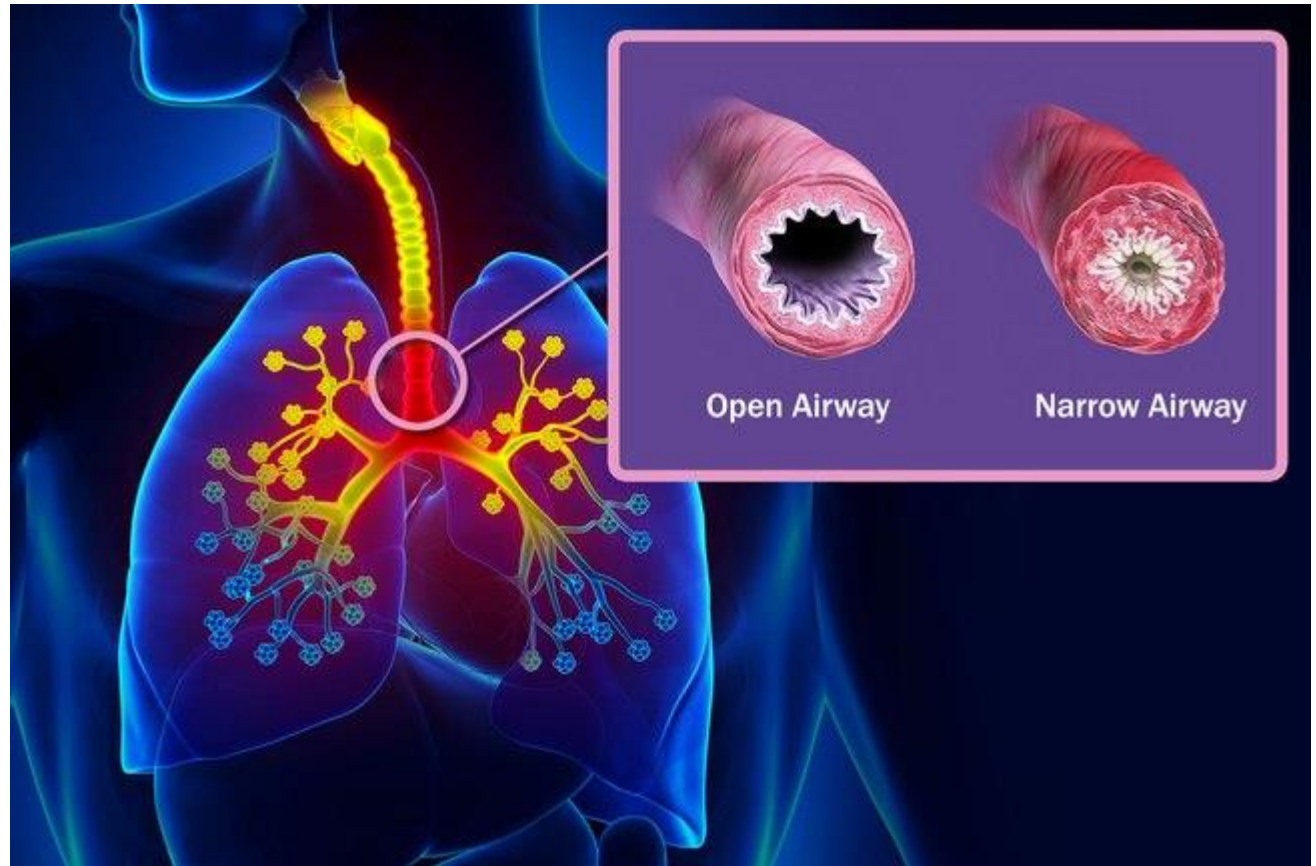


# Perioperative management of patients with Asthma

Dr Ali Ashraf

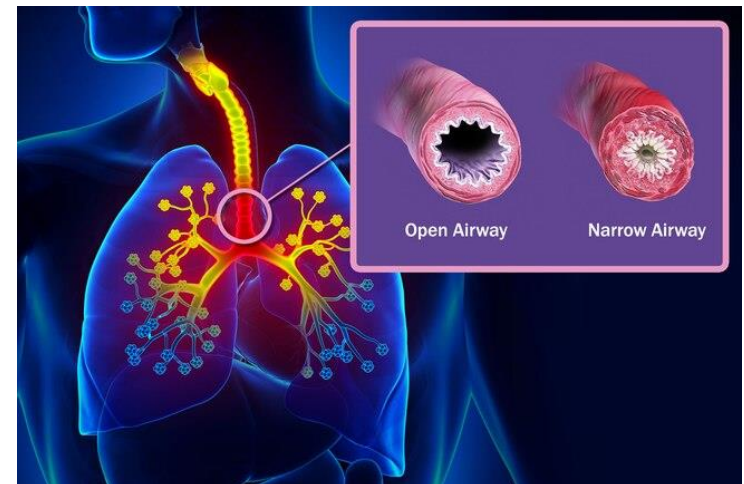
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GUMS

