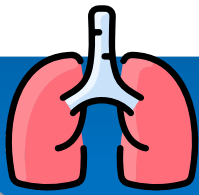




Round : Internal medicine.....

Group no : A4.....

Done By : Batool ALzubaidi.....



PULMONARY FUNCTION TESTS

I. LUNG VOLUME INTERPRETATION

- A. OBSTRUCTIVE LUNG DISEASE
B. RESTRICTIVE LUNG DISEASE

II. FORCED SPIROMETRY INTERPRETATION

- A. OBSTRUCTIVE LUNG DISEASE
B. RESTRICTIVE LUNG DISEASE

III. BRONCHODILATION AND

BRONCHOCONSTRICTION INTERPRETATION

- A. ASTHMA
B. COPD

IV. DIFFUSION LIMITATION OF CARBON MONOXIDE (DLCO) INTERPRETATION

- A. EMPHYSEMA
B. INTERSTITIAL LUNG DISEASE

V. DIAGNOSTIC APPROACH TO PFTS

- A. OBSTRUCTIVE DISEASES
B. RESTRICTIVE DISEASES

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I. LUNG VOLUME INTERPRETATION

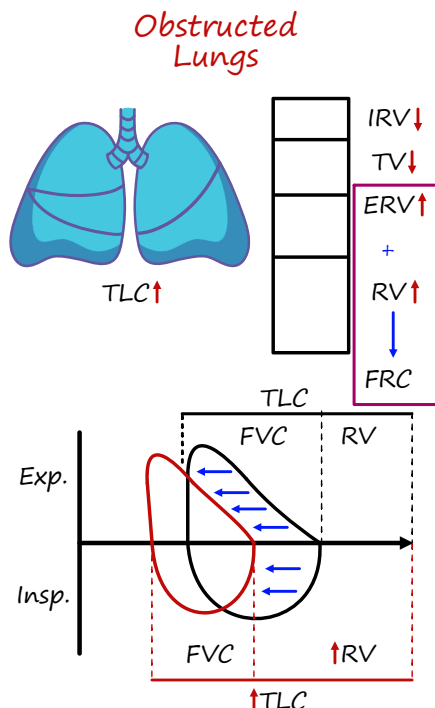
A. OBSTRUCTIVE LUNG DISEASE

1. Pathophysiology:

- Airway **obstruction** → Air trapping → Dynamic hyperinflation → Hypoventilation occurs during inspiration
- **Types:**
 - COPD
 - Asthma
 - Bronchiectasis

2. Lung Volume Findings:

- Airway Obstruction → Air trapping
 - FRC ↑
 - RV ↑
 - TLC ↑
- Air Trapping → Hyperinflation → Hypoventilation
 - IRV ↓
 - TV ↓ → Because the amount of deep breath that they can take above their normal tidal volume is very little



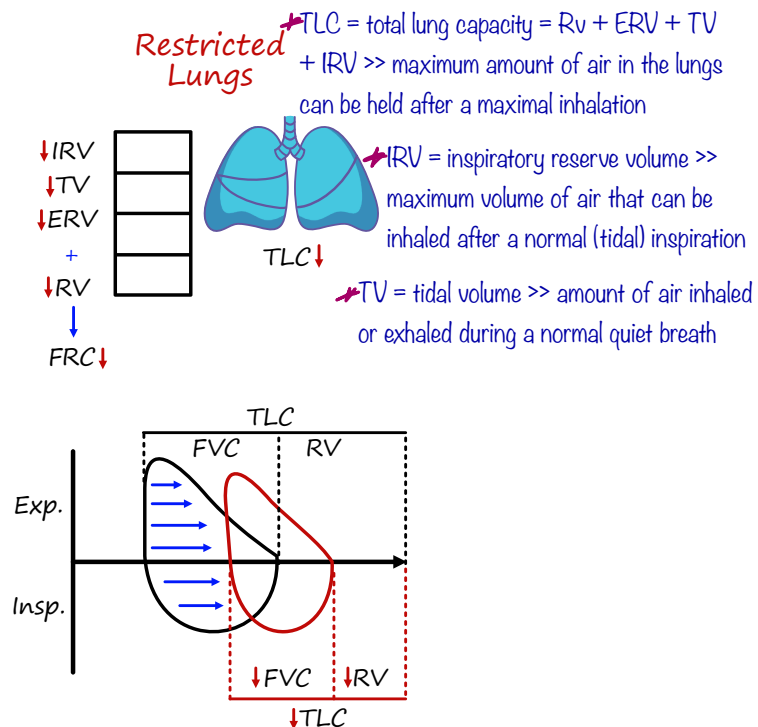
B. RESTRICTIVE LUNG DISEASE

1. Pathophysiology: Lungs are stiff

- Lung **fibrosis** → ↑ Elastic recoil and ↓ Lung compliance → ↓ Lung expansion → Hypoventilation
- **Types:**
 - Interstitial lung disease
 - Idiopathic Pulmonary Fibrosis (IPF)

