Approach to the Patient with Undifferentiated Dyspnea

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Dyspnea → Dyspnoea
Hematemesis → Haematemesis
Esophagus → Oesophagus
Tumor → Tumour
O approach to the Patient with Undifferentiated Dyspnea

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Outline

• Pathophysiology
• History and physical examination
• Organize your thoughts
• New diagnostic tests
Epidemiology

- 3-6% of ED visits
- 15-20% of hospital admissions
- 85% of cases:
  - COPD
  - Pneumonia
  - Cardiac Ischemia
  - Interstitial Lung Disease/CHF
  - Psychogenic
- 30% Multi-factorial
“Dyspnea is a term used to characterize a subjective experience of breathing discomfort that is comprised of qualitatively distinct sensations that vary in intensity. The experience derives from interactions among multiple physiological, psychological, social and environmental factors, and may induce secondary physiological and behavioral responses.”

- American Thoracic Society Consensus Statement
Dyspnea results when a stimulus activates a respiratory center beyond a certain threshold.

- Hypoxemia
- Acidosis or Hypercarbia
- Decreased Compliance
- Airway Resistance

- Carotid Body
- Medullary Chemoreceptors
- Lung or Muscle Mechano receptors
- Airway Receptors

Dyspnea
Shunt

\[ \text{V} = 2.5 \quad \text{Q} = 2.5 \text{ L} \quad \frac{\text{V}}{\text{Q}} = 1 \]

\[ \text{Q_T} = 5 \text{LPM} \]

\[ \text{V_T} = 5 \text{LPM} \]
Dead Space

V = 2.5
Q = 2.5 L
V:Q = 1

V = 2.5
Q = 2.5 L
V:Q = 1

Q_T = 5 LPM

V_T = 5 LPM
Decreased Compliance

- Compliance = \( \frac{dV}{dP} \)
- Mechanoreceptors in diaphragm, chest wall and airways
- Examples:
  - CHF
  - Obesity
  - Airway restriction
  - Surfactant loss
  - Chest wall tightness
Airway Resistance

- Decreased flow through narrowed airways
- Airway Receptors
- Increased work of breathing
- Examples
  - Reversible
    - Asthma
    - Allergic Bronchospasm
    - Toxic
  - Some Non-Reversible
    - Emphysema
    - Chronic Bronchitis
Hyperinflation

- Functional Residual Capacity =
  - Volume left at bottom of tidal volume breath
  - Our natural $O_2$ reservoir
- Mechanoreceptors in diaphragm, chest wall and airways
- Symptom:
  - “Fullness”
  - “Inability to take a deep breath”
- Examples:
  - Emphysema
  - Blebs
  - Pregnancy
  - Abdominal Distention
• **Volume Loss / External Compression**
  - Pleural Effusions
  - Pneumothorax
  - Malignancy

• **Decreased Oxygen Delivery to Tissues**
  - Anemia
  - Toxic Exposure
  - Sepsis
  - Metabolic Acidosis

• **Decreased Diaphragm/Chest Wall Strength**
  - Neuromuscular
    - CNS or Spinal Cord Disorder
    - Myopathy/Neuropathy
  - Chest Wall Injury

• **Constitutional or Psychiatric Factors**
  - Deconditioning
  - Psychogenic
Brief Differential Diagnosis
Brief Differential Diagnosis

- Asthma
- Primary lung cancer
- Metastatic cancer
- Chronic bronchitis
- Bronchiolitis
- Laryngeal disease
- Tracheal stenosis
- Tracheomalacia
- Alveolitis
- Drug toxicity
- Anaphylaxis
- Emphysema
- Chronic Bronchitis
- Pneumonitis
- Pulmonary edema
- Pulmonary fibrosis
- Abdominal distention
- Chest wall trauma
- Pulmonary effusion
- Pericardial effusion
- Pulmonary hypertension
- Pulmonary embolism
- Vasculitis
- Myocardial Infarction
- Arrhythmia
- Myocardial ischemia
- Congestive heart failure
- Intracardiac shunt
- Left ventricular hypertrophy
- Atrial myxoma
- Pericarditis
- Myocarditis
- Valvular disease
- Myopathy
- Neuropathy
- Phrenic nerve dysfunction
- Spinal cord injury
- Anemia
- Deconditioning
- Gastroesophageal reflux disease
- Hyperthyroidism
- Metabolic Acidosis
- ARDS
- Sepsis
- Psychogenic dyspnea
- Acute bronchitis
- High altitude pulmonary edema
- PLUS HUNDREDS MORE>>>>>>>>>>
So where do we start?
• History:
  – 56% accurate for all causes
  – 67% accurate for cardiac causes
  – 47% accurate for pulmonary causes

