หัวใจล้มเหลว

Heart failure

สมเกียรติ แสงวัฒนาโรจน์ พบ.

สาขาวิชาโรคหัวใจและหลอดเลือด

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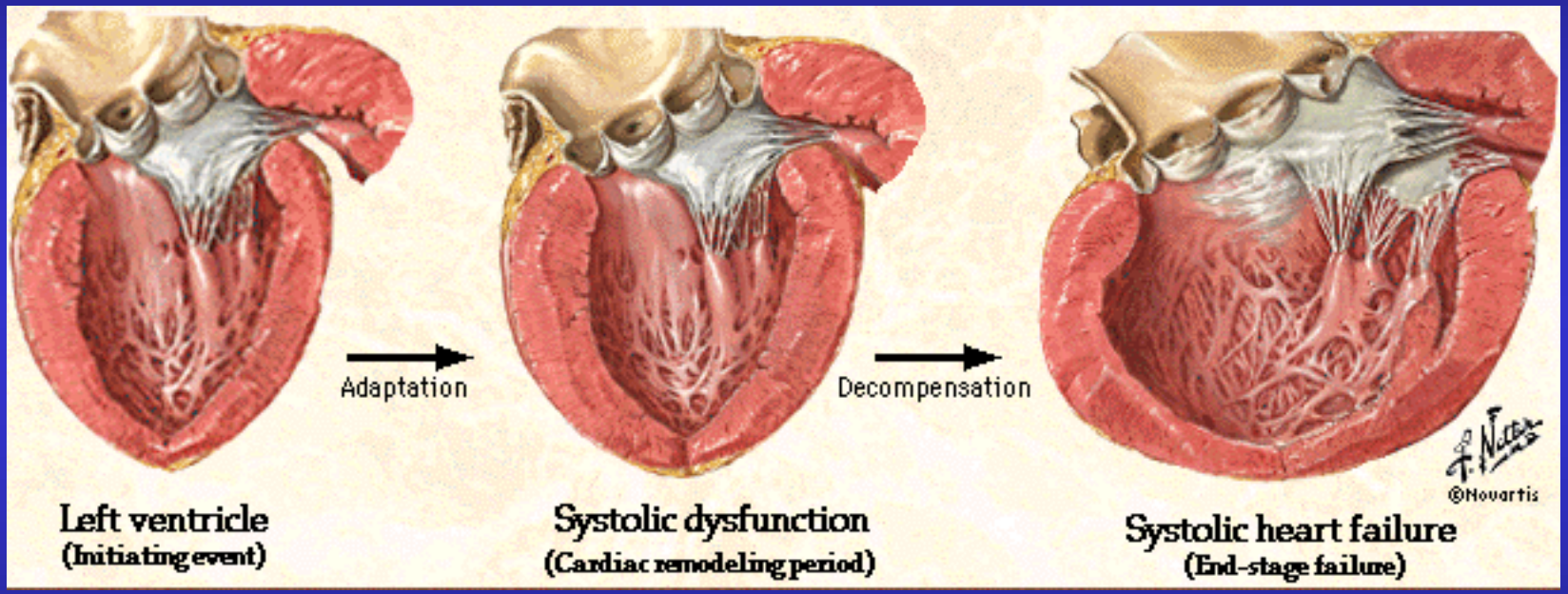
2013 ACCF/AHA Heart Failure Guideline.

Yancy CW. Circulation 2013;

- A complex clinical syndrome that results from any structural or functional impairment of ventricular filling or ejection of blood.
- Cardinal manifestations of HF: dyspnea and fatigue, which may limit exercise tolerance & fluid retention, which may lead to pulmonary ± splanchnic congestion ± peripheral edema.

HF with reduced EF

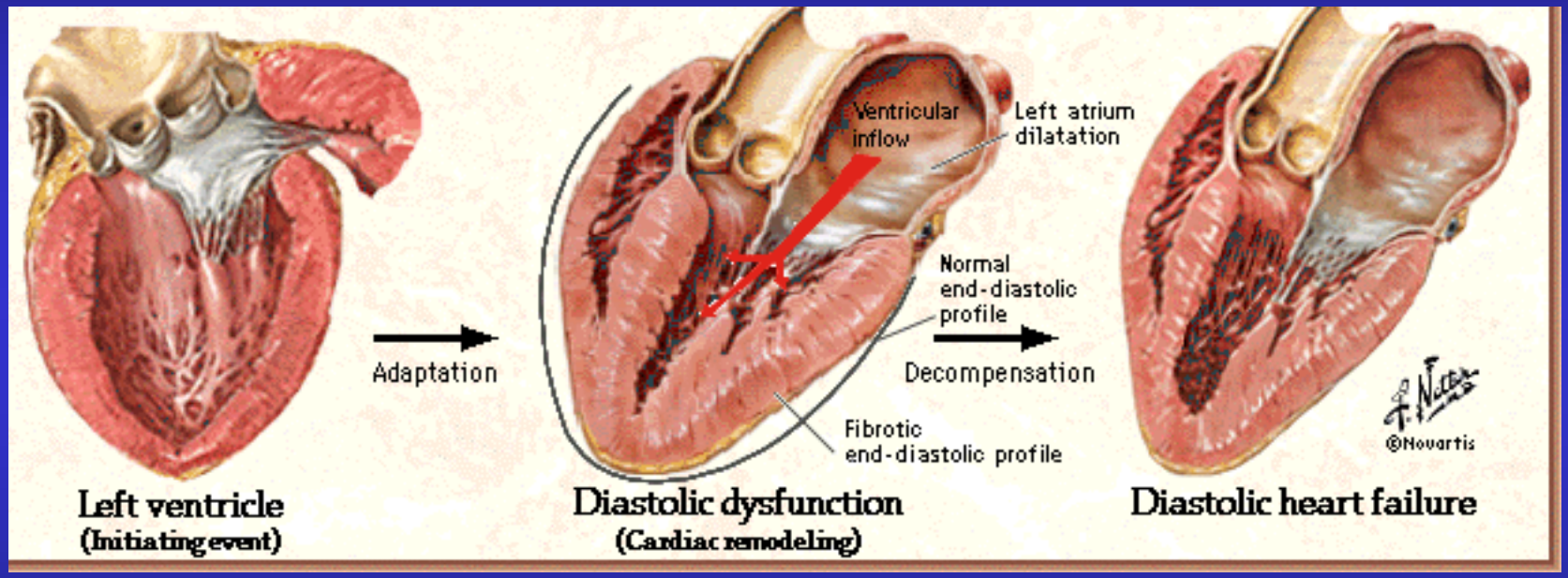
Or Systolic heart failure



Mechanism of S_3 gallop: rapid filling

HF with preserved EF

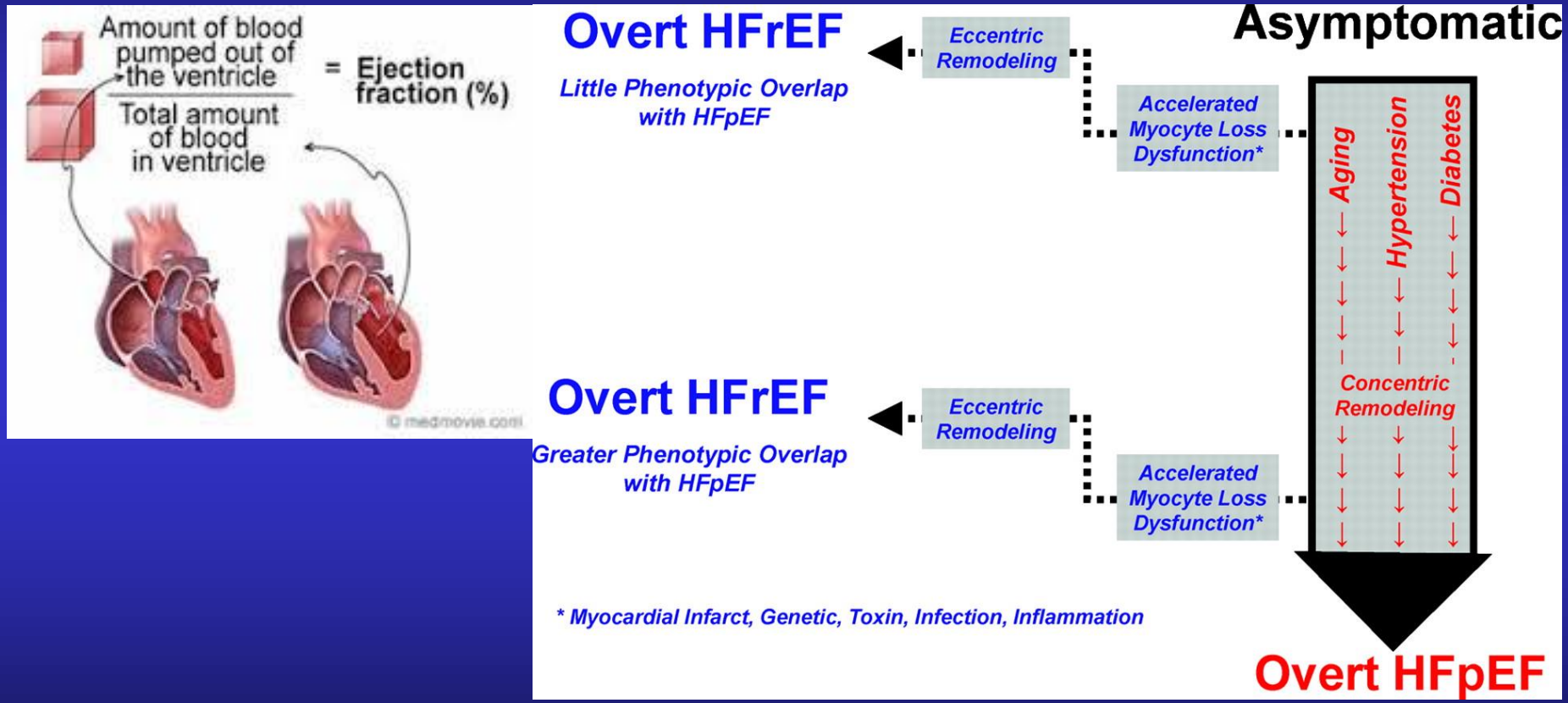
or Diastolic heart failure



Mechanism of S_4 gallop: atrial contraction

HFpEF & HFrEF distinct phenotypes.

Borlaug BA. Circulation 2011;123:2006



HFpEF & HFrEF distinct phenotypes.

Borlaug BA. Circulation 2011;123:2006

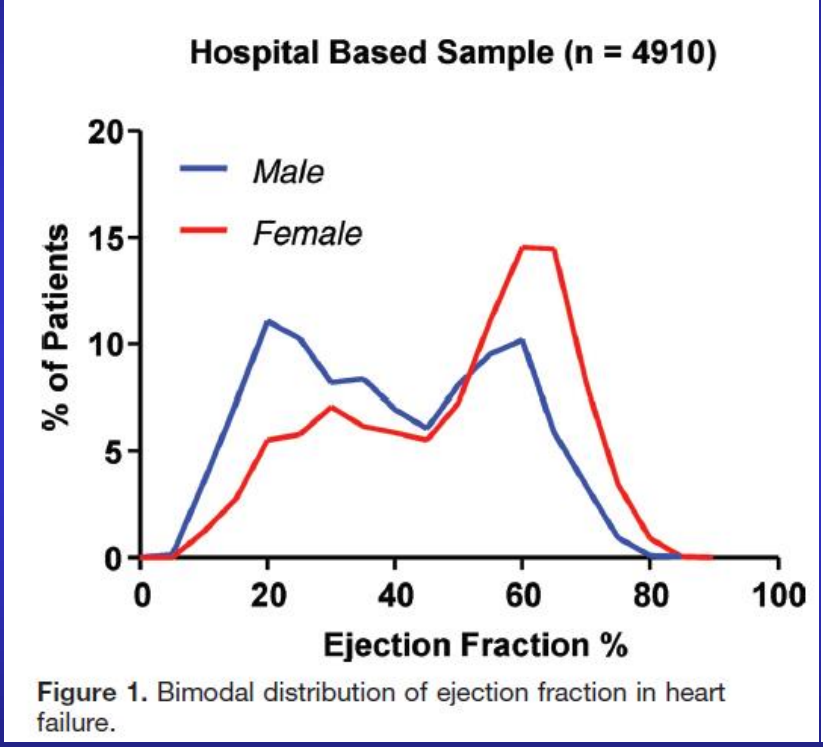


Figure 1. Bimodal distribution of ejection fraction in heart failure.

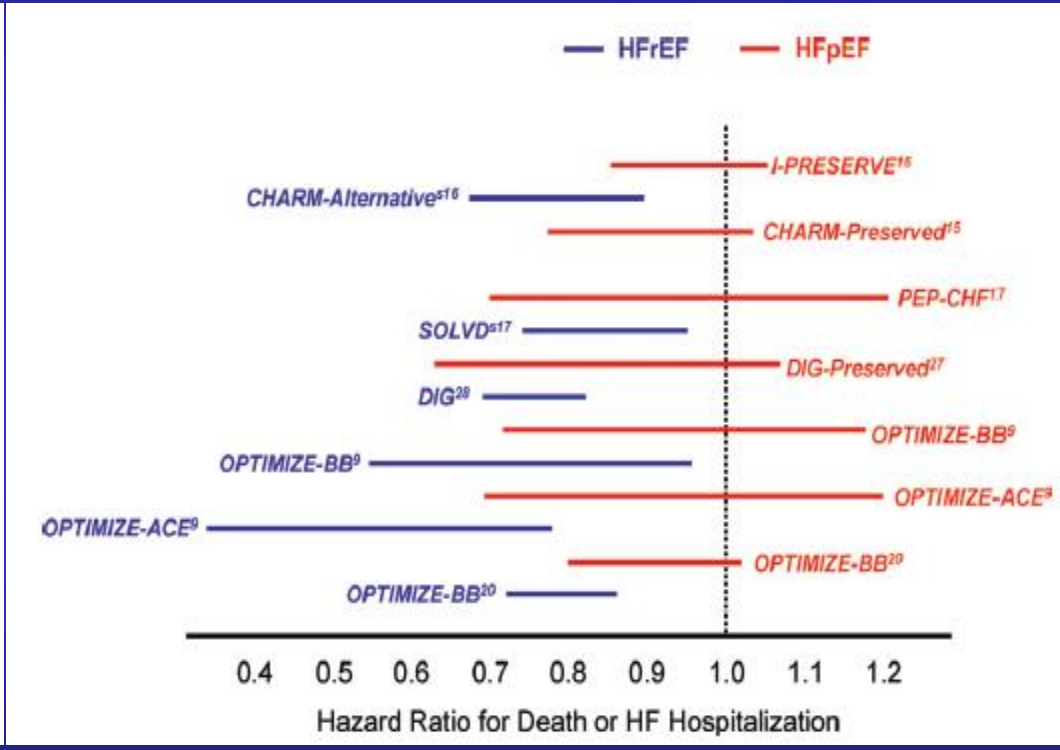


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Table 3. Definitions of HF*r*EF and HF*p*EF

Classification	EF (%)	Description
I. Heart failure with reduced ejection fraction (HF*r*EF)	≤40	Also referred to as systolic HF. Randomized clinical trials have mainly enrolled patients with HF*r*EF, and it is only in these patients that efficacious therapies have been demonstrated to date.
II. Heart failure with preserved ejection fraction (HF*p*EF)	≥50	Also referred to as diastolic HF. Several different criteria have been used to further define HF*p*EF. The diagnosis of HF*p*EF 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.
a. HF*p*EF, borderline	41 to 49	These patients fall into a borderline or intermediate group. Their characteristics, treatment patterns, and outcomes appear similar to those of patients with HF*p*EF.
b. HF*p*EF, improved	>40	It has been recognized that a subset of patients with HF*p*EF previously had HF*r*EF. 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.

No therapy has been proven to reduce morbidity and mortality in HFpEF.Borlaug BA. Nat Rev Cardiol 2013;10:244.

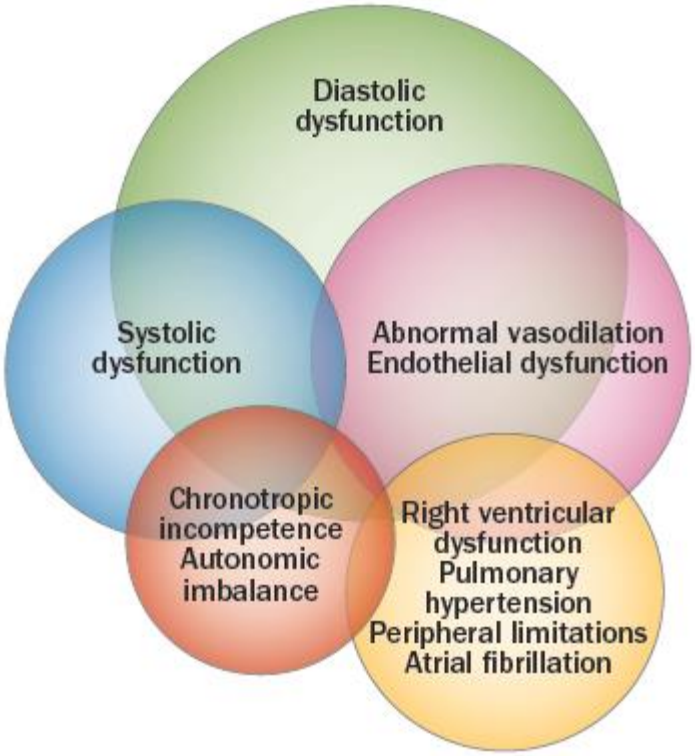

Figure 1 | Heart failure with preserved ejection fraction is a complex 'systems disease', in which symptoms of effort intolerance are caused by numerous abnormalities in myocardial diastolic, systolic, vascular, autonomic, and skeletal muscle function that coexist to varying degrees within the individual patient.

Heart failure

- Heart failure (HF)
  - Clinical syndrome with breathlessness, fatigue & exercise intolerance from impaired myocardial function
- Congestive heart failure (CHF)
  - HF with circulatory congestion (eg; rales, edema)
- Right-sided HF
  - JVP↑ , abdominal organ engorgement, ascites, edema
- Noncardiac circulatory congestion
  - no structural heart disease cause CHF (eg; ARF)

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ACCF/AHA Stages of HF (38)		NYHA Functional Classification (46)	
A	At high risk for HF but without structural heart disease or symptoms of HF	None	
B	Structural heart disease but without signs or symptoms of HF	I	No limitation of physical activity. Ordinary physical activity does not cause symptoms of HF.
C	Structural heart disease with prior or current symptoms of HF	I	No limitation of physical activity. Ordinary physical activity does not cause symptoms of HF.
		II	Slight limitation of physical activity. Comfortable at rest, but ordinary physical activity results in symptoms of HF.
		III	Marked limitation of physical activity. Comfortable at rest, but less than ordinary activity causes symptoms of HF.
		IV	Unable to carry on any physical activity without symptoms of HF, or symptoms of HF at rest.
D	Refractory HF requiring specialized interventions		

ACCF indicates American College of Cardiology Foundation; AHA, American Heart Association; HF, heart failure; a
NYHA, New York Heart Association.

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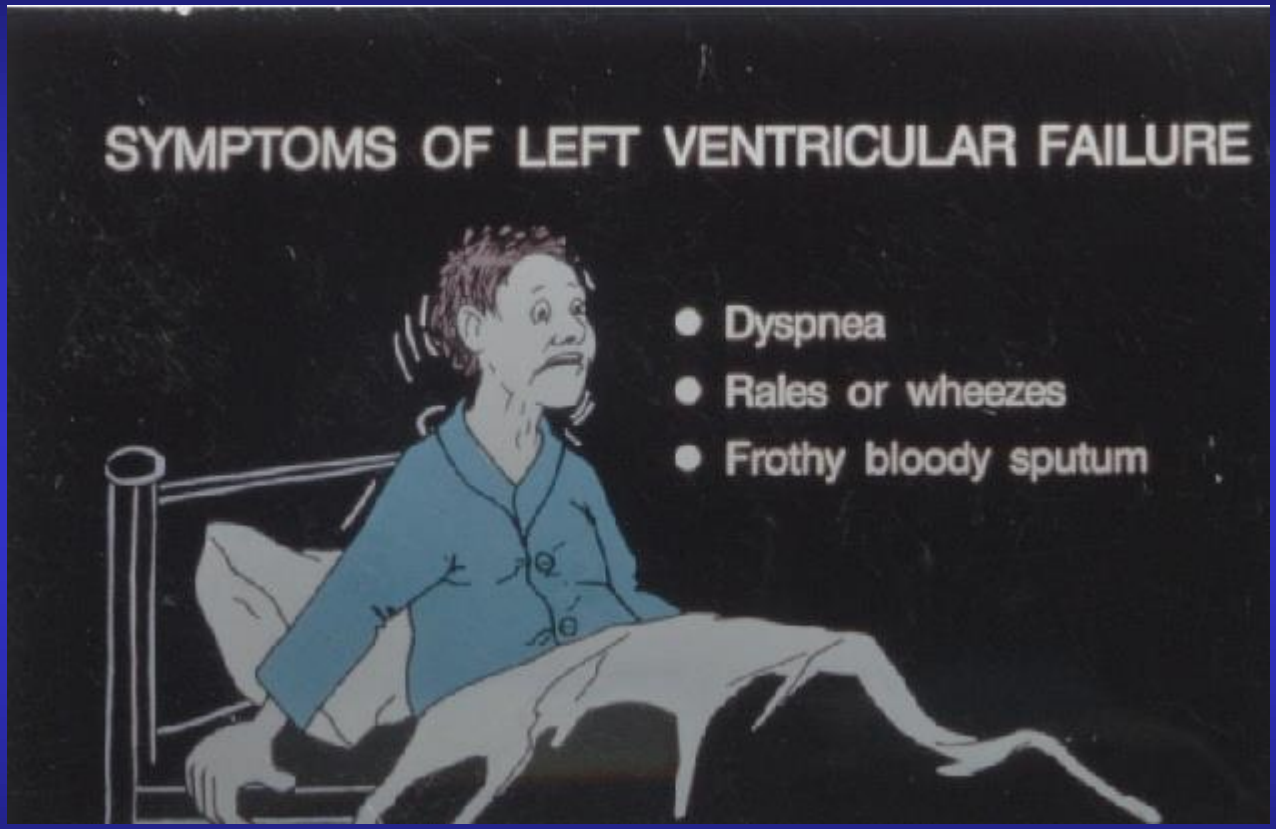
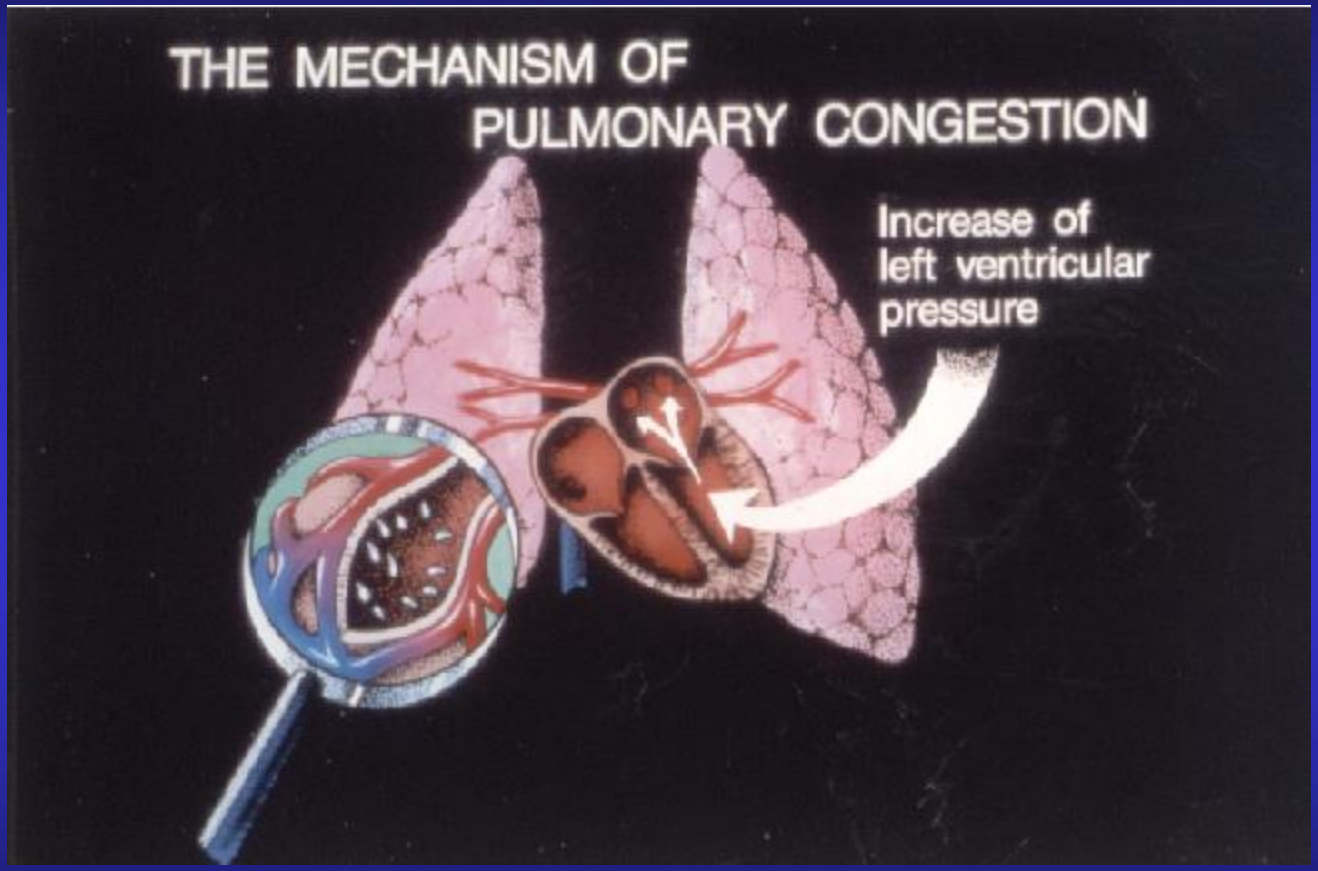
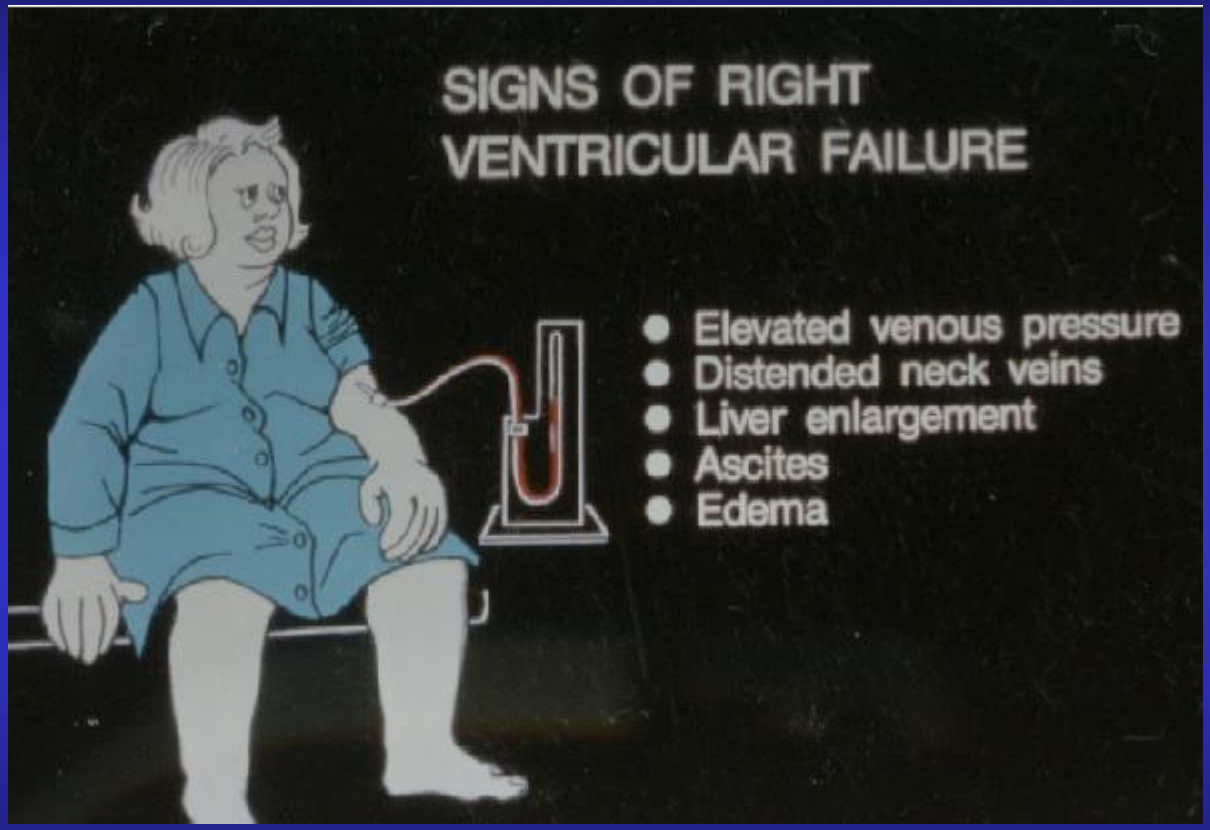
6.1.1. History and Physical Examination: Recommendations

