L12: Bronchial Asthma

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MEDICINE 433

Objectives

1. Define asthma and its clinical features.
2. Have an understanding how to diagnose asthma.
3. Pathophysiology of asthma.
4. Basic Management of asthma.

Color index: Step up to medicine , slide , Doctor's note , Davidson , Extra Explanation

General Characteristics of Asthma

- Asthma is characteristically defined by the following triad:
  1. Airway inflammation
  2. Airway hyper-responsiveness
  3. Reversible airflow obstruction

- Asthma can begin at any age.
- Extrinsic versus intrinsic asthma:

Signs of acute severe asth- ma attacks: -Tachypnea, diaphoresis, wheezing, speaking in incomplete sentences, and use of accessory muscles of respiration • Paradoxic movement of the abdomen and dia- phragm on inspiration is sign of impending respira- tory failure.

Extrinsic Asthma	Intrinsic Asthma
○ Most Cases ○ Patients are atopic (Produce IgE to environmental antigens.) May be associated with eczema and fever. ○ Patients become asthmatic at a young age.	Not related to atopy or environmental factors.

- Triggers include pollens, house dust, molds, cockroaches, cats, dogs, cold air, viral infections, tobacco smoke, medications (Beta blockers, aspirin, NSAIDs)

Pathophysiology

Airway hyper-reactivity (AHR): the tendency for airways to narrow excessively in response to triggers that have little or no effect in normal individuals. Other factors likely to be important in the behaviour of airway smooth muscle include the degree of airway narrowing and neurogenic mechanisms.

The relationship between **atopy (the propensity to produce IgE)** and asthma is well established, and in many individuals there is a clear relationship between sensitisation and allergen exposure, as demonstrated by skin prick reactivity or elevated serum specific IgE. Common examples of allergens include house dust mites, pets such as cats and dogs, and fungi. Inhalation of an allergen into the airway is followed by an early and late-phase broncho-constrictor response . Allergic mechanisms are also implicated in some cases of occupational asthma

In cases of **aspirin-sensitive asthma**, the ingestion of *salicylates* results in inhibition of the *cyclooxygenase enzymes*, preferentially shunting the metabolism of *arachidonic acid* through the *lipoxygenase pathway* with resultant production of the asthmogenic cysteinyl leukotrienes.

In **exercise-induced asthma**, hyperventilation results in water loss from the peri-cellular lining fluid of the respiratory mucosa, which, in turn, triggers mediator release. Heat loss from the respiratory mucosa may also be important.

In **persistent asthma**, a chronic and complex inflammatory response ensues, characterised by an influx of numerous inflammatory cells, the transformation and participation of airway structural cells, and the secretion.

With increasing severity and chronicity of the disease, **remodelling of the airway** may occur, leading to fibrosis of the airway wall, fixed narrowing of the airway and a reduced response to bronchodilator medication.

Clinical Features

1. Characterized by intermittent symptoms of SOB, wheezing, chest tightness, and cough. These symptoms:
   a. have variable severity and may not be present simultaneously.
   b. Usually occur ***within 30 minutes*** of exposure to triggers.

2. Symptoms are typically ***worse at night***.

3. Wheezing (during both inspiration and expiration) is ***the most common finding*** on physical examination and Tachypnea

Cough may be the dominant symptom in some patients, and the lack of wheeze or breathlessness may lead to a delay in reaching the diagnosis of so-called **'cough-variant asthma'.**

Asthma characteristically displays a diurnal pattern, with symptoms and lung function being worse in the early morning. Particularly when poorly controlled, symptoms such as cough and wheeze disturb sleep and have led to the term **'nocturnal asthma'**

Complications of asthma
1. Status asthmaticus—does not respond to standard medications
2.acute respiratory failure (due to respiratory muscle fatigue)

Dyspnea is common when a patient is exposed to rapid changes in temperature

Diagnosis

1. Pulmonary function tests (PFTs):

- required for diagnosis.
- They show an obstructive pattern: decrease in expiratory flow rates, decreased FEV1, and decreased FEV1/FVC ration (<0.75).

