RISK OF VOCAL PALSY AFTER THYROIDECTOMY WITH IDENTIFICATION OF THE RECURRENT LARYNGEAL NERVE

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The purpose of this study was to assess the risk of vocal palsy after thyroidectomy with identification of recurrent laryngeal nerve (RLN) during surgery. In all, 521 patients treated by the same surgeon were enrolled in this study. Temporary and permanent vocal palsy rates were analyzed for patient groups classified according to surgery for primary benign thyroid disease, thyroid cancer, Graves' disease, and reoperation. Measurement of the vocal palsy rate was based on the number of nerves at risk. Twenty-six intentionally sacrificed RLNs were excluded from analysis. Forty patients developed postoperative unilateral vocal palsy. Complete recovery of vocal palsy was documented for 35 of the 37 patients (94.6%) whose RLN integrity had been ensured intraoperatively. Recovery from temporary vocal palsy ranged from 3 days to 4 months (mean, 30.7 days). The overall incidences of temporary and permanent vocal palsy were 5.1% and 0.9%, respectively. The rates of temporary/permanent vocal palsy in groups classified according to underlying disease were 4.0%/0.2% for benign thyroid disease, 2.0%/0.7% for thyroid cancer, 12.0%/1.1% for Graves' disease, and 10.8%/8.1% for reoperation. Surgery for thyroid cancer, Graves' disease, and recurrent goiter were associated with significantly higher vocal palsy rates. Most patients without documented nerve damage during the operation recovered from postoperative vocal palsy. Total lobectomy with routine RLN identification is recommended as a basic procedure in thyroid surgery.

Key Words: complications, recurrent laryngeal nerve palsy, thyroidectomy, vocal palsy
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Vocal palsy is one of the most common complications after thyroid surgery. The resulting phonetic paralysis is not only a serious impairment for patients who rely on their voice professionally, but it may also lead to serious disturbances in ventilation in cases with bilateral vocal palsy. Therefore, procedures that reduce the rate of temporary and, particularly, permanent vocal palsy are essential. The reported incidence of vocal palsy after thyroid surgery varies widely, and many factors may account for this variation, such as different surgeons, operative procedures, and the way the incidence is calculated, some based on the number of patients undergoing surgery and some on the nerves at risk. These variations make it difficult to compare the various reports meaningfully. In contrast, in the present study, operations were performed by the same surgeon and the operative procedure was restricted to total lobectomy (unilateral or bilateral) with routine identification of the recurrent laryngeal nerve (RLN). The rates of temporary and permanent vocal palsy were analyzed on the basis of underlying disease and calculated in relation to the number of nerves at risk of damage. Recovery potential and risk factors for vocal palsy were also evaluated.

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MATERIALS AND METHODS

From January 1986 to December 2002, 890 patients underwent thyroidectomy in our department for treatment of various thyroid diseases. The study was confined to 521 patients

treated by the same surgeon, 118 men and 403 women with ages ranging from 17 to 78 years (mean, 42 years). There were 348 total lobectomies and 178 total thyroidectomies (5 patients underwent total lobectomies twice). Routine identification of the RLN was performed during all operative procedures. The surgical procedure to identify the RLN was similar to that described in 1986 by Harness et al [1]. The RLN was not identified early in the operative procedure. When dissection proceeded to the area of Berry's ligament, the RLN was identified where it coursed through the ligament or close to it. For a large thyroid mass or substernal goiter, the RLN was identified and traced from the recurrent nerve triangle as advocated by Lore [2].

We classified our patients into four groups according to the underlying disease (thus, some patients were in more than one group): primary benign thyroid disease (n = 359), thyroid cancer (n = 103), Graves' disease (n = 46), and reoperation (n = 29). Patients undergoing initial surgery for nodular goiter, adenoma, or thyroiditis were included in the primary benign thyroid disease category. Individuals diagnosed with thyroid carcinoma from histopathology, or those who underwent completion thyroidectomy for cancer, were grouped with the thyroid cancer cases. Patients who had thyrotoxicosis, diffuse goiter, or clinical ophthalmopathy were included in the Graves' disease category; six of these were associated with thyroid cancer. Patients who had previously undergone thyroid surgery were included in the reoperation group. Of these, one had recurrent Graves' disease, eight had thyroid cancer, and 20 had recurrent goiter.

