

# Morbidity following thyroid surgery: does surgeon volume matter?

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Received: 14 July 2012 / Accepted: 23 October 2012 / Published online: 6 November 2012  
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## Abstract

**Purpose** The aim of our study was to analyze the relationship between surgeon volume and morbidity in patients operated on by surgeons with endocrine specialization (EndS group) and those operated on by general surgeons (GenS group) in a single tertiary institution.

**Methods** We present the results of a prospective cohort study of all patients undergoing thyroid surgery in our institution between January 2008 and January 2010, all of whom attended for follow-up for at least 12 months. We assessed pre- and postoperative recurrent laryngeal nerve (RLN) function by laryngoscopy. We monitored serum calcium concentrations in all patients until these values were normal without vitamin D and oral calcium supplementation.

**Results** We studied 225 patients: 30 in the GenS group (six surgeons performing <5 procedures per surgeon per year) and 195 in the EndS group (two surgeons performing >40 procedures per surgeon per year). The total number of exposed RLN was 46 and 325, respectively. The incidence of RLN palsy persisting beyond 12 months was higher in the GenS group (2/46 vs. 1/325 exposed RLNs,  $p=0.04$ ). The incidence of hypocalcaemia persisting beyond 12 months (bilateral procedures) was also higher in the GenS group (3/16 vs. 3/130 patients,  $p=0.028$ ).

**Conclusions** Morbidity in terms of permanent RLN palsy and hypocalcaemia was less frequent among patients operated on by endocrine-dedicated surgeons. Differences in surgical volume and specialized training in neck endocrine surgery may explain these variations in morbidity.

**Keywords** Endocrine surgery · Post-thyroidectomy hypocalcaemia · Recurrent laryngeal nerve palsy · Surgeon volume

## Introduction

Most studies about volume–outcome have focused on the relationship between hospital volume of patients and mortality from surgical procedures [1, 2] and have demonstrated lower mortality rates for procedures performed in high-volume hospitals [2]. There are reportedly similar relationships between volume and outcome for surgeon-based care, lower surgical mortality and morbidity rates occurring in patients treated by high-volume surgeons [1].

In endocrine surgery, the effects of surgeon volume on clinical and economic outcomes correlate inversely with complication rates, length of stay, and total charges. The lowest complication rates are achieved by surgeons performing  $\geq 100$  endocrine operations annually [1, 3]. Other studies have focused on the association between length of experience and postoperative complications [4, 5]. In a multivariate analysis, 20 years or more of practice was associated with increased probability of both recurrent laryngeal nerve (RLN) palsy and hypoparathyroidism. Surgeons aged 35 to 50 years had better outcomes than their younger and older colleagues. Based on their findings, Duclos et al. stated that “optimum individual performance in thyroid surgery cannot be passively achieved or maintained by accumulating experience” [4]. The factors contributing to poor performance in very experienced surgeons remain undefined. However, there are no published investigations concerning the influence of volume and specialized training on postoperative complications of neck

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This paper has been presented to the fifth Biennial Congress of the European Association of Endocrine Surgeons (ESES), Gothenburg (Sweden), May 25–26, 2012.

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endocrine surgery. The aim of our study was to analyze the relationship between surgeon volume and morbidity of patients operated on by surgeons with endocrine specialization (EndS group) and those operated on by general surgeons (GenS group) in a single tertiary institution.

## Material and methods

A prospective cohort study of all patients undergoing thyroid surgery in our institution between January 2008 and January 2010 was designed. Surgeons in a single institution were allocated to one of the following two groups: (1) the EndS group, composed of two surgeons with endocrine specialization (Endocrine Surgery Unit), and (2) the GenS group, composed of six general surgeons. Both groups of surgeons had access to the same operating room facilities. Thyroid surgery was performed using ligatures, surgical clips and monopolar or bipolar electrocautery. Details about the use of harmonic scalpel and vessel-sealing devices were not collected. In the EndS group, the RLN was always identified; however, intraoperative laryngeal nerve monitoring technique was not used. The parathyroid glands were liberally autotransplanted into the sternocleidomastoid muscle if their vascular supply was jeopardized during surgical dissection. Fine technical details about how the RLN and parathyroid glands were managed were not available for the GenS group.

