

EXERCISE INDUCED ASTHMA

Background

1. Definition: Exercise induced symptoms of asthma in patients who have asthma.
 - Exercise induced bronchoconstriction is airway obstruction with exercise without presence of chronic asthma.

Pathophysiology

1. Pathology of dz
 - Hyperosmolarity theory
 - Hyperventilation during exercise causes evaporative water loss
 - Water loss causes hypertonicity/hyperosmolarity of cells
 - Change in cell composition causes release of bronchoconstricting mediators
 - Histamine
 - Prostaglandins
 - Leukotrienes
 - Airway rewarming theory
 - Large volume of cold air overwhelms ability of airways to warm air
 - Cold air reaches distal airways causing airway narrowing and edema
 - Inflammatory mediator theory
 - People that exercise frequently, especially in cold air, develop chronic inflammatory changes
 - Increased levels of IL-8, LTC₄, LTD₄, and histamine
 - TH-2 lymphocytes increased
 - Increased IgE
 - Increased activation of eosinophils
2. Incidence/ prevalence
 - About 10% of pts w/o dx of asthma will have bronchospasm w/exercise
 - Approx. 20.5 million Americans have asthma.ⁱ
 - Between 60-90% of people with asthma experience Exercise-Induced Bronchospasm (EIB)/EIA and consider it a major trigger of asthma symptoms.ⁱ
3. Risk factorsⁱ
 - High ventilation sports
 - Football
 - Basketball
 - Endurance sports
 - Cross country skiing
 - Swimming
 - Long-distance running
 - Winter sports
 - Participation in a location w/environmental pollutants (ex: automobile exhaust, sulfur dioxide, nitrogen dioxide, smoke, ozone, chlorine)
 - Cold temperatures
 - Dry air
 - Allergens, molds, dust, irritants

- Respiratory tract infections
 - Sinusitis
 - Rhinitis
 - Concurrent medications ex: salicylates, NSAIDs, beta-blockers
 - Pre-exercise food: peanuts, celery, shrimp, grain, carrots, bananas
4. Morbidity/ mortality
- Unrecognized and inadequately treated cases increase risk of sudden death in a given athlete
 - All individuals involved in physical activity should be aware of exercise-induced asthma risks
 - morbidity associated w/this disease decreased by specifically training coaches/trainers to recognize and treat exercise-induced asthma

Diagnostics

1. History

- Personal or family hx of asthma
- Symptoms
 - Cough
 - Wheeze
 - Chest tightness
 - Dyspnea
 - Peak at 5 to 10 min into exercise
 - May last up to 60 min
 - Refractory period
 - Period during which repeated exertion causes less bronchoconstriction

2. Physical Examination

- Generally negative when pt is evaluated
- Careful ENT exam
 - Rule out nasal allergies, sinusitis, or otitis
- Careful cardiac exam
 - Rule out cardiac arrhythmias and murmurs
- During exacerbation, will resemble that of an asthmatic
 - Wheeze/ rhonchi
 - Prolonged expiratory phase
 - Poor inspiratory effort
 - Increased work of breathing
 - Nasal flaring
 - Substernal/subcostal retractions

3. Diagnostic Testingⁱ

- Measure change in FEV₁ before and after a standardized exercise challenge test (ECT) on treadmill or bicycle ergometer
 - Gold Standard
 - Minute ventilation must reach the target level in first 4 minutes of the challenge.

- Exercise-induced bronchoconstriction defined by plotting FEV₁ as percentage of pre-exercise baseline FEV₁ at each post-exercise interval.
 - 10% decrease in baseline FEV₁ (i.e., <90% of baseline) generally accepted as abnormal response.
 - Some authors suggest a decrease of 15% (i.e., <85% of baseline FEV₁) more diagnostic of EIB/EIA, particularly if exercise performed in the field^v
- In elite athletes: sport specific challenges, free running asthma screening tests (FRAST), measures of direct bronchial responsiveness to methacholine (MCH), and indirect responsiveness to eucapnic voluntary hyperpnea (EVH) or mannitol.
- EIB/EIA quantified using maximum percent fall index, which is maximum reduction in lung function post-exercise, expressed as a percent of the pre-exercise value.
 - Calculated using formula:

$$\frac{FEV_1 / PEF_{pre-exercise} - \text{minimum } FEV_1 / PEF_{post-exercise}}{FEV_1 / PEF_{pre-exercise}} \times 100$$
 - A result of 50% or more clinically significant

