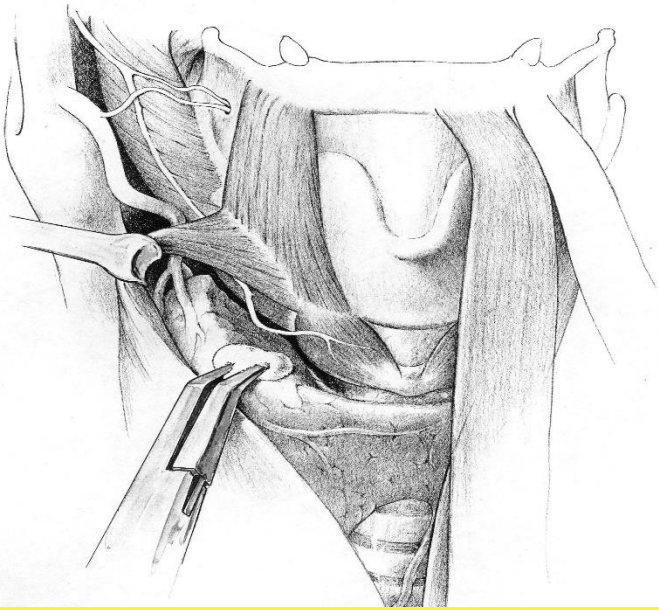
7th Turkish Congress of Endocrine Surgery 2015

SLN monitoring and Continuous Vagal monitoring



Greg Randolph
Harvard Medical School

HARVARD MEDICAL SCHOOL | DEPARTMENT OF Otolaryngology

Disclosure Elements

- Relevant Financial Disclosures

-- None

Name of Presenter Gregory W. Randolph

Fenway

Monitoring 2015

1- SLN-100% ID

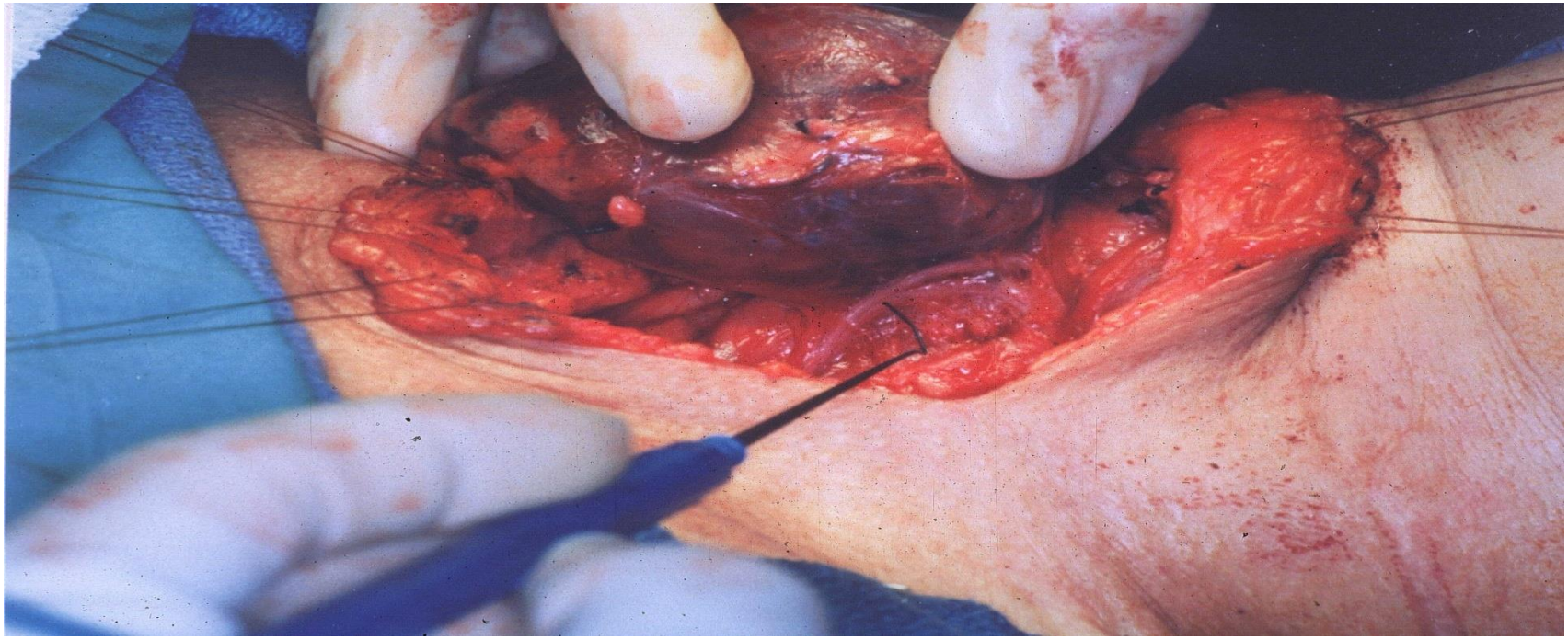
2- CIONM -Prevention

3- IONM -Professional Voice

LIGACLIP MCA
LIGACLIP MCA

AMERICAN THYROID ASSOCIATION
FOUNDED 1923

RLN Neural Monitoring



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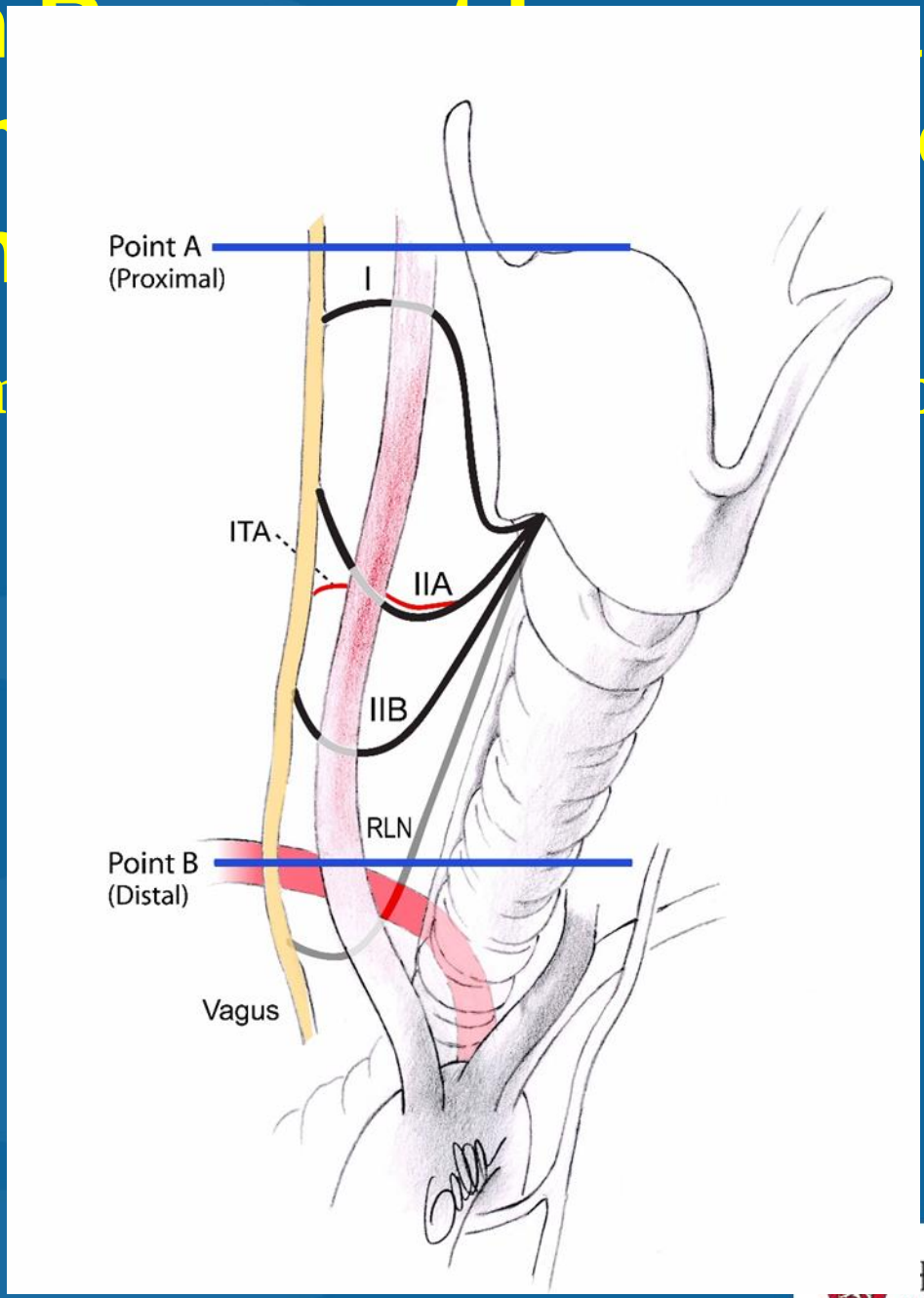
Electrophysiologic Recurrent Laryngeal Nerve Monitoring During Thyroid and Parathyroid Surgery: International Standards Guideline Statement

Gregory W. Randolph, MD; Henning Dralle, MD, with the International Intraoperative Monitoring Study Group*: Hisham Abdullah, MD; Marcin Barczynski, MD; Rocco Bellantone, MD; Michael Brauckhoff, MD; Bruno Carnaille, MD; Sergii Cherenko, MD; Fen-Yu Chiang, MD; Gianlorenzo Dionigi, MD, FACS; Camille Finck, MD; Dana Hartl, MD; Dipti Kamani, MD; Kerstin Lorenz, MD; Paolo Miccolli, MD; Radu Mihai, MD, PhD, FRCS; Akira Miyauchi, MD, PhD; Lisa Orloff, MD, FACS; Nancy Perrier, MD, FACS; Manuel Duran Poveda, MD; Anatoly Romanchishen, MD; Jonathan Serpell, MD, FRACS, FACS; Antonio Sitges-Serra, MD; Tod Sloan, MD, MBA, PhD; Sam Van Slycke, MD; Samuel Snyder, MD, FACS; Hiroshi Takami, MD; Erivelto Volpi, MD; Gayle Woodson, MD

The Non l Nerve: Anator ologic algorith ication

Dipti Kam o Cernea,



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Supplement to
Otolaryngology–
Head and Neck Surgery
Official Journal of the American Academy of Otolaryngology—Head and Neck Surgery Foundation

Volume 148 Supplement 6 June 2013

Clinical Practice Guideline: Improving Voice Outcomes after Thyroid Surgery

Sujana S. Chandrasekhar, MD, Gregory W. Randolph, MD, Michael D. Seidman, MD, Richard M. Rosenfeld, MD, MPH, Peter Angelos, MD, PhD, Julie Barkmeier-Kraemer, PhD, CCC-SLP, Michael S. Benninger, MD, Joel H. Blumin, MD, Gregory Dennis, MD, John Hanks, MD, Megan R. Haymart, MD, Richard T. Kloos, MD, Brenda Seals, PhD, MPH, Jerry M. Schreibstein, MD, Mack A. Thomas, MD, Carolyn Waddington, MS, FNP, Barbara Warren, PsyD, Med, and Peter J. Robertson, MPA

Statement 7.

AAO-HNS

INTRAOPERATIVE EMG MONITORING: The surgeon or their designee may monitor laryngeal electromyography (EMG) during thyroid surgery. ***Option*** *based on one RCT and observational studies with a balance of benefit versus harm*

Action Statement Profile

- Aggregate Evidence Quality: Grade C
- Benefit: Added information regarding neurophysiologic status of the RLN (specifically when the nerve is injured), potential improved accuracy in nerve identification, avoiding transient/temporary nerve paresis in one RCT (number needed to treat 33)

- AAOHNS guidelines 2013:-special utility in cases

1. bilateral thyroid surgery
2. revision thyroid surgery
3. surgery in the setting of existing RLN paralysis

2015

2014 American Thyroid Association Management Guidelines for Patients with Thyroid Nodules and Differentiated Thyroid Cancer

The American Thyroid Association (ATA) Guidelines Taskforce on Thyroid Nodules and Differentiated Thyroid Cancer

Bryan R. Haugen, M.D.[1] (Chair)*, Erik K. Alexander, M.D.[2], Keith C. Bible, M.D., Ph.D.[3], Gerard M. Doherty, M.D.[4], Susan J. Mandel, M.D., M.P.H.[5], Yuri E. Nikiforov, M.D., Ph.D.[6], Furio Pacini, M.D.[7], Gregory W. Randolph, M.D.[8], Anna M. Sawka, M.D., Ph.D.[9], Martin Schlumberger, M.D.[10], Kathryn Schuff, M.D.[11], Steven I. Sherman, M.D.[12], Julie Ann Sosa, M.D.[13], David L. Steward, M.D.,[14] R. Michael Tuttle, M.D.[15], and Leonard Wartofsky, M.D.[16]

2015

- [B13] Intraoperative Voice and Parathyroid Management
- ■ RECOMMENDATION 41
- A) Visual identification of the recurrent laryngeal nerve (RLN) during dissection is required in all cases. Steps should also be taken to preserve the external branch of the superior laryngeal nerve (EBSLN) during dissection of the superior pole of the thyroid gland. (Strong recommendation, Moderate-quality evidence)
- B) Intraoperative neural stimulation (with or without monitoring) may be considered to facilitate nerve identification and confirm neural function. (Weak recommendation, Low-quality evidence)

Monitoring 2015

1- SLN-100% ID

2- CIONM -Prevention

3- IONM -Professional Voice

Statement 6.