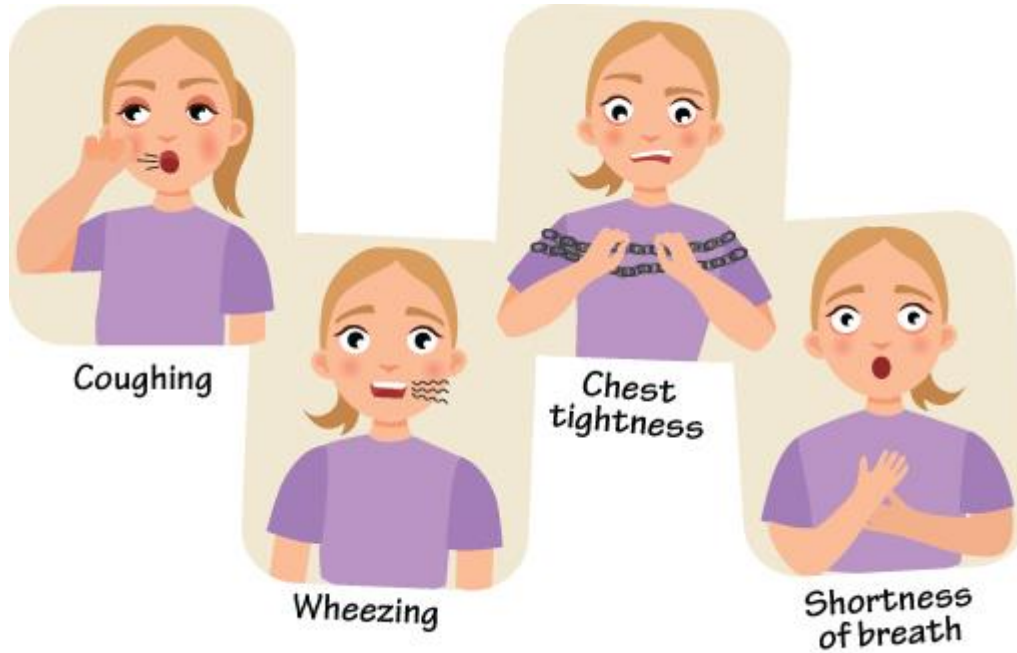


# Asthma

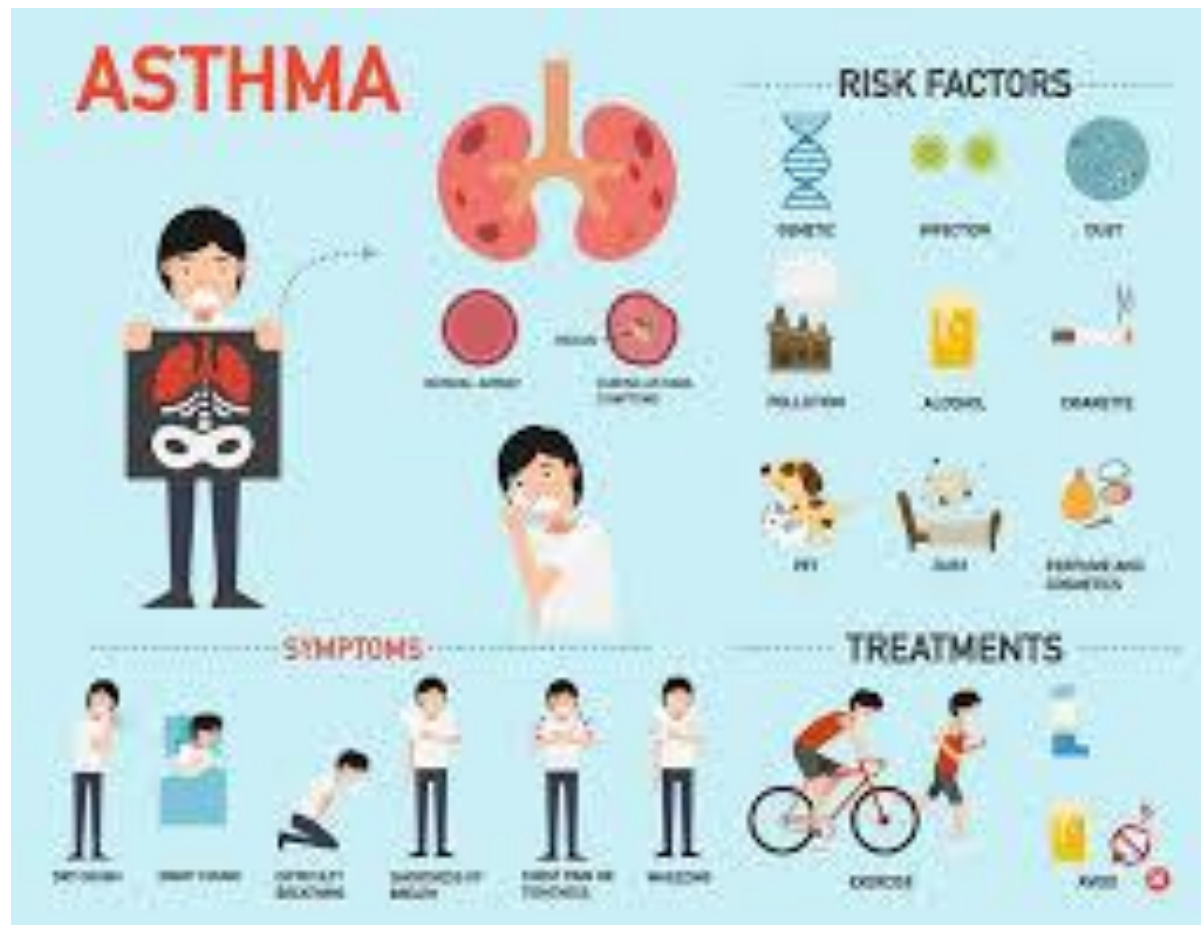
- airway inflammation
- Hyper-responsiveness
- wheezing, coughing, breathlessness, chest tightness
- reversible airflow obstruction



# symptoms

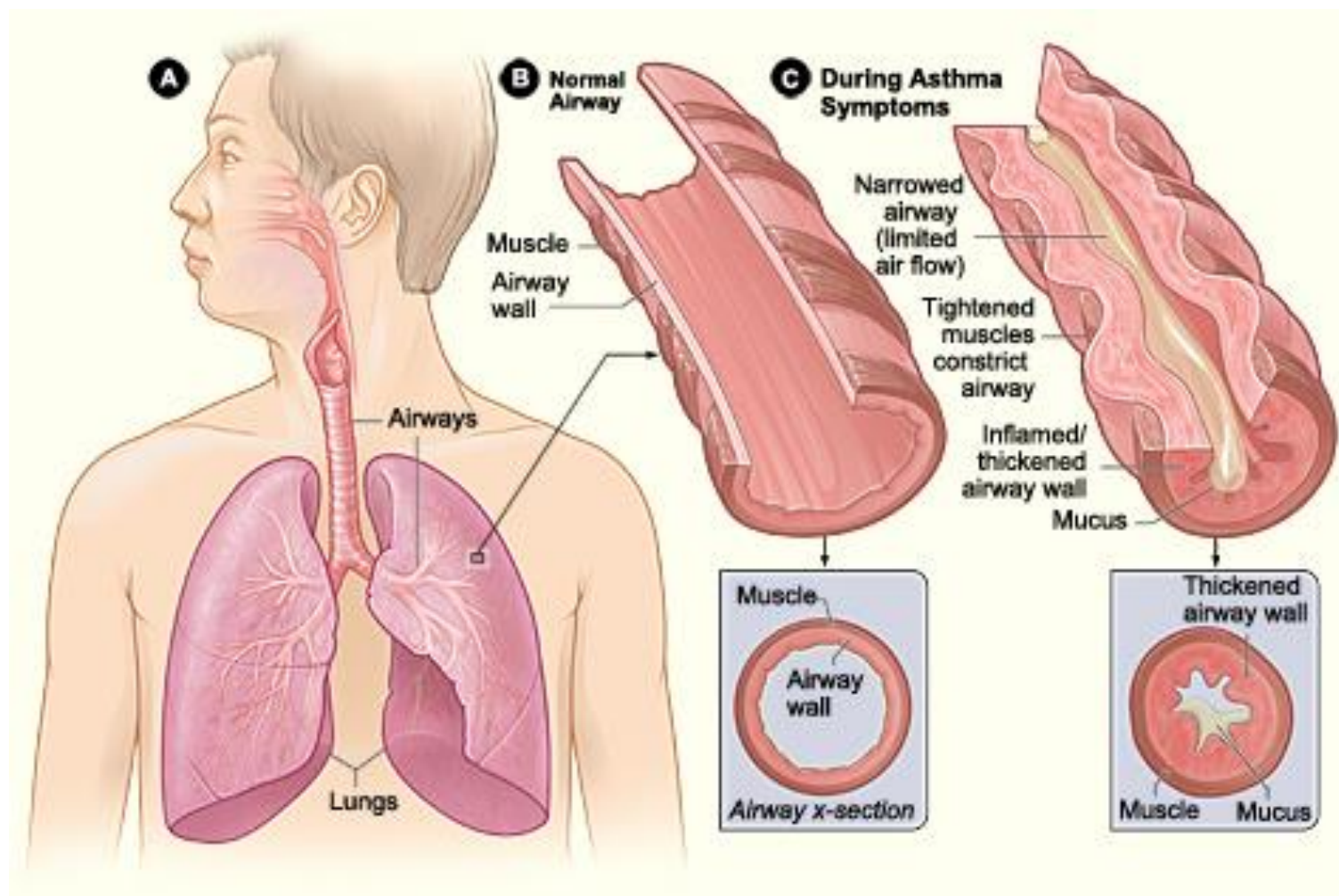


# Risk factors



# The pathophysiology of asthma

- Reduction in airway diameter
- contraction of smooth muscle
- Edema of the bronchial wall
- Tenacious secretions
- Airflow obstruction
- Changes in lung volume, peak flow rate, ventilation-perfusion
- Altered cardiovascular function





**TABLE 2.2****Most Clinically Useful Spirometric Tests of Lung Function**

**Forced expiratory volume in 1 sec ( $FEV_1$ ):** The volume of air that can be forcefully exhaled in 1 sec. Values between 80% and 120% of the predicted value are considered normal.

