Management of Laryngeal Nerve Injuries

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Type of Laryngeal Nerve Injuries

1. Recurrent laryngeal nerve (RLN)
   - Motor supply
     - Vocal fold
     - Pharyngeal wall
   - Sensory supply to pharynx and larynx

2. Superior laryngeal nerve (SLN)
   - Motor supply cricothyroid muscle
     - External branch (pitch control)
   - Sensory to larynx above the vocal fold

Intrinsic Laryngeal Musculature

Controls VF Movement
- Adduction – Closure
  - Thyroarytenoid
  - Lateral cricoarytenoid
  - Interarytenoidus
- Abduction – Opening
  - Posterior cricoarytenoid
- Tension
  - Cricothyroid

Intrinsic Laryngeal Anatomy

Lateral pharyngeal wall
Vallecula
Epiglottis
False vocal fold
True vocal fold
Esophageal inlet
Interarytenoid region
Arytenoid complex
Aryepiglottic fold
Pyriform sinus
**Laryngeal Function - Voice**
- Intrinsic laryngeal muscles approximate vocal folds
- Exhaled air from lungs creates vocal fold vibration
  - Ability of vocal folds to achieve “pre-phonatory configuration”
  - Pliability of vocal fold mucosa – “cover”

**Laryngeal Function - Swallowing**
- Extrinsic laryngeal muscles provide laryngeal elevation
  - Pharyngeal constrictors
  - Cervical strap muscles
- Larynx is pulled up and forward as food bolus is directed through the pyriform sinus – “lateral channels”
- Vocal fold closure occurs late during swallow
  - EMG finding
  - Lessens aspiration of retained food particles
Types of Injury

Unilateral SLN

- Voice
  - Acute – often not noticed and thought secondary to intubation trauma
  - Chronic
    - Mild breathy voice
    - Vocal Fatigue – voice wears out with use
    - Slight reduction in vocal range noted in singing voice
- Physical findings
  - Vocal fold mobile
  - Larynx may "tilt" to side of injury

Types of Injury

Bilateral SLN

- Voice
  - Acute – breathy dysphonia and loss of range
  - Chronic – low pitched speaking voice with inability to elevate pitch and cannot sing
- Physical findings
  - Vocal folds do not elongate
  - Abduction/adduction normal

Endoscopy – Bilateral SLN Injury

Acute
Chronic

Mechanism of SLN Injury

- Transect during dissection of superior pole vessels
  1. Skeletonize superior pole vessels
  2. Identify nerve prior to taking superior vessels
Mechanism of SLN Injury

- Transection during dissection of superior pole vessels
  1. Skeletonize superior pole vessels by dissecting on gland
  2. Identify nerve prior to taking superior vessels
- Minimally invasive surgical techniques
  - Superior pole vessels taken in larger groups
  - May be associated with a higher incidence of SLN injury
  - SLN should be visualized

Types of Injury

Unilateral RLN

- Voice
  - Acute – breathy voice with fatigue
  - Chronic
    - Significant voice change – high or low pitch increased roughness and breathiness
    - Near normal – 30%
- Physical findings
  - Abduction/adduction absent one vocal fold

Endoscopy – Unilateral RLN Injury

Acute

Chronic

Types of Injury

Bilateral RLN

- Voice
  - Acute – breathy voice, loss of range and vocal fatigue
  - Chronic – strain to near normal voice
- Airway considerations
  - Acute – flaccid paralysis may allow adequate respiration
  - Chronic – patients adapt lifestyle to marginal airway
- Physical
  - Bilateral loss of abduction
Endoscopy – Bilateral RLN Injury

Acute
Chronic

Mechanism of RLN Injury

- Dissection of inferior thyroid artery
  - Transection
  - Pressure/stretch

Management Strategies

Acute Injuries

- Best avoided
  - Incidence of RLN injury 0.3-3%
  - Incidence of SLN injury unknown

Management Strategies

Acute Injuries

- Noted nerve injury in OR
  - Suture ends together – increases likelihood of developing vocal tone and voluntary EMG activity
Management Strategies

Acute Injuries

- Noted nerve injury in OR
  - Suture ends together – increases likelihood of developing vocal tone and voluntary EMG activity

- Personal experience with EMG in the management of vocal fold paralysis
  - Unpublished study in 20 patients undergoing thyroplasty for management of chronic UVP
    - EMG performed with needles placed under direct visualization in OR
    - 18/20 with active voluntary potentials
  - Mirrors current clinical experience in performing 3 – 5 laryngeal EMG/month with certified electromyographer

- In the recovery room
    - Suggest acute re-exploration may allow decompression and return of function
    - Small study on 10 patients
    - Little support

- Immediate re-exploration – little support
  - Unilateral paralysis usually observed

- Acute needs for airway management in bilateral paralysis
  - Re-intubate
  - Tracheotomy
  - Suture lateralization
Management Strategies

Acute Injuries

- In the recovery room – Airway management
  - Reintubation
  - Incidence
    - Transient bilateral paralysis up to 5.9% dependent on indication for surgery
    - Permanent bilateral paralysis 1.9%
    - Presentation varied from airway obstruction to only voice complaints
    - Rate of recovery unpredictable

- Reintubation
  - Tracheotomy

- Temporary suture lateralization


Management Strategies

Bilateral Vocal Fold Paralysis - Acute Airway

- During the postoperative visit
  - Re-assure
  - Refer
  - Role of Electromyography
    - Unproven
  - Management of voice and swallowing difficulties

