BRAINSTEM REFLEXES

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Mount Sinai West
New York
BRAINSTEM REFLEXES ARE PRESENT UNDER GENERAL ANESTHESIA TIVA
- Trigemino-Trigeminal
- Monosynaptic
- Unilateral
- Propioceptive
- Fibers Ia
- Mesencephalic nucleus and Pons

- Trigemino-Facial
- Oligo-Polisynaptic
- Bilateral
- Cutaneous
- Fibers Aβ
- R1 Pons
- R2 Medulla

- Vagus-vagus
- Oligo-Polisynaptic
- Bilateral
- Mucosal
- Fibers Aβ?
- R1 Medulla
- R2 Medulla
**METHODOLOGY**

**UNDER GENERAL ANESTHESIA**

**BLINK REFLEX**

1. **Short Train**
   - Short train (4-7 stimuli)
   - ISI 2ms, 0.4 Hz

2. **Only R1 recording (ipsilateral)**
   - Double train (n=5) ITI 20-40 ms

**THE FEASIBILITY OF RECORDING BLINK REFLEXES UNDER GENERAL ANESTHESIA**

VEDRAN DELETS, MD, PhD,1,3 JAVIER URRIZA, MD,1 SEDAT ULKATAN, MD,1 ISABEL FERNANDEZ-CONEJERO, MD,1 JONATHAN LESSER, MD,2 and DAVID MIŠTA, MD1
**METHODOLOGY**

**UNDER GENERAL ANESTHESIA**

**BLINK REFLEX**

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**THE FEASIBILITY OF RECORDING BLINK REFLEXES UNDER GENERAL ANESTHESIA**

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**Double train (n=5) ITI 20-40 ms**

**Short train (4-7 stimuli)**

ISI 2ms, 0.4 Hz

1. **Short Train**

2. **R1 recording (ipsilateral)**

(suborbital branch)

Recording subdermal needles

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10.0 ms/div

200 U/div
Patients with abnormal and normal R1 strongly contracted the area containing significantly affected voxels (P < 0.001) to a dorsal–medial pontine region just caudal to the trigeminal principal nucleus, medial to the trigeminal spinal nucleus pars oralis and ventral to the facial nerve loop around the abducens nucleus.
We describe the case of a patient who developed hemifacial and hemitongue hypoesthesia after MVD surgery for trigeminal neuralgia. BR e-test was asymmetric R1 on the right (subclinical).

Intraoperative monitoring showed a severe loss of amplitude of R1 component of the BR.

No cases have been previously reported on the relationship between BR intraoperative modification, recorded under general anesthesia, and sensory trigeminal outcome.
Place the needles while stimulating with a portable stimulator.
MASSETER REFLEX

A) Sensory pathway:
- EMG
- Motor
- Antidromic motor signal
- Orthodromic motor signal (reflex)

B) M-wave and H-reflex
- Stimulus
- 10 ms

C) Response amplitude (mV)
- H
- M
- Stimulus strength (V)
- 500μV
- 5 ms

Graphs showing the response amplitude in mV for different stimulus strengths (V) and currents (mA).
Trigeminal schwannoma
LEFT Cavernous sinus

<table>
<thead>
<tr>
<th>Muscle</th>
<th>M (onset/peak)</th>
<th>H (onset/peak)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Masseter</td>
<td>2.8 ms/ 5.4 ms</td>
<td>6.9 ms/ 8.6 ms</td>
</tr>
<tr>
<td>Temporalis</td>
<td>14.3 ms/ 16.9 ms</td>
<td></td>
</tr>
</tbody>
</table>
Trigeminal schwannoma
LEFT Cavernous sinus

Masseter muscle

<table>
<thead>
<tr>
<th>[mA]</th>
<th>Masseter</th>
<th>Temporalis</th>
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</thead>
<tbody>
<tr>
<td>10:30:26</td>
<td>-6.4</td>
<td>50 μV</td>
</tr>
<tr>
<td>10:30:28</td>
<td>-6.4</td>
<td>Amp: -40</td>
</tr>
<tr>
<td>10:30:29</td>
<td>-6.4</td>
<td>Amp: -43</td>
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<tr>
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<td>Amp: -40</td>
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<td>-6.4</td>
<td>Amp: -42</td>
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<tr>
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<td>-6.4</td>
<td>Amp: -42</td>
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<tr>
<td>10:30:35</td>
<td>-6.4</td>
<td>Amp: -38</td>
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<tr>
<td>10:30:36</td>
<td>-6.3</td>
<td>Amp: -41</td>
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<tr>
<td>10:30:38</td>
<td>-6.3</td>
<td>Amp: -42</td>
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<tr>
<td>10:30:39</td>
<td>-6.4</td>
<td>Amp: -40</td>
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<tr>
<td>10:30:40</td>
<td>-6.4</td>
<td>Amp: -38</td>
</tr>
<tr>
<td>10:30:42</td>
<td>-6.4</td>
<td>Amp: -40</td>
</tr>
<tr>
<td>10:30:56</td>
<td>-6.4</td>
<td>Amp: -39</td>
</tr>
</tbody>
</table>

