**Chronic Heart Failure**
Pathophysiology & Pharmacotherapy

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**Objectives**

Learners should be able to:
1) Summarize the basic pathophysiology of CHF
2) Describe basic signs & symptoms of CHF
3) Outline therapeutic goals of treating CHF
4) Describe the general approach to treatment of CHF

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**The Heart as a Target Organ**

- **Coronary Artery Disease**
- **Arrhythmia**
- **Valvular Heart Disease**
- **Hypertension**
- **Cardiomyopathy**

**Sympathetic Activation in Heart Failure**

- \( \uparrow \text{CNS sympathetic outflow} \)
- \( \uparrow \text{Cardiac sympathetic activity} \)
- \( \uparrow \text{Sympathetic activity to kidneys} \)
- \( \uparrow \text{Blood vessels} \)
- \( \text{Myocyte death} \)
- \( \text{Increased arrhythmias} \)
- \( \text{Vasoconstriction} \)
- \( \text{Sodium retention} \)
- \( \text{Disease progression} \)

**Chronic Heart Failure**

- **Systolic Dysfunction**
  - Impaired Ejection
  - Decreased Contractility
- **Diastolic Dysfunction**
  - Impaired Filling
  - Depressed Relaxation
  - Clinical trials lacking this group of patients

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Systolic and diastolic LV dysfunction compared with normal LV function. Solid lines indicate the extent of ventricular contraction during systole.

References: Noble/Textbook of Primary Care Medicine, 3rd Edition. 2001
NEW YORK HEART ASSOCIATION (NYHA) FUNCTIONAL CLASSIFICATION

Based on the degree of effort needed to elicit symptoms:

CLASS I  Pts. with documented heart disease of any type who are symptom free except with more than normal activity

CLASS II  Slight limitation of physical activity because symptoms (shortness of breath, chest pain) occur only with ordinary physical activity

CLASS III  Marked limitation of physical activity because symptoms occur even with less than ordinary physical activity (eg. eating meals)

CLASS IV  Severe limitation of physical activity because symptoms occur even at rest (eg. in a sitting or lying position)

Stages of Heart Failure

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>High risk of developing HF because of presence of conditions associated with development of HF. No structural or functional abnormalities of heart and has not shown s/sx HF</td>
<td>HTN, CAD, diabetes mellitus, history of rheumatic fever, family history of cardiomyopathy, history of cardiotoxic drug therapy or alcohol abuse</td>
</tr>
<tr>
<td>B</td>
<td>Patients who have developed structural heart disease that is strongly associated with development of HF, but have never shown s/sx HF</td>
<td>Left ventricular hypertrophy or fibrosis, asymptomatic valvular heart disease, previous MI, left ventricular dilatation or hypocontractility</td>
</tr>
<tr>
<td>C</td>
<td>Patients who have current or prior symptoms of HF associated with underlying structural heart disease</td>
<td>Dyspnea or fatigue due to LV systolic dysfunction; asymptomatic patients who are undergoing treatment for prior symptoms of HF</td>
</tr>
<tr>
<td>D</td>
<td>Patients with advanced structural heart disease marked symptoms of HF at rest despite maximal medical therapy and who require specialized interventions</td>
<td>Frequent hospitalizations for HF, on transplant list, hospice setting for management of HF, continuous intravenous support</td>
</tr>
</tbody>
</table>

Management of Heart Failure

Goal: To reduce morbidity and mortality while improving quality of life

Correct Underlying Causes: Hypertension, Ischemic Heart Disease, arrhythmias etc.

Restrict Fluid Intake: 1.5-2 liters is advised. Mod. alcohol intake is permitted

Restrict Sodium Intake: Intake should be limited to 2 grams/day (1 tsp table salt)

Drug Therapy:
- Diuretics
- Vasodilators (ACE-Is, ARBs)
- Beta-blockers
- Digoxin
- Spironolactone

Sodium Content in Everyday Food

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Amount</th>
<th>Mg of Sodium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbonated beverage</td>
<td>12 oz.</td>
<td>25-50</td>
</tr>
<tr>
<td>Milk</td>
<td>1 cup</td>
<td>125</td>
</tr>
<tr>
<td>Tomato Juice</td>
<td>6 oz.</td>
<td>660</td>
</tr>
<tr>
<td>Waffle</td>
<td>7” diam.</td>
<td>515</td>
</tr>
<tr>
<td>Corn flakes</td>
<td>1 cup</td>
<td>300</td>
</tr>
<tr>
<td>Cheeseburger</td>
<td>1</td>
<td>616</td>
</tr>
<tr>
<td>Big Mac®</td>
<td>1</td>
<td>1100</td>
</tr>
<tr>
<td>Turkey luncheon</td>
<td>1 slice</td>
<td>200</td>
</tr>
<tr>
<td>Vegetable soup</td>
<td>1/4 cup</td>
<td>823</td>
</tr>
<tr>
<td>Dill pickle</td>
<td>1</td>
<td>928</td>
</tr>
</tbody>
</table>

