

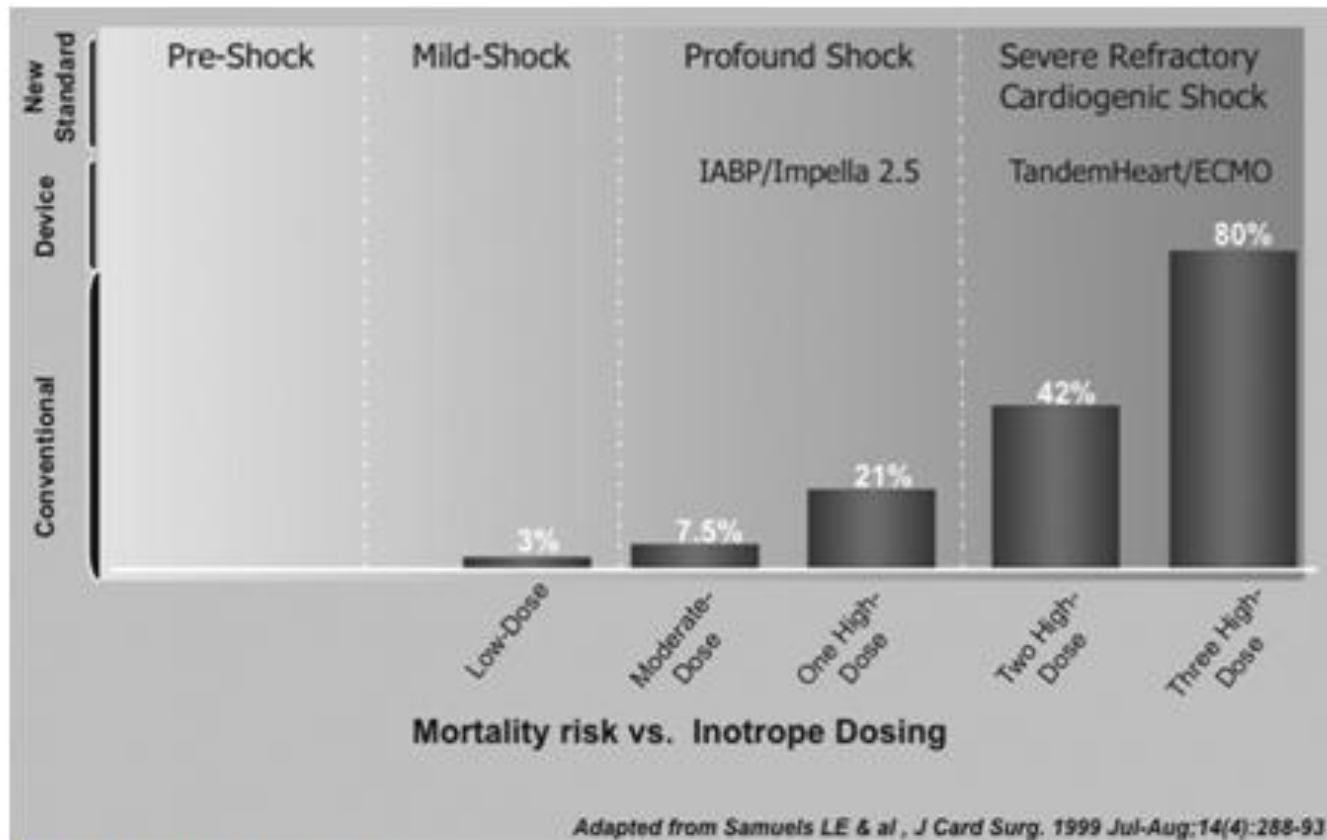
Cardiogenic Shock Due to Myocardial Infarction: Diagnosis, Monitoring and Treatment

Ass. Prof. Ta Manh Cuong, MD., PhD.,
*Head of the emergency and cardiac intensive care units
C1, Vietnam Heart Institute*

Introduction

- Infarction-related cardiogenic shock (ICS): usually due to left-ventricular pump failure.
- Mortality: 30-80% (ICS: most common cause of death from acute myocardial infarction AMI)

Clinical spectrum of cardiogenic shock.



Kar B et al. Circulation. 2012;125:1809-1817



Copyright © American Heart Association, Inc. All rights reserved.

