11° CONGRESSO NAZIONALE

CAMPUS Cuore

Quello che le Linee Guida Non Dicono

Napoli, 5-6 aprile 2024

MASTER CLASS - Venerdì 5 aprile

SHOCK CARDIOGENO E SISTEMI DI ASSISTENZA VENTRICOLARE

Dalla valutazione multiparametrica al timing appropriato del trattamento con sistemi di assistenza ventricolare: Le Evidenze Scientifiche

S Valente
AOU Siena

Reviews

Cardiogenic Shock: Failure of Oxygen Delivery and Oxygen Utilization

Hoong Sern Lim, MD, FRCP, FESC
Department of Cardiology, University Hospital Birmingham NHS Trust, Birmingham, United Kingdom

Address for correspondence:
Hoong Sern Lim, MD, FRCP, FESC
University Hospital Birmingham NHS Foundation Trust
Edgbaston, Birmingham, B15 2TH
United Kingdom
sern.lim@uhb.nhs.uk

As cardiac output is a key determinant of global oxygen delivery (DO2), cardiogenic shock can also be defined as a failure of global DO2 to meet oxygen consumption (VO2), resulting in tissue hypoperfusion

Clin. Cardiol. 39, 8, 477–483 (2016)

Cardiogenic shock is a heterogeneous syndrome with varied presentations and outcomes.

Presentations of Cardiogenic Shock

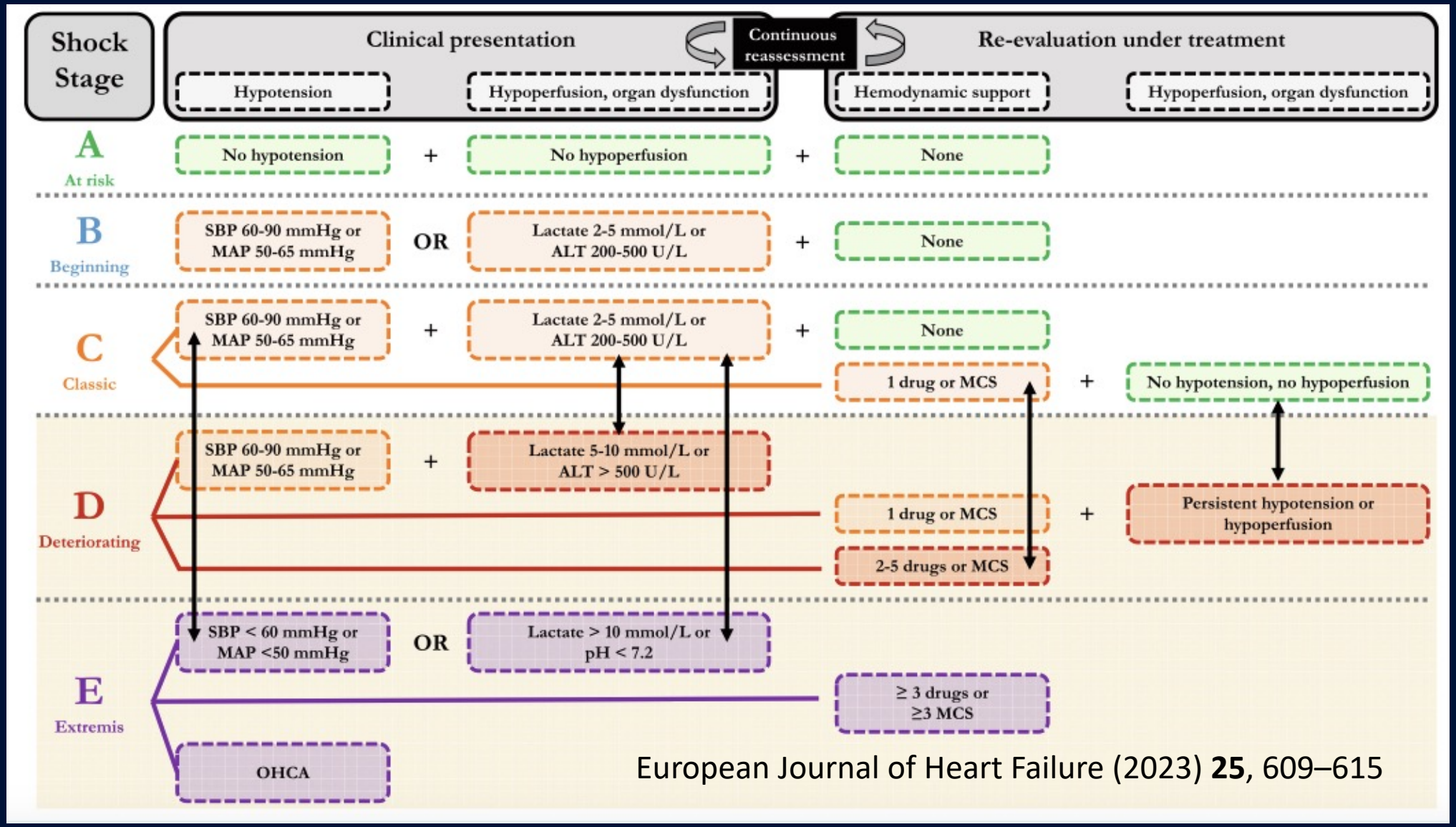
Catastrophic Shock

Acute Severe Shock

Indolent Progressive Shock

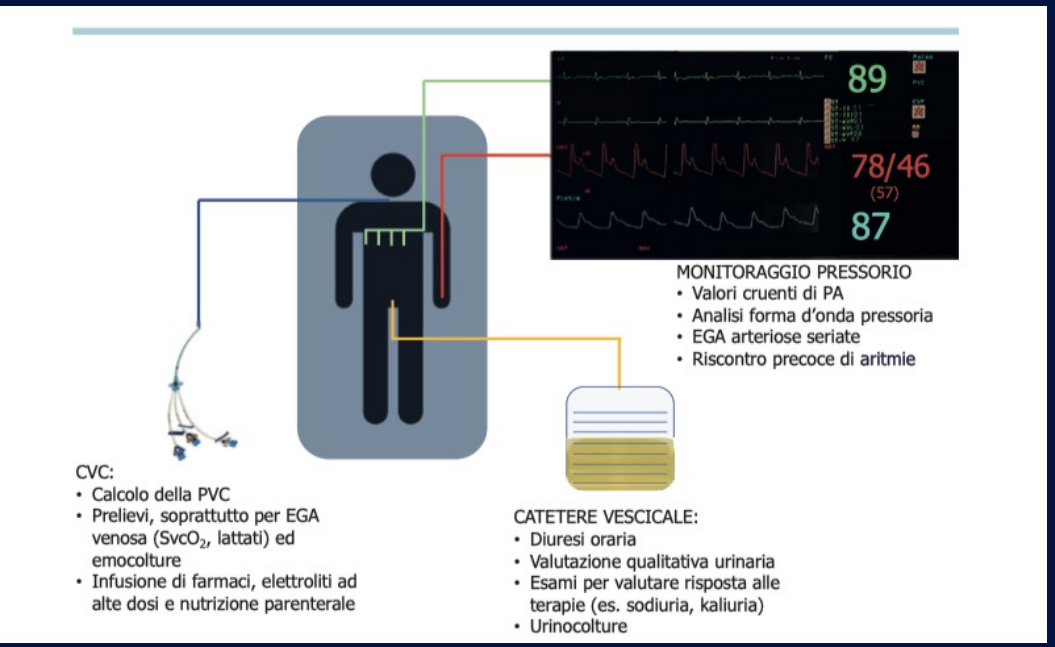
	Catastrophic Shock	Acute Severe Shock	Indolent Progressive Shock
Typical Scenario	Ventricular Fibrillation PEA arrest	Acute Myocardial Infarction Fulminant Myocarditis	Progressive Congestive HF Moving from Stage C to Stage D.
Physiology	Complete cessation of cardiac function.	Severe reduction in CO and BP.	Moderate reduction in CO and BP.
Time Course to Effectively Intervene	<5 minutes to provide adequate CPR or restore cardiac function. <1 hour to restore CO, BP.	Restore CO, BP within 1-6 hours.	Hours to days to improve hemodynamics.
Goals of Therapy	Anoxic brain injury must be avoided.	Avoid SIRS, MOF.	Improve CO, BP and lower filling pressures. Evaluate for TX, LVAD or hospice.

