

Bronchial Asthma

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Our Goals

Definition of bronchial asthma

Etiologic factors

Immunology

Pathophysiology

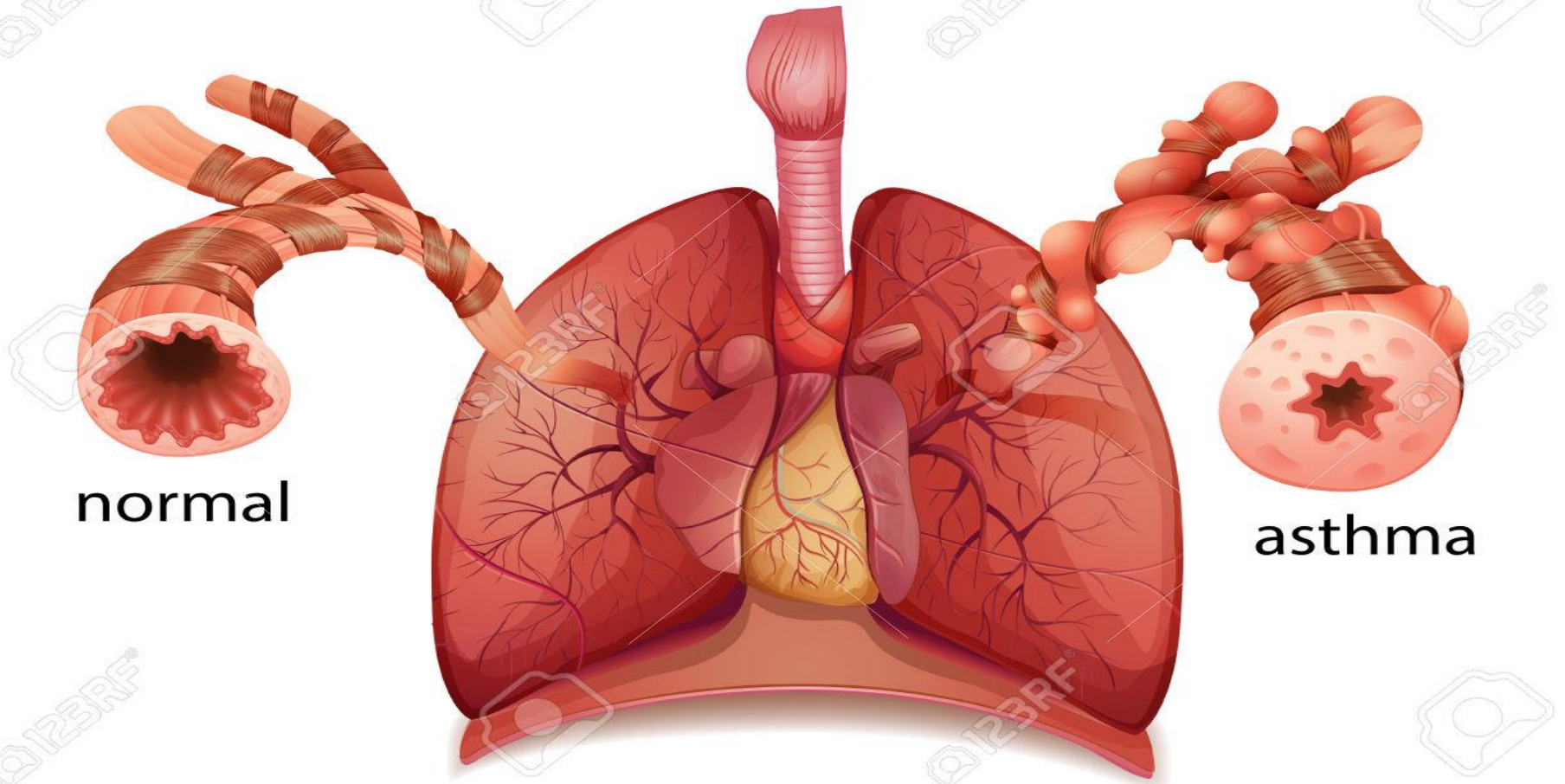
Diagnosis

Differential diagnosis

Treatment guidelines

What is asthma?

