٢٩/١٢/١٤٤٠

Pediatric Asthma

Muna Kilani, MD

Definition of asthma

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

signs of airway obstruction و recurrent wheezing عند آدم بني بشكل عام كل ← و ما عند أشياء ثانية (ex. CF / infections/...) مسببة asthma

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.

GINA 2016

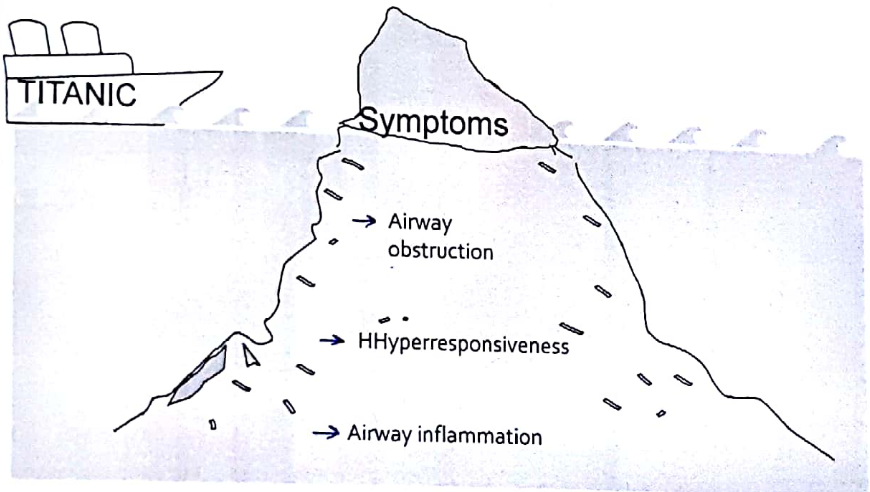
→ Asthma is a disease of the airways (not a disease of the alveoli, or air spaces such as pneumonia)

- Airway Inflammation leads to:
  - ✓ Hyperresponsiveness - responses to triggers
  - ↓
  - ✓ Obstruction - usually fully reversible
  - ↓
  - ✓ Symptoms - cough, wheeze, dyspnea

→ Hyperresponsiveness → الها دخل بال allergy
يعني واحد عندو ربو و اجاه trigger بالتالي
بصيرلا contraction ال smooth ms. of the airway

← أما واحد ما عندو ربو ، وما عندو hyperresponsiveness ← بيجي ال allergin
و بتغل ال muscles زي ماهي ، ما بتسكر

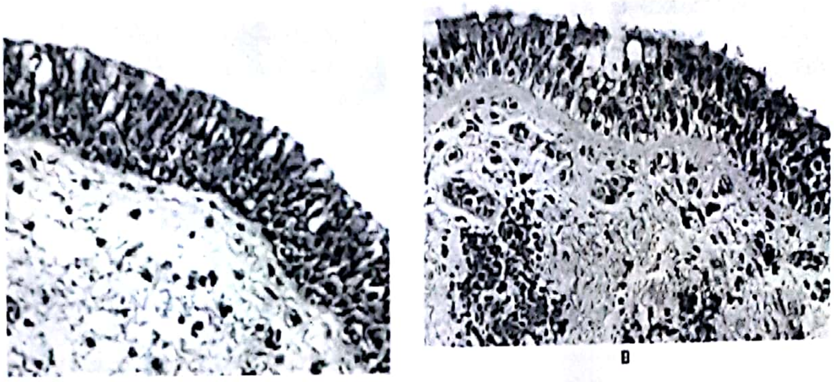
* بال airway في smooth ms. و احنا ما منعرف ليش موجودة (ما الها هالد fx المهم) ، فوحدة
من ال modalities اللي موجودة كعلاج للربو هو الـBronchial Thermoplasty (بدخلوا على ال bronchi
و بحرقوا هاي ال smooth ms.) ← بس هاي مش ال Ht mainstray



يعني في ناس بيجوا على العيادة و بكونوا بهاك الوقت منيحين
ما عندهم wheezing و لا بشكي من اشي ، بس لما تعملهم PFT
بطلع عندهم Airway obstruction

→ In asthma, airway inflammation occurs → leading to thickening of the basement membrane and infiltration of inflammatory cells (neutrophils and lymphocytes)

Normal airway | Mild Asthma

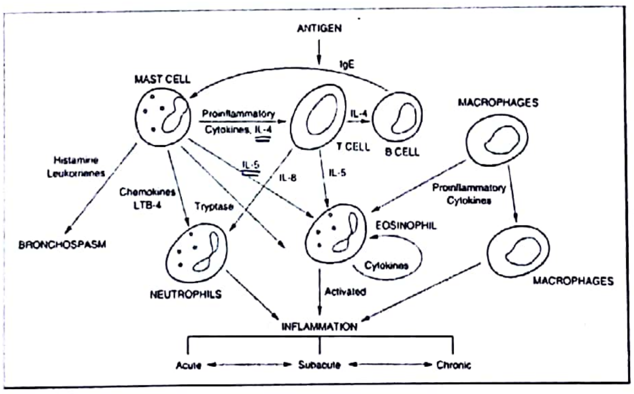


Busse et al., N Engl J Med 2001;344(5):350-362

Pathophysiology of Asthma

Important ☆

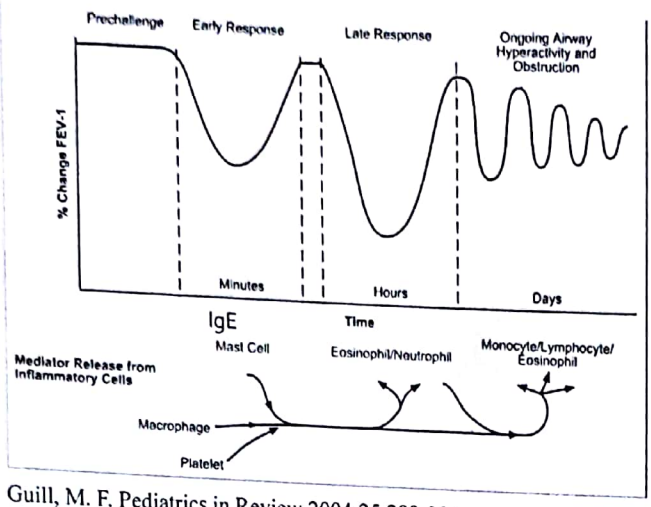
Cellular mechanisms involved in airway inflammation and the interaction of multiple cell types and mediators in airway inflammation



