APPROACH TO THE RESPIRATORY PATIENT

Differential Diagnosis of Dyspnea

Respiratory
- **Airway disease**
  - Asthma*
  - COPD exacerbation*
  - upper airway obstruction (anaphylaxis, foreign body, etc)*
  - mucus plugging*
- **Parenchymal lung disease**
  - ARDS*
  - Pneumonia*
  - interstitial lung disease
- **Pulmonary vascular disease**
  - PE*
  - pulmonary HTN
  - pulmonary vasculitis
- **Pleural disease**
  - pneumothorax*
  - pleural effusion
- **Neuromuscular and chest wall disorders**
  - polymyositis, myasthenia gravis, Guillain-Barré syndrome
  - kyphoscoliosis
  - C-spine injury*

Cardiovascular
- **Elevated pulmonary venous pressure**
  - LVF with pulmonary edema*
  - mitral stenosis
- **Decreased cardiac output**
- **Severe anemia**

Anxiety/psychosomatic*

* denotes causes that should be considered for acute dyspnea

Differential Diagnosis of Cough

Airway irritants
- inhaled smoke, dusts, fumes
- aspiration
  - gastric contents
  - oral secretions
  - foreign body
- postnasal drip

Airway disease
- URTI including postnasal drip and sinusitis
- acute or chronic bronchitis
- bronchiectasis
- neoplasm
- external compression by node or mass lesion
- asthma
- COPD

Parenchymal disease
- pneumonia
- lung abscess
- interstitial lung disease

CHF

Drug-induced

Differential Diagnosis of Hemoptysis

Airway disease
- acute or chronic bronchitis
- bronchiectasis
- bronchogenic CA
- bronchial carcinoid tumour

Parenchymal disease
- TB
- lung abscess
- pneumonia
- miscellaneous
  - Goodpasture's syndrome
  - idiopathic pulmonary hemosiderosis

Vascular disease
- PE
- elevated pulmonary venous pressure
  - LVF
  - mitral stenosis
- vascular malformation

Miscellaneous
- impaired coagulation
- pulmonary endometriosis

Differential Diagnosis of Chest Pain

Nonpleuritic	Pleuritic
Pulmonary neoplastic pneumonia PE **Cardiac** MI ischemia myocarditis/pericarditis **Esophageal** spasm esophagitis ulceration achalasia neoplasm **Mediastinal** lymphoma thymoma **Subdiaphragmatic** PUD gastritis biliary colic pancreatic **Vascular** dissecting aortic aneurysm **MSK** costochondritis skin breast ribs	**Pulmonary** pneumothorax hemothorax PE pneumonia bronchiectasis neoplasm TB empyema **Cardiac** pericarditis Dressler's syndrome **GI** pancreatitis **MSK** costochondritis fractured rib myositis herpes zoster

dyspnea/SOB

- **orthopnea:**
  SOB when recumbent in CHF, asthma, COPD, or GERD

- **trepopnea:**
  SOB when right or LLD position in CHF, cardiac mass

- **platypnea:**
  SOB when upright in post-pneumonectomy, neurologic disease, hepatopulmonary syndrome (ie. liver failure), hypovolemia

- **episodic:** in bronchospasm, transient pulmonary edema

Degree of Dyspnea

A frequently used scale to assess the degree of dyspnea due to lung diseases is that of the British Medical Research Council:

- Grade 0: dyspnea only during strenuous exercise
- Grade I: dyspnea only caused by brisk walking
- Grade II: brisk walking not possible due to shortness of breath
- Grade III: stopping due to dyspnea after 100 m walking
- Grade IV: does not leave the house due to shortness of breath.

Table 2.5. Modified MRC dyspnea scale[3]	
PLEASE TICK IN THE BOX THAT APPLIES TO YOU (ONE BOX ONLY) (Grades 0-4)	
mMRC Grade 0. I only get breathless with strenuous exercise.	❑
mMRC Grade 1. I get short of breath when hurrying on the level or walking up a slight hill.	❑
mMRC Grade 2. I walk slower than people of the same age on the level because of breathlessness, or I have to stop for breath when walking on my own pace on the level.	❑
mMRC Grade 3. I stop for breath after walking about 100 meters or after a few minutes on the level.	❑
mMRC Grade 4. I am too breathless to leave the house or I am breathless when dressing or undressing.	❑

MRC dyspnoea scale

1- Not troubled by breathlessness except on strenuous exercise

2 - Short of breath when hurrying or walking up a slight hill

3 - Walks slower than contemporaries on level ground because of breathlessness or has to stop for breath when walking at own pace

4 - Stops for breath after walking about 100 m or after a few minutes on level ground

5 - Too breathless to leave the house, or breathless when dressing or undressing.

