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**Huseyin Seven · Asli Batur Calis · Cetin Vural
Suat Turgut**

Microscopic thyroidectomy: a prospective controlled trial

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Abstract The purpose of this prospective study was to evaluate microsurgical thyroidectomy by comparing it with traditional thyroidectomy. Before surgery, patients were assigned either to the microscopic thyroidectomy group (MT group), with the use of the surgical microscope, or the traditional thyroidectomy group (TT group), without the use of visual magnification. Outcome measures were operative time, intraoperative bleeding and complication rates including injury to the recurrent laryngeal nerve (RLN), the external branch of the superior laryngeal nerve (EBSLN) or the parathyroid glands. Ninety-eight patients underwent thyroid surgery (58 patients in the MT group, 40 patients in the TT group). The two groups were similar in age, sex, surgical procedures and histological findings. There was no difference between the two techniques regarding the operative time and the amount of blood loss. Neither permanent nerve palsy nor persistent hypocalcemia occurred in either group. Transient nerve palsies (RLN and EBSLN) were lower in the MT group (1.7%) compared to the TT group (7.5%), but the difference did not reach statistical significance ($P>0.05$). Overall transient hypocalcemia was significantly lower in the MT group (1.7%) compared with the TT group (12.5%, $P=0.032$). If the population was restricted to total thyroidectomy, the rate of transient hypocalcemia was 4.1% in the MT group and 33.3% in the TT group, respectively ($P=0.022$). In conclusion, microsurgical thyroidectomy is a feasible and efficacious surgical procedure. It significantly reduces the complications without increasing the operating time in thyroid surgery procedures. A major advantage of this technique is the possibility of attaching a camera to the microscope, thereby greatly facilitating teaching.

Keywords Thyroidectomy · Surgical microscope · Laryngeal nerve injury · Hypocalcemia · Complication

Introduction

Thyroidectomy is a commonly performed surgical procedure for certain thyroid gland diseases. The 19th century was a time of revolution for thyroid surgery, as for other surgeries. Today, although thyroid surgery has become a relatively safe and standardized surgical procedure, the risk of complications related to closely investing structures such as the laryngeal nerves and the parathyroid glands continues to make this operation interesting and challenging. The rate of these complications is directly related to the extent of thyroidectomy as well as to the surgeon's experience [4, 13, 18, 19].

There is no doubt that one of the most important factors in minimizing these complications is also the surgeon's attention to meticulous surgical technique in the critical areas. These critical areas include the recurrent laryngeal nerve (RLN), parathyroid glands and the external branch of the superior laryngeal nerve (EBSLN). In 1938, Lahey was the first to suggest the identification and the meticulous dissection of the RLN in thyroid surgery [11]. He demonstrated that the incidence of RLN injury could be decreased by the surgical technique. In 1975, Attie and Khafi described a fine dissection technique using magnification in thyroid surgery [2]. The authors reported that the incidence of postoperative hypoparathyroidism was decreased with this technique. It is surprising that little information is available to support the use of the microdissection technique in addition to standard thyroid surgical techniques in the literature. In two retrospective publications in the English language, it was emphasized that by using the microsurgical technique in thyroid surgery, complication rates related to the parathyroid glands and the

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H. Seven · A. B. Calis · C. Vural · S. Turgut
ENT Clinic, Sisli Etfal Training and Research Hospital,
Istanbul, Turkey

H. Seven (✉)
Hark sk. 10/8 Mecidiyekoy mh, Sisli, 34387 Istanbul, Turkey
Tel.: +90-212-3565716, Fax: +90-212-2111232,
e-mail: hseven1@hotmail.com

RLN could be decreased [5, 16]. However, no prospective controlled study has been reported analyzing its efficacy on a sound scientific basis.

To evaluate the possible advantages and disadvantages of microsurgical thyroidectomy carried out by using the surgical microscope, we compared it with the traditional thyroidectomy in a prospective case-controlled study.