2. Lung Volume Findings:

- ↑ Elastic recoil and ↓ Lung compliance → ↓ Lung expansion
 - FRC ↓ → It's really hard to expand their lungs so they can't take a good deep breath
 - RV ↓
 - TLC ↓
 - ↓ Lung expansion → Hypoventilation
 - IRV ↓ → FRC = functional residual capacity = ERV + RV >> volume of air remaining in the lungs after a normal passive expiration
 - TV ↓ → RV = residual volume >> amount of remaining air in the lungs after a maximal forceful expiration (it can not be voluntarily exhaled)
- Restricted Lungs**
- TLC = total lung capacity = Rv + ERV + TV + IRV >> maximum amount of air in the lungs can be held after a maximal inhalation
- IRV = inspiratory reserve volume >> maximum volume of air that can be inhaled after a normal (tidal) inspiration
- TV = tidal volume >> amount of air inhaled or exhaled during a normal quiet breath



II. FORCED SPIROMETRY INTERPRETATION

A. OBSTRUCTIVE LUNG DISEASE

- **Pathophysiology:**
 - **Airway obstruction** → Reduction in expiratory airflow
- **Lung Volume Findings:**
 - Airway obstruction → Reduction in expiratory airflow
 - **FEV₁↓↓↓**
 - This is markedly reduced given expiratory airflow is significantly limited in the first second
 - **FVC↓**
 - This is **mildly reduced** given forced expiration is increased from air trapping and forced inspiration and TV is reduced from hypoventilation
 - **FEV₁/FVC ratio < 70%**
 - Flow-Volume Loop shifts to the left
 - This is largely a result of an ↑RV

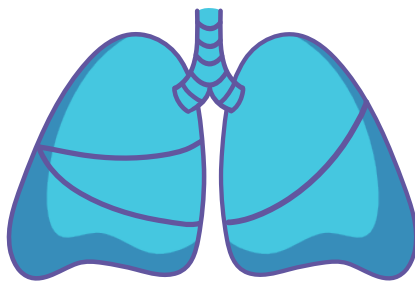
B. RESTRICTIVE LUNG DISEASE

- **Pathophysiology:**
 - **↓Lung expansion** → Hypoventilation
- **Lung Volume Findings:**
 - ↓Lung expansion → Hypoventilation
 - **FVC↓↓↓**
 - This is markedly reduced given forced inspiration, and expiration is reduced given reduced lung expansion
 - **FEV₁↓**
 - This is **minimally reduced** given expiratory airflow is only mildly limited in the first second, given reduced lung volumes available to exhale in the first second
 - **FEV₁/FVC ratio > 70%**
 - Flow-Volume Loop shifts to the right
 - This is largely a result of an ↓RV

✚ FEV₁ = forced expiratory volume at 1 second

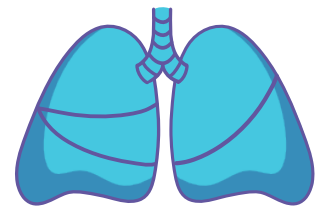
Forced Spirometry

Obstructed Lungs

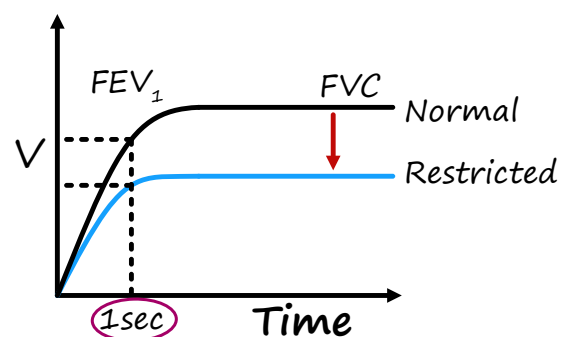
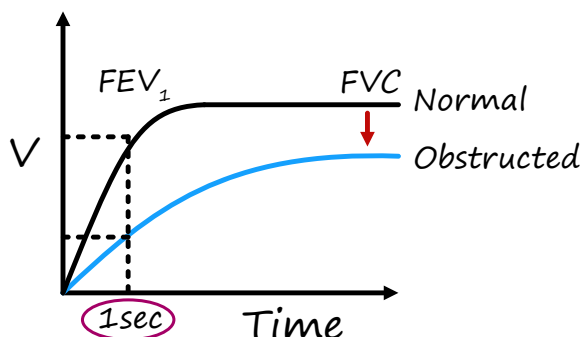


