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Total thyroidectomy is safer with identification of recurrent laryngeal nerve

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Abstract: Objective: To investigate the effect of recurrent laryngeal nerve (RLN) identification on the complications after total thyroidectomy and lobectomy. Methods: Total 134 consecutive patients undergoing total thyroidectomy or thyroid lobectomy from January 2003 to November 2004 were investigated retrospectively. Patients were divided into two groups: RLN identified (Group A) or not (Group B). The two groups were compared for RLN injury and hypocalcaemia. Results: The numbers of patients and nerves at risk were 71 and 129 in Group A, and 63 and 121 in Group B, respectively. RLN injury in Group A (0) was significantly lower than that in Group B (5 [7.9%]) patients, 7 [5.8%] nerves) for the numbers of patients (P=0.016) and nerves at risk (P=0.006). Temporary hypocalcaemia was significantly higher in Group A than in Group B (14 [24.1%] vs 6 [10.3%], P=0.049). Permanent complications in Group B were significantly higher than those in Group A (13 [20.6%] vs 4 [5.6%], P=0.009). Conclusion: RLN injury was prevented and permanent complications were decreased by identifying the whole course and branches of the recurrent laryngeal nerve during total thyroidectomy.

Key words: Total thyroidectomy, Lobectomy, Recurrent laryngeal nerve (RLN) identification, Complication
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INTRODUCTION

Total thyroidectomy or thyroid lobectomy has been accepted as current surgical therapy for benign and malignant thyroidal disorders (Erolu *et al*., 1998; Sturniolo *et al*., 1999; Dener, 2002; Bron and O′Brien, 2004; Rosato *et al*., 2004), but extensive resection might increase the risk of postoperative complications (Wagner and Seiler, 1994; Thomusch *et al*., 2003). Recurrent laryngeal nerve (RLN) dysfunction and hypoparathyroidism are well-recognized important complications of thyroid surgery (McHenry, 2002). Complication rates of thyroidectomy have a varying range for both RLN injury (0 to 14%) and permanent hypoparathyroidism (1% to 11%) (Harness *et al*., 1986). Paralysis of vocal cords may cause serious phonatory, respiratory and psychological problems that limit working capacities and quality of life of the patients (Sturniolo *et al*., 1999). Intensive effort should be spent to prevent the complications especially related to RLN and parathyroid glands, because they can be prevented with appropriate surgical technique during total thyroidectomy.

The surgical technique is one of the important factors affecting the outcome of thyroidectomy (Wagner and Seiler, 1994). In the past, most surgeons avoided dissections in close proximity to the RLN to prevent its injury. Recently, endocrine surgeons consider this totally unacceptable. The identification and preservation of the RLN are essential to avoid its injury (Hisham and Lukman, 2002). Meticulous hemostasis and delicate technique are required to prevent nerve injury. Once found, the nerve with all the identified branches must be followed superiorly through

the entire course, until it enters the larynx (Ardito *et al*., 2004). This surgical technique, which needs more dissection, may give undesirable harm to RLN and parathyroid glands (Wagner and Seiler, 1994). The aim of this retrospective study was to find the effect of RLN identification on the important complications after total thyroidectomy and lobectomy.

PATIENTS AND METHODS

Patients

This retrospective study consisted of 134 consecutive patients who underwent total thyroidectomy or only lobectomy from January 2003 to November 2004. The preparation for surgical treatment of the patients included the following investigations: ultrasound, determination of free T3, free T4, thyroid stimulating hormone and serum calcium concentration, and fine-needle aspiration biopsy. The status of vocal cords of patients with hoarse voice was checked by laryngoscope. Operations were performed by six experienced surgeons or residents under vision of experienced surgeons.

