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The role of intraoperative neuromonitoring in thyroid surgery training

Tiroid cerrahisi eğitiminde intraoperatif nöromonitörizasyonun rolü

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ABSTRACT

Aim: Intraoperative nerve monitoring (IONM) during thyroid surgery has been widely accepted as an additive improvement to the gold standard of visually identifying the RLN. This study aims to evaluate the role of IONM application in thyroid surgery education during general surgery residency.

Materials and Methods: Patients who underwent total thyroidectomy between January 2012 and December 2019 were included in the study. The patients were divided into 2 groups according to the use of IONM (Group 1: With IONM, Group 2: Without IONM). These groups were also divided into subgroups as assistants and experts among themselves.

Results: This study involved 256 patients. There were 116 patients in group 1, and 140 patients in group 2. Histologic analysis results revealed that IONM was used more frequently in patients with a malignancy (p=0.015). The median operative time was significantly longer when IONM was used, with an operative time of 130 minutes for group 1 and 120 minutes for group 2 (p=0.015). When Group 1B and Group 2B were compared among themselves, the median operation time in Group 1B was 130 minutes, and the median operation time in Group 2B was 125 minutes (p=0.026). In the comparison between Groups 1B and 2B, it was detected that the rate of use of IONM was higher in malignancies (p=0.025).

Conclusion: According to our results, the use of IONM did not reduce the incidence of RLN paralysis in thyroidectomy performed by specialists and residents.

Keywords: Thyroidectomy, intraoperative nerve monitoring, thyroid surgery training.

ÖZ

Amaç: *Tiroid cerrahisi sırasında intraoperatif sinir monitörizasyonu (İONM), rekürren laringeal siniri (RLS) görsel olarak tanımlamanın altın standardına ilave bir gelişme olarak geniş çapta kabul görmüştür. Bu çalışma, genel cerrahi ihtisası sırasında tiroid cerrahisi eğitiminde İONM uygulamasının rolünü değerlendirmeyi amaçlamaktadır.*

Gereç ve Yöntem: *Ocak 2012-Aralık 2019 tarihleri arasında total tiroidektomi yapılan hastalar çalışmaya dahil edildi. Hastalar İONM kullanımına göre 2 gruba ayrıldı (Grup 1: İONM'li, Grup 2: İONM'siz). Bu gruplar da kendi aralarında asistan ve uzman olarak alt gruplara ayrılmıştır.*

Bulgular: *Bu çalışmaya 256 hasta dahil edildi. Grup 1'de 116, grup 2'de 140 hasta vardı. Histolojik analiz sonuçları İONM'nin malignitesi olan hastalarda daha sık kullanıldığını gösterdi (p=0.015). Grup 1 için 130 dakika ve grup 2 için 120 dakika operasyon süresi ile IONM kullanıldığında medyan operasyon süresi anlamlı olarak daha uzundu (p=0.015). Grup 1B ve Grup 2B kendi aralarında karşılaştırıldığında Grup 1B'de ortanca ameliyat süresi 130 dakika, Grup 2B'de ortanca ameliyat süresi 125 dakika idi (p=0.026). Grup 1B ve 2B karşılaştırmasında malignitelerde İONM kullanım oranının daha yüksek olduğu saptandı (p=0.025).*

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Sonuç: *Sonuçlarımıza göre uzman ve asistanlar tarafından yapılan tiroidektomilerde İONM kullanımı RLS paralizi insidansını azaltmamıştır.*

Anahtar Sözcükler: *Tiroidektomi, intraoperatif sinir monitörizasyonu, tiroid cerrahisi eğitimi.*

INTRODUCTION

The progress in diagnosing thyroid diseases led to an increased number of thyroidectomies recently (1). This increases the importance of the place of thyroid surgery in general surgery education. The goal of thyroid surgery is to complete the procedure with the lowest complication rate without adversely affecting surgical success and quality of life. Lack of surgical experience is one of the most important factors in the development of complications (2).

Surgeon experience of more than 25 thyroidectomies/year was reported to reduce complications in thyroid surgery (3). But the vast majority of thyroidectomies are performed by surgeons who do not have such experience. For this reason, general surgery residency training shall include appropriate attention to thyroid surgery also involving current improvements in the technique. Accreditation Council for Graduate Medical Education in the United States in 2017 stated that general surgery residents required 15 endocrine surgery cases, ten of which were thyroid or parathyroid surgery, during their training (4).