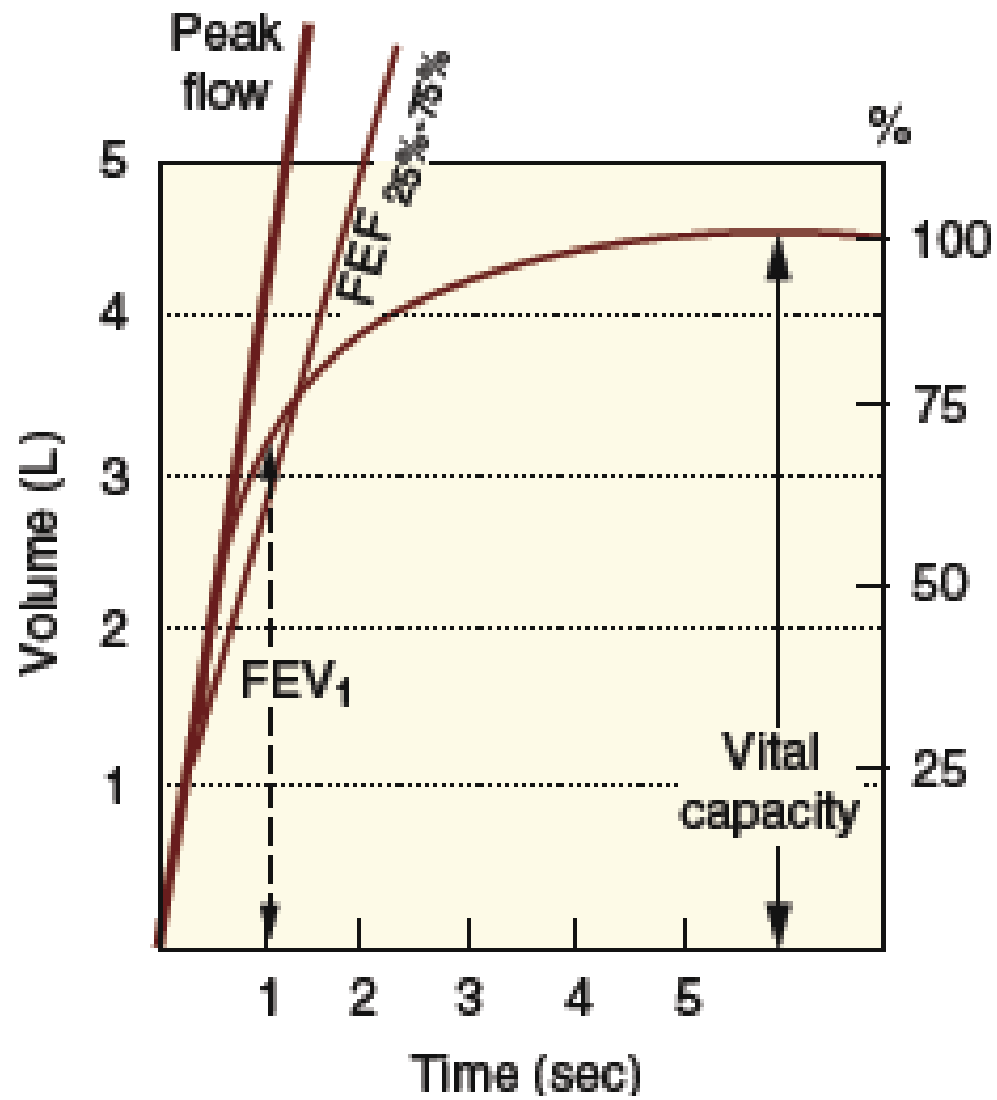
**Forced vital capacity (FVC):** The volume of air that can be exhaled with maximum effort after a deep inhalation. Normal values are  $\approx 3.7$  L in females and  $\approx 4.8$  L in males.

**Ratio of  $FEV_1$  to FVC:** This ratio in healthy adults is 75%–80%.

**Forced expiratory flow at 25%–75% of vital capacity ( $FEF_{25\%-75\%}$ ):** A measurement of airflow through the midpoint of a forced exhalation.

**Maximum voluntary ventilation (MVV):** The maximum amount of air that can be inhaled and exhaled within 1 min. For patient comfort, the volume is measured over a 15-sec time period and results are extrapolated to obtain a value for 1 min expressed as liters per minute. Average values for males and females are 140–180 and 80–120 L/min, respectively.

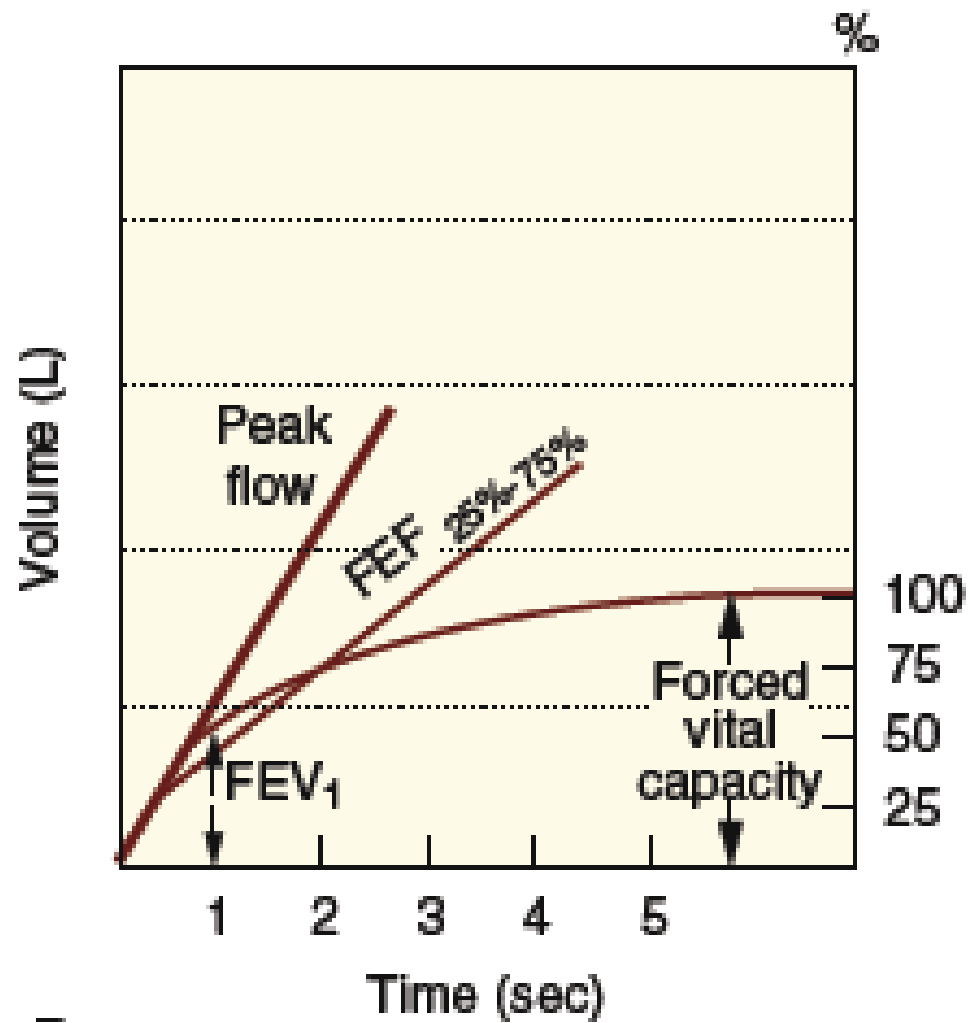
**Diffusing capacity ( $D_{LCO}$ ):** The volume of a substance (carbon monoxide [CO]) transferred across the alveoli into blood per minute per unit of alveolar partial pressure. CO is rapidly taken up by hemoglobin. Its transfer is therefore limited mainly by diffusion. A single breath of 0.3% CO and 10% helium is held for 20 sec. Expired partial pressure of CO is measured. Normal value is 17–25 mL/min/mm Hg.