Temporalis muscle

<table>
<thead>
<tr>
<th>[mA]</th>
<th>Masseter</th>
<th>Temporalis</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:30:26</td>
<td>-6.4</td>
<td>100 μV</td>
</tr>
<tr>
<td>10:30:28</td>
<td>-6.4</td>
<td>Amp: 217</td>
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<tr>
<td>10:30:29</td>
<td>-6.4</td>
<td>Amp: 220</td>
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<td>-6.4</td>
<td>Amp: 296</td>
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<td>Amp: 227</td>
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<tr>
<td>10:30:36</td>
<td>-6.3</td>
<td>Amp: 218</td>
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<tr>
<td>10:30:38</td>
<td>-6.3</td>
<td>Amp: 217</td>
</tr>
<tr>
<td>10:30:39</td>
<td>-6.4</td>
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<tr>
<td>10:30:40</td>
<td>-6.4</td>
<td>Amp: -17</td>
</tr>
<tr>
<td>10:30:42</td>
<td>-6.4</td>
<td>Amp: -14</td>
</tr>
<tr>
<td>10:30:56</td>
<td>-6.4</td>
<td>Amp: -14</td>
</tr>
</tbody>
</table>

Temporals

<table>
<thead>
<tr>
<th>Time</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.3 ms</td>
<td>16.9 ms</td>
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</tbody>
</table>
A novel methodology for assessing laryngeal and vagus nerve integrity in patients under general anesthesia

Catherine F. Sinclair, Maria J. Téllez, Oscar R. Tapia, Sedat Ulkatan, Vedran Deletis

Department of Otolaryngology Head and Neck Surgery, Mount Sinai West Hospital, New York, NY, USA
Department of Intraoperative Neurophysiology, Mount Sinai West Hospital, New York, NY, USA

Clinical Neurophysiology 128 (2017) 1399–1405
LARYNGEAL ADDUCTOR REFLEX (LAR)
Hookwires recordings

Right Vocal fold

Left Vocal fold

Awake

Under Anesthesia

Left Mucosa stimulation: Concentric Probe 20mA
Hookwire recording TA muscle
The LAR is anesthesia dependent: Inhalational anesthetic agents at ≥ 1MAC concentration and lidocaine (4%) topically applied to the laryngeal mucosa significantly decrease all components of the LAR.

Sinclair, C.F., et al., Contralateral R1 and R2 components of the laryngeal adductor reflex in humans under general anesthesia. Laryngoscope, 2017
Electrode positioning within the larynx is best performed under direct visualization by video laryngoscopy (Kanotra et al. 2012).

**Gender** is an important criterion: in adults, the glottic diameter is on average 4mm larger in males than females.

**Weight is not**: there is no correlation between laryngeal dimensions and patient body weight.

For reliable monitoring, a minimum opening amplitude of $150-200\mu V$, optimally $>200 \mu V$, is necessary.

During surgery, optimal stimulating polarity may have to be re-checked due to slight movements of the tube relative to the laryngeal mucosa.

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The LAR is recorded using three different derivations

1) \((V+/V-)\): the positive electrode (V+) versus negative electrode (V-), both from the same side of the tube

2) \(V+\) versus a reference electrode (sternum)

3) \(V-\) versus a reference electrode (sternum)
ANESTHESIA INDUCTION

Succinylcholine (short action muscle relaxant)
**STIMULATION**

Single Pulse or Short train

Intensity: 3-25 mA.
Mean 10mA

**AMPLITUDE**

Mean 400 µV (1-2mV)

**No Habituation**

at 1Hz or less
LAR & THYROIDECTOMY SURGERY

- LAR for monitoring the **recurrent laryngeal nerve** (RLN) at risk, ipsilateral to the surgery.
- Amplitude decrements correlate with surgical maneuvers that stretch or put pressure on the RLN, and recover upon tissue release.
- >60% amplitude decrement correlates with vocal fold paresis/paralysis.

**Graph:**

- **IIONM vs LAR-CIONM**
- **Transition Period:**
- **LAR-CIONM since warning criteria**
- **Paresis**
- **Transient VFI**
Letter to the Editor
Clinical Neurophysiology 129 (2018) 2497–2498

A method for intraoperative recording of the laryngeal adductor reflex during lower brainstem surgery in children
Paolo Costa et al.

Removal of large IV ventricle tumors in 3 pediatric patients

Use of hook-wires electrodes for stimulating and recording the LAR

Letter to the Editor
Clinical Neurophysiology 130 (2019) 1253–1255

The intraoperative laryngeal adductor reflex (LAR) in brainstem tumor removal: A case of unilateral loss of LAR signal
Anna-Liisa Satomaa et al.

Large IV ventricle
INTRAAXIAL ASTROCYTOMA

Scope the patient:
VF movement and mucosa sensitivity, LAR
Swallowing test
CHOROID PLEXUS PAPILLOMA

Coronal T1
WOODGROVE BANK

BLINK REFLEX

LAR

BAER

OPENING BASELINES
Monitoring the **Right AFFERENT (iSLN)**
- Right stimulation
- Left recording (Left LAR)

Monitoring the **Right EFFERENT**
- Left stimulation
- Right recording (Right LAR)
WARNINGS GIVEN

- Severe swallowing dysfunction
- Aspiration
- Pneumonia
Mapping with brainstem reflexes identifies sensory fibers of cranial nerves
Schwannoma grows off of one nerve fiber, splaying the remaining fibers over the tumor surface.
Intraoperative Mapping and Monitoring of Sensory Vagal Fibers During Vagal Schwannoma Resection

Catherine F. Sinclair, MD; Maria J. Téllez, MD; M. Angeles Sánchez Roldán, MD; Mark Urken, MD; Sedat Uluutan, MD
CONCLUSIONS  Monitoring with Brainstem Reflexes is a True Continuous Monitoring Technique ...

✓ Fast (no average)
✓ No movement on the surgical field
✓ No need of surgeon collaboration
✓ Direct assessment of the integrity of V, VII, X cranial nerves

✓ Monitors sensory and motor fibers of cranial nerves and intrinsic brainstem pathways
✓ Identifies sensory fibers of cranial nerves (mapping)
THANK YOU

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FOR
SHY PEOPLE