PROTECTION OF SUPERIOR LARYNGEAL NERVE: The surgeon should take steps to preserve the external branch of the superior laryngeal nerve(s) when performing thyroid surgery.
Recommendation *based on preponderance of benefit over harm*

Action Statement Profile

- Aggregate Evidence Quality: Grade C
- Benefit: Preserves vocal projection and high frequencies, may improve airway in extreme circumstances
- Risk, Harm, Cost: May leave superior pole thyroid tissue
- Benefit-Harm Assessment: Preponderance of benefit
- Value Judgments: None
- Intentional Vagueness: The steps taken to preserve the nerve are purposefully not specified in the statement to emphasize the important issue is preserving the nerve, which may or may not be identifiable during surgery. Therefore, it is the attention to the nerve that is important
- Role of Patient Preferences: None
- Exclusions: None
- Policy level: Recommendation

Amelita Galli-Curci

- ***"the surprising voice is gone forever. The sad specter of a ghost replaces the velvety softness"***

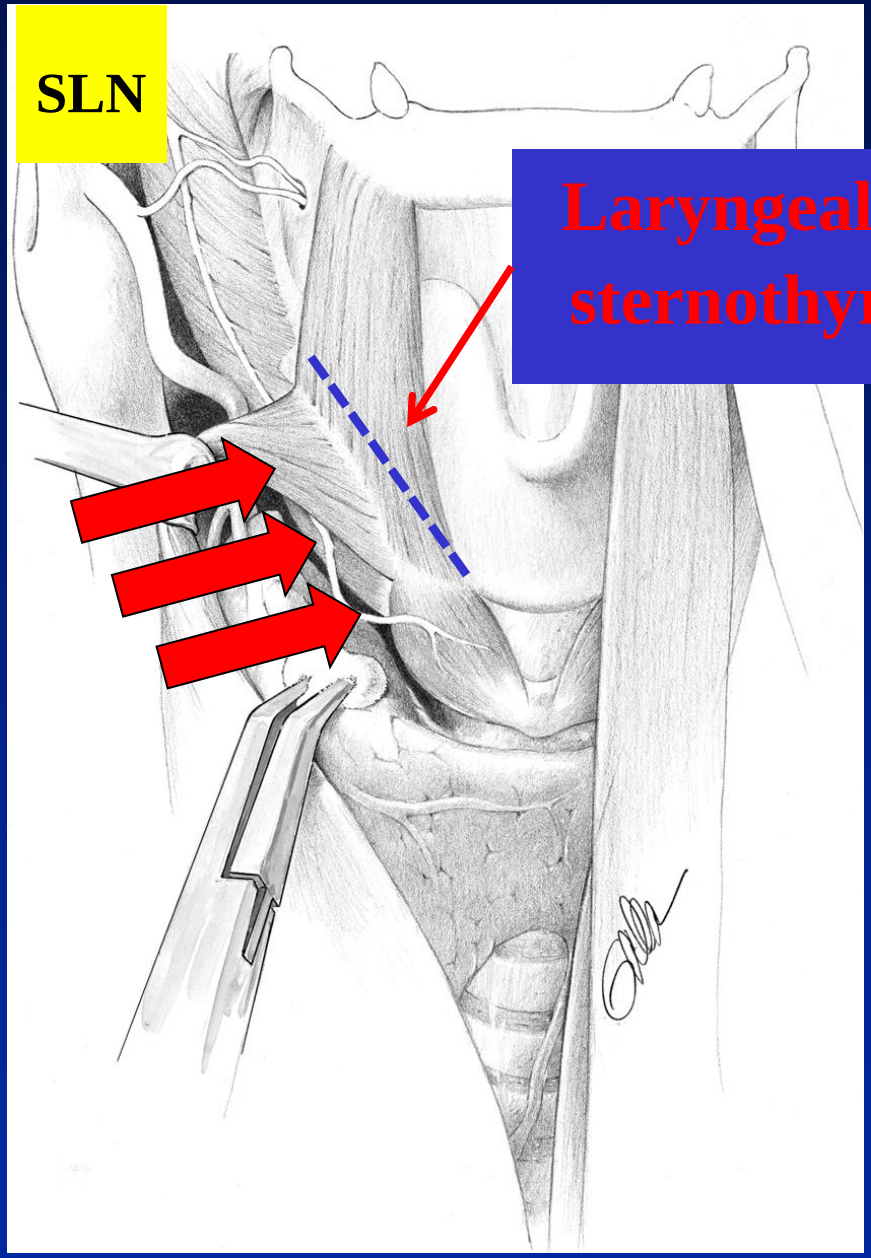
Author's personal copy

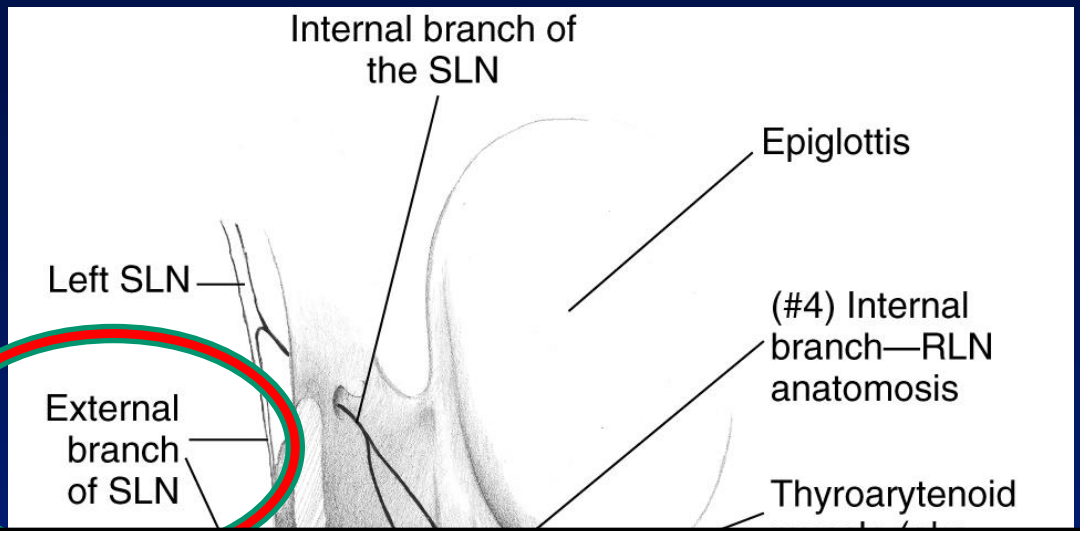
World J Surg
DOI 10.1007/s00268-013-2148-9

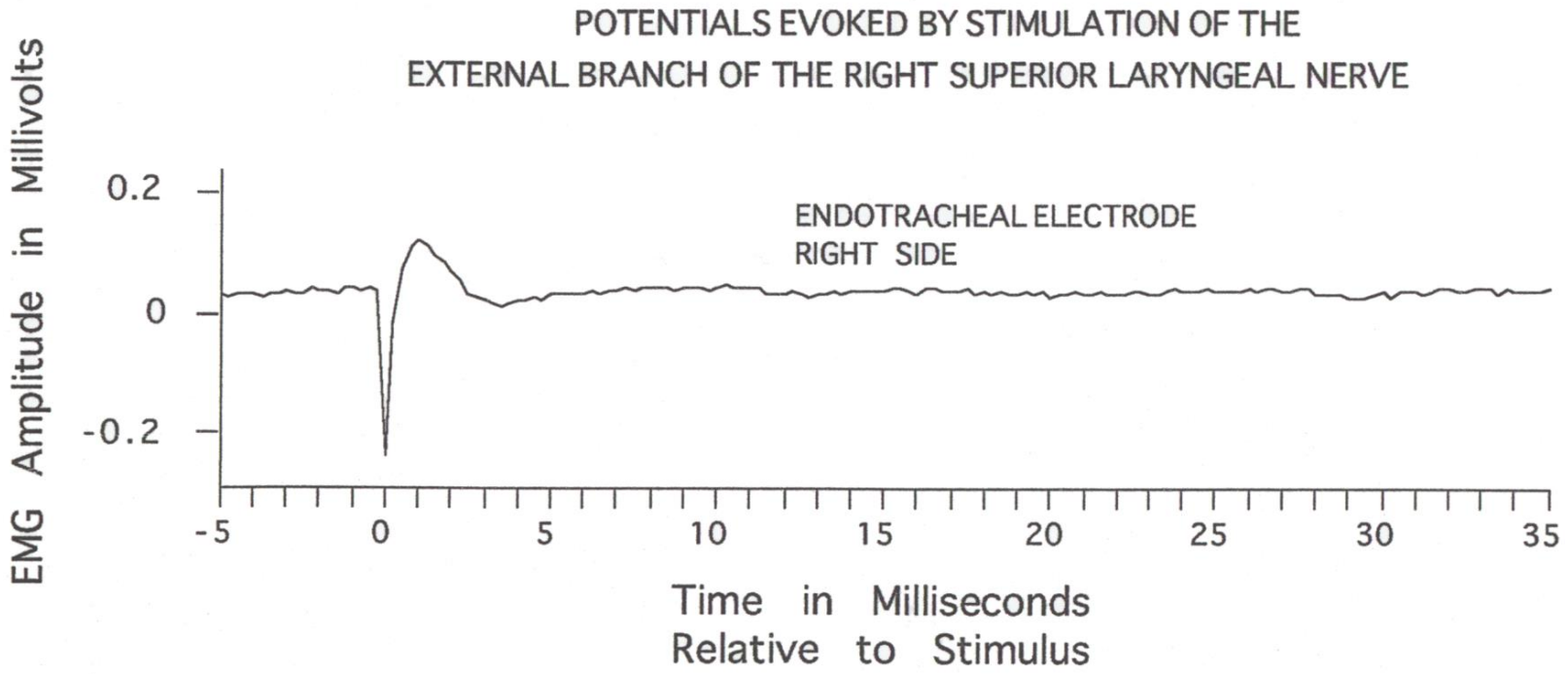
World Journal of Surgery

Normative Intra-operative Electrophysiologic Waveform Analysis of Superior Laryngeal Nerve External Branch and Recurrent Laryngeal Nerve in Patients Undergoing Thyroid Surgery