Guill, M. F. Pediatrics in Review 2004;25:299-305

الناس اللي ~~جاله~~ بحاولوا يعملوا therapies للربو ، بستهدفوا ال cytokines و ال cellular mechanisms اللي بتكون involved له مثلاً صار في
→ Anti - IL 5
→ Anti - Ig E

Biphasic airway response to allergen exposure



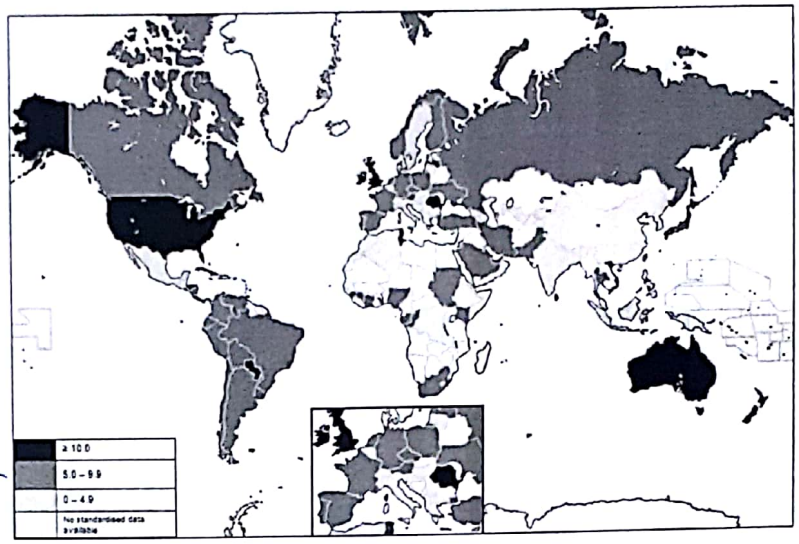
Guill, M. F. Pediatrics in Review 2004;25:299-305

Pediatrics in Review

Burden of disease

- #1 chronic illness in childhood
- #1 chronic illness causing school absence
- 78% of parents report a negative impact on family

Prevalence of asthma in children aged 13-14 years

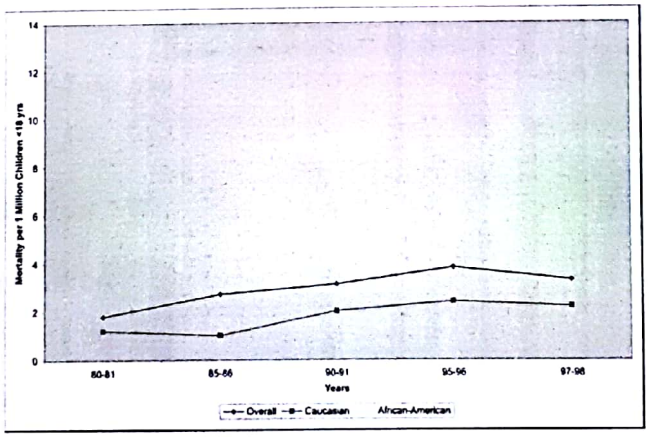


GINA 2016 Appendix Box A1-1: figure provided by Global Initiative for Asthma

الأردن احنا باللون الأزرق

الفكرة من هاي السلايد انه نعرف انه في mortality من الأزمة (لمش كتير بس موجودة)

Asthma mortality from 1980 to 1998



Guill, M. F. Pediatrics in Review 2004;25:299-305

Pediatrics in Review

Important

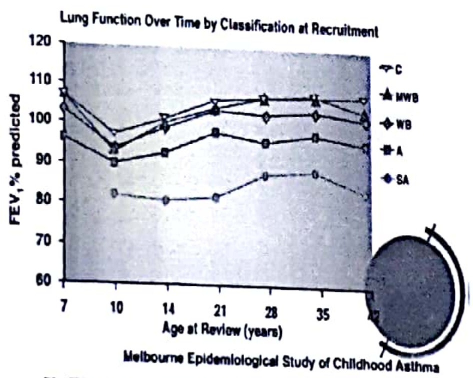
Natural History & Prognosis

- Remains incompletely understood
- Most children do not ultimately "grow out of it"

  However they might get better w/ age
  - "Loss" of symptoms may be related to growth of lungs and not due to a change of airway hyperresponsiveness.
  - Disease may go through a silent, asymptomatic period in young adulthood

To know what's going on and to further understand the natural Hx of the disease we need longitudinal studies → اللي موجودين بالعالم عن الربو مش كتار

Asthma and Wheezing from 7 to 42 Years Melbourne Study



Melbourne Epidemiological Study of Childhood Asthma

FIG 2. FEV1 percent predicted at ages 7, 10, 14, 21, 28, 35, and 42 years in subjects in their recruitment groups. C, Control; MWB, mild wheezy bronchitis; WB, wheezy bronchitis; A, asthma; SA, severe asthma.

Phelan et al JACI 2002 109;189-196

Scanned by CamScanner

What's Unique?
Pediatric asthma epidemiology

- Some risk factors for asthma are common for adults and children, but some clearly differ
  - Differences are perhaps most marked in the youngest age groups

- Asthma and wheezing in the first 6 years of life
  - Studied by Martinez and colleagues
  - Results from 826 infants followed from birth through age 6

Martinez et al. N Engl J Med 332:133-8, 1995.

