LARYNGEAL ELECTROMYOGRAPHY FOR PROGNOSIS OF VOCAL FOLD PALSY: A META-ANALYSIS

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INTRODUCTION

- Laryngeal electromyography (LEMG) techniques and normative data were established in the 1950s
- Still no consensus regarding its application in cases of vocal fold palsy (VFP)
- Weddel et al first to suggest that LEMG may have prognostic value for VFP
- Lack of clear information regarding prognosis
  - No well-established natural history of VFP like facial palsy

INTRODUCTION

- Issues with studies involving LEMG involve differences in data collection and reporting
  - Variable time elapsed from onset to initial exam
  - Variable definitions of recovery
    - Vocal fold motion
    - Voice quality
    - Unspecified/combination
  - Variable duration of follow-up
  - Simplified “all-or-none” concepts of paralytic dysphonia that do not reflect the clinical reality of heterogenous recovery

LEMG uses characteristic electrical signals to identify
- Normal innervation
- Absence of innervation
- Reinnervation
- Synkinesis
- Some dismiss it as being subjective – but so is laryngoscopy

Typical electromyography findings tend to be clear in appearance and significance
- Fibrillations
- Normal and polyphasic motor unit potentials
- Positive sharp waves
- Requires some judgment to define degree of impairment
INTRODUCTION

Study Goal
- To analyze existing evidence regarding utility of LEMG for prognosis in cases of VFP

MATERIALS AND METHODS

Study Design
Meta-analysis of LEMG studies of VFP identified by literature search
- Method of diagnosis
- Interval to LEMG
- Criteria for prognostication
  - Standardized to the extent possible across all studies
- Clinical outcome
- Follow-up time
  - Studies were checked for consistency in outcome measures and assessments

Clinical outcomes identified by literature search
- Electromyographic findings defining good recovery and poor recovery
- Positive predictive value (PPV)
  - Patients with predicted poor recovery who had poor recovery
  - Accurate prediction of non-recovery
- Negative predictive value (NPV)
  - Patients with findings consistent with recovery who noted return of motion
  - Accurate prediction of recovery
- Statistics
  - Odds ratio to determine significance of the data

RESULTS

- 10 studies identified with 503 patients
  - VFP identified by laryngoscopic examination
  - LEMG performed 2 weeks to 6 months after onset
  - TA muscle assessed in all studies, CT in 4 studies
  - All studies used LEMG data to distinguish ‘high-grade injury’ from ‘low-grade injury’
    - Specific criteria varied but broadly consistent
RESULTS

- **High-grade injury** = absence of activation of motor unit potentials and/or recruitment with appropriate voluntary activity
  - Presence of fibrillation potentials was considered consistent with high-grade injury
  - Evidence of significant axonal injury

- **Low-grade injury** = normal/near-normal activation of volitional motor unit potentials and/or recruitment
  - No evidence of significant axonal injury