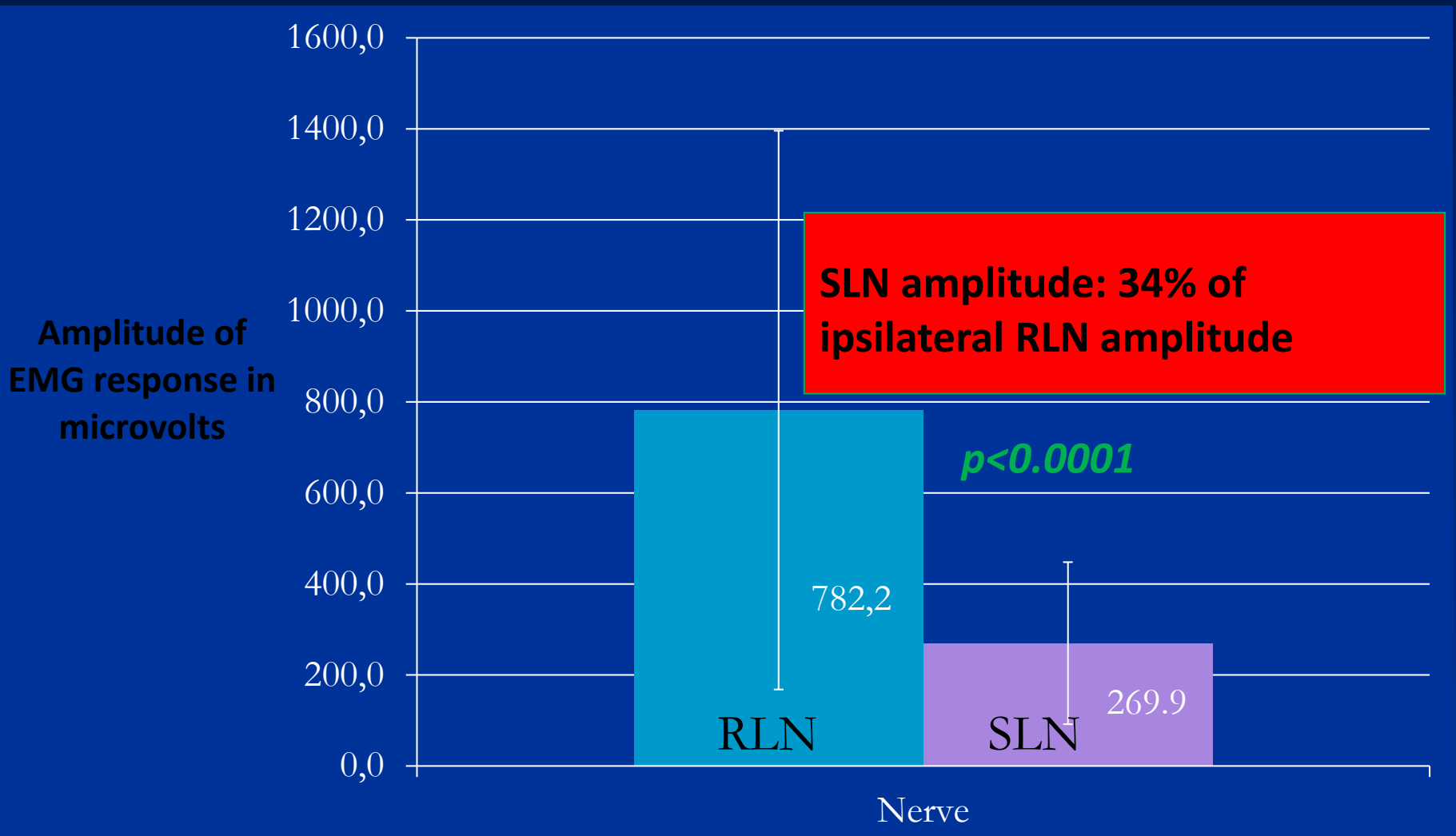
Andre S. Potenza · Eimear A. Phelan · Claudio R. Cernea · Cristian M. Slough · Dipti V. Kamani · Ashlie Darr · David Zurakowski · Gregory W. Randolph


SLN
Laryngeal head of the sternothyroid muscle


Internal branch of the SLN
Epiglottis
Left SLN
(#4) Internal branch—RLN anatomosis
External branch of SLN
Thyroarytenoid


POTENTIALS EVOKED BY STIMULATION OF THE
EXTERNAL BRANCH OF THE RIGHT SUPERIOR LARYNGEAL NERVE
ENDOTRACHEAL ELECTRODE
RIGHT SIDE
EMG Amplitude in Millivolts
0.2
0
-0.2
-5
0
5
10
15
20
25
30
35
Time in Milliseconds
Relative to Stimulus

RLN and SLN – Statistical Analysis



EBSLN and Cricothyroid muscle twitch

Superior Laryngeal Nerve Quantitative Intraoperative Monitoring is Possible in all Thyroid Surgeries

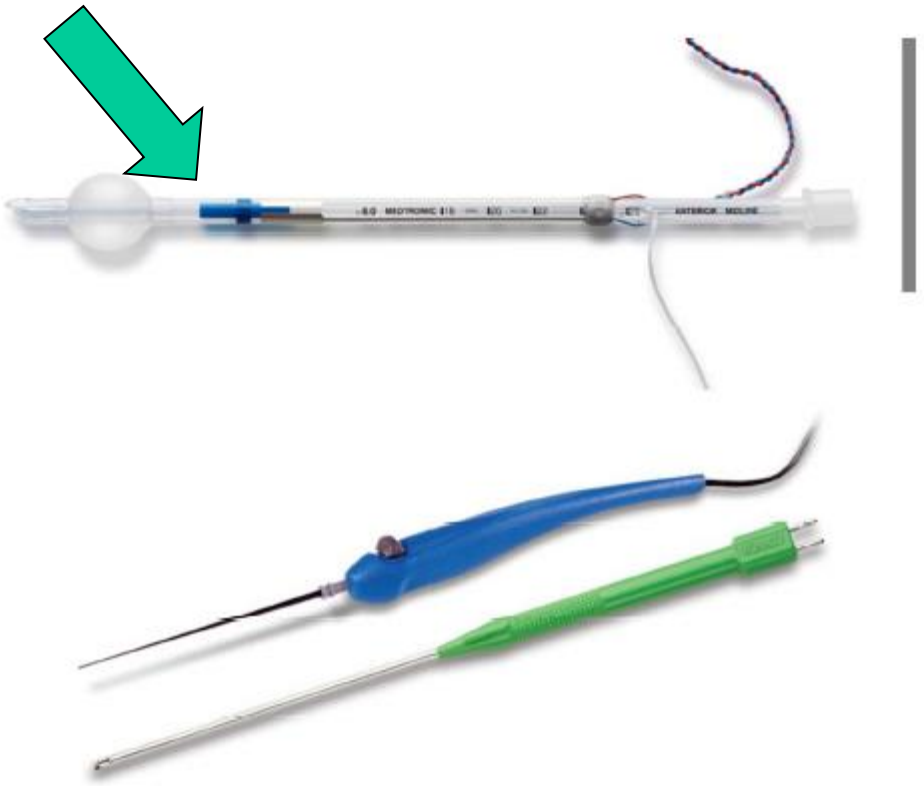
E. Ashlie Darr M.D.[1], Ralph P. Tufano , M.D., MBA, FACS[2], Suleyman Ozdemir, M.D.[2], Dipti Kamani, M.D.[1], Shelley Hurwitz, PhD[3], Gregory Randolph M.D.[1,4]

[1] Division of Thyroid and Parathyroid Surgery, Department of Laryngology and Otology, Massachusetts Eye and Ear Infirmary, Harvard Medical School

[2] Division of Head and Neck Endocrine Surgery, Department of Otolaryngology-Head and Neck Surgery, Johns Hopkins University School of Medicine

[3] Division of Endocrinology, Department of Medicine, Brigham and Women's Hospital, Harvard Medical School

[4] Division of Surgical Oncology, Department of Surgery, Massachusetts General Hospital, Harvard Medical School



(Above) Tri-Vantage NIM endotracheal tube. (Center) Monopolar (Prass) stimulatorprobe. (Below) Bipolar stimulator prob

Results: In 100% of cases, external branch of the superior laryngeal nerve was identified as well as quantifiable EMG response was observed. EMG amplitude did not change despite extensive nerve dissection and multiple nerve stimulations. External branch of the superior laryngeal nerve amplitude was similar for left and right sides, for patients under age 50 and aged 50 or older, for both genders and with monopolar and bipolar stimulators.

Table 1. Overall amplitudes for EBSLN, RLN, and VN using monopolar and bipolar stimulator probes

Stimulator probe		Nerves at risk (n)	Minimum Amplitude (uV)	Maximum Amplitude (uV)	Mean Amplitude (uV)
Monopolar	EBSLN initial	29	100	916	272.2±202.9
	EBSLN final	17	49	685	263.8±184.7
	RLN	16	391	2054	1041.4±542
	VN	10	236	1253	699.1±331.8

For Peer Review

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Contemporary Review

External Branch of the Superior Laryngeal Nerve Monitoring During Thyroid and Parathyroid Surgery: International Neural Monitoring Study Group Standards Guideline Statement

Marcin Barczyński, MD; Gregory W. Randolph, MD; Claudio R. Cernea, MD; Henning Dralle, MD; Gianlorenzo Dionigi, MD; Piero F. Alesina, MD; Radu Mihai, MD; Camille Finck, MD; Davide Lombardi, MD; Dana M. Hartl, MD; Akira Miyauchi, MD; Jonathan Serpell, MD; Samuel Snyder, MD; Erivelto Volpi, MD; Gayle Woodson, MD; Jean Louis Kraimps, MD; Abdullah N. Hisham, MD; with the International Neural Monitoring Study Group

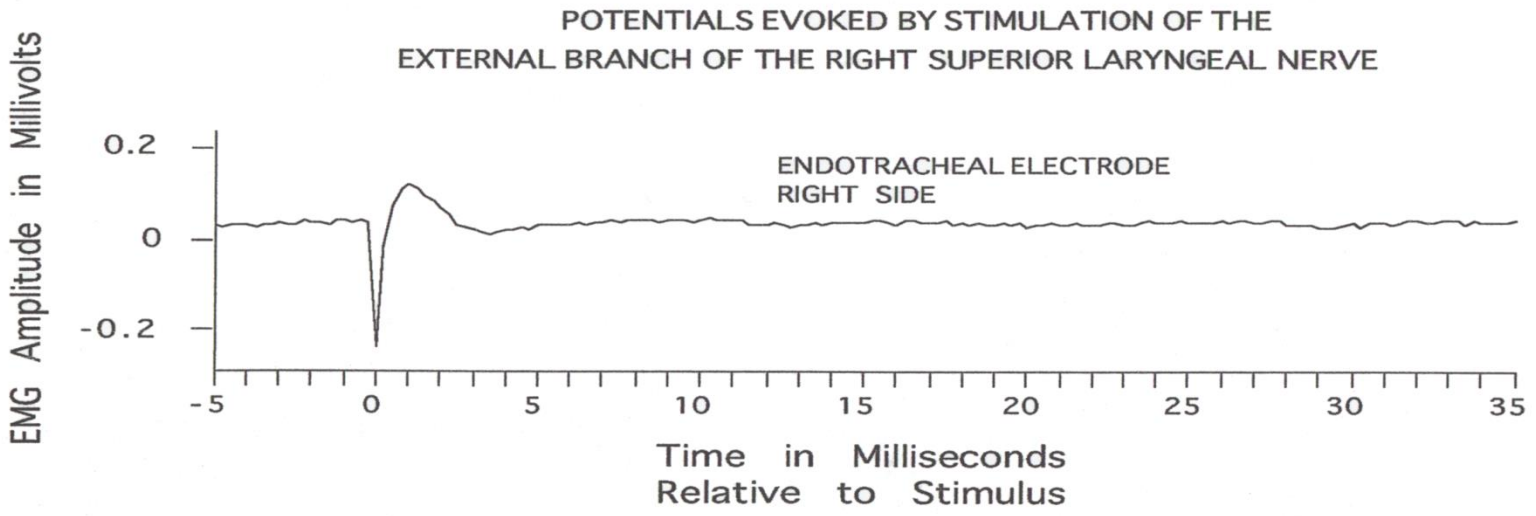


TABLE I.

The Mnemotechnic Formula of EBSLN Facilitates Recall of the Steps Necessary for Safe Dissection and Identification of the EBSLN.

Acronym	Description	Aims
E	Expose the space harboring the EBSLN	Exposure of the EBSLN can be improved by transverse division of the laryngeal head of the sternothyroid muscle and gentle traction of the superior thyroid lobe towards the lateral and caudal direction.
B	Bluntly dissect tissues	Blunt dissection within the avascular space between the cricothyroid muscle and medial aspect of the superior thyroid pole allows for visual identification of the EBSLN lying on the inferior constrictor muscle before its termination within the cricothyroid muscle.
S	Stimulate tissues during dissection	Stimulation of tissues during blunt dissection should be undertaken in order to facilitate visual identification of the nerve.
L	Look for cricothyroid twitch	Looking for a positive cricothyroid twitch is recommended during gentle dissection of tissues with the tip of the stimulation probe rather than expecting a positive EMG response on the monitor.
N	Navigate your dissection using the technique of nerve mapping	Navigation of the dissection should be continued once the nerve is identified to assure functional nerve preservation. In cases when the nerve is not seen but mapped out in the operative field, this navigation should allow for optimizing the level of the superior thyroid artery ligation to ensure intact functional integrity of the EBSLN provided by electrical nerve testing. One obtains positive stimulation medially and then only divides tissue in the superior pole dissection, which stimulates negatively.

EBSLN = external branch of the superior laryngeal nerve; EMG = electromyography.