Methods

Patients were divided into two groups according to the RLN identification during operation. Group A contained patients whose RLNs were exposed and the courses were followed completely during operation. Group B consisted of patients without RLN identification. Postoperative complications investigated in the study were hypocalcaemia and RLN injury (either temporary or permanent). RLN injury was evaluated according to the number of patients or nerves at risk. The complications in each group were evaluated by the following parameters: age, gender, preoperative diagnosis (multinodular goiter, diffuse goiter, malignancy suspicion or malignancy), status of thyroid function (euthyroid, hyperthyroid or hypothyroid), purpose of operation (primary, completion or operation for recurrence), type of operation (total thyroidectomy or thyroid lobectomy), operator (surgeon or resident), and postoperative diagnosis (benign or malignant).

Surgical technique

Total thyroidectomy or lobectomy was performed by a technique of capsular dissection. Although some surgeons identified RLN routinely, some surgeons never identified RLN. The delicate technique was performed by seeking, identifying and exposing the nerve itself with all branches and following its course with care until it entered larynx. However, special care was not given to identify superior laryngeal nerves. All the parathyroid glands were identified, if possible. Parathyroid glands were transplanted in the sternocleidomastoid muscle, if the blood supply to the glands was compromised.

Follow-up period

The patients were followed up at the end of the first week, at the end of the first month, and then every three months in the first postoperative year. During follow-up, patients were evaluated by physical examination and, if necessary, free T3, free T4 and thyroid stimulating hormone levels, serum levels of calcium and laryngoscopy. After total thyroidectomy, 100 mg of levothyroxine was commenced, and thereafter, the dose of levothyroxine was adjusted according to the free T3, free T4 and thyroid stimulating hormone levels. Postoperative serum calcium levels were checked on the first postoperative day, and then were subsequently checked daily if serum calcium level was under the normal limit or the patient had clinical signs of hypocalcaemia. Hypoparathyroidism was defined as sustained symptomatic hypocalcaemia with lower serum calcium levels. Hypocalcaemia was considered permanent, if the patient required calcium supplement to maintain normal serum calcium level for longer than 6 months. If the patient stopped the calcium supplementation within 6 months, the situation was accepted as temporary hypocalcaemia. Postoperative laryngoscopy was not routinely performed but was performed after the operation for patients with dyspnea, hoarseness or loss of voice quality. RLN injury was defined as permanent if there was not a documented proof of recovery of the RLN by laryngoscopy within 6 months after surgery. The patients were followed at least one year postoperatively.

Statistical analysis

Data were expressed as mean±*SD* for age, and the frequencies were calculated for other parameters. The homogeneity of groups was analyzed by *t*-test,

and χ^2 test for the properties of patients. χ^2 test and logistic regression analysis were used to evaluate the relationship between the properties of patients and the occurrence and types of complications. Statistical analysis was made by SPSS 11.5.

RESULTS

The numbers of patients and nerves at risk were 71 and 129 in Group A vs 63 and 121 in Group B respectively. There was not a significant difference between the two groups according to age (P=0.205), gender (P=0.836), status of thyroid function (P=0.521), purpose (P=0.140) and type (P=0.073) of the operation, operators (P=0.256), postoperative diagnosis (P=0.423), and the numbers of patients (P=0.328) and nerves at risk (P=0.079). Preoperative diagnosis of groups was not significantly different (P=0.089), but the number of malignancies in Group B was significantly higher than that in Group A (P=0.018). The properties of patients in each group were detailed in Table 1.

Temporary RLN injury was not detected in both groups. The total number of complications in Group A (18 [25.3%]) was significantly lower than that in Group B (19 [30.1%]) (P=0.019). This difference was caused by RLN injury rather than hypocalcaemia (P=0.020). Logistic regression test showed that this situation had a significant relationship with the type of operation and the operators in Group A (P=0.020 and P=0.029, respectively). The number of total complications during total thyroidectomy was greater than that during thyroid lobectomy (P=0.0001). Total number of complications caused by surgeons was approximately 3.5 times greater than that by residents (P=0.031). The reason was the bigger number of temporary hypocalcaemia (P=0.031).

