

Bronchial asthma in children

Plan of the lecture



- 1. Definition of bronchial asthma
- 2. Factors of development
- 3. Bronchial asthma pathogenesis
- 4. Clinics of asthma exacerbation
- 5. Diagnostic criteria and principles of treatment

What do we know about asthma?

Bronchial asthma is a chronic inflammatory disorder of the airways in which many cells and cellular elements play role. The chronic inflammation is associated with airway hyperresponsiveness that leads to recurrent episodes of wheezing, breathlessness, chest tightness and coughing, particularly at night or in the early morning. These episodes are usually associated with widespread but variable airflow obstruction within the lung that is often reversible either spontaneously or with treatment.

(Asthma definition from Global Strategy for Asthma Management and Prevention 2007)

- **Asthma is a problem worldwide with an estimated 300 million affected individuals**
- **BA morbidity increased twice more in Europe if we compare it with early 80-th.**
- **BA morbidity in Ukraine is 1,6 times more for the last decade**
- **According to the European Allergy Association child morbidity in various European countries ranges from 5% to 22%**
- **Children from urbanized regions fell ill on BA more frequently**

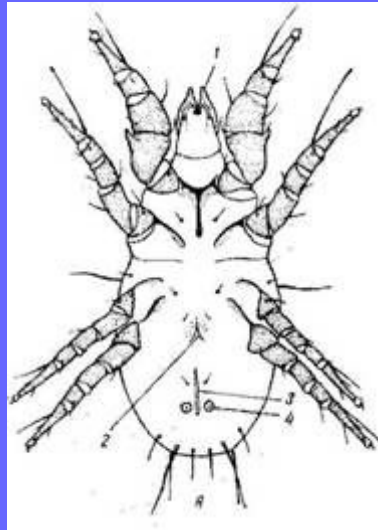
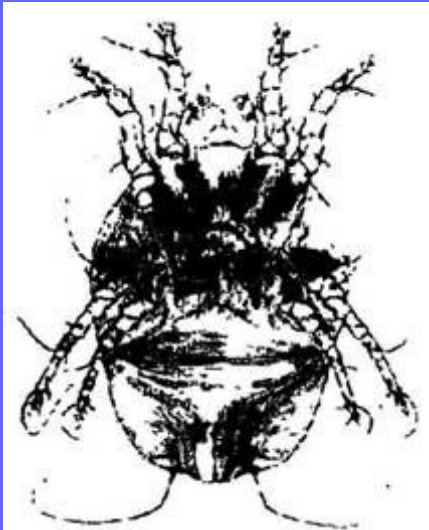
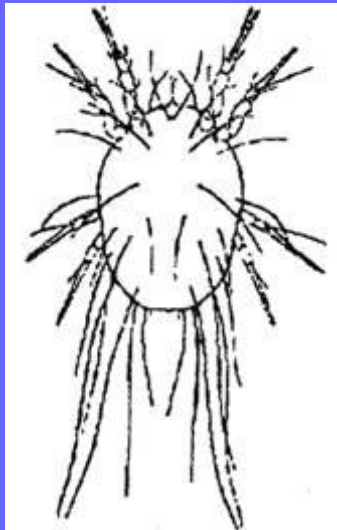
Predisposing Factors:

- Genes pre-disposing to allergic reactions
- ***Airway hyperresponsiveness***– The characteristic functional abnormality of asthma results in airways narrowing in response to a stimulus that would be innocuous in a normal person
- ***Atopy*** - is hyperproduction of IgE

Sensibilization Factors :

- **Indoor: domestic mites, domestic and library dust, cockroaches allergenes, fish fodder, feather of pillows**
- **Fungi, molds, yeasts**
- **Epidermal allergens: furred animals (dogs, cats, mica)**
- **Outdoor: Pollens of trees,weeds, flowers , molds, yeasts**
- **Infections (predominantly viral)**

Prematurity play significant role due to immaturity of lung tissue and immune system



Family
Glycyphagidae

Mites
Dermatophagoides rodens

Stock mites
Acarus siro

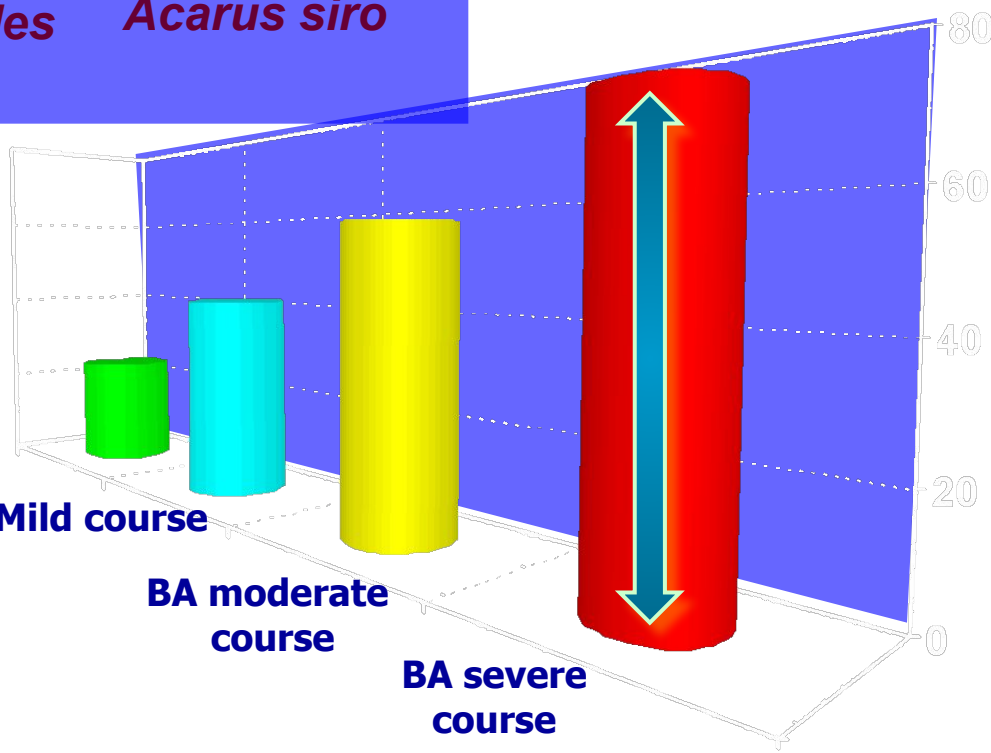
**Guanine concentration
in dust samples**

Healthy

BA Mild course

BA moderate course

BA severe course



Resolution factors (triggers):

- **Pollutants – compounds of serum, nickel, Cobalt etc.-result of industrial plants activity, car exhaust gases**
- **Tobacco smoking – active and passive**
- **Viral infections (RSV, parainfluenza, etc)**
- **Food products**
- **Physical training**
- **Stress**
- **Meteorological factors**

Extrinsic asthma



The asthma episode is typically initiated by the type 1 hypersensitivity reaction induced by exposure to the extrinsic antigen.

Three types of extrinsic asthma are recognized

1. Atopic asthma

2. Occupational asthma (many forms)

3. Allergic bronchopulmonary aspergillosis (bronchial colonization with aspergillus organisms followed by development of IgE antibodies)

Atopic asthma is the most common type of asthma. Its onset is usually in the 1st two decades of life and is commonly associated with other allergic manifestation in the patient as well as in other family members.

Serum IgE levels are usually elevated as is the blood eosinophils count. This form of asthma is believed to be driven by CD4⁺T cells.

Intrinsic asthma



The triggering mechanisms are non-immune in this form a number of stimuli that have little or no effect in normal subjects can trigger broncho-spasm. Such factors include aspirin, pulmonary infections, especially those caused by virus (RSV) ,cold, psychological stress, exercise and inhaled irritatants such as ozone and sulfur dioxide. there is usually no personal or family history of allergic manifestation and serum IgE levels are normal. These patients are said to have an asthmatic diathesis.