In the thyroid cancer group, 20 individuals were identified with invasive disease involving the RLN. Six patients required total laryngectomy, one required partial laryngectomy, and 13 had nerve encasement by the tumor intraoperatively and required intentional resection of the RLN. Therefore, a total of 26 nerves were excluded from the statistics, which left 678 at risk. All patients underwent preoperative and postoperative laryngoscopic examination of the vocal cords. Where vocal cord palsy was identified, follow-up was weekly initially, and every 3–4 weeks thereafter until recovery was achieved, with the dysfunction considered permanent if it persisted after 6 months. Measurement of the rate of vocal palsy was based on the number of nerves at risk. The Chi-squared test was used for statistical analysis.

Results

There were 40 patients with unilateral vocal palsy after surgery, three of whom had recognizable nerve damage intraoperatively. Complete recovery of vocal cord function was documented in 35 of 37 patients (94.6%) in whom integrity of the RLN had been ensured intraoperatively. The overall incidences of temporary and permanent vocal palsy were 5.1% and 0.9% of the nerves at risk, respectively. The rates of temporary/permanent vocal palsy were 4.0%/0.2% for benign thyroid disease, 2.0%/0.7% for thyroid cancer, 12.0%/1.1% for Graves' disease, and 10.8%/8.1% for reoperation. (Table). Compared with the benign thyroid disease group, the temporary vocal palsy rate was significantly increased in patients with Graves' disease ($p < 0.005$), and the permanent vocal palsy rate was significantly increased in patients undergoing reoperation ($p < 0.001$). The recovery time for temporary vocal palsy ranged from 3 days to 4 months (mean, 30.7 days) (Figure). Of the 35 temporary vocal palsy cases, 34 (97.1%) recovered within 9 weeks, with peak nerve recovery occurring at 5–6 weeks. Recovery from vocal palsy took up to 4 months in one patient.

Table. Incidence of recurrent laryngeal nerve palsy according to underlying disease

	Patients, n*	TL, n	TT, n	Nerves at risk, n	Vocal palsy, n (%)	
					Temporary	Permanent
Primary benign thyroid disease	359	296	63	422	17 (4.0)	1 (0.2)
Thyroid cancer	103	32	71	148†	3 (2.0)	1 (0.7)‡
Graves' disease	46	0	46	92	11 (12.0)	1 (1.1)‡
Reoperation	29	21	8	37	4 (10.8)	3 (8.1)
Total	521	348	178	678†	35 (5.1)	5 (0.9)

*Some patients were in more than one group; †26 nerves with intentional sacrifice excluded; ‡Graves' patient with thyroid cancer. TL = total lobectomy; TT = total thyroidectomy.

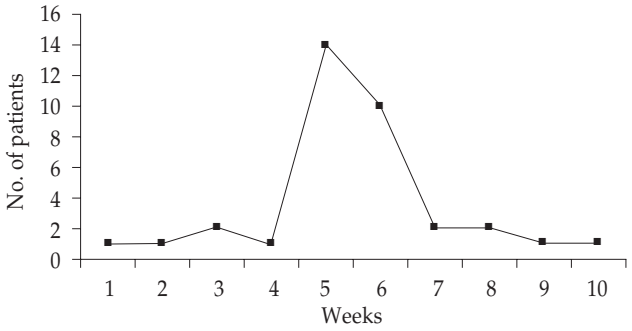

Figure. *Time course of recovery from temporary recurrent laryngeal nerve (RLN) palsy. For 34 of 35 (97.1%) patients recovering from temporary RLN palsy within 9 weeks, peak recovery occurred at 5–6 weeks. Recovery was up to 4 months in one patient who had recovery time exceeding 9 weeks.*