- Guideline characterizes the current evidence-based treatment of ICS:
 - Early revascularization,
 - Treatment of shock,
 - Intensive care treatment of multi-organ dysfunction syndrome (MODS) if it arises.
 - The success or failure of treatment for MODS determines the outcome in ICS.
- Experts (German and Austrian) analyzed approximately 3600 publications:

Results

- Early revascularization (PCI): paramount importance.
- The medical treatment consists:
 - dobutamine
 - norepinephrine
 - levosimendan: addition to treat catecholamine-resistant shock.
 - IABP (+/-), ECMO
 - Optimal intensive-care interventions:
 - prevention and treatment of MODS,
 - ventilation, nutrition, erythrocyte-concentrate transfusion,
 - prevention of thrombosis and stress ulcers,
 - follow-up care, and rehabilitation.

Diagnosis and monitoring: initial phase

- A preliminary diagnosis of ICS:
 - ECG (“STEMI,” ST-segment elevation myocardial infarction) + clinical findings (“cardiogenic shock”) (recommendation ↑↑).
 - Even in the rare case of ICS following NSTEMI (no ST elevation): diagnose ICS on the basis of clinical criteria in a pts with ACS.

Diagnosis and monitoring: initial phase (cont.)

- The most important symptom of ICS:
 - SBP <90 mm Hg (at least 30 min + signs of reduced organ perfusion - ROP).
 - 1/4 ICS without initial hypotension: diagnosis rest on clinical signs of ROP (cold extremities, oliguria, altered mental status, e.g., agitation).

Revascularization

- Revascularization of the infarcted coronary artery:
performed as early as possible, usually by PCI.
- Initial cardiovascular and respiratory stabilization of the
PCS patient:
 - dobutamine/norepinephrine,
 - ventilation (respiratory failure)
 - adequate volume (right ventricular infarction)

Results of the SHOCK study: 30 day to 6 years survival rates of two groups

	Early revascularization	Conservative medical treatment
Primary endpoint Survival 30 days	56.0%	47.6% (p=0.11)
Secondary endpoint		
Survival 6 months	49.7%	36.9% (p=0.027)
Survival 12 months	46.7%	33.6% (p<0.04)
Survival 6 years	32.8%	19.6% (p=0.03)

N Engl J Med. 2012; 366:54-63
Arch Intern Med. 2005;165:1643–1650.
*Eur Heart J.*2008;29:2909–2945.

Revascularization (cont.)

- PCI on the coronary infarct artery: usually stent implantation + intensive use of platelet aggregation inhibitors.
- If PCI unsuccessful: surgery should be rapidly as possible.

Revascularization (cont.)

- Resuscitated patients form a special subgroup, which may make up as much as 30% of all ICS.
- Early PCI should be considered in rapidly defibrillated patients and mild hypothermia (12-24h).

Resuscitation.2010;81:1353–1363

Curr Opin Crit Care. 2010;16:216–222

Persistent shock after revascularization

- The goals of hemodynamic management if shock symptoms persist:
 - BP stabilization
 - Adequate organ perfusion
- Close invasive monitoring: BP, CO
- MAP: 65-75 mm Hg, CI: $>2.5 \text{ L} \times \text{min}^{-1} \times \text{m}^{-2}$, SVR: 800 to 1000 $\text{dyn} \times \text{s} \times \text{cm}^{-5}$, SvO₂ $>65\%$

Persistent shock (cont.)

- The cardiac power (product of cardiac output and mean arterial pressure as a measure of overall cardiac hydraulic performance) or cardiac power index ($CP > 0.6 \text{ W}$ or $CPI > 0.4 \text{ W} \times \text{m}^{-2}$) may be chosen instead of cardiac index.

European Journal of Heart Failure. 2003;5:443–451
Journal of the American College of
Cardiology. 2004;44:340–348
Crit Care Med. 2009;37:3017–3023

Which vasopressor and which inotrope?

- Norepinephrine: is the vasopressor of choice in patients with MAP < 65 mm Hg.
- The MAP can usually be effectively raised by intravenous infusion of 0.1 to 1 $\mu\text{g} \times \text{kg}^{-1} \times \text{min}^{-1}$.

- In the SOAP II study (1679 patients), norepinephrine showed a tendency to:
 - lower mortality than dopamine (28-day mortality 45.9% vs. 50.2%; OR 1.19; CI 0.98-1.44; $p = 0.07$)
 - significantly fewer arrhythmias (12.4% vs. 24.1%), especially atrial fibrillation.
- In the prospectively defined subgroup of ICS patients, norepinephrine treatment led to a significantly better survival rate than the dopamine treatment (OR 0.75; $p = 0.03$).