<table>
<thead>
<tr>
<th>Study</th>
<th>Time of onset to LEMG (mo)</th>
<th>F/U time from onset (mo)</th>
<th>Muscle Used</th>
<th>Good Prognosis Predictors</th>
<th>Poor Prognosis Predictors</th>
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</thead>
<tbody>
<tr>
<td>Sittel</td>
<td>1 (average)</td>
<td>6</td>
<td>TA</td>
<td>Near normal motor unit recruitment - Absence of spontaneous activity (FIBs, PSW)</td>
<td>Presence of FIBs or PSW</td>
</tr>
<tr>
<td>Munin</td>
<td>0.75-6</td>
<td>6</td>
<td>CT/TA</td>
<td>Near normal motor unit recruitment - Absence of spontaneous activity (FIBs, PSW)</td>
<td>Absence or reduced amount of voluntary MUPs - Possible presence of FIBs or PSW</td>
</tr>
<tr>
<td>Parnes</td>
<td>Not fully defined (6)</td>
<td>39</td>
<td>CT/TA</td>
<td>Near normal presence of MUPs - Absence of spontaneous activity (FIBs, PSW)</td>
<td>Presence of FIBs or PSW - Decreased MUPs</td>
</tr>
<tr>
<td>Wang</td>
<td>0.75-6</td>
<td>6</td>
<td>TA</td>
<td>Near normal (80-100%) motor unit recruitment - Absence of spontaneous activity (FIBs, PSW)</td>
<td>&lt;80% of normal motor unit recruitment - Presence of FIBs or PSW</td>
</tr>
<tr>
<td>Grosheva</td>
<td>0.5</td>
<td>4.8 +/- 3.5</td>
<td>TA</td>
<td>Near normal motor unit recruitment - Absence of spontaneous activity (FIBs, PSW)</td>
<td>Presence of FIBs - Absence or decreased voluntary motor unit activity</td>
</tr>
<tr>
<td>Gupta</td>
<td>0.75-6</td>
<td>Not defined</td>
<td>TA</td>
<td>Near normal presence of voluntary MUPs</td>
<td>Absence or reduced amount of voluntary MUPs</td>
</tr>
<tr>
<td>Min</td>
<td>1-5</td>
<td>3-19</td>
<td>TA</td>
<td>Near normal presence of voluntary MUPs</td>
<td>Presence of FIBs or PSW</td>
</tr>
<tr>
<td>Hirano</td>
<td>1-6</td>
<td>12</td>
<td>TA</td>
<td>Presence of voluntary MUPs</td>
<td>Absence of voluntary MUPs</td>
</tr>
<tr>
<td>Hydman</td>
<td>0.5-0.75</td>
<td>6</td>
<td>TA</td>
<td>Absence of spontaneous activity (FIBs, PSW)</td>
<td>Presence of FIBs or PSW</td>
</tr>
<tr>
<td>Elorz</td>
<td>0.5-6</td>
<td>9-13</td>
<td>CT/TA</td>
<td>Presence of voluntary MUPs</td>
<td>Absence of voluntary MUPs</td>
</tr>
</tbody>
</table>

MUP = motor unit potentials; FIB = fibrillation potentials; PSW = positive sharp waves.
RESULTS

<table>
<thead>
<tr>
<th></th>
<th>No recovery</th>
<th>Good recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>High grade injury</td>
<td>269</td>
<td>27</td>
</tr>
<tr>
<td>Low grade injury</td>
<td>92</td>
<td>115</td>
</tr>
</tbody>
</table>

- Positive Predictive Value: Patients with predicted poor recovery who had poor recovery
  - PPV = \( \frac{269}{296} = 0.909 \)

- Negative Predictive Value: Patients with findings consistent with recovery who noted return of motion
  - NPV = \( \frac{115}{207} = 0.556 \)

- Odds Ratio = 11.56 (7.10-18.81) – strong association

CONCLUSIONS

- LEMG not useful in predicting recovery in patients with VFP and low-grade injury
  - NPV = 0.556

- LEMG is a good predictor of poor recovery in patients with VFP and high-grade injury
  - PPV = 0.909

- Identifying candidates with poor prognosis allows for timely early intervention
  - Helps to select patients appropriate and offer a more definitive intervention over temporary intervention

CONCLUSIONS

- Further investigations are needed
  - To establish how early LEMG can be used as a reliable tool
    - Spontaneous fibrillation activity does not appear for 10-14 days after injury
    - After 6 months, less useful as few recover function
  - To determine whether prediction of recovery may be enhanced by additions to the neurodiagnostic armamentarium

Study Limitations

- Inconsistencies in definition of ‘high-grade injury’ versus ‘low-grade injury’ between studies
  - Broadly consistent

- Follow up time from onset varied
  - At least 3 months, most studies 6 months or more

- Recovery is defined as vocal fold motion
  - Reinnervation is complex and uncertain

- Definition of recovery does not account for synkinesis

- Synkinesis may explain why those with low-grade injury do not recover as well as expected

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