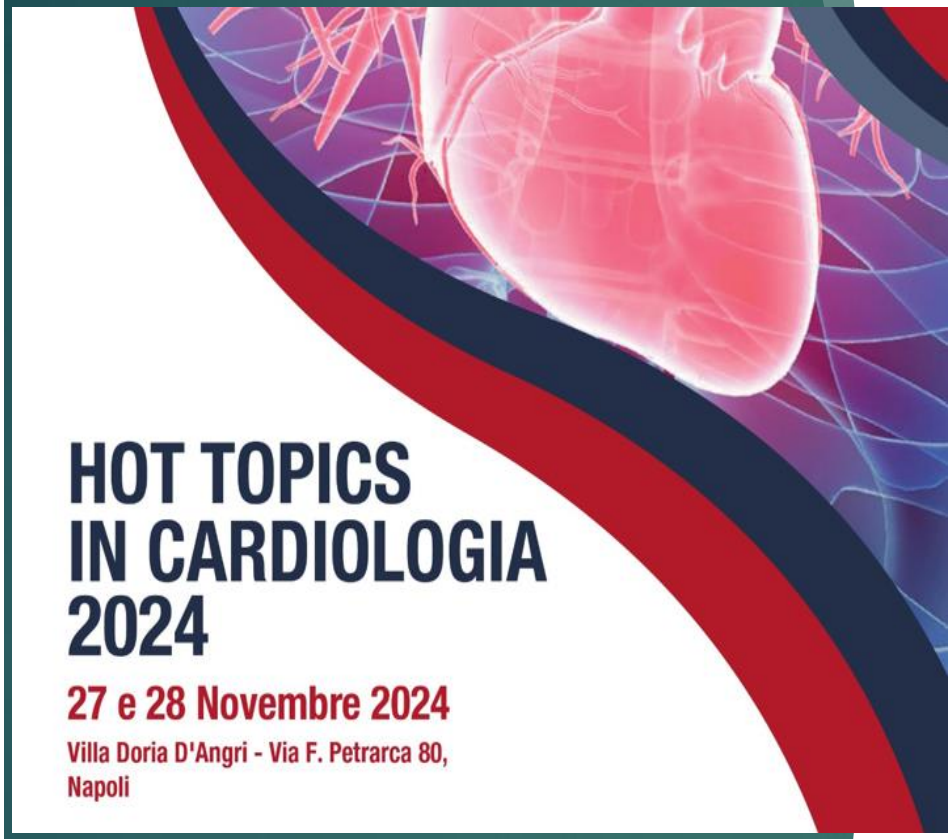

Gestione post-UTIC dei Pazienti con Shock Cardiogeno

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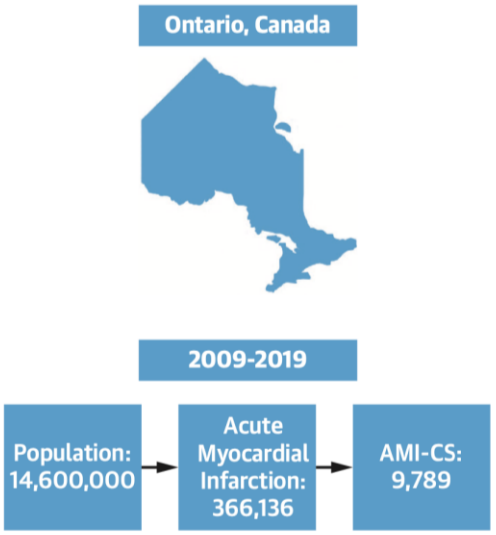
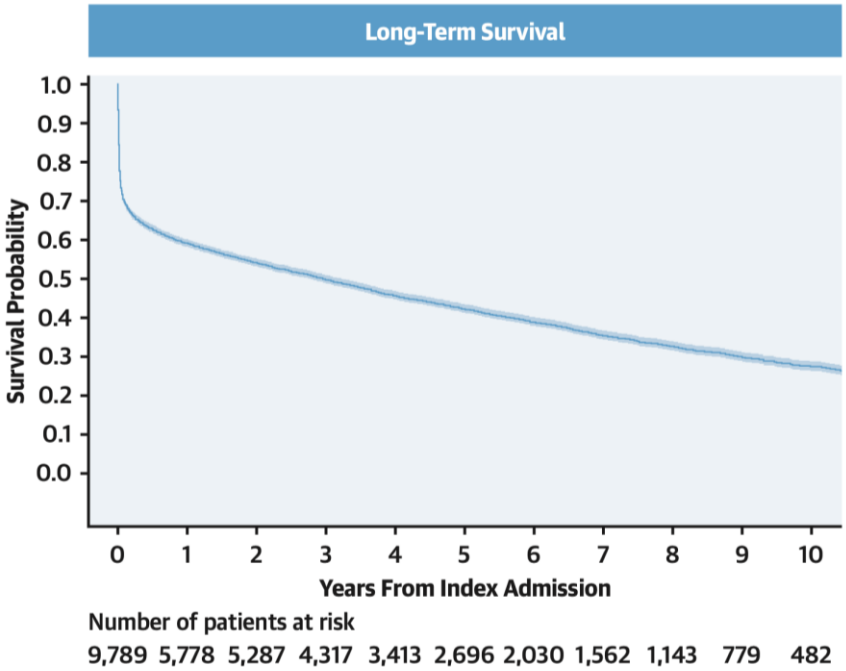
JOURNAL OF THE AMERICAN COLLEGE OF CARDIOLOGY VOL. 82, NO. 10, 2023

Long-Term Outcomes of Cardiogenic Shock Complicating Myocardial Infarction

Lee H. Sterling, MDCM,[a,*] Shannon M. Fernando, MD, MS,[a,b,c,d,*] Robert Talarico, MS,[d,e] Danial Qureshi, MS,[d,e,f] Sean van Diepen, MD, MS,[g,h,i] Margaret S. Herridge, MD, MS, MPH,[j,k,l] Susanna Price, MD, PhD,[m,n] Daniel Brodie, MD,[o] Eddy Fan, MD, PhD,[j,k,l] Pietro Di Santo, MD,[a,b] Richard G. Jung, MD, PhD,[a] Simon Parlow, MD,[a] Mir B. Basir, DO,[p] Damon C. Scales, MD, PhD,[e,j,q,r] Alain Combes, MD, PhD,[s,t] Rebecca Mathew, MD,[a] Holger Thiele, MD,[u] Peter Tanuseputro, MD, MHS,[d,e,f,v,†] Benjamin Hibbert, MD, PhD[a,w,†]





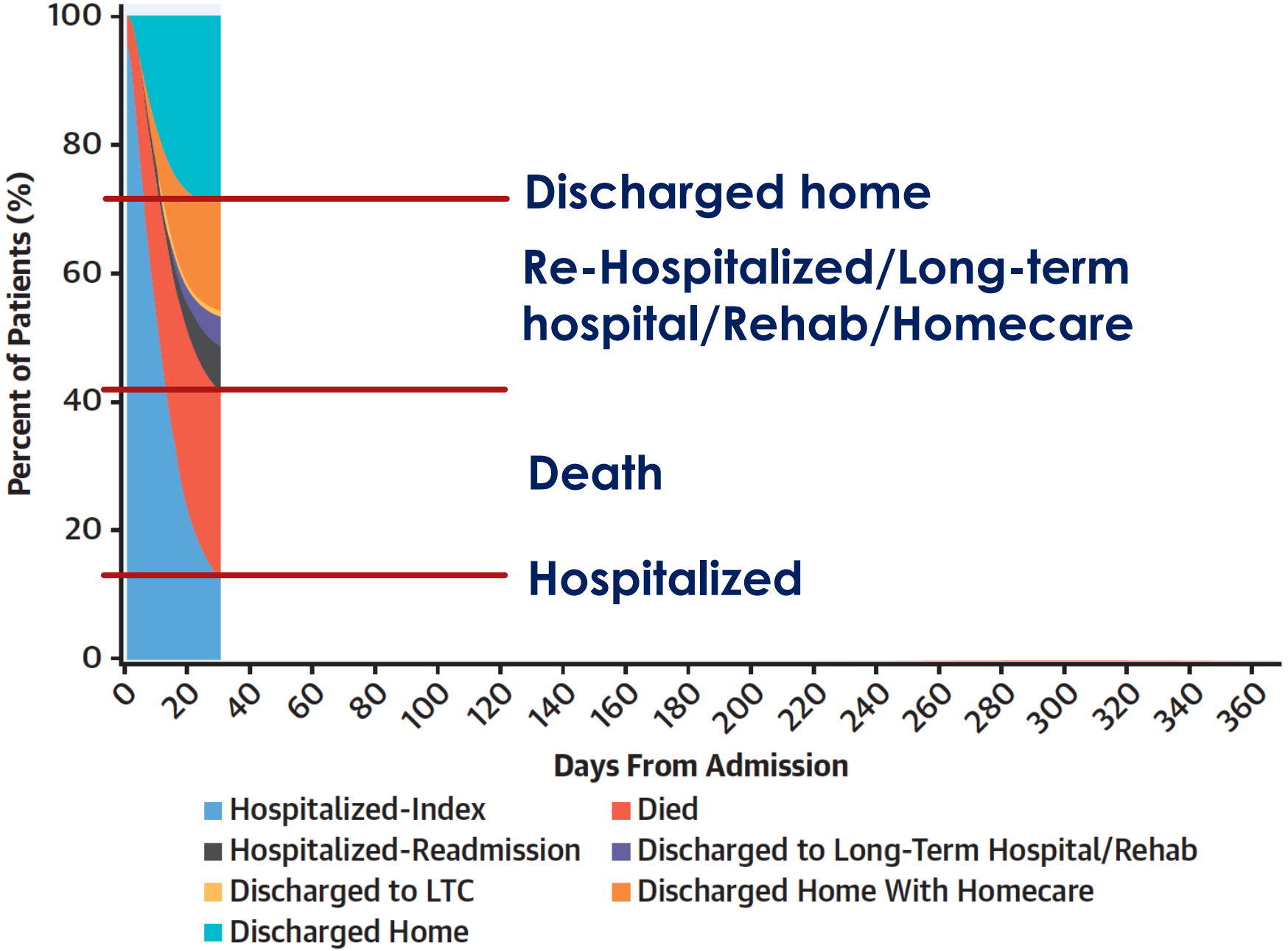
Sterling LH, et al. J Am Coll Cardiol. 2023;82(10):985–995.