Asthma and Wheezing in the First Six Years
Tucson Children's Respiratory Study

Category	Age 3	Age 6
"Transient" Wheezing	(+)	(–)
"Persistent" Wheezing	(+)	(+)
"Late" Wheezing	(–)	(+)

True asthma

(+) Age 3: ≥1 lung illness with *wheezing* before age 3

(+) Age 6: ≥1 *wheezing* episode during the year before age 6

Martinez et al. N Engl J Med 332:133-8, 1995.

هدول على عمر الـ ٣ سنين كانوا wheezers و على عمر الـ ٦ بطلوا

wheezing بلشوا من هم صغار و ضلوا على كبر

wheezers ما كانوا و هم صغار ... بس صاروا لما كبروا

* فالناس اللي بكون عندهم wheezing تحت الـ ٣ سنوات مش شرط يكون عندهم asthma

Asthma and Wheezing in the First Six Years
Categories of wheezing: Risk factors

Transient (+)Age 3, (–)Age 6	Persistent (+)Age 3, (+)Age 6	Late (–)Age 3, (+)Age 6
• Lung function LOW soon after birth • Maternal smoking during pregnancy	■ Atopy ■ Elevated IgE ■ Maternal smoking during pregnancy ■ Male gender	■ Atopy ■ Male gender

Martinez et al. N Engl J Med 332:133-8, 1995.

ما حكيت عن هذا السلايد

Asthma and Wheezing in the First Six Years
Categories of wheezing: Transient

Transient: *(+)Wheeze <3 y.o.; (–) Wheeze at 6 y.o.*

- Lung function *low* after birth: "*congenitally smaller airways*"
- With *smaller airways* from birth, these children may be *predisposed* to wheeze during viral respiratory infections
- Wheezing was no longer present -- after sufficient lung growth had occurred -- by age 6 years

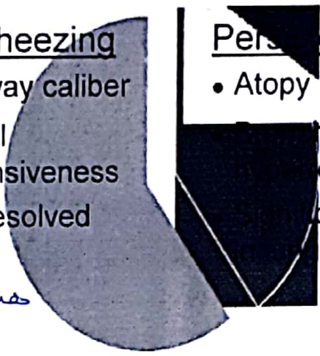
Martinez et al. N Engl J Med 332:133-8, 1995.

ما حكيت عن هذا السلايد

Asthma and Wheezing in the First Six Years

Significance of wheezing at age 3

- Of patients who wheezed before age 3, wheezing persisted through age 6 in about 40%



Transient wheezing

- Smaller airway caliber
- No bronchial hyperresponsiveness
- Wheezing resolved by age 6

Persistent Wheezing

- Atopy
- Bronchial hyperresponsiveness
- Significant deterioration of lung function by age 6

Martinez et al. N Engl J Med 332:133-8, 1995.

→ هدول بصير عندهم viral infx فممكن نسمع wheezing

هدول ما بكونوا asthma

*Signs of atopy → Allergic rhinitis/Eczema/ +ve skin testing to allergin

→ Can be tested or evaluated by using methacholine (which cause smooth ms. contraction and obstruction) OR by using Salbutamol/Albutarol و بشوفوا اذا صار في توسع بال airways و تحسن ال lung fx

→ Probability of asthma diagnosis or response to asthma Ht in children ≤ 5 years

(كان في مخطط بس ما حكى عنه اشي)

Symptom patterns in children ≤5 years

*Important

← هاي الأشياء منسأل عنها بالهستوري

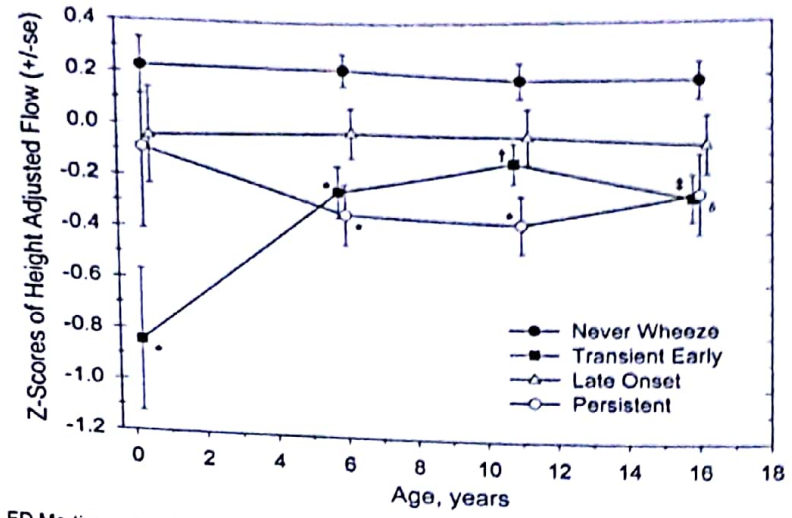
SYMPTOM PATTERN
(may change over time)

More likely viral illness		More likely asthma
Symptoms (cough, wheeze, heavy breathing) for <10 days during upper respiratory tract infections	Symptoms (cough, wheeze, heavy breathing) for >10 days during upper respiratory tract infections	Symptoms (cough, wheeze, heavy breathing) for >10 days during upper respiratory tract infections
2–3 episodes per year	>3 episodes per year, or severe episodes and/or night worsening	>3 episodes per year, or severe episodes and/or night worsening
No symptoms between episodes	Between episodes child may have occasional cough, wheeze or heavy breathing	Between episodes child has cough, wheeze or heavy breathing during play or when laughing
		Atopy, or family history of asthma

GINA 2016, Box 6-1 (2/2)

ما حكيت عن هذا السلايد

Asthma and Wheezing in the First Six teen Years
Tucson Study: 10 years later



FD Martinez et al. AJRCM Vol 172. pp. 1253-1258, 2005.

☆ Important

When should wheezing be called asthma

- When it is recurrent
- When other wheezing conditions have been excluded
- When a number of risk factors are present
- When the child responds to anti asthma therapy

Asthma Predictive Index

- Used in children younger than 3 to predict the likelihood of developing asthma in the future
  - 3 Episodes of wheezing
  - Plus 1 major criteria (Parental history, atopy like eczema, positive sensitization to environmental allergen)
  - or 2 minor criteria like allergic rhitinits, wheezing without URI, or eosinophils >4% in peripheral bld.

