POST-OPERATIVE LARYNGEAL COMPLICATIONS AFTER ENDOCRINE SURGERY

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<table>
<thead>
<tr>
<th>Etiology</th>
<th>1985-1995 (n=280)</th>
<th>1995-2005 (n=363)</th>
<th>Overall Trends (literature review)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malignancy</td>
<td>24.7%</td>
<td>13%</td>
<td></td>
</tr>
<tr>
<td>Surgical/Iatrogenic</td>
<td>23.9%</td>
<td>46.3%</td>
<td></td>
</tr>
<tr>
<td>Idiopathic</td>
<td>19.6%</td>
<td>17.6%</td>
<td></td>
</tr>
<tr>
<td>Nonsurgical Trauma</td>
<td>11.1%</td>
<td>2.2%</td>
<td></td>
</tr>
<tr>
<td>Neurologic</td>
<td>7.9%</td>
<td>3.0%</td>
<td></td>
</tr>
<tr>
<td>Intubation</td>
<td>7.5%</td>
<td>4.4%</td>
<td></td>
</tr>
<tr>
<td>Thoracic aortic aneurysm</td>
<td>4.3%</td>
<td>0.6%</td>
<td></td>
</tr>
<tr>
<td>Infectious</td>
<td>---</td>
<td>3.6%</td>
<td></td>
</tr>
</tbody>
</table>

Ext.br.
SLN
Vocal fold paralysis

- Superior laryngeal nerve (SLN)
  - Pitch control

- Recurrent laryngeal nerve (RLN)
  - Vocal fold (VF) movement
    - Adduction (closing) / abduction (opening)
  - Unilateral
  - Bilateral
Vocal fold paralysis – Symptoms

• **Unilateral (large glottal gap)**
  - Dysphonia (bad voice)
  - Dysphagia (swallowing difficulty)
  - “Dyspnea”

• **Bilateral (limited glottal gap)**
  - Airway restriction, stridor
  - Good voice, swallowing
Vocal fold paralysis - Prognosis

- VF paralysis can recover
  - Complete or partial
  - ~ 6 months

- Laryngeal electromyography (LEMG)
  - Measures electrical activity of laryngeal muscles
  - Diagnosis: paralysis vs. dislocation
  - Prognosis for spontaneous recovery
  - Shortens time to permanent treatment
Laryngeal electromyography
### "Traditional" qualitative LEMG

<table>
<thead>
<tr>
<th>Class</th>
<th>Spontaneous Activity</th>
<th>Recruitment</th>
<th>Individual Motor Unit Morphology</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Absent</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
</tr>
<tr>
<td>II</td>
<td>Absent</td>
<td>Reduced</td>
<td>Polyphasic units</td>
<td>&quot;Old injury&quot;*</td>
</tr>
<tr>
<td>III</td>
<td>Present</td>
<td>Reduced</td>
<td>Polyphasic units</td>
<td>&quot;Equivocal&quot;‡</td>
</tr>
<tr>
<td>IV</td>
<td>Present</td>
<td>Absent</td>
<td>Fibs, myokymia, etc.</td>
<td>Denervation</td>
</tr>
</tbody>
</table>

Positive predictive value (PPV): 80%
Negative predictive value (NPV): 67-71%

Synkinesis

• Misdirected re-innervation of the adductor and abductor laryngeal muscle nerve fibers
  • 88% of specimens after nerve injury (animal studies)

Statham MM, Rosen CA, Smith LJ, Munin MC. *Laryngoscope* 2010;120:285-290

PPV increased from 67 to 76%
NPV from 53 to 100%
Quantitative LEMG

- Widely commercially available
  - Common component in EMG of other body parts
- Mean turns analysis
  - Change in signal direction at peak of MU signal
    - Each successive turn separated by ≥100 µV
    - Excludes low-amplitude peaks from noise and electrical interference

- Differentiate normal from acute vocal fold paralysis
  - 400 mean turns/s

Statham MM, Rosen CA, Nandedkar SD, Munin MC. *Laryngoscope* 2010;120:2036-2041
Severe neuropathy

* Optimal LEMG Interpretation

Qualitative Motor Unit Characteristics

Presence of Synkinesis

Quantitative Mean Turns Analysis

PPV = 100%
NPV = 90%
Accuracy = 91%
Vocal fold paralysis - Treatment

• (Voice therapy, swallow therapy)
• Surgical options
  • Temporary
    • VF injection $^1, 2$
  • Permanent
    • VF injection
    • Laryngeal framework surgery
    • Laryngeal re-innervation
    • Drug trials?

