DYSPNEA: 
THE CRITICAL EVALUATION

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OBJECTIVES

• Define dyspnea
• Review the physiology of dyspnea
• Evaluation of the adult with dyspnea
  – History
  – Physical exam
  – Differential
  – Labs and diagnostics
• Special considerations
CASE STUDY

• 56 yo female c/o 1 wk hx of worsening dyspnea

• PMHx: DM, HTN, hypercholesterolemia, obesity, seropositive RA (10 yrs)

• Meds: methotrexate 10 mg PO weekly, folic acid 1 mg daily, enbrel (etanercept) 50 mg SQ weekly and ibuprofen 800 mg daily PRN only.

• FHx: mother with type 2 diabetes, younger brother with asthma.

• SHx: Tobacco use 1/2 ppd x 40 years. No recent travel
DYSPNEA

• Consensus statement of the American Thoracic Society

“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 the interactions among multiple physiological, psychological, social, and environmental factors, and may induce secondary physiological and behavioral responses”
PATHOPHYSIOLOGY

• Respiratory System
  – “Respiratory Controller”
    (Air Hunger)
    • Rate and depth via efferent pathways to respiratory muscles
  – “Ventilatory Pump”
    (Work of Breathing)
    • Ventilatory muscles
    • Chest wall skeletal system
    • Pleura
  – “Gas Exchanger”
    (Stimulate Control Center)
    • Alveoli
    • Pulmonary capillaries

• Cardiovascular System
  – Transport oxygen to tissue
  – Transport carbon dioxide from tissue
    • CHF
    • Anemia
• Adequate oxygenation
• Maintenance of acid-base status
  – Chemoreceptors
    • Sensory cortex – Most sensitive to PCO2
    • Medullary – pH and PCO2
    • Carotid bodies – O2, PCO2, pH
    • Aortic arch - O2, PCO2, pH
PATHOPHYSIOLOGY

- Maintenance of acid-base status
  - Facial receptors – trigeminal nerve
  - Mechanoreceptors – pressure/flow/volume
    - Airways
    - Lungs
    - Chest wall
  - Ergoreceptors – peripheral muscles sensitive to localized metabolic acidosis
  - Limbic system and brainstem
HISTORY AND PHYSICAL

• “Language” the pt uses to describe dyspnea
• PMHx and Meds
• Tobacco use and occupational history
• Disease focused physical exam
WHAT WORDS MEAN

• Acute hypercapnia/restricted thoracic motion
  – “air hunger”
• Acute bronchoconstriction/neuromuscular dz/reduced chest wall/pulm compliance
  – “chest tightness”
  – Increased “effort to breathe”
  – Severe condition leads to “air hunger”
• COPD
  – Increased “effort to breathe”
  – “can not get a deep breath”
• CHF
  – “air hunger”
  – “suffocation”
• Deconditioning
  – “heavy breathing”
ACUTE DYSPNEA

- Acute myocardial ischemia
- Heart failure
- Cardiac tamponade
- Bronchospasm/COPD/asthma
- Pulmonary embolus
- Pneumothorax
- Pneumonia
- Anaphylaxis
DIFFERENTIAL

- HEENT
- Chest wall
- Pulmonary
- Cardiac
- Neurologic
- Toxic/Metabolic
- Miscellaneous
<table>
<thead>
<tr>
<th>Differential diagnosis of acute dyspnea</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HEENT</strong></td>
</tr>
<tr>
<td>Angiodema</td>
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<tr>
<td>Anaphylaxis</td>
</tr>
<tr>
<td>Pharyngeal infections</td>
</tr>
<tr>
<td>Deep neck infections</td>
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<tr>
<td>Foreign body</td>
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<tr>
<td>Neck trauma</td>
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<tr>
<td><strong>Chest wall</strong></td>
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<tr>
<td>Rib fractures</td>
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<tr>
<td>Flail chest</td>
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<tr>
<td><strong>Pulmonary</strong></td>
</tr>
<tr>
<td>COPD exacerbation</td>
</tr>
<tr>
<td>Asthma exacerbation</td>
</tr>
<tr>
<td>Pulmonary embolism</td>
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<tr>
<td>Pneumothorax</td>
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<tr>
<td>Pulmonary infection</td>
</tr>
<tr>
<td>ARDS</td>
</tr>
<tr>
<td>Pulmonary contusion or other lung injury</td>
</tr>
<tr>
<td>Hemorrhage</td>
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<tr>
<td><strong>Cardiac</strong></td>
</tr>
<tr>
<td>ACS</td>
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<tr>
<td>ADHF</td>
</tr>
<tr>
<td>Hash pulmonary edema</td>
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<tr>
<td>High output failure</td>
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<tr>
<td>Cardiomyopathy</td>
</tr>
<tr>
<td>Arrhythmia</td>
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<tr>
<td>Valvular dysfunction</td>
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<tr>
<td>Cardiac tamponade</td>
</tr>
</tbody>
</table>

