Take My Breath Away...
The Cardiovascular Consequences of Pulmonary Diseases

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Objectives

- Review the physiologic relationship between the heart and lungs
- Pathophysiologic effects of pulmonary vascular remodeling and hypoxemia
- Link between COPD and CAD
- Overlapping assessments and treatments between CAD, CHF, and COPD
- Truths and myths about inhaled medications and CHF
- Questions
COPD and CAD

- COPD leads to an increased risk of acute cardiovascular events
- One-third of deaths in patients with COPD are from cardiac disease
- CV mortality increases 28% for every 10% decline in FEV1
- COPD associated with worse long term outcomes in PCI or CABG

Sinha SS, Gurm HS The double jeopardy of chronic obstructive pulmonary disease and myocardial infarction Open Heart 2014;1:e000010. doi: 10.1136/openhrt-2013-000010

Introduction - COPD

- Progressive, life threatening lung disease
- Primary cause is exposure to tobacco smoke
- Appropriate and accurate diagnosis
- Not curable, but treatable to improve mortality, symptoms and quality of life

World Health Organization Fact Sheet 2016
COPD Definition

► Chronic Obstructive Pulmonary Disease (COPD) is a common, preventable and treatable disease that is characterized by persistent respiratory symptoms and airflow limitation that is due to airway and/or alveolar abnormalities usually caused by significant exposure to noxious particles or gases.

Chronic Obstructive Pulmonary Disease (COPD)

► COPD is currently the fourth leading cause of death in the world.¹

► COPD is projected to be the 3rd leading cause of death by 2020.²

► More than 3 million people died of COPD in 2012 accounting for 6% of all deaths globally.

► Globally, the COPD burden is projected to increase in coming decades because of continued exposure to COPD risk factors and aging of the population.


Some common comorbidities occurring in patients with COPD with stable disease include:

- Cardiovascular disease (CVD)
- Heart failure
- Ischaemic heart disease (IHD)
- Arrhythmias
- Peripheral vascular disease
- Hypertension
- Osteoporosis
- Anxiety and depression
- COPD and lung cancer
- Metabolic syndrome and diabetes
- Gastroesophageal reflux (GERD)
- Bronchiectasis
- Obstructive sleep apnea
Pulmonary Vascular Changes

- Highly prevalent in patients with COPD
- Endothelial cell damage from cigarette smoking
- Increased bronchial angiogenesis with altered pulmonary and bronchial circulation
- Similarities among COPD, IPAH, and high altitude

A hypothetical mechanism underlying the pulmonary vascular remodelling in highlanders, chronic obstructive pulmonary disease (COPD) patients and idiopathic pulmonary arterial hypertension (IPAH) patients.

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80% of COPD sufferers have been smokers but only 15% of smokers will develop significant COPD

http://www.asons.co.uk/wp-content/uploads/2014/06/COPD-8.png
TABLE 5. KEY INDICATORS FOR CONSIDERING A DIAGNOSIS OF COPD*

<table>
<thead>
<tr>
<th>Chronic cough:</th>
<th>Present intermittently or every day</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Often present throughout the day; seldom only nocturnal</td>
</tr>
<tr>
<td>Chronic sputum Production</td>
<td>Any pattern of chronic sputum production may indicate COPD</td>
</tr>
<tr>
<td>Dyspnea that is:</td>
<td>Progressive (worsens over time) Persistent (present every day)</td>
</tr>
<tr>
<td></td>
<td>Described by the patient as: increased effort to breathe, heaviness, air hunger, or gasping</td>
</tr>
<tr>
<td></td>
<td>Worse on exercise</td>
</tr>
<tr>
<td></td>
<td>Worse during respiratory infections</td>
</tr>
<tr>
<td>History of exposure to risk factors, especially:</td>
<td>Tobacco smoke</td>
</tr>
<tr>
<td></td>
<td>Occupational dusts and chemicals</td>
</tr>
<tr>
<td></td>
<td>Smoke from home cooking and heating fuels</td>
</tr>
</tbody>
</table>

American College of Physicians Guidelines for COPD 2011

The JAMA Network

From: Geographic Variation in Diagnosis Frequency and Risk of Death Among Medicare Beneficiaries


Figure Legend:
Relative rates were calculated using logistic regression adjusted for age/sex/race and number of coexisting chronic conditions and are not calculable from raw counts of numbers of deaths and numbers with each condition. CAD indicates coronary artery disease; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; PVD, peripheral vascular disease.
Symptoms and Physical Findings

CHF
- Dyspnea, PND, nocturnal cough
- JVD and Hepatic displacement
- S3 and displaced PMI

COPD
- Same
- Lung Hyperinflation can displace the liver
- Difficult to hear with hyperinflation

Hawkins, Nathaniel Mark et al. "Heart Failure and Chronic Obstructive Pulmonary Disease: Diagnostic Pitfalls and Epidemiology." European Journal of Heart Failure

Radiology

CHF
- Asymmetric and reticular pulmonary edema
- Cephalization and Kerley B lines
- Pleural Effusions

