Heart Failure
Background, recognition, diagnosis and management

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Disclosures

- Speaker bureau: Novartis
Objectives

At the conclusion of this activity, participants will be able to:

- Recognize signs and symptoms of heart failure and initial diagnosis approach
- Identify the pathophysiology of heart failure
- Discuss the value of a “Team approach/multidisciplinary care “
Definition

- HF is a complex clinical syndrome that results from any structural or functional impairment of ventricular filling or ejection of blood

  - The cardinal manifestations of HF
    - Dyspnea and fatigue
    - Fluid retention, which may lead to pulmonary and/or splanchnic congestion and/or peripheral edema.

  - Clinical Diagnosis
A Growing and Unstable Burden for Patients, Caregivers, Healthcare Providers, and Payers

Annual Mortality for HF Is Higher Than That of Some Common Cancers

Approximately 50% of patients with HF have HFrEF\(^1\)

Number of Deaths, 2013

<table>
<thead>
<tr>
<th>Condition</th>
<th>Number of Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prostate Cancer</td>
<td>29,720(^2)</td>
</tr>
<tr>
<td>Pancreatic Cancer</td>
<td>38,460(^2)</td>
</tr>
<tr>
<td>Breast Cancer</td>
<td>40,030(^2)</td>
</tr>
<tr>
<td>Colon or Rectal Cancer</td>
<td>50,830(^2)</td>
</tr>
<tr>
<td>HF</td>
<td>65,120(^3)</td>
</tr>
</tbody>
</table>

HFrEF: 40% Rate of Mortality Within 5 Years in the PREVEND Study

Risk of CV Death

Mode of Death in Patients With Heart Failure With Reduced EF by NYHA Class

NYHA Class II
1-year mortality: 6.3%
- Sudden death: 64%
- CHF: 12%
- Other: 24%
- n=103

NYHA Class III
1-year mortality: 10.5%
- Sudden death: 59%
- CHF: 26%
- Other: 15%
- n=232

NYHA Class IV
1-year mortality: 18.6%
- Sudden death: 33%
- CHF: 56%
- Other: 11%
- n=27

### Heart Failure Progression, Morbidity, and Mortality

- With each acute event, myocardial injury may contribute to progressive LV dysfunction
- Increasing frequency of acute events with disease progression leads to high rates of hospitalization and increased risk of mortality

50% of people diagnosed with HF, 75 years of age, will die within 5 years

<table>
<thead>
<tr>
<th>NYHA Classification</th>
<th>% of HF Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>NYHA I</td>
<td>Compensated</td>
</tr>
<tr>
<td>NYHA II</td>
<td>Chronically</td>
</tr>
<tr>
<td>NYHA III</td>
<td>Acutely</td>
</tr>
<tr>
<td>NYHA IV</td>
<td>Death</td>
</tr>
</tbody>
</table>

- Episode of acute decompensation
- Death as part of an acute decompensation
- Sudden death at any timepoint

- **45%** of CV deaths due to sudden death
- **26%** of CV deaths due to pump failure

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Etiology

- Ischemic Cardiomyopathy

- Non-Ischemic Cardiomyopathy
  - Structural Heart Disease
  - Toxic
  - Tachycardia mediated cardiomyopathy
  - Myocarditis/Inflammatory
  - Peripartum
I. Heart Failure with reduced ejection fraction (HF\textsubscript{r}EF) EF $\leq 40\%$

II. Heart Failure with preserved ejection fraction (HF\textsubscript{p}EF) EF $\geq 50\%$

   I. HF\textsubscript{p}EF, borderline EF 41-49 %

   II. HF\textsubscript{p}EF, improved $> 40\%$

2017 ACC/AHA Guideline for the Management of Heart Failure
Risk Factors

- Hypertension
  - *Single most important modifiable risk factor*
- Diabetes Mellitus
  - *Clinical diabetes mellitus markedly increases the likelihood of developing HF in patients without structural heart disease*
- Metabolic Syndrome
  - (abdominal adiposity, hypertriglyceridemia, low high density lipoprotein, hypertension, and fasting hyperglycemia)
  - Prevalence 20% ≥ 20 years of age and 40% > 40 years of age
- Atherosclerotic Disease
  - Coronary, cerebral or peripheral disease
Hypertension remains the most important cause of HFpEF, with a prevalence of 60% to 89%.
- Older women
- Obesity
- CAD
- Diabetes mellitus
- Atrial fibrillation
- Hyperlipidemia
Imbalance in Neurohormonal Systems Drives HF Progression

