Acute Decompensated Heart Failure: A Case Presentation

Avital Porter, MD
,Department of Cardiology
,Rabin Medical Center
Israel

Demographics and past history

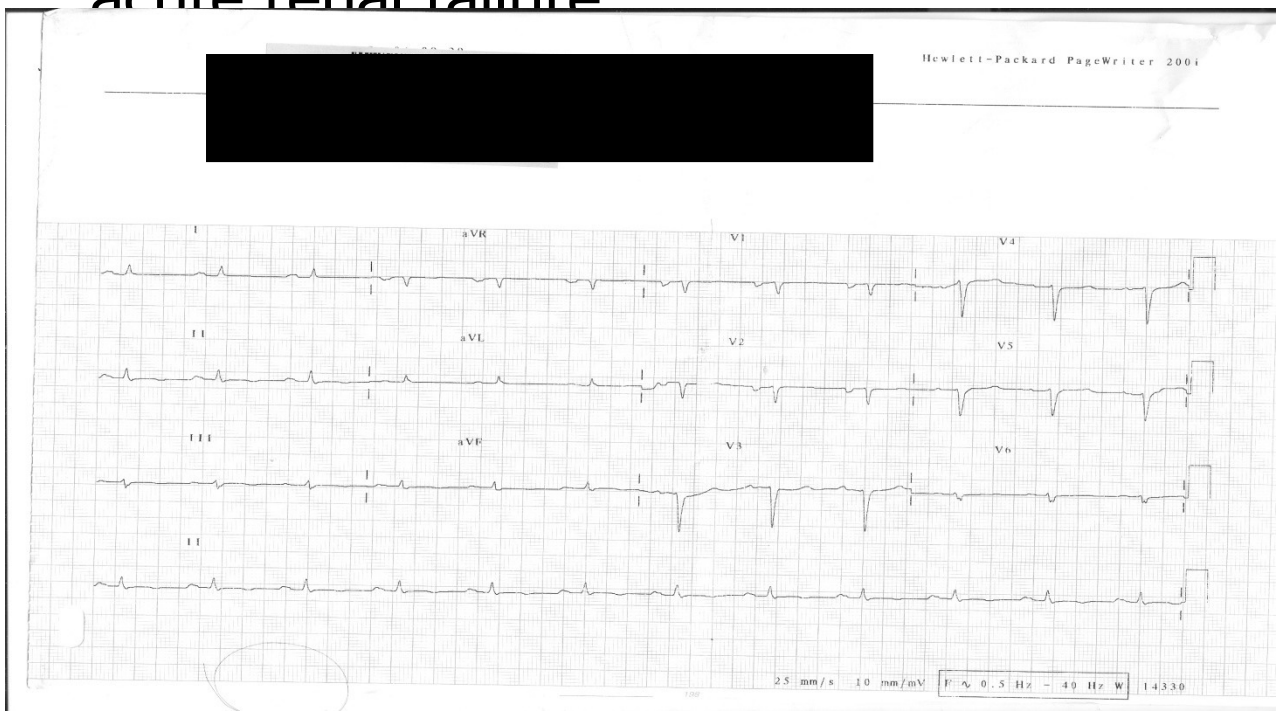
- C.G, a 48 y old male, married+4, until recently non-sedentary lifestyle
- *2000*- left temporal intracranial bleeding D/T AV malformation, treated by embolization and radiation. No neurological deficit. Impaired short-term memory and mood fluctuations.
- *Risk factors* : Dyslipidemia treated with statins, past history of smoking (18 years ago). No significant family history for IHD or CMP

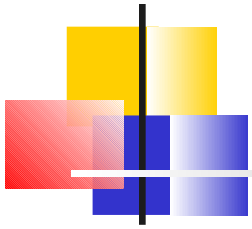
Current event

- Fatigue over recent months.
- A month before admission “common cold” w/o fever.
- Progressive symptoms of fatigue, extreme weakness, effort dyspnea, epigastric pain,vomiting and weight loss.
- Admission to another hospital. Echo demonstrated dilated left ventricle with estimated LVEF of 20% and antero-apical dyskinesis
- Coronary angiography revealed anatomically normal coronary arteries.
- A diagnosis of **non-ischemic CMP (M/P post myocarditis**) was made and the patient was discharged under treatment of B.blockers, ACE inhibitors and diuretics.

‘Current event- contd

- Due to further clinical deterioration (NYHA 3) the patient was admitted to a second hospital with signs of low CO state with secondary “shock liver” and acute renal failure

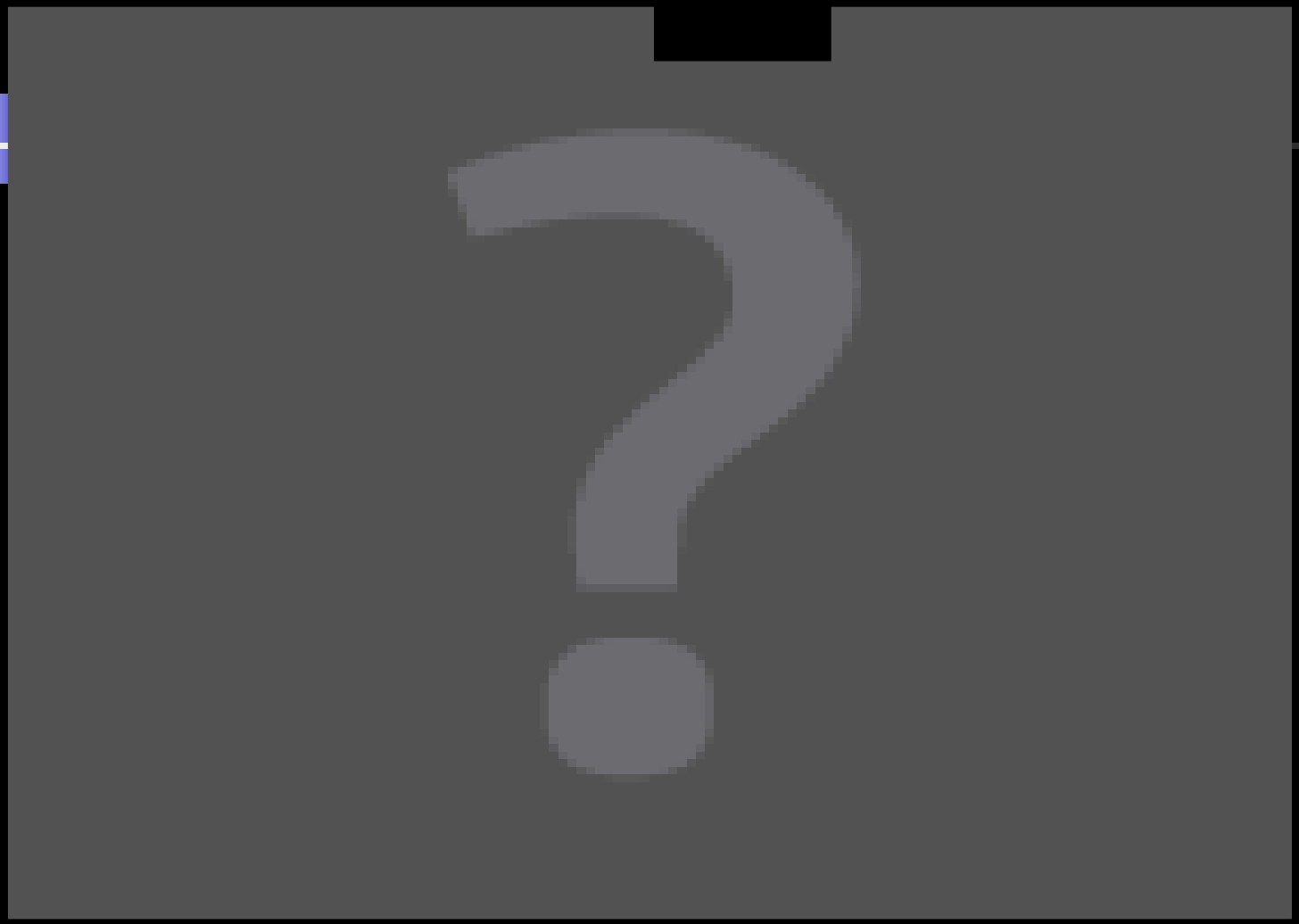


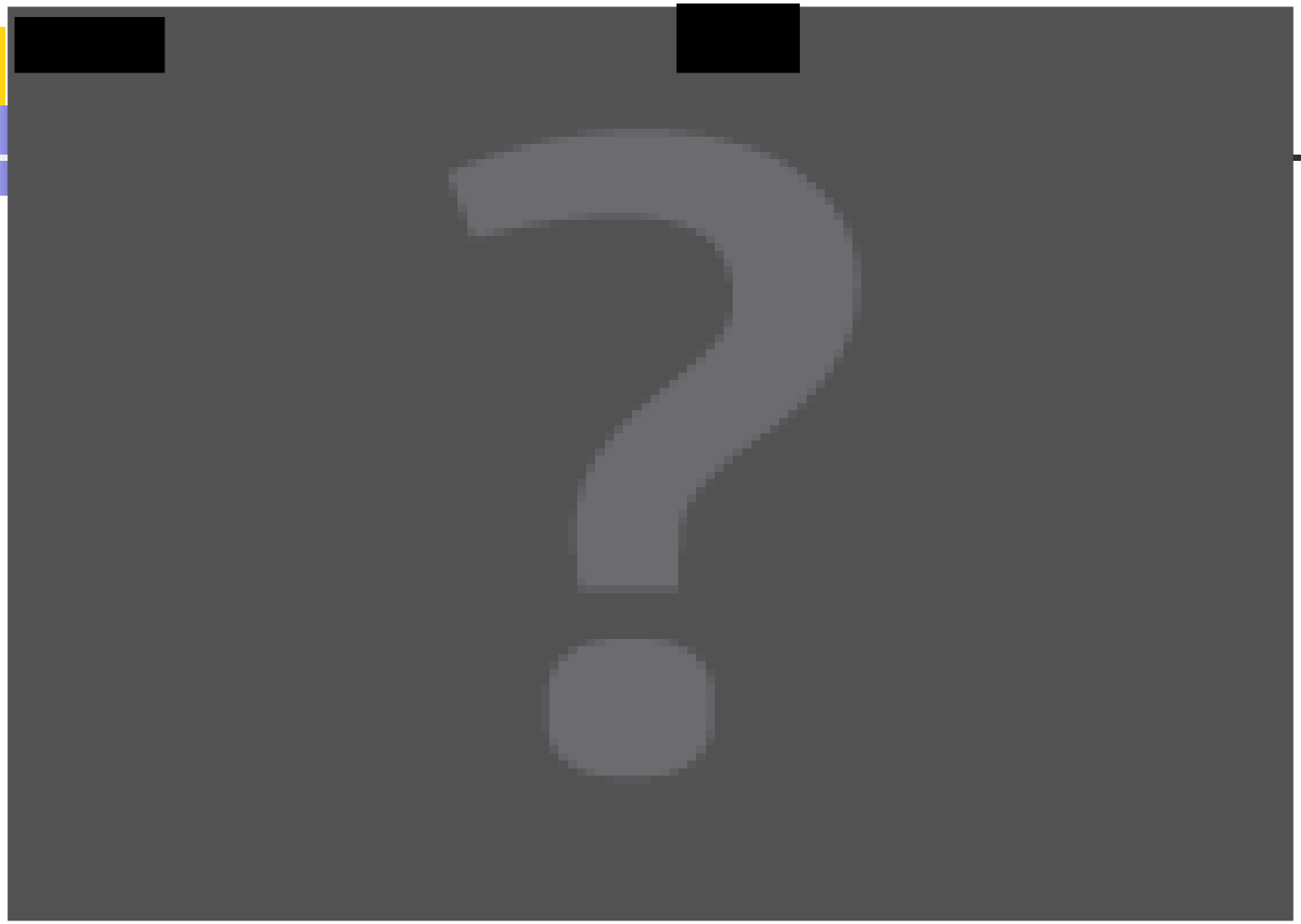


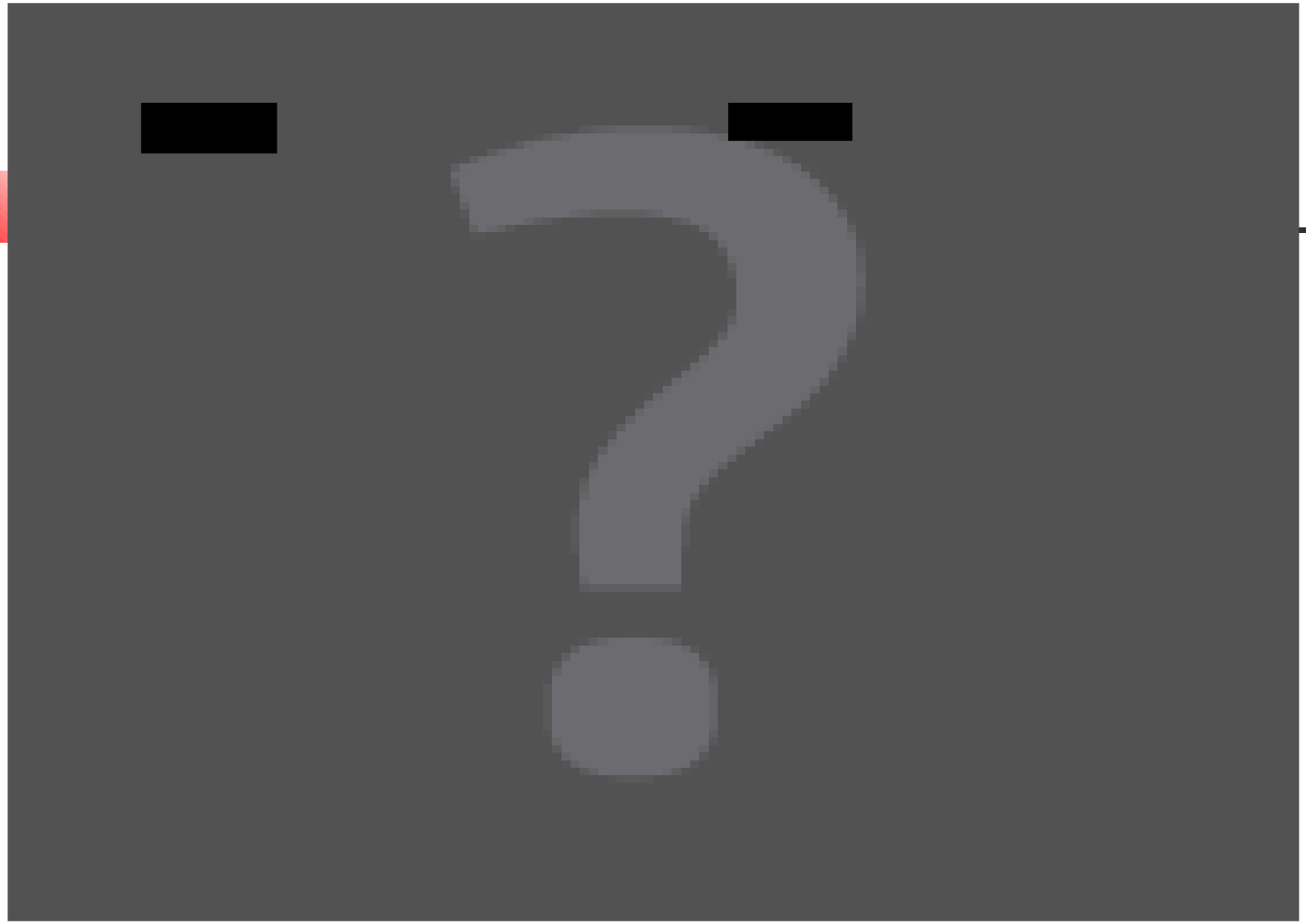
- Echo at that time: LVEDD 62 mm, EF 15%, moderate MR, mild pulmonary HTN, severe RV dysfunction
- TDI- no evidence of intraventricular disynchrony.

