



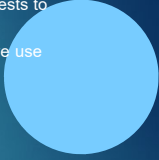

Evaluation and management of asthma

CLAIRE ATKINSON, MD





Disclosures

- I do not have any relevant financial or commercial interests to disclose.
- I do not intend to discuss an unapproved or investigative use of a commercial product/device in my presentation.



Learning objectives

- Evaluation and management of exercise-induced bronchospasm
- Evaluation and management of vocal cord dysfunction
- Evaluation and management of asthma
 - Classifying intermittent versus persistent asthma based on severity and control in children, adolescents and adults
 - SMART (single maintenance and reliever therapy)



Clinical Case #1

- ❑ 16 year old athletic female with diagnosis of asthma
- ❑ Started ICS in 6th grade
- ❑ Presents to clinic for an initial visit and reports symptoms of shortness of breath and chest tightness with physical activity
- ❑ Reports pretreating with albuterol prior to physical activity and reports minimal improvement of symptoms



Clinical Case #2

- ❑ 5 yo female with diagnosis of mild persistent asthma
- ❑ Started on ICS a few months ago with marginal improvement in symptoms
- ❑ Parents report use of nebulized albuterol and albuterol HFA multiple times per week for productive cough and wheeze



Clinical Case #3

- ❑ 12 yo male with diagnosis of severe persistent asthma
- ❑ Dx with asthma at 18 months by Pulmonology
- ❑ Typically requires 3-4 courses of systemic steroids yearly and reports prior hospitalization
- ❑ On high-dose ICS/LABA; has been on ICS since 18 months old



Asthma is characterized by airway inflammation and smooth muscle hyper-reactivity

Sputum, Spasm, & Swelling

Slide courtesy: Dr. Michelle Hernandez

Types of Asthma

Oklahoma ALLERGY & ASTHMA CLINIC

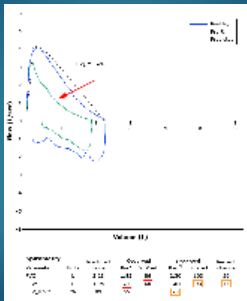
Heckley & Bai: The Journal of Allergy and Clinical Immunology: In Practice 2014;2: 071-080DOI: 10.1016/j.jaip.2014.03.007

Asthma Diagnosis: Objective Testing

- Pulmonary Function Test
 - Obstructive pattern noted in patients with asthma
 - Albuterol challenge pre- and post-PFT to determine reversibility
- Bronchoprovocation
 - Methacholine challenge
 - Exercise challenge
 - Eucapnic voluntary hyperpnea (for athletes): breathing cold dry air x 6 min
- CXR

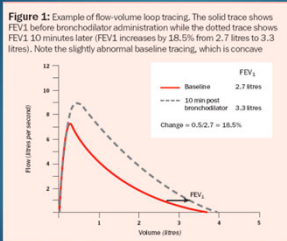
Oklahoma ALLERGY & ASTHMA CLINIC

Obstructive defect on spirometry in a child



<https://www.uptodate.com/contents/se>

Positive bronchodilator challenge in asthma



**Increase FEV1 or FVC (ATS) 12% with increase 200 ml
 **Increase FEF 25-75% of 20-25%

Slide courtesy: Dr. Michelle Hernandez



Exercise-induced bronchoconstriction (EIB)

- Acute onset of bronchoconstriction occurring during or immediately after exercise
- Approximately 5-20% of the general population
- Up to 90% of patients with symptomatic asthma have some degree of EIB
- The magnitude of EIB is most strongly correlated with the underlying degree of airway hyperresponsiveness and the presence of eosinophilic airway inflammation
- Many patients with mild intermittent asthma do not experience clinically significant bronchoconstriction even with strenuous exercise


Slide courtesy: Dr. Michelle Hernandez



Who and why?