Materials and methods

Patients who were admitted to the ENT Clinic of Sisli Etfal Training and Research Hospital between November 1999 and December 2002 and who were candidates for thyroid operation were considered eligible. Exclusion criteria were previous laryngeal nerve paralysis, previous thyroid operation with referral from other hospitals and any other anterior cervical operation.

Eligible patients were assigned either to the microscopic thyroidectomy group (MT group) or traditional thyroidectomy group (TT group). The choice between the type of surgery for eligible patients depended on the availability of the surgical microscope. All patients had a routine preoperative work-up for their disease and the same hospital care regardless of the surgical technique employed. All operations were performed with endotracheal general anesthesia. Our general strategy in thyroid surgery is to perform either unilateral total lobectomy or total thyroidectomy. All procedures were performed or supervised by the same surgeon (H.S.), who was familiar with both thyroidectomy techniques.

Mean outcome measures included complications regarding injury to the RLN, the EBSLN or the parathyroid glands. Additional outcome measures were operating time and intraoperative blood loss. Other complications, such as serohematoma, wound infection and postoperative hemorrhage, were also studied. A nurse in the operating room measured the duration of the operation and the amount of bleeding during the operation. Waiting time for the report of the frozen section was not included in the operating time. Patients who underwent completion thyroidectomy on the basis of permanent sections were also considered under total thyroidectomy cases for practical reasons. Preoperative and postoperative laryngeal examinations were performed by an experienced otolaryngologist who was masked to the surgical technique. Hypocalcemia was defined as a patient with symptoms or an ionized calcium value of less than 1.0 mmol/l. The patients with hypocalcemia were treated with calcium supplementation.

Surgical technique

The technique we applied was an entirely conventional extracapsular dissection. Briefly, a 4- to 6-cm horizontal incision was made over the level of the thyroid isthmus. The upper and lower subplatysmal flaps were raised. The cervical linea alba was divided longitudinally. After the dissection of the lobe from the strap muscles had been carried out completely, the middle thyroid vein was divided and ligated. The lymphatic and capsular vessels on the anterior surface of the gland at its inferior pole were then dissected, permitting elevation and medial rotation of the thyroid lobe.

After these steps, the surgical procedure for the identification and the preservation of the parathyroid glands with blood supply, the RLN and the EBSLN was continued either under direct vision or with the use of a surgical microscope (×4 to ×10 magnification under Zeiss OpMi, with a 250-mm ocular lens). Attention was directed toward visualization of the superior and inferior parathyroid glands. Once they were identified, efforts were made to preserve the blood supply to these glands. During this process, the superior and inferior parathyroid glands were reflected posterolaterally along with their vascular pedicule. The RLN was identified near the inferior pole of the thyroid lobe and then exposed to the point where it enters the larynx. Then, the tertiary branches of the inferior thyroid artery lying on the thyroid capsule were either divided and ligated or cauterized individually using the standart bipolar cauter used in other head and neck procedures, such as parotidectomy. Dissection then was continued on the superior pole, and the avascular cricothyroid space was carefully examined for the EBSLN without using electrostimulation. Routinely, the superior pole vessels and the loose areolar tissue surrounding them were not dissected until the EBSLN was explored, whenever possible. Then, superior thyroid vessels were individually ligated and transected near the thyroid capsule.

The thyroid lobe was elevated from the pretracheal fascia, and dissection was completed by mobilizing the isthmus and pyramidal lobe. For unilateral disease, if the specimen was benign or the pathologist's report was inconclusive, the operation was terminated. If the specimen was malignant, total thyroidectomy was performed, using the same technique for the contralateral lobe.

The data of the groups were analyzed and compared. The statistical analysis was performed by using Student's t test for continuous variables and the chi-squared with Fisher's exact test as appropriate for categorical variables, and was considered significant at $P<0.05$.