Monitoring 2015

1- SLN-100% ID

2- CIONM -Prevention

3- IONM -Professional Voice

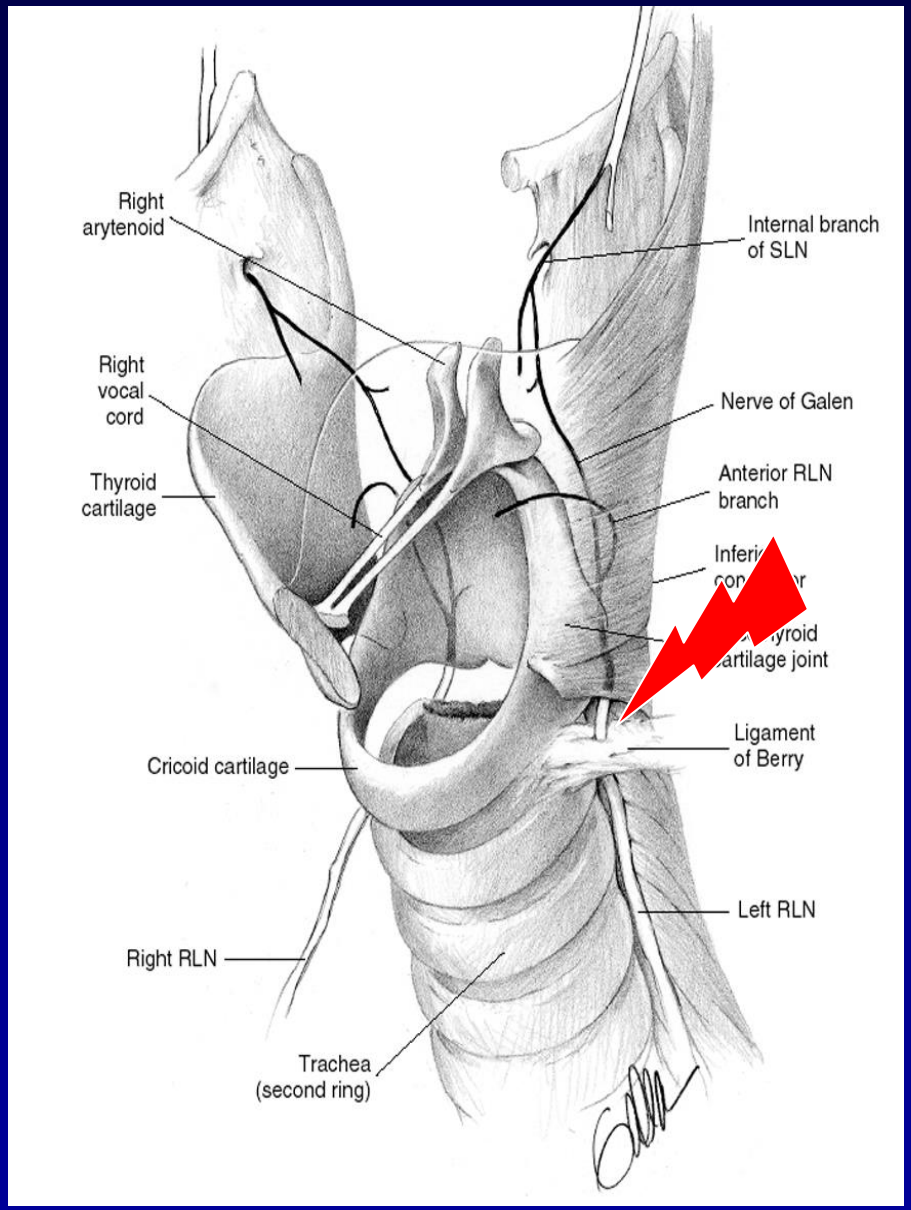
Why Continuous Vagal Nerve Monitoring (CIONM) ?

1-Standard IONM- stim is intermittent

→ *Stimulation-injury-stimulation*

2-Passive traumatic (non-evoked) responses are poorly related to nerve injury

Standard IONM has great utility but CIONM brings the potential of preventing injury



Mechanism of injury

Snyder 08 and Chiang 08 IONM mapping studies 75% RLN injuries are stretch injury at LOB

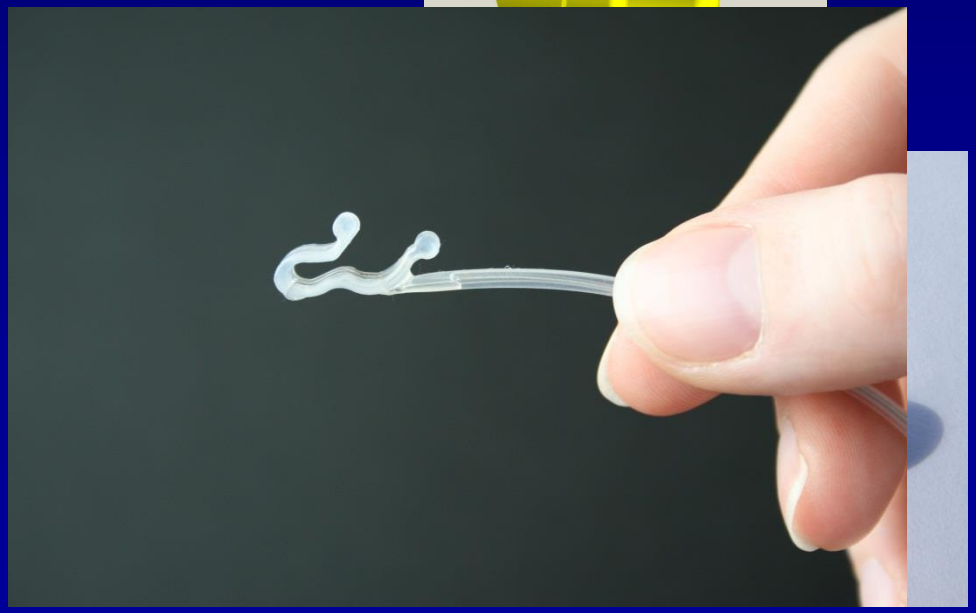
Vagal Electrode configuration

Closed

- Medtronic
- Saxophone

Open

- Inomed
- Langer



Initial CIONM studies during thyroidectomy-Safety

- Lamade 00,07, 11 Ulmer 08: saxophone and cuff <1mA, stim ~ 1-1/2 hrs
- Schneider 09: 45 pts, Anchor < 1hr
- Jonas 10: V3 inomed 100 pts-LOS
- Ulmer 11: studied HRV-parasympathetic predominance w/o cardiac arrthyrmia,hemodynamic instablity
- Dralle, Randolph 12

→ Safe-neural, cardiac, pulmonary

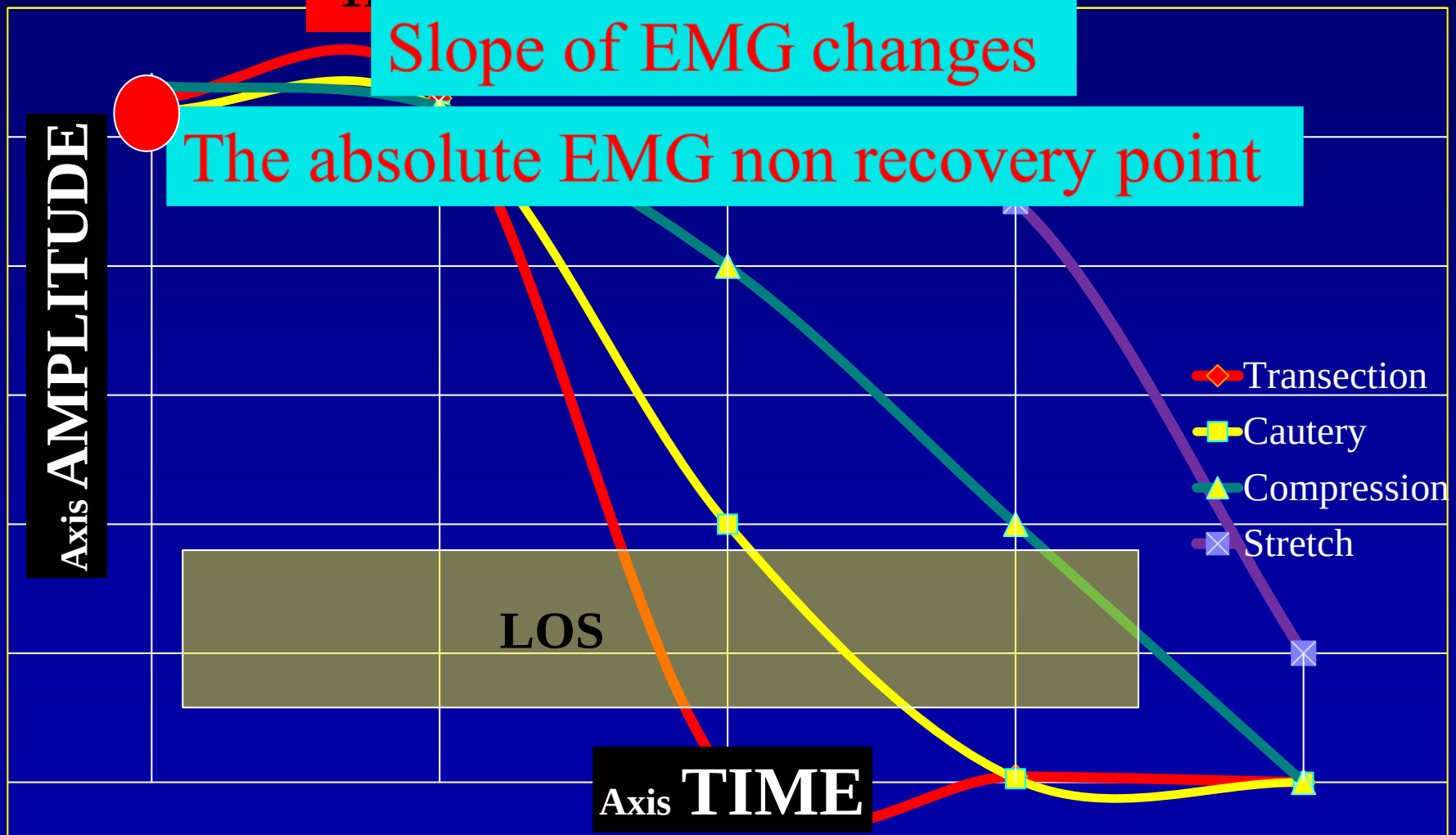
CIONM EMG Injury Construct

Type, amount and speed of onset of injury

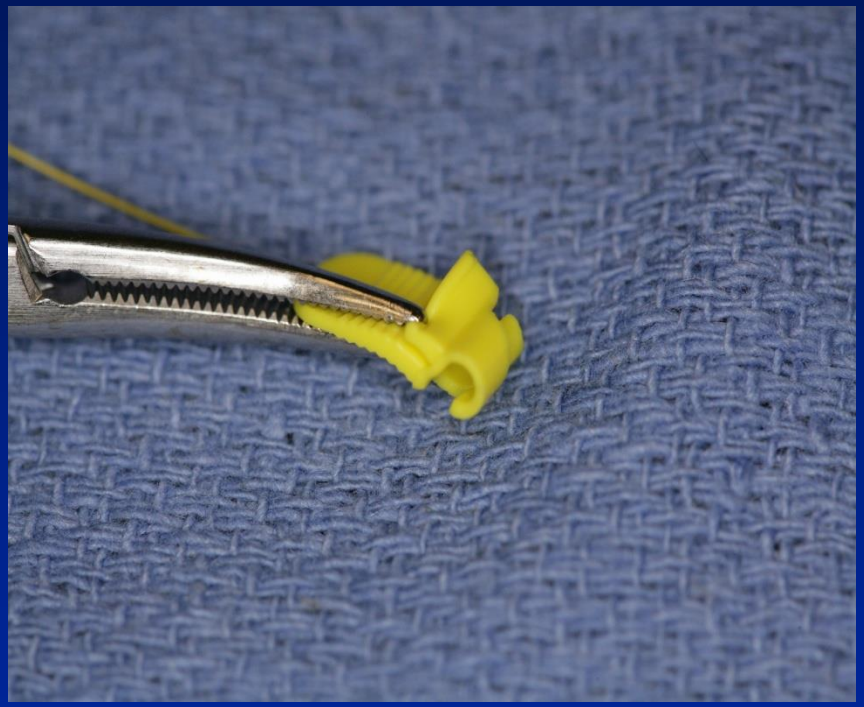
Nature of EMG change-Ampl, latency, etc…

