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Research Article

### THE VALUE OF NEURO STIMULATION WITH LARYNGEAL PALPATION (NSLP) AND INTRAOPERATIVE NERVE MONITORING (IONM) OF RECURRENT LARYNGEAL NERVE IN THYROID SURGERY

<sup>1</sup>Dr. Tanvir Hussain, <sup>2</sup> Dr. Hadi Al-Hakami, <sup>3</sup> Dr. Mohammed Al Garni

<sup>1</sup>MBBS. FCPS, DOHNS, Ebeorl-hns, Assistant Professor HBS Medical College Islamabad  
Pakistan and Assistant Consultant, ENT, King Abdul Aziz Medical City Jeddah

<sup>2</sup>Assistant Professor and Consultant Otolaryngology-Head and Neck Surgery,  
KSAU-HS & KAMC-Jeddah

<sup>3</sup>Assistant Professor and Consultant Otolaryngology-Head and Neck Surgery,  
KSAU-HS & KAMC-Jeddah

**Abstract:**

**Objective:** To compare the accuracy of utilizing neuro stimulation with laryngeal palpation (NSLP) and intraoperative neuro monitoring (CIONM) in total thyroidectomy with regards to injury to the recurrent laryngeal nerve.

**Methods:** A retrospective historical cohort study was carried out during the period between January 2014 and January 2018 in King Abdul Aziz Medical, Jeddah. A total of 260 cases that underwent total thyroidectomy were evaluated for recurrent laryngeal nerve injury. The injury rate in these cases was compared between cases done with continuous intraoperative nerve monitoring (group 1; n = 115) and those performed using neuro stimulation with laryngeal palpation (group 2; n = 145).

**Results:** There was no significant difference in nerve injury between cases done with intraoperative nerve monitoring and those with neuro stimulation with laryngeal palpation ( $P = 0.25$ ). The presence or absence of laryngeal twitch (LT) ( $P < 0.001$ ) and the acoustic response to electrical stimulation ( $P = 0.03$ ) were significantly associated with nerve function at the end of the surgery.

**Conclusion:** Our results indicate that NSLP is a safe and reliable intraoperative method of RLN monitoring. Moreover, our data confirm that IONM is not significantly better than NSLP to reduce the rate of permanent RLNI in thyroid surgery.

**Keywords:** Thyroidectomy, Neuro stimulation, Laryngeal Palpation, Intraoperative Nerve Monitoring, Vocal Cord Palsy, Recurrent Laryngeal Nerve Injury.

**\*Corresponding author:**

**Tanvir Hussain,**

MBBS. FCPS, DOHNS,

Ebeorl-hns, Assistant Professor HBS Medical College,

Islamabad

QR code



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**INTRODUCTION:**

Thyroidectomy is the most commonly performed endocrine surgical procedure in the Kingdom of Saudi Arabia. Total thyroidectomy has been the treatment of malignant lesions and certain benign conditions of the thyroid gland. Laryngeal dysfunction after total thyroidectomy is a common complication, in which, recurrent laryngeal nerve injury is the leading cause of the problem [1]. In essence, the prevention of injury to the recurrent laryngeal nerve during thyroidectomy requires the identification of the nerve and the evaluation of its function. Surgical exposure and visual identification of the RLN during thyroid surgery has been shown to provide the best rates of normal postoperative vocal fold function. Identification of RLN can be difficult in patients who have undergone previous thyroid surgery. Moreover, an anatomically intact nerve does not always correlate with normal vocal fold function, and so it is fundamental for surgeons to identify the RLN and to establish its function [2]. Numerous methods to facilitate visual identification of the RLN and to test its function have been described: intermittent monitoring techniques such as palpation (laryngeal twitch, [LT]) of the posterior cricoarytenoid muscle (PCA) after stimulation of the nerve with a stimulator probe (neurostimulation with laryngeal palpation, [NSLP]) and continuous monitoring methods such as intramuscular electromyographic electrodes placed in the vocal muscles.<sup>4,5</sup> Recently, suggestions have been made that the use of continuous intraoperative nerve monitoring of RLN during thyroid gland operation improves the safety of RLN. There has been, consequently, an augmented concern in the engagement of continuous intraoperative nerve monitoring since the method promises early identification of the recurrent laryngeal nerve stress [3]. Most institutions are, thereby, currently performing monitored thyroidectomies [4]. However, controversy remains as to whether IONM confers any significant benefit in injury prevention and prediction of postoperative vocal cords function compared with the current practice of anatomic dissection to identify and preserve the RLN. Several reports have advocated that IONM was a useful and reliable tool for identification and preservation of the RLN, although the value of reducing the risk of RLN palsy rates remains controversial. There are many recent studies have shown that continuous intraoperative nerve monitoring has no significant effect in reducing chances of injury to the recurrent laryngeal nerve [5]. Other studies claim that IONM may provide a measure of safety in challenging cases in which visual identification of the nerve is limited. The aim of our study was to report and compare the results of our experience about IONM and NSLP in total

thyroidectomy with regards to injury to the recurrent laryngeal nerve.

