
بسم الله الرحمن الرحیم

Asthma In Children

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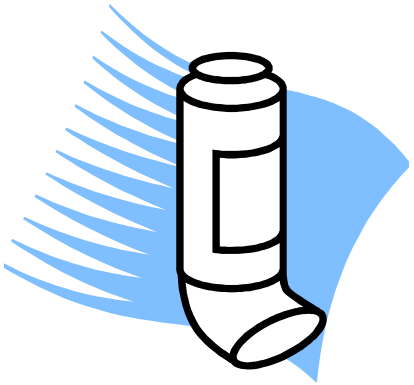


Case Presentation #١

- A ٥ year old male presents to your office with a chronic cough
  - Cough is productive, increased at night, recurrent
  - Worse with exercise and with upper respiratory infections
  - Growth has been normal
  - Chest xray findings are normal except for mild hyperinflation

Burden of asthma

- Asthma is one of the most common chronic diseases worldwide with an estimated ٣٠٠ million affected individuals
- Prevalence is increasing in many countries, especially in children
- Asthma is a major cause of school and work absence
- Health care expenditure on asthma is very high

Definition of asthma

Asthma is a heterogeneous disease, usually characterized by chronic airway inflammation.

It is defined by the history of respiratory symptoms such as wheeze, shortness of breath, chest tightness and cough that vary over time and in intensity, together with **variable** expiratory airflow limitation.

NEW!

Prevalence

- The survey found that nearly ١ out of ١٠ (٩٫٢%) American children ١٨ years of age and younger currently suffer from asthma

- Boys (١٤% vs ١٠% girls) and children in poor families (١٦% vs ١٠% not poor) are more likely to have asthma. Approximately ٨٠% of all asthmatics report disease onset prior to ٦ yr of age.

- The prevalence of asthma is higher in children than in adults.

- In both adolescents and adults it is more prevalent in females.

ETIOLOGY

a combination of environmental exposures and inherent biological genetic vulnerabilities.

environment include

- inhaled allergens
- respiratory viral infections
- chemical and biological air pollutants such as environmental tobacco smoke.
- Occupational exposures

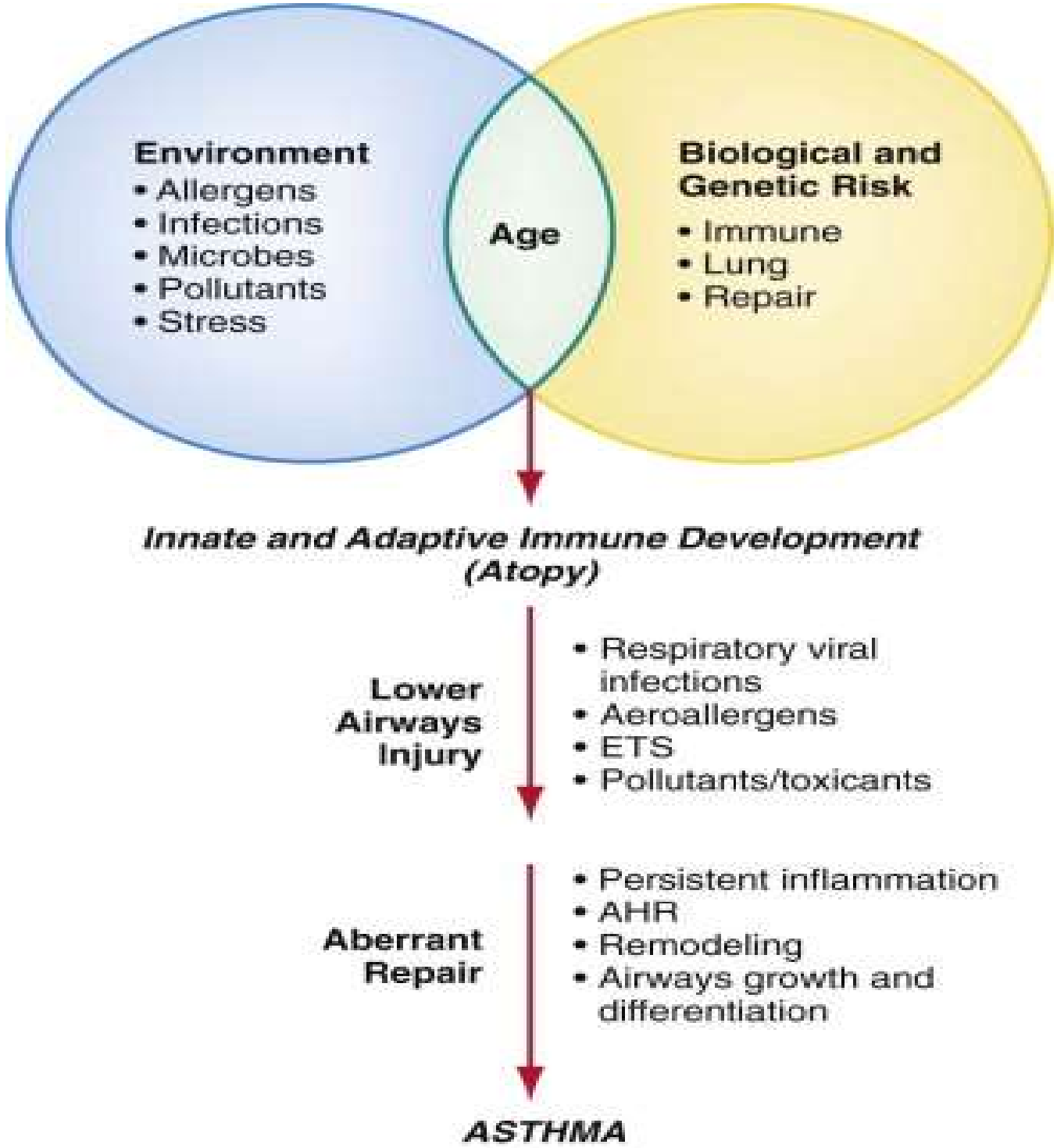
Genetic

More than ٢٢ loci on ١٥ autosomal chromosomes have been linked to asthma.

-asthma has been consistently linked with loci containing pro-allergic, proinflammatory genes (the interleukin [IL]–٤ gene cluster on chromosome ٥).

-Genetic variation in receptors for different asthma medications is associated with variation in biologic response to these medications (polymorphisms in the β_2-adrenergic receptor).