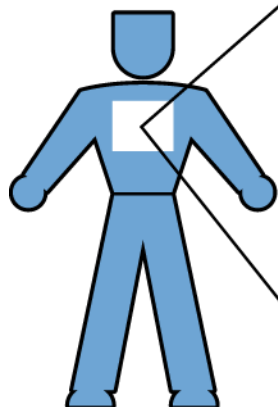
Asthma - Inflamed Bronchial Tube



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 overtime and in intensity**, together with **variable expiratory airflow limitation**.

Asthma Pathophysiology

Individual



Inflammation

INFLAMMATION

Impact

*Airway
Obstruction*

*AHR /
Bronchospasm*

*Airway
Remodeling (?)*

- Genetic predisposition
- Environmental triggers

- Inflammation underlies disease processes

Clinical symptoms also vary by individual and over time

- **chronic inflammatory disorder of the airways** in which many cells and cellular elements play a role, in particular,

- mast cells,

- eosinophils,

- T lymphocytes,

- macrophages,

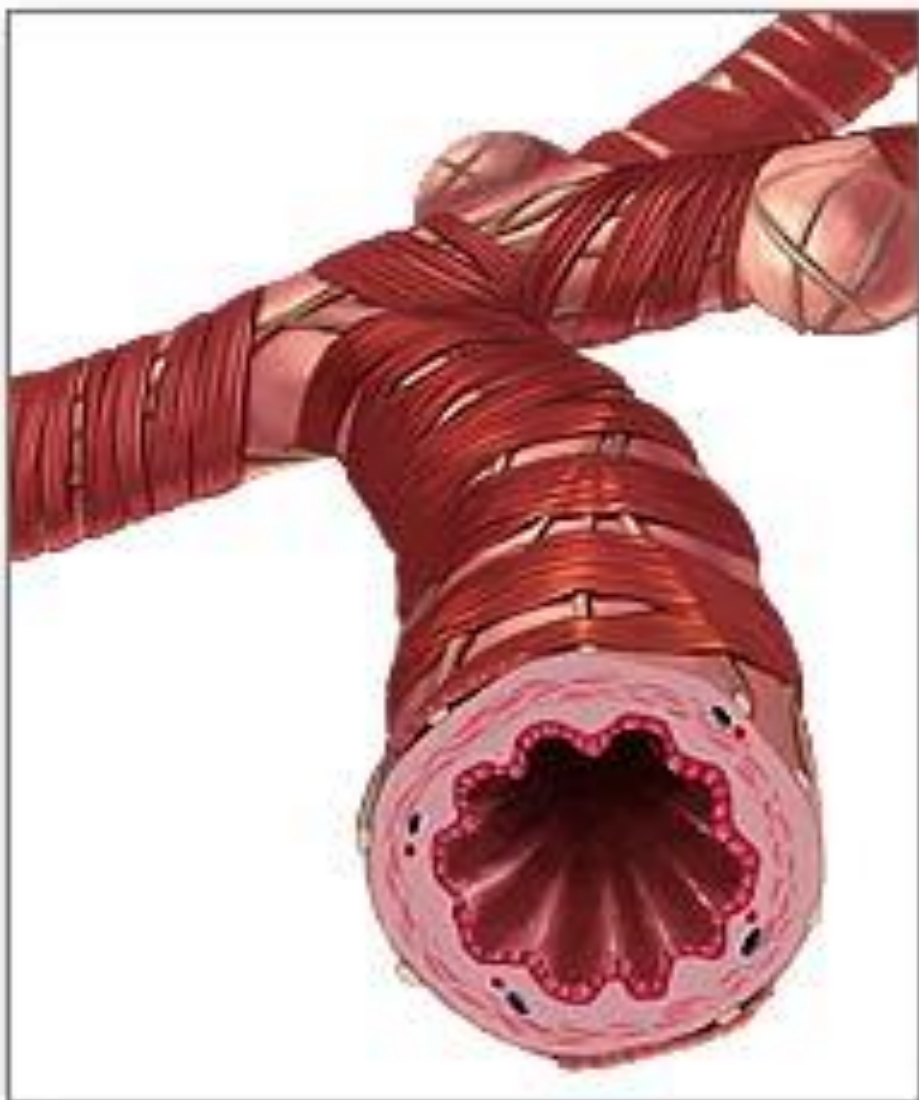
- neutrophils, and epithelial cells

Airflow obstruction is often **variable, reversible** either spontaneously or with treatment and associated with **recurrent episodes of wheezing, breathlessness, chest tightness, and coughing**, particularly at night or in the early morning.

