

# Exercise-Induced Bronchoconstriction

## EIB



 ADAM

# Case 1

- 14 yo boy, freshman in high school
- Complains of shortness of breath 2 minutes into a mile-run in his first gym class
- Same complains in his 2<sup>nd</sup> gym class
- Parents requesting albuterol inhaler
- No history of asthma
- Normal physical exam

# Case 2

- 20 yo woman who is on the soccer team at a Division 1 college
- Complains of chest tightness and shortness of breath 15 minutes into her practices and games
- No problems when she played soccer in high school
- History of allergic rhinitis with positive skin tests for tree and grass pollens
- No history of asthma

# Case 3

- 16 yo girl who is a junior in high school
- Complains of shortness of breath 3 minutes into each of her first 2 games on the varsity team
- No problems during practices
- No problems in the previous 2 basketball seasons on the freshmen and sophomore teams
- No history of asthma

# Definition of EIB

- Exercise-induced bronchoconstriction (EIB) is the transient narrowing of the lower airways after vigorous exercise
- Occurs in asthmatics and non-asthmatics
- Should not use the term exercise-induced asthma

# Duration of EIB Symptoms

- Symptoms begin during or after exercise and usually worsen 5 to 20 minutes after stopping activity
- Some people experience a “late-phase reaction” 4 to 12 hours after exercising

# Prevalence of EIB

- EIB is found in:
  - ❖ A majority of asthmatics (up to 90%)
  - ❖ 45% of people with allergic rhinitis
  - ❖ 50% of elite athletes
  - ❖ 12% of the general population



# Categories of Athletes

- Elite athletes are highly competitive person who train and compete consistently at higher levels
  - Olympians, professional athletes
- Competitive athletes are persons who engage in strenuous aerobic activity at any level from grade school age and older
  - High school teams, travel teams
- Recreational athletes
  - Most of us?
  - “weekend warriors”

# EIB in Elite Athletes

- Prevalence higher in swimmers, ice skaters, hockey players
- Evidence of chronic airway inflammation caused by many months or years of intense training and inability to adequately humidify extremely large volumes of air

# Etiology of Dyspnea in Athletes (Mix of Elite, Competitive)

- 148 athletes referred to tertiary care center for respiratory complaints with exercise
- 40% have diagnosis of asthma prior to referral
- Diagnoses after evaluation at tertiary center were:
  - ❖ 17% asthma
  - ❖ 70% vocal cord dysfunction
  - ❖ 52% EIB
  - ❖ 8% EIB plus asthma
  - ❖ 31% EIB plus vocal cord dysfunction
  - ❖ 6% asthma plus vocal cord dysfunction

# Medications for treating EIB in Elite/ Competitive versus Recreational Athletes

- Elite and competitive athletes might require maintenance therapy whereas recreational athletes might only require intermittent therapy

# Pathophysiology of EIB

- When we exercise, we need to heat and humidify very large volumes of air
- The most important determinants of EIB are the water content of the inspired air and the level of ventilation
- Respiratory water loss at high ventilation is associated with airway cooling and dehydration and an increase in osmolarity of the airway surface

# Pathophysiology of EIB

- Exercise itself is not necessary to cause narrowing to the airways
- Voluntary hyperpnea of dry air can induce bronchoconstriction
- EIB is accompanied by release of mediators such as eosinophil cationic protein, leukotrienes, prostaglandins, and histamine

# Diagnosis of EIB

- Self-reported symptoms alone are not reliable for diagnosis of EIB
- Exercise challenge (treadmill or ergometric cycle) is not very sensitive
  - ❖ Environmental conditions in the clinic not the same as where the patients exercise
  - ❖ Field challenge is more sensitive but portable equipment is needed
- Eucapnic voluntary hyperpnea is the preferred test for elite athletes
  - ❖ Elite athletes have high  $\text{VO}_2\text{max}$
  - ❖ Unable to reach high enough intensity with exercise challenge in clinic
- Hyperosmolar (4.5% saline) challenge might be of value