The most serious complications of thyroidectomy are hypoparathyroidism and recurrent laryngeal nerve (RLN) palsy. RLN paralysis affects people's quality of life significantly especially if it's permanent. Visualizing to preserve the RLN has become the standard for nearly 90 years (5). Intraoperative nerve monitoring (IONM) during thyroid surgery has been widely accepted as an additive improvement to the gold standard of visually identifying the RLN (6).

This study aims to evaluate the role of IONM application in thyroid surgery education during general surgery residency.

MATERIALS and METHODS

Patients who underwent total thyroidectomy between January 2012 and December 2019 were included in the study. Patients under 18 years of age, who were undergoing secondary thyroid surgery, and the ones with simultaneous parathyroidectomy, neck dissection, hemi-thyroidectomy and vocal cord dysfunction in the preoperative evaluation were excluded from the study. Demographics, histopathological and clinical diagnoses, duration of operation, length of hospital stay, complications were studied retrospectively.

The patients were divided into 2 groups as the patients.

Group 1: With IONM

Group 2: Without IONM

These groups were further divided into subgroups among themselves. IONM was not performed to the patients in Group 2 due to the fact that the use of IONM was not so common in the first years of the study and due to the financial reasons of the institution. None of the patients in Group 1 had any complications related to performing IONM.

Groups 1A and 2A: Consisted of patients whose surgeries were performed by a qualified general surgeon.

Groups 1B and 2B: 1B and 2B consisted of patients who were operated by 4th year residents with supervising by a qualified general surgeon

In IONM performing, intermittent stimulation technique and sterile disposable bipolar stimulation probe (NIM, Dr. Langer, Germany) and (Neurostyle Smart IONM Intraoperative nerve monitor, Neurostyle Neurological & Neuromuscular Devices, Singapore) were used for nerve stimulation. Threshold of monitor 100 μV, probe 1 mA current, set to 100 μs excitation time at 4 Hz frequency.

The amplitude of the electromyography (EMG) waves defined the adductor motor function of the vocal cords. RLN measurements were made using the standard steps of intraoperative nerve monitoring. (Table-1) (7). EMG responses were recorded.

A positive warning signal for RLN was defined as both an audible beep on the monitor and an EMG wave above 100 μV. Measurements and administrations were done in accordance with international criteria (8).

The surgical technique involved conventional standard ligation (clamping-tie) and vascular closure devices for hemostasis. Parathyroid glands were identified and dissected within their capsules maintaining vascularization as much as possible. The recurrent nerve was always identified at the laryngeal penetration point. Approval from the institutional research ethics board was obtained (decision number 2022/01-33). The study made in accordance with the Helsinki Declaration.

Table-1. Standard steps of RLN monitoring in intraoperative nerve monitoring.

Step	Symbol	Procedure
I	L1	Preoperative vocal cord examination
II	V1	Stimulation of the ipsilateral vagus prior to RLN exploration
III	R1	First stimulation of RLN
IV	R2	Stimulation of the RLN from its most proximal point after dissection is complete
V	V2	Vagus stimulation after bleeding control is complete
VI	L2	Postoperative vocal cord examination

Table-2. Demographic and clinical characteristics of all patients.

Characteristics	**All patients** n=256	**Group 1 (with IONM)** n=116	**Group 2 (without IONM)** n=140	p-value
Sex, n (%)				0.946
Male	80 (31.3)	36 (31)	44 (31.4)	
Female	176 (68.8)	80 (69)	96 (68.6)	
Age (years), mean±SD	48.1±12.5	47±12.3	48.9±12.7	0.220
Preoperative diagnosis, n (%)				0.100
Multinodular goiter	121 (47.3)	46 (39.7)	75 (53.6)	
Toxic multinodular goiter	9 (3.5)	4 (3.4)	5 (3.6)	
Differentiated thyroid cancer	91 (35.5)	50 (43.1)	41 (29.3)	
Graves' disease	34 (13.3)	15 (12.9)	19 (13.6)	
Medullary thyroid cancer	1 (0.4)	1 (0.9)	0	
Performing the surgery, n (%)				0.784
Resident surgeon	126 (49.2)	56 (48.3)	70 (50)	
Expert surgeon	130 (50.8)	60 (51.7)	70 (50)	
Pathologic diagnosis, n (%)				0.015
Benign	164 (64.1)	65 (56)	99 (70.7)	
Malignancy	92 (35.9)	51 (44)	41 (29.3)	
Operation time (min), median (Q1-Q3)	128 (110-150)	130 (120-155)	120 (110-150)	0.015
Hospital stay (days), median (Q1-Q3)	2 (1-2)	1 (1-2)	2 (1-2)	0.083
Complications				
Transient RLN palsy	8 (3.1)	4 (3.4)	4 (2.9)	1.000*
Permanent RLN palsy	2 (0.8)	0	2 (1.4)	0.502*
Transient hypoparathyroidism	80 (31.3)	39 (33.6)	41 (29.3)	0.456
Permanent hypoparathyroidism	2 (0.8)	2 (1.7)	0	0.204*
Postoperative bleeding	3 (1.2)	3 (2.6)	0	0.092*