Visualization of cardiogenic shock stages based on initial presentation and response to medical therapy.

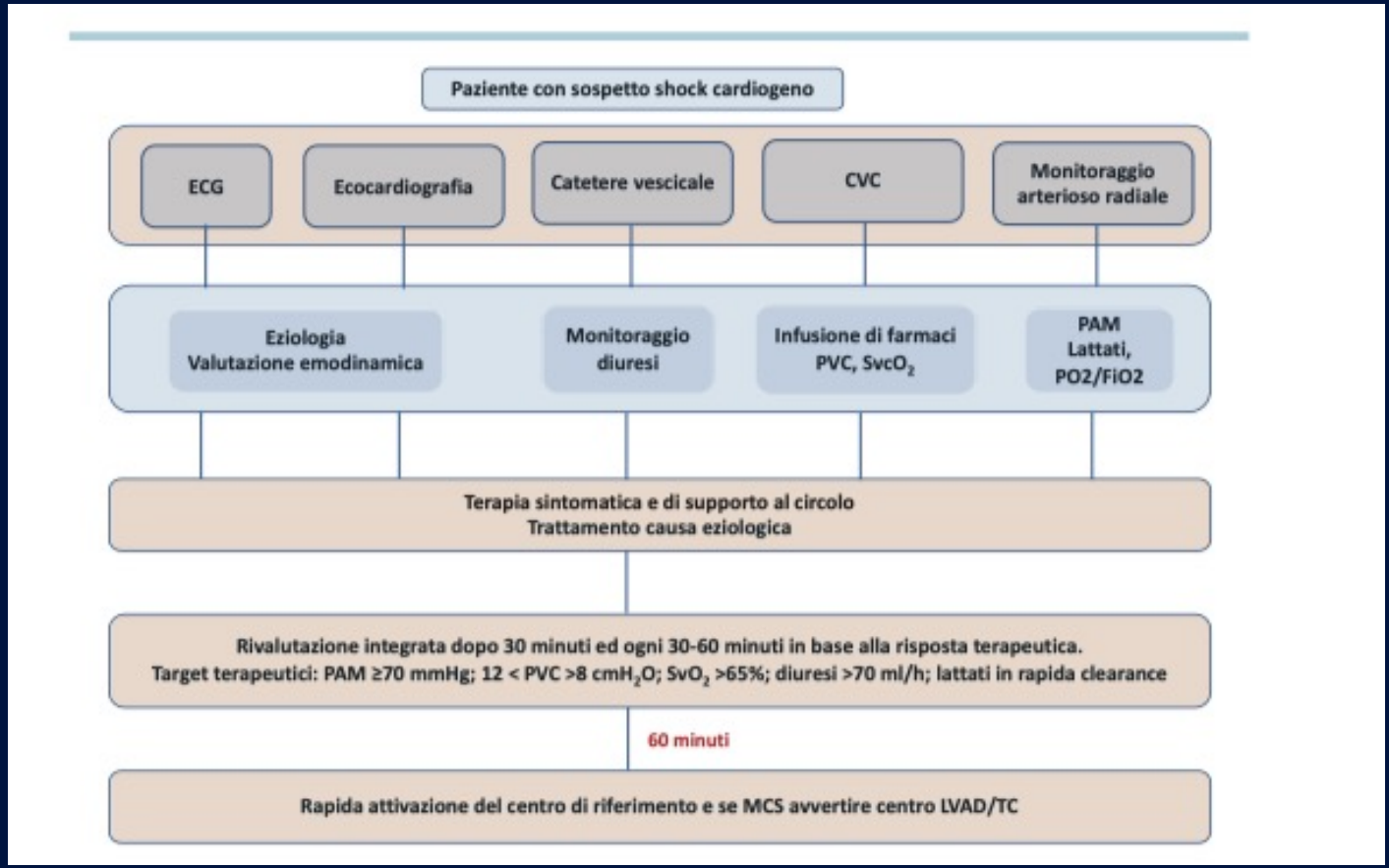


European Journal of Heart Failure (2023) **25**, 609–615

Inquadramento diagnostico precoce e monitoraggio multiparametrico del paziente con shock cardiogeno.



- Identificare il tipo di shock
- Selezionare gli interventi terapeutici
- Valutare la risposta alla terapia



S Valente G Ital Cardiol 2020

S Valente G Ital Cardiol 2023

Strumenti di monitoraggio e relativi obiettivi delle principali fasi di salvataggio del paziente con shock circolatorio

Fase	Strumenti	Monitoraggio	Obiettivo
Ventilazione	• Ossigenoterapia • Ventilazione non invasiva • Ventilazione invasiva	Emogasanalisi arteriosa Pulsossimetria	Aumentare il *delivery* di ossigeno e impedire la vasocostrizione polmonare
Infusione	• Riempimento volemico (cristalloidi, derivati ematici) • Farmaci vasopressori • Terapie specifiche per tipo di shock circolatorio (corticosteroidi, antibioticoterapia, fibrinolitici, ecc.)	Pressione arteriosa cruenta Pressione venosa centrale Emogasanalisi Output urinario	Rendere il paziente indipendente dal precarico con una buona pressione di perfusione
Pompa	• Infusione di inotropi/vasopressori • Dispositivi di supporto meccanico cardio-circolatorio	Pressione arteriosa cruenta Gittata sistolica Emogasanalisi Output urinario	Assicurare un inotropismo adeguato alle esigenze periferiche

S Valente ; G ITAL CARDIOL | VOL 24 FEBBRAIO 2023

Tabella 3. Principali farmaci inopressori, vasopressori e inodilatatori in uso nei vari fenotipi di shock circolatorio. Vengono riportati il sito d'azione, il dosaggio, gli effetti emodinamici e i principali usi clinici.

