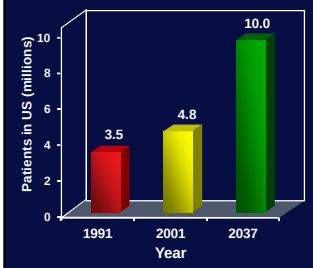
ACUTE DECOMPENSATED HEART FAILURE

Robert E. Hobbs, MD

CLEVELAND CLINIC

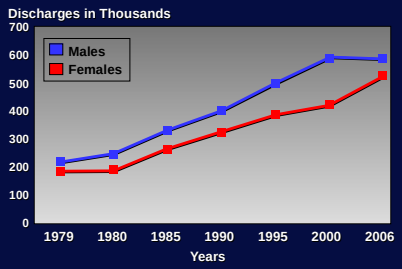
EPIDEMIOLOGY OF HEART FAILURE



- 5 million Americans have HF; likely 10 million in 2037
- 550,000 new cases annually
- 1.1 million hospitalizations
- Mortality is high
- Sudden cardiac death is 6 to 9 times higher than normal

American Heart Association. *Heart Disease and Stroke Statistics 2010 Update. Circulation 2010;121:e1-170*

HOSPITAL DISCHARGES FOR HEART FAILURE BY SEX



(United States: 1979-2006). Source: NHDS/NCHS and NHLBI.
Note: Hospital discharges include people discharged alive, dead and status unknown.

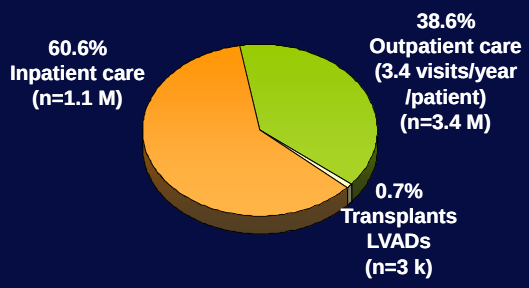
HF HOSPITALIZATIONS

- Incidence: 1.1 million/year
- Costs: $8,000 +/-
- Outcomes: poor longterm
- Mortality: 4-22%
- 30 day mortality: 10-22%
- 30 day readmission: 25%

HOSPITALIZATIONS ARE INCREASING

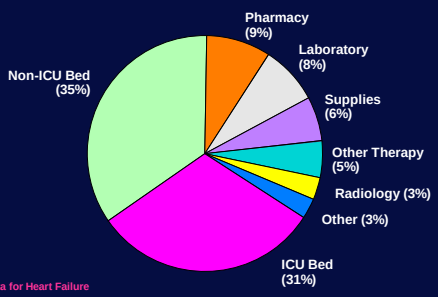
- Aging population (“Baby Boomers”)
- Rising incidence of chronic heart failure
- Improved outcomes: MI, CABS, stenting
- Inevitable progression of heart disease
- Inadequate CHF treatment in hospital
- Suboptimal education and followup
- Noncompliance with diet and drugs

HEART FAILURE COSTS



DISTRIBUTION OF HOSPITAL COSTS

DRG 127



Medpar Data for Heart Failure

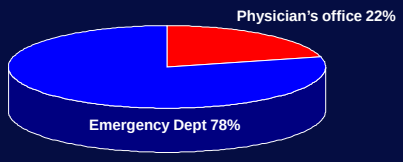
2008 NATIONAL AVERAGE PER CASE FOR DRG 127

- Hospital costs……..$8250
- Amount reimbursed……$4989
- Net financial loss……...$3261

CMS Discharge Database (MEDPAR)

HOSPITALIZATION

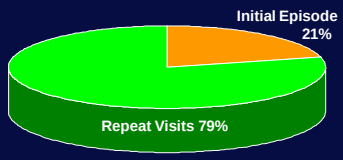
INITIAL POINT OF CARE



Approximately 80% of ED visits for HF result in hospitalizations

ADHERE 2006

EMERGENCY DEPARTMENT VISITS FOR HEART FAILURE



Aghababian RV. *Rev Cardiovasc Med*. 2002;3(suppl 4):S3–S9.