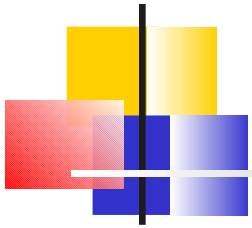
Right heart Catheterization

- RA A: 25.4
- RA V: 21.7
- PA: 48/34; mean 38
- PCW A: 32.6
- PCW V: 38.3
- RV 40 /15
- CO 1.7
- CI 1.1
- SVR 34 wood
- PVR 5.9 wood









?What can we do

Clinical Conditions

Acute decompensation of CHF: Signs and symptoms are mild

- Heart rate +/-
- SBP +/-
- CI +/-
- PCWP +
- Diuresis +
- Hypoperfusion +/-

AHF with pulmonary oedema: severe respiratory distress with rales over the lungs

- Heart rate +
- SBP +/-
- CI -
- PCWP ++
- Diuresis +
- Hypoperfusion +/-

Clinical Conditions
Cardiogenic shock

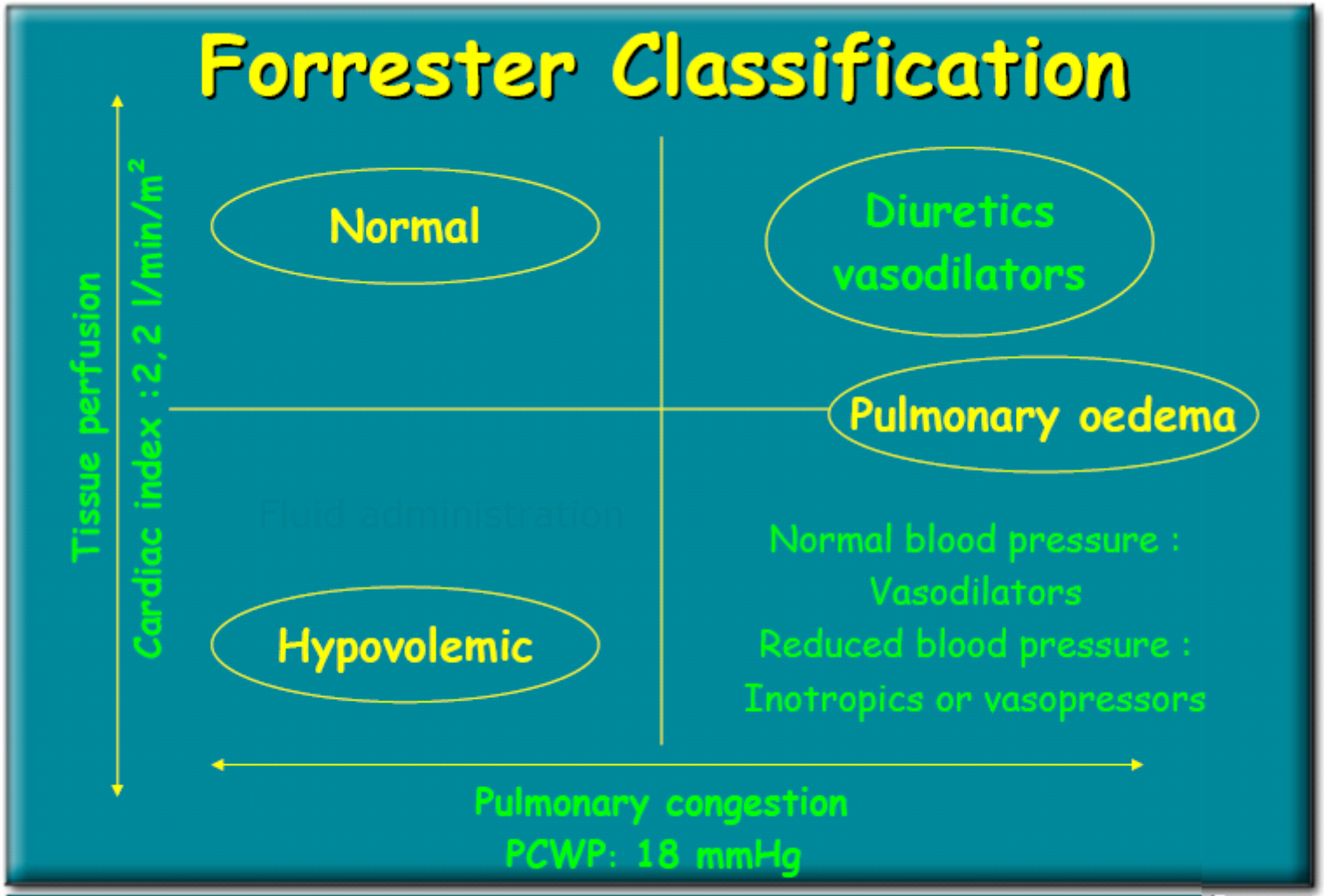
Low output syndrome: reduced BP, low urine output, tissue hypoperfusion

- Heart rate +
- SBP -
- CI -
- PCWP +
- Diuresis -
- Hypoperfusion +

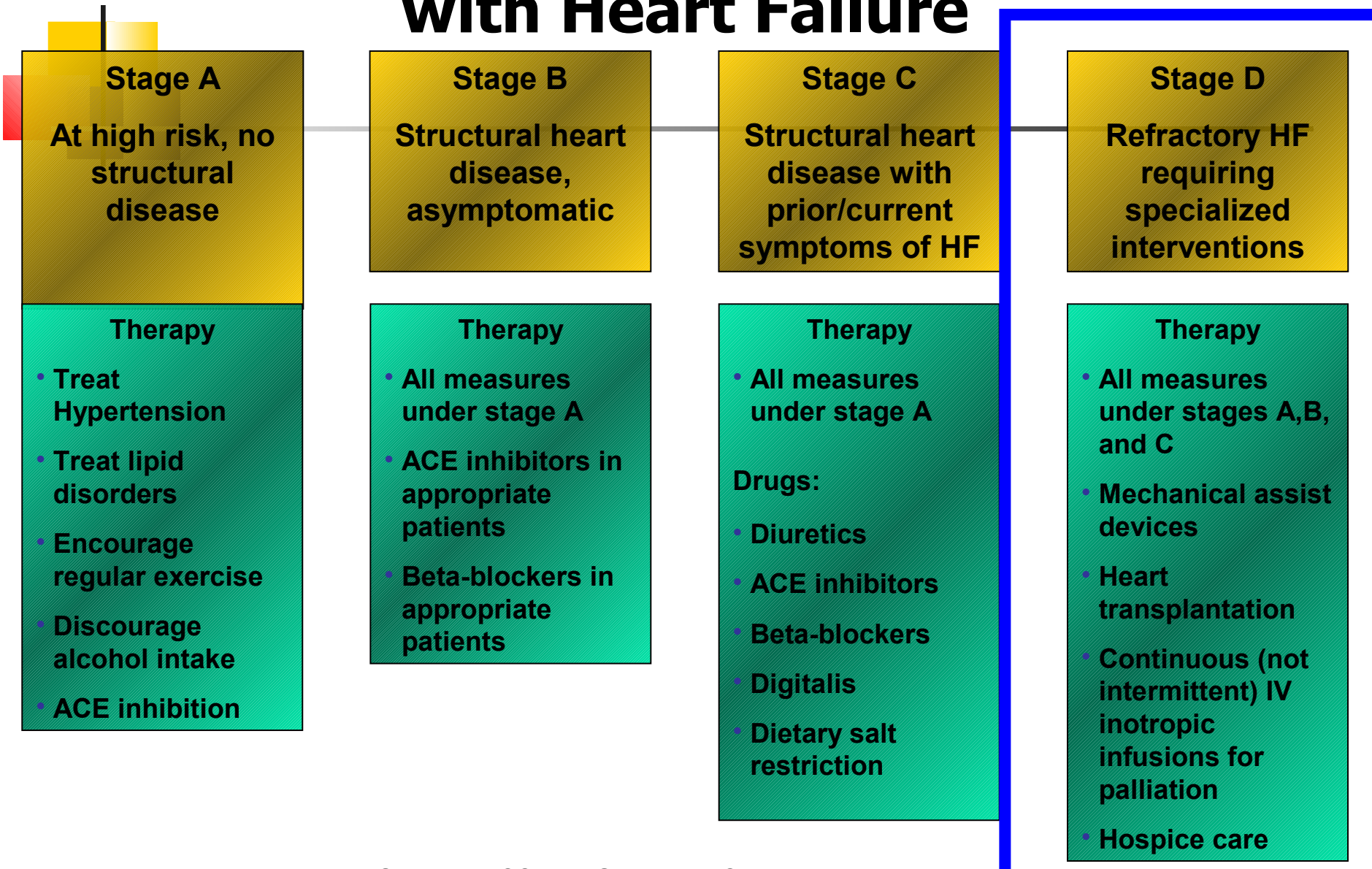
Severe Cardiogenic shock: low BP, organ hypoperfusion, anuria

- Heart rate ++
- SBP --
- CI --
- PCWP ++
- Diuresis --
- Hypoperfusion ++

Forrester Classification



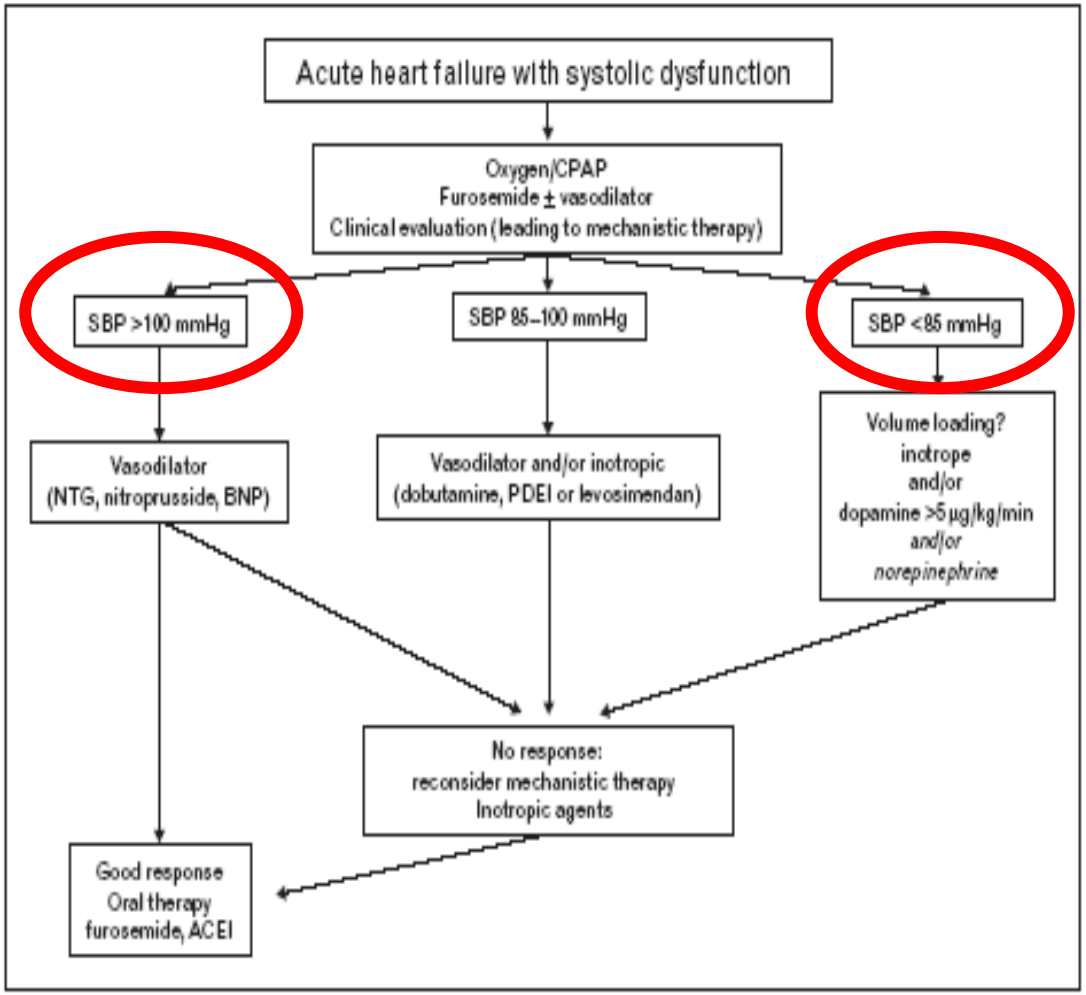
Treatment Approach for the Patient with Heart Failure



Hunt, SA et al. ACC/AHA Guidelines CHF, 2001.

