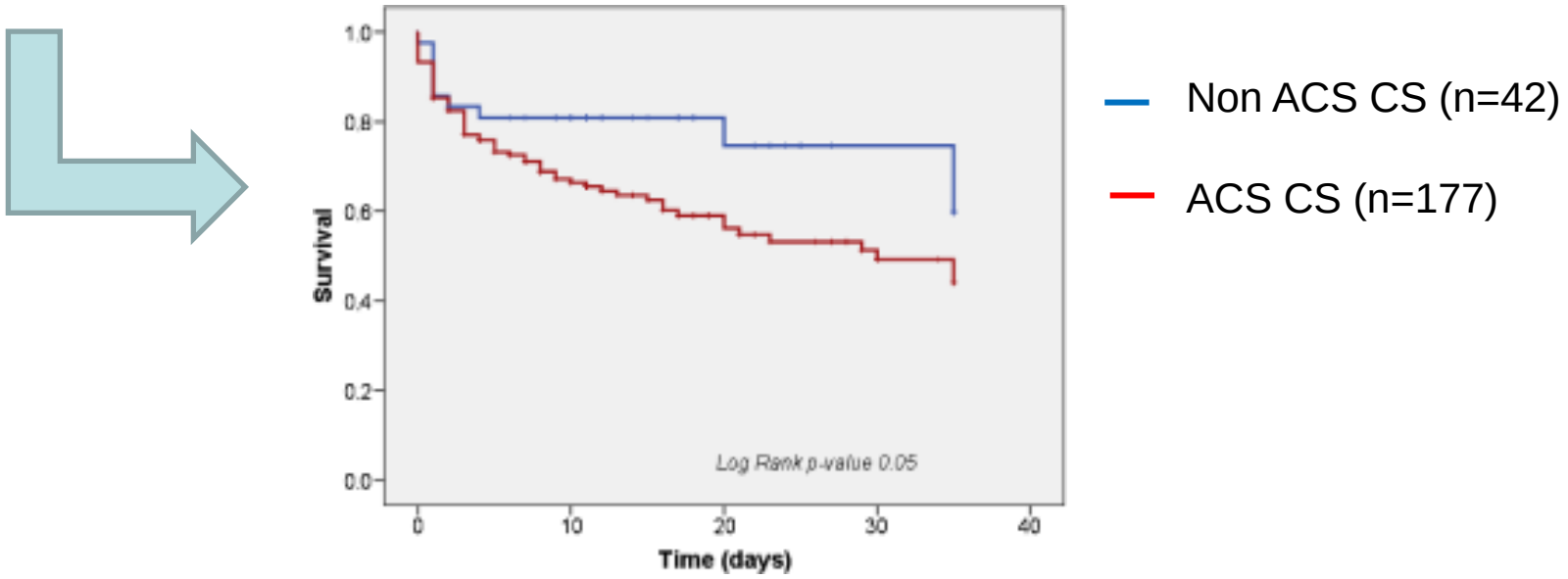
SHOCK CARDIOGÈNIC

Paula Poveda
Unitat Coronària

EPIDEMIOLOGIA

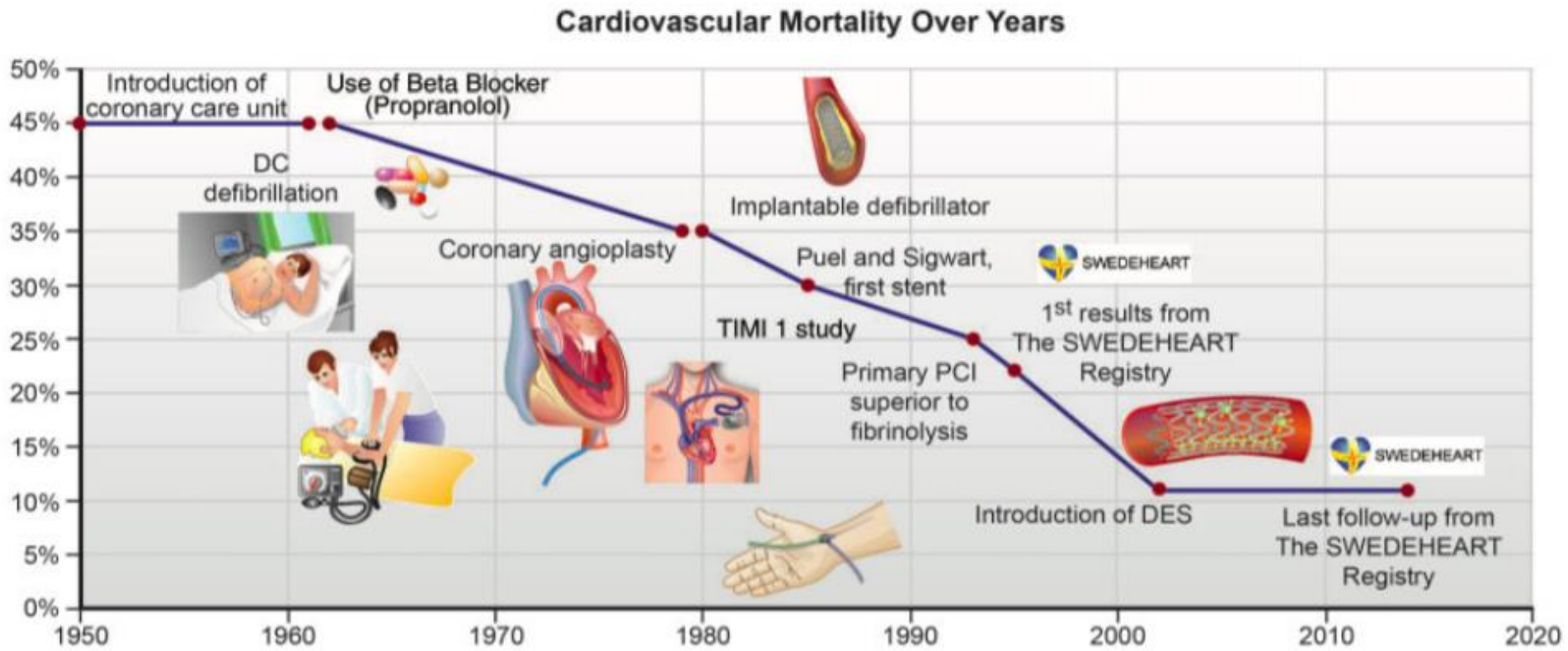
- ↓ Cabal cardíac → ↓ perfusió orgànica + hipòxia
- IAM + disfunció ventricular: 80% dels casos. Incidència 5-8% dels IAM
- Alta mortalitat (40-50% post IAM)
- No gaire informació sobre altres etiologies de xoc cardiogènic



Harjola VP et al. Clinical picture and risk prediction of short-term mortality in cardiogenic shock. Eur J Heart Fail. 2015;17:984

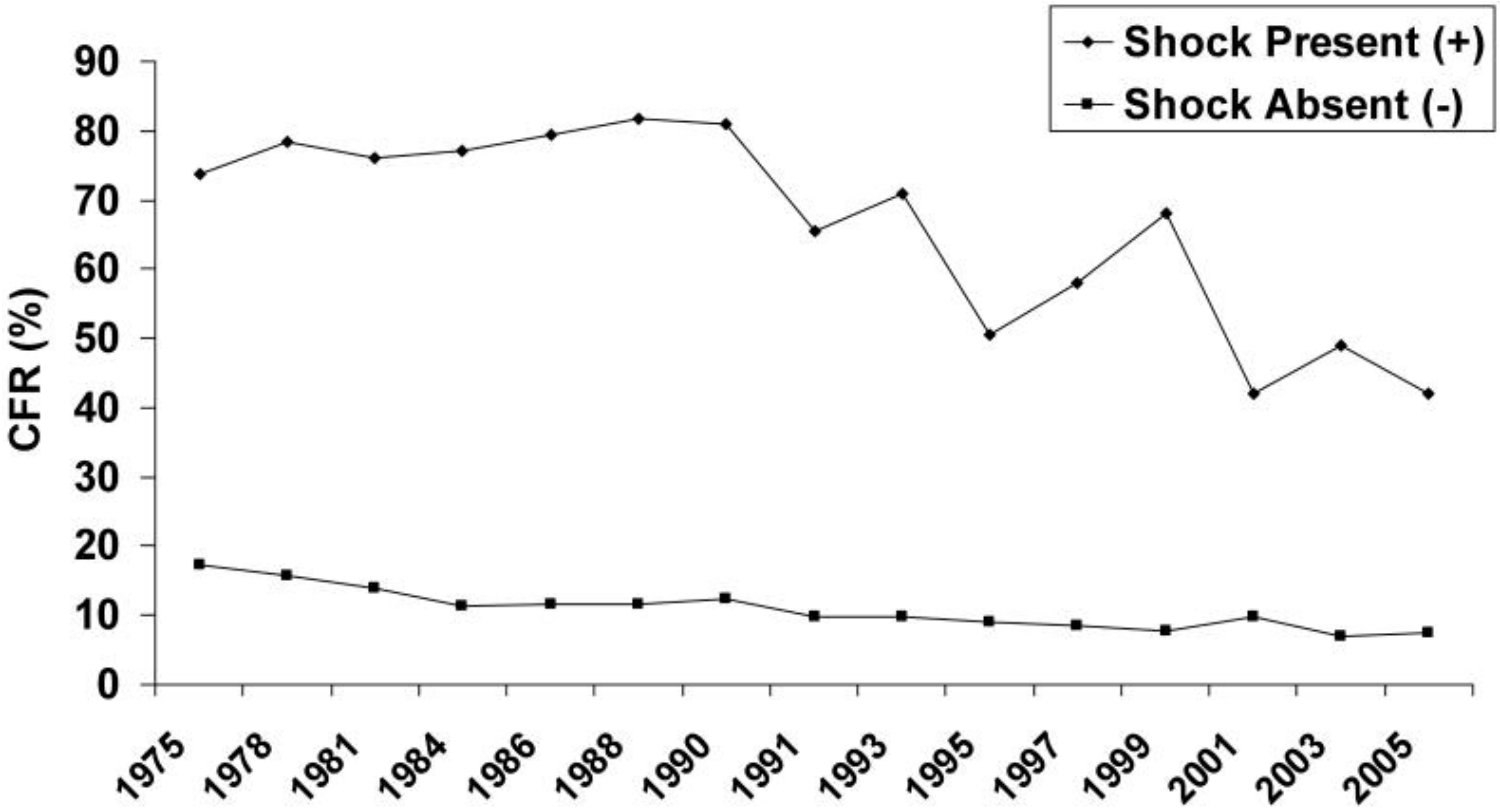
EPIDEMIOLOGIA

- Disminució de la mortalitat per IAM durant els últims anys



Lüscher TF and Obeid S. From Eisenhower's heart attack to modern management: a true success story! *Eur Heart J* 2017; 38(41): 3066-3069

EPIDEMIOLOGIA

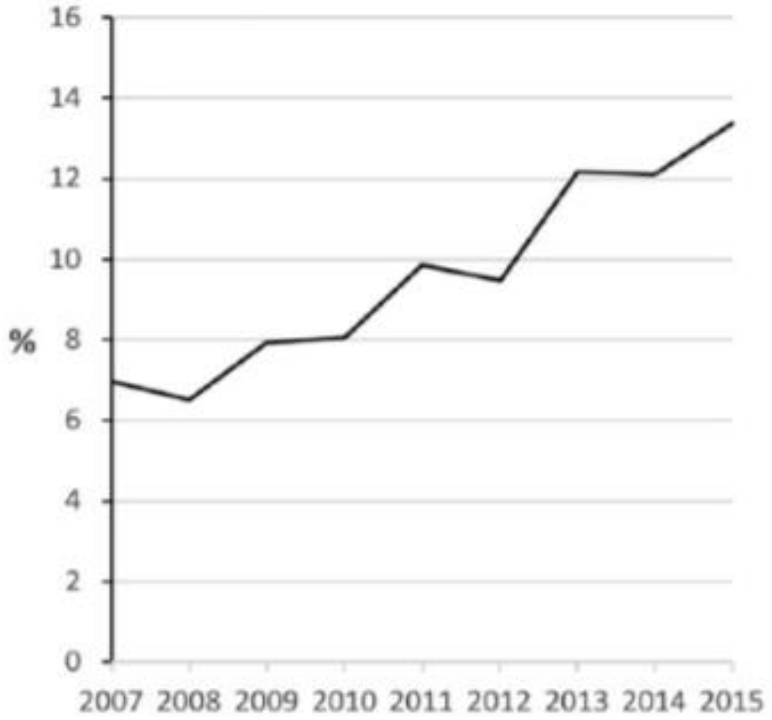


Goldberg et al. *Circulation*. 2009; 119: 1211–9

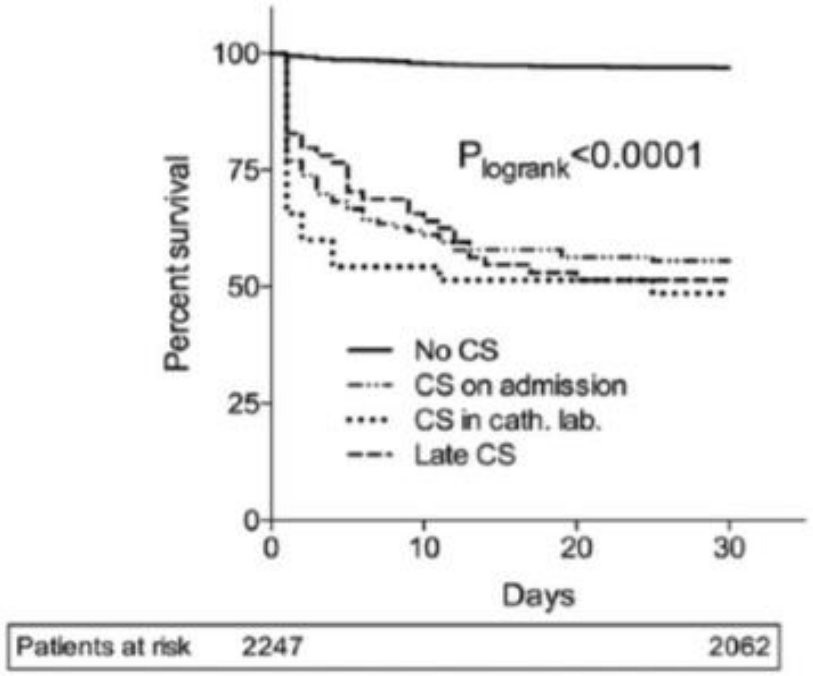
EPIDEMIOLOGIA

- Augment de la incidència: pacients més crítics i d'edat avançada (xarxes de Codi IAM, RCP més efectiva)
- Major mortalitat 48h
- Persisteix alta mortalitat independentment del moment d'aparició