## Classification of Asthma Severity in Youths Older Than 12 Years and in Adults

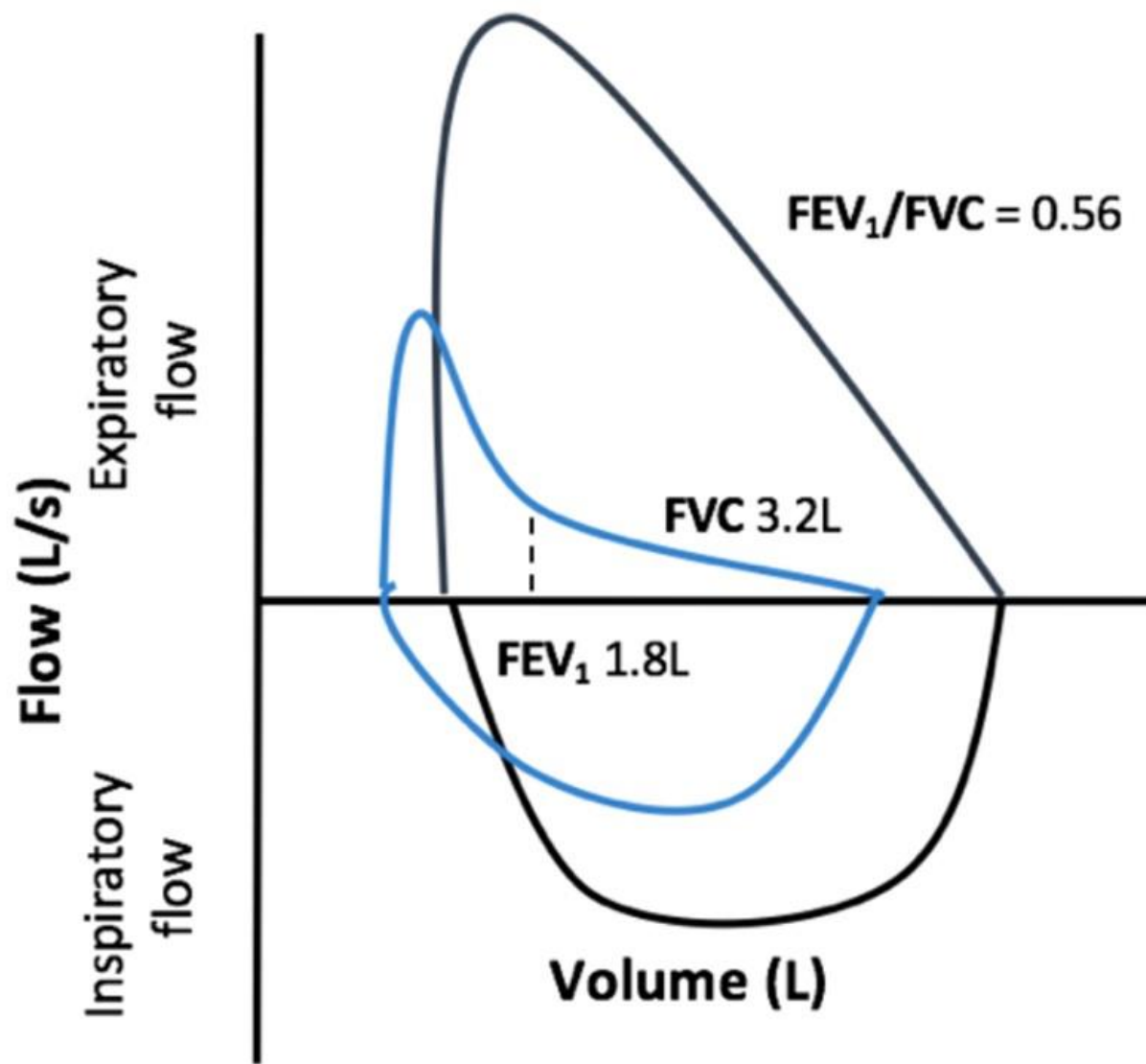
Components of Severity		Classification of Asthma Severity (Youths ≥ 12 years of age and adults)			
		Intermittent	Persistent		
			Mild	Moderate	Severe
<b>Impairment</b>  Normal FEV <sub>1</sub> :FVC:  8–19 yr 85% 20–39 yr 80% 40–59 yr 75% 60–80 yr 70%	Symptoms	≤ 2 days/week	> 2 days/week but not daily	Daily	Throughout the day
	Nighttime awakenings	≤ 2x/month	3–4x/month	> 1x/week but not nightly	Often 7x/week
	Short-acting β <sub>2</sub> -agonist use for symptom control (not prevention of EIB)	≤ 2 days/week	>2 days/week but not daily	Daily	Several times per day
	Interference with normal activity	None	Minor limitation	Some limitation	Extremely limited
	Lung function	<ul style="list-style-type: none"> <li>• Normal FEV<sub>1</sub> between exacerbations</li> <li>• FEV<sub>1</sub> &gt; 80% predicted</li> <li>• FEV<sub>1</sub>:FVC normal</li> </ul>	<ul style="list-style-type: none"> <li>• FEV<sub>1</sub> &lt; 80% predicted</li> <li>• FEV<sub>1</sub>:FVC normal</li> </ul>	<ul style="list-style-type: none"> <li>• FEV<sub>1</sub> &gt; 60% but &lt; 80% predicted</li> <li>• FEV<sub>1</sub>:FVC reduced 5%</li> </ul>	<ul style="list-style-type: none"> <li>• FEV<sub>1</sub> &lt; 60% predicted</li> <li>• FEV<sub>1</sub>:FVC reduced &gt; 5%</li> </ul>
<b>Risk</b>  Exacerbations (consider frequency and severity)		<div> <div>0–2/year</div> <div>&gt;2/year</div> <div>← Frequency and severity may fluctuate over time for patients in any severity category →</div> <div>Relative annual risk of exacerbations may be related to FEV<sub>1</sub>.</div> </div>			



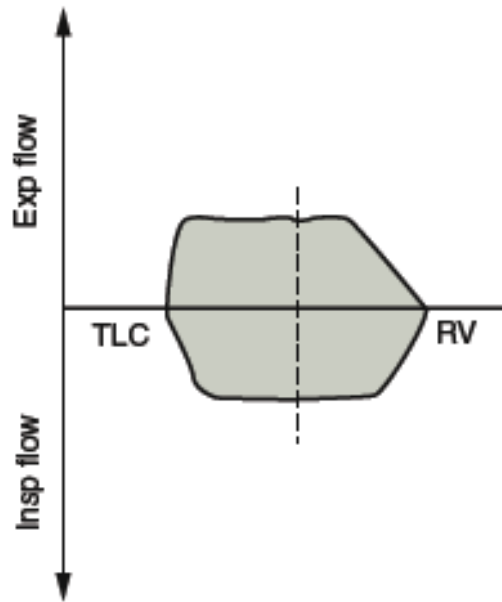
## Performing Spirometry

### Confirm or Preclude COPD or Asthma using Spirometry

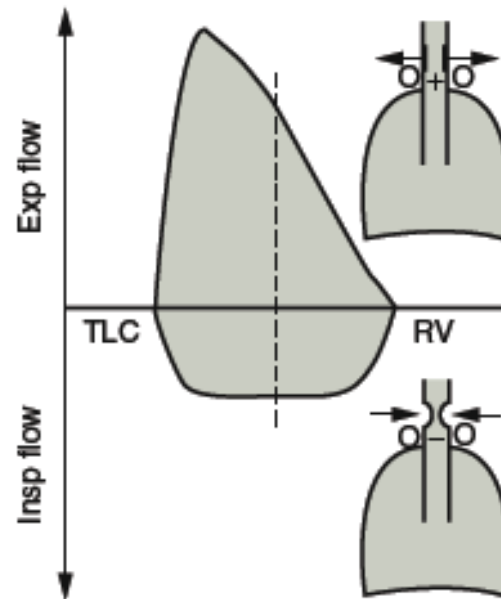
Spirometry	COPD	Asthma
VC	Reduced	Nearly Normal
FEV1	Reduced	Reduced in attack
FVC (or FEV6)	Reduced	Nearly Normal
FEV1 Ratio (of VC/FVC/FEV6)	Reduced anytime	Reduced in attack
FEV1 compared to 'predicted'	< LLN	Reduced in attack
Bronchodilator reversibility	A little	Marked if in attack
Serial spirometry	Progressive deterioration	Constant or erratic
Home monitoring	Use for alerts	Use for variability
Peak Flow measurement	Not useful	As above
Peak Inspiratory Flow measurement	Not useful	Not useful
DLCO	Normal	Reduced
SpO2	Normal between exacerbations	Permanently reduced
Airway challenge testing	Normal	May be significant
FENO	Normal or low	Elevated if eosinophilic inflammation
Sputum or condensate analysis	Not useful	Not useful