■ Dobutamine: inotrope of choice:

- Dose $2.5-10 \mu\text{g} \times \text{kg}^{-1} \times \text{min}^{-1}$:
- In a multicenter cohort observation study (1058 shock patients treated with catecholamines):
 - dopamine was an independent risk factor for mortality, while application of dobutamine or norpinephrine was not.

■ Levosimendan:

- ICS refractory to catecholamine treatment
- additional use
- loading dose $12\text{--}24\ \mu\text{g} \times \text{kg}^{-1}$ over 10 minutes,
- followed by $0.05\text{--}0.2\ \mu\text{g} \times \text{kg}^{-1} \times \text{min}^{-1}$)
- more than phosphodiesterase III inhibitors
(enoximone, milrinone)

Skepticism about intraortic balloon counterpulsation

- European and the American myocardial infarction guidelines regard the use of IABP as a class IIa recommendation (STEMI-SC).
- In ICS patients, however, the hemodynamic effects of IABP are moderate:
 - These results of the randomized controlled IABP SHOCK trial
 - Cochrane analysis of six randomized studies of a total of 190 ICS patients
 - Meta-analysis of 10 529 ICS patients from nine cohort studies:are confirmed by the negative results of a IABP

Crit Care Med. 2010;38:152–160

Cochrane Database Syst Rev. 2011CD007398

Eur Heart J. 2009;30:459–468

- The ICS patients PCI: no benefit from adjunctive IABP treatment (rather even showed an absolute increase in mortality of 6% (ARR +6%; RRR +15%))
- Only when used together with systemic fibrinolysis: + IABP lead to an 18% reduction in mortality (ARR -18%; RRR -26%)
- The German–Austrian guideline gives only a weak recommendation for the use of IABP in ICS patients treated with systemic fibrinolysis, and only “may” information for patients treated with PCI.

Catheter Cardiovasc Interv. 2010;75(Suppl 1):1–6
Am Heart J. 2012 in press
J Invasive Cardiol 2014;26(8):E109-E114

ECMO

(ExtraCorporeal Membrane Oxygenation)

- High mortality and frequent bleeding complications limited use in the 1970s and 1980s
- Now: veno-arterial ECMO for cardiogenic shock can be placed centrally
- Can be instituted quickly and provide full support
- A review of 10 patients with acute MI and cardiovascular collapse supported with ECMO showed a 40% long-term survival.
- The University of Pittsburgh: 33 patients with AMI-CS showed a 1-year survival rate of 64%.
- In another series: 27 patients with AMI-CS supported with ECMO, 59% survived to discharge
- A study of 20 patients with AMI-CS + ECMO: 50% survival to discharge.

Ventilation

- Mechanical ventilation of an ICS patient ensures oxygenation and relieves the heart of the work of breathing.
- Should be preferred in patients with ICS invasive ventilation
- The reasons: constant, stable ventilation conditions, avoidance of psychomotor excitement in the patient.
- The advantages of lung-protective ventilation should be made use of at the earliest possible moment
- The depth of analgesia/sedation should be recorded three times a day.

Intensive care

- Continuous intravenous insulin therapy with the aim of achieving normoglycemia (+/-)
- High blood glucose levels are unfavorable prognostic indicators in heart attack patients
- Recommendation in ICS patients: $G < 8.3 \text{ mmol} \times \text{L}^{-1}$.

Intensive care (cont.)