Drug induced asthma



Is seen most commonly with

1.NSAID'S (COX-1 inhibitors)

2.Aspirin, Ibuprofen

3.Propranolol (because non selective Beta blockers)

- hypertrophic obstructive cardiomyopathy
- migraine

4.Timolol (eye drops, used to lower internal eye pressure in patient with glaucoma)

Propranolol blocks the action of epinephrinic and norepinephrine on both B1 and B2 adrenergic receptors.

Cox-1 inhibitors converts arachidonic acid to PG resulting in pain and inflammation.

So In the case of joint pain +asthmatic condition we can use Cox-2.

- COX-2

1.Nimesulide

2.Celecoxib

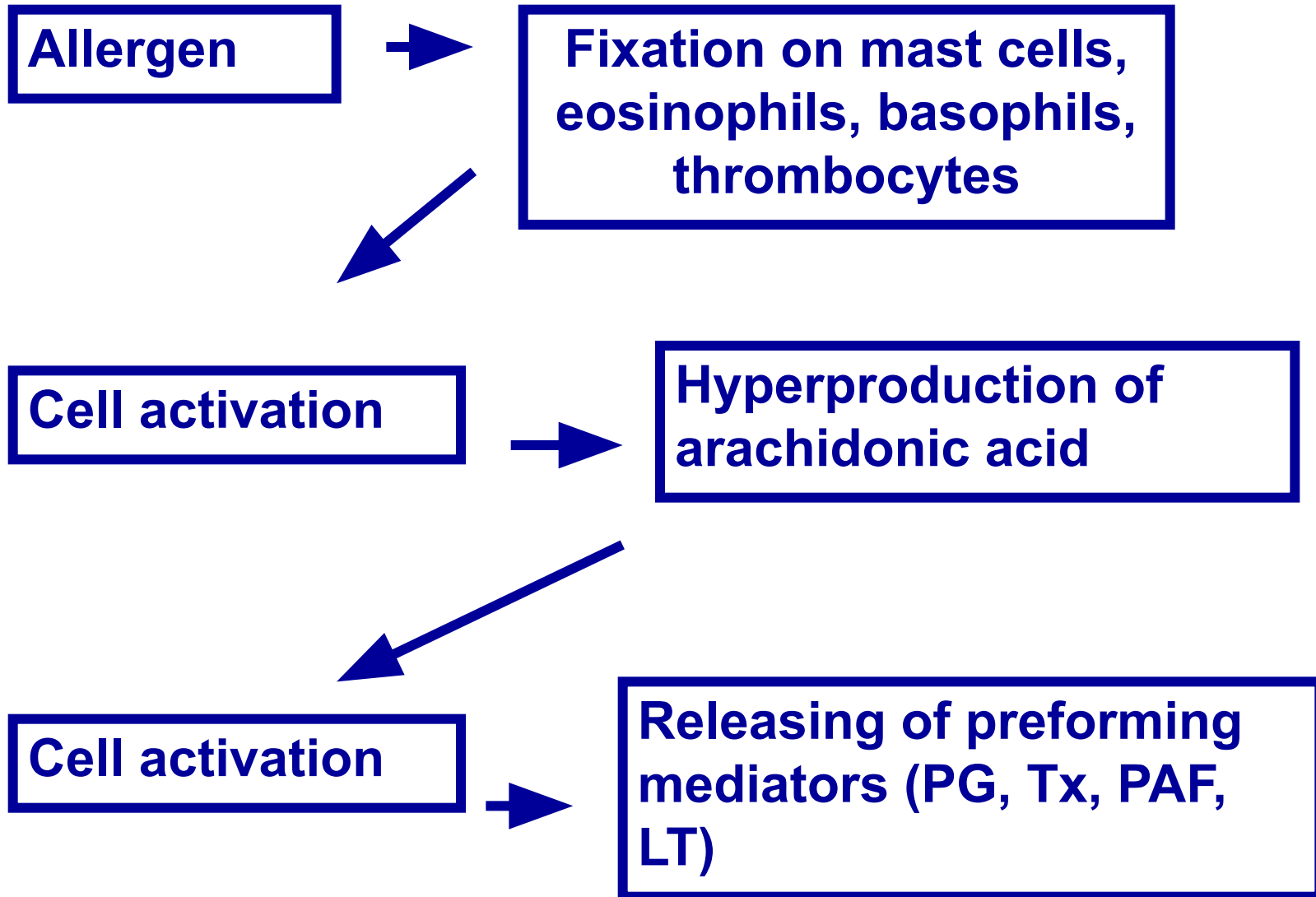
3.Etoricoxib

- COX-3

paracetamol

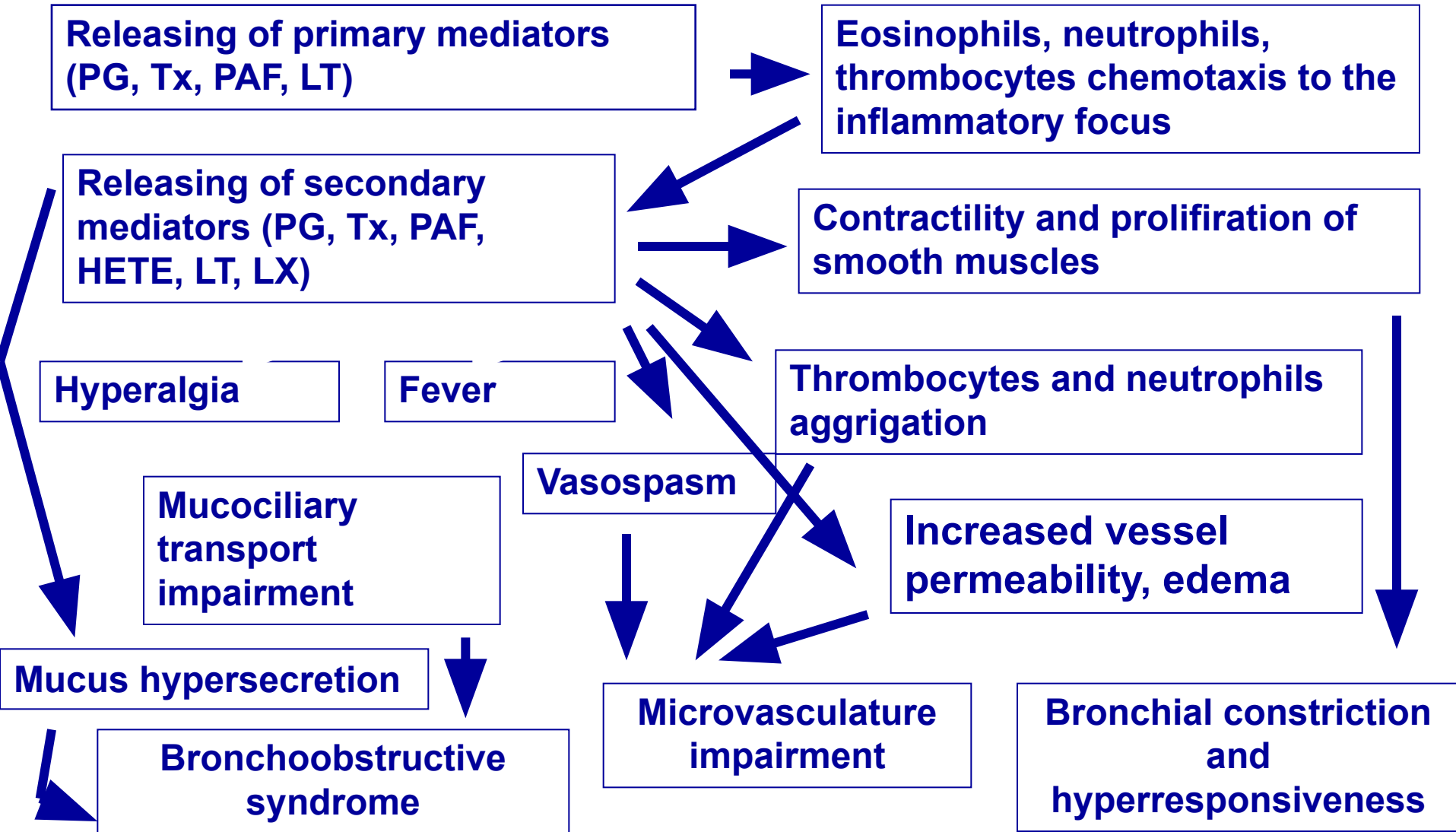
Bronchial Asthma Pathogenesis

Early phase



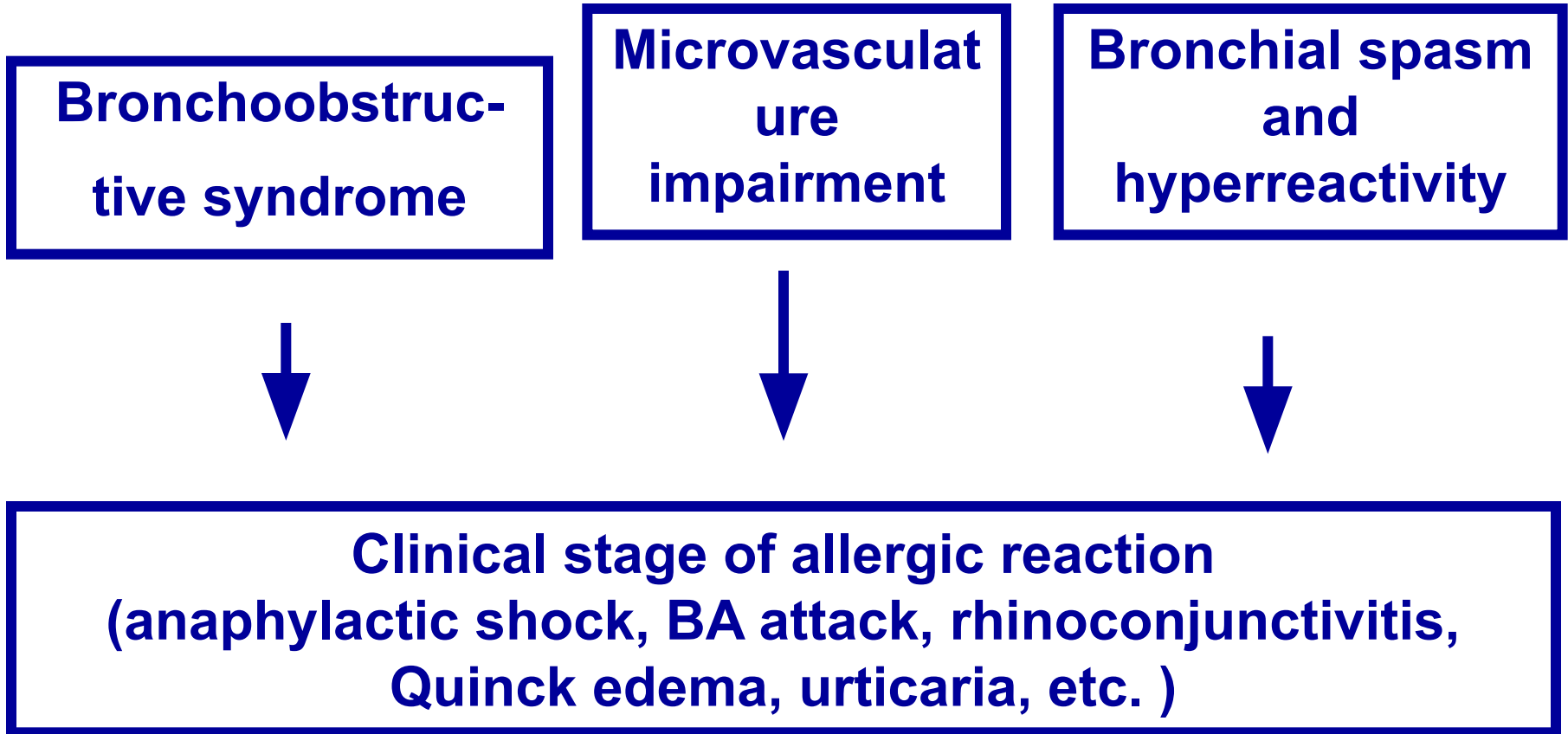
Bronchial Asthma Pathogenesis

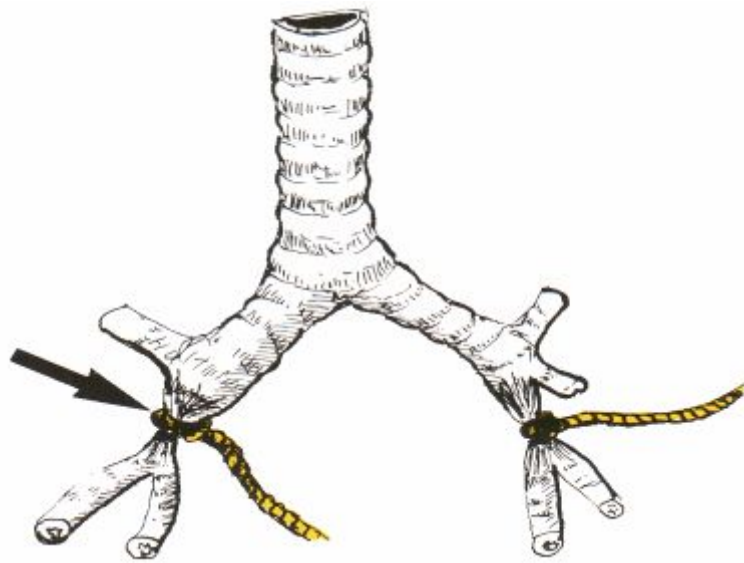
Late phase Pathophysiological stage)



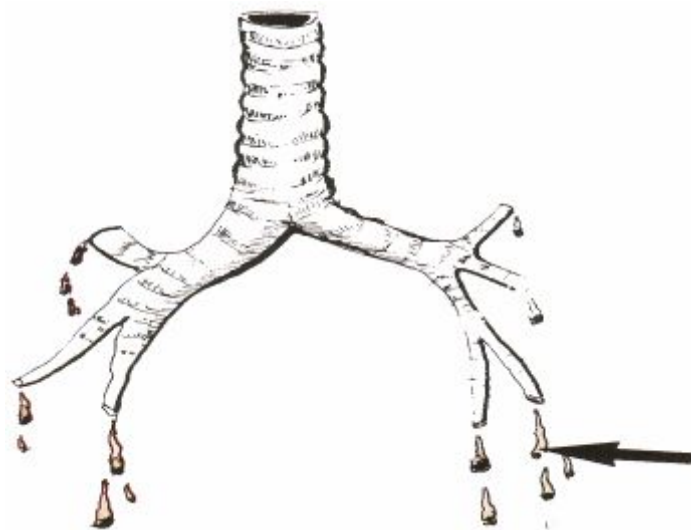
Bronchial Asthma Pathogenesis

Late stage (Pathophysiological stage)



