Vocal Cord Paralysis
Medialization Laryngoplasty

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Overview

- Anatomy of the Larynx
- Function of the Larynx
- Causes of Vocal Cord Paralysis
- Evaluation of Vocal Cord Paralysis
- Anterior TVC Medialization
- Posterior TVC Medialization
- Overview of Treatment for Bilateral Vocal Cord Paralysis
- Conclusion (Key Points)
Anatomy of the Larynx - Cartilages
Anatomy of the Larynx - Cartilages
Anatomy of Larynx - Muscles
Anatomy of Larynx - Muscles
Anatomy of Larynx - Nerves
Anatomy of Larynx - Nerves
Anatomy of Larynx - Motion

- Adductors of the Vocal Folds:
Anatomy of the Larynx - Motion

- Adductors of the Vocal Folds:
Anatomy of the Larynx - Motion

- Abductor of Larynx:
Anatomy of Larynx - Histology
Function of Larynx

- Passage for Respiration
- Prevents Aspiration
- Allows Phonation
- Allows Stabilization of Thorax
Respiration
Phonation
Vocal Cord Paralysis

Etiology, Preoperative Evaluation, Treatment
Etiology

- Causes of Vocal Cord Paralysis in Adults:

<table>
<thead>
<tr>
<th>Cause</th>
<th>Unilateral %</th>
<th>Bilateral %</th>
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<tbody>
<tr>
<td>Surgery</td>
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<td>26</td>
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<td>Idiopathic</td>
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<td>Malignancy</td>
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<td>Trauma</td>
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<td>Neurologic</td>
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<td>Intubation</td>
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<td>18</td>
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<tr>
<td>Other</td>
<td>5</td>
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Evaluation – Patient History

- Alcohol and Tobacco Usage
- Voice Abuse
- URI and Allergic Rhinitis
- Reflux
- Neurologic Disorders
- History of Trauma or Surgery
- Systemic Illness – Rheumatoid
- Duration – Affects Prognosis
Evaluation – Physical Examination

- Complete Head and Neck Examination
- Flexible Fiberoptic Laryngoscopy
- 90 degree Hopkins Rod-lens Telescope
- Adequacy of Airway, Gross Aspiration
- Assess Position of Cords
  - Median, Paramedian, Lateral
  - Posterior Glottic Gap on Phonation
Evaluation - Videostroboscopy

- Demonstrates subtle mucosal motion abnormalities
- Video documentation (not available online)
Evaluation - Electromyography

- Assesses integrity of laryngeal nerves
- Differentiates denervation from mechanical obstruction of vocal cord movement
- Electrode in Thyroarytenoid and Cricothyroid
Evaluation - Electromyography

- Normal
  - Joint Fixation
  - Post. Scar

- Fibrillation
  - Denervation

- Polyphasic
  - Synkinesis
  - Reinnervation
Evaluation - Imaging

- Chest X-ray
  - Screen for intrathoracic lesions
- MRI of Brain
  - Screen for CNS disorders
- CT Skull Base to Mediastinum
- Direct Laryngoscopy
  - Palpate arytenoids, especially when no L-EMG
Evaluation – Unilateral Paralysis

- Preoperative Evaluation
  - Speech Therapy
  - Assess patient’s vocal requirements
  - Do not perform irreversible interventions in patients with possibility of functional return for 6-12 months
  - Surgery often not necessary in paramedian positioning
Evaluation – Unilateral Paralysis

- Manual Compression Test
Evaluation – Unilateral Paralysis

- Assess extent of posterior glottic gap
- Consider consenting patient for both anterior and posterior medialization procedures
Management – Unilateral Paralysis

○ Type of Anesthesia
  ● Local – allows patient to phonate
    ○ Careful administration of IV sedation
    ○ Internal superior laryngeal nerve block at the thyrohyoid membrane
    ○ Glossopharyngeal nerve block at the inferior pole of the tonsils
    ○ Flexible endoscope allows visualization
  ● Laryngeal Mask
  ● General
Management – Unilateral Paralysis
Management – Unilateral Paralysis
Vocal Cord Injection