$$\begin{aligned} FEV_1 &\downarrow\downarrow\downarrow \\ FVC &\downarrow \\ \frac{FEV_1}{FVC} &\downarrow\downarrow\downarrow < 70\% \end{aligned}$$

Restricted Lungs



$$\begin{aligned} FEV_1 &\downarrow \\ FVC &\downarrow\downarrow\downarrow \\ \frac{FEV_1}{FVC} &\downarrow\downarrow\downarrow > 70\% \end{aligned}$$

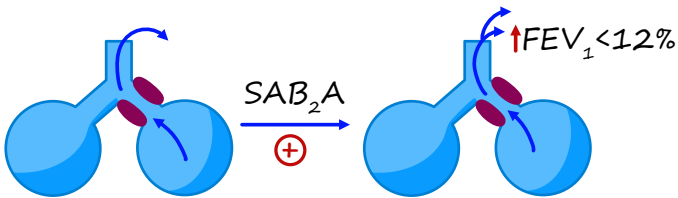


III. BRONCHODILATION AND BRONCHOCONSTRICTION INTERPRETATION

A. ASTHMA

- **Pathophysiology:**
 - Bronchospasm → Narrows bronchioles → Reduces FEV₁
- **Lung Volume Findings:**
 - **Bronchodilators** (e.g. Albuterol)
 - Promote bronchodilation → Improves FEV₁ (> 12 % ↑ from baseline) → Indicates reversibility
 - **Bronchoconstriction** (e.g. Methacholine)
 - Promote bronchoconstriction → Reduces FEV₁ (> 20% ↓ from baseline) → Indicates inducibility

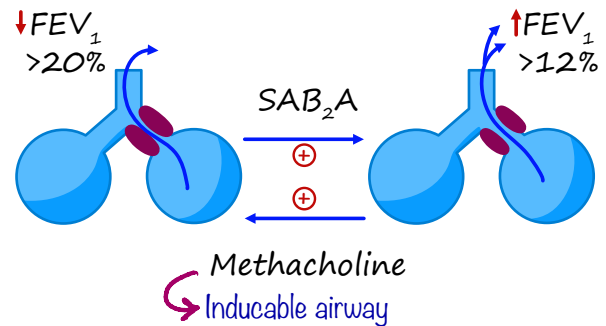
Obstructed Lungs (COPD)



B. COPD

- **Pathophysiology:**
 - Bronchospasm → Narrows bronchioles → Reduces FEV₁
- **Lung Volume Findings:**
 - **Bronchodilators** (e.g. Albuterol)
 - Promote bronchodilation → Improves FEV₁ (< 12 % ↑ from baseline) → Indicates irreversibility

Obstructed Lungs (Asthma)



IV. DIFFUSION LIMITATION OF CARBON MONOXIDE (DLCO) INTERPRETATION

A. EMPHYSEMA

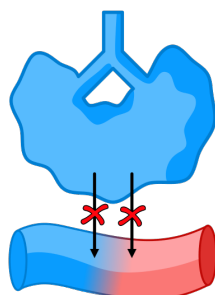
- **Pathophysiology:**
 - Emphysema → ↓ Total surface area → ↓ Diffusion of respiratory gases
- **Lung Volume Findings:**
 - ↓ DLCO in Emphysema

B. INTERSTITIAL LUNG DISEASE

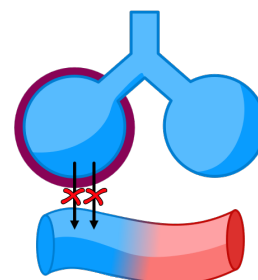
- **Pathophysiology:**
 - Interstitial Lung Disease (ILD) → ↑ Thickness of respiratory membrane → ↓ Diffusion of respiratory gases
- **Lung Volume Findings:**
 - ↓ DLCO in Interstitial Lung Disease (ILD)

