

## Anaesthesia for thyroid surgeries using neural integrity monitoring endotracheal tube-our initial experience with more than 600 cases

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### Abstract

**Background and Aims:** Recurrent laryngeal nerve (RLN) palsy is one of the most feared and common complication of thyroid surgeries. The neural integrity monitor electromyogram (NIM FLEX EMG) tracheal tube was introduced to identify RLN palsy. This retrospective study was conducted to record the incidence of nerve palsies during thyroid surgery while using a NIM FLEX EMG endotracheal tube as well as the anaesthesia technique employed without the use of muscle relaxants. **Methods:** This was a retrospective study of 628 patients who underwent thyroidectomy for benign and malignant goitres during a period from October 2015 to September 2022 in a tertiary centre in Kerala, India. The case records of all the patients were thoroughly scrutinised and anaesthesia technique as well as a nerve palsy developing in the post operative period were noted. All patients were undergoing indirect laryngoscopy preoperatively in order to know the status of vocal cords. After induction of anaesthesia, direct laryngoscopy was performed and all patients were intubated with a NIM FLEX EMG endotracheal tube. The crucial step is to ensure proper placement and prevent a malpositioning in the perioperative period. Since a continuous nerve monitoring was in place, there was no need for a laryngoscopy at the end of the procedure. **Results:** Only in the case of two patients there was post operative RLN palsy. These two were due to the pre operative entrapment of the nerve within the malignant thyroid. None of them experienced bucking or coughing at any time during the procedure. **Conclusion:** We found that intraoperative nerve monitoring tube had greatly reduced the incidence of RLN/SLN (Superior laryngeal nerve) palsy. Adequate depth of anaesthesia could be achieved without the use of muscle relaxants. No incidence of increased length of hospital stay was noted. We have highlighted our perioperative anaesthetic management strategies so that it will be useful for the future anaesthesiologists.

**Keywords:** Intraoperative nerve monitoring (IONM), Recurrent laryngeal nerve palsy, Nerve integrity monitoring endotracheal tube, Thyroid surgery.

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### Introduction

Thyroid surgeries are the most frequently performed endocrine procedure world-wide. RLN palsy is one of the most common and feared complications after thyroid surgeries that can greatly affect the quality of life [1,2]. Previously direct visualization of the vocal cord movement at the end of procedure was the gold standard to detect a RLN injury during surgery. But this procedure give a lot of stress to the patient especially in the recovering phase of anaesthesia. With the advent of nerve integrity endotracheal tube, localization and protection of the nerves can be done effectively during the intraoperative period itself. But this offers an additional challenge to the anaesthesiologists, because we cannot use skeletal muscle relaxant as it interferes with electromyographic signal and we need to maintain in a deeper plane of anaesthesia throughout the surgery.

In our institution, we routinely use MEDTRONIC NIM FLEX EMG endotracheal tube for real time monitoring RLN and SLN during the surgery. This tube has got integrated surface electrode that are placed in contact with the true vocal cords to monitor EMG activity. This precise positioning is important for the nerve signals. This nerve monitoring device convert laryngeal muscle action potential into an electromyographic signals when RLN is stimulated.

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### Methods

After preop evaluation and optimization, a written informed consent was obtained from all patients undergoing thyroidectomy. All patients underwent indirect laryngoscopy by Otorhinolaryngologist for assessing preoperative vocal cord function. Premedication given with Injection Midazolam 0.02-0.03mg/kg/IV, Injection Ondansetron 0.15mg/kg/IV, Injection Dexamethasone 0.15mg/kg/IV followed by Injection Amoxicillin and Clavulanic acid. All ASA monitoring standards were kept which include NIBP (Non-invasive blood pressure), ECG, Pulse oximeter, and Entropy. Heart rate and baseline vitals were noted.