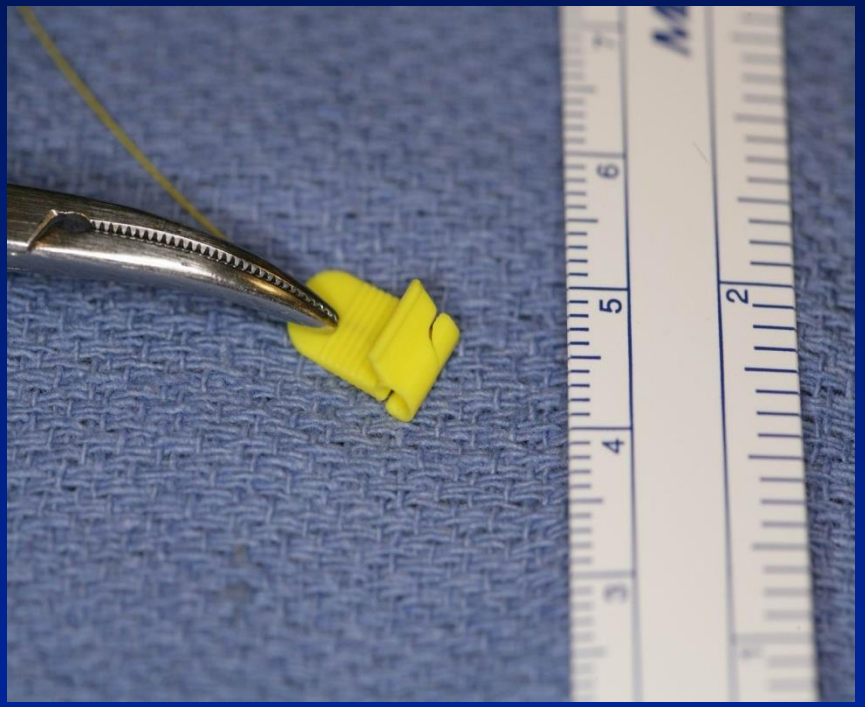
Slope of EMG changes

The absolute EMG non recovery point

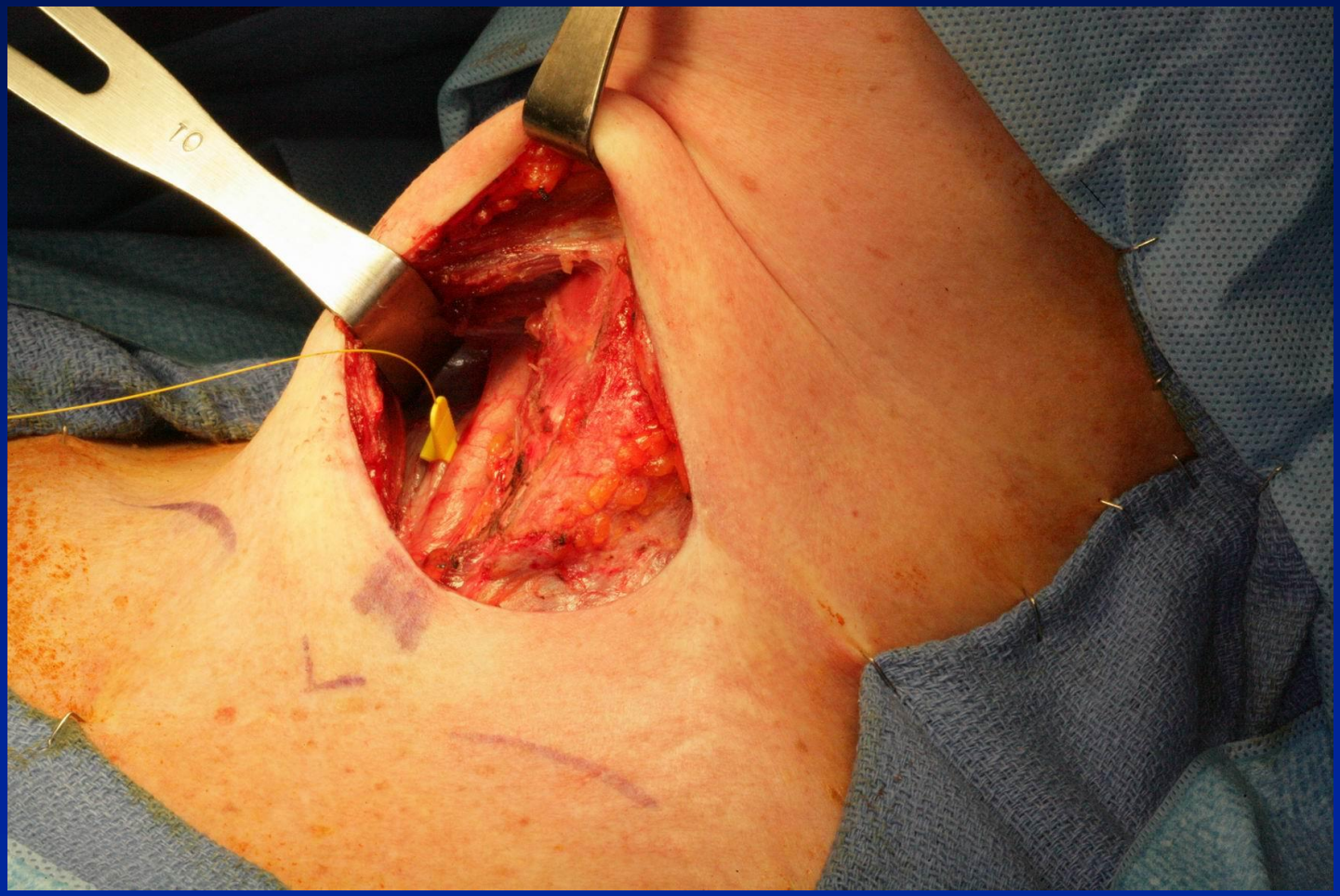


CIONM Electrode Image

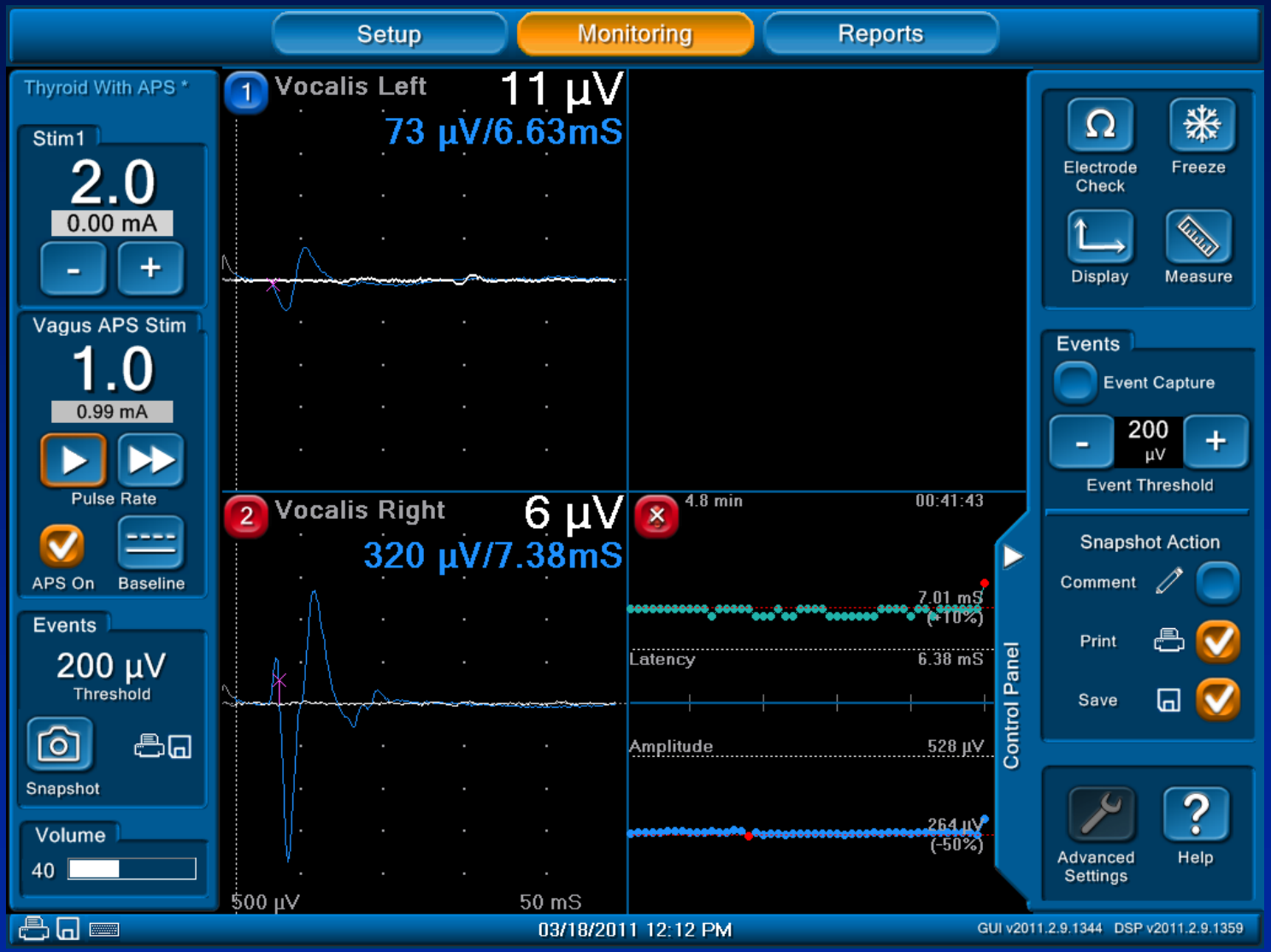




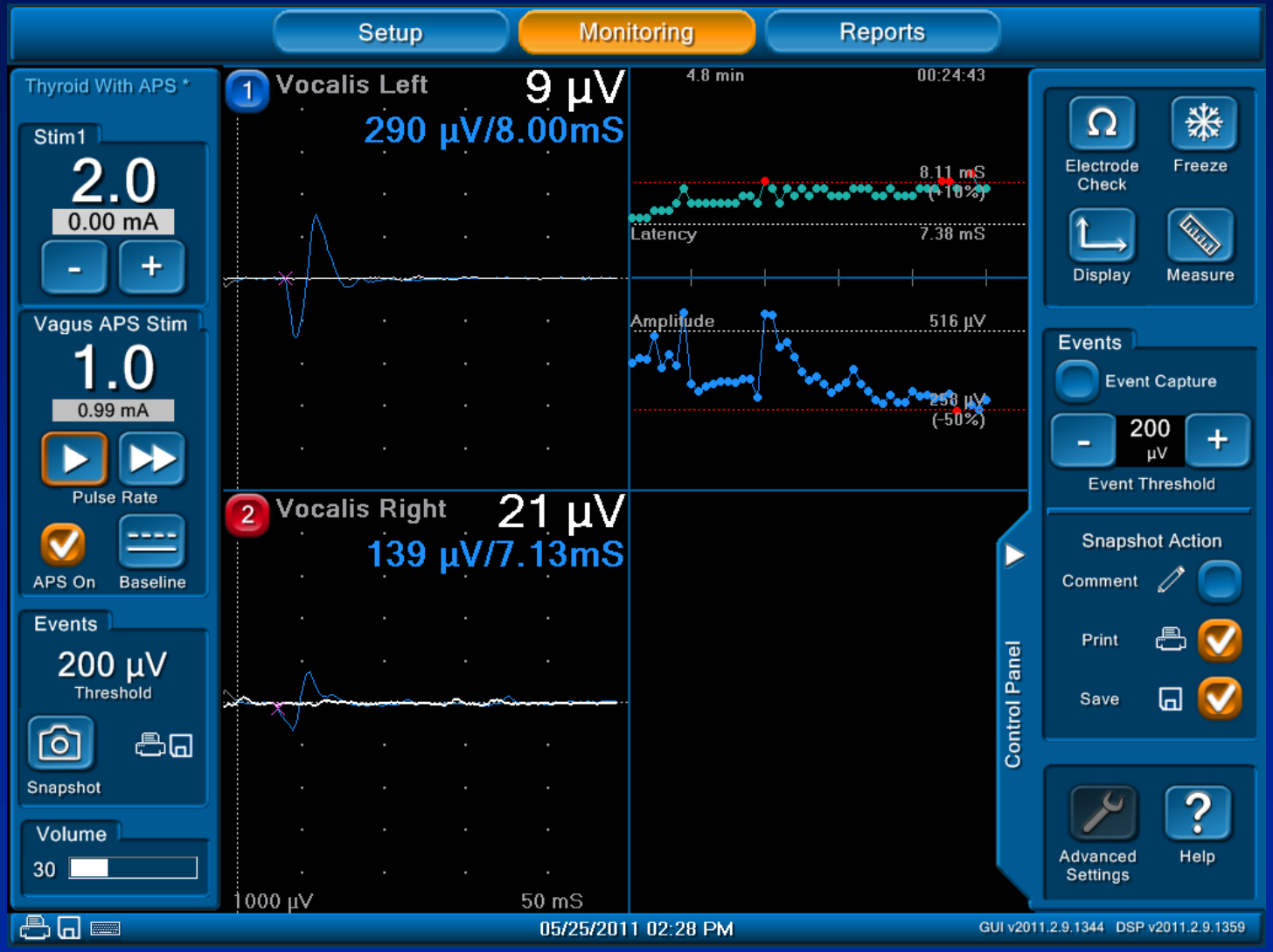
APS Electrode on Vagus Nerve



Case 4- RLN Recovery Post Manipulation



Case 37- Mild Combined Event

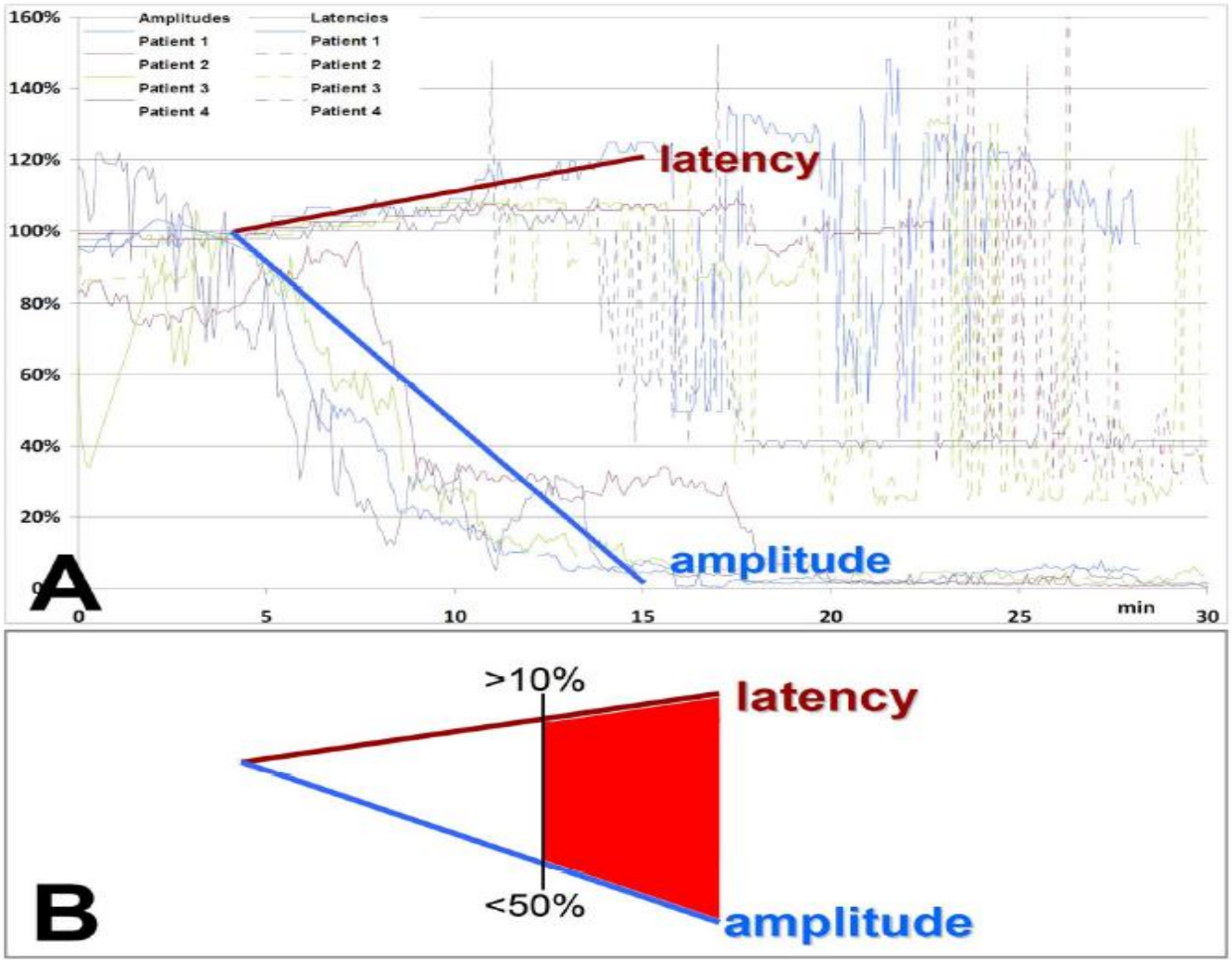


Continuous Intraoperative Vagus Nerve Stimulation for Identification of Imminent Recurrent Laryngeal Nerve Injury

Rick Schneider[1*], MD, Gregory W. Randolph[2*], MD, Carsten Sekulla[1], PhD, Eimear Phelan[2], MD, Phuong Nguyen Thanh[1],MD, Michael Bucher[3], MD, Andreas Machens[1], MD, Henning Dralle[1], MD, Kerstin Lorenz[1], MD

[1] Department of General, Visceral, and Vascular Surgery, Martin Luther University Halle-Wittenberg, Halle (Saale), Germany;
[2] Department of Otolaryngology, Division of Thyroid and Parathyroid Surgery, Massachusetts Eye and Ear Infirmary, Harvard Medical School, Boston, Massachusetts, USA.;
[3] Department of Anesthesiology and Intensive Care Medicine, Martin Luther University Halle-Wittenberg, Halle (Saale), Germany

For Peer



Superposition of the EMG tracing from 4 patients.
A. Complete loss of signal resulting in postoperative recurrent laryngeal nerve palsy;
