



Pulmonary disease have only 6 Symptoms...

- Dyspnea
- Cough
- Sputum production
- Hemoptysis
- Wheeze
- Chest pain



However, Pulmonologists have only 4 things they can do

- History/Physical exam
- Pulmonary function testing
- Imaging
- Bronchoscopy



Luckily, only 4 diseases affect the lung anyways

- Infection
- Inflammatory/Autoimmune disease
- Vascular disease
- Cancer



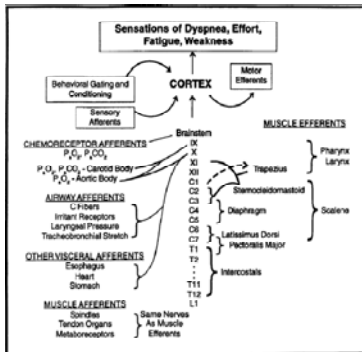
Our 6 symptoms...

- Dyspnea
- Cough
- Sputum production
- Hemoptysis
- Wheeze
- Chest pain

Objectives

- Dyspnea
 - Be able to identify the acutely ill dyspneic patient
 - Understand the mechanisms of dyspnea
 - Develop an approach to management of the dyspneic patient
- Hemoptysis
 - Develop an approach to hemoptysis
 - Appreciate the broad differential

Dyspnea



Differential Diagnosis of Dyspnea According to Category of Disease

Cardiac	Nutritional
Pulmonary	Pharmacologic
Endocrine	Pregnancy
Pulmonary	GI
Hematologic	Psychiatric
Infectious	Renal
Deconditioning/obesity	Oncologic
Larynx/upper airway	Rheumatologic

Dyspnea

- 75-92% of cases in the ED are due to cardiopulmonary disease
- 46-85% of cases in outpatients are due to cardiopulmonary disease

Dyspnea

- Pneumonia
- Acute exacerbation COPD/asthma
- Congestive heart failure
- Pulmonary embolism
- Interstitial pulmonary fibrosis

When is dyspnea an emergency?

- When the patient is:
 - Hypoxic
 - Hypercapnic
 - In extremis

Hypoxia

- What specifically does hypoxia mean?
- Why is hypoxia bad?

Definitions

- Hypoxia
- Hypoxemia



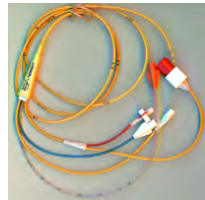
More definitions

- S_pO_2
- P_aO_2
- $P_{A}O_2$



Even more definitions...

- C_aO_2 (arterial oxygen content)
 - $1.34 (Hgb) (S_pO_2) + 0.003 P_aO_2$
- DO_2 (oxygen delivery)
 - $HR (SV) (C_aO_2)$



Types of hypoxia

- Anemic
- Stagnant
- Hypoxemic
- Histotoxic

Types of hypoxia

- | | | | |
|------------------------------|------------|------------|------------|
| • Anemic | N S_pO_2 | N P_aO_2 | ↓ C_aO_2 |
| – ↓ Hgb | | | |
| • Stagnant | N S_pO_2 | N P_aO_2 | N C_aO_2 |
| – ↓ DO_2 | | | |
| • Hypoxemic | ↓ S_pO_2 | ↓ P_aO_2 | ↓ C_aO_2 |
| • Histotoxic | N S_pO_2 | N P_aO_2 | N C_aO_2 |
| – ↓ ability to utilize O_2 | | | |

Hypoxemic Hypoxia

- 5 Causes...

Hypoxemic Hypoxia

- 5 Causes:
 - $\downarrow P_iO_2$
 - Hypoventilation
 - V/Q mismatch
 - Shunt
 - Diffusion impairment
 - (Acidosis)
 - (Poor venous admixture)

Aside I: A-a gradient

- $P_AO_2 = F_iO_2 (P_B - P_{H_2O}) - P_aCO_2 / 0.8$
- Predicted A-a gradient:
 - $= 2.5 + 0.21$ (age in years)
 - ± 11 mmHg

Aside II: Paroxysmal desaturation

- Mucous plugging
- Aspiration
- (Flash pulmonary edema)
- (PE)



Management of Hypoxia

- Correct Hgb
- IV fluids
- Inotropes
- Address the underlying cause

Basic Management of Hypoxemia?

Management of Hypoxemia I

- Supplemental O_2
- NIMV (?)
- Intubation/Ventilation
- \uparrow PEEP/ \uparrow F_iO_2

Aside III: A note on O₂

- We have a vague idea how much O₂ we are giving at any given moment
- Nasal cannula (24-40% O₂)
- Oximizer (?)
- Non-rebreather Mask (~60% O₂)
- Optiflow (70-90% O₂)



More advanced management of Hypoxemia?