Farmaco	Sito d'azione	Dosaggio	Effetti emodinamici				Usi clinici
			PA	FC	CO	SVR	
Inopressori							
Noradrenalina	$\alpha_1 > \beta_1 > \beta_2$	0.05-0.5 µg/kg/min	↑↑↑	↑	↑	↑↑↑	• Prima linea shock settico • Tutti i tipi shock circolatorio
Adrenalina	$\alpha_1 = \beta_1 > \beta_2$	0.01-0.5 µg/kg/min	↑↑	↑↑	↑↑	↑↑	• Shock cardiogeno • Shock settico • Shock anafilattico
Dopamina	Recettori dopaminergici	0.5-3 µg/kg/min	=	=	↑	=/ ↓	Scarse evidenze a supporto
Dopamina	$\beta_1 > \alpha_1$	4.0-10 µg/kg/min	↑	↑	↑	↑	Scarse evidenze a supporto
Vasopressori							
Vasopressina	$V_1 > V_2$	0.02-0.05 U/min	↑↑↑	=/ ↓	=/ ↓	↑↑↑	• 2° linea shock distributivo
Terlipressina	V_1	20-160 µg/h	↑↑↑	=/ ↓	=/ ↓	↑↑↑	• 2° linea shock distributivo
Fenilefrina	α_1	0.1-10 µg/kg/min	↑↑↑	=/ ↓	=/ ↓	↑↑↑	• 2° linea shock distributivo
Inodilatatori							
Dobutamina	$\beta_1 > \beta_2 > \alpha$	2-10 µg/kg/min	=/ ↓	↑	↑↑	↓	• Shock cardiogeno
Levosimendan	Calcio sensibilizzante	0.05-0.2 µg/kg/min	↓	↑	↑↑	↓	• Shock cardiogeno in fase di stabilizzazione
Milrinone	Inibitore PDE3	0.125-0.75 µg/kg/min	↓	↑	↑↑	↓	• Shock cardiogeno destro
Enoximone	Inibitore PDE3	2-10 µg/kg/min	↓	↑	↑↑	↓	• Shock cardiogeno destro

CO, portata cardiaca; FC, frequenza cardiaca; PA, pressione arteriosa; PDE, fosfodiesterasi 3; SVR, resistenze vascolari sistemiche; V, recettore della vasopressina.

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 MARCH 4, 2010 VOL. 362 NO. 9

Comparison of Dopamine and Norepinephrine in the Treatment of Shock

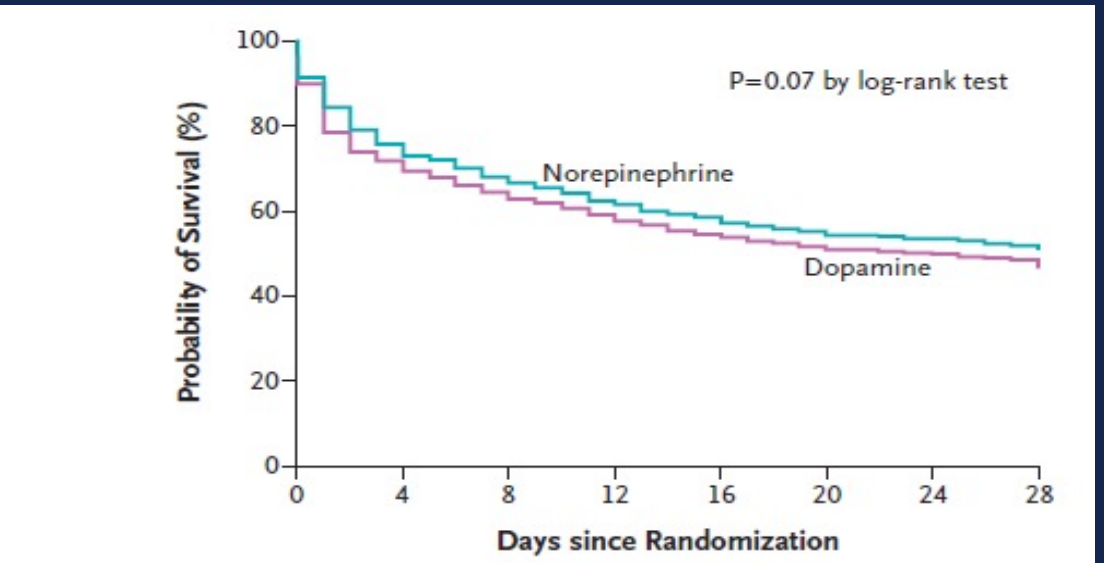


Figure 2. Kaplan–Meier Curves for 28-Day Survival in the Intention-to-Treat Population.