Castro-Rodriguez JA. The Asthma Predictive Index: early diagnosis of asthma. Curr Opin Allergy Clin Immunol. 2011;11(3):157–161

40% of asthma pts as adults started wheezing before 1 year of age

Risk factors

Viral infections are both a
- Risk factor for developing asthma later in life
- and a trigger for an asthma flare up

هاي من سلايد ضايفته مش موجود هون (بس هاد اللي كان مكتوب فيه)

- RSV → respiratory syncytial virus
- PIV → Para influenza virus

Asthma Risk Factor
Viral infections

Healthy infant

rhino

RSV
PIV → ex. bronchiolitis

Wheezing Illness

Atopy

Resolution

Asthma

* في اشي بطيب و في asthma اشي بعير

Child with asthma

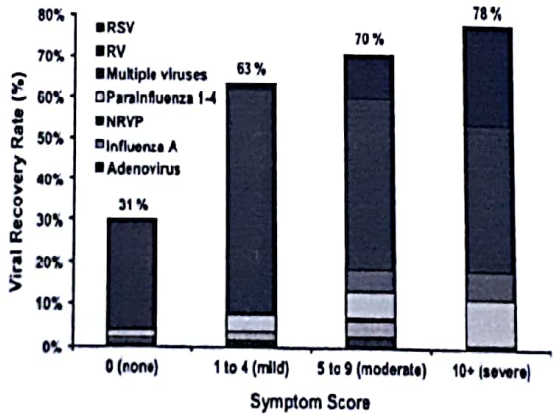
Rhinovirus

Asthma exacerbation
- Emergency room visit
- Hospitalization

* Note: Viral infx is the most common trigger for asthma

Impact of Viral LRIs Before Age 3 Years

#



Lemanske et al JACI 116(3):571-577 2005

Asthma Risk Factor
Atopy

- Atopy is the most important risk factor for the development of asthma.
- By school age 40-80% of asthmatic children have positive immediate type allergy skin tests.
- Allergic rhinits, eczema, high IgE levels and more than 4% eosinophils.
- ~~FAMILY HISTORY~~

symptoms or manifestations of atopy

Asthma Risk Factor
Male gender

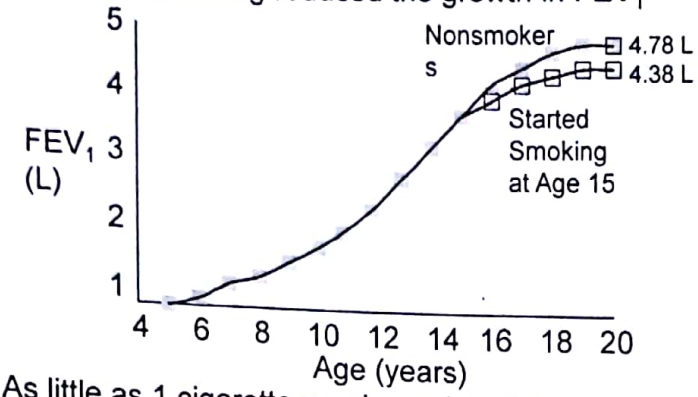
- In general,
  - Female lungs are smaller than male lungs
  - Female airways are smaller than male airways
- However, relative to lung size, male airways are smaller than female airways
  - This may explain the greater incidence of asthma in boys than in girls
  - It is certainly clear from epidemiology that asthma is more common in boys than in girls

ما حكت الني عن هاد السلايد

Asthma Risk Factor

Cigarette smoking in early adolescence

Active smoking reduced the growth in FEV_1



- As little as 1 cigarette per day reduced the maximal growth in FEV_1 by 5%

Tager et al. Am Rev Respir Dis. 1985;131:752-759.

Asthma risk factors

There is a genetic component بس ما منعرف بالارجح شو هو.

- A positive family history of asthma
- Maternal history of asthma had a stronger association with developing asthma than paternal history

فأول اشي بسأل إذا الأم عندها أزمة و بعدين بسأل عن الأب.

- If one parent has asthma the likelihood of asthma in their children increases by 3 times, if both parents have asthma it increases by 6 times

Clinical Presentation

Presentations of Wheezing

- The most common cause of wheezing in young children is viral respiratory infection

BUT

- The strongest ***predictor*** for wheezing that develops into asthma is ATOPY
  - About 70–90% of children with asthma are atopic (i.e., positive skin tests)

٢٩/١٢/١٤٤٠

Making the diagnosis: History

Symptoms
- ✓ Cough, wheeze, dyspnea ← هاي مهمة ... بصحى بالليل مش عارف يتنفس
- ✓ Nocturnal awakenings

Frequency & Severity
- ✓ Seasonal, perennial
- ✓ Precipitating factors / "Triggers"
- ✓ Interference with daily activities
- ✓ ER visits or hospitalizations

Medication Usage → ex. salbutamol / Albutarol
- Short-acting beta-agonist use

Family History
- ✓ Allergy / Atopy
- ✓ Asthma

Precipitating / Aggravating Factors Asthma Triggers

- Viral upper respiratory infections
- Allergen exposure → Causing bronchospasm
- Exercise, hyperventilation → The passage of air causes friction of the airway
- Irritants (especially smoke) ↳ Dust is also an allergin
- Weather
- Strong emotion (rare)
- Gastroesophageal reflux??? Symptomatic GERD benefits from treatment
  - ↳ Can cause bronchospasm and trigger wheezing
  - ↳ براي الحالة، معالج ال GER فبتحسن المريض

→ examples on allergins:
- Cats are a strong allergin
- Pollen
- ~~Gl...~~ mold
- Grass

* Dust and Smoke are irritants not allergins

(Weather:)
- Very cold air can cause bronchospasm
- Hot air causes inflammation
- Change in the weather or in the pressure can also be a trigger (مثلاً كان بمكان حامي و دخل عى مكان سخن ...)