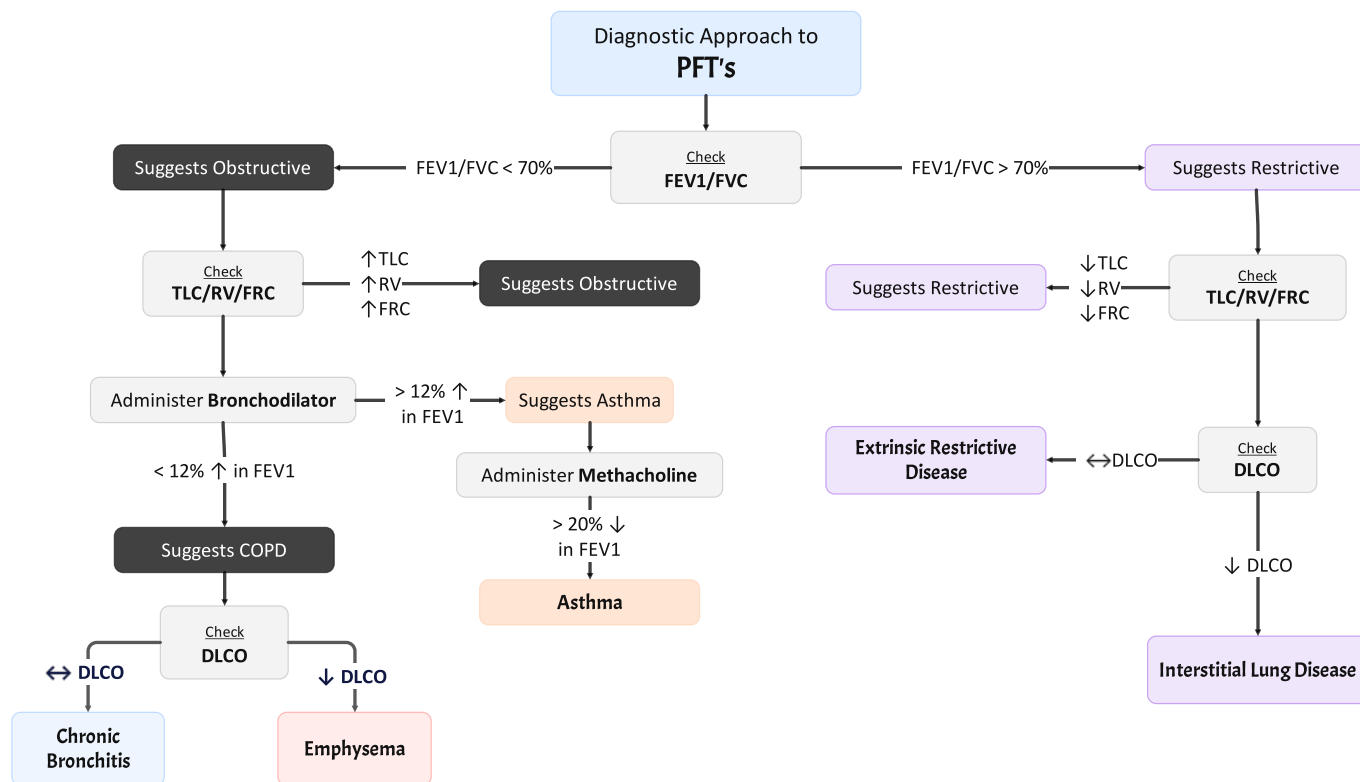
$$DLCO = \frac{\text{Surface Area} \downarrow}{\text{Thickness} \uparrow}$$

Obstructed Lungs (Emphysema)



Restricted Lungs (ILD)





A. OBSTRUCTIVE DISEASES

Obstructive Lung Diseases	FEV1/FVC	TLC RV FRC	Bronchodilator Test and Bronchoconstriction Test	DLCO
<i>COPD</i>	< 70%	↑	FEV1 < 12% ↑ in baseline with albuterol	↓ in Emphysema
<i>Asthma</i>			FEV1 > 12% ↑ in baseline with albuterol FEV1 > 20% ↓ in baseline with methacholine	Normal or ↑ in Asthma

B. RESTRICTIVE DISEASES

Restrictive Lung Diseases	FEV1/FVC	TLC RV FRC	Bronchodilator test and Bronchoconstriction test	DLCO
<i>Interstitial Lung Disease</i>	> 70%	↓	N/A	↓ in ILD
<i>Extrinsic Disease</i>				Normal

