Exercise Induced Asthma
Vocal Cord Dysfunction

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Disclosures

Unfortunately, none to report
Learning Objectives

- Identify the most common trigger of bronchospasms in individuals known to be asthmatic.
- List the most common clinical manifestations of EIB.
- State the most established diagnostic indicator of EIB.
- Indicate preventative methods that should be considered by those individuals who participate in organized sports who are also known asthmatics.
- Suspect, recognize and manage Vocal Cord Dysfunction as a cause of exercise respiratory distress.
IOC to crack down on asthma claims. USA Today 7/8/2005

- 2004 Olympics
  - 45 athletes who claimed EIA did not have disease.
  - Represents 10% of those who declared asthma.
  - Speculation - “most of the athletes unjustifiably seeking asthma medicine probably were doing so based on faulty diagnoses from their doctors.”
• 1993-2000 61 deaths in athletes during or immediately following competition.
• 81% < 21 years of age.
• 57% Elite or competitive individual
• 10% No Known h/o asthma.

EIA Incidence

School children 9-12%

- Atlanta Olympics 16%
- NCAA 14%
- Nagano Olympics 17%

- Spirometric Testing before and after sport specific challenge.
- Winter Sports 23%
- CC Skiing 50%
Pathophysiology

- Triggers differ from chronic persistent asthma
- Hyperosmolality Theory
- ReWarming Theory
Hyperosmolarity Theory

- Hyperventilation causes airway dessication and consequent increased concentration of solute. Hyperosmolarity and hypertonicity.
- Mediator release
  - Histamines
  - Prostaglandins
  - Leukotrienes
Rewarming Theory

- Hyperventilation causes cooling during the period of exercise followed by rapid airway rewarming upon exercise cessation.
- Small bronchial vessel dilation.
  - Fluid leakage
  - Mediator release
Symptoms

- Wheezing
- Cough
- SOB
- Chest Tightness
- Dry cough that may last for a day after exercise

- Less common
- Abdominal pain
- Muscle cramping
- Dizziness
- Fatigue
- “being out of shape”
Timing

- Generally need at least 5-8 minutes of strenuous exercise.
- Symptoms peak 5-10 minutes after cessation of exercise.
- Slight symptoms during exercise, reduced exercise intensity ➔ symptoms worsen.
- Dissipates at about 30-60 minutes.
Diagnosis

- **Self reported symptoms are not good predictors for EIB.**
  - False-negatives and false positives when symptoms are used as the only criteria for EIB

- **Historical clues**
  - Worse with cold, dry air
  - Worse with higher intense continuous exercise rather than intermittent sports
Examination

- ENT - observe for:
  - Nasal allergies
  - Sinusitis
  - Otitis
  - Cardiac exam - murmurs, arrhythmias
  - Chest exam - wheezes, rhonchi or rales
Exercise Challenge Spirometry

- Baseline + Post exercise.
  - 6-10 minutes vigorous exercise.
    - Longer leads to a blunted FEV$_1$ drop.

- 15% Drop to FEV$_1$
  - IOC - 10% Drop to FEV$_1$

- Testing may have to be done in the athletes usual environment to induce symptoms.
  - Difficult to control temperature and humidity.
Surrogate Testing

- Achieve 6-8 minutes exercise at 80%-85% predicted HR Max in a dry, air-conditioned environment.

- **EVH** - Eucapnic voluntary hyperventilation
  - Specific for EIB
  - Not available in most offices or hospitals.

- **Methacholine challenge**
  - Does not predict EIB as well as newer tests
  - Available in physician offices and hospitals.

- **Inhaled mannitol test**
  - As accurate as the EVH
  - Not available in the U.S.
Treatment

- Nonpharmacologic
- Pharmacologic
EIA Refractory Period

- ~50% of EIA sufferers.
- Initial bronchospasm improves; further exercise results in less intense or no bronchospasm - tachyphylaxis.
- This refractory period may last 1-4 hours.
- May be most applicable to start and stop type sports.
- Practical implications- warm up may induce the bronchospasm which then abates and then athlete enjoys a symptom free interval.
Warm up experiment


8 x 30 second treadmill sprint w/ 45 second rest periods vs Inhaled ventolin vs. both.

