

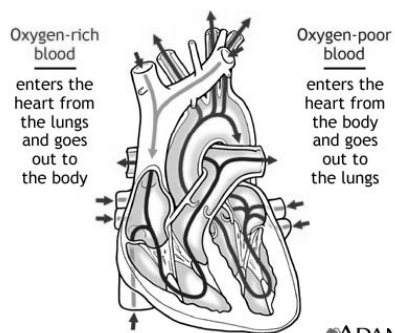
Congestive Heart Failure

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Basic pathophysiology

- Blood flow through the heart
- Valves
- Blood flow to the heart
- Effects of hypertension
- Dilated left ventricle

Blood flow through the heart



Intracardiac pressures

- | | |
|--------|----------------|
| ■ CVP | ■ 3-8 mmHg |
| ■ PAP | ■ 15-30 mmHg |
| ■ PAWP | ■ 2-15 mmHg |
| ■ LVP | ■ 100-140 mmHg |

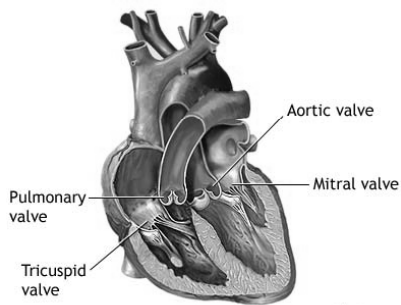
Preload, afterload & contractility

- **Preload** is the end volumetric pressure that stretches the right or left ventricle to its greatest geometric dimensions under variable physiologic demand.
- **Afterload** is the pressure that the chambers of the heart must generate in order to eject blood out of the heart.
- **Contractility** is the intrinsic ability of the heart to contract.

Frank-Starling Law

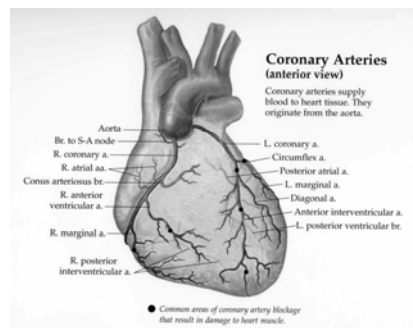
- Stroke volume of the heart increases in response to an increase in the volume of blood filling the heart (the end diastolic volume). The increased volume of blood stretches the ventricular wall, causing cardiac muscle to contract more forcefully

Coronary valves



ADAM.

Blood flow to the heart



Definition of heart failure

HF is a complex clinical syndrome that can result from any structural or functional cardiac disorder that impairs the ability of the ventricle to fill with or eject blood.

Incidence

- **Approximately 5 million patients in this country have HF**
- **Over 550,000 patients are diagnosed with HF for the first time each year**
- **Primary reason for 12 to 15 million office visits and 6.5 million hospital days each year**
- **In 2001, nearly 53,000 patients died of HF as a primary cause**

ACC/AHA 2009, Focused Update I incorporated into the ACC/AHA 2005 Guidelines for the Diagnosis and Management of Heart Failure in Adults

However...

Death rates are falling:

- Overall mortality rates cut nearly in half (2000-2007)
- Patients over 85 dropped from 87 to 48 deaths per 1000 admissions
- Patients over 65 fell from 64 to 34/1000
- Medicare patients fared better than private pay

2010 national Healthcare Disparities Report

Condition of the Elderly

- **The incidence of HF approaches 10 per 1000 population after age 65**
- **HF is the most common Medicare diagnosis-related group**
- **More dollars are spent for the diagnosis and treatment of HF than any other diagnosis by Medicare**

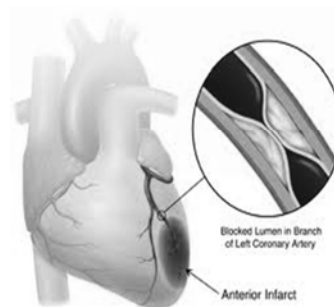
ACC/AHA 2009, Focused Update I incorporated into the ACC/AHA 2005 Guidelines for the Diagnosis and Management of Heart Failure in Adults