ACS: Acute coronary syndrome; ADHF: Acute decompensated heart failure; ARDS: Acute respiratory distress syndrome; CO: Carbon monoxide; COPD: Chronic obstructive pulmonary disease
DIFFERENTIAL

• 3.5%-10% emergency room visits for dyspnea or related complaints
  – Over 1 million visits
  – Comprised of
    • Heart failure
    • Pneumonia
    • COPD
    • PE
    • Asthma
RED FLAGS

- Decreased mental status
- Labored respiratory effort
- Cyanosis
- Speaks in fragmented sentences
- Diaphoresis
DIAGNOSTICS

• Pulse oximetry
• Vital signs
• Disease specific exam
  – Stridor/wheeze
  – Crackles – dry vs wet
  – Lack of breath sounds
  – Paradoxical or nonsymmetrical chest excursion
  – JVD
  – Lower extremity edema – bilateral vs unilateral
  – Cardiac murmurs/gallop/rubs
    • Cardiac heave (retrosternal lift)
  – Pulses paradoxus
DIAGNOSTICS

• PCXR
• ECG
• Cardiac enzymes
• ABG
• CBC
DIAGNOSTICS

- BNP
- D-dimer
- Peak flow
- Negative inspiratory force/forced vital capacity
- Pulmonary function testing
- Chest CT/VQ scan/HRCT
- Echocardiography
SPECIAL CONSIDERATIONS

• Christopher Study
  – Prospective cohort study – 3306
  – Sudden onset of dyspnea/worsened dyspnea/pleuritic chest pain
  – Modified Wells criteria
    • <= 4 vs >4
  – Low probability – D-dimer negative
  – High probability or low probability with D-dimer positive – CT - PA
SPECIAL CONSIDERATIONS

• 3 month followup
  – 1028 Low probability with negative D-dimer
    • DVT 0.1%
    • Nonfatal PE 0.4%
  – 1436 CT-PA negative
    • DVT 0.6%
    • Nonfatal PE 0.2%
    • Fatal PE (1.6%)
  – 674 CT-PA positive
    • DVT 0.9%
    • Nonfatal PE 0.4%
    • Fatal PE 1.6%
SPECIAL CONSIDERATIONS

• PERC-based study
  – Multicenter, prospective cohort study - 8138
    • Chest pain or dyspnea
    • Evaluated with 8 clinical criteria
      – Age < 50
      – HR < 100
      – Saturation > 95%
      – No hemoptysis
      – No estrogen
      – No DVT/PE hx
      – No unilateral leg swelling
      – No surgery/trauma with hospitalization in past 4 wks
  • AND
    – Wells criteria = low probability
SPECIAL CONSIDERATIONS

- 45 day follow-up
  - 1666 fulfilled PERC criteria + low probability
    - DVT/PE < 1%
### Wells criteria and modified Wells criteria: clinical assessment for pulmonary embolism