Discussion

There has been some controversy surrounding routine dissection and identification of the RLN during thyroidectomy, but it is now the treatment of choice of most surgeons. Wade reports that the RLN is very vulnerable and should not be visualized or touched [3]. Bergamaschi et al demonstrated that temporary and permanent vocal palsy rates were not statistically different whether or not the RLN had been exposed [4]. In Wagner and Seiler's study [5], there was no statistically significant difference in vocal palsy rates for subtotal lobectomies with and without nerve exposure. For total lobectomy, however, the risk of vocal palsy was 21%, and the permanent palsy rate increased from 3.8% to 7% when the nerve was not exposed or identified. Most current reports recommend visualization of the nerve, suggesting that this may decrease the permanent nerve palsy rate [1,2,6–10]. Karlan et al reported 1,000 consecutive thyroid operations with complete nerve dissection, without any permanent vocal palsy [6]. Mattig et al demonstrated decreased permanent RLN palsy rates (from 5.9% to 0.8%) following routine nerve identification [7]. In our study, surgery was performed by the same surgeon, and the procedure consisted exclusively of total lobectomy (unilateral or bilateral) with routine identification of the RLN. The overall incidences of temporary and permanent vocal palsy were 5.1% and 0.9% of the nerves at risk, respectively. We believe that identification of the nerve is the only way to ensure the integrity of the RLN. Dissection of the nerve itself may increase the rate of vocal palsy, which is probably caused by stretching during the operation or impairment of nutrition by the surrounding tissue. Therefore, although the temporary vocal palsy rate may be somewhat higher when the nerve is dissected routinely, we believe that this is acceptable as long as the permanent vocal palsy rate is reduced.

Vocal palsy rates may vary for different thyroid diseases, with a higher expected risk of intraoperative nerve damage for thyroid cancer, Graves' disease, and recurrent goiter. Therefore, in this study, we analyzed temporary and permanent RLN palsy rates among patients with benign thyroid disease, thyroid cancer, Graves' disease, and reoperation. Primary surgery for benign thyroid disease with routine identification of the RLN has been reported to have a very low incidence of vocal palsy. Perzik reported temporary and permanent vocal palsy rates of 0.4% and 0% after 250 total thyroidectomies for benign nodular goiter [11]. Jatzko et al found rates of 3.0% and 0% for temporary and permanent vocal palsy, respectively, in a sample of 736 patients who underwent primary surgery for benign thyroid disease [8]. Lo et al reported temporary and permanent vocal palsy rates of 3.4% and 0.2%, respectively, for patients with benign goiter [9]. For our population of 359 patients who underwent primary surgery for benign thyroid disease (296 total lobectomies and 63 total thyroidectomies), temporary and permanent vocal palsy rates were 4.0% and 0.2%, respectively. Our results are comparable to those of other investigations.

The incidence of vocal palsy following surgery for thyroid cancer varies widely in the literature. Intraoperative nerve injury rates of 9.7%, 1%, and 5% have been reported for thyroid cancer by Van Heerden et al [12], Flynn et al [13], and Perzik [11], respectively. Wagner and Seiler determined temporary/permanent vocal palsy rates of 3%/17% [5], and Steurer et al reported analogous results of 15.4%/2.4% [10]. In our study, we found that thyroid cancer with extracapsular invasion was the most important risk factor for permanent postoperative vocal palsy. Of our 103 patients with thyroid cancer, invasive disease involving the RLN and/or upper aerodigestive tract was identified in 20 (19.4%). Six cases underwent total laryngectomy due to extensive laryngeal infiltration and one case underwent partial laryngectomy. Another 13 individuals had intraoperative nerve encasement by the tumor, which required intentional RLN resection; six of these underwent partial resection of the constrictor muscle or tracheal cartilage. Of the 20 patients requiring intentional resection of the RLN, 13 had preoperative RLN palsy, with histologic findings confirming poorly differentiated carcinomas for eight. These results explain why the incidence of intentional RLN resection was higher in our study. Furthermore, although surgery for thyroid can-