Causes of HF

- Coronary artery disease (CAD)
- Hypertension
- Valvular disease
- Dilated cardiomyopathy
 - Viral
 - Post-partum
 - Idiopathic

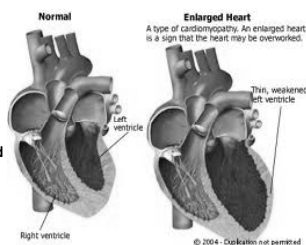
Acute coronary syndrome (ACS)

- Ischemic heart disease
- Myocardial infarction



Hypertension

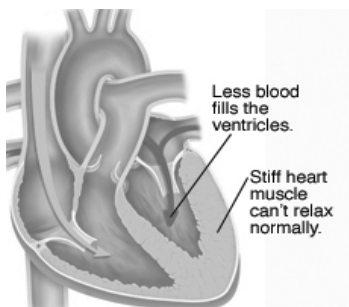
- Renals: impaired ability of the kidneys to excrete sodium, resulting in natriuretic factors secreted to promote salt excretion resulting in increased total peripheral resistance.
- RAAS – potent vasoconstriction and retention of sodium and water. Increased volume plus vasoconstriction
- Sympathetic nervous system -- increased stress responses



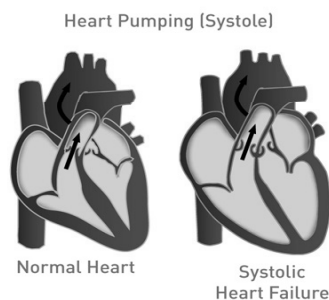
Valvular disease

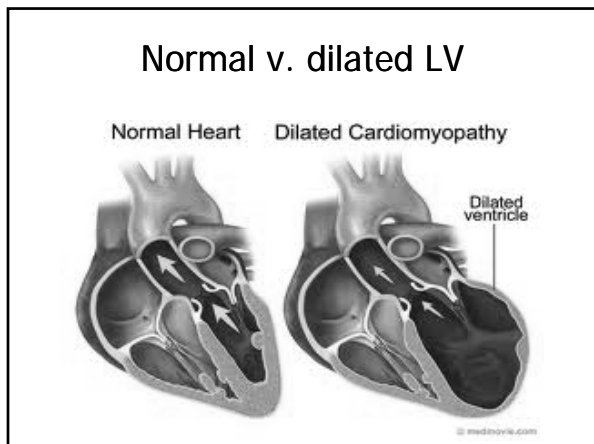
- Aortic valvular stenosis
 - Stenosis
 - Regurgitation
- Mitral insufficiency
 - Stenosis
 - Regurgitation
- Tricuspid regurgitation

Hypertension changes to ventricular function



Left ventricular dysfunction





That "CHF look"