# Criteria for Positive Bronchial Challenge

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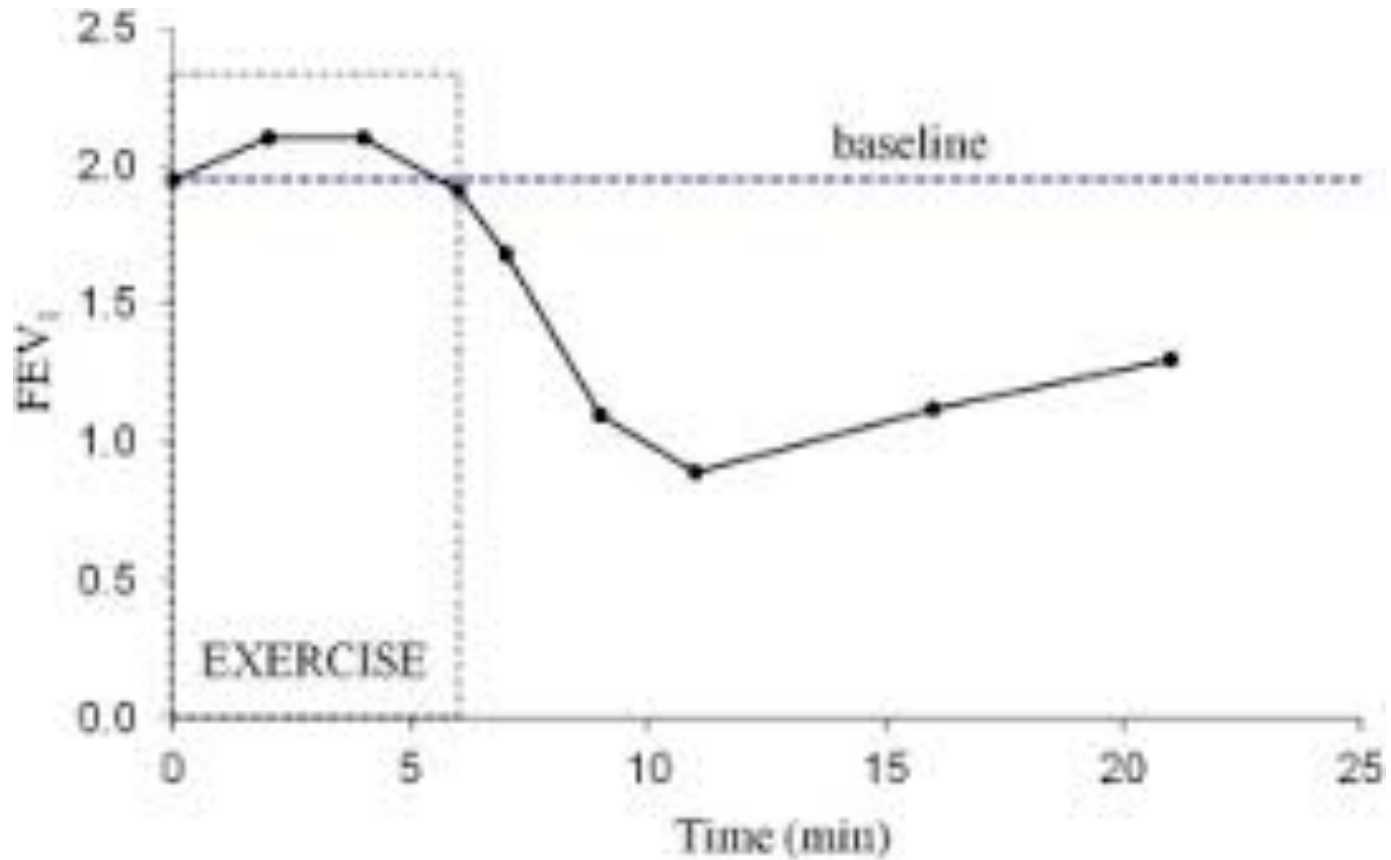
www.medscape.com