The New York heart Association functional and therapeutic classification applied to dyspnea

- **Grade 1 :** No breathlessness
- **Grade 2 :**Breathlessness on severe exertion
- **Grade 3 :**Breathlessness on mild exertion
- **Grade 4 :** Breathlessness at rest

cough

- **productive:** bronchiectasis, bronchitis, abscess, bacterial pneumonia, TB
- **nonproductive:** viral infections, interstitial lung disease, anxiety, allergy
- **wheezy:** suggests bronchospasm, asthma, allergy
- **nocturnal:** asthma, CHF, postnasal drip, GERD, or aspiration
- **barking:** epiglottal disease (croup) in children
- **positional:** abscess, tumour

sputum

- **mucoid:** asthma, tumour, TB, emphysema
- **purulent green:** bacterial pneumonia, bronchiectasis, chronic bronchitis
- **purulent rusty:** pneumococcal pneumonia
- **frothy pink:** pulmonary edema
- **red currant jelly:** *Klebsiella pneumoniae*
- **foul odour:** abscess (anaerobic pathogens)

Table 17.1 Causes for chronic cough

	Children	Adults
Frequent	- bronchial hyperresponsiveness after viral infections - bronchial asthma - gastroesophageal reflux-pulmonary aspiration - "postnasal drip"	- chronic bronchitis (smokers) - "postnasal drip" - bronchial asthma - gastroesophageal reflux - congestive left-sided heart failure
Rare	- aspiration of a foreign body - bronchiolitis after viral infections - cystic fibrosis - primary cilicary dyskinesia	- ACE inhibitors - recurrent aspiration bronchial cancer - tuberculosis - bronchiectases - pneumonia - interstitial lung diseases - psychogenic

hemoptysis

hemoptysis **vs.** **hematemesis**

- cough
- sputum present
- stable bubbles
- alkaline pH
- alveolar macrophages

- nausea/vomiting
- no sputum
- no stable bubbles
- acid pH
- no alveolar macrophages

chest pain

- due to parietal pleura, chest wall, diaphragm, or mediastinal involvement

- pleuritic: sharp knife-like pain worse with deep inspiration or coughing

PHYSICAL EXAM AND DIFFERENTIAL DIAGNOSIS OF SIGNS IN RESPIRATORY DISEASE

Inspection

- face
  - nasal flaring, pursed lip breathing
  - pallor: anemia
  - central cyanosis: inadequate SaO2
- posture
  - tripod sit
- accessory muscle use
- chest shape
  - horizontal ribs: emphysema
  - barrel chest (increased AP diameter): advanced COPD
  - kyphosis/scoliosis: restricts chest expansion
  - pectus excavatum (sternal depression): restricts chest expansion
  - flail chest: multiple rib fractures

Inspection

- **hands**
  - **clubbing** (base angle of nail obliterated, increased sponginess of nail bed)
  - **peripheral cyanosis:** excessive O2 extraction
- **respiratory rate and patterns**
  - **apnea** (complete cessation of airflow lasting at least 10 seconds)
  - **hypopnea** (a decrease in airflow by at least 50% lasting at least 10 seconds)
- **Central cyanosis is not detectable until the SaO2 is < 85%. It is also marked in polycythemia and less readily detectable in anemia.**

Differential Diagnosis of Clubbing (Hypertrophic Osteoarthropathy)

Pulmonary
- CF
- Pulmonary fibrosis
- Chronic pus in the lung (bronchiectasis, abscess, infections, etc.)
- Lung CA (primary or mets)
- Mesothelioma
- A-V fistula

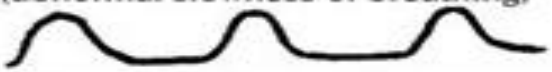
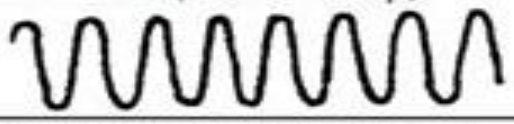
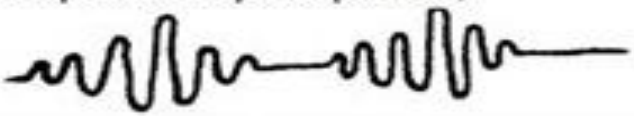
Gastrointestinal
- IBD
- Chronic infections
- Laxative abuse
- Polyposis
- Malignant tumours
- Cirrhosis
- HCC

Cardiac
- Cyanotic congenital heart disease
- Infective endocarditis

Mediastinal
- Esophageal CA
- Thymoma
- Achalasia

Other
- Graves' disease
- Thalassemia
- Other malignancies
- Primary hypertrophic osteoarthropathy

6. Respiration Patterns in Normal and Disease States

Respiration Pattern	Causes
normal inspiration and expiration 	
obstructive (prolonged expiration) 	asthma, COPD
bradypnea (abnormal slowness of breathing) 	drug-induced respiratory depression diabetic coma increased ICP
Kussmaul's (fast and deep) 	metabolic acidosis exercise anxiety
Biot's/ataxic (irregular with long apneic periods) 	drug-induced respiratory depression increased ICP brain damage, especially medullary
Cheyne-Stokes (changing rates and depths with apneic periods) 	drug-induced respiratory depression brain damage (especially cerebral) CHF uremia
apneustic (prolonged inspiratory pause) 	pontine lesion

Palpation

- **chest wall tenderness**: MSK disease
- asymmetrical chest excursion
  - pleural effusion, lobar pneumonia, pulmonary fibrosis, bronchial obstruction, pleuritic pain , pneumothorax
- **tactile fremitus**
  - increased: consolidation (pneumonia)
  - decreased

unilateral	vs.	bilateral
• pneumothorax		• COPD
• pleural effusion		• pleural effusion
• bronchial obstruction		• chest wall thickening (fat, muscle)
• pleural thickening		