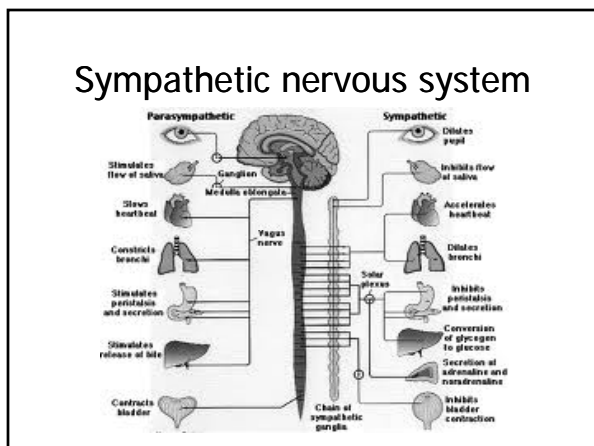
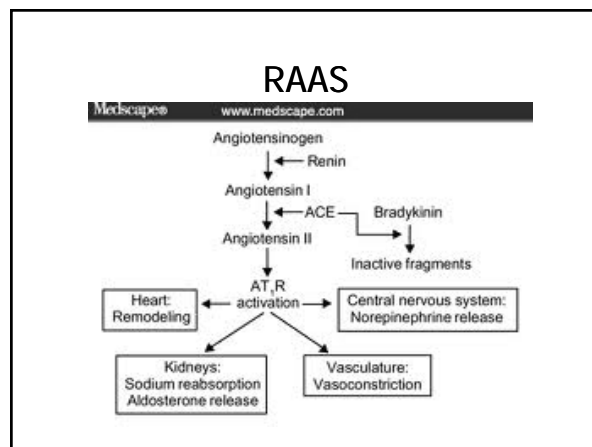
- Fatigue
- Dyspnea
- Cough
- Pulmonary edema
- Pleural effusion
- Orthopnea
- Paroxysmal nocturnal dyspnea
- Abdominal bloating
- Peripheral edema

Left ventricular remodeling

- Stimulation of sympathetic nervous system
- Activation of RAAS

Resulting in

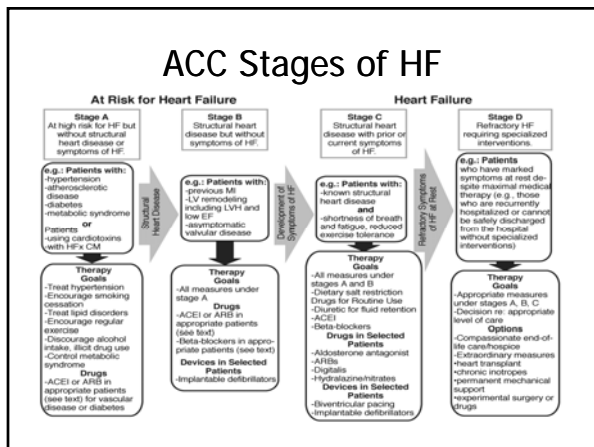
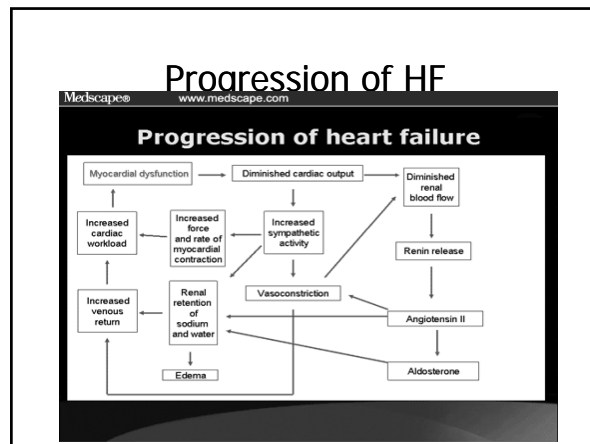
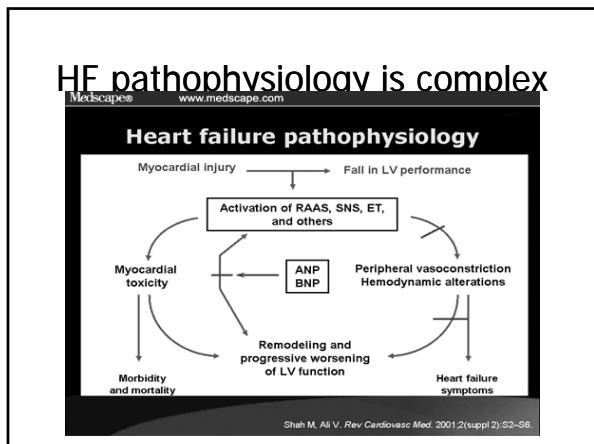
- Sodium retention
- Myocardial fibrosis
- Myocardial muscle changes