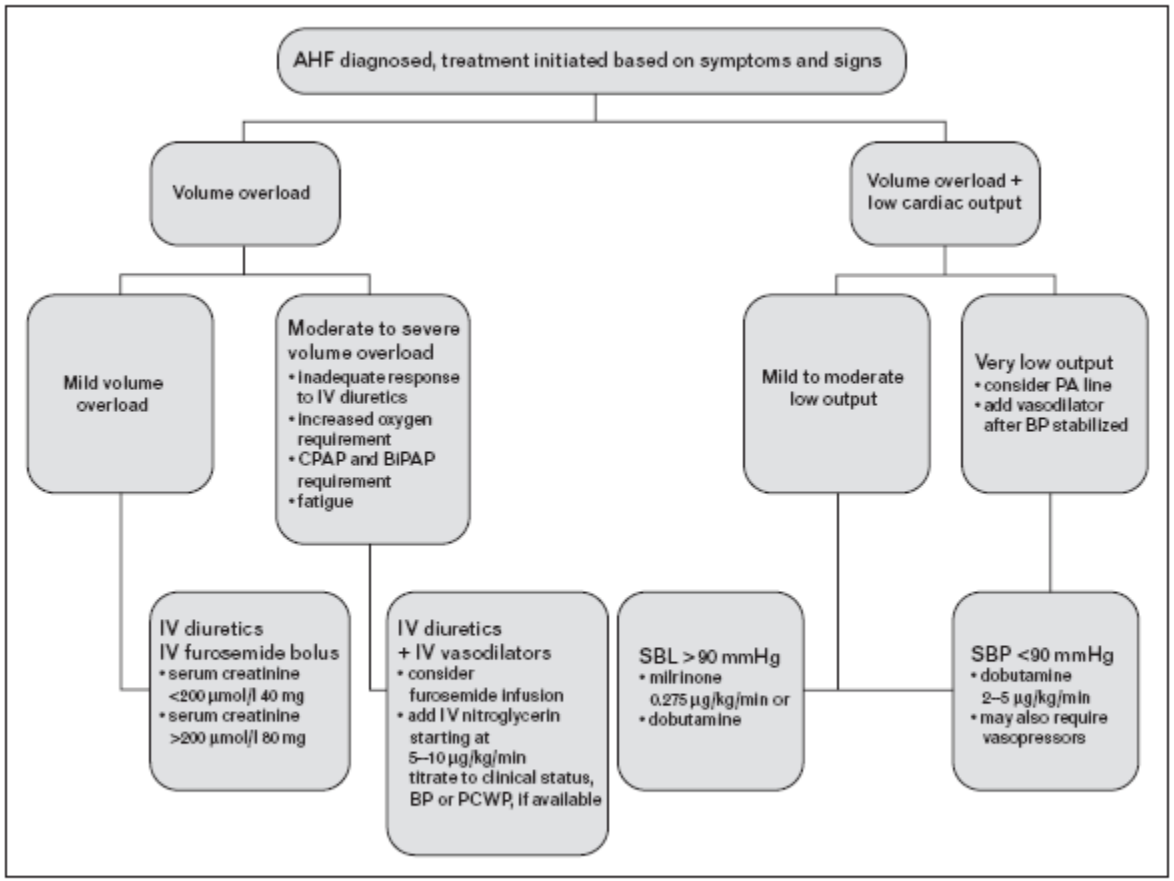
Figure 1 Immediate goals in treatment of the patients with acute heart failure [13]

ACEI, angiotensin-converting-enzyme inhibitor; BNP, brain natriuretic peptide; CPAP, continuous positive airway pressure; NTG, nitroglycerine; PDEI, phosphodiesterase inhibitors; SBP, systolic blood pressure.

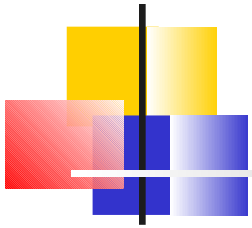


Current Opinion in Cardiology 2008, 23:134

Figure 2 Algorithm for acute heart failure treatment, data from Canadian Cardiovascular Society guidelines on the management of acute decompensated heart failure [14]



AHF, acute heart failure; BiPAP, bilevel positive airway pressure; BP, blood pressure; CPAP, continuous positive airway pressure; IV, intravenous; PA, pulmonary artery; PCWP, pulmonary capillary wedge pressure; SBP, systolic blood pressure.



Medical treatment

Medical Rx

- The ideal treatment should:
  - improve symptoms and hemodynamics without increasing myocardial oxygen demand and increasing propensity for arrhythmias.
  - Improve outcome!!!
- Do current therapies meet these criteria?

Table 1: Summary of selected treatment options for acute decompensated heart failure

Medication	Mechanism	Setting	Dosing	Comments
Furosemide	Natriuresis (preload reduction)	Volume overload with elevated left and right ventricular filling pressures	Bolus intravenous infusion (dose is often about twice the patient's usual dose at home); adjust dose based on urine output; add thiazide (metolazone 2.5-5 mg orally daily or chlorothiazide 250-500 mg intravenously once or twice daily), or switch furosemide to a continuous infusion (5-30 mg/h), or both in severe cases with diuretic resistance	Foundation of treatment for acute decompensated heart failure in patients with symptoms of congestion ("wet and warm")
Ultrafiltration	Venovenous filter to remove free water	Alternative to loop diuretics for treatment of volume overload	Ultrafiltration/hemofiltration system; fluid removal rates as dictated by clinical assessment, adequate blood pressure and system capabilities	
Nitroglycerin	Venodilation (preload reduction), coronary vasodilator (anti-ischemic)	Volume overload with adequate blood pressure, cardiac ischemia	1-2 sprays of sublingual nitroglycerin (0.3-0.8 mg) every 3-5 min at first. Consider transition to continuous intravenous infusion (v. topical paste): 10-20 μg/min intravenously at first; increase by 5-20 μg/min every 3-5 min as blood pressure allows	Probably underused in patients presenting with acute decompensated heart failure and adequate blood pressure
Positive pressure ventilation	Positive intrathoracic pressure (preload reduction)	Volume overload with (or without) dyspnea or hypoxia	Continuous positive airway pressure (with or without bilevel positive airway pressure) at pressure of 5-20 cm H_2O	Consider short-term use (hours) in patients with acute decompensated heart failure in acute respiratory distress
Morphine	Venodilator (preload reduction)	Volume overload with adequate blood pressure *after* nitroglycerin	Bolus 2-4 mg intravenously	No evidence of efficacy; second-line treatment

Nesiritide	Venodilator (preload reduction)	Volume overload with adequate blood pressure	Bolus 2 μg/kg; then infusion 0.01 μg/kg per min, adjusting dose up to 0.03 μg/kg per min	Not currently available in Canada
Nitroprusside	Arterial vasodilator (afterload reduction)	Acute heart failure with severe hypertension, or mitral valve regurgitation with adequate blood pressure	Continuous intravenous infusion of 0.3 μg/kg per min at first; titrate rapidly to desired blood pressure; maximum dose 10 μg/kg per min	Use nitroglycerin instead in most patients with acute decompensated heart failure; light sensitive; toxic levels of thiocyanate may accumulate
Vasodilating inotropes (dobutamine, milrinone)	Inotrope, chronotrope, systemic vasodilator, pulmonary vasodilator	Acute heart failure unresponsive to above therapies, worsening renal function	Dobutamine: 2-20 μg/kg per min intravenously Milrinone: 0.125-0.75 μg/kg per min intravenously (may load 50 μg/kg intravenously over 10 min, but not necessary); renal adjustment necessary	For short-term use in patients with significantly impaired cardiac output; may increase arrhythmia and risk of death; milrinone has longer half-life than the β-agonists
Vasopressor inotropes (dopamine, norepinephrine)*	Inotrope, chronotrope, vasoconstrictor	Shock with inadequate blood pressure (possibly low-dose dopamine in cardiorenal syndrome)	Dopamine: 1-50 μg/kg per min intravenously Norepinephrine: 0.01-0.4 μg/kg per min intravenously	Used in critically ill patients with hypotension; typically avoided in pure heart failure with high systemic vascular resistance, but such resistance may be low in acute decompensated heart failure owing to activation of systemic inflammatory response or total circulatory collapse

*Vasopressin and phenylephrine would not typically be used in acute decompensated heart failure.

Diuretics

Table 1 Systemic effects associated with acute high-dose diuretic administration

- ↑ RAAS stimulation
- ↑ AVP levels
- ↑ HR
- ↑ Norepinephrine levels
- ↓ GFR
- ↑ SVR

RAAS-renin-angiotensin-aldostrerone-system; AVP-arginine vasopressin; HR-heart rate; GFR-glomerular filtration rate; SVR-systemic vascular resistance

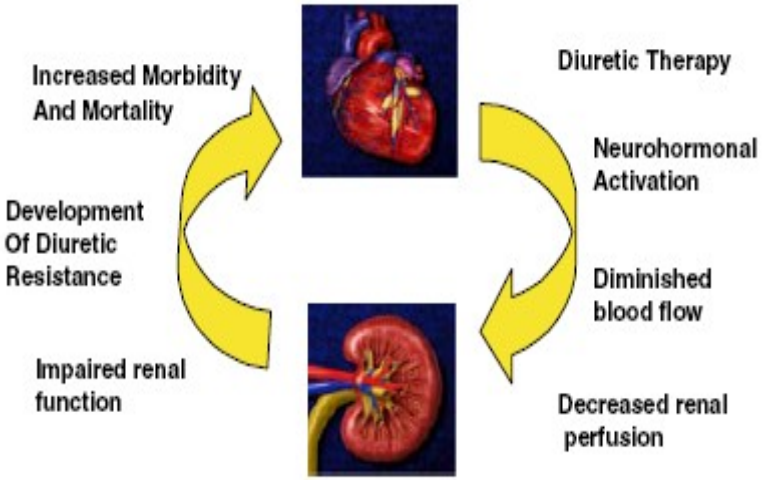


Fig. 1 The ''latrogenic'' cardio-renal syndrome of heart failure

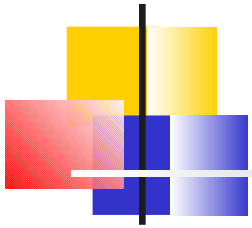
- The use of diuretics for the treatment of patients with

ADHF represents an area of medicine with a paucity of rigorous clinical trials.

- The acceptance of diuretics into the HF treatment paradigm is largely based on clinical and anecdotal experience over the last forty years without the benefit of large, multi-center randomized trials.

There is evidence that low-dose furosemide in combination with vasodilators may enhance diuresis with less adverse effects than high-dose boluses.

23. Cotter G, Metzkor E, Kaluski E et al (1998) Randomized trial of high-dose isosorbide dinitrate plus low-dose furosemide versus high-dose furosemide plus low-dose isosorbide dinitrate in severe pulmonary edema. Lancet 351:389–393



Inotropes

Table 2 Classification and mechanisms of agents which improve contractility and their concomitant clinical effects

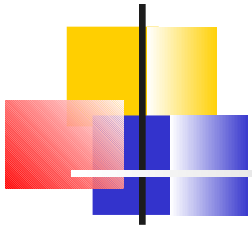
	Mechanism			
	Incr. i Ca	PDEi	SV	Vasodilation
Inotropic agents				
Dobutamine	++		+	
Dopamine	++		+	
Milrinone	++	++	+	++
Enoximone	++	++	+	++
Cardiac enhancers				
Levosimendan	+ –	+	+	++
Pimobendan	+ –	+	+	+

Incr. I Ca: increasing of intracellular calcium; PDEi: Phosphodiesterase inhibitors; SV: stroke volume

- *Short-term inotropic infusion*, although frequently used to improve hemodynamics and symptoms in acute decompensated heart failure, remains controversial. When patients present with profound circulatory collapse, inotropes may be absolutely required.
- For patients with acute decompensated heart failure who have evidence of end-organ hypo perfusion or diuretic resistance, but no frank hypotension, the use of inotropes is not well supported.

Elkayam U, Tasissa G, Binanay C, Stevenson L. Use and impact of inotropes and vasodilator therapy in hospitalized patients with severe heart failure. ***Am Heart J 2007; 153:98–104.***

The ESCAPE trial published in 2007 revealed that inotropic agents such as dobutamine and milrinone in heart-failure patients with low ejection fraction and hypotension had higher 6-month mortality rates [hazard ratio (HR) 2.14, 95% CI 1.10– 4.15] than patients on vasodilators such as Nesiritide when compared with placebo (HR 1.39, 95% CI 0.64–3.0). **Inotropes in combination with vasodilators showed the highest mortality (HR 2.90, 95% CI 1.88–4.48)**



- Indicated in the case of peripheral hypo perfusion with or without pulmonary edema

Class IIa C

HFSA 2006 Practice Guideline

Acute HF—IV Inotropes

Recommendation 12.18 (1 of 3)

Intravenous inotropes (milrinone or dobutamine) may be considered to relieve symptoms and improve end-organ function in patients with advanced HF characterized by:

- **LV dilation**
- **Reduced LVEF**
- **And diminished peripheral perfusion or end-organ dysfunction (low output syndrome)**

Particularly if these patients:

- **Have marginal systolic blood pressure (<90 mm Hg),**
- **Have symptomatic hypotension despite adequate filling pressure,**
- **Or are unresponsive to, or intolerant of, intravenous vasodilators.**

Strength of Evidence = C

Heart Failure Society of America

Adams KF, Lindenfeld J, et al. HFSA 2006 Comprehensive Heart Failure Guideline. J Card Fail 2006;12:e1-e122.

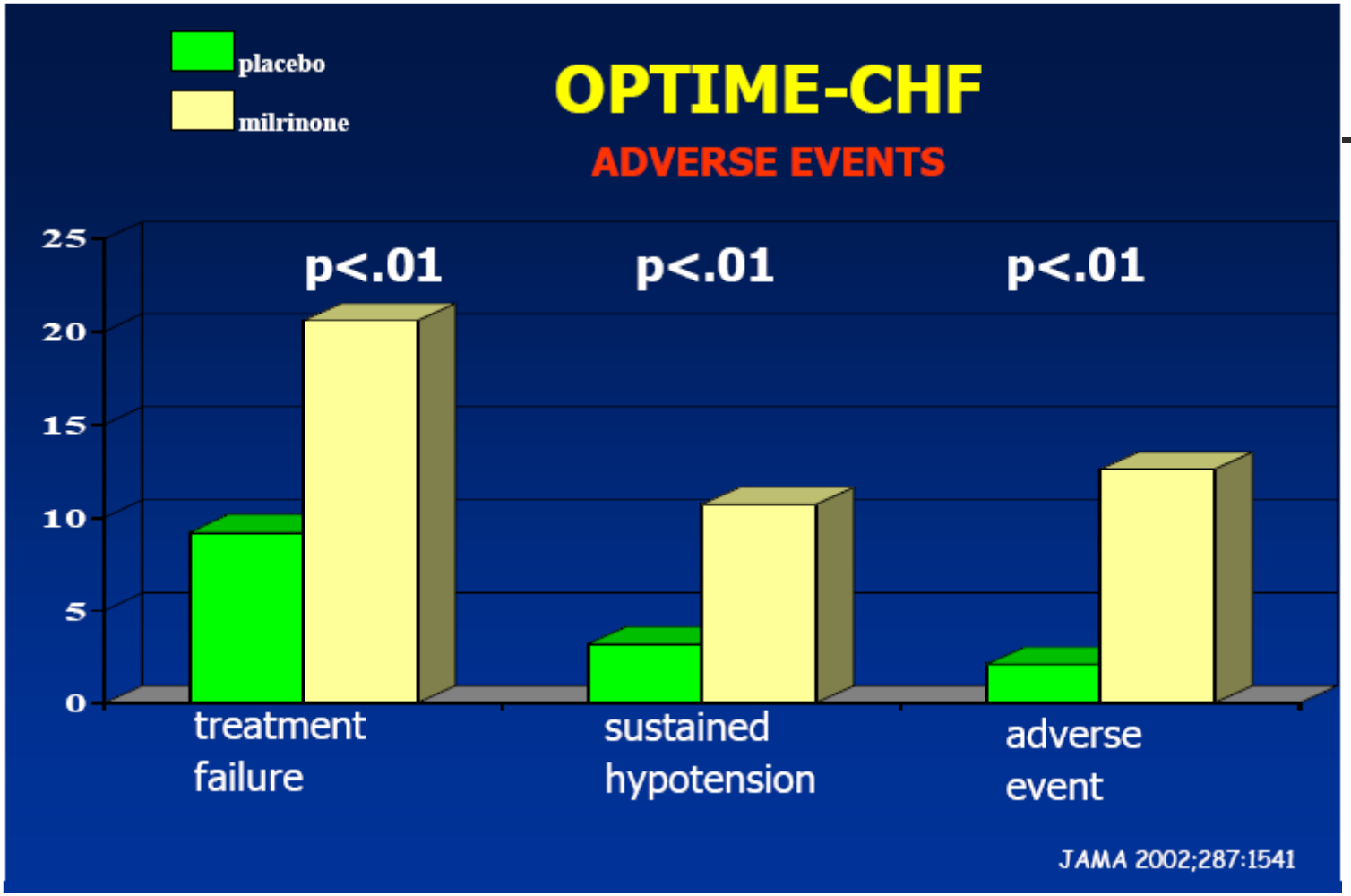
Phosphodiesterase inhibitors ((Milrinone

- Increases myocardial cAMP concentrations by selective inhibition of phospho-diesterase III, which leads to an increase in intracellular calcium, causing increased myocardial contractility, myocardial toxicity secondary to calcium overload, and relaxation of the endothelium.
- Intermediate effect between pure vasodilator to pure inotropic agent

OPTIME-CHF

OUTCOME	PLACEBO n 472	MILRINONE n 477	
1. Days of H for CV cause within 60 days (mean)	12.5	12.3	n.s.
2. Days of H from infusion to discharge (mean)	7.0	7.0	n.s.
3. Death/readmission within 60 days (%)	35.3	35.0	n.s.

