

Microsurgery as a Method for Prevention of Postoperative Hypocalcemia and Laryngeal Nerves Injury in Thyroid Surgery

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Abstract—

Introduction: Postoperative hypocalcaemia and impairment of vocal cord function due to iatrogenic injury of the parathyroid glands and laryngeal nerves are the most frequent complications in thyroid surgery. Various procedures have been introduced to prevent the glands and the nerves from lesion the incidence of these complications varies between 1.5-22%. The aim of the study is to evaluate the role of the microsurgical technique as a method for identification of parathyroid glands, terminal branches of inferior thyroid artery and both external branch of superior laryngeal nerves /EBSLN/ and recurrent laryngeal nerve /RLN/ in the operative field.

Material and methods: 224 patients underwent total thyroidectomy in the surgical clinic of University Hospital “Kaspela”, Plovdiv for the period of 2017 were analyzed. The extra capsular embrional approach was used. For the magnification a microscope was used. Postoperative levels of PTH and Ca were measured on the first postoperative day.

Results: In all patients the recurrent laryngeal nerves RLN were successfully identified along their whole length from the inferior thyroid artery to their entering the laryngeal muscles. In 180 /80.30%/ patients EBSLN were seen and identified. None of the patients had temporary or permanent vocal cord palsy. In 24 /10.70%/ patients there was significant decrease of the normal levels of PTH and Ca. In another 45 /10.08%/ a mild regression was registered. All other patients were clinically and biochemically normal.

Conclusion: Microsurgical technique could be very helpful for identification and preservation of both parathyroid glands and laryngeal nerves in thyroid surgery.

Keywords— Microsurgical technique, laryngeal nerves, parathyroid glands.

I. INTRODUCTION

Iatrogenic injuries of the both parathyroid glands and laryngeal nerves /EBSLN/ and /RLN/ are the most frequently met complications in thyroid surgery. One-side injuries of RLN cause remarkable change and loss of loudness of the voice as well as impairment of swallowing. In bilateral injury complete loss of voice is frequently associated with acute laryngeal dyspnea due to the paramedian position of the paretic vocal folds. EBSLN palsy leads to loss of high pitches and is of great importance for voice professionals. Temporary

or permanent postoperative hyperparathyroidism cause muscle cramps and change of sensations. Both complications not infrequently results in permanent disability of the patients. According to some authors the incidence of iatrogenic injuries in patients with total thyroidectomy vary between 1.5-22.0% /1,2,3/

II. MATERIAL AND METHODS

The study includes 224 patients treated in the Surgical Clinic, University Hospital “Kaspela”, Plovdiv from January 01, 2017 to December 31, 2017. 165 were female patients of mean age 35 years (range 16-53), and 59 male of mean age 52 /range 25-78/. 84 of all were with a diagnosis of papillary carcinoma diagnosed preoperatively by fine needle aspiration biopsy /FNAB/, and the other 140 were with multinodular goiter. All patients underwent total thyroidectomy along with central node dissection in patients with malignancies.

III. SURGICAL TECHNIQUE

Cervical incision after Kocher was used to access to thyroid gland. The middle and inferior thyroid veins were cut between two ligatures which allowed lifting and rotating medially the thyroid gland. The trunk and branches of the inferior thyroid artery were next exposed under microscope. The microscope was used to identify and trace the RLN up to its penetration in the laryngeal muscles. After lateralization of the superior pole of the thyroid the EBSLN were identified. Then the both superior and inferior parathyroid glands were identified as well as their terminal blood supply. Generally the RLN was found close to the trunk of the artery and in twenty cases it passed between its branches. Only arteries that entered the thyroid gland were ligated and cut. Arteries supplying the parathyroid glands were preserved to avoid development of postoperative hypoparathyroidism. As a rule the superior laryngeal nerve was searched close to the vascular bundle which was ligated and cut close to the gland capsule. Instant histological examination was done in all patients. The patients with papillary cancer had the prophylactic central compartment node dissection. At the end of the operation the glandular bed was drained with passive drainage and the operative wound was clasped. The clasps were removed together with the drains on the 24th hour after the operation.

IV. RESULTS

In all patients the recurrent laryngeal nerves RLN were successfully identified along their whole length from the inferior thyroid artery to their entering the laryngeal muscles. In 180 /80.30%/ patients EBSLN were seen and identified. None of the patients had temporary or permanent vocal cord palsy. In 24 /10.70%/ patients there was significant decrease of the normal levels of PTH and Ca. In another 45 /10.08%/ a mild regression was registered. All other patients were clinically and biochemically normal.

V. DISCUSSION

Avoiding the injury of the laryngeal nerves during surgery of the thyroid has been a challenge to the surgeons since the dawn of the thyroid surgery. Zografski reports of injury of the RLN in 13 out of 44 operated patients in the Billroth Clinic /1,2/. This fact make the surgeons improve the operative methods (concerned with the character of the thyroid gland disease) and hence increase the chance of avoiding this iatrogenic lesion.

Since then the idea of special attention to the inferior laryngeal nerve during operation has been put forth.

Prioleau's view that if the recurrent nerve is visible in thyroid surgery it means that it is already injured dominated for a long time (until 1944) (cited by 2).