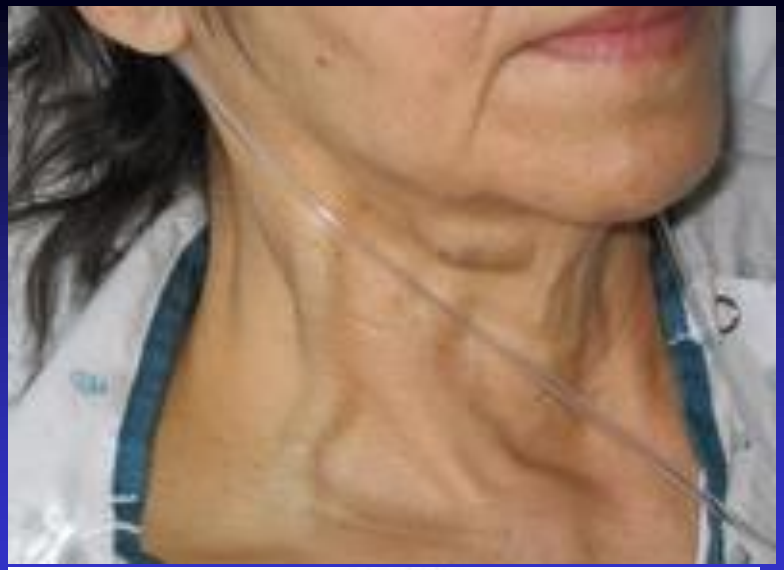
Class I

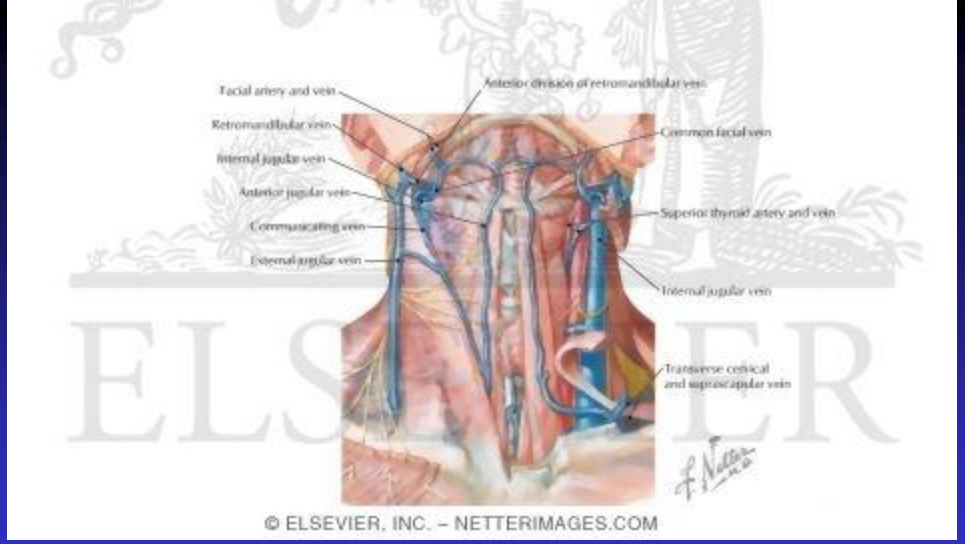
1. **A thorough history and physical examination should be obtained/performed in patients presenting with HF to identify cardiac and noncardiac disorders or behaviors that might cause or accelerate the development or progression of HF. (*Level of Evidence: C*)**
2. **In patients with idiopathic DCM, a 3-generational family history should be obtained to aid in establishing the diagnosis of familial DCM. (*Level of Evidence: C*)**
3. **Volume status and vital signs should be assessed at each patient encounter. This includes serial assessment of weight, as well as estimates of jugular venous pressure and the presence of peripheral edema or orthopnea (187-190). (*Level of Evidence: B*)**


SYMPTOMS OF LEFT VENTRICULAR FAILURE
Dyspnea
Rales or wheezes
Frothy bloody sputum


THE MECHANISM OF
PULMONARY CONGESTION
Increase of
left ventricular
pressure


SIGNS OF RIGHT
VENTRICULAR FAILURE
Elevated venous pressure
Distended neck veins
Liver enlargement
Ascites
Edema




Facial artery and vein
Anterior division of retromandibular vein
Retromandibular vein
Common facial vein
Internal jugular vein
Anterior jugular vein
Superior thyroid artery and vein
Communicating vein
External jugular vein
Internal jugular vein
Transverse cervical and suprascapular vein
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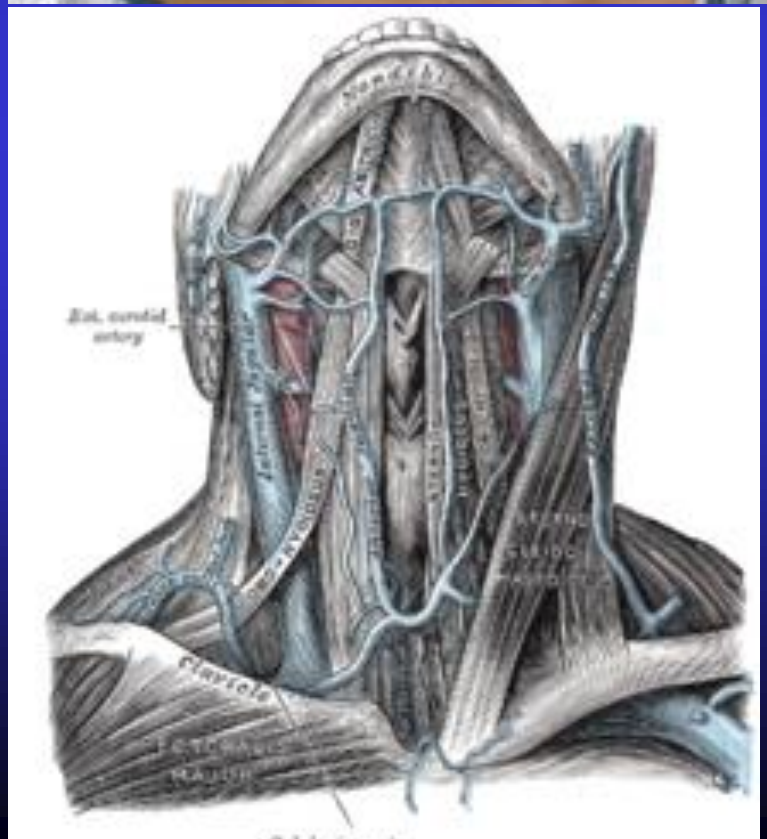
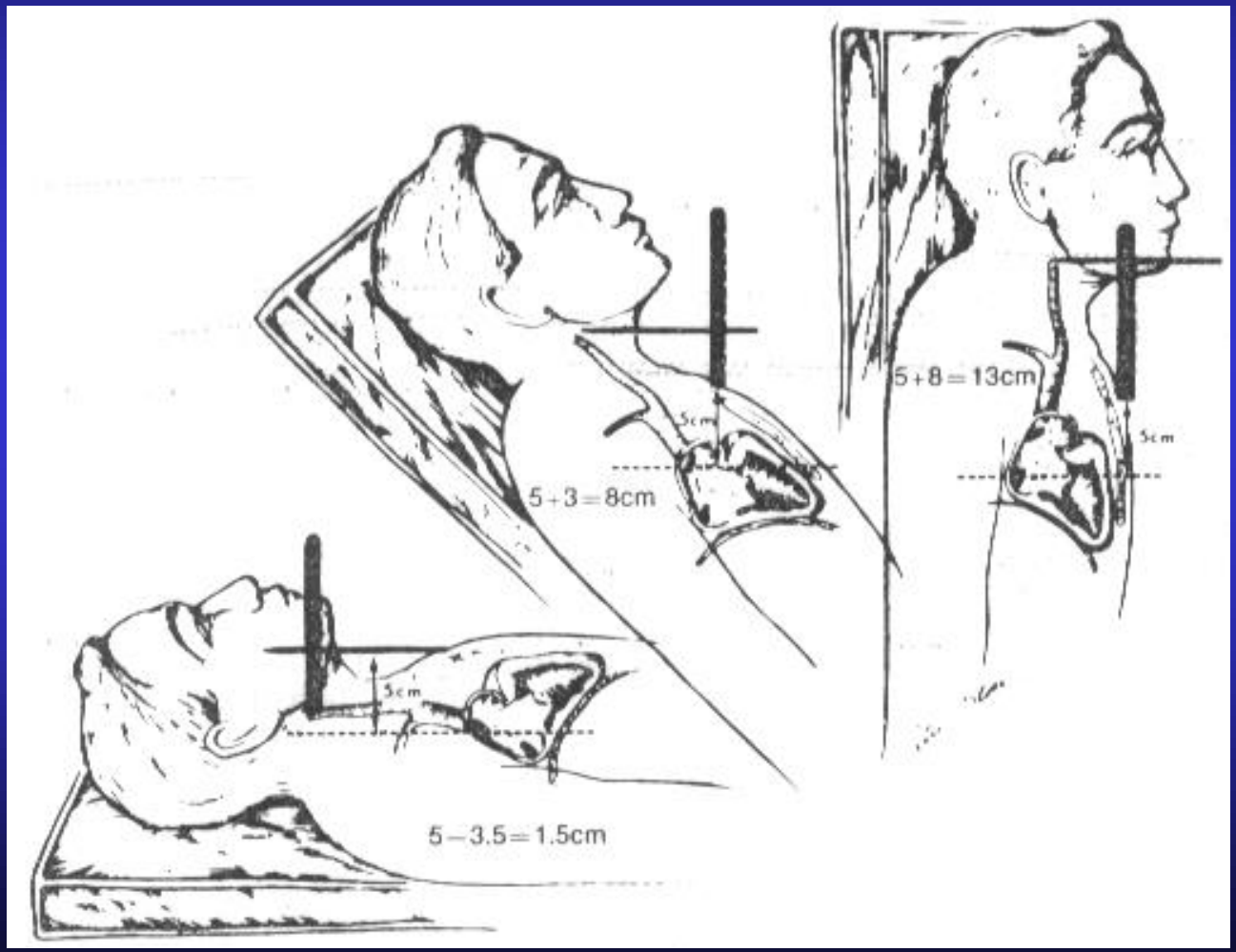


Jugular venous pressure estimation



Framingham Criteria for Dx of CHF:

(at least 1 major & 2 minor criteria)

Major criteria

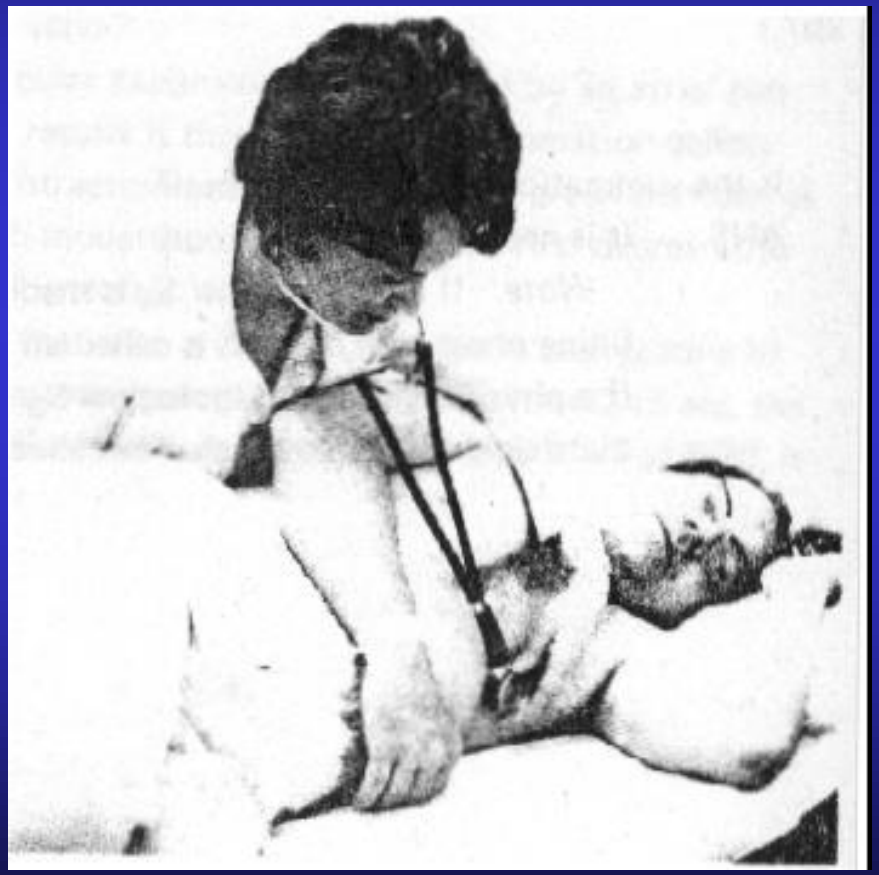
- PND
- Neck vein distention
- Cardiomegaly
- Hepatojugular reflux +ve
- S_3 gallop
- Rales
- Acute pulmonary edema
- Venous P. $>_{16}$ cmH_2O

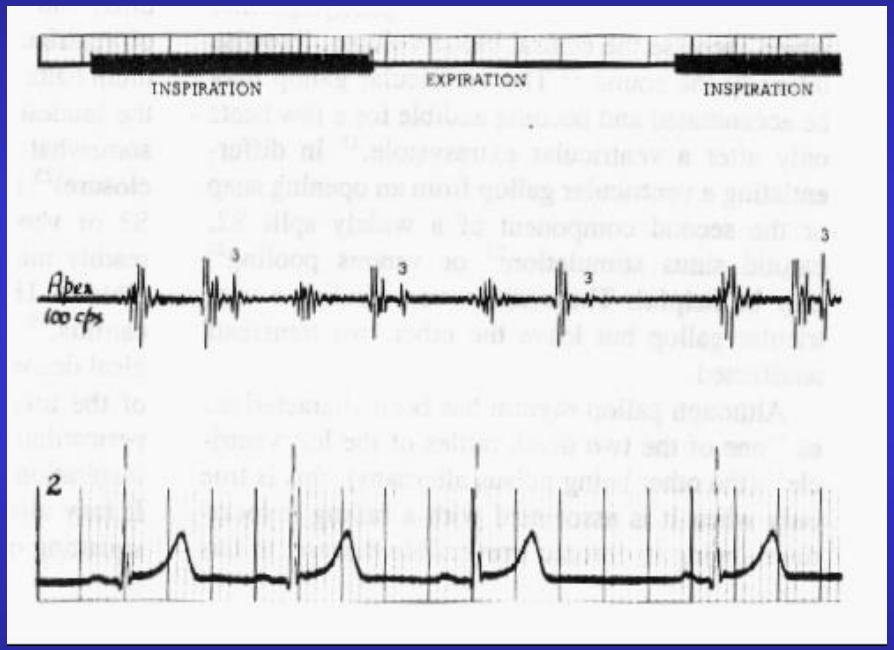
Minor criteria

- Dyspnea on exertion
- Night cough
- Tachycardia(≥ 120/min)
- Pleural effusion
- Hepatomegaly
- Extremity edema
- Vital capacity $_1$ / $_3$ of normal

Wt. Loss ≥ 4.5 kg over $_5$ days, Rx

Third heart sound or S_3 gallop





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6.2. Diagnostic Tests: Recommendations

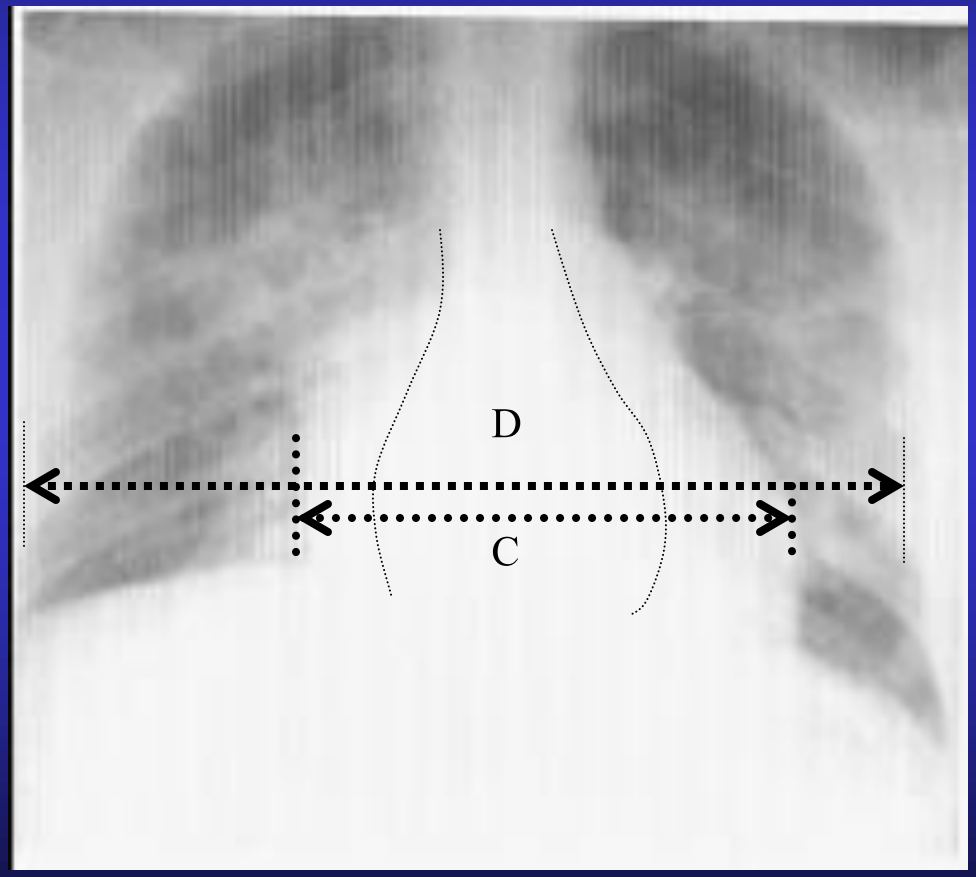
Class I

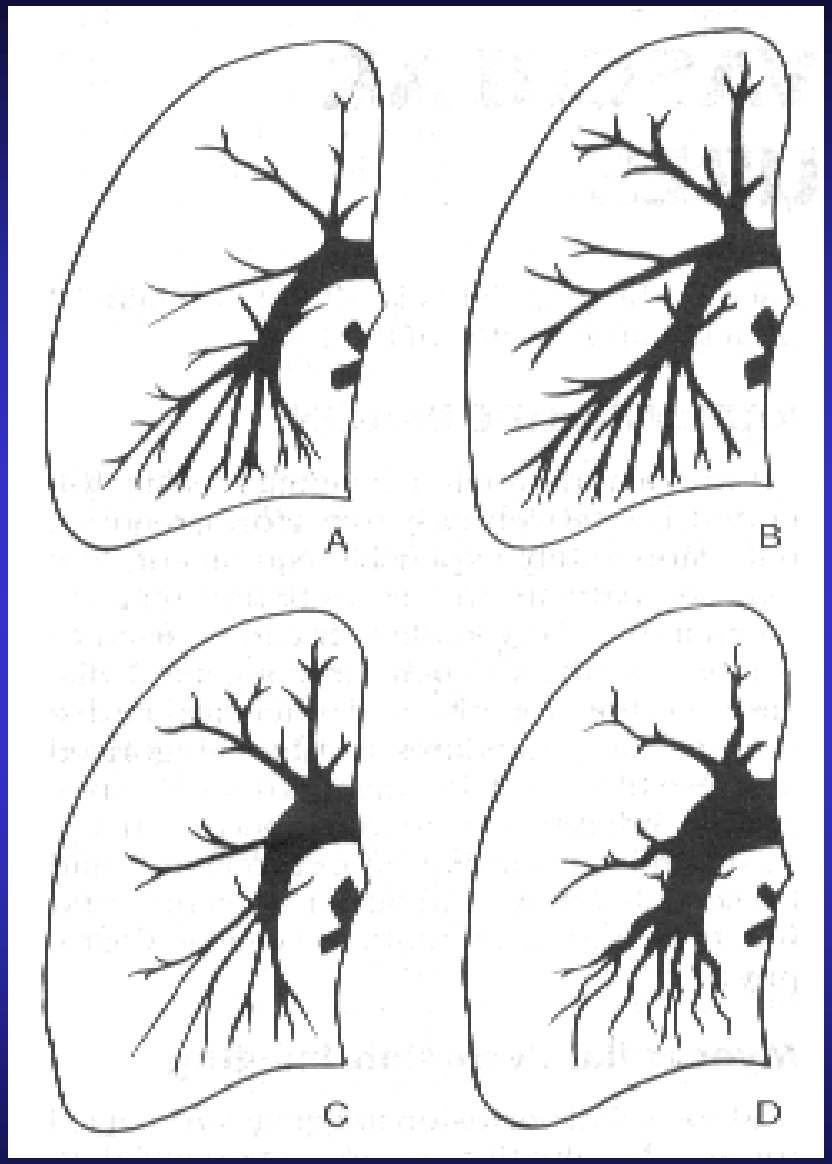
1. Initial laboratory evaluation of patients presenting with HF should include complete blood count, urinalysis, serum electrolytes (including calcium and magnesium), blood urea nitrogen, serum creatinine, glucose, fasting lipid profile, liver function tests, and thyroid-stimulating hormone. *(Level of Evidence: C)*
2. Serial monitoring, when indicated, should include serum electrolytes and renal function. *(Level of Evidence: C)*
3. A 12-lead ECG should be performed initially on all patients presenting with HF. *(Level of Evidence: C)*

Electrocardiography in HF

- Underlying etiology
  - eg; HT: LVH with strained pattern, CAD: MI
- Precipitating factors
  - eg; arrhythmia: AF,
- Compensatory mechanism
  - dilation: LVH by voltage, hypertrophy: LVH with strained
- Complication
  - eg; arrhythmia: VT

Cardiothoracic ratio





Chest x-ray of rt. lung

A. Normal pulmonary vessels

B. General increase pulmonary vessels

C. Pulmonary congestion

D. Pulmonary hypertension

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6.3. Biomarkers: Recommendations

A. Ambulatory/Outpatient

Class I

1. **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 (217-223). *(Level of Evidence: A)***
2. **Measurement of BNP or NT-proBNP is useful for establishing prognosis or disease severity in chronic HF (222, 224-229). *(Level of Evidence: A)***

B. Hospitalized/Acute

Class I

1. **Measurement of BNP or NT-proBNP is useful to support clinical judgment for the diagnosis of acutely decompensated HF, especially in the setting of uncertainty for the diagnosis (212, 245-250). *(Level of Evidence: A)***
2. **Measurement of BNP or NT-proBNP and/or cardiac troponin is useful for establishing prognosis or disease severity in acutely decompensated HF (248, 251-258). *(Level of Evidence: A)***

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Table 9. Recommendations for Biomarkers in HF

Biomarker, Application	Setting	COR	LOE
Natriuretic peptides			
Diagnosis or exclusion of HF	Ambulatory, Acute	I	A
Prognosis of HF	Ambulatory, Acute	I	A
Biomarkers of myocardial injury			
Additive risk stratification	Acute, Ambulatory	I	A
Biomarkers of myocardial fibrosis			
Additive risk stratification	Ambulatory	IIb	B
	Acute	IIb	A

Natriuretic peptides in untreated pts with symptoms suggestive of HF. ESC guidelines of HF 2008

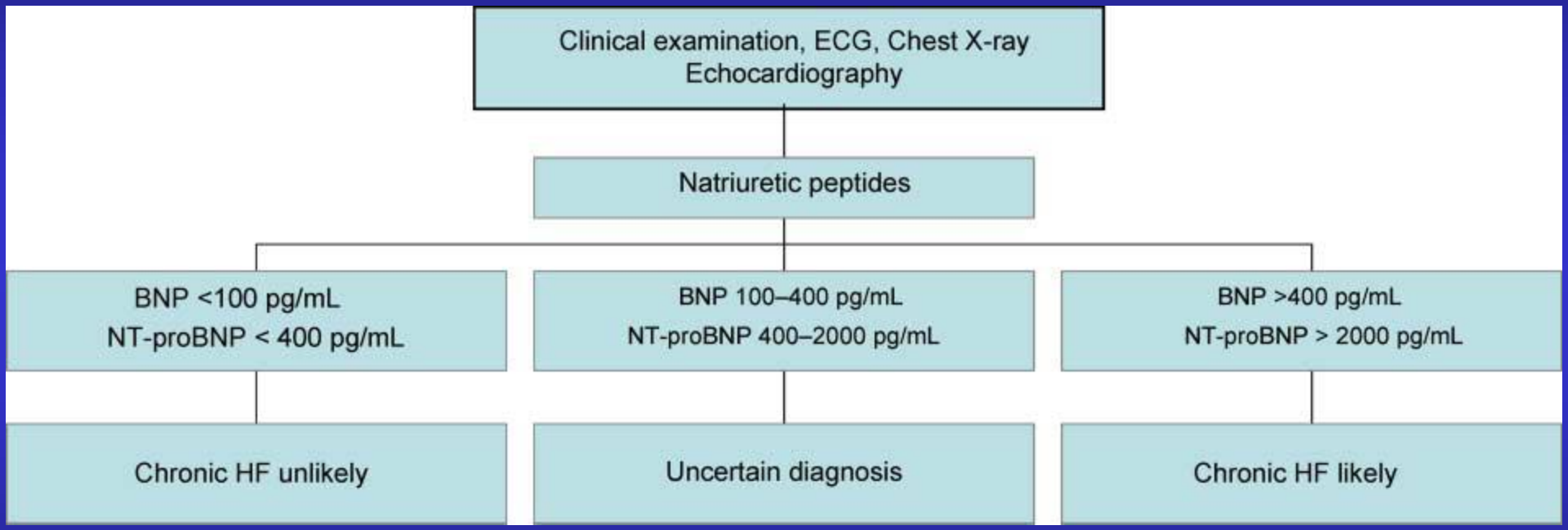

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Table 8. Selected Causes of Elevated Natriuretic Peptide Concentrations

Cardiac	Noncardiac
• Heart failure, including RV syndromes • Acute coronary syndrome • Heart muscle disease, including LVH • Valvular heart disease • Pericardial disease • Atrial fibrillation • Myocarditis • Cardiac surgery • Cardioversion	• Advancing age • Anemia • Renal failure • Pulmonary: obstructive sleep apnea, severe pneumonia, pulmonary hypertension • Critical illness • Bacterial sepsis • Severe burns • Toxic-metabolic insults, including cancer chemotherapy and envenomation

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Table 10. Recommendations for Noninvasive Cardiac Imaging

Recommendations	COR	LOE
Patients with suspected, acute, or new-onset HF should undergo a chest x-ray	I	C
A 2-dimensional echocardiogram with Doppler should be performed for initial evaluation of HF	I	C
Repeat measurement of EF is useful in patients with HF who have had a significant change in clinical status or received treatment that might affect cardiac function or for consideration of device therapy	I	C
Routine repeat measurement of LV function assessment should not be performed	III: No Benefit	B (289, 290)

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Table 11. Recommendations for Invasive Evaluation

Recommendations	COR	LOE
Monitoring with a pulmonary artery catheter should be performed in patients with respiratory distress or impaired systemic perfusion when clinical assessment is inadequate	I	C
Routine use of invasive hemodynamic monitoring is not recommended in normotensive patients with acute HF	III: No Benefit	B (305)
Endomyocardial biopsy should not be performed in the routine evaluation of HF	III: Harm	C

COR indicates Class of Recommendation; HF, heart failure; and LOE, Level of Evidence.