Results

Ninety-eight consecutive patients who underwent either unilateral lobectomy or total thyroidectomy and who met the eligibility criteria for inclusion were the subject of this study (58 in the MT group, 40 in the TT group). Table 1 summarizes the demographic and surgical distribution. The two groups were similar regarding age, sex, surgical procedures and histological findings. Although there were more total thyroidectomies in the MT group, the difference was not statistically significant ($P>0.05$). One patient in the TT group and four patients in the MT group received lobectomy, and then the completion thyroidectomy for carcinoma, which was not recognized until the permanent sections were available.

The mean ± SD operating time was 91.2±32.4 min (range 45–140) in the TT group and 98.6±24.7 min (range 38–130) in the MT group ($P>0.05$). The mean ± SD amount of intraoperative blood loss was 132±114 ml (range 20–380) in the TT group and 95±103 ml (range 15–600) in the MT group ($P>0.05$). Table 2 summarizes the incidence of complications. There was neither permanent nerve palsy nor persistent hypocalcemia in either group. Transient nerve

Table 1 Demographic and histopathological data

	TT group (n=40)	MT group (n=58)
Age	42.3±6.8	44.6±7.2
Female-male ratio	37/3	51/7
Total thyroidectomy	15	24
Unilateral lobectomy	25	34
Disease		
Benign tumor	11	16
Malignant tumor	4	9
Goiter (toxic/nontoxic)	4/17	10/18
Thyroiditis	3	1
Grave's disease	1	4

Data are presented as mean ± standard deviation, or N. No significant differences among groups

Table 2 Complications

Complication	TT group (n=40)	MT group (n=58)
RLN injury		
Transient	2 (5%)	1 (1.7%)
Permanent	0	0
EBSLN injury		
Transient	1 (2.5%)	0
Permanent	0	0
Hypopcalcemia		
Transient*	5 (12.5%)	1 (1.7)
Persistent	0	0
Wound hematoma	1 (2.5%)	0
Minor wound problems	4 (10%)	5 (8.6%)

Data are presented as N (%). *Statistically significant difference ($P<0.05$)

palsies (the RLN and the EBSLN) were lower in the MT group (1.7%) than they were in the TT group (7.5%). The difference was not statistically significant ($P>0.05$). When calculating the number of nerves at risk for injury, these rates were lower in each group: 1.2% in the MT group and 5.2% in the TT group. The recovery period for transient nerve palsies was shorter than 4 months. Transient hypocalcemia was significantly lower in the MT group (1.7%) than it was in the TT group (12.5%). The difference was statistically significant (P=0.032). All patients with persistent hypocalcemia received total thyroidectomy. If the population was restricted to total thyroidectomy, these incidences were higher: 4.1% in the MT group and 33.3% in the TT group (P=0.022). The recovery period for hypocalcemia lasted less than 3 months in all cases. In patients with hypocalcemia, final pathological diagnoses included goiter in two patients (one of them had toxic symptoms), cancer in three and thyroiditis in one. In two of the patients with hypocalcemia in the TT group, one parathyroid was autotransplanted during the operation for blood supply injury.

Discussion

The microscopic thyroidectomy applied here is technically very similar to traditional thyroidectomy, and each step in the procedure is performed with the traditional view with which most surgeons are familiar. The procedure differs from traditional thyroidectomy only in that it requires a microdissection technique using the surgical microscope, which is used routinely for other operations in otolaryngology and head and neck surgery settings, even by residents in their early training.

There has been enormous progress in thyroid surgery over the past century. The complications of thyroid surgery are directly related to the extent of the thyroidectomy, the experience of the surgeon and the use of careful dissection in the critical areas [12, 20]. If the surgeon gives special attention to these critical areas, the complications can be minimized. The microscope provides better illumination and magnification, allowing for greater precision in the dissection and the hemostasis.