DEMOGRAPHIC PROFILE

- Mean age: 75 years
- 52% female
- 72% hypertension
- 57% coronary disease
- 44% diabetes mellitus
- Smoked 48%; active 13%

ADHERE 2006

PRESENTATION OF ADHF

- Heart failure with congestion
- Heart failure with hypertension
- Acute pulmonary edema
- Low output failure, shock
- High output heart failure
- Right sided heart failure

HEART FAILURE PATIENTS

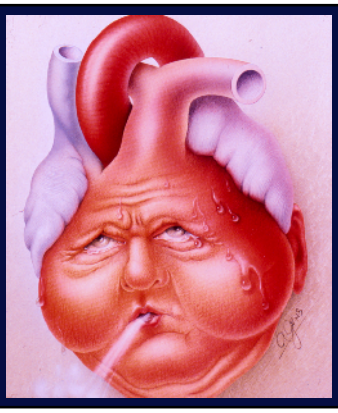
	GROUP 1	GROUP 2
ABNORMALITY	Systolic	Diastolic
AGE	Older	Elderly
GENDER	Male	Female
BP	Normal	High
CONGESTION	Peripheral	Pulmonary
ONSET	Gradual	Acute

HF HOSPITALIZATIONS

- Prior heart failure……76%
- Hospitalized < 6 months……33%
- LVEF < 40%……47%
- Creatinine >1.5 mg/dL……..39%

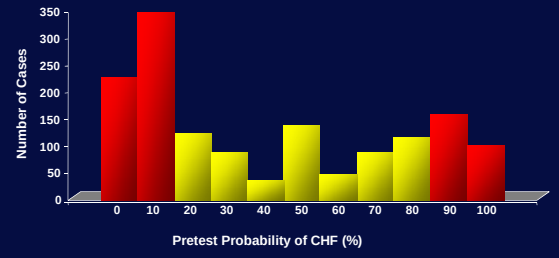
ADHERE Registry 2006

DIAGNOSIS



CLINICAL INDECISION IN THE ED

Physician Report on Clinical Probability of CHF

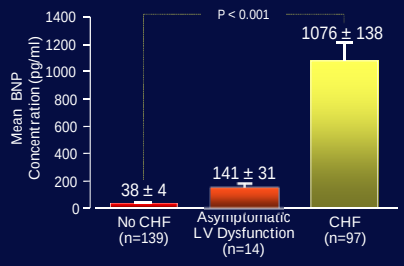


McCullough PA et al. *Circulation*. 2002;106:416–422.

DIFFERENTIAL DIAGNOSIS

- Pulmonary infection
- Decompensated COPD
- Asthma exacerbation
- Acute coronary syndrome
- Pulmonary embolism
- Pneumothorax
- Obesity, anxiety, drugs

BNP LEVELS OF PATIENTS DIAGNOSED WITHOUT CHF, WITH BASELINE LEFT VENTRICULAR DYSFUNCTION, AND WITH CHF



Maisel A. et al. J Am Coll Cardiol 2001;37(2):379-85

RAPID ASSESSMENT OF CHF

Congestion at Rest

Low Perfusion at Rest	No	Yes
No	Warm & Dry	Warm & Wet
Yes	Cold & Dry	Cold & Wet

Signs/symptoms of congestion
- Orthopnea/PND
- JV distension
- Ascites
- Edema
- Rales (rare in chronic)

Possible evidence of low perfusion
- Narrow pulse pressure
- Sleepy / obtunded
- Low serum sodium
- Cool extremities
- Hypotension
- Renal dysfunction (one cause)

Stevenson LW. *Eur J Heart Fail.* 1999;1:251–257.

ACUTE HF HOSPITALIZATION

ED LOS…….. 5 hours

Hosp LOS……..4.3 days

ICU Admit…….. ……20%

ICU LOS…….. 2.5 days

ADHERE 2006

ACUTE HF HOSPITALIZATION

Mortality……..4.1%

PA catheter……..4.0%

Ventilator……..4.8%

Dialysis……5.3%

CPR……..1.5%

ADHERE 2006

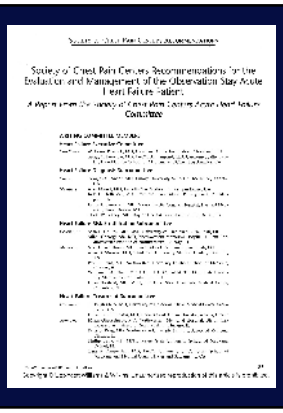
PREDICTORS OF DEATH ADHERE REGISTRY

- Elevated BUN (>43 mg/dL)
- Elevated creatinine (2.75 mg/dL)
- Low blood pressure (SBP<115)