<table>
<thead>
<tr>
<th>Clinical symptoms of DVT (leg swelling, pain with palpation)</th>
<th>3.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other diagnosis less likely than pulmonary embolism</td>
<td>3.0</td>
</tr>
<tr>
<td>Heart rate &gt;100</td>
<td>1.5</td>
</tr>
<tr>
<td>Immobilization (≥3 days) or surgery in the previous four weeks</td>
<td>1.5</td>
</tr>
<tr>
<td>Previous DVT/PE</td>
<td>1.5</td>
</tr>
<tr>
<td>Hemothysis</td>
<td>1.0</td>
</tr>
<tr>
<td>Malignancy</td>
<td>1.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Probability</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Traditional clinical probability assessment (Wells criteria)</strong></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>&gt;6.0</td>
</tr>
<tr>
<td>Moderate</td>
<td>2.0 to 6.0</td>
</tr>
<tr>
<td>Low</td>
<td>&lt;2.0</td>
</tr>
<tr>
<td><strong>Simplified clinical probability assessment (Modified Wells criteria)</strong></td>
<td></td>
</tr>
<tr>
<td>PE likely</td>
<td>&gt;4.0</td>
</tr>
<tr>
<td>PE unlikely</td>
<td>≤4.0</td>
</tr>
</tbody>
</table>

## Pretest probability of deep vein thrombosis (Wells score)

<table>
<thead>
<tr>
<th>Clinical feature</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active cancer (treatment ongoing or within the previous 6 months or palliative)</td>
<td>1</td>
</tr>
<tr>
<td>Paralysis, paresis, or recent plaster immobilization of the lower extremities</td>
<td>1</td>
</tr>
<tr>
<td>Recently bedridden for more than 3 days or major surgery, within 4 weeks</td>
<td>1</td>
</tr>
<tr>
<td>Localized tenderness along the distribution of the deep venous system</td>
<td>1</td>
</tr>
<tr>
<td>Entire leg swollen</td>
<td>1</td>
</tr>
<tr>
<td>Calf swelling by more than 3 cm when compared to the asymptomatic leg (measured below tibial tuberosity)</td>
<td>1</td>
</tr>
<tr>
<td>Pitting edema (greater in the symptomatic leg)</td>
<td>1</td>
</tr>
<tr>
<td>Collateral superficial veins (nonvaricose)</td>
<td>1</td>
</tr>
<tr>
<td>Alternative diagnosis as likely or more likely than that of deep venous thrombosis</td>
<td>-2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Score</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>High probability</td>
<td>5 or greater</td>
</tr>
<tr>
<td>Moderate probability</td>
<td>1 or 2</td>
</tr>
<tr>
<td>Low probability</td>
<td>0 or less</td>
</tr>
</tbody>
</table>

**Modification:**

This clinical model has been modified to take one other clinical feature into account: a previously documented deep vein thrombosis (DVT) is given the score of 1. Using this modified scoring system, DVT is either likely or unlikely, as follows:

- **DVT likely** 2 or greater
- **DVT unlikely** 1 or less

SPECIAL CONSIDERATIONS

• Quarterly Journal of Medicine – Oxford journal
  – Differential diagnosis of acute dyspnea: the value of B natriuretic peptides in the emergency department
    • Review
    • MEDLINE studies January 1990 – January 2008
      – Diagnosis
      – Acute dyspnea
      – Acute respiratory failure
      – Heart failure
      – Pulmonary edema
    • Human studies only
    • Sn/Sp/ROC
SPECIAL CONSIDERATIONS

• BNP
  – Independent predictor of high left ventricular end diastolic pressure
  – Correlates with NYHA classification
  – Inverse relationship with EF
  – < 100 – 98% negative predictive value
  – > 500 – 87% CHF
SPECIAL CONSIDERATIONS

• Proposed algorithm for acute dyspnea evaluation
  – Medical hx/physical exam/CXR/ABG/EKG
    • Unknown dx vs obvious dx
    • Evaluate BNP
      – <100 – suspect pulmonary as cause – CT chest with contrast
      – >500 – CHF very likely – begin treatment
      – 100-500 – consider echocardiogram +/- CT chest with contrast
PEARLS

• Baseline activity level before the illness serves as a useful point of comparison for the current functional level
• Physical exam has greater negative predictive value than positive predictive value
• Dyspnea is the dominant presenting symptom in > 50% of pts with ACS and NO chest pain
• Clinically unrecognized MI’s are detected by routine ECG’s in the elderly 21%-68%
PITFALLS

• Failure to recognize red flags and secure the airway prior to respiratory failure
• Failure to recognize abnormal vital signs
• Failure to expand your differential diagnosis
• Failure to recognize that tachypnea is not always do to pulmonary disease
REFERENCES


REFERENCES