Incidence



Mortality



Vrints C. Cardiogenic shock: the next frontier in acute cardiovascular care! European Heart Journal: Acute Cardiovascular Care 2018, Vol. 7(1) 3–6

DEFINICIÓ

- Diferent segons la font, clínica vs paràmetres hemodinàmics

Clinical Definition	SHOCK Trial[9]*	IABP-SHOCK II[1]†	ESC HF Guidelines[15]
Cardiac disorder that results in both clinical and biochemical evidence of tissue hypoperfusion	Clinical criteria: SBP <90 mm Hg for ≥30 min OR Support to maintain SBP ≥90 mm Hg AND End-organ hypoperfusion (urine output <30 mL/h or cool extremities) Hemodynamic criteria: CI of ≤2.2 L·min^{-1}·m^{-2} AND PCWP ≥15 mm Hg	Clinical criteria: SBP <90 mm Hg for ≥30 min OR Catecholamines to maintain SBP >90 mm Hg AND Clinical pulmonary congestion AND Impaired end-organ perfusion (altered mental status, cold/clammy skin and extremities, urine output <30 mL/h, or lactate >2.0 mmol/L)	SBP <90 mm Hg with adequate volume and clinical or laboratory signs of hypoperfusion Clinical hypoperfusion: Cold extremities, oliguria, mental confusion, dizziness, narrow pulse pressure Laboratory hypoperfusion: Metabolic acidosis, elevated serum lactate, elevated serum creatinine

Van Diepen et al. Contemporary Management of Cardiogenic Shock. Circulation. 2017;136:00–00

- Systolic blood pressure <90 mmHg >30 min or vasopressors required to achieve ≥90 mmHg
- Pulmonary congestion or elevated LV filling pressures (e.g. PCWP >18 mmHg)
- Signs of impaired organ perfusion with at least one of the following criteria:
  - **a)** Altered mental status
  - **b)** Cold, clammy skin and extremities
  - **c)** Oliguria with urine output <30 mL/hour
  - **d)** Serum lactate >2.0 mmol/L
- Reduced cardiac index (<1.8 L/min/m^2 without support, and 2.0–2.2 L/min/m^2 with support) (optional)

Thiele H, Zeymer U. Cardiogenic shock in patients with acute coronary syndromes. En Tubaro M, Vranckx P, Price S, Vrints C. The ESC Textbook of Intensive and Acute Cardiovascular Care. 2n Ed. Online

CAUSES

Supplemental Table 1: Etiologies of cardiogenic shock

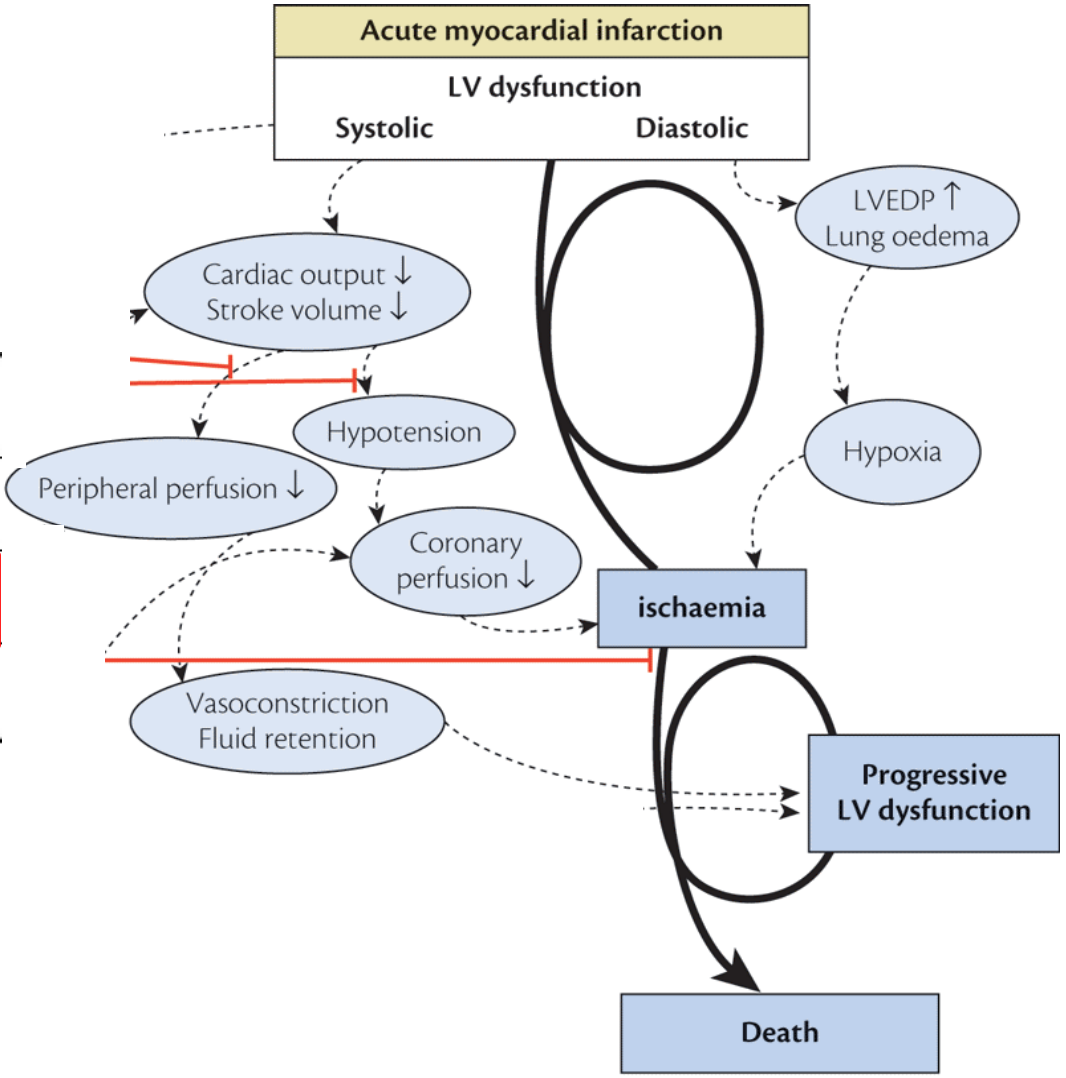
Myocardial
I. Acute myocardial infarction
a. >40% loss of left ventricular mass
b. <40% loss of left ventricular mass with arrhythmia or vasodilation
c. Right ventricular infarction
d. Mechanical complication
i. Papillary muscle rupture
ii. Ventricular septal rupture
iii. Free wall rupture
II. Acute decompensated heart failure
a. Chronic heart failure (established etiology) with decompensation
b. Acute heart failure first presentation
i. Chronic ischemia
ii. Dilated cardiomyopathy
iii. Myocarditis
iv. Stress induced cardiomyopathy (Takotsubo)
v. Pregnancy associated heart disease
- Peri-partum cardiomyopathy
- Coronary artery dissection
vi. Endocrine disorders (hypo/hyperthyroidism, pheochromocytoma)
III. Post-cardiotomy shock
a. Prolonged cardiopulmonary bypass
b. Insufficient cardioprotection
IV. Dynamic outflow tract obstruction
V. Post cardiac arrest stunning
VI. Myocardial depression in setting of septic shock or SIRS
VII. Myocardial contusion

Valvular
I. Native valve
a. Stenosis
b. Acute regurgitation
c. Valvular obstruction
II. Prosthetic valve
a. Valve obstruction
b. Leaflet failure or restriction
c. Mechanical failure
d. Valve dehiscence
Electrical
I. Atrial arrhythmia with rapid ventricular rate
II. Ventricular tachycardia
III. Bradycardia
Extra-cardiac/Obstructive
I. Cardiac tamponade
II. Constriction
III. Pulmonary embolism
Other
I. Toxidromes
II. Hypothermic myocardial depression

Van Diepen et al. Contemporary Management of Cardiogenic Shock. Circulation. 2017;136:00–00

FISIOPATOLOGIA

Red arrow indicates primary abnormality	PCWP (preload)	Cardiac Output	SVR (afterload)
Hypovolemic shock	↓	↑	↑
Cardiogenic shock	↑	↓	↑
Distributive shock (septic, neurogenic)	↓	↑	↓



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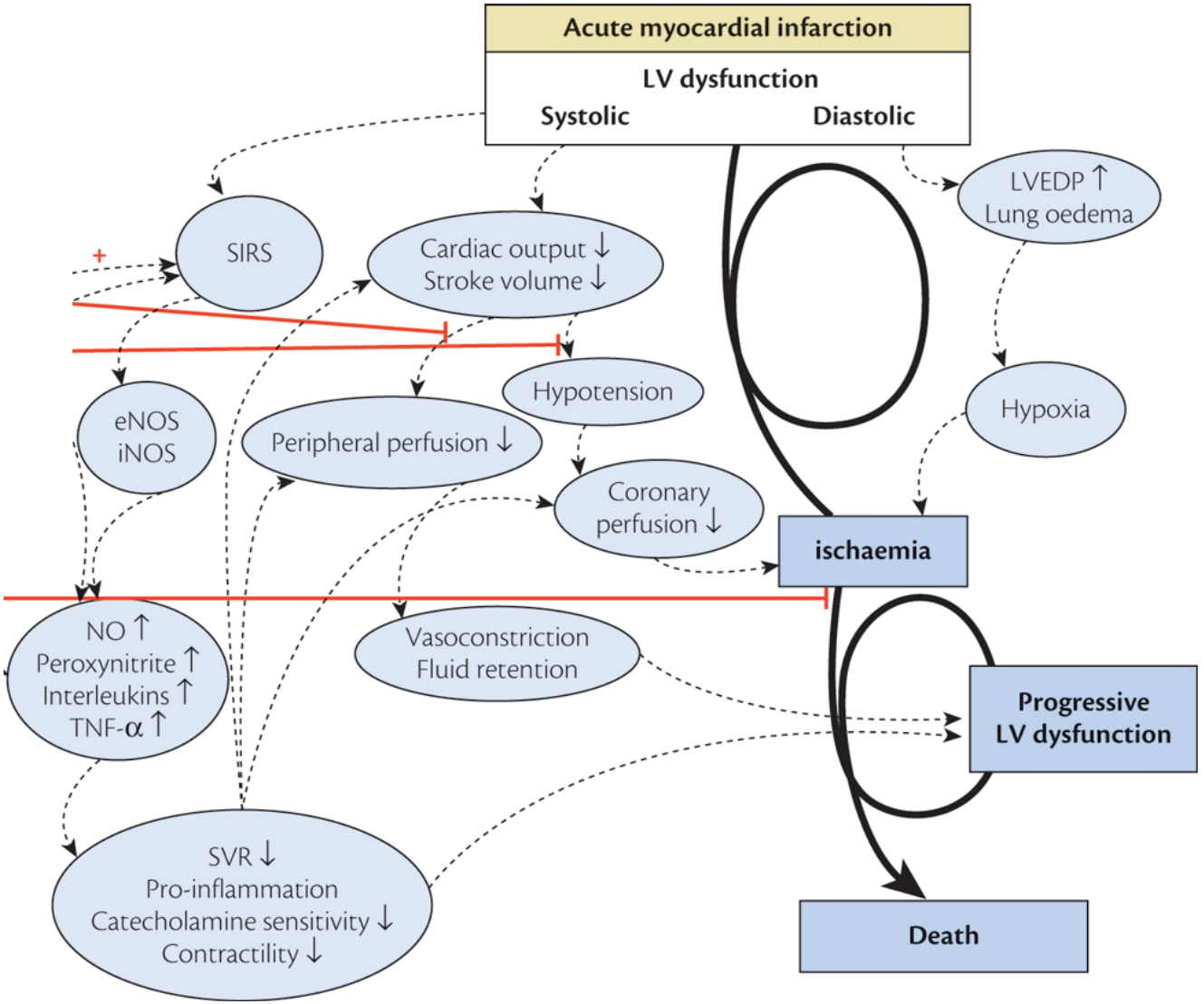
FISIOPATOLOGIA