Fonarow. JAMA 2005;293:572-80

MANAGEMENT

JACC 2009;53:1343

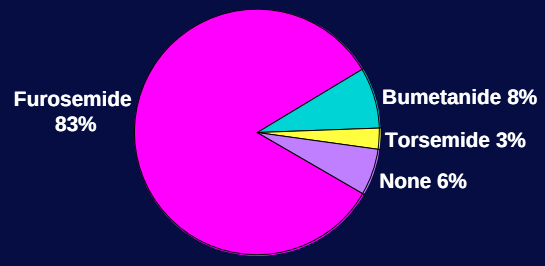


Crit Pathways Cardiol 2008;7:83-121

PROBLEMS

- Only 15% of ADHF guidelines are supported by randomized clinical trials
- Nearly all drug trials in ADHF failed
- No drug given for ADHF has ever been shown to improve longterm outcomes
- Readmissions and mortality are high

IV DIURETICS



ADHERE 2006

DIURETICS

- "First-line" agents for HF
- IV loop diuretic
- Rapidly control fluid
- Relieve congestion
- Diuresis / natriuresis

DIURETICS

- Bolus therapy when dose is low (<160 mg daily)
- Continuous infusion when daily dose is high
- Add thiazide; watch K+
- Add spironolactone

DIURETIC PROBLEMS

- K^{+}, Mg^{++} excretion
- Volume depletion
- Hypotension
- Pre-renal azotemia
- ↑ renin, vasopressin, NE
- Metabolic alkalosis

ACE INHIBITORS

- All ACEi probably are equal
- Lisinopril, enalapril, captopril studied in RCTs of chronic systolic heart failure
- Therapy mandated at discharge
- ACEi costs are similar

ANGIOTENSION RECEPTOR BLOCKERS

- Probably similar efficacy to ACEi
- Fewer side-effects than ACEi
- ARB costs are higher
- Losartan not FDA approved for HF
- Valsartan reduces hospitalizations
- Candesartan ↓ **hosp / mortality**

BETA-BLOCKERS

- Don't discontinue beta-blockers
- Start beta-blocker when euvolemic
- Therapy mandated at discharge
- Plan outpatient uptitration
- Don't use metoprolol tartrate

IV VASOACTIVE MEDICATIONS

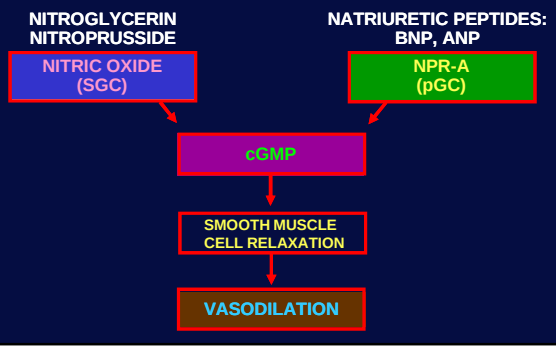
- Nesiritide……..…..12%
- Nitroglycerin……..9%
- Dobutamine……..6%
- Dopamine……..6%
- Milrinone……..3%
- Nitroprusside……..1%

ADHERE 2006

IV VASODILATORS

- Nitroglycerin
- Nitroprusside
- Nesiritide

VASODILATOR PATHWAYS



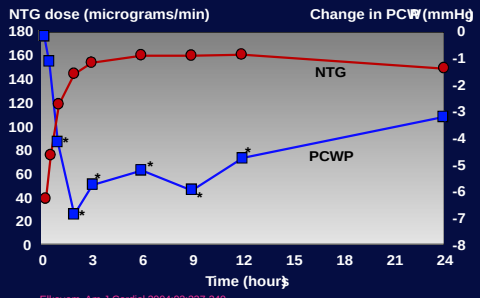
NITROGLYCERIN

Hemodynamic effects

Low dose	Venodilation*
High dose	Arteriolar dilation

*Venodilation is the predominant effect

NITROGLYCERIN DOSE AND CHANGE IN PCWP DURING TREATMENT WITH NTG



Elkayam. Am J Cardiol 2004;93:237-240

NITROPRUSSIDE

- Potent IV vasodilating agent
- Dilates arteries and veins
- Decreases wedge pressure
- Lowers intracardiac pressures
- Rapidly lowers blood pressure
- Increases cardiac output