One of the most important complications of thyroid surgery is RLN palsy resulting from intraoperative damage. Its frequency ranges from 0 to 5.8% [4, 10, 13, 14, 20]. The RLNs are located in each tracheoesophageal groove and course toward the cricothyroid joint to innervate the laryngeal muscles. RLN injury happens generally during surgery because of direct mechanical damage with or without disruption. Therefore, techniques that prevent this complication during surgery are of great interest. One method to ensure the integrity and function of the nerve is to identify and preserve it during surgery. However, exposure itself might increase the rate of complication resulting from mechanical injury or inadequate nutrition [20]. Besides, since there is a network of veins in the tracheoesophageal groove, which is the most critical area for RLN injury, dissection may lead to an oozing of blood that complicates nerve identification and provides a higher risk of nerve injury in this area with the dangerous hemostasis maneuvers. The microscope allows for greater precision in the dissection and hemostasis in this area.

The EBSLN is also at risk for injury during mobilization of the superior pole of the thyroid gland. The RLN has obviously overshadowed the clinical significance of the EBSLN in thyroid surgery [7]. However, lesions of the EBSLN after thyroid surgery are common, but frequently overlooked. Its frequency ranges from 0 to 58% [1, 3, 6, 7, 9, 12]. The variation in results is explained by the difference between diagnostic methods used. The risk can be decreased if special care is taken routinely for its location and preservation during thyroidectomy. Opinions differ concerning means of avoiding injury to the EBSLN. We agree with some authors who advocate identification of the EBSLN as a routine procedure in thyroid surgery, whereas others suggest careful skeletizing of the superior pole vessels with protective attention to the nerve, without thinking to identify it [3, 6, 7, 12]. We found a lower incidence of total transient nerve palsy (RLN and EBSLN) with the MT technique. The difference, however, did not reach statistical significance, probably because of the small number of nerve palsies in the entire population. To our knowledge, the use of the microscope in upper pole dissection has not been reported previously.

Postoperative hypocalcemia is the most frequent and unpleasant complication following total thyroidectomy, its occurrence ranging from 0.3 to 65% [2, 8, 15, 18]. The variation in results is explained by the differences among patient populations as well as different surgical techniques. Several factors have been involved in the pathogenesis of postoperative hypocalcemia after thyroidectomy [4, 8, 15, 17, 18]. The real cause is yet unclear, but postoperative hypoparathyroidism developing because of blood supply injury seems to be one of the most important factors. As the parathyroid glands and their blood supply are tenuous and easily injured by excessive manipulation, meticulous and gentle dissection along the thyroid capsule, separating the parathyroid gland from the thyroid tissue, is mandatory to prevent postoperative hypocalcemia. At times, this may not be possible because of intracapsular localization. Then the parathyroid should be autotransplanted, preferably in the sternocleidomastoid muscle [8, 18]. We did not find permanent hypocalcemia in either group. Total thyroidectomy was strongly associated with postoperative transient hypocalcemia when compared with lobectomy. Transient hypocalcemia occurred at a significantly lower rate in the MT group. This could be due to the microdissection technique, which helps to find and to better dissect the parathyroid glands without blood supply injury.

It was also reported that the operating time with the use of the microscope in thyroid surgery was longer [16]. Using the microscope did not increase the duration of thyroidectomy in our trial. Although the dissection time appeared longer with the MT technique, no or very little time was spent trying to achieve hemostasis at the end of surgery, and therefore the overall duration was similar. There was also no significant difference between the two groups regarding the amount of blood loss.

We believe that magnifying glasses, although not used in our practice, can be alternative devices to the surgical microscope in thyroid surgery. However, we did not find any published controlled study emphasizing its efficacy in thyroid surgery, even though its use is routine in some centers.

The technique is notably easy to master for those who are accustomed to using the surgical microscope. The use of small instruments, a bloodless technique and patience are prerequisites for microdissection. Many of the operations were done by senior residents in their HNS training under supervision of the first author. A major advantage of this technique is the possibility of attaching a camera to the microscope, thereby greatly facilitating the surgeon's ability to teach how to perform a meticulous dissection in the critical areas. Furthermore, it has the possibility of recording the operations with clear visualization.

Conclusion

Microsurgical thyroidectomy is a feasible and efficacious surgical procedure. It significantly reduces the postoperative complications without increasing the operating time. Our data, therefore, suggest it as a method for performing thyroidectomy, particularly in the patients undergoing total thyroidectomy.

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