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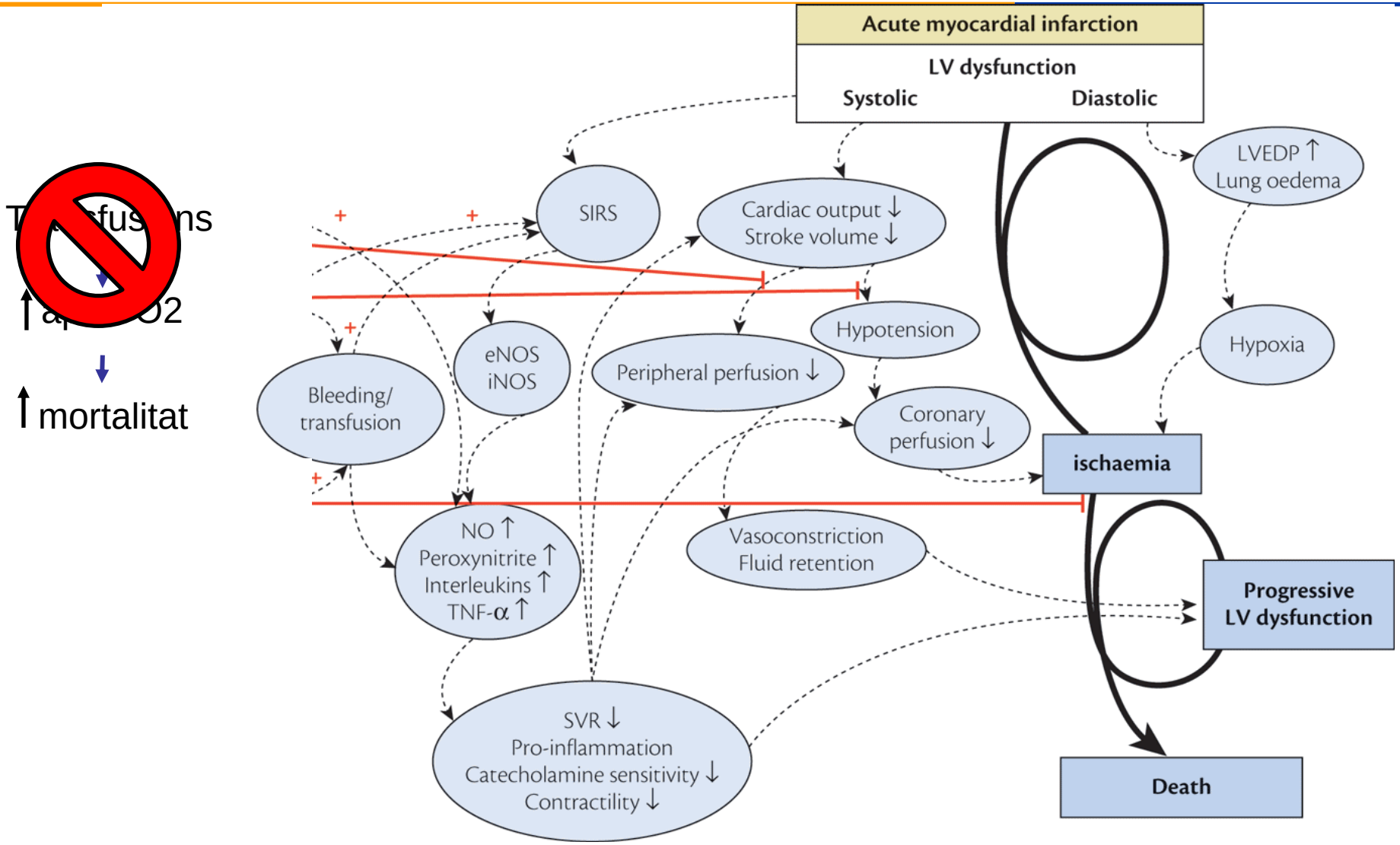

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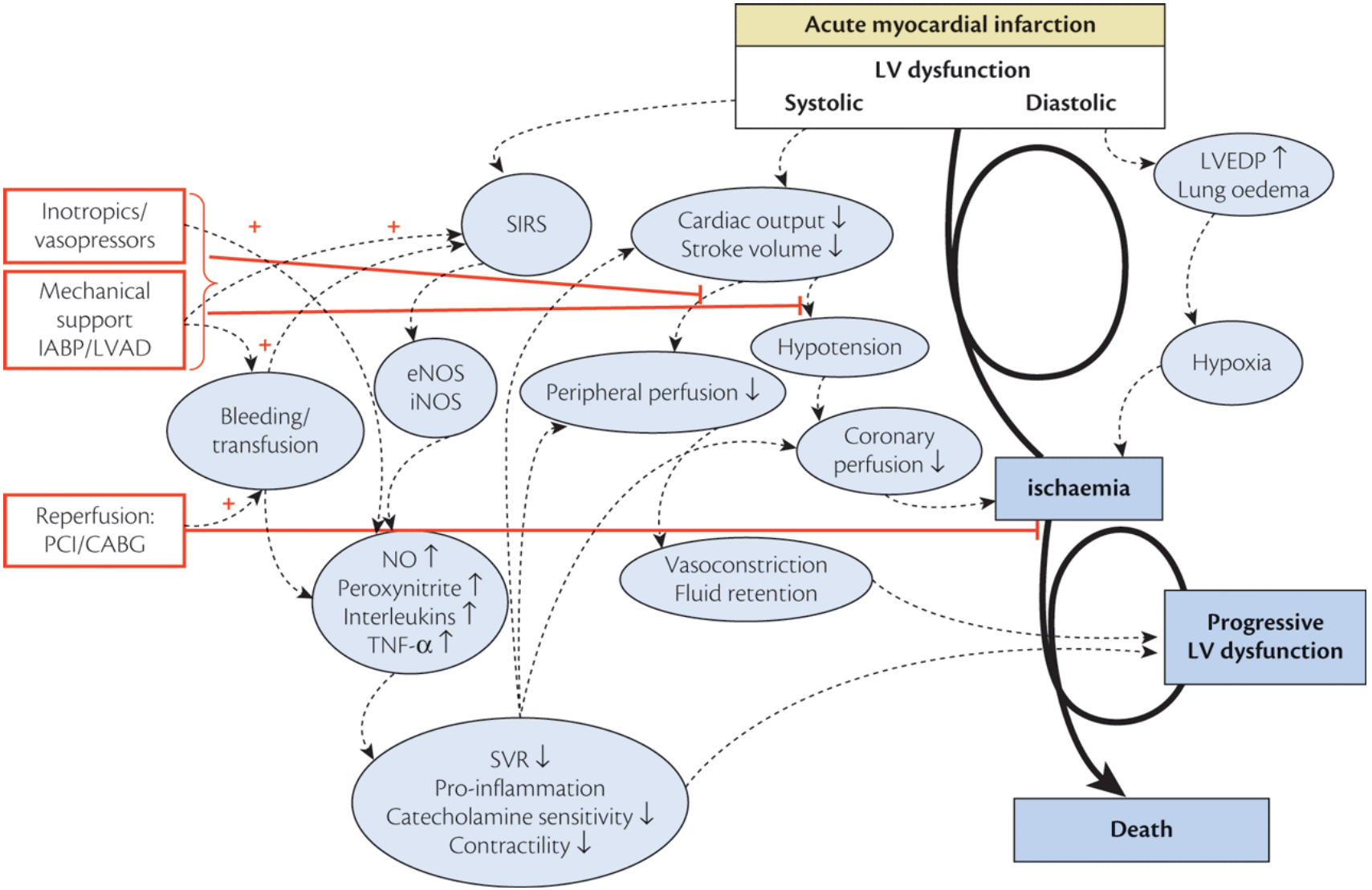
FISIOPATOLOGIA



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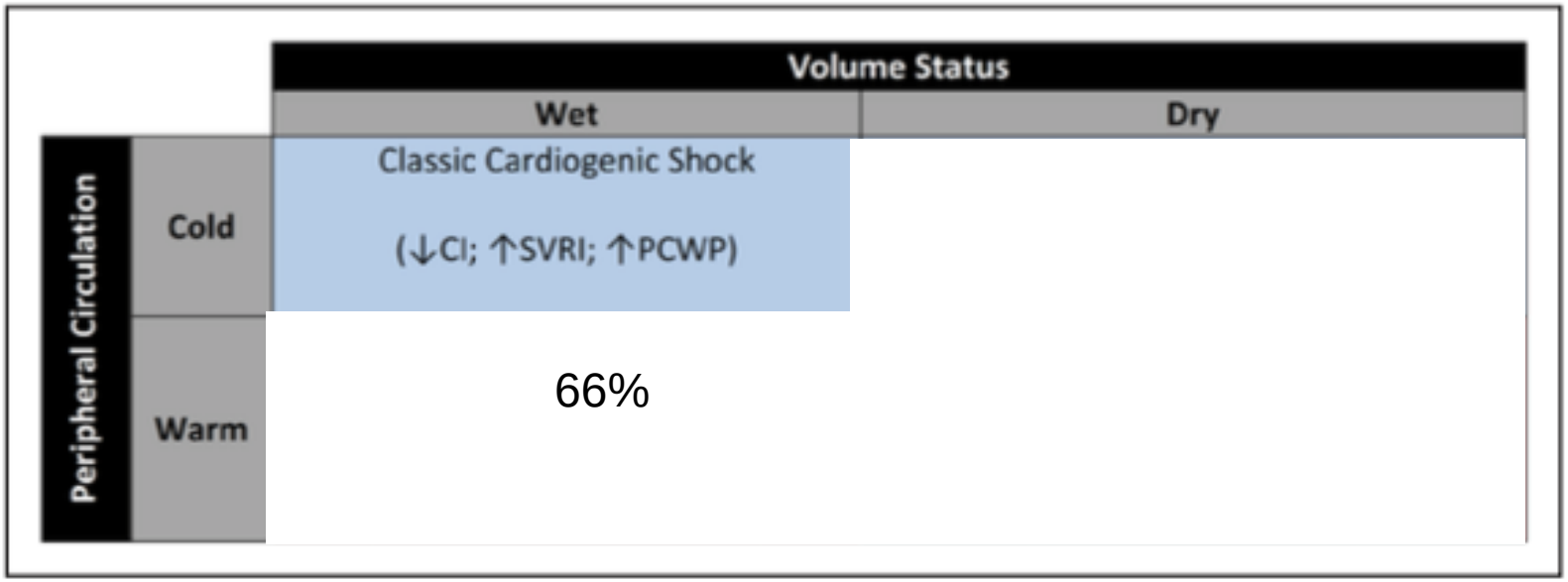
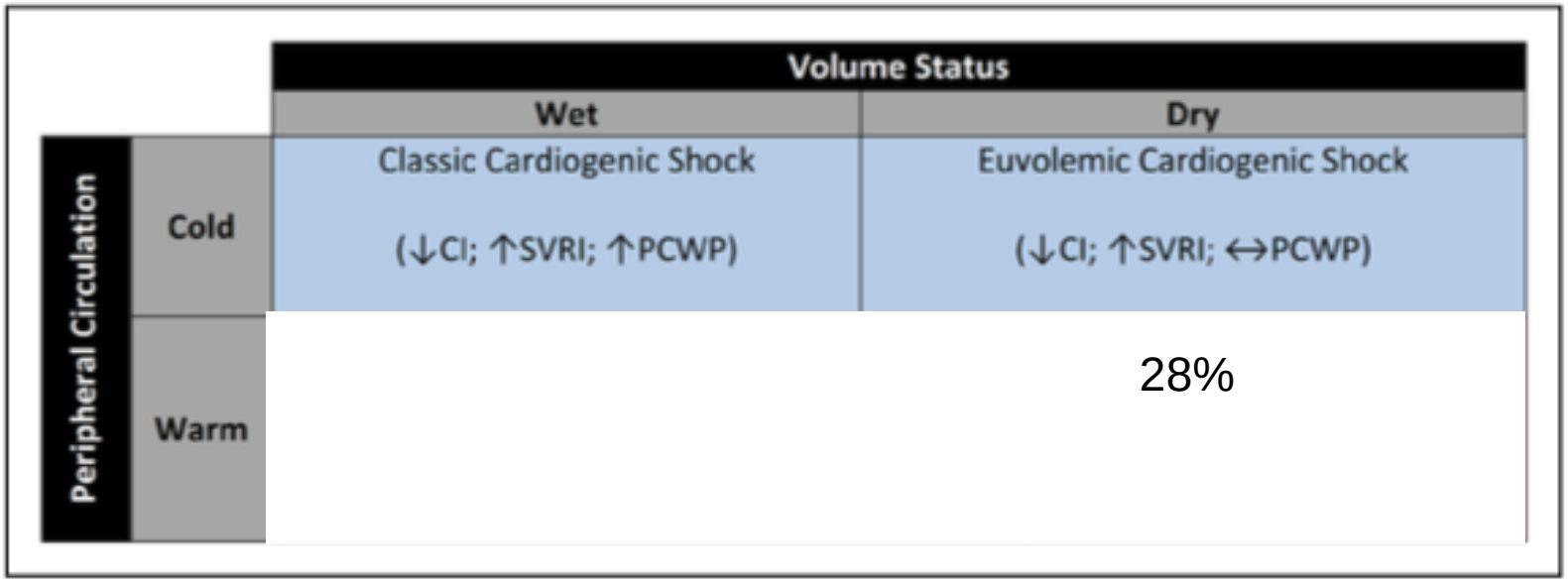
PATRONS HEMODINÀMICS



PATRONS HEMODINÀMICS



- SC normotensiu (5%): IC, PCP i FEVI =, ↑ RVS
- SC de VD (5%): IC i PCP =, ↑ FEV i PVC

MANEIG INICIAL

- Analítica: general (funció renal, coagulació), perfil hepàtic (fetge de xoc), GSA (control O2, pH), GSV (SvO2), lactat (↑ mortalitat), TnT (necrosi miocàrdica, mismatch eco/TnT)
- Rx de tòrax (CMG, IC, DissAo, pneumotòrax)
- ECG (IAMEST, IAMSEST, TEP
- Ecocardiograma (FEVI, etiologia)

Immediate Doppler echocardiography is indicated to assess ventricular and valvular functions, loading conditions, and to detect mechanical complications.	I	C
It is indicated that mechanical complications are treated as early as possible after discussion by the Heart Team.	I	C
Oxygen/mechanical respiratory support is indicated according to blood gases.	I	C

MONITORITZACIÓ

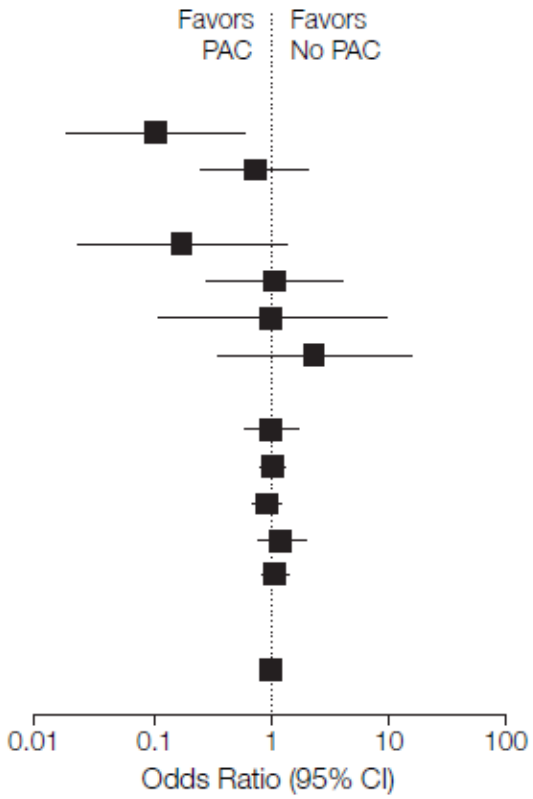
- Via arterial
- \
- (

Invasive blood pressure monitoring with an

I	C
IIb	B

Figure 2. Odds Ratio (PAC vs No PAC) for Mortality of RCTs Evaluating the Safety and Efficacy of the PAC