$^1$ Yung KC, Likhterov I, Courey MS, Laryngoscope 2011;121(10):2191-4
$^2$ Young VN, Smith LJ, Rosen CA, accepted OtoHNS 2012
VF injection - Locations

= Superior arcuate line
VF Injection – Material (Ideal)

- Biocompatible
- Safe from transmission of infectious disease
- Matched mechanical property to host location (viscosity)
- Stable (inert)
- Use a fine-gauge needle (24 g or smaller)
- “Off the shelf” (minimal prep)
VF Injection Material: Present

- Gelfoam
- Collagen
- Radiesse Voice Gel™
- Hyaluronic acid – Restylane, …
- Calcium hydroxylapatite (CaHA)
  - Radiesse Voice™
  - Fascia (autologous/allogenic)
  - Fat (autologous)
Gelfoam™

- Gelatin
  - Bovine gelatin
  - Sterile powder (1 gm)

- Longest track-record of laryngeal injectables
  - 30 years (1970s)
  - #1 injectable, ABEA survey, 2004 (Merati)

- Bottom line
  - Lasts 4 weeks
  - Requires preparation
  - 18g needle
  - Poor vibratory properties
  - Limited use today
Collagen-Based Injectables

- **Cymetra**
  - Micronized cadaveric dermis
  - Prion infection transmission risk?
  - Significant preparation required (hassle)

- **Cosmoplast/Cosmoderm**
  - Human engineered collagen
  - No track record

- **Bottom line**
  - Lasts 2-3 months
Radiesse Voice Gel™

- 3 Basic components
  - Water (82.3%), Glycerin (14.5%)
  - Carboxymethylcellulose (CMC 2.3%)
- Carboxymethylcellulose
  - Cortisone, decadron
  - Common food additive
- Gel carrier for Radiesse™ (CaHA)
  - FDA approved for VF injection
- Bottom line
  - Lasts 1-3 months
Hyaluronic Acid

- Glycosaminoglycan (polysaccharide)
- Found in dermis
- Low tissue reactivity
  - Hypersensitivity 0.6%

- Bottom line
  - Duration: 6-9 months?
Calcium Hydroxylapatite

- CaHA – Long-term, successful solid implant in orthopedics and dentistry
- Radiesse Voice™
  - Spherules of calcium hydroxylapatite (CaHA)
  - Suspended in aqueous-based gel
    - CMC, water, glycerin
    - Voice gel component resorbs
      → over-inject ~10%
- FDA approved for VF injection
- Inflammatory response?
- Bottom line
  - Lasts 1-2 years
Lipoinjection

- Liposuction or open harvest
- Fat preparation
  - Rinse fat, insulin?
- 18-19 gauge needle
- Overinjection by 30-50%
- Unpredictable
- MAC or general anesthesia
Lipoinjection

Pre-injection

Post-injection
VF injection - Material

- Gelfoam ~ 1 month
- Cymetra ~ 1-2 months*
- Radiesse Voice Gel ~ 1-3 months*
- Hyaluronic acid Gel ~ 6-9 months?*
- CaHA (Radiesse Voice) ~ 1-2 years
- Fat ~ forever?

Temporary VF injection duration study: currently in progress
Which glottic injectable should I use?

Why?

Temporary?
- short
- long

Permanent?
VF injection techniques: What setting?