NITROPRUSSIDE

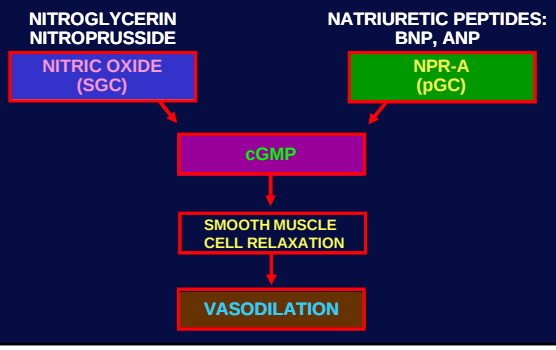
LIMITATIONS

- ICU: PA catheter, BPs
- Difficult titration (↓BP)
- Light sensitivity
- Coronary "steal" syndrome?
- "Rebound" phenomenon?
- Thiocyanate toxicity

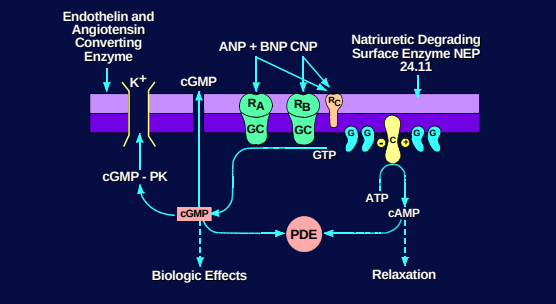
NESIRITIDE

- Balanced vasodilator
- No inotropic effects
- No chronotropic effects
- Lusitropic properties
- Not pro-arrhythmic

VASODILATOR PATHWAYS



NATRIURETIC PEPTIDE RECEPTOR



Chem Proc Assoc Am Physicians 111:5, 1999

NESIRITIDE DOSING

Bolus	2 µg / kg (60 sec)
Infusion	0.01 µg / kg / min

ASCEND STUDY

- 7000 patients worldwide
- Decompensated CHF
- Fluid overloaded
- Dyspnea (rest or min ADL)
- Elevated filling pressures

INOTROPIC THERAPY

- Routine use not indicated
- Hypotensive HF; shock: ok
- Bridge to transplant: ok
- Palliative therapy: ok
- Outpatient infusions: no

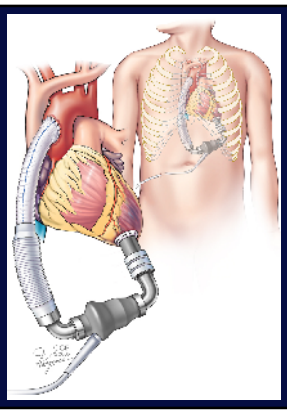
Felker. Am Heart J 2001; 142: 393

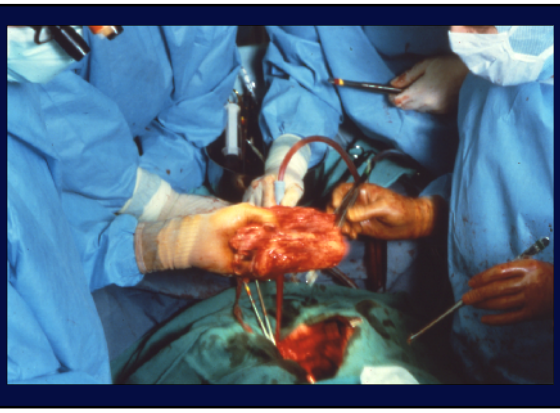
ULTRAFILTRATION
"SCUF"

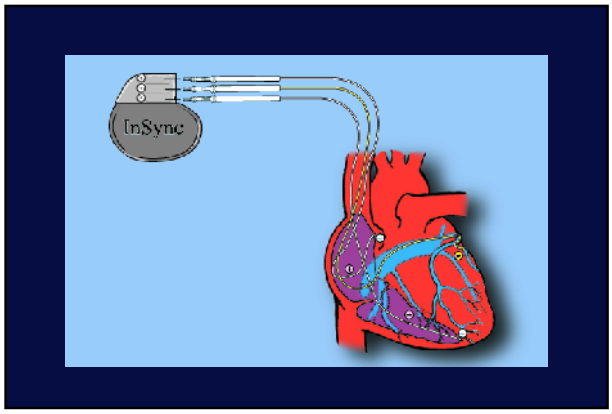
ULTRAFILTRATION

- Removes sodium and water
- Greater weight loss than diuretics
- Avoids intravascular volume depletion, electrolyte imbalance
- Expensive therapy
- Useful for anasarca, cardiorenal

