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MISCELLANEOUS

Surgery of benign thyroid disease by ENT/head and neck surgeons and general surgeons: 233 cases of vocal fold paralysis in 3509 patients

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Abstract

Purpose Thyroid surgery is mainly performed by general surgeons (GS). The aim of this study is to evaluate the safety and efficiency of thyroid surgery by ENT/head and neck surgeons (ENT), especially regarding the incidence of vocal fold palsy (VFP).

Methods We retrospectively analysed 3509 patients (69.0% female) who underwent surgery for benign thyroid diseases (56.8% nodular goitre, 18.6% inactive nodes, 14.0% thyroid autonomy, 7.0% Graves' disease). Operations were mainly performed with intraoperative neuromonitoring by GS ($n=1933$) or physicians trained for head and neck surgery ($n=1576$). 18.7% of the procedures were carried out by residents in training.

Results VFP occurred in 233 subjects (6.6%); 6.2% in females and 7.6% in males. A lower rate ($p<0.001$) was observed in operations performed by ENT (4.7%) than by GS (8.2%). No increased incidence of VFP was seen for surgeries performed by physicians in training (6.2%, $n=657$). Prevalence of VFP was not different for minimally invasive (6.3%, $n=950$) and conventional surgery (6.8%, $n=2559$), but higher in total (7.2%, $n=1916$) than in subtotal thyroidectomy (5.0%, $n=997$). Postoperative haemorrhage (5.6 vs. 1.9%) and hypocalcaemia < 2.0 mmol/l (32.8 vs. 22.0%) were documented more frequently in patients with VFP, also substitution therapy with calcium (23.2 vs. 14.7%) and dihydrotachysterol (8.1 vs. 3.7%) had to be applied more frequently.

Conclusion Thyroid surgery performed by surgeons specifically trained for ENT/head and neck surgery is safe and has a significantly reduced rate of VFP. VFP is associated with other complications (postoperative haemorrhaging, hypocalcaemia).

Keywords Thyroid surgery · Head and neck surgery · Vocal fold palsy · Postoperative complications · Benign thyroid surgery

Introduction

Thyroid gland surgery is one of the most frequent elective surgical procedures in Germany. 74,453 thyroid surgeries (total thyroidectomies, hemithyroidectomies and partial thyroidectomies) were performed in 2015 [1]. These operations are mainly performed by general surgeons (GS).

The most frequently occurring complications are injuries of the recurrent laryngeal nerve (RLN) with permanent or transient vocal fold palsy (VFP), injuries of the superior laryngeal nerve and permanent or transient hypocalcaemia, due to direct trauma, devascularisation or removal of the parathyroid glands. Furthermore, as in most surgical procedures, there is the risk of infection and bleeding.

To evaluate the safety and efficiency of thyroid surgery by ENT/head and neck surgeons (ENT) and the factors

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influencing the relative risk (RR) of vocal fold paralysis, we retrospectively analysed all patients having undergone surgery for benign thyroid disease in the Klinikum Mutterhaus der Borromäerinnen between 2001 and 2016.

Methods

In a retrospective study, the data of 3509 patients having undergone surgery for benign thyroid disease between 2001 and 2016 were analysed. The operations were performed either by GS ($n = 1933$, 55.1%) or physicians specially trained for ENT/Head and Neck Surgery ($n = 1576$, 44.9%). Intraoperative neuromonitoring (IONM), which can help identify the RLN and verify its integrity by giving acoustic and visual signals, was not used consistently from 2001 to 2005. From 2005 on, all operations were performed using IONM in both departments.

The characteristics of both groups of patients were compared. The risk analysis for VFP included the following parameters: gender, age, indication for surgery, extent of resection, technique (minimally invasive video-assisted thyroidectomy (MIVAT) vs. conventional), executing department, degree of experience of the surgeon, secondary intervention and complications (hypocalcaemia, postoperative bleeding). Only GS carried out MIVAT procedures. During inpatient care, every patient underwent an endoscopic examination of the larynx by an ENT-specialist before and after the procedure to detect VFP. No discrimination was made between permanent and transient paralysis due to the lack of data from follow-up laryngoscopies.