Schematic representation of the EMG changes preceding loss of signal and postoperative recurrent laryngeal nerve palsy
153x153mm (300 x 300 DPI)

The Laryngoscope
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Continuous Vagal IONM Prevents Recurrent Laryngeal Nerve Paralysis by Revealing Initial EMG Changes of Impending Neuropraxic Injury: A Prospective, Multicenter Study

Eimear Phelan, M.D.; Rick Schneider, M.D.; Kerstin Lorenz, M.D.; Henning Dralle, M.D.; Dipti Kamani, M.D.; Andre Potenza, M.D.; Niranjan Sritharan, M.D.; Jenifer Shin, M.D.; Gregory W. Randolph, M.D., FACS

Continuous Vagal IONM (CIONM):

Amplitude and latency changes :

1. **Mild Combined Event (mCE)-**
   amplitude decrease of >50 – 70 % with a concordant latency increase of 5-10%

2. **Severe Combined Event (sCE)-**
   amplitude decrease of >70% with an concordant latency increase of >10%

3. **Loss of Signal (LOS) –**
   complete loss of recognizable RLN signal (amplitude < 100 μV) intraoperatively

Continuous Vagal IONM (CIONM):

Table 2.
Vocal Cord Paralysis Group vs. No Vocal Cord Paralysis Group: Combined Events and Loss of Signal

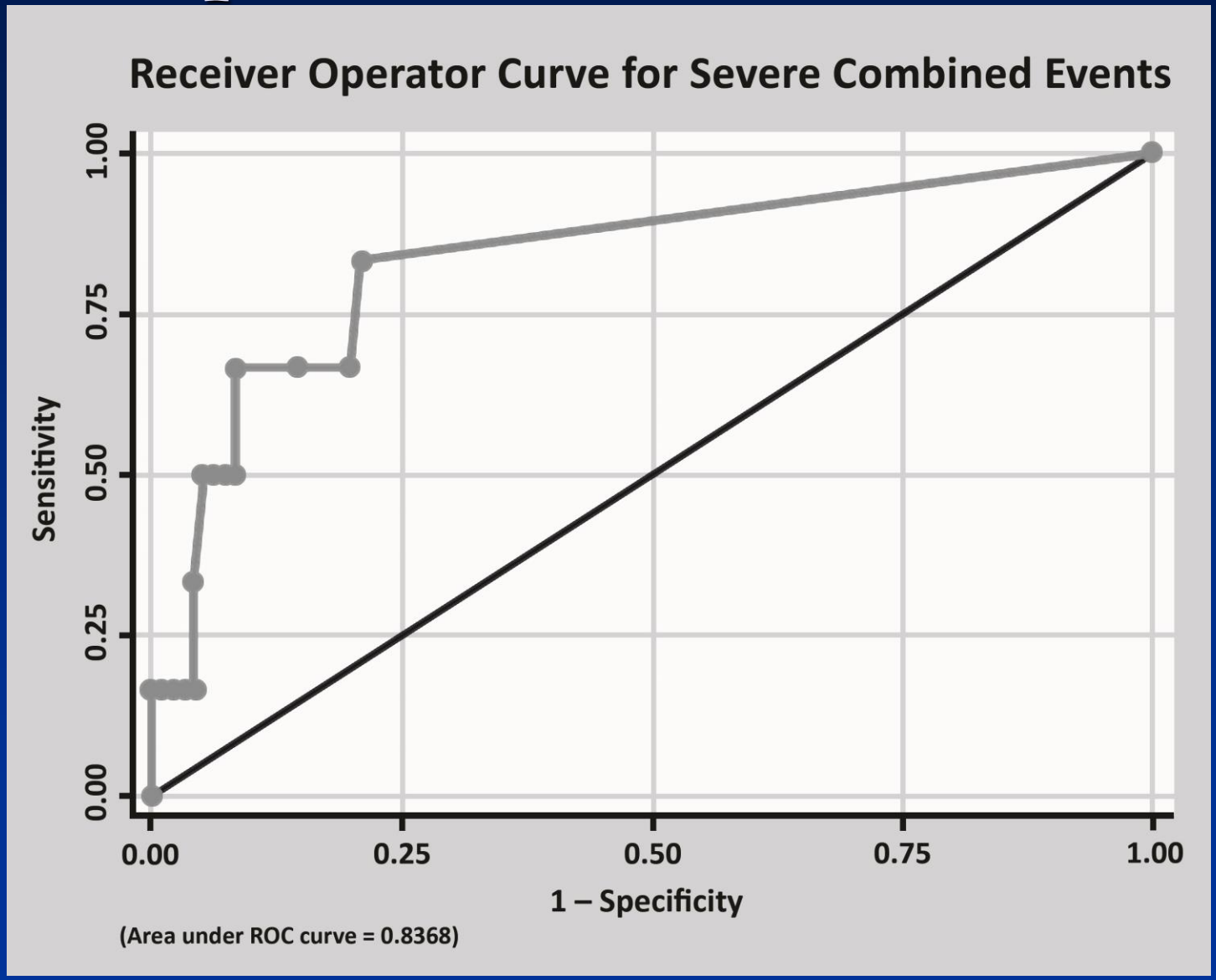
Vocal Cord Palsy (VCP)	Severe CEs % occurring/average #	LOS % occurring
VCP (N = 6)	**Occurring 83%** Average # 29.3 (range 0 – 124)	**83%**
No VCP (N = 96)	**Occurring 20%** Average # 3.5 (range 1 – 79)	**1%**