2. Spirometry:

- Before and after bronchodilators can confirm diagnosis by proving reversible airway obstruction.

- If inhalation of a bronchodilator (Beta 2 agonist) results in an increase in FEV1 or FVC at least 12%, airflow obstruction in considered reversible.

PFTs in asthma:
1. Decreased FEV1, decreased FVC, decreased FEV1/FVC ratio
2.Increase in FEV1 >12% with
3.albuterol
4.Decrease in FEV1 >20%
5.with methacholine or
6.histamine
7.Increase in diffusion
8.capacity of lung for carbon monoxide.

although asthma can be diagnosed with PFTs and spirometry, in an acute setting (ED) when patient is SOb, peak flow measure- ment is quickest method of diagnosis.

During asthma exacerba- tions, the patient hyper- ventilates, leading to low PaCO2 levels. If the patient is no longer hyperventilating (CO2 level is normal or high), this could be a sign that the patient is decompensating (due to fatigue) and that intubation may be required.

Diagnosis

3. Peak flow (peak expiratory flow rate; useful measure of airflow obstruction)

A. Adult ranges (varies depending on age/gender/height)

- Normal: 450 to 650 L/min (men), 350 to 500 L/min (women)
- Mild: >300
- Moderate to severe: 100 to 300
- Severe: <100

Remember that a severe exacerbation (peak flow <60% of predicted) requiring systemic corticosteroids can occur with any category of asthma.

B. Patients should self-monitor their peak flow

Mild persistent asthma	Moderate persistent asthma	Severe persistent asthma
Periodic monitoring is sufficient. **Increase the dose of inhaled steroid** if the peak flow decreases.	**Daily** monitoring is required. **Increase the dose of inhaled steroid** if the peak flow decreases.	Daily monitoring is required. **Initiate prednisone** if the peak flow decreases.

Absence of symptoms at the time of examination does not exclude the diagnosis of asthma

Diagnosis

For acute asthma exacerba- tion, test to order:
1. PEF—decreased
2. abG—increased a-a gradient
3. Chest x-ray—rule out pneumonia, pneumothorax

4. Bronchoprovocation test

- May be useful when asthma is suspected but PFTs are non-diagnostic
- Measures ease with which airways narrow in response to stimuli
- Measures lung function before and after inhalation of increasing doses of methacholine; hyperresponsive airways develop obstruction at lower doses

5. Chest x-ray

- Normal in mild cases; severe asthma reveals hyperinflation
- Only necessary in severe asthma to exclude other conditions (e.g., pneumonia, pneumothorax, pneumomediastinum, foreign body).

Diagnosis

6. Arterial blood gases (ABGs)

1. ABGs should be considered if the patient is in significant respiratory distress.
Hypocarbia is common. **Hypoxemia** may be present.

2. If the $PaCO_2$ is normal or increased, respiratory failure may ensue.

- Patients with an asthma attack have **an increased respiratory rate**, which should cause the **$PaCO_2$ to decrease**.

- Increased $PaCO_2$ is a sign **of respiratory muscle fatigue** or **severe airway obstruction**.The patient should be hospitalized and mechanical ventilation considered.

How to make a diagnosis of asthma

Compatible clinical history *plus either/or*:

- $FEV_1 \geq 15\%^*$ (and 200 mL) increase following administration of a bronchodilator/trial of corticosteroids
- > 20% diurnal variation on ≥ 3 days in a week for 2 weeks on PEF diary
- $FEV_1 \geq 15\%$ decrease after 6 mins of exercise

Treatment – Available modalities

avoid ®-blockers in asth- matics!

