Program

• **Lecture 1:** Update on chronic heart failure — 2012 ESC/HeFSSA guidelines

• **Lecture 2:** Update on acute heart failure — 2012 ESC/HeFSSA guidelines

• **Lecture 3:** Update on the use of devices and end stage HF — 2012 ESC/HeFSSA guidelines

• **Lecture 4:** Diagnosis and management of right heart failure
Program

Lecture 4:

UPDATE ON RIGHT HEART FAILURE
Recalcitrant Right Heart Failure

The most common cause of PH is that associated with LVF
Right heart disease

Relatively understudied

Poorly understood
# Pulmonary hypertension prognosis in CHF

<table>
<thead>
<tr>
<th>Mortality at 28 months (%)</th>
<th>PHT</th>
<th>NO PHT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>57</td>
<td>17</td>
</tr>
</tbody>
</table>
Ability of the Right Heart to Recover

Mortality and creatinine clearance in heart failure patients: Cleveland Clinic experience

Survival

Creatinine clearance

Quartile 4  > 85 mL/min
Quartile 3  60–85 mL/min
Quartile 2  50–60 mL/min
Quartile 1  < 50 mL/min

Days till death or last follow-up

0  250  500  750  1,000  1,250
Diuretics and arterial underfilling
Furosemide monotherapy may cause significant decline in glomerular filtration rate

![Graph showing change in glomerular filtration rate vs. urine output](image)

- Placebo
- IV furosemide

Urine output (mL) 0–8 hr

Change in glomerular filtration rate (%)
Common Pathophysiology of Cardiac Failure and Cirrhosis

Severe secondary hyperaldosteronism

Circ Heart Fail 2009;2;370-376
Case for high doses of MRA

• Although natriuretic doses of spironolactone are standard therapy in the management of patients with cirrhosis, there has been no large clinical trial evaluating the role of natriuretic doses of MRA’s in patients with HF

• Use of natriuretic doses of mineralocorticoid antagonists may be a better alternative to reverse diuretic resistance secondary to hyperaldosteronism.

Circ Heart Fail 2009;2;370-376
Normal Dietary Sodium vs. Low

- Normal sodium diet and high diuretic doses have reduced readmissions, neurohormonal activation and mortality
- Restrict fluids to 1 litre/day
- Keep sodium intake approx 120 mmol/day

AJC 2009:103(1);93-102
β-Blocker Therapy in Patients Admitted With Recalcitrant RVF

- Maintain “on admission” dose
- Reduce maintenance dose
- Stop treatment
Effects of Carvedilol on RV EF in CHF

<table>
<thead>
<tr>
<th>Age (yr) &amp; Sex</th>
<th>Disease</th>
<th>NYHA</th>
<th>RVEF (%)</th>
<th>LVEF (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>BSL</td>
<td>4 Mo</td>
</tr>
<tr>
<td>54 ± 13</td>
<td></td>
<td></td>
<td>0.27 ± 0.10</td>
<td>0.38 ± 0.09</td>
</tr>
</tbody>
</table>

AJC 1998;81:247
β-Blocker Therapy in Patients Admitted With Worsening CHF—Results from COMET

Causes of WHF hospitalisation
- Ischaemia (%): 16.4
- Atrial fibrillation (%): 14.8
- Infection (%): 3.3
- Non-compliance (%): 4.9
- Renal dysfunction (%): 9.8
- Other (%): 44.3
- Alcohol excess (%): 1.6
- Dietary salt excess (%): 3.3
- Hypertension (%): 3.3
- Iatrogenic (%): 11.5

