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Review of MEDICINE

Gaurav Gupta

New AIIMS Pattern Questions available on www.accesspgmee.com and App

Highlights

- **Simplified, fully colored illustrations**
- **Covers maximum topics being asked in the recent pattern examinations**
- **Written by subject expert**
- **Updated from 20th Edition of Harrison's Principles of Internal Medicine**

Latest Exam Pattern Questions Upto 2019
AIIMS (Nov 2018–2010)
PGI Chandigarh (Nov 2018–2010)
NEET-AIPGMEE (2019–2010)
DNB (2018–2010)

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Most Important ★★★★★
Very Important ★★★★
Important ★★★

2.1 PULMONARY FUNCTION TESTS

INTRODUCTION

Purposes of Pulmonary Function Tests (PFTs)

- As a diagnostic tool, PFTs help to classify diffuse lung disease into one of three broad categories:

Obstructive lung disease (OLD)	Restrictive lung disease (RLD)	Pulmonary vascular disease
COPD (chronic bronchitis ↔ emphysema) Asthma Bronchiectasis Cystic fibrosis	Interstitial lung disease (e.g. pulmonary fibrosis, sarcoidosis) Chest wall pathology (e.g. kyphosis, scoliosis) Obesity Neuromuscular disease (e.g. ALS, muscular dystrophy)	Primary pulmonary hypertension Chronic thromboembolic disease

  - **These categories are not mutually exclusive:**
    - COPD can be obstructive + vascular
    - Sarcoidosis can be restrictive + obstructive + vascular[Q]
- **Assessment of response of therapy**
- **Preoperative pulmonary evaluation.**

Note

Different parts of pulmonary system assessed

- Airways—large and small airways
- Parenchyma—alveoli and interstitium
- Pulmonary vasculature
- Pump mechanism—diaphragm and chest wall
- Neural control of ventilation.

Various Types of PFTs

Standard PFTs	Specialized PFTs
• Spirometry (including flow-volume loop) • Lung volumes • Diffusing capacity of carbon monoxide (DLCO)	• Arterial blood gas • Exercise oximetry • 6 minute walk test • Peak flow • Maximum inspiratory and expiratory pressure

Lung Volumes and Subdivisions

Definitions and Assessment

Total volumes of gas in lung is subdivided into:

- *Compartments (volumes)*
- *Combinations of two or more volumes → capacities.*

Glossary for Static Lung Volumes and Capacities

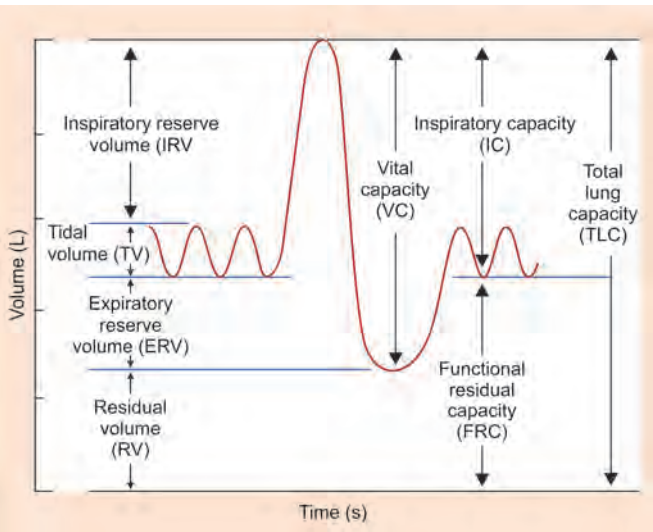
Term	Symbol	Definition
Volumes		
Residual volume	**RV**	**Volume of air remaining in the lungs after maximal expiration**[Q]
Expiratory reserve volume	ERV	Maximal volume of air expired from the resting end-expiratory level
Tidal volume	TV	Volume of air inspired or expired with each breath during quiet breathing
Inspiratory reserve volume	IRV	Maximal volume of air inspired from the resting end-inspiratory level

Contd...

Contd...

Capacities		
Inspiratory capacity	**IC**	**Maximal volume of air inspired from the end-expiratory level (the sum of IRV and TV)**[Q]
Vital capacity	VC	Maximal volume of air IRV+TV+ERV from the maximal inspiratory level
Inspiratory vital capacity	IVC	Maximal volume of air inspired from the maximal expiratory level
Functional residual capacity	**FRC**	**Volume of air remaining in the lungs at the end-expiratory level (the sum of RV and ERV)**
Total lung capacity	TLC	Volume of air in the lungs after maximal inspiration (VC+RV sum of all volume compartments)

Subdivisions of lung volume as recorded by a spirometer



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Static lung functions which are used for defining the elastic properties of lung.

- All lung volumes and capacities that *do not include the RV can be measured by spirometry.*[Q]
- *Measurement of RV and hence all* **capacities including it require more complex techniques which are discussed subsequently**.
- **Vital capacity and its subdivision (ERV + TV + IRV) → two methods of performing open and closed circuits methods**.
- **FRV and RV** → RV cannot be measured by spirometry since RV is volume of air remaining in the lungs at the end of the maximal expiration:
  - RV indirectly depends on (a) FRC (b) ERV (c) difference between FRC and ERV
  - FRC and RV can be determined by:[Q]
    a. **Helium** → dilution technique
    b. **Nitrogen washout method** → FRC can be calculated
    c. **Body plethysmography**.

FRC ~ Measure of Lung Compliance[Q]

- Volume of air in the lungs after a normal relaxed expiration
- Determine by the balance between the tendency of the lung to recoil inwards and chest wall to pull outwards.
  a. ↓↓ FRC a/w RLD ~ Decrease in outward pull of the chest wall
  b. ↑↑ FRC a/w OLD (emphysema), i.e. more outward pull of chest wall.

Dynamic lung functions—four categories:

1. FVC
2. Flow-volume curve
3. MVV (maximum ventilatory volume)
4. Airways resistance.

PERFORMING SIMPLE SPIROMETRY

Contraindications for Performing Spirometry

- **History of a myocardial infarction within 1 month**
- **Patients with any of the conditions listed below:**
  - Active chest infection
  - Aortic aneurysm
  - Acute chest or abdominal pain
  - Dementia or confused state
  - Stress incontinence.

Activities that should be Avoided Prior to Spirometry

- Smoking 1 hour prior to the test
- Alcohol intake within 4 hours of testing
- Vigorous exercise within 30 mins of testing
- Large meal within 2 hours of testing.