Management of Hypoxemia II

- Recruitment maneuvers
- Inverse ratio ventilation
- Vasodilators (epoprostenol/NO)
- Prone ventilation
- High frequency jet ventilation
- Liquid ventilation
- Extracorporeal membrane oxygenation



Take home points on hypoxia

- Don't forget about hypoxia
- 5 causes of hypoxemia
- Treat the specific cause
- Remember the basic principles of hypoxia management
- Hypoxemia can be difficult to fix

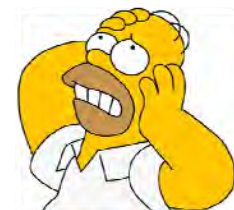


Hypercapnia

- What is the definition of hypercapnia?
- Why is hypercapnia bad?
- How do I tell if hypercapnia is acute or chronic?

Mechanisms of Hypercapnia

- $P_aCO_2 = (V_{CO_2} \times K) / V_A$
- Therefore, $\uparrow P_aCO_2$ could be due to:
 - $\uparrow V_{CO_2}$
 - $\downarrow V_A$
 - $V_A = V_E - V_D$



What causes $\uparrow V_{CO_2}$

- Fever
- Exercise
- Carbohydrate rich diet
- These are generally minor considerations, most people can increase V_E sufficiently to compensate for increased V_{CO_2}

What causes $\downarrow V_A$?

- $\downarrow V_E$
 - $\downarrow RR$
 - $\downarrow V_T$
- $\uparrow V_D$

English, please!

- Disorders of central control
- Disorders of motor neurons
- Disorders of peripheral nerves
- Disorders of NMJ
- Disorders of the respiratory muscles
- Disorders of the chest wall
- Disorders of the lung parenchyma
- Disorders of the airways

Potential clues to etiology

- A – a gradient
 - Only increased in disease affecting the lung itself
- RV/TLC ratio
 - Usually increased in disorders of motor neurons, disorders of peripheral nerves, disorders of NMJ and disorders of the respiratory muscles

Aside IV: Hypocapnia with O_2 ?

- Not just an urban myth
- 3 mechanisms:
 - Increased physiologic deadspace
 - Decreased hypoxic ventilatory drive
 - Haldane effect: O_2 displaces CO_2 from Hgb

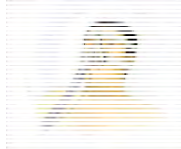
Management of Hypercapnia

- Respiratory stimulants
- CPAP (?)
- BiPAP



BiPAP

- Contraindications:
 - Decreased/Altered LOC
 - Hemodynamic instability
 - Inability to fit mask
 - Vomiting



BiPAP

- Indications:
 - Most beneficial in patients with COPD and cardiogenic pulmonary edema complicated by hypercarbia.
 - Non-hypercarbic COPD/CHF
 - Hypoxemic respiratory failure
 - Immunocompromised patients
 - Adjunct to weaning in COPD patients

How do I use BiPAP?

- Establish indication
- Ensure no contraindication
- Ensure correct setting
- Start at 12/5 cmH₂O
- Check ABG in 1-2 hrs



How do I use BiPAP?

- Patient uncomfortable:
 - Change mask
 - Change mode
- If P_aCO₂ remains high:
 - Increase IPAP
 - Intubate?
- If P_aO₂ remains low:
 - Increase FiO₂
 - Increase EPAP (analogous to PEEP)
 - Intubate

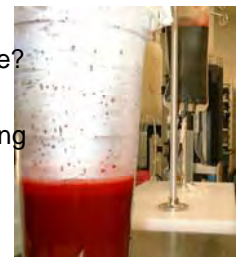
Take home points on Hypercapnia

- Establish cause
- Decide on management
- Reassess periodically
- Troubleshoot
- Usually easier to fix than hypoxemia



Acute management of Hemoptysis

- True hemoptysis?
- Massive or non-massive?
- ABCs
- Protect non-bleeding lung
- Bronchoscopy
 - Rigid
 - Flexible
- Arteriographic embolization



Approach to Hemoptysis

- History/Physical Exam
- Directed labs/serology
- Urinalysis
- CXR
- CT Chest
- Bronchoscopy
- Echocardiography

Common Causes of Hemoptysis

- Arteriobronchial fistula
- Congestive heart failure
- Pulmonary arteriovenous fistula
- Diffuse intrapulmonary hemorrhage (DAH)
- Diffuse parenchymal disease
- Iatrogenic
- Malposition of chest tube
- Pulmonary artery rupture
- Tracheoartery fistula
- Aspergilloma
- Bronchiectasis
- Bronchitis
- CF
- Lung abscess
- Sporotrichosis
- Tuberculosis
- Malignancies
- Bronchogenic carcinoma
- Leukemia
- Metastatic cancer

A brief word on DAH...

- Capillaritis:
 - Wegener's
 - MPA
 - Isolated capillaritis
 - CTD
 - Antiphospholipid Abs
 - Cryoglobulinemia
 - Goodpasture's
 - Drug induced
 - Acute rejection
- Bland hemorrhage:
 - Idiopathic hemosiderosis
 - SLE
 - Goodpasture's
 - DAD
 - Mitral stenosis
 - Coagulation disorders
 - PVOD
 - LAM/TS
 - Drug induced

Take home points on Hemoptysis

- ABCs first
- Supportive measures
- Once patient is temporized, consider the etiology



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Questions?

akapasi@ualberta.ca