- Adds fullness to the vocal cord to help it better appose the other side
- Injection technique is similar regardless of material used
- Injection into thyroarytenoid/vocalis
- Injection can be done endoscopically or percutaneously
- Poor correction of posterior glottic gap
Management – Unilateral Paralysis
Vocal Cord Injection

- External landmarks – several mm anterior to oblique line horizontally, midpoint between thyroid notch and inferior thyroid border vertically
Management – Unilateral Paralysis
Vocal Cord Injection
Management – Unilateral Paralysis
Vocal Cord Injection
Management – Unilateral Paralysis
Vocal Cord Injection
Management – Unilateral Paralysis
Vocal Cord Injection - Materials

- Teflon
- Fat
- Collagen
  - Autologous Collagen
  - Homologous Micronized Allo derm (Cymetra)
  - Heterologous Bovine Collagen (Zyderm)
- Hyaluronic Acid
- Calcium Hydroxyapatite gel (Radiance FN)
- Polydimethylsiloxane gel (Bioplastique)
Teflon - the first biosynthetic material specifically designed for implantation

- **Advantages**
  - Inexpensive and easily administered
  - Immediate voice improvement

- **Disadvantages:**
  - Irreversible
  - Granuloma formation leads to vocal cord stiffening
  - Migration
  - Useful mainly in terminal patients
Management – Unilateral Paralysis
Vocal Cord Injection

- Fat
  - Use first reported by Brandenberg 1987
  - Overcorrection is necessary – about 50%
  - Resorption in months to years
Management – Unilateral Paralysis
Vocal Cord Injection

○ Fat Injection
  ● Hsiung et al. divided failures into two categories
    ○ Early
      ● failure of fat to soften scarred segments
      ● large glottal gap
      ● large posterior defect
    ○ Late
      ● due to absorption of fat
Management – Unilateral Paralysis
Vocal Cord Injection

- Homologous Collagen
  - Cymetra (LifeCell Corp.)
    - Micronized AlloDerm
    - Reconstituted with Lidocaine or Saline
    - Lasts 3-6 months
    - Requires low volume (~0.2ml) when placed just deep to the vocal ligament in the vocalis muscle (varies with dilution)
  - Injection into superficial lamina propria must be avoided or rigidity of cord will occur
Management – Unilateral Paralysis
Vocal Cord Injection

- Heterologous Collagen
  - Zyderm
    - Bovine collagen
    - May cause immune reaction in 1-2% of cases
    - Does not last as long as micronized allogenic alloderm (Cymetra)
Management – Unilateral Paralysis
Vocal Cord Injection

- Calcium Hydroxyapatite gel
  (Radiance FN; BioForm)
  - Composed of small spherules of CaHydroxyapatite
  - No granuloma formation
  - Currently under study

- Polydimethylsiloxane gel
  (Bioplastique; Bioplasty)
  - Widely used in Europe, not approved for U.S.
  - Sustained phonatory improvement up to 7 years
Management – Unilateral Paralysis
Type I Thyroplasty

- First described by Payr and reintroduced by Ishiki in 1974
- Variety of materials used for implants
  - Autologous Cartilage
  - Silastic
  - Hydroxyapatite
  - Gore-Tex
  - Titanium
- Useful for anterior glottic gap
Management – Unilateral Paralysis
Type I Thyroplasty
Management – Unilateral Paralysis
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Type I Thyroplasty
Management – Unilateral Paralysis
Type I Thyroplasty

○ Advantages:
  ● Permanent, but surgically reversible
  ● No need to remove implant if vocal function returns
  ● Excellent at closing anterior gap

○ Disadvantages:
  ● More invasive
  ● Poor closure of posterior glottic gap
Management – Unilateral Paralysis
Type I Thyroplasty – Gore-Tex

