Introduction to Heart Failure

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Heart Failure

Heart Failure is a complex clinical syndrome that can result from any structural or functional cardiac disorder that impairs the ability of the ventricle to fill with or eject blood.
Heart Failure
vs.
“Congestive Heart Failure” or CHF

Because not all patients have volume overload and Heart Failure is considered a lifelong condition, the term “heart Failure” is preferred over the older term Congestive Heart Failure or CHF
Acute Decompensated Heart Failure

• New onset of severe heart failure OR sudden intensification of chronic HF

• Life threatening condition that usually requires hospitalization and is the most common cause of hospital admission among patients with heart failure
Heart Failure Statistics

• Heart failure is the most common type of heart related hospital admission
• Heart failure accounts for 1 million discharges in the United States
• Effects 10% of men and 8% of women over the age of 60
• Incidence increases with age
• In 2010 the cost of HF was estimated to be 39.2 Billion dollars

## Conditions Associated with Heart Failure

<table>
<thead>
<tr>
<th>Abnormal Volume Load</th>
<th>Abnormal Pressure Load</th>
<th>Myocardial Abnormalities</th>
<th>Filling Disorders</th>
<th>Increased Metabolic Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aortic Valve incompetence</td>
<td>Aortic Stenosis</td>
<td>Cardiomyopathy</td>
<td>Mitral Stenosis</td>
<td>Anemias</td>
</tr>
<tr>
<td>Mitral Valve incompetence</td>
<td>Hypertrophic Cardiomyopathy</td>
<td>Myocarditis</td>
<td>Tricuspid Stenosis</td>
<td>Thyrotoxicosis</td>
</tr>
<tr>
<td>Tricuspid Valve incompetence</td>
<td>Coarctation of the Aorta</td>
<td>Coronary Heart Disease</td>
<td>Cardiac Tamponade</td>
<td>Fever</td>
</tr>
<tr>
<td>Left to Right Shunts</td>
<td>Hypertension</td>
<td>Ischemia</td>
<td>Restrictive Pericarditis</td>
<td>Beriberi</td>
</tr>
<tr>
<td>Secondary hypervolemia</td>
<td></td>
<td>Infarction</td>
<td>Restrictive Cardiomyopathy</td>
<td>Paget’s Disease</td>
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<td></td>
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<td>Arrhythmias</td>
<td>Arteriovenous Fistulas</td>
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<td>Toxic Disorders – Alcohol/Cocaine</td>
<td>Pulmonary Emboli</td>
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<td>Cardiac Depressants or salt retaining drugs</td>
<td>Systemic Emboli</td>
</tr>
</tbody>
</table>
Comorbidities & Risk Factors for developing heart failure

- Hypertension
- CAD
- Diabetes
- Chronic Renal Disease
- Chronic Obstructive Pulmonary Disease
- Dysrhythmias (Atrial Fibrillation)
- Smoking
- Increased body mass index
- Abdominal fat accumulation
## Definition of Heart Failure

<table>
<thead>
<tr>
<th>Classification</th>
<th>Ejection Fraction</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Heart Failure with Reduced Ejection Fraction (HFrEF)</td>
<td>≤40%</td>
<td>Also referred to as systolic HF. Randomized clinical trials have mainly enrolled patients with HFrEF and it is only in these patients that efficacious therapies have been demonstrated to date.</td>
</tr>
<tr>
<td>II. Heart Failure with Preserved Ejection Fraction (HFpEF)</td>
<td>≥50%</td>
<td>Also referred to as diastolic HF. Several different criteria have been used to further define HFpEF. The diagnosis of HFpEF is challenging because it is largely one of excluding other potential noncardiac causes of symptoms suggestive of HF. To date, efficacious therapies have not been identified.</td>
</tr>
<tr>
<td>a. HFpEF, Borderline</td>
<td>41% to 49%</td>
<td>These patients fall into a borderline or intermediate group. Their characteristics, treatment patterns, and outcomes appear similar to those of patients with HFpEF.</td>
</tr>
<tr>
<td>b. HFpEF, Improved</td>
<td>&gt;40%</td>
<td>It has been recognized that a subset of patients with HFpEF previously had HFrEF. These patients with improvement or recovery in EF may be clinically distinct from those with persistently preserved or reduced EF. Further research is needed to better characterize these patients.</td>
</tr>
</tbody>
</table>
Systolic vs. Diastolic