Source	No. of Deaths/ Total No. of Patients: PAC	No. of Deaths/ Total No. of Patients: No PAC	Odds Ratio (95% CI)
Schultz et al,[15] 1985	1/35	10/35	0.11 (0.02-0.63)
Shoemaker et al,[16] 1988	11/58	7/30	0.76 (0.27-2.15)
Isaacson et al,[17] 1990	1/49	0/53	NA
Berlauk et al,[18] 1991	1/66	2/21	0.18 (0.02-1.42)
Guyatt,[19] 1991	10/16	9/17	1.10 (0.29-4.22)
Bender et al,[20] 1997	1/51	1/53	1.04 (0.11-9.95)
Valentine et al,[21] 1998	3/60	1/60	2.38 (0.35-16.29)
Bonazzi et al,[22] 2002	0/50	0/50	NA
Rhodes et al,[23] 2002	46/95	50/106	1.01 (0.58-1.76)
Sandham et al,[24] 2003	163/997	155/997	1.06 (0.83-1.35)
Richard et al,[25] 2003	199/338	208/343	0.93 (0.68-1.26)
ESCAPE,[10] 2005	45/215	38/218	1.25 (0.78-2.02)
Harvey et al,[14] 2005 (PAC-Man)	346/506	333/507	1.13 (0.87-1.47)
Combined			1.04 (0.90-1.20)



Shah MR, Hasselblad V, Stevenson LW, Binanay C, O'Connor CM, Sopko G, et al. Impact of the pulmonary artery catheter in critically ill patients. Meta-analysis of randomized clinical trials. *JAMA*. 2005; 294: 1664–70

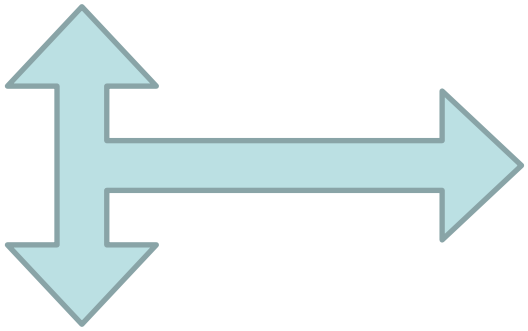
MONITORITZACIÓ

- Via arterial
- Via central per PVC i SvO2 (opcional)
- Catèter Swan-Ganz?
- Monitorització no invasiva per ecocardiograma?

Invasive blood pressure monitoring with an arterial line is recommended.	I	C
Haemodynamic assessment with pulmonary artery catheter may be considered for confirming diagnosis or guiding therapy.[433]	IIb	B

TRACTAMENT – REVASCULARITZACIÓ

- Si isquèmia → Cateterisme URGENT



SHOCK TRIAL (1999)

152 revascularització precoç vs 150 tt mèdic

Sense ≠ en mortalitat a 30d

Sí ≠ als 6m, 3 a i 6 a. NNT estimat 8

PCI = CABG

66% ACTP simple vs 34% stent

Recommendations for the management of cardiogenic shock in ST-elevation myocardial infarction

Recommendations	Class[a]	Level[b]
Immediate PCI is indicated for patients with cardiogenic shock if coronary anatomy is suitable. If coronary anatomy is not suitable for PCI, or PCI has failed, emergency CABG is recommended.[248]	I	B
Fibrinolysis should be considered in patients presenting with cardiogenic shock if a primary PCI strategy is not available within 120 min from STEMI diagnosis and mechanical complications have been ruled out.	IIa	C
Complete revascularization during the index procedure should be considered in patients presenting with cardiogenic shock.	IIa	C

TRACTAMENT – REVASCULARITZACIÓ… COMPLERTA?

Recommendations for the management of cardiogenic shock in ST-elevation myocardial infarction

Recommendation		
Immediate PCI is indi cardiogenic shock if c suitable. If coronary a for PCI, or PCI has fa is recommended.[248]		
Fibrinolysis should be presenting with cardi mary PCI strategy is r 120 min from STEMI cal complications hav		
Complete revascularization during the index procedure should be considered in patients presenting with cardiogenic shock.	IIa	C

Primary PCI should be limited to the culprit vessel with the exception of cardiogenic shock and persistent ischaemia after PCI of the supposed culprit lesion.	IIa	B	75, 103–105

TRACTAMENT – REVASCULARITZACIÓ… COMPLERTA?

Consideració fisiopatològica

↑ aport O2

⇩

Millora funció ventricular i hemodinàmica

Complete revascularization during the index procedure should be considered in patients presenting with cardiogenic shock.	IIa	C

Multivessel versus culprit lesion only percutaneous coronary intervention in cardiogenic shock complicating acute myocardial infarction: A systematic review and meta-analysis

Suzanne de Waha[1,2], Alexander Jobs[1,2], Ingo Eitel[1,2], Janine Pöss[1,2], Thomas Stiermaier[1,2], Roza Meyer-Saraei[1,2], Georg Fuernau[1,2], Uwe Zeymer[3], Steffen Desch[1,2] and Holger Thiele[1,2,4]

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1–10
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TRACTAMENT – REVASCULARITZACIÓ… COMPLERTA?

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Complete revascularization during the index procedure should be considered in patients presenting with cardiogenic shock.	IIa	C

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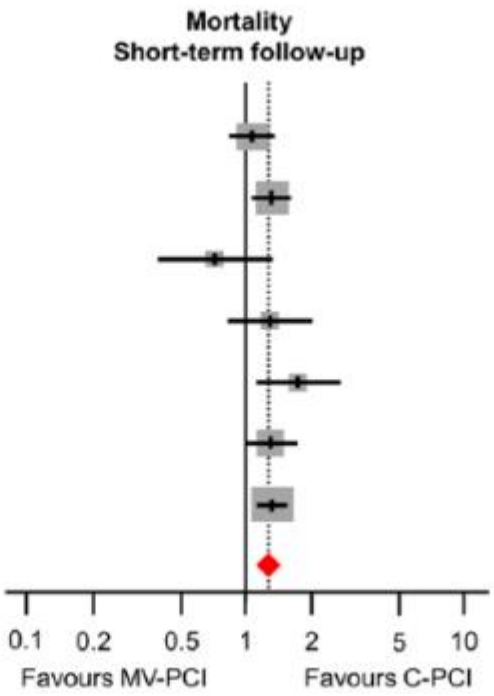
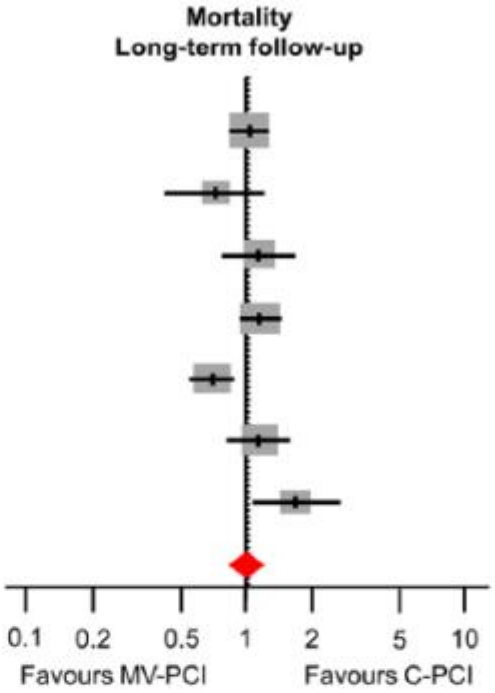
	MV-PCI		C-PCI		RR	95%CI	Weight
	Events	Total	Events	Total			
IABP-SHOCK II	75	167	119	284	1.07	[0.86-1.33]	18.5%
ALKK	81	173	201	562	1.31	[1.08-1.33]	21.1%
KAMIR	13	124	56	386	0.72	[0.41-1.28]	3.9%
Yang et al.	19	60	68	278	1.29	[0.85-1.98]	6.6%
Cavender et al.	20	43	42	156	1.73	[1.14-2.61]	7.0%
EHS-PCI	40	82	95	254	1.30	[0.99-1.71]	13.5%
NCDR	158	433	737	2654	1.31	[1.14-1.51]	29.3%
Overall	**406**	**1082**	**1318**	**4574**	**1.26**	**[1.12-1.41]**	**100%**

Heterogeneity: τ^2=0.007, I^2=31.0%, p=0.19
Test for overall effect: p=0.001



	MV-PCI		C-PCI		RR	95%CI	Weight
	Events	Total	Events	Total			
IABP-SHOCK II	91	167	149	284	1.04	[0.87-1.24]	19.3%
KAMIR	16	124	69	386	0.72	[0.43-1.19]	9.0%
Yang et al.	21	60	85	278	1.14	[0.78-1.69]	12.0%
Cavender et al.	32	43	101	156	1.15	[0.93-1.42]	18.1%
Mylotte et al.	37	66	82	103	0.70	[0.56-0.89]	17.2%
van der Schaaf et al.	22	37	66	124	1.12	[0.82-1.53]	14.3%
SHOCK	7	9	26	57	1.71	[1.09-2.67]	10.3%
Overall	**226**	**506**	**578**	**1387**	**1.03**	**[0.85-1.25]**	**100%**

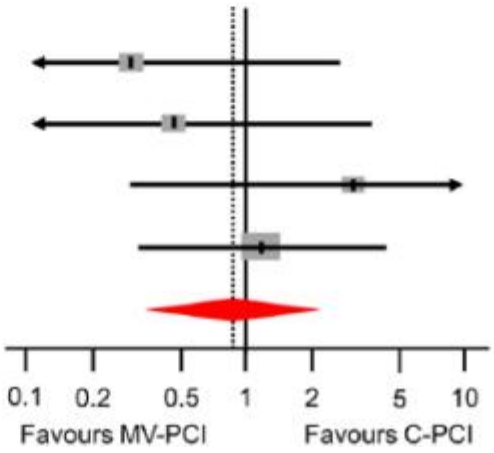
Heterogeneity: τ^2=0.043, I^2=67.8%, p=0.005
Test for overall effect: p=0.77



(b)

	MV-PCI		C-PCI		RR	95%CI	Weight
	Events	Total	Events	Total			
IABP-SHOCK II	1	92	6	162	0.29	[0.04-2.40]	18.5%
ALKK	1	173	7	562	0.46	[0.06-3.75]	18.8%
Mylotte et al.	2	66	1	103	3.12	[0.29-33.74]	14.5%
EHS-PCI	3	82	8	254	1.16	[0.32-4.28]	48.2%
Overall	**7**	**413**	**22**	**1081**	**0.87**	**[0.35-2.16]**	**100%**

Heterogeneity: τ^2=0, I^2=0%, p=0.44
Test for overall effect: p=0.77



TRA… RTA?

- IAM - …entificable)
- Reva… …lpable
- Cara…

Characteristic	Culprit-Lesion-Only PCI Group (N=344)	Multivessel PCI Group (N=342)
Heart rate — beats/min		
Median	90	91
Interquartile range	73–109	72–107
Creatinine — mg/dl‡		
Median	1.17	1.20
Interquartile range	0.90–1.66	0.90–1.68
Creatinine clearance — ml/min		
Median	64	66
Interquartile range	42–95	43–93
No. of affected vessels — no./total no. (%)		
1	3/343 (0.9)	2/342 (0.6)
2	122/343 (35.6)	124/342 (36.3)
3	218/343 (63.6)	216/342 (63.2)
Vessel related to the infarction — no./total no. (%)		
Left anterior descending artery	132/343 (38.5)	156/342 (45.6)
Left circumflex artery	76/343 (22.2)	70/342 (20.5)
Right coronary artery	102/343 (29.7)	89/342 (26.0)
Left main artery	31/343 (9.0)	22/342 (6.4)
Bypass graft	2/343 (0.6)	5/342 (1.5)
≥1 Chronic total occlusion — no./total no. (%)	77/344 (22.4)	82/342 (24.0)
Left ventricular ejection fraction — %		
Median	33	30
Interquartile range	25–40	21–40

IIa C

TRACTAMENT – REVASCULARITZACIÓ… COMPLERTA?

PCI Strategies in Patients with Acute Myocardial Infarction and Cardiogenic Shock

Variable	Culprit-Lesion-Only PCI Group (N=344)	Multivessel PCI Group (N=342)	P Value
Arterial access — no./total no. (%)			
Femoral	287/343 (83.7)	277/342 (81.0)	0.36
Radial	61/343 (17.8)	66/342 (19.3)	0.61
Brachial	2/343 (0.6)	1/342 (0.3)	>0.99
Stent in culprit lesion — no./total no. (%)			
Any	326/343 (95.0)	324/342 (94.7)	0.86
Bare metal	20/326 (6.1)	17/324 (5.2)	0.63
Drug eluting	305/326 (93.6)	308/324 (95.1)	0.41
Bioresorbable scaffold in culprit lesion — no./total no. (%)	2/326 (0.6)	3/324 (0.9)	0.69
Aspiration thrombectomy of culprit lesion — no./total no. (%)	60/343 (17.5)	39/342 (11.4)	0.02*

Complete revascularization during the index procedure should be considered in patients presenting with cardiogenic shock.	IIa	C

TRACTAMENT – REVASCULARITZACIÓ… COMPLERTA?