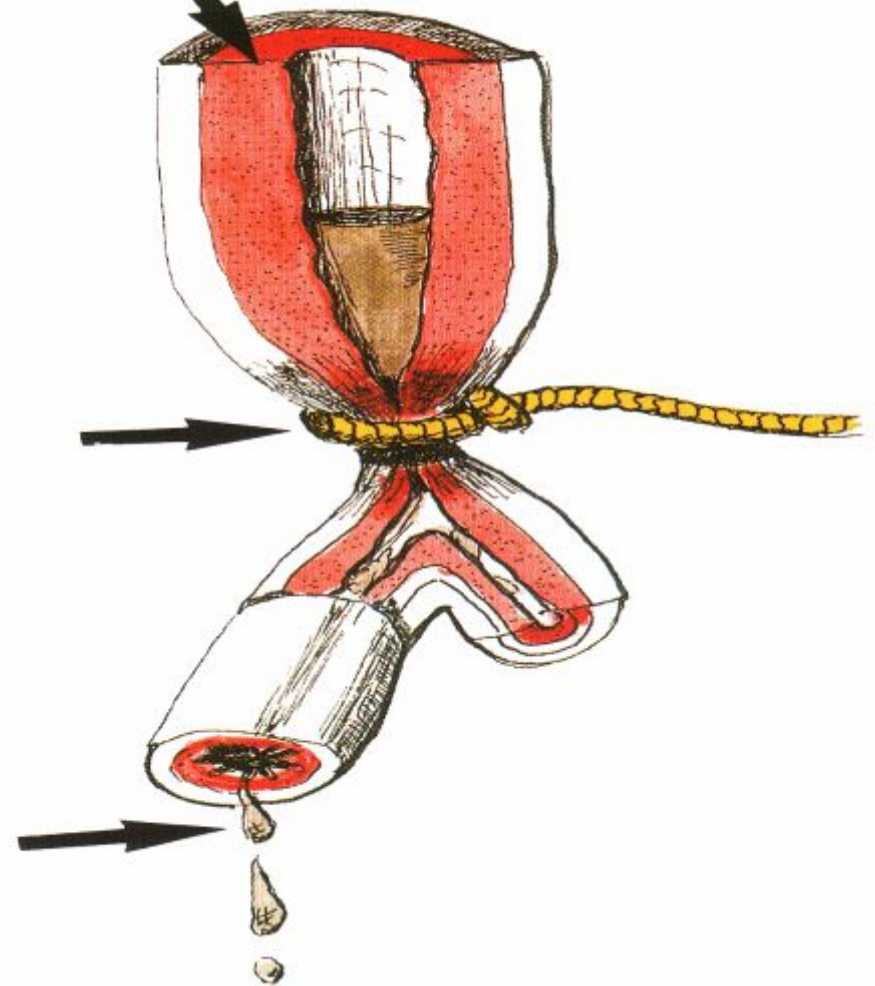


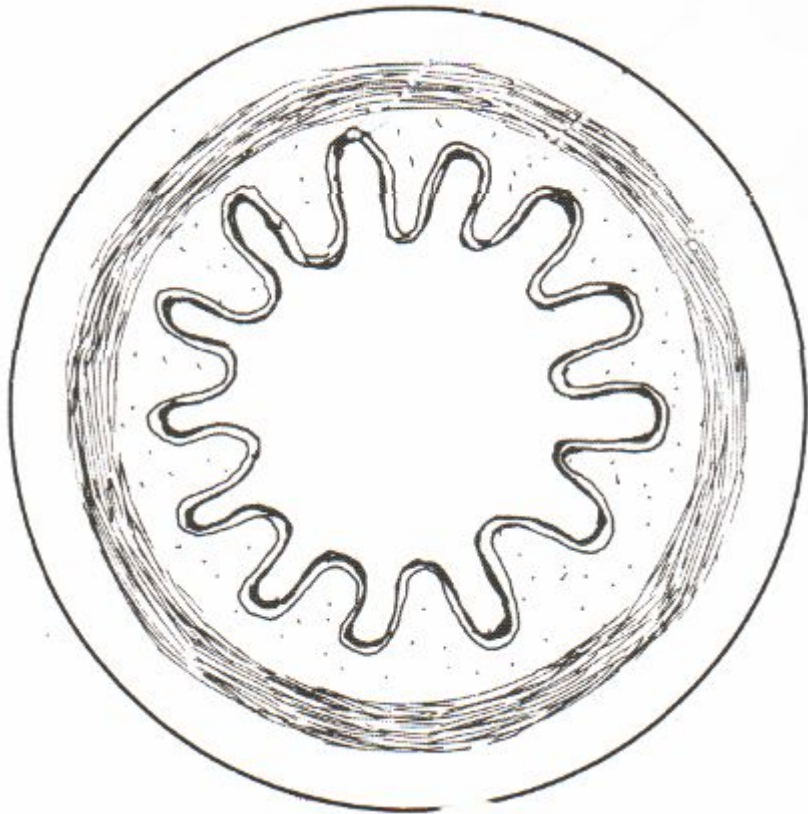
Bronchial spasm



Sputum hyperproduction

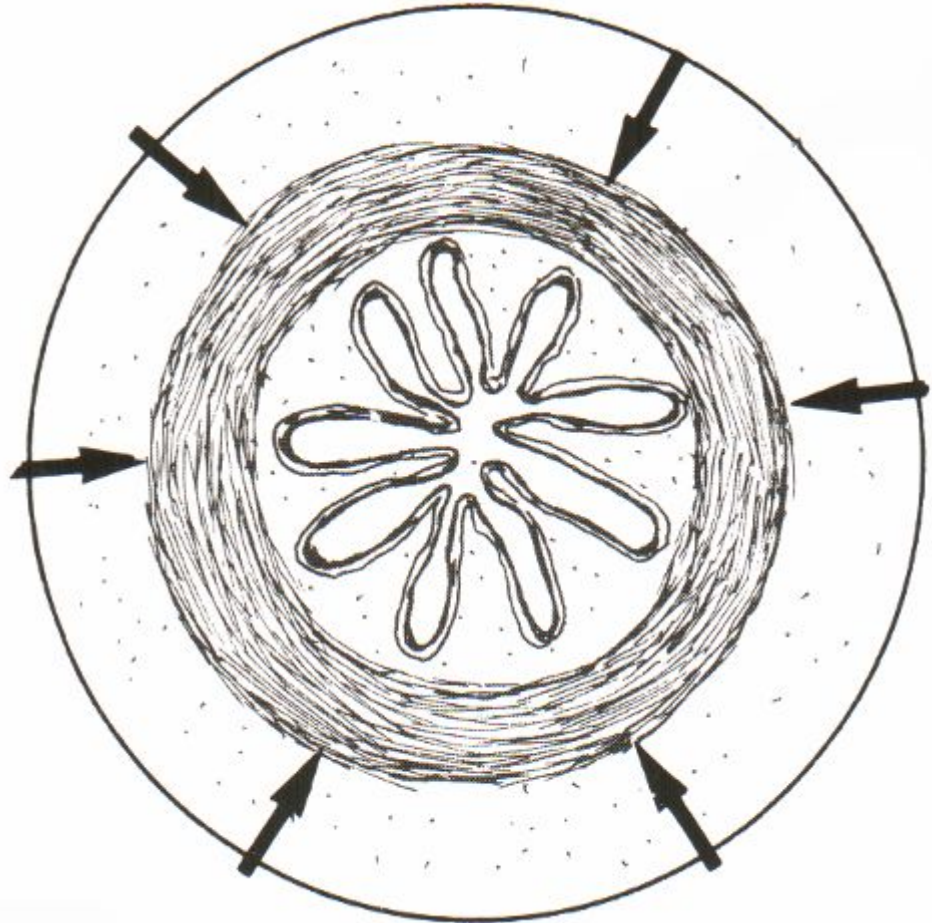
MUCOUS EDEMA

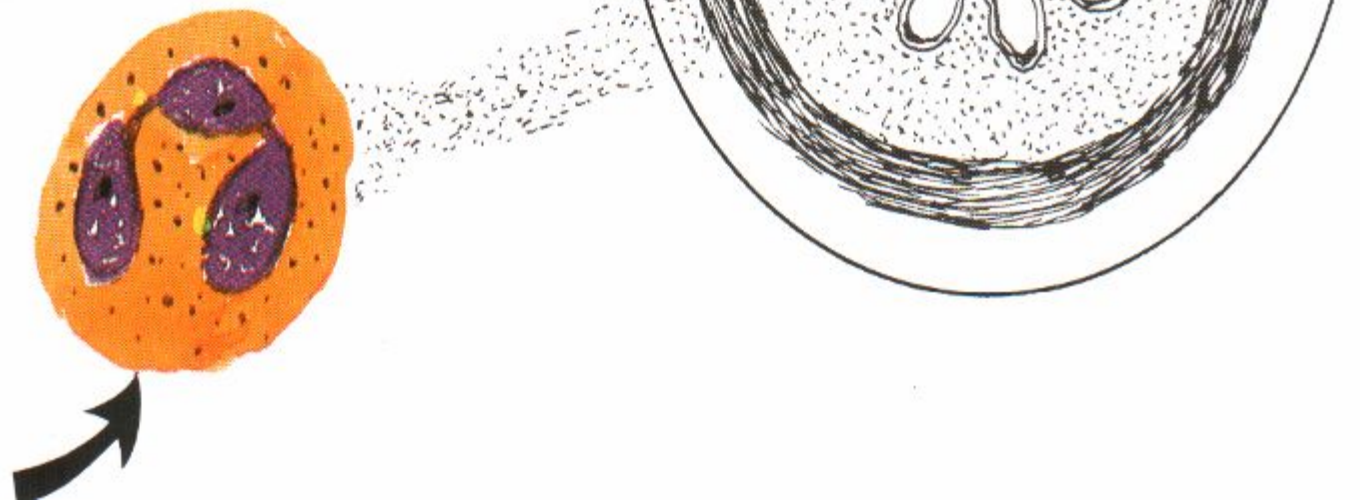




Slice of normal bronchi