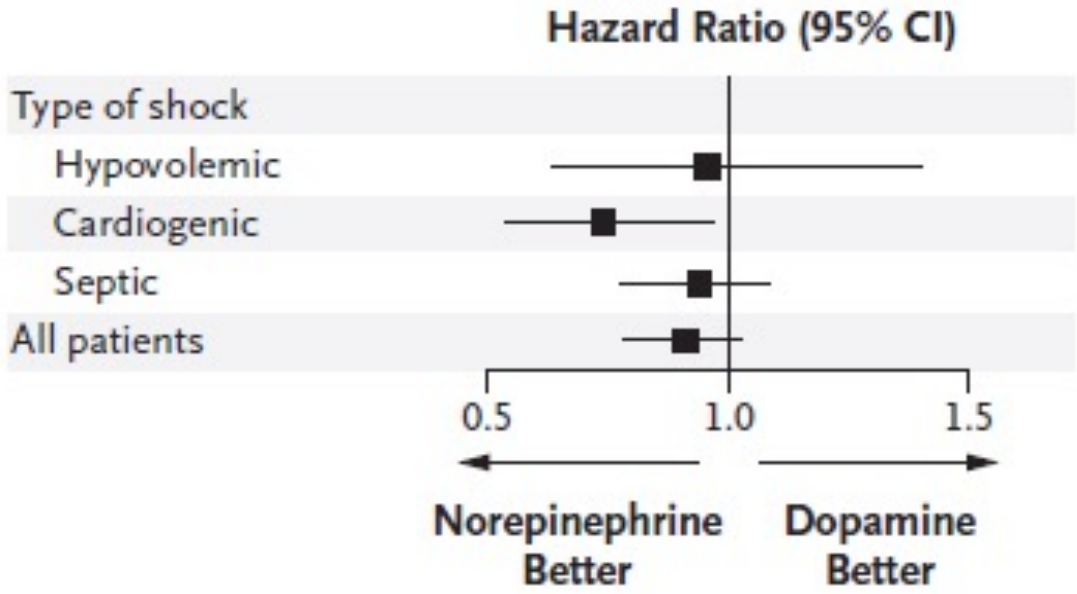
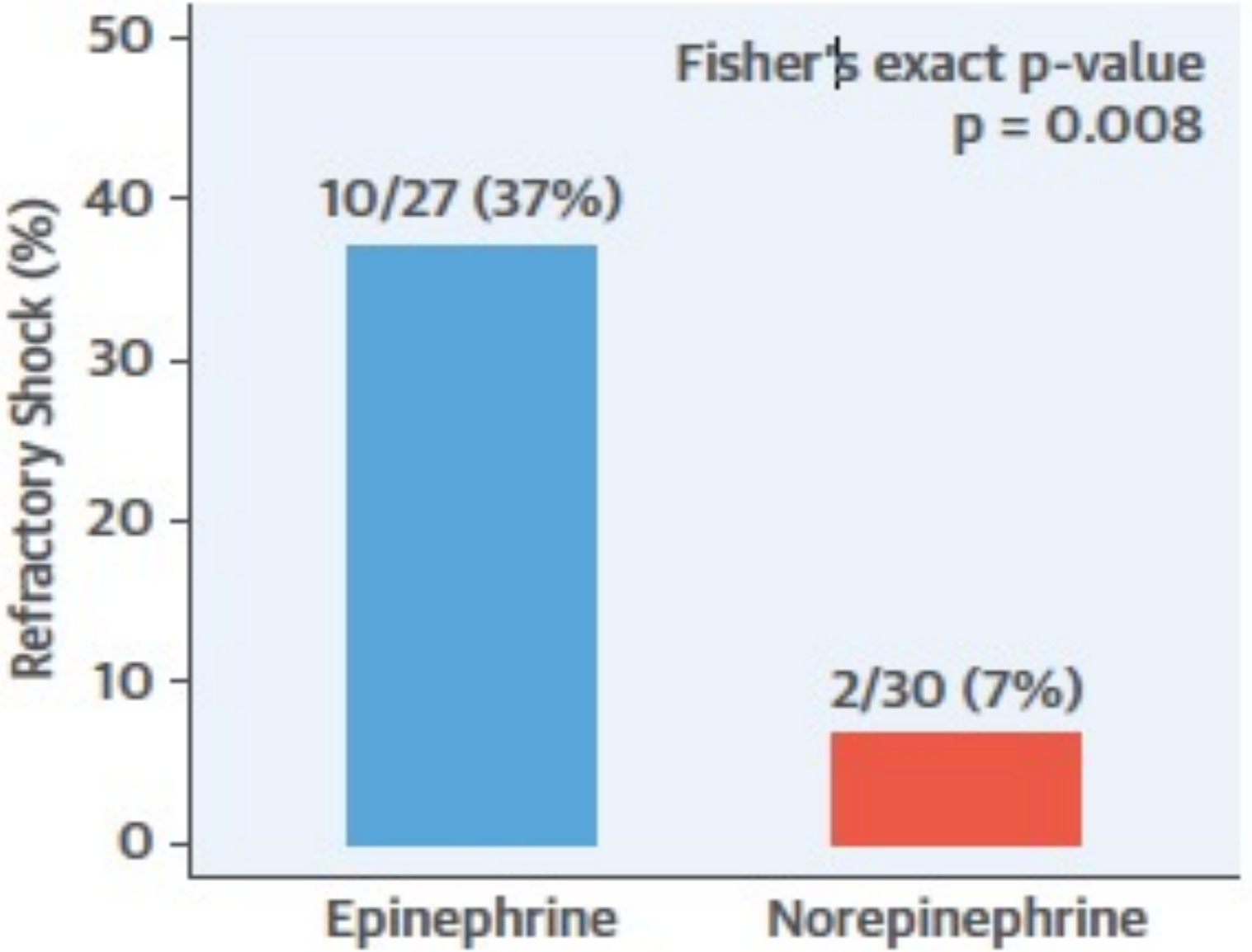
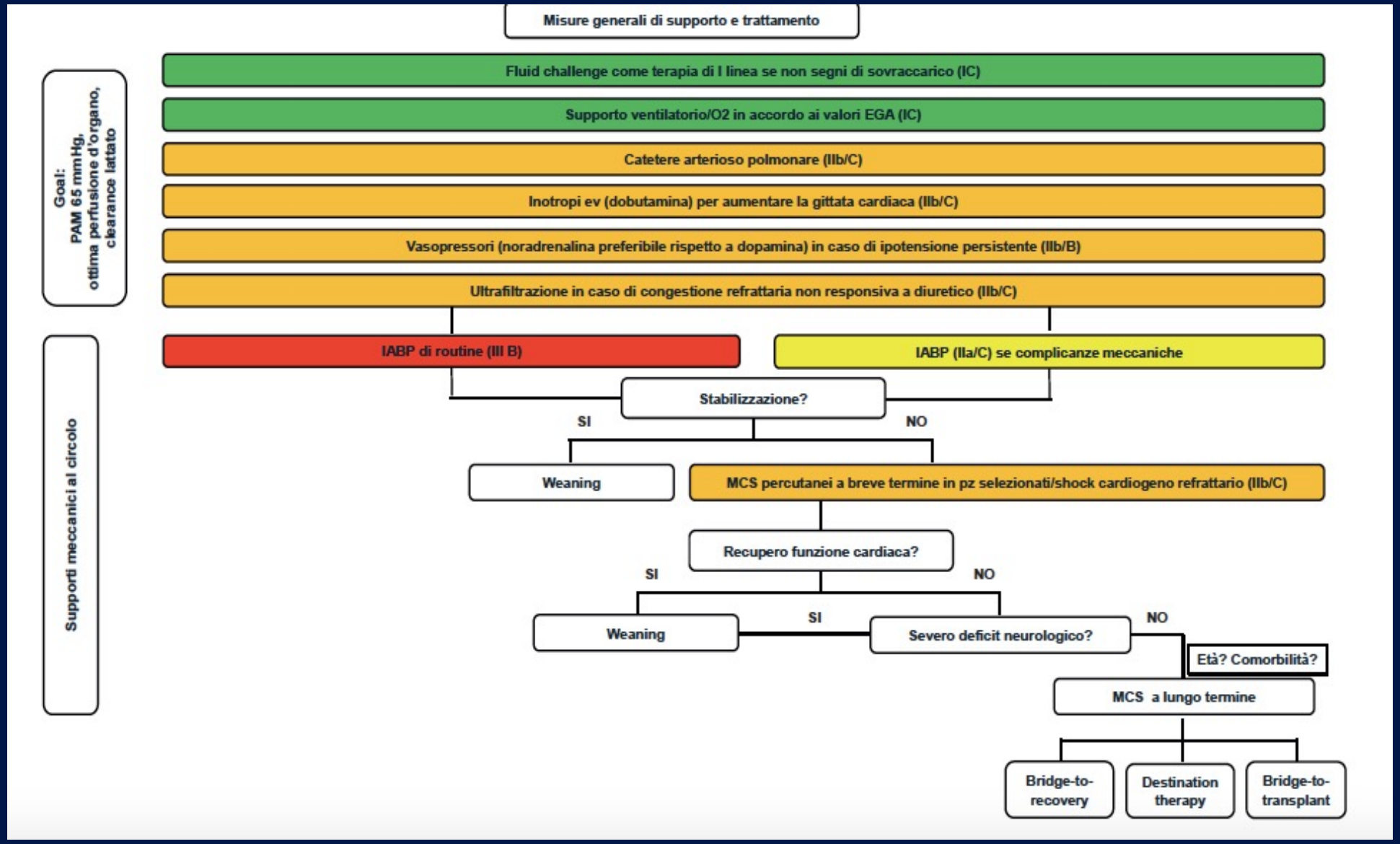


Figure 3. Forest Plot for Predefined Subgroup Analysis According to Type of Shock.


Refractory Shock (%)
50
40
30
20
10
0
Fisher's exact p-value
p = 0.008
10/27 (37%)
2/30 (7%)
Epinephrine
Norepinephrine



S Valente GIC; vol 21; 2020

ESC European Society of Cardiology
European Heart Journal (2023) **00**, 1–107
https://doi.org/10.1093/eurheartj/ehad191

Cardiogenic shock complicating acute coronary syndromes

Recommendations	Class[a]	Level[b]
Immediate coronary angiography and PCI of the IRA (if indicated) is recommended in patients with CS complicating ACS.[394,396,404]	I	B
Emergency CABG is recommended for ACS-related CS if PCI of the IRA is not feasible/unsuccessful.[394,395]	I	B
In cases of haemodynamic instability, emergency surgical/catheter-based repair of mechanical		
In patients with ACS and severe/refractory CS, short-term mechanical circulatory support may be considered.[402]	IIb	C
The routine use of an IABP in ACS patients with CS and without mechanical complications is not recommended.[399,405–407]	III	B

Background MCS : sono un gruppo di device, generalmente usati per meno di 30 giorni, per mantenere un'adeguata perfusione d'organo e «compensare» l'incapacità del cuore a mantenere una portata adeguata.