SD, standard deviation; RLN, recurrent laryngeal nerve

* Fisher's Exact test was used

Statistical Analysis

Statistical analyses were done with IBM SPSS Statistics software, version 25.0 (IBM Corp, Armonk, NY, USA). The number of units (n), percent (%), mean ± standard deviation (SD), median (Q1-Q3) values were given where appropriate. Chi-Square test were used to evaluate categorical variables. The normal distribution of data's continuous variables were evaluated by Shapiro Wilk test. Independent Samples t-test was used for variables with normal distribution, and Mann-Whitney U test for variables that did not fit the normal distribution. $p < 0.05$ value was considered statistically significant.

RESULTS

This study involved 256 patients. There were 116 patients in group 1, and 140 patients in group 2. There was no statistically significant difference between the two groups in terms of gender, age, postoperative complications and length of hospital stay (Table-2).

Histologic analysis results revealed that IONM was used more frequently in patients with a malignancy. Examining the groups, 65 (56%) patients in group 1 were reported as benign, 51 (44%) patients were reported as malignant, 99 (70.7%) patients in group 2 were reported as benign and 41 (29.3%) as malignant (p=0.015). The median operative time was significantly longer when IONM was used, with an operative time of 130 (120-155) minutes for group 1 and 120 (110-150) minutes for group 2 (p=0.015).

Then the subgroups regarding whether the surgeon was a resident or consultant were analyzed. Number of patients in each group was similar: group 1A: 60 (51.7%) patients, group 1B: 56 (48.3%), group 2A: 70 (50%), and group 2B: 70 (50%).

There was no difference in terms of age, gender, operation time, hospital stay, histopathological results, and postoperative complications when group 1A and group 2A were compared among themselves. When Group 1B and Group 2B were compared among themselves, the median operation time in Group 1B was 130 (120-160) minutes, and the median operation time in Group 2B was 125 (110-141) minutes (p=0.026).

In the comparison between Groups 1B and 2B, it was detected that the rate of use of IONM was higher in malignancies (p=0.025). There was no significant difference was found between the two groups in terms of age, gender, length of hospital stay, and postoperative complications.

DISCUSSION

The use of IONM in thyroid surgery is becoming more common. This study aims to determine the importance of IONM application in residency training. According to our results, the use of IONM did not reduce the incidence of RLN paralysis in thyroidectomy performed by specialists and residents.

The most serious complications of thyroidectomy are hypoparathyroidism and RLN paralysis. According to a recent meta-analysis, the median incidence of transient and permanent hypoparathyroidism following thyroidectomy ranges from 19% to 38% and 0% to 3%, respectively (7). In a meta-analysis of RLN injuries, where 25000 cases were evaluated; the mean rate of transient RLN palsy was 9.8% (1.4–38.4%), and the rate of permanent RLN palsy was 2.3% (0–18.6%) (8). IONM is used to prevent RLN injury in thyroid and parathyroid surgery, and there are various methods in its performing (9). Although there are many reports supporting IONM use in RLN dissection and identification (10-12), its contribution in reducing RLN injuries still controversial (13-14). However, it has also be reported that there is a significant decrease in the incidence of permanent RLN paralysis in low-volume surgeons using IONM (12).

The widespread use of IONM in thyroid surgery and the significant decrease in the incidence of permanent RLN paralysis with the use of IONM by low-volume surgeons has made the place of this practice in thyroid surgery education a matter of interest. A study by Erçetin et al. involving 748 patients showed that there was a significant difference in rate of RLN paralysis between residents and consultants when IONM was not used. On the other hand, this difference disappeared when IONM was used. They claimed the importance of IONM use when the surgeon has limited experience based on their results (6). Another interesting finding of this study was shortened operative time with IONM contrary to our study. This result was thought to occur due to the time spent for vagal nerve and RLN stimulation, and the time spent for the management of the problems encountered during the IONM performing. In addition, in our series, there was no significant difference in terms of

RLN palsy in patients operated by residents and specialists in the group with and without IONM.