HEARTMATE II LVAD

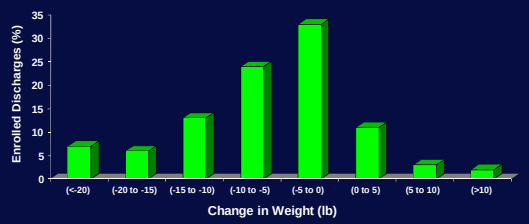






DISCHARGE

CHANGE IN WEIGHT FROM ADMISSION TO DISCHARGE



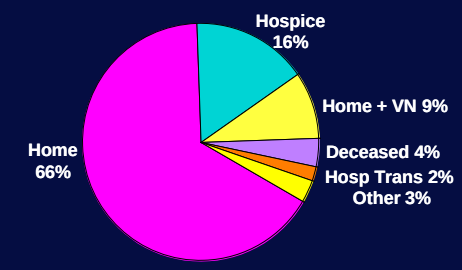
ADHERE

PATIENT EDUCATION

DOCUMENTATION

Diet	Daily weights
Fluids	BP Monitoring
ACE/BB	Smoking Cessation
Activities	Who to call for sx
Exercise	Follow-up visit

DISPOSITION



ADHERE

"I hope they fly"

OUTCOMES OF ACUTELY DECOMPENSATED HEART FAILURE

- **Hospital readmissions**
  - **25% at 30 days[1]**
  - **50% at 6 months[1]**
- **Mortality**
  - **11.6% at 30 days[2]**
  - **33.1% at 12 months[2]**
  - **50% at 5 years[1]**

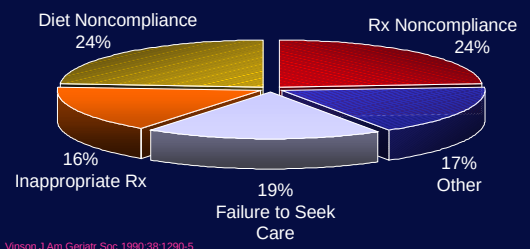
1. Aghababian RV. *Rev Cardiovasc Med*. 2002;3(suppl 4):S3–S9.
2. Jong P et al. *Arch Intern Med*. 2002;162:1689–1694.

HIGH READMISSION RATE

- **Pathophysiology not understood**
- **"One size fits all" therapy**
- **Different clinical presentations**
- **Ignore co-morbid conditions**
- **LVEF does not predict prognosis**
- **Core measures are inadequate**

30-DAY READMISSIONS

CAUSES OF HOSPITAL READMISSION WITH HEART FAILURE



Vinson J Am Geriatr Soc 1990;38:1290-5

RISK FACTORS FOR READMISSIONS

Frailty	No family
Dementia	Poverty
Uninsured	Nursing home
Illiteracy	Complexity

READMISSIONS

- Heart failure related
- Renal failure related
- Other co-morbidities
- Planned readmissions
- End-of-life care

PREVENTION OF ADMISSIONS

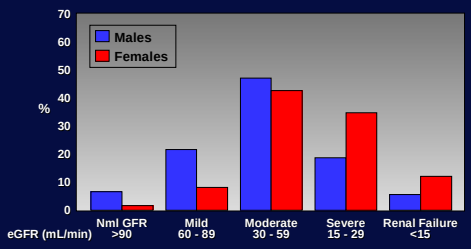
- Adequate discharge planning
- Educate: meds, diet, fluids, etc
- Evidence based medications
- Address co-morbidities
- Telephone call 24-72 in hours
- Followup visit in 1 week

WHAT WORKS?

Pill minder	Nurse
Scale	Telephone
BP cuff	Family
Pill chart	Computer

IT'S ALL ABOUT THE KIDNEY

FREQUENCY OF RENAL DYSFUNCTION IN 88,075 ADMISSIONS



Heywood JT, ADHERE data as of 8/2004: 88,075 admissions with complete information.