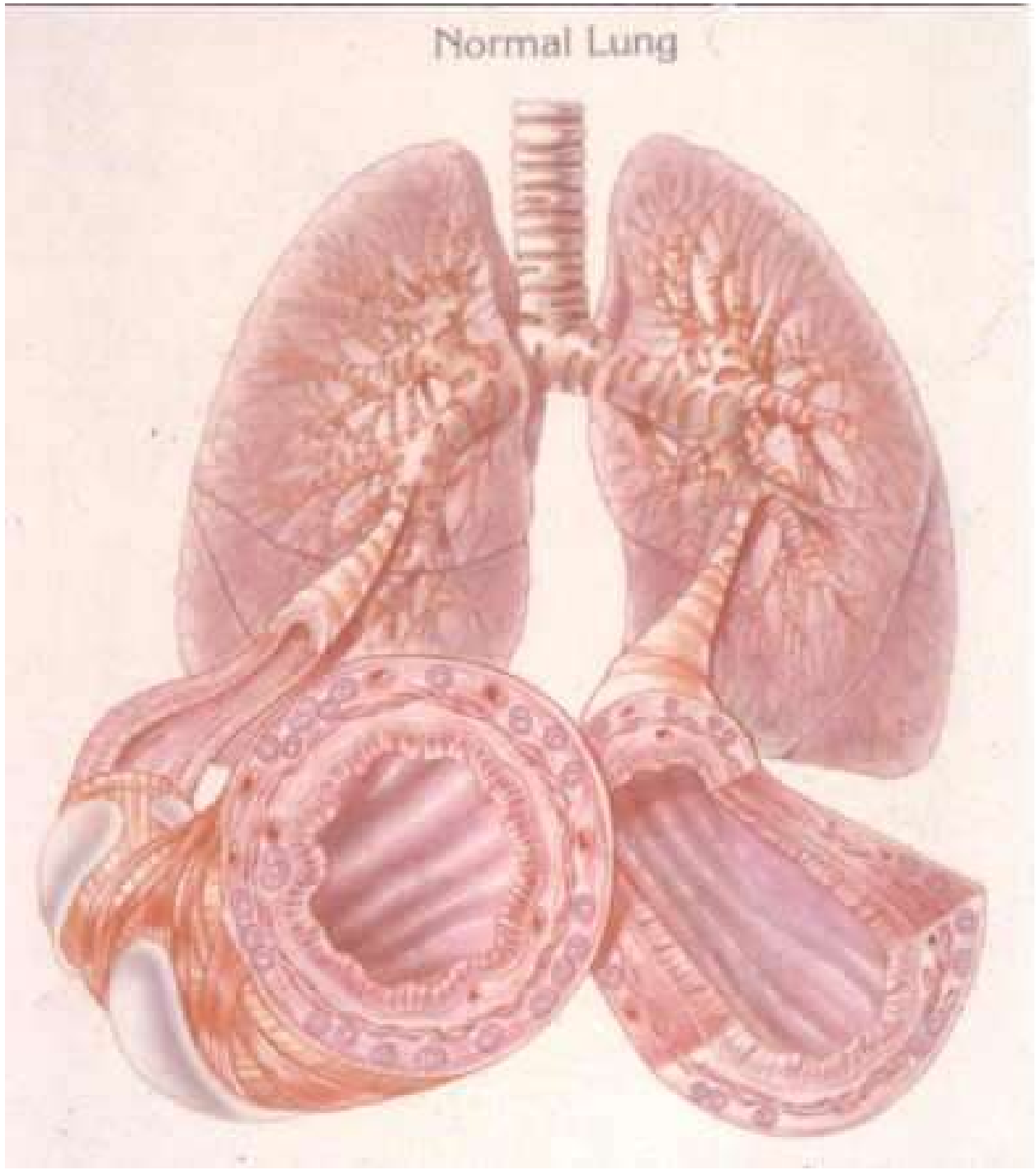
- Other candidate genes include *ADAM-٣٣* (member of the metalloproteinase family), the gene for the prostanoid DP receptor, and genes located on chromosome ٥q٣١ (possibly IL-١٢).

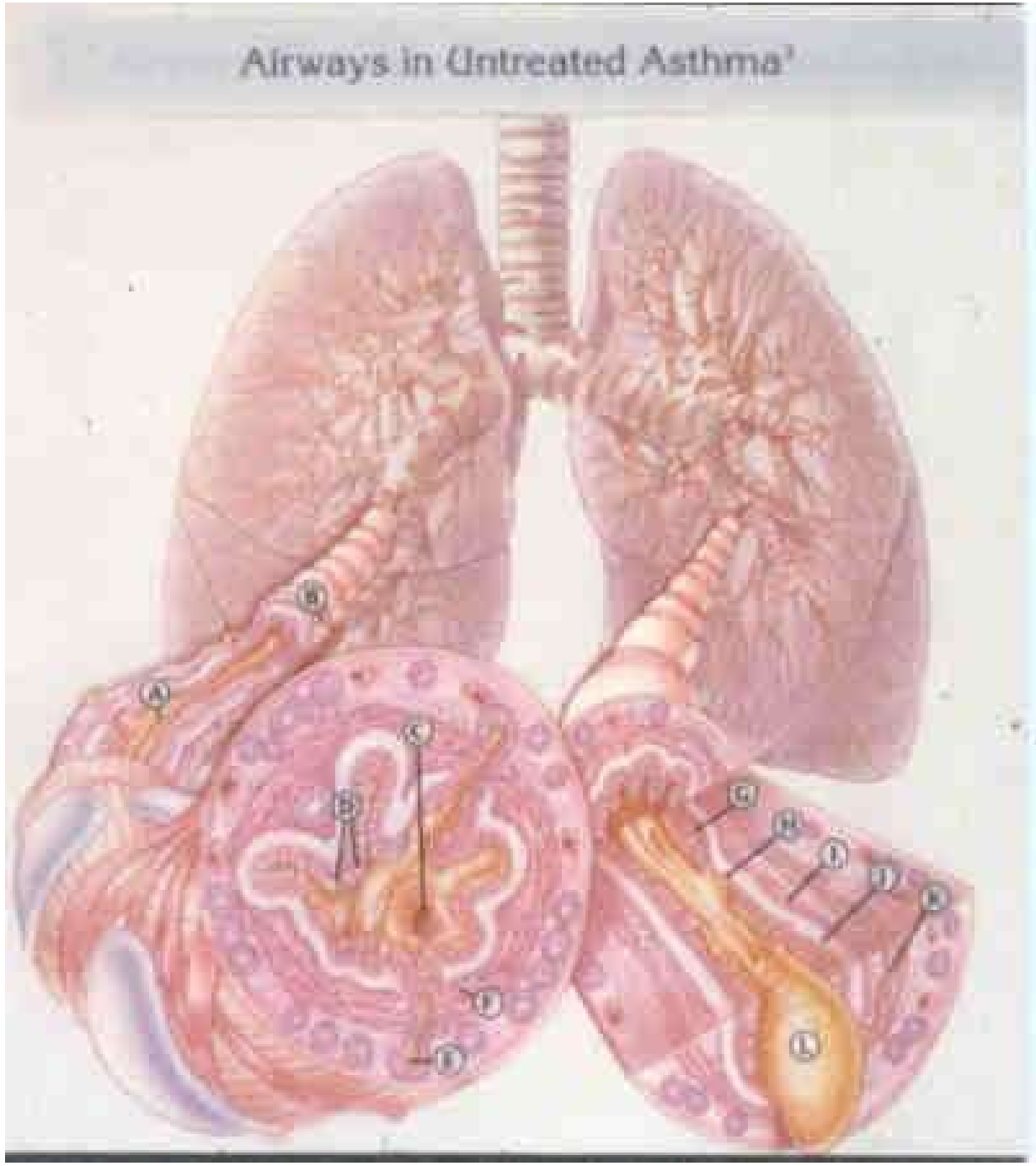

Environment
• Allergens
• Infections
• Microbes
• Pollutants
• Stress
Age
Biological and Genetic Risk
• Immune
• Lung
• Repair
Innate and Adaptive Immune Development (Atopy)
Lower Airways Injury
• Respiratory viral infections
• Aeroallergens
• ETS
• Pollutants/toxicants
Aberrant Repair
• Persistent inflammation
• AHR
• Remodeling
• Airways growth and differentiation
ASTHMA