JAMA 2002;287:1541


placebo
milrinone
OPTIME-CHF
ADVERSE EVENTS
25
20
15
10
5
0
p<.01
p<.01
p<.01
treatment failure
sustained hypotension
adverse event
JAMA 2002;287:1541

It can be used simultaneously with catecholaminergic agonists or antagonists.

Class IIb C

Table 3 Drawbacks of dobutamine and milrinone

(A) *Dobutamine*

(i) Increased myocardial oxygen consumption

(ii) Myocardial injury

(iii) Tolerance/tachyphylaxis

(iv) Interaction with beta-blockers

(v) Arrhythmiogenesis

(vi) Increased mortality

(B) *Milrinone*

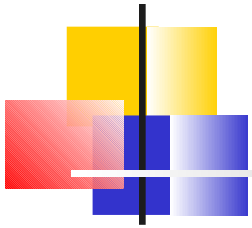
(i) Hypotension

(ii) Arrhythmiogenesis

(iii) Worsening prognosis in ischemic disease

Levosimendan

- Levosimendan differs from conventional inotropic agents due to its vasodilator properties and positive inotropic effects achieved by enhancing myocyte sensitivity to calcium that is already in the cells rather than increasing calcium in the cell



- The positive inotropic effects of levosimendan are achieved by its binding to troponin C and calcium, thereby stabilizing the tropomyosin molecule and prolonging the duration of actin-myosin overlap without a change in the net concentration of intracellular calcium.
- The vasodilatory effect of levosimendan is reached through activation of ATP-dependent potassium channels.

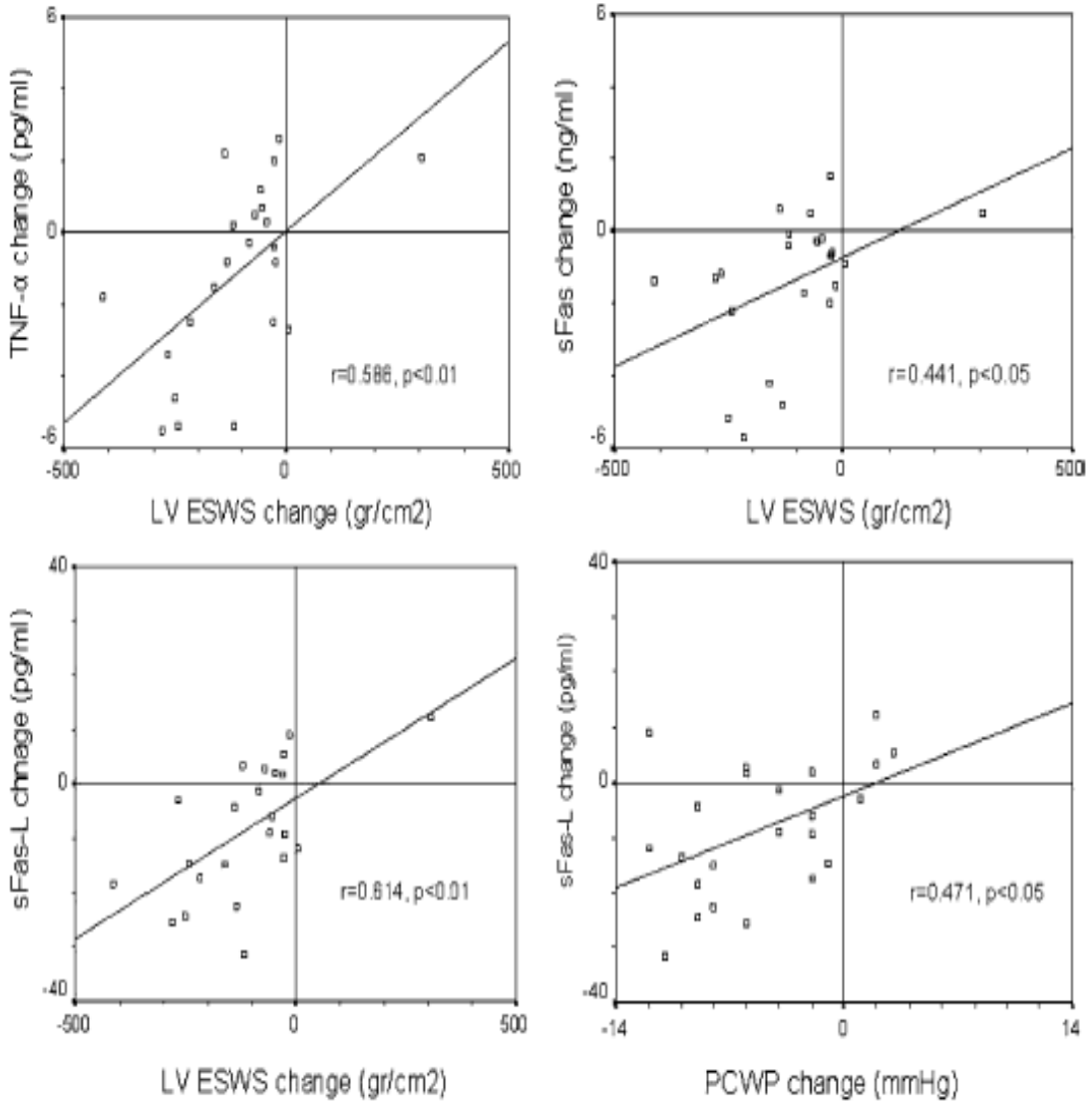
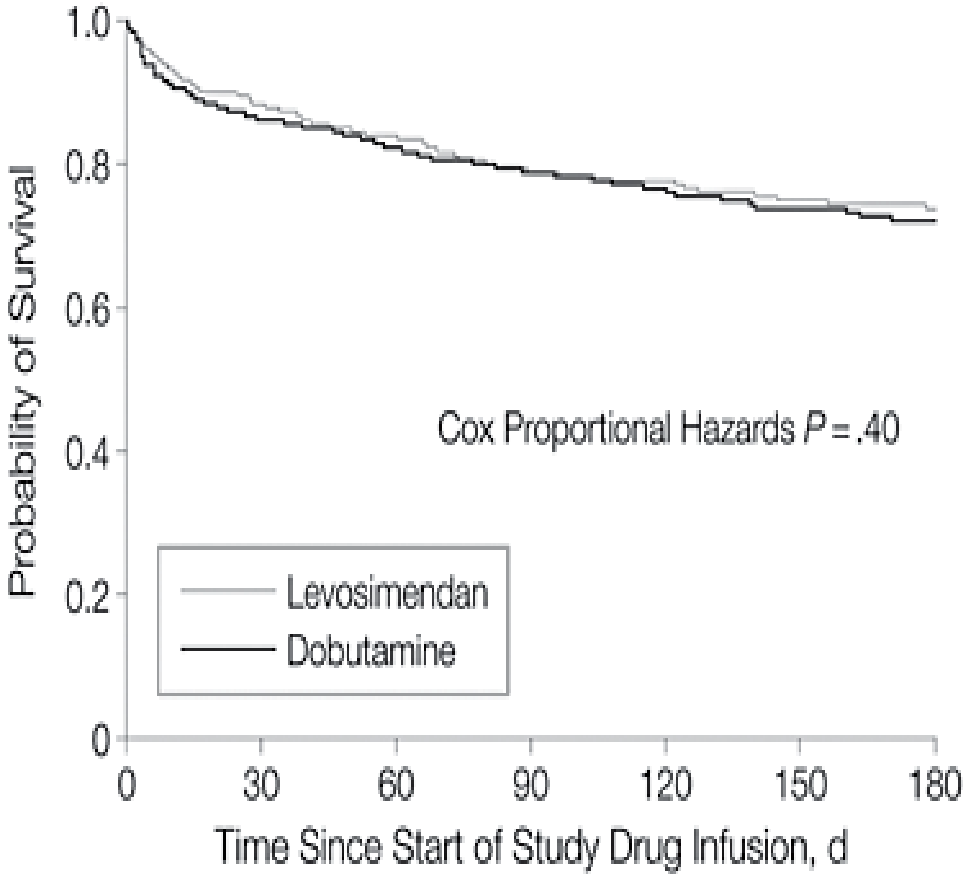


Fig. 1 Levosimendan-induced improvement in left ventricular end-systolic wall stress and pulmonary capillary wedge pressure are correlated with the concomitant reduction of circulating pro-inflammatory cytokines and soluble apoptosis mediators in patients with acutely decompensated heart failure (modified from ref. [27])

Class of recommendation IIa, level of evidence B

- Two most recent trials, SURVIVE and REVIVE II, both support the symptomatic benefit of Levosimendan in comparison with placebo.
- **Mortelity** untill 180 days did not differ between levosimendan vs either inotropes or plcebo(survive),and was non- significantly increased at 90 days (Revive2)

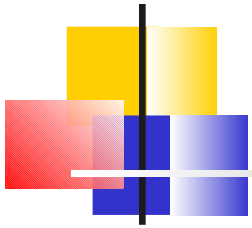
In a meta-analysis of LIDO, CASINO and SURVIVE, mortality at 6months was lower in the Levosimendan group (relative risk 0.76, P¼0.032)



No. at Risk					
Levosimendan	664	608	586	525	462
Dobutamine	663	596	568	519	454

Table 4 Large-scale randomized clinical trials comparing the effects of levosimendan with dobutamine or placebo treatment in patients with acutely decompensated heart failure

Trial acronym	*N*	Treatment arms	Duration of therapy	Primary end-point	Survival
RUSSLAN	504	Levosimendan versus placebo in post-MI cardiac failure	Loading dose + 6-h infusion	Hypotension or myocardial ischemia	↓ Risk of death or worsening of heart failure at 6 and 24 h ↓ mortality at 14 days and at 180 days
LIDO	203	Levosimendan versus dobutamine in decompensated heart failure	Loading dose + 24-h infusion	Hemodynamic improvement	↓ Mortality at 180 days
REVIVE-1	100	Levosimendan versus placebo in decompensated heart failure	10-min loading dose + 50-min infusion + 23-h infusion (if well-tolerated)	Clinical outcome	↓ "Worsening" (including death) at 24 h and at 5 days
REVIVE-2	600	Levosimendan versus placebo in decompensated heart failure	Loading dose (6–12 mcg/kg) + 24-h infusion (0.1–0.2 mcg/kg/min)	A composite of clinical signs and symptoms of acute decompensated heart failure over 5 days	Neutral effects on mortality at 90 days (secondary end-point); improvement of primary-end-point and length of hospitalization; reduction of BNP
SURVIVE	1,327	Levosimendan versus dobutamine in decompensated heart failure	Loading dose (12 mcg/kg) + 24-h infusion (0.1–0.2 mcg/kg/min)	Survival at 5, 15, 30 and 180 days	No significantly different effects compared with dobutamine on mortality; greater reduction of BNP than dobutamine (secondary end-point)



acute heart failure guidelines published by the European Society of Cardiology recommend its use on patients having symptomatic, low-output heart failure secondary to systolic dysfunction which is not accompanied by severe hypotension (Delle Karth et al 2003; Lehmann et al 2004; Nieminen et al 2005). Use on patients with a systolic blood pressure below 85 mmHg is not recommended (Nieminen et al 2005.

