Tiroid Cerrahisinde Larengeal Sinir Explorasyonunun Berry Ligamanı Düzeyinde Yapılması Sinir Hasarını Önlemek için Daha mı Güvenli?

Is Laryngeal Nerve Exploration at Berry Ligament Level Safer to Prevent Nerve Damage in Thyroid Surgery

Ali Çiftçi[1], Erol Kisli[2]

1Sağlık Bilimleri Üniversitesi, Kocaeli Derince Eğitim ve Araştırma Hastanesi, Genel Cerrahi Kliniği, Kocaeli, Türkiye

2Cumhuriyet Üniversitesi, Tıp Fakültesi, Genel Cerrahi Kliniği, Sivas, Türkiye

ÖZ

GİRİŞ ve AMAÇ: *Tiroid cerrahisi esnasında Rekürren Laringeal Siniri (RLS) ortaya koymak için çeşitli teknikler tanımlanmıştır. Bu çalışmanın amacı; Berry ligamanı seviyesinde yapılan sinir disseksiyon tekniğinin kalıcı RLS hasarı üzerine olan etkinliğini araştırmaktır.*

YÖNTEM ve GEREÇLER: *13 yılda benign tiroid hastalıkları nedeniyle lobektomi, total veya totale yakın tiroidektomi uygulanan 803 olgunun hastane kayıtları retrospektif olarak tarandı. Bütün hastalarda yaş, cinsiyet, preoperatif tanı, yapılan tiroidektomi tipi ve hastalara ait histopatolojik sonuçlar değerlendirildi.*

BULGULAR: *Çalışmamızda vakaların 656'sı (%81.69) kadın, 147'si (%18.31) erkekti. Kadınların erkeklere oranı 4.4 / 1 idi, Toplam 1474 RLS diseksiyonu yapıldı. Tüm vakalarda RLS ortaya kondu. Ses / konuşma bozukluğu olan hastalara 6 ay sonra indirekt laringoskopi yapıldı. Dokuz (% 0.61) hastada tek taraflı vokal kord paralizi saptandı. Bu vakalar kalıcı RLS felci olarak kabul edildi. Serimizde bilateral kalıcı RLS paralizisine rastlanmadı.*

TARTIŞMA ve SONUÇ: *Sonuç olarak; Rekürren larengeal sinirin inferior tiroid arteri çaprazladığı bölgede ve boyunda yukarı doğru çıkarken birçok varyasyon göstermesi ve larinkse girmeden önce Berry ligamanı seviyesinde sabit bir yol izlemesi nedeniyle, tiroid cerrahisinde rekürren larengeal sinir disseksiyonunun bu sevide yapılması ve sinirin explore edilmesi, düşük oranda kalıcı RLS felci oluşmasına neden olabilir.*

Anahtar Kelimeler: *tiroidektomi, berry ligamenti, rekürren laringeal sinir*

ABSTRACT

INTRODUCTION: *Several techniques have been described for the Recurrent Laryngeal Nerve (RLN) identification. The aim of the present study is to evaluate the effect of the RLN identification technique at the level of the Berry's Ligament on permanent RLN injury rate in Thyroid Surgery.*

METHODS: *803 cases with benign thyroid diseases, those underwent surgical therapy with at least lobectomy, and total or near total thyroidectomy during the last 13 years evaluated retrospectively. Hospital records of the patients were evaluated according to the age, sex, indications for the surgical therapy and postoperative complications.*

RESULTS: *In our study, 656 (81.69%) of the cases were female and 147 (18.31%) were male. The ratio of the women to men was 4.4/1, A total of 1474 RLN dissection/identification were performed. RLN was able to be visualized in all cases. Indirect laryngoscopy was performed on patients with voice / speech disorders after 6 months. Unilateral vocal cord paralysis was detected in nine (0.61%) patients. These cases were accepted as permanent RLN paralysis. No bilateral permanent RLN paralysis was encountered in our series.*

DISCUSSION AND CONCLUSION: *As a result it can be said that, in it's course during the travelling in the neck RLN shows different variations. But at the level of the cricothroid articulation, where it enters the larynx, beyond the Berry's Ligament, the position of the nerve is more constant than elsewhere. So identification of the nerve at this point may lead to low ratio of permanent RLN palsy..*