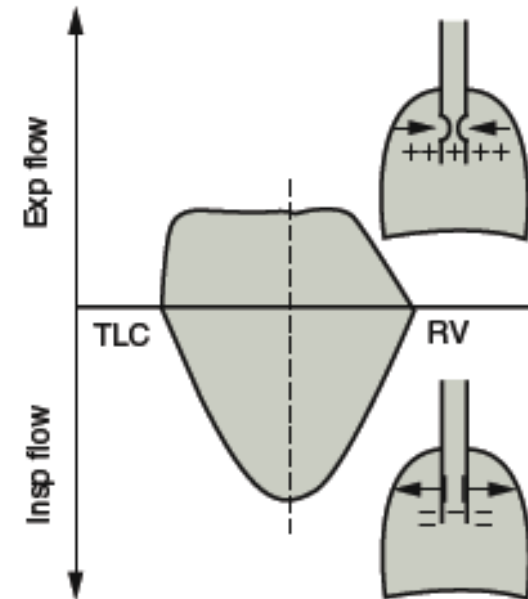
# Flow volume curves



Fixed obstruction  
intra- or extrathoracic



Extrathoracic obstruction  
(variable)



Intrathoracic obstruction  
(variable)

**TABLE 2.5**    **Drugs Used for Long-Term Treatment of Asthma**

Class	Drug	Action	Adverse Effects
Inhaled corticosteroids	Beclomethasone Budesonide (Pulmicort) Ciclesonide Flunisolide Fluticasone (Flovent) Mometasone Triamcinolone	Decrease airway inflammation Reduce airway hyperresponsiveness	Dysphonia Myopathy of laryngeal muscles Oropharyngeal candidiasis
Long-acting bronchodilators	Arformoterol (Brovana) Formoterol Salmeterol	$\beta_2$ -Agonist: stimulates $\beta_2$ -receptors in tracheobronchial tree	Therapy with just long-acting bronchodilators can cause airway inflammation and an increased incidence of asthma exacerbations. Should not be used except with an inhaled corticosteroid
Combined inhaled corticosteroids + long-acting bronchodilators	Budesonide + formoterol (Symbicort) Fluticasone + salmeterol (Advair)	Combination of long-acting bronchodilator and inhaled corticosteroid	
Leukotriene modifiers	Montelukast (Singulair) Zafirlukast (Accolate) Zileuton (Zyflo)	Reduce synthesis of leukotrienes by inhibiting 5-lipoxygenase enzyme	Minimal
Anti-IgE monoclonal antibody	Omalizumab (Xolair)	Decreases IgE release by inhibiting binding of IgE to mast cells and basophils	Injection site reaction Arthralgia Sinusitis Pharyngitis Headache
Methylxanthines	Theophylline Aminophylline	Increase cAMP by inhibiting phosphodiesterase, block adenosine receptors, release endogenous catecholamines	Disrupted sleep cycle Nervousness Nausea/vomiting, anorexia Headache Dysrhythmias
Mast cell stabilizer	Cromolyn	Inhibit mediator release from mast cells, membrane stabilization	Cough Throat irritation

# Prevalence of Asthm

- 300 million of people worldwide
- ranging from 0.7% to 18.4%



perioperative respiratory adverse events :

- bronchospasm
- Laryngospasm
- Desaturation
- Coughing and excessive secretion



- Surgical patients with history of uncontrolled asthma three months before surgery had nearly
- double risk of postoperative mortality
- three times risk of developing post-operative pneumonia



# *Preoperative assessment*

- Most well-controlled asthmatics tolerate anesthesia and surgery well.
- The incidence of perioperative bronchospasm in asthmatic patients undergoing routine surgery is less than 2%, especially if routine medication is continued.

# perioperative respiratory adverse events are increased

- patients over 50 years
- major surgery
- unstable disease
- Poorly controlled asthma
- patients with current symptoms
- history of frequent exacerbations or hospital admissions
- bronchospasm, sputum retention, atelectasis, infection and respiratory failure.