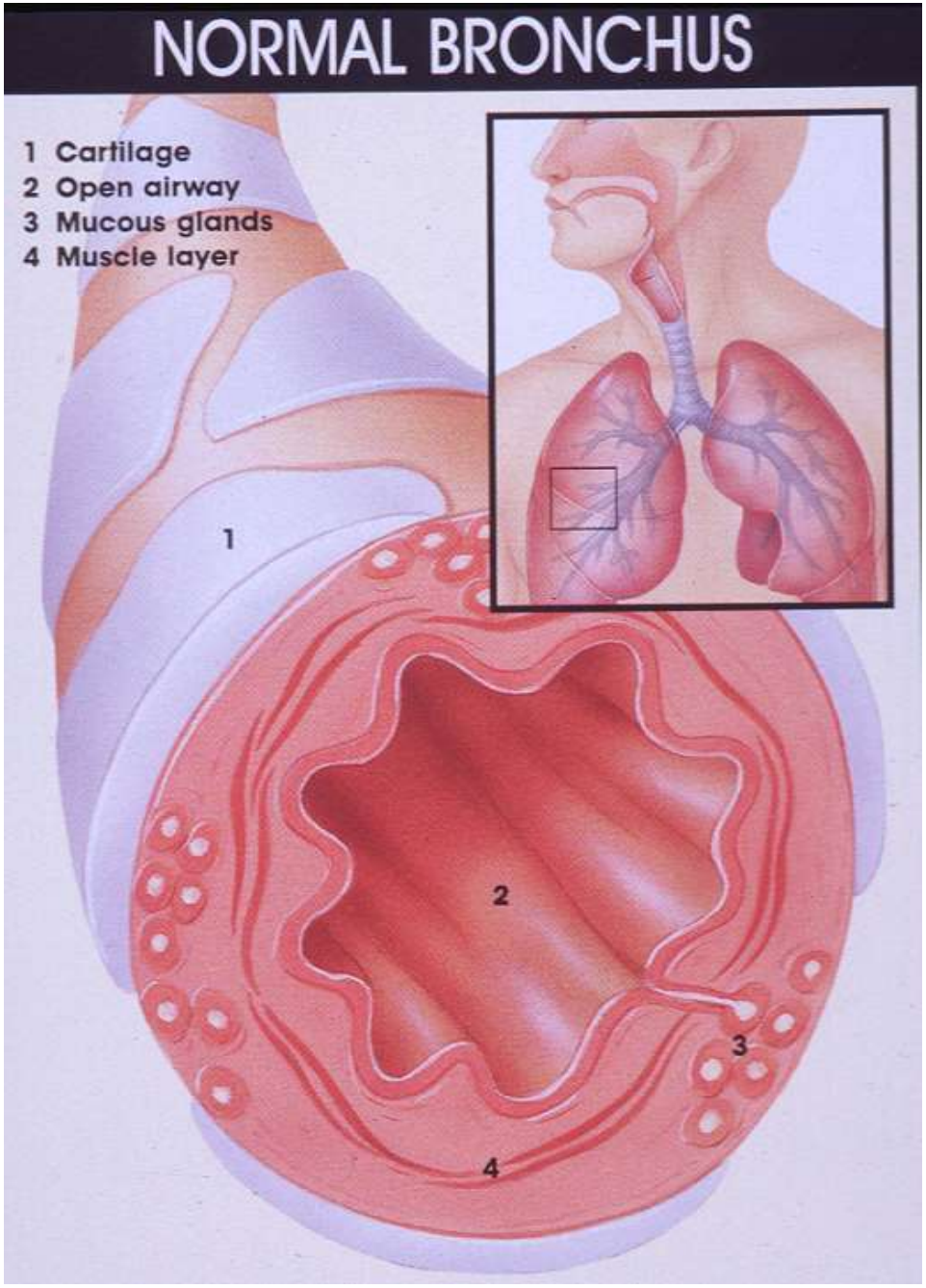
PATHOGENESIS

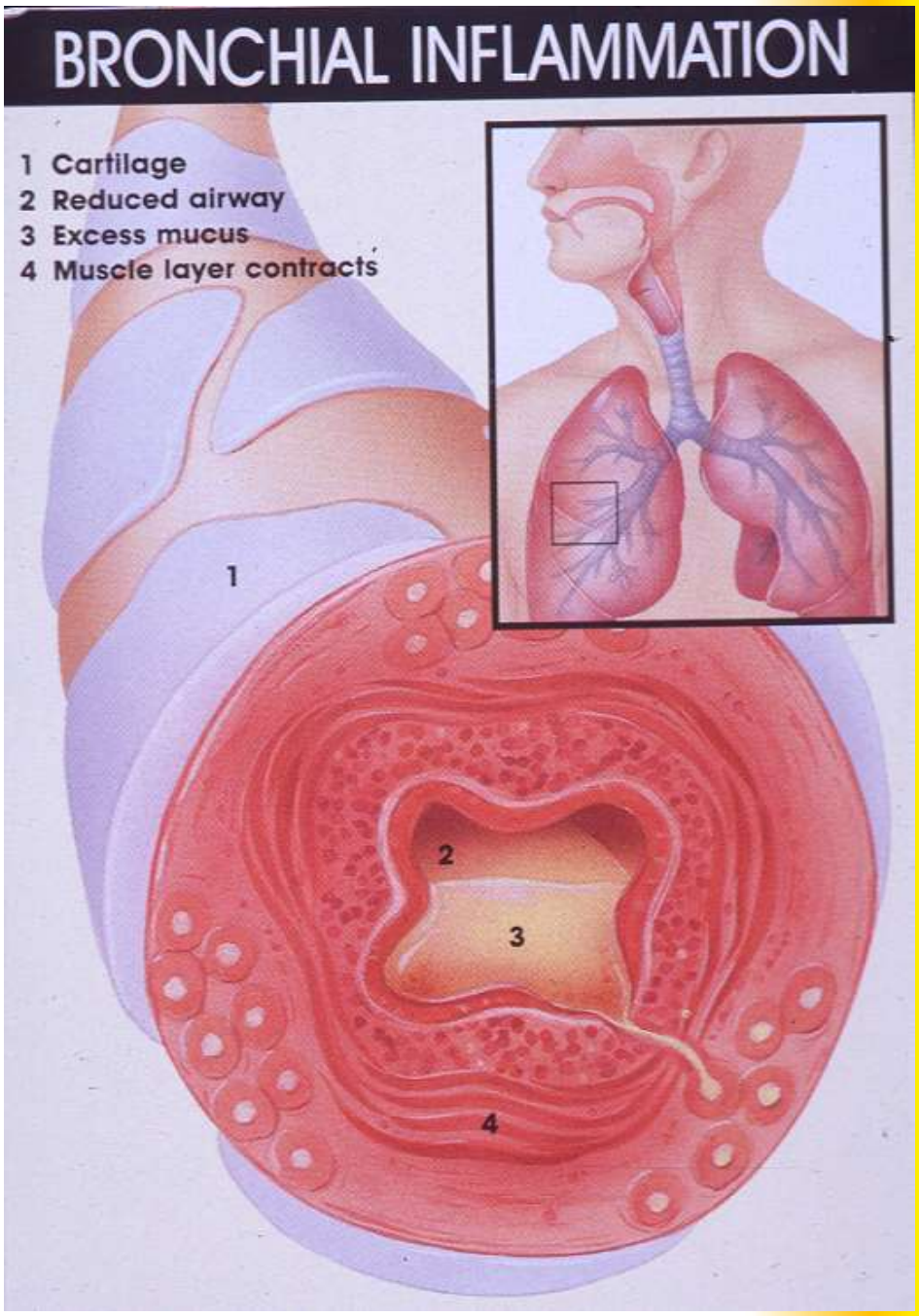
All inflammatory processes that contribute to airflow obstruction .

- airways edema
- basement membrane thickening
- subepithelial collagen deposition
- smooth muscle hypertrophy
- mucous gland hypertrophy, and mucus hyper secretion


Normal Lung


Airways in Untreated Asthma[3]


NORMAL BRONCHUS
1 Cartilage
2 Open airway
3 Mucous glands
4 Muscle layer
1
2
3
4


BRONCHIAL INFLAMMATION
1 Cartilage
2 Reduced airway
3 Excess mucus
4 Muscle layer contracts
1
2
3
4

Risk Factors For Asthma Development

Asthma Predictive Index

Major criteria

- Parental history of asthma
- Physician diagnosed atopic dermatitis
- Allergic sensitization to at least one aeroallergen

Minor Criteria

- Allergic sensitization to milk, egg, or peanut
- Wheezing unrelated to colds
- Blood Eosinophilia ≥ ۴ %

Children with wheezing and either one major or ۲ minor criteria→ ۴-۷ times

Low sensitivity (۱۵-۵۷%)

High negative predictive value

Phenotype @ Risk Factors

Transient early wheezing

- mainly in the first year of life
- the most prevalent form of early wheezing.
- Some ٦٠% of children who wheeze in the first ٣ years of life have resolution of their symptoms by ٦ years of age.
- It has no significant relationship to atopy and maternal smoking
- less than ١/٣ of transient wheezers continued to wheeze during adolescence
- risk factors : include infants with school-aged older siblings, day-care attendance, house-dust endotoxin and allergen exposure, such as cockroach, male sex, and bottle-feeding.

Non-atopic persistent wheezing

- < ١ y/o
- ٢٠% of wheezy children under age ٣
- Children with this phenotype have a lower level of pre-bronchodilator lung function and enhanced airway reactivity
- caused by an alteration in the regulation of airway tone leading to viral-induced wheeze.