* food allergy rarely causes an asthma attack

Making the diagnosis: Exam

(Physical exam)

- Wheezing
  - A sign of intrathoracic airway obstruction
  - A musical sound generated by airway passing at high velocity through an airway narrowed to the point of almost closure

* Not every wheeze is asthma
But every wheeze is narrowing of the airways

* Important

- Differential diagnosis of wheezing
  - Bronchiolitis
  - Cystic Fibrosis
  - Foreign body
  - Anatomical lesions like vascular rings, mediastinal cysts
  - GERD, aspiration
  - Heart failure
    ↳ How?! via pulmonary edema.

Making the diagnosis: Physical exam

- Decreased air entry bilateral
- Prolonged forced expiration
- Use of accessory muscles
- Retractions
- Hyperexpansion of the chest
- Signs of other allergic diseases
  - Atopic dermatitis
  - Allergic rhinitis

Physical examination of the chest may be normal

Challenges in Treating Childhood Asthma

Assessing airway function

For Dx

Spirometry: Pulmonary function test

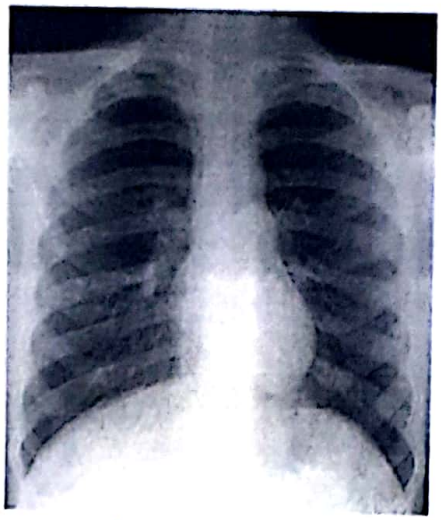
An FEV_1 response of ≥12% post-bronchodilator is suggestive of asthma

BUT,

- Spirometry is difficult in children <4 yrs
- Some children cannot perform spirometry adequately until >7 years of age

Diagnosis

- X rays



When?

- May be normal
- May show ~~hyperinflammation~~ hyperinflation (but this is not diagnostic)

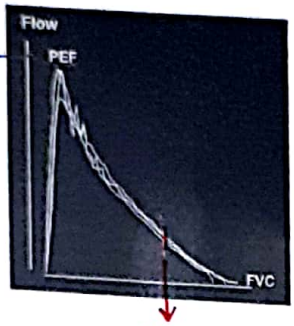
- First time wheezing
- Fever (to rule out pneumonia)
- Unilateral Wheezing
- Sever symptoms (ex. if pt enters ICU)

How often?

Diagnosis

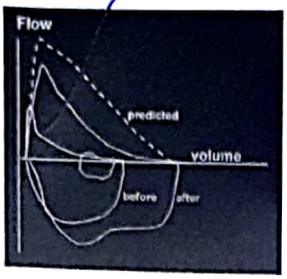
- Pulmonary function testing.
  - Flow volume curves

Peak flow ←



FEV$_1$

very obstructed →



When doing spirometry we usually use a short acting β agonist such as salbutamol

← بس إذا واحد عطاه بخاخ و طلع spirometry نورمال و لساته شاكك ← بتعطيه واحد من الأشياء اللي بالنقطة الأولى و بتعيد الـ spirometry

Diagnosis
Assessing airway function

- Metholine/ Histamine/Exercise challenge test. → These cause more contraction (constriction of the smooth ms)
- Sputum eosinophils. → to assess inflammation in the airway
- Exhaled NO.
- Allergy testing.
- Infant lung testing.

Peak flow??

↳ Next slide

- Peak Flows
  - It is effort dependent
    * However FEV_1 is NOT effort dependent
  - Not routinely indicated
  - -Used in moderate and sever asthma
    (in teenagers or adults who can do this test)

Management

Management of asthma

- Long term goals — How important ?
  - Maintain child symptom free
  - * Best lung function at all times
  - Avoid need for bronchodilators
  - Prevent the restriction of childhood activities
  - Prevent the development of irreversible lung disease
  - Reduce the risk of death
  - Avoid unnecessary side effects.

Treatmen of asthma

- Bronchodilators -β agonist * Important SABA (Salbutamol / Albutarol)
  - Relax smooth muscle in the bronchial tree.
  - Duration of action around 4 hours, peak 10-30min
  - Can cause sympathomimetic effects
  - Available as inhalers or nebulizers

Medications

- Dosing for albuterol
  - MDI 90mcg per puff, 2-4puffs as needed
  - For nebulize 2.5mg of albutrol/dose

هاد السلايد
ما حكته

Medications

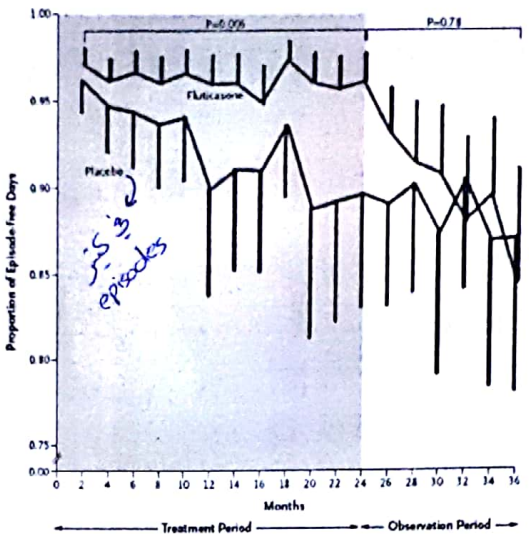
- Anticholinergic agents: (Atrovent)
  - Blocks the postganglionic efferent vagal pathways leading to bronchodilation.
  - Additive effect to B_2 agonist in an acute asthma attack.
  - Effective in acute asthma management, use in first 24 hours decreased rate of hospital admission.