**TABLE 2.7**

**Characteristics of Asthma to Be Evaluated Preoperatively**

Age at onset

Triggering events

Hospitalization for asthma

    Frequency of emergency department visits

    Need for intubation and mechanical ventilation

Allergies

Cough

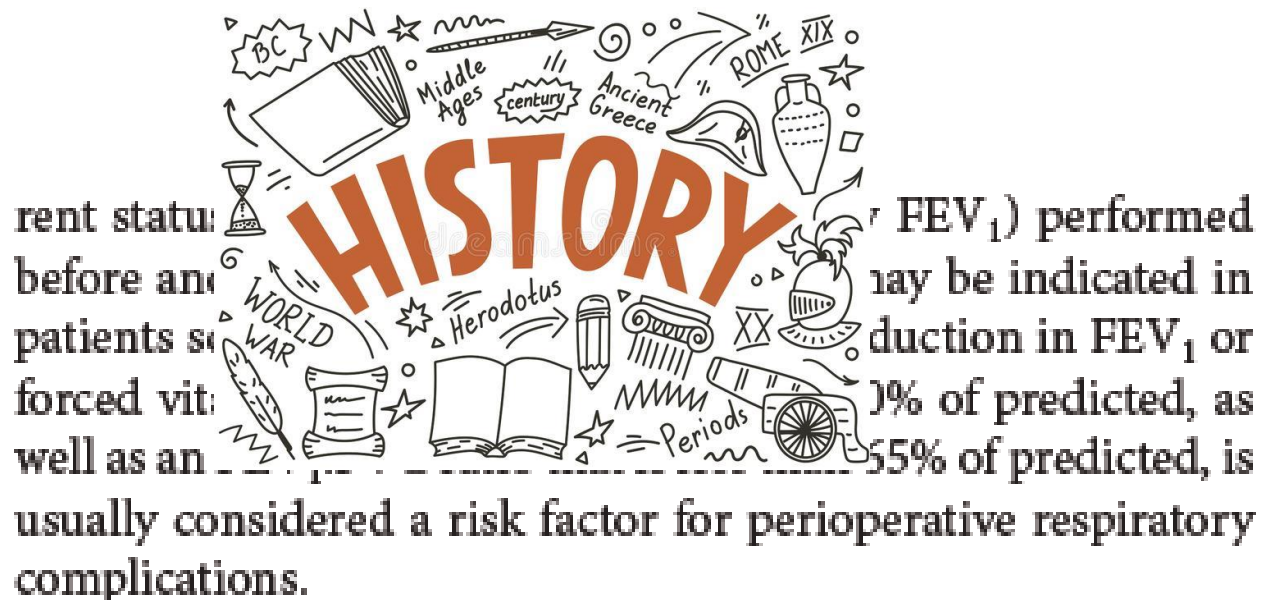
Sputum characteristics

Current medications

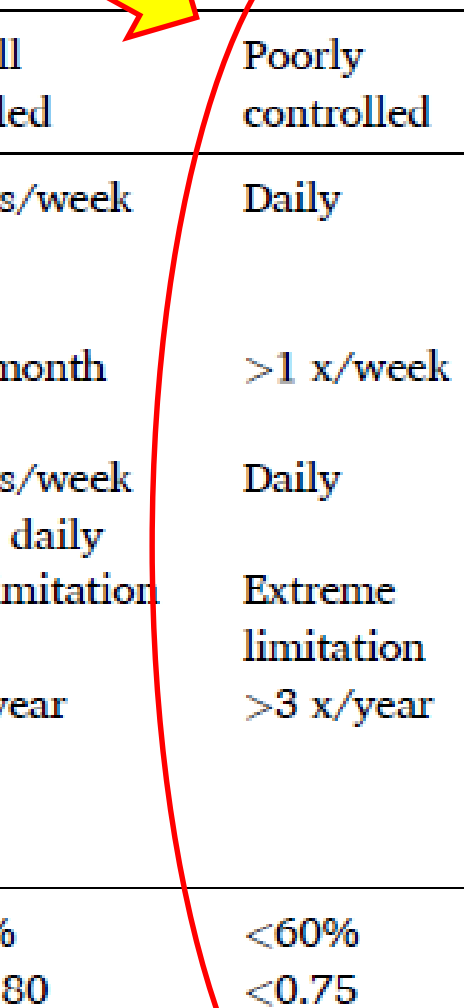
Anesthetic history

# Preop visit

- History
- Physical examination



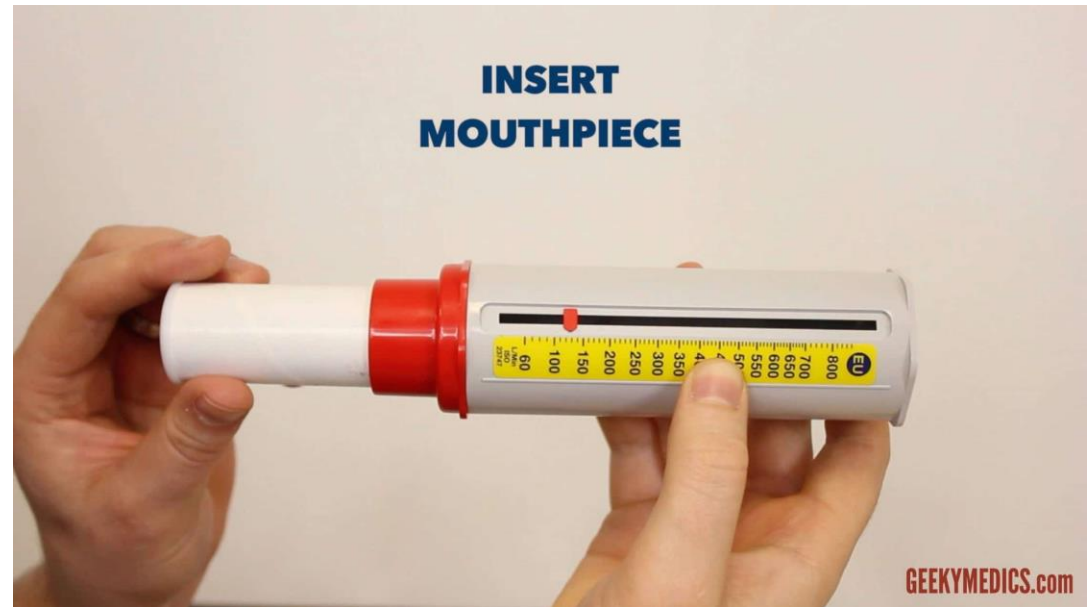
## Assessment of severity of asthma.



Clinical assessment	Well controlled	Not well controlled	Poorly controlled
1. Symptoms (wheezing, shortness of breath, chest tightness)	$\leq 2$ days/week	$> 2$ days/week	Daily
2. Night time awakenings with breathing problems	$\leq 2$ x/month	3–4 x/month	$> 1$ x/week
Short-acting beta 2 agonist use for rescue	$\leq 2$ days/week	$> 2$ days/week but not daily	Daily
Interference with normal activity	None	Some limitation	Extreme limitation
Exacerbations requiring systemic corticosteroids	$\leq 1$ x/year	2–3 x/year	$> 3$ x/year
Patients above 5 years include additionally			
FEV1 predicted	$> 80\%$	60–80%	$< 60\%$
FEV1/FVC	$> 0.8$	0.75–0.80	$< 0.75$

# Preoperative evaluations

- CXR
- CBC
- PFT
- PEFR
- ABG





# Medications

- Chest physiotherapy
- Antibiotics
- Anti-inflammatory
- Bronchodilators
- Inhaled corticosteroids

# Physical examinations




- signs of acute bronchospasm or active lung infection???
- chronic lung disease and right heart failure

# forced expiratory time (FET),

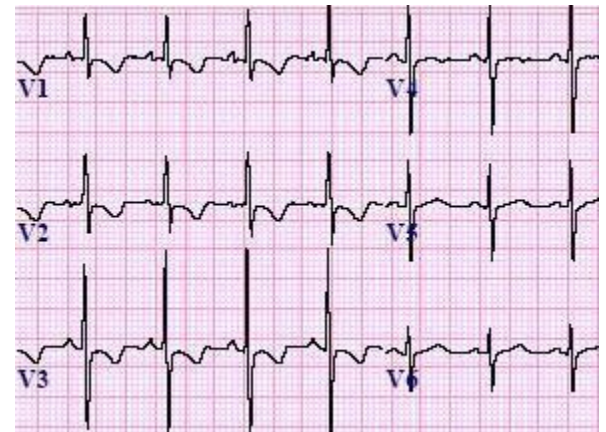
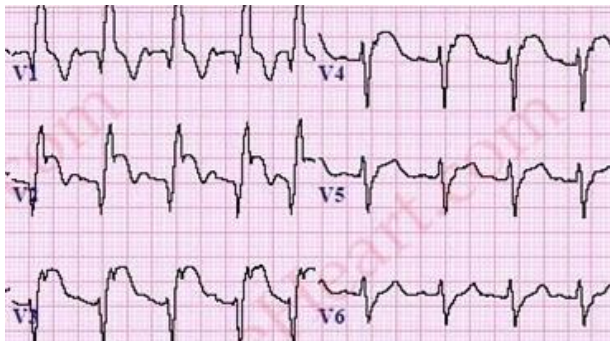
- listening over the trachea while the patient exhales forcibly and fully.
- $FET > 6\text{ s}$
- Preoperative wheezing



# Pulmonary function test/Spirometry:

- reversibility 
-  12% in FEV1 from baseline
- In adults  FEV1 >200 mL

- **Electrocardiogram (ECG):**
- asthmatic patients may show
- right atrial or ventricular hypertrophy
- acute strain
- right axis deviation
- right bundle branch block



# Chest x-rays

- R/O pneumonia
- R/O heart failure
- Hyperinflation
- increased lung markings
- bronchial thickening



# *Preoperative pharmacologic optimization*

- treatment “step” based upon symptoms and severity of disease.
- Inhaled corticosteroids
- beclomethasone (40 µg 2x/daily)
- hydrocortisone (200 mg IV stat
- methyl prednisolone (40–80 mg IV per day)
- for 5 days remain a mainstay of the treatment of acute exacerbation of asthma
- $\beta$ 2-adrenergic agonist(Salbutamol)





# smoker patients with uncontrolled asthma

- for elective surgery should stop smoking at least **6–8weeks** before surgery to allow the greatest recovery of endobronchial cilia mucus clearance (1a).