Kidney changes in HF

The kidneys in heart failure

1. Decreased cardiac output
Which results in:
2. Decreased renal blood flow
Which results in:
3. Decreased glomerular filtration rate (GFR)
Which results in:
4. Inability of the diuretic to reach site of action
Which results in:
5. Na and H2O retention



- ### Stages of HF
- Stage A – high risk (HTN, DM, CAD)
 - Stage B – asymptomatic LV dysfunction
 - Stage C – symptomatic (past or present) LV dysfunction
 - Stage D – refractory to traditional therapies

ER presentation

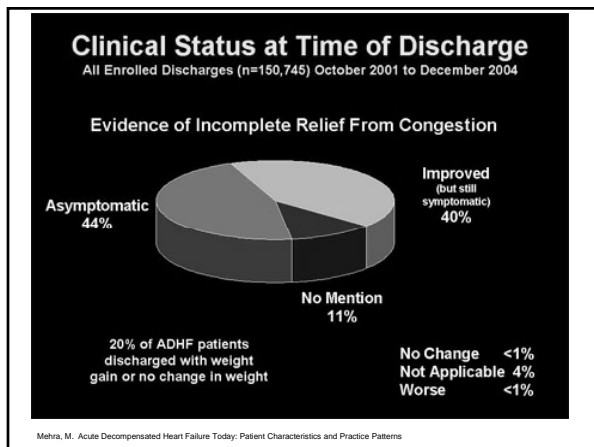
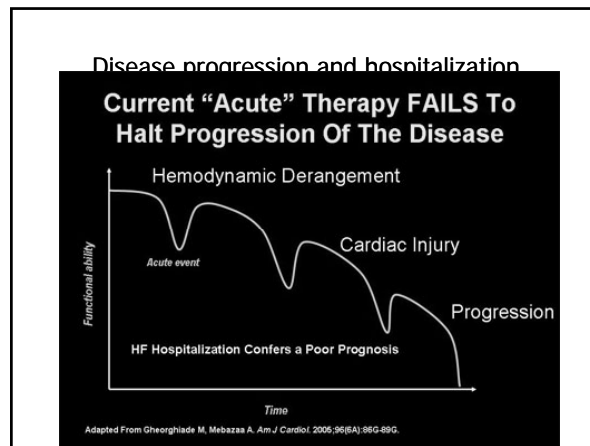
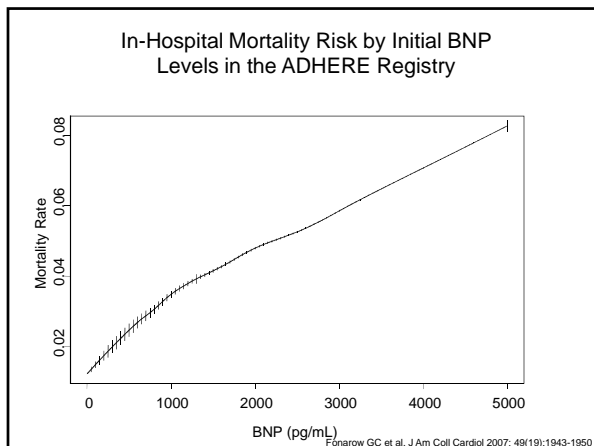
Clinical presentation at registry hospital

All enrolled discharges (N = 105,388) from October 2001 to January 2004

Any dyspnea (%)	89
Dyspnea at rest (%)	34
Fatigue (%)	32
Rales (%)	68
Peripheral edema (%)	66
NYHA class assessed (%)	11 (n = 11,555)
NYHA class I (%)	2
NYHA class II (%)	11
NYHA class III (%)	40
NYHA class IV (%)	47
Systolic blood pressure assessed (%)	99 (n = 104,573)
SBP < 90 mm Hg (%)	2
SBP 90-140 mm Hg (%)	48
SBP > 140 mm Hg (%)	50