Medications

- Inhaled steroids:
  - Anti inflammatory agents that lead to the modification of arachidonic acid metabolism.
  - Associated with decreased airway responsiveness.
  - Available as beclomethasone, budesonide, fluticasone, and triamcinolone
  - Inhaled or nebulized

Medication

- Side effects:
  - Suppression of hypothalamic-pituitary axis, rarely doses below 800mcg.
  - Decrease in height. (CAMP study). → بنقصوا نص سم أو سم (مش اشي مجزوز)
  - Oral thrush, hoarseness.
  - Similar to oral steroids in high doses.
- Are not believed to prevent the development of asthma



Guilbert et al NEJM 354(5):1198-97 2006

Medications

- Oral steroids:
  - Most commonly used in the management of an acute attack.
  - Also in children with sever chronic asthma.
  - Onset of action is after 8 hours. → ما يزبط بالطوارئ
  - Side effects: reduced growth, Hypothalamic pituitary axis suppression, hypertension, cataract…

Treatmen of asthma

- Long acting β agonist LABA
  - Salmeterol—up to 12 hours
  - Formoterol—observed in most patients to last up to 12 hours
  - Are steroid sparing
  - Black box warning
    ↳ They may cause death because of overstimulation of the heart

أول ما يوخذوا يحسوا إنهم تحسنوا فورًا

LABA Labeling 2006

WARNING: Long-acting beta$_2$-adrenergic agonists may increase the risk of asthma-related death. Therefore, when treating patients with asthma, FORADIL AEROLIZER should only be used as additional therapy for patients not adequately controlled on other asthma-controller medications (e.g., low- to medium-dose inhaled corticosteroids) or whose disease severity clearly warrants initiation of treatment with two maintenance therapies, including FORADIL AEROLIZER. Data from a large placebo-controlled US study that compared the safety of another long-acting beta$_2$-adrenergic agonist (salmeterol) or placebo added to usual asthma therapy showed an increase in asthma-related deaths in patients receiving salmeterol. This finding with salmeterol may apply to formoterol (a long-acting beta$_2$-adrenergic agonist), the active ingredient in FORADIL AEROLIZER (see WARNINGS).

Medications

- Leukotriene-receptor antagonist (Zafirlukast, montelukast), and Leukotrene- receptor inhibitors (Zileuton)
  - Block airway response to challenges, lead to improved lung function.
  - Oral medication taken ONCE daily.
  - *Have a role in mild asthma.*
  - Some pharmaco-genetics involved

استجابة الناس للدوا بختلف حسب الشخص

Medications

- Theophyllin (Methylxanthines):A phophodiesterase inhibitor, increases intracellular cAMP , decreases inflammation
  - Narrow therapeutic index, multiple drug interactions, needs drug levels
- Cromolyn sodium: Mast cell stabilizer
- Nedocromomil Sodium: Long acting mast cell stabilizer
- * Magnesuim sulphate: Inhibits smooth muscle contraction, stabilizes mast cells, inhibits acetylcholine release.
  - A cochrane review 2160, showed that it may reduce the need for hospital admission in children with acute moderate to sever asthma, but the evidence is extremely limited
  - Omalizumab: Anti IgE (Xolair)
  - Anti IL-5 Antibodies

له دور بحالات acute asthma attacks

New and Emerging Therapies Being Evaluated for Asthma.

Table 1. New and Emerging Therapies Being Evaluated for Asthma.*

Therapy	Target	Reference or ClinicalTrials.gov Number
Anticholinergic agents	Acetylcholine receptor	Kerstjens[8]
Chemokine receptor antagonists	CXCR2, CCR3	Nair,[9] NCT01160224
	CCR3 (antisense)	NCT00822861
Cytokine mediators	Interleukin-4 receptor α	Wenzel,[6] NCT00801853
	Interleukin-5	Pavord,[5] Nair,[4] Haldar,[7] Castro,[10] NCT01691508, NCT01285323
	Interleukin-5 receptor	NCT00659659
	Interleukin-13	Corren,[3] Piper,[10] NCT01545440, NCT01402986
Leukotriene inhibitors	5-Lipoxygenase activating protein	NCT01471665
	Leukotriene A_4 hydrolase	NCT01241422
Mast-cell inhibitors	Tyrosine kinase	Humbert,[11] NCT01449162, NCT01097694
Once daily beta agonists and inhaled glucocorticoids	β_2 adrenergic receptor and multiple targets	Busse,[12] NCT01686633, NCT00556673
Prostaglandin D_2 receptor antagonists	CRTH2	Busse,[13] Barnes,[14] NCT01545726, NCT01561690, NCT01197794
Toll-like receptor agonists	Toll-like receptor 9	Beeh,[15] NCT01673672

* This list is not exhaustive but represents a sample of therapies being investigated for asthma. CCR3 denotes chemokine (C C motif) receptor 3, CRTH2 chemoattractant receptor expressed on type 2 helper T cells, and CXCR2 chemokine (C-X-C motif) receptor 2.

Wechsler ME. N Engl J Med 2013;368:2511-2513.

Treating asthma to control symptoms and minimize risk

GINA Global Strategy for Asthma management and Prevention 2016

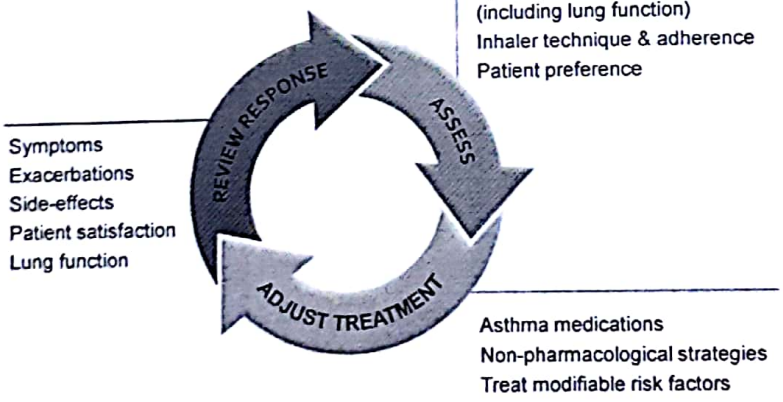
Assessing asthma severity

(mild/mod/severe)