TABLE 2 Index Admission Characteristics Among Patients With Cardiogenic Shock Complicating Acute Myocardial Infarction in Ontario

	Total (N = 9,789)	Survivors (n = 6,828)	Nonsurvivors (n = 2,961)	ASD[a]	*P* Value[b]
STEMI	4,347 (44.4)	2,901 (42.5)	1,446 (48.8)	0.13	<0.001
Revascularization strategy					
Coronary angiogram during admission	6,894 (70.4)	5,312 (77.8)	1,582 (53.4)	0.53	<0.001
Coronary angiogram in first 24 h	3,020 (30.9)	2,128 (31.2)	892 (30.1)	0.02	0.306
PCI	4,338 (44.3)	3,192 (46.7)	1,146 (38.7)	0.16	<0.001
CABG	2,058 (21.0)	1,896 (27.8)	162 (5.5)	0.63	<0.001
Length of stay, d					
ICU	5 (3-10)	6 (3-10)	5 (2-10)	0.23	<0.001
Total	12 (6-20)	14 (8-22)	6 (3-14)	0.72	<0.001
MODS at ICU admission	4 (3-6)	4 (2-6)	5 (3-7)	0.42	<0.001
ICU days on vasoactive medications, d	2 (1-4)	2 (1-3)	3 (1-5)	0.28	<0.001
ICU interventions					
Invasive mechanical ventilation	5,422 (55.4)	3,422 (50.1)	2,000 (67.5)	0.36	<0.001
Renal replacement therapy	1,425 (14.6)	807 (11.8)	618 (20.9)	0.25	<0.001
Any mechanical circulatory support	1,484 (15.2)	817 (12.0)	667 (22.5)	0.28	<0.001
IABP	1,464 (15.0)	811 (11.9)	653 (22.1)	0.27	<0.001
Impella	30 (0.3)	6 (0.1)	24 (0.8)	0.11	<0.001
ECMO	30 (0.3)	9 (0.1)	21 (0.7)	0.09	<0.001

Values are n (%) or median (IQR), unless otherwise indicated. [a]ASD between survivors and nonsurvivors; ASD <0.1 implies good balance between 2 groups. [b]*P* value between survivors and nonsurvivors; *P* <0.05 is statistically significant.

ECMO = extracorporeal membrane oxygenation; IABP = intra-aortic balloon pump; ICU = intensive care unit; MI = myocardial infarction; MODS = Multiorgan Dysfunction Score; PCI = percutaneous coronary intervention; STEMI = ST-segment elevation myocardial infarction; other abbreviations as in Table 1.


Discharged home
Re-Hospitalized/Long-term hospital/Rehab/Homecare
Death
Hospitalized
Percent of Patients (%)
100
80
60
40
20
0
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360
Days From Admission
Hospitalized-Index
Hospitalized-Readmission
Discharged to LTC
Discharged Home
Died
Discharged to Long-Term Hospital/Rehab
Discharged Home With Homecare

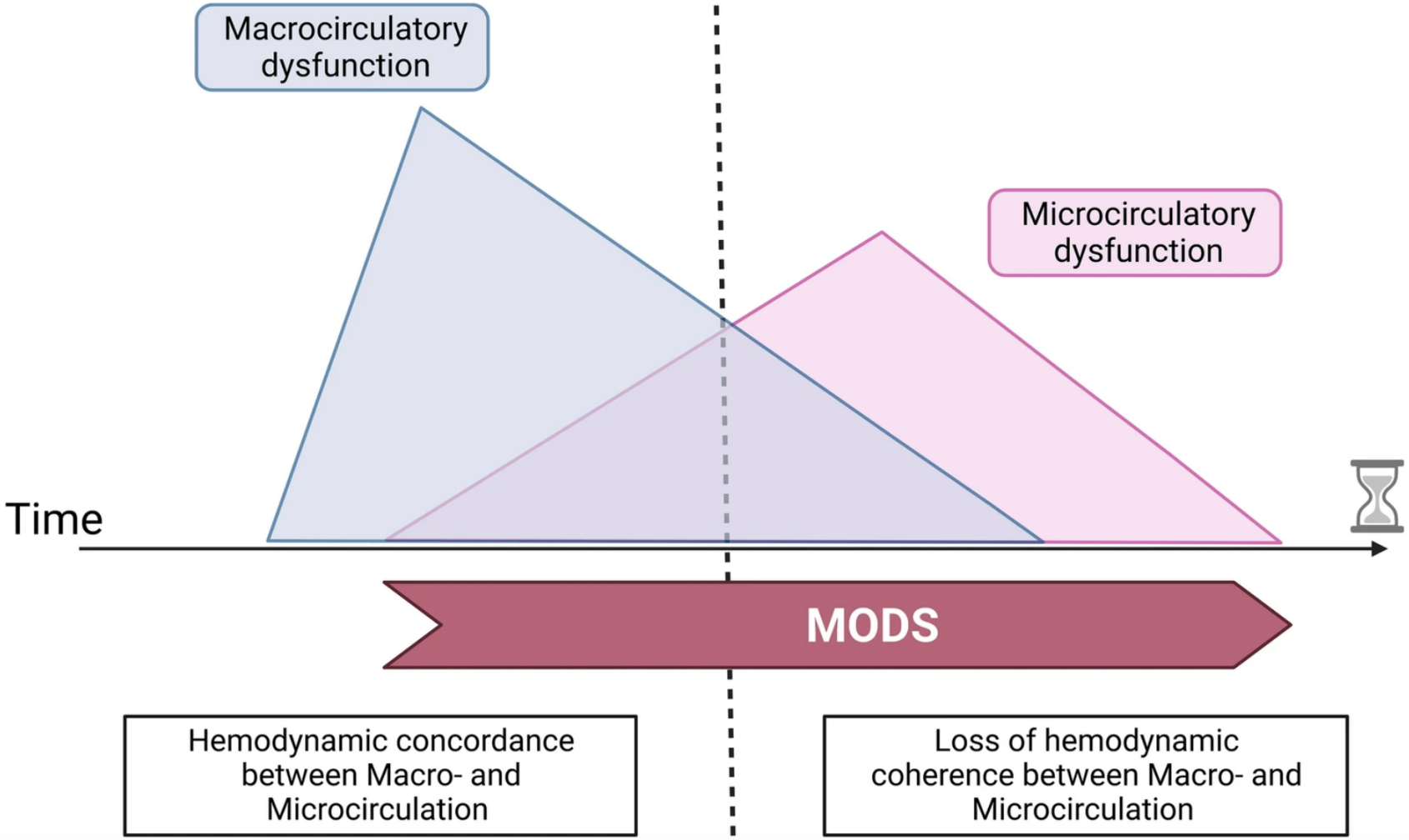
When Can Patients with Cardiogenic Shock be Discharged from ICU?

- Stabilization of vital signs
- Resolution of shock
- Adequate organ perfusion
- Improved cardiac function
- Weaning from mechanical circulatory support or vasopressors
- Recovery of organ systems (i.e. renal and hepatic function)
- Discharge criteria should also consider the **availability of intermediate care facilities** for continued monitoring and rehabilitation.