- Systolic Dysfunction
  - HF Symptoms and **reduction** in Left Ventricular Ejection Fraction (<0.50)
- Diastolic Dysfunction
  - HF Symptoms and **preserved** LVEF
Systolic Dysfunction

- Impaired Pump
- EF $< 0.50$
- Enlarged end diastolic chamber volume
- Dilated ventricle, often thin walled
- May be eccentrically hypertrophied
- Clinical manifestations of LV systolic dysfunction result from inadequate cardiac output and fluid retention
Diastolic Dysfunction

• Normal systolic function in the presence of clinical HF
• Increased resistance to filling
• One or both ventricles becoming stiff or noncompliant
• Reduction in ventricle relaxing compromising
• Ventricle walls are thick
Left Sided Heart Failure Symptoms

• Associated with elevated pulmonary venous pressure and decreased cardiac output

• Appears as breathlessness, weakness, fatigue, dizziness, confusion, pulmonary congestion, hypotension
Left Sided Heart Failure Symptoms
(continued)

• Weakness – decreased profusion to muscles
• Decreased cerebral profusion – changes in mental status – restlessness, insomnia, nightmares, memory loss, anxiety, feeling of impending doom (late stage)
• Pulmonary congestion – high pulmonary pressures cause filtration of fluid into the intestinal space.
• Nocturnal dyspnea – postural redistribution of blood flow that increases venous return
LEFT SIDED HEART FAILURE

- Paroxysmal Nocturnal Dyspnea
- Elevated Pulmonary Capillary Wedge Pressure
- Pulmonary Congestion
  - Cough
  - Crackles
  - Wheezes
  - Blood-Tinged Sputum
  - Tachypnea
- Restlessness
- Confusion
- Orthopnea
- Tachycardia
- Exertional Dyspnea
- Fatigue
- Cyanosis

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Right Sided Heart Failure Symptoms

• Increased systemic venous pressure
• Jugular venous distension
• Hepatomegaly – large tender pulsating liver
• Dependent peripheral edema – Starts in lower legs and ascends to the thighs & abdominal wall
• Ascites – pressure causes the fluid to ooze into the abdominal cavity
RIGHT SIDED HEART FAILURE
(Cor Pulmonale)

- Fatigue
- ↑ Peripheral Venous Pressure
- Ascites
- Enlarged Liver & Spleen
- May be secondary to chronic pulmonary problems
- Distended Jugular Veins
- Anorexia & Complaints of GI Distress
- Weight Gain
- Dependent Edema
Key Assessment Findings
Acute Decompensated Heart Failure

• The goal in assessing the patient with HF is to determine the type and severity of the underlying diseases causing HF and the extent of the HF syndrome
Cardiovascular Assessment

• Pulse rate is usually high
• Increased heart size and a shifting of the apical impulse down and to the left
• (ADD S1S2) Third Heart Sound (S₃) or Fourth Heart Sound (S₄)
• Mitral regurgitation (insert heart sound)
• Jugular Venous Pulse – Distention: reflect filling volume and pressure on the right side of the heart
Abdominojugular reflux – reflection of right ventricular failure

Distended Jugular Vein

Increased distention when pressing on periumbilical area 30-60 seconds.
Pulmonary Assessment

• Pulmonary Crackles
• Dependent portions initially then become diffuse and heard over the entire chest
• Rate and pattern reflect severity of pulmonary compromise—Tachypnea to periodic respirations (Cheyne-Stokes)
Acute Pulmonary Edema