Nieminen MS, Bohm M, Cowie MR et al (2005) ESC committee for practice guideline. Executive summary of the guidelines on the diagnosis and treatment of acute heart failure: the task force on acute heart failure of the European society of cardiology. Eur Heart J 26:384–416

Table 5 Dosing schedules, recommendation classes and levels of evidence for positive inotropic agents in acute heart failure syndromes (modified from ref. [11])

Agent	Intravenous bolus dose	Intravenous infusion rate	Recommendation class	Level of evidence
Dobutamine	–	2–20 μg/kg/min	IIa	C
Dopamine	–	≤ 2 μg/kg/min: renal effect, 2–5 μg/kg/min: inotropic effect, >5 μg/kg/min: vasoconstriction	IIb	C
Milrinone	25–75 mg/kg	0.375–0.75 μg/kg/min	IIb	C
Enoximone	0.25–0.75 mg/kg	1.25–7.5 μg/kg/min	IIb	C
Levosimendan	12–24 mg/kg	0.05–0.2 μg/kg/min	IIa	B

Vasodilators

- **Nitroglycerin**

Class I recommendation, level of evidence B

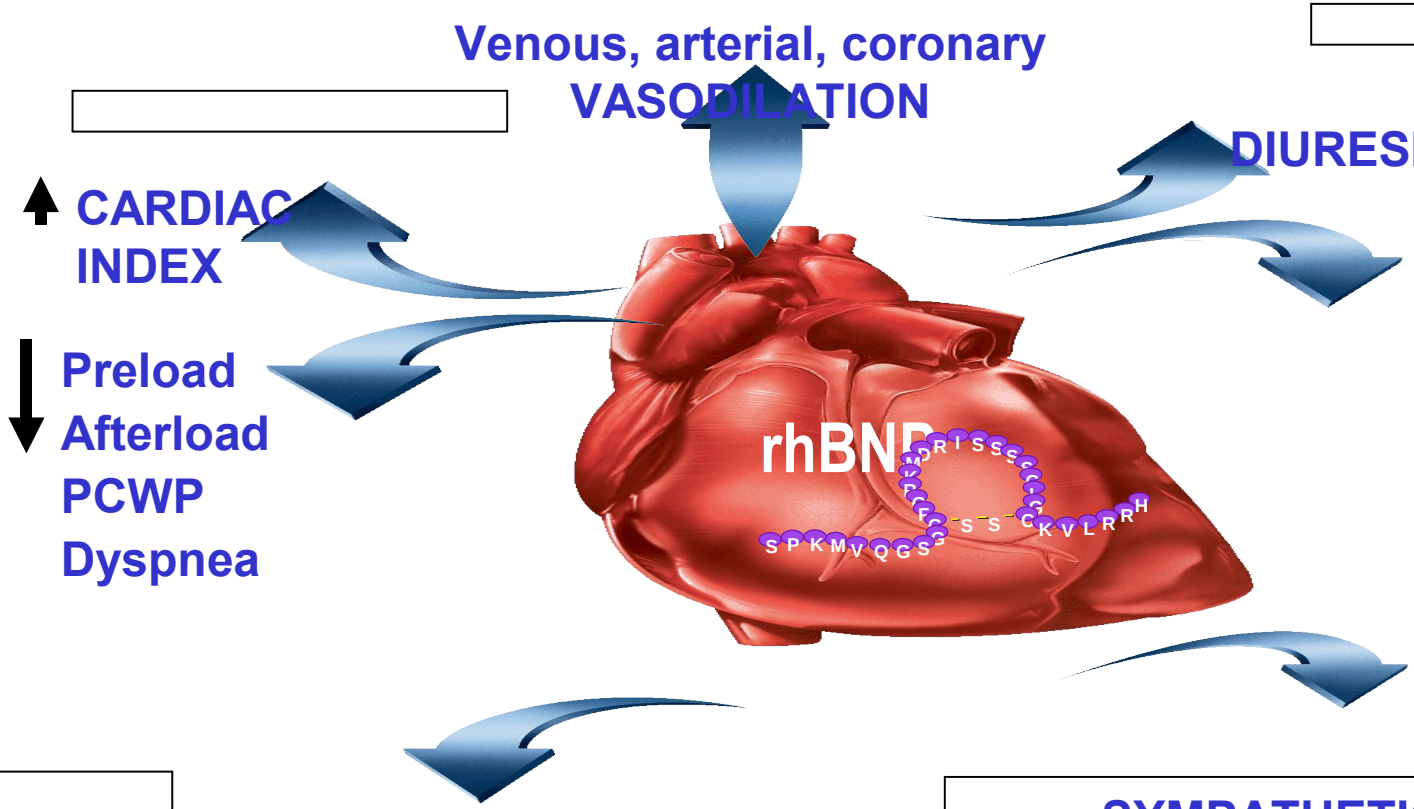
- **Nitropruside**

In severely decompensated CHF, intravenous nitroglycerin is preferred because of questionable absorption of oral and transdermal preparations and for ease of titration.

Class I recommendation, level of evidence C

- **Nesiritide**

Nesiritide



Not proarrhythmic

Short-term Risk of Death After Treatment With Nesiritide for Decompensated Heart Failure

A Pooled Analysis of Randomized Controlled Trials

Jonathan D. Sackner-Bernstein, MD
Marcin Kowalski, MD
Marshal Fox, MD
Keith Aaronson, MD, MS

Context Nesiritide improves symptoms in patients with acutely decompensated heart failure compared with placebo and appears to be safer than dobutamine. Its short-term safety relative to standard diuretic and vasodilator therapies is less clear.

Objective To investigate the safety of nesiritide relative to noninotrope-based control therapies, primarily consisting of diuretics or vasodilators.

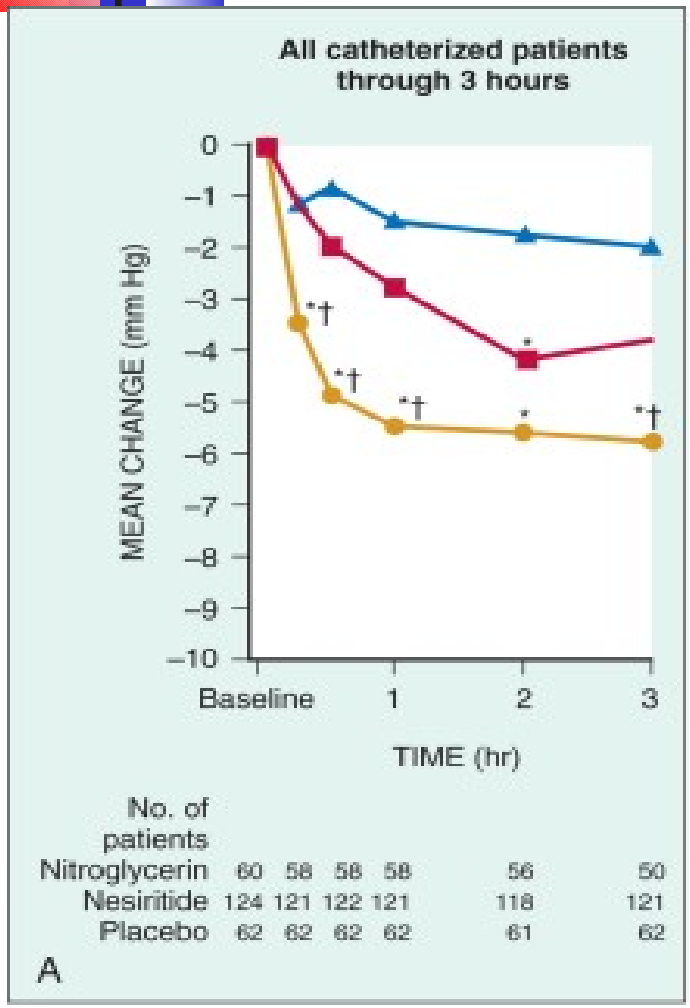
Table 2. Mortality Within 30 Days of Treatment Associated With Nesiritide or Control Therapy With Overall Risk Ratio Calculated by Mantel-Haenszel Test Using a Fixed-Effects Model

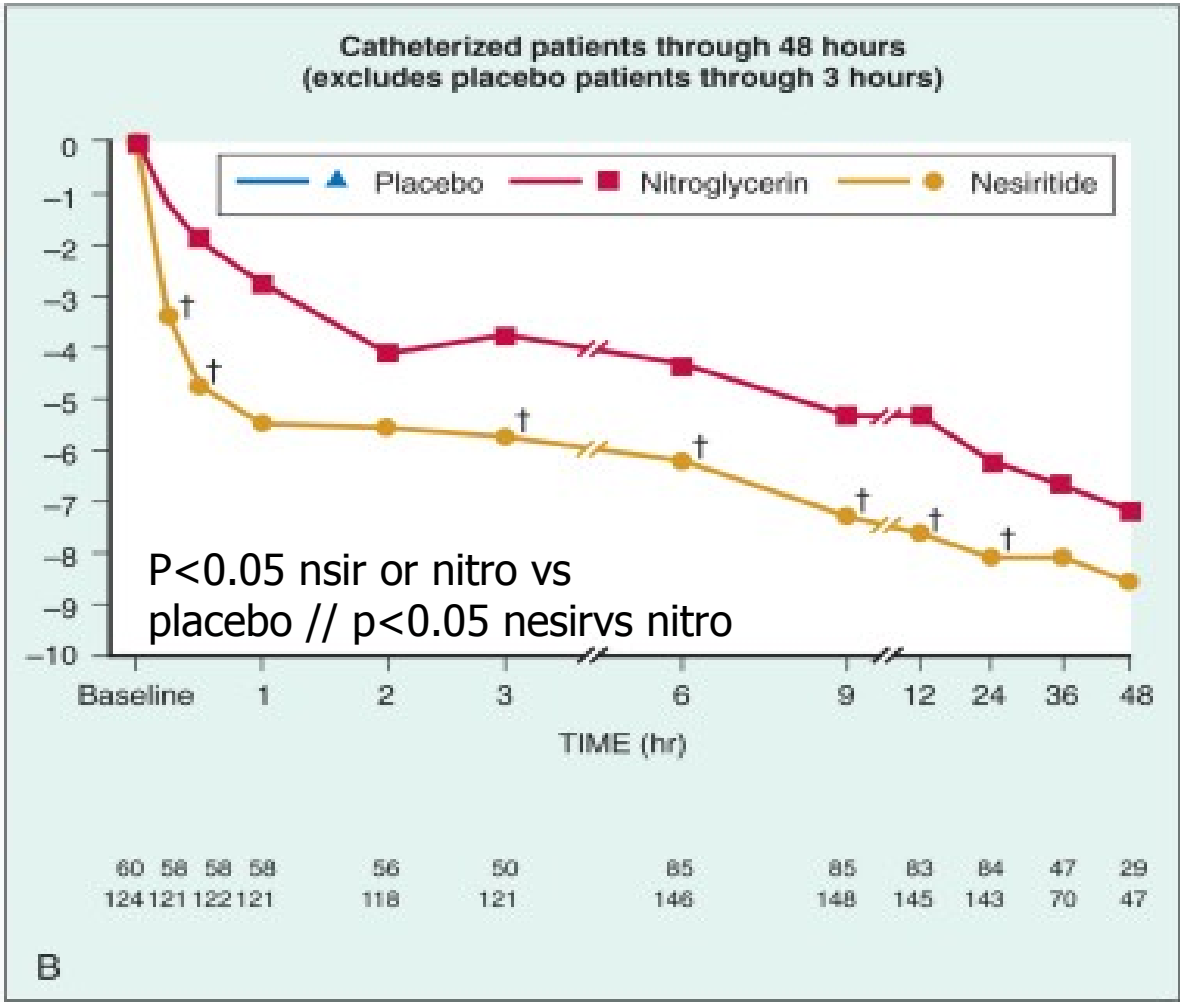
Study	No. of Deaths/Total No. (%) of Patients		Risk Ratio (95% CI)	*P* Value
	Nesiritide Therapy	Control Therapy		
NSGET	6/85 (7.1)	2/42 (4.8)	1.48 (0.31-7.03)	ND
VMAC	24/280 (8.6)	12/218 (5.5)	1.56 (0.80-3.04)	ND
PROACTION	5/120 (4.2)	1/117 (0.9)	4.88 (0.58-41.1)	ND
Total	35/485 (7.2)	15/377 (4.0)	1.74 (0.97-3.12)	.059

Abbreviations: CI, confidence interval; ND, not determined; NSGET, Nesiritide Study Group Efficacy Trial; PROACTION, Prospective Randomized Outcomes Study of Acutely Decompensated Congestive Heart Failure Treated Initially in Outpatients with Natrecor; VMAC, Vasodilation in the Management of Acute Congestive heart failure.

VMAC investigators *JAMA2002 287:1531*

*(*acute heart failure+RHC*)*





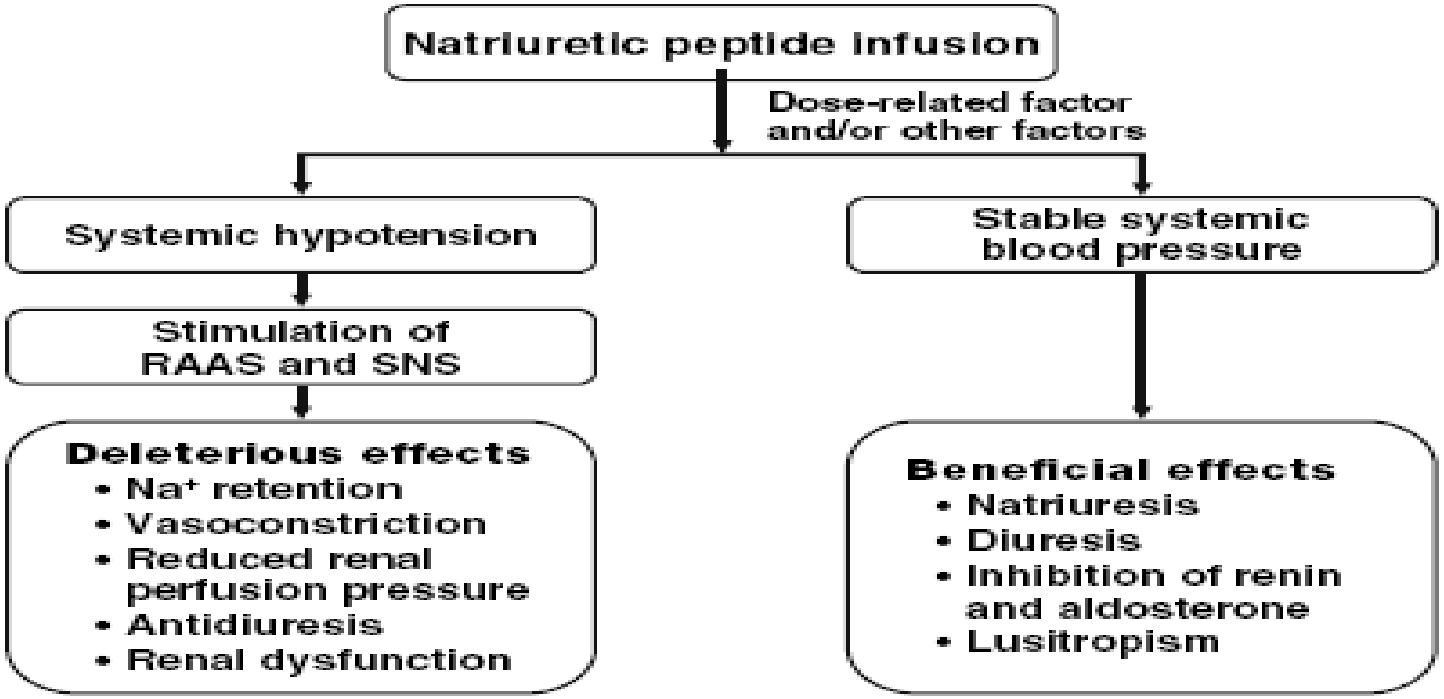


Fig. 3 Proposed mechanisms for differential renal effects mediated by natriuretic peptides [3, 68]. NPs = natriuretic peptides RAAS = -renin-angiotensin-aldosterone system SNS = sympathetic nervous system

FDA Formed the Braunawald Committee

- **The use of nesiritide should be strictly limited to patients presenting to the hospital with acutely decompensated congestive heart failure who have dyspnea at rest.**

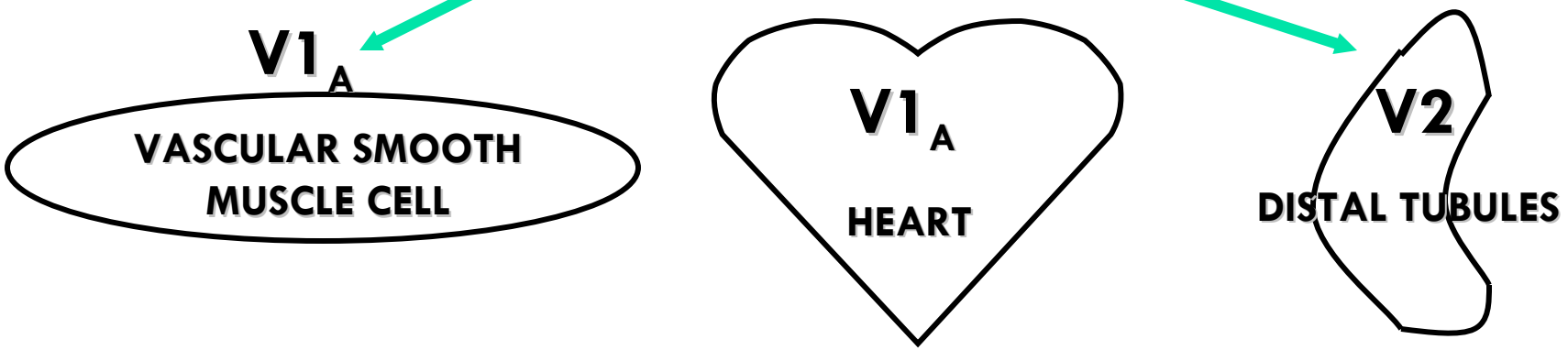
- **Physicians considering the use of nesiritide should consider its efficacy in reducing dyspnea, the possible risks of the drug ,and the availability of alternate therapies to relieve the symptoms of congestive heart failure**

Future targets

- Vasopressin receptor antagonists (**tolvaptan** and **conivaptan**) There are two types of receptor, V1a and V2 receptors. V1a receptors activate peripheral arterial and coronary vasoconstriction, therefore increasing both preload and afterload. V2 receptors are responsible for free water absorption in the renalcollecting duct by increasing the amount of aquaporin-2 within the membrane

(Arginine Vasopressin (AVP

aka Antidiuretic Hormone



Coronary Vasoconstriction
- Myocyte Hypertrophy

Increased afterload and wall stress
- LV hypertrophy
- Ischemia
- Increased preload, hyponatremia, edema

Effects of *tolvaptan*, a vasopressin antagonist, in patients hospitalized with worsening heart failure: A randomized controlled trial. *JAMA 2004* 29:1963-.