cer was associated with a higher permanent vocal palsy rate, there was no statistical difference between the cancer group and the benign thyroid disease group in the rates of temporary (2.0% vs 4.0%; $p > 0.1$) and permanent (0.7% vs 0.2%; $p > 0.1$) vocal palsy when cases of intentional RLN sacrifice were excluded.

Surgery for Graves' disease has a higher palsy rate than for other diseases in several reports [5,14,15]. Wagner and Seiler determined temporary/permanent palsy rates of 8%/4% in a sample of 75 patients with Graves' disease [5], with analogous rates of 16%/1.6% reported by Razack et al [14]. Agarwal and Mishra found that 11.1% of Graves' disease patients had temporary vocal palsy [15]. Total thyroidectomy is our preferred option for Graves' disease because it has several advantages, including immediate cure of any hyperthyroidism, avoidance of recurrence, and diminution of cancer risk. In our study, surgery for Graves' disease had a significantly higher temporary than permanent vocal palsy rate (12% vs 4.0%; $p < 0.005$). However, there was no statistical difference in permanent palsy rate when compared with benign thyroid disease. Six of the 46 Graves' cases (13%) were associated with thyroid cancer, but this did not appear to influence the nerve palsy rate. Furthermore, we found that stretching of the nerve occurred more frequently during dissection of the RLN from a large thyroid mass because of the increased vascularity associated with Graves' disease, and it seems reasonable to suggest that this is the cause of the higher rate of temporary RLN palsy in our Graves' disease patients.

The RLN is more vulnerable to damage during secondary thyroidectomy. Mårtensson and Terins reported permanent vocal palsy in 14% of their reoperation patients [16]. Beahrs and Vandertoll determined a permanent vocal palsy rate of 8% for patients who underwent two surgical procedures for benign thyroid disease, and 22% for those who underwent three or more [17]. Jatzko et al determined that the incidence of permanent vocal palsy increased from nil during primary operations for benign goiter to 7.5% for the recurrent variant [8]. Reeve et al reported a very low palsy rate (1.5%) among 408 secondary thyroidectomy patients [18]. In our sample, common indications for reoperation were presence of thyroid cancer in a lobe that had been previously removed, presence of recurrent goiter, or recurrent thyrotoxicosis. Of the 29 reoperation patients, one had recurrent Graves' disease, eight were cancer patients, and 20 had recurrent goiter. There was a significant difference in permanent vocal palsy rates compared with the benign thyroid disease group (8.1% vs 0.2%; $p < 0.001$). We found that the extent of the previous thyroid surgery was a major factor in the occurrence of vocal palsy. Seven instances of vocal palsy (3 permanent, 4 temporary) occurred as a result of operations for benign recurrent goiter, where the previous surgery had been partial or subtotal lobectomy. Nerve damage was recognized intraoperatively in the three patients who suffered permanent vocal palsy. Completion thyroidectomy for thyroid cancer was not a risk factor for vocal palsy, although the risk of temporary/permanent vocal palsy increased to 12.9%/9.7% in those who had undergone less than total lobectomy in the previous surgery. As might be expected, stretching or inadvertent transection of the RLN occurred more frequently where the nerve had to be dissected from distorted and/or scarred tissue. These results emphasize the need for total lobectomy with routine identification of the RLN in any initial thyroid surgery, so that thyroidectomy can be completed after unilateral total lobectomy with little risk of nerve injury.

