Paradoxical Vocal Fold Motion (Vocal Cord Dysfunction) Evaluation and Treatment

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Disclosure

- Relevant financial relationships
  None

- Off-label/investigational uses
  None
Overview

• Historical perspective of PVFM diagnosis and therapy
• Understand laryngeal hyper-sensitivity
• Apply neuropathic pain concepts to disorders of larynx
• Understand laryngeal hyper-responsiveness
• Evaluation of paradoxical vocal fold motion (PVFM)
• Treatment paradigm for PVFM
History of Paradoxical Vocal Fold Motion

• “Hysterical croup” – 1842 by Robley Dunglison.
  Disorder of laryngeal muscles in hysteric females.
• “Laringismus stridulus” – 1842 by Austin Flint
  Described similar syndrome in two male adults.
• First visual observation of vocal folds adducting during inspiration in hysteric adults with stridor – 1869 by MacKenzie.
• “Spasm of the muscles may occur with violent inspiratory efforts and great distress…Extraordinary cries may be produced either inspiratory or expiratory” – 1902 by Sir William Osler.
• “Purely psychogenic”

No other literature until 1974

- Patterson, Shatz, & Horton, 1974. 33 y/o woman with 15 hospital admissions. **Munchausen’s stridor**
- **Non-organic upper airway obstruction** (Cormier, Camus & Desmeules, 1980)
- **Factitious asthma** (Downing, Braman, Fox, & Corrao, 1982)
- **Paradoxical vocal cord motion** (Kellman & Leopold, 1982)
- **Emotional laryngeal wheezing** (Rodenstein, Francis, & Stanescu, 1983)
Vocal cord dysfunction presenting as asthma (Christopher, Wood, Eckert, Blager, Raney, & Souharda, New England Journal of Medicine, 1983):

- 5 patients with history of failed treatments for asthma
- Episodic dyspnea/SOB, mostly with inhalatory stridor
- Concomitant cough, laryngospasm and “choking.”
- No “Munchausen’s stridor” or “factitious asthma”
- Laryngoscopy confirmed abnormal glottic closure on inspiration
- Variable extrathoracic airway obstruction on PFTs
- Functional stridor
“Vocal cord dysfunction presenting as asthma”
Christopher et al., 1983

- Study conducted by University of Colorado Health Sciences and National Jewish Hospital, Denver, CO
  - Division of Pulmonary Sciences and department of Otolaryngology and Speech Pathology
- “Relaxed throat breathing technique”
  - Created by Florence Blager, SLP at National Jewish
    - Combination of respiratory retraining techniques for pulmonary diseases, voice therapy, and theater background.
  - Still used today
Now… the bigger picture
Primary

Laryngeal Sensory-Motor Dysfunction

Secondary (LHR)

Chronic Cough
PVFM
Dyspnea

Globus Pharyngeus

Muscle Tension Dysphonia

Muscle Tension Dysphagia

Breathing

Sensation

Voice

Swallow
Laryngeal Sensory and Motor Function

• Closely tied to the sensory function with protective reflexes
  • Larynx is highly reflexogenic
    • Mechanosensitivity
    • Chemosensitivity
    • Thermal sensitivity (not well researched)
  • Aberrant sensory stimulus can cause laryngeal
    • hypofunction
    • hyperfunction
Peripheral Laryngeal Sensory Nerve Injury

• Results in neuroplastic changes
  • somatosensory information can become distorted
  • This distortion is varied
  • Can include reorganization of structures processing noxious information.

• Postulation
  • Laryngopharyngeal reflux causes the larynx to become
    • Hyper-responsive to chemosensitivity
    • Hypo-responsive to mechanosensitivity

Bradley RM, AJM 2000
Laryngeal Sensory Neuropathy

- Abnormal laryngeal sensation
  - Sensory and motor function are tied to each other
- Larynx becomes hyper-responsive from a minor or even a lack of stimulus
Sensory Neuropathic Dysfunction

**Hyperalgesia**
(hypersensory with low response threshold)

**Paraesthesia**
(abnormal sensation in the absence of stimulus)

**Allodynia**
(sensation triggered by nonpainful stimulus)

Vertigan et al. *Cough* 2014
Sensory Neuropathic Dysfunction

- Applied to the larynx
  - Paresthesia
    - Throat irritation
    - Tickle
    - Tightness
  - Sensation of mucus
  - Sensation of something sticking in the throat
- Leads to laryngeal motor dysfunction
Laryngeal Hyper-responsiveness (LHR)

