Cardiac Causes of Dyspnoea

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Dyspnoea - causes

**Pulmonary Disease**
- Airways disease
- Interstitial Lung Disease
- Vocal Cord Dysfunction

**Heart Disease**
- Myocardial Disease (Systolic, Diastolic)
- Valvular Heart Disease
- Coronary Artery Disease

**Pulmonary Vascular Disease**
- (Pulmonary Hypertension, PE)

**Neuromuscular**

**Metabolic Disease**
- Anemia
- Thyroid Disease

**Deconditioning, Anxiety**

**Obesity**
Case GM

HISTORY:
Ms GM - 35 year old female
3-month history of breathlessness, wheeze and cough.
Began after a flu-like illness
PMHx: nil
Meds: nil
Non smoker

EXAM:
Afebrile PR 90 bpm BP: 102/60mmHg, no pallor, normal BMI
CVS- no obvious mumurs, Chest: with an expiratory wheeze
Peripheries: no oedema
Case GM

Diagnosis:
? LRTI and asthma

Management
Ventolin, Flixotide, Augmentin
Case GM:

Symptoms worsening despite treatment
Now gives history of orthopnoea
JVP clearly elevated
Case GM

CXR
Demonstrated cardiomegaly, upper lobe diversion and pulmonary oedema
Case GM

- **Echocardiogram**
  Confirmed presence of cardiomyopathy. LV dilated with global impairment of LV systolic function

- In retrospect strong family history of dilated cardiomyopathy.

- **Treatment**
  - Furosemide
  - Beta blocker
  - ACE inhibitor
Workup of Exertional Dyspnea

• History

• Physical examination
  – Paleness (anemia), cyanosis
  – BMI
  – Respiratory rate, heart rate, BP, body temperature
  – Respiratory effort
  – JVP
  – Lungs and heart auscultation
  – Peripheral edema

• Pulse oximetry
# Workup of Exertional Dyspnea

## Respiratory
- CXR
- PFTs
- ABG
- CT
- Methacholine Challenge testing
- CPET

## Cardiac
- ECG
- BNP
- Stress testing
- Echocardiography
- CTCA / angiography
- CPET

## Pulmonary vascular disease
- Echo
- CTPA
- V/Q scan

## Metabolic
- Complete blood count
- TFTs
Causes of dyspnea as assessed by Spirometry, Echocardiography & ECG in 129 Danish Subjects

69% of patients were diagnosed by these 3 tests

* Heart Disease defined as AFib, LV systolic dysfunction or valve disease

† Lung Disease defined as FEV1% < 70%

‡ Obesity defined as BMI > 30 kg/m²

Pedersen et al., Int J Clin Pract, 2007, 61, 9, 1481–1491
Clinical diagnosis of heart failure

- **Worsening dyspnoea** is a cardinal symptom of HF and typically is related to increases in cardiac filling pressures but also may represent restricted cardiac output.
- Another cardinal symptom of HF is **fatigue**, generally held to be reflective of reduction in cardiac output as well as abnormal skeletal muscle metabolic responses to exercise.
Clinical diagnosis of heart failure

• Patients may sleep with the head elevated to relieve dyspnea while recumbent (orthopnea)
• Paroxysmal nocturnal dyspnea, shortness of breath developing in recumbency, is one of the most highly reliable indicators of HF.
• Nocturnal cough is a frequently overlooked symptom of HF.
• Wheezing
• These symptoms all typically reflect pulmonary congestion
Clinical diagnosis of heart failure

Clinical Signs

- Irregular pulse
- Elevated JVP
- Hepatojugular reflux
- Displaced apex beat
- Cardiac murmur
- Third heart sound
- Pulmonary crepitations
- Peripheral oedema
- Ascites
2016 ESC Guidelines for the diagnosis and treatment of heart failure

**PATIENT WITH SUSPECTED HF**
(non-acute onset)

**ASSESSMENT OF HF PROBABILITY**

1. Clinical history:
   - History of CAD (MI, revascularization)
   - History of arterial hypertension
   - Exposition to cardiotoxic drug/radiation
   - Use of diuretics
   - Orthopnoea / paroxysmal nocturnal dyspnoea

2. Physical examination:
   - Rales
   - Bilateral ankle oedema
   - Heart murmur
   - Jugular venous dilatation
   - Laterally displaced/broadened apical beat

3. ECG:
   - Any abnormality

   - ≥1 present
   - All absent

**NATRIURETIC PEPTIDES**

- NT-proBNP ≥125 pg/mL
- BNP ≥35 pg/mL

- No
- Yes

**ECHOCARDIOGRAPHY**

- Normal

If HF confirmed (based on all available data):
determine aetiology and start appropriate treatment
In ambulatory patients with dyspnea, measurement of BNP or N-terminal pro-B-type natriuretic peptide (NT-proBNP) is useful to support clinical decision making regarding the diagnosis of HF, especially in the setting of clinical uncertainty.