- ❑ High endurance sports: swimming, cycling, triathlon and rowing
- ❑ Low endurance sports: gymnastics and sailing
- ❑ Minute ventilation (TV x RR) increases with exercise
 - ❑ Large volume of relatively cool, dry air inhaled during vigorous activity
 - ❑ Inspired gas is more fully humidified and closer to body temperature
- ❑ Probably airway dehydration as a result of increased ventilation → increased osmolarity of airway lining fluid → inflammation
- ❑ Numerous bronchoconstrictive & inflammatory mediators are secreted
 - ❑ Leukotrienes, histamine, interleukin-8, activation of Th2 lymphocytes

Slide courtesy: Dr. Michelle Hernandez



Clinical characteristics

- ❑ Initial bronchodilation during the first 6-8 minutes of exercise followed by bronchoconstriction
- ❑ Begins 3 minutes after exercise, peaks within 10-15 minutes and resolves by 60 minutes
- ❑ Typical symptoms: shortness of breath, chest tightness and cough
- ❑ Allergic Asthma patients:
 - ❑ more likely when exercise includes exposure to the relevant allergen






Image from: <https://my.clevelandclinic.org/health/diseases/22620-bronchoospasm>



Differential Diagnosis

- ❑ Central airway obstruction
 - ❑ Ex: Double aortic arch and subglottic cysts
- ❑ Vocal cord dysfunction
- ❑ Exercise-induced laryngomalacia
- ❑ Exercise-induced anaphylaxis
- ❑ Exercise-associated reflux
- ❑ CV disease (arrhythmias)


Slide courtesy: Dr. Michelle Hernandez



Diagnosis

- Combination of compatible clinical symptoms (eg, exercise-related symptoms of dyspnea, cough or wheeze)
- AND demonstration of reversible airflow limitation in response to exercise or a surrogate challenge
- Don't need exercise testing in patients with well-documented asthma and typical asthma symptoms following exercise
 - exception: if have limited improvement with albuterol


Slide courtesy: Dr. Michelle Hernandez



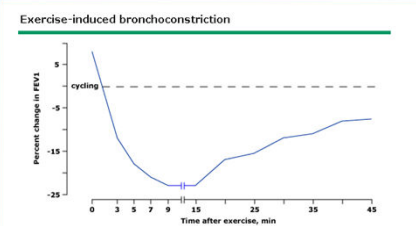
Exercise Challenge

- An exercise challenge test is the most direct and preferred way to establish a diagnosis of EIB
- Usually involves 6 -10 minutes of treadmill exercise
 - Goal: Raise the heart rate to 80-90% of the predicted maximum
 - Maximum Predicted Heart Rate: 220-age
- What is a positive test
 - Drop in FEV₁ ≥ 10%

Slide courtesy: Dr. Michelle Hernandez




Exercise-induced bronchoconstriction



The time course of exercise-induced bronchoconstriction in an asthmatic patient in whom the FEV₁ fell by more than 20 percent after cycling. FEV₁: forced expiratory volume in one second.


UpToDate



EIB Management

- ❑ DO NOT avoid exercise
- ❑ Nonpharmacologic measures
- ❑ Reduce the magnitude of minute ventilation (TV X RR)
 - ❑ Improving a patient's CV fitness reduces the minute ventilation required for a given level of exercise
- ❑ Increase the temperature and humidity of the inspired air
 - ❑ breathe through a loosely fitting scarf or mask when exercising in cold, dry conditions
- ❑ Allergic asthma
- ❑ Avoiding air pollution


Slide courtesy: Dr. Michelle Hernandez



Pharmacologic measures

- ❑ **Prevention**
 - ❑ 2 puffs of albuterol 15-20 minutes prior to exercise
 - ❑ Improved control of underlying asthma
 - ❑ ICS ± LABA
 - ❑ Leukotriene Receptor Antagonists
- ❑ **Acute Treatment**
 - ❑ Albuterol 2-4 puffs