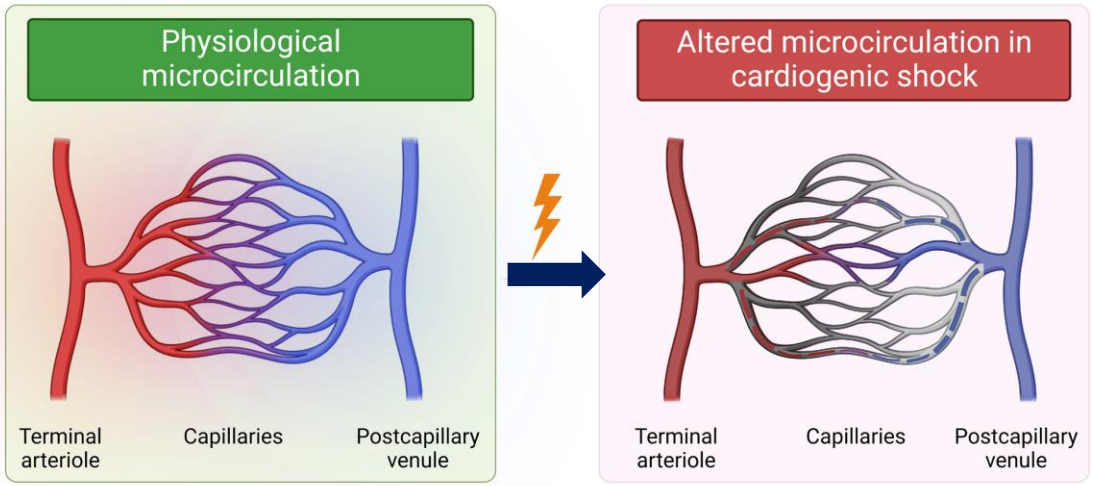
Do All Nonsurvivors of Cardiogenic Shock Die With a Low Cardiac Index?*

Noelle Lim, MBBS, MMed; Marc-Jacques Dubois, MD;
Daniel De Backer, MD, PhD; and Jean-Louis Vincent, MD, PhD, FCCP

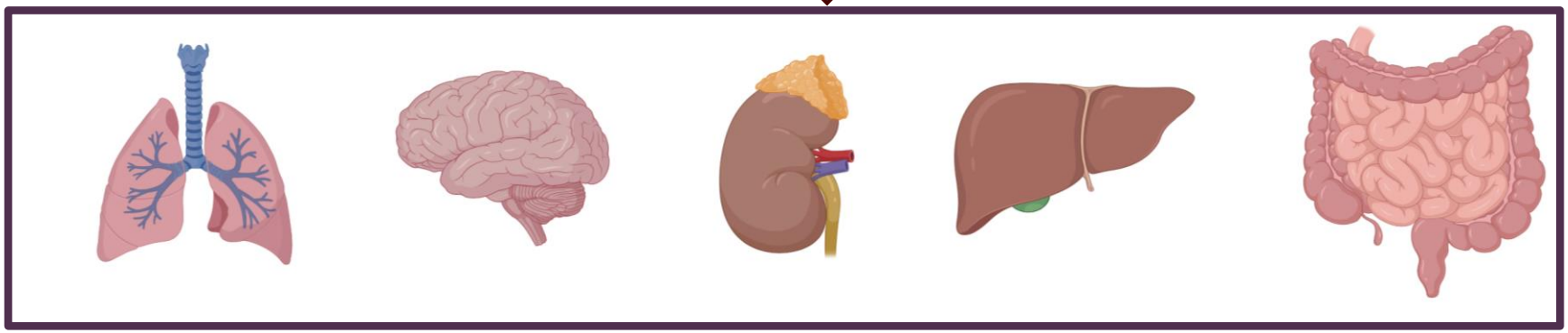
Chest 2003; 124:1885–1891


Macrocirculatory dysfunction
Microcirculatory dysfunction
Time
MODS
Hemodynamic concordance between Macro- and Microcirculation
Loss of hemodynamic coherence between Macro- and Microcirculation

Mechanisms of Microcirculatory Dysfunction in Cardiogenic Shock



- No/Low/ Heterogeneous capillary perfusion
- Stasis
- Shunting area
- Hemodilution of microcirculatory blood
- Capillary leak syndrome



European Heart Journal
Acute Cardiovascular Care
ESC European Society of Cardiology

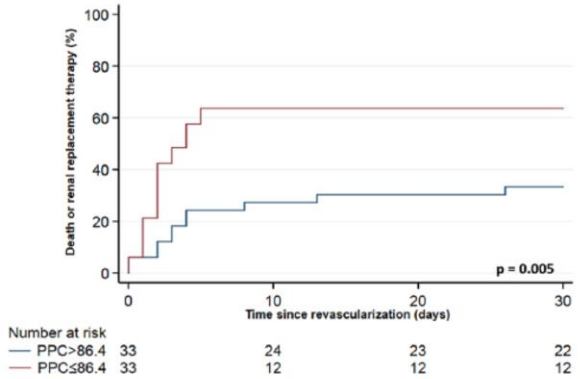
Original scientific paper

European Heart Journal: Acute Cardiovascular Care
2020, Vol. 9(2) 108–119

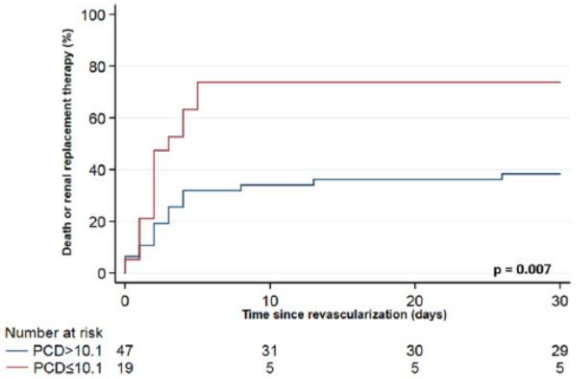
DOI: 10.1177/2048872619870035
journals.sagepub.com/home/acc
SAGE

Prognostic implications of microcirculatory perfusion versus macrocirculatory perfusion in cardiogenic shock: a CULPRIT-SHOCK substudy

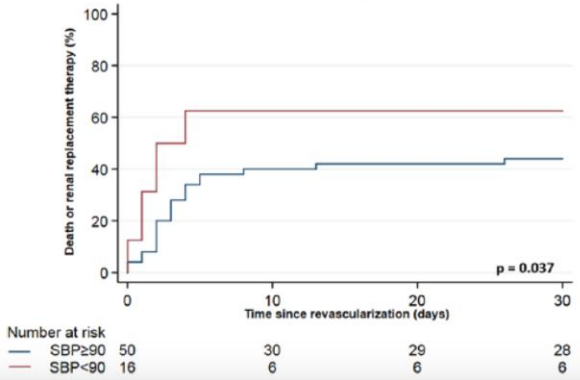
Gilbert WM Wijntjens[1], Karl Fengler[2], Georg Fuernau[3], Christian Jung[4], Corstiaan den Uil[5,6], Sakir Akin[6,7], Tim P van de Hoef[1], Rokas Šerpytis[8], Roberto Diletti[6], José PS Henriques[1], Pranas Šerpytis[8], Holger Thiele[2] and Jan J Piek[1]