p = 0.001

p < 0.001

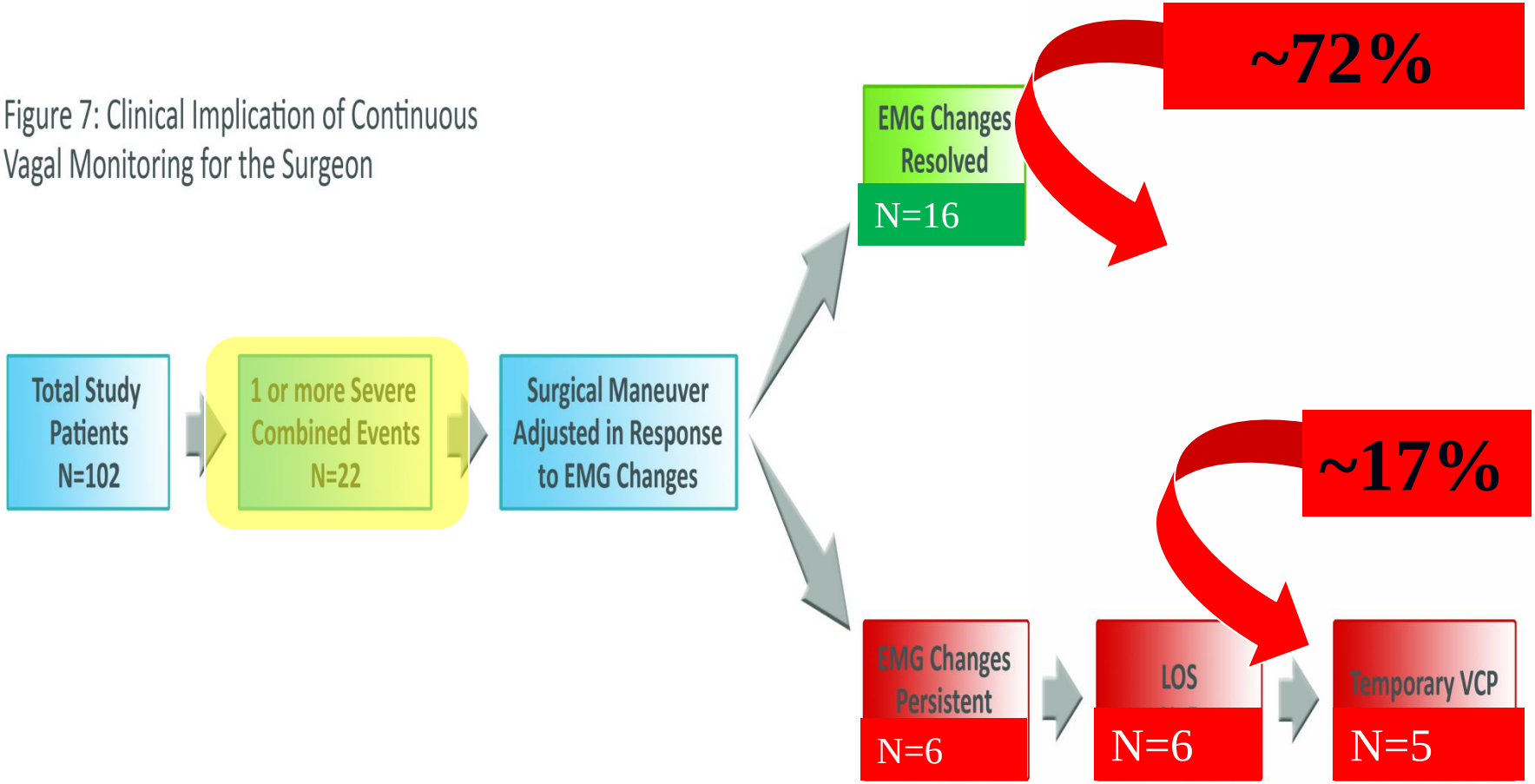
sCE (>7)	Sensitivity **66.7%**	Specificity **91.7%** for VCP	PPV 33% NPV 97%
LOS	Sensitivity **83%**	Specificity **99%** for VCP	PPV 83% NPV 98%

Adverse but nascent EMG outcome parameter: severe CE



Continuous Vagal IONM (CIONM):

Figure 7: Clinical Implication of Continuous Vagal Monitoring for the Surgeon



LOS –an evolution

CIONM:

-amp, latency in isolation without utility

-severe Combined Events: p=0.001 -VCP

sens 67% spec 91% NPV 97% PPV 33%

reversible in >70%%

- LOS: p<0.001 –VCP

sens 83% spec 99% NPV 98% PPV 83%

reversible in <20%

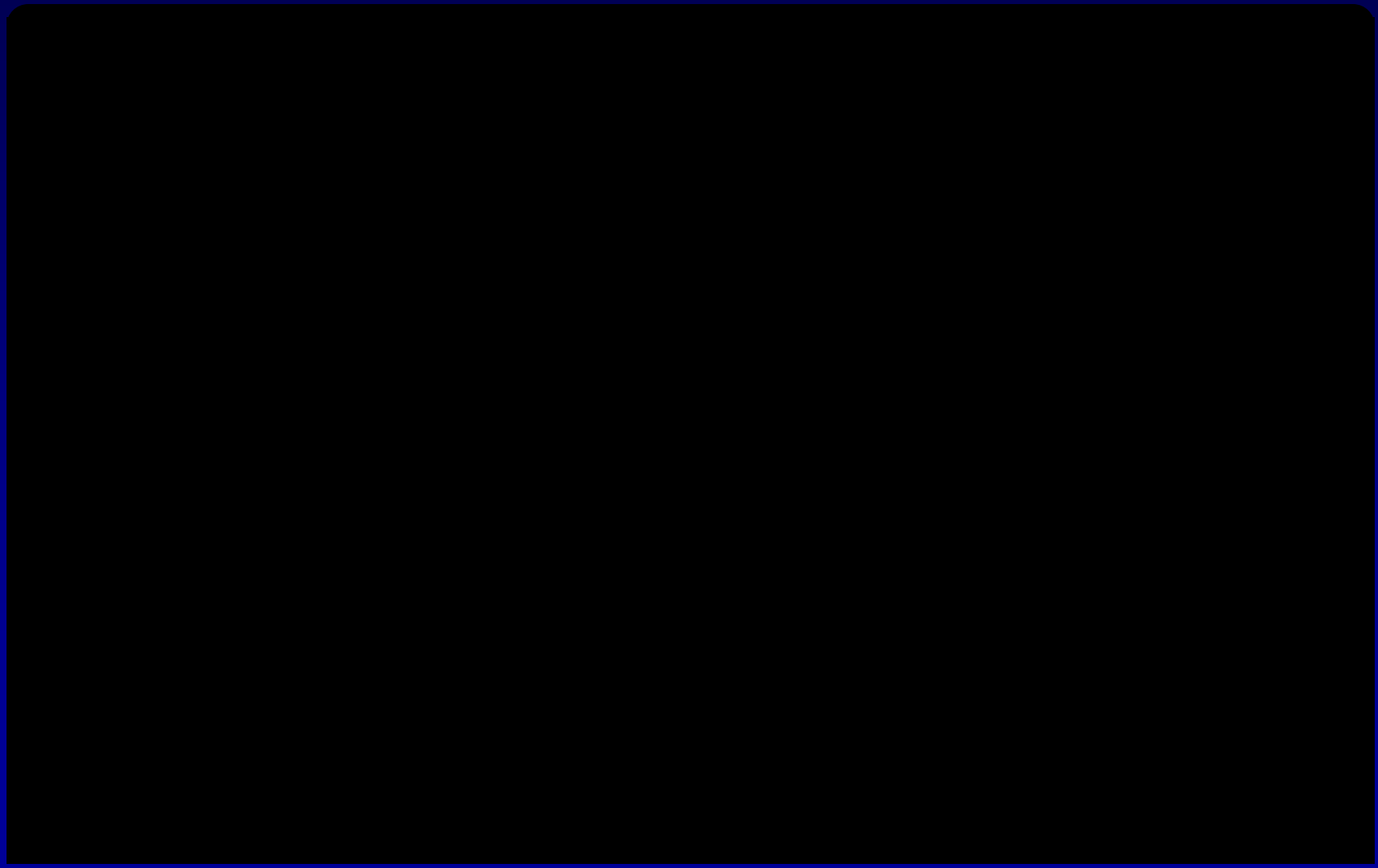
Monitoring 2015

1- SLN-100% ID

2- CIONM -Prevention

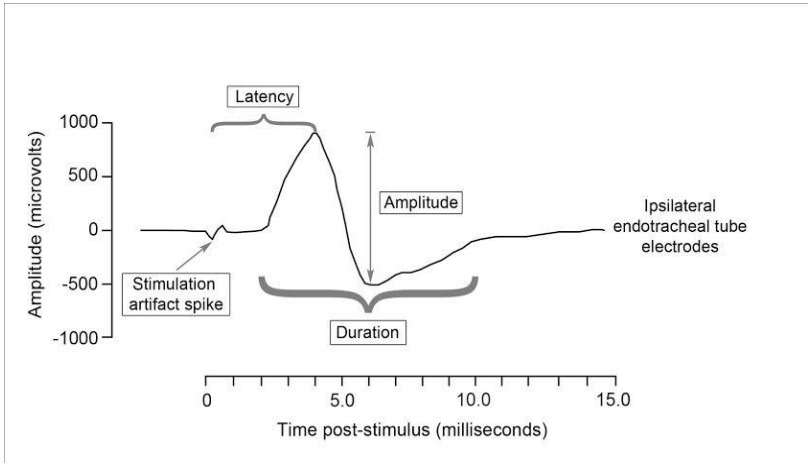
3- IONM -Professional Voice

Normal Singing Voice

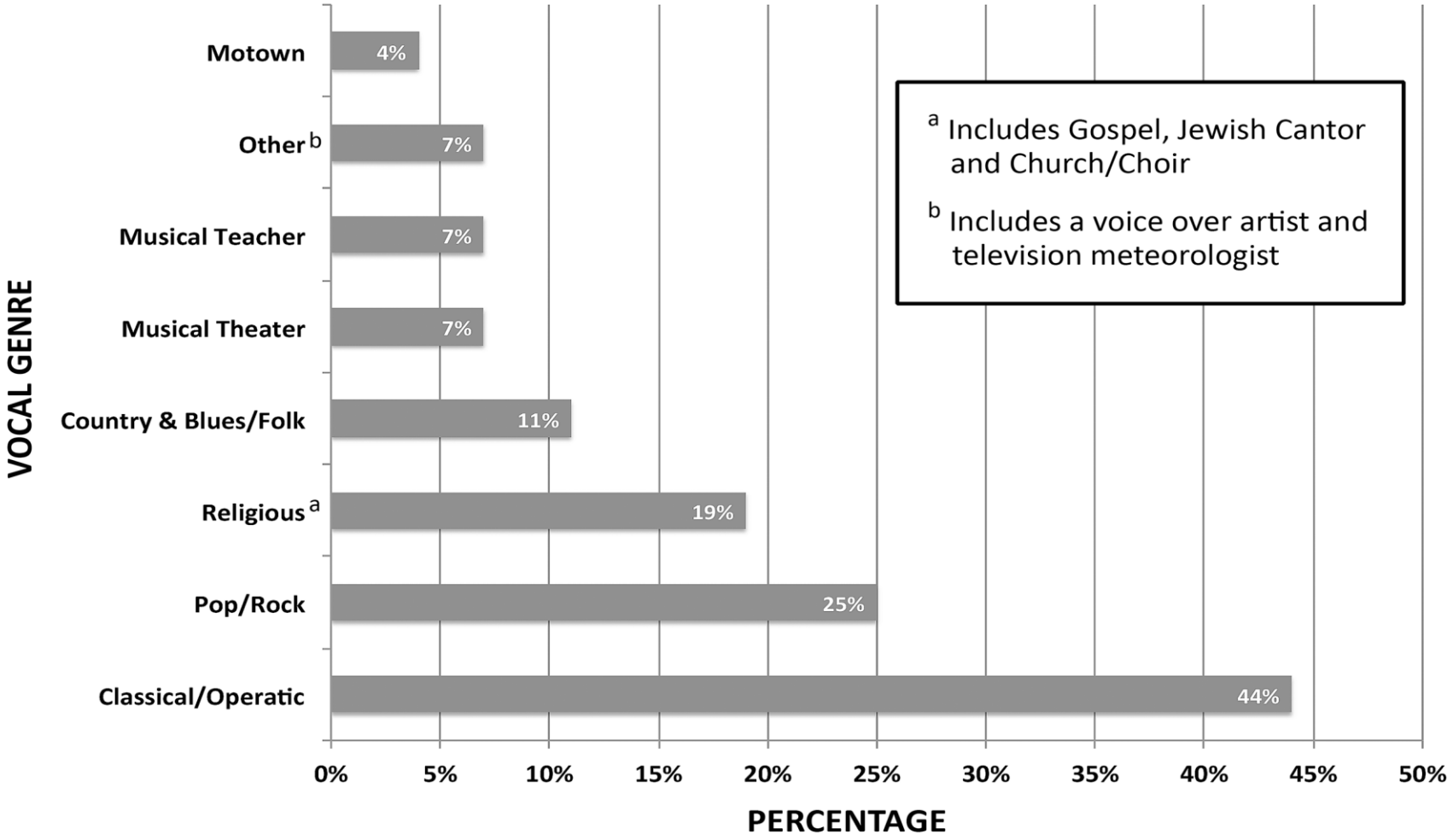


Thyroidectomy in the Professional Singer – Neural Monitored Surgical Outcomes

- Methods
  - Prospective database of 30 professional voice users undergoing thyroid surgery with IONM between August 2002 – March 2014
  - Pre- and post-operative vocal cord function was normal in all patients