A descriptive, nonparametric statistic with Chi-squared test, two-tailed *t* test and ANOVA was compiled.

Results

The study group consisted of 3509 patients. Among these, 661 hemithyroidectomies and 2848 thyroidectomies were carried out, with 6357 nerves at risk. A comparison of the ENT and GS departments showed no difference in patient gender or age (mean value 52.1 ± 13.4) (Table 1).

The main indications for surgery at the Klinikum Mutterhaus der Borromäerinnen were nodular goitre (56.8%), inactive nodes (18.6%), thyroid autonomy (14.0%) and Graves' disease (7.0%). Within the GS department a greater number of patients had isolated nodes without endocrine activity. Within the ENT department, more patients had surgery for nodular goitre, thyroid cysts or thyroiditis (such as thyroiditis de Quervain). In the ENT department, the percentage of patients undergoing a second surgery because of recurrent thyroid disease was higher than in the GS department (9.1 vs. 7.0%). Patients with Grave's disease and hyperthyroid goitres were equally distributed between both departments (Table 1).

18.7% of the procedures were carried out by residents in training. A comparison of the degree of experience of the surgeons of both departments reveals that in ENT the surgery was more often performed by residents and less frequently by the heads of department (Table 1). Regarding the extent of resection in both departments, there was no significant difference in terms of the type of surgery performed, except for the number of hemithyroidectomies ($p < 0.01$), which was significantly higher in the GS department (22.0 vs. 15.0%). This might be due to the higher number of solitary nodes treated by the GS (Table 1).

Among the combined population of 3509 patients, VFP occurred in 233 subjects (6.6%). More injuries were documented on the left RLN ($n = 123$, 53%), than on the right ($n = 88$, 38%). 2% ($n = 5$) of all injuries were both sided. Considering the nerves at risk, the rate of VFP was 3.6%. Patients with VFP were significantly older (54.2 vs. 51.9, $p < 0.05$). Prevalence was not influenced by gender.

The rate of VFP was higher in total (7.2%) and in near total thyroidectomy (8.0%), than in subtotal thyroidectomy (5.0%). This difference was statistically significant only, if total and subtotal thyroidectomy are compared by ANOVA ($p < 0.05$). The rate of VFP in hemithyroidectomy (6.2%) was not different from the rate in other types of subtotal surgery (5.0%). Prevalence of VFP was not significantly different ($p > 0.05$) in minimally invasive surgery (6.3%) compared to conventional surgery (6.8%) (Fig. 1).

Risk was significantly (ANOVA, $p < 0.05$) increased in the prevalence of VFP if nodular goitre (7.3%) was compared with isolated endocrine inactive node (4.6%). But the rate of VFP was not different ($p > 0.05$) for Graves' disease (7.0%) or other causes of thyroid surgery. 8.0% of the patients had surgery due to a recurrence of the disease. Significantly more patients ($p < 0.05$) with secondary thyroid surgery were treated in the ENT department (9.1%) than in the GS department (7.0%). However, the rate of VFP was not different ($p > 0.05$) in first operations and operations for recurrent disease (Fig. 1).

Vocal fold palsy had no higher prevalence ($p > 0.05$) in surgeries performed by physicians in training (6.2%) than in surgeries performed by senior physicians (7.5%) or by chief physicians (5.9%) (Fig. 1).

A significantly ($p < 0.001$) lower rate of VFP was observed in operations performed by ENT (4.7%), compared to GS (8.2%) (Fig. 1).