Slide courtesy: Dr. Michelle Hernandez



Vocal cord dysfunction

- ❑ Inspiratory stridor accompanied by respiratory distress
- ❑ Symptoms: throat and upper chest tightness, throat clearing, dizziness, anxiousness, a choking sensation, sensation of not being able to breath, noisy breathing or stridor when breathing in, dysphonia and cough
- ❑ Onset of symptoms may be spontaneous or associated with triggers such as exercise, irritant exposure or anxiety
- ❑ Albuterol has minimal to no beneficial effect

Slide courtesy: Dr. Michelle Hernandez



Vocal cord movement

(A) Normal vocal cord abduction at midexpiration. The anterior tracheal rings are visible beyond the vocal cords. (B) Paradoxical adduction of the vocal cords at midexpiration, as seen in most cases of VCD. (C) Partial adduction of the vocal cords with a posterior opening or "chink", as seen during inspiration in a small percentage of VCD cases.

Hoyle JC. Vocal cord dysfunction. In: Conditions mimicking asthma. Chest Exp (Ed). Elsevier; Philadelphia 2012.

UptoDate

Oklahoma ALLERGY ASTHMA CLINIC

What exacerbates VCD

- ❑ Asthma
- ❑ Exercise
- ❑ Irritants
 - ❑ Smoking
 - ❑ Air pollution
 - ❑ Perfumes and odors
- ❑ Upper respiratory infection
- ❑ Gastroesophageal reflux
- ❑ Psychosocial disorders and stress

Oklahoma ALLERGY ASTHMA CLINIC

VCD diagnosis

- ❑ Pulmonary function test
 - ❑ Flattening of the inspiratory loop
 - ❑ Exercise testing
- ❑ Laryngoscopy can be performed immediately after exertion, when symptomatic


Image courtesy: <https://www.aafp.org/pubs/afp/issues/2010/0115/p156.html>

Oklahoma ALLERGY ASTHMA CLINIC

VCD management


- Acute episode:
 - Reassurance and supportive care until the episode spontaneously resolves
 - Asking patients to pant can sometimes abort an episode
 - Use of continuous positive airway pressure (CPAP) exercise
- Prevention:
 - Behavioral speech/voice therapy –help the patient regain laryngeal control
 - Vocal hygiene

Slide courtesy: Dr. Michelle Hernandez




VCD breathing exercises

- Paused breathing
 - Sit in a position that allows your neck & shoulders to relax but keep your back straight.
 - Breathe in gently through the nose.
 - Stick your tongue out of your mouth, past the teeth & lower lip, in preparation to exhale. This forward stretch of the tongue helps to open the airway at the vocal cords. This may be difficult to do with a severe spasm but will be easier the more you repeat this exercise.
 - With the tongue out, exhale only through the mouth in slow, paused or spaced breaths. The timing should be like saying Ha, Ha, Ha, Ha, very slowly. Don't use your voice, just breathe out
 - Repeat 10 times and practice 3 times a day so you will know how to do it well when VCD occurs.



VCD breathing exercises

- Belly breathing
 - Sit in a position that allows your neck and shoulder to relax but keep your back straight.
 - Place your hand on your belly. Breathe in gently through the nose with your belly pushing your hand outward from your body.
 - As you start to exhale, place the tip of your tongue where your upper teeth meet the roof of your mouth. This will allow you to make a hissing or "S" sound as you exhale. This creates a back pressure to help keep the airway open.
 - Slowly exhale allowing the hand & belly to move inward to a resting position and make the hissing or "S" sound as you push the air between your tongue & teeth.