All patients were followed up for at least 12 months. Pre- and postoperative RLN function was assessed by laryngoscopy performed by an independent ear, nose, and throat specialist. Ongoing postoperative laryngoscopies were scheduled monthly for 12 months if there was impaired postoperative RLN function. RLN palsy was considered permanent if it persisted for more than 12 months.

Serum calcium concentrations were monitored in all patients pre- and postoperatively, the first test being performed 24 h after surgery. A diagnosis of hypocalcaemia was established if the total serum calcium concentration was <8 mg/dL. After being discharged from

the hospital, patients with hypocalcaemia were monitored until their serum calcium concentrations were normal without vitamin D and oral calcium supplementation. Hypocalcaemia was considered permanent if it persisted for more than 12 months.

The influence of surgeon volume, surgeon's age, years of practice, and specialized training in neck endocrine surgery on postoperative complications (permanent RLN palsy and permanent hypocalcaemia) in the two groups was analyzed. The statistical software package JMP 9.0 (SAS Institute, Cary, NC, USA) was used for analyzing the data. Fisher's exact test was used to test differences for nominal data. In all cases, 5 % was chosen as the level of statistical significance ( $p < 0.05$ ).

## Results

We studied 225 patients: 195 in the EndS group and 30 in the GenS group, all of whom were followed up for at least 12 months. Among these 225 cases, 91 patients underwent total thyroidectomy, 38 total thyroidectomy with dissection of the central compartment for cancer, 17 subtotal thyroidectomy, and 79 thyroid lobectomy. In all, 371 RLNs were exposed. Data about how the various procedures were distributed between the two surgeon groups are summarized in Table 1. The number of exposed RLNs was 325 in the EndS group and 46 in the GenS group.

There were no differences between the EndS and GenS groups concerning surgeon mean age ( $54 \pm 17$  vs.  $58 \pm 9$  years) and mean years of practice. The mean number of procedures per surgeon per year was >40 in the EndS group ( $49 \pm 12$ ) and <5 in the GenS group ( $2.5 \pm 1$ ).

In the whole patient group, transient postoperative RLN palsy was detected in 4 % of exposed nerves, and permanent RLN palsy in 0.8 % of exposed nerves. The incidence of RLN palsy persisting beyond 12 months was significantly higher in the GenS group (Table 2).

Regarding postoperative hypocalcaemia, persistence of hypocalcaemia at 6 months was more frequent in the GenS group (8/16 vs. 8/130 bilateral procedures,  $p = 0.0005$ ). The incidence of persistent hypocalcaemia

**Table 1** Number of procedures and exposed recurrent laryngeal nerves

	Procedures	TT	TT + DCC	ST	L	Exposed RLN
EndS group	195	78 (40 %)	38 (19.5 %)	14 (7 %)	65 (33 %)	325
GenS group	30	13 (43 %)	0 (0 %)	3 (10 %)	14 (46.5 %)	46
Total	225	91	38	17	79	371

Percentages are of the total number of procedures in each group

TT total thyroidectomy, DCC dissection of the central compartment, ST subtotal thyroidectomy, L lobectomy, RLN recurrent laryngeal nerve, EndS surgeons with endocrine specialization, GenS general surgeons

**Table 2** Incidence of permanent postoperative RLN palsy

	EndS	GenS	<i>p</i> <sup>a</sup> value
RLN exposed	325	46	
RLN palsy	1 (0.3 %)	2 (4.3 %)	0.04

Percentages are of the 371 exposed nerves

*EndS* surgeons with endocrine specialization, *GenS* general surgeons, *RLN* recurrent laryngeal nerve

<sup>a</sup> Fisher's exact test

beyond 12 months was also higher in the GenS group (3/16 vs. 3/130, *p*=0.028) (Fig. 1).

## Discussion

The aim of this study was to analyze the relationship between surgeon volume and morbidity of patients operated on by surgeons with endocrine specialization compared with those operated on by general surgeons in our institution from January 2008 and January 2010. In terms of outcome, our results reinforce the contention that surgeons with endocrine specialization should preferentially perform thyroid surgery.