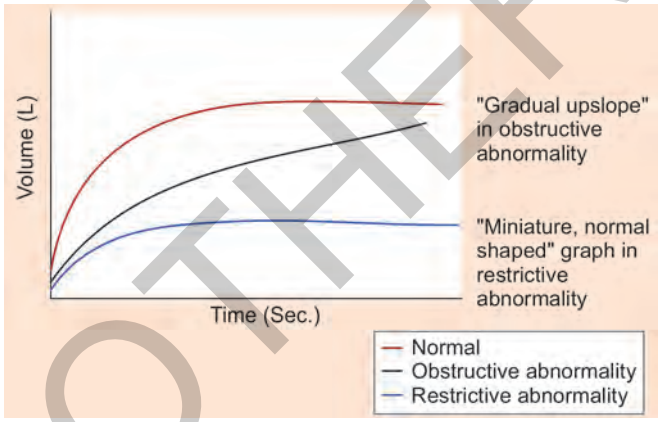
For airway disorder protocol the following bronchodilators must be avoided for the period indicated:

- Short-acting bronchodilators—within the previous 6 hours.
- Long-acting bronchodilators—within the previous 12 hours.
- Slow release theophyllines—within the previous 24 hours.

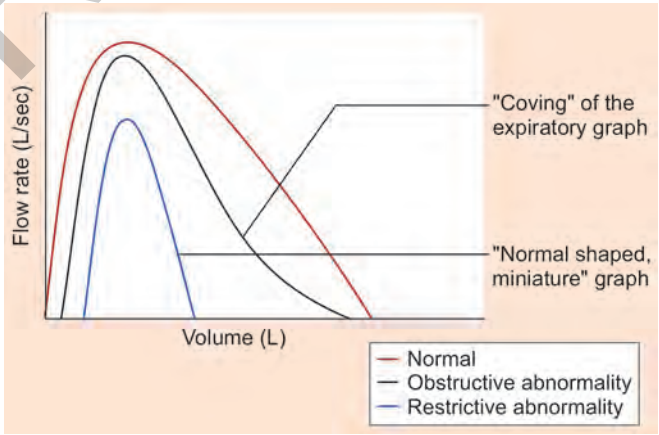
Graphs Recorded

- Volume versus time (Spirogram).
- Flow rate versus volume.
  - *Flow volume curve* when only expiratory flow is recorded
  - *Flow volume loop* when inspiratory flow is also recorded.

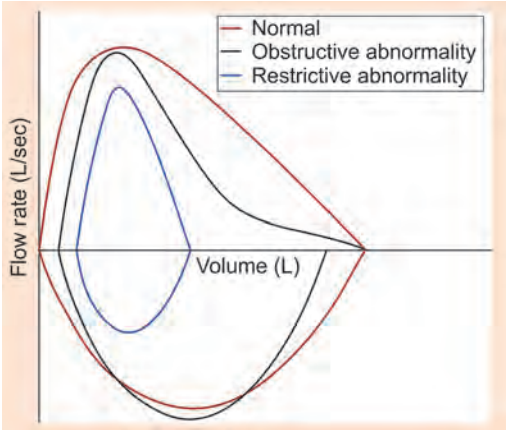
Graphic display of volume versus time (Spirogram)



Graphic display of flow rate versus volume (Flow volume curve)



Flow volume loop



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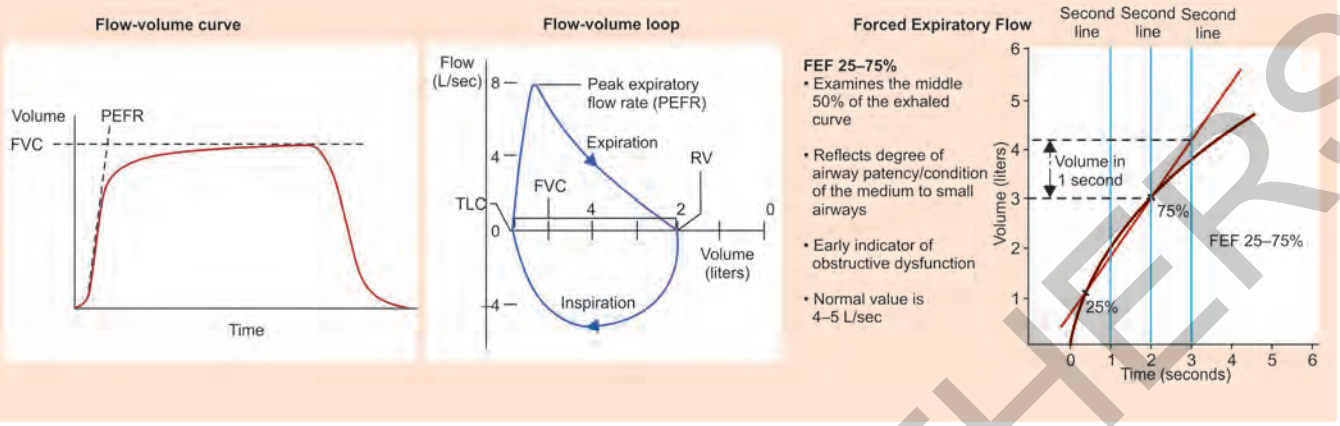
Values Measured from a PFT



Values measured by spirometry	
Major	*Minor*
• FEV_1 • FVC • FEV_1/FVC ratio • Flow volume loop	• Peak expiratory flow rate (PEFR) • $FEV_{25–75\%}$ • Maximal voluntary ventilation (MVV)

- **FVC (in** liters) and percentage of predicted FVC%.
- **FEV_1** and as percentage of predicted FEV_1%
- **FEV_1/ FVC%,** which is the relation of the patient's recorded FEV_1 and FVC.
- **PEF** (in liters per minute or liters per second) and percentage of predicted PEF daily.
- **PEF** (peak flow meter)—for monitoring asthma control.
- **Post-bronchodilator change in FEV_1**—improvement by 12% and 200 mL is considered as good bronchodilator reversibility (BDR).[Q]
- **Maximal mid-expiratory flow (MMFR) or forced expiratory flow between 25–75% ($FEF_{25–75\%}$)**—sensitive measure **of small airways obstruction**.
- However, more recently, MMFR is not considered a reliable parameter.

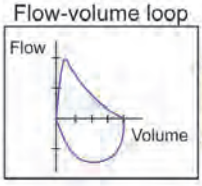
REPORTING A PFT

- Values are reported as a % of that predicted (% Ref), given the patient's age gender, and height
- "Normal" is generally considered within ~80–120% predicted, or between 5th and 96th percentile.

