cardio-operative procedures employed were close to those procedures conducted worldwide (aortic valve replacement, mitral valve replacement, tricuspid Valve or mitral valve annuloplasty, CABG) (Lithmathe et al., 2005; Testini 2010; Abboud et al., 2003; Demirag et al., 2007).

There was noted within our research group very few post-operational complications. Though here in one patient a right recurrent laryngeal nerve palsy was observed, and in another a pus infection appeared in a wound to the chest (rib cage). A similar low number of post-operational complications is recorded in the world subject literature. Testini et al. (2010) also report that in a group of 10 operated on patients there occurred a single case of laryngeal nerve palsy and one postoperative wound infection. None of these patients required a repeat operation, and did not suffer from temporary hypocalcemia as well as there being no parathyroid gland autotransplantation conducted. In the subject literature there has been described but a single temporary bypass occlusion, Transient hypocalcaemia in the 3 patients who had undergone parathyroid gland autotransplantation was also noted (Testini et al. 2010).

It is important to emphasize that such procedures require a professional multidisciplinary approach in specialized centers incorporating cardiac and general/endocrinological surgeons as well as experienced anesthesiologists. One of the reasons for careful anesthesiology planning is that the risk of post-goiter tracheomalacia is supposedly higher (De Silva & Dignan 2015) and might lead to trachea perforation during intubation. Thyroid surgery by itself can prove to be challenging and should only be performed by a surgeon skilled in this procedure – in our case all strumectomies were performed by a single surgeon, specialist in general and vascular surgery, vastly experienced in thyroid and neck surgery.

Some authors also reasonably suggest that after thyroidectomy the collar incision should not be closed until the end of cardiac surgery for better hemostasis control, especially when it is necessary to administer the heparin (Testini et al. 2010; Demirag et al., 2007), although, we achieved good results in this regard. Moreover, the anatomical location of the thyroid and heart makes a combined operation possible and convenient, as median sternotomy and a cervical collar incision performed together provide excellent exposure of the thyroid area, which can be a great facilitation when patient has enlarged thyroid glands which extend

to the anterior mediastinum (Testini et al. 2010; Tang et al., 2006). During thyroid resection, a sternotomy may also be a significant factor in reducing intraoperative complications such as inferior laryngeal nerve damage due to a better insight of the surrounding structures (Testini et al. 2010; Hamdan et al., 2002; Wolfhar et al., 1994).

In summing up it follows to state that both our results as those from the subject literature show that the cumulative risk is less in the combined operation in comparison with that of a two-stage operation (Matsuyama et al., 1999; Wolfhar et al., 1994), complications are few in number. Our own tests as equally the data from subject literature publications have shown that the single-stage method of approach is safe, efficient and effective, and results in a favorable outcome.

CONCLUSIONS

As a result of the research conducted it has been noted that the cumulative risk is less in the combined operation in comparison with that of a two-stage operation, with cases of complications being rare. Our own tests as equally the data from subject literature publications have shown that the single-stage method of approach is safe, efficient and effective, producing a good outcome.

REFERENCES

- Abboud B., Sleilaty G., Asmar B., Jebara V. Interventions in heart and thyroid surgery: can they be safely combined? *European Journal of Cardio-thoracic Surgery* 24 (2003) 712–715.
- Banker MC, Sambol J, Raina S. Management of an ascending aortic aneurysm with coronary artery disease and tracheal compression from a substernal goiter. *J Card Surg* 2005; 20: 177–179.
- Canaris GJ, Manowitz NR, Mayor G, Ridgway EC. The Colorado thyroid disease prevalence study. *Arch Intern Med* 2000; 160: 526–530.
- De Silva R.P., Dignan R.J. Does a combined procedure for cardiac surgery and thyroidectomy offer acceptable outcomes? *Interactive CardioVascular and Thoracic Surgery* 21 (2015) 787–791.
- Demirag M. K., Topgül K., Sarac A., Keceligil H.T. Atrial Septal Defect and Retrosternal Toxic Goitre Operated in the Same Session: A Case Report. *Ann Thorac Cardiovasc Surg* Vol. 13, No. 4 (2007), 272-274.
- Finlayson SR, Birkmayer JD. Cost-effectiveness analysis in surgery. *Surgery* 1998; 123: 151–156.
- Hamdan AL, Moukarbel RV, Farhat F, Obeid M. Vocal cord paralysis after open-heart surgery. *Eur J Cardiothorac Surg* 2002; 21: 671–674.
- Hill GE, Whitten CW, Landers DF. The influence of cardiopulmonary bypass on cytokines and cell-cell communication. *J Cardiothorac Vasc Anesth* 1997; 11: 367–375.
- Jones TH, Hunter SM, Price A, Angelini GD. Should thyroid function be assessed before cardiopulmonary bypass operations? *Ann Thorac Surg* 1994;58:434–6.
- Klein I, Danzi S. Thyroid disease and the heart. *Circulation* 2007; 116: 1725–1735.
- Lithmathe J, Kurt M, Boeken U, Roehrborn A, Feindt P, Gams E. Combined cardiothoracic surgery and interventions of the para/thyroid gland. *Z Kardiol* 2005; 94: 28–32.
- Matsuyama K, Ueda Y, Ogino H, Sugita T, Nishizawa J, Matsubayashi K, Yoshimura S, Yoshioka T, Tokuda Y. Combined cardiac surgery and total thyroidectomy: a case report. *Jpn Circ J* 1999; 63: 1004–6.
- Paçalska M., Kaczmarek B., Kropotov J.D. *Neuropsychologia kliniczna: od teorii do praktyki*. Warszawa: Wydawnictwo Naukowe PWN. 2014.
- Tang GH, Feindel CM, Gullane PJ, Butany J. Combined cardiac surgery and excision of a retrosternal thyroid mass: a case report. *J Card Surg* 2006; 21: 281–283.

- Testini M., Poli E., Lardo D., Lissidini G., Gurrado A., Scrascia G., Malvindi P. G., Rubino G., Piccinni G., De Luca Tupputi Schinosa L. Combined Cardiac Surgery and Total Thyroidectomy: Our Experience and Review of the Literature. *The Thoracic And Cardiovascular Surgeon*, December 2010, 450-454.
- Wolfhard U., Krause U, Walz MK, Lederbogen S. Combined interventions in heart and thyroid surgery—an example of interdisciplinary cooperation. *Chirurg* 1994; 65: 1107–10.

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