Journal of Clinical Anesthesia (2016) **29**, 10–13

ELSEVIER

Journal of Clinical Anesthesia

Original contribution

Effect of laryngotracheal topical anesthesia on recurrent laryngeal nerve monitoring during thyroid Surgery

Justin Pachuski MD[a], Sonia Vaida MD[a], Kathleen Donahue DO[a], John Roberts MD[b], Allen Kunselman MA[c], Benjamin Oberman MD[b], Hetal Patel MD[b], David Goldenberg MD, FACS[b,*]

[a]*Department of Anesthesiology, Head and Neck Surgery, Penn State College of Medicine and Penn State Hershey Medical Center, Hershey, PA, USA*
[b]*Department of Surgery, Division of Otolaryngology, Head and Neck Surgery, Penn State College of Medicine and Penn State Hershey Medical Center, Hershey, PA, USA*
[c]*Department of Public Health Sciences, Penn State College of Medicine, Hershey, PA, USA*

Received 1 January 2015; accepted 16 September 2015

Keywords:
Intraoperative neuromonitoring;
Recurrent laryngeal nerve;
Laryngotracheal topical anesthesia;
Lidocaine;
Thyroidectomy

Abstract

Study Objective: Intraoperative neuromonitoring of the recurrent laryngeal nerve (RLN) is often used as an adjunct for RLN identification and preservation during thyroidectomies. Laryngotracheal anesthesia (LTA) with topical lidocaine reduces coughing upon emergence from anesthesia and in the immediate postoperative period; however, its use is prohibited with concerns that it could decrease the sensitivity of the intraoperative neuromonitoring. We hypothesize that there is no difference in measurements of nerve conduction made before and after LTA administration.

Design: An observational study in which all patients were subjected to LTA administration was conducted. Recurrent laryngeal nerve threshold currents were measured before and after the intervention.

Setting: Tertiary medical center operating room.

Patients: Eighteen patients (total of 25 nerves at risk) with American Society of Anesthesiologists classes 1 to 3 undergoing thyroid surgery.

Interventions: After the thyroid was removed and threshold currents at the RLN were obtained, LTA with endotracheal lidocaine was applied on the left and right side of the in situ endotracheal tube (2 cc of 4% lidocaine per side). Threshold currents were reassessed at 5 and 10 minutes after LTA administration.

Measurements: Threshold currents (minimum stimulus current applied to the RLN required to generate a discernible electromyographic response at the vocal cords) were recorded along the RLN for a baseline at 5 and 10 mm from the insertion point of the RLN into the larynx. Threshold currents were reassessed at the same 2 positions on the RLN at 5 and 10 minutes after LTA administration. Differences in mean values, between threshold currents recorded at the 3 different times, at 2 positions on the RLN, were used to compare effects of LTA on nerve conduction.

* Corresponding author at: Department of Surgery, Division of Otolaryngology–Head and Neck Surgery, Penn State Hershey Medical Center, 500 University Drive, Hershey, PA 17033, USA. Tel.: +1 717 531 8945.

E-mail addresses: jpachuski1@hmc.psu.edu (J. Pachuski), svaida@hmc.psu.edu (S. Vaida), kdonahue@hmc.psu.edu (K. Donahue), jroberts8@hmc.psu.edu (J. Roberts), ark3@psu.edu (A. Kunselman), boberman@hmc.psu.edu (B. Oberman), hpatel5@hmc.psu.edu (H. Patel), dgoldenberg@hmc.psu.edu (D. Goldenberg).

http://dx.doi.org/10.1016/j.jclinane.2015.09.003

Main Results: There were no statistically significant differences when comparing threshold currents before and after LTA administration.
Conclusions: Laryngotracheal anesthesia had no significant effect on RLN nerve conduction in the period assessed.

1. Introduction

Recurrent laryngeal nerve (RLN) paralysis after thyroid surgery has a reported incidence of 0 to 11% [1], with an even higher incidence in cases presenting with large multinodular goiters, cancers, and revision surgery [2]. Intraoperative neuromonitoring (IONM) of the RLN has become a popular adjunct to aid the surgeon in locating and preserving the RLN during thyroid and other neck surgeries [3–5]. Another potential complication is postthyroidectomy hematoma resulting in airway compromise. Coughing upon emergence from anesthesia as well as in the postoperative period may be a contributing factor to the development of these hematomas [6]. Laryngotracheal anesthesia (LTA) with topical lidocaine applied to the trachea and glottis prior to intubation is used to decrease the incidence of coughing upon emergence from general anesthesia [7,8].