Hasenfuss G, Mann DL. In: Braunwald’s Heart Disease. 2015:454-472.
Pathophysiology HFrEF

HFrEF OLD
- Hypertension
  - Concentric Remodeling
    - LVH/Fibrosis/Diastolic Dysfunction
    - NH Activation

HFrEF NEW
- Comorbidity Driven Microvascular Inflammation
  - Myocardial Inflammation
    - Fibrosis
    - Impaired NO - cGMP Signaling
      - Concentric Remodeling
      - Cardiomyocyte Diastolic Dysfunction

†Paulus W et al, JACC, 2013
# 2017 ACC/AHA/HFSA Focused Update.

<table>
<thead>
<tr>
<th>ACCF/AHA Stages of HF</th>
<th>NYHA Functional Classification</th>
<th>Symptom Terminology</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong></td>
<td>At high risk for HF but without structural heart disease or symptoms of HF</td>
<td>None</td>
</tr>
<tr>
<td><strong>B</strong></td>
<td>Structural heart disease but without signs or symptoms of HF</td>
<td>I</td>
</tr>
<tr>
<td><strong>C</strong></td>
<td>Structural heart disease with prior or current symptoms of HF</td>
<td>I</td>
</tr>
<tr>
<td></td>
<td></td>
<td>II</td>
</tr>
<tr>
<td></td>
<td></td>
<td>III</td>
</tr>
<tr>
<td><strong>D</strong></td>
<td>Refractory HF requiring specialized interventions</td>
<td>IV</td>
</tr>
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ACCF, American College of Cardiology Foundation; AHA, American Heart Association; HF, heart failure; NYHA, New York Heart Association
NYHA Classification

Class I  Ordinary physical activity does not cause HF symptoms
Class II Ordinary physical activity results in HF symptoms
Class III Less-than-ordinary physical activity results in HF symptoms
Class IV Any physical activity results in HF symptoms; HF symptoms at rest

Initial Evaluation

**HISTORY**
- Severity and triggers of dyspnea and fatigue
- Exercise capacity
- Physical activity
- Presence of chest pain
- Weight gain
- Peripheral edema/Ascites
- Duration of illness
- Change in appetite
- Palpitations

**PHYSICAL EXAM**
- Weight
- Blood pressure/Orthostatic Changes
- JVD/HJR
- Extra Heart Sounds (s3)
- Rales, pleural effusion
- Hepatomegaly/Ascites
- Peripheral Edema
- LE temperature
Diagnostic Test

LABORATORY
- CBC with Diff
- Chem-10
- LFT’s
- Lipid Profile
- TSH
- NT-Pro BNP

IMAGING
- Chest Xray (2V)
- Echocardiogram

ECG
Pro-BNP, Why is it lower in HFpEF?

- Wall stress → BNP production
- Wall stress = P * radius/wall thickness

Normal  HFpEF  SHF
Does an elevated BNP diagnose HF?

- **Neurohormonal of cytokine cardiac stimulation**
  - Hyperthyroidism
  - Sepsis
  - Shock
  - Intracranial pathologies

- **Cardiac infiltrative, inflammation or infectious diseases**
  - Cardiac amyloidosis
  - Infective endocarditis
  - Myocarditis
  - Pericarditis
  - Kawasaki disease

- **High-output status**
  - Hyperdynamic circulation
  - Volume expansion

- **Right ventricular dysfunction secondary to pulmonary diseases**
  - Pulmonary embolism
  - Pulmonary hypertension
  - Chronic lung diseases

- **Decreased clearance**
  - Acute or chronic renal failure
  - Advanced age

- **Systolic or diastolic left ventricular dysfunction or hypertrophy**
  - Acute or decompensate heart failure*
  - Acute coronary syndrome
  - Valvular heart diseases
  - Cardiac dysrhythmia
  - Congenital heart diseases
  - Carbon monoxide poisoning
Hypertension and lipid disorders should be controlled in accordance with contemporary guidelines to lower the risk of HF.