Keywords: *thyroidectomy, berry's ligament, recurrent laryngeal nerve*

İletişim / Correspondence:

Dr. Öğr. Üyesi Ali Çiftçi
S.B.Ü Derince Eğt. Ve Arş. Hastanesi Genel Cerrahi Kliniği Kocaeli - Türkiye
E-mail: draliciftci@hotmail.com
Başvuru Tarihi: 02.11.2020
Kabul Tarihi: 12.11.2021

Doi: 10.5505/ktd.2021.24861
Ali Çiftçi: 0000-0001-8217-575X
Erol Kisli: 0000-0002-2268-8702

INTRODUCTION

Thyroid surgery is one of the most common operations performed in general surgery clinics (1). The first successful thyroidectomy on record was performed by Albucasis in about 1000 AD (2). However, according to some authors, successful thyroidectomy was carried out for the first time by Emil Theodor Kocher (1841-1917), who received the Nobel Prize for Medicine in 1909 (3). Until the middle of the 19th century, the mortality rate of thyroidectomies was 40%, but today this rate has been reduced to zero by experienced surgeons. A series of changes have occurred in thyroid surgery since Kocher performed the first successful thyroidectomy (4). Although thyroidectomy is one of the most frequently performed operations with a very low mortality rate, it has some complications that cause serious morbidity. Fortunately, the morbidity rate is very low (5). In order to perform thyroid surgery with the least complication rate; protection of laryngeal nerves (external and inferior), protection of parathyroid glands, capsular dissection technique, isolated ligation of thyroid vessels, protection of infrahyoid muscles and a small cervical incision are required. The success of thyroid surgery can be expressed as functional and anatomical protection of the laryngeal nerves and parathyroid glands (4). The several techniques have been described for dissection of recurrent laryngeal nerve in thyroid surgery (6). The most common method is to visualize the recurrent laryngeal nerve (RLN) by considering its relationship with the inferior thyroid artery (7, 8). However, one or more branches of recurrent laryngeal nerve may be overlooked, as there are dozens of variations between the artery and the nerve (9-11). Some authors have reported that visualizing the RLN at the level of the Berry's Ligament where it shows a more stable course and with a limited dissection would be more rational and appropriate (11-13).

The aim of the study is to evaluate the effectiveness of RLN dissection technique which routinely started at the Berry's ligament level, in the prevention of permanent nerve paralysis, during the surgical treatment of benign thyroid diseaeses.

MATERIAL AND METHOD

Between December 1994 and June 2007, the data of 803 cases who underwent total thyroidectomy, near-total thyroidectomy and lobectomy for benign reasons were analyzed retrospectively. Cases with bilateral subtotal thyroidectomy were excluded from the study. Thyroidectomy was performed using capsular dissection technique in all cases. During thyroidectomy, removal of a lobe with its anatomical capsule was accepted as total lobectomy, leaving less than 1 gram of tissue as near-total thyroidectomy, and removal of both lobes with their anatomic capsule as bilateral total thyroidectomy. During thyroidectomy, the nerve was found by performing RLN dissection at the "Berry's Ligament level". The removed thyroid lobes and the the risk of RLN injury were evaluated. Indirect laryngoscopy was performed in all cases to evaluate the condition of the vocal cords in the preoperative period. Age, gender, preoperative diagnosis, type of thyroidectomy and histopathological results were analyzed in all cases. Routine blood and hormonal tests including Triiodothyronine (T3), Thyroxine (T4), and Thyroid Stimulating Hormone (TSH) were studied in all patients in the preoperative period. Thyroid ultrasound was routinely performed in all patients. Fine-needle aspiration biopsy (FNAB) was performed on cases with nodules. Patients with thyrotoxicosis symptoms and signs were made euthyroid with antithyroid drugs. Indirect laryngoscope was performed in all patients in the preoperative period for vocal cords evaluation. In the postoperative period, indirect laryngoscopy was performed in cases with suspected RLN damage. Patients with nerve damage were re-evaluated by indirect laryngoscopy 1 and 6 months later. Paralysis lasting longer than 6 months was accepted as permanent paralysis.