Palpation

- **trachea**
  - **deviated**
    - **contralateral:** pneumothorax (especially tension), pleural effusion
    - **ipsilateral:** atelectasis
  - **decreased mobility:** mediastinal fixation (neoplasm, TB)

Percussion

- **dull:** pneumonia, pleural effusion, atelectasis, hemothorax, empyema, tumour

- **hyperresonant:** emphysema, pneumothorax, asthma

- **diaphragmatic excursion (normal diaphragmatic movement 4-5 cm from inspiration to expiration)**

Breath Sounds

Vesicular	Bronchial
• soft • low-pitched • inspiratory >> expiratory phase • normal over most of peripheral lung	• loud • high-pitched • expiratory > inspiratory phase • normal over manubrium but represents consolidation elsewhere
Decreased air entry	**Crackles (Rales/Crepitations)**

• asthma
• emphysema
• pneumothorax
• pleural effusion
• atelectasis
• ARDS
	• coarse crackles:
	  • bronchitis
	  • respiratory infections, pneumonia
	  • pulmonary edema
	  • interstitial fibrosis
	  • CHF
	  • excess airway secretions
	• fine crackles: interstitial fibrosis

Wheeze (Rhonchi)	**Pleural rub**
• asthma • bronchitis • pulmonary edema • CHF • foreign body • CF • aspiration • tumour, vascular ring • rapid airflow through obstructed airway	• pneumonia • pleural effusion • pulmonary infarction
	Voice sounds
	• egophony (e to a) • whispered pectoriloquy • bronchophony • all are due to consolidation

Characteristics of Breath Sounds

	Duration of Sounds	Intensity of Expiratory Sound	Pitch of Expiratory Sound	Locations Where Heard Normally
Vesicular* 	Inspiratory sounds last longer than expiratory sounds.	Soft	Relatively low	Over most of both lungs
Broncho-vesicular 	Inspiratory and expiratory sounds are about equal.	Intermediate	Intermediate	Often in the 1st and 2nd interspaces anteriorly and between the scapulae
Bronchial 	Expiratory sounds last longer than inspiratory ones.	Loud	Relatively high	Over the manubrium, (larger proximal airways)
Tracheal 	Inspiratory and expiratory sounds are about equal.	Very loud	Relatively high	Over the trachea in the neck

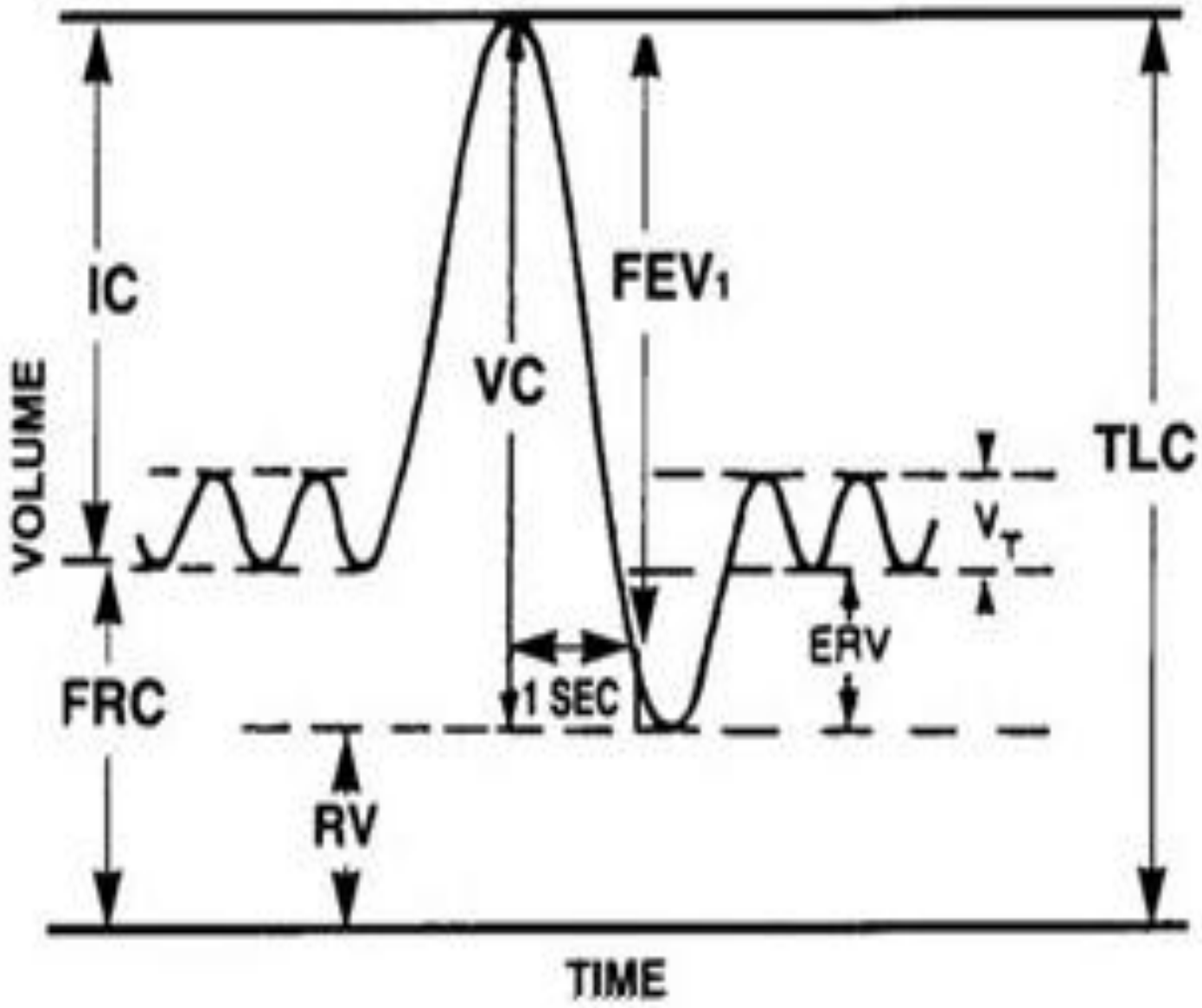
PULMONARY FUNCTION TESTS (PFTs)