There was no RLN injury in Group A, whereas 5 (7.9%) patients had 7 (5.8%) RLN injuries (two of them were bilateral) in Group B. The RLN injury in Group A was significantly lower than that in Group B when compared for the number of patients (P=0.016) or nerves at risk (P=0.006). Logistic regression analysis showed that RLN injury of patients with hyperthyroid status was significantly higher than that of patients with euthyroid and hypothyroid status (P=0.044 and P=0.022, respectively) in Group B.

Table 1 Properties of the patients in each group

Evaluation parameters	Group A	Group B	Total
Number			
Patients	71	63	134
Nerves at risk	129	121	250
Demographic parameters			
Age (year)	46.85±12.4	44.13±12.2	45.57±12.4
Gender, F/M	53/18	48/15	101/33
Preoperative diagnosis			
Multinodular goiter	50 (70.4%)	35 (55.6%)	85 (63.4%)
Diffuse goiter	2 (2.8%)	1 (1.6%)	3 (2.2%)
Malignancy suspicion	15 (21.1%)	15 (23.8%)	30 (22.4%)
Malignancy	4 (5.6%)	12 (19.0%)	16 (11.9%)
Status of thyroid function			
Euthyroid	47 (66.2%)	43 (68.3%)	90 (67.2%)
Hyperthyroid	17 (23.9%)	17 (27.0%)	34 (25.4%)
Hypothyroid	7 (9.9%)	3 (4.8%)	10 (7.5%)
Purpose of operation			
Primary	67 (94.4%)	53 (84.1%)	120 (89.5%)
Operation for recurrence	2 (2.8%)	6 (9.5%)	8 (6.0%)
Completion	2 (2.8%)	4 (6.3%)	6 (4.5%)
Type of operation			
Total thyroidectomy	58 (81.7%)	58 (92.1%)	116 (86.5%)
Thyroid lobectomy	13 (18.3%)	5 (7.9%)	18 (13.5%)
Operator			
Surgeon	28 (39.4%)	31 (49.2%)	59 (44.0%)
Resident	43 (60.6%)	32 (50.8%)	75 (56.0%)
Postoperative diagnosis			
Benign disease	55 (77.5%)	45 (71.4%)	100 (74.5%)
Malign disease	16 (22.5%)	18 (28.6%)	34 (25.4%)

Because hypocalcaemia was almost nonexistent in the patients undergoing lobectomy, in the present study only patients with total thyroidectomy (n=58 for each group, as shown in Table 1) were assessed for hypocalcaemia. No significant difference was found between the two groups for the number of hypocalcaemia (18 [31.0%] in Group A vs 14 [24.1%] in Group B, P=0.406) or permanent hypocalcaemia (4 [6.9%] in Group A vs 8 [13.8%] in Group B, P=0.223). However, temporary hypocalcaemia in Group A (14 [24.1%]) was significantly higher than that in Group B (6 [10.3%]) (P=0.049). The properties of the patients with complications were given in Table 2.

Table 2 Properties of the patients with complications*

Evaluation parameters	RLN palsy		Hypocalcaemia				Total complications	
			Temporary		Permanent			
	Group A	Group B	Group A	Group B	Group A	Group B	Group A	Group B
Gender, M/F	0/0	0/5	5/9	0/6	1/3	2/6	6/12	2/17
Preoperative diagnosis								
Multinodular goiter	0	3	8	3	2	3	10	9
Diffuse goiter	0	0	1	0	0	1	1	1
Malignancy suspicion	0	2	3	1	1	2	4	5
Malignancy	0	0	2	2	1	2	3	4
Status of thyroid function								
Euthyroid	0	1	11	5	3	8	14	14
Hyperthyroid	0	4	1	0	1	0	2	4
Hypothyroid	0	0	2	1	0	0	2	1
Purpose of operation								
First	0	3	12	6	4	7	16	16
Operation for recurrence	0	2	1	0	0	0	1	2
Completion	0	0	1	0	0	1	1	1
Type of operation								
Total thyroidectomy	0	5	14	6	4	8	18	19
Thyroid lobectomy	0	0	0	0	0	0	0	0
Operator								
Surgeon	0	1	8	5	3	6	11	12
Resident	0	4	6	1	1	2	7	7
Postoperative diagnosis								
Benign	0	4	11	4	2	4	13	12
Malign	0	1	3	2	2	4	5	7