Reduced dose vs. withdrawn study drug:
HR, 1.32; 95% CI, 0.88-1.98; p=0.1786

Same dose vs. ceased or reduced dose:
HR, 0.559; 95% CI, 0.33-0.94; p=0.0287
Predictors of vasodilator and inotrope use in the ESCAPE trial

| Table III. Multivariable predictors of vasodilator and inotrope use |
|-----------------------|---------------------|------------------|
|                         | OR (95% CI)          | P               |
| **Vasodilator use**    |                     |                 |
| Site                   | NA                  | <.001           |
| SUN (10 U)             | 1.19 (1.07-1.33)    | .001            |
| PCWP*                  | 1.08 (1.03-1.13)    | .003            |
| Pulmonary artery       | 1.00 (0.97-1.03)    | .856            |
| systolic pressure*     |                     |                 |
| **Inotrope use**       |                     | <.001           |
| Site                   | NA                  |                 |
| RAP*                   | 1.06 (1.01-1.12)    | .024            |
| SUN (10 U)             | 1.13 (1.01-1.26)    | .042            |
| Systolic blood pressure| 1.54 (0.92-2.57)    | .097            |
| <100 (dichotomous)    |                     |                 |
| Sodium                 | 0.96 (0.91-1.02)    | .143            |
| PCWP*                  | 1.00 (0.96-1.05)    | .920            |
| Pulmonary artery       | 1.01 (0.98-1.03)    | .729            |
| systolic pressure*     |                     |                 |

OR, Odds ratio.
*In patients with a pulmonary artery catheter.

(Am Heart J 2007;153:98-104.)
Mortality risk in the ESCAPE trial

Kaplan-Meier survival curve for freedom from death or rehospitalization by intravenous vasoactive medication use.

(Am Heart J 2007;153:98-104.)
Stratified according to RVEF: K–M plots for all-cause mortality on (a) placebo or (b) bucindolol (BEST trial)
• Class IIa, Evidence level B

• “In patients admitted to hospital due to worsening HF, a reduction in the β-blocker dose may be necessary. In severe situations, temporary discontinuation can be considered. Low-dose therapy should be re-instituted and up-titrated as soon as the patient’s clinical condition permits, preferably prior to discharge.”
Putting guidelines into practice.

• When ‘Worsening symptoms/signs (e.g. increasing dyspnoea, fatigue, oedema, weight gain) occur:
  – If increasing congestion – increase dose of diuretic and/or halve dose of β-blocker (if increasing diuretic doesn’t work)
  – If marked fatigue (and/or bradycardia) – halve dose of β-blocker (rarely necessary)’.
The effects of oral hydralazine on RVEDP in patients with RVF

The mean RVEDP decreased from $17.4 \pm 5.6$ to $11.6 \pm 5.3$ mm Hg ($p < 0.0001$).

*Circulation* 1982, 65:1369-1373
Nitrates

- Complex cardiovascular responses
- Concept of preload reduction inadequate
  - Dilate pulmonary and systemic resistance vessels
  - Thereby, translocate blood volume from the pulmonary circulation and LV to the systemic circulation
  - Relieve subendocardial ischaemia
  - Favourably alter the P/V relationship in LV
Nitrates

- Nitrates (either nitroglycerin or isosorbide dinitrate) have been shown to produce a substantial decrease in pulmonary artery pressure (30% to 50%)

Digoxin

- Complex beneficial mechanisms
  - Positive inotropic properties
  - Sympatholytic effects
  - Normalise baroreceptor responsiveness

Cardiac glycosides reduce right-sided filling pressures and increase cardiac output when they are given acutely to patients with right-heart failure

Plasma levels should be between 0.5-1.0 ng/ml

*Chest* 1998;114;787-792  
*Circulation* 1982, 65:1369-1373
Sleep disordered breathing

O.S.A

C.S.A

PERIODIC BREATHING

CHEYNE-STOKES

EPISODIC HYPOXIA

RESPONDS TO CPAP
CPAP for central sleep apnea and CHF: Heart-Transplantation–free Survival

Hypoxia

• A responsive pulmonary vasoconstriction (can lead to RVH)
• In hospital, supplemental oxygen advised to maintain oxygen saturation > 90% (pO₂ > 60mmHg)
• HOT – no clear recommendation
  – Undergoing study in the UK
Non invasive evaluation of oxygen therapy in CHF