ADHERE Registry. Report on first 100,000 patients. Sept. 2004

- ### BNP
- Elevated admission BNP is a significant predictor of in-hospital mortality in ADHF, independent of other risk factors
 - BNP is predictive of mortality in both patients with reduced and those with preserved LVEF
 - Further research necessary to determine whether pts with higher admission BNP would benefit from more intensive monitoring and/or aggressive treatment strategies



- ### Medical management of HF
- Fix underlying problem
 - Valve
 - CAD
 - HTN
 - Medications
 - ACE/ARB
 - Beta blocker
 - Diuretics
 - Aldosterone antagonists
 - Diet
 - 2 gram low sodium diet
 - Fluids
 - 2000-2500 mL/day

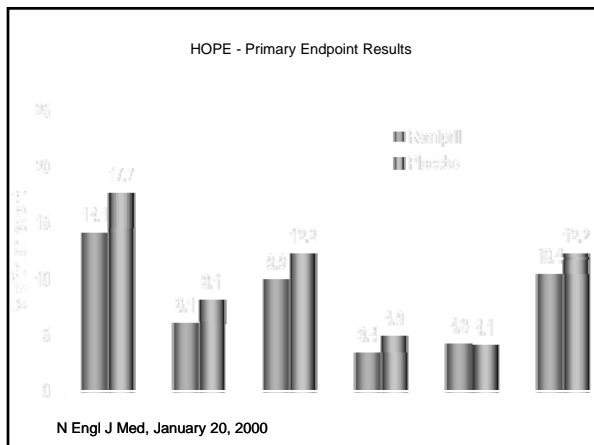
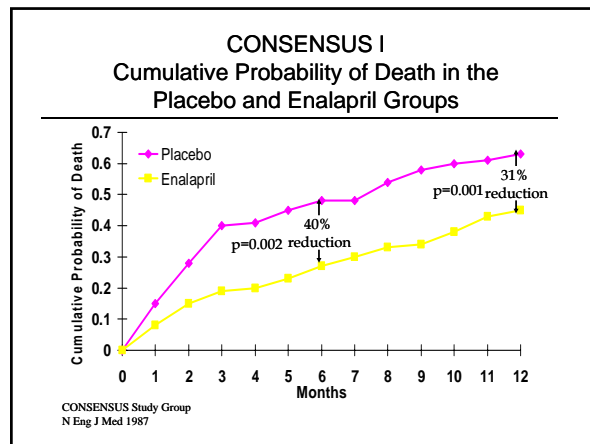
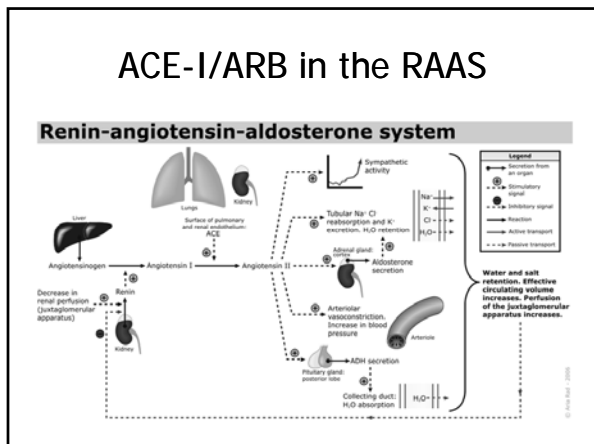
- ### Underlying medical problems
- Valvular dysfunction
 - Mitral valve
 - Aortic valve
 - Hypertension
 - Rhythm disturbance
 - Atrial fibrillation
 - Ventricular tachycardia
 - Coronary artery disease
 - Medical management
 - Percutaneous coronary intervention
 - Hypothyroidism

ACE - Inhibitors

Cardiovascular Medications Useful for Treatment of Various Stages of Heart Failure (Slide 1 of 3)