# adrenal suppression

- systemic corticosteroids for >2 weeks during the prior 6 months

at risk for adrenal suppression

intra operative hydrocortisone 1–2 mg/kg iv Q8h  
and more on the day of surgery followed by return  
to previous dosage by gradual tapering off

**(1b and 1a)**

# acute exacerbated asthma

- should treated with
- steroids and inhaled beta 2-agonists
- Infections should be eradicated
- Fluid and electrolyte imbalances should be corrected

## Classify the severity of bronchial asthma

### Well controlled asthma

- ✓ *Symptoms  $\leq 2$  days /week*
- ✓ *Short-acting beta2 agonist use  $\leq 2$  days/week*
- ✓ *No Interference with normal activity*
- ✓ *Exacerbations requiring systemic corticosteroids  $\leq 1$ x/year*
- ✓ *Awakenings due to asthma  $\leq 1$ x/month.*

### Not well controlled asthma





- ✓ *Symptoms  $> 2$  days / week*
- ✓ *Short-acting beta2 agonist use  $\geq 2$ days/week*
- ✓ *Some limitation with normal activity*
- ✓ *Exacerbations requiring systemic corticosteroids 2–3x/year.*

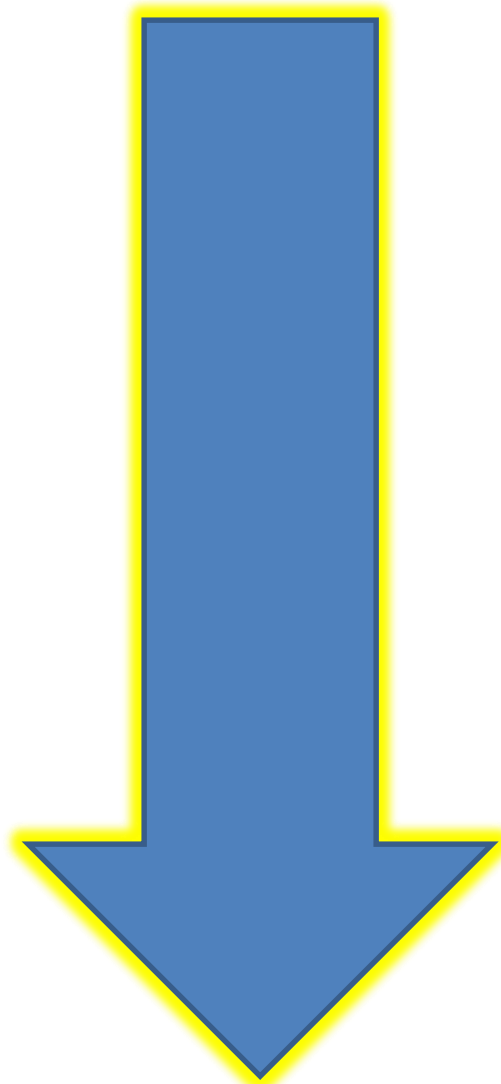
### Poorly controlled asthma

- ✚ *Symptoms throughout the day*
- ✚ *Short-acting beta2 agonist use Several times a day*
- ✚ *Extreme limitation with normal activity*
- ✚ *Exacerbations requiring systemic corticosteroids  $> 3$ x/year*

**Pulmonary Function Test  
(PFT) via Spirometry**

### **Poorly controlled asthma**

-  **Symptoms throughout the day**
-  **Short-acting beta2 agonist use Several times a day**
-  **Extreme limitation with normal activity**
-  **Exacerbations requiring systemic corticosteroids > 3x/year**





# Anesthesia

- detailed history
- pulmonary function test
- medications are imperative
- Adequate depth of Anesthesia
- using less histamine releasing agents



# *Premedication*

- alleviate anxiety
- favored sympatholysis
- antisialogogue
- Midazolam
- Opioids are not recommended
- combination of
  - low dose ketamine (0.15 mg/kg IV)
  - fentanyl (2 mcg/ kg IV)

# *Induction and intraoperative management*

- Adequate depth of anesthesia
- Deep level of anesthesia : appropriate IV anaesthetic agents

ultra short acting opioids

volatile agents

intravenous anaesthetic agents:

propofol and ketamine

# *Muscle relaxants*

- suxamethonium can releases low levels of histamine, it has a great useful for the asthmatic that needs a rapid sequence induction
- Vecuronium, rocuronium, and *cis*-atracurium are safe for use in asthmatics during induction and maintenance
- pancronium which releases low levels of histamine, has been used safely in asthmatics with little morbidity

# *Airway management*

- Warm, humidified gases
- Rapid sequence induction.
- The decision whether to intubate the trachea, provide anesthesia by mask, or use a laryngeal mask airway (LMA) based on the type of surgery, patient condition and other clinical parameters. However, there is evidence that tracheal intubation causes reversible increases in airway resistance not observed with placement of LMA
- Deep and smooth extubation is recommended if airway difficulties were not encountered during induction

# Anesthesia in asthma

- Regional
- General
  - » IV ketamin
  - » Volatile sevoflurane
  - » Opioids remifentanil fentanyl
  - » Lidocaine
  - » NMBA

# ventilatory mode

- long expiratory time
- smaller tidal volumes than usual

# Regional anesthesia



# LMA





# Post-operative management

- mainly depends up on the Intraoperative course

## Intra operative management Bronchospasm

- Give 100% oxygen.
- Ventilate by hand.
- Stop stimulation.
- Consider allergy / Anaphylaxis.

Bronchospasm relieved

- Deep extubation in bed
- head up position
- 100 % of O2 via nasal prongs
- close follow-up
- Continue drugs.

Difficult to ventilate with decrease SPO2

Call for help

- Deepen anesthesia.
- Rule out mal function of equipment's.
- Exclude laryngospasm in non-intubated patients.

Bronchospasm relieved

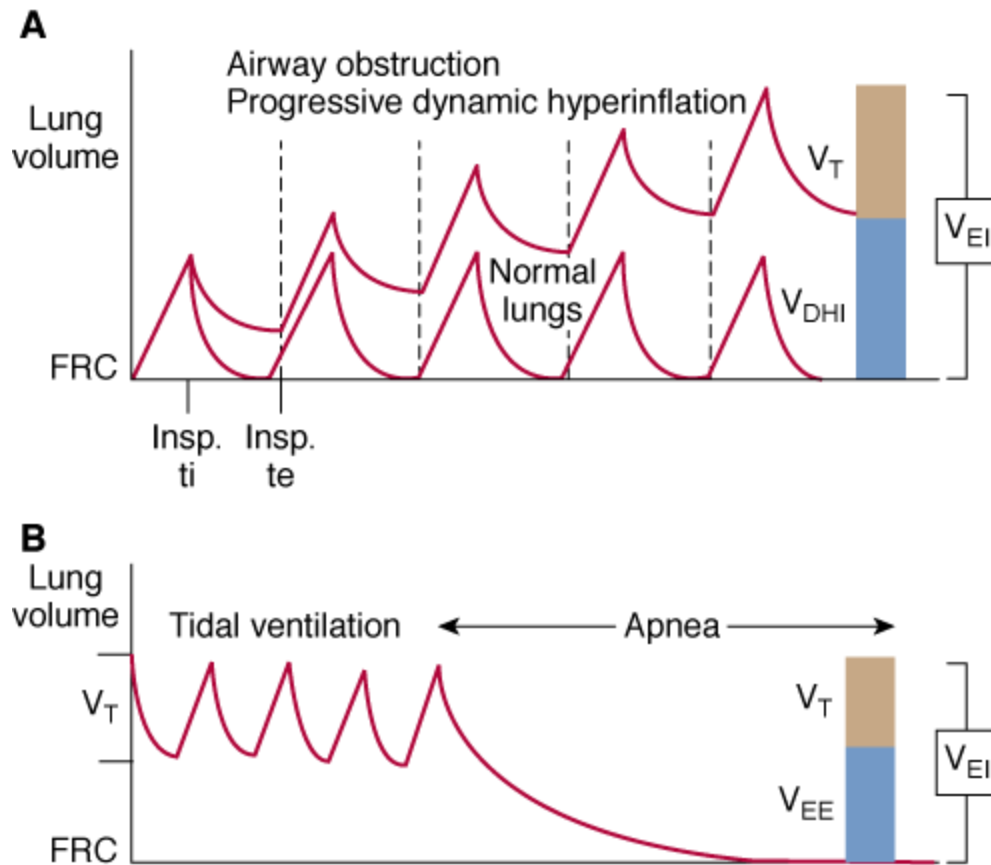
- Deep extubation in bed head up position and send to RR close follow-up
- Continue drugs
- Consider ICU/HDU.