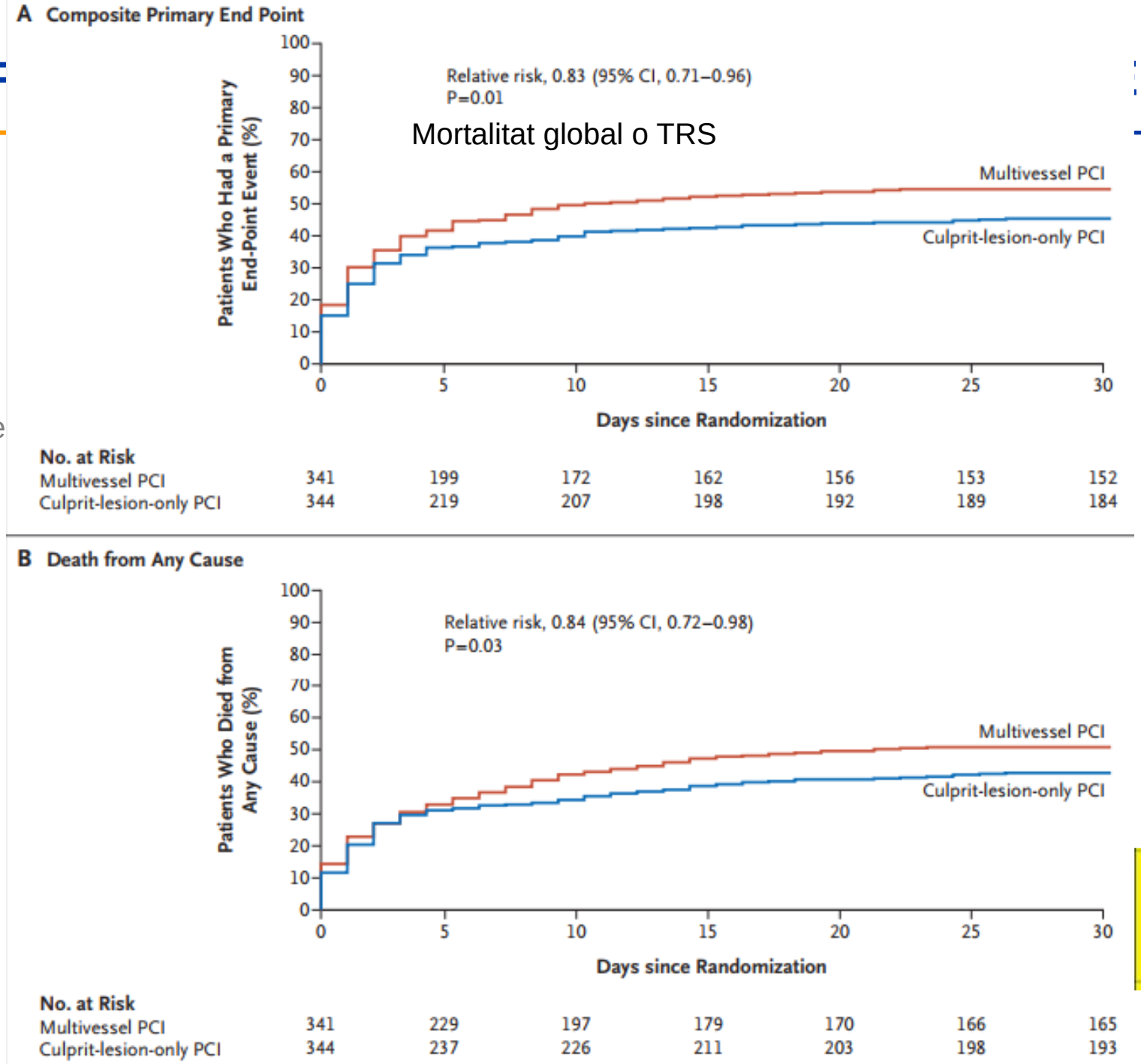
PCI Strategies in Patients with Acute Myocardial Infarction and Cardiogenic Shock

Variable	Culprit-Lesion-Only PCI Group (N=344)	Multivessel PCI Group (N=342)	P Value
Immediate PCI of nonculprit lesions — no./total no. (%)	43/344 (12.5)	310/342 (90.6)	<0.001
Immediate complete revascularization achieved — no./total no. (%)	26/344 (7.6)	277/342 (81.0)	<0.001
Total dose of contrast material — ml			<0.001
Median	190	250	
Interquartile range	140–250	200–350	
Total duration of fluoroscopy — min			<0.001
Median	13	19	
Interquartile range	7–20	12–29	
Staged PCI of nonculprit lesions — no./total no. (%)	60/344 (17.4)	8/341 (2.3)	<0.001
Staged coronary-artery bypass grafting — no./total no. (%)	1/344 (0.3)	0/341	>0.99

Complete revascularization during the index procedure should be considered in patients presenting with cardiogenic shock.	IIa	C

TF ERTA?

- Se



IIa C

Table 3. Clinical Outcomes at 30 Days.

Outcome	Culprit-Lesion-Only PCI Group (N=344)	Multivessel PCI Group (N=341)	Relative Risk (95% CI)	P Value
	no./total no. (%)			
Primary end point: death from any cause or renal-replacement therapy	158/344 (45.9)	189/341 (55.4)	0.83 (0.71–0.96)	0.01
Death from any cause*	149/344 (43.3)	176/341 (51.6)	0.84 (0.72–0.98)	0.03
Renal-replacement therapy	40/344 (11.6)	56/341 (16.4)	0.71 (0.49–1.03)	0.07
Indication for renal-replacement therapy				
Hyperkalemia	7/40 (17.5)	9/56 (16.1)		
Metabolic acidosis	18/40 (45.0)	20/56 (35.7)		
Uremia	13/40 (32.5)	20/56 (35.7)		
Volume overload	12/40 (30.0)	17/56 (30.4)		
Other cause	6/40 (15.0)	4/56 (7.1)		
Recurrent myocardial infarction	4/344 (1.2)	3/341 (0.9)	1.32 (0.30–5.86)	1.00
Rehospitalization for congestive heart failure	1/344 (0.3)	1/342 (0.3)	0.99 (0.10–9.50)	0.99
Death, recurrent myocardial infarction, or rehospitalization for congestive heart failure	151/344 (43.9)	179/342 (52.3)	0.84 (0.72–0.98)	0.03
Staged or urgent repeat revascularization	74/344 (21.5)	13/341 (3.8)	7.43 (3.61–15.31)	<0.001
Stroke	12/344 (3.5)	10/341 (2.9)	1.19 (0.52–2.72)	0.68
BARC type 2, 3, or 5 bleeding†				
Any	57/344 (16.6)	75/341 (22.0)	0.75 (0.55–1.03)	0.07
BARC 2	14/57 (24.6)	23/75 (30.7)		
BARC 3a	21/57 (36.8)	28/75 (37.3)		
BARC 3b	17/57 (29.8)	19/75 (25.3)		
BARC 3c	0/57	2/75 (2.7)		
BARC 5a	4/57 (7.0)	1/75 (1.3)		
BARC 5b	1/57 (1.8)	2/75 (2.7)		

TRACTAMENT – REVASCULARITZACIÓ… COMPLERTA?

PCI Strategies in Patients with Acute Myocardial Infarction and Cardiogenic Shock

H. Thiele, I. Akin, M. Sandri, G. Fuernau, S. de Waha, R. Meyer-Saraei, P. Nordbeck, T. Geisler, U. Landmesser, C. Skurk, A. Fach, H. Lapp, J.J. Piek, M. Noc, T. Goslar, S.B. Felix, L.S. Maier, J. Stepinska, K. Oldroyd, P. Serpytis, G. Montalescot, O. Barthelemy, K. Huber, S. Windecker, S. Savonitto, P. Torremante, C. Vrints, S. Schneider, S. Desch, and U. Zeymer, for the CULPRIT-SHOCK Investigators*

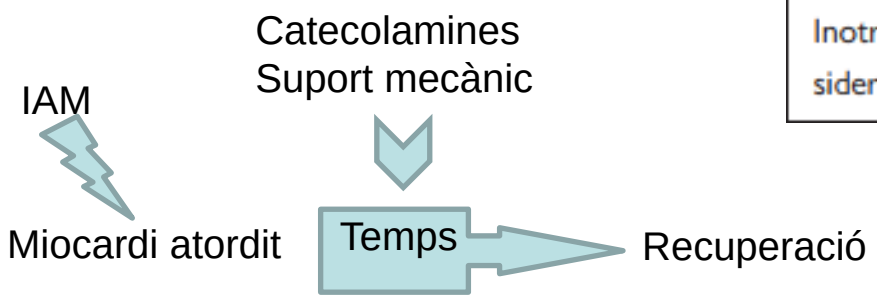
N Engl J Med 2017;377:2419-32

- Augment de contrast
  - empitjorament de la funció renal (no dif signific en TRS)
  - augment volum VE → efecte negatiu per funció miocàrdica

- Major durada del procediment → efecte deleteri en pacients hemodinàmicament inestables

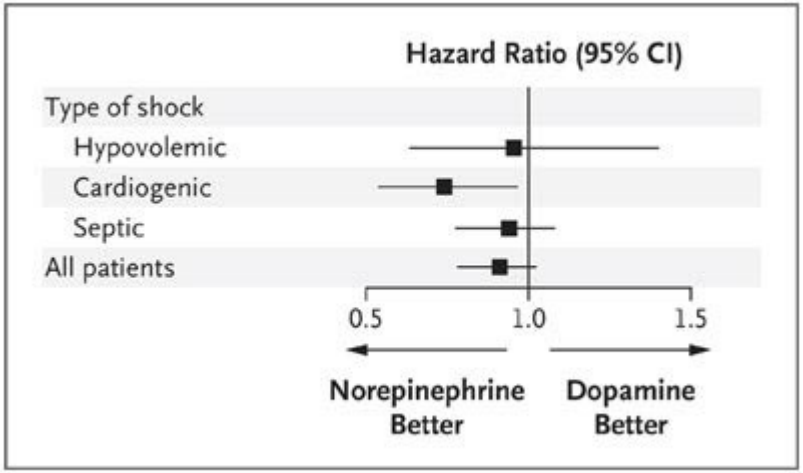
Complete revascularization during the index procedure should be considered in patients presenting with cardiogenic shock.	IIa	C

TRACTAMENT – MÈDIC



Inotropic/vasopressor agents may be considered for haemodynamic stabilization.	IIb	C

- Descartar hipovolèmia
- Objectiu tensional diferent en cada malalt (TAS >90 mmHg o PAM >65 mmHg)
- Guiar tractament inotròpics/vasopressors amb objectius clínics i analítics, menor dosi possible
- Noradrenalina o Dobutamina
- Dopamina: ↑arrítmies i mortalitat
- Levosimendan? tt BB previ. No ben definit



De Backer. Comparison of dopamine and norepinephrine in the treatment of shock. *N Engl J Med*. 2010;362:779–789.

TRACTAMENT – MÈDIC

Cause or Presentation of CS	Vasoactive Management Considerations	Hemodynamic Rationale
Classic wet and cold	Norepinephrine or dopamine[144] Inotropic agent[210,211]*	This subtype has low CI and high SVR. Consider hemodynamic stabilization with norepinephrine (preferred in ↑HR or arrhythmias) or dopamine (↓HR preferred but associated with higher risk of arrhythmias) Consider addition of inotropic agent when stabilized and after revascularization (MI only)
Euvolemic cold and dry	Norepinephrine or dopamine[144] Inotropic agent[210,211] Small fluid boluses	Consider hemodynamic stabilization with norepinephrine (preferred in ↑HR or arrhythmias) or dopamine (↓HR preferred but associated with higher risk of arrhythmias) Consider addition of inotropic agent when stabilized and after revascularization (MI only) LVEDP may be low, and patients may tolerate fluid boluses
Vasodilatory warm and wet or mixed cardiogenic and vasodilatory	Norepinephrine Consider hemodynamics-guided therapy	This subtype has low SVR
RV shock	Fluid boluses[144,145] Norepinephrine, dopamine, or vasopressin[144,212,213] Inotropic agents[144]* Inhaled pulmonary vasodilators[214]	Hemodynamic goals include maintaining preload, lowering RV afterload (PVR), treating absolute or relative bradycardias, and maintaining atrioventricular synchrony Dopamine (↓HR preferred but associated with arrhythmia risk) Vasopressin may raise SVR and have neutral effect on PVR Consider adding or transitioning to inotrope after initial hemodynamic stabilization and revascularization
Dynamic LVOT obstruction	Fluid boluses[215,216] Phenylephrine or vasopressin[215,216] Avoid inotropic agents[215,216] Avoid vasodilating agents[215,216] Esmolol or amiodarone[215] RV pacing	Dynamic gradients may be reduced by increasing preload and afterload, reducing inotropy and ectopy, maintaining atrioventricular synchrony, and inducing ventricular dyssynchrony
Bradycardia	Chronotropic agents or Temporary pacing	Treatment should also focus on identifying and treating underlying cause of bradycardia Chronotropic agents may include atropine, isoproterenol, dopamine, dobutamine, and epinephrine