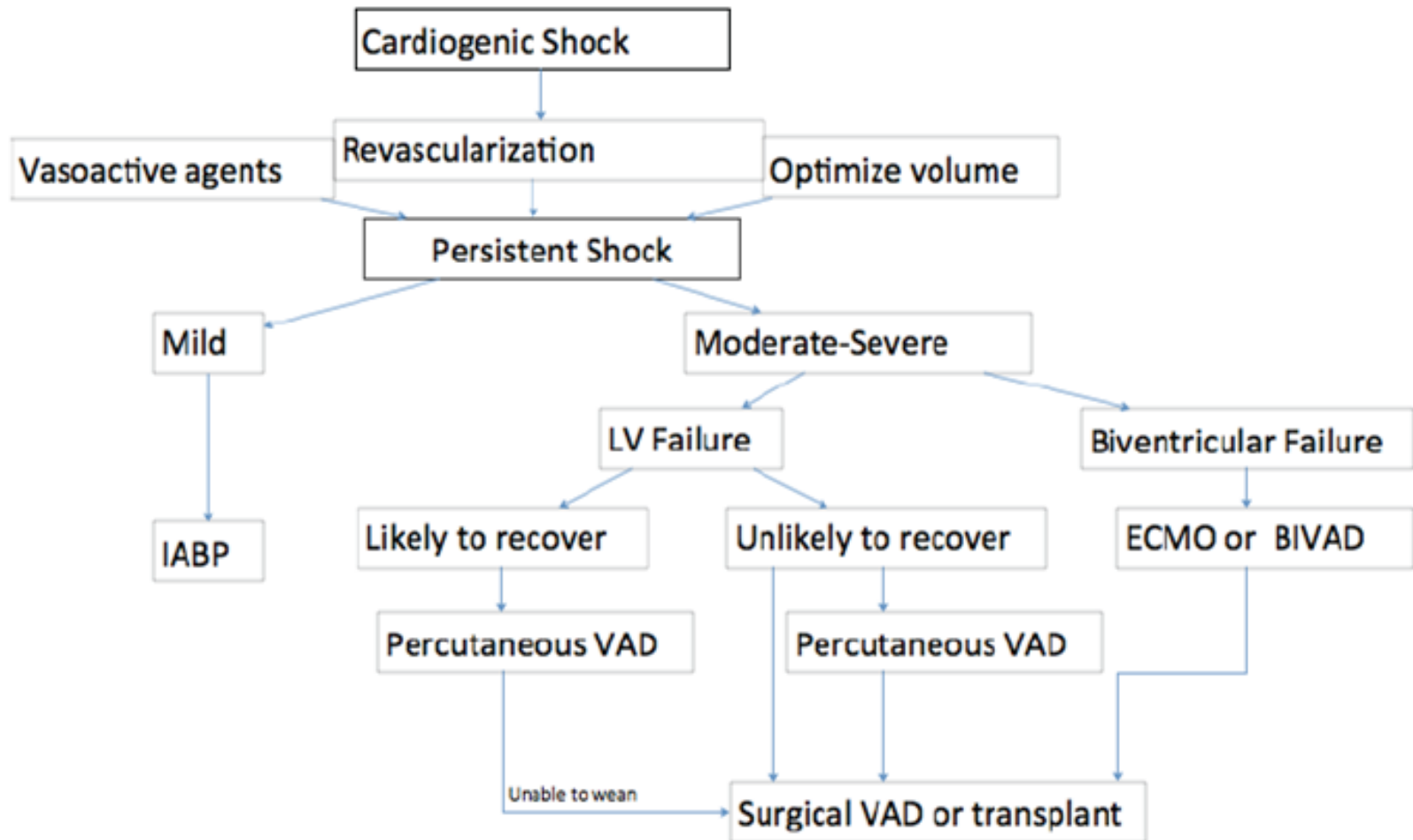
- The use of insulin–glucose–potassium infusions: should therefore not be used in ICS patients

Intensive care (cont.)

- At what Hb threshold value should intensive care patients receive red cell concentrates?
 - Red cell concentrates given from a Hb value $< 7.0 \text{ g} \times \text{dL}^{-1} / < 4.3 \text{ mmol} \times \text{L}^{-1}$ or hematocrit $< 25\%$.
 - Target values are Hb $7.0\text{-}9.0 \text{ g} \times \text{dL}^{-1} / 4.3 \text{ to } 5.6 \text{ mmol} \times \text{L}^{-1}$ or hematocrit $> 25\%$
 - In older patients (> 75 years), Ht $> 30\%$.
- Mandatory measures are thrombosis, stress ulcer prophylaxis (heparin, PPI).

Recommendations for aftercare/rehabilitation

- Inpatient rehabilitation lasting usually about 3 to 4 weeks should be aimed at if possible, because of the severity of the infarction event.



- A retrospective study analyzed 138 patients with AMI-CS, all of whom who received intensive medical therapy and IABP:
 - 43 patients were treated with intensive medical therapy,
 - 77 were treated with PCI or CABG,
 - 18 were treated with circulatory support with VAD/ECMO or transplant, in-hospital mortality:
 - The circulatory support/transplant group: 33%
 - The revascularization group: 63%
 - The medical therapy group: 81%.
 - Five-year survival for the VAD/ECMO/heart transplant group: 63%; the revascularization group: 21%, the intensive therapy group: 6%.

Thanks for your attention!