Tipo di Flusso

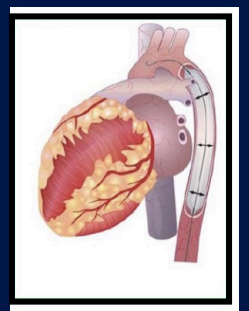
Pompe a flusso continuo

Pulsatile

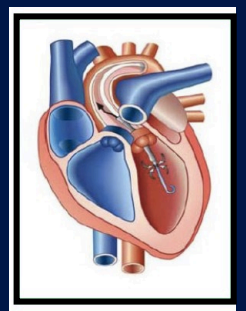
Pompa assiale

Pompa centrifuga

Pompa assiale

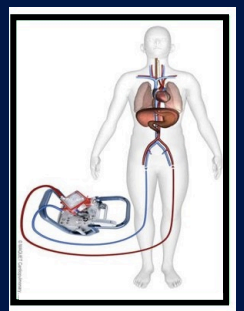


IABP

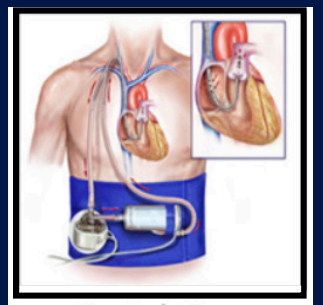


Impella CP

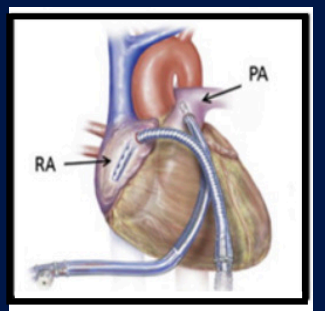
TandemHeart



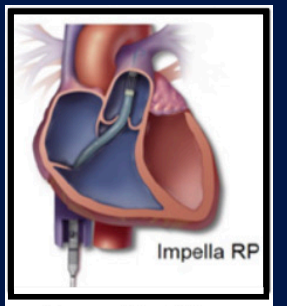
VA-ECMO



Protek Duo



Tandem RVAD



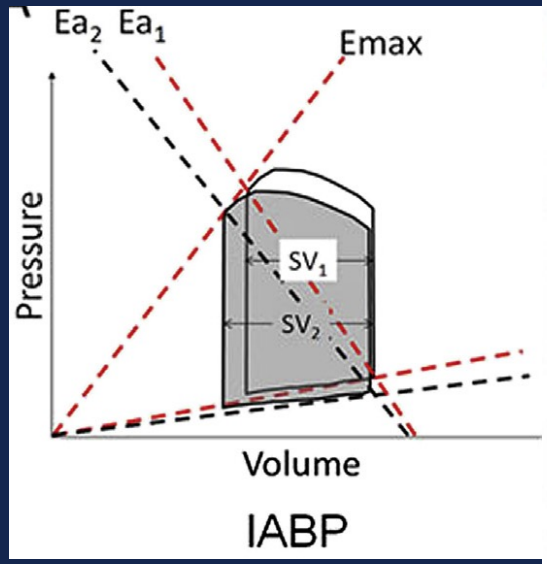
Impella RP

VSn | Biventricolare | VDx

1) <u>Tipo di Flusso</u>: pulsatile vs continuo
2) <u>Tipo di pompa</u>: assiale vs centrifuga
3) <u>Posizione:</u> paracorporea vs extracorporea
4) <u>Assistenza Ventricolare</u> : sin, dx, biventricolare
5) <u>Assistenza circolatoria</u>

Adattata da Kapur N et al, JACC 2016 e da Kapur N et al, Circ 2017

IABP



Rihal CS et al J Am Coll Cardiol 2015;65:e7–26

	IABP
Cardiac Flow	0.3-0.5 L/ min
Mechanism	Aorta
Maximum implant days	Weeks
Sheath size	7-8 Fr
Femoral Artery Size	>4 mm
Cardiac synchrony or stable rhythm	Yes
Afterload	↓
MAP	↑
Cardiac Flow	↑
Cardiac Power	↑
LVEDP	↓
PCWP	↓
LV Preload	---
Coronary Perfusion	↑
Myocardial oxygen demand	↓

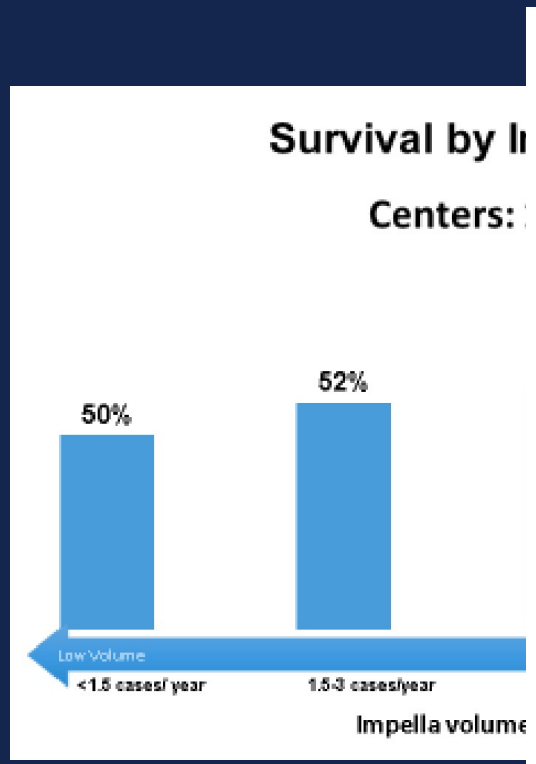
Atkinson et al J Am Coll Cardiol Intv 2016;9:871–83