Differential Diagnosis

1. Key Differential Diagnoses
 - Vocal cord dysfunction
 - Central airway obstruction
 - Cystic Fibrosis
 - Laryngomalacia
 - Cardiac arrhythmias
 - Congestive Heart Failure (CHF)
 - Pulmonary or cardiac shunt
 - Gastroesophageal reflux dz
 - Normal physiologic exercise limitation

Therapeutics

1. Acute Treatment
 - Pharmacological pre-treatment
 - Short acting beta-agonist (SABA)
 - Example: albuterol
 - First-line tx, most effective in preventing exercise-induced bronchoconstriction (SOR:A)ⁱ
 - Use: 2-4 puffs given 15 min before exercise as prophylaxis
 - Quick onset of action
 - Provides relief for up to 4 hrs
 - Is rescue medication and can be repeated if prophylaxis ineffective
 - Caution: overuse can lead to tachyphylaxis within 1 wk of regular use; however, medication should not be discontinued if still effectiveⁱ
 - Should be used w/spacer to ensure more efficient medication delivery

- Long acting beta-agonist (LABA)ⁱⁱⁱ
 - Example: Salmeterol
 - 50 mcg x 1, 30-60 min before exercise
 - Caution: can lead to tachyphylaxis within 4 weeks of use; increased risk of sudden death without use of concomitant inhaled corticosteroid
 - Provides protection for 6-12 hrs in first 30 days, then drops to 6 hrs (not applicable if used less than 3 days per week)
 - Mast cell stabilizers (MCS)ⁱ
 - Example: Nedocromil sodium (not available in US)
 - 4 mg, 15-60 min before exercise
 - Example: Cromolyn
 - 20 mg NEB x 1, 10-60 min before exercise
 - Not as effective as SABA
 - Can be used in combination
 - Leukotrine receptor antagonists (LTRA)
 - Example: Singular
 - 10 mg adults, 5 mg children
 - More than 2 hrs before exercise
 - Expect effect from 8-24 hrs
 - Use with caution in patients with history of psychiatric conditions due to possible behavioral side-effects.ⁱⁱⁱ
 - Short-acting anticholinergics (SAAC)
 - Example: Atrovent
 - 2 puffs, 30 min before exercise
 - Decreases mucus
 - Blocks muscarinic cholinergic receptors in bronchial smooth muscle.ⁱⁱⁱ
 - Nonpharmacologic therapyⁱⁱⁱ
 - Physical conditioning
 - Warm up and cool down
 - Nasal breathing
 - Avoidance of cold weather
 - Avoid environmental allergens
 - Face mask or other aid to warm and humidify inhaled air
2. Long-Term Care
- Underlying asthma, which commonly contributes to exercise-induced bronchoconstriction, should be diagnosed and controlled first (SOR:C)ⁱ
 - Control allergy and asthma
 - Antihistamines
 - Intra-nasal steroids
 - Inhaled corticosteroids (ICS)
 - Dietary salt restriction may improve lung function after exercise and possibly base line lung function.^{iv}
 - Very difficult to maintain due to severe sodium restriction (less than 165mmol/day)

Follow-Up

1. Return to play
 - Monitor closely after an acute attack
 - An athlete's peak flow should be >85% of baseline
 - Should be free of wheezing before returning to field of play
 - Incomplete response to "rescue" medications on sideline
 - Restrict from play
 - Refer for further medical evaluation
2. Return to office
 - Routine follow-up yearly; appropriate if symptoms under control
 - Reassess treatment strategies with any exacerbation
3. Refer to specialist
 - For uncontrolled symptoms despite maximal therapy
 - May be utilized earlier in more competitive athletes
4. Admit to hospital
 - For respiratory compromise requiring intubation
 - For exacerbations requiring continuous bronchodilator therapy or continuous oxygen admin

Prognosis

1. Excellent prognosis with proper therapy
2. Should not pose a health risk or limit athletic achievement.

Preventionⁱⁱ

1. Control baseline asthma
2. Avoid known allergens
3. Choose appropriate sports with short bursts of activity
4. Choose warm, humid environments for activities
5. Warm-up before athletic events (take advantage of a 30-90 minute refractory period)

Patient Education

1. Handout from Family Doctor

Evidence Based Inquiries

1. What best prevents exercise-induced bronchoconstriction for a child with asthma?

References

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ⁱⁱⁱ Millward DT, Tanner LG, Brown MA. Treatment options for the management of exercise-induced asthma and bronchoconstriction. *The Physician and Sports Medicine*. 2010 Dec;38(4):74-80.

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^v Guidelines for Methacholine and Exercise Challenge Testing—1999. *Am. J. Respir. Crit. Care Med.* January 1, 2000 vol. 161no. 1 309-329. Available at: <http://ajrccm.atsjournals.org/content/161/1/309.full>

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