- There were no differences in worsening heart failure at 60 days between the tolvaptan and placebo groups (P =.88 for trend). In post hoc analysis, 60-day mortality was lower in tolvaptan-treated patients with renal dysfunction or severe systemic congestion.
- A phase III trial EVEREST is currently being conducted to evaluate the long-term efficacy and safety of tolvaptan in hospitalized patients with severe HF

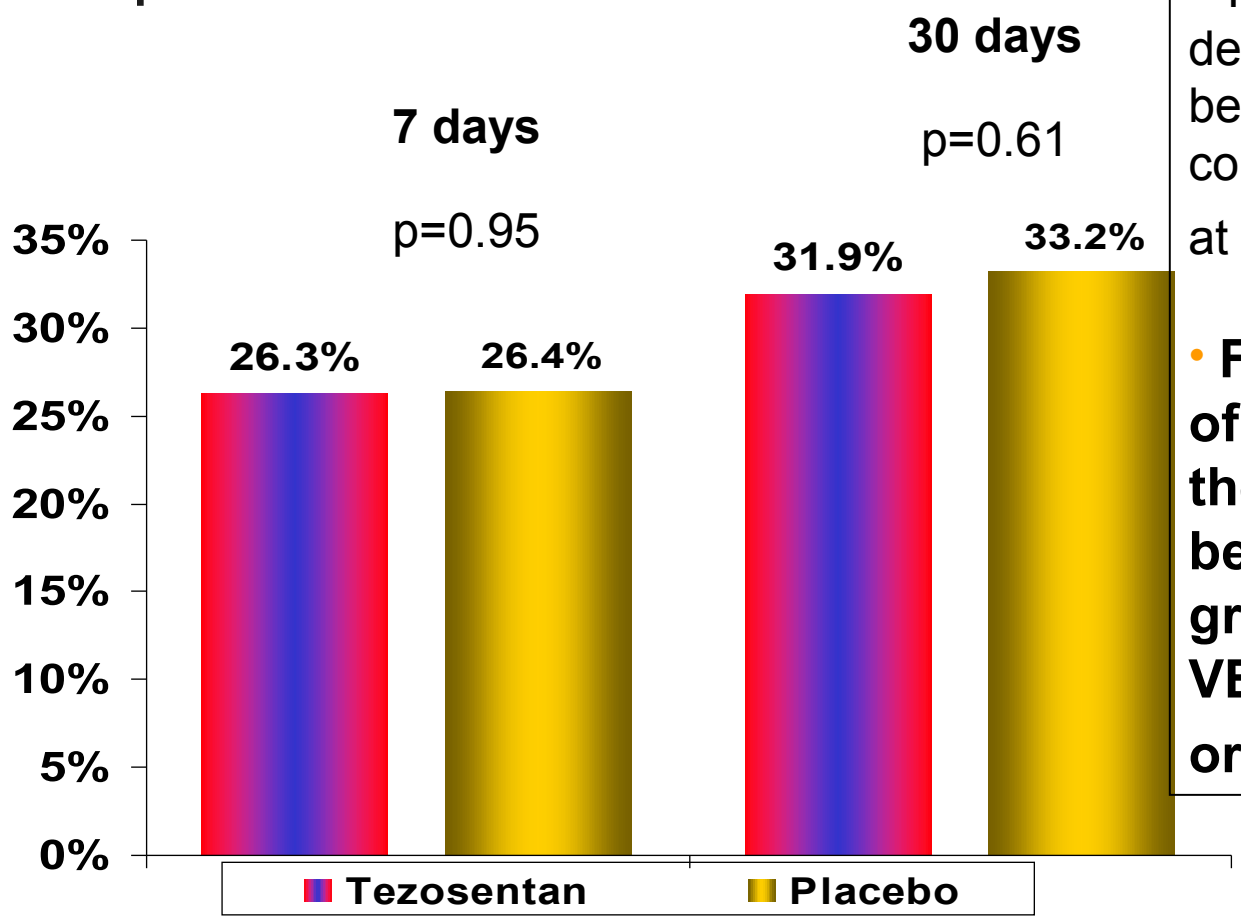
•Adenosine A1 receptor antagonists

Show promising diuretic properties in patients with acute decompensated heart failure, particularly diuretic-refractory patients. Renal A1-receptor blockade prevents arteriolar vasoconstriction and post glomerular vasodilation resulting in improved glomerular blood flow.

(***Rolofylline*** - presented ACC 2008 ***PROTECT*** pilot study)

Endothelin receptor antagonists (*tezosentan* and *bosentan*)

Primary endpoint of death or worsening heart failure at 7 and 30 days



- There was no difference in death or worsening heart failure between the Tezosentan group compared to the placebo group at both 7 and 30 days.
- **For the primary endpoint of dyspnea at 24 hours, there was no difference between the treatment groups in either of the VERITAS trials individually or together.**

VERITAS Trial: Primary Endpoint

Presented at ACC 2005

Published AM Heart J

New inotropes
Cardiac myosin activators

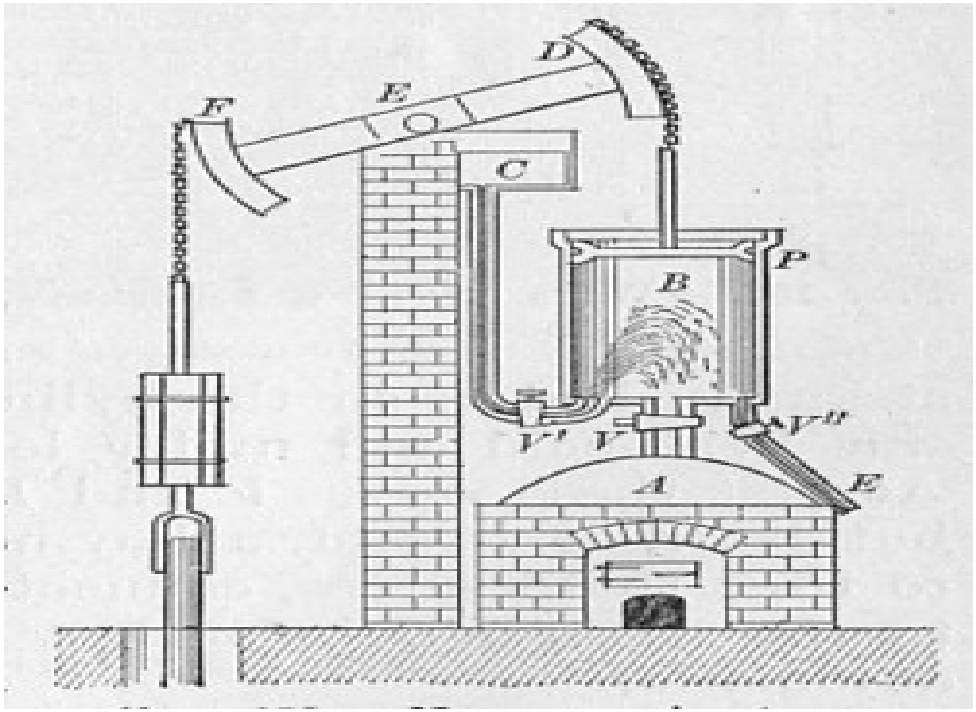
- Enhancing the efficiency of actin–myosin coupling
- Increasing contractility W/O increasing intracellular calcium or oxygen consumption

Non-pharmacological therapies

- Small randomized trials have shown that continuous positive airway pressure ***(CPAP)*** and other noninvasive ventilation decreased the need for endotracheal intubation in cardiogenic shock without a significant impact in mortality.
- ***Ultrafiltration***- small trials revealed its potential benefit for relief of pulmonary edema, ascites,and peripheral edema

Costanzo MR, Guglin M, Saltzberg M, et al. ***UNLOAD*** Trial Investigators, ultrafiltration versus intravenous diuretics for patients hospitalized for acute decompensated heart failure. *J Am Coll Cardiol 2007; 49:675–683*

Mechanical assistance



IABP

- Recommended in acute decompensated states, as an urgent measure of cardiac support, to stabilize the patient and maintain organ perfusion until transplantation is done.

Class I B

‘Case presentation – cont

- Being at a state of cardiogenic shock, IABP was inserted and IV inotropes (milrinone) were given with stabilization of the blood pressure and mild improvement of CI
- The patient was transferred to our ICCU without improvement in LV function under above Rx

?What can we do more

!!!Assist device

Rationale of assist device use

- Restoration of normal hemodynamics and vital organ perfusion.
- Reduction of ventricular strain and improving remodeling

Circulatory Support Milestones

- 1982 - Begin Clinical Evaluation / Pennington, SLU 1984 - 1st Successful Bridge to Transplant / Hill, CPMC
- 1995 - FDA Approval for Bridge to Transplant
- 1998 - FDA Approval for Postcardiotomy Recovery
- 1998 - Smallest VAD Recipient (17 Kg)
- 2000 - Youngest VAD Recipient (6 yrs)
- 2000 - Longest Duration VAD Support (566 days)

The New England Journal of Medicine

VOLUME 345 NOVEMBER 15, 2001 NUMBER 2

LONG-TERM USE OF A LEFT VENTRICULAR ASSIST DEVICE FOR END-STAGE HEART FAILURE

ERIC A. ROSE, M.D., ANNETINE C. GELIJNS, PH.D., ALAN J. MOSKOWITZ, M.D., DANIEL F. HEITJAN, PH.D., LYNNE W. STEVENSON, M.D., WALTER DEMBITSKY, M.D., JAMES W. LONG, M.D., PH.D., DEBORAH D. ASCHEIM, M.D., ANITA R. TIERNEY, M.P.H., RONALD G. LEVITAN, M.SC., JOHN T. WATSON, PH.D., AND PAUL MEIER, PH.D., FOR THE RANDOMIZED EVALUATION OF MECHANICAL ASSISTANCE FOR THE TREATMENT OF CONGESTIVE HEART FAILURE (REMATCH) STUDY GROUP*

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Left Ventricular Assist Device and Drug Therapy for the Reversal of Heart Failure

Emma J. Birks, M.R.C.P., Ph.D., Patrick D. Tansley, F.R.C.S., James Hardy, M.B., B.S., B.Sc., Robert S. George, M.R.C.S., B.Sc., Christopher T. Bowles, Ph.D., Margaret Burke, F.R.C.Path., Nicholas R. Banner, F.R.C.P., Asghar Khaghani, F.R.C.S., and Magdi H. Yacoub, F.R.S.

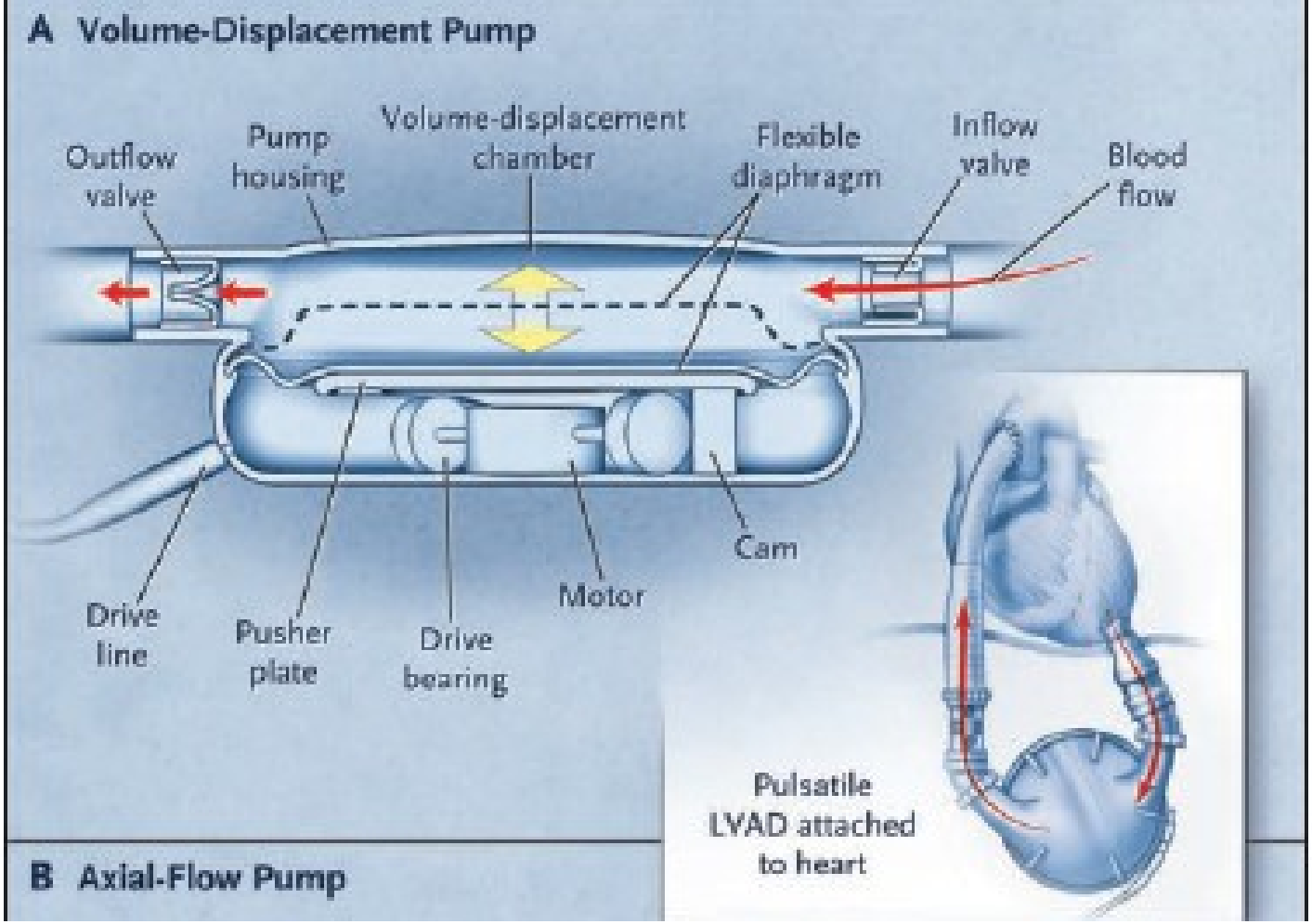
the β2-adrenergic–receptor agonist clenbuterol in combination with LVA in pts with non ischemic CMP