Protocol Type	Protocol	Criteria
Bronchodilator	FEV <sub>1</sub> pre and post inhalation of permitted $\beta_2$ agonist	$\geq 12\%$ from the baseline FEV <sub>1</sub> and exceeding 200 mL
Bronchial provocation	Eucapnic voluntary hyperpnea (6 min of dry air)	$\geq 10\%$ decrease in FEV <sub>1</sub> within 30 min of challenge
	Exercise challenge in the laboratory or field (heart rate $> 85\%$ for at least 4 min)	$\geq 10\%$ decrease in FEV <sub>1</sub> within 30 min of challenge.
	Hypertonic aerosol (22.5 mL of 4.5 gm % saline)	$\geq 15\%$ decrease in FEV <sub>1</sub>
	Metacholine test (inhalation of solution 4 mg·mL <sup>-1</sup> —PC20)	$\geq 20\%$ decrease in FEV <sub>1</sub>

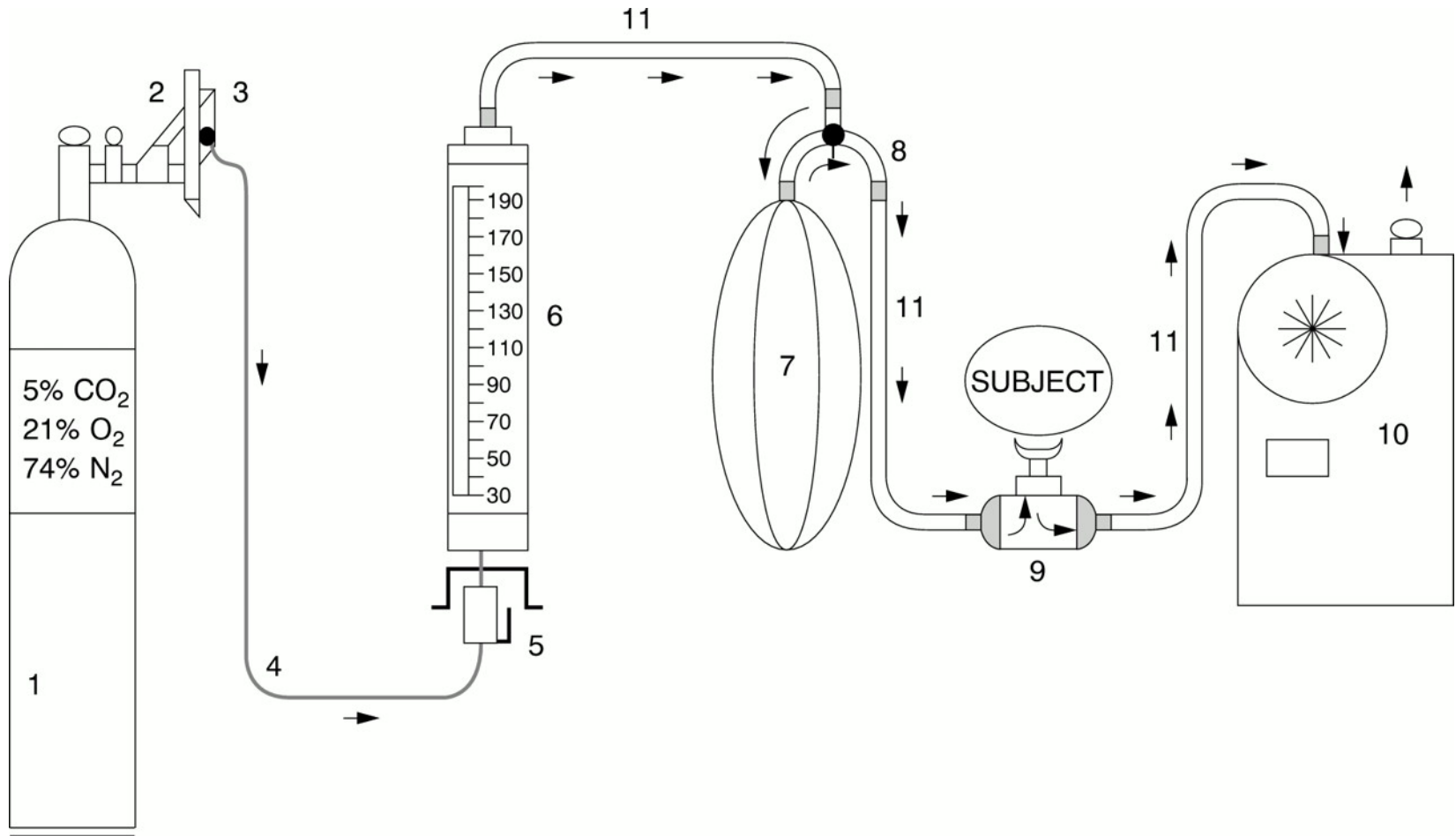
Source: Med Sci Sports Exerc © 2007 American College of Sports Medicine