Bronchial hyperreactivity

- exaggerated response of bronchial smooth muscle to trigger stimuli to physical, chemical, immunologic, and pharmacologic stimuli

Normal bronchiole



Asthmatic bronchiole



Asthma Etiology

- Asthma is a complex trait
 - Heritable **and** environmental factors contribute to its pathogenesis

What are the Triggering Factors?

TRIGGERS

inflammatory factors



irritants



others



Types of asthma

There are 2 types of Asthma

Extrinsic

- Usually begins in **childhood** or early adulthood.
- **Personal** and/or **family history** of preceding allergies
- **Hypersensitivity** to allergens
- Increased **IgE** levels in serum and positive skin test

Intrinsic

- Develops later in **adulthood**
- **No family history** of preceding allergies
- **No recognizable allergens**
- **Normal IgE** levels
- Symptoms come on after a **respiratory infection, emotional reactions, exercise, handling chemicals, taking aspirin, etc.**

Diagnosing Asthma

History

- Based on **intermittent symptoms** of wheezing, chest tightness, shortness of breath, and coughing
- May worsen seasonally-spring, fall
- May worsen with exercise
- Note any triggers
 - cats, perfume, tobacco
- **Family history**

Symptoms

- Intermittent episodes of expiratory wheezing, coughing and dyspnea
- Severity of disease
 - occasional, mild bouts of breathlessness
 - daily wheeze in spite of multiple medications
 - may be triggered by environmental factors (e.g. seasonal allergens)

Acute severe asthma

- Tachycardia ≥ 110 beat/min
- Tachypnea ≥ 25 breath/min
- Use of accessory muscles of respiration
- Anxiety, can not complete one sentence.
- PEF $\leq 50\%$
- Bilateral generalised inspiratory and expiratory rhonchi
- Pulsus paradoxus