Measurement of BNP or NT-proBNP is useful for establishing prognosis or disease severity in chronic HF.
What are BNP, pro-BNP and NT-pro-BNP?

Enzymatic cleavage of pro-BNP
Cardiac myocyte stretch results in pro-BNP release

pro-BNP (aa1 – aa108)

NT-proBNP (aa1 – aa76)

Physiologically active form

BNP (aa77 – aa108)
Biomarkers- BNP

• BNP – Brain natriuretic peptide
• Primarily synthesised in the ventricular myocardium
• Stimulus for release is myocyte stretch rather than transmural pressure load
• Has been shown to:
  – Be a good rule out test for heart failure
  – Predict prognosis in those with CHF and MI
  – Be useful in optimisation of HF therapy
## NT-Pro BNP Cutoffs

<table>
<thead>
<tr>
<th>Age</th>
<th>pmol/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;50 years</td>
<td>50</td>
</tr>
<tr>
<td>50-75 years</td>
<td>100</td>
</tr>
<tr>
<td>&gt;75 years</td>
<td>210</td>
</tr>
</tbody>
</table>

NT-proBNP levels below 35pmol/l - CHF unlikely negative predictive value of 98 percent.
# Causes for Elevated Natriuretic Peptide Levels

<table>
<thead>
<tr>
<th>Cardiac</th>
<th>Noncardiac</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Heart failure, including RV syndromes</td>
<td>• Advancing age</td>
</tr>
<tr>
<td>• Acute coronary syndrome</td>
<td>• Anemia</td>
</tr>
<tr>
<td>• Heart muscle disease, including LVH</td>
<td>• Renal failure</td>
</tr>
<tr>
<td>• Valvular heart disease</td>
<td>• Pulmonary causes: obstructive sleep apnea, severe pneumonia, pulmonary hypertension</td>
</tr>
<tr>
<td>• Pericardial disease</td>
<td>• Critical illness</td>
</tr>
<tr>
<td>• Atrial fibrillation</td>
<td>• Bacterial sepsis</td>
</tr>
<tr>
<td>• Myocarditis</td>
<td>• Severe burns</td>
</tr>
<tr>
<td>• Cardiac surgery</td>
<td>• Toxic-metabolic insults, including cancer chemotherapy and envenomation</td>
</tr>
<tr>
<td>• Cardioversion</td>
<td></td>
</tr>
</tbody>
</table>
BNP and Body Weight in Normals

Framingham participants without CVD (N = 3389)

BNP Cut-Points for 90% Sensitivity

B-type natriuretic peptide (BNP) cut-points for 90% sensitivity in diagnosing congestive heart failure in patients with dyspnea, on the basis of body mass index (BMI) subgroup. Specificity at the 90% sensitivity level shown was at least 70% for all 3 groups. Data from the Breathing Not Properly Multinational Study
Heart failure and COPD: Diagnostic Challenge

• Symptoms overlap
• Chest radiograph may be equally misleading, as pulmonary vascular remodelling in those with COPD either mimics (upper lobe venous diversion) or masks pulmonary oedema (asymmetric, regional, and reticular patterns).
• BNP good rule out with high negative predictive value but low specificity
BNP in HF and COPD
2016 ESC Guidelines for the diagnosis and treatment of heart failure
HFpEF definition

• Approximately half of the patients with HF have normal left ventricular function, that is, HF with preserved ejection fraction (HFpE)

• HFpEF generally is defined as a left ventricular ejection fraction of 50% or greater, whereas HFrEF is defined as an ejection fraction below 40%.

- HFpEF:
  - Older and more often female
  - Higher frequency of hypertension; lower CAD
- Prevalence HFpEF rising 1% / yr relative to HFrEF
HFpEF Diagnosis

• Signs and symptoms of heart failure
• Preserved global systolic LV function (EF>50%)
• Indices of abnormal LV relaxation, filling, compliance or stiffness
• BNP or NT proBNP
**Pharmacological Treatment for Stage C HF With Preserved EF**

<table>
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<tr>
<th>COR</th>
<th>LOE</th>
<th>Recommendations</th>
<th>Comment/Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>B</td>
<td>Systolic and diastolic blood pressure should be controlled in patients with HFP EF in accordance with published clinical practice guidelines to prevent morbidity</td>
<td>2013 recommendation remains current.</td>
</tr>
<tr>
<td>I</td>
<td>C</td>
<td>Diuretics should be used for relief of symptoms due to volume overload in patients with HFP EF.</td>
<td>2013 recommendation remains current.</td>
</tr>
</tbody>
</table>
## Pharmacological Treatment for Stage C HF With Preserved EF