# Exercise Challenge and FEV1

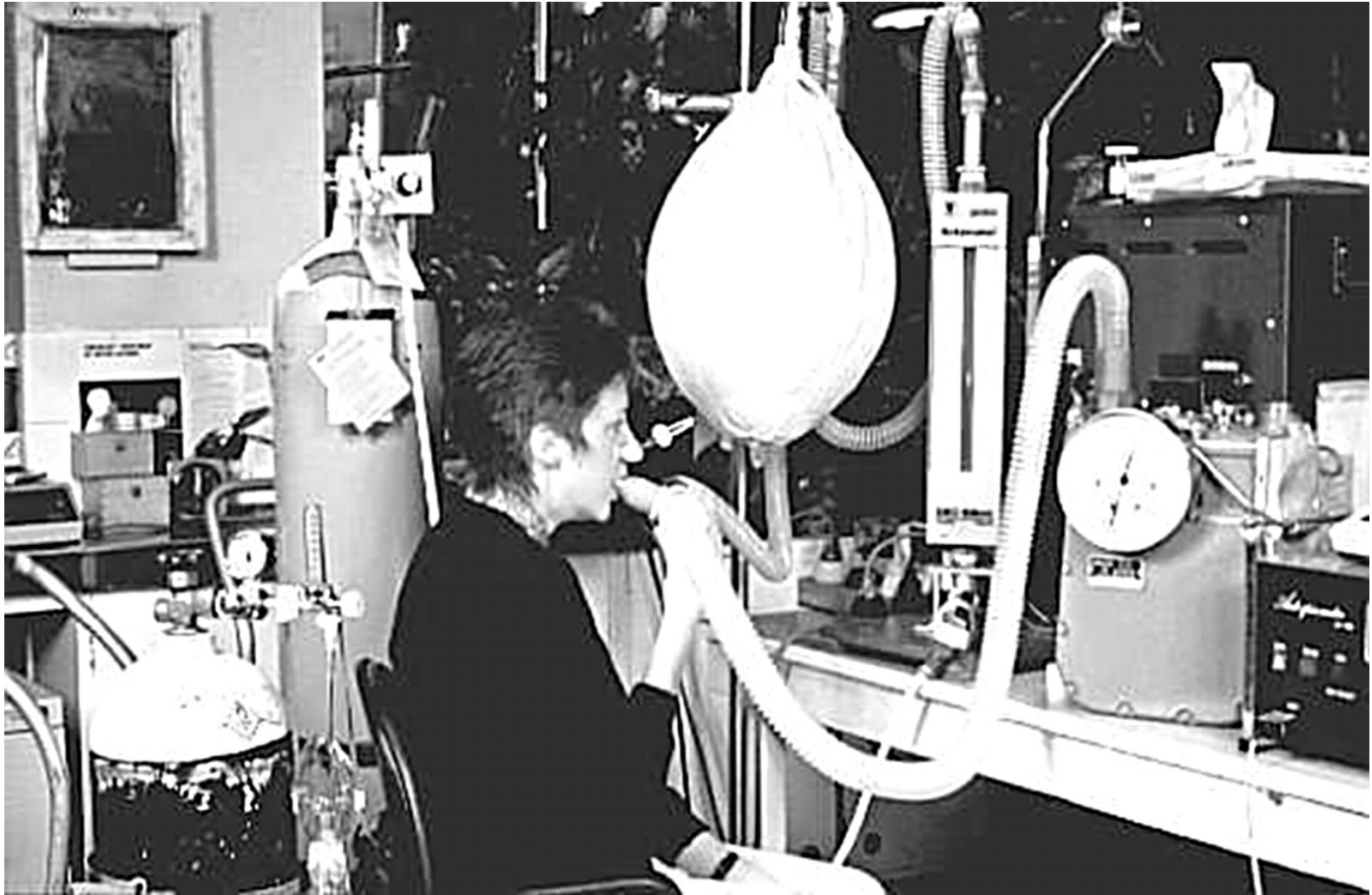


# Equipment for Eucapnic Voluntary Hyperpnoea Test



1, Compressed gas mixture; 2, regulator; 3, demand resuscitator, 30–150 litres/min; 4, high pressure tubing; 5, demand valve; 6, rotameter, 30 to >200 litres/min; 7, meteorological balloon, 100–300 g or a Douglas Bag of 150 litres capacity; 8, metal connector with tap that allows gas to simultaneously enter and leave the balloon (for example, Morgan PKM 90750105 000); 9, low resistance, low dead space volume; 10, gas meter accurate to 1 litre or any other device; 11, hoses, minimum diameter 1.25 inches.

## A subject is shown undergoing a eucapnic voluntary hyperpnoea challenge



Anderson S D et al. Br J Sports Med 2001;35:344-347

# Differential Diagnosis of EIB

- Exercise-induced laryngeal dysfunction
  - ❖ Vocal cord dysfunction
- Exercise-induced hyperventilation
- Skeletal defects (pectus excavatum)
- Diaphragmatic paralysis
- Physiologic limitation
- Psychological factors

# Treatment of EIB

## Beta-2 Agonists

- In asthmatics, ensure optimal control of asthma
- For patients with EIB:
  - ❖ Beta-2 agonists are the most effective
  - ❖ Inhaled short acting Beta-2 agonists before exercise and after exercise if symptoms occur
  - ❖ Long acting Beta-2 agonists provide protection for up to 12 hours

# Treatment of EIB

## Beta-2 Agonists

- Be cautious in daily use of beta-2 agonists