Slice of Spasmodic bronchi



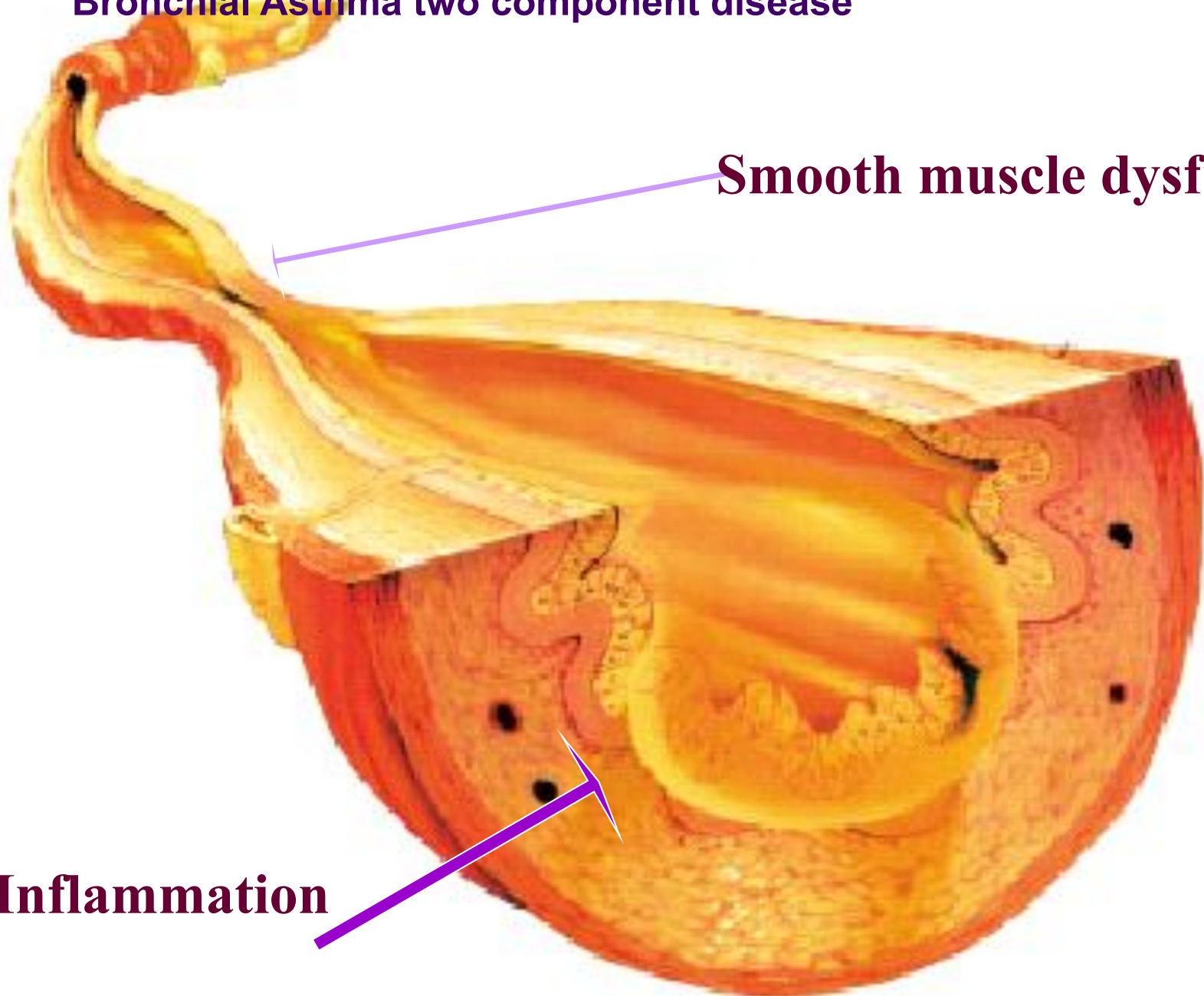


Neutrophil

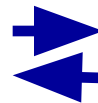
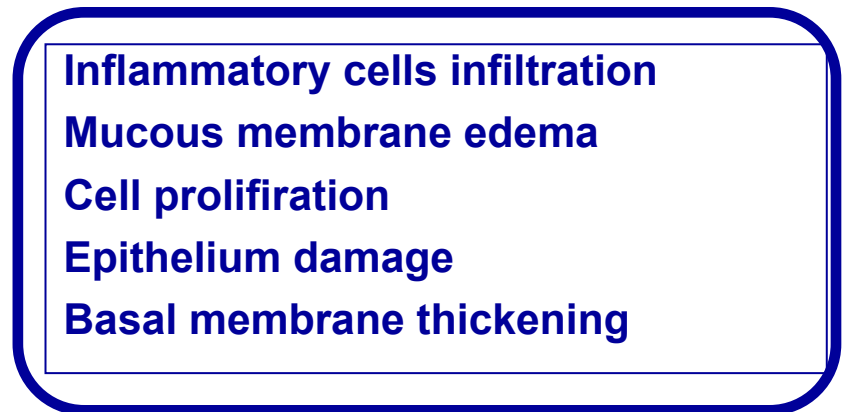
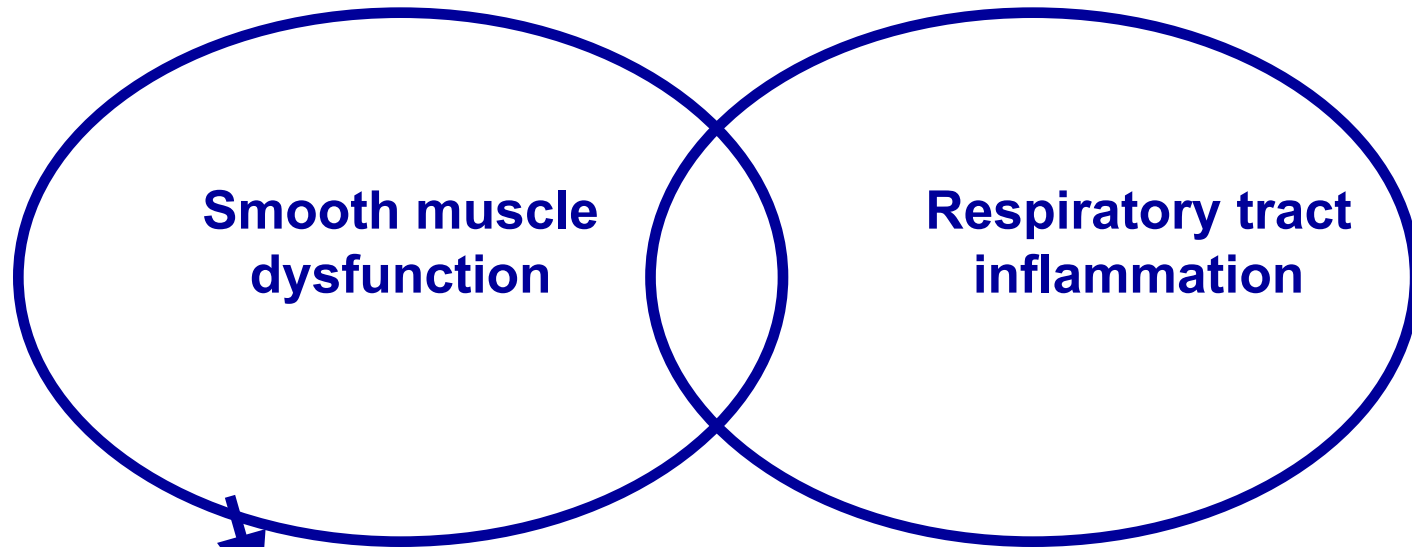
Bronchial Asthma two component disease