Drug	Stage A	Stage B	Stage C
ACE Inhibitors			
Benazepril	H	-	-
Captopril	H, DN	Post MI	HF
Enalapril	H, DN	Asymptomatic LVSD	HF
Fosinopril	H	-	HF
Lisinopril	H, DN	Post MI	HF
Moexipril	H	-	-
Perindopril	H, CV Risk	-	-
Quinapril	H	-	HF
Ramipril	H, CV Risk	Post MI	Post MI
Trandolapril	H	Post MI	Post MI

CV Risk indicates reduction in future cardiovascular events; DN, diabetic nephropathy; H, hypertension; HF, heart failure; Asymptomatic LVSD, Asymptomatic left ventricular systolic dysfunction; Post MI, reduction in heart failure or other cardiac events following myocardial infarction.



Angiotensin receptor blockers

Cardiovascular Medications Useful for Treatment of Various Stages of Heart Failure (Slide 2 of 3)

Drug	Stage A	Stage B	Stage C
Angiotensin Receptor Blockers			
Candesartan	H	-	HF
Eprosartan	H	-	-
Irbesartan	H, DN	-	-
Losartan	H, DN	CV Risk	-
Olmesartan	H	-	-
Telmisartan	H	-	-
Valsartan	H, DN	Post MI	Post MI, HF
Aldosterone Antagonists			
Eplerenone	H	Post MI	Post MI
Spirololactone	H	-	HF

CV Risk indicates reduction in future cardiovascular events; DN, diabetic nephropathy; H, hypertension; HF, heart failure; Asymptomatic LVSD, Asymptomatic left ventricular systolic dysfunction; Post MI, reduction in heart failure or other cardiac events following myocardial infarction.

Beta-blockers

Cardiovascular Medications Useful for Treatment of Various Stages of Heart Failure (Slide 3 of 3)

Drug	Stage A	Stage B	Stage C
Beta Blockers			
Acetabulolol	H	-	-
Atenolol	H	Post MI	-
Betaxolol	H	-	-
Bisoprolol	H	-	HF
Carteolol	H	-	-
Carvedilol	H	Post MI	HF, Post MI
Labetalol	H	-	-
Metoprolol succinate	H	-	HF
Metoprolol tartrate	H	Post MI	-
Nadolol	H	-	-
Penbutolol	H	-	-
Pindolol	H	-	-
Propranolol	H	Post MI	-
Timolol	H	Post MI	-
Digoxin	-	-	HF

CV Risk indicates reduction in future cardiovascular events; DN, diabetic nephropathy; H, hypertension; HF, heart failure; Asymptomatic LVSD, Asymptomatic left ventricular systolic dysfunction; Post MI, reduction in heart failure or other cardiac events following myocardial infarction.

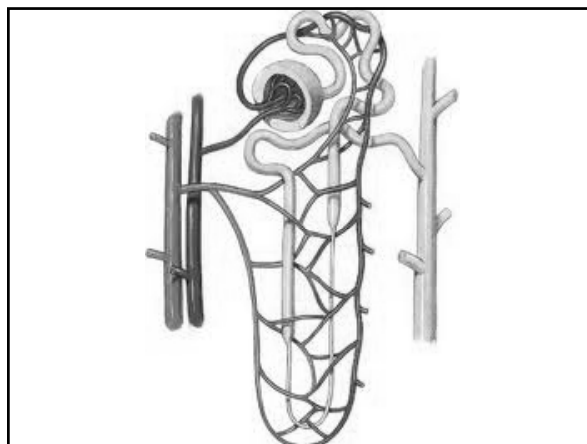
- ### Pathophysiology of beta-blockers
- Block sympathetic response
 - Average reduction in HR of 10-15 bpm
 - Increase heart rate variability
 - Reduce remodeling
 - Antiarrhythmic

Diuretics

Oral Diuretics Recommended for Use in the Treatment of Fluid Retention in Chronic Heart Failure