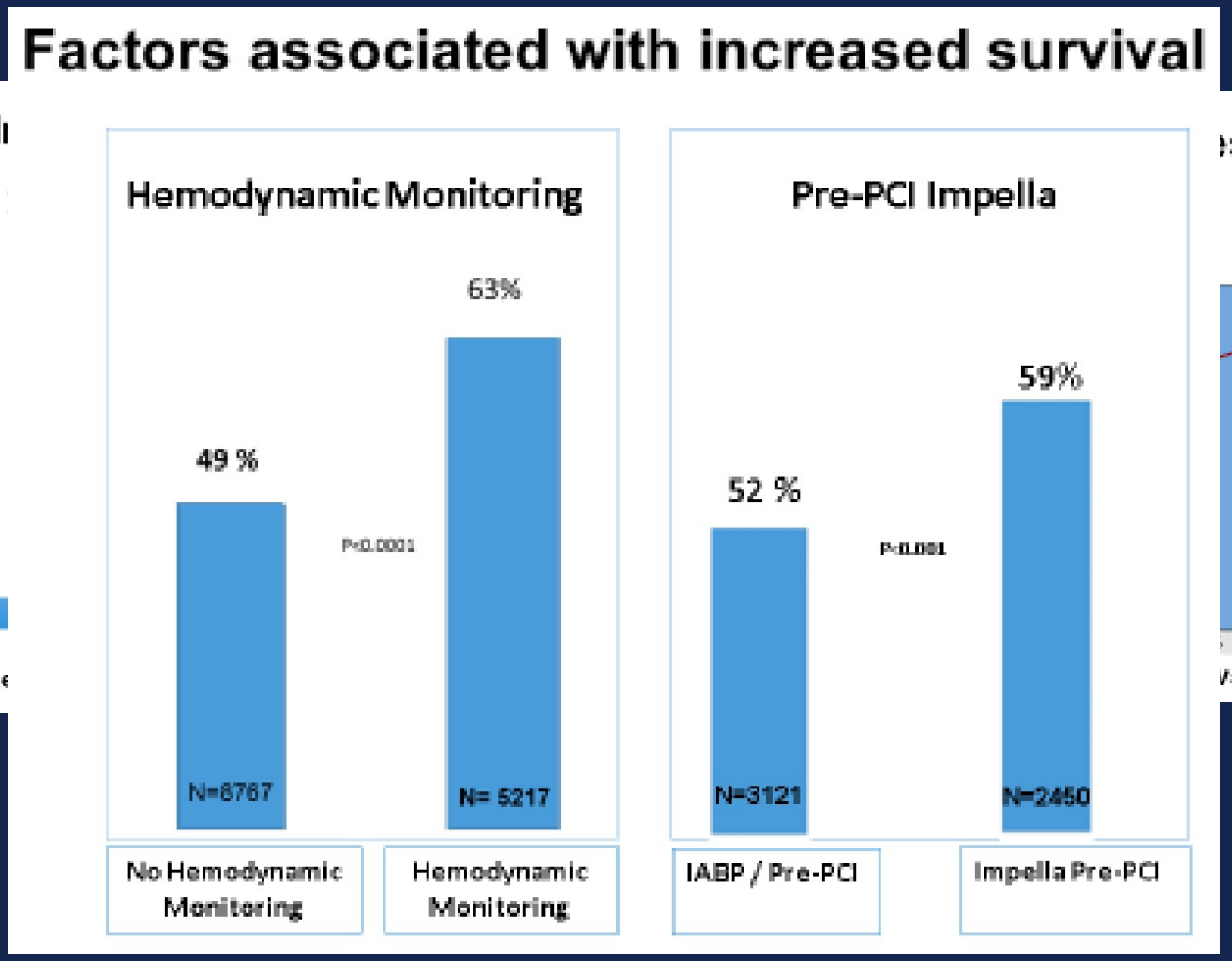
Position paper ANMCO: Ruolo del contropulsatore aortico nel paziente con insufficienza cardiaca acuta avanzata

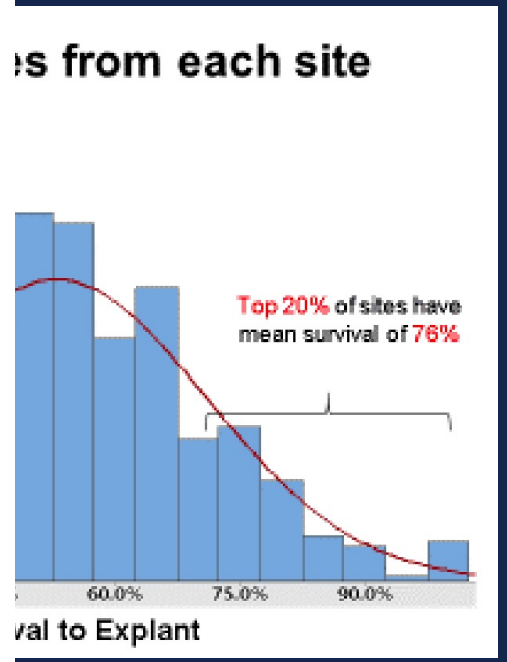
- ***IMA non complicato da SC*** se PCI non efficace o parzialmente efficace (no reflow); se condizione a rischio di shock (stadio A classificazione SCAI)
- ***IMA complicato da SC*** se complicanze meccaniche; se PCI non efficace come bridge to bridge o bridge to decision; se altri sistemi non disponibili o controindicati
- ***SC ad eziologia non ischemica*** nelle fasi precoci (bridge to recovery) o se altri device non disponibili, controindicati (bridge to bridge o bridge to decision), o futili
- ***PCI ad alto rischio*** se altri device non disponibili, non necessari o controindicati
- ***Aritmie ventricolari refrattarie*** come bridge al trattamento
- ***Supporto perioperatorio*** pazienti ad alto rischio sottoposti a cardiochirurgia
- ***Terapia di combinazione con ECMO-VA*** per unloading del ventricolo sinistro

Rossini R et al G Ital Cardiol 2021;22(5):404-423

Analysis of Outcomes for 15,259U.S. Patients with Acute Myocardial Infarction Cardiogenic Shock (AMICS) Supported with the Impella Device



