Recent Modalities In Monitoring Of the Recurrent Laryngeal Nerve in Various Neck Operations

Essay

by

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ABSTRACT

Anatomic and functional preservation of the recurrent laryngeal nerve (RLN) is the gold standard in thyroid and various neck surgery. Visual identification of RLN has decreased the rates of permanent RLN palsy during thyroid and parathyroid operations. However, unexpected RLN palsy still occurs. This is one of the most frequent causes of medicolegal litigation after thyroid and parathyroid surgery. In addition, most nerve injuries are not recognized intraoperatively and visualization of the nerve is insufficient to assess nerve damage. Intraoperative neuro-monitoring (IONM) of the RLN represents an adjunct to routine visual identification of the nerve during surgery and provides a broader vision of surgical anatomy incorporating new clinical neurophysiologic and functional patterns to surgical practice.

The lack of standardized procedures for nerve monitoring during thyroid and parathyroid operations has led to variable and disparate results. A review of the relevant medical literature on RLN monitoring over the last 10 years shows that IONM was performed in an unstandardized way and, thus, it is difficult to compare studies and obtain a concurred opinion on IONM.

KEYWORDS: Recurrent laryngeal nerve - Intraoperative neuromonitoring - various neck surgery - thyroid and parathyroid.

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List of Abbreviations

$: dollar.

%: percent.

±: Plus or minus.

^{o}: Degree.

2^{nd}: Second.

5^{th}: Fifth.

ACDF: Anterior cervical discectomy and spine fusion.

APS™: Adjustable Positioning System.

ATA: American Thyroid Association.

C: Celsius.

C6: cervical vertebrae number 6.

C7: cervical vertebrae number 7.

CBTs: Carotid body tumors.

Cm: centimeter.

DTC: Differentiated thyroid cancer.

E.g.: exempli gratia (example).

EMG: Electromyography.

et al.: et alia (and others).

ETT cuff: Endotracheal Tube Cuff.

GERD: gastroesophageal reflux disease.

i.e.: id est (that is).

IH: Inhaler.

IONM: Intraoperative neuromonitoring.

IV: Intravenous.

kΩ: kiloohm.

mA: Milliampere.

Mm: millimeter.

NMB: neuromuscular blocking.

PCA: posterior cricoarytenoid.

PDA: Patent Ductus Arteriosus.

PH: potential of hydrogen.

PTC: papillary thyroid cancer.

PTH: Parathyroid hormone.

RLN: recurrent laryngeal nerve.

SLN: superior laryngeal nerve.

SNG: Simple nodular goitre.

T1: thoracic vertebrae number 1.

T2: thoracic vertebrae number 2.

TSH: thyroid stimulating hormone.

UCLA: University of California, Los Angeles.

US: ultrasound.

Yr: year.

µV: microvolt.

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Introduction

Anatomic and functional preservation of the recurrent laryngeal nerve (RLN) is the gold standard in thyroid and various neck surgery. Visual identification of RLN has decreased the rates of permanent RLN palsy during thyroid and parathyroid operations. However, unexpected RLN palsy still occurs. This is one of the most frequent causes of medicolegal litigation after thyroid and parathyroid surgery. In addition, most nerve injuries are not recognized intraoperatively and visualization of the nerve is insufficient to assess nerve damage. Intraoperative neuromonitoring (IONM) of the RLN represents an adjunct to routine visual identification of the nerve during surgery and provides a broader vision of surgical anatomy incorporating new clinical neurophysiologic and functional patterns to surgical practice ***(Dionigi et al., 2012).***

Intraoperative neuromonitoring is not intended as a substitute for adequate surgical technique. The identification of neural structures during surgery of the neck, however, can be difficult even with extensive anatomical knowledge and surgical experience. RLN monitoring during various neck surgery facilitates anatomic neural identification and dissection in order to avoid iatrogenic injuries, helps in resident medical education and training and gives a prognostic value regarding postoperative neural function. Although these three specific functions are sufficient to consider the value of IONM as a new technology that allows a refinement in surgical technique and its outcome, RLN monitoring's main role is based on the ability of predicting intraoperatively postoperative glottis function. Therefore, the use of IONM may also facilitate intraoperative decision-making for bilateral thyroid surgery **(*Witt., 2005).***