- AKA laryngeal motor dysfunction
- Response to laryngeal hyper-sensitivity
- Challenging disorder
- Aberrant laryngeal activity
- Peripheral sensory and motor neuropathies
- CNS plays a role per growing body of literature
LHR

• Seen in laryngeal sensory neuropathy
  • Chronic cough
  • Globus pharyngeus
  • Throat clearing
  • Vocal cord dysfunction/paradoxical vocal cord motion
  • General throat discomfort
  • Dysphonia
Most Common Causes of LHR

• Chronic reflux stimulation leading to laryngopharyngeal reflux (LPR)
• Sensory neuropathy
• Habitual muscle misuse
• Emotional stress
• Viral illness

Laryngeal hyper-responsiveness (LHR)

- Chronic Cough & PVFM MTDyspnea
- Globus Pharyngeus
- Muscle Tension Dysphonia
- Muscle Tension Dysphagia
- Breathing
- Sensation
- Voice
- Swallow

Laryngeal muscle tension
Evaluation of PVFM
PVFM

• As opposed to COPD or asthma, PVFM is a laryngeal disorder, not a lung disorder
• Abnormal vocal fold adductory motion during inhalation (partial or full adduction)
• Patients do not desaturate
• Most common symptoms
  • Shortness of breath
  • Chronic cough
• The focus is on improving breathing mechanics, not breathing efficiency (pulmonary perspective)
PVFM – Multidisciplinary Assessment

- Case history
- Voice Handicap Index (VHI)
- Reflux Symptom Index (RSI) (>13 = significant)
- Dyspnea Index (>10 = significant)
- Laryngeal Hypersensitivity Questionnaire (>17.1 = significant)
- ENT - Flexible laryngoscopy
- Pulmonology
  - Flow loop spirometry with challenge
- Allergy
- Patients often see multiple specialists.
PVFM – what to look for

- Non-productive daytime cough
- Shortness of breath with no exercise
  - May be BETTER or WORSE with exercise
- Intermittent hoarseness (45-55% have dysphonia complaint)
  - No visible abnormality in larynx
- Cough with talking
- Cough with eating
- Choking sensation
- Complaints of intermittent reflux or bad taste in mouth
- Minimal or no response to medications
  - PPI, Steroids, Allergy, Inhalers
Laryngeal Hyperresponsiveness
Laryngoscopy Findings

• +/- post nasal drainage
• Supraglottic edema (LPR)
• Hyperactive gag or increased cough
• Supraglottic constriction or spasms
• Glottal incompetency
• Significant adductory vocal fold motion during quiet breathing
• Intermittent vocal fold immobility or hypomobility
Laryngoscopy of PVFM
PVFM -spirometry

• Spirometry shows a fairly normal expiratory curve with flattened inspiratory curve
Management Strategy

1. Control Irritants
2. Address Hypersensitivity
3. Behavioral Modification
Treatments

• Based on underlying causes
  • Inflammatory
  • Rhinologic
  • Sensory neuropathy
  • Other neurological disorders and injuries
• Medical
• Behavioral
• De-enervating
• Other
• Many patients respond to a combined treatment paradigm.
Control Irritants
Multidisciplinary Team

• Must identify the pathology
• Evaluation
  • ENT
  • Speech Pathology
  • Pulmonary Medicine
  • GI
  • Allergy
  • Psychiatry/Psychology
Control Irritants

Sinonasal

**Rhinitis**
- Nasal sprays – corticosteroid vs antihistimine vs combo
- PO antihistamine
- Role of allergist

**Sinusitis**
- Diagnosis: CT, nasopharyngoscopy
- Nasal sprays – corticosteroids
- Nasal rinses
- Abx x 2-3 weeks
- Steroid taper (30 mg x 4 days, 20 mg x 4 days, 10 mg x 4 days)
- Surgery
Control Irritants
Laryngopharyngeal Reflux

GERD vs. LPR

- GERD = problem of LES
- LPR = problem of LES & UES
- Reflux events – 50 vs. 4
- Laryngopharynx epithelium vs. esophageal
- Carbonic anhydrase enzyme absent in LPR
Mechanisms Linking Reflux and Cough
Jaclyn Smith, MB, ChB, PhD University Hospital of South Manchester, UK

• Esophago-bronchial reflux
  • Convergence of vagal afferents from the airway and esophagus allow esophageal stimuli to evoke cough and PVFM responses