Smooth muscle dysfunction

Inflammation



Bronchial asthma – two component disease



Exacerbation symptoms

Clinics of asthma exacerbation



- cough
- typical attacks of chest tightness, exhalative dyspnea, wheezing, dry cough, viscous sputum
- Percussion findings are
 - hyperresonance, tympanic sound due to emphysema
- Auscultation:
 - -rough respiratory sounds, different rales like dry, whistling, moist bubbling usually bilateral different in quantity
- Can be accompanied by
 - -Hypoxia and hypercapnia signs like- cyanosis
 - - cardiovascular abnormalities (tachycardia, murmurs, rhythm abnormalities).

Sputum analysis



1.curschman's spirals:

Refers to finding in sputum of spiral shaped mucus plugs

- Airway epithelium has tendency to curl upon itself in the brochial asthma cases.
- Curved airway epithelium.

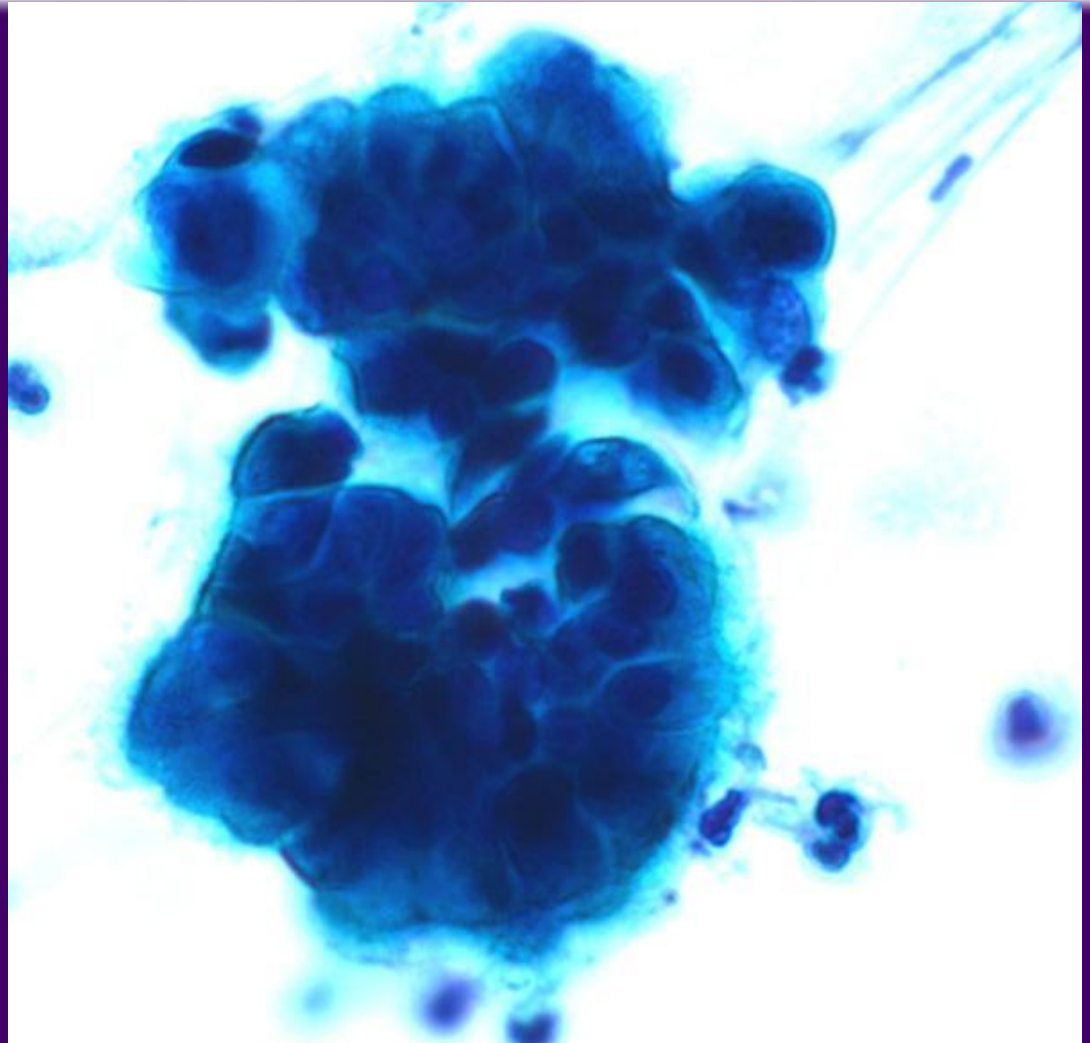


Sputum analysis



Creole bodies:

Found in a patient's sputum they are ciliated columnar cells sloughed from the bronchial mucosa of a patient with asthma (60% in pediatric asthma.)



Blood analysis



- **Neutrophils (band cells increased)**
- **Eosinophils also increased**
- **Serum IgE increased (Extrinsic asthma)**

Skin allergy test: (prick test)



- Is a method for medical diagnosis of allergies that attempts to provoke a small controlled allergic response.
- In the prick test ,a few drops of the purified allergen are gently pricked on to the skin surface usually the forearm.
- This test is usually done in order to identify allergies to pet dander ,dust, pollen,food or dust mites.
- Intradermal injection are done by injecting a small amount of allergen just beneath the skin surface.
- The test is also done to assess allergies to drug like penicillin or bee venom.
- If an immune-response is seen in the form of a rash urticaria or anaphylaxis it can be concluded that the patient has a hypersensitivity (or allergy) to the allergen.

Skin allergy test





It is very important that the subject should stay in the observation of physician for at least an hour or two the subject may develop some signs and symptoms like:

low grade fever

Light headedness or dizziness

Wheezing or shortness of breath

Extensive skin rash

Swelling of face ,lips, mouth

Difficulties swallowing or speaking

For emergency condition the medications used are

Histamine antagonists

Epinephrine

Glucocorticoids

The skin rash or hives maybe itchy and best treated by applying over the counter hydrocortisone cream.

Peakflow meter



Used to measure a person's maximum speed of expiration.