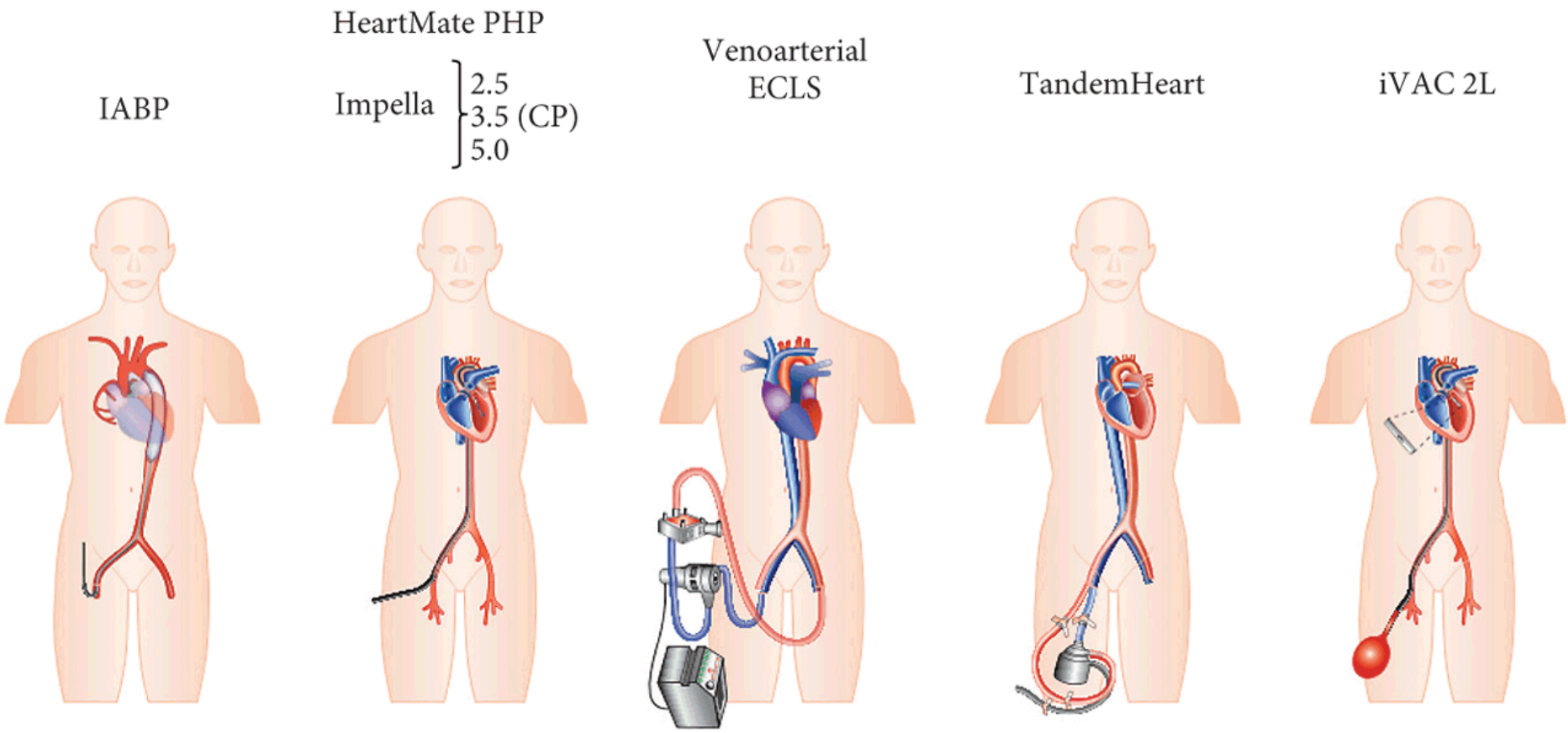
TRACTAMENT – ALTRES

- Control glucèmic (evitar hipoglicèmies)
- Maneig general VM, profilaxi tromboembòlia, úlceres GI, úlceres cutànies,…
- Hipotèrmia
- Ultrafiltració
- Hemofiltració
- Suport mecànic
- Transplant

Ultrafiltration may be considered for patients with refractory congestion, who failed to respond to diuretic-based strategies.[434–436]	IIb	B

TRACTAMENT – SUPORT MECÀNIC

- Xoc cardiogènic refractari a tractament inotròpic i revascularització



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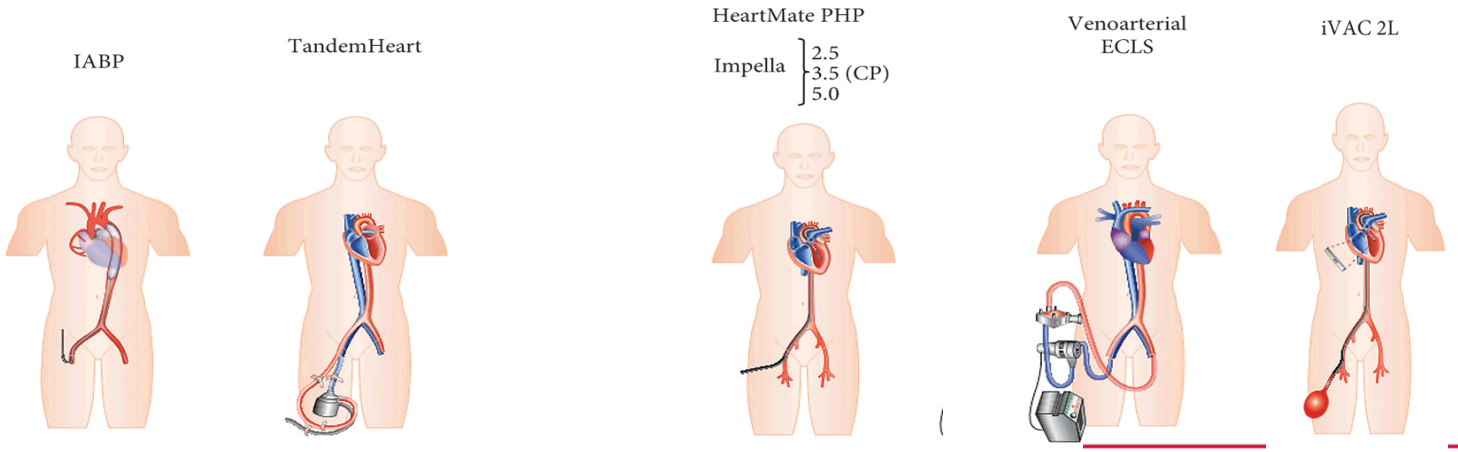
TRACTAMENT – SUPORT MECÀNIC



	IABP	TandemHeart	Impella 2.5	Impella CP	ECM
Pump mechanism	Pneumatic	Centrifugal	Axial flow	Axial flow	Cent
Cannula size (French)	7–9	21 inflow, 15–17 outflow	13	14	18–2
Haemodynamic support (l/min)	0,5	Max 4.0	Max. 2.5	Max. 3.7–4.0	Max.
Pump speed (rpm)	0	Max. 7500	Max. 51,000	Max. 51,000	Max.
Implantation time	+	++++	++	++	++
Risk of limb ischaemia	+	+++	++	++	+++
Anticoagulation	+	+++	+	+	+++
Haemolysis	+	++	++	++	++
Post-implantation management complexity	+	++++	++	++	+++

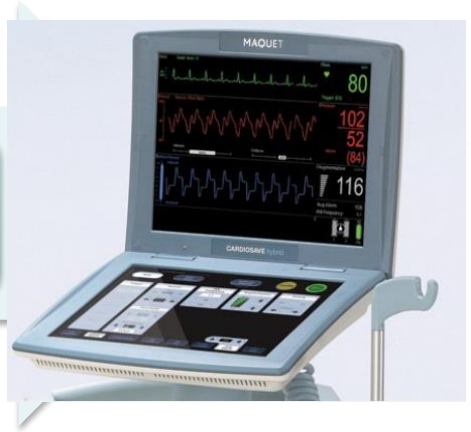
	iVAC 2L®
Catheter size (F)	11 (expandable)
Cannula size (F)	17
Flow (L/min)	Max 2.8
Pump speed (rpm)	Pulsatile, 40 mL/beat
Insertion/ Placement	Percutaneous (femoral artery)
LV unloading	+
Anticoagulation	+
Recommended duration of use	−21 days
CE-certification	+
FDA	−
Relative costs	++

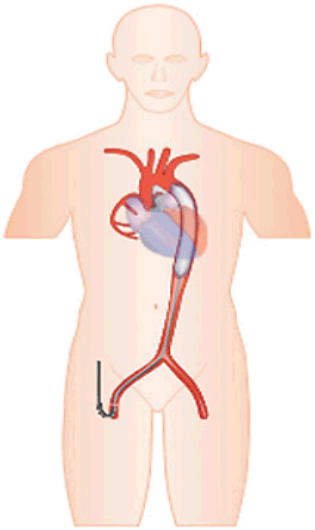
Van Herck. Management of cardiogenic shock complicating acute myocardial infarction. Eur Heart J Acute Cardi
Jun;4(3):278-97
Thiele H. Management of cardiogenic shock. Eur Heart J. 2015 May 21;36(20):1223-30.

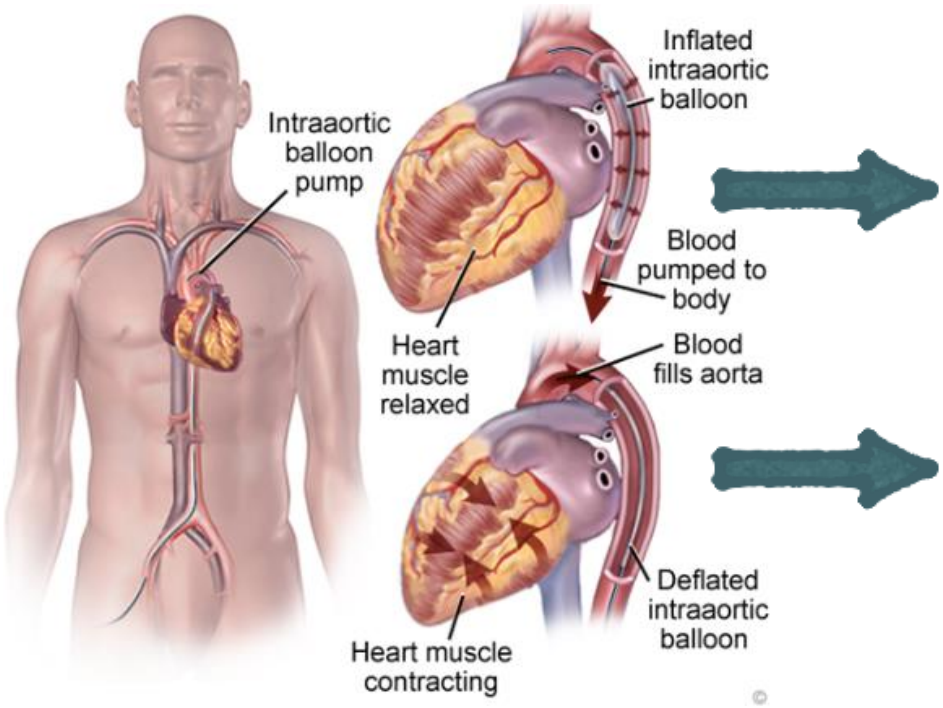
TRACTAMENT – SUPORT MECÀNIC - IABP

1961
Prototip

1971
1r estudi 30 malalts



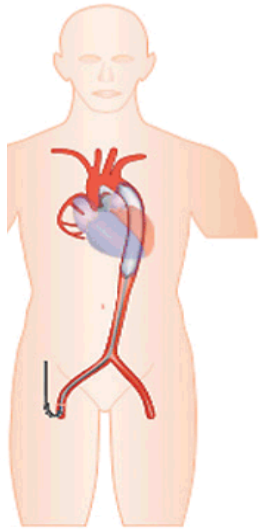




↑ circulació coronària i esplàcnica

↑ FE i CC
↓ Consum O_2 miocàrdic

TRACTAMENT – SUPORT MECÀNIC - IABP



Intraaortic Balloon Suppo … ith Cardi…

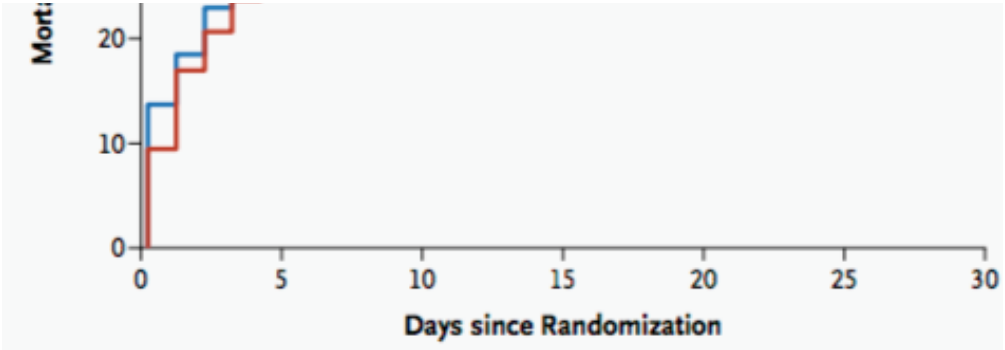
Holger Thiele, M.D., Uwe Zeymer, M.D., Franz-Josef Neumann, M.D., Mi… dt, M.D., Marcus Hennersdorf, M.D., Klaus Empen, M.D., Georg Fuernau, M.D… ators*

N Engl J M…

Intra-aortic balloon pumping should be considered in patients with haemodynamic instability/cardiogenic shock due to mechanical complications.	IIa	C
Short-term mechanical support[c] may be considered in patients in refractory shock.	IIb	C
Routine intra-aortic balloon pumping is not indicated.[177,437]	III	B

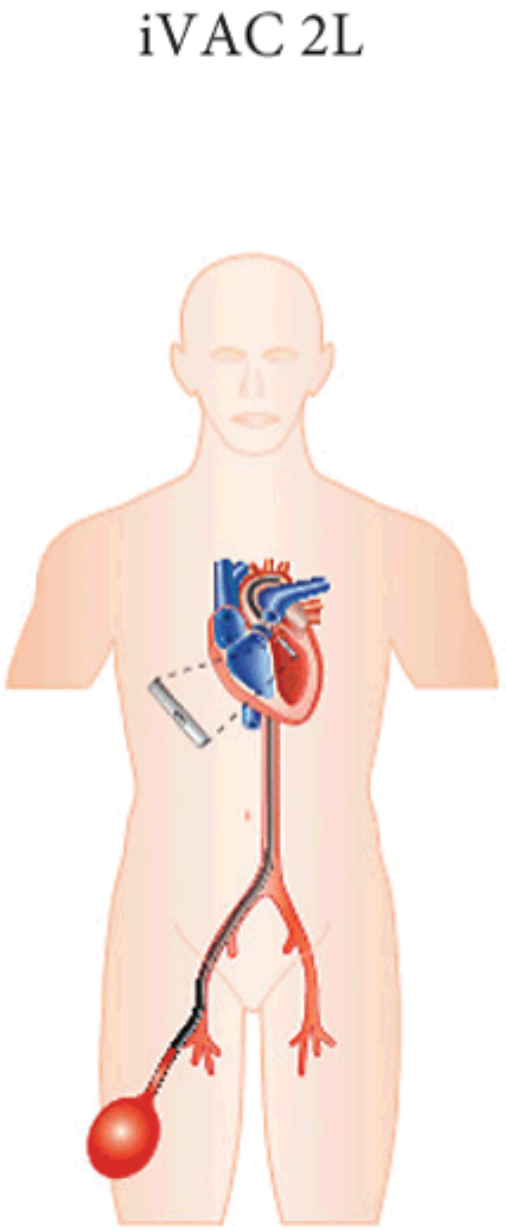
- BCPAo vs tt mèdic òptim en I…
- No diferències en lactat, FR, PCR, sèpsis, ictus ni sagnat