• Laryngopharyngeal reflux
  • Reflux into the larynx may cause chronic laryngeal inflammation, sensitizing nerve terminals and stimulating cough receptors

• Micro aspiration
  • Refluxate enters the airway, leading to chronic inflammation and stimulating airway cough receptors.
Mechanisms Linking LPR and Cough

Jaclyn Smith, MB, ChB, PhD
University Hospital of South Manchester, UK
Laryngopharyngeal Reflux
Endoscopic Findings

- Post-cricoid edema
- Interarytenoid thickening
- Arytenoid erythema and edema
- True vocal fold edema
- Blunted laryngeal ventricles
Laryngopharyngeal Reflux

Laryngoscopy

Periarytenoid Edema

Interarytenoid Hyperplasia
Laryngopharyngeal Reflux pH Probe

• “Esophageal pH testing using pH catheters and wireless pH monitors, once considered the gold standard for diagnosing GERD, have NOT shown adequate sensitivity and specificity for this group of (LPR) patients”

• Pharyngeal probes (Restec) have shown mixed sensitivity and specificity for LPR patients
Laryngopharyngeal Reflux Treatment

- **Dietary and behavioral modifications**
- Drug Therapy
  - PPI
  - H2 blocker
- American Academy of Otolaryngology-Head and Neck Surgery
  - Twice daily PPI for no less than 6 months
- American Gastroenterological Association
  - No treatment unless concomitant esophageal GERD
- However, care should be taken when deciding on empirical treatment.
Address Hypersensitivity
Neuromodulators

Gabapentin and Pregabalin
- Inhibit voltage-gated calcium channel release
- Exact mechanism in cough not understood
- Gabapentin vs. placebo studies showed improved QOL and reduced cough frequency and severity in those on gabapentin
- Improvements not sustained after treatment cessation

Amitriptyline
- Reduces sensory threshold of afferent nerve endings
  - Improves cough reflex
  - Jeyakumar et al. study
    - Compared amitriptyline to codeine/guaifensin
    - 86.7% had > 50% improvement vs. 7.7%
  - Bastian et al. found sustained cough relief 20 days after medication cessation
    - > 50% improvement in 6/8 patients
Behavioral Treatment
Respiratory Retraining

• Breathing rhythm
• Breathing location
  • Lower thoracic
• Breathing rate
  • Change speeds
• Not traditional voice therapy
  • Approx. half have no voice complaints.

PVFM - Respiratory Retraining

• Dry Sponge Bob analogy
• Cycle of breathing ALWAYS begins with easy exhalation
  • Avoid tightening of the chest muscles
• Slow down breathing
• Exhale and inhale duration are initially equal
• Cueing/distraction may be needed
• Dose escalation when ready
  • Increase speed
PVFM – Respiratory Retraining

- Breathing with resistance
  - Breath trainer (i.e. Expand-A-Lung)
  - Breathe through a straw while utilizing abdominal breathing technique
  - Exhale while sustaining one of several phonemes (Sh, F, or Z). Keep the lips pursed and inhale with control.
  - Focus is on the abdominal movement
  - Slow the breathing
- Pulsed exhalation
  - Produce pulse of air using “ha” or “sha” followed by sniffing in sharply through the nose with the mouth closed.
- Voice therapy exercises based on abdominal breathing foundation
PVFM – Respiratory Retraining

- Practice frequently throughout the day
- Walk to maintain breathing rhythm
  - Use breathing resistance
    - Common straw
    - Pursed lips on Sh, F, or Z
  - Rhythmic breathing through nose and mouth
    - Sitting and standing
    - On steps, bicycle or treadmill
PVFM – Respiratory Retraining
Key Points

• Initial breath in the sequence
  • Always start with easy exhalation

• Transition
  • From exhalation to unforced inhalation
    • First through nose
    • Passive inhalation – do not force air in. “Let air in.”
  • Rhythmic breathing with walking
  • Exhale on even walking rhythm with/without sound
  • Advance from low to high resistance
  • Athletes – mastery to oral inhalation (for swimmers and runners)

• Continuity
  • The patients may feel air hungry at first
  • Early on, sequences should be practiced in sets to avoid tension build up.
Summary

• PVFM requires a multidisciplinary care with comprehensive work up for proper diagnosis

• Thorough history

• Endoscopy – observance of LHR

• Spirometry – Observe inspiratory pattern

• Treatments
  • Medications – stop if it doesn’t help
  • Treat LHR (allergy, LPR, rhinology)
  • Respiratory retraining
  • Counseling – very rare
Questions & Discussion