* Patients did not have more than one complication simultaneously

Parathyroid glands were transplanted in the sternocleidomastoid muscle, when the blood supply was compromised. The rate of parathyroid gland autotransplantation in Group A (10 [14.1%]) was significantly higher than that in Group B (2 [3.2%]) (P=0.020); surprisingly no significant relationship was found between parathyroid gland autotransplantation and temporary or permanent hypocalcaemia in each group when considering the autotransplanted patients only. In this study, parathyroid autotransplantation was found to be ineffective to reduce the complications related to parathyroid glands.

Table 2 shows that the total numbers of permanent complications in Groups A and B were 4 (5.6%) and 13 (20.6%), respectively. Hypocalcaemia was the only permanent complication in Group A and constituted 22.2% of all complications in this group. Permanent complications constituting 68.4% of all complications in Group B were significantly higher than those in Group A (P=0.009). There was no significant relationship between the total number of permanent complications and any evaluation parameter (P>0.05 for each comparison).

DISCUSSION

Although risk factors for morbidity of thyroid surgery are well defined, their actual contribution to morbidity rates is still debated (Bergamaschi *et al*., 1998; Dackiw *et al*., 2002). Postoperative morbidity was found to be increased with the increasing extent of thyroid resection (Wagner and Seiler, 1994; Thomusch *et al*., 2003). In addition, underlying thyroid disease, intraoperative technique, surgeon's experience (Wagner and Seiler, 1994; Thomusch *et al*., 2003), operation for completion (Shaha and Jaffe, 1992) and the addition of neck dissection (Betka *et al*.,

1997) were the risk factors for postoperative thyroid morbidity. The surgical technique is one of those factors debated to affect the outcome of thyroid surgery. For this reason, we investigated the effect of RLN identification on the major complications, such as RLN injury or hypocalcaemia, during total thyroidectomy or lobectomy.

The identification, careful exposure and preservation of the RLN throughout its course are important to prevent nerve injury (Ardito *et al*., 2004). The approach for the identification of the RLN during surgery on the thyroid gland was described in some previous studies (Pimpl *et al*., 1992; Mattig *et al*., 1998; Ardito *et al*., 2004). Although Bergamaschi *et al*.(1998) reported that the RLN identification failed to reduce injury rate, there are many studies demonstrating a significant decrease in the rate of RLN injury maintained by the identification of the nerve (Wagner and Seiler, 1994; Mattig *et al*., 1998; Sturniolo *et al*., 1999; Hermann *et al*., 2002; Thomusch *et al*., 2003). Wagner and Seiler (1994) reported that in total lobectomy the permanent injury rate significantly increased from 3.8% to 7% when the nerve was not identified. Mattig *et al*.(1998) showed that routine preparation of the RLN decreased the permanent injury rate from 5.99% to 0.88%. Like the studies mentioned above, our study showed that RLN injury might be prevented by nerve identification.

Postoperative laryngoscopy that could identify asymptomatic nerve palsy was not routine in our practice. The absence of temporary RLN palsy could be attributed to the selective use of laryngoscopy only for patients with dyspnea, hoarseness or loss of voice quality.

Even in the hands of surgeons experienced in endocrine surgery, hyperthyroidism was reported as an independent risk factor for developing RLN injury and hypoparathyroidism after total thyroidectomy (Zambudio *et al*., 2004). This study shows that hyperthyroidism increased the risk of RLN injury when the nerve was not identified. The observation of no RLN injury in Group A was the result of surgical technique using delicate dissection, identification and exposure of the entire course of RLN, but not avoiding dissection close to the nerve. Inadvertent injury to RLN was prevented by this technique. Because extensive dissection facilitates visual control of nerve integrity and identification of extralaryngeal ramifications during resection, it is superior to a more limited exposure of the nerve (Hermann *et al*., 2002).