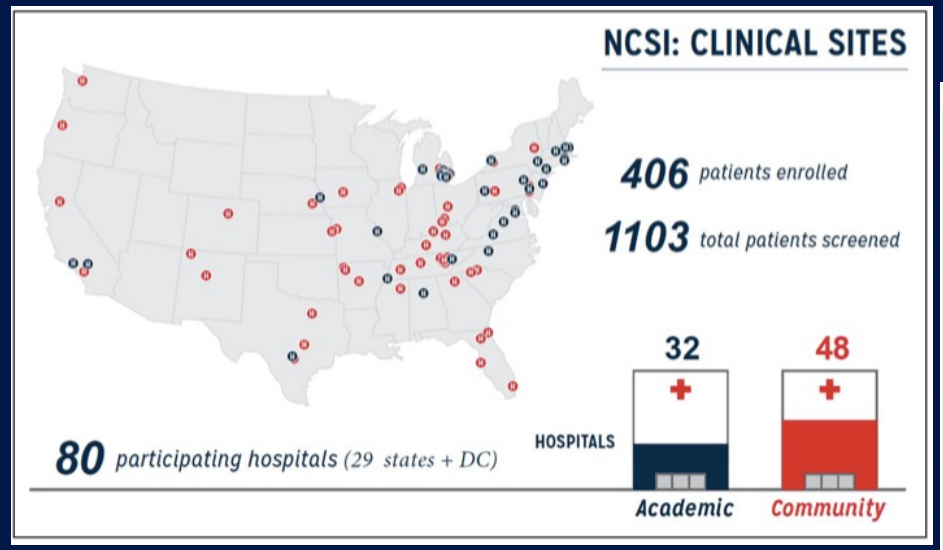


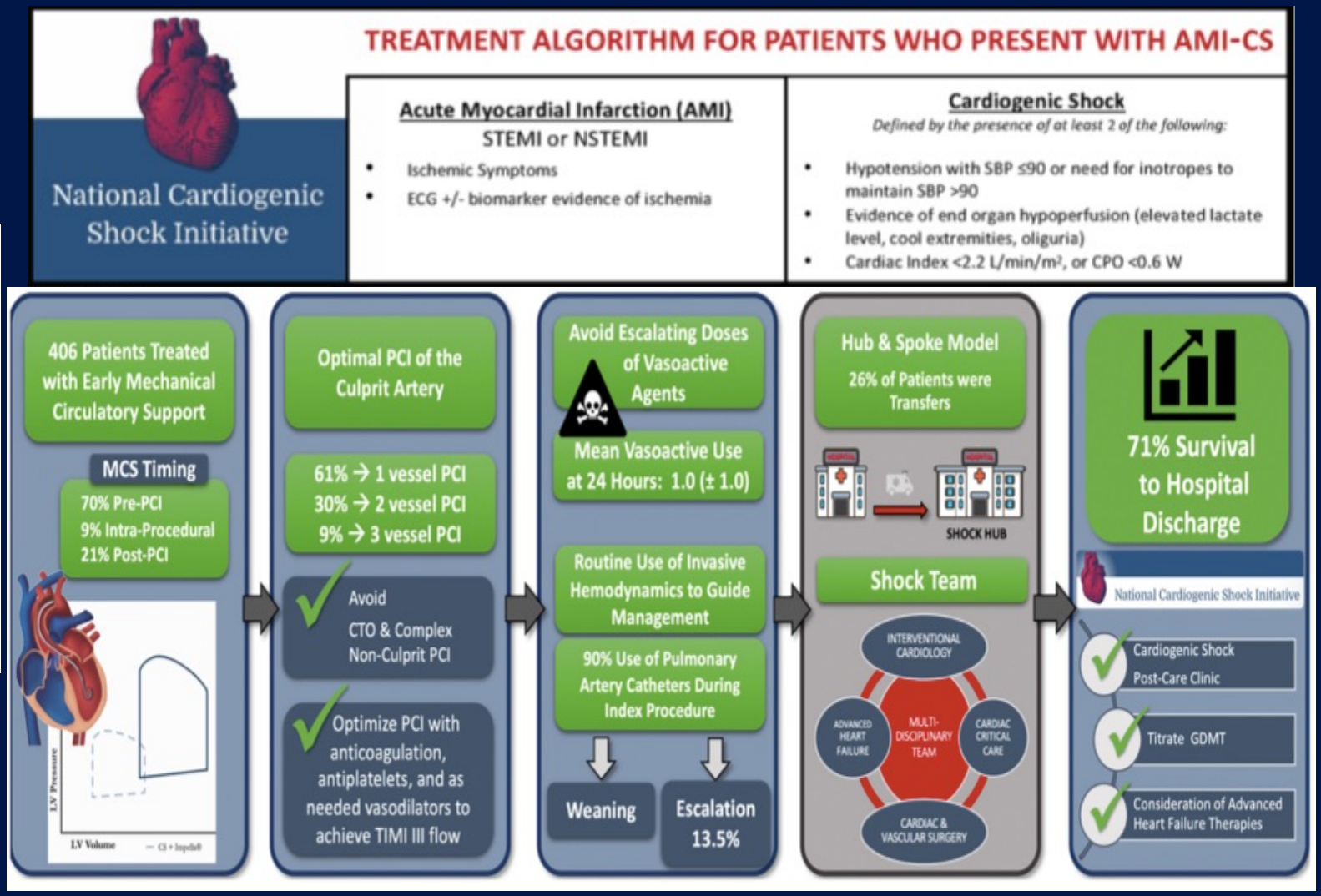


Journal of the American Heart Association

ORIGINAL RESEARCH

Early Utilization of Mechanical Circulatory Support in Acute Myocardial Infarction Complicated by Cardiogenic Shock: The National Cardiogenic Shock Initiative





J Am Heart Assoc. 2023;12:e031401.

ORIGINAL ARTICLE

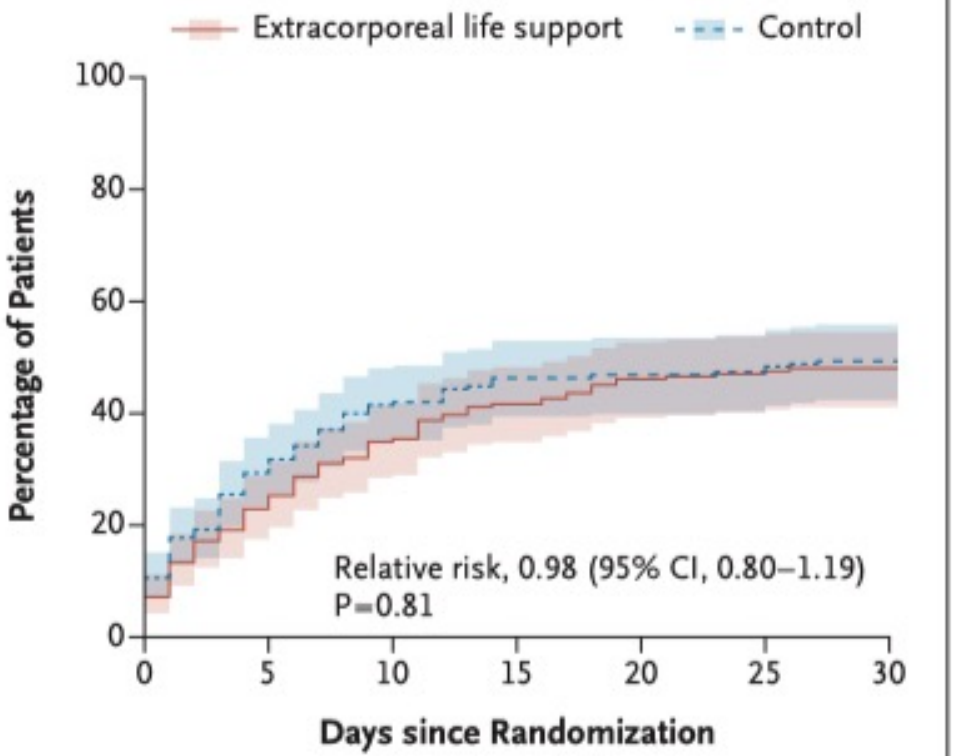
Extracorporeal Life Support in Infarct-Related Cardiogenic Shock

H. Thiele, U. Zeymer, I. Akin, M. Behnes, T. Rassaf, A.A. Mahabadi, R. Lehmann, I. Eitel, T. Graf, T. Seidler, A. Schuster, C. Skurk, D. Duerschmied, P. Clemmensen, M. Hennersdorf, S. Fichtlscherer, I. Voigt, M. Seyfarth, S. John, S. Ewen, A. Linke, E. Tigges, P. Nordbeck, L. Bruch, C. Jung, J. Franz, P. Lauten, T. Goslar, H.-J. Feistritzer, J. Pöss, E. Kirchhof, T. Ouarrak, S. Schneider, S. Desch, and A. Freund, for the ECLS-SHOCK Investigators*

METHODS

In this multicenter trial, patients with acute myocardial infarction complicated by cardiogenic shock for whom early revascularization was planned were randomly assigned to receive early ECLS plus usual medical treatment (ECLS group) or usual medical treatment alone (control group). The primary outcome was death from any cause at 30 days.

August 26, 2023, at NEJM.org.



No. at Risk

Control	208	146	120	109	105	104	100
Extracorporeal life support	209	161	136	119	109	107	105

Figure 1. Death from Any Cause at 30 Days.

Shown are the time-to-event curves for death from any cause at 30 days (the primary outcome) among the patients who received extracorporeal life support plus medical therapy as compared with those who received only medical therapy (control). The shaded areas indicate the 95% confidence intervals.

ORIGINAL RESEARCH ARTICLE

Extracorporeal Membrane Oxygenation in the Therapy of Cardiogenic Shock: Results of the ECMO-CS Randomized Clinical Trial

Circulation. 2023;147:454–464.