Other complications such as postoperative haemorrhaging (5.6 vs. 1.9%, $p < 0.05$, RR 2.92), hypocalcemia < 2.0 mmol/l (32.8 vs. 22.0%, $p < 0.05$, RR 1.47) and the need for calcium substitution (23.2 vs. 14.7%, $p < 0.05$, RR 1.58) or dihydrotachysterol treatment (8.1 vs. 3.7%, $p < 0.05$, RR 2.18) at

Table 1 Patient characteristics by executing department

	Head and neck department	General surgery department	OR[a]	$p <$
Number of patients				
n	1576 (44.9%)	1933 (55.1%)	ns	
Age				
$X \pm SD$	52.2 ± 13.5	52.0 ± 13.3	ns	
Gender				
Women	1073 (68.1%)	1365 (70.6%)	ns	
Men	503 (31.9%)	568 (29.1%)		
Indication for surgery				
Diffuse goitre (euthyroid)	1 (0.1%)	2 (0.1%)	ns	
Isolated inactive nodes	234 (14.8%)	419 **(21.7%)**	0.63	**0.001**
Nodular goitre (euthyroid)	955 **(60.6%)**	1039 (53.8%)	1.32	**0.001**
Goitre and thyroid autonomy	204 (12.9%)	286 (14.8%)	ns	
Thyroid cyst	14 **(0.9%)**	2 (0.1%)	8.65	**0.05**
Graves' disease	120 (7.6%)	124 (6.4%)	ns	
Thyroiditis	9 **(0.6%)**	2 (0.1%)	5.55	**0.05**
Other thyroid diseases	7 (0.4%)	4 (0.2%)	ns	
Experience level of the surgeon				
Medical assistant	362 **(23.0%)**	295 (15.3%)	1.66	**0.01**
Specialist (ENT or GS)	185 **(11.7%)**	132 (6.8%)	1.81	**0.01**
Senior physician	704 (44.7%)	866 (44.8%)	ns	
Head of department	325 (20.6%)	640 **(33.1%)**	0.52	**0.01**
Extent of resection				
Total thyroidectomy	852 (54.1%)	1,064 (55.0%)	ns	
Near total thyroidectomy	247 (15.7%)	267 (13.8%)	ns	
Subtotal thyroidectomy	436 (27.7%)	561 (29.0%)	ns	
Less than subtotal thyroidectomy	21 (1.3%)	31 (1.6%)	ns	
Hemithyroidectomy	236 (15.0%)	425 **(22.0%)**	0.62	**0.01**
Secondary intervention for recurrent disease	144 **(9.1%)**	136 (7.0%)	1.33	**0.05**

Significantly higher values are marked in bold

ns not significantly different ($p > 0.05$)

[a]OR < 1.0 less frequent in ENT, OR > 1.0 more frequent in ENT

discharge from the hospital, were all documented more frequently among patients with VFP.

Table 2 shows the rates of complications and medical treatment according to the executing department. The risk of VFP was significantly lower within the ENT/head and neck surgery department, whereas the risks of postoperative bleeding and hypocalcaemia did not differ between the two departments. ENT patients were more frequently treated with dihydrotachysterol to improve hypocalcaemia. At discharge, 76.4% of the GS patients received thyroxin replacement vs. 90.7% in the ENT department ($p < 0.01$) and the dose of thyroxin was lower.

Discussion

Iatrogenic injury of the RLN is the most common reason for VFP [2]. According to Prasad et al. [3] thyroid surgery causes 1/3 of all vocal fold paralysis. This study examines the risk factors for VFP, as well as the safety and efficiency of operations performed by ENT vs. operations performed by GS.

Current evidence is unclear on whether IONM brings about a significant difference in the incidence of VFP