Patient: ABC Age: 40 Gender: male

			Ref	Pre	% Ref	Post	% Ref
Step-1	Spirometry						
	FVC	Liters	3.2	2.3	72	2.5	78
	FEV_1	Liters	2.6	1.0	38	1.2	46
	FEC_1/FVC	%	81	43		48	
	FEF 25–75%	L/sec	2.8	0.6	21	0.7	25
	PEF	L/sec	5.9	3.9	66	4.2	71
Step-2	Lung volumes						
	TLC	Liters	4.9	6.4	131		
	VC	Liters	3.2	2.4	75		
	IC	Liters	2.1	1.8	86		
	FRC	Liters	2.7	3.2	119		
	RV	Liters	1.7	3.6	212		
	RV/TLC	%	35	56			
Step-4	Diffusing capacity						
	DLCO	mL/mm Hg/min	22	16	73		
	DL Adj	mL/mm Hg/min	22	14	64		

Flow-volume loop



Step-3

Comments: Tests are pre and Post 4 puffs salbutamol

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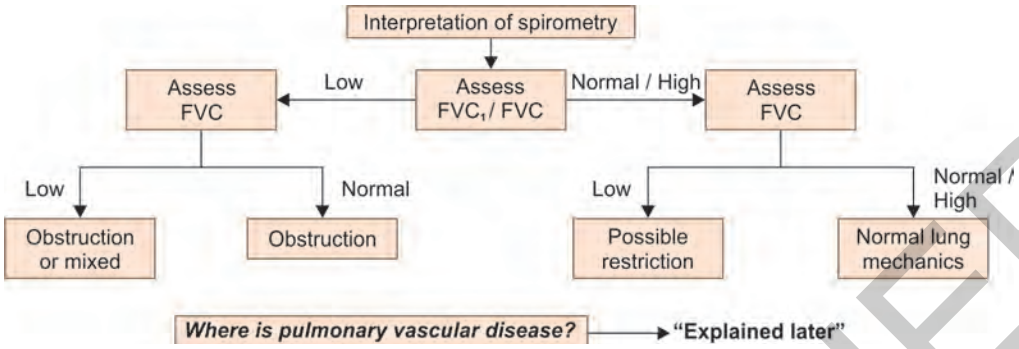
Interpretation of Spirometry

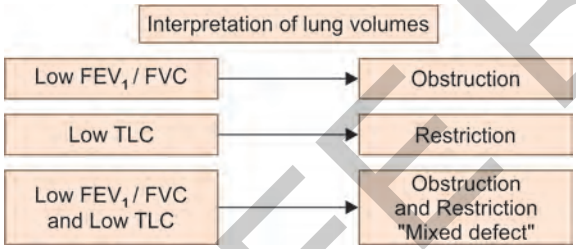
Step 1



FAQ interpretation of FEV_1.FVC, and FEV_1/FVC ratio[Q]

	FEV_1	FVC	FEV_1/ FVC ratio (Tiffeneau index)
Obstructive lung disease (OLD)	Normal (very mild obstruction) or Decreased (mod/severe obstruction)	Normal (mild/mod obstruction) or Decreased (severe obstruction)	Decreased (< 70%)
Restrictive lung disease (RLD)	Normal or decreased	Decreased	Normal or increased (≥ 70%)

Step 2: Interpretation of Lung Volumes



PFTs help to classify diffuse lung disease into three broad categories:

- Obstructive, restrictive and mixed
- Small airway obstruction
- Probably normal pattern
- Upper airway obstruction.

Step 3: Flow Volume-loop

Obstructive pattern

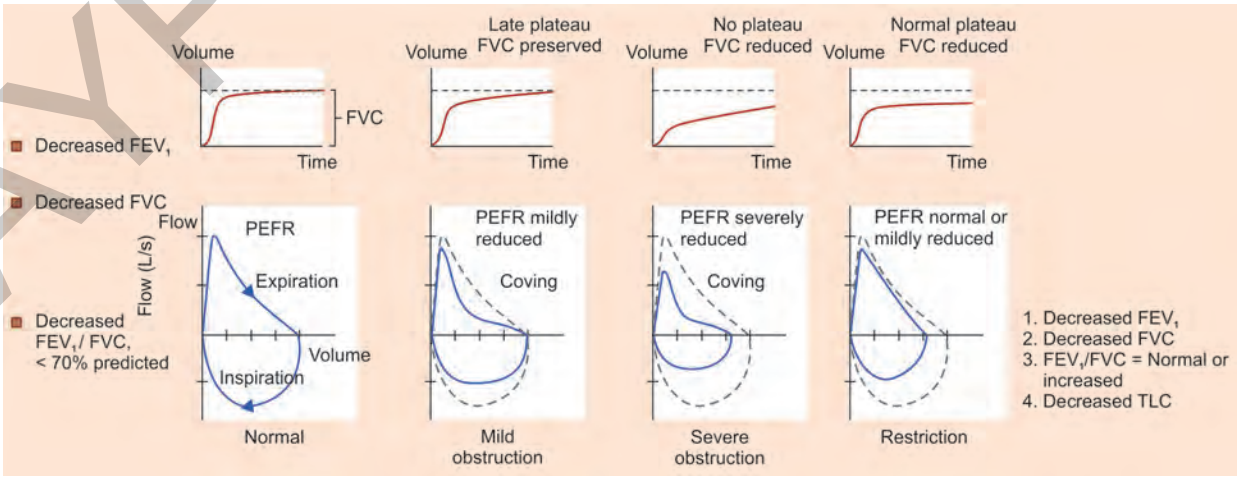


Fig. 2.1.1: Obstructive and restrictive pattern.

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GOLD Staging of COPD Based on FEV_1 [Q]

	FEV_1 compared to predicted for age/gender/height
GOLD Stage I	$FEV_1 \geq 80\%$
GOLD Stage II	$50\% \leq FEV_1 < 80\%$
GOLD Stage III	$30\% \leq FEV_1 < 50\%$
GOLD Stage IV	$FEV_1 < 30\%$

The global initiative for chronic obstructive lung disease (GOLD) classifies COPD severity based on post-bronchodilator FEV_1

Small Airway Obstruction (SAO)

Spirometry shows:

- Low FVC (due to air trapping distal to the obstructed small airways), low FEV_1 and flow rates.
- "Paradoxical fall" in FEV_1 /FVC% due to greater increase in FVC compared to FEV_1 following bronchodilators.
- **Best diagnosed by high-resolution Mosaic attenuation tomography (HRCT) chest revealing "mosaic perfusion".**
- Classical condition like obliterative bronchiolitis (OB) or constructive bronchiolitis (CB).
- SAO is also seen in bronchial asthma, COPD and bronchiectasis.

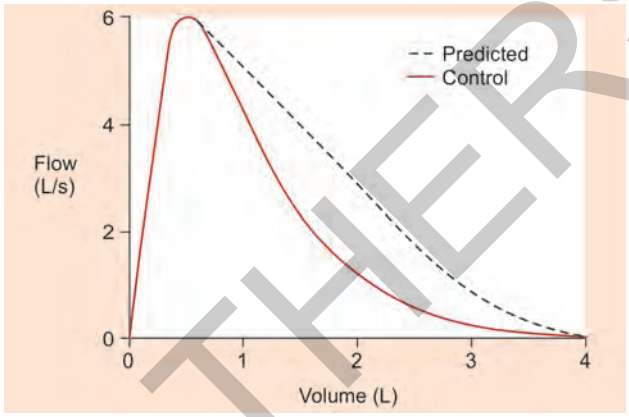


Fig. 2.1.2: Small airway obstruction.

