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Utility of continuous intraoperative neural monitoring in thyroid surgery in a low volume centre

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SUMMARY: **Utility of continuous intraoperative neural monitoring in thyroid surgery in a low volume centre.**

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This retrospective study, of a single surgeon's experience, evaluates the role of intraoperative neuromonitoring (IONM) for total thyroidectomy, in a low-volume district general hospital.

128 patients with normal preoperative vocal fold function underwent thyroid surgery with routine use of nerve monitoring. Patients were followed for 6 months after surgery, and postoperative nerve function was determined by fiberoptic laryngoscopy.

One (0,8%) patient was found to have a unilateral vocal fold paralysis, but after 6 months this patient had regained vocal fold motion.

The technique of intraoperative neuromonitoring in thyroid surgery is safe and reliable in excluding postoperative recurrent laryngeal nerve palsy; it has high accuracy, specificity, sensitivity and negative predictive value. Neuromonitoring is useful to identify the recurrent laryngeal nerve and it can be a useful adjunctive technique for reassuring surgeons of the functional integrity of the nerve.

Its application can be particularly recommended for low-volume thyroid operation centres.

KEY WORDS: Intraoperative neuromonitoring - Recurrent laryngeal nerve - Thyroid surgery.

Introduction

Despite advances in surgical techniques during the last decades, the risk for recurrent laryngeal nerve (RLN) injury during thyroid surgery has only declined, not disappeared (1). The overall incidence of damage ranges widely and has been reported to vary from 0.4 to 8% for transient palsy and 0 to 5.2% for permanent paralysis (2, 3), depending on the type of disease, the type of surgery, the extention of resection and the surgeon's experience (4, 5).

RLN dysfunction commonly causes dysphonia, difficulty swallowing, aspiration, and severe airway obstruction.

Anatomic and functional preservation of RLN is the gold standard of thyroid surgery (4, 6). Although visual identification of RLN has decreased the rates of permanent palsy during thyroid operations, unexpected RLN paralysis still occurs and it is the most frequent cause of medical malpractice claims (7). Since most nerve injuries are not recognised during thyroid surgery (7), and visualization of nerve, that can be difficult even with extensive anatomical knowledge and surgical experience, is insufficient to assess the nerve damage, intraoperative neuromonitoring (IONM) can help ascertaining the location of the RLN during dissection, verifying the functional integrity of the RLN before the conclusion of operation and providing guidance for the surgeon in difficulty, in order to avoid nerve traumas (8, 9).

Higher-volume surgeons are more likely to use IONM consistently: increased surgeon confidence and improved safety are two of the most frequently cited reasons for IONM (10). The real benefits of IONM are not only in high-risk thyroid surgeries but, in low-volume surgeries where RLN nerves is likely to be dissected.

The aim of the present study was to stress the importance of utilizing intraoperative neuromonitoring when operating in low-volume surgical centre.

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Patients and methods

The study was carried out retrospectively in 128 consecutive patients who underwent thyroid surgery for various diseases. 90 were females and 38 males with a mean age of 55 years (range 33-78 years). Exclusion criterium was pre-operative RLN palsy or intentional nerve transection. Patients were followed in collaboration with the Division of ENT surgery where pre-operative direct laryngoscopy to check vocal cord mobility was performed by an independent laryngologist at 24 to 48 h before surgery and within patient' discharge (usually at first post-operative day) who was in charge of documenting any reduction in the movement of cords.

Participants provided informed consent.

All operations were performed by the same experienced surgeon (MDP), with a standard Kocher's incision. Intraoperative neuromonitoring was performed for all patients. All these patients underwent general anaesthesia.

Equipment set-up

The Nerve Integrity Monitor (NIM-Response 3.0 System, Medtronic Xomed, Jacksonville, Florida) was the used device for laryngeal nerve monitoring providing both audio and visual evoked waveform information when the recurrent laryngeal nerve was stimulated. This nerve monitoring device transforms laryngeal muscle activity into audible and visual electromyographic (EMG) signals whenever the RLN is stimulated intraoperatively. For IONM, a low pressure-cuffed silicone endotracheal tube (NIM Standard EMG Reinforced Tube, Medtronic Xomed) was positioned. This tube is similar to a standard endotracheal tube but, in addition, it has two integrated stainless steel contact electrodes on each side of the tube that monitor vocal cord EMG activity.

Following correct positioning of the endotracheal tube, the vocal cord electrodes and ground wires were connected to the NIM 3 monitor via a connector box. Both the recording electrodes and nerve stimulator probe require electrodes subcutaneously placed on the patient's sternum region. The NIM 3 monitor has a pulse generator which is connected to the stimulating probe. Neural stimulation occurs via a sterile, handheld probe (Prass Standard Flush- Tip Probe, Medtronic Xomed). Stimulating probes can be monopolar or bipolar. We used a monopolar one; there is any striking differences between the two stimulating probes (11).