Clinical Case #1

- 16 year old athletic female with diagnosis of asthma
- Symptoms: shortness of breath (difficulty getting air in)
- Allergy testing: positive to ragweed, dust mite
- Spirometry: no evidence of obstruction but with flattening of the inspiratory loop
- Therapy: started breathing exercises/speech therapy with improvement in symptoms



Clinical Case #2

- 5 yo female with diagnosis of mild persistent asthma
- Started on ICS a few months ago with marginal improvement in symptoms
- Parents report use of nebulized albuterol and albuterol HFA multiple times per week for productive cough
- Prior to onset of cough was diagnosed with rhinovirus and previously did not have respiratory symptoms
- Deny parental history of asthma, personal history of allergic rhinitis, eczema or food allergy
- She was treated with a 21 day course of Augmentin for presumed chronic sinusitis and symptoms resolved




Clinical Case #3

- 12 yo male with diagnosis of severe persistent asthma
- Dx with asthma at 18 months by Pulmonology
- Typically requires 3-4 courses of systemic steroids yearly
- Family has 2 inside dogs
- On high-dose ICS/LABA; has been on ICS since 18 months old
- Spirometry showed moderate-to-severe obstruction with improvement after bronchodilator




What's next?

- Check adherence and evaluate technique
- Call pharmacy to confirm patient has filled prescriptions
- Do they have a spacer?
- If adherence and technique are good, then step-up asthma therapy
- Consider Spiriva 1.25 mcg 2 puffs daily
- Consider montelukast 5 mg daily
 - Discuss black box warning
- Follow-up in 4-6 weeks to assess control
- If well-controlled, proceed with allergy testing
- If not well-controlled at follow-up visit, then obtain CBC with differential (evaluate eosinophilia), total IgE level and comprehensive environmental panel to determine eligibility for biologic
 - Bridge to SCIT
- Once asthma is well controlled, allergen immunotherapy will be started



Asthma assessment

- Good asthma control criteria
- Symptoms of asthma requiring quick-reliever medication ≤ 2 days per week
- Night-time awakenings no more than two nights per month
- Lung function (PEF or FEV1) within the normal range (or within 20 percent of the patient's personal best value)
- No more than one exacerbation in the past year requiring urgent care and/or oral glucocorticoids
- Lung function



Asthma control

Components of Control		Classification of Asthma Control (Children 0-4 years of age)		
		Well Controlled	Not Well Controlled	Very Poorly Controlled
Impairment	Symptoms	<2 days/week	>2 days/week	Throughout the day
	Nighttime awakenings	<1/month	>1/month	>3/month
	Interference with normal activities	None	Some limitation	Extensive limitation
Risk	Exacerbations requiring oral corticosteroids	<2 days/year	>2 days/year	Several times per day
	Treatment-related adverse effects	Medication side effects can vary in severity from mild to very troublesome and potentially life threatening. The level of medication side effect depends on specific levels of control but should be considered in the overall assessment of risk.		

Components of Control		Classification of Asthma Control (Children 5-11 years of age)		
		Well Controlled	Not Well Controlled	Very Poorly Controlled
Impairment	Symptoms	<2 days/week but not more than 1 day on 2 consecutive days	>2 days/week	Throughout the day
	Nighttime awakenings	<1/month	>1/month	>3/month
	Interference with normal activities	None	Some limitation	Extensive limitation
Risk	Exacerbations requiring oral corticosteroids	<2 days/year	>2 days/year	Several times per day
	Treatment-related adverse effects	Medication side effects can vary in severity from mild to very troublesome and potentially life threatening. The level of medication side effect depends on specific levels of control but should be considered in the overall assessment of risk.		




Image from: <https://www.ncbi.nlm.nih.gov/books/NBK7229/figure/A1937/>

Which asthma therapy should be started first?

- ❑ ICS preferred therapy
- ❑ FDA approved therapies
 - ❑ ICS budesonide nebulizer solution (children 1-8 yo)
 - ❑ ICS fluticasone DPI (children > 4 yo)
 - ❑ Salmeterol and combination product (salmeterol + fluticasone) DPI (children > 4 yo)
 - ❑ Montelukast 4 mg chewable tablet (children 2-6 yo) and 4 mg granules (children ≥ 1 yo)
- ❑ Reassess in 3 months and if improved consider step down therapy
- ❑ ****Administration of an ICS early in the course of the disease will not alter the underlying progression of the disease**



<https://www.ncbi.nlm.nih.gov/books/NBK7229/>

When to refer to an Allergist?