- Daily use can lead to tolerance manifested as a reduction in duration, magnitude, or both of protection against EIB and a prolongation of recovery in response to SABAs after exercise

# Treatment of EIB

## Leukotriene Inhibitors

- Montelukast or zafirlukast
- Daily therapy with leukotriene inhibitors does not lead to tolerance
- Has been shown to attenuate EIB in 50% of patients
- Can be used for intermittent (taken in hour before exercise) or maintenance prophylaxis
- Not effective for reversing airway obstruction

# Treatment of EIB

## Mast Cell Stabilizers

- Consider inhaled cromolyn 20 minutes before exercise
- Shorter duration of action than beta-2 agonists
- No bronchodilator activity
- Can also be added on if beta-2 agonists not completely effective



# Treatment of EIB

## Inhaled Corticosteroids (ICS)

- Consider ICS in combination with other therapies
- ICS can decrease frequency and severity of EIB but not necessarily eliminate it
- ICS might not prevent the occurrence of tolerance from daily beta-2 agonist use

# Treatment of EIB

## Anticholinergic Agents

- Consider inhaled ipratropium for patients who have not responded to other agents
- Its ability to attenuate EIB is inconsistent

# Treatment of EIB

## Other Medications

- Theophylline
- Roflumilast (phosphodiesterase 4 inhibitor)
- Caffeine
- Antihistamines
- Calcium channel blockers

# Treatment of EIB

## Non-pharmacologic Therapy

- Pre-exercise warm-up
- Diet
  - Reduction of sodium intake
  - Fish oil
  - Ascorbic acid (vitamin C)

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