Adequate preoxygenation was done with 100% oxygen for 3 minutes. Inj Fentanyl 2mcg/kg and defasciculating dose of Atracurium were given before induction and general anaesthesia was induced with Inj Propofol 1-2mg/kg. Intubation is facilitated with Inj Succinylcholine 1-2mg/kg/ or Inj Atracurium 0.5 mg/kg as per the anaesthesiologist choice (After that no muscle relaxants were given). Usually we were performing direct laryngoscopy (DLS) and intubate with 7/7.5/8mm ID NIM FLEX EMG endotracheal tube (ETT) under the bougie guidance. The tube should be advanced in such a way that electrodes should be in contact of the patients' vocal cords in order to generate accurate EMG signal (Fig1). ETT secured after auscultatory and capnography confirmation of the correct placement. Once the tube is in optimal position, cervical extension was achieved by keeping a shoulder roll under the scapula and 15-degree head up. The position of electrodes for intraoperative nerve monitoring were confirmed in both neck flexed and extended position.

Anaesthesia was maintained with an oxygen and air mixture (FiO<sub>2</sub> 0.5 total flow of 1L/min), Sevoflurane of MAC 0.6-1, Fentanyl

infusion 1-2mcg/kg/hr, Dexmedetomidine 0.2-0.7mcg/kg/hr and titrate according to entropy value (usually kept between 40-60). Depth of anaesthesia should be such that there should not be any patient movements during the perioperative time but at the same time should reflect a proper EMG signal. Oropharyngeal temperature probe, mechanical calf pump, bodywarmers were kept. Analgesia supplemented with IV Paracetamol 1gm. Patient's haemodynamic parameters and ventilation were closely monitored throughout the surgery.

After excision of the thyroid gland, inhalational agents and anaesthetic infusions were stopped. Once the procedure is complete, Inj Lignocaine 1.5mg/kg will be given 90sec prior to the presumed time of extubation. Patients were all extubated in a deeper plane to avoid bucking and hematoma formation. Postoperatively, Patients were supplemented with oxygen by a non-rebreathing mask at a flow of 4-5 litre and kept in a 30-45° head up position to prevent hematoma formation.

#### NIM flex endotracheal tube

Nerve-integrity monitoring (NIM) electromyographic (EMG) endotracheal tube is a flexo metallic-tube with integrated stainless-steel bipolar contact-electrodes and audio-visual alarms useful for IONM [3] (Fig 2). It is particularly useful for identifying the recurrent LN. The anaesthesiologist should be familiar with the proper

use and functioning of this device. Initially, this unique tracheal tube must be positioned so that its colour-coded contact band is appropriately placed between the vocal cords. When attempting to identify LNs, a stimulating electrical current of 0.5-2.0 mA is used by the surgeon. This current is administered via a sterile probe, which is placed directly on the anatomical site in question. Additionally, return electrodes are positioned in the skin above the sternum [4]. When a LN is located, an electrical signal is subsequently generated by the motion of the vocal cords. An audibly recognizable "machine gun clicks" is then produced from the device associated monitor. This sound has a set frequency of 4 times/s (4 Hz). Simultaneously, an oscilloscope-like screen displays an identifiable sinusoidal response. (Fig 3)

#### Results

This is a retrospective study of patients underwent total thyroidectomy for benign and malignant goitres. All Surgeries were performed by single surgeon. Among 628 patients, only one patient experienced bucking or coughing during surgery. No one developed awareness during surgery. Only 2 patients were developed RLN palsy due to preop entrapment of nerve

Growth ( Table 1) Those two patients had malignant thyroid glands. No signals were lost during surgeries which are narrated in literatures as complications due to malposition of tube while positioning the patients.

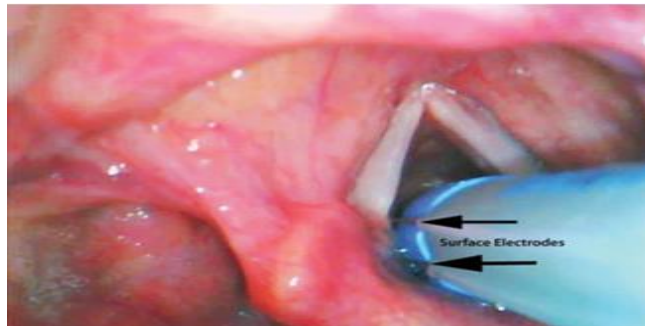


Fig1: Correct Placement of Nerve integrity monitoring tube.