Upper Airway Obstruction (UAO)

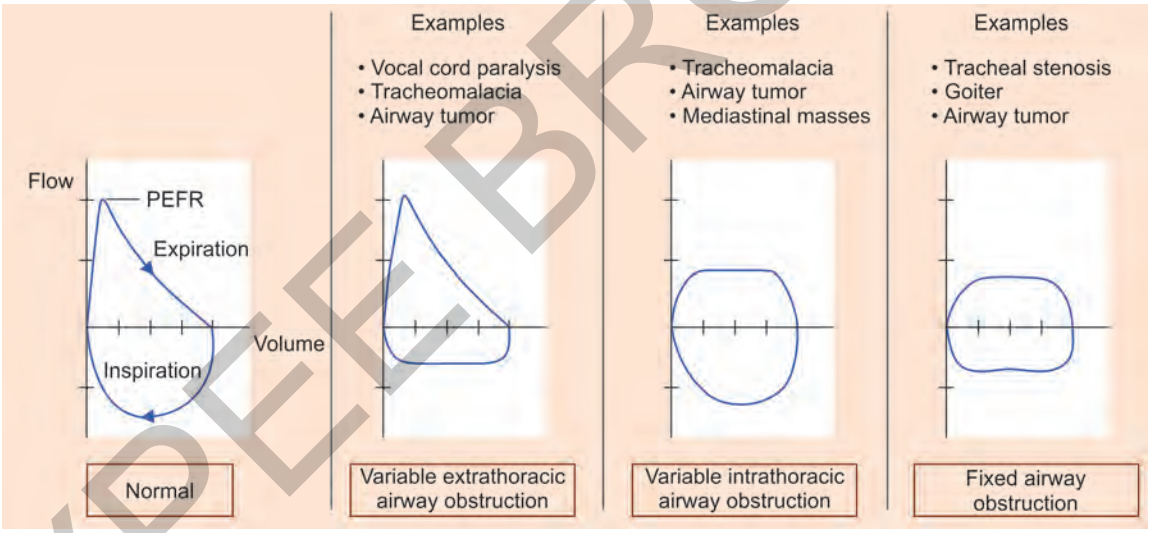
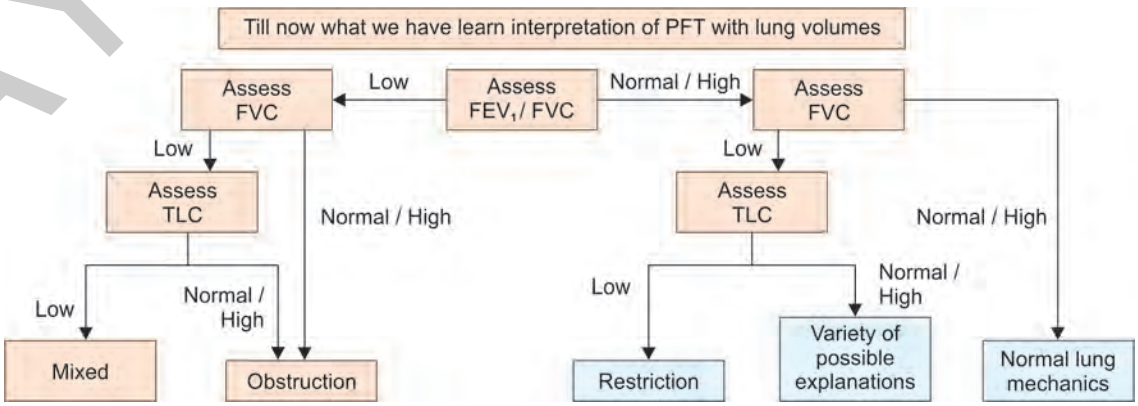


Fig. 2.1.3: Upper airway obstruction can be fixed, variable extrathoracic or variable intrathoracic. [Q]



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Step 4: Diffusing capacity of carbon monoxide (DLCO)

DLCO is a measure of the overall function of the alveolar-capillary membrane.

$$\dot{V}_x = \frac{D \times A \times \Delta P}{\Delta x}$$

$\dot{V}_x$ – Rate of gas diffusion
D – Diffusion coefficient
A – Surface area
ΔP – Partial pressure gradient
Δx – Thickness of membrane

Fick's law of diffusion

***Five methods for DLCO estimation:**[Q]

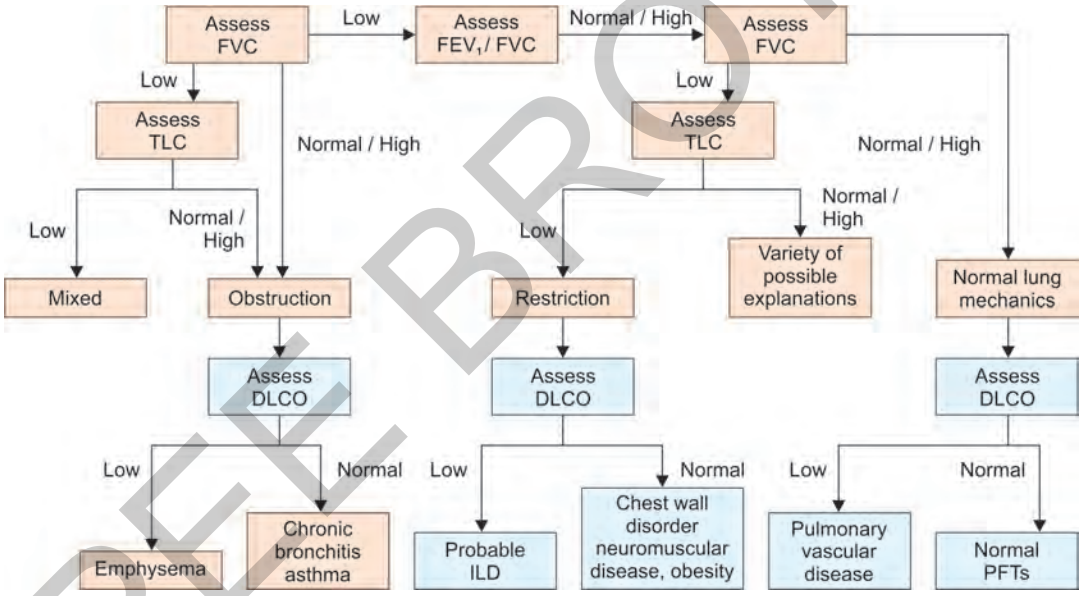
1. Single-breath method—best standardized and most validated method
2. Steady-state method
3. Re-breathing method
4. Three-gas equation
5. Intra-breath method.

Primary indications for measuring DLCO

- To categorize a patient with restrictive lung disease as either probable ILD versus extrathoracic restriction (e.g. obesity, neuromuscular disease).
- To identify early ILD in high-risk patients (e.g. chronic amiodarone use, history of chest radiation, stage I sarcoidosis).
- To quantify anatomic emphysema in patients with COPD.
- To document disability for legal purposes.