- **useful in differentiating the pattern of lung disease** (obstructive vs. restrictive)

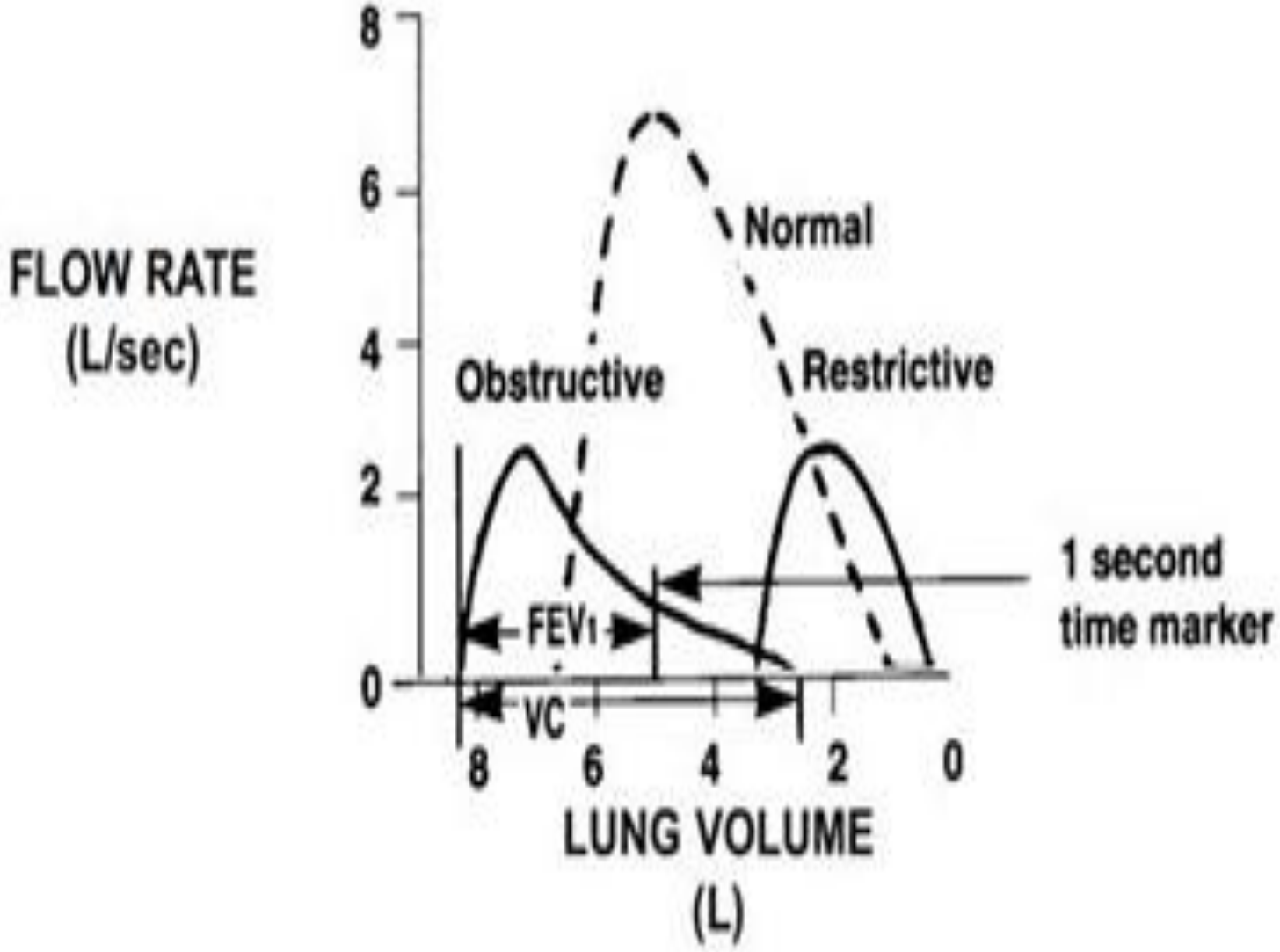
- **assesses lung volumes, flow rates, and diffusion capacity**

- **Dco decreases with:**
  1) decreased surface area
  2) decreased hemoglobin,
  3) interstitial lung disease, and
  4) pulmonary vascular disease.