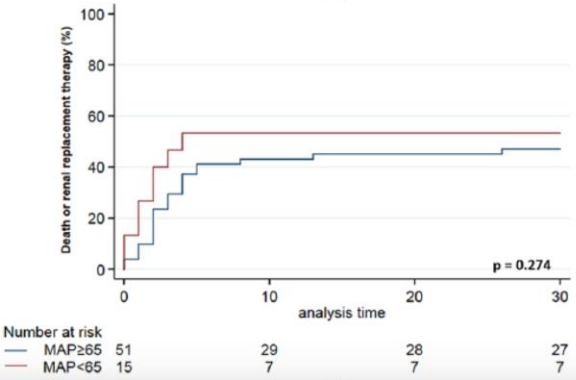


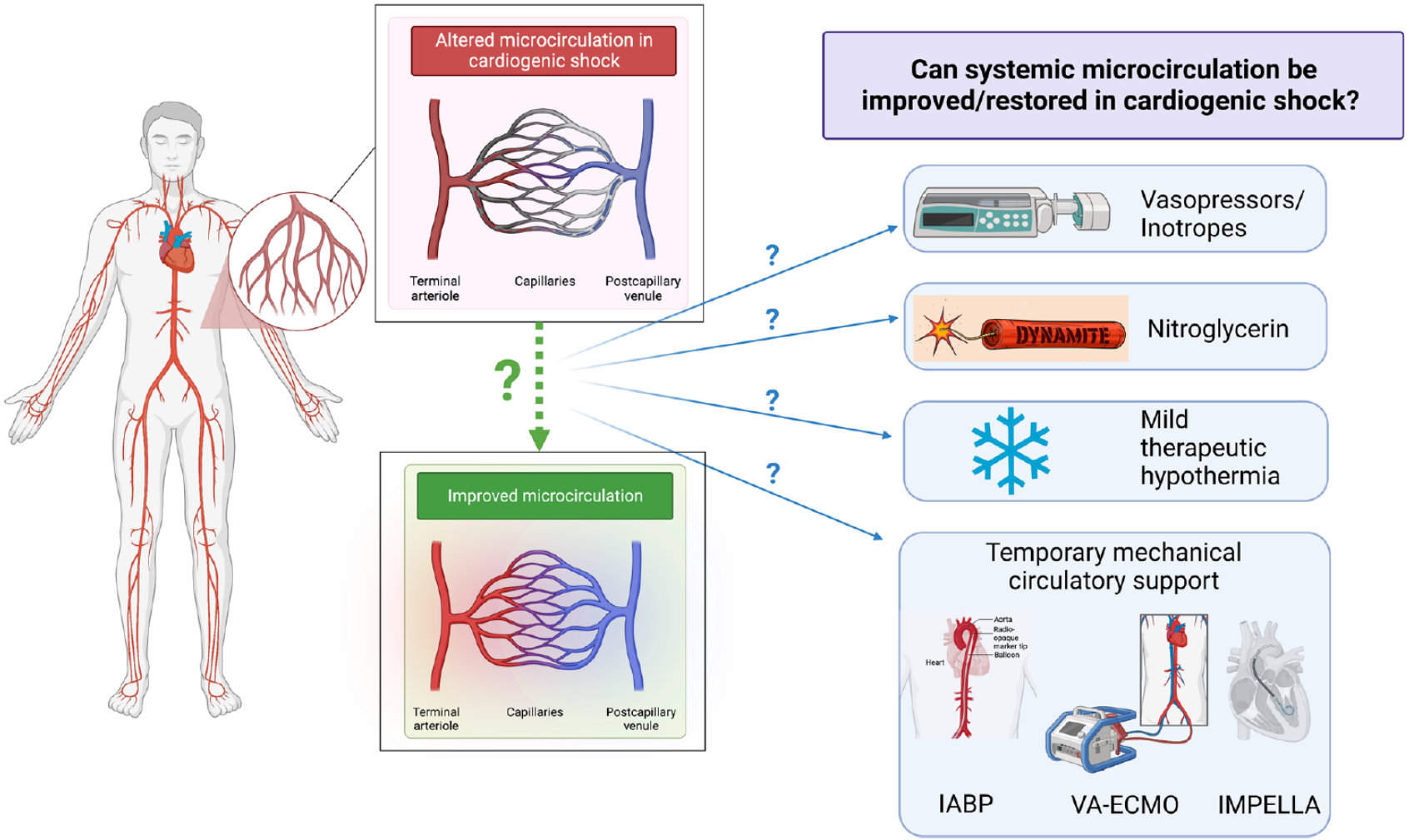
(a)



(b)





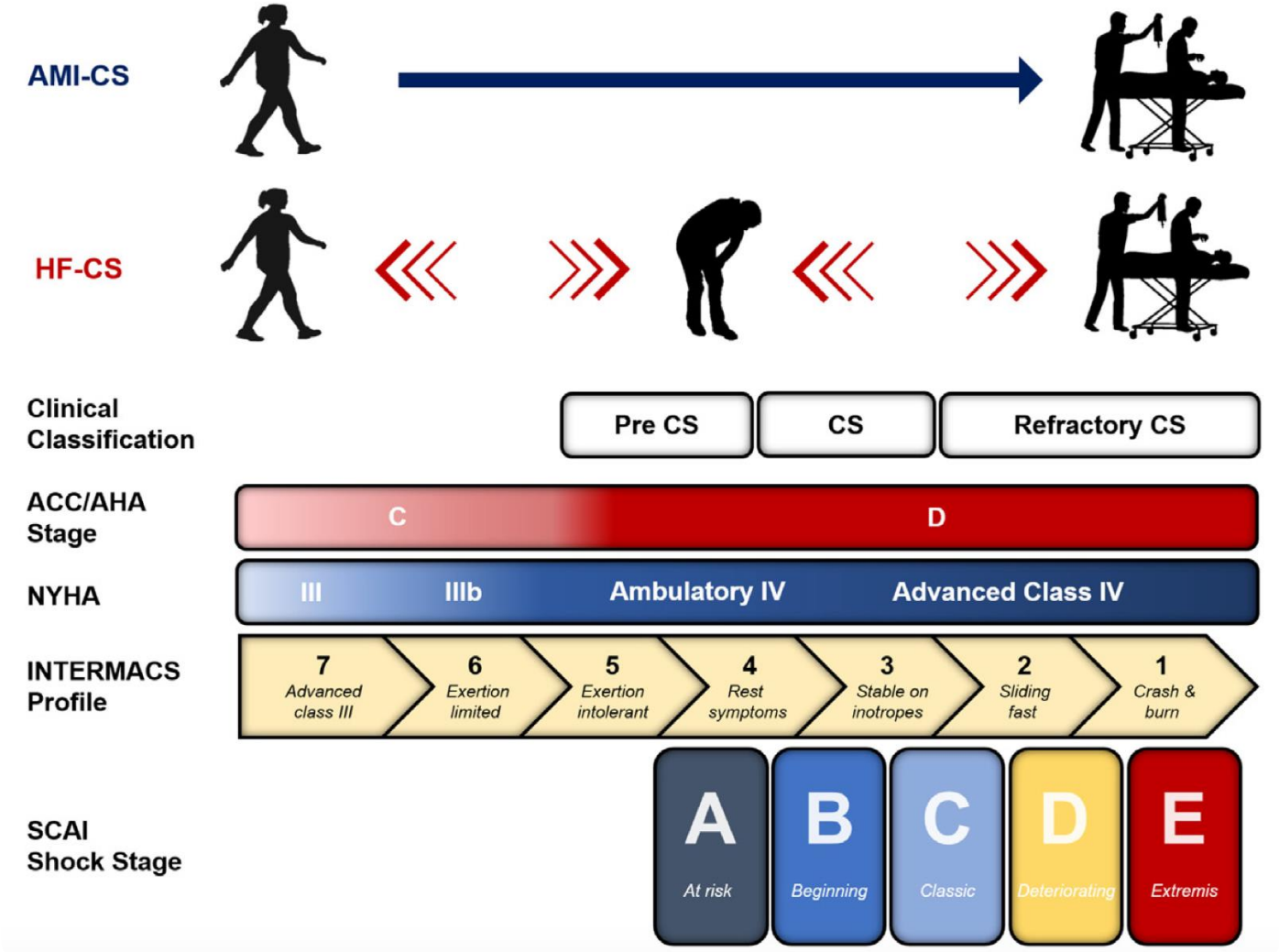

Altered microcirculation in cardiogenic shock
Terminal arteriole
Capillaries
Postcapillary venule
?
Improved microcirculation
Terminal arteriole
Capillaries
Postcapillary venule
Can systemic microcirculation be improved/restored in cardiogenic shock?
?
Vasopressors/ Inotropes
?
DYNAMITE
Nitroglycerin
?
Mild therapeutic hypothermia
?
Temporary mechanical circulatory support
Aorta
Radio-opaque marker tip
Balloon
Heart
IABP
VA-ECMO
IMPELLA

Management of patients recovering from cardiogenic shock after discharge from the ICU:

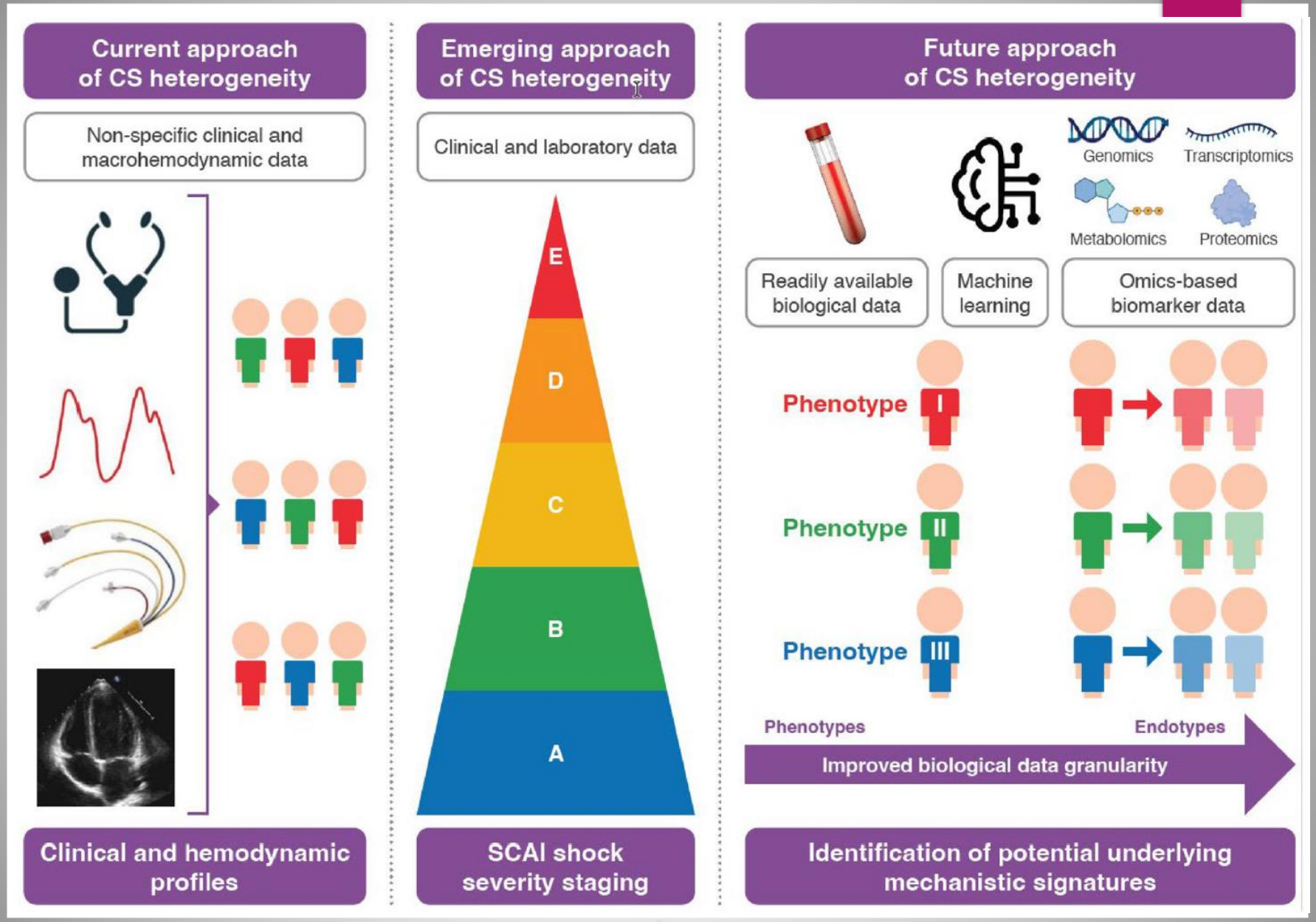
- Addressing the underlying causes
- Preventing recurrence
- Optimizing therapy and cardiac function
- Treating and monitoring complications
- Ensuring rehabilitation to improve quality of life.

A comprehensive, multidisciplinary approach is essential.

Addressing underlying causes

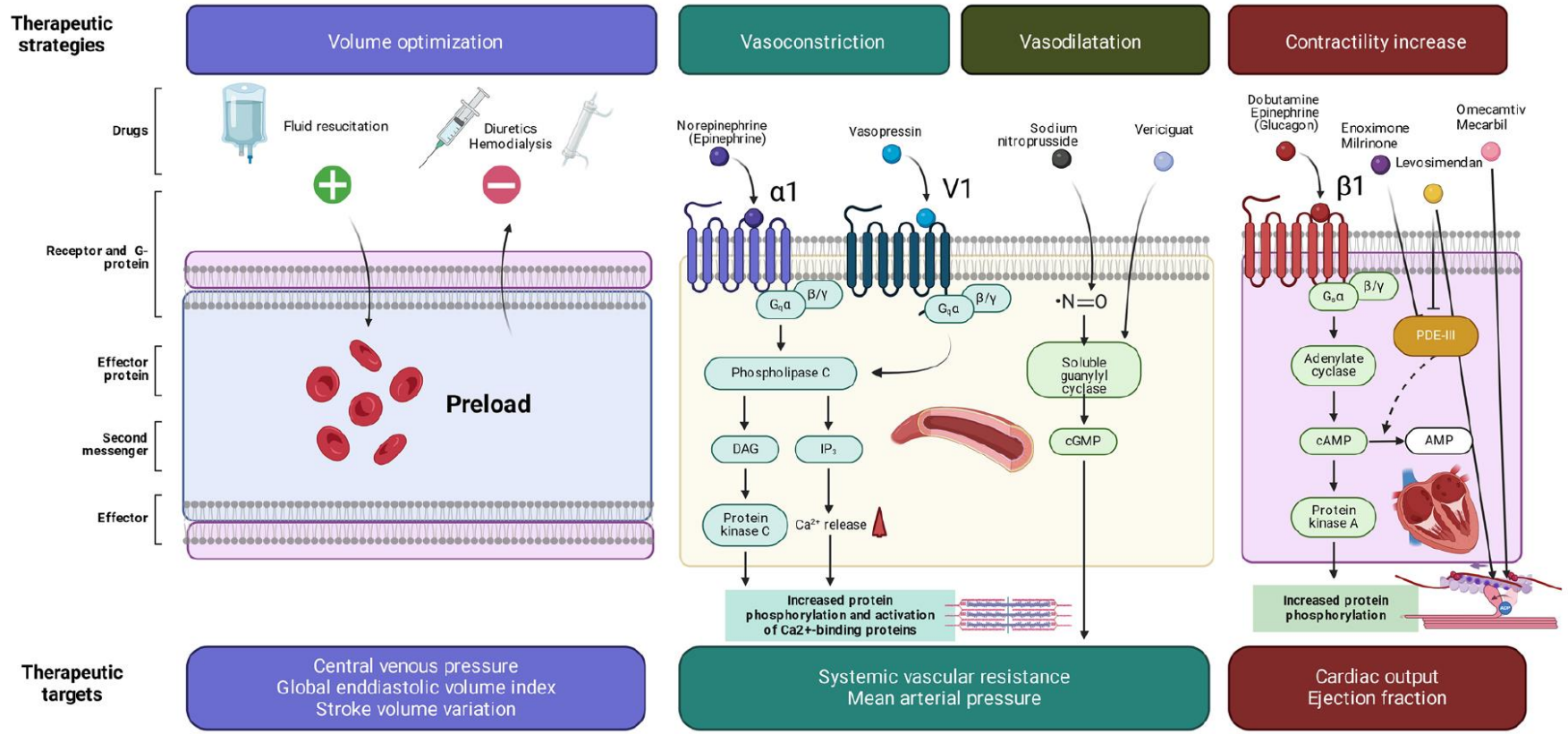


Journal Of Cardiac Failure 2021 27(10): 1126-1132.