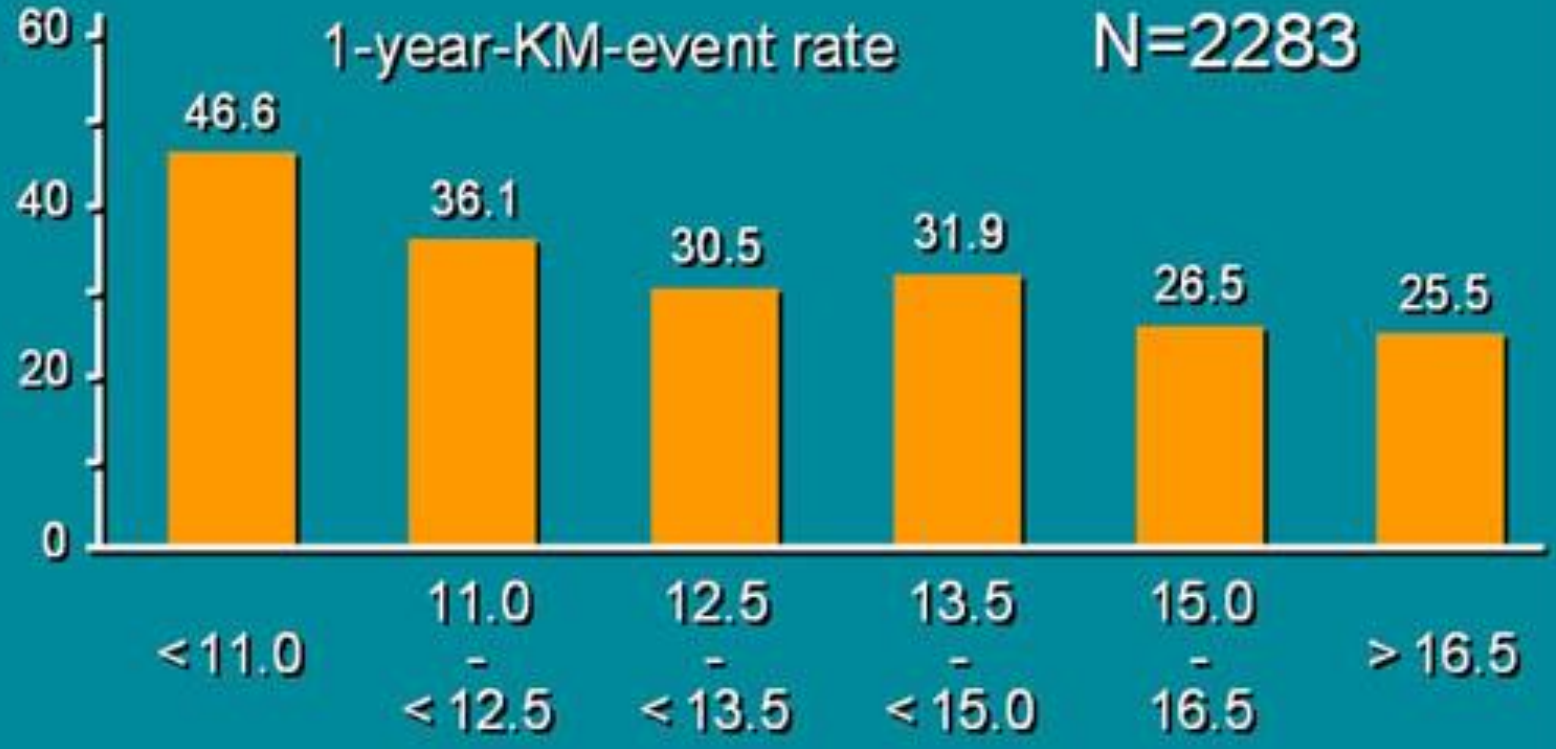
Precipitating causes of HF (e-Thai & e-Siam)

- **E**xcess of
  - physical,diet, fluid, environmental, emotional Infection
- **Th**yrotoxicosis/ pregnancy
- **A**nemia
- **I**nfection & endocarditis
- **E**mbolism
- **S**ystemic hypertension
- **I**nfarction
- **A**rrhythmia
  - Tachyarrhythmia
  - AV dissociation
  - Abn. vent. Conduction
  - Marked bradycardia
- **M**yocarditis

Potential reversible factors in HF

- Noncompliance with Rx
- Systemic infection
- Pulmonary embolism
- Extensive ischemia
- Primary valvular dis.
- Tachycardia
- Pregnancy
- Medications
- Hypertension
- Heavy alcohol consump.
- Cocaine, amphetamine or excessive bronchodilators
- Anemia
- Metabolic
  - Thyroid
  - Obesity
  - Hemochromatosis
  - E'lyte disorder

Hb vs mortality / HF hospitalisation



S. Anker, 2592 (COPERNICUS)

Compensation mechanism in HF

- Hemodynamic & ANS
  - Heart:
    - Frank-starling law
    - CO
  - Peripheral circulation
  - Kidney (RAAS)
- Hypertrophy
- Peripheral O_2 delivery
- Anaerobic metabolism

- Neurohoumoral
  - NE, Epinephrine
  - RAAS
  - Endothlin
  - ANP, BNP
  - Arginine vasopressin
  - PGI_2, PGE_2
  - Bradykinin
  - Dopamine, IL-6, insulin, cortisol, growth hormone,TNF-a, VIP etc

Ramani GV. Mayo Clinic Proc 2010;85:180-95.

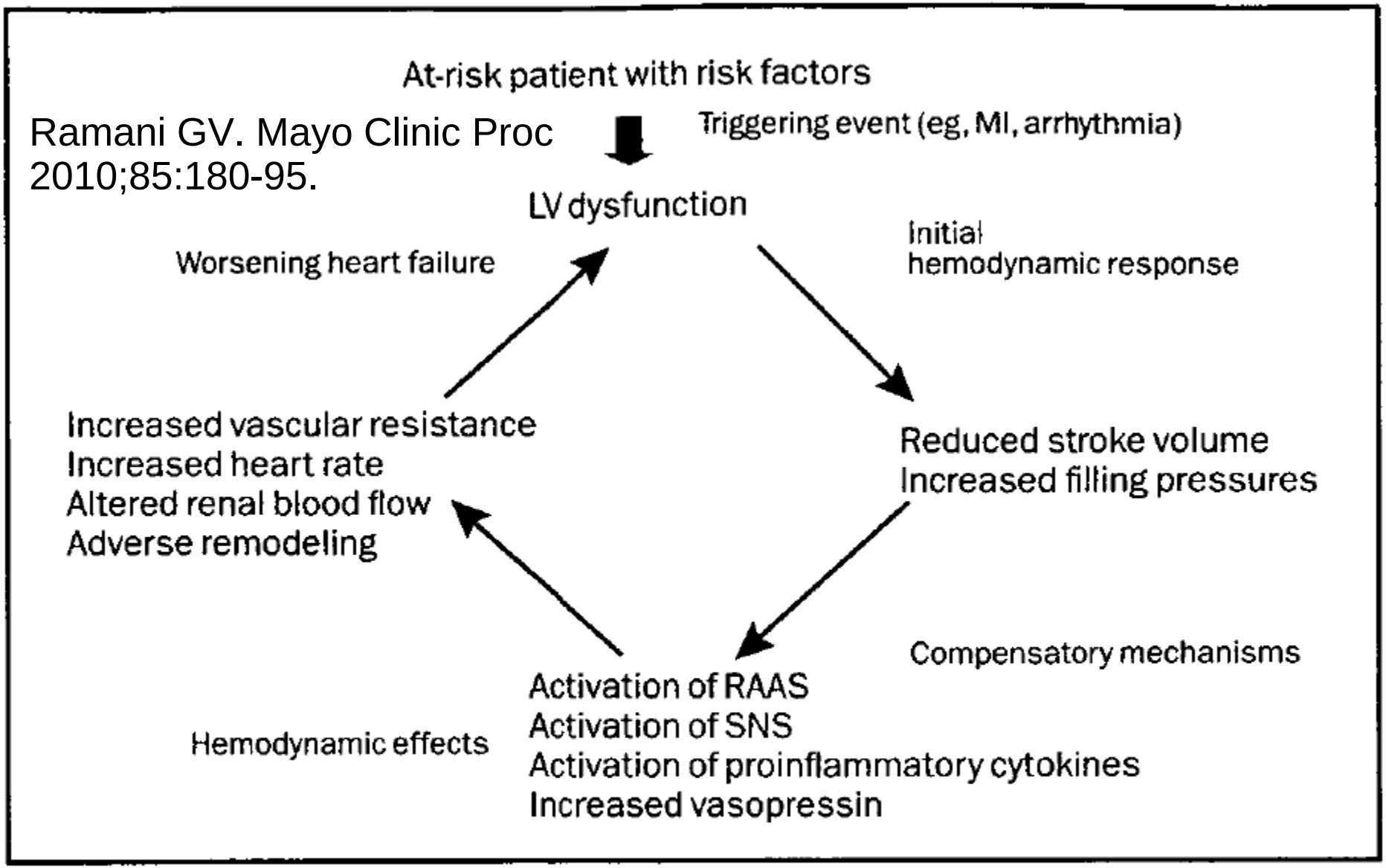


FIGURE 1. Pathophysiology of chronic heart failure. LV = left ventricular; MI = myocardial infarction; RAAS = renin-angiotensin-aldosterone system; SNS = sympathetic nervous system.

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7. Treatment of Stages A to D

7.1. Stage A: Recommendations

Class I

1. Hypertension and lipid disorders should be controlled in accordance with contemporary guidelines to lower the risk of HF (27, 94, 311-314). *(Level of Evidence: A)*
2. Other conditions that may lead to or contribute to HF, such as obesity, diabetes mellitus, tobacco use, and known cardiotoxic agents, should be controlled or avoided. *(Level of Evidence: C)*

Table 227-1 Etiologies of Heart Failure

Depressed Ejection Fraction (<40%)	
Coronary artery disease	Nonischemic dilated cardiomyopathy
Myocardial infarction[a]	Familial/genetic disorders
Myocardial ischemia[a]	Infiltrative disorders[a]
Chronic pressure overload	Toxic/drug-induced damage
Hypertension[a]	Metabolic disorder[a]
Obstructive valvular disease[a]	Viral
Chronic volume overload	Chagas' disease
Regurgitant valvular disease	Disorders of rate and rhythm
Intracardiac (left-to-right) shunting	Chronic bradyarrhythmias
Extracardiac shunting	Chronic tachyarrhythmias

Table 227-1 Etiologies of Heart Failure

Preserved Ejection Fraction (>40–50%)	
Pathological hypertrophy	Restrictive cardiomyopathy
Primary (hypertrophic cardiomyopathies)	Infiltrative disorders (amyloidosis, sarcoidosis)
Secondary (hypertension)	Storage diseases (hemochromatosis)
Aging	Fibrosis
	Endomyocardial disorders
Pulmonary Heart Disease	
Cor pulmonale	
Pulmonary vascular disorders	
High-Output States	
Metabolic disorders	Excessive blood-flow requirements
Thyrotoxicosis	Systemic arteriovenous shunting
Nutritional disorders (beriberi)	Chronic anemia

[a] ***Note:*** Indicates conditions that can also lead to heart failure with a preserved injection fraction.

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Table 12. Recommendations for Treatment of Stage B HF

Recommendations	COR	LOE
In patients with a history of MI and reduced EF, ACE inhibitors or ARBs should be used to prevent HF	I	A
In patients with MI and reduced EF, evidence-based beta blockers should be used to prevent HF	I	B
In patients with MI, statins should be used to prevent HF	I	A
Blood pressure should be controlled to prevent symptomatic HF	I	A
ACE inhibitors should be used in all patients with a reduced EF to prevent HF	I	A
Beta blockers should be used in all patients with a reduced EF to prevent HF	I	C
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	IIa	B
Nondihydropyridine calcium channel blockers may be harmful in patients with low LVEF	III: Harm	C

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7.3. Stage C

7.3.1. Nonpharmacological Interventions

7.3.1.1. Education: Recommendation

Class I

1. **Patients with HF should receive specific education to facilitate HF self-care (363-368).** ***(Level of Evidence: B)***

7.3.1.2. Social Support

Social support is thought to buffer stress and promote treatment adherence and a healthy lifestyle (371). Most studies examining the relationship between social support and hospitalization in adults with HF have found that a lack of social support is associated with higher hospitalization rates (372, 373) and mortality risk (374, 375).

7.3.1.3. Sodium Restriction: Recommendation

Class IIa

1. **Sodium restriction is reasonable for patients with symptomatic HF to reduce congestive symptoms. (*Level of Evidence: C*)**

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7.3. Stage C

7.3.1.4. Treatment of Sleep Disorders: Recommendation

Class IIa

1. **Continuous positive airway pressure (CPAP) can be beneficial to increase LVEF and improve functional status in patients with HF and sleep apnea (393-396).** ***(Level of Evidence: B)***

7.3.1.5. Weight Loss

Obesity is defined as a BMI ≥30 kg/m^2. Patients with HF who have a BMI between 30 and 35 kg/m^2 have lower mortality and hospitalization rates than those with a BMI in the normal range (99). Weight loss may reflect cachexia caused by the higher total energy expenditure associated with HF compared with that of healthy sedentary subjects (399). The diagnosis of cardiac cachexia independently predicts a worse prognosis (191). At

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7.3. Stage C

7.3.1.6. Activity, Exercise Prescription, and Cardiac Rehabilitation: Recommendations

Class I

1. Exercise training (or regular physical activity) is recommended as safe and effective for patients with HF who are able to participate to improve functional status (404-407). *(Level of Evidence: A)*

Class IIa

1. Cardiac rehabilitation can be useful in clinically stable patients with HF to improve functional capacity, exercise duration, HRQOL, and mortality (404, 406-411). *(Level of Evidence: B)*

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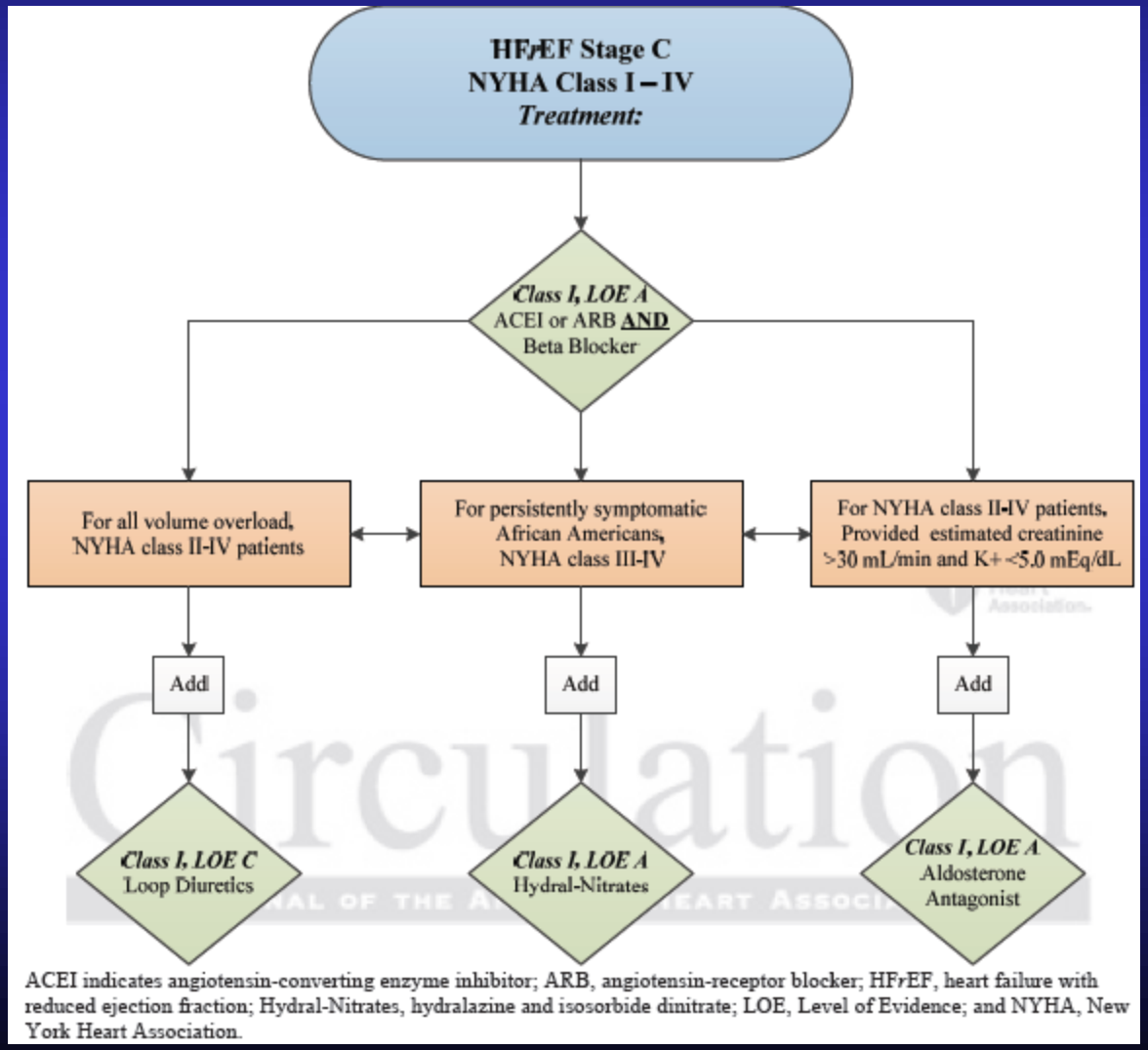
7.3. Stage C



ACEI indicates angiotensin-converting enzyme inhibitor; ARB, angiotensin-receptor blocker; HFrEF, heart failure with reduced ejection fraction; Hydral-Nitrates, hydralazine and isosorbide dinitrate; LOE, Level of Evidence; and NYHA, New York Heart Association.

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Recommendation	COR	LOE
Diuretics		
Diuretics are recommended in patients with HF*r*EF with fluid retention	I	C
ACE inhibitors		
ACE inhibitors are recommended for all patients with HF*r*EF	I	A
ARBs		
ARBs are recommended in patients with HF*r*EF who are ACE inhibitor intolerant	I	A
Routine *combined* use of an ACE inhibitor, ARB, and aldosterone antagonist is potentially harmful	III: Harm	C
Beta blockers		
Use of 1 of the 3 beta blockers proven to reduce mortality is recommended for all stable patients	I	A
Aldosterone receptor antagonists		
Aldosterone receptor antagonists are recommended in patients with NYHA class II-IV who have LVEF ≤35%	I	A
Aldosterone receptor antagonists are recommended following an acute MI who have LVEF ≤40% with symptoms of HF or DM	I	B
Inappropriate use of aldosterone receptor antagonists may be harmful	III: Harm	B

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Recommendation	COR	LOE
Hydralazine and isosorbide dinitrate		
The combination of hydralazine and isosorbide dinitrate is recommended for African Americans with NYHA class III–IV HF*r*EF on GDMT	I	A
Digoxin		
Digoxin can be beneficial in patients with HF*r*EF	IIa	B
Anticoagulation		
Patients with chronic HF with permanent/persistent/paroxysmal AF and an additional risk factor for cardioembolic stroke should receive chronic anticoagulant therapy*	I	A
The selection of an anticoagulant agent should be individualized	I	C
Anticoagulation is not recommended in patients with chronic HF*r*EF without AF, a prior thromboembolic event, or a cardioembolic source	III: No Benefit	B
Statins		
Statins are not beneficial as adjunctive therapy when prescribed solely for HF	III: No Benefit	A

*In the absence of contraindications to anticoagulation.

2013 ACCF/AHA Heart Failure Guideline.

Yancy CW. Circulation 2013;

Recommendation	COR	LOE
Omega-3 fatty acids		
Omega-3 PUFA supplementation is reasonable to use as adjunctive therapy in HF*r*EF or HF*p*EF patients	IIa	B
Other drugs		
Nutritional supplements as treatment for HF are not recommended in HF*r*EF	III: No Benefit	B
Hormonal therapies other than to correct deficiencies are not recommended in HF*r*EF	III: No Benefit	C
Drugs known to adversely affect the clinical status of patients with HF*r*EF are potentially harmful and should be avoided or withdrawn	III: Harm	B
Long-term use of an infusion of a positive inotropic drug is not recommended and may be harmful except as palliation	III: Harm	C
Calcium channel blockers		
Calcium channel blocking drugs are not recommended as routine treatment in HF*r*EF	III: No Benefit	A

*In the absence of contraindications to anticoagulation.

2013 ACCF/AHA Heart Failure Guideline.

Yancy CW. Circulation 2013;

- Strategies for achieving Optimal Guideline-Directed Medical Therapy:

1. Uptitrate in small increments
2. More frequent visits & Lab monitor: CKD, elder
3. Monitor vital sign closely: orthostatic symptoms
4. Alternate adjust different med. class: BB, ACEi
5. Monitor renal fn & e'lyte: Cr, K

2013 ACCF/AHA Heart Failure Guideline.

Yancy CW. Circulation 2013;

- Strategies for achieving Optimal Guideline-Directed Medical Therapy:

6. Fatigue & weakness with dosage increase
7. Discourage sudden spontaneous discon. GDMT
8. Carefully review doses of other med.: diuretics
9. Temporary adjust doages of GDMT: acute event
10. Educate pt, family, clinicians of GDMT benefits

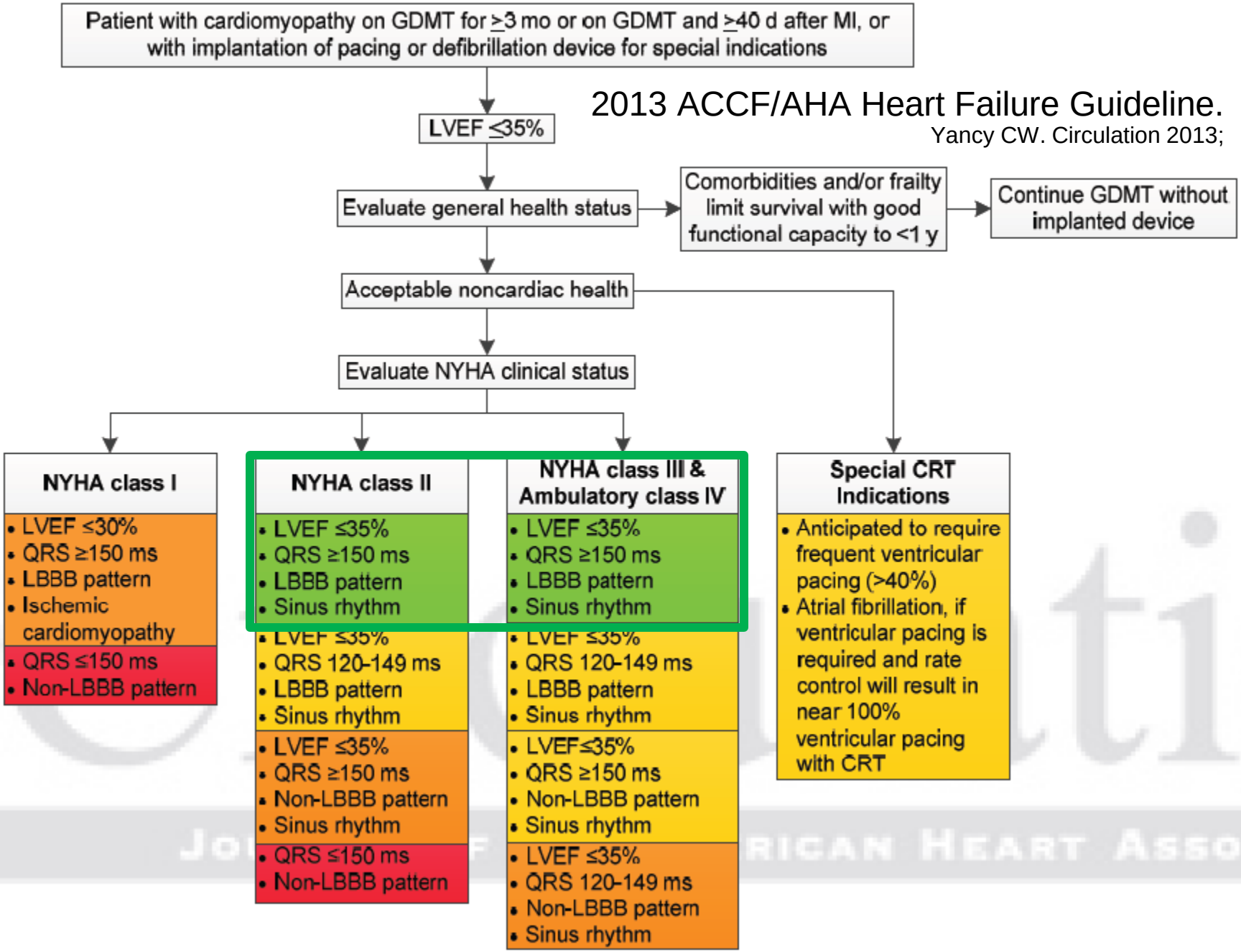
Recommendations for Treatment of HF*p*EF

2013 ACCF/AHA Heart Failure Guideline.

Yancy CW. Circulation 2013;

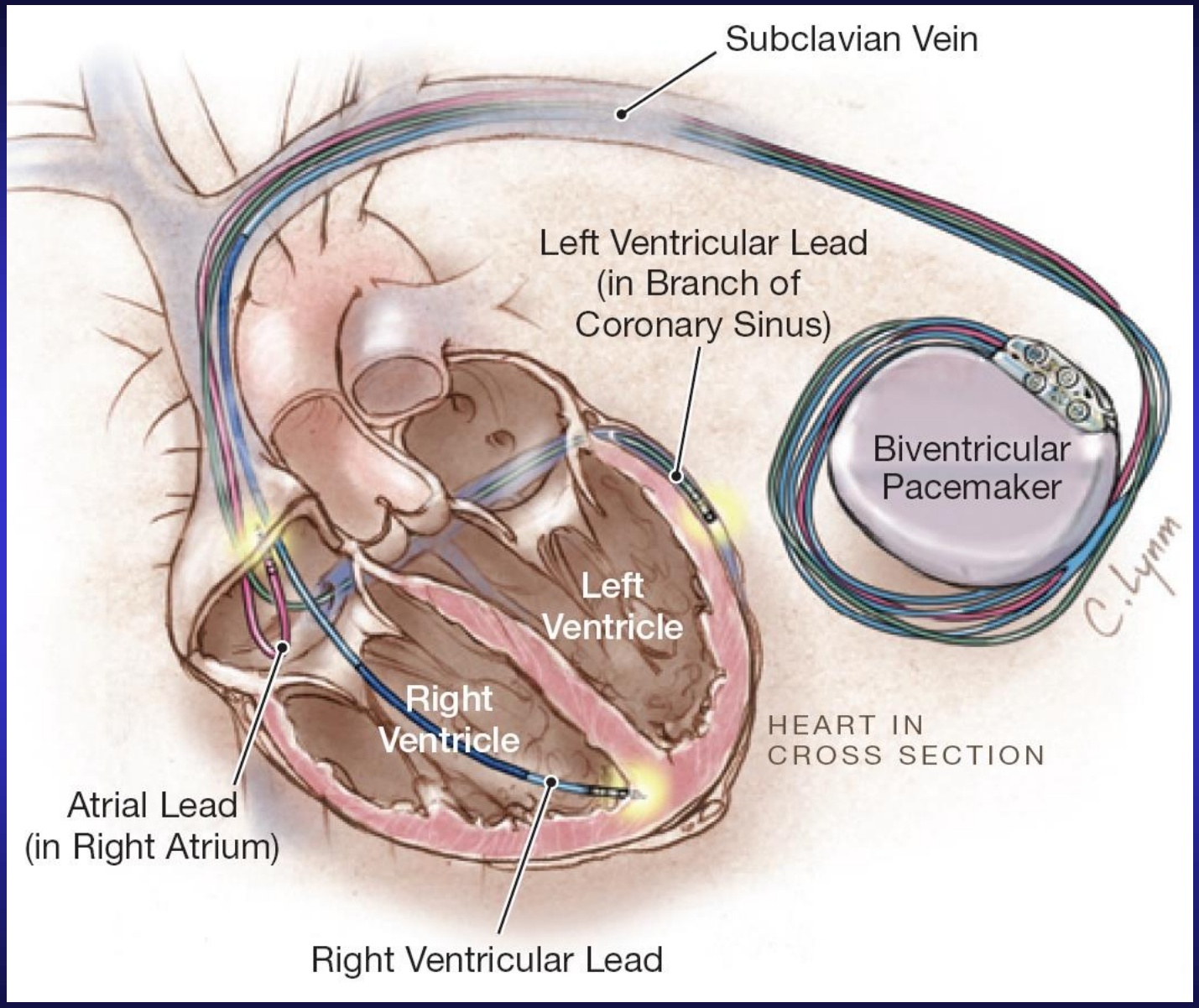
Recommendation	COR	LOE
Systolic and diastolic blood pressure should be controlled according to published clinical practice guidelines	I	B (27, 91)
Diuretics should be used for relief of symptoms due to volume overload.	I	C
Coronary revascularization for patients with CAD in whom angina or demonstrable myocardial ischemia is present despite GDMT	IIa	C
Management of AF according to published clinical practice guidelines for HF*p*EF to improve symptomatic HF	IIa	C
Use of beta-blocking agents, ACE inhibitors, and ARBs for hypertension in HF*p*EF	IIa	C
Nutritional supplementation is not recommended in HF*p*EF	III: No Benefit	C

Indications for CRT Therapy Algorithm.