There was only one malignancy patient with RLN injury in Group B, whose nerves were not involved with tumor tissue, so none of the nerve injuries in Group B was inevitable or intentional. Two patients with bilateral vocal cord palsy had moderate dyspnea and did not need tracheotomy. They were hospitalized for two weeks and given medical therapy consisting of steroid (prednisolone 1 mg/(kg·d)), anti-inflammatory drug and vitamin B complex. Also, exercise and over-effort were limited. By these therapies, a relative relief of complaints was maintained. As there was no recovery of vocal cord movements at the end of six months, patients were suggested to have a posterior cordectomy. However, both of the patients did not accept this operation. They were hospitalized and given medical therapy when they had an upper respiratory tract infection. Moreover, they had been going on with laryngoscopic control twice a year.

Hypoparathyroidism can only be assessed by identification of subnormal parathyroid hormone levels. In many studies (Bergamaschi *et al*., 1998; Erolu *et al*., 1998; Pappalardo *et al*., 1998; Bron and O′Brien, 2004; Rosato *et al*., 2004; Zambudio *et al*., 2004; Ozbas *et al*., 2005), although parathyroid hormone levels were not assessed, hypoparathyroidism was accepted as the cause of hypocalcaemia. Hypoparathyroidism constituted the majority of the complications after total thyroidectomy in most series (Erolu *et al*., 1998; Pappalardo *et al*., 1998; Rosato *et al*., 2004; Zambudio *et al*., 2004; Ozbas *et al*., 2005). The incidence of hypoparathyroidism varied in different series with the dominance of temporary nature (Bergamaschi *et al*., 1998; Rosato *et al*., 2004; Zambudio *et al*., 2004; Ozbas *et al*., 2005). Although there were reports of hypoparathyroidism with high incidences as 30.4% and 35% after total thyroidectomy, the incidence of permanent hypoparathyroidism was not high (0.4% and 3%, respectively) in these studies (Pappalardo *et al*., 1998; Ozbas *et al*., 2005). Systematic dissection of RLN was reported to increase hypoparathyroidism, mainly by devascularization of parathyroid glands (Megherbi *et al*., 1992). However, in the experienced hands routinely identifying RLN, percentages of total and permanent hy-

poparathyroidism after total thyroidectomy were not high (9.6% and 0.7%, respectively) (Zambudio *et al*., 2004). Although the incidences of hypocalcaemia in both of our groups were as high as some other studies (Pappalardo *et al*., 1998; Ozbas *et al*., 2005), the incidence of permanent hypocalcaemia was higher in our groups than in those studies. The reason for significantly high incidence of temporary hypocalcaemia in the group identifying RLN of this study was thought to be the result of the comprehensive dissection which might have caused temporary trouble to vascular supply of parathyroid glands.

It was known that routine parathyroid autotransplantation increased postoperative temporary hypocalcaemia and decreased permanent hypocalcaemia (Zedenius *et al*., 1999; Lo, 2002). Parathyroid gland autotransplantation was not routine in our study. The increased incidence of parathyroid gland autotransplantation in Group A showed that parathyroid gland autotransplantation was influenced by the identification of RLN, but did not reduce the incidence of hypocalcaemia. Increased number of ischemic glands might have been recognized as a result of comprehensive dissection. Autotransplantation was thought to be unsuccessful owing to the implantation of only the ischemic gland.

CONCLUSION

In this study, we compared the major complications of thyroidectomies by identifying and not identifying RLN. The results showed that the delicate surgical technique identifying and exposing the whole course and branches of the RLN during total thyroidectomy increased the rate of temporary hypocalcaemia and parathyroid gland autotransplantation, but decreased the rate of total permanent major postoperative complications and prevented RLN injury, so total thyroidectomy is safer with identification of recurrent laryngeal nerve.

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