- Control; warm up only; ventolin inh; combined

- Control - 18.25% drop in postexercise FEV1
- Warm up - 9.1% drop in FEV1
- INH ventolin - 8.9% rise in FEV1
- Combined - 15.2% rise in FEV1
Treatment Nonpharmacologic

- Sport Choice
- Induce Refractory Period
  - 30-60 minutes before exercise; Achieve 60% VO$_2$max. Rest 30 minutes.

- Surgical mask or scarf; Nasal breathing?
  - Beuther DA, Martin RJ. Chest. 129(5) Efficacy of a Heat Exchanger Mask in Cold Exercise-Induced Asthma

- Dietary??
  - Low Sodium diets.

- Fish Oil?

- Avoid pollutants
Treatment Pharmacologic

- Treat Asthma if it exists
- Medication Choices
  - Short-acting $\beta_2$-agonists
  - Long-acting $\beta_2$-agonists
  - Inhaled corticosteroids
  - Mast cell stabilizers
  - Inhaled anti-cholinergics
  - Leukotriene inhibitors
Pre-exercise prevention

Short-acting $\beta_2$-agonists

- $\beta_2$ agonist 15 minutes before exercise
  - Effective in 90% of patients
  - Albuterol (Ventolin); terbutaline; metaproterenol (Alupent); Pirbuterol (MaxAir) and formoterol (Foradil)

- Cromolyn sodium (Intal)
  - 40% effective; 73% some protection

- Nedocromil (Tilade)
Daily Controller medications

- Inhaled corticosteroids
- Leukotriene receptor antagonist
  - Zafirlukast (Accolate)
  - Montelukast (Singulair)
- Long-acting $\beta_2$-agonists
  - Salmeterol
    - Suffers tachyphylaxis, lower effectiveness with chronic usage.
- Combo
  - Advair
    - Also may have tachyphylaxis
Emerging Therapies

- **Symbicort - inhaled combo**
  - Bedesonide
  - Formoterol - quick-onset, long acting $\beta_2$ agonist

- **Phosphodiesterase-4 inhibitors**
  - Roflumilast
  - Cilomulast

- **Low molecular weight heparin**

- **Fish Oil Capsules**
  - 10 Elite w/ EIB; 10 Elite w/o EIB. Double Blind Crossover with fish oil or placebo qd for 3 weeks.

  - Postexercise FEV$_1$ drop 3%, compared to 14% in controls
Caring for the Elite

• Oral beta-agonists and systemic steroids are banned.
• Inhaled beta-agonists, nasal steroids, inhaled steroids require a TUE - Therapeutic Use Exemption.
• [www.wada-ama.org](http://www.wada-ama.org)
• [www.usantidoping.org](http://www.usantidoping.org)
Still having trouble breathing with exercise?

Exercise breathing problem

= EIA

Not Working
All that wheezes is not asthma
Vocal Cord Dysfunction: Don't Mistake It for Asthma

Susan M. Brugman, MD; Stephen M. Simons, MD

THE PHYSICIAN AND SPORTSMEDICINE - VOL 26 - NO. 5 - May 98

- Normal Vocal Chord function
  – Abduction during inhalation
  – Slight adduction at end-expiration
- VCD -cords abnormally adduct during inspiration
Vocal Cord Dysfunction
Very Confusing Disorder
Breathing disorder can be difficult to detect

Sally Gallena, a speech-language pathologist, clinical supervisor and instructor at Loyola College in Maryland, works with Colleen Murphy, a Radford field hockey athlete who has VCD. "The thought of not being able to get a breath in . . . was very scary," Murphy says.