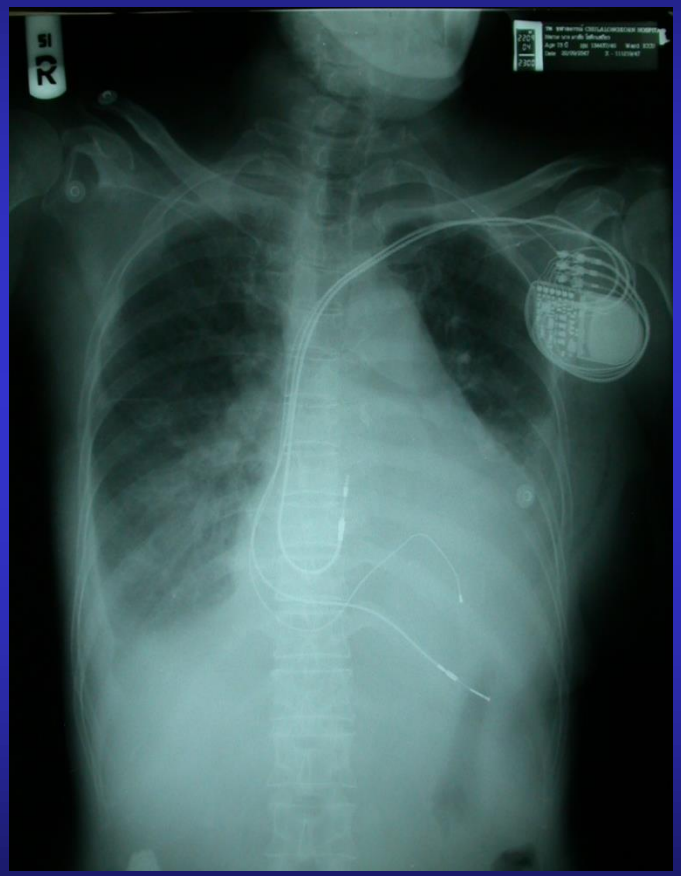
2013 ACCF/AHA Heart Failure Guideline.

Yancy CW. Circulation 2013;

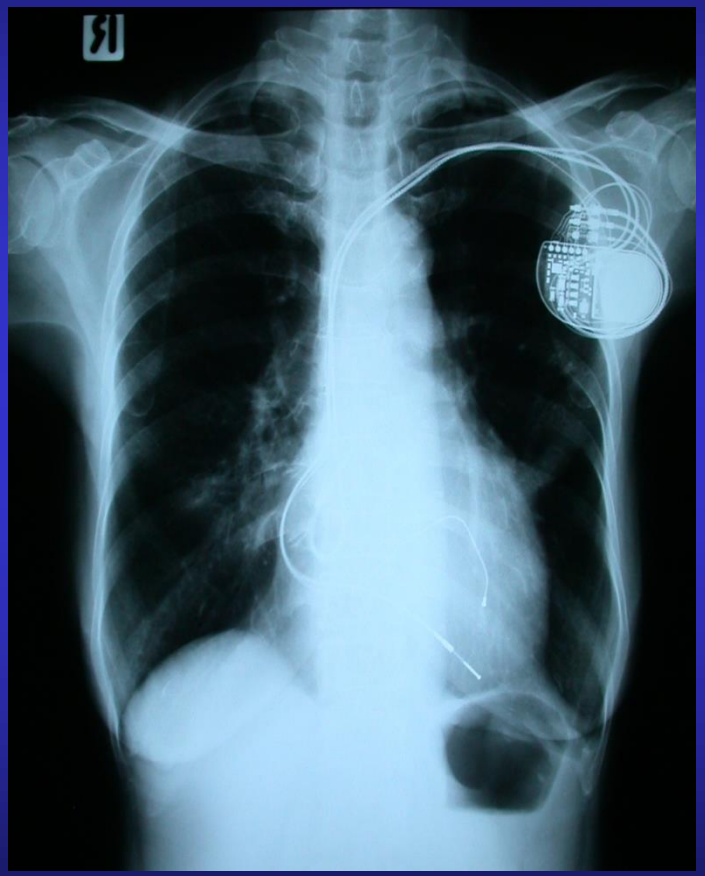

Subclavian Vein
Left Ventricular Lead
(in Branch of
Coronary Sinus)
Biventricular
Pacemaker
Left
Ventricle
Right
Ventricle
HEART IN
CROSS SECTION
Atrial Lead
(in Right Atrium)
Right Ventricular Lead

Cardiac Resynchronized Therapy

หญิงไทยคู่อายุ ๖๗ ปี DCM, FC 4, EF 20%, QRS 175 ms.



One day



6 months after CRT

TABLE 4. **Indications for Cardiac Resynchronization Therapy**[a]

Cardiac resynchronization therapy indicated[b]
LVEF ≤35%
QRS duration >120 ms
NYHA II-IV symptoms with optimal medical therapy
Consider cardiac resynchronization therapy[b]
LVEF ≤35%
NYHA II-IV symptoms with frequent right ventricular pacing

[a] LVEF = left ventricular ejection fraction; NYHA = New York Heart Association.

[b] Only if all listed criteria are satisfied.

Ramani GV. Mayo Clinic Proc. 2010;85:180-95.

Table 23 **Class I recommendations for devices in patients with LV systolic dysfunction**

ICD	
Prior resuscitated cardiac arrest	Class I Level A
Ischaemic aetiology and >40 days of MI	Class I Level A
Non-ischaemic aetiology	Class I Level B
CRT	
NYHA Class III/IV and QRS >120 ms	Class I Level A
To improve symptoms/reduce hospitalization	Class I Level A
To reduce mortality	Class I Level A

ESC guidelines 2008

2013 ACCF/AHA Heart Failure Guideline.

Yancy CW. Circulation 2013;

Table 22. Recommendations for Device Therapy for Management of Stage C HF

Recommendation	COR	LOE
ICD therapy is recommended for primary prevention of SCD in selected patients with HF*r*EF at least 40 d post-MI with LVEF ≤35% and NYHA class II or III symptoms on chronic GDMT, who are expected to live >1 y*	I	A
CRT is indicated for patients who have LVEF ≤35%, sinus rhythm, LBBB with a QRS ≥150 ms, and NYHA class II, III, or ambulatory IV symptoms on GDMT	I	A (NYHA class III/IV)
		B (NYHA class II)
ICD therapy is recommended for primary prevention of SCD in selected patients with HF*r*EF at least 40 d post-MI with LVEF ≤30% and NYHA class I symptoms while receiving GDMT, who are expected to live >1 y*	I	B
CRT is not recommended for patients with NYHA class I or II symptoms and non-LBBB pattern with QRS <150 ms	III: No Benefit	B
CRT is not indicated for patients whose comorbidities and/or frailty limit survival to <1 y	III: No Benefit	C

Stage D: AHA Heart Failure Guideline.

Yancy CW. Circulation 2013;

Table 24. Clinical Events and Findings Useful for Identifying Patients With Advanced HF
Repeated (≥2) hospitalizations or ED visits for HF in the past year
Progressive deterioration in renal function (e.g., rise in BUN and creatinine)
Weight loss without other cause (e.g., cardiac cachexia)
Intolerance to ACE inhibitors due to hypotension and/or worsening renal function
Intolerance to beta blockers due to worsening HF or hypotension
Frequent systolic blood pressure <90 mm Hg
Persistent dyspnea with dressing or bathing requiring rest
Inability to walk 1 block on the level ground due to dyspnea or fatigue
Recent need to escalate diuretics to maintain volume status, often reaching daily furosemide equivalent dose >160 mg/d and/or use of supplemental metolazone therapy
Progressive decline in serum sodium, usually to <133 mEq/L
Frequent ICD shocks

Stage D: AHA Heart Failure Guideline.

Yancy CW. Circulation 2013;

7.4.3. Water Restriction: Recommendation

Class IIa

1. **Fluid restriction (1.5 to 2 L/d) is reasonable in stage D, especially in patients with hyponatremia, to reduce congestive symptoms.** ***(Level of Evidence: C)***

Recommendation	COR	LOE
Inotropic support		
Cardiogenic shock pending definitive therapy or resolution	I	C
Routine intravenous use, either continuous or intermittent, is potentially harmful in stage D HF	III: Harm	B
Short-term intravenous use in hospitalized patients without evidence of shock or threatened end-organ performance is potentially harmful	III: Harm	B
Cardiac transplantation		
Evaluation for cardiac transplantation is indicated for carefully selected patients with stage D HF despite GDMT, device, and surgical management	I	C

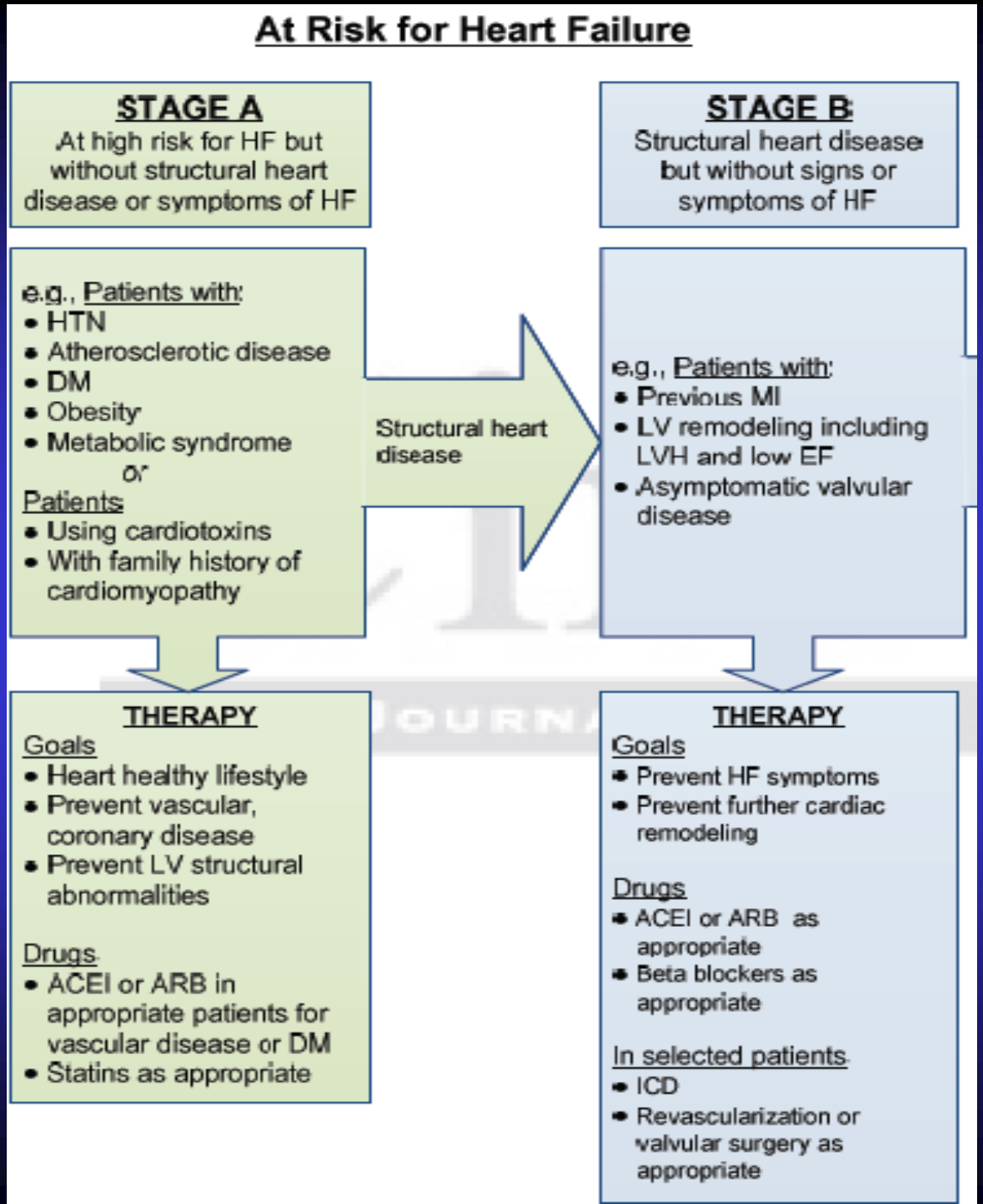
Stage D: AHA Heart Failure Guideline.

Yancy CW. Circulation 2013;

Table 26. Intravenous Inotropic Agents Used in Management of HF

Inotropic Agent	Dose (mcg/kg)		Drug Kinetics and Metabolism	Effects				Adverse Effects	Special Considerations
	Bolus	Infusion (/min)		CO	HR	SVR	PVR		
Adrenergic agonists									
Dopamine	N/A	5 to 10	$t_{1/2}$: 2 to 20 min R,H,P	↑	↑	↔	↔	T, HA, N, tissue necrosis	Caution: MAO-I
	N/A	10 to 15		↑	↑	↑	↔		
Dobutamine	N/A	2.5 to 5.0	$t_{1/2}$: 2 to 3 min H	↑	↑	↓	↔	↑/↓BP, HA, T, N, F, hypersensitivity	Caution: MAO-I; CI: sulfite allergy
	N/A	5 to 20		↑	↑	↔	↔		
PDE inhibitor									
Milrinone	N/R	0.125 to 0.75	$t_{1/2}$: 2.5 h H	↑	↑	↓	↓	T, ↓BP	Renal dosing, monitor LFTs

$t_{1/2}$ Indicates elimination half-life; BP, blood pressure; CI, contraindication; CO, cardiac output; F, fever; H, hepatic; HA, headache; HF, heart failure; HR, heart rate; LFT, liver function test; MAO-I, monoamine oxidase inhibitor; N, nausea; N/A, not applicable; N/R, not recommended; P, plasma; PDE, phosphodiesterase; PVR, pulmonary vascular resistance; R, renal; SVR, systemic vascular resistance; and T, tachyarrhythmias.

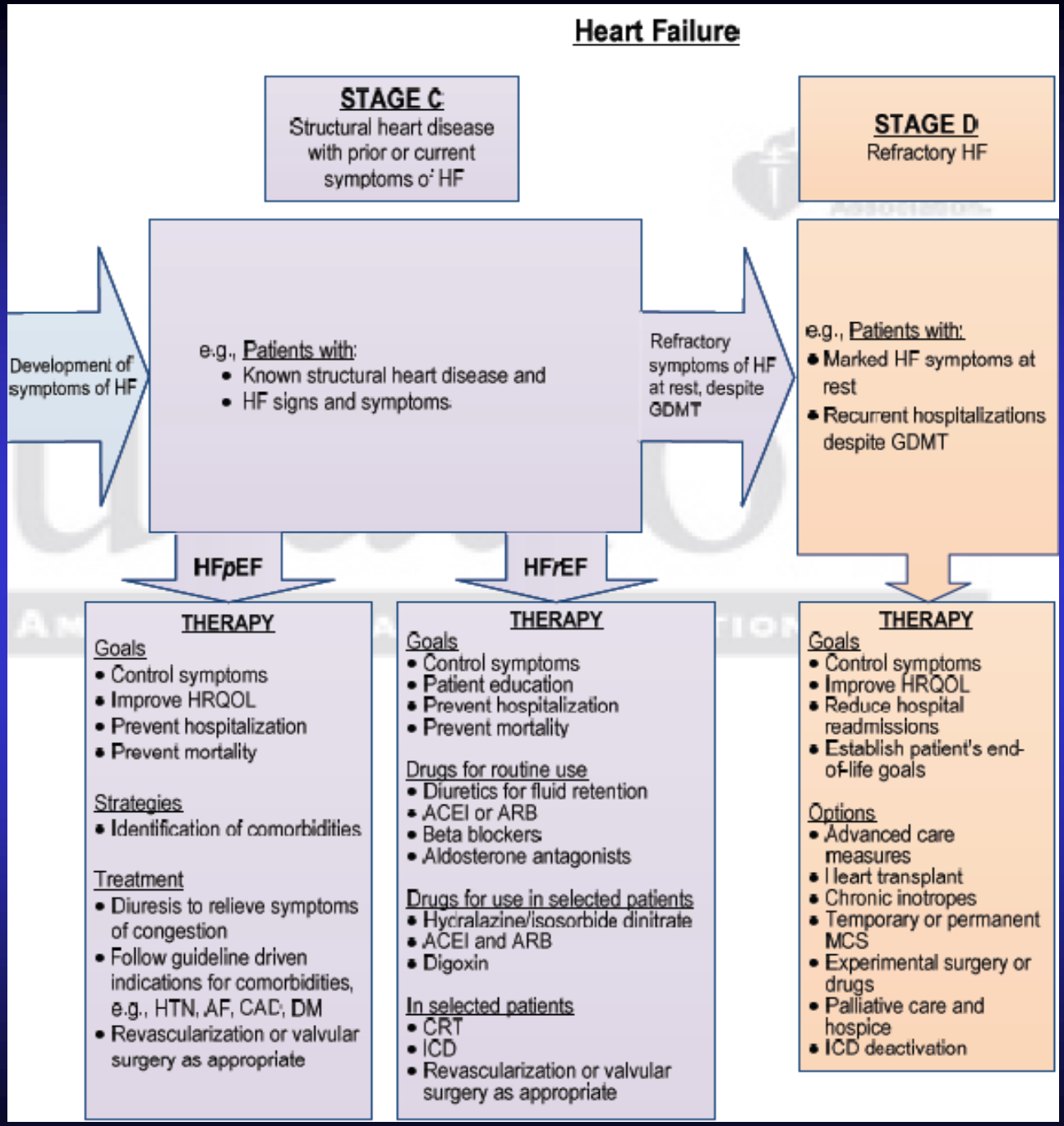


AHA HF Guideline.

Yancy CW. Circulation 2013;

AHA HF Guideline.

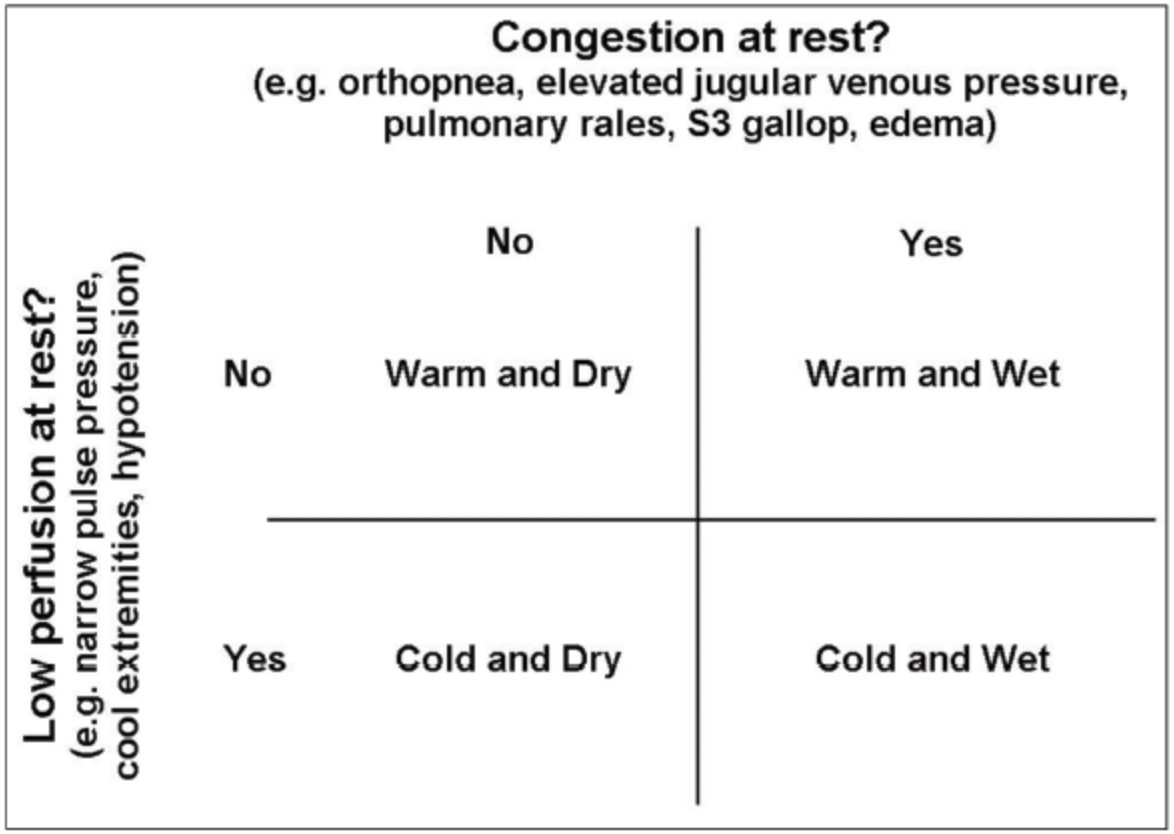
Yancy CW. Circulation 2013;



2013 Heart Failure Guideline: Acute HF

Yancy CW. Circulation 2013;

Figure 4. Classification of patients presenting with acutely decompensated HF.



Adapted with permission from Nohria et al (716).

Sign of low cardiac output

- Lethargy, dizziness, confusion, agitate
- Oliguria
- Weak pulse, tachycardia
- Narrow pulse pressure
- Cool, moist skin
- Sign of etiology or precipitating factor

With heart failure = low-output HF; with hypotension = shock

Sign of high cardiac output

- Pulse full, bounding
- Wide pulse pressure
- Warm skin
- Prominent PMI
- Soft Systolic ejection murmur at LSB
- Sign of etiology or precipitating factor

With heart failure = high-output HF

สาเหตุ high output

- Athero, heart block
- Thyrox, regurg.
- Hypertension
- สำคัญ anemia
- อ่อนเพลีย beriberi
- 4 P ทีเด็ด
  - Pyrexia
  - Pregnancy
  - PDA
  - Paget's disease
- เบ็ดเสร็จ aneurysm
- อย่าลืม AV fistula

Heart failure (HF)

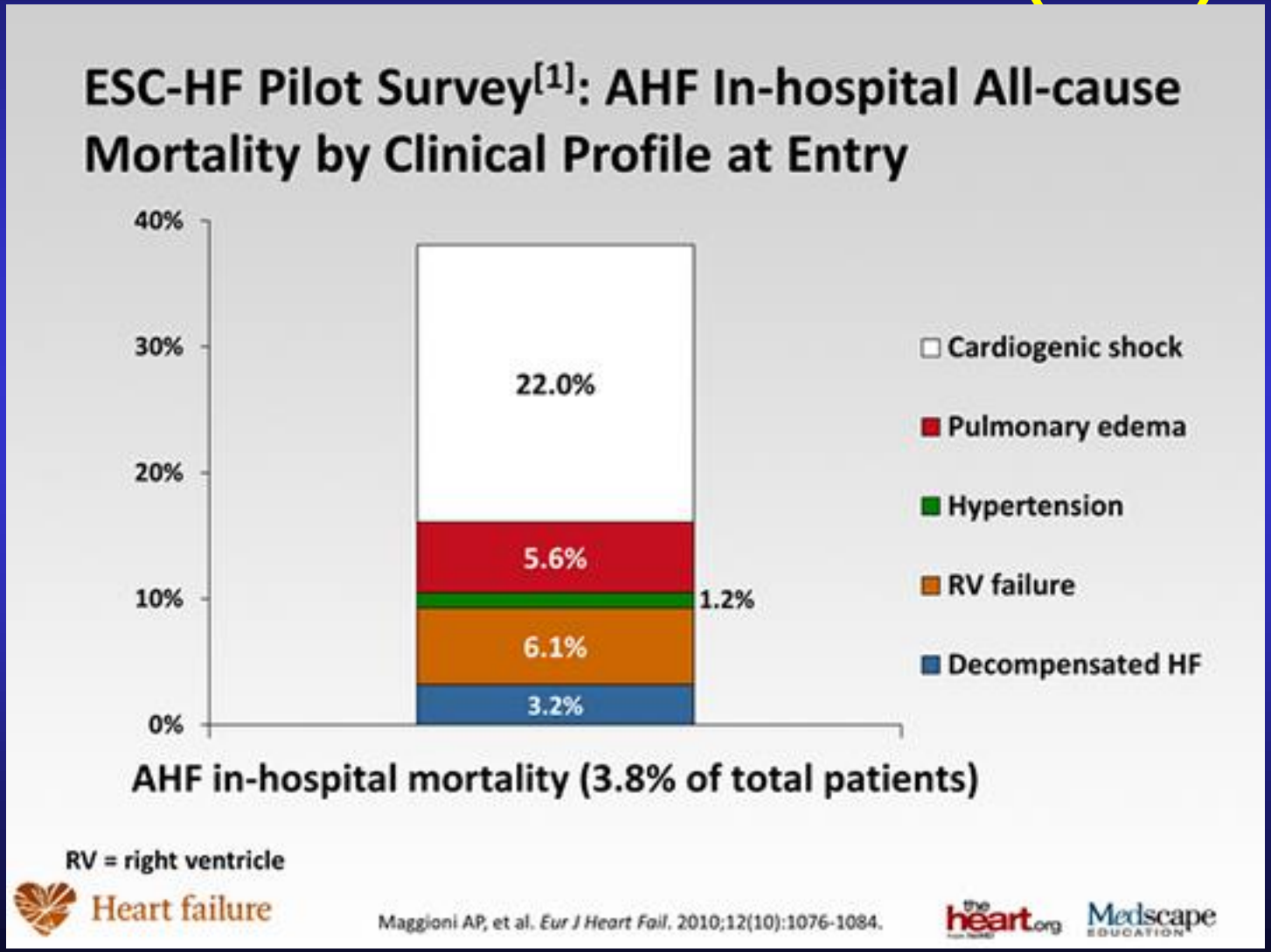
- Acute HF
  - New onset acute or decompensation of chronic HF
  - Hypertensive Acute HF
  - Pulmonary edema
  - Cardiogenic shock
  - High output failure
  - Right heart failure
  - Acute coronary syndrome
- Chronic HF

Acute Heart Failure (HF)

ESC Guidelines 2012: Triggers

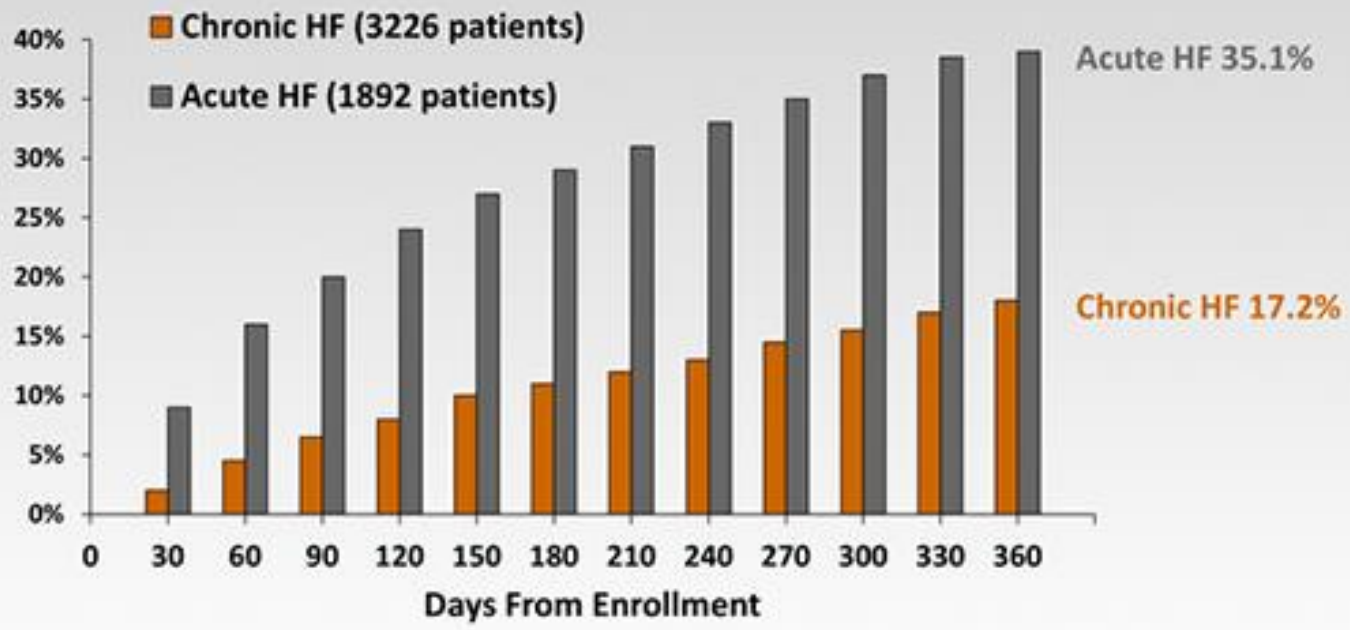
- Rapid arrhythmia or severe bradycardia
- Acute coronary syndrome
- Pulmonary embolism
- Hypertensive crisis
- Infection
- Anemia
- Nonadherence to diet/medications
- Kidney dysfunction
- Iatrogenic causes
- Thyroid disorders