• History, Physical Exam, Chest X-Ray
  – 66% accurate for all diagnoses
  – 81% accurate for most common diagnoses
  – 27% of CXR will demonstrate ‘serious’ findings
Physical Exam Findings

- **Wheezeing**
  - Asthma
  - COPD
  - Cardiac Ischemia?
  - Heart Failure?
  - Anaphylaxis?
- **Fever**
  - Pneumonia
  - PE?
- **Cough**
  - Pneumonia
  - COPD/Asthma?
  - PE?
  - Heart Failure?
- **Leg Edema**
  - Heart Failure
  - PE
  - Myocardial Ischemia?
- **Tachycardia**
  - PE
  - Tachyarrhythmia
  - Pneumonia?
  - CHF?
- **Chest Pain**
  - Myocardial Ischemia
  - PE
  - Pneumonia?
  - Trauma?
## Signs and Symptoms Overlap

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Pneumonia</th>
<th>CHF</th>
<th>PE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dyspnea</td>
<td>37-93%</td>
<td>86%</td>
<td>78-85%</td>
</tr>
<tr>
<td>Fever</td>
<td>70%</td>
<td>--</td>
<td>44%</td>
</tr>
<tr>
<td>Cough</td>
<td>85%</td>
<td>12%</td>
<td>40%</td>
</tr>
<tr>
<td>Chest Pain</td>
<td>60%</td>
<td>--</td>
<td>65%</td>
</tr>
<tr>
<td>Tachycardia</td>
<td>62%</td>
<td>10%</td>
<td>26-69%</td>
</tr>
<tr>
<td>Rales or Rhonchi</td>
<td>26-85%</td>
<td>24-65%</td>
<td>--</td>
</tr>
<tr>
<td>Wheezing</td>
<td>36%</td>
<td>17%</td>
<td>15%</td>
</tr>
<tr>
<td>Leg Edema</td>
<td>--</td>
<td>--</td>
<td>33%</td>
</tr>
</tbody>
</table>

Organize your thoughts

Is the dyspnea…
   – A new problem?
   – An exacerbation of a chronic problem?
   – A combination?

Is the dyspnea…
   – Pulmonary?
   – Cardiac?
   – Neither?

Is the dyspnea one of the deadly but subtle diagnoses I should think of every time?
Is the Dyspnea...

A new problem?
- Myocardial ischemia
- Pneumonia
- Pulmonary embolism
- Anaphylaxis
- Arrhythmia
- Trauma

- Keys to Diagnosis:
  - No history of prior cardiopulmonary disease
  - Atypical of other disease presentations
  - New risk factors
    - e.g. recent surgery
Is the Dyspnea...

An exacerbation of a preexisting problem?

- Asthma
- Emphysema/Chronic Bronchitis
- Congestive Heart Failure
- Interstitial Lung Disease
- Cardiac Arrhythmia
  - e.g. atrial fibrillation with rapid ventricular response
- Pleural or pericardial effusion
- Neuromuscular Disorder
- Anemia

- Keys to diagnosis:
  - Past medical history
  - Typical or atypical of prior presentations
    - Is there a reason this presentation could be different than usual?
  - Precipitating or exacerbating factors
    - e.g. missed medications, dietary indiscretion, infection
  - Corroborating findings on physical examination and testing
    - Be careful to notice signs of compensated or decompensated disease
Is the Dyspnea...

A combination of a new and chronic problem?