In light of the effects of lidocaine on nerve conduction and the proximity of the RLN to the trachea, concern has been expressed that LTA may decrease the ability to adequately monitor the function of the RLN. This concern is supported by previous work that demonstrated a reduction in percutaneous laryngeal electromyography (EMG) signal after transtracheal lidocaine administration in phonating patients [9]. On the basis of these concerns, 2 manufacturers of endotracheal tubes (ETTs) with embedded electrodes for sampling laryngeal EMG recommend avoiding endotracheal lidocaine [10,11]. This prohibition on topical local anesthetic has also been expressed in an article discussing anesthetic considerations for IONM of the RLN [12].

Our aim was to assess the effect of LTA on IONM of the RLN during thyroidectomy. We hypothesized that there is no difference in nerve conduction (as defined by the threshold current—minimum stimulus current applied to the RLN required to generate a discernible EMG response at the vocal cords) between measurements made before and after LTA.

2. Materials and methods

Institutional review board approval was obtained. Adult patients with American Society of Anesthesiologists classes 1 to 3 undergoing total or hemi-thyroidectomy were included. In total, 18 patients were enrolled for a total of 25 nerves at risk: 11 hemi-thyroidectomies (1 nerve at risk) and 7 total thyroidectomies (2 nerves at risk). Patients with known difficult airway, suspected RLN invasion, preoperative vocal cord paralysis, or anticipated RLN sacrifice due to gross disease were excluded from the study.

The patients were intubated with a NuVasive NV JJB/M5 EMG ETT, Long Electrode (NuVasive, Inc, San Diego, CA), an ETT with embedded laryngeal surface electrodes. The neuromonitoring technique included placement of 2 surface electrodes at the wrist, overlying the ulnar nerve (train-of-four [TOF] stimulation), 2 needle electrodes in the muscle bellies of the abductor pollicus brevis and the abductor digiti minimi (monitoring TOF EMG), one needle in left deltoid (ground), and one needle placed in a midline cervical location (stimulus return). A sterilized Prass monopolar probe was used for RLN stimulation. After completion of thyroidectomy and hemostasis was achieved, a TOF ratio greater than 85% was confirmed by the neurophysiologist.

The RLN was identified anatomically by the attending surgeon and stimulated at 2 points: 5 and 10 mm from the insertion of the RLN into the larynx. Resident surgeons in their postgraduate years 4 and 5 also participated under the supervision of the attending surgeon: however, all measurements were confirmed by the attending surgeon. The nerve was stimulated to the threshold current with each stimulus delivered for 100 μs at a frequency of 4 Hz. Stimuli start at 0 mA and increase by 0.05 mA until an EMG response was detected at the vocal cords. The current was then decreased by 0.1 mA and again increased by 0.05 mA until a response was detected. *Threshold current* was defined as the minimum stimulus current that produced a response detected via vocal cord EMG. All clinical neurophysiologists received Certification in Neurophysiologic Intraoperative Monitoring (CNIM) certified and the oversight reading neurologist performed real time Web-based guidance from an off-site location for all cases.

After the baseline threshold value was obtained, the anesthesiologist performed laryngoscopy and visualized the larynx (direct laryngoscopy or indirect video laryngoscopy), suctioned any secretions, and then deflated the ETT cuff. The LTA device ("LTA 360 kit," lidocaine hydrochloride topical solution, 4%; Hospira, Lake Forest, IL) was passed on each side of the ETT (inserted to appropriate depth to spray carina, with care taken not to touch the EMG electrodes taped onto the ETT), and lidocaine, a total of 4 mL of 4%, was administered bilaterally while withdrawing the LTA. The ETT cuff was then reinflated. Response thresholds were reassessed at 5 and 10 minutes after administration of topical lidocaine.

Prior to study initiation, we assumed that a change in threshold current of 0.2 mA would be clinically meaningful and that the standard deviation would be 0.1 mA^3 [3], with a