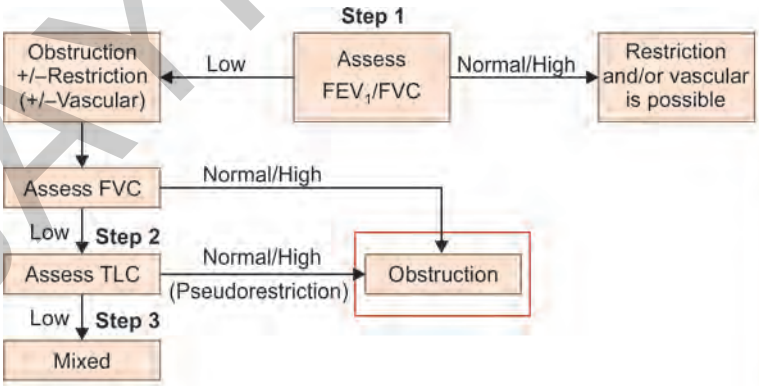
Conditions and physiologic states that alter DLCO[Q]	
↓ DLCO	↓ Membrane surface area (e.g. emphysema) ↑ Membrane thickness (e.g. ILD) Pulmonary hypertension Anemia
↑ DLCO	Exercise, supine position Asthma Pulmonary hemorrhage Polycythemia Mild left heart failure

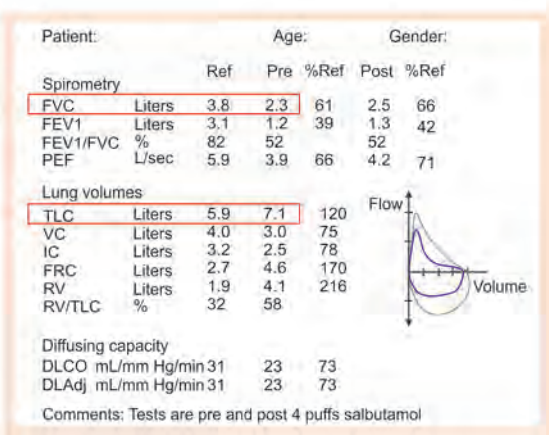
Interpretation of PFT with lung volumes and DLCO



Practical Cases

***Case 1*:** Fifty years chronic smoker with progressive chronic cough and dyspnea for 6 months. **Interpret the PFT.**





Patient:			Age:		Gender:	
		Ref	Pre	%Ref	Post	%Ref
Spirometry						
FVC	Liters	3.8	2.3	61	2.5	66
FEV1	Liters	3.1	1.2	39	1.3	42
FEV1/FVC	%	82	52		52	
PEF	L/sec	5.9	3.9	66	4.2	71
Lung volumes						
TLC	Liters	5.9	7.1	120		
VC	Liters	4.0	3.0	75		
IC	Liters	3.2	2.5	78		
FRC	Liters	2.7	4.6	170		
RV	Liters	1.9	4.1	216		
RV/TLC	%	32	58			
Diffusing capacity						
DLCO	mL/mm Hg/min	31	23	73		
DLAdj	mL/mm Hg/min	31	23	73		

Flow
Volume

Comments: Tests are pre and post 4 puffs salbutamol

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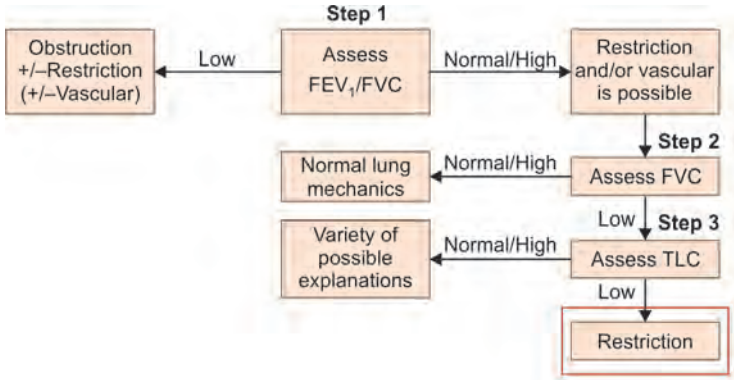
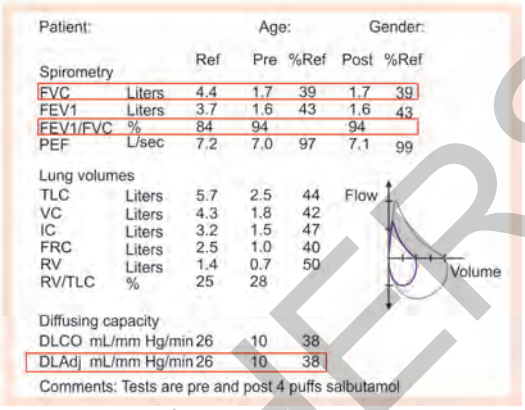
Case 2 : Animal trainer with progressive dyspnea with low grade fever. **Interpret the PFT.**





Patient: Age: Gender:

		Ref	Pre	%Ref	Post	%Ref
Spirometry						
FVC	Liters	4.4	1.7	39	1.7	39
FEV1	Liters	3.7	1.6	43	1.6	43
FEV1/FVC	%	84	94		94	
PEF	L/sec	7.2	7.0	97	7.1	99
Lung volumes						
TLC	Liters	5.7	2.5	44		
VC	Liters	4.3	1.8	42		
IC	Liters	3.2	1.5	47		
FRC	Liters	2.5	1.0	40		
RV	Liters	1.4	0.7	50		
RV/TLC	%	25	28			
Diffusing capacity						
DLCO	mL/mm Hg/min	26	10	38		
DLAdj	mL/mm Hg/min	26	10	38		

Flow Volume

Comments: Tests are pre and post 4 puffs salbutamol

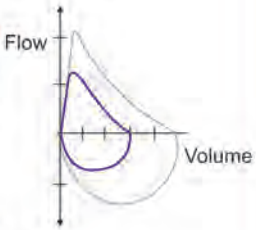
Answer: Restrictive lung disease further intrapulmonary versus extrapulmonary restriction.

- DLCO low (indicative of impairment of gas exchange) thus intrapulmonary pathology like interstitial lung disease like hypersensitivity pneumonitis is common in animal trainer.

Case 3: 15 years old boy with history of spinal cord injury, presents with dyspnea for 2 months. **Interpret the PFT**.