. Subcompartments of Lung



Expiratory Flow Volume Curves



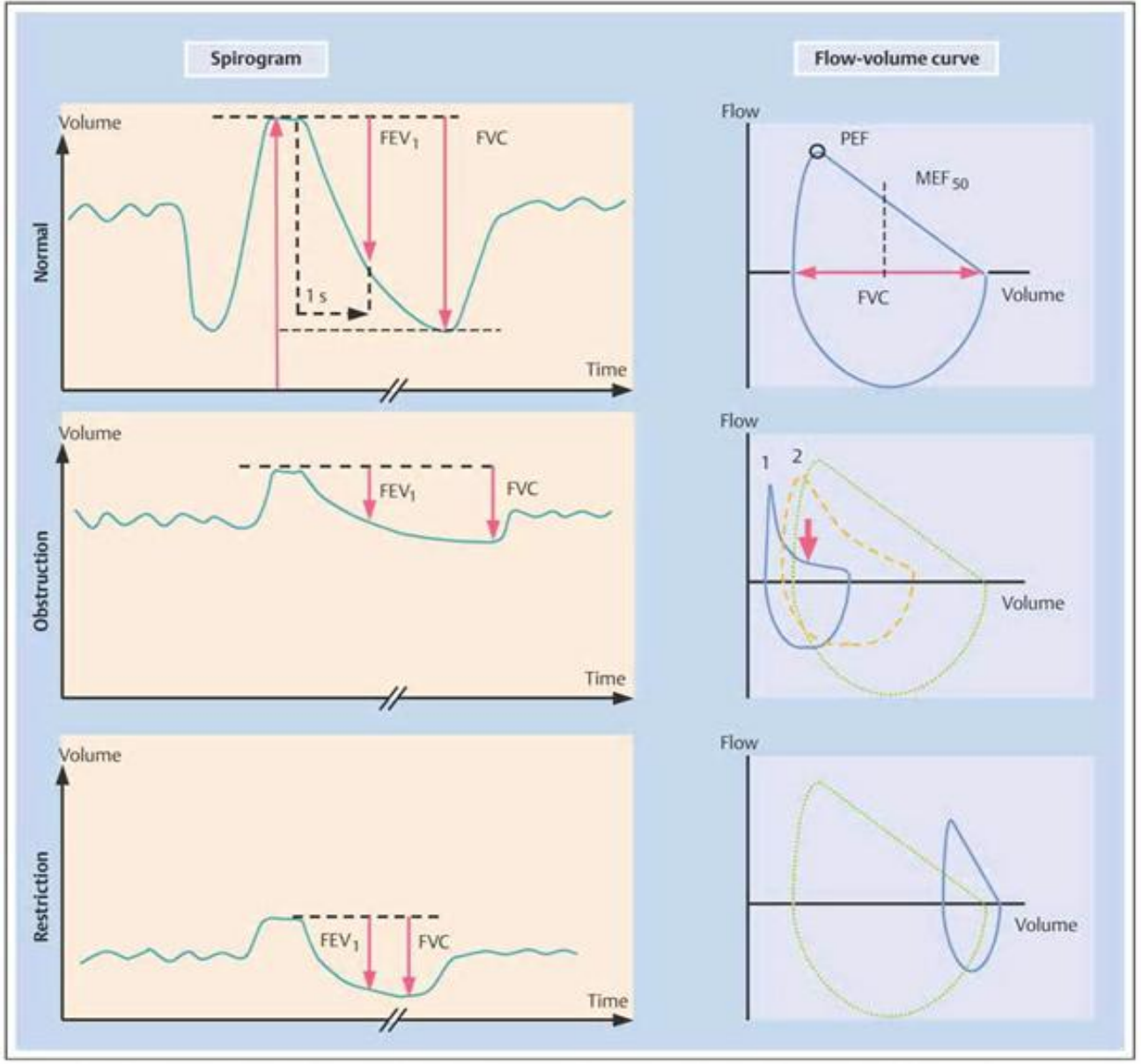


Fig. 17.1 Spirogram and flow–volume curve in a healthy person, in obstruction and restriction to airflow:
FEV_1: forced expiratory volume in the first second, i. e., the lung volume, which is expired during one second.
FVC: forced vital capacity: volume, which is measured after > 6 seconds maximal expiration.
PEF: peak expiratory flow: maximal flow (L/s).
In obstructive ventilatory defects the ratio FEV_1/FVC is < 0.7. In restriction, both volumes i. e., the FEV_1 and FVC are decreased by the same degree and the ratio $FEV_1/FVC > 0.7$. Notice the characteristic flow–volume curve 1: before, and curve 2: after, inhalation of a beta-adrenergic drug: characteristic for bronchial asthma.