Stages for Systolic HF

<table>
<thead>
<tr>
<th>Stage A</th>
<th>Stage B</th>
<th>Stage C</th>
<th>Stage D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospice</td>
<td>VAD, Transplant</td>
<td>ACE Inhibitors and beta-blockers</td>
<td>Treat HTN, DM, Dyslipidemia, CAD</td>
</tr>
<tr>
<td>Adrenergic antagonists</td>
<td>Cardiac resynchronization if LBB</td>
<td>ACE Inhibitors and Beta-blockers if selected patients</td>
<td>Risk factor reduction</td>
</tr>
</tbody>
</table>

Key Evidence-Based HF Trials

- ACEI: SOLVD (Prev. vs. Treatment)
- β-blockers: MERIT-HF, COPERNICUS, COMET
- Diuretics: RALES, EPHEBUS (Post-MI)
- Digoxin: DIG
- ARBs: CHARM, Val-HeFT
- Vasodilators: V-HeFT I
- CCB: PRAISE

**Diuretics**

- Consider for all patients predisposed to fluid retention
- Loops are considered the drug of choice
- Metolazone may be used in addition to a loop in cases of severe volume overload
- Monitor: daily weight, potassium, renal function

**ACE Inhibitors in Heart Failure**

- Start low and wait at least two weeks before increasing dose
- Dose titration is based on target dose rather than symptomatic improvement (Atlas Trial)
  - Consider dividing the dose if necessary
- Monitor: BP, renal function, potassium

**Beta-blockers in Heart Failure**

- Patient should be on background ACE inhibition
- Start at a low dose
- Wait at least two weeks before increasing dose
- Monitor BR, HR, clinical status (congestion, mental status)
- Use caution when starting in an unstable NYHA III or IV patient
- Avoid in patients with reactive airway disease, symptomatic bradycardia, or advanced heart block

**Beta-blockers for CHF**

<table>
<thead>
<tr>
<th>Medication</th>
<th>Brand Name</th>
<th>Initiating Dose</th>
<th>Maintenance Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carvedilol</td>
<td>Coreg</td>
<td>3.125mg BID</td>
<td>25mg BID if PR</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>50mg BID</td>
</tr>
<tr>
<td>Metoprolol</td>
<td>Lopressor</td>
<td>6.125mg BID</td>
<td>75mg BID</td>
</tr>
<tr>
<td>Metprolol XL</td>
<td>Toprol XL</td>
<td>12.5-25mg QD</td>
<td>200mg QD</td>
</tr>
<tr>
<td>Bisoprolol</td>
<td>Zebeta</td>
<td>1.25mg QD</td>
<td>20mg QD</td>
</tr>
</tbody>
</table>

**Digoxin in Heart Failure**

- Use in patients who remain symptomatic despite use of an ACE inhibitor & β-blocker
- No need to load for chronic heart failure
- Use low dose (0.125mg QD or QOD) if patient is >70 y.o. or has impaired renal fxn
- Little evidence to support monitoring levels in chronic heart failure
- Monitor: HR, GI, Neuro
- Withdrawal of digoxin is NOT recommended

**Spironolactone in Heart Failure**

- Consider using in patients who remain symptomatic (NYHA III) despite the use of an ACE inhibitor, β-blocker, digoxin and diuretics
- Monitor potassium
<table>
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<tr>
<th><strong>ARBs in Heart Failure</strong></th>
</tr>
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<tbody>
<tr>
<td>• Clearly beneficial when ACE inhibitors cannot (sign. Cough/angioedema) be used (CHARM-Alternative, ValHeFT)</td>
</tr>
<tr>
<td>• Appear to be beneficial when added to optimal HF therapy (CHARM-Added) IIb</td>
</tr>
<tr>
<td>• Not to be used before a beta-blocker</td>
</tr>
<tr>
<td>• Monitor: BP, renal function, potassium</td>
</tr>
</tbody>
</table>