Pulmonary Emergencies

Medicine ½ Day
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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

According to Category of Disease

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

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

• $S_pO_2$
• $P_aO_2$
• $P_{aO_2}$

Even more definitions...

• $C_aO_2$ (arterial oxygen content)
  • $1.34 \text{ (Hgb)} (S_pO_2) + 0.003 \text{ Pa}_O_2$
• $DO_2$ (oxygen delivery)
  • HR (SV) ($C_aO_2$)

Types of hypoxia

• Anemic
• Stagnant
• Hypoxemic
• Histotoxic

Types of hypoxia

• Anemic $\downarrow S_pO_2$ $N P_{aO_2}$ $\downarrow C_aO_2$
  – $\downarrow \text{Hgb}$
• Stagnant $\downarrow S_pO_2$ $N P_{aO_2}$ $N C_aO_2$
  – $\downarrow DO_2$
• Hypoxemic $\downarrow S_pO_2$ $\downarrow P_{aO_2}$ $\downarrow C_aO_2$
• Histotoxic $\downarrow S_pO_2$ $N P_{aO_2}$ $N C_aO_2$
  – $\downarrow \text{ability to utilize O}_2$

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

• $P_{A}O_2 = F_iO_2 (P_B-P_H2O) - P_aCO2 / 0.8$
• Predicted A-a gradient:
  – $= 2.5 + 0.21 \text{ (age in years)}$
  – +/- 11 mmHg

Aside II: Paroxysmal desaturation

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

Management of Hypoxemia

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

Basic Management of Hypoxemia?

• 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 $\uparrow V_{CO2}$

- Fever
- Exercise
- Carbohydrate rich diet
- These are generally minor considerations, most people can increase $V_E$ sufficiently to compensate for increased $V_{CO2}$

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: Hypecapnia 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

How do I use BiPAP?

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

Take home points on Hypercapnia

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

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?

• Patient uncomfortable:
  – Change mask
  – Change mode
• If PₐCO₂ remains high:
  – Increase IPAP
  – Intubate?
• If PₐO₂ remains low:
  – Increase FiO₂
  – Increase EPAP (analagous to PEEP)
  – Intubate

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

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?

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