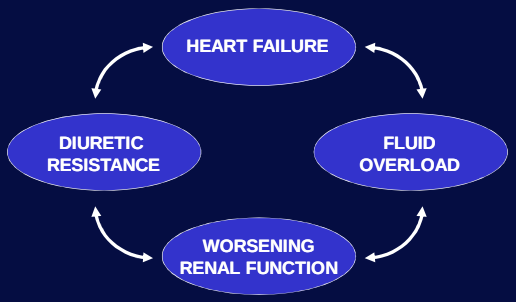
WORSENING RENAL FUNCTION

- 30% patients with ADHF
- Longer hospital stay
- Higher hospital costs
- Higher in-hospital mortality
- More readmissions

WHEN CREATININE RISES

- Patient can't go home
- Diuretics held or decreased
- ACE and ARB's held
- Tests and procedures delayed
- To ICU for PA catheter
- Inotroptes may be initiated

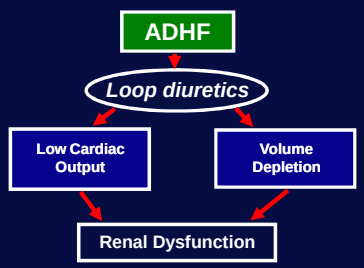
CARDIORENAL SYNDROME



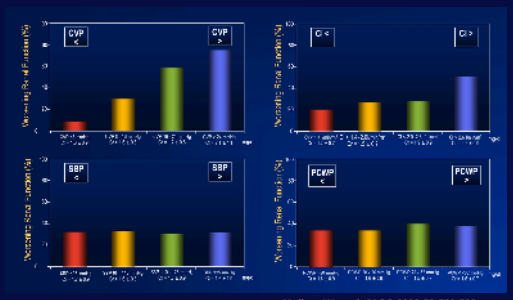
DIURETIC RESISTANCE

- Increase diuretic dose
- Different loop diuretic
- Combination (loop + thiazide)
- Continuous IV infusion
- Ultrafiltration
- Paracentesis

TRADITIONAL THEORY FOR WORSENING RENAL FUNCTION



PREVALENCE OF WORSENING RENAL FUNCTION RELATED TO CVP, CI, SBP, AND PCWP



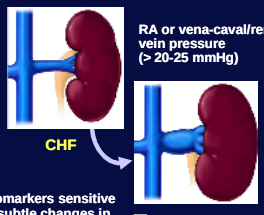
Mullens W, et al. JACC 2009;53:589-596

INCREASED INTRA-ABDOMINAL PRESSURE

- Normal pressure 5-7 mm Hg
- CHF pressure 15-20 mm Hg
- Prevalence: 60% in ADHF
- Visible ascites uncommon
- Abdominal compartment syndrome

INCREASED CONGESTION (RA PRESSURE) MAY IMPAIR TUBULAR FUNCTION

RA Pressure 5 mmHg



CHF

RA or vena-caval/renal vein pressure (> 20-25 mmHg)

- Intracapsular pressure
- Peritubular pressure
- Medullary ischemia
- Decreased GFR
- Tubular dysfunction
- Adenosine release
- Activation of RAAS

Biomarkers sensitive to subtle changes in GFR; may be superior to serum Cr

↑ NGAL – Neutrophil gelatinase associated lipocalin Mishra et al. 2005

↑ Cystatin_C, KIM-1

VENOUS CONGESTION

- Only predictor of ARF
- Occurs days-weeks before
- Ascites not always present
- Cytokines + neurohormones
- Causes “renal tamponade”

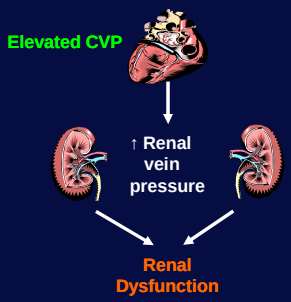
CARDIORENAL SYNDROME
NOT MECHANISMS

- Low cardiac output
- Low ejection fraction
- Low blood pressure
- Elevated PCWP
- Use of diuretics

CARDIORENAL SYNDROME
MECHANISMS

- ↑ venous pressure
- ↑ renal vein pressure
- ↑ renal interstitial pressure
- ↓ glomerular filtration rate
- ↓ sodium excretion

"CONGESTIVE KIDNEY FAILURE"



SUMMARY