In our group of 225 patients, surgeon volume was a significant predictor of thyroid surgery morbidity. High-volume surgeons (>40 procedures per year) were more likely to have a lower incidence of postoperative RLN injury and hypocalcaemia.

The present findings seem to be consistent with other studies of endocrine surgery [3, 4, 6] in which surgeon volume correlated inversely with complication rates. The lowest complication rates are achieved by surgeons performing >100 endocrine operations annually and the highest by those performing <4 procedures per year [3,

4, 6]. In our study, the best results were obtained by surgeons performing >40 operations per year (EndS group) and the worst by those performing 5 operations per year (GenS group). However, we are not able to define the minimum number of procedures required for achieving optimal results or for being considered a high-volume surgeon.

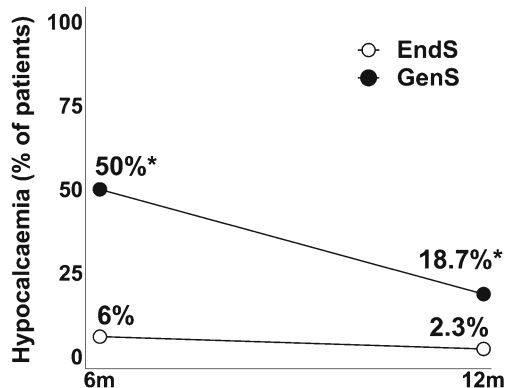
Another predictor of morbidity suggested by our results is specialized training in neck endocrine surgery. That variable is probably the most crucial in explaining the results of the EndS group. Our findings acquire even more relevance when we consider surgical complexity because 19.5 % of procedures performed by the EndS group surgeons included dissection of the central compartment and none in the GenS group. This more extensive surgery carries a higher postoperative morbidity risk in terms of RLN palsy and hypocalcaemia, as it has been shown in other studies [1]. In our study, only the EndS group surgeons performed thyroid surgery for cancer, whereas in other studies, general surgeons also performed thyroid surgery for cancer [2].

Contrary to expectations, we found no significant outcome differences between the two groups regarding age and years of practice. Others have reported that 20 years or more of practice is associated with increased probability of both RLN palsy and hypoparathyroidism [4, 6]. Surgeons' performance reportedly has a concave association with their 199 length of experience and age, with surgeons aged 35 to 50 years having better outcomes than their 201 younger and older colleagues [3, 4].

Our findings have important implications for developing quality control in endocrine surgery. Surgical volume can serve as a crude measure of quality because it is a structural characteristic that is easy to calculate [6]. Nevertheless, volume-based investigations have limited potential for improving patient outcomes because they do not predict the performance of individual hospitals or surgeons [1, 2, 5].

Our study does have some limitations. A major drawback is the single-center design and the small number of procedures, especially in the GenS group. We are conscious of other factors that may have contributed to postoperative morbidity (the use of specific surgical instruments, technical resources, and so on). Finally, specialization in endocrine surgery may provide the surgeons with additional surgical skills that may improve their technical results. How to quantify and assess the influence of such specialized training in endocrine surgery is yet to be defined.

A strength of our study is the reliance on objective measurements of RLN function and hypocalcaemia. These complications were systematically assessed during follow-up. Information obtained through monitoring these complications could give surgeons useful objective feedback and,



**Fig. 1** Postoperative incidence of hypocalcaemia at 6 and 12 months. The *asterisk* indicates that differences between groups are statistically significant (*p*<0.05; Fisher's exact test)

if continued, provide data about late recovery of hypocalcaemia and RLN palsy. Monitoring of morbidity adequately evaluates quality of surgical units, but more investigation is necessary to assess the real influence of volume and specialized training on postoperative outcomes of neck endocrine surgery.

### Conclusions

Morbidity in terms of permanent RLN palsy and hypocalcaemia was less frequent among patients operated on by surgeons with endocrine specialization in our institution. Differences in surgical volume and specialized training in endocrine thyroid surgery may explain these variations in morbidity. Monitoring morbidity has positive implications, namely detection of preoperative idiopathic dysphonia, verification of late recovery of hypocalcaemia and RLN palsy, and its contributions to assessing the quality of our endocrine surgery units.

**Conflicts of interest** None.

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