Acute Heart Failure (HF)



Acute Heart Failure (HF)

ESC-HF Pilot Survey[1]: All-cause Death or HF Hospitalization



Heart failure

Maggioni AP, et al. *Eur J Heart Fail*. 2010;12(10):1076-1084.

theheart.org Medscape EDUCATION

Acute Heart Failure (HF)

Goals of Treatment of AHF[10]

Improvement of symptoms
Clinical stabilization

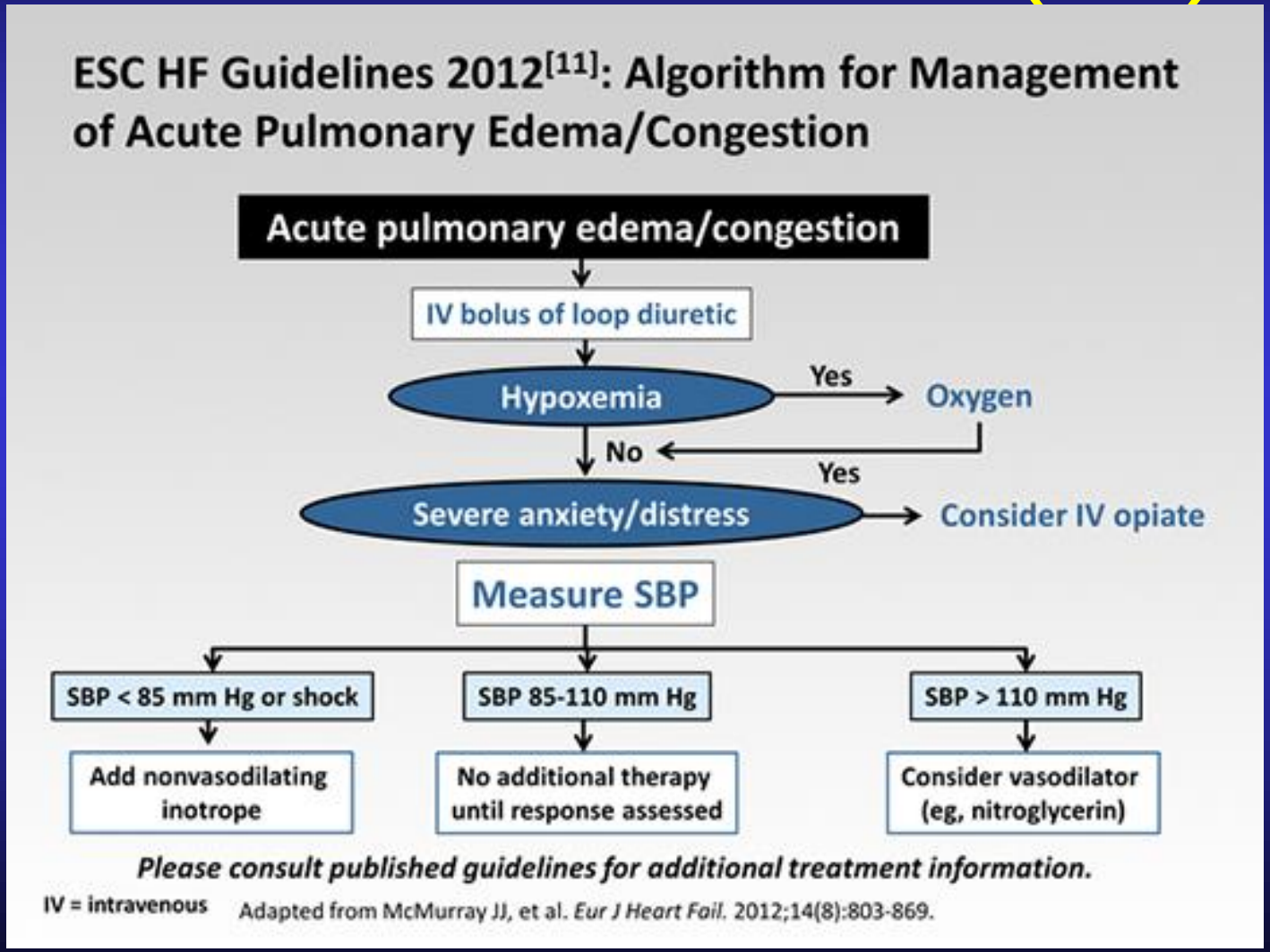
+

Avoidance/limitation of myocardial and renal damage

} Favorable effects on long-term prognosis

Nieminen M, et al. *Eur Heart J.* 2005;26(4):384-416.

Acute Heart Failure (HF)



Acute Heart Failure (HF)

Lack of Evidence-Based Therapies

- Endothelin antagonists (tezosentan, VERITAS[13])
- Inotropic agents (levosimendan, SURVIVE[14])
- Arginine vasopressin antagonists (tolvaptan, EVEREST[15])
- Cytokine modulators (RENAISSANCE[16])
- Adenosine receptor antagonists (rolofylline, PROTECT[17])
- Recombinant human natriuretic peptide (nesiritide, ASCEND HF[18])
- Direct renin inhibitor (aliskiren, ALTITUDE[19])

See reference list for complete citations.

2013 Heart Failure Guideline: Acute HF

Yancy CW. Circulation 2013;

Table 28. Recommendations for Therapies in the Hospitalized HF Patient

Recommendation	COR	LOE
HF patients hospitalized with fluid overload should be treated with intravenous diuretics	I	B
HF patients receiving loop diuretic therapy should receive an initial parenteral dose greater than or equal to their chronic oral daily dose; then should be serially adjusted	I	B
HF*r*EF patients requiring HF hospitalization on GDMT should continue GDMT unless hemodynamic instability or contraindicated	I	B
Initiation of beta-blocker therapy at a low dose is recommended after optimization of volume status and discontinuation of intravenous agents	I	B
Thrombosis/thromboembolism prophylaxis is recommended for patients hospitalized with HF	I	B
Serum electrolytes, urea nitrogen, and creatinine should be measured during titration of HF medications, including diuretics	I	C
When diuresis is inadequate, it is reasonable to a) give higher doses of intravenous loop diuretics; or b) add a second diuretic (e.g., thiazide)	IIa	B B

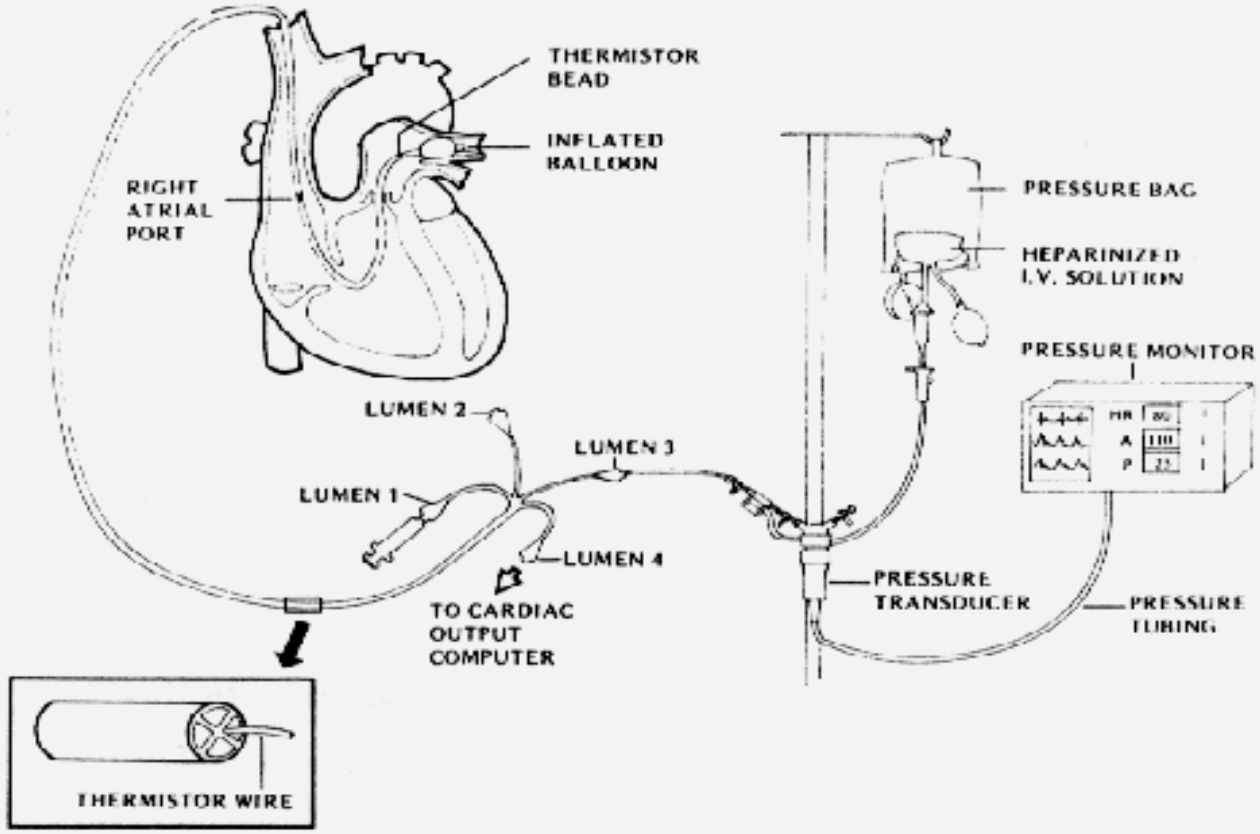
Acute pulmonary edema

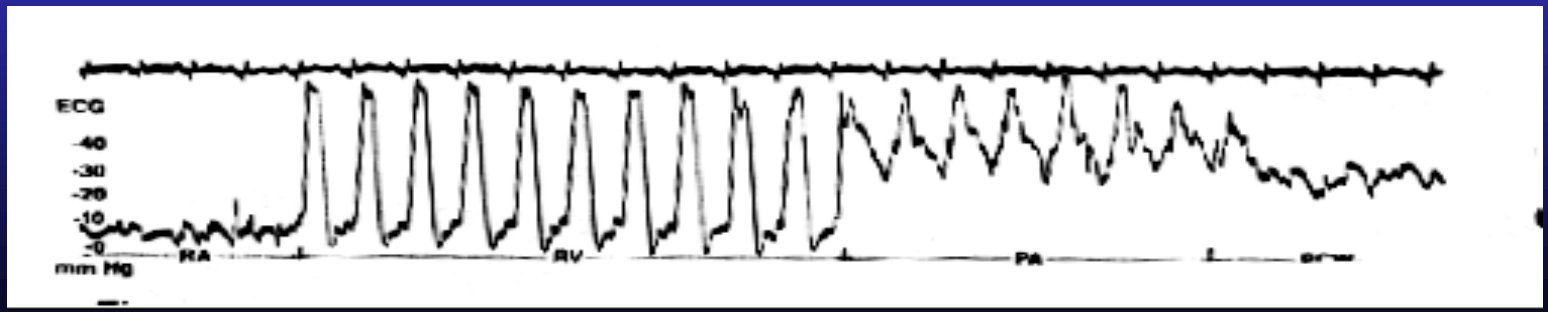
- Cardiogenic
  - Severe Lt. HF
  - Severe MS
- Diff. Dx
  - Bronchial asthma
    - previous episodes
    - rales & rhochi
  - ARDS
- Non-cardiogenic
  - Imbalance starling force
    - hypoalbumin
    - rapid remove pneumothorax
  - Unknown
    - High altitude
    - Neurogenic
    - Narcotic overdose

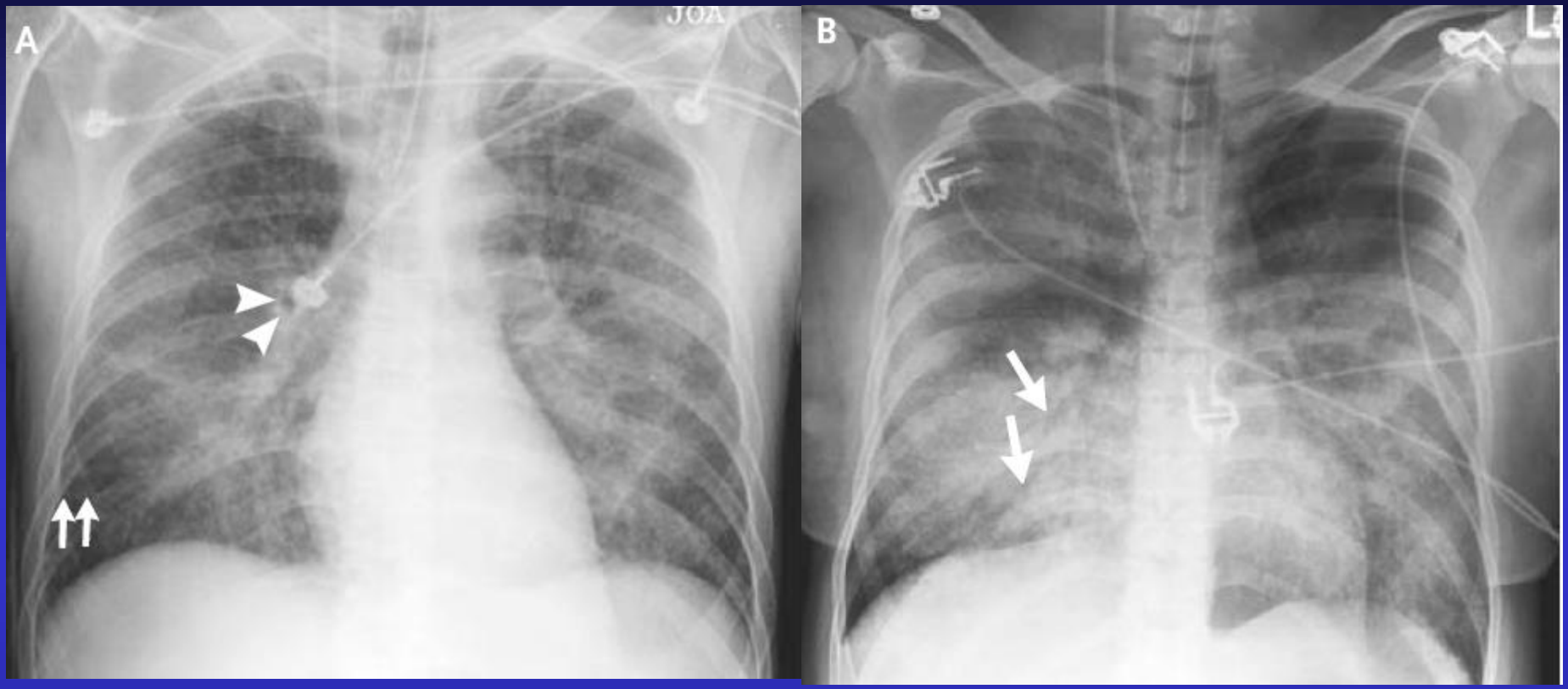
Acute pulmonary edema

Cardiac	Noncardiac
Hx: cardiac event	Underlying
PE: low CO	High CO
S3, cardiomegaly	No
JVP, crakles	No
CXR: perihilar distribution	Peripheral distribution
PCWP: > 18 mmHg	< 18 mmHg

BALLOON-TIPPED PULMONARY ARTERY CATHETERS 73







Acute cardiogenic pulmonary edema vs. non-cardiogenic pulmonary edema

N Engl J Med 2005;353:2788-96

Rx of acute cardiogenic pulmonary edema

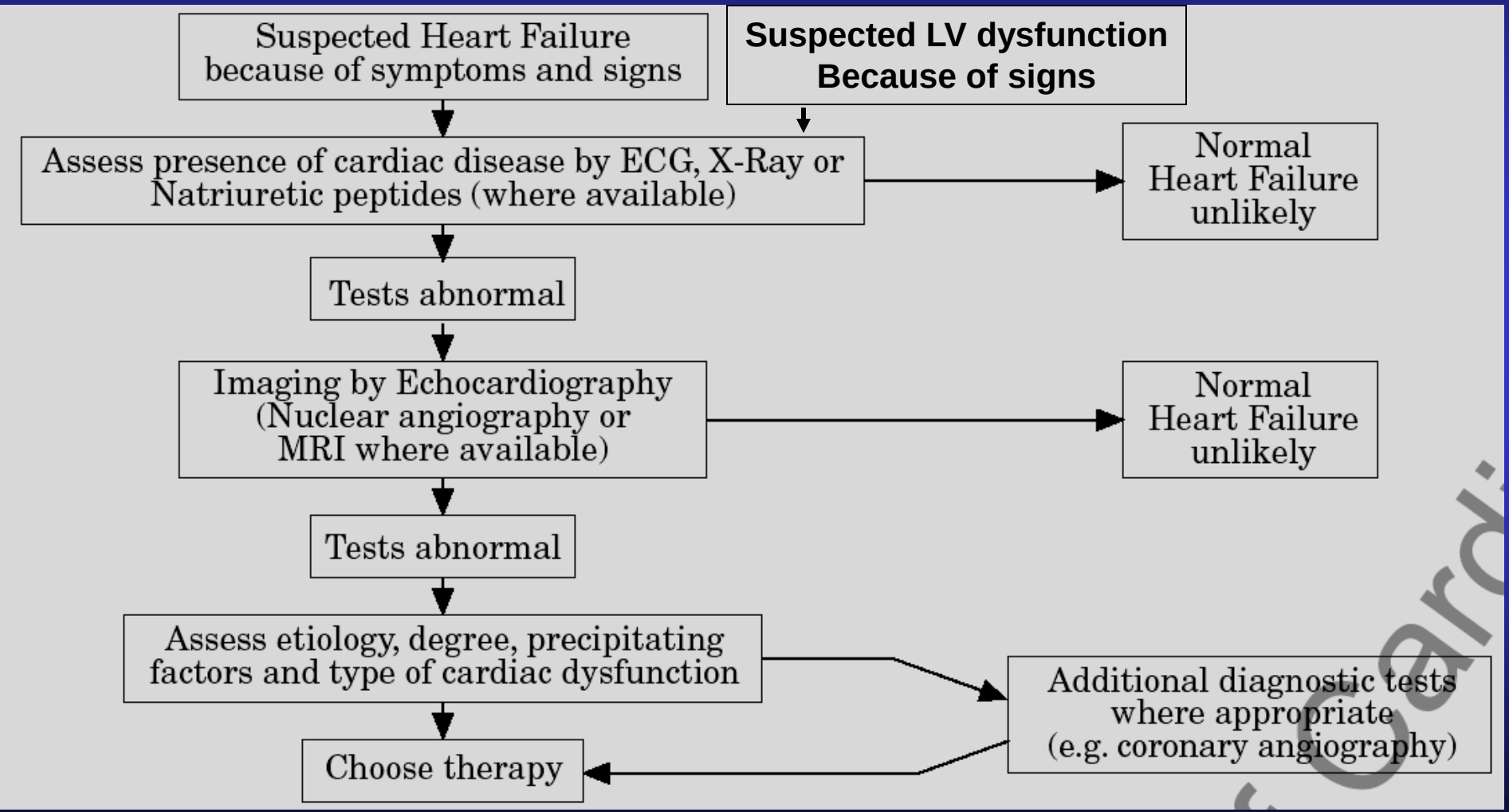
- L: Lasix or Diuretic iv.
- M: Morphine iv.
- N: Nitroprusside , Nitroglycerin iv.
- O: Oxygen 100%; ventilation support
- P: Position-Sitting, leg dangling

Six steps to Dx of heart failure

ESC text book of cardiovascular medicine 2006:710

- Step 1: Diagnosis
  - Symptoms & signs
  - History of cardiac disease
    - Myocardial, pericardial, endocardial, CAD
  - 1st line tests: ECG, X-ray, BNP/NT-proBNP
  - Cardiac dysfn: doppler echocardiogram
  - Nuclear angiography / NMR

European Society of Cardiology guidelines for chronic HF 2005



Six steps to Dx of heart failure

ESC text book of cardiovascular medicine 2006:710

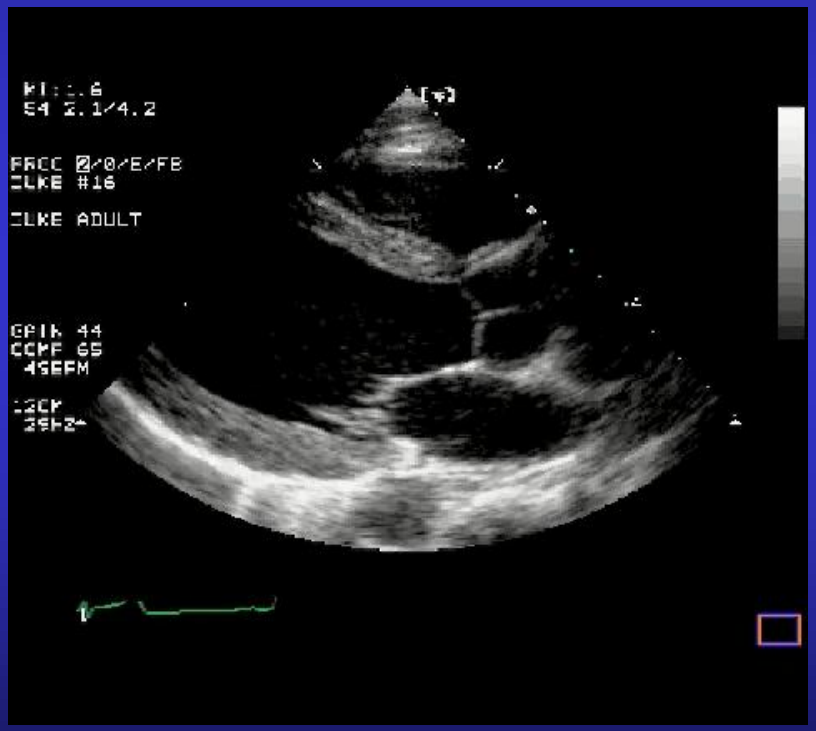
- Step 2: Clinical profile
  - Acute *de novo* /decompensated/chronic HF
  - Left/right side
  - Dry-warm, wet-warm, dry-cold, wet-cold.
  - Comorbidities
    - Stroke, COPD, DM, renal failure
  - Age and severity

Six steps to Dx of heart failure

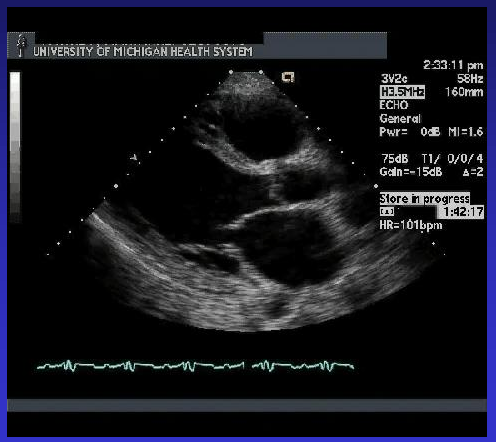
ESC text book of cardiovascular medicine 2006:710

- Step 3: Etiology
  - Coronary; CHD: CAG
  - Myocardial disease: echo
    - B1 def., myocarditis
    - Dilated, Hypertrophic, Restrictive, Peripartum CM
    - Hypertensive cardiomyopathy
  - Endocardial disease; valvular heart dis: echo
  - Pericardial disease; effusion, constriction

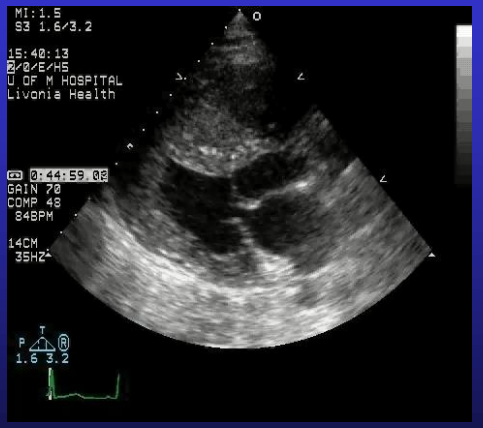
Echocardiography
normal
para-sternal long axis



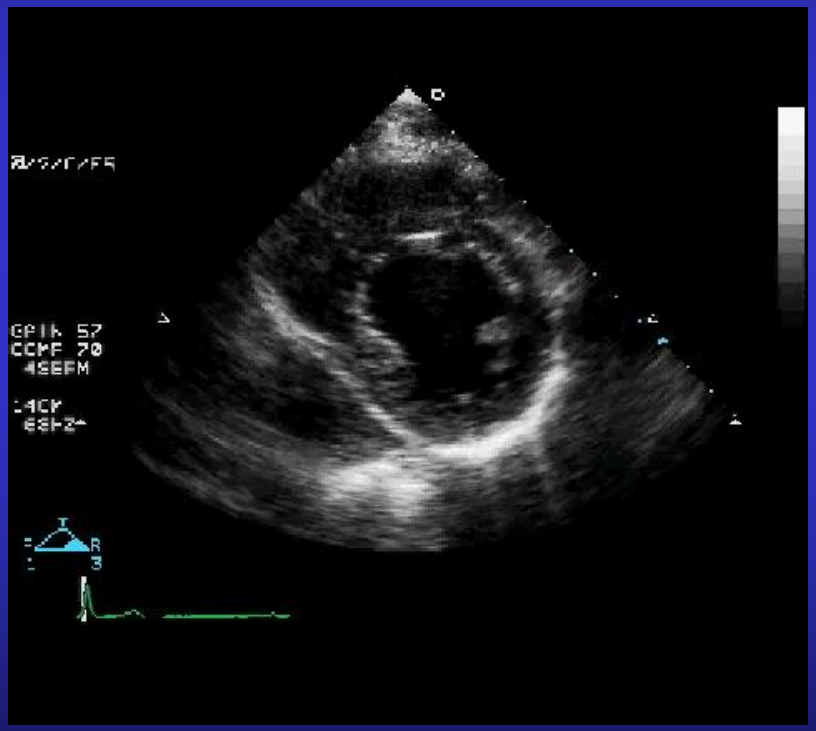
Left ventricular dilatation



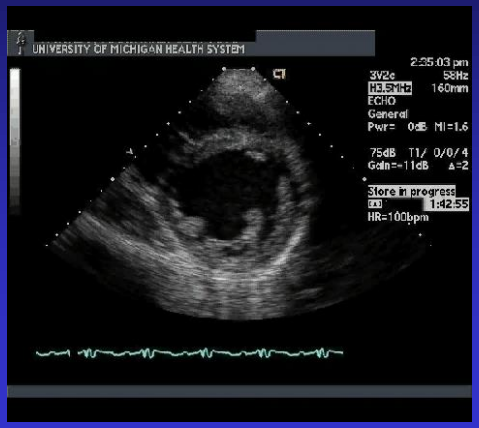
Left ventricular hypertrophy



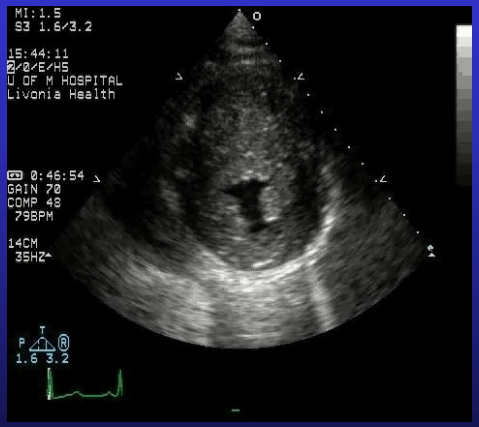
Echocardiography
normal
para-sternal short axis