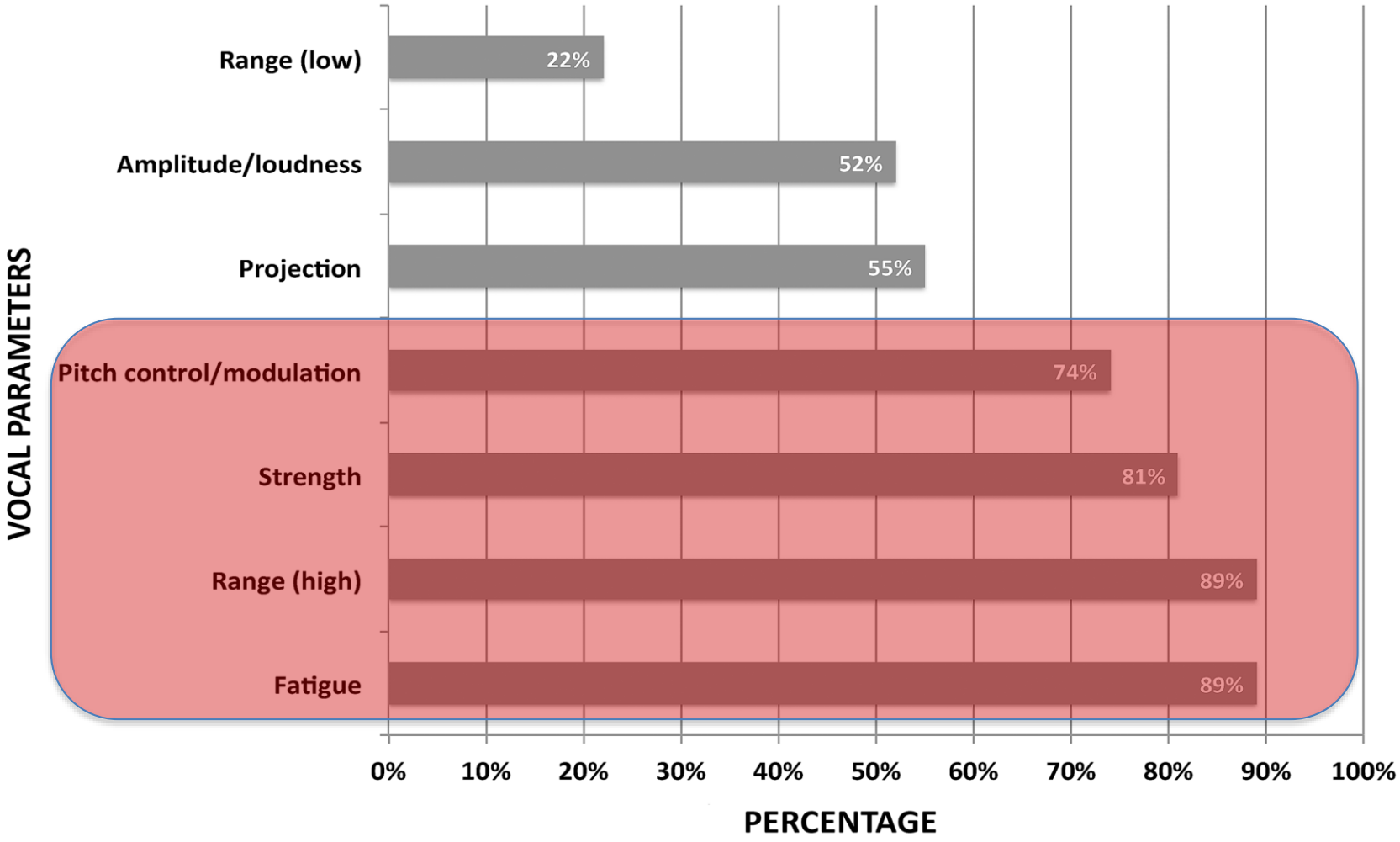
- Methods
  - I.Surveys to collect pre & post-operative voice instrument data
    - Voice Handicap Index (VHI)
    - Singing Voice Handicap Index (SVHI)
    - Evaluation of the Ability to Sing Easily (EASE)
  - II. Additional questions formulated by our laryngologist team
    - Vocal parameters affected during ‘recovery phase’
    - Time to return to performance


Motown
4%
Other b
7%
Musical Teacher
7%
Musical Theater
7%
Country & Blues/Folk
11%
Religious a
19%
Pop/Rock
25%
Classical/Operatic
44%
VOCAL GENRE
0%
5%
10%
15%
20%
25%
30%
35%
40%
45%
50%
PERCENTAGE
a Includes Gospel, Jewish Cantor and Church/Choir
b Includes a voice over artist and television meteorologist

- Results
  - Average age 44.81 (range 17 – 76)
  - 100 % return to performance
  - Mean time of 2.26 months (range 0.5 – 8 months)

- Results
  - *Vocal instrument mean scores showed **no** statistically significant difference in pre-operative to post-operative comparisons*

Vocal Instrument	Pre –Op	Post -Op	P-value
VHI	4.15	4.04	0.9301
SVHI	11.26	12.07	0.8297
EASE	6.19	6.00	0.9348


Range (low)
22%
Amplitude/loudness
52%
Projection
55%
Pitch control/modulation
74%
Strength
81%
Range (high)
89%
Fatigue
89%
VOCAL PARAMETERS
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
PERCENTAGE

- Conclusion
  - Neural monitored thyroid surgery in professional voice users is safe
  - Key elements are:
    - Strict adherence to INMSG with respect to RLN & EBSLN
    - pre and post-operative laryngeal assessment (in compliance with the AAO-HNS voice guidelines)
    - specific intra-operative surgical techniques to maximize vocal integrity

Monitoring 2015

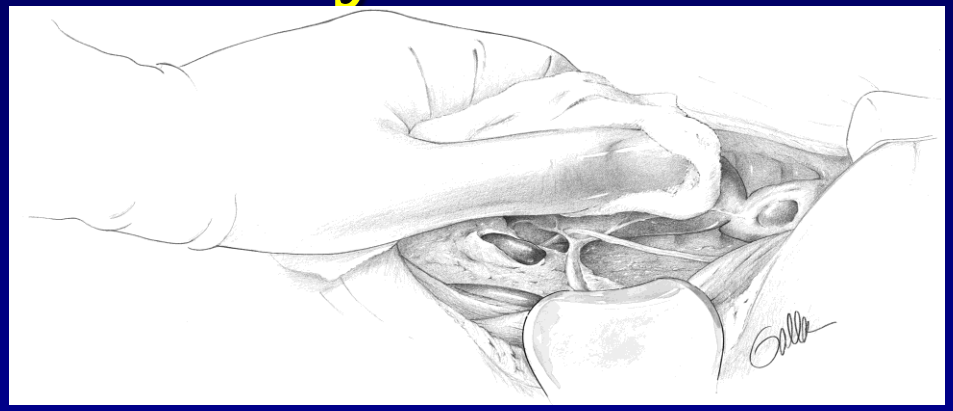
1- SLN-100% ID

2- CIONM -Prevention

3- IONM -Professional Voice

Invitations

Surgery of the Thyroid and Parathyroid Glands



Harvard Medical School, Boston

October 2016

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617 –573- 4115

JAGIELLONIAN UNIVERSITY MEDICAL COLLEGE KRAKÓW, POLAND SEPTEMBER 2015

September 17-19 2015

FIRST WORLD CONGRESS OF NEURAL MONITORING IN THYROID AND PARATHYROID SURGERY

INTERNATIONAL ORGANIZING COMMITTEE:

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Feng-Yu Chiang, Taiwan
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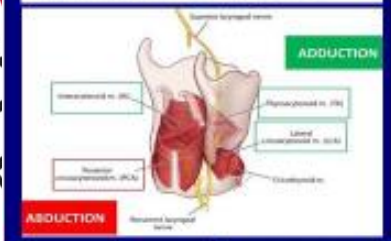
Henning Dralle, Germany
Gregory Randolph, USA



TOPICS:

- Prevalence of IONM
- Why IONM?
- Technique
- Anesthetic perspective
- SLN monitoring
- c-IONM
- Loss of signal and what to do?
- Safety analysis
- Limits of IONM
- IONM in endoscopic thyroidectomy
- Neurophysiology of the RLN
- Staged thyroidectomy
- Cost-effectiveness analysis
- Informed consent and legal issues
- Update of INMSG Guideline Statements

For more information please visit: http://www.neuromonitoring.com.pl/

3rd World Congress on Thyroid Cancer

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www.thyroidworldcongress.com

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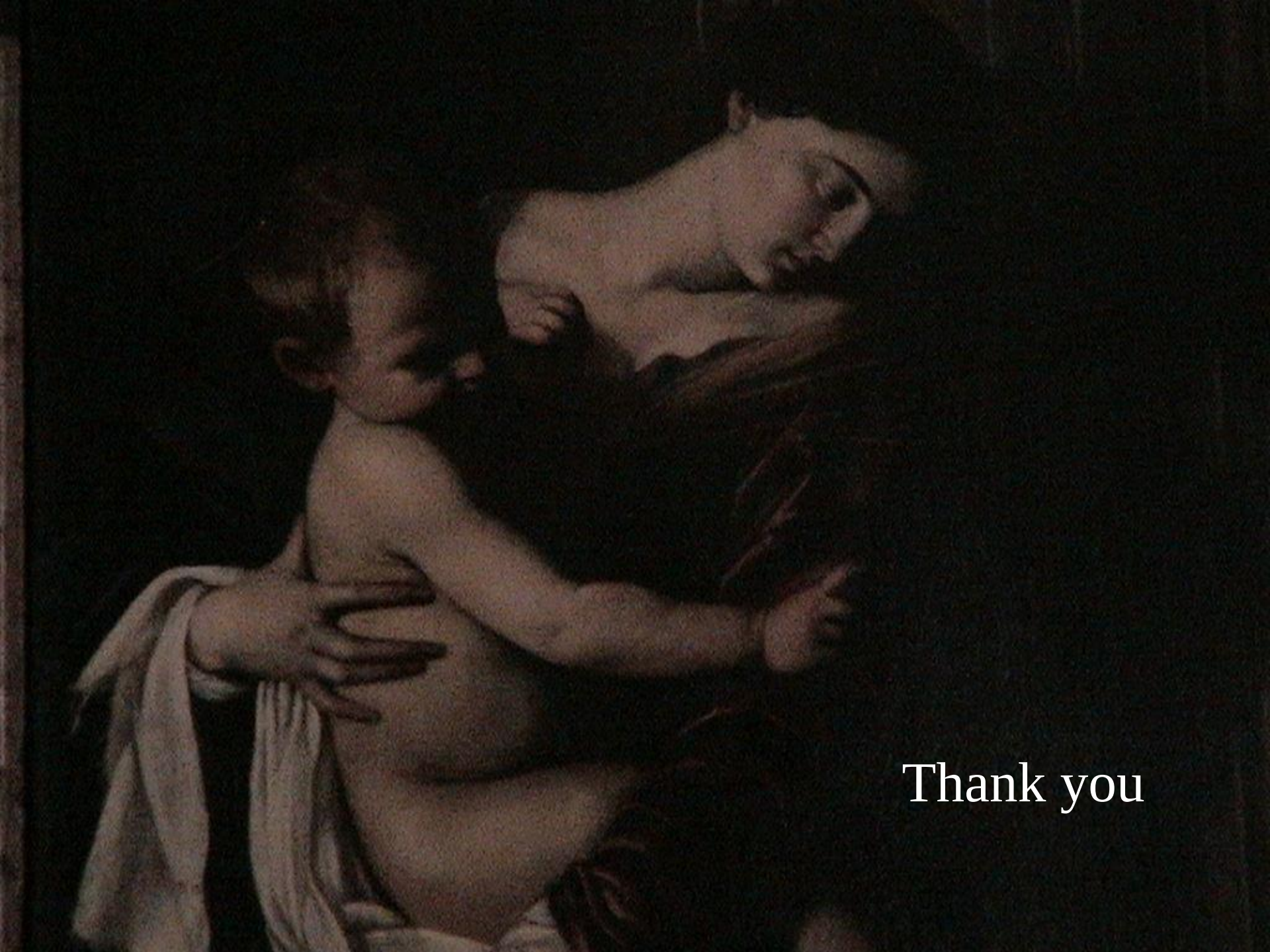
Thank you