		IABP	Control	Relative risk (95% CI)	p value
30-day mortality	Total	119/300 (39.7%)	123/298 (41.3%)	0.96 (0.79-1.17)	0.69
30-day events	Reinfarction	9/300 (3.0%)	4/298 (1.3%)	2.24 (070-7.18)	0.16
	Stroke	2/300 (0.7%)	5/298 (1.7%)	0.40 (0.08-2.03)	0.28
12-month mortality	Total	155/299 (52%)	152/296 (51%)	1.01 (0.86-1.18)	0.91
	Cardiac cause	150/299 (50%)	148/296 (51%)	1.00 (0.85-1.18	0.97
	Non-cardiac cause	5/299 (2%)	4/296 (1%)	1.23 (0.34-4.56)	1.00



TRACTAMENT – SUPORT MEC

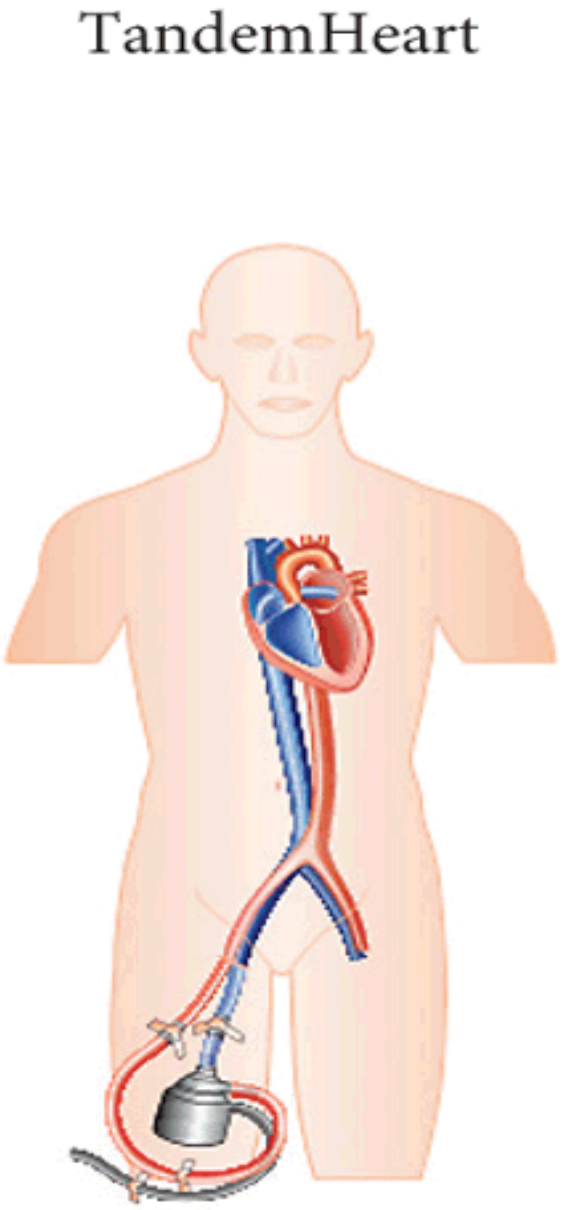
	iVAC 2L®	Tandem Heart™	Impella® 5.0	Impe	ECLS (multiple systems)
Catheter size (F)	11 (expandable)	–	9	9	–
Cannula size (F)	17	21 venous 12–19 arterial	21	12	17–21 venous 16–19 arterial
Flow (L/min)	Max. 2.8	Max. 4.0	Max. 5.0	Max.	Max. 7.0
Pump speed (rpm)	Pulsatile, 40 ml/beat	Max. 7500	Max. 33 000	Max.	Max. 5000
Insertion/Placement	Percutaneous (femoral artery)	Percutaneous (femoral artery + vein for left atrium)	Peripheral surgical (femoral artery)	Percu (femo artery	Percutaneous (femoral artery + vein)
LV unloading	+	++	++	+	–
Anticoagulation	+	+	+	+	+
Recommended duration of use	–21 days	–4 days	10 days	10 da	–7 days
CE-certification	+	+	+	+	+
FDA	–	+	+	+	+
Relative costs	++	+++++	++++	+++	+(+)



Thiele H, Zeymer U. Cardiogenic shock in patients with acute coronary syndromes. En Tubaro M of Intensive and Acute Cardiovascular Care. 2n Ed. Online

TRACTAMENT – SUPORT MEC

	iVAC 2L®	Tandem Heart™	Impella® 5.0	Im	LS ultiple tems)
Catheter size (F)	11 (expandable)	–	9	9	
Cannula size (F)	17	21 venous 12–19 arterial	21	12	21 ous 19 arterial
Flow (L/min)	Max. 2.8	Max. 4.0	Max. 5.0	Ma	. 7.0
Pump speed (rpm)	Pulsatile, 40 ml/beat	Max. 7500	Max. 33 000	Ma	. 5000
Insertion/Placement	Percutaneous (femoral artery)	Percutaneous (femoral artery + vein for left atrium)	Peripheral surgical (femoral artery)	Pe (fe art	cutaneous noral ry + vein)
LV unloading	+	++	++	+	
Anticoagulation	+	+	+	+	
Recommended duration of use	–21 days	–4 days	10 days	10	days
CE-certification	+	+	+	+	
FDA	–	+	+	+	
Relative costs	++	+++++	++++	++	)



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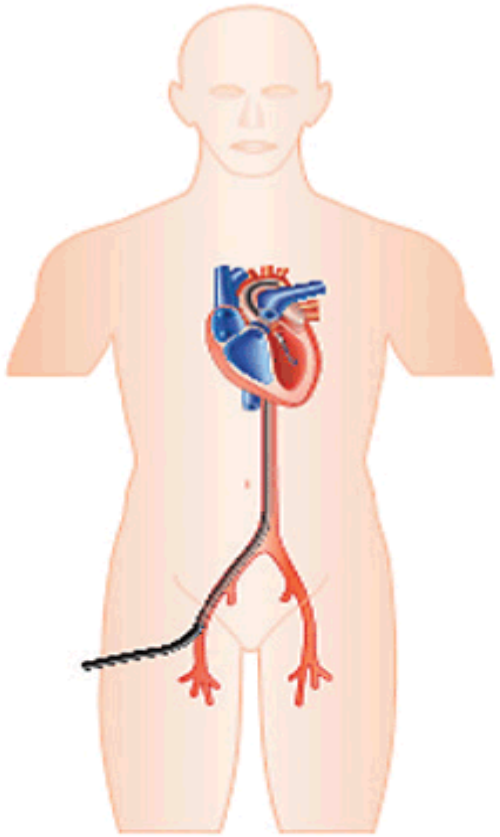
TRACTAMENT – SUPORT MECÀNIC PERCUTANI

HeartMate PHP

Impella { 2.5 / 3.5 (CP) / 5.0

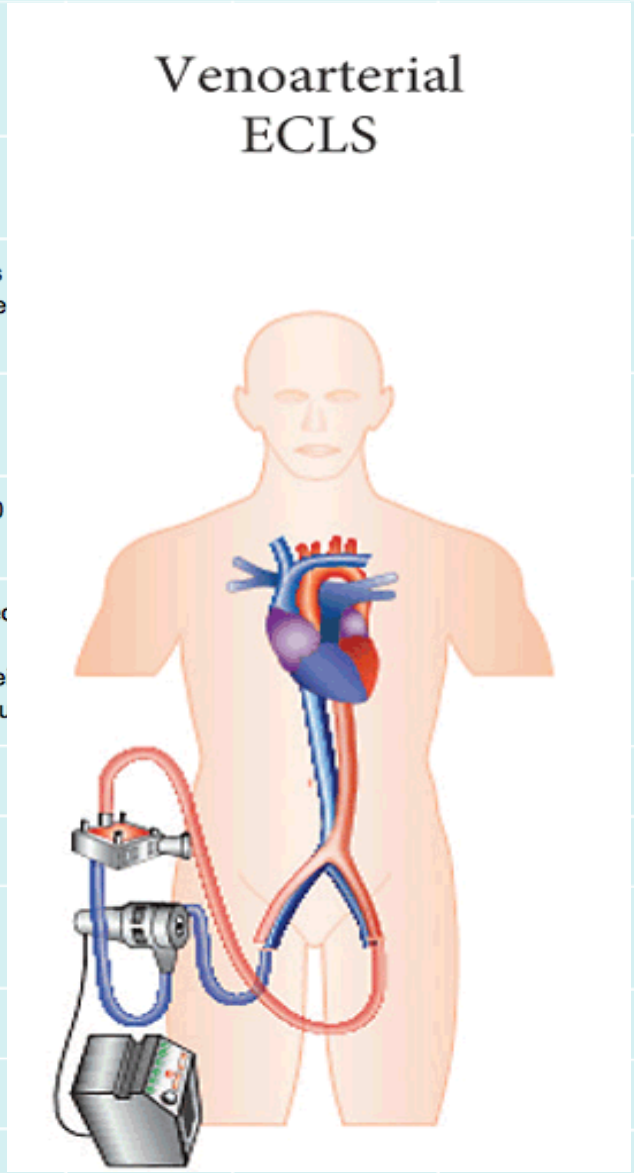


	iVAC 2L®	Tandem Heart™	Impella® 5.0	Impella® 2.5	Impella® CP	Heartmate PHP	ECLS (multiple systems)
			9	9	9	14	–
			21	12		13	17–21 venous 16–19 arterial
			Max. 5.0	Max. 2.5	3.7 – 4.0	>4.0 (Max. > 5.0)	Max. 7.0
			Max. 33 000	Max. 51 000	Max. 51 000	Max. 20 500	Max. 5000
			Peripheral surgical (femoral artery)	Percutaneous (femoral artery)	Percutaneous (femoral artery)	Percutaneous (femoral artery)	Percutaneous (femoral artery + vein)
			++	+	+	++	–
			+	+	+	+	+
			10 days	10 days	10 days	6 hours	–7 days
			+	+	+	+	+
			+	+	+	–	+
			++++	+++	++++	++++	+(+)

Thiele H … ndromes. En Tubaro M, Vranckx P, Price S, Vrints C. The ESC Textbook of Intensive and Acute Cardiova…

TRACTAMENT – SUPORT MECÀNIC PERCUTANI

	iVAC 2L®	Tandem Heart™	Heartmate PHP	ECLS (multiple systems)
Catheter size (F)	11 (expandable)	–	14	–
Cannula size (F)	17	21 venous 12–19 arte	13	17–21 venous 16–19 arterial
Flow (L/min)	Max. 2.8	Max. 4.0	>4.0 (Max. > 5.0)	Max. 7.0
Pump speed (rpm)	Pulsatile, 40 ml/beat	Max. 7500	Max. 20 500	Max. 5000
Insertion/Placement	Percutaneous (femoral artery)	Percutaneo (femoral artery + ve for left atriu	Percutaneous (femoral artery)	Percutaneous (femoral artery + vein)
LV unloading	+	++	++	–
Anticoagulation	+	+	+	+
Recommended duration of use	–21 days	–4 days	6 hours	–7 days
CE-certification	+	+	+	+
FDA	–	+	–	+
Relative costs	++	+++++	++++	+(+)



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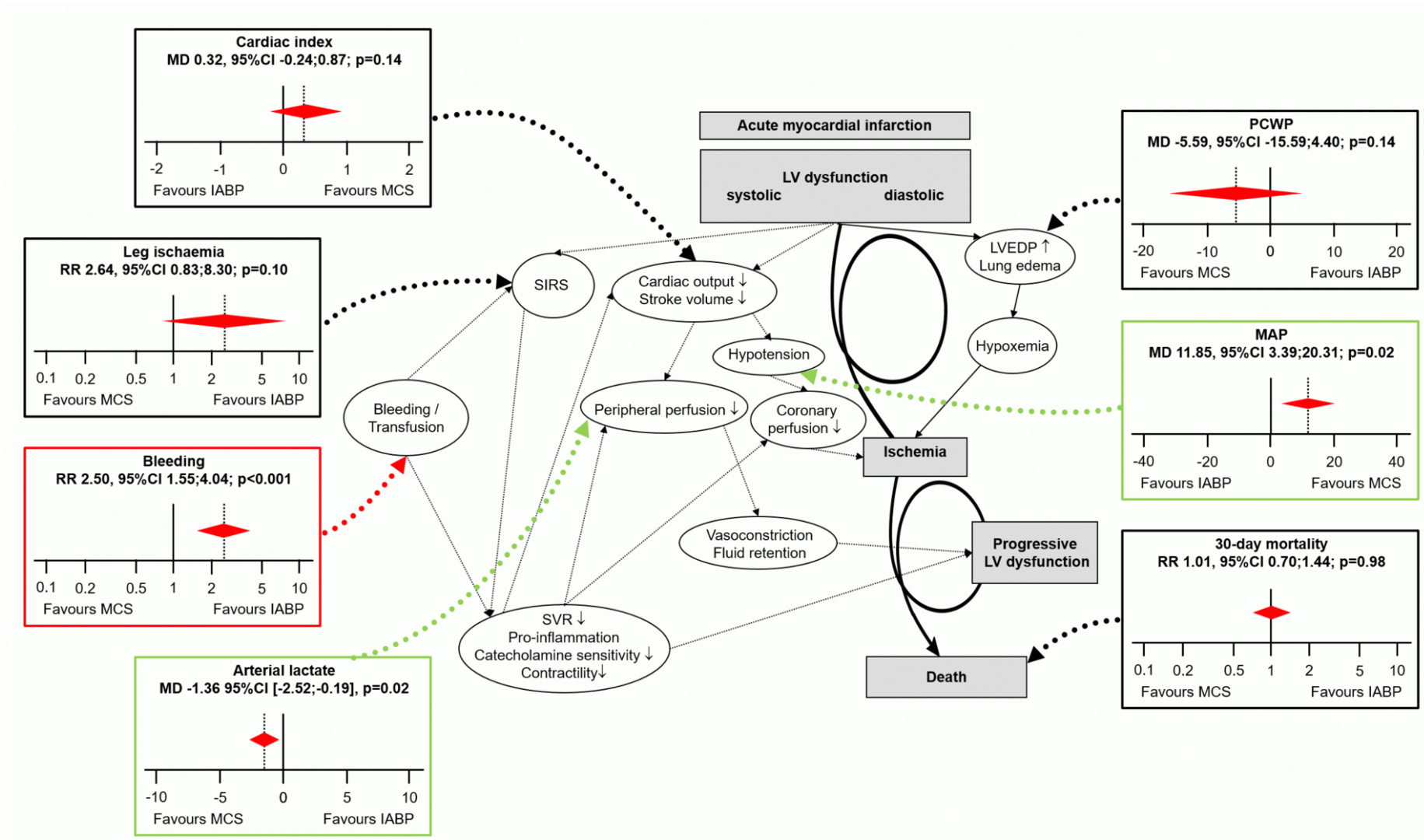