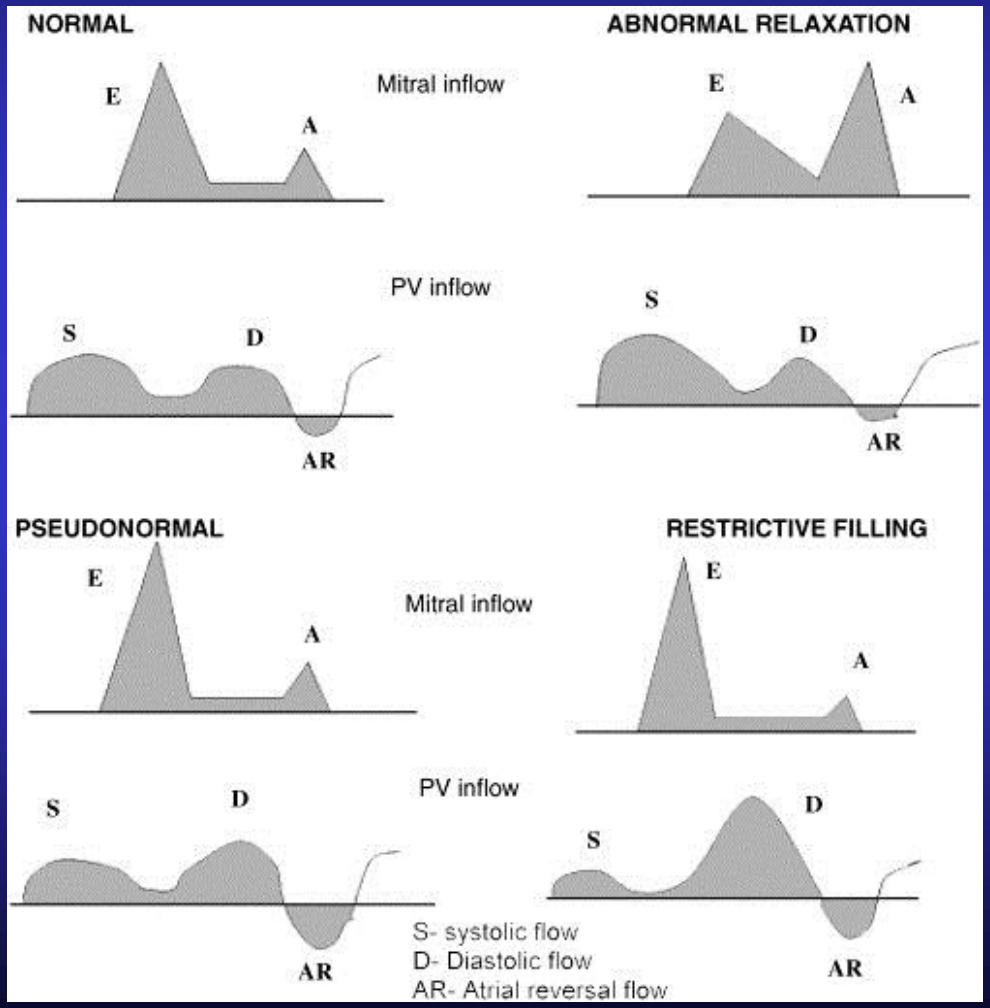
Left ventricular dilatation



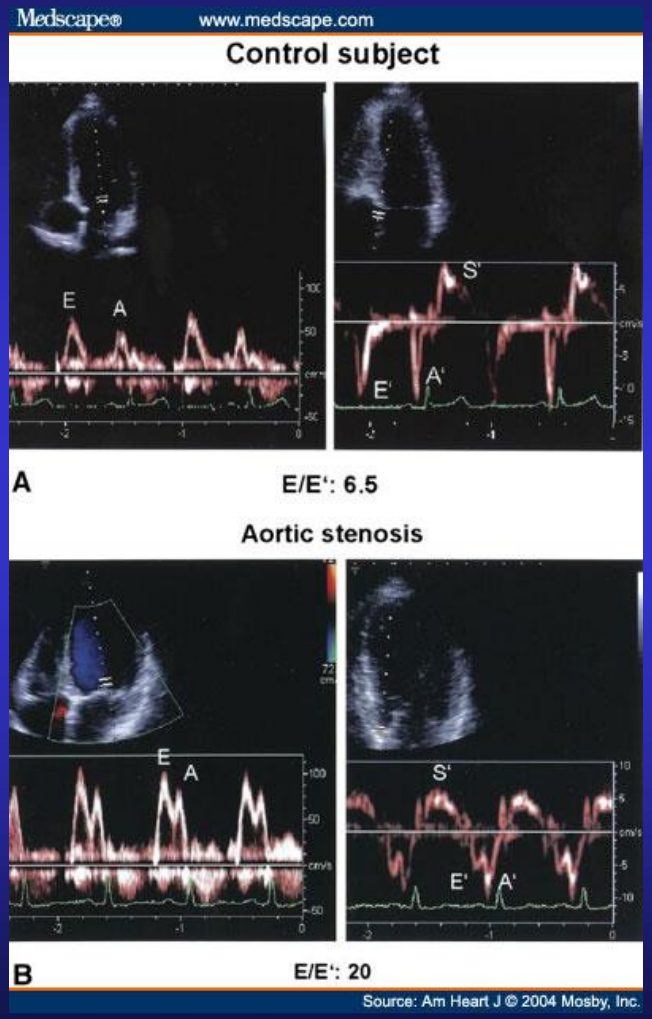
Left ventricular hypertrophy

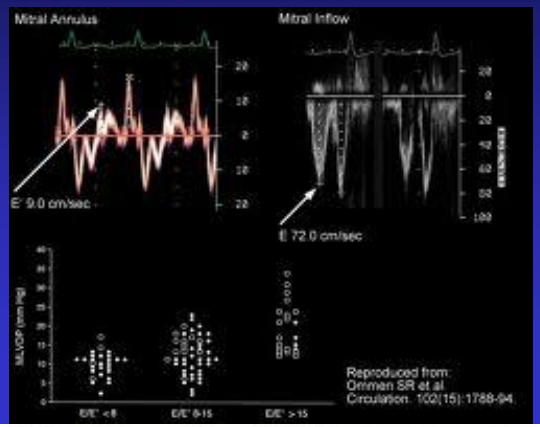


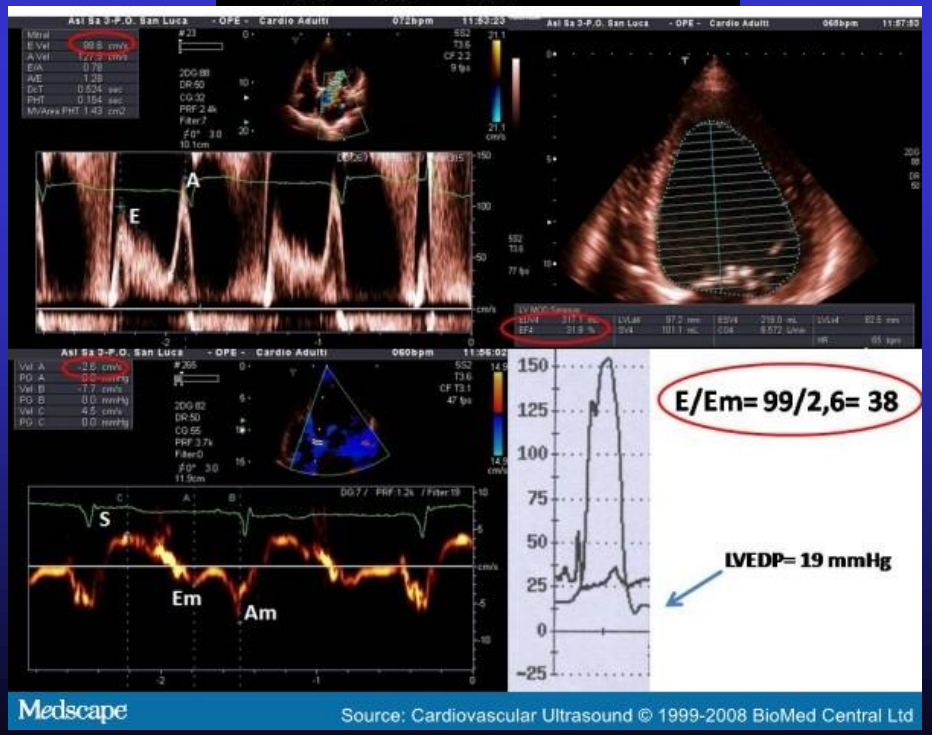
Doppler echo diastolic dysfunction



E/Ea or E/E’ > 15: high filling pressure







Six steps to Dx of heart failure

ESC text book of cardiovascular medicine 2006:710

- Step 4: Precipitating factors
  - Anemia - Infection
  - Tachycardia (atrial fibrillation), - bradycardia
  - Pulmonary embolism -Thyroid
  - Hypertensive crisis - Poor compliance
  - Acute myocardial ischemia
  - Medications (NSAIDS, COX2 inh, glitazones, steroid, class I antiarrhythmic, antidepresant

Six steps to Dx of heart failure

ESC text book of cardiovascular medicine 2006:710

- Step 5: Prognostic evaluation
  - Clinical factors eg, age, NYHA class, sign of congestion, DM, depression, CKD, ischemia
  - Biochemical eg, serum Na, Cr/CCr, Hb
  - Neurohormone/cytokine eg, BNP, TNF-apha
  - Electrical eg, QRS width, LVH, AF, HRV
  - Imaging eg, EF<0.4, restrictive pattern, RV
  - Exercise/hemodynamic eg, VO2max, 6-minute walk

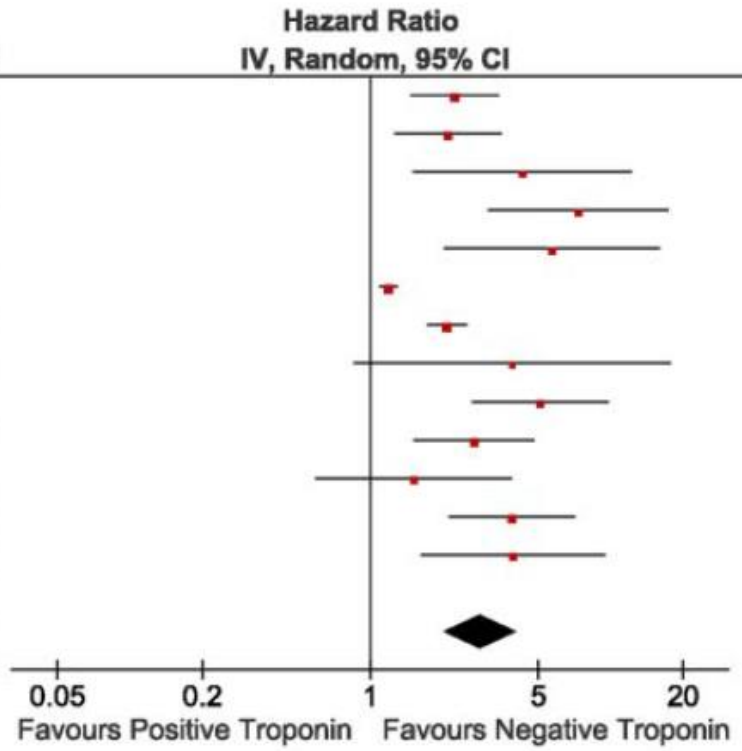
Troponin T >0.01 ng/ml in HF higher Death & CV death risk

Systematic Review. Nagarajan V. Heart 2012;98:1778.

Study or Subgroup	log[Hazard Ratio]	SE	Weight	Hazard Ratio IV, Random, 95% CI
Alehagen 2010	0.806	0.217	9.7%	2.24 [1.46, 3.43]
Horwich 2003	0.741	0.261	9.1%	2.10 [1.26, 3.50]
Hudson 2004	1.457	0.535	5.5%	4.29 [1.50, 12.25]
Jungbuer 2011	1.991	0.44	6.6%	7.32 [3.09, 17.35]
Kawahara 2011	1.74	0.527	5.6%	5.70 [2.03, 16.00]
Latini High 2007	0.174	0.045	11.3%	1.19 [1.09, 1.30]
Latini Low 2007	0.732	0.098	11.0%	2.08 [1.72, 2.52]
Macin 2006	1.358	0.774	3.5%	3.89 [0.85, 17.73]
Orea Tejeda 2010	1.626	0.334	8.0%	5.08 [2.64, 9.78]
Ralli 2005	0.992	0.295	8.6%	2.70 [1.51, 4.81]
Stanton 2005	0.415	0.48	6.1%	1.51 [0.59, 3.88]
Tentzeris 2011	1.355	0.308	8.4%	3.88 [2.12, 7.09]
Tsutamoto 2010	1.364	0.451	6.5%	3.91 [1.62, 9.47]
Total (95% CI)				**2.85 [2.02, 4.03]**

Heterogeneity: $Tau^2 = 0.27$; $Chi^2 = 98.34$, df = 12 ($P < 0.00001$); $I^2 = 88\%$

Test for overall effect: $Z = 5.96$ ($P < 0.00001$)



2 Forest plot for primary outcome (either all-cause or cardiovascular mortality).

Six steps to Dx of heart failure

ESC text book of cardiovascular medicine 2006:710

- Step 6 Treatment and follow up
  - General
    - Education, Nurse-monitored OPD, Diet, alcohol, smoking, work, exercise, sexual, factors to avoid, concomitant disorders & psycholocial/pain
  - Pharmacologic Rx: imparied/preserved LVEF
  - Device Rx: CRT, ICD
  - Surgical Rx: CABG, HTx, MR, remodeling LV, circulatory assist device, cell Tx

Management outline

1. Establish that the patient has heart failure [redacted]
2. Ascertain presenting features: pulmonary oedema, exertional breathlessness, fatigue, peripheral oedema
3. Assess severity of symptoms
4. Determine aetiology of heart failure
5. Identify precipitating and exacerbating factors
6. Identify concomitant diseases relevant to heart failure and its management
7. Estimate prognosis
8. Anticipate complications
9. Counsel patient and relatives
10. Choose appropriate management
11. Monitor progress and manage accordingly

ACC/AHA guideline summary: Initial evaluation of patients with heart failure (HF)

Circulation 2009

Class I - There is evidence and/or general agreement that the initial evaluation of patients presenting with HF should include the following:
• A complete history and physical examination to identify cardiac and noncardiac disorders or behaviors that might cause or accelerate the development or progression of HF.
• A careful history of current and past use of alcohol, illicit drugs, standard or "alternative" therapies, and chemotherapy drugs.
• An assessment of the ability to perform routine and desired activities of daily living.
• An assessment of the volume status, orthostatic blood pressure changes, height and weight, and calculation of body mass index.
• Laboratory studies including complete blood count, urinalysis, serum electrolytes (including calcium and magnesium), blood urea nitrogen, serum creatinine, fasting blood glucose (glycohemoglobin), lipid profile, liver function tests, and serum thyroid-stimulating hormone.
• A twelve-lead electrocardiogram and chest radiograph (posteroanterior and lateral).
• Two-dimensional echocardiography with Doppler to assess left ventricular ejection fraction (LVEF), left ventricular size, wall thickness, and valve function. Radionuclide ventriculography can be performed to assess LVEF and volumes.
• Coronary arteriography if there is a history or angina or significant ischemia unless the patient is not eligible for revascularization of any kind.

Class IIa - The weight of evidence or opinion is in favor of benefit from performing the following studies as part of the initial evaluation of patients presenting with HF:
• Coronary arteriography in patients who have chest pain that may or may not be of cardiac origin who have not had a prior evaluation of their coronary anatomy and are eligible for coronary revascularization.
• Coronary arteriography in patients with known or suspected coronary artery disease who do not have angina and are eligible for revascularization.
• Noninvasive imaging to detect myocardial ischemia and viability in patients with known or suspected coronary artery who do not have angina and are eligible for revascularization.
• When the contribution of HF to exercise limitation is uncertain, maximal exercise testing with or without measurement of respiratory gas exchange and/or blood oxygen saturation.
• To identify candidates for cardiac transplantation or other advanced treatments, maximal exercise testing with measurement of respiratory gas exchange.
• In selected patients, screening for hemochromatosis, sleep disturbed breathing, or human immunodeficiency virus (HIV) infection.
• When suspected clinically, diagnostic tests for rheumatologic disease, amyloidosis, or pheochromocytoma.
• Endomyocardial biopsy when a specific diagnosis is suspected that would influence therapy.
• Measurement of serum B-type natriuretic peptide (BNP) in the urgent care setting if the clinical diagnosis of HF is uncertain. Measurement of natriuretic peptides (BNP and NT-proBNP) can be useful in risk stratification.
Class IIb - The weight of evidence or opinion is less well established for the following testing

Class IIb - The weight of evidence or opinion is less well established for the following testing in the initial evaluation of patients with HF
• Noninvasive imaging to define the likelihood of coronary artery disease in patients with left ventricular dysfunction.
• Holter monitoring in patients who have a history of myocardial infarction and are being considered for electrophysiologic study to document the inducibility of ventricular tachycardia.
Class III - There is evidence and/or general agreement that the following tests are not useful or may be harmful in the initial evaluation of patients with HF
• Routine endomyocardial biopsy in the absence of suspicion of a specific diagnosis that would influence therapy suspected.
• Routine signal-averaged electrocardiography.
• Routine measurement of serum neurohormones other than BNP (eg, norepinephrine or endothelin).

Data from Hunt, SA, Abraham, WT, Chin, MH, et al. 2009 focused update incorporated into the ACC/AHA 2005 Guidelines for the Diagnosis and Management of Heart Failure in Adults: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines: developed in collaboration with the International Society for Heart and Lung Transplantation. Circulation 2009; 119:e391.

2013 Heart Failure Guideline: HF discharge

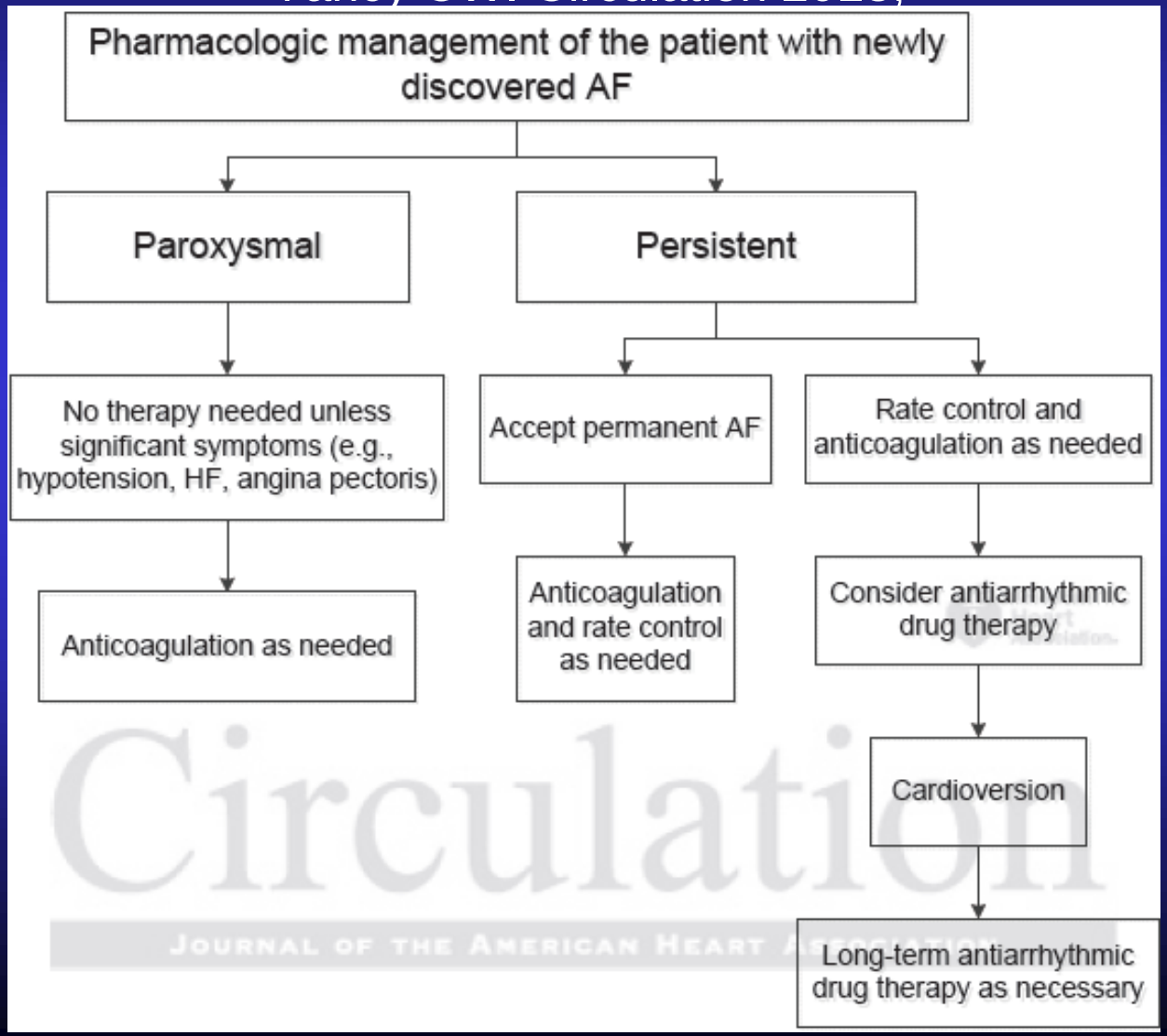
Yancy CW. Circulation 2013;

Table 29. Recommendations for Hospital Discharge

Recommendation or Indication	COR	LOE	References
Performance improvement systems in the hospital and early postdischarge outpatient setting to identify HF for GDMT	I	B	(82, 365, 706, 792-796)
Before hospital discharge, at the first postdischarge visit, and in subsequent follow-up visits, the following should be addressed: a. initiation of GDMT if not done or contraindicated; b. causes of HF, barriers to care, and limitations in support; c. assessment of volume status and blood pressure with adjustment of HF therapy; d. optimization of chronic oral HF therapy; e. renal function and electrolytes; f. management of comorbid conditions; g. HF education, self-care, emergency plans, and adherence; and h. palliative or hospice care	I	B	(204, 795, 797-799)
Multidisciplinary HF disease-management programs for patients at high risk for hospital readmission are recommended	I	B	(82, 800-802)
A follow-up visit within 7 to 14 d and/or a telephone follow-up within 3 d of hospital discharge is reasonable	IIa	B	(101, 803)
Use of clinical risk-prediction tools and/or biomarkers to identify higher-risk patients is reasonable	IIa	B	(215)

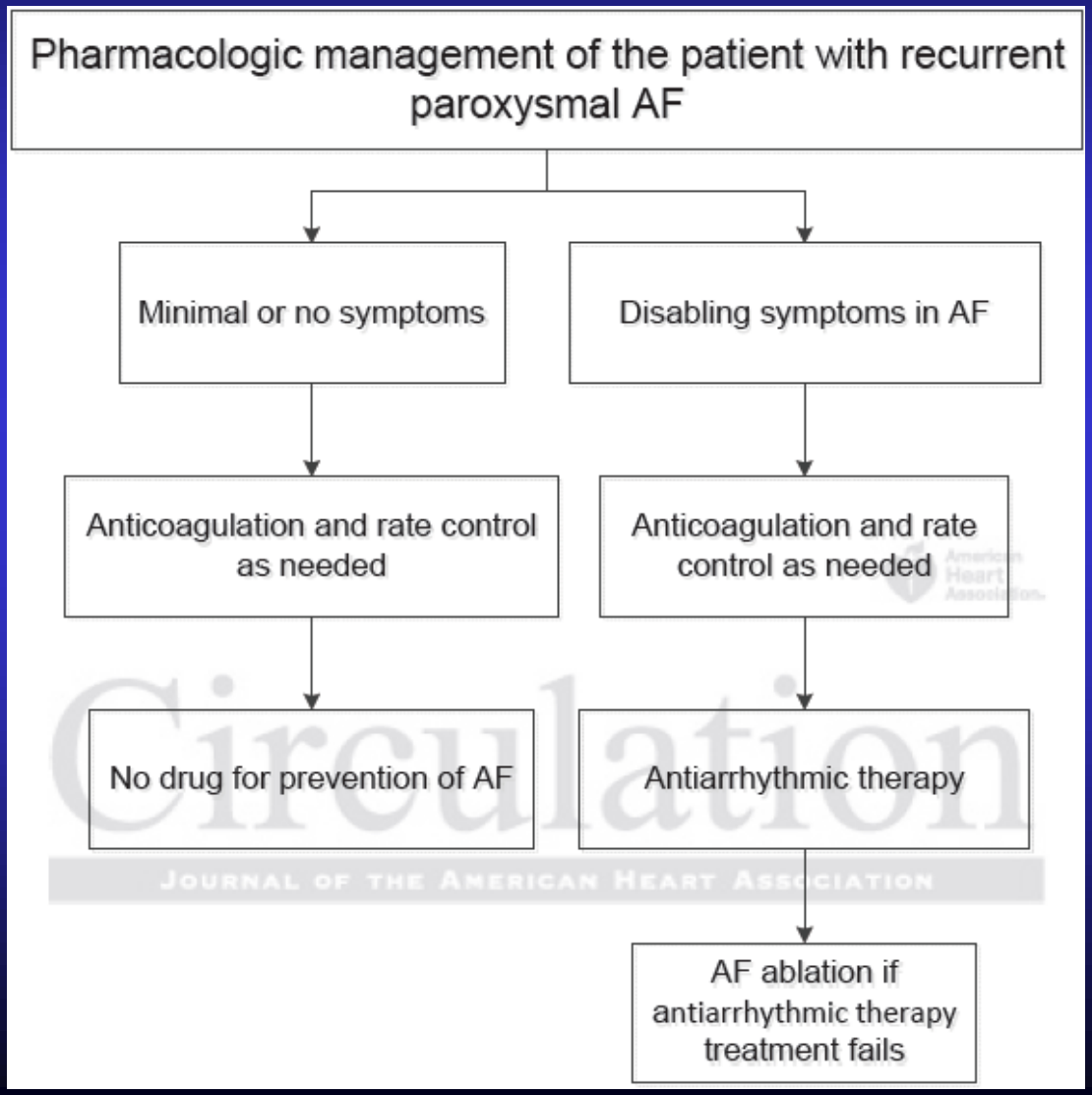
2013 Heart Failure Guideline: new AF

Yancy CW. Circulation 2013;



2013 Heart Failure Guideline: recurrent paroxysmal AF

Yancy CW. Circulation 2013;



2013 Heart Failure Guideline: Co-morbidities of HF

Yancy CW. Circulation 2013;

Table 31. Ten Most Common Co-Occurring Chronic Conditions Among Medicare Beneficiaries With Heart Failure (N=4,947,918), 2011

Beneficiaries Age ≥65 y (N=4,376,150)*			Beneficiaries Age <65 y (N=571,768)†		
	N	%		N	%
Hypertension	3,685,373	84.2	Hypertension	461,235	80.7
Ischemic heart disease	3,145,718	71.9	Ischemic heart disease	365,889	64.0
Hyperlipidemia	2,623,601	60.0	Diabetes	338,687	59.2
Anemia	2,200,674	50.3	Hyperlipidemia	325,498	56.9
Diabetes	2,027,875	46.3	Anemia	284,102	49.7
Arthritis	1,901,447	43.5	Chronic kidney disease	257,015	45.0
Chronic kidney disease	1,851,812	42.3	Depression	207,082	36.2
COPD	1,311,118	30.0	Arthritis	201,964	35.3
Atrial fibrillation	1,247,748	28.5	COPD	191,016	33.4
Alzheimer's disease/dementia	1,207,704	27.6	Asthma	88,816	15.5

*Mean No. of conditions is 6.1; median is 6.

†Mean No. of conditions is 5.5; median is 5.

Data source: CMS administrative claims data, January 2011–December 2011, from the Chronic Condition Warehouse (CCW), ccwdata.org (847).

CMS indicates Centers for Medicare and Medicaid Services; and COPD, chronic obstructive pulmonary disease.