Coad Output Change From Baseline

<table>
<thead>
<tr>
<th>Concentration</th>
<th>CO Change From Baseline (L/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Room Air</td>
<td></td>
</tr>
<tr>
<td>40%</td>
<td>Medical Air: 0.00, Oxygen: -0.25</td>
</tr>
<tr>
<td>High Conc</td>
<td>Medical Air: 0.00, Oxygen: -0.50</td>
</tr>
</tbody>
</table>

At 40%:
- Medical Air: p=0.452
- Oxygen: p=0.031

Forearm Blood Flow Change From Baseline

<table>
<thead>
<tr>
<th>Concentration</th>
<th>FBF Change From Baseline (ml/min/100ml forearm volume)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Room Air</td>
<td></td>
</tr>
<tr>
<td>40%</td>
<td>Medical Air: 0.00, Oxygen: 0.25</td>
</tr>
<tr>
<td>High Conc</td>
<td>Medical Air: 0.00, Oxygen: 0.50</td>
</tr>
</tbody>
</table>

At 40%:
- Medical Air: p=0.02
- Oxygen: p=0.01

At high concentration:
- Medical Air: p=0.01
- Oxygen: p=0.01

Heart 2010:96;533-538
**Non invasive evaluation of oxygen therapy in CHF**

<table>
<thead>
<tr>
<th></th>
<th>Medical air</th>
<th>Oxygen</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td>40%</td>
<td>High conc.</td>
</tr>
<tr>
<td><strong>Cardiac output (l/min)</strong></td>
<td>5.24 (1.04)</td>
<td>5.03 (0.88)</td>
<td>5.22 (0.99)</td>
</tr>
<tr>
<td><strong>Cardiac index (l/min/m²)</strong></td>
<td>2.66 (0.51)</td>
<td>2.54 (0.46)</td>
<td>2.63 (0.48)</td>
</tr>
<tr>
<td><strong>Stroke volume (ml/beat)</strong></td>
<td>80.38 (17.42)</td>
<td>80.38 (16.02)</td>
<td>79.97 (17.26)</td>
</tr>
<tr>
<td><strong>Stroke volume index (ml/beat/m²)</strong></td>
<td>40.77 (8.03)</td>
<td>40.46 (7.47)</td>
<td>40.33 (8.39)</td>
</tr>
<tr>
<td><strong>Heart rate (beats/min)</strong></td>
<td>66.21 (10.56)</td>
<td>63.65 (9.87)</td>
<td>66.62 (11.54)</td>
</tr>
<tr>
<td><strong>SVR (dyne/s/cm²)</strong></td>
<td>3940 (1017)</td>
<td>4319 (1280)</td>
<td>4175 (1128)</td>
</tr>
</tbody>
</table>

*Heart 2010:96;533-538*
# Enteral Nutrition-ESPEN Guidelines

## Summary of statements: Chronic heart failure (CHF)

<table>
<thead>
<tr>
<th>Subject</th>
<th>Recommendations</th>
<th>Grade&lt;sup&gt;68&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indication</td>
<td>EN is recommended in cardiac cachexia to stop or reverse weight loss on the basis of physiological plausibility. There is no indication for enteral nutrition (EN) in the prophylaxis of cardiac cachexia.</td>
<td>C</td>
</tr>
<tr>
<td>Contraindications</td>
<td>There are no specific contraindications. Avoid fluid overload.</td>
<td></td>
</tr>
</tbody>
</table>

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*Clinical Nutrition (2006) 25, 311–318*
Recalcitrant RHF: Concluding Ideas

- Normal sodium intake – 120 mmol/day
- Restrict oral fluid to 1-1.2 l/day
- Maximise MRA dose
- Reduce/stop β-blocker until “fluid neutral”
- Oxygen only if hypoxic
- CPAP for OSA – individualise
- Hydralazine/nitrate
- Digoxin
- Enteral nutrition