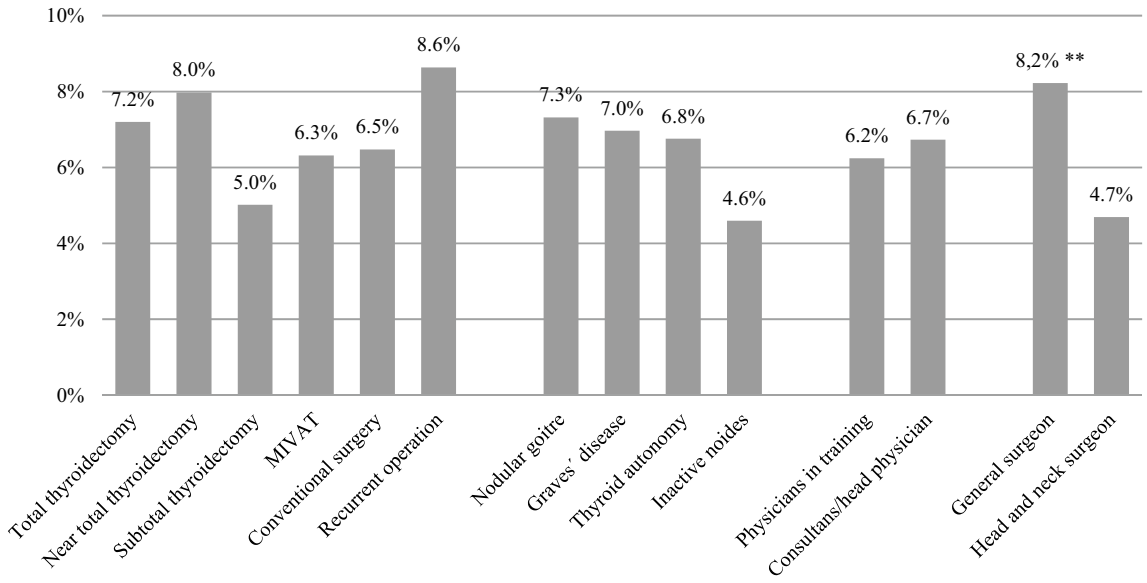

Fig. 1 Rate of VFP according to operation, indication, experience of the surgeon and executing department. $*p < 0.05$ = significant. $**p < 0.01$ = highly significant

Table 2 Complications and postoperative therapy according to executing department

	Head and neck department	General surgery department	OR[a]	$p <$
Complications				
Postoperative bleeding	35 (2.2%)	29 (1.5%)	ns	
Calcium < 2.0 mmol/l	322 (20.4%)	364 (18.8%)	ns	
Vocal fold palsy	74 (4.7%)	159 **(8.2%)**	0.55	**0.001**
Postoperative treatment				
Thyroid hormone replacement	1429 **(90.7%)**	1476 (76.4%)	3.0	**0.001**
Mean dose of thyroxin in the case of replacement	**96.8** ± 18.6 µg	92.4 ± 23.1 µg		**0.001**
Calcium substitution	256 (16.2%)	279 (14.4%)	ns	
Dihydrotachysterol treatment	86 **(5.5%)**	33 (1.7%)	3.20	**0.001**

Significantly higher values are marked in bold

ns not significantly different ($p > 0.05$)

[a]OR < 1.0 less frequent in ENT, OR > 1.0 more frequent in ENT

when using IONM vs. visualisation alone (VA) during thyroidectomies. The benefits hereof are often seen in operations with increased risk, such as thyroid reoperation or malignancy [4–6]. Neuromonitoring was not specifically considered for this analysis, because almost all operations were performed using IONM.

In the relevant literature, the average incidence of temporary VFP after benign thyroid operations varies widely (between 0 and 26%) [6–11]. The observed rate of permanent palsy mostly lies between 1 and 2% [2, 7, 9]. According to Jeannon et al. [11] this wide range of palsy rates could be explained by different methods for examining the larynx. In a systematic review of 27 articles including 25,000 patients, they found an average rate of temporary VFP of 9.8% and an average rate of permanent palsy of 2.3%. Joosten et al. [12] found that VFP occurred in 6.6% and that in relation to the nerves at risk, the incidence of primary postoperative nerve damage was 4.3%. Pisanu et al. [6] documented rates of overall VFP per nerve at risk of 3.47% in operations with IONM and 3.67% in operations with visualisation alone.

In the present study, we found similar results with VFP in 6.6% of the examined patients. Considering the nerves at risk, the rate of VFP was 3.6%. A significantly lower rate (RR 0.54) was observed in operations performed by surgeons specially trained for ENT and head and neck surgery (4.7%) compared to operations performed by GS (8.2%). In

view of the nerves at risk, the paralysis rate was also noticeably lower in the ENT (2.5%) than GS (4.6%) department. Due to the lack of follow-up laryngoscopies, no discrimination was made between permanent and transient palsy of the vocal fold.