Patient: Age: Gender:

		Ref	Pre	%Ref	Post	%Ref
Spirometry						
FVC	Liters	4.9	3.5	71	3.5	71
FEV1	Liters	4.2	3.0	72	2.9	69
FEV1/FVC	%	85	86		83	
PEF	L/sec	6.2	6.3	102	6.3	102
Lung volumes						
TLC	Liters	6.6	4.4	67		
VC	Liters	4.9	3.0	61		
IC	Liters	3.4	2.1	62		
FRC	Liters	3.2	2.3	72		
RV	Liters	1.7	1.4	82		
RV/TLC	%	26	32			
Diffusing capacity						
DLCO	mL/mm Hg/min	38	37	97		
DLAdj	mL/mm Hg/min	38	37	97		



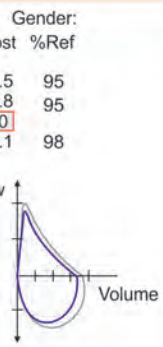
Comments: Tests are pre and post 4 puffs salbutamol

Answer: Restrictive lung disease with normal DLCO thus extrapulmonary pathology of restriction like chest wall defects, obesity and spinal cord or phrenic nerve injury or neuromuscular disease.

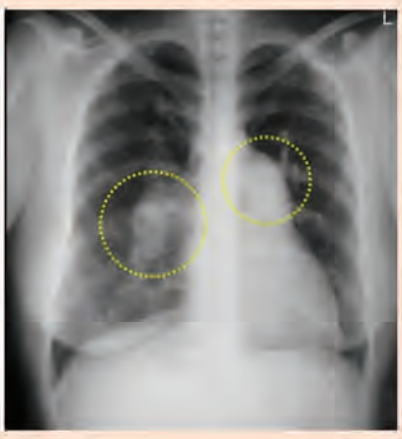
Case 4: 41 years old woman with no significant PMH, presents with dyspnea for 2 months. With chest X-ray also shown in figure.

Patient: Age: Gender:

		Ref	Pre	%Ref	Post	%Ref
Spirometry						
FVC	Liters	3.7	3.5	95	3.5	95
FEV1	Liters	2.9	2.8	95	2.8	95
FEV1/FVC	%	78	80		80	
PEF	L/sec	5.2	5.2	98	5.1	98
Lung volumes						
TLC	Liters	5.5	5.4	98		
VC	Liters	4.2	4.0	95		
IC	Liters	3.1	3.2	103		
FRC	Liters	2.4	2.2	92		
RV	Liters	1.3	1.4	108		
RV/TLC	%	24	26			
Diffusing capacity						
DLCO	mL/mm Hg/min	24	9	38		
DLAdj	mL/mm Hg/min	24	9	38		



Comments: Tests are pre and post 4 puffs salbutamol



Answer: All values and flow volume loop are normal thus normal lung mechanics but low DLCO suggest of pulmonary vascular disease like pulmonary hypertension.

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Multiple Choice Questions

PULMONARY FUNCTION TEST

1. Which of the following is measured by body plethysmography and gas dilution techniques? *(PGI)*

a. TV
b. VC
c. FRC
d. RV
e. TLC

2. Gold criteria for very severe COPD is best represented by: *(NEET 2018)*

a. FEV1/FVC < 0.7 and FEV1 < 30% predicted
b. FEV1/FVC < 0.7 and FEV1 ≥ 30% but <50% predicted
c. FEV1/FVC < 0.7 and FEV1 ≥ 50% but <80% predicted
d. FEV1/FVC < 0.7 and FEV1 ≥ 80% predicted

3. All the following are true about Obstructive lung disease(OLD) *except*: *(NEET 2019)*

a. FEV1/FVC less than 0.7
b. Decreased MEFR
c. Increased RV
d. Increased diffusion capacity

4. Best method for objective assessment of acute asthmatic attack?

a. Peak flow meter
b. Hypercapnia
c. Body plethysmography
d. Clinical assessment

5. False regarding restrictive lung disease: *(JIPMER May 2018/NOV 2017)*

a. FEV1/FVC decreased
b. FVC decreased
c. TLC decreased
d. FEV1 increased

6. A patient presents with decreased vital capacity and total lung volume. What is the most probable diagnosis? *(NEET Pattern)*

a. Bronchiectasis
b. Sarcoidosis
c. Cystic fibrosis
d. Asthma

7. All are decreased in infiltrative lung disease, *except*: *(NEET Pattern)*

a. Vital capacity
b. Alveolar arterial difference in PaO2
c. Total lung capacity
d. Lung compliance

8. Carbon monoxide diffusion capacity decreases in all, *except*: *(NEET Pattern)*

a. Emphysema
b. Primary pulmonary hypertension
c. Alveolar haemorrhage
d. Infiltrative lung disease

ASTHMA

9. All of the following are true about intrinsic Asthma, *except*: *(PGI 2004)*

a. Increasing incidence
b. Allergic asthma is more common in young patients
c. Idiosyncratic asthma is more common older patients
d. IgE is increased in idiosyncratic asthma
e. IgE is increased in extrinsic asthma

10. Aspirin sensitive asthma is associated with which of the following?

a. Obesity
b. Urticaria
c. Nasal polyp
d. Extrinsic asthma

11. Bronchial asthma is characterized by all of the following, *except*: *(PGI)*

a. Inflammatory disease of airway
b. Allergic disease of airway
c. Hyporesponsiveness of airway
d. Hyperresponsiveness of airway
e. Treatment is mostly inhaled steroid

12. All of the following are true about Asthma, *except*:

a. Charcot-Leydin crystals may be seen in sputum
b. Reversible airflow obstruction is a characteristic feature
c. Large airways are involved
d. Small airways are not involved
e. Intermittent Asthma responds better to bronchodilator therapy than persistent Asthma

13. Feature of Acute severe asthma include all of the following, *except*: *(PGI)*

a. Tachycardia> 120/min
b. Pulsus paradoxus
c. Respiratory acidosis
d. PEFR<50%
e. None (All are features of acute severe asthma)

14. In a Patient with clinical signs of Asthma which of the following tests will confirm the diagnosis *(NEET Pattern)*

a. Increase in FEV1/FVC
b. > 200 ml increase in FEV1 after Methacholine
c. Diurnal variation in PEF > 20 Percent
d. Reduction of FEV1 > 20 % after bronchodilators

15. A known asthmatic, presented to the emergency with severe exacerbation not relieved by pMDI Salbutamol. The patient was given corticosteroids and aminophylline. What is the rationale of giving corticosteroids? *(AIIMS Nov 2017)*

a. Corticosteroid facilitates the action of β agonists
b. Corticosteroids sensitizes adenosine receptors to xanthines
c. Direct bronchodilation action of corticosteroids
d. Increase mucociliary clearance

CHRONIC OBSTRUCTIVE PULMONARY DISEASE

16. Which of the following can occur in COPD: *(PGI May 2018)*

a. Hypoxemia
b. Hypercarbia
c. Decreased gas exchange in terminal bronchioles
d. Acidosis

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17. Static compliance is decreased in all of the following *except*: *(PGI)*
a. ARDS
b. Pulmonary edema
c. Interstial fibrosis
d. Fibrosing alveolitis
e. Emphysema

18. In ICU setting patients suffering from which respiratory pathology are at risk of CO_2 narcosis? *(NEET 2017)*
a. Pneumonia
b. Asthma
c. Emphysema
d. Bronchiectasis