In the last 10 years, noninvasive RLN monitoring has been introduced in Europe in thyroid and parathyroid surgery. Recently, Sturgeon et al published an internet-based survey among members of the American Association of Endocrine Surgeons regarding the different attitudes, usage patterns and predictors of use of IONM in their clinical practice. They found that a 37.1% of the respondents did use IONM; this category was divided into routine (13.8%) and selective users (23.3%) of nerve monitoring. Recent studies have pointed out the benefit of nerve monitoring for younger surgeons and low volume thyroid surgeons. Indeed, some studies have suggested an increase in surgeon confidence among users of neuro-monitoring ***(Sturgeon et al., 2009).***

The lack of standardized procedures for nerve monitoring during thyroid and parathyroid operations has led to variable and disparate results. A review of the relevant medical literature on RLN monitoring over the last 10 years shows that IONM was performed in an unstandardized way and, thus, it is difficult to compare studies and obtain a concurred opinion on IONM. Although these studies do have varying specific conclusions almost all agree that RLN monitoring can be effective in assisting the surgeon in the identification of the nerve, especially during revision surgery where the anatomic course can be distorted, and in predicting nerve functional integrity. Recently, a standardized approach to IONM has been established by Randolph et al. ***(Randolph et al., 2011).***

Aim Of The Work

This work aimed to review the methods of monitoring of recurrent laryngeal nerve during various neck operations and their advantages**.**

Applied Anatomy of Recurrent Laryngeal Nerve

In order to understand the various neurological problems affecting the mobility of the vocal cord a clear understanding of the anatomy of recurrent laryngeal nerve is a must because it supplies the muscles acting on the vocal cord. The larynx is intimately involved in swallowing, breathing, coughing and phonation. These functions are dependent on normal movements of the vocal cords. These movements are controlled by muscles which are innervated by the recurrent laryngeal branch of the vagus nerve.

The Recurrent laryngeal nerves consist of both myelinated motor and sensory nerve fibers and non-myelinated sympathetic and parasympathetic postganglionic fibers ***(Tiago et al., 2007).***

The epineurium of the recurrent laryngeal nerve is thicker than other peripheral nerves. The adductor and abductor fibers are not segregated within the nerve and are distributed diffusely throughout the nerve, although 2-4 times more adductor fibers exist than abductor fibers. The motor fibers tend to be located in the anterior half of the vagus in the upper neck and in the medial half of the vagus in the lower neck ***(Tiago et al., 2007).***

The right RLN branches from the right vagus nerve in the neck at the right of T1-T2 or more inferiorly, anterior to the right subclavian artery ***(Haller et al., 2012)***.It travels inferior and posterior to the sub-clavian artery to ascend in the neck between the trachea and the esophagus, behind the right common carotid artery in the tracheoesophageal fascia. The left RLN branches from the left vagus nerve in the thorax. It travels inferior and then posterior to the arch of the aorta to ascend into the neck in between the trachea and esophagus. The terminal portion of both RLNs pass superiorly, deep to the inferior border of the inferior pharyngeal constrictor muscle, just posterior to the cricothyroid joint to supply the interarytenoid, posterior cricoarytenoid, and lateral cricoarytenoid muscles.