IgE-associated/atopic persistent wheezing

- ٢٠% of children who wheeze during the first ٣ years of life, with symptoms typically first presenting after age ١ year.
- Risk factors associated include male sex, parental asthma, atopic dermatitis, eosinophilia at ٩ months, and a history of wheezing with lower respiratory tract infections.
- early sensitization to food or aeroallergens
- reduced lung function at age ٦
- Bronchial hyperreactivity is often observed and may only be observed after the first episode of wheezing.

Asthma Symptoms

Symptoms may include:

- Coughing
- Wheezing
- Chest tightness
- Shortness of breath
- Excessive fatigue

- Intermittent dry coughing and/or expiratory wheezing
- Respiratory symptoms can be worse at night.
- Daytime symptoms, often linked with physical activities or play, are reported with greatest frequency in children.
- Other asthma symptoms in children can be subtle and nonspecific

Key symptom indicators for considering a diagnosis of asthma

- Wheezing
- History of any following

  Cough
  Recurrent wheeze
  Recurrent difficulty breathing
  Recurrent chest tightness

- Symptoms occur or worsen in presence of trigger
- Symptom occur or worsen at night, waking the patient

Features isn't favor of asthma

- Symptom starting at or shortly after birth
- FTT
- Complete failure to respond to anti asthmatic medication
- Continuous wheezing
- No association with typical trigger

DIAGNOSIS OF ASTHMA

- History and patterns of symptoms
- Physical examination
- Measurements of lung function

History

- Asking about previous experience with asthma medications

- The presence of risk factors

  - history of other allergic conditions (allergic rhinitis, allergic conjunctivitis, atopic dermatitis, food allergies),

  -parental asthma

  -symptoms apart from colds

- patient's age

History Cont....

- **course of onset (acute versus gradual)**

→Acute onset of wheezing → foreign body aspiration, particularly if there is a history of choking.

→ distinguish between intermittent and persistent wheezing.

→Persistent wheezing presenting very early in life → congenital or structural abnormality

→ slowly progressive onset of wheezing → extraluminal bronchial compression by a growing mass or lymph node or interstitial lung disease

- A history of neonatal or perinatal respiratory problems and wheezing since birth → congenital abnormality

- Association of wheezing with feeding or vomiting → gastroesophageal reflux or impaired swallowing complicated by aspiration

- Wheezing with little cough suggests a purely mechanical cause of obstruction, and raises suspicion for foreign body aspiration

Cont….

- Symptoms that vary with changes in position → tracheomalacia, bronchomalacia, or vascular rings.

- Poor weight gain and recurrent ear or sinus infections → cystic fibrosis, immunodeficiency, or ciliary dysfunction.

- FTT without feeding difficulties, electrolyte abnormalities, signs of intestinal malabsorption including frequent, greasy, or oily stools →cystic fibrosis

Asthma Triggers

- Common viral infections of the respiratory tract
- Aeroallergens in sensitized asthmatics
  - Animal dander
  - Indoor allergens
  - Dust mites
  - Cockroaches
  - Molds
- Seasonal aeroallergens
  - Pollens (trees, grasses, weeds)
  - Seasonal molds
- Environmental tobacco smoke
- Air pollutants
  - Ozone
  - Sulfur dioxide
  - Particulate matter
  - Wood- or coal-burning smoke
  - Endotoxin, mycotoxins
  - Dust
- Strong or noxious odors or fumes
- Perfumes, hairsprays
- Cleaning agents
- Occupational exposures
  - Farm and barn exposures
  - Formaldehydes, cedar, paint fumes
- Cold air, dry air
- Exercise
- Crying, laughter, hyperventilation
- Co-morbid conditions
  - Rhinitis
  - Sinusitis
  - Gastroesophageal reflux

Physical Examination

- The chest examination is often normal. Deeper breaths can sometimes elicit otherwise undetectable wheezing.

- In clinic, quick resolution (within ١٠ min) or convincing improvement in symptoms and signs of asthma with administration of a short-acting inhaled beta-agonist (SABA [albuterol]) is supportive of the diagnosis of asthma.

Physical Examination

Exacerbation

- Crackles (or rales) and rhonchi can sometimes be heard, resulting from excess mucus production and inflammatory exudate in the airways

- The combination of segmental crackles and poor breath sounds can indicate lung segmental atelectasis

- In severe exacerbations

-inspiratory and expiratory wheezing,

-increased prolongation of exhalation,

-poor air entry, suprasternal and intercostal retractions,

-nasal flaring, and accessory respiratory muscle use.

-In extremis, airflow may be so limited that wheezing cannot be heard

Case # ٢

- A ٤-month-old infant boy is brought to the Emergency Room because of lethargy.

- ***Physical Examination***

  Afebrile HR ١٦٠ bpm RR ٥٠ breaths/min HbSaO٢: ٩٨% on RA
  Weight: ٣٫٢ kg

  GENERAL : Very thin, appearing to be **malnourished**; Lethargic but arousable
  HEENT : dry mucous membranes
  CHEST : equal breath sounds; diffuse **ronchi**
  ABDOMEN : distended; no organomegaly
  SKIN : decreased turgor and elasticity
  NEUROLOGIC : poor muscle tone; poor suck

Past Medical History: Which are the most relevant aspects ?

A. Perinatal history
B. Immunization record
C. Social/Environmental history
D. Family History
E. Nutrition and Growth

Case # ٢

- **PMHx**: Born at term; No problems at birth.
  Hospitalized at ١ month of age for pneumonia;
  Chronic cough; Frequent vomiting and **diarrhea**
- **Immunizations**: None
- **Social Hx**: The family lives in a small, poor island of the Carribean
- **FHx**: An older **sibling died at ١ year** of age from unknown illness
- **Nutrition & Growth**: breast fed; used to have good appetite but it got progressively worse; poor weight gain in the beginning; actual **weight loss** lately

SERUM CHEMISTRIES	
Na	۱۲۱
K	۴/۶
Cl	۹۴
CO_2	۱۶
BUN	۴
Cr	۰/۲
Tot Protein	۳/۱
Albumin	۱/۷

SWEAT TEST

- **Sweat Chloride: ٧٨٫١٢ mmol/L**

Normal <٤٠ mmol/L

Borderline ٤٠-٦٠ mmol/L

Abnormal >٦٠ mmol/L

***However, in infants anything >٣٠ should be repeated and worked up**

Case Presentation #٣

- Six year old female presents to the ER after a one week history of nasal congestion and mild cough. Two days ago, she developed high fevers, chills, and increased cough.
- Upon arrival in the ER, she is ill-appearing, tachypneic, and febrile.
- PE: Rales are appreciated on exam over right posterior lung fields.

Case Presentation #۴

PMHx: No prior pneumonia or wheezing

FHx: +Asthma (brother)