Intensive Care Med (2024) 50:1814–1829

Addressing mechanisms



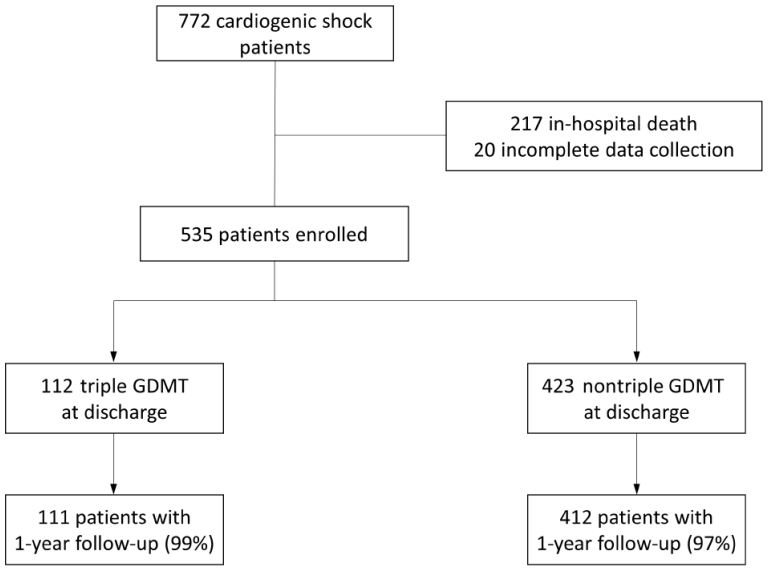
Intensive Care Med (2024) 50:1814–1829

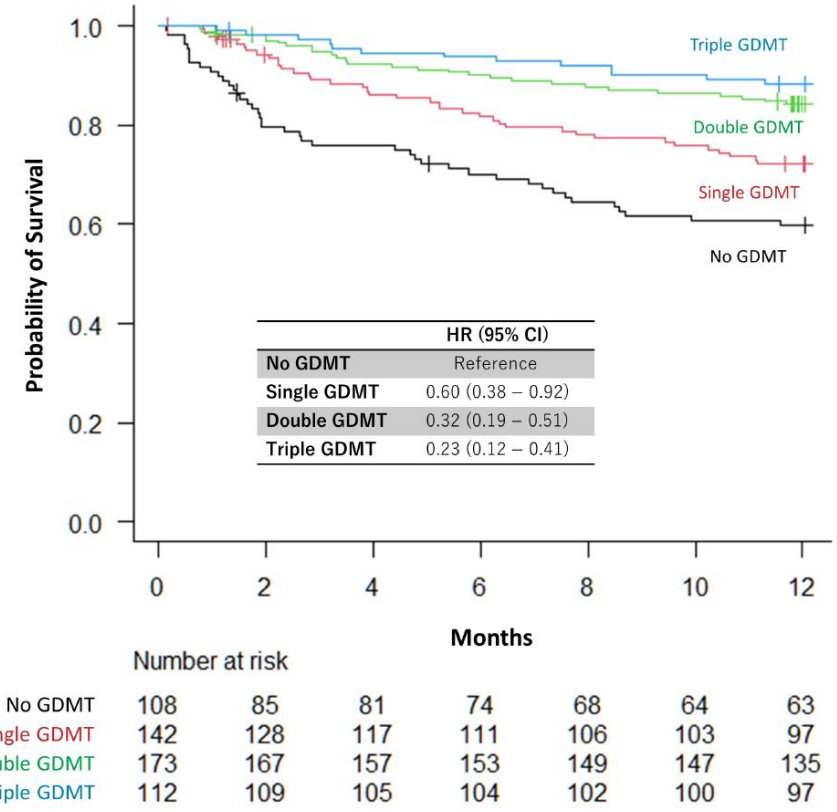
Optimizing therapy

ORIGINAL RESEARCH

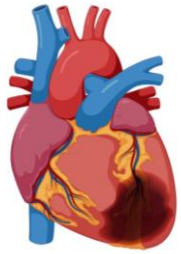
Optimal Heart Failure Medical Therapy and Mortality in Survivors of Cardiogenic Shock: Insights From the FRENSHOCK Registry

Kensuke Matsushita, MD, PhD; Clément Delmas, MD, PhD; Benjamin Marchandot, MD; François Roubille, MD, PhD; Nicolas Lamblin, MD, PhD; Guillaume Leurent, MD, MSc; Bruno Levy, MD, PhD; Meyer Elbaz, MD, MSc; Sebastien Champion, MD; Pascal Lim, MD, PhD; Francis Schneider, MD; Hadi Khachab, MD; Adrien Carmona, MD; Antonin Trimaille, MD, MSc; Jeremy Bourenne, MD, PhD; Marie-France Seronde, MD, PhD; Guillaume Schurtz, MD; Brahim Harbaoui, MD, PhD; Gerald Vanzetto, MD; Caroline Biendel, MD; Vincent Labbe, MD, MSc; Nicolas Combaret, MD, PhD; Jacques Mansourati, MD; Emmanuelle Filippi, MD; Julien Maizel, MD, PhD; Hamid Merdji, MD, PhD; Benoit Lattuca, MD, PhD; Edouard Gerbaud, MD, PhD; Eric Bonnefoy, MD, PhD; Etienne Puymirat, MD, PhD; Laurent Bonello, MD, PhD; Olivier Morel, MD, PhD





Preventing recurrence



- **Frequent Clinical Assessments:**
  Monitoring for signs of recurrent heart failure, arrhythmias, or worsening organ dysfunction.
- **Echocardiography**:
  Serial evaluation of cardiac function, particularly LV function, to guide therapy adjustments.
- **Biomarker Monitoring**:
  Natriuretic peptides (BNP/NT-proBNP) and kidney function for early detection of decompensation.
- **Risk Factor Optimization**
- **Control of Comorbidities**
- **Smoking Cessation**
- **Weight Management**

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*

Mechanisms of Recurrent Ischemia

- Incomplete Revascularization
- Stent Thrombosis
- Progression of Atherosclerosis
- Microvascular Dysfunction
- Increased Myocardial Oxygen Demand

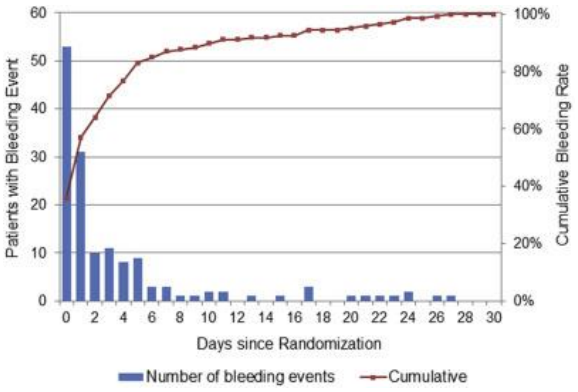
Table 3. Clinical Outcomes at 30 Days.

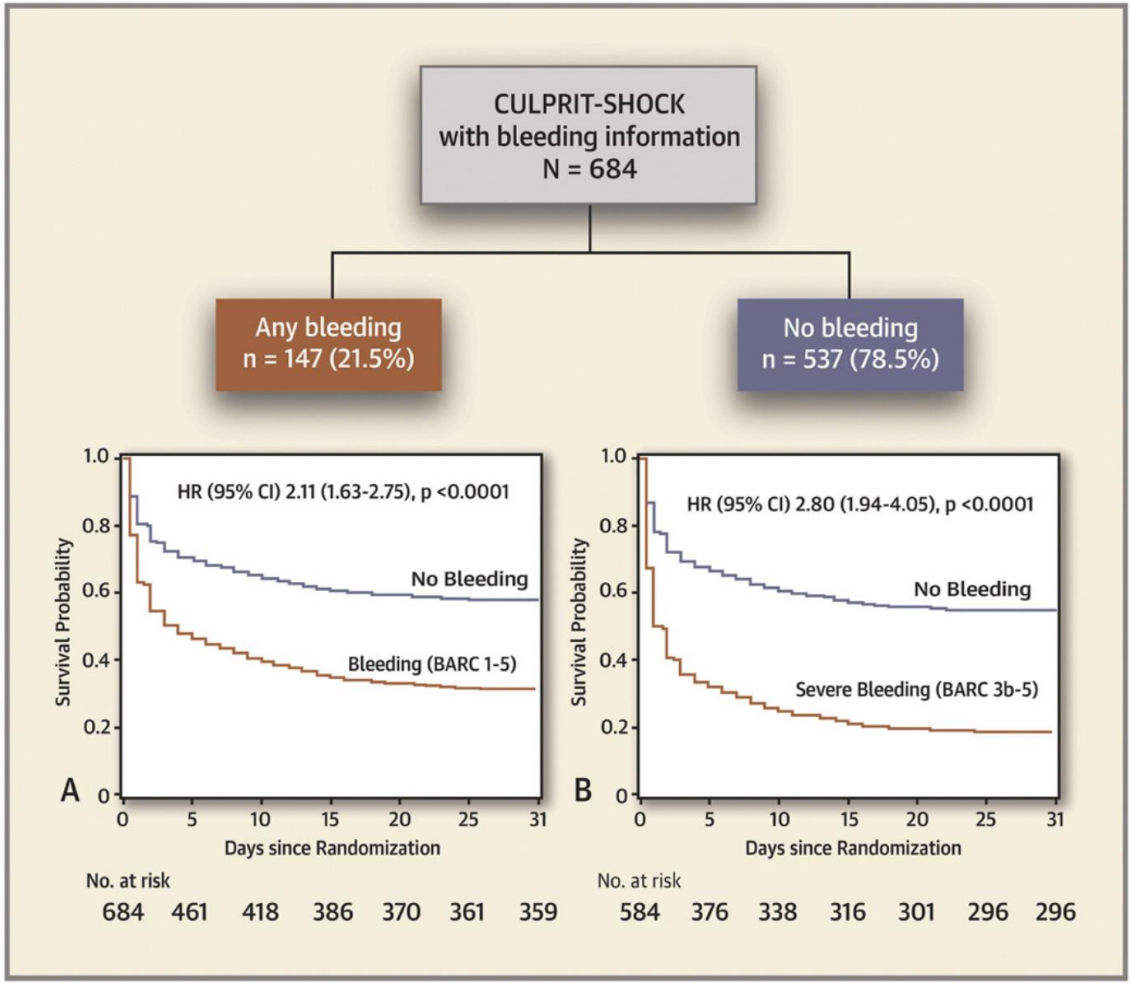
Outcome	Culprit-Lesion-Only PCI Group (N=344)	Multivessel PCI Group (N=341)	Relative Risk (95% CI)	P Value
	no./total no. (%)			
Primary end point: death from any cause or renal-replacement therapy	158/344 (45.9)	189/341 (55.4)	0.83 (0.71–0.96)	0.01
Death from any cause*	149/344 (43.3)	176/341 (51.6)	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)		

* Causes of death are shown in Table S3 in the Supplementary Appendix.