Strict management of contributing conditions:

- Obesity, diabetes mellitus, tobacco use, and known cardio toxic agents, should be controlled or avoided.
Treatment of HFrEF Stage C and D
2017 ACC/AHA/HFSA Focused Update

Step 1
Establish Dx of HFrEF; assess volume; initiate GDMT

HF/HF
NYHA class I–IV (Stage C)

ACEI or ARB AND GDMT beta blocker; diuretics as needed (COR I)

Step 2
Consider the following patient scenarios

NYHA class II–IV, provided est. CrCl >30 mL/min & K+<5.0 mEq/L

NYHA class II–III HF
Adequate BP on ACEI or ARB*, No CVA to ARB or sacubitril

NYHA class III–IV, in black patients

NYHA class II–III, LVEF ≤35%; (caveat: >1 y survival, >40 d post MI)

NYHA class II–IV, LVEF ≤35%, NSR & QRS ≥150 ms with LBBB pattern

NYHA class II–III, NSR, heart rate ≥70 bpm on maximally tolerated dose beta blocker

Step 3
Implement indicated GDMT. Choices are not mutually exclusive, and no order is inferred

Aldosterone antagonist (COR I)

Discontinue ACEI or ARB; initiate ARNI* (COR I)

Hydral-Nitrates†† (COR I)

ICD‡ (COR I)

CRT or CRT-D‡ (COR I)

Ivabradine (COR IIa)

Step 4
Reassess symptoms

Refractory NYHA class III–IV (Stage D)

Symptoms improved

Step 5
Consider additional therapy

Palliative care‡ (COR I)

Transplant‡ (COR I)

LVAD‡ (COR IIa)

Investigational studies§

Continue GDMT with serial reassessment & optimized dosing/adherence
New Therapies Available

- CardioMEMS
  - Implantable PA sensor
  - Ambulatory PA pressure monitoring
  - NYHA class III patients and a HF hospitalization in the last year.
CardioMEMS™ HF System

PA Pressure Sensor on Catheter Delivery System

4.5cm 120cm

Hospital and Patient Electronics Unit

PA Pressure Database

Physician Access Via Secure Website

[Image of medical equipment and diagrams]
CardioMEMS

Actionable Data
Stage D, NYHA IV → Stage C, NYHA I
Thank you.
An estimated 5.7 million Americans aged ≥20 years have heart failure (HF), and 870,000 new cases occur annually\(^1\)

Prevalence of HF is projected to increase 46% from 2012 to 2030, resulting in >8 million people ≥18 years of age with HF\(^2\)

Approximately half of patients presenting with symptoms of HF have reduced LVEF (≤40%)\(^3\)

- **Definite HFrEF**: LVEF <35%, <40%, and ≤40%\(^1\)
- **Uncertain**: LVEF 40-50%\(^1\)
- **Definite HFpEF**: LVEF >40%, >45%, >50%, and ≥55%\(^3\)

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<th>Definite HFpEF</th>
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<td>Proportion</td>
<td>50%</td>
<td>14%</td>
<td>36%</td>
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Heart failure costs the nation an estimated $32 billion each year.

HFpEF: heart failure with preserved ejection fraction; LVEF: left ventricular ejection fraction

Recommendations for Renin-Angiotensin System Inhibition With ACE Inhibitor or ARB

1. Yancy CW, et.al., 2016 ACC/AHA/HFSA Focused Update on New Pharmacological Therapy for Heart Failure: An Update
Class I

Use of 1 of the 3 beta blockers proven to reduce mortality (eg, bisoprolol, carvedilol, and sustained-release metoprolol succinate) is recommended for all patients with current or prior symptoms of HFrEF, unless contraindicated, to reduce morbidity and mortality. (Level of Evidence: A)
Aldosterone receptor antagonist

- NYHA class II–IV HF and who have LVEF of 35% or less.
- Creatinine should be 2.5 mg/dL or less in men or 2.0 mg/dL or less in women, and potassium should be less than 5.0 mEq/L.
- Following an acute MI in patients who have LVEF of 40% or less who develop symptoms of HF or who have a history of diabetes mellitus.
Hydralazine and nitrates

- African Americans with NYHA class III–IV HFrEF receiving optimal therapy with ACE inhibitors and beta blockers.
- Intolerance to ACE/ARB
Treatment of Stage C

NON PHARMACOLOGICAL

- Specific education to facilitate HF self-care
- Sodium restriction (<3 g/dl)
- CPAP, improve functional status in patients with HF and sleep apnea
- Regular physical activity
- Cardiac Rehab
Outline

- Definition
- Prevalence
- Etiology
- Classification
- Initial Evaluation
- Pharmacological and Non pharmacological Interventions
- New Therapies in Heart Failure
## Heart Failure Progression, Morbidity, and Mortality

- With each acute event, myocardial injury may contribute to progressive LV dysfunction
- Increasing frequency of acute events with disease progression leads to high rates of hospitalization and increased risk of mortality, 50% of people diagnosed with HF, 75 years of age, will die within 5 years

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<tr>
<td>Chronically decompensated</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Acutely decompensated</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

- **Episode of acute decompensation**
- **Death as an “end stage” of disease**

The mortality rate in patients with HFrEF remains high despite the advent of new therapies.