- Office
- Operating room
- General anesthesia
- Local/MAC
Where we have been…Where are we going?
2009 – 7 Laryngologists – 3 voice centers

5 year trends

Number of patients

Year

Bedside
Office
OR

2003-4  57
2004-5  57  125
2005-6  57  125  155
2006-7  57  125  155  175
2007-8  57  125  155  175  244
Comparison

Office

- Co-morbidities
- Real time monitoring
- Well tolerated/preferred
  - Young et al, Laryngoscope 2012
- Costs 505% less
  - Bove et al, Laryngoscope 2007
- Efficacy/complications = to OR
  - Sulica et al, Laryngoscope 2010

OR

- Co-morbidities
- Anatomy
- Anxiety
  - Xanax
  - Ativan
- Technical precision
Bilateral deep vocal fold augmentation
Vocal fold injection - OR

- **Local/MAC**
  - Endoscopic

- **General**
  - MSL
  - Endoscopic

![Diagram of vocal fold injection in OR with labels for head and neck positioning]
Vocal fold injection - OR
Laryngeal framework surgery

• Medialization laryngoplasty
  • Implant placed into larynx to medialize VF
  • Type I thyroplasty
  • Isshiki 1974
    • Silastic
    • Gore-Tex™

• Arytenoid adduction
  • Suture placed to re-position the VF

Awake
Intra-operative voice monitoring
Type I Thyroplasty
AKA Medialization Laryngoplasty
c. 1974

- Gold standard
- VFP $\rightarrow$ expect improvement
- Implants
  - Silastic
    - Netterville/block
  - VoCom Hydroxyapatite
  - Gore-tex
  - Titanium
Medialization Laryngoplasty

Intra-op monitoring

Localization
Pearls of ML

- Excellent window localization

- Implant placement
  - Posterior (toward muscle process)
  - Inferior (infraglottis)
  - Anterior?
    - Often not needed
    - When done, very small amount of implant

- Slight over-correction to compensate for peri-op edema
  - Decadron 8mg PO night before sx
  - Decadron 10-20mg IV pre-op

- Inadvertent entry into airway → stop. NO implant!
New Trends

• No drain, bone wax, glue
• No antibiotics
• Post-op steroids?
• 23 hr. obs?
  • Same day sx: U/L, local
  • 23 hr obs: B/L (atrophy/VFP + atrophy), not local
ML: pros / cons

**BENEFITS**
- Improved glottic closure
- Intraoperative monitoring
- Adjustable
- “Reversible”

**COMPLICATIONS**
- Implant migration
- Implant extrusion
- Implant misplacement
- Under/over-augmented
- Hematoma/edema → airway compromise
- Need to revise
Arytenoid Adduction

• Indications
  • Large posterior gap
  • Unequal vocal fold levels
  • Improve tone?

• Improves acoustical power and increases subglottic pressure
From Rosen CA and Simpson CB. *Operative Techniques in Laryngology*. Springer, 2009
Arytenoid Adduction

Complications

- Piriform sinus injury
- Over/Under correct
- Thyroid cartilage fx

Basically…

- All the time
- Never
- Sometimes
- Adds 2 hrs
- Increased risks
  - Technically challenging
Vocal fold paresis

• Partial injury (weakness) of the RLN or SLN
• RLN Paresis
  • VF is mobile
  • VF strength is weak
  • VF closure is incomplete
  • Voice is weak and tires easily
• Frequently seen following recovery from VF paralysis
Vocal fold paresis - Treatment

• Similar to vocal fold paralysis
  • Observation
  • Voice therapy
  • VF injection
  • Thyroplasty
Bilateral vocal fold paralysis

- Poor airway
  - May require tracheotomy
  - Good voice

- Once permanent paralysis - treatment aimed to improve breathing
  - Remove small portion of VF to increase size of breathing space
  - Airway v. Voice
Bilateral VFP - Surgery
Management of VF paralysis

- LEMG provides prognostic information about nerve function recovery

- Unilateral VF paralysis
  - Breathy voice
  - Swallowing, cough impaired

- Bilateral VF paralysis
  - Voice and swallowing good
  - Airway compromised
• Thank you.