† On the Bleeding Academic Research Consortium (BARC) scale, type 2 indicates any overt, actionable sign of bleeding; type 3a, overt bleeding with a decrease in the hemoglobin level of 3 to less than 5 g per deciliter or any transfusion; type 3b, overt bleeding with a decrease in the hemoglobin level of 5 g or more per deciliter, cardiac tamponade, or surgical intervention; type 3c, intracranial hemorrhage or intraocular bleeding; type 5a, probable fatal bleeding; and type 5b, definite fatal bleeding.

Balancing thrombo-embolic vs. Hemorragic risk



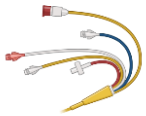


Freund, A. et al. J Am Coll Cardiol Intv. 2020;13(10):1182-93.

Treating and monitoring complications Infective risk

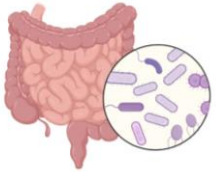
Pneumonia: Frequently ventilator-associated in patients requiring mechanical ventilation.

Bloodstream Infections: Central venous catheter use for monitoring and medication delivery can lead to infections by pathogens such as *Staphylococcus aureus* or *Candida* species.



Urinary Tract Infections: Indwelling urinary catheters commonly lead to hospital-acquired UTIs.

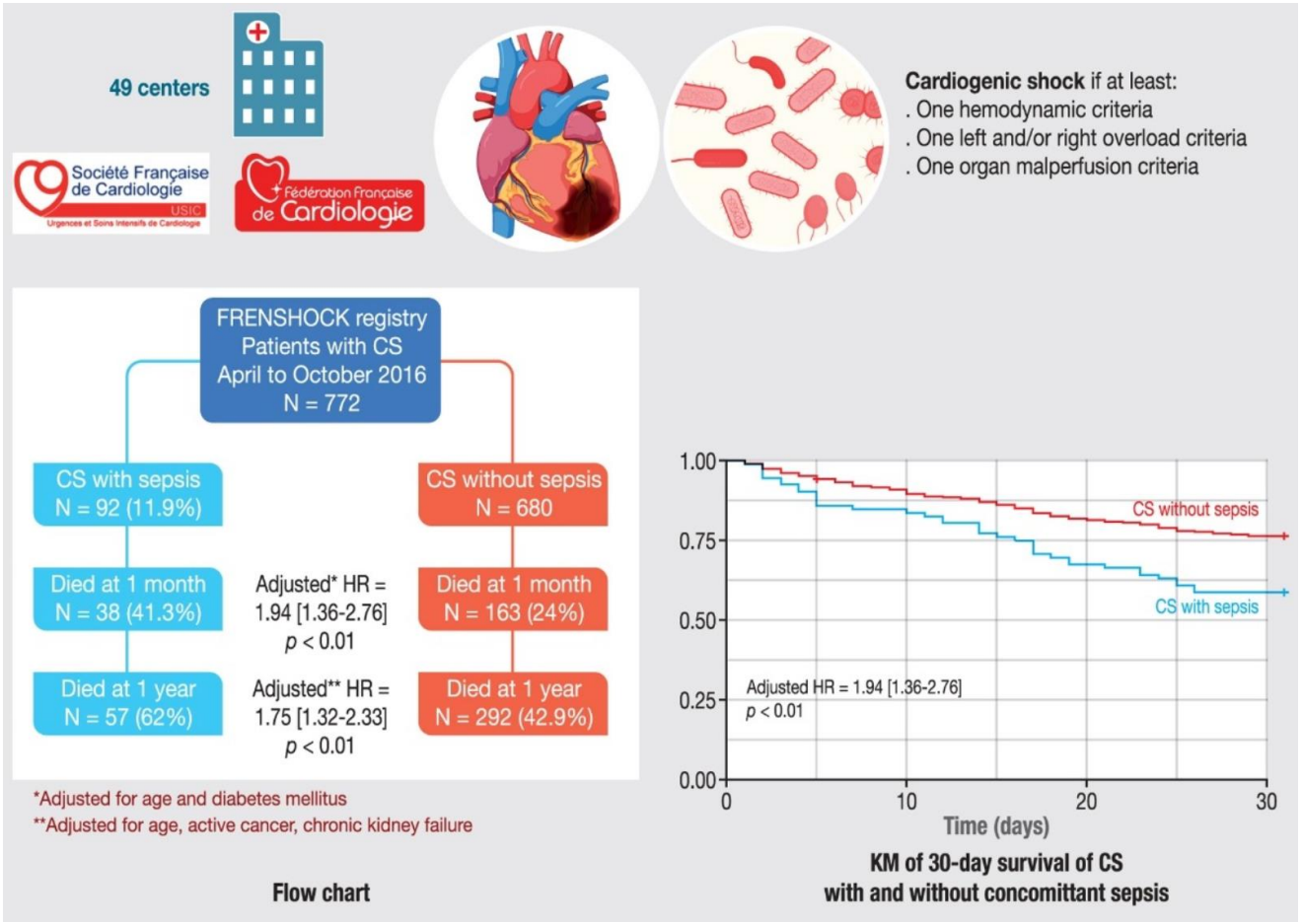
Surgical and Device-Related Infections: Intra-aortic balloon pumps (IABP), extracorporeal membrane oxygenation (ECMO), or left ventricular assist devices (LVADs).

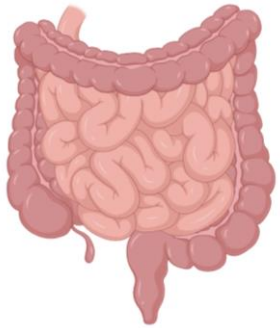


Sepsis: localized infections spreading systemically, further impairing cardiac function.

Cardiogenic shock and infection: A lethal combination

Miloud Cherbi[a,b], Hamid Merdji[c], Vincent Labbé[d], Eric Bonnefoy[e], Nicolas Lamblin[f], François Roubille[g], Bruno Levy[h], Pascal Lim[i,j], Hadi Khachab[k], Guillaume Schurtz[g], Brahim Harbaoui[l,m], Gerald Vanzetto[n], Nicolas Combaret[o], Benjamin Marchandot[p], Benoit Lattuca[q], Caroline Biendel-Picquet[a,b], Guillaume Leurent[r], Edouard Gerbaud[s,t], Etienne Puymirat[u,v], Laurent Bonello[w,x,y], Clément Delmas[a,b,*]



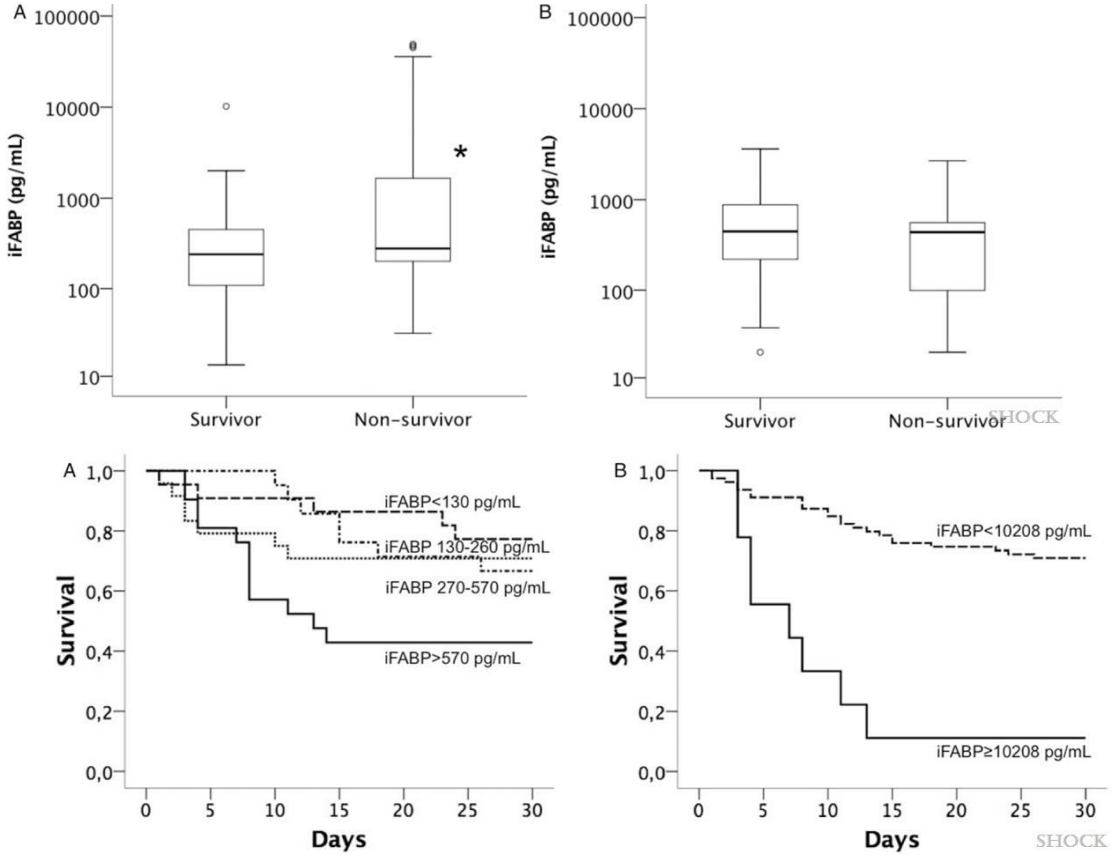


- Ischemic Enteritis and Colitis
- Stress-Related Mucosal Damage
- Intestinal Barrier Dysfunction
- Acute Mesenteric Ischemia
- Paralytic Ileus