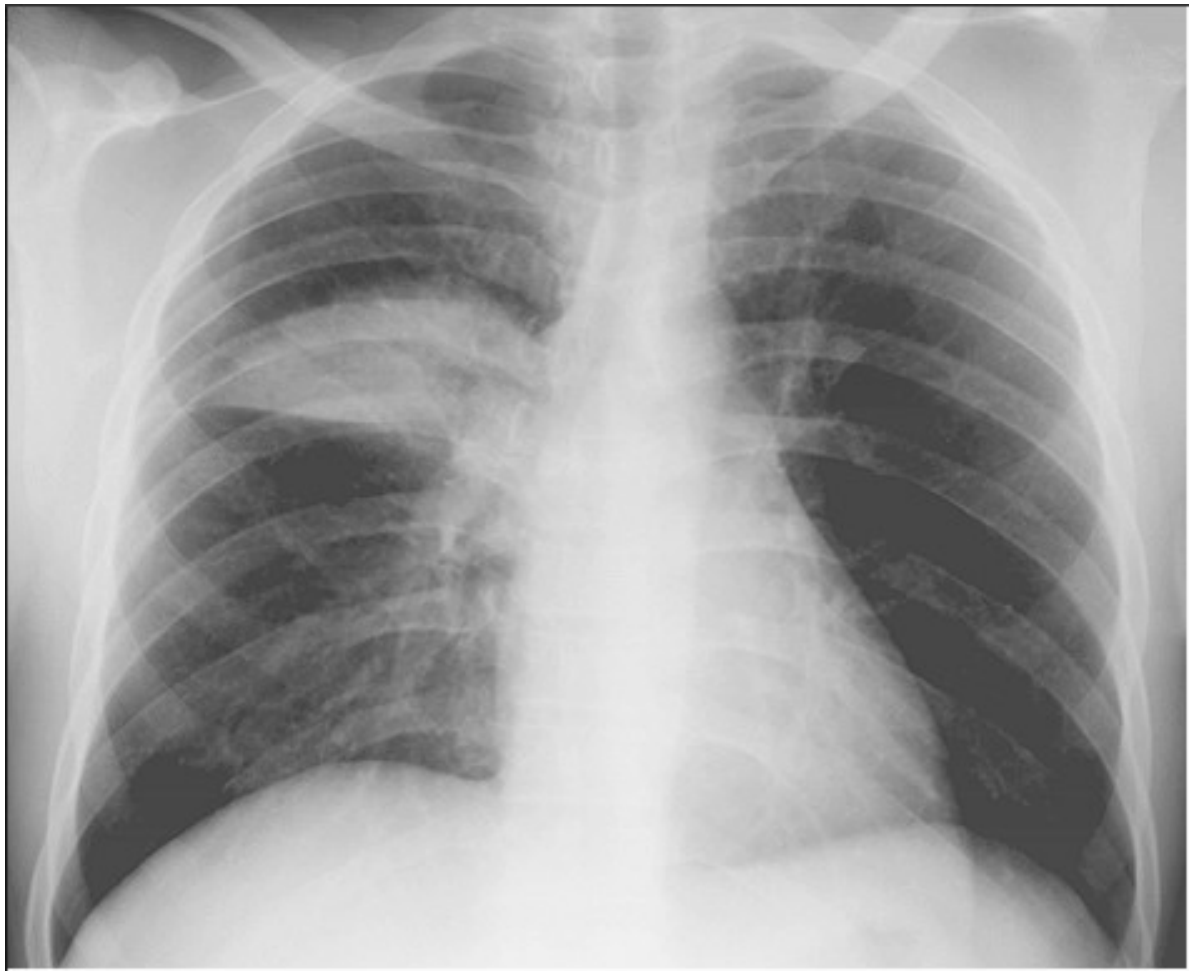
ALL: NKDA

IMM: Missing part of primary series; no recent ppd done.

SHx: No recent travel out of the country.

Laboratory: WBC ۳۵’۰۰۰

Radiographic Findings



Definition: Pneumonia

An inflammation of the lung parenchyma

Case #٥

A ٢-month-old infant boy is brought to the Emergency Room because of persistent cough and difficulty in breathing.

On examination the infant has audible stridor, a harsh cough, and suprasternal and subcostal chest wall retractions

CASE ۶

- A ۳ Y/O BOY WITH SUDDENLY CHOCKING,RESPIRATORY DISTRESS AND WHEEZING AFTER INGESTION OF PEANUT
- PAST HX: NOT SIGNIFICANT

Pulmonary Function Test

variable airflow limitation

- **Confirm presence of airflow limitation**

- Document that FEV١/FVC is reduced (at least once, when FEV١ is low)

- FEV١/ FVC ratio is normally >٠/٧٥ – ٠/٨٠ in healthy adults, and >٠/٩٠ in children

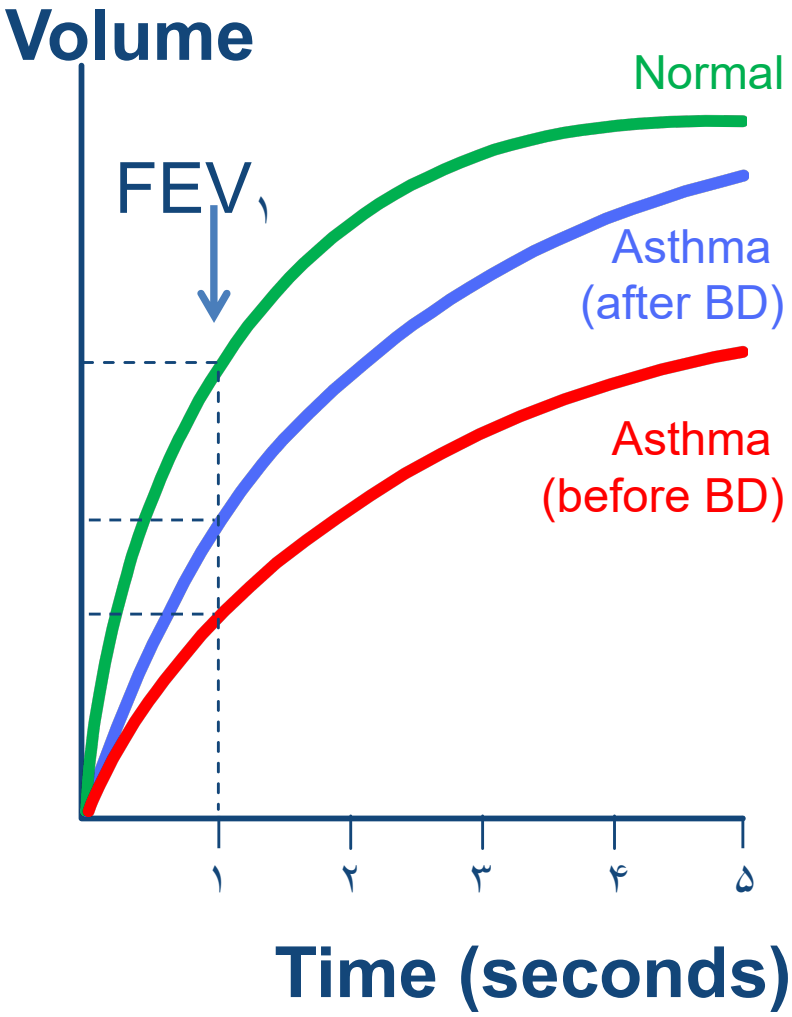
Confirm variation in lung (One or more of the tests below)

- Excessive bronchodilator reversibility (adults: increase in FEV_1 >١٢% and >٢٠٠mL; children: increase >١٢% predicted)
- Excessive diurnal variability from ١-٢ weeks' twice-daily PEF monitoring (>١٠% in adult, >١٣% in children)
- Significant increase in FEV_1 or PEF after ٤ weeks of controller treatment