By Vicki Michaelis, USA TODAY
VCD DEFINITION

- Spectrum of non-organic disorders
- Involves larynx and/or periglottic structures
- Acute upper airway obstruction occurs when the VC’s close paradoxically on inspiration or the supraglottic structures prolapse or constrict
VCD TERMINOLOGY
(a sample of 68 terms)

- Paroxysmal vocal cord motion
- Laryngoneurosis
- Psychosomatic wheezing
- Functional upper airway obstruction
- Hysteric croup
- Pseudoasthma
- Fictitious asthma
- Adult spasmodic croup
- Episodic paroxysmal laryngospasm
- Irritable larynx syndrome
- Munchausen’s stridor
- Parosysmal vocal fold dysfunction
Incidence of VCD 1994-2005

- Urban ER: 22%
- Elite Athletes: 5%
- NJC Adult: 40%
- NJC Peds: 10%
- Military: 10%
- Euro Clinic: 3.1%
- Asthma Hosp: 2.4%
# VCD DEMOGRAPHICS
1966 - 2005 (206 citations)

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Adult</th>
<th>Peds</th>
</tr>
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<tbody>
<tr>
<td># Patients</td>
<td>1,495</td>
<td>1,167 (78%)</td>
<td>328 (22%)</td>
</tr>
<tr>
<td>% Males</td>
<td>25</td>
<td>23</td>
<td>29</td>
</tr>
<tr>
<td>% Females</td>
<td>75</td>
<td>77</td>
<td>71</td>
</tr>
<tr>
<td>F : M ratio</td>
<td>3.0 : 1</td>
<td>3:1</td>
<td>2.5:1</td>
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<tr>
<td>Median Age (yrs)</td>
<td>30.2</td>
<td>42</td>
<td>12.9</td>
</tr>
<tr>
<td>Range (yrs)</td>
<td>0.02 - 82</td>
<td>19-82</td>
<td>0.02 - 18</td>
</tr>
<tr>
<td>Mean Duration Sx (mos)</td>
<td>27</td>
<td>31</td>
<td>7.6</td>
</tr>
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HOW DO WE DIAGNOSE VCD?

- History
- PFT’s
- Measures of oxygenation
- Laryngoscopy
Questions for Active Patients if Vocal Cord Dysfunction Is Suspected

• Do you have more trouble breathing in than breathing out?
• Do you experience throat tightness?
• Do you have a sensation of choking or suffocation?
• Do you have hoarseness?
• Do you make a breathing-in noise (stridor) or a breathing out noise (wheezing)?
• How soon after exercise starts do your symptoms begin? How quickly do symptoms subside?
Questions for Active Patients if Vocal Cord Dysfunction Is Suspected

- Do symptoms recur to the same degree when you resume exercise?
- Do inhaled bronchodilators prevent or abort attacks?
- Do you experience numbness and/or tingling in your hands or feet or around your mouth with attacks?
- Do symptoms ever occur during sleep?
- Do you routinely experience nasal symptoms (eg, postnasal drip, nasal congestion, runny nose, sneezing)?
VCD triggers

- URI
- Exposure to smoke, chemicals, pollution
- Emotional stress
- GERD
- Cold air
- Exercise

- Remember cords two functions
  - Phonation
  - Airway protection
Symptoms

- SOB
- Cough
- Stridor
- Wheeze
- Voice Change
- Chest Tight
- Throat Tight

Scale:
- 0
- 25
- 50
- 100
Important to find out when symptoms occur

- Early in the activity v. late
- Practice v. competition
- Major races v. other races
- Environmental conditions
- Exposures
Physical examination

- Typically normal at rest
- Look for evidence of upper airway inflammation.
  - Rhinitis
  - Postnasal drip
  - Pharyngeal erythema
- Stridor may be noted
  - Post-exercise
  - High stress
Diagnostic tests

– PFTs
VARIABLE SEQUENTIAL FLOW/VOLUME LOOPS IN A VCD PATIENT

FLOW (L/sec) vs VOLUME (L)
RATIO OF EXPIRATORY TO INSPIRATORY FLOWS AT 50% OF THE VITAL CAPACITY

\[
\frac{\text{FEF}_{50}}{\text{FIF}_{50}} = 0.64
\]
FLOW VOLUME LOOPS IN A 15 YO GIRL WITH VCD

FEF50/FIF50 = 20  
FEV1 = 82% pred.

FEF50/FIF50 = 20  
FEV1 = 85% pred.

FEF50/FIF50 = 0.64  
FEV1 = 121% pred.