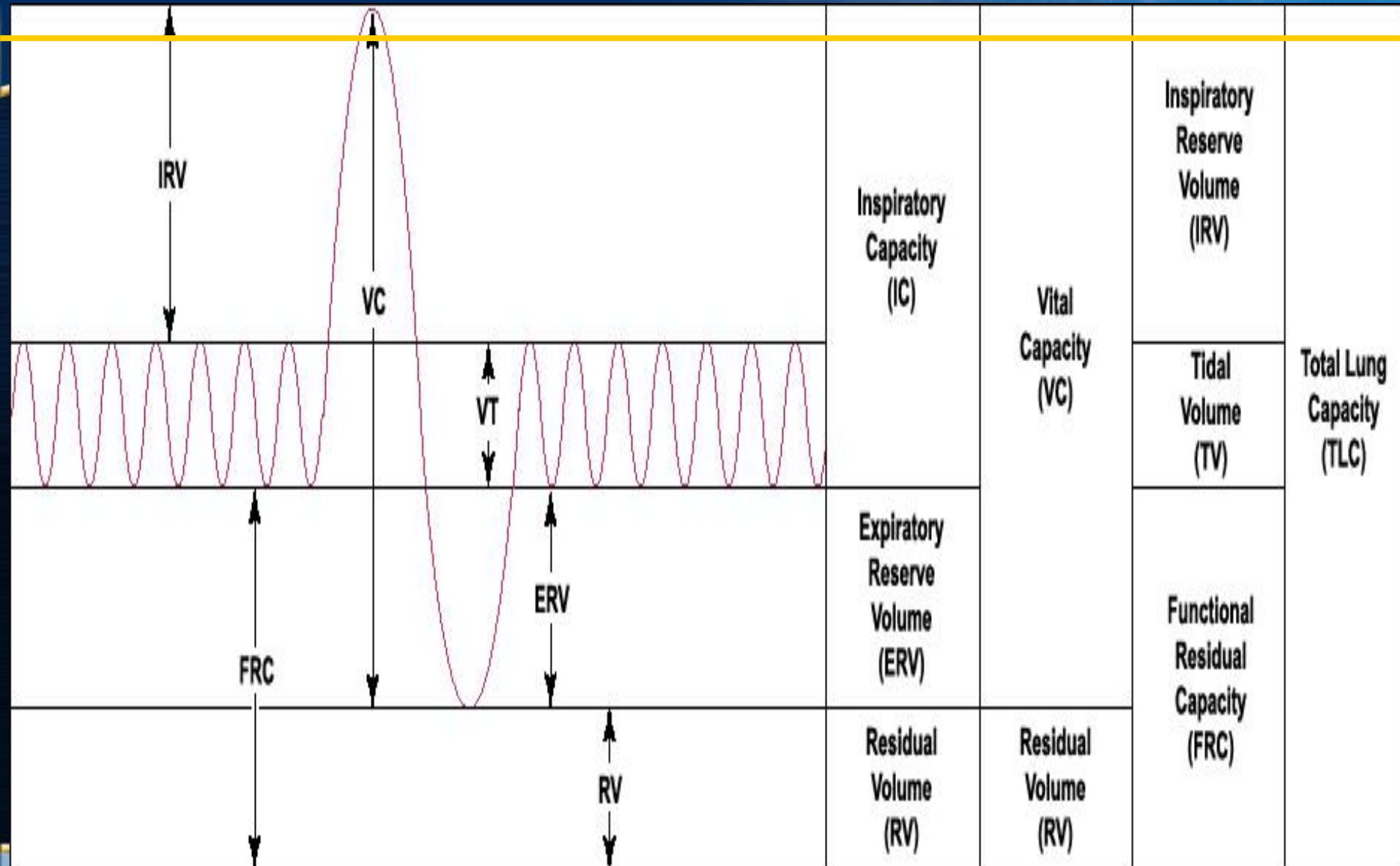
Life-threatening asthma

- Confusion
- Silent chest, cyanosis
- Bradycardia, hypotension
- $P_{aO_2} < 60$, $P_{aCO_2} \geq 50$
- $PEF < 33\%$

Pulmonary function tests



Lung Volumes



Pulmonary Function Tests-Spirometry²⁴

- **FEV1**

- is that volume of air exhaled in 1 second

- **FVC**

- Forced vital capacity - volume of air exhaled with maximal forced effort

- **FEV1:FVC ratio**

- Most reproducible of the PFTs
- Healthy individuals can exhale 75-80% of VC in 1 second and almost all in 3 seconds
- Normal ratio is 70%



e-hospital
 Department of Pneumology
 Dr. John Smith

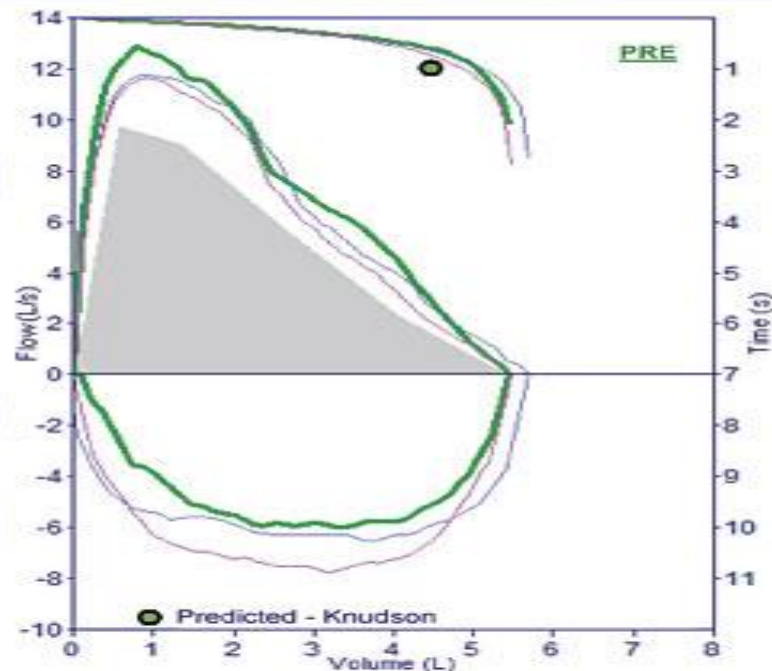
Visit date 24/07/2003

Patient code	0	Age	28
Surname	MARTINI	Gender	Male
Name	DAVID	Height, cm	180
Date of birth	06/05/1975	Weight, kg	76
Ethnic group	Caucasian	Pack-Year	5
Smoke	Smoker		
Patient group			