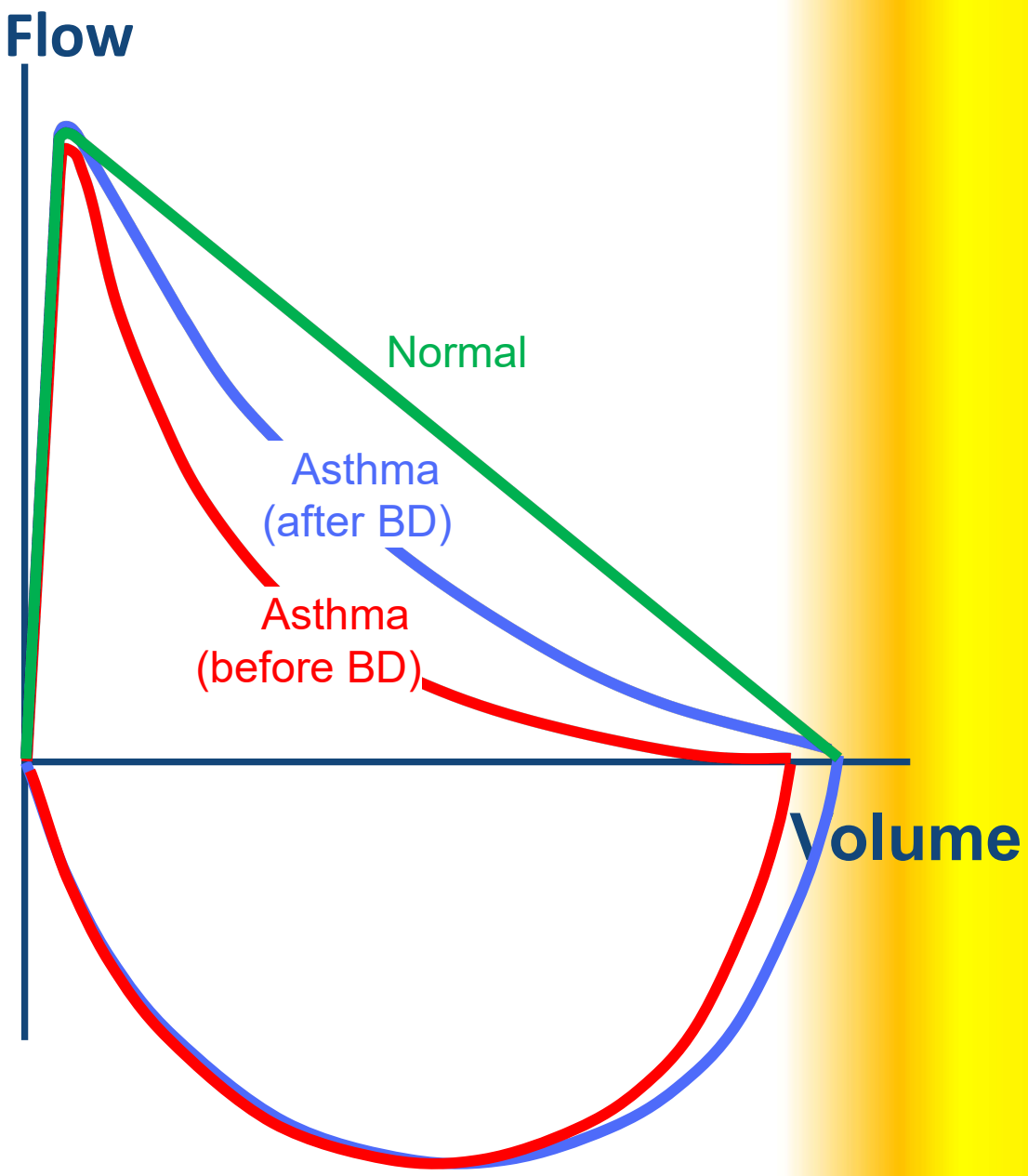
- Positive exercise challenge test
- Positive bronchial challenge tests
- Excessive variation in lung function between visits

- -variation in FEV١ > ١٢% & >٢٠٠ ml , outside of respiratory infection in adult
- -Variation in FEV١ > ١٢% OR in PEF >١٥% , including respirator infection in child

Typical spirometric tracings



Note: Each FEV١ represents the highest of three reproducible measurements



Radiology

CXR

- often appear to be normal, aside from subtle and nonspecific findings of hyperinflation (flattening of the diaphragms) and peribronchial thickening .

- **R/O asthma masqueraders** (aspiration pneumonitis, hyperlucent lung fields in bronchiolitis obliterans), and complications during asthma exacerbations (atelectasis, pneumomediastinum, pneumothorax)

DIFFERENTIAL DIAGNOSIS

Upper airway disease

Allergic rhinitis & Sinusitis

Small airway

Viral bronchiolitis or obliterative bronchiolitis

Cystic fibrosis

Broncho pulmonary dysplasia

Heart Disease

Others

Infection, habit cough, PND

Aspiration syndromes

Large airway

Foreign body in trachea or bronchus

Vocal cord dysfunction

Vascular ring or laryngeal web

Laryngotracheomalacia, tracheal stenosis, or bronchostenosis

Enlarged lymph nodes or tumor

Treatment

Asthma Therapy Goals

"The goal of asthma therapy is to control asthma so patients can live active, full lives while minimizing their risk of asthma exacerbations and other problems"

NAEPP EPR -٣

Treatment

Four Components of Optimal Asthma Management

REGULAR ASSESSMENT AND MONITORING

Asthma checkups

Every ٢–٤ wk until good control is achieved

٢–٤ per yr to maintain good control

Lung function monitoring

CONTROL OF FACTORS CONTRIBUTING TO ASTHMA SEVERITIY

Eliminate or reduce problematic environmental exposures

Treat co-morbid conditions: rhinitis, sinusitis, gastroesophageal reflux

ASTHMA PHARMACOTHERAPY

Long-term-control vs quick-relief medications

Classification of asthma severity for anti-inflammatory pharmacotherapy

Step-up, step-down approach

Asthma exacerbation management

PATIENT EDUCATION

Provide a two-part care plan

Daily management

Action plan for asthma exacerbations

- EPR٣ recommends stepwise approach to asthma therapy guided by asthma severity & level of control, including an assesment of the domains of impairment & risk

Regular assessment and Monitoring

◉ Asthma severity:
Directs initial level of therapy
Determined at the time of diagnosis
Categories: Intermittent, Persistent
Determined by the most severe level of symptoms

◉ Asthma control: Important for adjusting therapy

- Regular Clinic visits every ٢-٦ weeks until good control established
- Two or more Asthma check ups per year for maintaining Asthma control

Step-up, Step-down Approach

- Initiate with higher level controller therapy
- Step-down, once good control is achieved
- If child has had well controlled asthma for at least ٣ months, consider decreasing dose or number of controller medications.
- Step up for poorly controlled asthma

Severity & Control are used as follows for managing asthma:

- If the patient is not currently on a long-term controller at the first visit:
  - Assess asthma severity to determine the appropriate medication & treatment plan.

- Once therapy is initiated, the emphasis is changed to the assessment of **asthma control**.
  - The level of asthma control will guide decisions either to maintain or adjust therapy.

Asthma Severity Classification

- Two domain

  Risk → during ١ year ago

  Impairment →during ٢-٤ week ago

Intermittent

Persistent : mild, moderate, persistent

Persistent				
Category	**Intermittent**	**Mild**	**Moderate**	**Severe**
Impairment				
Symptoms	≤٢ days/wk	≥٢ days/wk	**Daily**	**Throughout the day**
Nighttime awakening	٠-٤ y/o ٠ ≥٥ y/o ≤٢ /mo	≤٢ /mo ٣-٤/mo	٣-٤/mo >١/wk	>١/wk Often ٧/wk
SABA use for symptom	≤٢ days/wk	≥٢ days/wk	**Daily**	**Several times/day**
Interference with normal activity	**None**	**Minor limitation**	**Some Limitation**	**Extremely limitation**
Lung function	**nl**	**nl**	FEV١ ٦٠-٨٠ % FEV١/FVC	FEV١< ٦٠% FEV١/FVC reduced>

Asthma Severity Classification			
Category		**Intermittent**	**Persistent**
Risk	**٠-٤ y/o**	٠-١/yr	≥٢ exacerbation/ ٦ mo Or ≥٤ whezing episode /yr lasting > ١ day & risk factor for persistent asthma
	≥٥ y/o	٠-١/yr	≥٢/yr