Despite enormous efforts in research, only small prolongations in survival have been achieved with new therapeutic approaches.

### Study (yr) Intervention ↓ Mortality

- **SOLVD-T**
  - (1991)
  - Enalapril
  - 16% risk reduction all-cause mortality; 18% risk reduction CV death

- **RALES**
  - (1999)
  - Spironolactone
  - 30% risk reduction all-cause mortality; 31% risk reduction CV death

- **MERIT-HF**
  - (1999)
  - Metoprolol CR/XL
  - 34% risk reduction all-cause mortality

- **BEST**
  - (2001)
  - Bucindolol
  - NS difference

- **COPERNICUS**
  - (2001)
  - Carvedilol
  - 35% lower risk of all-cause death

- **EMPHASIS**
  - (2011)
  - Eplerenone
  - 24% risk reduction all-cause mortality

HF, heart failure; HFrEF, heart failure reduced ejection fraction


Echocardiogram report interpretation.

- **HFpEF**
  - Grade I/Impaired relaxation Abnormality= Normal filling pressures.
  - Grade II/Pseudonormal pattern= ↑ filling pressures
  - Grade III/Restrictive pattern= ↑↑ filling pressures

- Echocardiographic limitations to diagnosis.
  - Clinical evaluation and risk profile for HFrEF
HFpEF. Treatment

- Beta Blockers to ↓ HR in pts with NSR, Abn Relaxation and DOE
- Avoid ↓ HR in pts with Restrictive Filling and Severe Sxs
- BP still high, another reason to add BB
### Recommendations for Treatment of Stage B HF

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>COR</th>
<th>LOE</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>In patients with a history of MI and reduced EF, ACE inhibitors or ARBs should be used to prevent HF</td>
<td>I</td>
<td>A</td>
<td>314, 342–345</td>
</tr>
<tr>
<td>In patients with MI and reduced EF, evidence-based beta blockers should be used to prevent HF</td>
<td>I</td>
<td>B</td>
<td>346–348</td>
</tr>
<tr>
<td>In patients with MI, statins should be used to prevent HF</td>
<td>I</td>
<td>A</td>
<td>104, 349–354</td>
</tr>
<tr>
<td>Blood pressure should be controlled to prevent symptomatic HF</td>
<td>I</td>
<td>A</td>
<td>27, 94, 311–313</td>
</tr>
<tr>
<td>ACE inhibitors should be used in all patients with a reduced EF to prevent HF</td>
<td>I</td>
<td>A</td>
<td>65, 344</td>
</tr>
<tr>
<td>Beta blockers should be used in all patients with a reduced EF to prevent HF</td>
<td>I</td>
<td>C</td>
<td>N/A</td>
</tr>
<tr>
<td>An ICD is reasonable in patients with asymptomatic ischemic cardiomyopathy who are at least 40 d post-MI, have an LVEF ≤30%, and on GDMT</td>
<td>IIa</td>
<td>B</td>
<td>355</td>
</tr>
<tr>
<td>Nondihydropyridine calcium channel blockers may be harmful in patients with low LVEF</td>
<td>III: Harm</td>
<td>C</td>
<td>N/A</td>
</tr>
</tbody>
</table>

ACE indicates angiotensin-converting enzyme; ARB, angiotensin-receptor blocker; COR, Class of Recommendation; EF, ejection fraction; GDMT, guideline-directed medical therapy; HF, heart failure; ICD, implantable cardioverter-defibrillator; LOE, Level of Evidence; LVEF, left ventricular ejection fraction; MI, myocardial infarction; and N/A, not available.

HFpEF. Treatment

ACC/AHA Guidelines 2009
Class I

• Control of BP
  • Agents not specified 2009
  • ACEi, ARB and Beta blockers
    • IIa as first line HTN therapy in 2013 GL
• Control of tachycardia in AF
• Reduction in Central Blood Volume