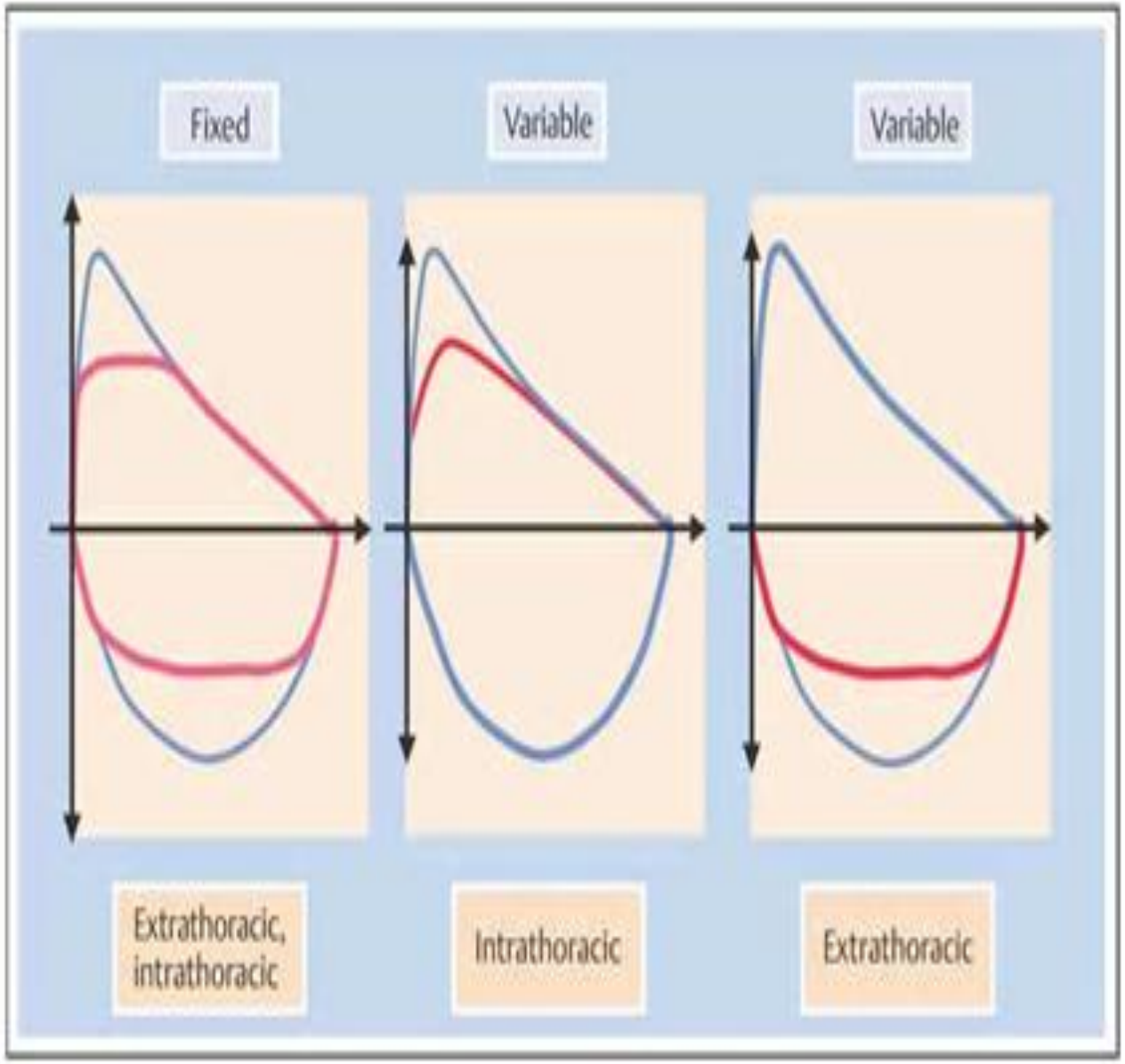


Fig. 17.2 Upper airway stenosis. The inspiratory and expiratory flows are limited both during inspiration and expiration to the same degree if the stenosis is fixed, independent of its localization. If the stenosis is variable and localized outside the thorax, only the inspiratory flow is limited. If the variable stenosis is localized inside the thorax, only the expiratory flow becomes limited.

Comparison of Lung Flow and Volume Parameters in Obstructive vs. Restrictive Lung Disease

		Obstructive	Restrictive
Flow Rates (i.e. Lung Mechanics)	FEV_1	↓	↓ or N
	FVC	↓	↓
	FEV_1/FVC	↓	↑ or N
	FEF_{25-75}=MMFR	↓	↑ or N
Lung Volumes	TLC	↑ or N	↓
	FRC	↑ or N	↓
	VC	↓ or N	↓
	RV	↑↑	↓
	RV/TLC	↑	N
Diffusing Capacity	Dco	↓ or N	↓ or N

Obstructive Lung Disease

- **characterized by**
  - obstructed airflow
  - decreased flow rates (most marked during expiration)
  - air trapping (increased RV/TLC), and hyperinflation (increased FRC, TLC)