In another series, 1116 patients operated by residents were evaluated. This study showed that the routine use of intermittent IONM during thyroid surgery did not reduce the incidence of RLN palsy but it provided surgeons with limited experience to be able to perform thyroidectomy with a complication rate comparable to experienced surgeons (15). This study was in line with ours showing a prolonged operative time when using IONM. In addition to our result, the prolonged operation time of less than 10 minutes due to the use of IONM was attributed to the lack of surgical experience rather than the time spent for vagal nerve and RLN stimulation.

The limitations of this study are the small number of cases, the retrospective method, and the fact that the annual thyroidectomy volumes of the specialists who perform the operations are different and therefore one-to-one matches could not be done.

CONCLUSION

In conclusion, our study showed no superiority of IONM use both among consultants and residents.

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

References

1. Sosa JA, Wang TS, Yeo HL, et al. The maturation of a specialty: workforce projections for endocrine surgery. Surgery. 2007; 142: 876– 83.
2. Ali U Emre, Güldeniz Karadeniz Cakmak, Oge Tascilar, Bülent H Ucan, Oktay Irkorucu, Kemal Karakaya et al.Complications of total thyroidectomy performed by surgical residents versus specialist surgeons. Surg Today. 2008; 38 (10): 879-85. doi:10.1007/s00595-008-3760-4.
3. Adam MA, Thomas S, Youngwirth L, Hyslop T, Reed SD, Scheri RP, et al. Is There a Minimum Number of Thyroidectomies a Surgeon Should Perform to Optimize Patient Outcomes? Ann Surg. 2017; 265 (2): 402-7.
4. http://www.acgme.org/Portals/0/440_GS_Defined Category Minimum Numbers.pdf
5. Jatzko GR, Lisborg PH, Muller MG, Wette VM. Recurrent nerve palsy after thyroid operations: principal nerve identification and a literatüre review. Surgery 1994; 115: 139-44.
6. Candaş Erçetin, Alper Şahbaz, Sami Acar, Fırat Tutal, Nihat Aksakal, Serkan Sarı, Yeşim Erbil. Is intraoperative nerve monitoring useful for surgical training in thyroid surgery? Turk J SurG. 2018 Nov 20; 35 (4): 259-64. doi:10.5578/turkjsurg.4281.
7. Edafe O, Antakia R, Laskar N, Uttley L, Balasubramanian SP 2014 Systematic review and meta-analysis of predictors of post-thyroidectomyhypocalcaemia. Br J Surg 101: 307-20.
8. Jeannon JP, Orabi AA, Bruch GA, Abdalsalam HA, Simo R. Diagnosis of recurrent laryngeal nerve palsy after thyroidectomy: a systematic review. Int J Clin Pract 2009; 63: 624–9.
9. Peter Angelos. Recurrent laryngeal nevre monitoring. state of the art, ethical and legal issues. Surg Clin North Am 2009 Oct; 89 (5): 1157-69.
10. Dralle H, Sekulla C, Haerting J, Timmermann W, Neumann HJ, Kruse E, et al. Risk factors of paralysis and functional outcome after recurrentlaryngeal nerve monitoring in thyroid surgery. Surgery 2004; 136: 1310-22.
11. Hermann M, Hellebart C, Freissmuth M. Neuromonitoring in thyroid surgery: prospective evaluation of intraoperative electrophysiological responses for the prediction of recurrent laryngeal nerve injury. Ann Surg 2004; 240: 9-17.
12. Dralle H, Sekulla C, Lorenz K, Brauckhoff M, Machens A; German IONM Study Group. Intraoperative monitoring of the recurrent laryngealnerve in thyroid surgery. World J Surg 2008; 32: 1358-66.
13. Chan WF, Lang BH, Lo CY. The role of intraoperative neuromonitoring of recurrent laryngeal nerve during thyroidectomy: a comparative study on 1000 nerves at risk. Surgery 2006; 140: 866-72.
14. Loch-Wilkinson TJ, Stalberg PL, Sidhu SB, Sywak MS, Wilkinson JF, Delbridge LW. Nerve stimulation in thyroid surgery: is it really useful? ANZ J Surg 2007; 77: 377-80.
15. Alesina PF, Hinrichs J, Meier B, Cho EY, Bolli M, Walz MK. Intraoperative neuromonitoring for surgical training in thyroid surgery: its routine use allows a safe operation instead of lack of experienced mentoring. World J Surg 2014; 38: 592-8.