- Catastrophic indicator of Heart Failure
- Rapid movement of fluid out of the intravascular and interstitial spaces into the alveoli
- Alveoli are no longer open
- Fluid invades the large airways
- Pts are acute short of breath
- Gasping, Cyanotic
- Frothy Pink Sputum
Integumentary Assessment

- Dependent edema
- Feet, ankles or sacral area
- Pallor, coolness, cyanosis & diaphoresis
- Cardiac cachexia – decrease in tissue mass – long standing HF
Gastrointestinal Assessment

- Hepatomegaly – Liver span is increased and the liver is palpated well below the right costal margin
Pathophysiology of Heart Failure

- Coughing
- Tiredness
- Shortness of breath
- Pulmonary edema (excess fluid in lungs)
- Pumping action of the heart grows weaker
- Pleural effusion (excess fluid around lungs)
- Swelling in abdomen (ascites)
- Swelling in ankles and legs
Pressure Load → Myocardial Failure → Heart Pump Failure → Diastolic Dysfunction

Volume Load → Myocardial Failure

Myocardial Abnormality → Myocardial Failure

Diastolic Dysfunction

- ↑ Ventricular diastolic pressure
- ↑ Peripheral Capillary Pressure
- ↑ Pulmonary Capillary Pressure
- Congestion → Edema, Dyspnea

Heart Pump Failure

- ↑ Sympathetic activity
- ↑ Peripheral vasoconstriction
- Decreased arterial blood volume

Systolic Dysfunction

- ↑ Renin Angiotensin
- ↑ Aldosterone
- ↑ Peripheral resistance
- ↑ Na, H2O Retention
- ↑ Plasma Volume
- Ventricular Stiffness
- Ventricular Distention

Increased arterial blood volume

- Renal vasoconstriction
- Peripheral vasoconstriction
- Sympathetic activity
- Peripheral resistance
- Renin Angiotensin
- Aldosterone
Cardio Renal Mechanism of Heart Failure

Sympathetic Activity
Contribution to Heart Failure


↓ β-AR responsiveness
Myocyte hypertrophy
Myocyte necrosis and apoptosis, fibrosis
↓ Norepinephrine stores
↓ Sympathetic innervation
Arrhythmias
Impaired diastolic, systolic function

↑ Tubular reabsorption of Na⁺
Activation of RAS
↑ Renal vascular resistance
↓ Response to natriuretic factors

Neurogenic vasoconstriction
Vascular hypertrophy
# Neurohormonal Response  **Short & Long Term**

<table>
<thead>
<tr>
<th>Mechanism</th>
<th>Short Term Adaptive</th>
<th>Long Term Maladaptive</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Functional</strong></td>
<td>Adaptive Response</td>
<td>Maladaptive Consequences</td>
</tr>
<tr>
<td>Salt and water retention</td>
<td>↑Preload, maintain cardiac output</td>
<td></td>
</tr>
<tr>
<td>Vasoconstriction</td>
<td>↑Afterload, maintain blood pressure</td>
<td></td>
</tr>
<tr>
<td>Cardiac B-adrenergic drive</td>
<td>↑Contractility, ↑ Relaxation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>↑Heart Rate</td>
<td>Edema, anasarca, pulmonary congestion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>↓Cardiac output, ↑Energy expenditure, cardiac necrosis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>↑cytosolic calcium (arrhythmias &amp; sudden death)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>↑Cardiac Energy Demand</td>
</tr>
<tr>
<td><strong>Pro inflammatory</strong></td>
<td>“Anti Other”</td>
<td>“Anti-Self”</td>
</tr>
<tr>
<td>Microbial, helminthic</td>
<td>Adaptive Hypertrophy</td>
<td>Cachexia (Skeletal catabolism)</td>
</tr>
<tr>
<td>Adaptive Hypertrophy</td>
<td></td>
<td>Skeletal muscle myopathy</td>
</tr>
<tr>
<td><strong>Proliferative</strong></td>
<td>Adaptive Hypertrophy</td>
<td>Maladaptive Hypertrophy</td>
</tr>
<tr>
<td>Transcriptional</td>
<td>Cell thickening (normal wall stress, maintain cardiac output)</td>
<td></td>
</tr>
<tr>
<td>activation</td>
<td>↑Sarcomere number</td>
<td>Cell elongation (dilation, remodeling, increased wall stress)</td>
</tr>
<tr>
<td>More sarcomeres</td>
<td></td>
<td>Apoptosis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>↑Cardiac Energy Demand</td>
</tr>
</tbody>
</table>
Remodeling