Assessing Control & Adjusting Therapy
Children ٠-٤ Years of Age

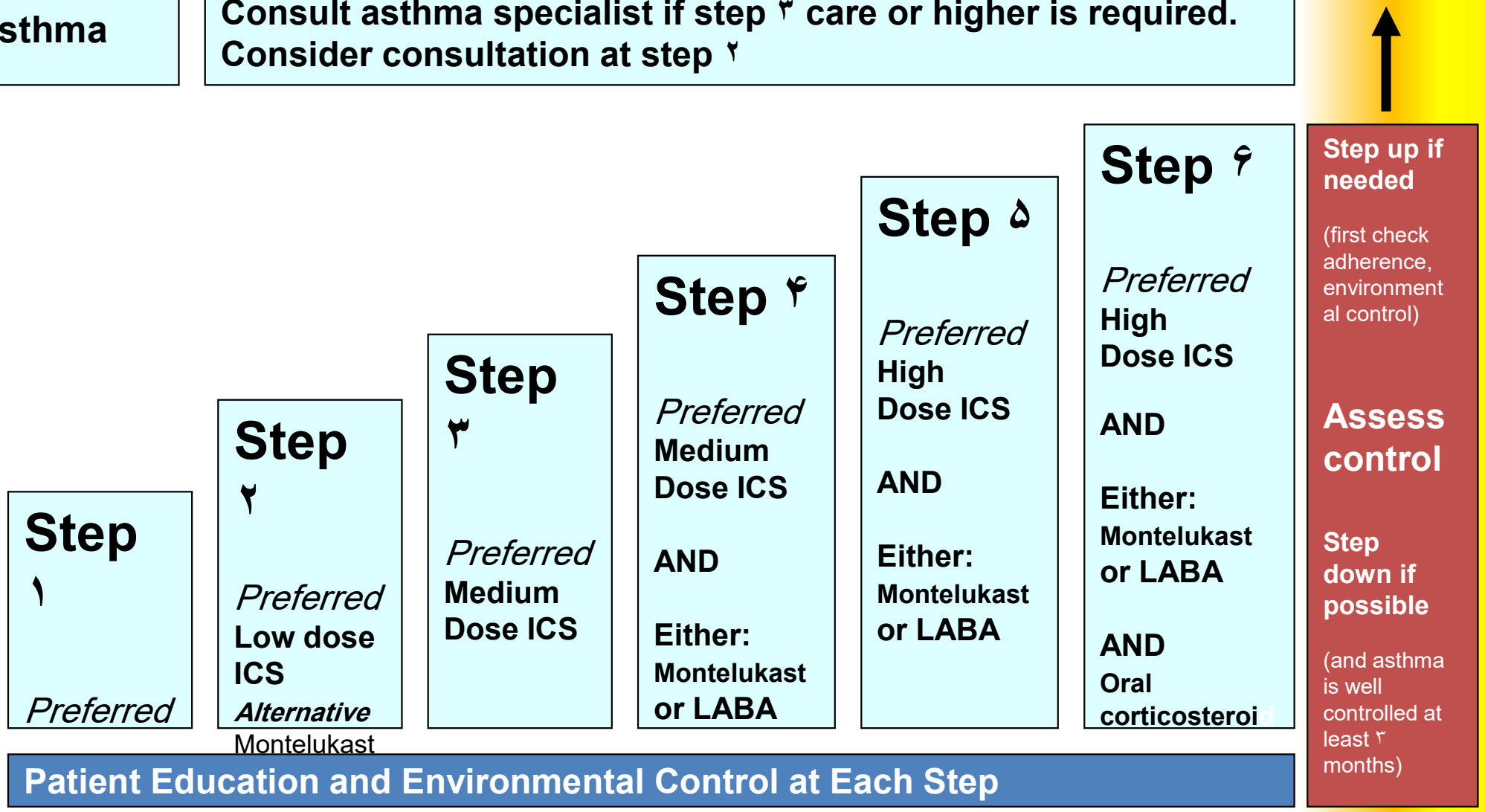
Components of Control		Classification of Asthma Control (٠–٤ years of age)		
		Well Controlled	**Not Well Controlled**	**Very Poorly Controlled**
Impairment	Symptoms	≤٢ days/week	>٢ days/week	Throughout the day
	Nighttime awakenings	≤١x/month	>١x/month	>١x/week
	Interference with normal activity	None	Some limitation	Extremely limited
	Short-acting $beta_{٢}$-agonist use for symptom control (not prevention of EIB)	≤٢ days/week	>٢ days/week	Several times per day
Risk	Exacerbations requiring oral systemic corticosteroids	٠–١/year	٢–٣/year	>٣/year
	Treatment-related adverse effects	Medication side effects can vary in intensity from none to very troublesome and worrisome. The level of intensity does not correlate to specific levels of control but should be considered in the overall assessment of risk.		
Recommended Action for Treatment **(See figure ٤–١a for treatment steps.)**		• Maintain current treatment. • Regular followup every ١–٦ months. • Consider step down if well controlled for at least ٣ months.	• Step up (١ step) and • Reevaluate in ٢–٦ weeks. • If no clear benefit in ٤–٦ weeks, consider alternative diagnoses or adjusting therapy. • For side effects, consider alternative treatment options.	• Consider short course of oral systemic corticosteroids, • Step up (١–٢ steps), and • Reevaluate in ٢ weeks. • If no clear benefit in ٤–٦ weeks, consider alternative diagnoses or adjusting therapy. • For side effects, consider alternative treatment options.

Lowest level of treatment required to maintain control	Classification of Asthma Severity			
	Intermittent	Persistent		
	Step ١	Mild	Moderate	Severe
		Step ٢	Step ٣	Step ٤ or ٥

Stepwise Approach for Managing Asthma in Children ٠-٤ Years of Age

Intermittent Asthma

Persistent Asthma: Daily Medication
Consult asthma specialist if step ٣ care or higher is required.
Consider consultation at step ٢



Patient Education and Environmental Control at Each Step

Quick-relief medication for ***ALL*** patients -SABA as needed for symptoms.
With VURI: SABA every ٤-٦ hours up to ٢٤ hours.
Consider short course of corticosteroids with (or hx of) severe exacerbation

Stepwise approach for managing asthma in children ٥-١١ years of age

Intermittent Asthma

Persistent Asthma: Daily Medication
Consult asthma specialist if step ٤ care or higher is required.
Consider consultation at step ٣

Step ١
Preferred

SABA PRN

Step ٢
Preferred

Low dose ICS

Alternative
LTRA, Cromolyn Nedocromil or Theophylline

Step ٣
Preferred
Either
Low Dose ICS + LABA, LTRA, or Theophylline

OR

Medium Dose ICS

Step ٤
Preferred

Medium Dose ICS + LABA

Alternative
Medium dose ICS + either LTRA, or Theophylline

Step ٥
Preferred

High Dose ICS + LABA

Alternative
High dose ICS + either LTRA, or Theophylline

Step ٦
Preferred

High Dose ICS + LABA + oral corticosteroid

Alternative
High dose ICS + either LTRA, or Theophylline + oral corticosteroid

Step up if needed

(first check adherence, environmental control, and comorbid conditions)

Assess control

Step down if possible

(and asthma is well controlled at least ٣ months)

Patient Education and Environmental Control at Each Step

Quick-relief medication for ***ALL*** patients
SABA as needed for symptoms.
Short course of oral corticosteroids maybe needed.

Medications to Treat Asthma

- Medications come in several forms.
- Two major categories of medications are:
  - Long-term control
  - Quick relief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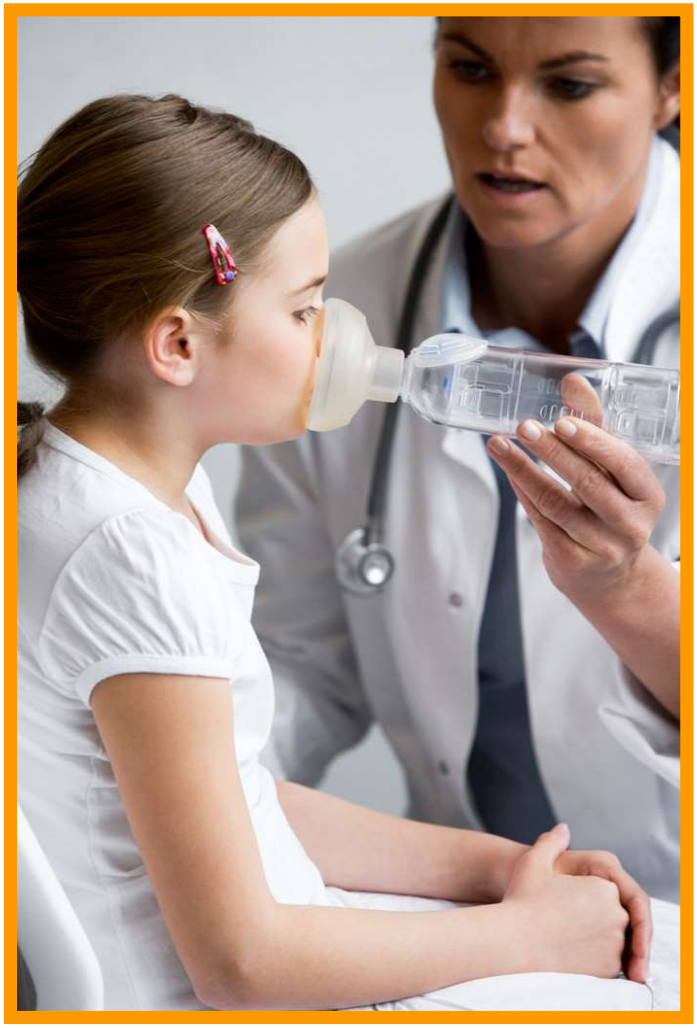
Long Term Controller Medications

- **All persistent Asthmatics require daily controller medications**

Medications to Treat Asthma: Inhalers and Spacers



Spacers can help patients who have difficulty with inhaler use and can reduce potential for adverse effects from medication.