Recommendations for Surgical/Percutaneous/Transcather Interventional Treatments of HF

2013 AHA Heart Failure Guideline:

Yancy CW. Circulation 2013;

Recommendation	COR	LOE
CABG or percutaneous intervention is indicated for HF patients on GDMT with angina and suitable coronary anatomy, especially significant left main stenosis or left main equivalent	I	C
CABG to improve survival is reasonable in patients with mild to moderate LV systolic dysfunction and significant multivessel CAD or proximal LAD stenosis when viable myocardium is present	IIa	B
CABG or medical therapy is reasonable to improve morbidity and mortality for patients with severe LV dysfunction (EF <35%), HF, and significant CAD	IIa	B
Surgical aortic valve replacement is reasonable for patients with critical aortic stenosis and a predicted surgical mortality of no greater than 10%	IIa	B
Transcatheter aortic valve replacement is reasonable for patients with critical aortic stenosis who are deemed inoperable	IIa	B

ACCF/AHA/AMA-PCPI 2011 HF Measurement Set

2013 AHA Heart Failure Guideline:

Yancy CW. Circulation 2013;

Measure	Description*	Care Setting	Level of Measurement
1. LVEF assessment	Percentage of patients aged ≥18 y with a diagnosis of HF for whom the quantitative or qualitative results of a recent or prior (any time in the past) LVEF assessment is documented within a 12-mo period	Outpatient	Individual practitioner
2. LVEF assessment	Percentage of patients aged ≥18 y with a principal discharge diagnosis of HF with documentation in the hospital record of the results of an LVEF assessment performed either before arrival or during hospitalization, OR documentation in the hospital record that LVEF assessment is planned for after discharge	Inpatient	• Individual practitioner • Facility
3. Symptom and activity assessment	Percentage of patient visits for those patients aged ≥18 y with a diagnosis of HF with quantitative results of an evaluation of both current level of activity and clinical symptoms documented	Outpatient	Individual practitioner
4. Symptom management†	Percentage of patient visits for those patients aged ≥18 y with a diagnosis of HF and with quantitative results of an evaluation of both level of activity AND clinical symptoms documented in which patient symptoms have improved or remained consistent with treatment goals since last assessment OR patient symptoms have demonstrated clinically important deterioration since last assessment with a documented plan of care	Outpatient	Individual practitioner

ACCF/AHA/AMA-PCPI 2011 HF Measurement Set

2013 AHA Heart Failure Guideline:

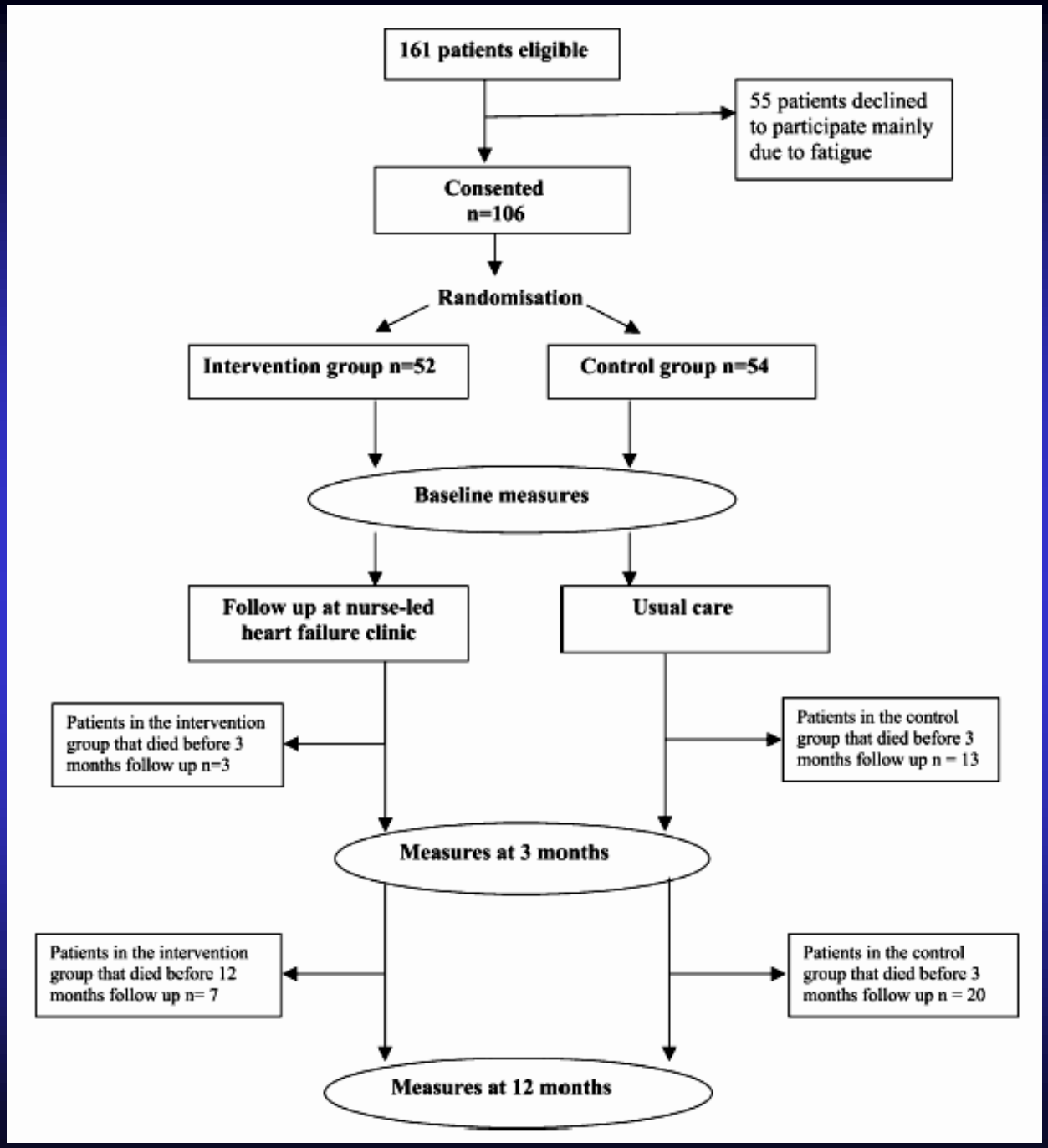
Yancy CW. Circulation 2013;

Measure	Description*	Care Setting	Level of Measurement
5. Patient self-care education†‡	Percentage of patients aged ≥18 y with a diagnosis of HF who were provided with self-care education on ≥3 elements of education during ≥1 visits within a 12-mo period	Outpatient	Individual practitioner
6. Beta-blocker therapy for LVSD (outpatient and inpatient setting)	Percentage of patients aged ≥18 y with a diagnosis of HF with a current or prior LVEF <40% who were prescribed beta-blocker therapy with bisoprolol, carvedilol, or sustained-release metoprolol succinate either within a 12-mo period when seen in the outpatient setting or at hospital discharge	Inpatient and outpatient	• Individual practitioner • Facility
7. ACE inhibitor or ARB therapy for LVSD (outpatient and inpatient setting)	Percentage of patients aged ≥18 y with a diagnosis of HF with a current or prior LVEF <40% who were prescribed ACE inhibitor or ARB therapy either within a 12-mo period when seen in the outpatient setting or at hospital discharge	Inpatient and outpatient	• Individual practitioner • Facility
8. Counseling about ICD implantation for patients with LVSD on combination medical therapy†‡	Percentage of patients aged ≥18 y with a diagnosis of HF with current LVEF ≤35% despite ACE inhibitor/ARB and beta-blocker therapy for at least 3 mo who were counseled about ICD implantation as a treatment option for the prophylaxis of sudden death	Outpatient	Individual practitioner
9. Postdischarge appointment for HF patients	Percentage of patients, regardless of age, discharged from an inpatient facility to ambulatory care or home health care with a principal discharge diagnosis of HF for whom a follow-up appointment was scheduled and documented, including location, date, and time for a follow-up office visit or home health visit (as specified)	Inpatient	Facility

Nurse-led HF clinics improve survival & self-care behavior

Stromberg A. Eur Heart J 2003; 24: 1014-1023

- 106 patients randomly assigned to FU at nurse-led heart failure clinic vs.usual care.
- Nurse-led heart failure clinic staffed by specially educated & experienced cardiac nurses, delegated responsibility making protocol-led changes in meds.
- First FU visit 2-3 weeks after discharge.
- During visit, nurse evaluated HF status, treatment, gave education, social support to patient & family.


161 patients eligible
55 patients declined to participate mainly due to fatigue
Consented n=106
Randomisation
Intervention group n=52
Control group n=54
Baseline measures
Follow up at nurse-led heart failure clinic
Usual care
Patients in the intervention group that died before 3 months follow up n=3
Patients in the control group that died before 3 months follow up n = 13
Measures at 3 months
Patients in the intervention group that died before 12 months follow up n= 7
Patients in the control group that died before 3 months follow up n = 20
Measures at 12 months

Nurse-led HF clinics improve survival & self-care behavior

Stromberg A. Eur Heart J 2003; 24: 1014-1023

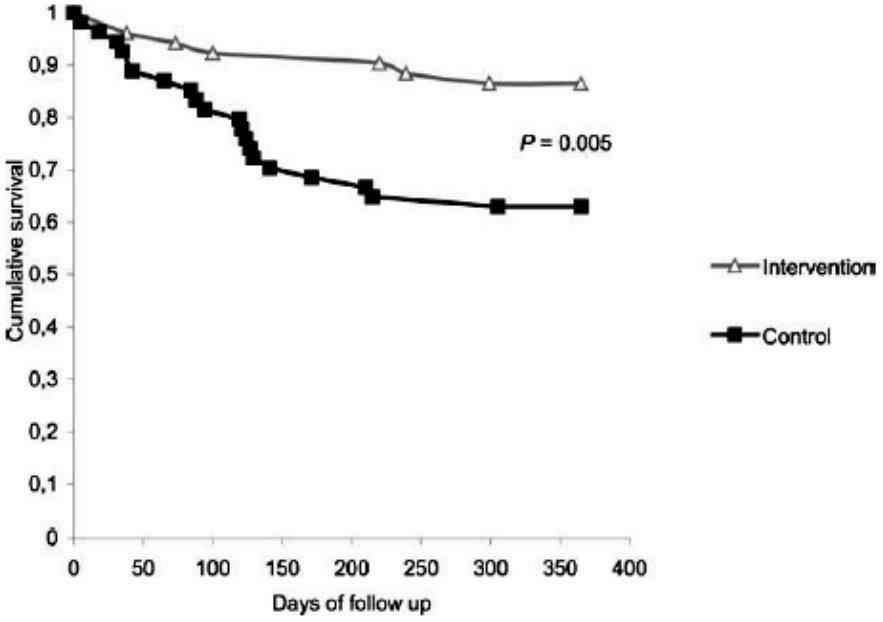


Fig. 3 Cumulative survival of the patients with heart failure during study follow-up, 94% of the 52 patients in the intervention group were alive after 3 months and 76% of the 54 patients in the control group (p=0.009). After 12 months 87% of the patients were alive in the intervention group and 63% in the control group (p=0.005).

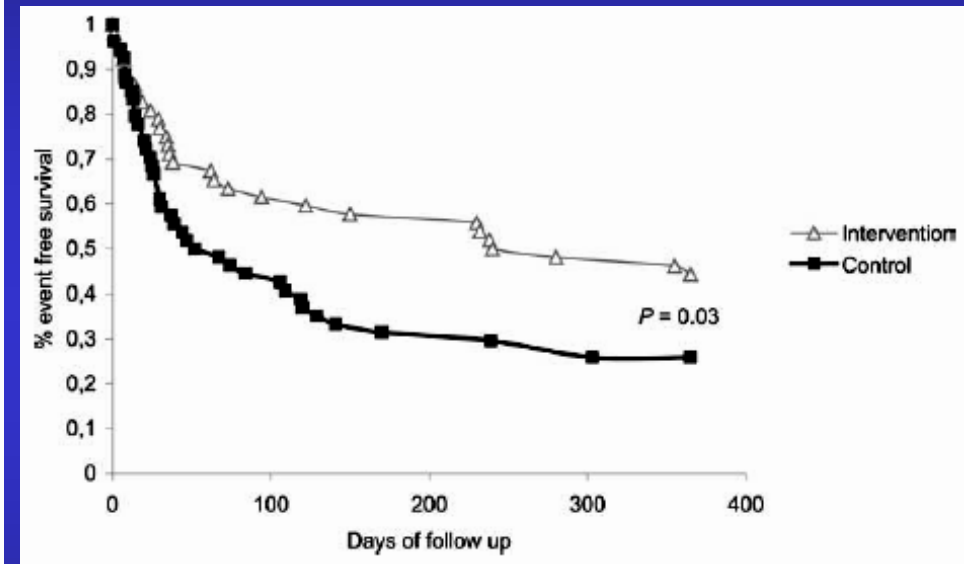


Fig. 2 Time to first event (death or hospital admission for all causes) in the patients with heart failure in the intervention (n=52) and control group (n=54).

Nurse-Dr-directed HF clinic & outcomes

de la Porte PWFB. Heart 2007;93:819-25

- Two regional teaching hospitals in The Netherlands.
- 240 pts randomly allocated to
- 1-year intervention (n = 118): pt contacts at day 3 by phone & at wks 1, 3, 5, 7 & at months 3, 6, 9 & 12 by a visit HF outpt clinic, within a week after discharge.
  - treatment, access clinic, exercise & rest, symptom monitoring & self-care.
- Usual care (n = 122).
  - outpatient visits initialised by individual cardiologists in cardiology departments & guidelines of ESC.

Nurse-Dr-directed HF clinic & outcomes

de la Porte PWFB. Heart 2007;93:819-25

Variable	Intervention group (incidence rate) n = 118	Usual care group n = 122	Rate ratio (95% CI)
Hospitalisation for CHF and/or death	23 (20.7 per 100 patient years)	47 (42.2 per 100 patient years)	0.49 (0.30 to 0.81)
Death (all-cause)	12 (10.8 per 100 patient years)	23 (20.6 per 100 patient years)	0.52 (0.26 to 1.05)
Days in hospital	359 (324 per 100 patient years)	644 (578 per 100 patient years)	0.56 (0.49 to 0.64)

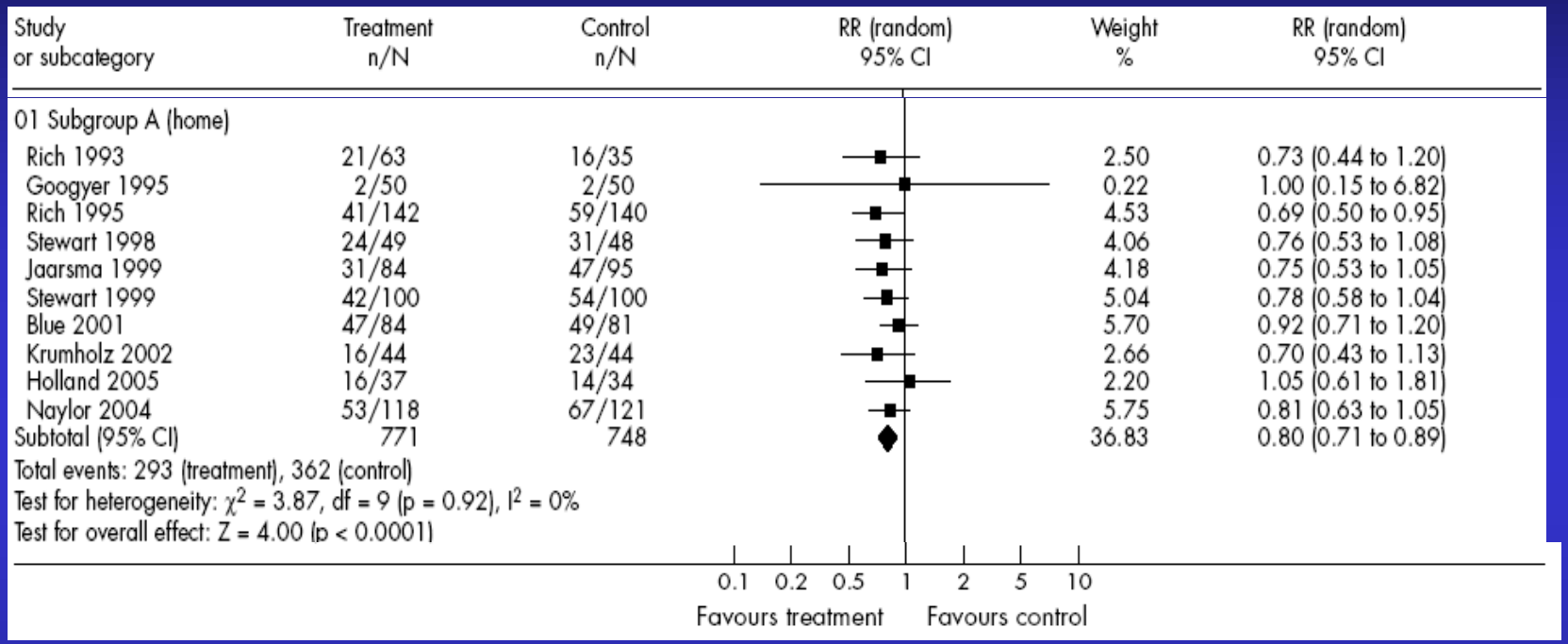
Multidisciplinary interventions (Mi) in HF. All cause mortality, Systematic review.

Holland R. Heart 2005;91:899.

- Mi = HF management was responsibility of a team: medical input + ≥1 of
  - specialist nurse, pharmacist, dietician, social worker.
- Interventions:
  - provision of home visits;
  - home physiological monitoring or televideo link;
  - telephone follow up but no home visits; and
  - hospital or clinic interventions alone.
- Excluded pharmaceutical & exercise-based.

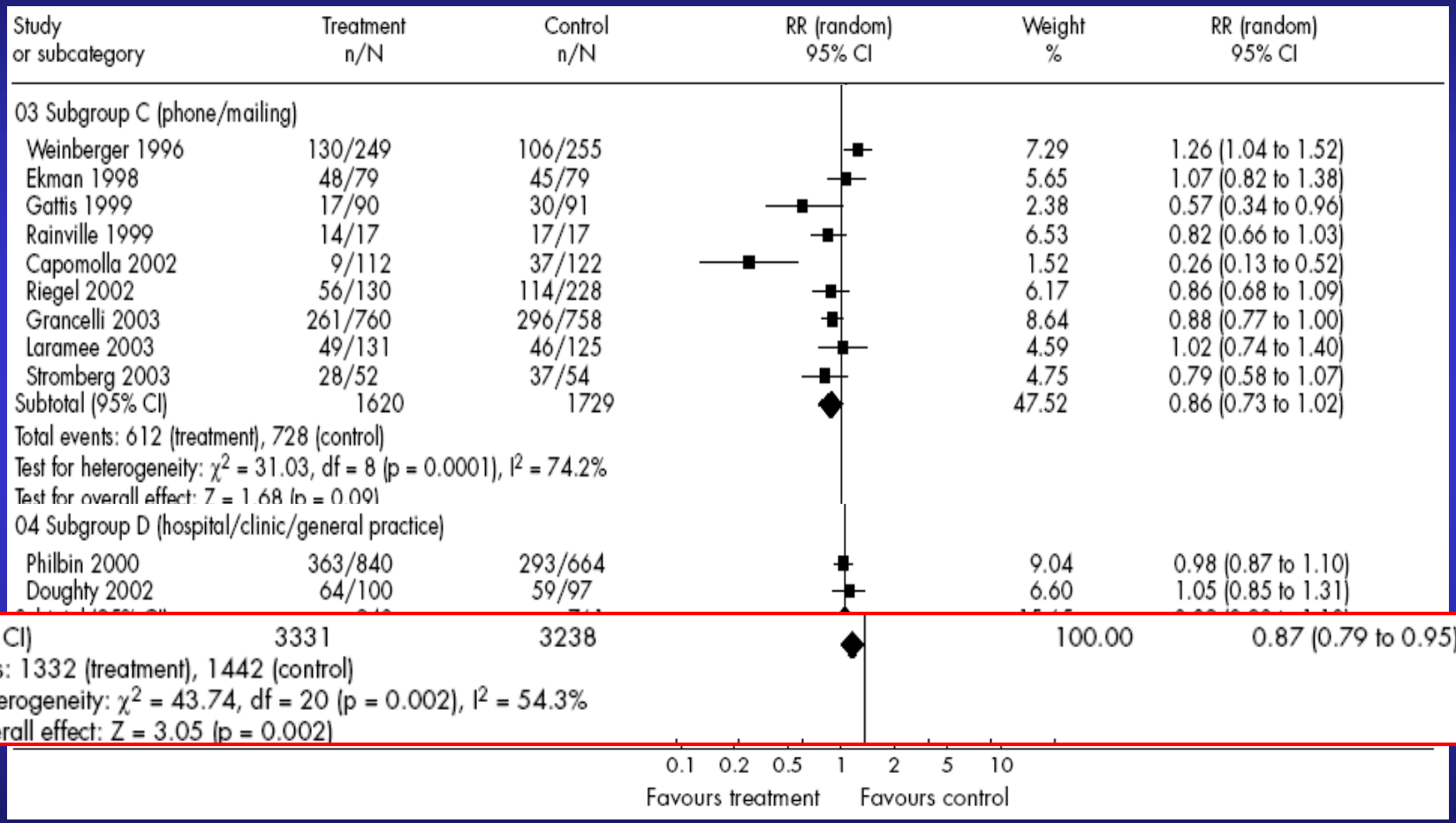
Multidisciplinary interventions in HF. All cause admission, Systematic review.

Holland R. Heart 2005;91:899.



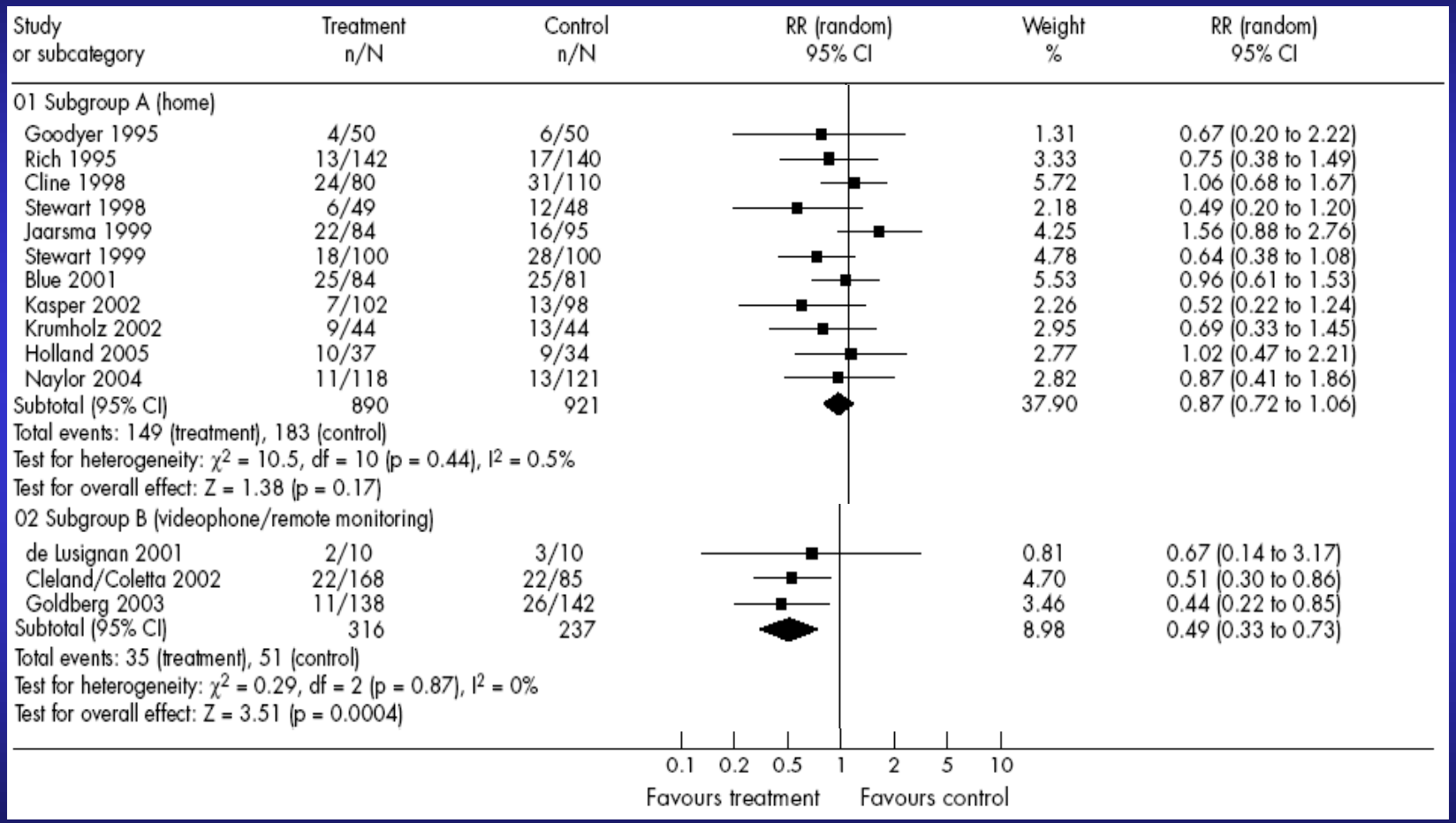
Multidisciplinary interventions in HF. All cause admission, Systematic review.

Holland R. Heart 2005;91:899.



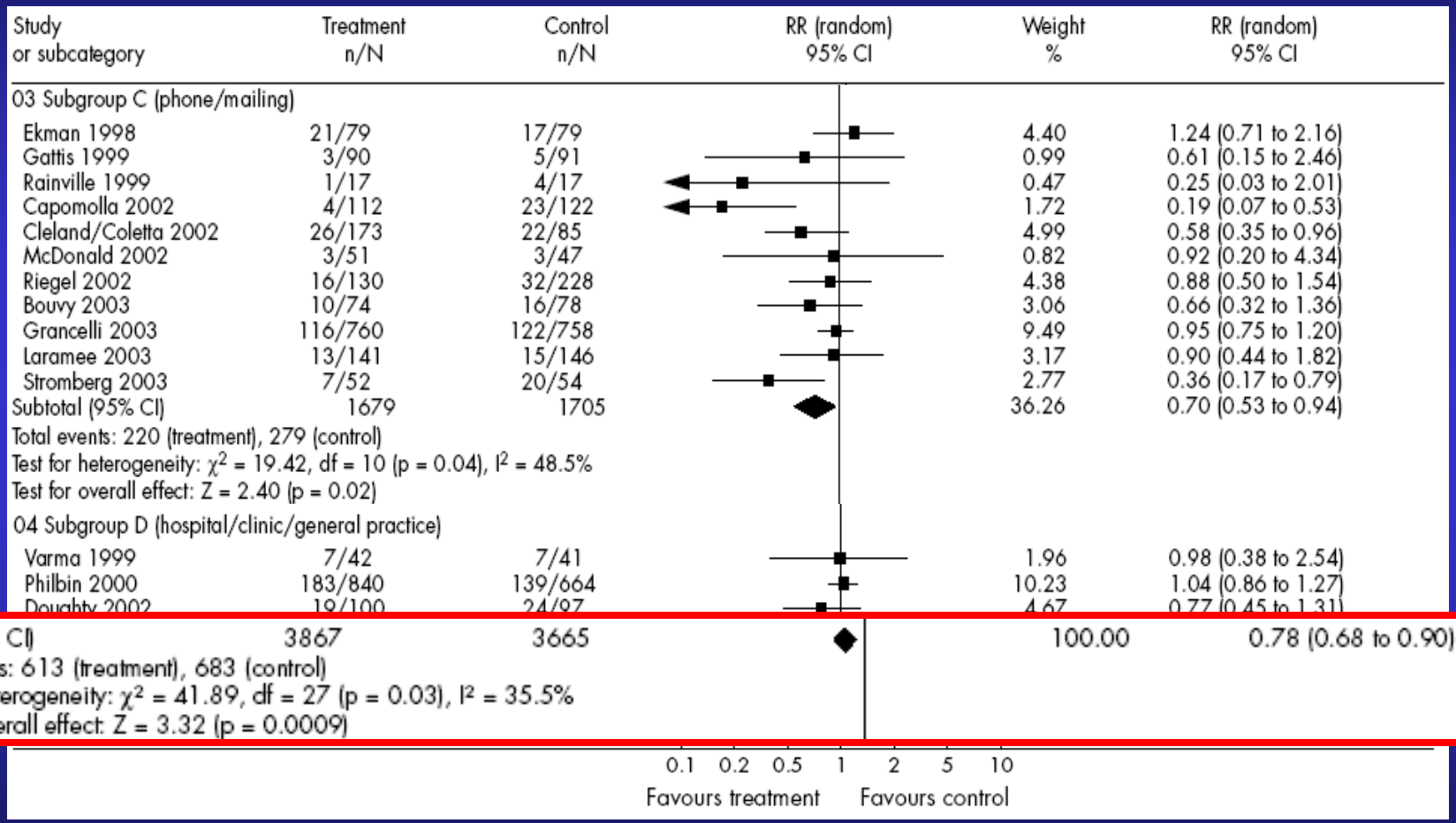
Multidisciplinary interventions in HF. All cause mortality, Systematic review.