Surgical Technique: After the induction of general anesthesia, the head was brought to extension by placing a roll-shaped pillow under the patient's shoulders. The upper half of the operating table was lifted up and the patient was placed in a semi-sitting position. The right arm of the patient was brought closer to the body in order to prevent the brachial plexus injury. Kocher's collar incision was made and the incision was continued up to the platysma muscle. The incision was extended to the anterior border of the sternocleidomastoid muscle (SCM) on both sides. After the lower and upper flaps were prepared, the thyroid gland was explored with a midline incision between the sternohyoid and sternothyroid muscles. Dissection was continued until the ansa cervicalis and the medial edge of the internal jugular vein was seen. The sternothyroid

muscle was separated from the thyroid gland by blunt and sharp dissection. While the thyroid was pulled towards the anteromedial line with the help of a finger, the lateral tissues were pulled towards the posterolateral line with the retractor. Later, the middle thyroid vein was ligated and cut. First the thyroid upper pole was mobilized, then the lower pole. After the upper and lower pole of the thyroid was mobilized, the RLN was found at the level of the Berry's Ligament. No ligation and electrocautery were used in this area. Hemostasis was achieved after the nerve was found and protected. The nerve was protected by following up and down. The branches of the ITA were isolated and ligated over the thyroid capsule, so as not to endanger the lower parathyroid circulation. The lower and upper parathyroid gland were separated from the thyroid tissue carefully. The thyroid was completely mobilized from the lateral and anterior surface of the trachea. When lobectomy was performed, the pyramidal lobe and isthmus were dissected and included in the specimen. In patients scheduled for bilateral total thyroidectomy, the procedure was continued in the same way in the opposite lobe. Both thyroid lobes, isthmus and pyramidal lobe, were removed in one piece. In some cases, 1 gr of thyroid tissue was left on the Berry's Ligament to avoid nerve damage. This procedure was called near total thyroidectomy. In patients suspected of bleeding after hemostasis, a hemovac drain was placed in the thyroid lodge and the incision was closed in the anatomical plan.

Statistical analysis: The analysis of the patients' information was made with the Microsoft Office Excel 2003. The statistical analyses for the study were performed by using the Statistical Package for the Social Sciences (SPSS 10 Inc., IBM, IL, USA). Chi-square and Fisher's exact test were used to compare the proportions. Statistical significance was set at $p<0.05$.

RESULTS

In our study, 656 (81.69%) of the cases were female and 147 (18.31%) were male. The mean age was 40.76 ± 13.10 (16-78) for female and 39,81 ± 13,59 (14-78) for male. The demographic characteristics of the patients are shown in table 1. The ratio of the women to men was 4.4/1. indications for surgical therapy were multinodulary goitre in 679, solitary nodule in 74 , diffuse non-toxic goitre in 28, and Basedow-Graves in 22 patients respectively. The performed operations were total thyroidectomy in 616, lobectomy in 84, near total thyroidectomy in 61 and Dunhil procedure in 42 patients respectively. A total of 1522 thyroid lobes were explored, both lobes on 719 and single lobe on 84 cases. In our study, a total of 1474 RLN dissections were performed at the level of the Berry's Ligament on 803 cases. RLN was able to be visualized in all cases. The identification technique was the 'superior approach' meaning the technique of the dissecting the nerve at level of the Berry's Ligament, where the nerve enter the larynx. Indirect laryngoscopy was performed on patients with voice / speech disorders after 6 months. Unilateral vocal cord paralysis was detected in nine (0.61%) patients. These cases were accepted as permanent RLN paralysis. No bilateral permanent RLN paralysis was encountered in our series.

Table 1. Demographic Characteristics of Patients:

Sex	**n**	**%**
Female	656	81.69
Male	147	18.31
The mean age	**years ± SD**	**range**
Female	40.76 ± 13.10	(16-78)
Male	39,81 ± 13,59	(14-78)
indications for surgical therapy	**n**	**%**
Multinodulary Goitre	679	84.55
Solitary Nodule	74	9.22
Diffuse Non-toxic	28	3.49
Goitre	22	2.74
Basedow-Graves		
Operation Type	**n**	**%**
Total Thyroidectomy	616	76.71
Lobectomy	84	10.46
Near Total	61	7.60
Thyroidectomy	42	5.23
Dunhil Procedure		
Postoperative pathology results	**n**	**%**
Nodular Hyperplasia	680	84.69
Follicular Adenoma	18	2.24
Lymphocytic	28	3.49
Thyroiditis	33	4.11
Diffuse Hyperplasia	39	4.86
Thyroid Papillary	4	0.49
Carcinoma	1	0.12
Hurthle Cell Ca		
Follicular Carcinoma		
Number of dissected RLN* (n)	1474	
Permanent RLN paralysis	**n**	**%**
	9	0.61

