A Novel Means of Clinical Assessment of Laryngeal Nerve Conduction

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Vocal Fold Paresis: Neurological Mechanisms

VF can become dysfunctional on a number of etiologic bases

Muscle Weakness
--Myopathic
--Neuropathic

Vagus Nerve and Nuclei
Electrodiagnostic Studies of the Larynx

- Provide diagnosis of neuropathic injury
- Provide evidence of normal nerve function
- Definitively localize site of nerve injury
- Provide information regarding severity (grade) of nerve injury
- In some cases potentially could inform prognosis

Electrodiagnostic Studies: Underlying Basics

**Nerve and muscle cells are electrically active**
-- maintain electrochemical potential
-- can alternate between RESTING state and ACTIVE state

These states have different electrical characteristics, and we can measure them.

The electrophysiological parameters of nerve and muscle have identifiable characteristics in health and disease states

Laryngeal Electromyography (LEMG)

- Standard of electrodiagnostic study of the larynx
- Using a needle electrode the intrinsic laryngeal muscles are accessed, and their electrical activity is observed and measured.

LEMG: Limitations

- EMG without NCS is limited
  - Solely evaluates motor pathways
  - Role of sensory neuropathic dysfunction not addressed
  - Limited regarding what can be learned by early study
Nerve Conduction Studies of the Larynx

- Would be extremely helpful
- Have been done in animal models
- Open neck dissection
- Surface studies difficult to interpret and/or verify

Laryngeal Closure Reflex Study

Analogous to other “brainstem reflexes”

**Blink Reflex Study**— electrophysiological correlate of corneal reflex (CN V-VII) (stimulate supraorbital nerve (V), record from orbicularis oculi muscle (VII)

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We describe a novel, clinically applicable, nerve conduction study of CN X. We propose a set of normative electrodiagnostic values and variations of the reflex responses of the laryngeal adductor muscles in response to irritative stimulation of the laryngeal mucosa (Laryngeal Closure Reflex).

(AAN 2011)

Laryngeal closure (adductor) reflex

- The blink reflex study described by Kimura in 1969 provides quantifiable parameters allowing for evaluation and assessment of the peripheral afferent and efferent limbs of this reflex, as well as information regarding relay of this reflex through the central nervous system.
- The airway protective reflex (laryngeal or vocal cord closure reflex) employs analogous cranial nerve-brainstem pathways.
- We hypothesize that determination of the electrophysiological parameters of the nerves subserving the larynx have similar clinical value for diagnosis and prognosis in patients with laryngeal dysfunction.
Materials and Methods

- Activation of the sensory territory of the superior laryngeal nerve was performed by providing unilateral irritative stimulation to the laryngeal mucosa (low level, brief electrical stimulus given to the mucosal surface via a wire electrode passed through the working channel of a flexible laryngoscope).
- The reflex adduction of bilateral vocal folds evoked by unilateral sensory stimulation was recorded using needle electromyography.
- The evoked potentials recorded from bilateral laryngeal adductor muscles were displayed on a dual trace oscilloscope after conventional amplification using a two-channel amplifier (Nicolet Viking), and response latencies were measured.

Results

17 normal volunteer subjects were included in the study.

Findings:
A uniform and consistent early ipsilateral response (LR1) and late bilateral responses (ipsilateral LR2 (LR2i) and contralateral LR2 (LR2c)), which exhibit greater variation in latency and morphology, were recorded.

LCR: Normal Values

Mean Minimal Latencies

<table>
<thead>
<tr>
<th>Stimulation Side</th>
<th>LR1 Latency Ipsilateral (ms)</th>
<th>LR2 Latency Ipsilateral (ms)</th>
<th>LR2 Latency Contralateral (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right</td>
<td>13.2</td>
<td>50.5</td>
<td>50.7</td>
</tr>
<tr>
<td>Left</td>
<td>15.2</td>
<td>52.2</td>
<td>50.6</td>
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Upper Limit of Normal = 3 SD above mean

<table>
<thead>
<tr>
<th>Stimulation Side</th>
<th>LR1 Latency Ipsilateral (ms)</th>
<th>LR2 Latency Ipsilateral (ms)</th>
<th>LR2 Latency Contralateral (ms)</th>
</tr>
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<tbody>
<tr>
<td>Right</td>
<td>15.6</td>
<td>60.6</td>
<td>63.5</td>
</tr>
<tr>
<td>Left</td>
<td>18.8</td>
<td>61.2</td>
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Conclusion

• This technique yields clear, quantifiable data regarding neurologic integrity of laryngeal function, previously unobtainable in the clinical setting. In combination with routine clinical laryngeal EMG, this study may result in clinically relevant information regarding severity and prognosis of neuropathic laryngeal injury causing dysphonia, dysphagia and aspiration, and dyspnea.

Future Directions

• In process of studying patients with established laryngeal neuropathy

• Early data is encouraging, with lateralizing departure from normal values

• Future directions to be informed by results of above

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