Fig 2: Nerve integrity monitoring (NIM) endotracheal tube.



Fig 3: Medtronic nerve integrity monitor showing the sinusoidal response.

Table 1: Our matrix of cases.

TYPES OF CASES	OF	NUMBER OF CASES	OF RLN PALSY	BUCKING/COUGHING
Malignancy		186	2	0
Multinodular goitre		432	0	1
Retrosternal goitre		7	0	0
Required sternotomy		3	0	0

**Discussion**

Recurrent laryngeal nerve injury is the leading major complication of thyroid surgery. Unilateral nerve injury may lead to hoarseness, aspiration-related respiratory complications and dysphagia, whereas a bilateral recurrent laryngeal nerve injury, although rare, may cause life-threatening dyspnoea requiring tracheostomy. The rate of transient recurrent laryngeal nerve paralysis has been reported to be between 0.4% and 12%, whereas that of permanent paralysis has been reported to be less than 1% in experienced hands[5,6]. NIM-aided intraoperative dissection was able to successfully identify the external branch of superior laryngeal nerve in 97.2% of the cases compared to 87.5% in traditional surgical dissection alone[7]. Malpositioning of endotracheal tube during induction and maintenance may inadvertently disrupt intraoperative neuromonitoring, resulting in increased risk of damage to the recurrent laryngeal nerves[4] which has not happened in our series cases. Anaesthetic management also very crucial role to avoid interference with myographic signals. In our institution we routinely use NIM tube and give anaesthesia with successful results while maintaining adequate depth throughout the perioperative periods with Fentanyl and Dexmedetomidine infusions to prevent inducing airway reflexes[8].

**Conclusion**

Thyroid surgeries using intraoperative nerve monitoring is going to be a routine in near future. The challenge is to place the NIM tube properly for the signals, to keep the patient in a plane of anaesthesia so that patient will not be bucking during the surgery, at the same time our technique should not interfere with the production of signals also. There should be a smooth emergence from the anaesthesia as in all head and neck surgeries.

**Conflicts of interest**

No conflicts of interest.

**References**

1. Deniwar A, Kandil E, Randolph G. Electrophysiological neural monitoring of the laryngeal nerves in thyroid surgery: review of the current literature. *Gland surg.* 2015; 4:368.

2. Caragacianu D, Kamani D, Randolph GW. Intraoperative monitoring: normative range associated with normal postoperative glottic function. *The Laryngoscope.* 2013; 123:3026-31.

3. Dralle H, Sekulla C, Lorenz K, Brauckhoff M, Machens A, German IONM Study Group. Intraoperative monitoring of the recurrent laryngeal nerve in thyroid surgery. *World J surg.* 2008; 32:1358-66.

4. Lu IC, Chu KS, Tsai CJ, Wu CW, Kuo WR, et al. Optimal depth of NIMEMG endotracheal tube for intraoperative neuromonitoring of the recurrent laryngeal nerve during thyroidectomy. *World J surg.* 2008; 32:1935-9.

5. Pisanu A, Porceddu G, Podda M, Cois A, Uccheddu A. Systematic review with meta-analysis of studies comparing intraoperative neuromonitoring of recurrent laryngeal nerves versus visualization alone during thyroidectomy. *Journal of surgical research.* 2014; 188:152-61.

6. Goretzki PE, Schwarz K, Brinkmann J, Wirowski D, Lammers BJ. The impact of neuromonitoring (IONM) on surgical strategy in intraoperative bilateral thyroid diseases: is it worth the effort? *World J surg.* 2010; 34:1274-84.

7. Glover AR, Norlen O, Gundara JS, Morris M, Sidhu SB. Use of the nerve integrity monitor during thyroid surgery aids identification of the external branch of the superior laryngeal nerve. *Ann Surg Oncol.* 2015; 22: 1768-73.

8. Byun SH, Jeon JM. Sinus pause during nerve integrity monitoring tube insertion following anesthetic induction with a low-dose neuromuscular blocking agent: a CARE-compliant case report. *Medicine* 2021; 100:29.