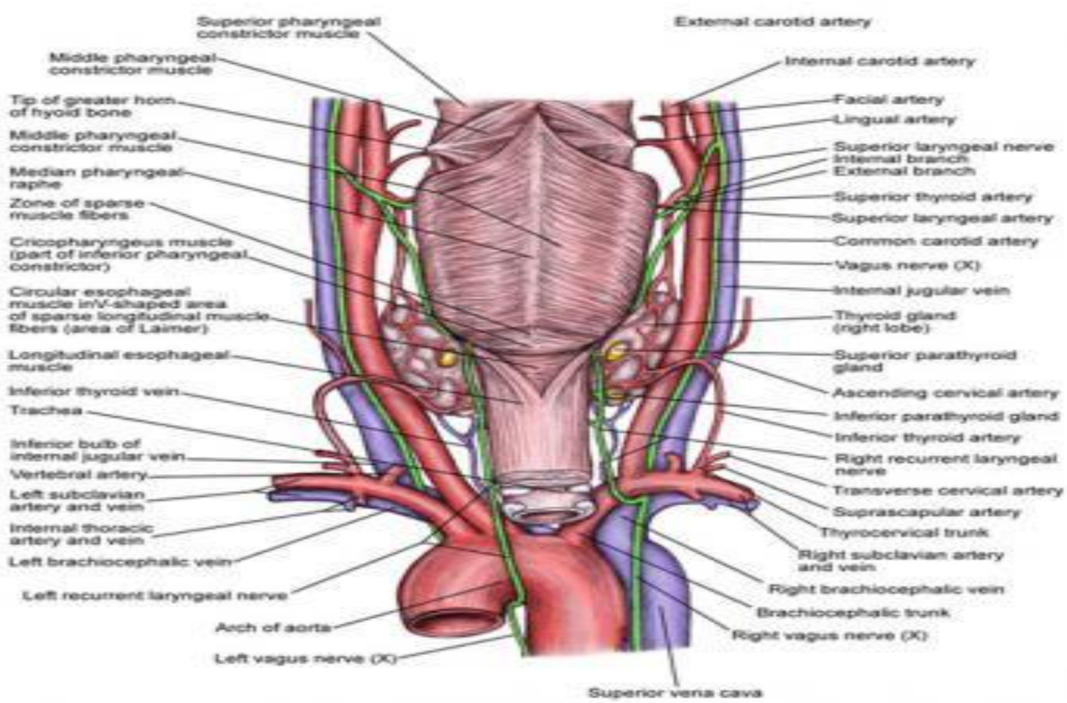

Fig. 1: Anatomy of the thyroid region. Recurrent laryngeal nerve course

In the upper chest and neck (posterior view). Note that the relationships

Of both nerves with different anatomical landmarks ***(Courtesy., 2003).***

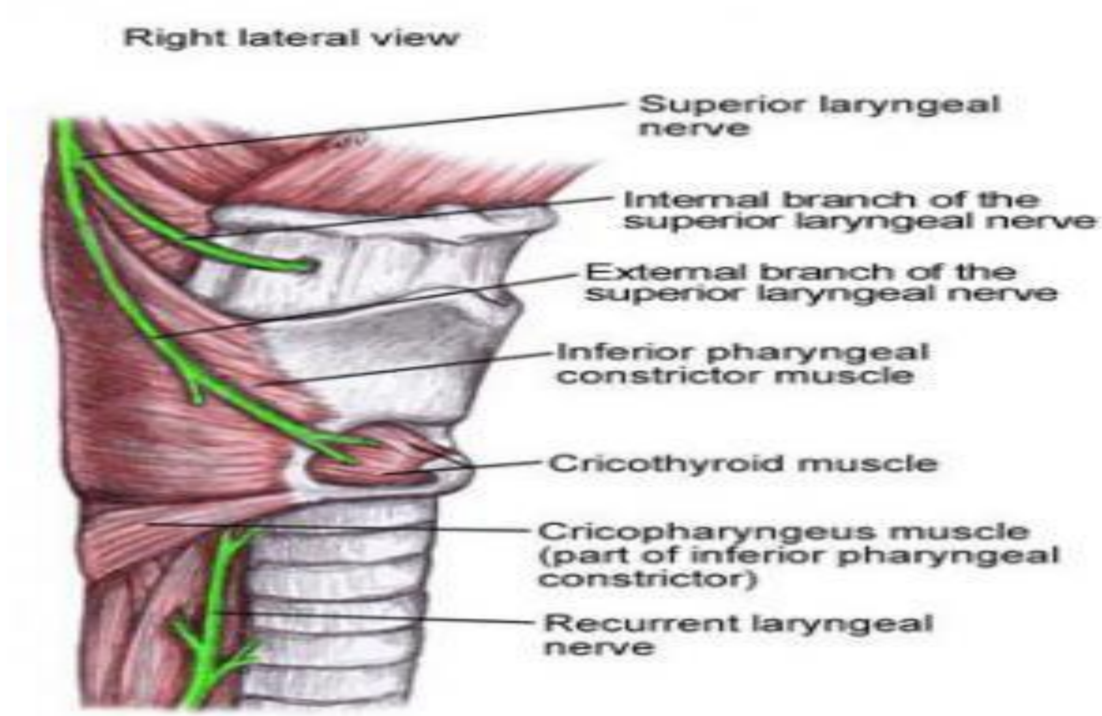

Fig. 2: Anatomy of the thyroid region. Recurrent laryngeal nerve coursein the upper neck (right lateral view). Note that the relationships Of nerves with different anatomical landmarks ***(Courtesy., 2003).***

During anterior cervical diskectomy and fusion operations, the RLN can be exposed, causing traction or crush injuries, with postoperative dysphagia or hoarseness. Haller et al describe that greater than 80% of right RLN entered the larynx at or inferior to C6-C7, while the left RLN was invested in the tracheoesophageal fascia starting inferior to the T2 level and entered the larynx at or inferior to C6-C7 ***(Haller et al., 2012).***

Most of the right RLNs course between 15-45º when entering the cricothyroid joint, whereas most of the left-sided nerves course between 0-