******RLS: Recurrent laryngeal nerve*

Table 2: Surgical Results of the Cases

Preoperative Diagnosis	Postoperative Pathology Results							Total	Type of Surgery Performed				Total	Number of Lobes Dissected	Number of RLN Dissected	Permanent RLN Paralysis	
	NH (n)	FA (n)	FC (n)	LT (n)	DH (n)	PTC (n)	HCC (n)		NTT (n)	DP (n)	BTT (n)	TL (n)				(n)	(%)
MG	596	14	1	21	11	34	2	679	54	37	576	12	679	1346	1304	7	0,53
SN	66	2	-	-	-	4	2	74	-	2	-	72	74	76	74	2	2,70
BGD	5	-	-	-	17	-	-	22	3	-	19	-	22	44	44	-	
DNTG	13	2	-	7	5	1	-	28	4	3	21	-	28	56	52	-	
Total	680	18	1	28	33	39	4	803	61	42	616	84	803	1522	1474	9	0,61

***MG**:Multinodulary Goitre*

***SN:** Solitary Nodule*

***BGD:** Basedow-Graves Disease*

***DNTG:** Diffuse Non-toxic Goitre*

***NH:** Nodular Hyperplasia*
***FA:** Follicular Adenoma*
***FC:** Follicular Carcinoma*
***LT:** Lymphocytic Thyroiditis*
***DH:** Diffuse Hyperplasia*
***PTC:** Papillary Carcinoma*
***HCC:** Hürthle Cell Carcinoma*

***NTT:** Near Total Thyroidectomy*

***DP:** Dunhil Procedure*

***BTT:** Bilateral Total Thyroidectomy*

***TL:** Total Lobectomy*

DISCUSSION

Total thyroidectomy, which is increasingly used in benign thyroid diseases, has brought the necessity of routine RLN dissection to prevent RLN paralysis. It was previously believed that even looking for the RLN during thyroidectomy could easily lead to nerve damage (14). But nowadays, RLN dissection has become an indispensable component of total thyroidectomy. Thyroid surgery requires special knowledge, skills and experience because the thyroid gland is adjacent to vital organs and structures in the neck (12, 13, 15). Therefore, routine RLN dissection during thyroidectomy is an important stage of the surgery (16). Zakaria et al.(17). reported that the rate of permanent paralysis was 0.33% in patients made nerve exploration. Jatzko et al.(18) reported that the rate of permanent RLN paralysis was 7.2% in the group without nerve dissection and 1.2% in the group with nerve dissection . There are several methods for RLN dissection (19, 20). However, the most preferred dissection methods are the dissection at the lower level of the middle 1/3 of the thyroid where the RLN crosses the ITA and the dissection at the level of the Berry's Ligament. The easiest area to see the RLN is near where the ITA crosses the lateral border of the lower pole of the thyroid gland. The biggest advantage of this method is that it is relatively easy (21, 22). But, its very important disadvantage is that one or more of its branches may be unnoticed, as the nerve shows dozens of variations in this area (6, 15). Another way to visualize the RLN is to make a dissection at the level of Berry's ligament just below the level where the RLN enters the larynx through the cricoid muscle (15). Because nerve injuries most often occur at the level of Berry's Ligament (13). RLN can always be seen at the level of Berry's ligament easily because of ıts route. If the nerve is not exposed at this level, it cannot be said to be safe. Because this is the area where the thyroid gland is the closest to the recurrent nerve. The nerve is in contact with the thyroid gland in this area (23). Due to this anatomical feature, the nerve is greater under absolute risk in this area during total thyroidectomy (6). The another advantage of this technique is to prevent impairment of blood circulation and to