# PREOPERATIVE MANAGEMENT OF CHILDREN WITH POORLY CONTROLLED ASTHMA

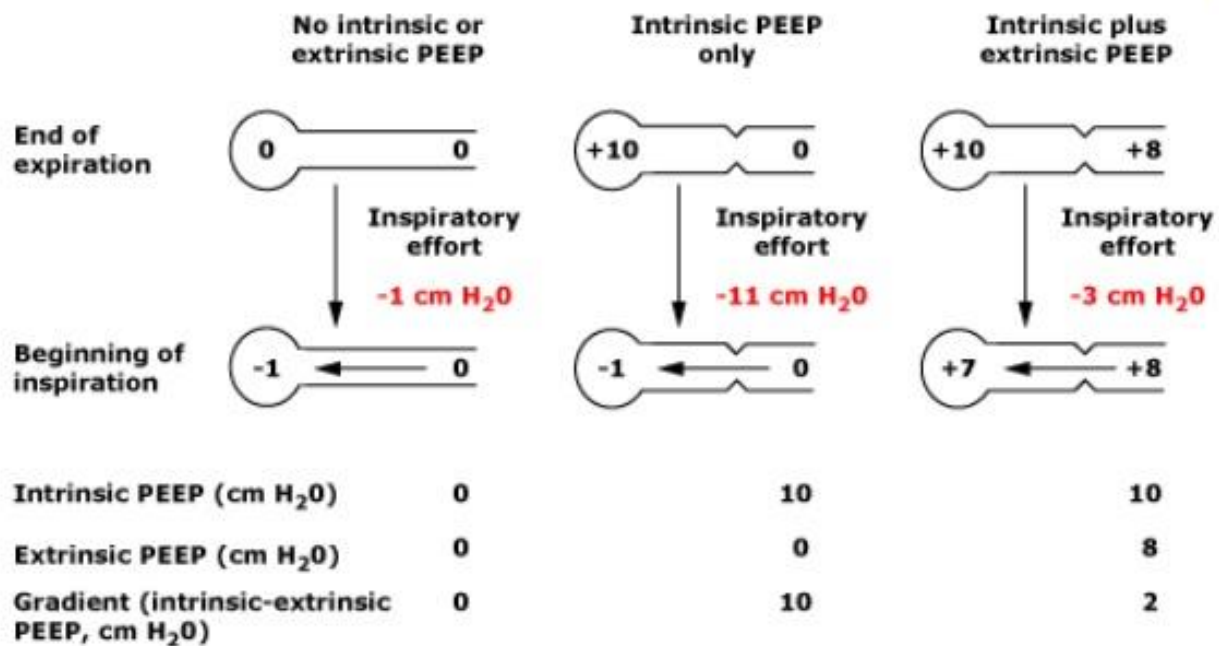
- ongoing wheeze
- high puffer use (e.g. >2 canisters/month or >10 puffs/day)
- surgery should be postponed until asthma is better controlled







Source: Tobin MJ: *Principles and Practice of Mechanical Ventilation*,  
3rd Edition: [www.accessanesthesiology.com](http://www.accessanesthesiology.com)  
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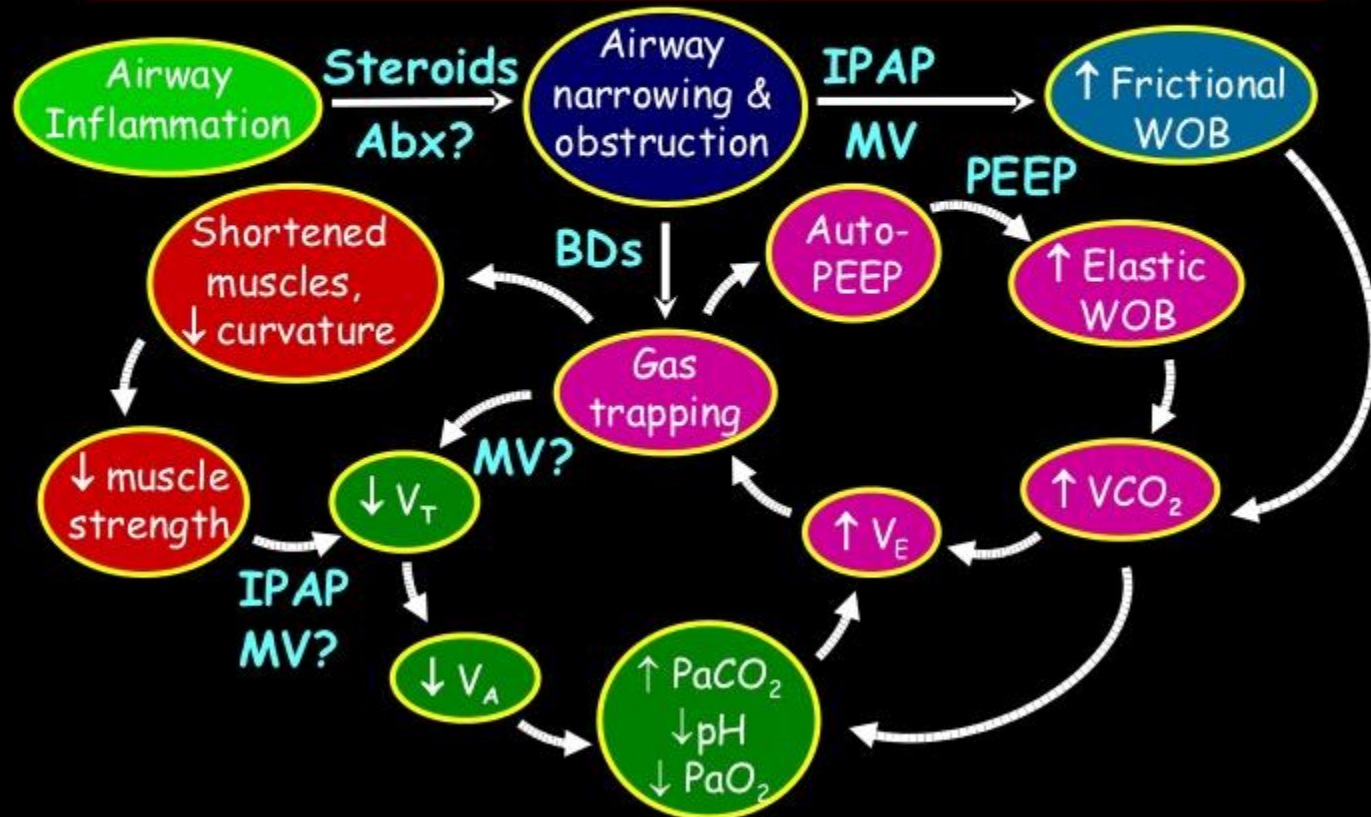
# Mechanical Ventilation

- **Initial ventilator settings**
  - ♦ **Low RR (8-12 breaths/min)**
  - ♦ **Small Vt 6-8 cc/kg of predicted body weight**
  - ♦ **High peak inspiratory flow (70-100 L/min)**
  - ♦ **Prolonged expiratory time (I:E 1:2-1:3)**
  - ♦ **PEEP to compensate for PEEPi if patient is breathing spontaneously (80% of auto-PEEP)**
  - ♦ **ZEEP if patient is sedated, paralyzed and on controlled mechanical ventilation to maximize exhalation.**



Denver Health

# Pathophysiology of Asthma/COPD Exacerbations





# Have a nice weekend