Inhaled Corticosteroids

- Treatment of choice for persistent Asthma
- Improve lung function
- Reduce use of rescue medicines
- Reduce ED visits, hospitalizations
- May lower the risk of death due to Asthma

- Fluticasone propionate, mometasone furoate and, to a lesser extent, budesonide are considered "٢nd-generation" ICSs

-they have increased anti-inflammatory potency

- reduced systemic bioavailability for potential adverse effects, owing to extensive first-pass hepatic metabolism

Long Acting β-Agonists

- Salmeterol, Formoterol
- Not used as monotherapy
- Major role as add-on agents with ICS
- LABA use should be stopped once optimal Asthma control is achieved

Leukotriene Modifying Agents

- Leukotriene Receptor Antagonists: Montelukast, Zafirlukast
- Leukotriene synthesis inhibitor: Zileuton (Not approved for children < ١٢ years)

- reduce exercise-, aspirin-, and allergen-induced bronchoconstriction.

-an alternative treatment for mild persistent asthma and as an “add-on” medication to ICS for moderate persistent asthma.

Non-steroidal Anti- inflammatory Agents

- Cromolyn, Nedocromil
- Inhibit exercise induced bronchospasm

- Can be used in combination of SABA for exercise induced bronchospasm

- alternative anti-inflammatory drugs for children with mild persistent asthma

Theophyllin

- Can reduce Asthma symptoms and need for SABA use
- Narrow therapeutic window
- Not used as first line anymore
- Can cause cardiac arrhythmias, seizures and death

Omalizumab

- Anti IgE monoclonal antibody
- Blocks IgE mediated allergic response
- Approved for children > ١٢ years with moderate to severe Asthma
- Given sub cutaneously every ٢-٤ weeks

Exacerbations Defined (Risk)

- Are acute or subacute episodes of progressively worsening shortness of breath, cough, wheezing, and chest tightness — or some combination of these symptoms.
- Are characterized by decreases in expiratory airflow that can be documented and quantified by spirometry or Peak expiratory flow.
  - These objective measures more reliably indicate the severity of an exacerbation than does the severity of symptoms.

Classifying Severity of Asthma Exacerbations in the UC or ER Setting

Severity	Symptoms & Signs	Initial PEF (or FEV_1)	Clinical Course
Mild	Dyspnea only with activity (assess tachypnea in young children)	PEF ≥٧٠ percent predicted or personal best	▪ Usually cared for at home ▪ Prompt relief with inhaled SABA ▪ Possible short course of oral systemic corticosteroids
Moderate	Dyspnea interferes with or limits usual activity	PEF ٤٠–٦٩ percent predicted or personal best	▪ Usually requires office or ED visit ▪ Relief from freq. inhaled SABA ▪ Oral systemic corticosteroids; some symptoms last ١–٢ days after treatment is begun
Severe	Dyspnea at rest; interferes with conversation	PEF <٤٠ percent predicted or personal best	▪ Usually requires ED visit and likely hospitalization ▪ Partial relief from frequent inhaled SABA ▪ PO systemic corticosteroids; some symptoms last >٣ days after treatment is begun ▪ Adjunctive therapies are helpful
Subset: Life threatening	Too dyspneic to speak; perspiring	PEF <٢٥ percent predicted or personal best	▪ Requires ED/hospitalization; possible ICU ▪ Minimal or no relief w/ frequent inhaled SABA ▪ Intravenous corticosteroids ▪ Adjunctive therapies are helpful

Managing Asthma Exacerbations At Home

Assess Severity

- **Patients at high risk for a fatal attack (see figure ٥–٢a) require immediate medical attention after initial treatment.**
- Symptoms and signs suggestive of a more serious exacerbation such as marked breathlessness, inability to speak more than short phrases, use of accessory muscles, or drowsiness (see figure ٥–٣) should result in initial treatment while immediately consulting with a clinician.
- Less severe signs and symptoms can be treated initially with assessment of response to therapy and further steps as listed below.
- If available, measure PEF—values of ٥٠–٧٩٪ predicted or personal best indicate the need for quick-relief mediation. Depending on the response to treatment, contact with a clinician may also be indicated. Values below ٥٠٪ indicate the need for immediate medical care.

Initial Treatment

- Inhaled SABA: up to two treatments ٢٠ minutes apart of ٢–٦ puffs by metered-dose inhaler (MDI) or nebulizer treatments.
- Note: Medication delivery is highly variable. Children and individuals who have exacerbations of lesser severity may need fewer puffs than suggested above.

Good Response

No wheezing or dyspnea (assess tachypnea in young children).

PEF ≥٨٠٪ predicted or personal best.

- Contact clinician for followup instructions and further management.
- May continue inhaled SABA every ٣–٤ hours for ٢٤–٤٨ hours.
- Consider short course of oral systemic corticosteroids.

Incomplete Response

Persistent wheezing and dyspnea (tachypnea).

PEF ٥٠–٧٩٪ predicted or personal best.

- Add oral systemic corticosteroid.
- Continue inhaled SABA.
- Contact clinician urgently (this day) for further instruction.

Poor Response

Marked wheezing and dyspnea.

PEF <٥٠٪ predicted or personal best.

- Add oral systemic corticosteroid.
- Repeat inhaled SABA immediately.
- If distress is severe and nonresponsive to initial treatment:
  - Call your doctor AND
  - **PROCEED TO ED;**
  - Consider calling ٩–١–١ (ambulance transport).

- To ED.

Quick-Reliever Medications

- **Short acting β_2 agonists**

  Salbutamol

  Levosalbutamol

- **Anti-cholinergics**

  Ipratropium bromide

- **systemic corticosteroids (oral, IV)**
- **Magnesium sulfate**
- **Xanthines**

  Theophylline

- **Adrenaline injections**

Classifying Severity of Asthma Exacerbations in the UC or ER Setting

Severity	Symptoms & Signs	Initial PEF (or FEV_1)	Clinical Course
Mild	Dyspnea only with activity (assess tachypnea in young children)	PEF ≥٧٠ percent predicted or personal best	▪ Usually cared for at home ▪ Prompt relief with inhaled SABA ▪ Possible short course of oral systemic corticosteroids
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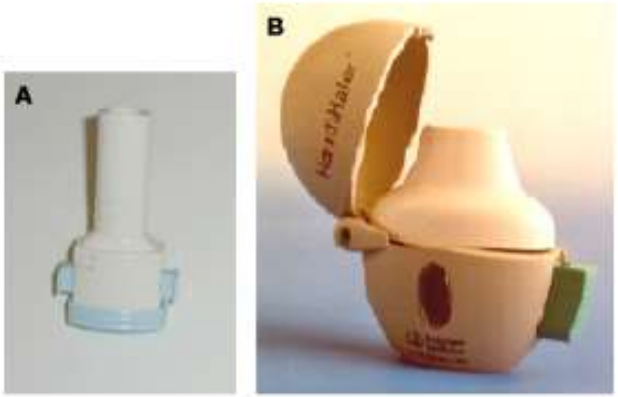
Subset: Life threatening	Too dyspneic to speak; perspiring	PEF <٢٥ percent predicted or personal best	▪ Requires ED/hospitalization; possible ICU ▪ Minimal or no relief w/ frequent inhaled SABA ▪ Intravenous corticosteroids ▪ Adjunctive therapies are helpful

Inhalation devices you can use

Single-dose devices



Multiple-dose devices

Questions?

Thank you