Not until the next decade did Lahey make a breakthrough suggesting intraoperative identification and exposure on hooks of the RLN and reporting only 0.3% lesions of the nerve in almost 1000 goitre patients subjected to thyroidectomy./6/

In 1956 Riddel reported a considerable decrease of the incidence of RLN injury from 6% when identification of the nerve was not used to 2% in 1056 patients treated by the Lahey method./7/

Later Warren and some other authors suggested the notion that injury of the nerve in its exposure on hooks could be avoided if identification was restricted to visualisation of the nerve./8/

In 1975 Wang presented an own method of identification of the inferior laryngeal nerve using as a landmark the inferior horn of the thyroid cartilage. In most cases this is the place where the nerve enters the laryngeal muscles./9/

By the same time the Nikolaev's method of intracapsular resection of the thyroid gland became popular in Russia and some other countries including Bulgaria./3/ The method provided operating in a field distant from the RLN and parathyroid glands. Until 1962 Vassilev et al. performed 642 resections of the thyroid gland by this method with excellent results. Later these authors introduced an own modification of the method, which reduced the RLN injury incidence to 1.63%./1/

In 1981 in Holland Engel et al. used a device composed of endotracheal tube with two balloons the second of which was placed between the vocal folds to record the changes in the pressure after electrical stimulation of the RLN¹⁰. The authors applied the method in 6 patients and found out the disadvantage of unreliable and unstable contact during the operation./10/

In 1971 Kratz published in the *Laryngoscope* the results of a wide-scale study including 60 patients. For identification of the RLNs and evaluation of their function the author used an operation microscope, conventional 3V neurostimulator and laryngoscopy of the vocal folds at the time of stimulation¹¹. The disadvantages of the method were the inability of the surgeon to self-assess the vocal muscle movement and the results of the nerve stimulation to be presented objectively./11/

In 1985 in the USA James et al. proposed a simple method for identification of RLN. They used palpation of the movements of the arythenoid muscles triggered by conventional neurostimulator with electric current of 1 mA¹². The authors reported good results in all 20 patients involved in the study./12/

Galvilan and Galvilan used a similar technique in 1986 in Spain. The larynx was pushed forward by one operator, who slid a finger behind it and palpated the arythenoid cartilage and the posterior cricoarythenoid muscle¹³. Vari-Stim stimulator with electric current of 1-2 mA was used to induce stimulation. Excellent results without injury of the RLN were achieved in all 120 patients. The major shortcoming of the method was the lack of control of the vocal muscle movements./13/

Flisberg and Lidholm first used stimulation EMG for intraoperative monitoring in thyroid surgery in 1970 in Sweden¹⁷. In 13 patients needle electrodes the inserted through the operation field (cricoarythenoid membrane) in the vocal folds. Positive results were achieved for all 15 nerves that were tested. The major disadvantage of the method was the position of the needle electrodes in the operation field, which hampered the dissection of the RLN./14/

In 1981 in the USA Spahn et al. revisited the method used by Lidholm reporting a successful identification and no injury of the RLN in 75 patients./15/

Also in the USA Rea et al. (1975) used a system for continuous unipolar stimulation of the tracheoesophageal groove and sound registration of the "M" response. The authors used needle electrodes that were constructed by themselves and placed through the mouth after the intubation of the patient. The method's disadvantage was the absence of recording of the results and the unipolar stimulation of the whole tracheoesophageal groove, which was less exact and reliable than stimulation only of the trunk of the RLN./16/

In Great Britain Lipton et al. (1988) used hook needles, which represented recording electrodes designed for achieving a more stable contact with the laryngeal muscles. The authors reported excellent results in 3 patients operated for recurrent goitre. Careful handling the hooks was recommended, especially in their removal at the end of the operation, because of the injury hazard of the vocal folds./17/

D. Rice and Cone-Wesson (1991) obtained good results with the Liptorr's method with hook wires./18/

In 1994 Maloney monitored successfully 16 nerves in 10 patients using needle electrodes without hooks./19/ In 1996 and 1997 Eisele and Mermelstein from the USA and Lamade from Germany presented results from using correspondingly modified and fabric made endotracheal tubes with adapted surface electrodes. There were neither false-positive nor false-

negative results and the RLN were intact before and after their identification./20,21/

In Germany Kienast et al. (1998) used needle electrodes for monitoring 181 nerves in 176 patients. The authors observed no postoperative signs of RLN injury and recommended neuromonitoring to be applied as a routine procedure./22/

In 1991 in Los Angeles Sercarz et al. addressed their efforts to the fabrication of endotracheal tube with surface recording electrodes to make the method less invasive and shorten the preoperative management of the patient /23/. However, probably due to technical inadequacy of the fabricated tube, the results they obtained were insufficient with some false-negative responses to the electrostimulation.

Srinivasan and Premahandra (1998) reported their results from using fabric made surface EMG electrodes in 15 patients /24/. In June 1999 in Germany Kunath et al. published excellent results from a wide scale study of RLN monitoring in 301 patients./25/ In August 1999 Horn and Rotzschester from Germany reported very good results of the method in 96 patients./26/

In December the same Timon and Rafferty published in Clinical Otolaryngology the results of a study with "Neurosign 100" system in 21 patients with primary operations of the thyroid gland. They achieved excellent results and recommended routine use of the method./27/

Torfinnur et al. shared their ten-year experience in using operation microscope for visualisation of the RLNs along their whole length during thyroid surgery". In a group of 573 patients the transient dysphonia lasting for 3-5 days was 'observed only in 2. 1 % of the patients./28/

About the EBSLN although magnification of the microscope or other surgical techniques were introduced it is impossible to identify all the nerves due to anatomical variations and technical difficulties./29/ This is relevant with our series of 180 patients with EBSLN identified out of 224.

Postoperative hypoparathyroidism is probably the most frequent complication after total thyroidectomy. It is caused either by physical damage of parathyroid gland or by impairment of their blood supply./30/ In our series we have no permanent hypocalcemia, but in 20% of patients have a mild non clinically significant hypoparathyroidism detected biochemically.

VI. CONCLUSION

Microsurgery could be a method of great significance for protecting both laryngeal nerves and parathyroid glands injury during surgery of the thyroid, especially in reoperation, thyroid cancer and retrosternal goiter.

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