a. Inhaled β2 agonists	b. Inhaled corticosteroids	c. Montelukast—leukotriene modifiers	d. Cromolyn sodium/nedocromil sodium
-Short-acting β2-agonists (e.g., albuterol, salbutamol or terbutaline) are used **for acute attacks** (rescue), Onset is 2 to 5 minutes, duration is 4 to 6 hours. -Long-acting versions (e.g., salmeterol and formoterol) are good **with nighttime and exercise-induced asthma**.	-For moderate to severe asthma such as beclometasone, budesonide (BUD), fluticasone or ciclesonide. Preferred over oral steroids due to fewer systemic side effects. (Oral steroids are reserved for severe, persistent asthma.) If used on a regular basis, airway **hyperresponsiveness decreases**, and the number of asthma **exacerbations decreases.**	-less efficacious than inhaled steroids **but useful for prophylaxis of mild exercise-induced asthma** **-control of mild to moderate persistent disease.** -They may allow **reductions in steroid and bronchodilator requirements.**	**only for prophylaxis** (e.g., before exercise); rarely used in adults Side effects of inhaled corticosteroids are due to oropharyngeal deposition and include sore throat, oral candidiasis (thrush), and hoarseness. • UsingaspacerwithMDIs and rinsing the mouth after use helps minimize these side effects.

Exacerbations of asthma

- The course of asthma may be punctuated by exacerbations with **increased symptoms**, **deterioration in lung function**, and an **increase in airway inflammation.**

- Exacerbations are most commonly precipitated by **viral infections**, but moulds (*Alternaria* and*Cladosporium*), pollens (particularly following thunderstorms)**.**

- Most attacks are characterised by a gradual deterioration over several hours to days but some appear to occur with little or no warning: **so-called brittle asthma.**

Immediate assessment of acute severe asthma

Acute severe asthma	Life-threatening features	Near-fatal asthma
•PEF 33–50% predicted (< 200 L/min) •Respiratory rate ≥ 25 breaths/min •Heart rate ≥ 110 beats/min •Inability to complete sentences in 1 breath	•PEF < 33% predicted (< 100 L/min) •*Sp*O_2 < 92% or *Pa*O_2 < 8 kPa (60 mmHg) (especially if being treated with oxygen) •Normal or raised *Pa*CO_2 •Silent chest •Cyanosis •Feeble respiratory effort •Bradycardia or arrhythmias •Hypotension •Exhaustion •Confusion & Coma	•Raised *Pa*CO_2 and/or requiring mechanical ventilation with raised inflation pressures

Treatment of acute severe asthma exacerbation (hospital admission)

a. Inhaled β2-agonist (first-line therapy)	b. Corticosteroids:	c. Third-line agent (IV magnesium; magnesium helps with bronchospasm)	d. Supplemental oxygen	e. Antibiotics	f. Intubation
Via nebulizer or Metered Dose Inhalers (MDIs)* • Mainstays of emergency treatment—have an onset of action of minutes • Assess patient response to bronchodilators (clinically and with peak flows).	Given intravenously initially, but may also be given orally if given in equivalent doses. Taper IV or oral corticosteroids, but only when clinical improvement is seen. Initiate inhaled corticosteroids at the beginning of the tapering schedule.	•Not as effective as β-agonists. Only used in acute severe exacerbation that has not responded to other medications (albuterol, steroids, oxygen).	(keep oxygen saturation **>90%)**	**if severe exacerbation or suspicion of infection**	for patients in **respiratory failure or impending respiratory failure**

•aspirin-sensitiveasthma should be considered in patients with asthma and nasal polyps.
•avoidaspirinoranynons- teroidal anti-inflammatory drugs in these patients because they may cause a severe systemic reaction.

Guidelines for treatment are based on severity.

TABLE 2-3 Chronic Treatment of Asthma

Severity	Long-term Control Medications
Mild intermittent (symptoms 2 or fewer times per week)	None
Mild persistent (symptoms 2 or more times per week but not every day)	Low dose inhaled corticosteroid
Moderate persistent (daily symptoms; frequent exacerbations)	Daily inhaled corticosteroid (low dose) or cromolyn/ nedocromil or methylxanthine or antileukotriene
Severe persistent (continual symptoms, frequent exacerbations, limited physical activity)	Daily inhaled corticosteroid (high dose) and long-acting inhaled β_2-agonists or methylxanthine and systemic corticosteroids

Note: All patients should have intermittent short-acting inhaled β_2-agonists as needed plus long-term control medications based on the severity of their asthma.
From The National Asthma Education and Prevention Program, *Expert Panel Report 2,* 1997.