- How?
  - Asthma severity is assessed retrospectively from the level of treatment required to control symptoms and exacerbations
- When?
  - Assess asthma severity after patient has been on controller treatment for several months
  - Severity is not static – it may change over months or years, or as different treatments become available
- Categories of asthma severity
  - *Mild asthma:* well-controlled with Steps 1 or 2 (as-needed SABA or low dose ICS)
  - *Moderate asthma:* well-controlled with Step 3 (low-dose ICS/LABA)
  - *Severe asthma:* requires Step 4/5 (moderate or high dose ICS/LABA ± add-on), or remains uncontrolled despite this treatment

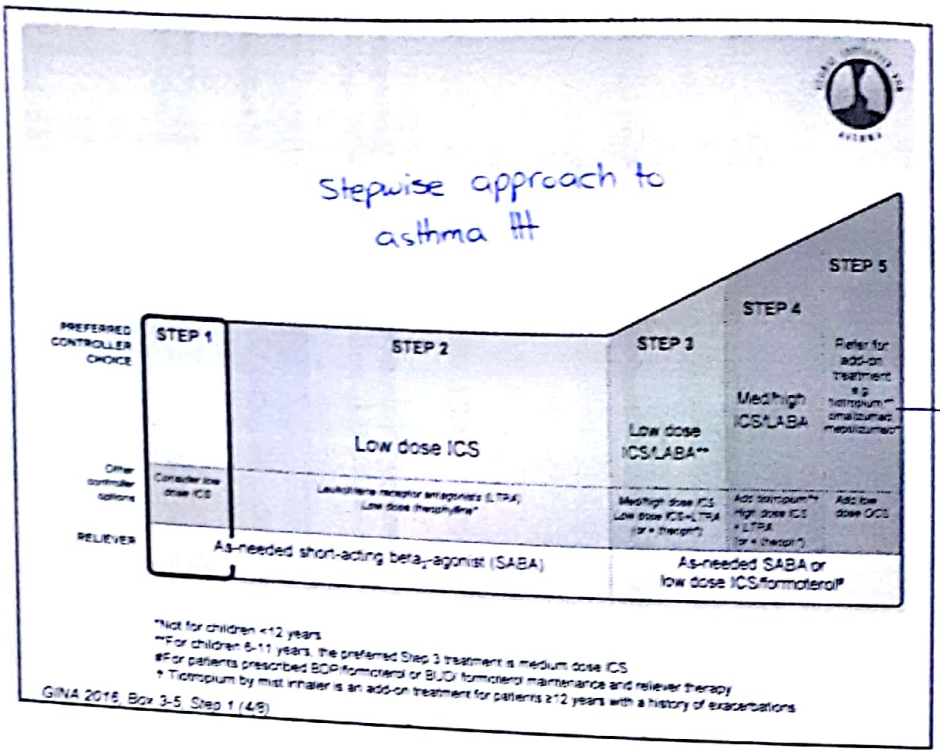
GINA 2016

The control-based asthma management cycle



GINA 2016, Box 3-2

Stepwise approach to asthma ##

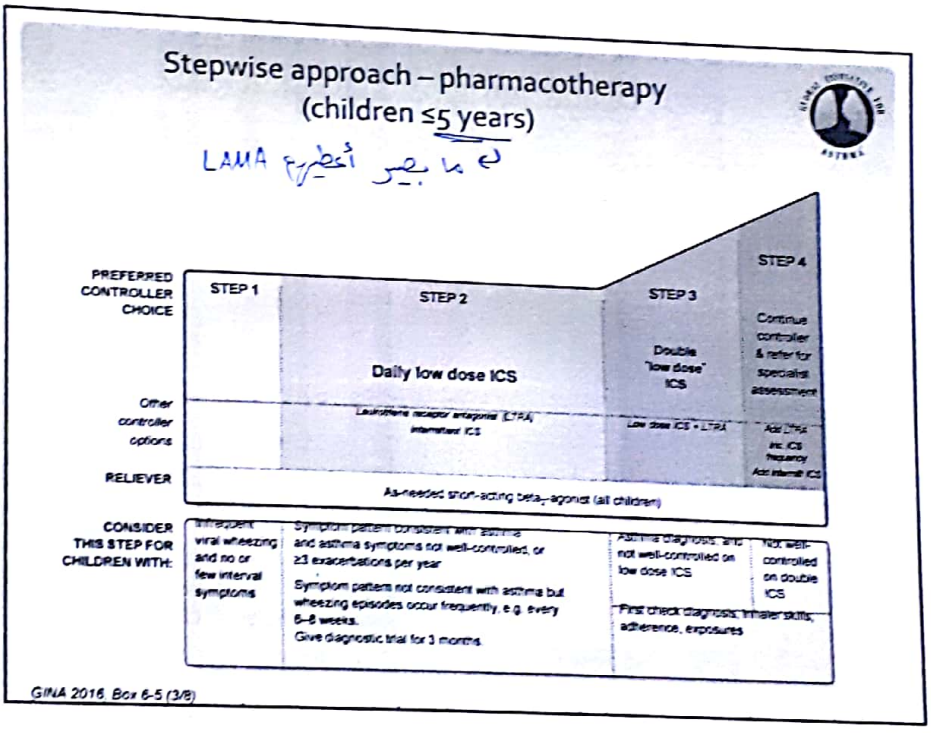


→ LAMA ← بشكل عام هدول منستخدمهم للكبار (الصغار ما منستخدمهم كيش)

هدول السلايدين مش حفظ

Stepwise approach – pharmacotherapy (children ≤5 years)

← ما بعبر أعطريه LAMA



✡ Important

الأطفال اللي أقل من ٣ سنين اللي بكون شاكة فيهم (بجيروا)

– For children with intermittent viral-induced wheeze and no interval symptoms, if as-needed SABA is not sufficient, consider intermittent ICS. Because of the risk of side-effects, this should only be considered if the physician is confident that the treatment will be used appropriately.