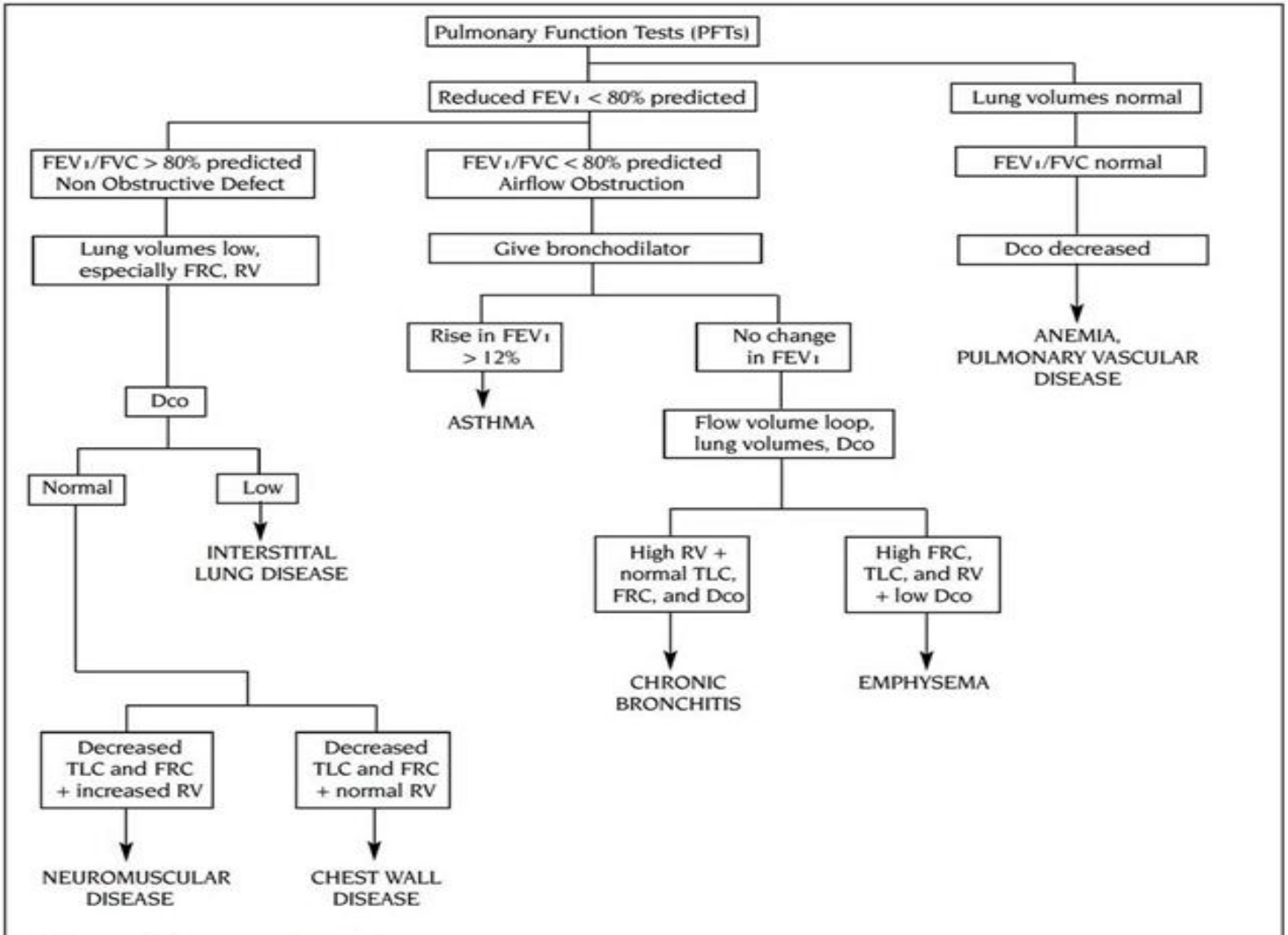
- **DDx includes asthma, COPD, CF, bronchiectasis**

Restrictive Lung Disease

- characterized by decreased lung compliance and lung volumes

- DDx includes interstitial lung, neuromuscular, or chest wall disease

Interpreting PFTs



Definitions

PaO_2	Partial pressure of oxygen in arterial blood. The PaO_2 does not reveal how much oxygen is in the blood but only the pressure exerted by dissolved O_2 molecules against the measuring electrode. Normal PaO_2 is age-dependent; when breathing air, the normal PaO_2 is 12.5 – 13.0 kPa (95 – 100 mmHg) at the age of 20 years and approximately 10.8 kPa (80 mmHg) at 65 years.
$PaCO_2$	Partial pressure of carbon dioxide in arterial blood (normal value 5.3 kPa [4.7 – 6.0] or 40 mmHg [35 – 45])
HCO_3^-	Bicarbonate concentration (normal value 24 mmol l^{-1} [22 – 26])
BE	Base excess – the quantity of strong acid or base required to restore pH to 7.4. The normal range is plus 2 mmol l^{-1} to minus 2 mmol l^{-1}. A positive value of BE indicates an excess of base (or deficit of acid), while a negative value indicates a deficit of base (or excess of acid)

ARTERIAL BLOOD GASES (ABGs)

1. **What is the pH? acidemic (pH < 7.35), alkalemic (pH > 7.45), or normal (pH 7.35-7.45)**

2. **What is the primary disturbance?**
   - **metabolic:** change in HCO3– and pH in same direction
   - **respiratory:** change in PaCO2 and pH in opposite direction

3. **Has there been appropriate compensation?**
   - **metabolic compensation occurs over 2-3 days reflecting altered renal HCO3– production/excretion**
   - **respiratory compensation through ventilation control of PaCO2 occurs immediately**
   - **inadequate compensation may indicate a second acid-base disorder**

4. **If there is metabolic acidosis, what is the anion gap ?**
   - **anion gap = [Na+]–([C1–]+[HCO3 –]); normal = 10-15 mmol/L**