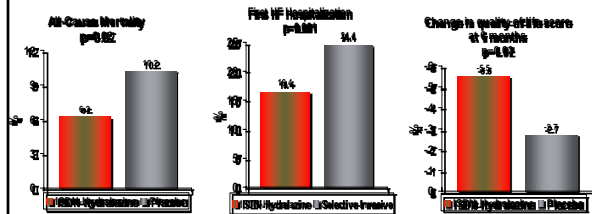
Drug	Initial Daily Dose(s)	Maximum Total Daily Dose	Duration of Action
Loop diuretics			
Bumetanide	0.5 to 1.0 mg once or twice	10 mg	4 to 6 hours
Furosemide	20 to 40 mg once or twice	600 mg	6 to 8 hours
Torsemide	10 to 20 mg once	200 mg	12 to 16 hours
Thiazide diuretics			
Chlorothiazide	250 to 500 mg once or twice	1000 mg	6 to 12 hours
Chlorthalidone	12.5 to 25 mg once	100 mg	24 to 72 hours
Hydrochlorothiazide	25 mg once or twice	200 mg	6 to 12 hours
Indapamide	2.5 once	5 mg	36 hours
Metolazone	2.5 mg once	20 mg	12 to 24 hours
Potassium-sparing diuretics†			
Amiloride	5 mg once	20 mg	24 hours
Spironolactone	12.5 to 25 mg once	50 mg*	2 to 3 days
Triamterene	50 to 75 mg twice	200 mg	7 to 9 hours
Sequential nephron blockade			
Metolazone	2.5 to 10 mg once plus loop diuretic		
Hydrochlorothiazide	25 to 100 mg once or twice plus loop diuretic		
Chlorothiazide (IV)	500 to 1000 mg once plus loop diuretic		

mg indicates milligrams; IV, intravenous. *Higher doses may occasionally be used with close monitoring. †Eplerenone, although also a diuretic, is primarily used in chronic heart failure as a suppressor of the renin-angiotensin-aldosterone system.



A-Heft Trial: Primary Endpoint

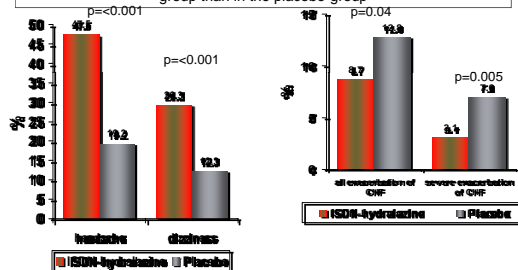
All individual components of the primary composite endpoint were significantly improved with ISDN-hydralazine therapy, namely death, first hospitalization for heart failure, and change in the quality-of-life score (a larger negative score indicates a better quality of life).



Presented at AHA 2004

A-Heft Trial: Adverse effects

Adverse events of headache and dizziness were significantly higher in the ISDN-hydralazine group, while the more serious adverse events of exacerbation of CHF were significantly lower in the ISDN-hydralazine group than in the placebo group



Presented at AHA 2004

Sodium restricted diet

- Ideal: 2300 mg/day
- **Sodium-free or salt-free.** Each serving in this product contains less than 5 mg of sodium.
- **Very low sodium.** Each serving contains 35 mg of sodium or less.
- **Low sodium.** Each serving contains 140 mg of sodium or less.
- Reality: 3400 mg/day (plus)
- **Reduced or less sodium.** The product contains at least 25 percent less sodium than the regular version. You should check the label to see how much sodium is in a serving.
- **Lite or light in sodium.** The sodium content has been reduced by at least 50 percent from the regular version. You should check the label to see how much sodium is in a serving.
- **Unsalted or no salt added.** No salt is added during processing of a food that normally contains salt. However, some foods with these labels may still be high in sodium because some of the ingredients may be high in sodium.

Fluid restriction



- 2000 mg/day = ???

Limit alcohol use, stop smoking

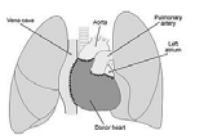
- Do you drink any alcohol/smoke?
- How much?
- What kind?
- How often?