June 12, 1996  
June 13, 1996  
July 2, 1996
16 yo Male Wrestler

- Previously healthy
- Past hx EIA, well-controlled
- Viral URI x 1 wk
- Persistent throat tightness
- Inability to compete

\[ FEV_1 = 106\% \]
\[ FEV_1 / FVC = 0.88 \]
\[ FEF_{50} / FIF_{50} = 2.46 \]
Direct Laryngoscopy
Normal Mid-Inspiratory Glottis

Closed Mid-Inspiratory Vocal Cord Adduction

Mid-Inspiratory Vocal Cord Adduction with Posterior Chinking

Mid-Inspiratory Prolapse of Periglottic Structures into Glottic Airway
Laryngoscopy Findings during VCD Attacks 1996-2005 (n=697)

- VC-I
- VC-I + E
- Chink
- Inflam
- VC-E
- Nml-sx
- Malacia
- Constric

% total
<table>
<thead>
<tr>
<th>Feature</th>
<th>VCD</th>
<th>EIA</th>
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<tbody>
<tr>
<td>Female preponderance</td>
<td>3:1</td>
<td>1:1</td>
</tr>
<tr>
<td>Chest tightness</td>
<td>+/-</td>
<td>+</td>
</tr>
<tr>
<td>Throat tightness</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Stridor</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Usual onset of symptoms after beginning exercise (min)</td>
<td>&lt;5*</td>
<td>&gt;5-10</td>
</tr>
<tr>
<td>Recovery period (min)</td>
<td>5-10</td>
<td>15-60</td>
</tr>
<tr>
<td>Refractory period</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Late-phase response</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Response to beta-agonist</td>
<td>-</td>
<td>+</td>
</tr>
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VCD Prevalence

- Unknown
  - Literature is largely case based.
  - 76 different names to describe disorder
- National Jewish Hospital in Denver
  - Referral Center
  - “Asthma” recalcitrant to treatment
  - 10% due to VCD
  - 30% coexist with EIA
    - 40% in pediatrics
Conclusions: Five percent of athletes were IS +, with EIB comorbidity observed in 53% of these subjects. Misdiagnosis of IS as EIB is common. The lack of a β2-agonist response in combination with postexercise serial spirometry can be useful in excluding solitary IS and confirming EIB diagnosis.
Disclosing VCD Diagnosis

- Numerous provocative names may frighten patient. Munchausen’s stridor, psychogenic stridor, poor performance stridor.

- Disclose diagnosis tactfully. Prefer Vocal Cord Dysfunction or paradoxical vocal fold motion.

- Remind patient of the protective role of the vocal cords.
Treatment Modalities for Vocal Cord Dysfunction

**Acute Treatment**
- Ask the patient to pant or cough
- Administer inhaled oxygen or heliox

**Long-Term Treatment and Prevention**
- Disclose the diagnosis carefully
- Discontinue unnecessary medications
- Refer for speech therapy
- Refer for psychotherapy, if indicated
- Refer for relaxation therapy/biofeedback
- Botulinum Toxin
Treat CoMorbidities

- URI
  - decongestants

- Allergies
  - antihistamines, nasal steroids

- Asthma
  - inhaled steroids, beta agonists

- GERD
  - PPI or H2 Blocker
Speech Therapy Goals
3-5 sessions

- Reduce tension in the extrinsic muscles
  - “wide open throat” breathing
- Reduce tension in the neck and shoulders
- Focus attention away from inhalation
- Increase awareness of early warning signs of an attack
- Empower patients to take voluntary control of their breathing
1. Tightening/relaxing exercise allows the athlete to recognize and control muscular tightness/tension throughout their body. In a relaxed environment, the therapist trains the athlete to perform a series of voluntary muscular contractions/relaxations across several different muscle groups with emphasis on identification of muscular tension.
Speech Pathology

2. Diaphragmatic or low breathing allows the athlete to decrease upper body tension by retraining the abdominal muscles to expand during inhalation, thereby decreasing the tension in the chest, shoulder, and neck regions.
3. Breathing recovery allows the athlete to control or prevent an impending VCD attack. The athlete is trained to inhale (sniff) quickly through their nose (a behavior which reflexively causes vocal fold abduction) at the first sign of an impending VCD event. The nasal inspiratory technique should be followed by slow and relaxed exhalation through pursed lips or while producing the ‘s’ sound.
Breathing at Rest
References

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- Rundell - Chest 2004;125:909-15
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