Assist devices

- A a bridge to recovery or to heart transplantation

Class IIa B

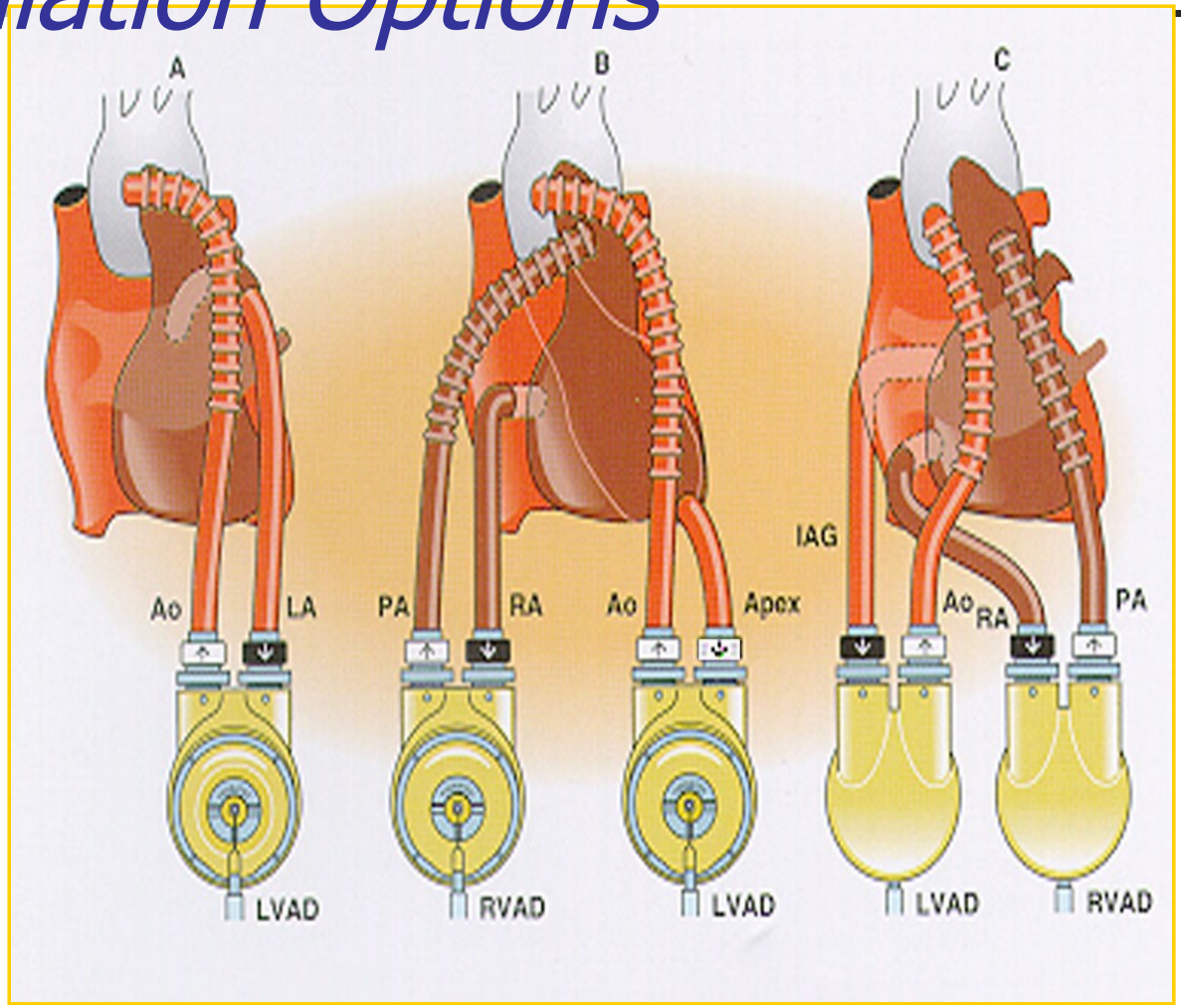
Oxygenator	Short term
Thoratec	LV+RV
Heartmate I/II	long term, destination
Total artificial heart	



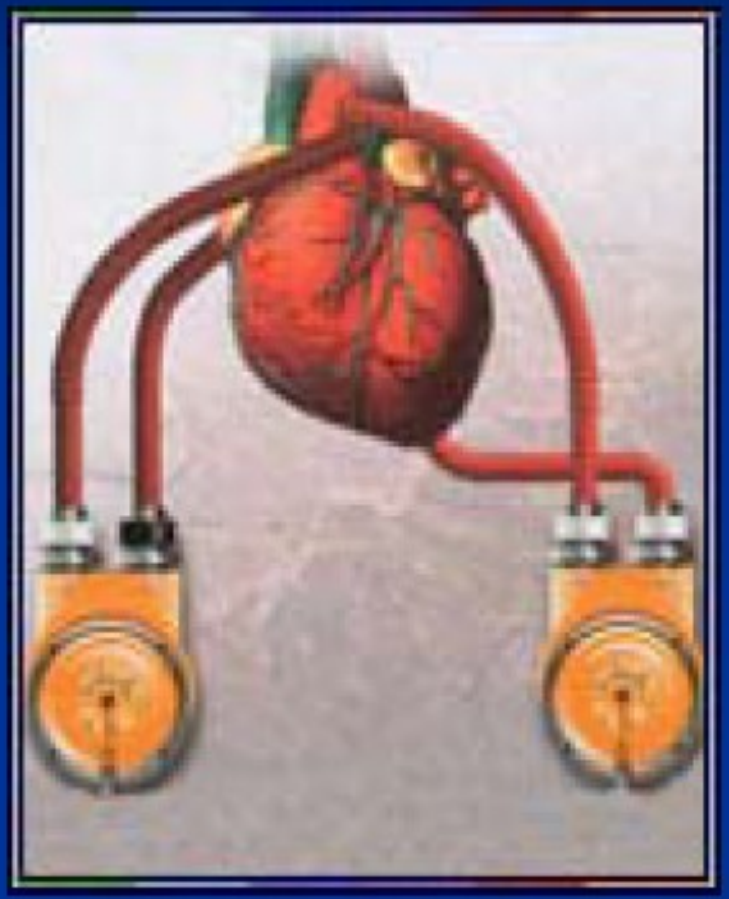
An external drive line provides electrical power to a motor within the device. The motor drives a pusher plate up and down repeatedly, expanding and compressing the volume-displacement chamber. The direction of blood flow is maintained by inflow and outflow valves. The inflow cannula is inserted into the left ventricular apex, and the outflow cannula is inserted into the ascending aorta.