Holland R. Heart 2005;91:899.



Multidisciplinary interventions in HF. All cause mortality, Systematic review.

Holland R. Heart 2005;91:899.



Multidisciplinary management of HF
All cause mortality, systematic review RCT

McAlister FA. J Am Coll Cardiol 2004;44:810-9.

Study (Year) (Ref.)	Length of Follow-Up (mos)	All-Cause Mortality (# Events/Total # Pts)		
		Intervention Arm	Control Arm	Risk Ratio (95% CI)
Multidisciplinary heart failure clinic				
Cline et al. (1998) (16)†	12	24/80	31/110	1.06 (0.68, 1.67)
Ekman et al. (1998) (17)	6	21/79	17/79	1.24 (0.71, 2.16)
Doughty et al. (2002) (14)	12	19/100	24/97	0.77 (0.45, 1.31)
Kasper et al. (2002) (18)	6	7/102	13/98	0.52 (0.22, 1.24)
Capomolla et al. (2002) (19)	12	3/112	21/122	0.16 (0.05, 0.51)
Stromberg et al. (2003) (20)*	12	7/52	20/54	0.36 (0.17, 0.79)
Ledwidge et al. (2003) (13)	3	3/51	3/47	0.92 (0.20, 4.34)
Subtotal			0.66 (0.42, 1.05)	
Multidisciplinary team providing specialized follow-up in non-clinic setting				
Hanchett and Torrens (1967) (21)‡	30	NR	NR	NR
Rich et al. (1993) (22)	3	NR	NR	NR
Rich et al. (1995) (9)	3	13/142	17/140	0.75 (0.38, 1.49)
Stewart et al. (1948) (11)*	6	6/49	12/48	0.49 (0.20, 1.20)
Stewart et al. (1999) (25)*	6	18/100	28/100	0.64 (0.38, 1.08)
Naylor et al. (1999) (12)*	6	NR	NR	NR
Blue et al. (2001) (27)	12	25/84	25/81	0.96 (0.61, 1.53)
Trochu et al. (2004) (37)*	12	38/102	42/100	0.89 (0.63, 1.25)
Subtotal			0.81 (0.65, 1.01)	
Summary for specialized multidisciplinary team follow-up (clinic or non-clinic settings)				
Subtotal			0.75 (0.59, 0.96)	

Multidisciplinary management of HF
All cause mortality, systematic review RCT

McAlister FA. J Am Coll Cardiol 2004;44:810-9.

Total				0.83 (0.70, 0.99)
Telephone follow-up and attendance with primary care physician if deteriorates				
Naylor et al. (1994) (28)*	3	NR	NR	NR
Weinberger et al. (1996) (10)*	6	NR	NR	NR
PHARM (1999) (29)	6	3/90	5/91	0.61 (0.15, 2.46)
Rainville et al. (1999) (30)	12	1/17	4/17	0.25 (0.03, 2.01)
Pugh et al. (2001) (26)	6	NR	NR	NR
Jerant et al. (2001) (15)*	6	2/25	0/12	2.50 (0.13, 48.36)
de Lusignan et al. (2001) (31)	12	2/10	3/10	0.67 (0.14, 3.17)
Riegel et al. (2002) (33)*	6	16/130	32/228	0.88 (0.50, 1.54)
Laramee et al. (2003) (35)*	3	13/141	15/146	0.90 (0.44, 1.82)
Tsuyuki et al. (2004) (36)*	6	16/140	12/136	1.30 (0.64, 2.64)
Subtotal			0.91 (0.67, 1.29)	
Enhanced patient self-care activities				
Serxner et al. (1998) (23)*	6	NR	NR	NR
Jaarsma et al. (1999) (24)*	9	22/84	16/95	1.56 (0.88, 2.76)
Harrison et al. (2002) (32)*	5	6/92	5/100	1.30 (0.41, 4.13)
Krumholz et al. (2002) (34)*	12	9/44	13/44	0.69 (0.33, 1.45)
Subtotal			1.14 (0.67, 1.94)	

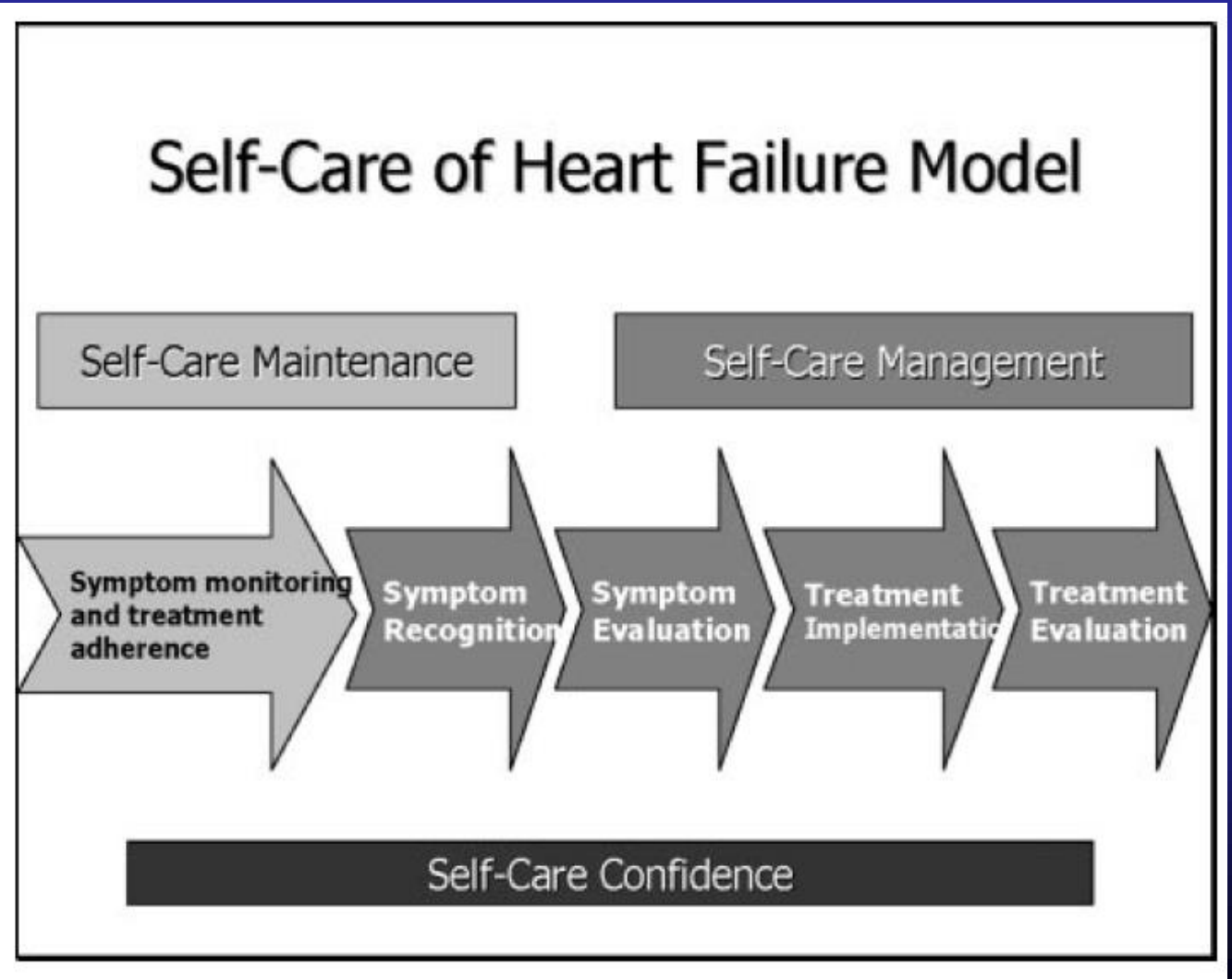
Multidisciplinary management of HF
HF hospitalization rate, systematic review RCT

McAlister FA. J Am Coll Cardiol 2004;44:810-9.

Study (Year) (Ref.)	Length of Follow-Up (mos)	Heart Failure Hospitalization Rates (# Re-Admitted at Least Once/ Total # Patients)*		
		Intervention Arm	Control Arm	Risk Ratio (95% CI)
Total			0.73 (0.66, 0.82)	
Jaarsma et al. (1999) (24)*	9	24/84	37/95	0.73 (0.48, 1.12)
Harrison et al. (2002) (32)*	5	18/92	24/100	0.82 (0.47, 1.40)
Krumholz et al. (2002) (34)*	12	18/44	30/44	0.60 (0.40, 0.90)
Subtotal			0.66 (0.52, 0.83)	

Self intervention in HF

AHA Scientific statement .Riegel B.Circulation 2009;120:1141-1163



Long term HF programs

ESC guidelines 2008

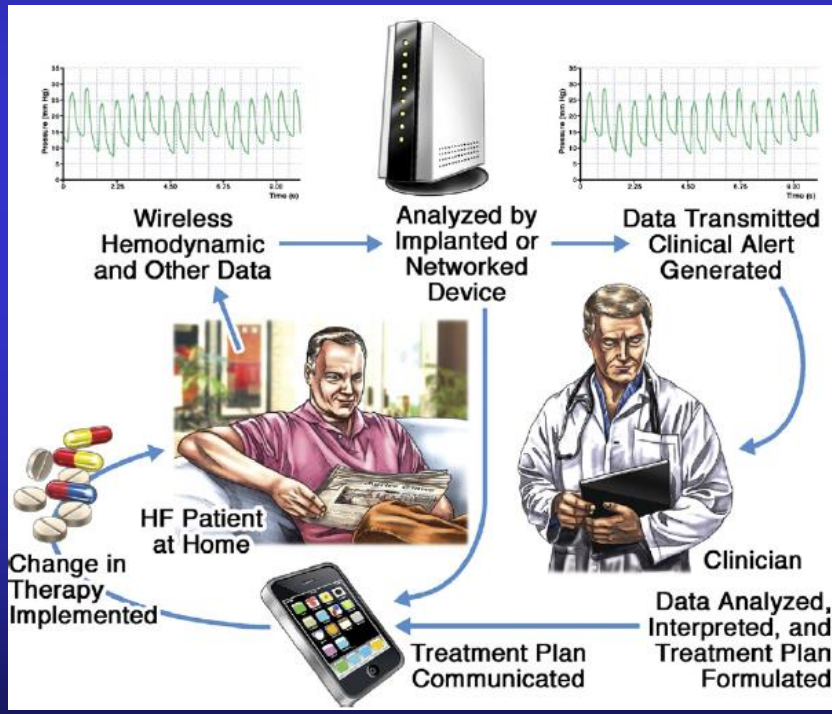
Table 33 Advantages and disadvantages of different models of heart failure programmes

	Advantages	Disadvantages
Clinic visits	• Convenient with medical expertise, facilities and equipment available. • Facilitates diagnostic investigation and adjustments of treatment strategy	• Frail, non-ambulatory patients not suitable for out-patient follow-up
Home care	• Access to immobile patients • More reliable assessment of the patient's needs, capabilities and adherence to treatment in their own home environment • Convenient for a follow-up visit shortly after hospitalization	• Time consuming travel for the HF team • Transportation and mobile equipment required • Nurses face medical responsibilities alone and may have difficulty contacting the responsible physician
Telephone support	• Low cost, time saving and convenient both for the team and the patient	• Difficult to assess symptoms and signs of heart failure and no tests can be performed • Difficult to provide psychosocial support, adjust treatment and educate patients
Remote monitoring	• Facilitates informed clinical decisions • Need is increasing as care shifts into patients' homes • New equipment and technology becoming rapidly available	• Requires education on the use of the equipment • Time-consuming for HF team • Difficult for patients with cognitive disability • Most helpful measurements not known

Home Monitoring for HF

Bui AL. J Am Coll Cardiol 2012;59:97.

	Usual Care	Hemodynamic Monitored and Guided Home Care
Daily Monitoring	Weight, symptoms	Weight, symptoms hemodynamics
Scheduled and PRN Assessments	Physical examination, laboratories, echocardiogram	Potentially less frequent need for physical exam, laboratories, echocardiogram
Visits	Patients regularly scheduled office visits 2-12 times a year. PRN calls, unscheduled office visits, ER visits if worsened symptoms	Opportunity for remote visits. Office visits only when needed. Less need for unscheduled office visits and ER visits
Therapy	Empiric and/or reactive adjustments in therapy	Proactive, guided, personalized adjustments in therapy



For pts: Self intervention in HF

AHA Scientific statement .Riegel B.Circulation 2009;120:1141-1163

Table 2. Self-Care Behaviors Recommended for Patients With HF

Maintain current immunizations, especially influenza and *Streptococcus pneumoniae*
Develop a system for taking all medications as prescribed
Monitor for an unexpected decline in body weight and for signs/symptoms of shortness of breath, swelling, fatigue, and other indicators of worsening HF
Restrict dietary sodium
Restrict alcohol intake
Avoid other recreational toxins, especially cocaine
Cease all tobacco use and avoid exposure to second-hand smoke
Do not ignore emotional distress, especially depression and anxiety. Seek treatment early
Tell your provider about sleep disturbances

For health care provider in HF

AHA Scientific statement .Riegel B.Circulation 2009;120:1141-1163

Healthcare Providers
Provide structured and individually reinforced education during all clinical encounters. Consider literacy level and cultural background.
Teach skills (eg, how to choose a low-sodium diet, how to monitor and evaluate symptoms when they occur) rather than simply providing information.
Simplify the medication regimen whenever possible. Use once-daily medicines and fixed-dose combinations whenever possible.
Assess for use of OTC medications and herbal remedies; involve a pharmacist if necessary to determine whether drug interactions are a problem.
Discourage NSAID use and help patients to identify alternatives.

For health care provider in HF

AHA Scientific statement .Riegel B.Circulation 2009;120:1141-1163

Healthcare Providers
Screen routinely for depression and anxiety. Treat depression and anxiety immediately, without waiting for symptoms to wane on their own.
Screen routinely for barriers to self-care (eg, inability to afford medicines) so that solutions can be developed before poor self-care is evident.
Encourage dental hygiene by inquiring about routine flossing and dental cleaning.
Ask about sleep quality. Refer patients who report poor sleep, who are obese, and whose bed partner reports snoring for screening for sleep-disordered breathing.
Strongly encourage use of CPAP in patients with sleep-disordered breathing.
Eliminate medications with daytime sleepiness as a side effect when possible (including as-needed medicines and OTC and herbal remedies).

European HF self-care behavior scale. Jaarsma T. Eur J Heart fail 2003; 5: 363-370

The European Heart Failure Self-care Behaviour Scale

		I completely agree				I don't agree at all
1	I weigh myself every day	1	2	3	4	5
2	If I get short of breath, I take it easy	1	2	3	4	5
3	If my shortness of breath increases, I contact my doctor or nurse	1	2	3	4	5
4	If my feet/legs become more swollen than usual, I contact my doctor or nurse	1	2	3	4	5
5	If I gain 2 kg in 1 week, I contact my doctor or nurse	1	2	3	4	5
6	I limit the amount of fluids I drink (not more than 1.5–2 l/day)	1	2	3	4	5
7	I take a rest during the day	1	2	3	4	5
8	If I experience increased fatigue, I contact my doctor or nurse	1	2	3	4	5
9	I eat a low salt diet	1	2	3	4	5
10	I take my medication as prescribed	1	2	3	4	5
11	I get a flu shot every year	1	2	3	4	5
12	I exercise regularly	1	2	3	4	5

Slow breathing/ meditation

การดูแลผู้ป่วยหัวใจล้มเหลวด้วยตนเอง

ดัดแปลงจาก Eur J Heart fail 2003;5:363-70

กิจกรรมดูแลตนเอง (วันที่....ถึง....เดือน....ปี.....)	จ	อ	พ	พฤ	ศ	ส	อา
๑.ชั่งน้ำหนักทุกวันก่อนอาหารเช้า (น้ำหนักเป็นกิโลกรัม)							
๒. ถ้าเหนื่อย นั่งพักหายใจ ช้า ๆ (มากกว่า ๖ วินาทีต่อครั้ง)							
๓. ถ้าเหนื่อยเพิ่มขึ้น โทรติดต่อรพ.							
๔. ถ้าเท้าหรือขาบวมขึ้นกว่าปกติ กดบุ๋ม ติดต่อรพ.							
๕. ถ้าน้ำหนักเพิ่ม ๒ กก.ใน ๑ สัปดาห์ ติดต่อรพ.							
๖. จำกัดน้ำดื่ม (ไม่เกิน ๖ ถึง ๘ แก้วต่อวัน)							
๗. นอนพักกลางวันครึ่งชั่วโมงต่อวัน							
๘. ถ้ารู้สึกอ่อนเพลียเพิ่มขึ้น ติดต่อรพ.							
๙. อาหารไม่เค็มและเกลือน้อย (เกลือน้อยกว่าครึ่งช้อนชาต่อวัน)							
๑๐. รับประทานยาสม่ำเสมอ ไม่ปรับยาเอง ถ้าสงสัย ติดต่อรพ.							
๑๑ เดินออกกำลังกายทุกวัน อย่างน้อย ครึ่งชั่วโมง							
๑๒. เจริญสมาธิ ฝึกหายใจช้าวันละอย่างน้อย ๑๕ นาที							

Slow breathing in Chronic heart failure

Bernardi L. Lancet 1998; 351: 1308-11

- Arterial oxygen saturation(SaO2) & other indices
- During baseline & controlled breathing at 15, 6 and 3 breaths / min (50 CHF vs. 11 controls)
- 15 CHF patients randomly allocated 1 month respiratory training (Yoga) to 6 breaths / min
- Respiratory indices were recorded before, at the end and 1 month after training.

Slow breathing in Chronic heart failure

Bernardi L. Lancet 1998; 351: 1308-11

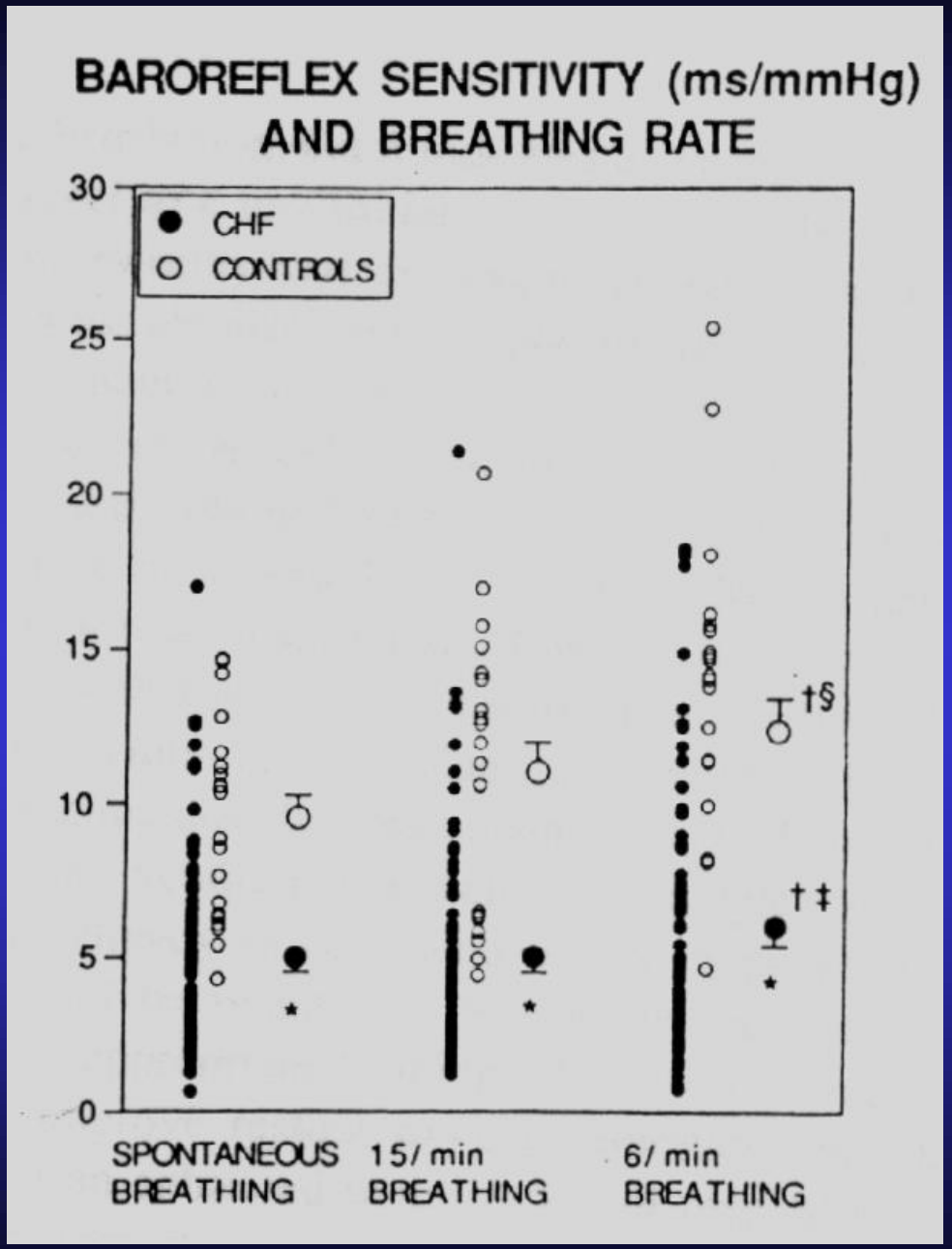
- SaO_2 CHF 91.4±0.4% vs. control 95.4±0.2% **
- After training (n = 9 CHF patients)
  - Breath rate 13.4 ± 1.5 to 7.6 ± 1.9/min **
  - SaO_2 92.5 ± 0.3 to 93.2 ± 0.4 *
  - Peak O_2 consumption 1157 ± 83 to 1368 ± 110 L/min *
  - Exercise time 583 ± 29 to 615 ± 23 min *
  - Dyspnea score 19.0 ± 0.4 to 17.3 ± 0.9 Borg scale *
  - Motivation to train 7.6 ± 0.3 to 9.1 ± 0.2 *
- No changes of indices in pts without training

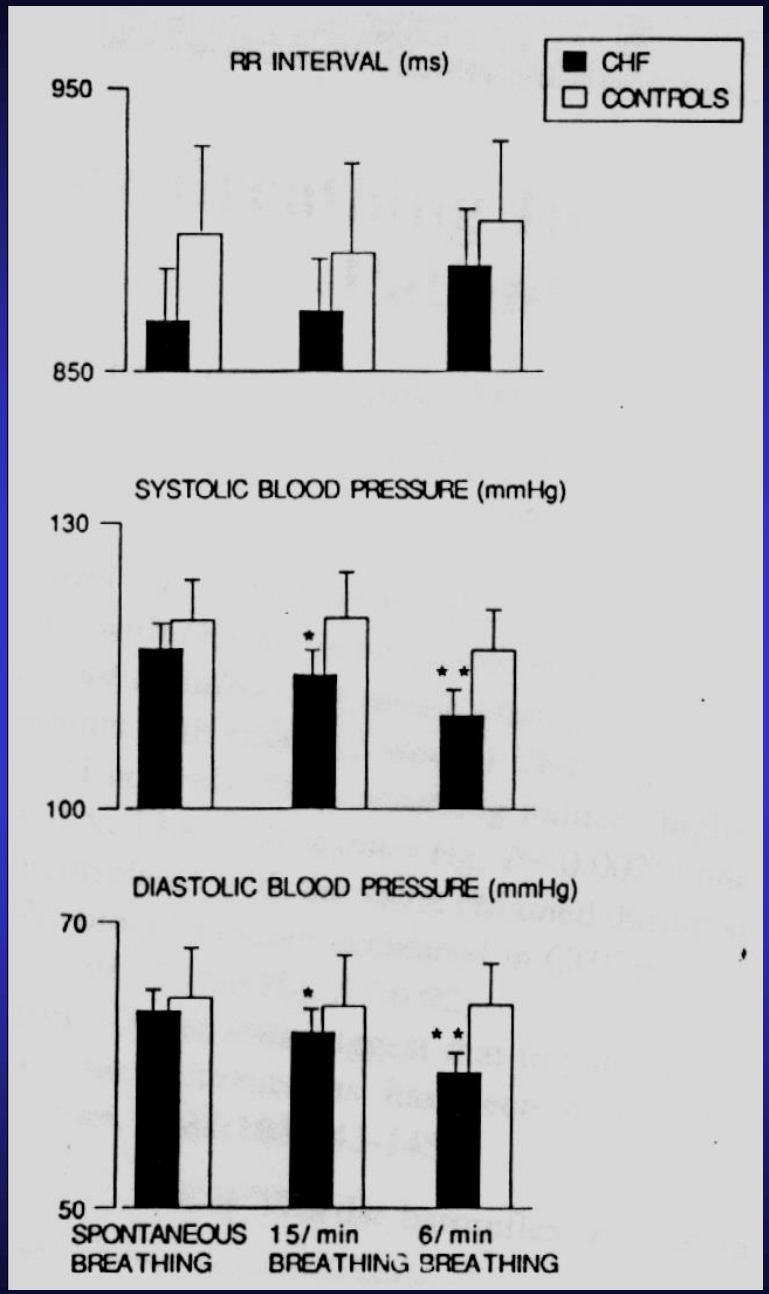
* $p < 0.05$, ** $p < 0.001$

Slow breathing increase baroreflex sensitivity in CHF

Bernardi L. Circulation 2002; 105: 143-145

- Slow breathing improve O2 saturation & exercise tolerance in CHF patients
- Preserved baroreflex sensitivity protective in CHF
- 81 stable CHF patients, 58±1 yr, FCI = 6, II = 33, III = 27, IV = 15 vs 21 control
- Spontaneous breathing (CHF 16.2±0.5,control 13.5±1.1 /min), RR 15/min vs. 6/min


BAROREFLEX SENSITIVITY (ms/mmHg)
AND BREATHING RATE
CHF
CONTROLS
30
25
20
15
10
5
0
†§
† ‡
SPONTANEOUS BREATHING
15/ min BREATHING
6/ min BREATHING


RR INTERVAL (ms)
CHF
CONTROLS
950
850
SYSTOLIC BLOOD PRESSURE (mmHg)
130
100
DIASTOLIC BLOOD PRESSURE (mmHg)
70
50
SPONTANEOUS BREATHING
15/ min BREATHING
6/ min BREATHING

Device-guided pace breathing in CHF

Resperate Open pilot study. Parati G. Circ Heart Fail 2008;1:178

- 24 CHF pts (61% ♂ , 64±9 yrs; NYHA class, 2.81±0.01) randomized to conventional Rx (n=12) or conventional Rx+Resperate (n=12) at home 18 min x 2/d. for 10 wks
- Baseline & after 10 wks evaluation by echo, PFT, CP stress test, QOL.
- Blinded data analysis.

Device-guided pace breathing in CHF

Resperate Open pilot study. Parati G. Circ Heart Fail 2008;1:178

Table 2. Effects of Device Guided Breathing on Symptoms and Functional Assessments

	NYHA	EF%	SBP, mm Hg	DBP, mm Hg	PAP, mm Hg	Maximal Workload, W	pVO_2, mL/(kg·min)	$ATVO_2$, mL/(kg·min)
Treated (n=12)								
Baseline	2.84±0.02	32±6	121±17	81±12	49±17	74±25	12.2±3.4	8.8±2.6
Home-based paced breathing	1.78±0.02*†	39±9*†	112±15*	76±11	38±9*†	85±20*†	14.1±3.2*	10.4±2.0
Controls (n=12)								
Baseline	2.72±0.03	33±4	111±11	77±9	45±13	75±21	13.4±4.4	9.3±5.6
After 10 weeks	2.78±0.02†	32±5†	110±10	77±14	46±15†	72±18†	13.6±3.9	9.0±6.4

* $P<0.05$ vs Baseline (within group, 2-tailed paired *t* test).

†$P<0.05$ between groups after 10 weeks (ANOVA).

EF% indicates left ventricular ejection fraction; SBP, systolic blood pressure; DBP, diastolic blood pressure; P anaerobic threshold; $VEVCO_2$, ratio between ventilation and CO_2 flow; FEV_1%, forced expiratory volume at 1-sec