Be specific



Advanced therapies

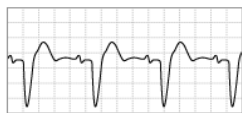
- Cardiac resynchronization therapy
- Cardiac transplantation
- LVAD



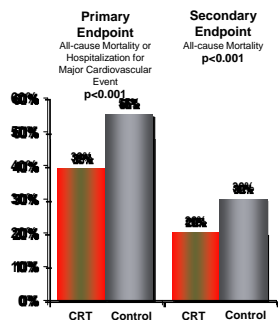
Indications for cardiac resynchronization therapy

- LVEF less than or equal to 35%
- NYHA functional class III or IV
- QRS duration greater than 120 ms

Left bundle branch block



CARE-HF Study



- Baseline clinical characteristics were similar between the treatment groups, with 46% of patients having dilated cardiomyopathy and 38% with ischemic heart disease.
- Mean LV ejection fraction was 25%.
- Of the 409 patients randomized to the CRT device, 95% had a successful implantation.
- The primary endpoint of all-cause mortality or hospitalization for a major cardiovascular event occurred less frequently in the CRT group than the medical therapy alone group (hazard ratio [HR] 0.63, 95% CI 0.51-0.77).
- The major secondary endpoint of all-cause mortality was also lower in the CRT group (HR 0.64, 95% CI 0.48-0.85).

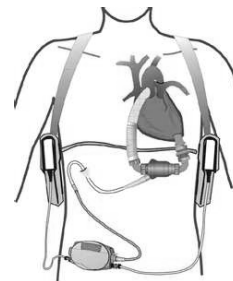
Presented at ACC Scientific Sessions 2005

CARE-HF Study: Summary

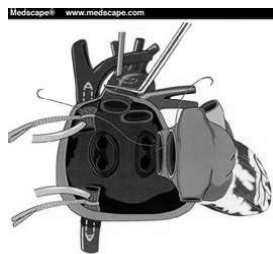
- Among patients with advanced heart failure despite standard pharmacological therapy, treatment with cardiac resynchronization therapy was associated with a reduction in the primary endpoint of all-cause mortality and hospitalization for major cardiovascular events compared with standard pharmacological therapy.
- Similar results were observed in the COMPANION trial, which showed a reduction in the composite endpoint of death or hospitalization through a mean 16 month follow-up in patients treated with CRT with or without an implantable defibrillator, but the reduction in mortality did not reach statistical significance ($p=0.06$).

Presented at ACC Scientific Sessions 2005

Left ventricular assist device



Cardiac transplant Artificial heart



Sleep apnea

- | | |
|---|---|
| <p>Obstructive</p> <ul style="list-style-type: none"> ■ Soft tissue airway obstruction <p>Associated with</p> <ul style="list-style-type: none"> ■ Obesity ■ Alcohol use ■ Smoking | <p>Central</p> <ul style="list-style-type: none"> ■ Altered neurological feedback ■ Lack of CO₂ regulation <p>Associated with</p> <ul style="list-style-type: none"> ■ CHF ■ Increased incidence in men |
|---|---|

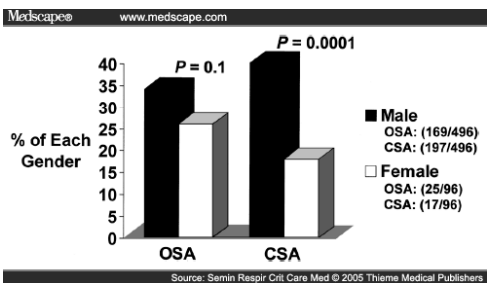
Signs and symptoms of sleep apnea

- Snoring
- Excessive daytime fatigue
- Restless leg syndrome

Obstructive sleep apnea



OSA v. CSA



CPAP: the good, the bad, the ugly