- ❑ Difficulties achieving or maintaining control of asthma
- ❑ A child 0-4 years old requires step 3 care or higher (step 4 care or higher for children 5-11 years old) to achieve or maintain control
- ❑ Patient has an exacerbation requiring hospitalization
- ❑ Immunotherapy is considered; additional tests are indicated to determine role of allergy
- ❑ Referral may be considered if child 0-4 years old requires step 2 care or a child 5-11 years old requires step 3 care



<https://www.ncbi.nlm.nih.gov/books/NBK7229/>

Estimated comparative daily dosages for ICS

Drug	Low Daily Dose		Medium Daily Dose		High Daily Dose	
	Child 0-4	Child 5-11	Child 0-4	Child 5-11	Child 0-4	Child 5-11
Beclometasone HFA 40 or 80 mcg/buff	NA	80-160 mcg	NA	>160-320 mcg	NA	>320 mcg
Budesonide DPI 90, 180, or 250 mcg/inhalation	NA	180-400 mcg	NA	>400-800 mcg	NA	>800 mcg
Budesonide Nebulizer Inhalation suspension for nebulization (2mg dose)	0.25-0.5 mg	0.5 mg	>0.5-1.0 mg	1.0 mg	>1.0 mg	2.0 mg
Flunisolide 250 mcg/buff	NA	500-750 mcg	NA	1,000-1,250 mcg	NA	>1,250 mcg
Fluticasone HFA 60 mcg/buff	NA	160 mcg	NA	320 mcg	NA	>640 mcg
Fluticasone HFA/MDI : 44, 110, or 220 mcg/buff DPI : 50, 100, or 250 mcg/inhalation	176 mcg	88-176 mcg	>176-352 mcg	>176-352 mcg	>352 mcg	>352 mcg
Mometasone DPI 200 mcg/inhalation	NA	NA	NA	>200-400 mcg	NA	>400 mcg
Fluticasone acetonide 75 mcg/buff	NA	200-400 mcg	NA	>400-800 mcg	NA	>800 mcg

Key: HFA, hydrofluoroalkane; NA, not approved and no data available for this age group.



<https://www.aacpi.org/>

Intermittent asthma (children 0-11 yo)

- If mild symptoms, recommend use of SABA (every 4-6 hours for 24 hours) as needed
- If therapy needs to be repeated more than once every 6 weeks, consider step-up
- If a viral respiratory infection causes a moderate-to-severe exacerbation, a short course of oral systemic corticosteroids should be considered
- If a viral respiratory infection causes a severe exacerbation, consider starting oral steroids at the start of illness
- **close monitoring required— if ≥ 2 exacerbations within 6 months with symptoms in between, the child would likely benefit from daily controller therapy

<https://www.ncbi.nlm.nih.gov/books/NBK7229/>



Persistent asthma (children 0-4 yo) Step 1-2

- Children with ≥ 4 wheezing episodes in 1 year and risk factors for persistent asthma, benefit from daily long-term therapy
- Consider if there is a second exacerbation requiring OCS in 6 months or children who consistently require symptomatic treatment > 2 days a week for > 4 weeks
- Consider OCS for patients with exacerbation when long-term control therapy is started or in patients who have moderate-to-severe asthma
- Close monitoring necessary; follow-up in 4-6 weeks and if no improvement change therapy or consider alternative diagnosis
- If improvement for at least 3 months, then step down therapy

<https://www.ncbi.nlm.nih.gov/books/NBK7229/>



Persistent asthma (children 0-4 yo) Step 3-6

- Step 3
 - medium-dose ICS
- Step 4
 - medium-dose ICS + either LABA or montelukast
- Step 5
 - High-dose ICS AND either LABA or montelukast
- Step 6
 - High-dose ICS AND either LABA or montelukast AND oral systemic corticosteroids