*Metered Dose inhalers (MDis) and nebulizers

- An MDI with a spacer is just as effective as a nebulizer. A spacer is a holding chamber that obviates the need to coordinate inhalation and depression of the canister, and thus makes the use of an MDI easier. Its use leads to a greater bronchodilator effect because more of the drug is deposited in smaller airways and less accumulates in the oropharynx.
- A nebulizer is no more effective than an MDI, but patients may report greater relief of symptoms simply because it provides more medication. It may be preferred by patients with very severe asthma unrespon- sive to MDIs.

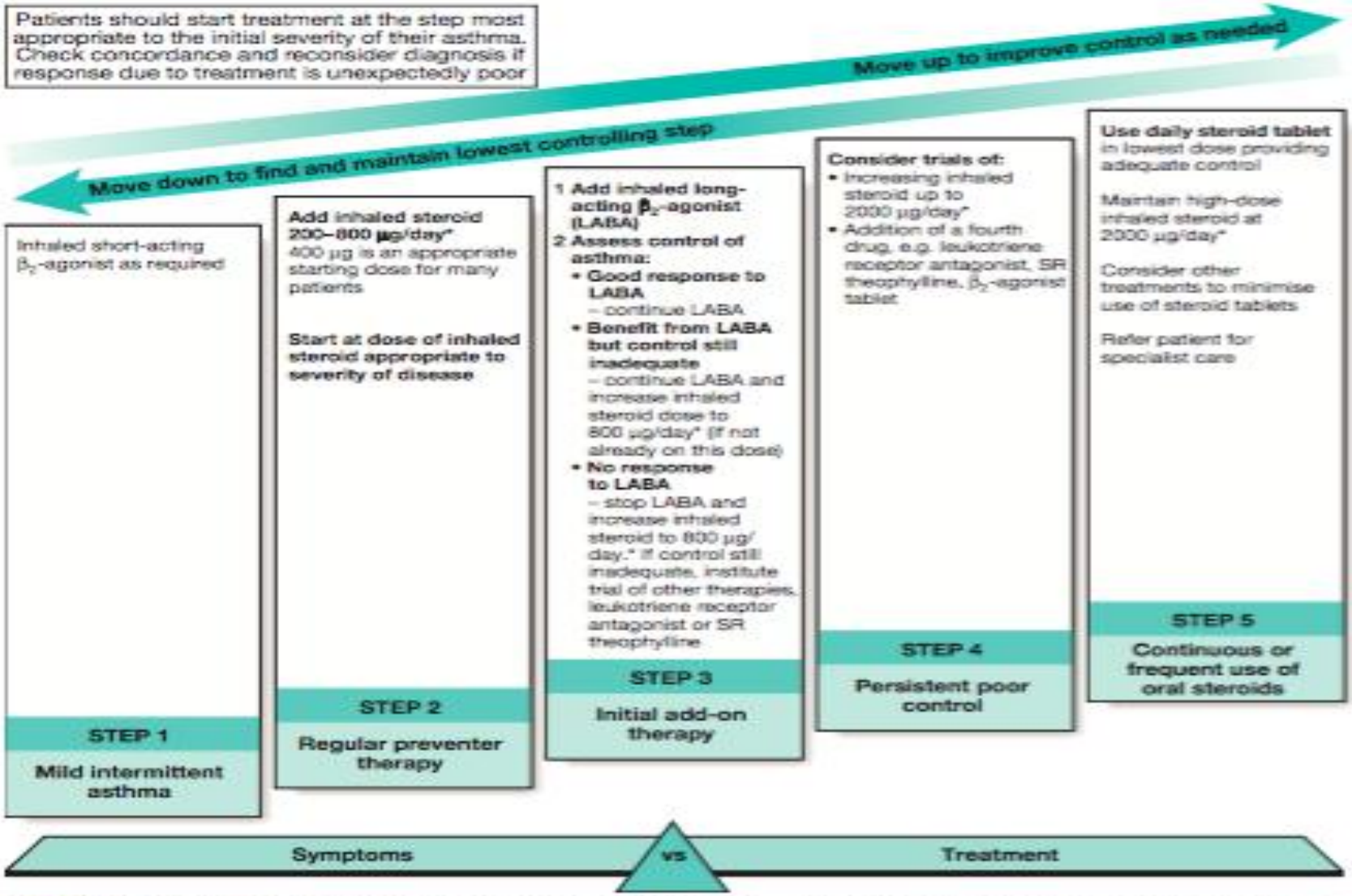

Fig. 19.22 Management approach in adults based on asthma control. *Beclometasone dipropionate (BDP) or equivalent. From British Thoracic Society and SIGN – see p. 732.

Reliever/ Rescue	Preventer/ Controller	Controller Drugs
Salbutamol-Bronchodilator (beta$_2$ agonist) • Quickly relieves symptoms (within 2-3 minutes) • **Not for regular use**	• Anti-inflammatory • Takes time to act (1-3 hours) • Long-term effect (12-24 hours) • **Only for regular use** (whether well or not well)	• Inhaled steroids • Leukotriene modifiers (montelukast) • Anti-IgE (omalizumab =Xolair) • Systemic steroids ***Need controller medication*!!**

1-Use of a quick-relief inhaler more than: *2 times per week*

2-Awaken at night due to asthma symptoms more than: *2 times per month*

3-Consumes a quick-relief inhaler more than: *2 times per year*

MCQs

(1) What is the best initial test in an acute asthma exacerbation ?

A. Peak expiratory flow
B. Pulmonary function test
C. Chest x-ray
D. Pulse oximetry

(2) 15 year old boy comes to the office because of occasional shortness of breath every few weeks. Currently he feels well and he use no medication and denies any medical problem. Physical examination reveals a pulse of 70 and a respiratory rate of 12 per minute and chest examination is normal, Which of the following is most accurate test at this case?

A. Peak expiratory flow
B. Increase in FEV1 with albuterol
C. >20% decrease in FEV1 with use of methacholine