- Apoptosis
- Physiologic hypertrophy
- Athlete's heart
- Normal
- Concentric hypertrophy
- Pressure overload
- Hypertrophic cardiomyopathy
- Sarcomeric disorganization
- Eccentric hypertrophy
- Volume overload (dilated cardiomyopathy)

Drexler & Hasenfuss, 2001
At Risk for Heart Failure

STAGE A
At high risk for HF but without structural heart disease or symptoms of HF
- e.g., Patients with:
  - HTN
  - Atherosclerotic disease
  - DM
  - Obesity
  - Metabolic syndrome or
  - Patients Using cardiotonins
  - With family history of cardiomyopathy

THERAPY
Goals
- Heart healthy lifestyle
- Prevent vascular, coronary disease
- Prevent LV structural abnormalities

Drugs
- ACEI or ARB in appropriate patients for vascular disease or DM
- Statins as appropriate

STAGE B
Structural heart disease but without signs or symptoms of HF
- e.g., Patients with:
  - Previous MI
  - LV remodeling including LVH and low EF
  - Asymptomatic valvular disease

THERAPY
Goals
- Prevent HF symptoms
- Prevent further cardiac remodeling

Drugs
- ACEI or ARB as appropriate
- Beta blockers as appropriate

In selected patients
- ICD
- Revascularization or valvular surgery as appropriate

STAGE C
Structural heart disease with prior or current symptoms of HF
- e.g., Patients with:
  - Known structural heart disease and HF signs and symptoms

THERAPY
Goals
- Control symptoms
- Improve HRQOL
- Prevent hospitalization
- Prevent mortality

Drugs for routine use
- Diuretics for fluid retention
- ACEI or ARB
- Beta blockers
- Aldosterone antagonists

Drugs for use in selected patients
- Hydralazine/isosorbide dinitrate
- ACEI and ARB
- Digoxin

In selected patients
- CRT
- ICD
- Revascularization or valvular surgery as appropriate

Heart Failure

STAGE D
Refractory HF
- e.g., Patients with:
  - Marked HF symptoms at rest
  - Recurrent hospitalizations despite GDMT

THERAPY
Goals
- Control symptoms
- Improve HRQOL
- Reduce hospital readmissions
- Establish patient’s end-of-life goals

Options
- Advanced care measures
- Heart transplant
- Chronic inotropes
- Temporary or permanent MCS
- Experimental surgery or drugs
- Palliative care and hospice
- ICD deactivation

Heart Failure
- HFpEF
- HFrEF

Goals
- Prevent HF symptoms
- Prevent further cardiac remodeling

Drugs
- ACEI or ARB as appropriate
- Beta blockers as appropriate

In selected patients
- ICD
- Revascularization or valvular surgery as appropriate

Development of symptoms of HF

REFRACTORY SYMPTOMS OF HF
- Refractory symptoms of HF at rest, despite GDMT

STAGE A
At high risk for HF but without structural heart disease or symptoms of HF

STAGE B
Structural heart disease but without signs or symptoms of HF

STAGE C
Structural heart disease with prior or current symptoms of HF

STAGE D
Refractory HF

Refractory symptoms of HF at rest, despite GDMT
Resources

Medtronic:  http://www.medtronic.com
Scios: http:// www.sciosinc.com
American Heart Association:  http://www.americanheart.org
www.acc.org/qualityandscience/clinical/slides/HFSlidesMASTER.ppt
Woods, Susan et al. Cardiac Nursing. 2010  Lippincott, Williams & Wilkins.