**MATERIALS AND METHODS:**

The study is a historical retrospective cohort study. Data from 260 patients who underwent total thyroidectomy at the Section of Otolaryngology Head and Neck Surgery, King Abdul Aziz Medical City, Jeddah from the period of January 2014 to January 2018 were collected in a computerized database [6]. Cases in which RLN section was necessary because of tumor involvement were excluded from the analysis. Patients were stratified into two groups according to the technique of neural monitoring performed. The first group (115 patients with 230 nerves at risk) included patients who underwent intraoperative nerve monitoring (IONM) and the second group (145 patients with 290 nerves at risk) consisted of those who underwent neuro stimulation with laryngeal palpation (NSLP). Thyroidectomies were performed by the same surgical team. The surgical procedure was performed with a standard anterior neck skin incision. Complete RLN identification and dissection were accomplished in all patients. Once the RLN was identified NSLP or IONM was performed to assess the neural functional integrity. At the end of the thyroidectomy, the RLN was again stimulated to document any change or absence in the LT or the acoustic signal. The presence or absence of LT or signal at the end of the procedure was taken as the definitive endpoint for comparison. NSLP was performed with a disposable nerve stimulator [7] with the current intensity set between 0.5 and 2.0 mA. Palpation for contraction of the PCA was performed after identification of the thyroid cartilage. The functionality of electrode was tested every time on the muscular tissue of the surgical field before direct nerve stimulation. The NSLP test was considered positive when laryngeal twitch (LT) was present at the completion of the thyroidectomy. The patient was regarded as true positive if postoperative vocal cord function was confirmed normal by postoperative laryngoscopy and false positive if postoperative vocal cord function was absent. During IONM, the Neurosign 100 (Magstim, Whitland, UK) was used to record burst and train responses and to confirm and monitor the RLN function during surgery. To apply the stimulation current to the nerve, a bipolar radial electric field nerve stimulator was used. A laryngeal surface electrode was applied and was adherent to the convexity of the endotracheal tube just proximal to the cuff. After induction of anesthesia, patients were intubated with the electrode positioned in proximity to the vocal cords. An impedance meter verifies the correct placement of the electrodes at the vocal cord with the patient in the final operating position. The

impedance should be less than 2 k. During surgery, a straight bipolar electrode was used for stimulation with a frequency of 3 Hz. The intensity of the electrical impulses was set at 0.5 mA and eventually raised to 2.0 mA depending on the threshold of the nerve stimulation. The loss of IONM signals (burst) was defined as true positive when the vocal cord palsy was confirmed on postoperative laryngoscopy and as false positive when no such palsy was verifiable. To assess the outcome, all patients were examined before and after the operation by an independent laryngologist and speech therapist blind to the technique adopted and to the neuro stimulation and IONM results. Statistical Package for Social Sciences Version 21.0 (SPSS Inc., Chicago, IL, USA) was used for the data collection and analysis. The incidence of nerve palsy was calculated based on the number of nerves at risk. The  $\chi^2$  test and Fischer exact test was applied, as appropriate, to evaluate the statistical significance of the association between categorical variables. A P value of  $< 0.05$  was regarded as statistically significant. The confidence intervals were determined at a 95 percent level.

### RESULTS:

Data from 260 total thyroidectomies done during the study period were retrospectively reviewed. There

were 203 (78.1%) female patients and 57 (21.9%) male patients, with a mean age of 42.6 years (range, 10 to 89 years)  $\pm 15.6$  SD. The overall rate of vocal cord palsy was 3.1% (16 of 520 nerves at risk). Transitory unilateral palsy occurred in 7 (2.7%) patients. One patient (0.4%) had permanent unilateral vocal cord palsy. Three cases of vocal cord palsy were in INOM group compared with five in the NSLP group. All cases were managed by medical and speech therapy and full recovery occurred within six months. The Surgical procedures and postoperative pathological analysis are demonstrated in Table 1.