Spirometer



Pulmonary function test are carried out mostly by using spirometer

The air in the lungs is classified in to 2 divisions

1. lung volumes 2.lung capacities

1.lung volumes:

a)tidal volume-500ml(0.5liter)tv

b)Inspiratory resere volume-3300ml(3.3liters)IRV

c)Expiratory reserve volume-1000ml(1liter)ERV

d)Residual volume-1200ml(1.2liter)RV

2.Lung capacities:

a)Inspiratory capacity(IC)

$$IC=TV+IRV$$

$$IC=500+3300=3800ml$$

b)Vital capacity (VC)

$$VC=IRV+TV+ERV$$

$$VC=3300+500+1000=4800ml$$

c)Functional residual capacity(FRC)

$$FRC=ERV+RV$$

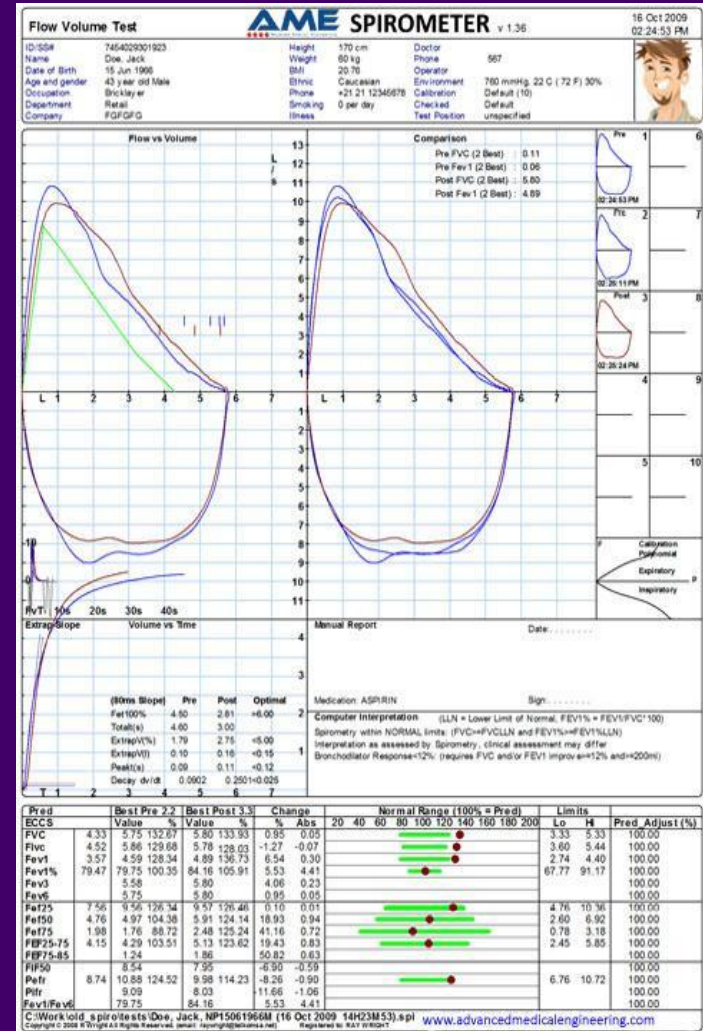
$$FRC=1000+1200=2200ml$$

d)Total lung capacity (TLC)

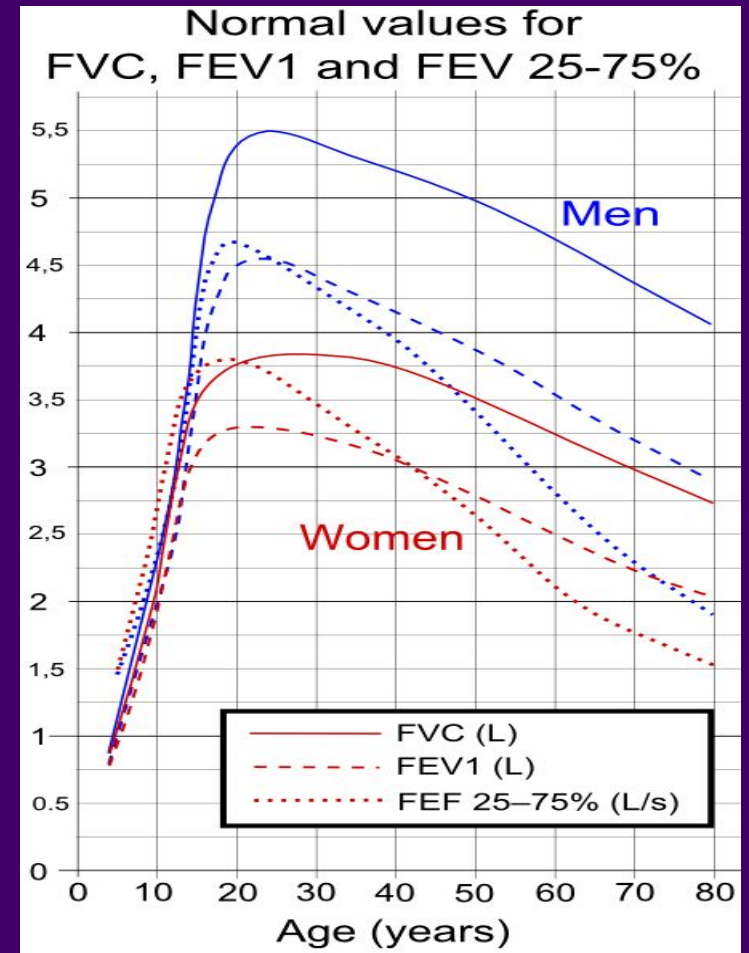
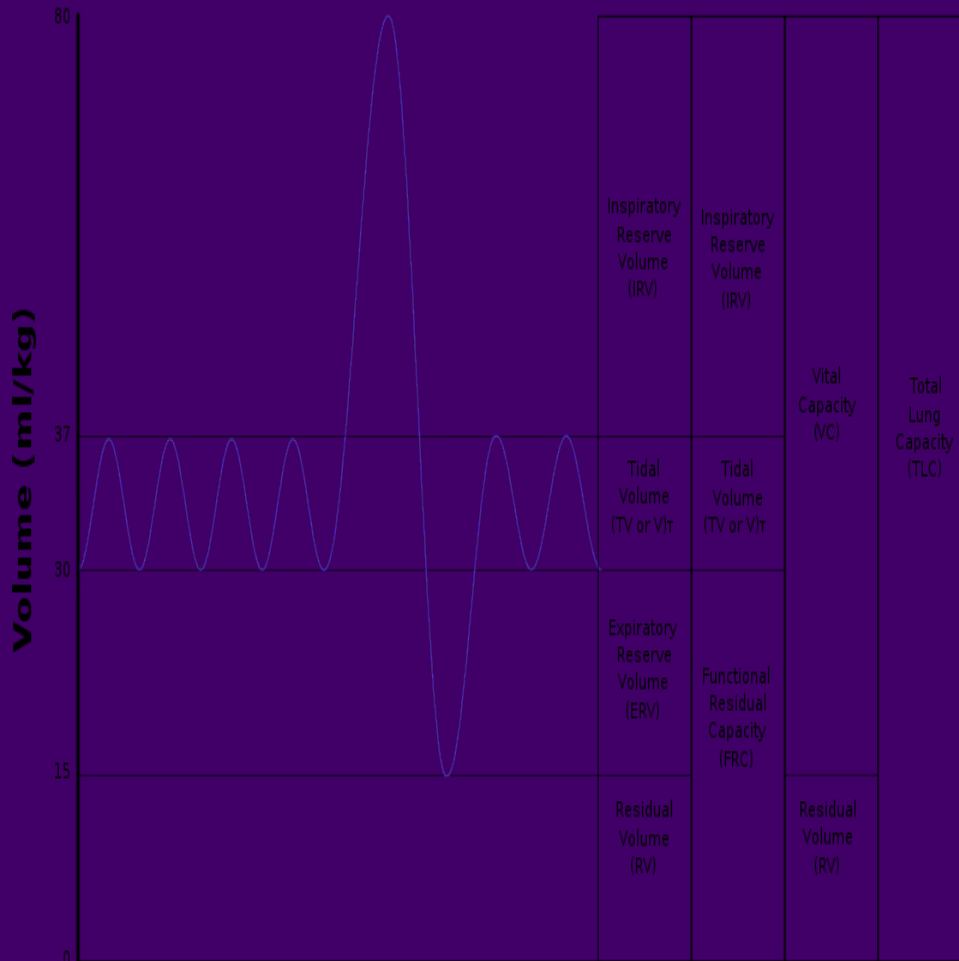
$$TLC=IRV+TV+ERV+RV$$

$$TLC=3300+500+1000+1200=6000ml(6 \text{ liters})$$

spirometer



spirometer



What do we know about asthma?