Thoratec® Implant Versatility

Cannulation Options

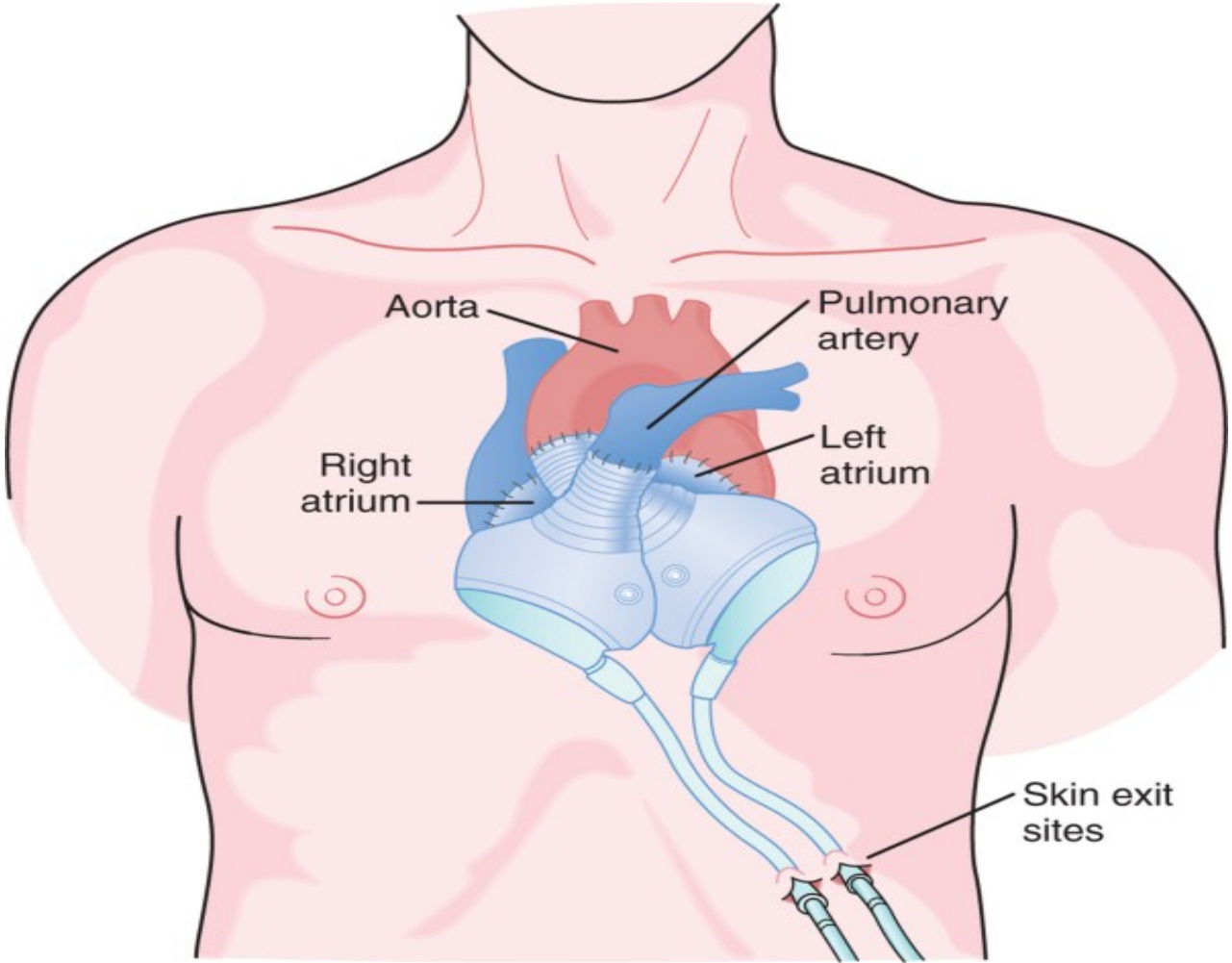


BIVAD

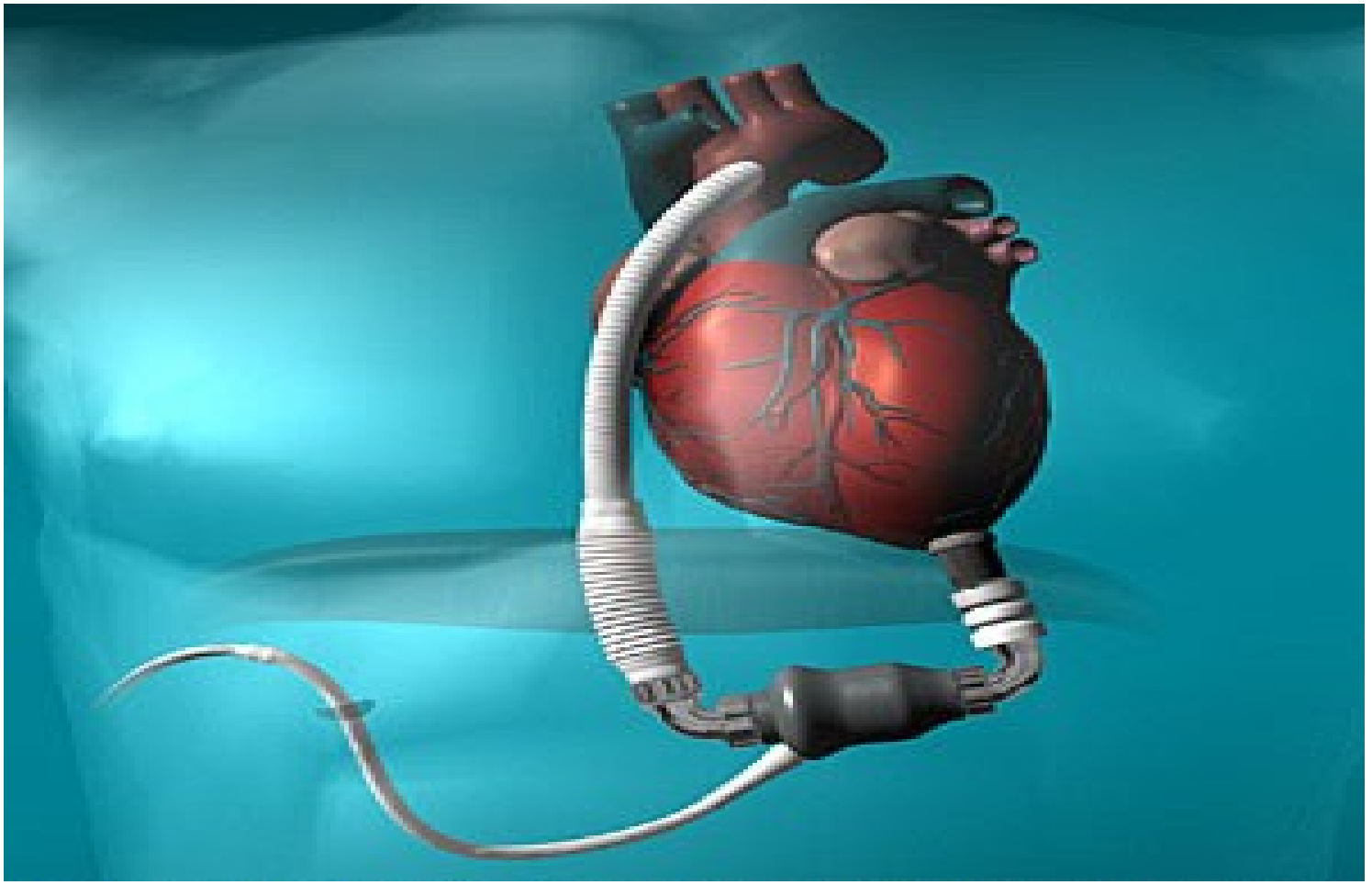


- support of RV and LV

Total artificial heart -abiocor



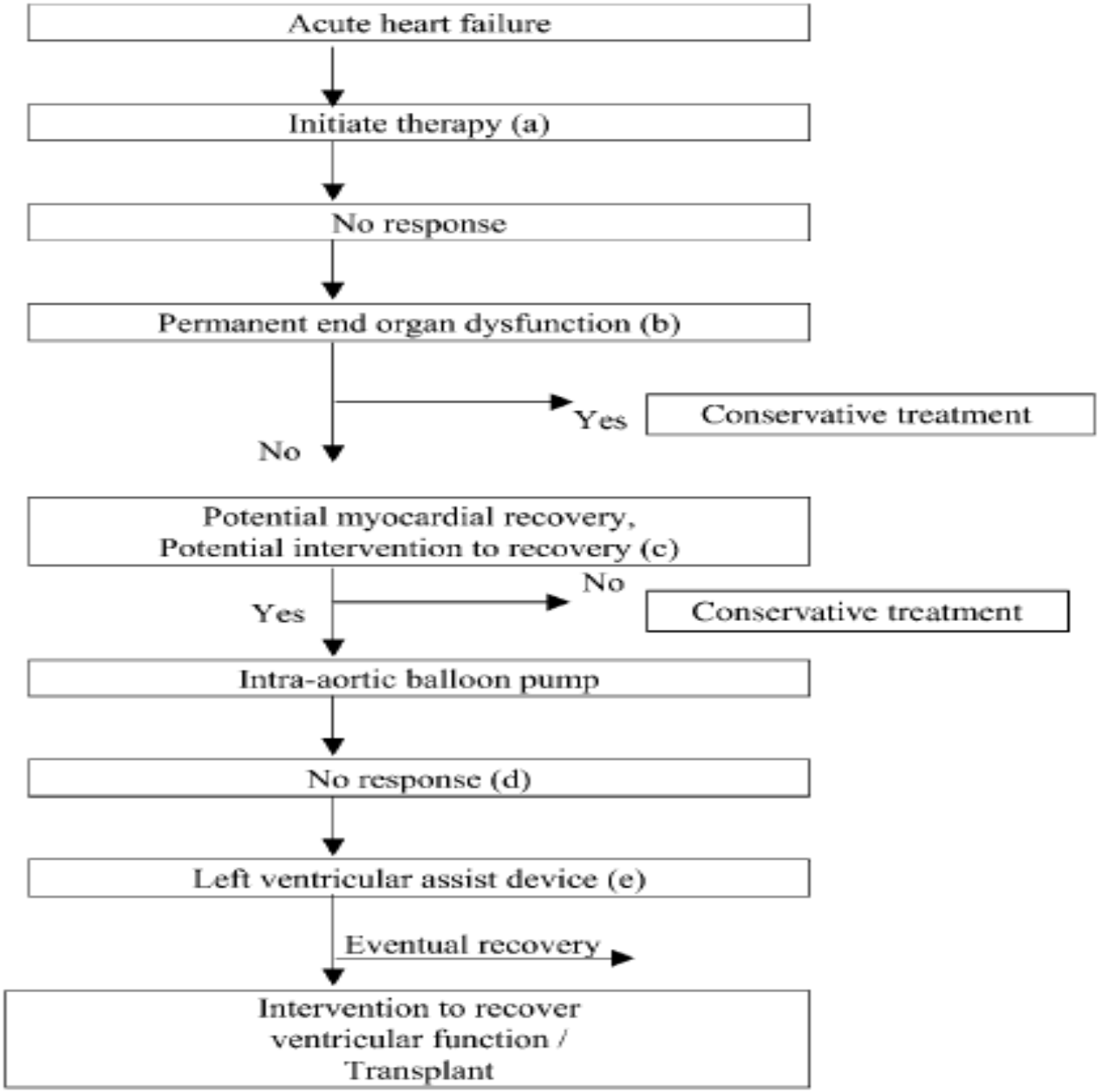
Heartmate II



Indications

- May be indicated to patients not responding to conventional Rx, when there is a potential for recovery or as a bridge to transplant

Who should get an assist device?



Major complications of assist device

- Bleeding
- Infection
- Neurologic events

Univentricular vs. Biventricular Assist Device Support

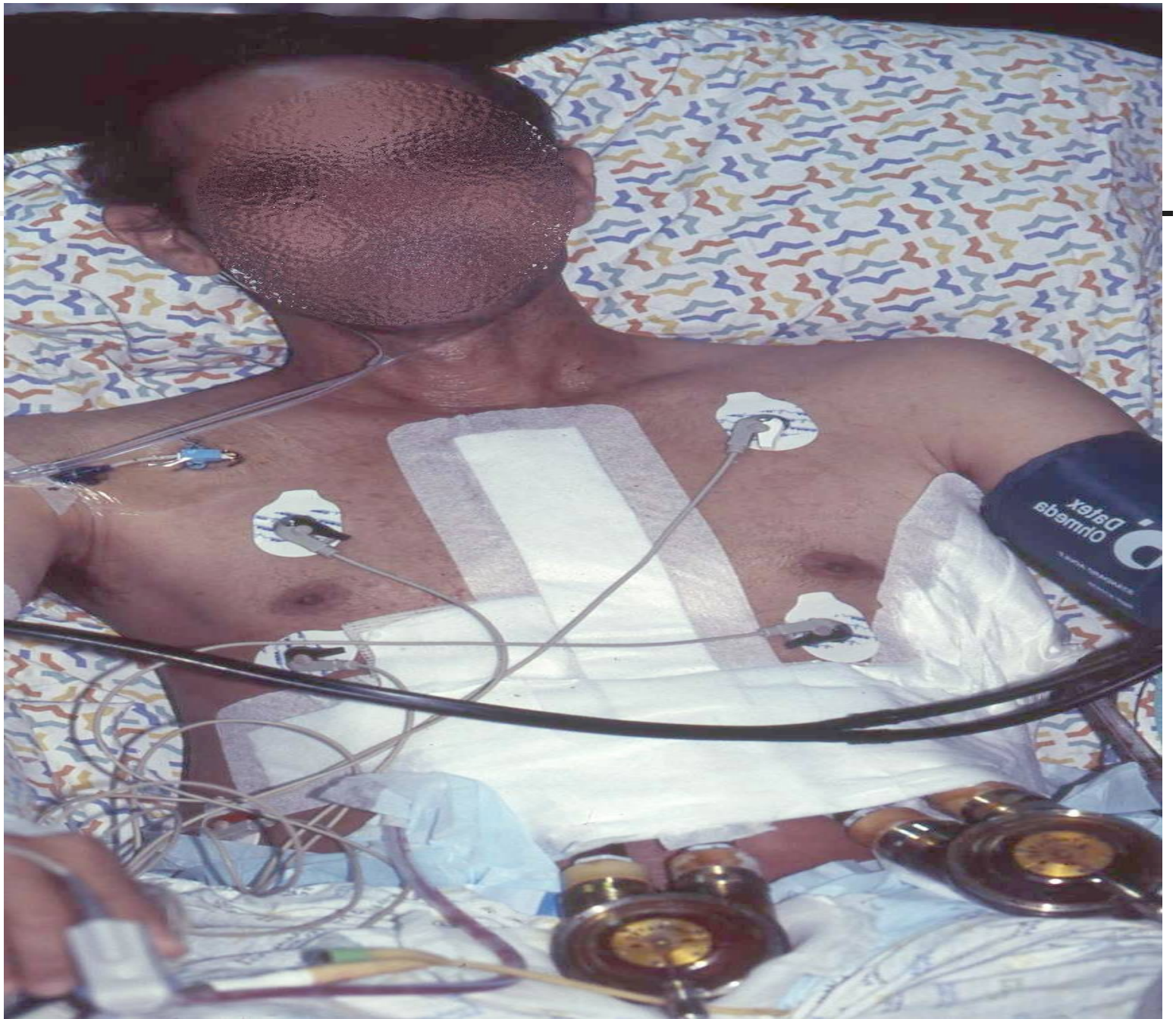
- *Indications for Biventricular Support*
  - Signs of Right Heart Failure
  - Intractable Arrhythmias
  - RV/Septal Infarction
  - Elevated PVR
  - Secondary Organ Involvement
  - Prolonged Cardiogenic Shock "Sicker Patients"

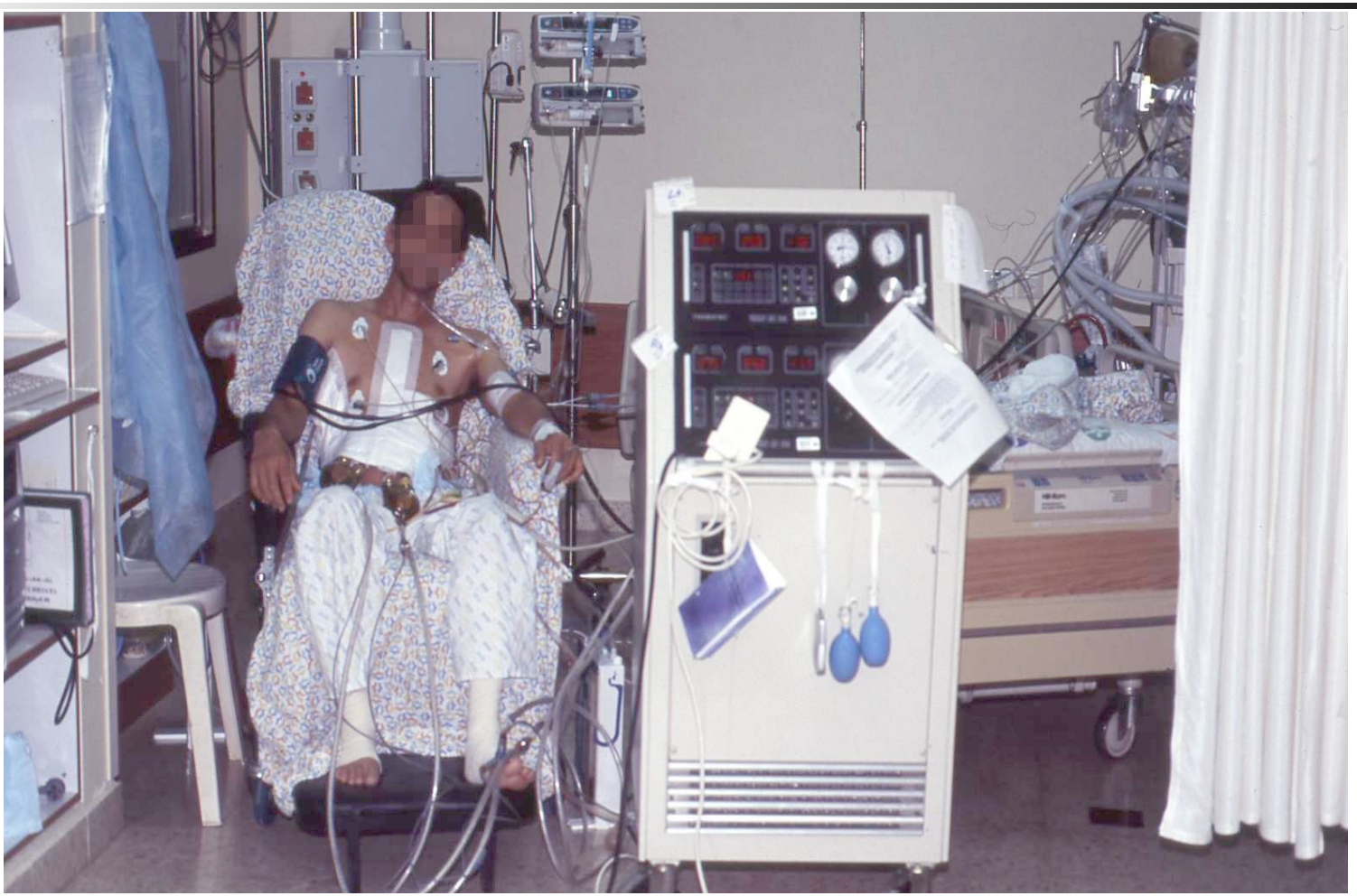
Patient's follow-up
BIVAD- Thoratec implantation

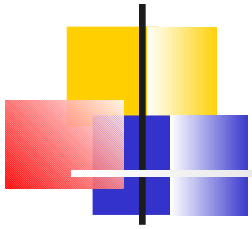
- Implantation of BIVAD
- Myocardial Biopsy- mild perivascular and interstitial fibrosis mild hypertrophic changes
- **Postoperative complications**:
- Revision due to bleeding and tamponade,
- Acute delirium and restlessness treated successfully with anti psychotics
- Sepsis d/t Klebsiella originating from surgical wound - resolved with broad-spectrum Abx

Survival with assist device in Israel

- During 2007 8 assist devices (7 BIVAD; 1 RVAD) were implanted in *Rabin Medical Center* and the *Sheba Medical Center*
- **Survival rate: 50 %**
- **Untill 9/2008 3** assist devices were implanted , of them only one (destination) survived







- After BIVD implantation, he is categorized as STATUS I, waiting for heart transplantation
- During this period he is mobile and even spends some time at home with the mobile BIVAD unit

Heart transplantation statistics during 2007/8 in Israel

- During 2007 15 patients (7 in Rabin Medical Center; 8 in Sheba Medical Center) underwent orthotrophic heart transplantation
- During 2008 7 pts underwent transplantation (3 kids)
- Survival rate: (86%) patients transplanted in Rabin Medical Center are alive, and in excellent condition

Heart transplantation

- 3 months after BIVAD implantation, while he is categorized as STATUS I, he underwent orthotropic heart transplantation
- Perioperative course – difficulties in hemostasis d/t warfarin Rx.
- Treatment with RATG and steroids followed by cellcept and takrolimus
- Postoperative course- no major complications, normal function of the transplanted heart

There is always an option for patients with severe decompensated heart failure

- Patients with acute decompensated heart failure should receive all evidence –based treatments (medical and mechanical) in order to maintain vital organ function
- After stabilization, patients should be transferred to tertiary centers specializing in assist device implantation and orthotropic heart transplantation

FIN