CCND: concomittant central neck dissection A significant difference in nerve injury between the group of neuro stimulation with laryngeal palpation (NSLP) and the group of intraoperative nerve monitoring (IONM) ( $P = 0.25$ ) was not observed. Thyroid malignancy was seen in all cases of vocal cord palsy. However, vocal cord palsy was not statistically affected by other factors as age ( $P = 0.28$ ), sex ( $P = 0.23$ ), and extent of surgery ( $P = 0.16$ ). In the 1<sup>st</sup> group, the acoustic response to electrical stimulation was significantly associated with nerve function ( $P = 0.003$ ). The presence or absence of LT in the 2<sup>nd</sup> group was significantly associated with the nerve function at the end of the surgery ( $P < 0.001$ ).

**Table 1. Operative Data and Permanent Pathology**

Variable	Group 1 (IONM)	Group 2 (NSLP)	Total
<b>Surgical Procedure</b>			
Total thyroidectomy with CCND	15 (13%)	30 (20.7%)	45 (17.3%)
Total thyroidectomy without CCND	100 (87%)	115 (79.3%)	215 (82.7%)
<b>Permanent Pathology</b>			
Benign	39 (33.9%)	46 (31.7%)	85 (32.7%)
Papillary thyroid carcinoma (PTC)	68 (59.1%)	91 (62.8%)	159 (61.1%)
Follicular thyroid carcinoma (FTC)	4 (3.5%)	6 (4.1%)	10 (3.8%)
Medullary thyroid carcinoma (MTC)	1 (0.9%)	1 (0.7%)	2 (0.8%)
Anaplastic thyroid carcinoma (ATC)	1 (0.9%)	1 (0.7%)	2 (0.8%)
Poorly differentiated thyroid carcinoma	2 (1.7%)	0 (0%)	2 (0.8%)
Total	115 (100%)	145 (100%)	260 (100%)

**DISCUSSION:**

Thyroidectomy is a common surgical procedure worldwide and is performed by surgeons with varied training including otolaryngology-head and neck surgery, general surgery, endocrine surgery, and oncologic surgery [8]. The incidence of RLNI which is the most feared complication and could jeopardize the quality of patients varies from 0% to 4.8% and are greater in extensive resections and the cases of reoperation [9]. There are many intraoperative tools could help the surgeon to identify and preserve RLN including NSLP and IONM. The value of RLN identification by using IONM which has been shown to decrease the rate of postoperative nerve palsy in multiple studies still debate among head and neck surgeons [10]. Nevertheless, identification of RLN can be difficult in patients who have undergone previous surgery. Our results about NSLP confirmed that the stimulation of RLN with laryngeal palpation is a safe and reliable intraoperative method of RLN monitoring. The presence of laryngeal twitch at the completion of lobectomy correlates reliably with normal postoperative vocal cord function. Nevertheless, as described by other authors, the accuracy of this technique is conditioned by the high rate of false positive cases and low PPV which could be related to many factors [11]. using NSLP technique can be very useful when the surgeon must decide on the extent of dissection of the contralateral lobe to avoid the risk of inducing bilateral cord palsy with life-threatening consequences [11]. In the last years, IONM has gained popularity and the number of scientific papers about this technique has increased constantly. There are various studies about IONM and a unanimous opinion that this technique can be very useful in the identification of the nerve in particular cases such as the anatomic situation complicated by prior surgery, large masses, or aberrant nerve course [12]. On the contrary, the results reported about the utility of IONM in reducing the rate of RLN injury are not homogeneous. Authors in a large multi-centric study showed promising results about the ability of IONM to reduce RLN damage [13]. However, the risk of multi-centric studies is that the results could be conditioned by the heterogeneity of surgical technique and surgeon experience. On the other hand, some authors did not prove the validity of IONM to reduce the rate of RLN injury during thyroidectomy [14]. Our results confirmed that IONM is not a helpful tool to reduce RLN injury significantly compared with NS. It can help in nerve identification in redo cases where the anatomy is distorted.

Moreover, few studies analyze the importance of neuro geneous evoked signals of IONM during

thyroidectomy. The auditory responses allow the surgeon to be alerted to possible traumatic injury during dissection and the real-time auditory monitoring can help to reduce surgical misadventures when the nerve is at risk [15]. Our results suggest that train activity, as in other surgical procedures, is a reliable predictor for postoperative ILN paralysis [16]. Finally, although the use of continuous neuro monitoring may provide more neurophysiologic information, it has to be remembered that an important learning curve is required to correctly interpret the auditory signals [17].

**CONCLUSION:**

Our results indicate that NS with laryngeal palpation is a safe and reliable intraoperative method of RLN monitoring. The presence of laryngeal twitch at the completion of lobectomy correlates reliably with normal postoperative vocal cord function. Our data confirm that IONM is not the superior tool to reduce the rate of vocal cord palsy in thyroid surgery. Therefore, the utilization of IONM in thyroid surgeries has no contribution to an experienced surgeon in regards to reduction or avoidance of injury to the recurrent laryngeal nerve.

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