Late diagnostics of bronchial asthma

- *Complicate bronchial asthma course prognosis*
- *Worsen life quality in bronchial asthma patients*
- *Increase cost of treatment of bronchial asthma*

What can be achieved due to full asthma control

Everyday symptoms	NO
Need for reliever/rescue medication	NO
Days with “bad” morning PEF	NO
Night attacks	NO
Decreased activity	NO
Exacerbations	NO
Sudden hospitalization	NO
Side effects from therapy	NO

Classification of Asthma severity

Degree	Day exacerbations	Nocturnal symptoms	Peakflowmetry
Severe persistent	Frequent. Limitation of physical activities	Frequent	Less than 60% predicted, variability more than 30%
Moderate persistent	Everyday attack Exacerbation affect activity and sleep	More than once per week	60-80% predicted variability more than 30%
Mild persistent	Symptoms more than once a week but less than once a day	More than twice a month	More or equal to 80% predicted, variability 20-30%
Intermittent	Less than once a week brief exacerbations ventilation lung functions between attacks is normal	Not more than twice a month	Not less 80% predicted variability less than 20%

The goal of asthma treatment is to achieve and maintain clinical control

- **Treatment of asthma is directed to**
 - 1. Prevention of acute and chronic asthma symptoms**
 - 2. Prevention of disease recurrence**
 - 3. To avoid side effects from asthma medication**
 - 4. To maintain normal or almost normal parameters of respiration**
 - 5. To achieve proper quality of life**

- **Step approach of BA treatment means increasing of medication according to severity of asthma. Physician can start with maximal treatment approach or increase medications steadily until desired therapeutic effect will be achieved. Only after gaining clinical remission not less than for 3 month medication may be decreased.**
- **The main goal of step treatment approach is complete control of disease by minimal quantity of medications**

BA treatment in acute period:

- **Termination of the contact with allergen**
- **Oxygen therapy**
- **Inhaled B₂-adrenomymetics (salbutamol (ventolin), terbutalin, berotec or combined B₂-adrenomimetics + M-cholinolytics (berodual, combivent)**
- **If 3 intakes of B₂-adrenomymetics within an hour are not efficient IV infusion of theophyllines and systemic corticosteroids are necessary**

Medications for basic BA therapy

- **Cromoglycium acid derivates**
- **Glucocorticosteroids (systemic, inhaled)**
- **Long acting inhaled b2-agonists**
- **Leukotriene modifiers**

Antiinflammatory medications- derivatives of cromoglycium acid

- **Inhibit mast cells degranulation process**
- **Retard IgE- linked secretion of histamine, cell activation of late phase mediators in asthmatic reaction**
- **Increase sensibility of cells for b-agonists**
- **Retard development of early and late allergic response phase.**
- **Decrease hyperresponsiveness of bronchi**
- **Usage of these medications are helpful in efficient control of BA, caused by domestic aero-allergenes**

Derivates of cromoglycium acid

- **Mast cells membranes stabilizers:**
cromoglycium acid
(intal,chromohexal,chromogenum)
- **Nedocromyl sodium (tailed,tailed-mint)**

Inhaled corticosteroids

- **Inhaled corticosteroids (ICS) has the most manifested anti-inflammatory activity**
- **Reduce BA symptoms**
- **Decrease quantity of exacerbations**
- **Decrease severity of airways inflammation and bronchi hyperresponsiveness**
- **Improve lung function.**
- **Among anti-inflammatory drugs ICS most efficient in reducing BA symptoms, prevention of its exacerbation, reduce inflammation of airways mucous membrane and bronchi responsiveness.**

- **Systemic corticosteroids**
(hydrocortisone, dexamethasone, methylprednisolone, prednisolone, polcortolone)
- **Inhaled corticosteroids**
- **Beclomethasone (becodisk, becotide, aldecine)**
- **Fluticasone propionate (seretide, flicsotide)**
- **Budesonide**
- **Flunisolide (Inhacort)**
- **Triamcinalone acetate (Pulmicort)**

Leukotriene modifiers

- **Acolad (Zaferlucastr)**
- **Singular (Montelucast)**

Long acting b-2-agonists агонисты:

- 1. Salmeterol (Serevent, Serevent rotadisk)**
- 2. Clenbutirole (Spiropent)**
- 3. Formoterol (Formoteroloxis, Foradil)**

Reliever Medications

Broncholytic medications (bronchospasmolytics)

- **Short acting β –adrenomymetics**
 - **Salbutamol (ventolin-
nebulas, ventolin, bolmax, salomol,
salben, saltos, terbutalin)**
- 1. Phenoterol (Berotec)**
 - 2. Hexaprenoline (Prodol)**

Reliever Medication

- **Methylxantines**
- **(euphylline, theophylline)**
- **M-cholynoblockers**
- **- Ipratropium bromide (Atrovent)**

Combined medications:

- **Phenoterol + Ipratropium bromide = berodual**
- **Salbutamol + Ipratropium bromide = combivent**
- **Cromoglycate sodium + Salbutamol = Intal**
- **Cromoglycate sodium + Phenoterol = Ditec**

Medications for Nebulizer therapy

- **Nebulizer – is inhalation device for spraying aerosol into very small disperse particles**

The main goal of nebulizer therapy

- **Delivering of medication therapeutic dosage in aerosol form**
- **Gaining of pharmacodynamic answer in shortest period**

Indications for nebulizer therapy

- It is used for intensive care in obstructive lung diseases, changed secretory capacity of bronchi, in cough
- It can be used in hospitals, in ambulatory care or at home

Absolute indication for nebulizer therapy is

- ineffective preceding broncholytic therapy,
- pMDI usage impossibility,
- infants and toddlers,
- purposeful delivery of medications into bronchi and alveoli

Advantages of nebulizer treatment

- **It isn't necessary coordinate respiratory with aerosole puffs**
- **Possibility to use high dosages of medications**
- **Continuous delivery of medication by compressor**
- **Absence of freon- gase that can induce bronchial reactivity**
- **Fast delivery**
- **Portability**
- **Nebulizer therapy imperfection: high cost, limited quantity of medications for treatment, device maintenance, necessity of electric energy sources.**

Medications for nebulizer therapy

Ventolin (in nebulas 2,5 ml/2,5 mg nondeluted form)

Berodual (solution for inhalations 20 ml vial)

- **Mild exacerbation 0,1 – 0,02 ml/kg once)**
- **Moderate exacerbation 0,15-0,3 ml/kg**
- **Severe attack 0,15 ml/kg every 20 minкаждые 20 мин 3 dosages, then 0,15 – 0, 3 ml/kg evry 3-4 hours.**
- **Prolonged therapy for 24 – 48 hours, by 0,25 ml/kg every 4-6 hours.**

Allergen specific immunotherapy

- **Nowadays this method is the most effective treatment because of opportunity to influence for natural allergic process progression and BA development prevention in patients with allergic rhinitis.**
- **Standardized allergic vaccines are usually used.**
- **Under the influence of allergenspecific immunotherapy hyperreactivity of bronchi is decreased and it is helpful for BA course full control obtaining.**

To decrease efficacy of BA therapy

A lot of additional arrangements are useful :

- **Educational programs (for affected children and their parents in asthma schools)**
- **Health promotion programs for decreasing ARD morbidity**
- **Co-morbidities sanitations like allergic rhinitis, etc.**

Key statements of BA treatment

- **The most efficient BA treatment is causative allergen elimination**
- **Asthma can be controlled but not cured of completely**
- **Late diagnostics and improper treatment are the main reasons of severe BA course and lethal outcome**
- **BA treatment choice according to course severity any case must be individual taking into account all personal peculiarities**
- **BA treatment is performed by step therapy approach**
- **It can be proposed some non-drug means of treatment**

Questions



- **Peculiarities of the respiratory system in children, peculiarities of organs of breathing in children.**
- **Etiology and pathogenesis of bronchial asthma.**
- **Modern features of course of this disease.**

Classification

- **Peculiarities of asthma in children of 1-st 3 year**
- **Laboratory diagnostic of asthma. Criteria of diagnostics.**
- **Main signs for the estimation of degree and period of asthma.**
- **Differential diagnostics of diseases of respiratory system.**