minimize the possibility of RLN paralysis by minimal dissection in the distal part of the nerve. An important disadvantage of this procedure is that it is difficult since nerve is located behind the thyroid gland. If the dissection in this area is done carefully, possible complications can be prevented (24). In addition, blood supply of thyroid gland is very good at the level of Berry's ligament. Distressing bleeding can develop easily, especially at the upper border of the Berry ligament and at the entry point of the RLN into the larynx. Using bipolar cautery in this area can cause nerve damage (25). In the literature, it has reported that the RLN dissection is usually performed in the area where the nerve crosses the ITA. The rate of permanent RLN paralysis is between 1% and 3% in this method (26, 27). In studies that the nerve dissection was performed at the level of the Berry's ligament the rate of permanent RLN paralysis is between 0-0.9%.(20, 28) We found that the rate of RLN paralysis was 0.61% in patients who underwent RLN dissection with this method. We think that the reason for this is that the operations are performed by different surgical teams and there are large number of patients in our study. However, rate of recurrent laryngeal nerve paralysis in our sudy is lower than the rates of the series in which other dissection techniques applied.

CONCLUSION

As a result it can be said that, in it's course during the travelling in the neck RLN shows different variations. But at the level of the cricothroid articulation, where it enters the larynx, beyond the Berry's Ligament, the position of the nerve is more constant than elsewhere. So identification of the nerve at this point may lead to low ratio of permanent RLN palsy

Acknowledgement

This study has produced from the author's master thesis which was conducted at Yüzüncüyıl University, Faculty of Medicine, Clinic of General Surgery under the supervision of Assistant Prof. Dr. Erol KİSLİ in 2007

Ethics Committee Approval: This study has produced from the author's master thesis. So we have no ethical approval for this article.

Conflict of Interest: There is no conflict of interest.

Funding: There is no financial support.

Informed Consent: This a retrospective study

REFERENCES

1. Kamer E, Unalp H, Derici H, Akguner T, Erbil Y, Issever H, et al. Flapless conventional thyroidectomy: a prospective, randomized study. Surg Today. 2010;40(11):1018-22.

2. Sarkar S, Banerjee S, Sarkar R, Sikder B. A Review on the History of 'Thyroid Surgery'. Indian J Surg. 2016;78(1):32-6.

3. Sivakumar T, Amizhthu RA. Transoral endoscopic total thyroidectomy vestibular approach: A case series and literature review. J Minim Access Surg. 2018;14(2):118-23.

4. Lal G, OH. C. Thyroid, parathyroid and adrenal in:. In: F.C B, editor. Schwartz SI, ed Principles of Surgery. 1. 11. ed. New York: Hill Book Comp; 2019. p. 1625-704.

5. Caulley L, Johnson-Obaseki S, Luo L, Javidnia H. Risk factors for postoperative complications in total thyroidectomy: A retrospective, risk-adjusted analysis from the National Surgical Quality Improvement Program. Medicine (Baltimore). 2017;96(5):e5752.

6. Uludag M, Tanal M, Isgor A. A Review of Methods for the Preservation of Laryngeal Nerves During Thyroidectomy. Sisli Etfal Hastan Tip Bul. 2018;52(2):79-91.

7. Nour AM, Al-Momen AHA. Prevention of Recurrent Laryngeal Nerve Injury in Thyroid Surgery: Are Neuromonitoring Techniques

Needed? East and Central African Journal of Surgery,. 2011;16(1):76-82.

8. Deniwar A, Kandil E, Randolph G. Electrophysiological neural monitoring of the laryngeal nerves in thyroid surgery: review of the current literature. Gland Surg. 2015;4(5):368-75.

9. Campos BA, Henriques PR. Relationship between the recurrent laryngeal nerve and the inferior thyroid artery: a study in corpses. Rev Hosp Clin Fac Med Sao Paulo. 2000;55(6):195-200.

10. Sultana SZ, Khan MK, Rahman H, Hossain A, Sultana S, Hasan N, et al. Morphological study of recurrent laryngeal nerve in relation to thyroid gland. Mymensingh Med J. 2006;15(2):192-6.

11. Chiang FY, Lu IC, Chen HC, Chen HY, Tsai CJ, Hsiao PJ, et al. Anatomical variations of recurrent laryngeal nerve during thyroid surgery: how to identify and handle the variations with intraoperative neuromonitoring. Kaohsiung J Med Sci. 2010;26(11):575-83.