Postoperative vocal palsy has the potential for recovery, with reported recovery rates ranging from 50–100% [6–10, 16]. Proponents of nerve identification report a significantly higher recovery rate after vocal palsy. Two studies have reported a recovery rate of 100% for primary surgery with routine nerve exposure [6,8]. Our overall recovery rate was 87.5%. However, when inadvertent intraoperatively recognized nerve injury was excluded, the recovery rate rose to 94.6%. The duration of temporary vocal cord paralysis ranged from 3 days to 4 months (mean, 30.7 days). Further, we found that most patients could pinpoint when their voice became better as the function of the vocal cord returned. Of 35 temporary vocal palsy cases, 34 (97.1%) recovered within 9 weeks; the recovery peak occurred at 5–6 weeks (Figure). Recovery of vocal palsy took up to 4 months in one patient who experienced cord palsy for more than 9 weeks. The results of this study suggest that, where cord palsy persists for longer than 2 months, there is only a limited chance of recovery. However, a recovery delay of 2 years has been reported by Steurer et al [10]. Of the patients with permanent vocal palsy, three had suffered inadvertent intraoperative nerve transection. Although the integrity of the RLN was ensured intraoperatively in another two patients, restoration of nerve function had not occurred after several years of follow-up.

Conclusion

Significantly higher vocal palsy rates were demonstrated after surgery for thyroid cancer, Graves' disease, and recurrent goiter compared with benign thyroid disease in our

study. The thyroid cancer group had a higher rate of permanent vocal palsy after surgery due to the higher incidence of extra-thyroid invasion, although statistical difference with the benign thyroid disease group in the rates of temporary and permanent vocal palsy was not demonstrated when cases of preoperative cord palsy and intentional sacrifice of the RLN were excluded. Surgery for Graves' disease was associated with a higher rate of temporary vocal palsy because stretching occurred more frequently during dissection of the nerve. Reoperation patients had a significantly higher rate of permanent vocal palsy compared to those undergoing primary surgery for benign thyroid disease, especially where previous partial or subtotal lobectomy had been performed. Total lobectomy with routine identification of the RLN is quite safe and should be recommended as a basic procedure in thyroid surgery. Most of our patients recovered vocal cord function postoperatively when nerve damage was not documented intraoperatively.

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甲狀腺切除術中找出喉返神經對於術後聲帶麻痺的危險性

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本研究的目的在於評估甲狀腺手術時例行性找出喉返神經對於術後聲帶麻痺的危險性。本研究包含 **521** 位由同一術者執刀的病人。將病人分為良性甲狀腺疾病、甲狀腺癌、**Graves'** 病和再次手術四組，並分別計算其暫時性及永久性聲帶麻痺的機率。聲帶麻痺機率的計算是以相關神經的數目為基礎，其中有二十位甲狀腺癌病人、二十六條返喉神經，因疾病關係必須於術中將其截斷者，則不列入計算。共四十位病人於術後有聲帶麻痺的情形，在三十七位於術中可確定返喉神經的完整性的病人，有三十五位 (**94.6%**) 其返喉神經之功能完全恢復。暫時性聲帶麻痺恢復的時間從三天至四個月不等，平均 **30.7** 天。整體而言，暫時性及永久性聲帶麻痺的機率分別為 **5.1%** 和 **0.9%**。若將病人分為良性甲狀腺疾病、甲狀腺癌、**Graves'** 病和再次手術四組，其暫時性及永久性聲帶麻痺的機率分別為 **4.0%/0.2%**，**2.0%/0.7%**，**12.0%/1.1%** 和 **10.8%/8.1%**。甲狀腺癌、**Graves'** 病和再次甲狀腺手術的病人有較高的聲帶麻痺的機率，甲狀腺癌的病人有 **19.4%** 的機率會有腫瘤侵犯返喉神經的情形。於術中可確定返喉神經的完整性的病人，大部分其返喉神經之功能會完全恢復，甲狀腺全葉切除並例行性找出返喉神經應被推薦為甲狀腺的基本手術方法。

關鍵詞：併發症，喉返神經，甲狀腺切除術，聲帶麻痺

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