Anaesthesia and operative technique

The anaesthesiologist plays a key role in IONM. Neuromuscular blockade interferes with monitoring as it reduces the EMG amplitude and the optimal laryngeal response, making nerve monitoring less effective. Thus, after induction with a short acting neuromuscular blocking agent, neuromuscular blocking agents (NMBA) should be avoided for the rest of the case. Small doses of a non-depolarizing muscle relaxant were used at intubation, as these agents allow normal return of basic physiological functions, within a few minutes and allow for full relaxation and ease in intubation with good visualization and accurate tube placement (12). Muscle relaxation during surgery directly affects the larynx and reduces glottic motor response. Care should be taken with the use of any paralytic agents after induction and during a monitoring case to have an appropriate EMG laryngeal response when stimulating the RLN (13).

Intubation was done by the anaesthesiologist in a normal fashion. Patient fully positioned with the neck hyperextended and the endotracheal tube taped in place, the operation starts. The RLN was located and identified at the tracheaesophageal groove in proximity to the inferior thyroid artery, then it was mapped and stimulated obtaining an EMG signal.

At the conclusion of the case the final testing of RLN was performed after removal of the surgical specimen and ensuring complete haemostasis of the surgical field.

Results

128 patients underwent thyroid surgery with the use of intraoperative nerve monitoring using the Medtronic© NIM system. There were 38 males (average age 54.2 years, range 33-90 years) and 90 females (average age 43.1 years, range 38-87 years). Patient clinical details are presented in Table 1.

Table 1 - PATIENTS DATA, INDICATIONS FOR SURGERY, TYPE OF SURGERY AND SELECTED OPERATIVE DETAILS.

Variable	Number
Age, year (median)	46 (33-90)
Women (N)	90
Men (N)	38
Disease	
Non-toxic nodular goitre	110 (85%)
Carcinoma	3 Papillary Thyroid cancer (2%) 1 Follicular carcinoma (0,7%)
Grave's Disease	2 (1%)
Toxic nodular goitre	8 (6%)
Procedure	
Total thyroidectomy	128
Lobectomy	0
Operative details	
Estimated blood loss, ml	45 ± 25
Operative time, min	70 ± 25,8
Thyroid volume, ml	56 ± 21

During the postoperative period, 1 (0,8%) patient was found to have a unilateral vocal fold paralysis; interestingly, after 6 months this patient had regained vocal fold motion.

Discussion

The incidence of recurrent laryngeal nerve palsy varies from less than 1% to as high as 20% (14, 15).

Several factors influence the likelihood of injury to the nerve: the underlying disease, the extent of resection, and the experience of the surgeon (14, 16, 17). Even experienced surgeons report inadvertent injury to the nerve and persistent palsy in about 1-2% of patients (15, 17).

Causes of nerve palsy include: damage to the nerve's anatomic integrity, thermal lesions, excessive nerve skeletization, axon damage caused by excessive strain, oedema, hematoma, difficult tracheal intubation, neuritis caused by scar tissue and viral neuritis (18).

In 1938 Lahey (19) carefully dissected the recurrent laryngeal nerve in virtually every case and the number of injuries to the recurrent laryngeal nerves decreased. This approach is most accepted by endocrine surgeons (14).

Nerve identification in certain types of operations may be very difficult (14, 16) and nerve monitoring has been developed to facilitate thyroid surgery (14, 20, 21).

IONM shows its utility in RLN identification, location and neural mapping, in RLN dissection and in predicting vocal cord function and identification of nerve injury site.

Our clinical results support that IONM is safe, effective and reliable in excluding postoperative recurrent laryngeal nerve palsy in thyroid procedures; it has an high accuracy, specificity, sensitivity and negative predictive value (22).

However, in any case, it should not replace clinical judgment and should not be intended as a substitute for adequate surgical technique, but as an important adjunct.

The most important principle of RLN monitoring to take in mind is that the surgeon must not only visually identify the nerve but must also demonstrate satisfactory electrical EMG response before dividing any tissue. When using IONM a negative response when stimulating suspicious neural tissue in the surgical field should not be accepted as a true negative until a true positive has been identified (11). This principle will make nerve identification and dissection safer.

In our experience, the use of this technique has decreased the stress of the surgeon, facilitated the identification of the nerve and given greater safety in the prosecution of the operations.

Its application can be particularly recommended for low-volume centres.