COPD
- Commonplace with COPD
- Emphysematous vascular bed loss cause upper lobe venous distention
- Impaired pleural lymphatic drainage secondary right heart failure (rarely)

Hawkins, Nathaniel Mark et al. "Heart Failure and Chronic Obstructive Pulmonary Disease: Diagnostic Pitfalls and Epidemiology." European Journal of Heart Failure
Echocardiography

- Changes in ejection fraction
- Poor acoustic windows in COPD

Hawkins, Nathaniel Mark et al. "Heart Failure and Chronic Obstructive Pulmonary Disease: Diagnostic Pitfalls and Epidemiology." European Journal of Heart Failure

Natriuretic Peptides

- Elevated due to left ventricular stretch
- Minor elevation if right heart failure is present

Hawkins, Nathaniel Mark et al. "Heart Failure and Chronic Obstructive Pulmonary Disease: Diagnostic Pitfalls and Epidemiology." European Journal of Heart Failure
Workup

• Look at work-up as an evaluation of dyspnea
• Comprehensive history
• Testing designed to look at the cardiopulmonary relationship
• Exacerbating factors and evaluation
Truth's and Myths about Cardiac and Pulmonary Medications
Beta Blockers

- Antagonists to Beta adrenergic receptors
- Historic concern regarding bronchoconstriction
- Caution in severe uncontrolled asthma
- Proven safe in multiple studies with COPD
- May even provide a survival benefit in COPD
Fig 1 Kaplan-Meier estimate of probability of survival among patients with COPD by use of β blockers.

Philip M Short et al. BMJ 2011;342:bmj.d2549

©2011 by British Medical Journal Publishing Group

Fig 2 Adjusted hazard ratios for all cause mortality among patients with COPD in reference to the control group (who received only inhaled therapy with short acting β agonists or antimuscarinics).

Philip M Short et al. BMJ 2011;342:bmj.d2549

©2011 by British Medical Journal Publishing Group
Table 4. Incidence Rate of Serious Adverse Events per 100 Patient-Years. *

<table>
<thead>
<tr>
<th>Adverse Event</th>
<th>Tiotropium (N=1906)</th>
<th>Placebo (N=1006)</th>
<th>Relative Risk for Tiotropium vs. Placebo (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiac</td>
<td>3.56</td>
<td>4.21</td>
<td>0.84 (0.73–0.98) †</td>
</tr>
<tr>
<td>Angina</td>
<td>0.51</td>
<td>0.36</td>
<td>1.44 (0.91–2.26)</td>
</tr>
<tr>
<td>Atrial fibrillation</td>
<td>0.74</td>
<td>0.77</td>
<td>0.91 (0.68–1.23)</td>
</tr>
<tr>
<td>Cardiac failure</td>
<td>0.61</td>
<td>0.68</td>
<td>1.21 (0.84–1.78)</td>
</tr>
<tr>
<td>Congestive heart failure</td>
<td>0.29</td>
<td>0.37</td>
<td>0.59 (0.37–0.96) †</td>
</tr>
<tr>
<td>Coronary artery disease</td>
<td>0.21</td>
<td>0.37</td>
<td>0.55 (0.33–0.91)</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>0.69</td>
<td>0.97</td>
<td>0.71 (0.52–0.99) †</td>
</tr>
<tr>
<td>Lower respiratory</td>
<td>11.31</td>
<td>13.47</td>
<td>0.84 (0.77–0.92) †</td>
</tr>
<tr>
<td>Bronchitis</td>
<td>0.37</td>
<td>0.31</td>
<td>1.20 (0.73–1.98)</td>
</tr>
<tr>
<td>COPD exacerbation</td>
<td>8.19</td>
<td>9.70</td>
<td>0.84 (0.76–0.94) †</td>
</tr>
<tr>
<td>Dyspnea</td>
<td>0.38</td>
<td>0.62</td>
<td>0.61 (0.40–0.94) †</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>3.23</td>
<td>3.46</td>
<td>0.91 (0.81–1.11)</td>
</tr>
<tr>
<td>Respiratory failure</td>
<td>0.90</td>
<td>1.31</td>
<td>0.69 (0.52–0.92) †</td>
</tr>
</tbody>
</table>

* Listed are the incidence rates of serious adverse events (excluding lung cancer) that were reported by more than 1% of patients in either study group, according to organ class during the study period (from the first day of administration of a study drug until the last day plus 30 days).

† P<0.05.
Cardiopulmonary Relationship

- Rarely do disease states work in isolation
- Work-up is a combination of pulmonary and cardiac testing
- Very common to have a multiple disease processes

Occam's Razor

The Simplest Solution is Usually the Correct One
Hickam's Dictum

"Patients can have as many diseases as they damn well please."

Conclusions

- The cardiopulmonary relationship is synergistic with issues with one organ invariably affecting the other
- Workup is generated by initial symptoms and comorbidities
- Frequently the pathology of dyspnea is multifactorial and requires multiple levels of workup and treatment