Interpretation

Normal Spirometry

Conclusion / Medical report



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PRE Trial date 24/07/2003 14:34:17

Parameters	BTPS 1,092 25°C - 77°F	Pred	PRE	%Pred	POST	%Pred	%Chg	PRE#1	PRE#2	PRE#3
Best values from all loops										
FVC	L	5,43	5,68	105				5,45	5,68	5,47
FEV1	L	4,49	5,12	114				5,06	5,12	4,85
FEV1/FVC	%	83,2	90,1	108				92,8	90,1	88,7
PEF	L/s	9,77	12,90	132				12,90	11,91	11,73
Values from best loop										
FEF2575	L/s	4,71	7,33	156				7,33	6,38	5,88
FEF25	L/s	9,07	12,02	133				12,02	11,36	10,94
FEF50	L/s	5,56	7,21	130				7,21	6,55	6,23
FEF75	L/s	2,34	4,00	171				4,00	3,06	2,67
FEV3	L	5,04								
FET	s	6,00	2,06	34				2,06	2,78	2,88
FIVC	L	5,43	5,41	100				5,41	5,78	5,56
FIV1	L	4,49	5,10	114				5,10	5,74	5,56
FIV1/FIVC	%	83,2	94,3	113				94,3	99,3	100,0
PIF	L/s	9,77	6,07	62				6,07	6,55	7,77
ELA	Years	33	33					33	33	33
EVC	L	5,43	6,11	113						
IVC	L	5,43								
FEV1/IVC	%	83,2	83,8	101						
ERV	L	1,77	2,06	116						
IC	L	3,65	4,05	111						
MVV	L/min	149,8	164,2	110						

Quality Report

Repeatable FVC, Repeatable FEV1, Repeatable PEF

Breathe out for a longer time, Breathe out ALL air in the lungs

D

Sex: Male Age: 72

Factor: 100(Caucasian)

Height: 163cm Weight: 55kg BMI: 20.7

	FEV1	FVC	PEF	Var	Quality	Time:	Date:
Base	1.21	2.90	161	0%	Good blow	10:03	31-07-09
Base	1.20	2.88	178	0%	Good blow	10:03	31-07-09
Base	1.06	2.72	195	-12%	Good blow	10:03	31-07-09
Post 1	1.63	3.96	236	0%	Good blow	10:28	31-07-09
Post 1	1.63	3.79	236	0%	Good blow	10:28	31-07-09
Post 1	1.59	3.73	245	-2%	Good blow	10:28	31-07-09

Variation is based on FEV1

Best Spirometry Result:

	Base	%Pr	Min	Pred	Max	Post	%Pr	%Chg	
EVC	2.95	89	2.36	3.28	4.20	3.94	120	34	1
FEV1	1.21	49	1.59	2.43	3.27	1.63	67	35	1
FVC	2.90	91	2.18	3.18	4.18	3.96	124	37	1
PEF	161	37	304	424	543	236	55	47	1/w
FEV1/VC	41.0					41.4		1	%
FEV1/FVC	41.7	56	62.5	74.3	86.1	41.2	55	-1	%
MEF75	1.11	17	3.53	6.34	9.15	1.41	22	27	1/s
MEF50	0.42	11	1.43	3.60	5.77	0.60	16	43	1/s
MEF25	0.14	13		1.04	2.32	0.21	20	50	1/s
OT	10.9					11.6		6	s

Age: 106

Interpretation(NICE): Moderate Obstructive

fastbleep))

Peak Expiratory Flow (PEF)