In most studies, the main risk factors for VFP are Graves' diseases, surgery for malignancy, complete resection of the thyroid lobe, reoperation for postoperative bleeding and secondary interventions [5, 9, 10, 13, 14]. Vasileiadis et al. [15] found additional risks for RLN injury to include operative time, maximum diameter greater than 45 mm of right or left thyroid lobe, extrathyroid extension, incidental parathyroidectomy and tumour size larger than 10 mm. Joosten et al. [12] found that besides the extent of resection, a ligature of the inferior laryngeal artery and a non-exposure of the RLN in subtotal lobectomy were significant risk factors. Dralle et al. [14] named lobectomy (OR 1.8), no nerve identification (OR 1.4), low or medium volume hospital (OR 1.3) and low volume surgeons (OR 1.2) as risk factors.

We found a higher risk for VFP only in cases of nodular goitre compared with isolated nodes, but not for Graves' disease. On average, patients with VFP were older. Operations due to malignancy of the thyroid were excluded for our study. Unexpectedly, VFP was lower for ENT surgeons, despite the fact that there were comparatively more patients with nodular goitre treated in the ENT collective and the rate of hemithyroidectomy was lower, whereas secondary interventions were performed more frequently.

Studies comparing ENT and GS in thyroid surgery are rare. Takesuye et al. [16] compared the techniques of ENT and GS performing thyroidectomy for cancer. They found no significant difference in estimated blood loss, number of patients with temporary hypoparathyroidism or duration of hypocalcaemia. In the present study, no difference in the rate of postoperative bleeding or hypocalcaemia could be observed either.

Prevalence of VFP was not influenced by gender, rate of surgeries performed by physicians in training or use of minimally invasive compared to conventional surgery. Even the extent of resection was no significant risk factor. A higher rate of VFP was documented in conjunction with other complications such as postoperative bleeding and hypocalcaemia. The average incidence of temporary and permanent hypocalcaemia after benign thyroid operations varies between 0.2 and 26% [7, 8]. One possible explanation for this large range might be varying definitions of hypocalcaemia [17]. Risk factors for hypoparathyroidism include a larger extent of resection and recurrent goitre, as well as patient gender, hospital operative volume and Graves' disease [13]. Our definition of hypocalcaemia was a postoperative calcium level under 2.0 mmol/l during the inpatient stay. So the rate of around 20% includes transient and permanent hypocalcaemia and is comparable with rates observed in other studies [7, 8, 17]. From the 2678 patients in a study of Zhang et al. [18] 1.5% of patients experienced postoperative bleeding. Bellantone et al. [19] also reported postoperative bleeding in 1.5% of total thyroidectomies. With an incidence of 1.6%, our result is very similar. Occurrence of postoperative bleeding was significantly higher in patients with VFP.

With regard to the level of experience of the surgeon, several studies showed similar complication rates when comparing operations performed by residents and attending surgeons [20–22]. Showing no difference in the VFP rate of physicians in training, the results of this study confirm the thesis that "thyroid surgery can, therefore, be safely and effectively performed by residents under close supervision" [21].

Conclusion

In Germany, thyroid surgery is traditionally the domain of GS. At the Klinikum Mutterhaus der Borromäerinnen in Treves, benign thyroid surgery is performed to the same extent in both departments, ENT and GS. The most common and serious complications are VFP and postoperative hypocalcaemia, which can both be transient or permanent.

In this study of 3509 patients, with 6357 nerves at risk, the risk factors for VFP were multinodular goitre, age and other complications such as postoperative haemorrhaging and hypocalcaemia, but not secondary interventions for recurring disease and the extent of thyroid resection. No lower rate of VFP was found in minimally invasive video-assisted thyroidectomy (MIVAT) and the prevalence of VFP was not influenced by the degree of experience of the surgeon, therefore, operations performed by well supervised physicians in training are safe.

The rate of VFP was significantly lower in surgeons having received special training for head and neck surgery.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval This article does not contain any studies with human participants performed by any of the authors.

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