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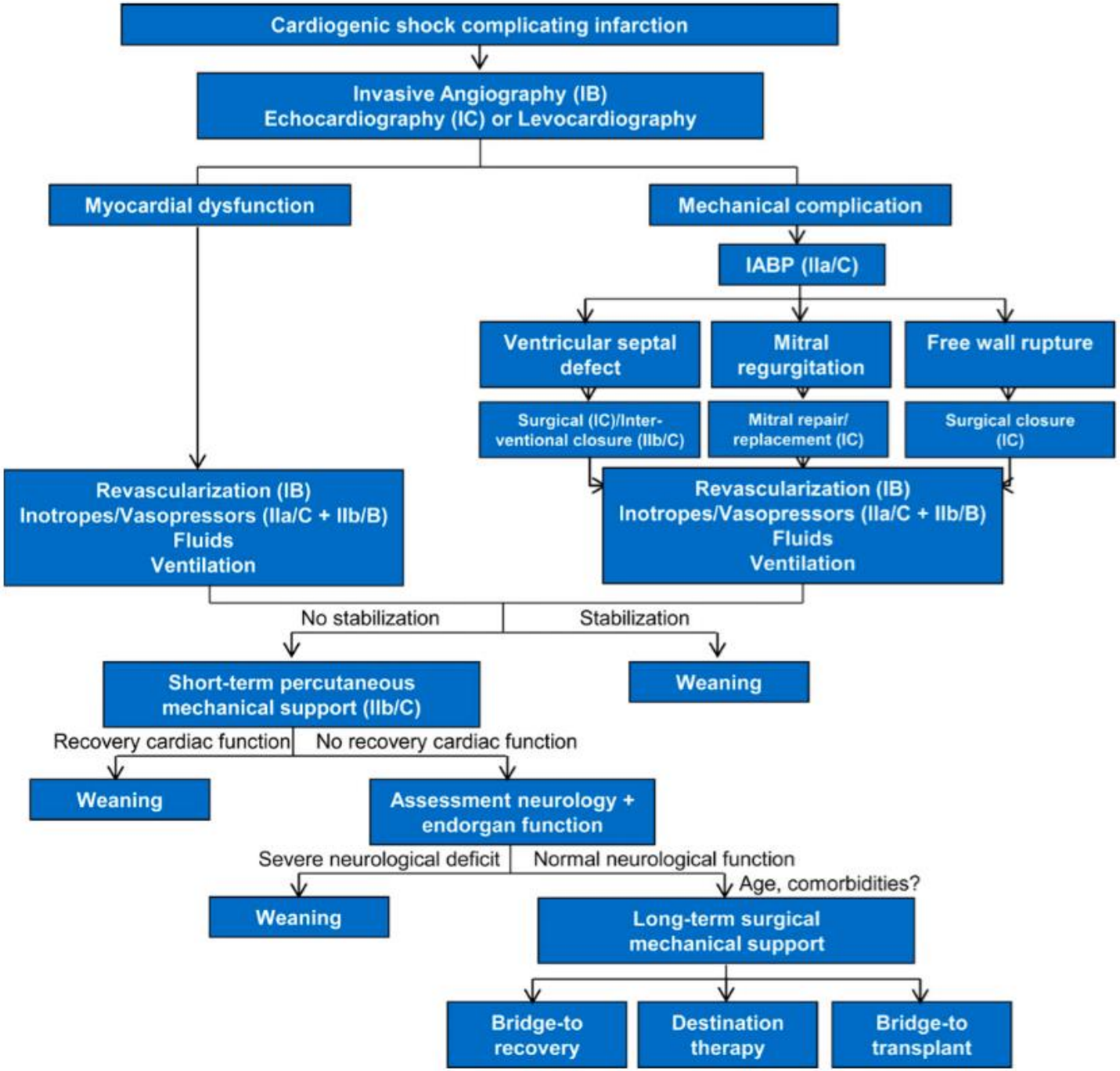
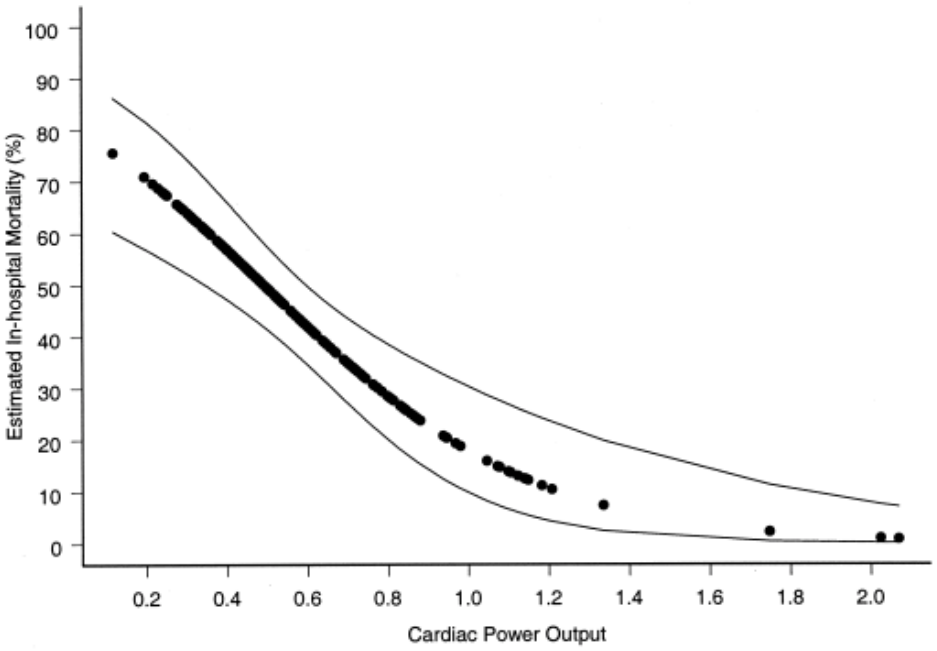


Thiele H. Management of cardiogenic shock. Eur Heart J. 2015 May 21;36(20):1223-30.

FACTORS PRONÒSTICS I ESCALES DE RISC

- Era fibrinolitics: scores validats de risc de desenvolupament de xoc cardiogènic
- Era angioplàstia: predictors mortalitat
  - Cardiac power output (≤ 0’53)
  - Inici →pas de guia
  - TIMI post ACTP
  - Glucèmia inicial
  - Lactat
  - Inflamació (IL6, procalcitonina)
  - Hb inicial



Fincke R et al. Cardiac power is the strongest hemodynamic correlate of mortality in cardiogenic shock: a report from the SHOCK trial registry. *J Am Coll Cardiol*. 2004; 44: 340–8

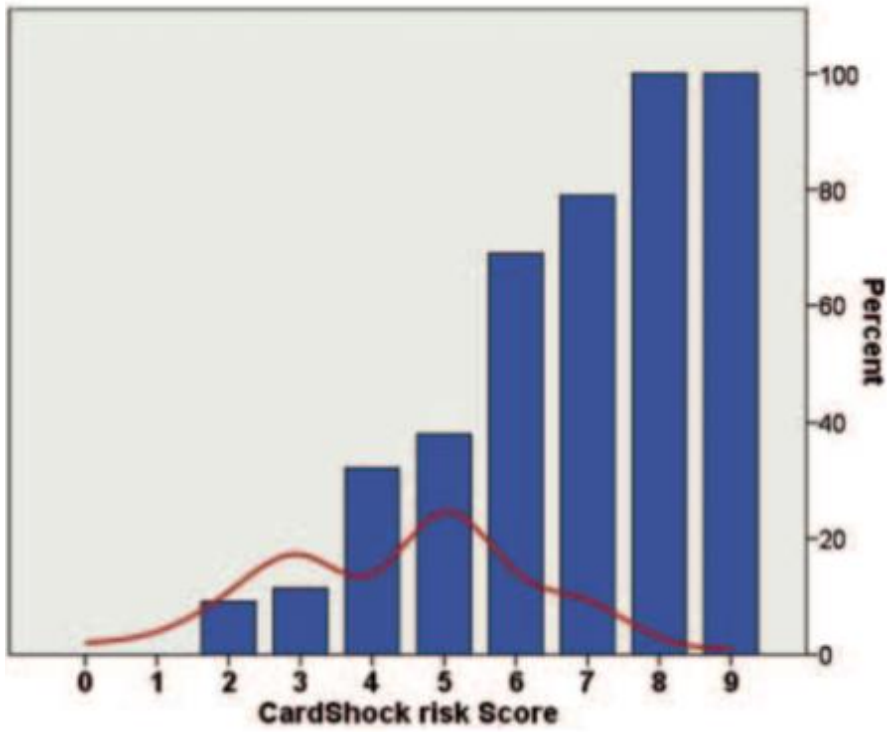
FACTORS PRONÒSTICS I ESCALES DE RISC

- Escales de mortalitat en xoc cardiogènic:
  - CardShock risk score (2015): xoc cardiogènic

- Baix: 0-3
- Intermig: 4-5
- Alt: 6-9

Table 4 The CardShock risk Score for risk prediction of in-hospital mortality in cardiogenic shock

Variable	CardShock risk Score
Age >75 years	1
Confusion at presentation	1
Previous MI or CABG	1
ACS aetiology	1
LVEF <40%	1
Blood lactate	
<2 mmol/L	0
2–4 mmol/L	1
>4 mmol/L	2
$eGFR_{CKD-EPI}$	
>60 mL/min/1.73 m^2	0
30–60 mL/min/1.73 m^2	1
<30 mL/min/1.73 m^2	2
Maximum points	9



Harjola VP et al. Clinical picture and risk prediction of short-term mortality in cardiogenic shock. Eur J Heart Fail. 2015;17:984

FACTORS PRONÒSTICS I ESCALES DE RISC

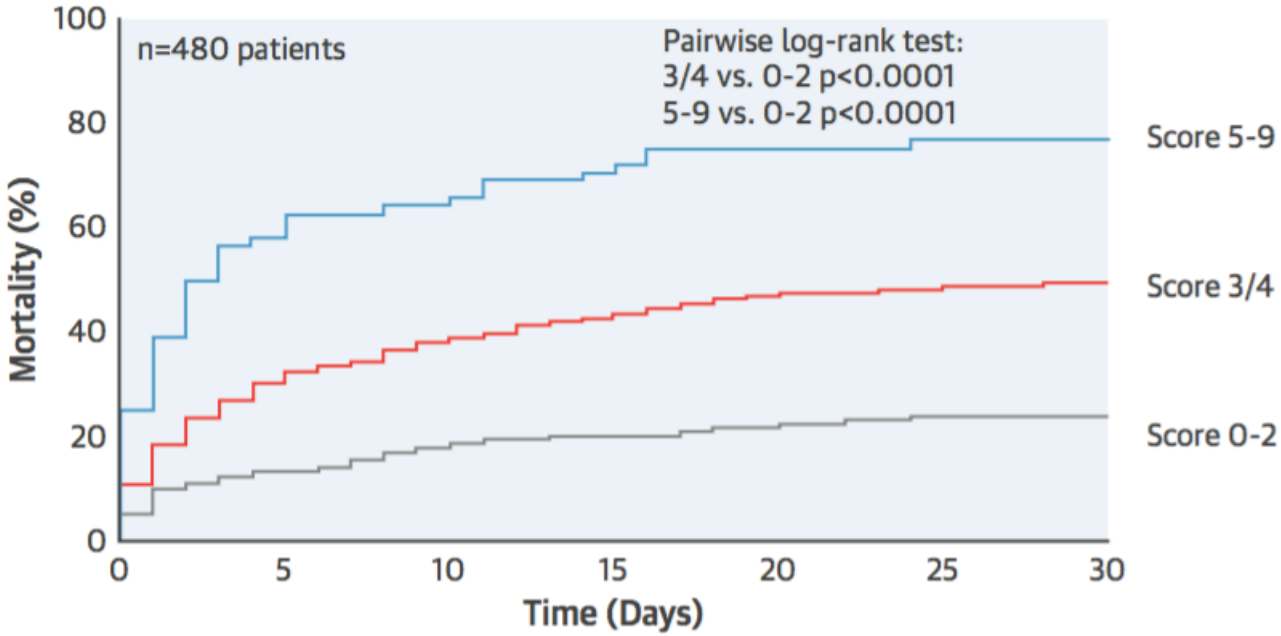
- Escales de mortalitat en xoc cardiogènic:
  - IABP SHOCK II risk score (2017): xoc cardiogènic per IAM. Cohort validada

Risk categories

Category	Points
Low	0-2
Intermediate	3/4
High	5-9

Score

Variable	Points
Age >73 years	1
History of stroke	2
Glucose >10.6 mmol/l (191 mg/dl)*	1
Creatinine >132.6 µmol/l (1.5 mg/dl)*	1
Arterial lactate >5 mmol/l*	2
TIMI flow grade <3 after PCI	2
Maximum	9



Risk Stratification for Patients in Cardiogenic Shock After Acute Myocardial Infarction. *J Am Coll Cardiol* 2017;69:1913-1920.

CONCLUSIONS

- Patologia complexa
- IAM causa més freqüent
- Alta mortalitat
- Diferents patrons hemodinàmics
- Revascularització precoç
- Pocs estudis randomitzats, preguntes no resoltes
  - Monitorització
  - Tractament inotròpic
  - Tipus de revascularització
  - IABP
  - Assistències
  - Escales pronòstiques

MOLTES GRÀCIES!!