12. Butskiy O, Chang BA, Luu K, McKenzie RM, Anderson DW. A systematic approach to the recurrent laryngeal nerve dissection at the cricothyroid junction. Journal of Otolaryngology - Head & Neck Surgery. 2018;47(1):57.

13. Calo PG, Medas F, Conzo G, Podda F, Canu GL, Gambardella C, et al. Intraoperative neuromonitoring in thyroid surgery: Is the two-staged thyroidectomy justified? Int J Surg. 2017;41 Suppl 1:S13-S20.

14. Skandalakis J, Gray S, Rowe J. Anatomical Complications in General Surgery. New York: McGraw-Hill Book Comp; 1986.

15. Henry BM, Sanna B, Graves MJ, Sanna S, Vikse J, Tomaszewska IM, et al. The Reliability of the Tracheoesophageal Groove and the Ligament of Berry as Landmarks for Identifying the Recurrent Laryngeal Nerve: A Cadaveric Study and Meta-Analysis. BioMed Research International. 2017;2017:4357591.

16. Hayward NJ, Grodski S, Yeung M, Johnson WR, Serpell J. Recurrent laryngeal nerve injury in thyroid surgery: a review. ANZ J Surg. 2013;83(1-2):15-21.

17. Zakaria HM, Al Awad NA, Al Kreedes AS, Al-Mulhim AM, Al-Sharway MA, Hadi MA, et al. Recurrent laryngeal nerve injury in thyroid surgery. Oman Med J. 2011;26(1):34-8.

18. Jatzko GR, Lisborg PH, Muller MG, Wette VM. Recurrent nerve palsy after thyroid operations--principal nerve identification and a literature review. Surgery. 1994;115(2):139-44.

19. Ngo Nyeki AR, Njock LR, Miloundja J, Evehe Vokwely JE, Bengono G. Recurrent laryngeal nerve landmarks during thyroidectomy. Eur Ann Otorhinolaryngol Head Neck Dis. 2015;132(5):265-9.

20. Page C, Peltier J, Charlet L, Laude M, Strunski V. Superior approach to the inferior laryngeal nerve in thyroid surgery: anatomy, surgical technique and indications. Surg Radiol Anat. 2006;28(6):631-6.

21. Yan S, Xie C, Zhao W, Wang B, Zhang L. A simple, efficient, and safe way of finding recurrent laryngeal nerve beneficial for PTC patients. Medicine (Baltimore). 2020;99(19):e20138.

22. Miyauchi A, Masuoka H, Yabuta T, Fukushima M, Kihara M, Higashiyama T, et al. The ima approach for the quick identification of the right recurrent laryngeal nerve in thyroid cancer surgery. Surg Today. 2013;43(2):225-8.

23. Naraynsingh V, Shamir C, Maharaj R, Dan D. Retrograde Thyroidectomy: Secrets of the Ligament of Berry. International Journal of Surgery Case Reports. 2014; 5(3):122-5.

24. Fatogoma Issa K, Sidiki D, Naouma C, Kassim D, N'Faly K, Djibril S, et al. Superior Approach of

Recurrent Laryngeal Nerve: Review of the Literature. J Thyroid Res. 2019;2019:5671816.

25. Allen E, A. F. Anatomy, Head and Neck, Thyroid 2020 [Available from: https://www.ncbi.nlm.nih.gov/books/NBK470452/.

26. Joliat GR, Guarnero V, Demartines N, Schweizer V, Matter M. Recurrent laryngeal nerve injury after thyroid and parathyroid surgery: Incidence and postoperative evolution assessment. Medicine (Baltimore). 2017;96(17):e6674.

27. Liddy W, Bonilla-Velez J, Triponez F, Kamani D, Randolph G. 31 - Principles in Thyroid Surgery. In: Randolph GW, editor. Surgery of the Thyroid and Parathyroid Glands (Third Edition): Elsevier; 2021. p. 272-93.e5.

28. Chiang FY, Wang LF, Huang YF, Lee KW, Kuo WR. Recurrent laryngeal nerve palsy after thyroidectomy with routine identification of the recurrent laryngeal nerve. Surgery. 2005;137(3):342-7.