GINA 2016

✡ Important

Risk factors for poor asthma outcomes in children ≤5 years

Risk factors for exacerbations in the next few months
• Uncontrolled asthma symptoms
• One or more severe exacerbation in previous year
• The start of the child's usual 'flare-up' season (especially if autumn/fall)
• Exposures: tobacco smoke; indoor or outdoor air pollution; indoor allergens (e.g. house dust mite, cockroach, pets, mold), especially in combination with viral infection
• Major psychological or socio-economic problems for child or family
• Poor adherence with controller medication, or incorrect inhaler technique
Risk factors for fixed airflow limitation
• Severe asthma with several hospitalizations
• History of bronchiolitis
Risk factors for medication side-effects
• Systemic: Frequent courses of OCS; high-dose and/or potent ICS
• Local: moderate/high-dose or potent ICS; incorrect inhaler technique; failure to protect skin or eyes when using ICS by nebulizer or spacer with face mask

GINA 2016, Box 6-4B (3/3)

GINA assessment of asthma control in children ≤5 years

يعتمد على ٤ شغلات

A. Symptom control	Level of asthma symptom control		
In the past 4 weeks, has the child had:	Well-controlled	Partly controlled	Uncontrolled
1. Daytime asthma symptoms for more than few minutes, more than once/week? Yes☐ No☐	None of these	1-2 of these	3-4 of these
2. Any activity limitation due to asthma? (runs/plays less than other children, tires easily during walks/playing) Yes☐ No☐			
3. Reliever needed* more than once a week? Yes☐ No☐			
4. Any night waking or night coughing due to asthma? Yes☐ No☐			

GINA 2016, Box 6-4A

Assessing asthma severity

- How?
  - Asthma severity is assessed retrospectively from the level of treatment required to control symptoms and exacerbations
- When?
  - Assess asthma severity after patient has been on controller treatment for several months
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GINA 2016

Very Very Important

Acute asthma flare up

Starts at home

Asthma management plan

Acute asthma management

- Inhaled albuterol, continuous, frequent
- Systemic steroids---- Oral or IV → equal effect
- Inhaled anticholinergics
- If no improvement consider
  - Subcutaneous terbutaline
  - Magnesium sulphate
  - Heliox
  - Intubation and ventilation

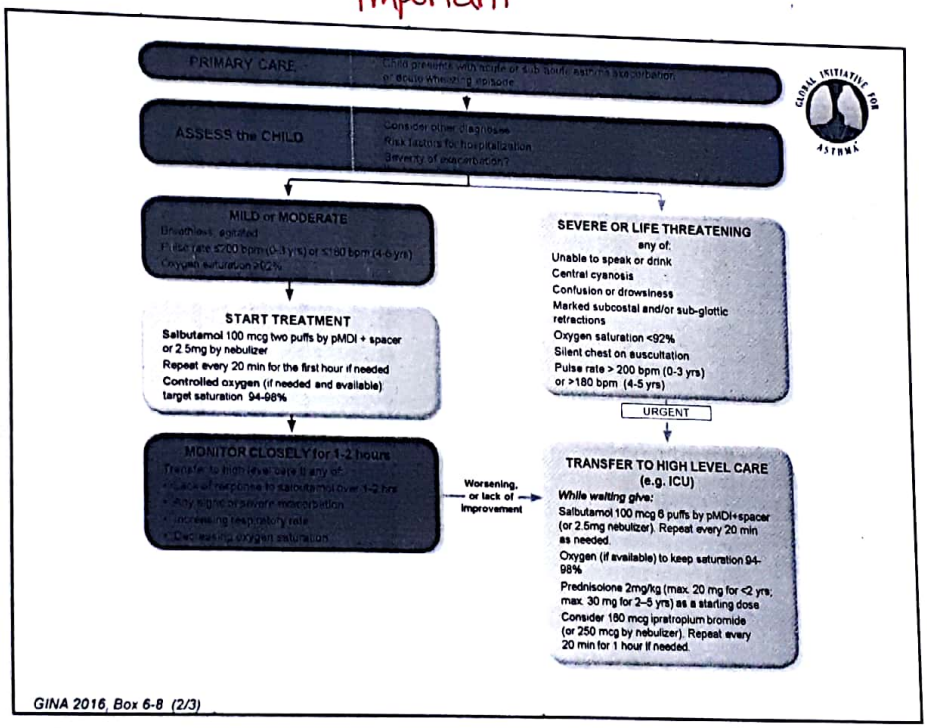
Important

Initial management of asthma exacerbations in children ≤5 years

Therapy	Dose and administration
Supplemental oxygen	24% delivered by face mask (usually 1L/min) to maintain oxygen saturation 94-98%
Inhaled SABA	2–6 puffs of salbutamol by spacer, or 2.5mg by nebulizer, every 20 min for first hour, then reassess severity. If symptoms persist or recur, give an additional 2-3 puffs per hour. Admit to hospital if >10 puffs required in 3-4 hours.
Systemic corticosteroids	Give initial dose of oral prednisolone (1-2mg/kg up to maximum of 20mg for children <2 years; 30 mg for 2-5 years)
Additional options in the first hour of treatment	
Ipratropium bromide	For moderate/severe exacerbations, give 2 puffs of ipratropium bromide 80mcg (or 250mcg by nebulizer) every 20 minutes for one hour only
Magnesium sulfate	Consider nebulized isotonic $MgSO_4$ (150mg) 3 doses in first hour for children ≥2 years with severe exacerbation

GINA 2016, Box 6-11 (2/2)

Important



GINA 2016, Box 6-8 (2/3)

Inhalers

< 4 yrs

> 4 yrs

Nebulizer

Medication delivery devices

- Inhalers
- Nebulizers
- Both used with mask if under 4 years and mouth piece after that.
- Always review technique with patient

* كانت حاطة صور عل ال Dry powder inhalers

Thank you!!!!!