Expected Compensation for Specific Acid-Base Disorders

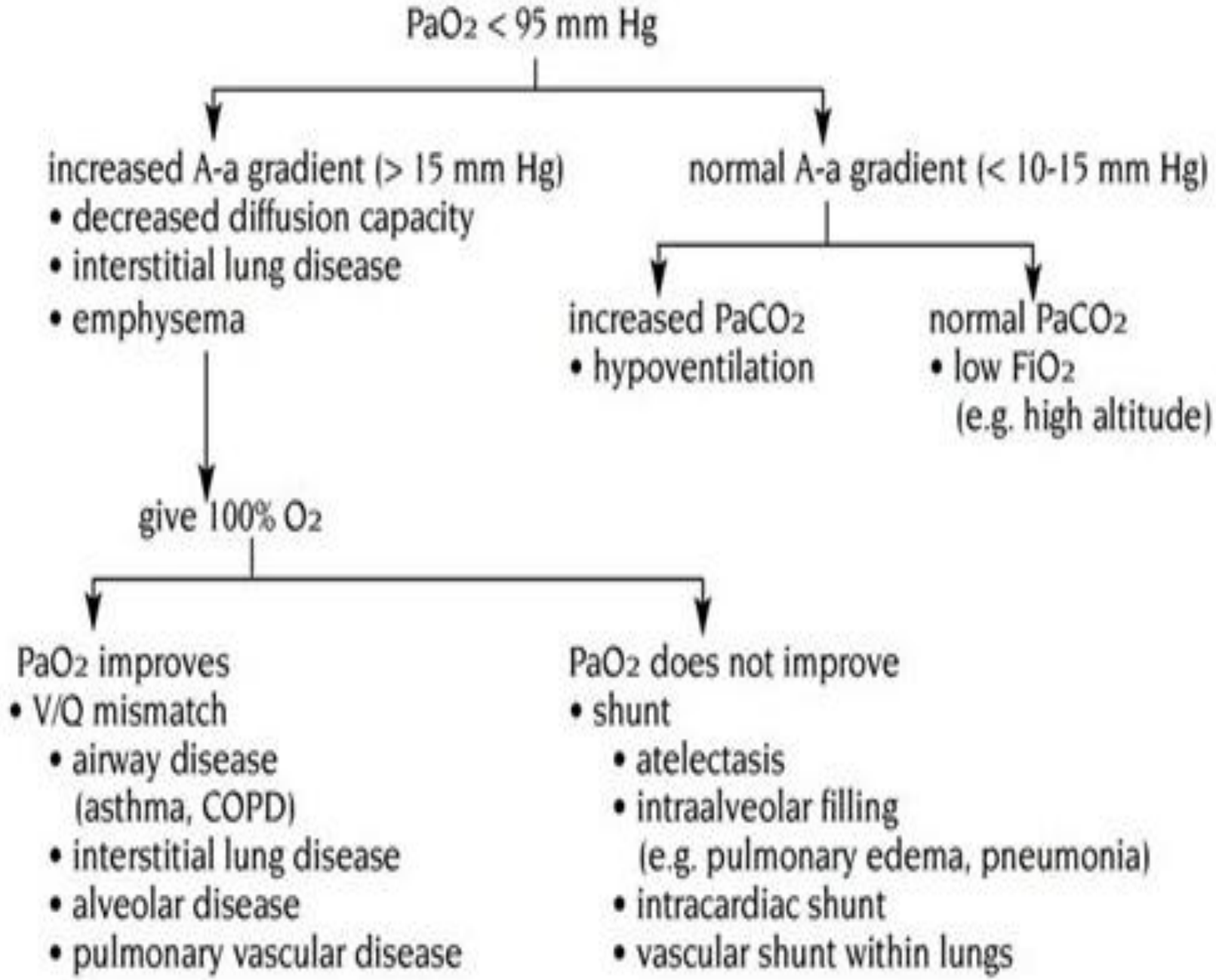
Disturbance	$PaCO_2$	HCO_3^-
Respiratory Acidosis		
Acute	10	1
Chronic	10	3
Respiratory Alkalosis		
Acute	10	2
Chronic	10	5
Metabolic Acidosis	1	1
Metabolic Alkalosis	3	10

Approach to Oxygenation Status

1. **What is the PaO_2? (normal = 95-100 mm Hg)**

2. **What is the $AaDO_2$? (normal < 15 mm Hg)**
   - **$AaDO_2 = PAO_2 - PaO_2 =$**
     $[FiO_2(Patm - PH_2O) - PaCO_2/RQ] - PaO_2$
   - **On room air: $FiO_2 = 0.21$, $Patm = 760$ mm Hg, $PH_2O = 47$ mm Hg, $RQ = 0.8$ —>**
     $AaDO_2 = [150 - 1.25(PaCO_2)] - PaO_2$
   - **the normal $AaDO_2$ increases with age**

3. **What is the cause of the hypoxemia?**


PaO_2 < 95 mm Hg
increased A-a gradient (> 15 mm Hg)
• decreased diffusion capacity
• interstitial lung disease
• emphysema
normal A-a gradient (< 10-15 mm Hg)
increased $PaCO_2$
• hypoventilation
normal $PaCO_2$
• low FiO_2
(e.g. high altitude)
give 100% O_2
PaO_2 improves
• V/Q mismatch
• airway disease
(asthma, COPD)
• interstitial lung disease
• alveolar disease
• pulmonary vascular disease
PaO_2 does not improve
• shunt
• atelectasis
• intraalveolar filling
(e.g. pulmonary edema, pneumonia)
• intracardiac shunt
• vascular shunt within lungs