19. α1 Antitrypsin deficiency is associated with: *(NEET Pattern)*
a. Centriacinar emphysema
b. Panaciner-emphysema
c. Irregular emphysema
d. Paraseptal-emphysema

20. All of the following statements about Emphysema are true, *except*: *(NEET Pattern)*
a. Breathlessness is the charachteristic presenting symptom
b. Diffusion rate of carbon monoxide is reduced
c. Restrictive pattern on pulmonary function test is seen
d. Long term bronchadilater therapy does not improve lung function

21. In an emphysematous patient with bullous lesions, which is the best investigation to measure lung volume: *(NEET Pattern)*
a. Body Plethysmography
b. Gas dilution
c. Transdiaphragmatic pressure
d. DLCO

22. In a patient with COPD, Which of the following is most closely associated with decreased mortality: *(NEET Pattern)*
a. Supplemental oxygen
b. Inhaled glucocorticoids
c. Beta agonists
d. Bronchodilators

23. Lung volume reduction surgery is recommended for patients with all of the following, *except*: *(NEET Pattern)*
a. Diffuse emphysema
b. Upper lobe emphysema
c. Low baseline exercise capacity
d. All of the above

24. First line therapy for management of COPD is: *(NEET Pattern)*
a. Smoking Cessation
b. Oxygen
c. Bronchodilators
d. Corticosteroids

25. Smokers are prone to which lung infect: *(NEET 2017)*
a. Mycobacterium tuberculosis
b. Pneumonia
c. Influenza
d. All the above

26. Which of the following drugs, is used for Smoking Cessation? *(NEET Pattern)*
a. Naltrexone
b. Bupropion
c. Buprenorphine
d. Methadone

INTERSTITIAL LUNG DISEASE

27. All of the following are true about interstitial lung disease, *except*: *(NEET Pattern)*
a. Decreased FVC
b. Decreased FEV1
c. Decreased FEVl/FVC
d. Decreased diffusion capacity

28. A 40-year-old female presents with progressive dyspnea for one year. Physical examination reveals bibasilar end-inspiratory crepitations. All of the following statements about her condition are true, *except*: *(NEET Pattern)*
a. May be associated with connective tissue disease
b. Residual volume is increased
c. Total Lung capacity is decreased
d. HRCT is a useful diagnostic test

29. Shrinking lung syndrome is seen most commonly in: *(NEET 2017)*
a. SLE
b. Scleroderma
c. Rheumatoid arthritis
d. Ankylosing spondylitis

30. Lower lobe fibrosis is seen in: *(NEET Pattern)*
a. Silicosis
b. Sarcoidosis
c. Cystic fibrosis
d. Asbestosis

31. Which of the following diseases doesn't cause lung cavitation? *(JIPMER May 2018)*
a. Sarcoidosis
b. Silicosis
c. Histoplasmosis
d. Wegener's

PLEURAL DISEASES

32. Which one of the following conditions may lead to transudative pleural effusion: *(PGI)*
a. Cirrhosis
b. Nephrotic syndrome
c. Congestive heart failure
d. Urinothorax
e. Tuberculosis

33. All of the following are Light's criteria for exudative pleural effusion: *(NEET Pattern)*
a. Pleural fluid protein to serum protein > 0.5
b. Pleural fluid LDH to serum LDH > 0.6
c. Pleural fluid LDH is two third times the normal upper limit for serum
d. Pleural fluid ADA to Serum ADA <16

34. Left -sided pleural effusion seen in: *(PGI)*
a. Pancreatitis
b. Rheumatoid arthritis
c. Hypoproteinemia
d. Heart failure
e. Esophageal rupture

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Answer with Explanations

PULMONARY FUNCTION TEST

1. Ans. c. FRC *Ref: Fishman's pulmonary diseases and disorders 5th Ed page 505*

All lung volumes and capacities that *do not include the RV can be measured by spirometry*. RV cannot be measured by spirometry since RV is volume of air remaining in the lungs at the end of the maximal expiration. RV indirectly depends (a) FRC (b) ERV (c) difference between FRC and ERV thus FRC and therefore RV can also be determined by:

- Helium dilution
- Nitrogen washout method
- Body plethysmography –gold standard for measurement for lung volumes

2. Ans. a. FEV1/FVC < 0.7 and FEV1 < 30% predicted
Ref: Fishman's pulmonary diseases and disorders 5th Ed page 512

Gold criteria classification is based on the FEV_1 and the FEV_1/FVC ratio reflects the rate of emptying of the lung and used in to define the presence of obstructive ventilatory defect.

3. Ans. d. Decreased diffusing capacity
Ref: Fishman's pulmonary diseases and disorders 5th Ed page 512

PFT of OLD shows airflow obstruction with a:

- Reduction in FEV1 and FEV1/FVC less than 0.7
- Increased RV
- Decreased maximum expiratory flow rate (MEFR) or peak expiratory ow rate (PEFR)
- DLCO
  - Measurement of DLCO helps to distinguish between emphysema and other causes of chronic airway obstruction.
  - Decrease in DLCO—Emphysema and
  - Unchanged DLCO—Obstructive chronic bronchitis
  - Increases DLCO—Asthma.

4. Ans. a. Peak flow meter
Ref: Fishman's pulmonary diseases and disorders 5th Ed page 703

Measurement of maximal expiratory airflow with a peak flow meter (or spirometer) is the best method for objective assessment of the severity of an asthma attack in patients who are able to perform testing. Patients with signs of impending respiratory failure should not be asked to perform this testing. Normally a peak flow rate below 200 L/min indicates severe obstruction for most adults. An exacerbation is considered severe when the peak expiratory flow (PEF) remains ≤50 percent predicted.

5. Ans. a. FEV 1/FVC decreased
Ref: Fishman's pulmonary diseases and disorders 5th Ed page 512

Spirometry can be useful in detecting restriction(poor compliance) of lung volumes, meaning a reduced FEV1 and/or FVC with a normal or increased FEV1/FVC ratio. Evaluation of lung volumes and diffusing capacity are helpful in confirming the presence of restriction and assessing severity of impairment.

6. Ans. b. Sarcoidosis *Ref: Fishman's pulmonary diseases and disorders 5th Ed page 834*

PFTs characteristically reveal a restrictive pattern (reduced vital capacity and total lung capacity) associated with a reduction in the DLCO, although it is not unusual for lung function to be normal. However sarcoidosis may have restrictive plus obstructive plus vascular pathologies together.

7. Ans. b. Alveolar arterial difference in PaO_2
Ref: Harrison 20th Ed page 1948

The **Alveolar–arterial gradient** (A–a gradient) is useful in determining the source of hypoxemia, either intrapulmonary (within the lungs) or extrapulmonary (elsewhere in the body).

An abnormally increased A–a gradient suggests a defect in diffusion, V/Q (ventilation/perfusion ratio) mismatch, or right-to-left shunt. ILD may have diffusion defect (Intrinsic lung diseases) or V/Q ratio mismatch(neuromuscular or chest wall disorder).