Conflict of interest

The Authors declare no conflict of interest.

References

1. Angelos P. Recurrent Laryngeal Nerve Monitoring: State of the Art, Ethical and Legal Issues. Surg Clin N Am. 2009; 89:1157-69.
2. Beldi G, Kinsbergen T, Schlumpf R. Evaluation of intraoperative recurrent nerve monitoring in thyroid surgery. World J Surg. 2004;28(6):589-91.
3. Rubin AD, Sataloff RT. Vocal fold paresis and paralysis. Otolaryngol Clin N Am. 2007;40 (5):1109-31. viii-ix.
4. Barczyński M, Konturek A, Cichoń S. Randomized clinical trial of visualization versus neuromonitoring of recurrent laryngeal nerves during thyroidectomy. Br J Surg. 2009;96:240-6.
5. Hemmerling TM, Schmidt J, Bosert C, et al. Intraoperative Monitoring of the Recurrent Laryngeal Nerve in 151 Consecutive Patients Undergoing Thyroid Surgery. Anesth Analg. 2001;93:396-9.
6. Dralle H, Sekulla C, Lorenz K, et al. Intraoperative Monitoring of the Recurrent Laryngeal Nerve in Thyroid Surgery World J Surg. 2008;32:1358-66.
7. Duran Poveda MC, Dionigi GL, Sitges-Serra A, Barczynski M, Angelos P, Dralle H, Phelan E, Randolph G. Intraoperative monitoring of the recurrent laringeal nerve during thyroidectomy: a standardized approach. World J Endocr Surgery. 2011;3:144-50.
8. Serpell J, Sidhu S, Vallance N, Panizza B, Randolph G. Consensus statement on intra-operative electrophysiological recurrent laryngeal nervemonitoring during thyroid surgery. ANZ J Surg. 2014;84 (9):603-4.
9. Yarbrough DE, Thompson GB, Kasperbauer JL, Harper CM, Grant CS. Intraoperative electromyographic monitoring of the recurrent laryngeal nerve in reoperative thyroid and parathyroid surgery. Surgery. 2004;136(6):1107-15.
10. Marti JL, Holm T, Randolph G. Universal use of intraoperative nerve monitoring by recently fellowship-trained thyroid surgeons is common, associated with higher surgical volume, and impacts intraoperative decision-making. World J Surg. 2016;40 (2):337-343.
11. Randolph GW. Surgical anatomy of the recurrent laryngeal nerve. In: Randolph GW (Ed). Surgery of the thyroid and parathyroid glands. Philadelphia, PA: Saunders 2003:300-42.
12. Chu KS, Wu SH, Lu IC, Tsai CJ, Wu CW, Kuo WR, et al. Feasibility of intraoperative neuromonitoring during thyroid surgery after administration of nondepolarizing neuromuscular blocking agents. World J Surg. 2009;33:1408-13.
13. Marusch F, Hussock J, Haring G, Hachenberg T, Gastinger I. Influence of muscle relaxation on neuromonitoring of the recurrent laryngeal nerve during thyroid surgery. Br J Anaesth. 2005;94:596-600.
14. Sari S, Erbil Y, Sumer A, et al. Evaluation of recurrent laryngeal nerve monitoring in thyroid surgery. Int J Surg. 2010;8:474-817.
15. Marrazzo A, Taormina P, David M, et al. Il carcinoma della tiroide: dalla diagnosi alla terapia. Chir Ital. 2008;60:685-95.
16. Calò PG, Pisano G, Medas F, et al. Risk factors in reoperative thyroid surgery for recurrent goitre. Our experience. G Chir. 2012;33:335-8.
17. Cirocchi R, Boselli C, Guarino S, et al. Total thyroidectomywith ultrasonic dissector for cancer: multicentric experience. World J Surg Oncol. 2012;10:70.
18. Calò PG, Pisano G, Medas F, et al. The use of harmonic scalpel in thyroid surgery. Our experience. Ann Ital Chir. 2012;83:7-12.
19. Lahey FH, Hoover WB. Injuries to the recurrent laryngeal nerve in thyroid operations: their management and avoidance. Ann Surg. 1938;108(4):545-62.
20. Chan WF, Lo CY. Pitfalls of Intraoperative Neuromonitoring for Predicting Postoperative Recurrent Laryngeal Nerve Function during Thyroidectomy. World J Surg. 2006;30:806-12.
21. 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.
22. Calò PG, Pisano G, Medas F, Tatti A, Pittau MR, Demontis R, Favoriti P, Nicolosi A. Intraoperative recurrent laryngeal nerve monitoring in thyroid surgery: is it really useful? Clin Ter. 2013;164(3):e193-8.