- Maximal rate of flow that can be produced during forced expiration
- Useful in ED, at home, at clinic
- Changes in PF usually correlate with change in FEV1
 - However, PEF is less reproducible than FEV1
- **Healthy young adult has PEF - 60L/min**



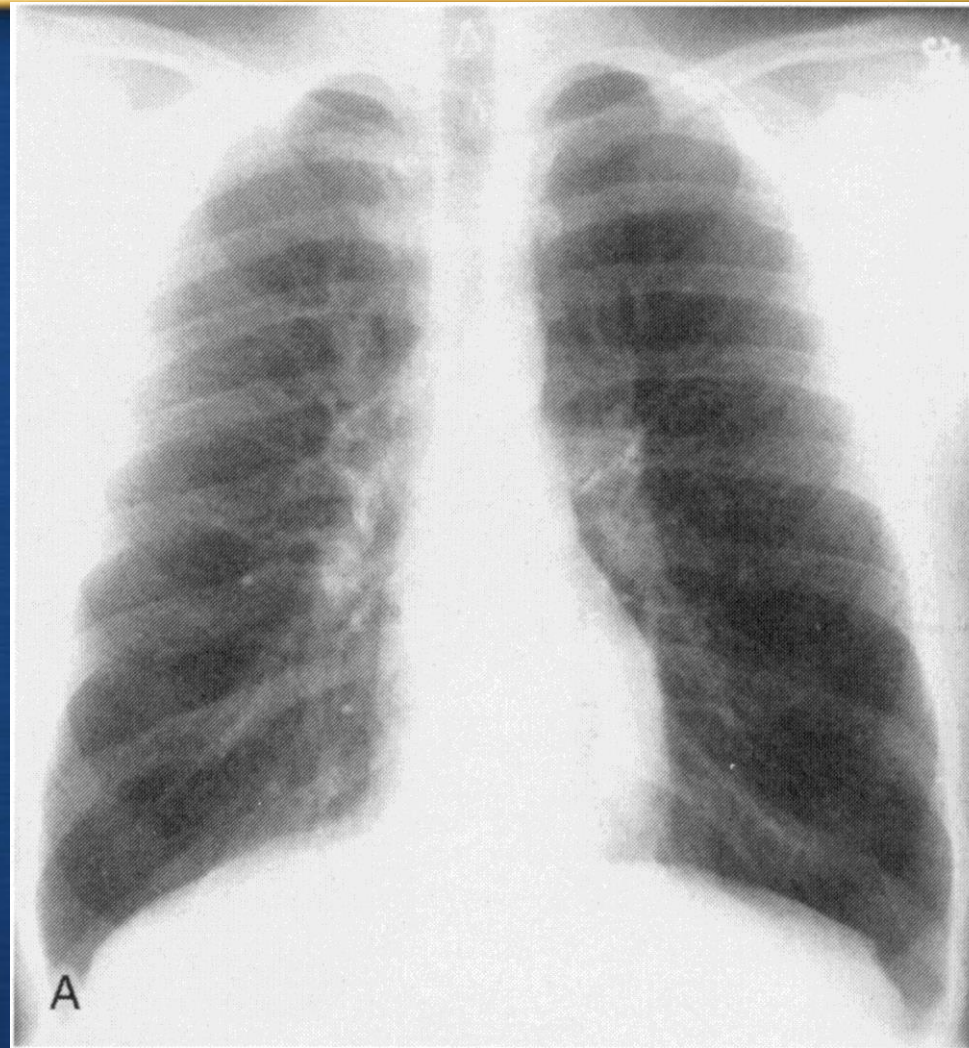
- **Allows patient to assess status of his/her asthma**
- **Persons who use peak flow meters should do so frequently**
- **Many physicians require for all severe patients**

Reversible Airway Obstruction

- FEV1 is gold standard for determining reversibility of airway disease and bronchodilator efficacy
- **Significant Clinical Reversibility**
More than or equal to 12%
improvement in FEV1 after inhaled bronchodilator

CXR

- Most patients with asthma have **normal x-rays.**
- Signs of **acute severe asthma:**
 1. Hyperinflation (Diaphragm is down to the 8th rib anteriorly, MCL-ribbon-shaped heart...)
- 2. Complications:**
 - Pneumonia
 - Pneumothorax