- Gore-Tex
  - Homopolymer of polytetrafluoroethylene in minute beads in a fine fiber mesh
  - Minimal tissue reaction
  - Cut into long 3mm wide sheet for use
  - Thyrotomy window drilled to 6-8mm long using a 2mm burr 1cm posterior to midline and 3 or 4mm above lower edge of thyroid
  - Undermining of perichondrium 4-5mm posterior and inferior to window prior to insertion
  - Insertion under endoscopic visualization with patient awake
Management – Unilateral Paralysis
Type I Thyroplasty – Gore-Tex
Complications
- Extrusion/Displacement (Intraoperative vs Postop)
- Misplacement – most often superior
- Infection
- Undercorrection – important to overcorrect by 1-2mm

Controversies
- Location of graft placement
- Status of inner perichondrium
  - Many series have shown low extrusion rate with sacrificed perichondrium
Management – Unilateral Paralysis
Type I Thyroplasty – Variations

- Many variations have been proposed to address the posterior gap
- When arytenoid is displaced, the implant is permanent because of scarring in the CA joint
- Hong et al.
Management – Unilateral Paralysis

Results

(These movies may not be available online)
Management – Unilateral Paralysis

Arytenoid Adduction

- Arytenoid Adduction
  - First described by Ishiki with modifications by Zeitels and others
  - Addresses posterior glottic gap by pulling arytenoid into adducted position
  - Difficult to predict which patients will benefit preoperatively.
  - Most advocate use in combination with anterior medialization
Management – Unilateral Paralysis

Arytenoid Adduction
Management – Unilateral Paralysis
Arytenoid Adduction

A

B
Endoscopic Approaches

Suture Placed to Cricoid Cartilage
- Simulates action of lateral cricoarytenoid

Zeitels Modification – Arytenopexy
- Presumably allows a more physiologic positioning of the arytenoid
- Involves suturing the arytenoid in a more posterior and medial position to allow more tension on flaccid cord
- Cricothyroid subluxation mimics action of cricothyroid muscle
- Modifications should be used selectively
Management – Unilateral Paralysis
Arytenoid Adduction

- Complications
  - Sutures too tight – may displace arytenoid complex anteriorly, adversely affecting voice
  - Entry of piriform sinus
Management – Unilateral Paralysis
Reinnervation

- Results in synkynetic tone of vocal cord
- Ansa to Recurrent Laryngeal Nerve
- Ansa to Omohyoid to Thyroarytenoid
Management – Unilateral Paralysis
Reinnervation

- Hypoglossal to recurrent laryngeal nerve
- Crossed nerve grafts or wire conduction prostheses from one muscle to its paralyzed counterpart are being researched
Management
Bilateral Abductor Paralysis

- Patients exhibit lack of abduction during inspiration, but good phonation
- Maintenance of airway is the primary goal
- Airway preservation often damages an otherwise good voice
Management
Bilateral Abductor Paralysis

- Tracheostomy
  - Gold standard
  - Most adults will require this
  - Speaking valves aid in phonation
- Laser Cordectomy
- Laser Cordotomy
- Woodman Arytenoidectomy
Bilateral Abductor Paralysis

- **Phrenic to Posterior Cricoarytenoid anastamosis**
  - Allows abduction during inspiration
  - Preserves voice when successful

- **Electrical Pacing**
  - Timed to inspiration with electrode placed on posterior cricoarytenoid
  - Long-term efficacy not yet shown
Bilateral Adductor Paralysis

- Patients have good airway with breathy voice
- Goal is to prevent aspiration and improve phonation while preserving airway
- Aforementioned medialization techniques can be applied
- Patients may need tracheostomy if over-medialized
Conclusions – Key Points

- **Anatomy**
  - TVC positioned at about ½ vertical height of the anterior thyroid cartilage and is anterior to the oblique line

- **Causes of Vocal Cord Paralysis**
  - Iatrogenic (Surgery and intubation #1)

- **Evaluation**
  - Realize that some function may return with time (6-12 months)
Conclusions – Key Points

- Management – Unilateral Paralysis
  - Anterior and Posterior Glottic gap must be addressed
  - Arytenoid adduction is irreversible
  - Continued improvement up to 1yr after Type I thyroplasty

- Management – Bilateral Paralysis
  - Preservation of airway is most important goal
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