8. Ans. c. Alveolar hemorrhage *Ref: Harrison 20th Ed page 1948*

DLCO is a measure of the overall function of the alveolar-capillary membrane.

Role of DLCO in OLDs

- Decreased—emphysema, bronchiolitis obliterans, and lymphangioleiomyomatosis
- Normal or high—asthma.

Role of DLCO in RLDs

- Low DLCO combined with reduced lung volumes—interstitial lung disease.
- Normal DLCO associated with low lung volumes—extrapulmonary cause of the restriction like pleural effusion or thickening, neuromuscular weakness, or kyphoscoliosis

Isolated decrease in the DLCO—pulmonary vascular diseases (e.g. pulmonary hypertension, thromboembolic disease), early interstitial lung disease, anemia, hepatopulmonary syndrome, and carboxyhemoglobinemia.

Increased DLCO

- Obesity
- Asthma
- High altitude
- Polycythemia
- Pulmonary hemorrhage
- Left-to-right intracardiac shunting
- Mild left heart failure (due to increased pulmonary capillary blood volume).

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ASTHMA

9. Ans. d. IgE is increased in extrinsic asthma

Ref: Harrison 20th Ed page 1958

Idiosyncratic asthma(intrinsic asthma) is usually *not* associated with history of atopy and have normal IgE levels. They may presents as adult-onset asthma, commonly have concomitant nasal polyps, and may be aspirin-sensitive. They are more severe, persistent asthma variant.

Extrinsic asthma or allergic asthma is associated with family history of *atopy and increases IgE levels*. Atopy is the major risk factor for asthma, and non-atopic individuals have a very low risk of developing asthma. Patients with asthma commonly suffer from other atopic diseases like allergic rhinitis, found in >80% of asthmatic patients, and atopic dermatitis (eczema). This observation suggests environmental or genetic factor(s) predisposition to the development of asthma in atopic individuals.

10. Ans. c. Nasal polyp

Ref: Harrison 20th Ed page 1959

Aspirin sensitive asthma is manifests as a tetrad of asthma, nasal polyps, chronic hypertrophic eosinophilic sinusitis and aspirin intolerance.

11. Ans. c. Hyporesponsiveness of airway

Ref: Harrison 20th Ed page 1960

Specific pattern of airway inflammation in asthma is associated with airway hyperresponsiveness (AHR), the physiologic abnormality of asthma, which is correlated with variable airflow obstruction.

12. Ans. d. Small airways are not involved

Ref: Harrison 20th Ed page 1960

Airway inflammation in respiratory mucosa occurs from the trachea to terminal bronchioles*(both small and large airways),* but with a predominance in the bronchi (cartilaginous airways). The airway inflammation in asthma is associated with airway hyperresponsiveness (AHR), and correlated with variable airflow obstruction.

Sputum microscopy may reveal Charcot-Leyden crystals (derived from granules and specific for asthma), Curschmann's spirals (twisted casts of airways) and Creola bodies (clumps of cells or metaplastic cells).

13. Ans. e. None: All are features of acute severe asthma

Ref: Harrison 20th Ed page 1960

Clinical features of acute severe asthma

- Increasing chest tightness and silent chest (indicates grave prognosis)
- Wheezing, and dyspnea not relieved by their usual reliever inhaler.
- Cyanosis in severe exacerbations
- Examination usually shows increased ventilation, hyperinflation, and tachycardia.
- Pulsus paradoxus may be present
- PFT shows marked fall in spirometric values and PEF.
- Arterial blood gases on air show hypoxemia, and PCO_2 low due to hyperventilation.
- Respiratory acidosis—rising PCO_2 is an indication of impending respiratory failure.

Management

- High concentration of oxygen to achieve oxygen saturation of >90%.
- High doses of SABA given either by nebulizer or via a MDI with a spacer.
- A nebulized anticholinergic may be added to the therapy.
- Refractory to inhaled therapies,
  - Aminophylline slow infusion
  - Magnesium sulfate given intravenously or by nebulizer
  - Prophylactic intubation may be indicated for impending respiratory failure.

14. Ans. c. Diurnal variation in PEF > 20 Percent

Ref: Harrison 20th Ed page 1960

The pulmonary function tests most helpful in diagnosing asthma are spirometry pre and post bronchodilator, bronchoprovocation testing (usually with methacholine), and peak expiratory flow (PEF) monitoring.

- Spirometry confirms airflow limitation with a reduced FEV_1, FEV_1/FVC ratio, and PEF.
- Reversibility is demonstrated by a >12% and 200-mL increase in FEV_1 15 min after an inhaled short-acting β_2-agonist (SABA; such as inhaled albuterol 400 μg).
- Measurements of PEF twice daily may confirm the diurnal variations in airflow obstruction and considered as *confirmatory for diagnosis.*
- Expiratory airflow obstruction with a reversible reduction in FEV1,
- Heightened sensitivity to bronchoprovocative agents such as methacholine or exercise, and variability over time of >20% in PEF are findings consistent with asthma.

15. Ans. a. Corticosteroid facilitates the action of β agonists *Ref: Harrison 20th Ed page 1965*

The primary action of B_2-agonists is to relax airway smooth-muscle cells of all airways and in contrast to corticosteroids, there are no effects on inflammatory cells in the airways and there is no reduction in AHR. Thus Inhaled corticosteroids (ICS) are the effectively acts as anti-inflammatory agents and reduce inflammatory cell numbers and their activation in the airways.

Long-acting β_2-agonists (LABA) include salmeterol and formoterol, both of which have a duration of action over 12 h and are given twice daily by inhalation; and indacaterol, olodaterol, and vilanterol, which are given once daily.

LABA have replaced the regular use of SABA, but LABA should not be given in the absence of ICS therapy as they do not control the underlying inflammation. The use of fixed combination inhalers that contain a corticosteroid and a LABA, which have proved to be highly effective in the control of asthma and prevention of exacerbations.

CHRONIC OBSTRUCTIVE PULMONARY DISEASE

16. Ans. a.; b.; c. and d. *Ref: Harrison 20th Ed page 1992*

Extensive alveolar and bronchiolar epithelial cells and pulmonary capillary damage leading to emphysema leading to decreased surface area of alveoli for gaseous exchange

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Review of MEDICINE

Medicine has evolved in last 50 years from classical physical diagnosis to use of modern technology for diagnosis. In last decade shift towards 'evidence-based medicine' has changed line of management of many diseases, thus knowledge of both classical features and essential latest guidelines of a disease is must for getting a good rank in PGMEE exams. This book is an attempt to cover both 'classical medicine' and 'evidence-based medicine' for a sound knowledge of subject and solving newer questions in exams.

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- Detailed and extensive analysis of physical signs and symptoms of diseases
- Complete differential diagnosis for symptoms and disease
- The book also features new case-based questions which help in developing approach to a disease or disorder.
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