Acute – 3 weeks out
Suture lateralization
Evaluation

- Evaluation of voice
  - Perceptual analysis by trained observer
  - Vocal range, quality, power and endurance

- Laryngeal EMG
  - Diagnostic
  - Guides expectations in cases with partial function

Management – Speech Therapy

SLN Injury

- Eliminate/Reduce maladaptive compensatory behaviors

- Pitch retraining
  - Success is limited

Management – Speech Therapy

RLN Injury

- Eliminate/Reduce maladaptive compensatory behaviors

- Vocal function exercise
  - Sustained vowel sounds with appropriate airflow
  - Strengthen vocal folds
  - Suggested to aid in return of function
    - Empiric evidence is limited

Management – Surgery

Acute Unilateral RLN

- Indications
  - Breathy dysphonia preventing patient from working
  - Aspiration
  - Need to improve cough for pulmonary function

- Injection laryngopalsty with temporary agent
  - Collagen
  - Glycerin based

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Injection Laryngoplasty for Unilateral Vocal Fold Paralysis

Historically - Injection into paraglottic space for the management of unilateral paralysis – “…to restore the ability to laugh.”

Limitations of Injection Laryngoplasty

Ability to restore pre-phonatory glottic configuration

Injection Substances

- Teflon®
- Fat
- Fascia
- Collagen
  - Cymetra®
  - Cosmoplast®
  - Zyderm®
- Calcium hydroxylapatite
- Hyaluronic Acid - Radiesse®
- Glycerine – Radiesse Voice Gel®

Percutaneous Injection Techniques
Percutaneous Injection Techniques

Direct Microlaryngoscopy Injection Techniques

- Microscopic guidance
- Placement - Deep to vocal ligament
- Membranous vocal fold
**Management – Surgery**

**Chronic Unilateral RLN**

- **Indications**
  - Dysphonia
  - Failure of speech therapy

- **Injection laryngoplasty with “permanent” agent**
  - Similar to temporary agent

**Considerations for Successful Surgery**

1. Laryngeal anatomy and physiology for voice
   - Vocal fold resting position
   - Neurologic tone

2. Patient vocal behaviors
   - Desirable
   - Undesirable

- **Speech-Language Pathology assistance**
  - Preoperative
    - Counseling to set realistic goals
    - Therapy to reduced hyperfunction – “unload”
  - Postoperative therapy

3. Surgical techniques
   - Continuous laryngeal visualization
   - Vocal process
     - Position 3-dimensional
     - Stabilization with arytenoid adduction
Laryngeal Function after Unilateral Paralysis

- Dependent on ability to achieve closure in three dimensions
  - Horizontal
  - Vertical
- Asymptomatic - 30%
- Patients with poor closure in any dimension will have greater symptoms
  - Breathy dysphonia
  - Loss of glottic valving
  - Aspiration

Patient Selection

- "Ideal"
  - Non – anxious
  - Cervical mobility
  - Voice characteristics
    - Breathy not strained
    - Patient should be "unloaded" by SLP prior to intervention

Operative Set-up

- Suspended fiberoptic laryngoscope
- Video tower
- Turn patient 180° from anesthesia
- Head of bed elevation
- Neck extension
Operative Set-up

Anesthesia

- Do not over sedate

- Infusion/drip
  - Dexmetomadine – short acting alpha-2 agonist
    - Reduce anxiety
    - Minimal sedation
  - Propofol – short acting potentiation of GABA-A receptor
    - Reduces anxiety
    - Sedating
    - Causes apnea

Sedation - Systemic

- Do not inject to toxic levels

- Xylocaine 1% with Epinephrine 1:100,000
  - Short acting – 1 hour
  - Mixed 1 to 1 with

- Marcaine ½% with Epinephrine 1:200,000
  - Longer acting up to 4 hours

Surgical Intervention

- Goals
  - Medialize the immobile vocal fold in the horizontal plane
  - Adjust the height of the vocal fold in the vertical plane

- Improve glottic closure

- Procedures
  - Medialization Laryngoplasty (ML)
  - Arytenoid Adduction (AA)
Surgical Intervention

- Type I thyroplasty with carved silastic block
  - Adjusts medial/horizontal position
  - Awake with local anesthesia
  - Flexible endoscopic visualization of larynx

- Arytenoid Adduction
  - Adjusts vertical position
  - If voice results and laryngeal configuration are not adequate from medialization alone

Intraoperative Monitoring of Vocal Fold Position

- Continuous
- Provides visual feedback to surgeon
  - Patients cannot always cooperate
  - Allows identification of vocal fold level
  - Allows observation of supraglottic configuration during phonation

Medialization Laryngoplasty
Instrumentation

Preparing the Implant

Medialization Laryngoplasty
Medialization Laryngoplasty with Arytenoid Adduction

Preoperative

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Conclusions

- Injury is best avoided
- Recognition in OR
  - Primary repair if possible
- Little support for re-exploration
- Airway management in setting of acute obstruction
  - Tracheotomy
  - Suture lateralization

Medialization Laryngoplasty with Arytenoid Adduction

Postoperative

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Conclusions

- Expectant management for nerve recovery
  - 30% develop enough return of tone that voice is adequate
- Surgical management of acute injury is indicated when voice demands are significant
- Outcomes of management for chronic unilateral paralysis with vocal repositioning techniques are good to excellent