Blood Gas Measurements

- Best indicators of overall lung function are arterial blood gases
 - PaO₂, PaCO₂, pH)
- Oxygen saturation (O₂ sat)
 - Quantity of O₂ bound to Hb/
 - Normal O₂ sat 97.5%

Conditions Mimicking Asthma

- Obstruction of small airways
 - COPD
 - Aspiration
 - Bronchiolitis
 - Cystic Fibrosis
- Obstruction of large airways
 - Foreign body
 - Congenital malformations
 - Cardiac disease
 - Endobronchial tumors
 - Extrabronchial obstruction
 - Psychogenic

Key Components of Asthma Therapy

- Assessment and monitoring
- Pharmacologic therapy
- “Trigger” control
- Patient education

Management of Acute exacerbation of Bronchial Asthma

Oxygen Therapy:

By nasal cannula or mask to achieve saturation $> 90\%$, Controlled O₂ therapy in patients with elevated CO₂

Bronchodilators:

- Nebulized **B₂ agonists** Combined with **nebulised ipratropium bromide**
- given continuously for one hour, then every 60 min, after that regularly every 4-6 hours, Reduced according to response.

Corticosteroids:

hydrocortisone 100 mg every 6-8 hours to be reduced to dexamethasone or oral preparation later ,then inhaled preparations started.

Antibiotics : when signs of bacterial infection

Intravenous magnesium

Aminophylline:

intravenous infusion every 8 hours to be transformed into oral long acting preparation after improvement of acute attack.

Overview of Asthma Medications

Daily: Long-term Control (anti-inflammatory)

- Corticosteroids (inhaled and systemic)
- LABAs
- Methylxanthines (theophylline) **SR**
- Leukotriene modifiers
- Immunomodulators: 1.Omalizumab
2.Allergen-specific immunotherapy

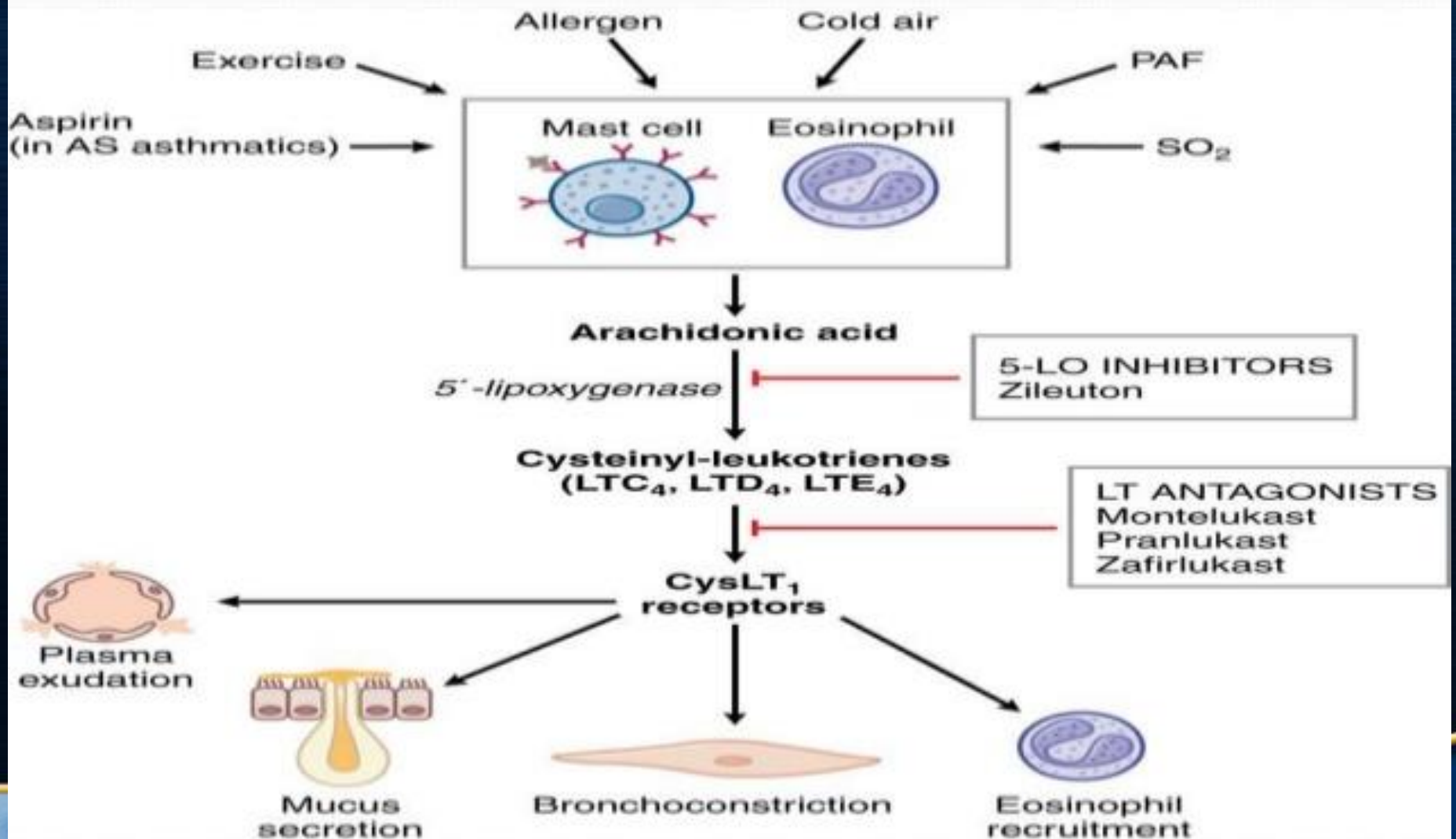
As-needed: Quick Relief (bronchodilators)