– Recurrent Disease:
  • Myocardial ischemia
  • Pulmonary embolism
  • Arrhythmia

– Multiple diseases conspiring together:
  • Infection exacerbating Heart Failure
  • Arrhythmia exacerbating Heart Failure
  • Anemia exacerbating Cardiac Ischemia
  • COPD complicated by pneumonia

– Keys to Diagnosis:
  • Stable disease becoming unstable
  • Findings consistent with multiple processes
    – e.g. fever and diffuse wheezing
Is the Dyspnea... Pulmonary?

- **Airway:**
  - Asthma
  - Emphysema
  - Anaphylaxis
  - Tracheal pathology

- **Parenchymal (V/Q Mismatch):**
  - Pneumonia
  - Pulmonary embolism
  - Mucous plugging

- **Decreased Tidal Volume or Functional Residual Capacity:**
  - Pneumothorax

- **Keys to Diagnosis:**
  - Abnormal breath sounds, I:E Ratio, Stridor
  - Chest X-Ray
Is the Dyspnea... 

Cardiac?

- Myocardial Ischemia
- Left Sided Dysfunction
  - CHF
  - Atrial Fibrillation
  - Aortic stenosis or insufficiency
- Right Sided Dysfunction
  - Pulmonary hypertension
  - Sleep apnea
- Insufficient filling / preload
  - Pericardial effusion / tamponade

- Keys to Diagnosis
  - EKG
  - Murmurs
  - Bedside ultrasound
Is the Dyspnea...

Something else entirely?

- Neuromuscular disease
- Anemia
- Metabolic acidosis
- Toxic exposure
- Endocrine disorder
- Obesity/deconditioning
- Traumatic injury
- Abdominal distention
- Psychogenic
Diagnoses to Consider Every Time

- Myocardial Ischemia
- Pulmonary Embolism
- Infection/Sepsis
- Pericardial Tamponade
- Arrhythmia
Nearly All Patients:
- Pulse Oximetry
- Electrocardiogram
- Chest X-Ray
  - 35% abnormal
  - 60% of clinical decisions
Diagnostic Tests

• Select Patients
  – Complete Blood Count
  – Basic Chemistry Panel
  – Arterial Blood Gas
  – Peak Flow / Spirometry
  – Cardiac Troponin
  – Bedside Ultrasound
  – D-dimer
  – BNP
Diagnostic Tests - D-dimer

Activation

Factor XIII

Factor XIIIa

Thrombin

Fibrinogen

Fibrin monomers

Fibrin clot

Plasmin

Fibrinogen-degradation products

Fibrinolysis

Cross-linked fibrin-degradation products containing D-dimer

Goldhaber, NEJM 1998
## Diagnostic Tests - D-dimer

<table>
<thead>
<tr>
<th>Test</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELISA</td>
<td>96%</td>
<td>45%</td>
</tr>
<tr>
<td>Immunoturbidametric</td>
<td>98%</td>
<td>43%</td>
</tr>
<tr>
<td>Erythrocyte Agglutination</td>
<td>89%</td>
<td>59%</td>
</tr>
<tr>
<td>Latex Agglutination</td>
<td>70%</td>
<td>76%</td>
</tr>
</tbody>
</table>

Diagnostic Tests – BNP

- **Brain Naturetic Peptide**

- **ProBNP → BNP + NT-proBNP**

- Counter-regulatory hormone produced in response to ventricular stretch
  - Vasodilation
  - Naturesis

- **100 pg/mL**
  - Sensitivity = 90%
  - Specificity = 76%
  - Accuracy = 83%

Summary

• Remember the pathophysiology.
• Remember that signs and symptoms often overlap.
• Is the dyspnea…
  – a new problem?
  – an exacerbation of a preexisting problem?
  – a combination?
• Is the dyspnea…
  – cardiac?
  – pulmonary?
  – neither?
• Is the dyspnea one of the diagnosis to consider every time?
• The differential diagnosis dictates diagnostic testing.
Thank You

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PERC Rule

Low Clinical Pretest Probability

+ 

- Age < 50
- Pulse < 100
- SaO₂ > 94%
- No unilateral leg swelling
- No hemoptysis
- No recent trauma or surgery
- No prior PE/DVT
- No hormone use

8,138 patients
- Sensitivity 97.4%
- False Negative 0.9%

Kline et al, Submitted