<https://www.ncbi.nlm.nih.gov/books/NBK7229/>



Persistent asthma (children 5-11 yo) Step 1

- Daily long-term control medication
- SABA as needed to relieve symptoms
 - If needed > 2 days/week indicates need to step-up therapy
- Consider OCS for patients with exacerbation when long-term control therapy is started or in patients who have moderate-to-severe asthma
- Consider daily therapy only during specific periods of previously documented risk
- Consider treating patients with ≥ 2 exacerbations requiring OCS in the past year


<https://www.ncbi.nlm.nih.gov/books/NBK7229/>



Persistent asthma (children 5-11 yo) Step 2

- Daily low-dose ICS
- Alternative therapies include leukotriene receptor antagonist
 - Preferred montelukast (discuss black box warning)
 - Less likely to respond as favorably if they have lower lung function and/or higher markers of allergic airway information

<https://www.ncbi.nlm.nih.gov/books/NBK7229/>




Persistent asthma (children 5-11 yo) Step 3-6

- Step 3
 - low-dose ICS plus some form of adjunctive therapy (LABA, LTRA) or medium-dose ICS
 - Masoli et al. 2004- dose-response to fluticasone propionate plateaus between 100-200 mcg/day
- Step 4
 - medium-dose ICS + either LABA or montelukast
- Step 5
 - High-dose ICS + LABA (not preferred: + montelukast)
- Step 6
 - High-dose ICS + LABA + oral systemic corticosteroids (not preferred: + montelukast)
 - Long-term OCS

Use lowest dose possible, monitor for side effects, follow-up and refer to specialist


<https://www.ncbi.nlm.nih.gov/books/NBK7229/>



Persistent asthma (≥ 12 yo) Step 3-6


- Step 3
 - Add LABA to a low-dose ICS OR increase to medium-dose ICS
 - Alternative therapy: add LTRA
 - Review inhaler technique and adherence prior to increasing therapy
 - Environmental factor and consider specialist referral
- Step 4
 - medium-dose ICS AND add LABA
 - Alternative therapy: add LTRA
- Step 5
 - High-dose ICS AND LABA
 - Omalizumab
- Step 6
 - Step 5 + OCS

<https://www.ncbi.nlm.nih.gov/books/NBK7222/>




Symbicort in intermittent asthma management

- Symbicort 80-4.5 mcg or Symbicort 160-4.5 mcg 1-2 puffs with spacer every 4 hours as needed
- May administer up to 2 inhalations every 20 minutes for 3 doses
- Maximum dose: 6 inhalations/exacerbation



SMART in pediatric (12-17 years) asthma management

- Maintenance therapy: 1-2 puffs twice daily or 2 puffs twice daily
- Reliever therapy: 1 additional inhalation as needed (maximum 8 inhalations/day)
- Recommend patients ≥ 12 years old for steps 3 and 4



When should a provider see a patient for follow-up and step-down asthma therapy?

- Follow-up visits: 1- to 6- month intervals, depending on the level of control
- Consider a 3-month interval if possible to step-down therapy
 - Reduced by 25-50% every 3 months to the lowest dose possible



<https://www.ncbi.nlm.nih.gov/books/NBK7222/>

References

- Hekking & Bel. The Journal of Allergy and Clinical Immunology: In Practice 2014 2, 671-680DOI: (10.1016/j.jaip.2014.09.007)
- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4115615/>
- <https://www.aafp.org/pubs/afp/issues/2010/0115/p156.html> <https://www.ncbi.nlm.nih.gov/books/NBK7229/>
- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4115615/>
- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4115615/>
- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4115615/>
- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4115615/>
- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4115615/>



THANK YOU



QUESTIONS?



Image courtesy: <https://www.health.harvard.edu/blog/antibiotics-dont-speed-recovery-asthma-attacks-2017/04/10941>