- SABAs
- Anticholinergics
- Systemic corticosteroids

DRUGS USED IN ASTHMA

(Mechanism of action and side effects)

Mechanism of Action



Corticosteroids

MOA:

- Decreases the synthesis of inflammatory mediators
- Prevent recruitment, proliferation and activation of leukocytes

Systemic steroid therapy –

- Severe chronic asthma
- Status asthmaticus

Inhaled steroids –

Long term treatment of asthma

• TOXICITY

- For the inhaled therapy:

- oropharyngeal candidiasis
- Dysphonia

- For oral therapy

- Gastritis

- DM

- Hypertension

- Osteoporosis

- Adrenal suppression

BETA-2 AGONISTS

- Most important **sympathomimetic** used to reverse bronchoconstriction
- Almost given exclusively by **inhalation**
 - Decreases the systemic dose and adverse effects
 - Occasionally by nebulizer

BETA-2 AGONISTS

- Salbutamol, terbutaline, Short-acting
 - Drug of choice for acute asthma
- Salmeterol and formoterol
 - Long-acting
 - 12 h or more
 - Used for prophylaxis

BETA-2 AGONISTS

• TOXICITY

- Skeletal muscle tremor
- Significant β_1 effects (tachycardia) at high clinical dosage
- Arrhythmias may occur when used excessively
- Hypokalaemia.

METHYLXANTHINES

- **Bronchodilation** is the most important therapeutic effect
- CNS stimulation, cardiac stimulation, vasodilation and slight increase in BP (due to release of NE from adrenergic nerves)

- Slow-release theophylline
 - For control of nocturnal asthma
 - Most important in clinical use
- TOXICITY
 - Common adverse effects
 - GI distress
 - Tremor
 - Insomnia
 - Overdosage
 - Severe nausea and vomiting
 - Hypotension
 - Cardiac arrhythmias
 - Convulsion

MUSCARINIC ANTAGONISTS

- Competitively blocks muscarinic receptors in the airways
- Prevents bronchoconstriction mediated by vagal discharge

MUSCARINIC ANTAGONISTS

• Ipratropium

- Delivered to the airways by pressurized aerosol
- Have little systemic action

• Tiotropium

- Newer longer-acting analog

• TOXICITY

- Delivered directly to the airway, **minimally absorbed**
- Systemic effects are small
- In excessive dosage, minor atropine-like toxic effects may occur
- **Does not cause tremor or arrhythmias**



Thanks!