D. Flow volume loop on spirometry

MCQs

(3) What is the most accurate diagnostic test of bronchial asthma?

A. Pulmonary function test
B. Arterial blood gas

(4) A 47 years old man with history of asthma comes to the emergency department with several days of increasing shortness of breath, cough and sputum production. On physical examination his respiratory rate was 34 per minute. He has diffuse expiratory wheezing and prolonged expiratory phase. Which of the following would you use as the best indication of the severity of his asthma?

A. Respiratory rate
B. Use of accessory muscle
C. Pulse oximetry
D. Pulmonary function test

(5) Which of the following doesnot indicate a poor prognostic finding in asthma?

A. Silent chest
B. Hypercapnia
C. Thoracoabdominal paradox (paradoxical respiration)
D. Pulsus paradoxus of 5 mm Hg
E. Altered mental status

MCQs

(6) The hallmark of asthma that distinguishes it from other obstructive airway diseases is that in asthma?

A. Hyperinflation is present on chest roentgenogram
B. Airway obstruction is reversible
C. Hypoxia occurs as a consequence of ventilation-perfusion mismatch
D. The FEV1/FVC ratio is reduced
E. Exacerbation often occurs as aresult of an upper respiratory tract infection

(7) A 30-year-old patient with a history of mild persistent asthma (baseline peak expiratory fl ow rate of 85%) presents to the emergency department with shortness of breath and wheezing that has not relieved by her albuterol inhaler for the past 12 hours. She was able to tolerate pulmonary function tests and a set was performed. Which of the following is the most likely test result?

A. Decreased FEV1, normal/increased FVC, decreased FEV1:FVC ratio, with postbronchodilator FEV1 increased by 13%
B. Decreased residual volume and total lung capacity
C. Increased FEV1, increased FVC, normal FEV1:FVC ratio
D. Increased residual volume, increased total lung capacity, increased FEV1

Answers : 1-A 2-C 3-A 4-A 5-D 6-B 7-A

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Medicine is a science of uncertainty and an art of probability