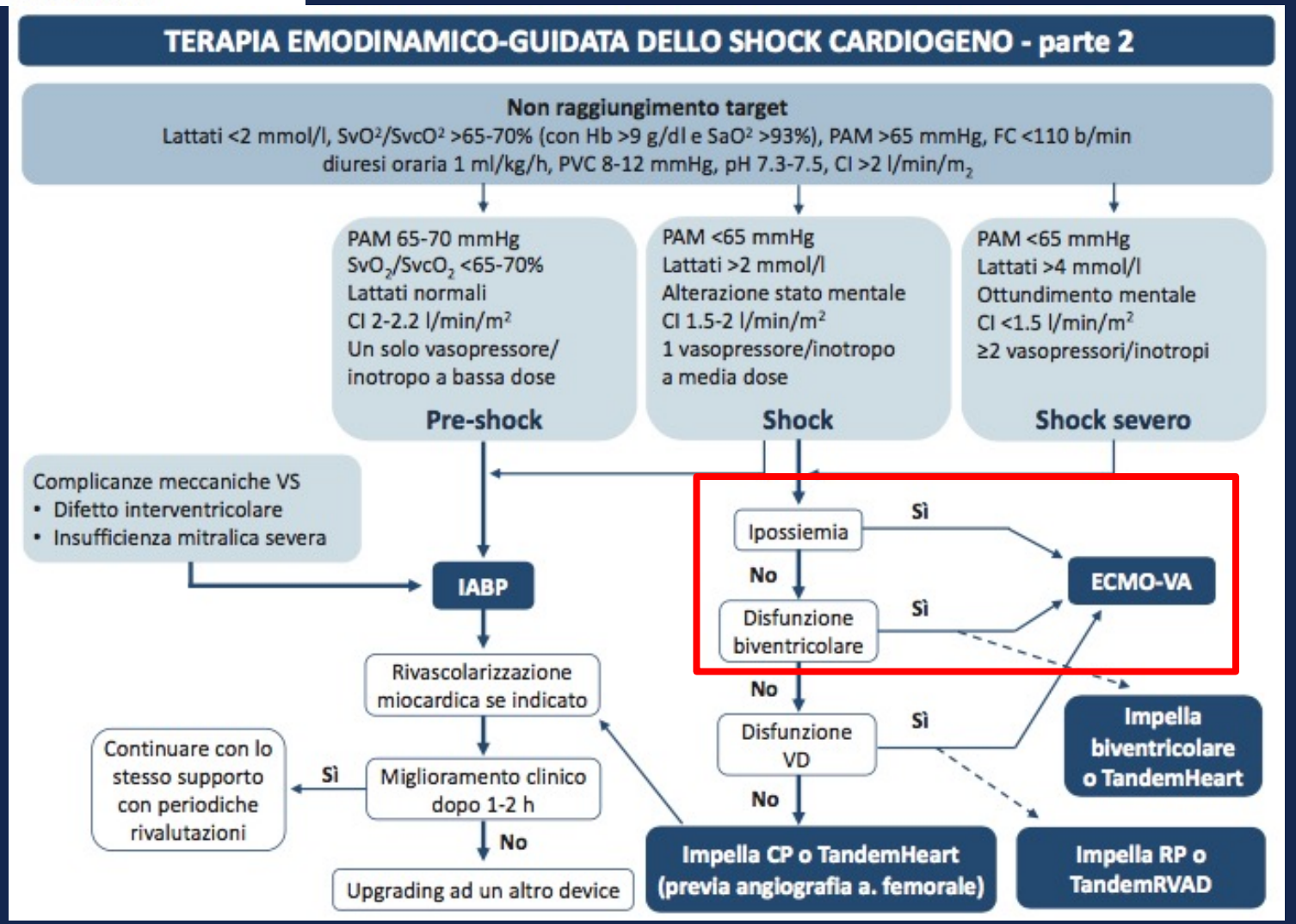
Table 3. Incidence of the Composite Primary End Point, Individual Components of the Composite Primary End Point and Secondary Composite Outcomes

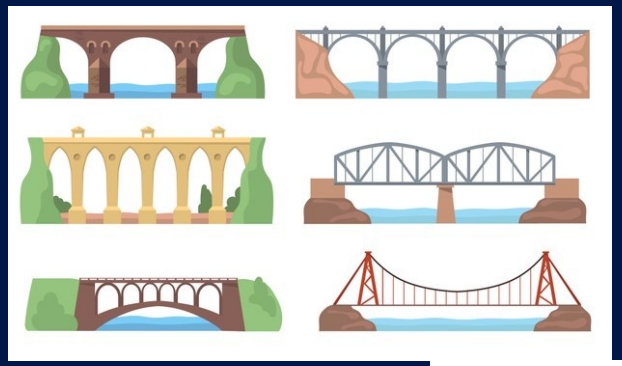
End point, n (%)	VA-ECMO N=58	Conservative N=59	Risk difference (95% CI)	Hazard ratio (95% CI)
Composite primary outcome—composite of death from any cause, implantation of another mechanical circulatory support, resuscitated cardiac arrest	37 (63.8)	42 (71.2)	−7.4 (−24.3 to 9.5)	0.721 (0.463 to 1.123)
Death	29 (50.0)	28 (47.5)	2.5 (−15.6 to 20.7)	1.110 (0.660 to 1.866)
Another mechanical circulatory support	10 (17.2)	25 (42.4)	−25.1 (−41.1 to −9.2)	0.380 (0.182 to 0.793)
Resuscitated cardiac arrest	6 (10.3)	8 (13.6)	−3.2 (−15.0 to 8.5)	0.790 (0.274 to 2.277)
Composite of death from any cause or resuscitated cardiac arrest	31 (53.4)	32 (54.2)	−0.8 (−18.9 to 17.3)	1.037 (0.633 to 1.700)
Composite of death from any cause, implantation of another mechanical circulatory support, resuscitated cardiac arrest, and serious adverse event	51 (87.9)	50 (84.7)	3.2 (−9.2 to 15.6)	

The primary end point was the composite of death from any cause, resuscitated circulatory arrest, and implementation of another mechanical circulatory support device at 30 days.

Shock cardiogeno: dal trattamento farmacologico all'assistenza meccanica al circolo

Ilaria Battistoni[1*§], Marco Marini[1**§], Alberto Lavorgna[2**], Fabio Vagnarelli[3**], Fabiana Lucà[4**], Emilia Biscottini[5**], Giorgio Caretta[6**], Vincenza Procaccini[7**], Letizia Riva[8**], Gabriele Vianello[9**], Massimo Iacoviello[10*], Renata De Maria[11**], Alessandro Navazio[12*], Nadia Aspromonte[13***], Andrea Di Lenarda[14****], Michele Massimo Gulizia[15***], Serafina Valente[16*****]





COMMON OBJECTIVES FOR T-MCS

TABLE 2 Common Objectives for Venoarterial Extracorporeal Membrane Oxygenation Insertion

Scenario	Explanation
Bridge to recovery	Temporize circulatory support while definitive and supportive treatment strategies are deployed to restore myocardial recovery and achieve successful weaning
Bridge to decision	To determine the reversibility of end-organ damage commonly seen after a catastrophic or critical myocardial event or to decide the next level of action
Bridge to bridge	To achieve a brief stability for end-organ perfusion until more definitive pump support (durable mechanical circulatory support) or cardiac replacement therapy (heart transplant or total artificial heart) is performed
Bridge to transplant	To achieve a brief stability for end-organ perfusion until cardiac transplantation is performed

GRAZIE PER L'ATTENZIONE