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</thead>
<tbody>
<tr>
<td>IIa</td>
<td>C</td>
<td>Coronary revascularization is reasonable in patients with CAD in whom symptoms (angina) or demonstrable myocardial ischemia is judged to be having an adverse effect on symptomatic HFpEF despite GDMT.</td>
<td>2013 recommendation remains current.</td>
</tr>
<tr>
<td>IIa</td>
<td>C</td>
<td>Management of AF according to published clinical practice guidelines in patients with HFpEF is reasonable to improve symptomatic HF.</td>
<td>2013 recommendation remains current.</td>
</tr>
<tr>
<td>IIa</td>
<td>C</td>
<td>The use of beta-blocking agents, ACE inhibitors, and ARBs in patients with hypertension is reasonable to control blood pressure in patients with HFpEF.</td>
<td>2013 recommendation remains current.</td>
</tr>
</tbody>
</table>
Controversies in use of BB in COPD

<table>
<thead>
<tr>
<th>Against</th>
<th>In favor</th>
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</thead>
<tbody>
<tr>
<td>BBs can induce lowering of FEV₁</td>
<td>Nonselective BBs can induce upregulation of beta-2 adrenoreceptors in bronchial smooth muscle cells</td>
</tr>
<tr>
<td>BBs can precipitate bronchospasm</td>
<td>enhancing airway reversibility</td>
</tr>
<tr>
<td>BBs can increase bronchial hyperresponsiveness</td>
<td>BBs can reduce mucus secretion and inflammation</td>
</tr>
<tr>
<td>BBs can increase bronchospasm during exacerbations</td>
<td>BBs can reduce sympathetic hypertone in CVD comorbidities</td>
</tr>
<tr>
<td></td>
<td>BBs can be protective in CVD comorbidities</td>
</tr>
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</table>
Beta-blockers in COPD: GOLD Guidelines 2017

• “There is no evidence that chronic heart failure should be treated differently in the presence of COPD. Treatment with B1-blockers improves survival in heart failure and is recommended. However, B1-blockers are often not prescribed in COPD despite available evidence showing that their use in COPD is safe. Selective B1-blockers should be used.”

• “The treatment of ischaemic heart disease should be according to guidelines irrespective of the presence of COPD and vice versa.”

Effect of obesity on lung volumes. BMI, body mass index; ERV, expiratory reserve volume; FEV1, forced expiratory volume in 1 s; FRC, functional residual capacity; FVC, forced vital capacity; VC, vital capacity.

D D Sin, and E R Sutherland Thorax 2008;63:1018-1023
Case: DG

67 year old male presents with dyspnoea / effort intolerance for 2-3 years.

Ex smoker who gave up 5 years ago (30 pkt yr)

No history of asthma or respiratory problems previously

No past cardiac history

Known to have dyslipidaemia. No hypertension or diabetes
Case DG

O/E BMI 30 kg/m2
Normal cardiac and respiratory exam

Investigations
Spirometry – mild obstructive airway disease with no reversibility
CXR normal
ECG normal
NT Pro-BNP 37 pmol/L
Case DG

Stress echocardiogram
Moderate area of ischaemia in RCA territory

Coronary angiogram
Minor disease of LCA and functional occlusion of proximal RCA.
Case DG

RCA angiography demonstrating subtotal occlusion
Case DG

Attempt to cross with antegrade wire excalation
Case 1:

Successful crossing using Stingray balloon and GAIA 3rd wire
Case DG

Final result post stenting
Case DG

Complete resolution of symptoms post stenting
Long term secondary prevention
IHD and dyspnoea

• Myocardial ischaemia most commonly presents with a chest, arm, or throat discomfort
• May present with dyspnoea alone
• May be silent.
Ticagrelor and Dyspnoea

PLATO:
• Dyspnoea more frequent with ticagrelor than with clopidogrel (13.8 vs. 7.8 %; p = 0.001)
• Treatment-related dyspnea more frequent with ticagrelor than with clopidogrel was reported 2.2 % vs 0.6 %

PEGASUS:
• Discontinuation due to dyspnoea over 33 months ticagrelor 90 mg (6.5%), ticagrelor 60 mg (4.6%) and placebo (0.8%) of patients (P < .001).

Registries:
• Rates of discontinuation due to dyspnoea varied considerably with rates between 3 and 14.3% being reported
Periodic breathing
What we want to know in the referral

• Relevant past history
  – Previous cardiac and respiratory history
  – Hypertension, smoking and other risk factors
• Medications
• Presence of murmur or other cardiac signs
• BMI
• BNP where suspected HF
Conclusions

Dyspnoea has a broad differential and diagnosis of the underlying cause can be challenging

Diagnosis can be made in majority with clinical exam, spirometry, BNP, ECG, CXR

HFpEF is under recognized and is an important cause of dyspnoea in the elderly

The impact of obesity on dyspnoea is under appreciated

Selective Beta-blockers such as bisoprolol should be prescribed in those with IHD or CHF and COPD.