INTESTINAL FATTY ACID BINDING PROTEIN IS ASSOCIATED WITH MORTALITY IN PATIENTS WITH ACUTE HEART FAILURE OR CARDIOGENIC SHOCK

Stefan P. Kastl,* Konstantin A. Krychtiuk,*† Max Lenz,*†
Klaus Distelmaier,* Georg Goliasch,* Kurt Huber,†‡ Johann Wojta,*†§
Gottfried Heinz,* and Walter S. Speidl*

*Department of Internal Medicine II, Division of Cardiology, Medical University of Vienna, Vienna, Austria; †Ludwig Boltzmann Cluster for Cardiovascular Research, Vienna, Austria; ‡3rd Medical Department, Wilhelminen Hospital, Vienna, Austria; and §Core Facilities, Medical University of Vienna, Vienna, Austria



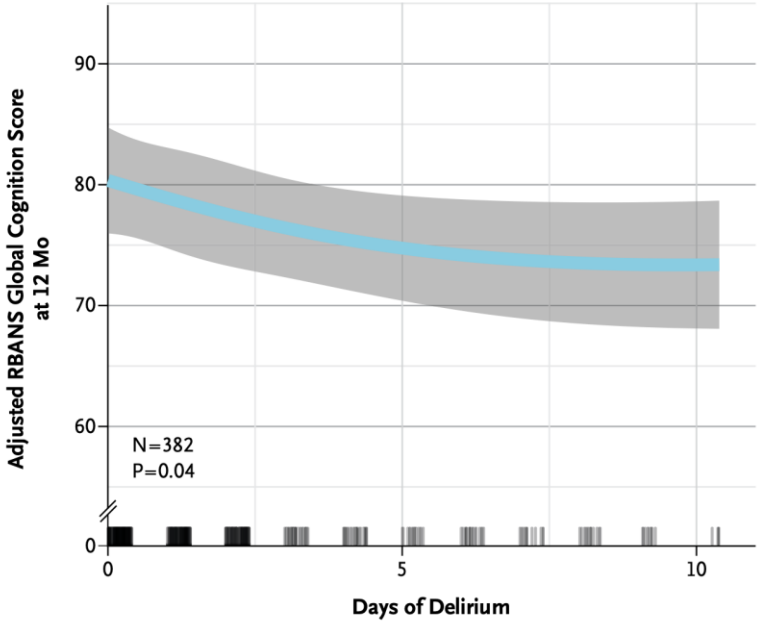
Shock 2019 51(4): 410-415.

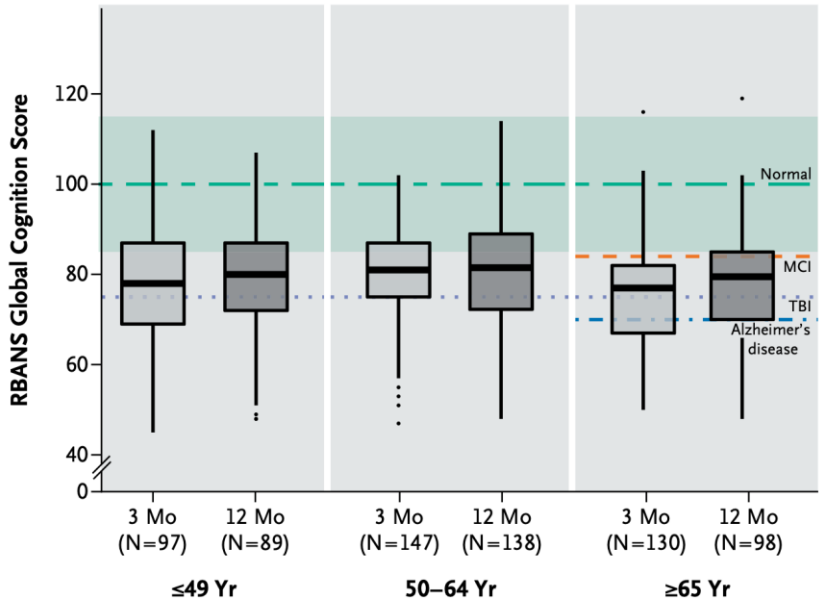
Treating and monitoring complications: Cognitive Impairment

ORIGINAL ARTICLE

Long-Term Cognitive Impairment after Critical Illness

P.P. Pandharipande, T.D. Girard, J.C. Jackson, A. Morandi, J.L. Thompson, B.T. Pun, N.E. Brummel, C.G. Hughes, E.E. Vasilevskis, A.K. Shintani, K.G. Moons, S.K. Geevarghese, A. Canonico, R.O. Hopkins, G.R. Bernard, R.S. Dittus, and E.W. Ely, for the BRAIN-ICU Study Investigators*





ORIGINAL

Mental health sequelae in survivors of cardiogenic shock complicating myocardial infarction. A population-based cohort study

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7812 Survivors of AMI-CS at 135 centers in Ontario, Canada between April 2009 and December 2021

Mean age of 68.4 years and 29.7% Female
Median MODS of 4
IMV in 51.5% and RRT in 12%
Tracheostomy among 2.4%
Median ICU Length of Stay of 6 days

Median Follow-Up After Discharge of 767 Days

Any New Mental Health Diagnoses
2568 (32.9%)

Mood, Anxiety or Related Disorder
2127 (27.2%)

Other Mental Health Diagnoses[a]
941 (12%)

Schizophrenia/Psychotic Disorder
110 (1.4%)

Substance Misuse
255 (3.3%)

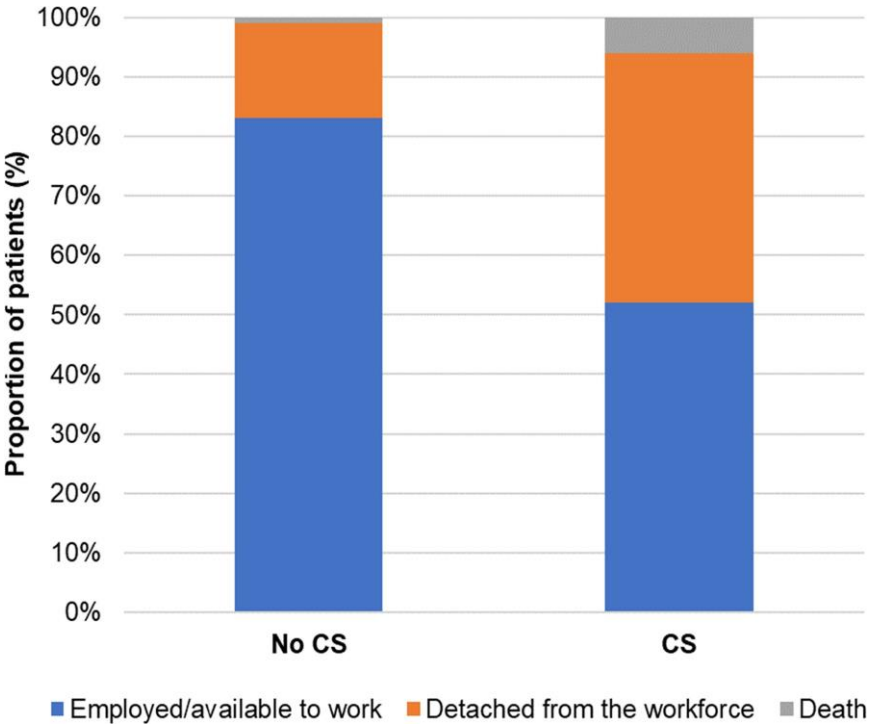
Retrospective, population-based cohort study in Ontario, Canada of critically ill adult (≥ 18 years) survivors of AMI-CS compared to patients to AMI survivors without shock.

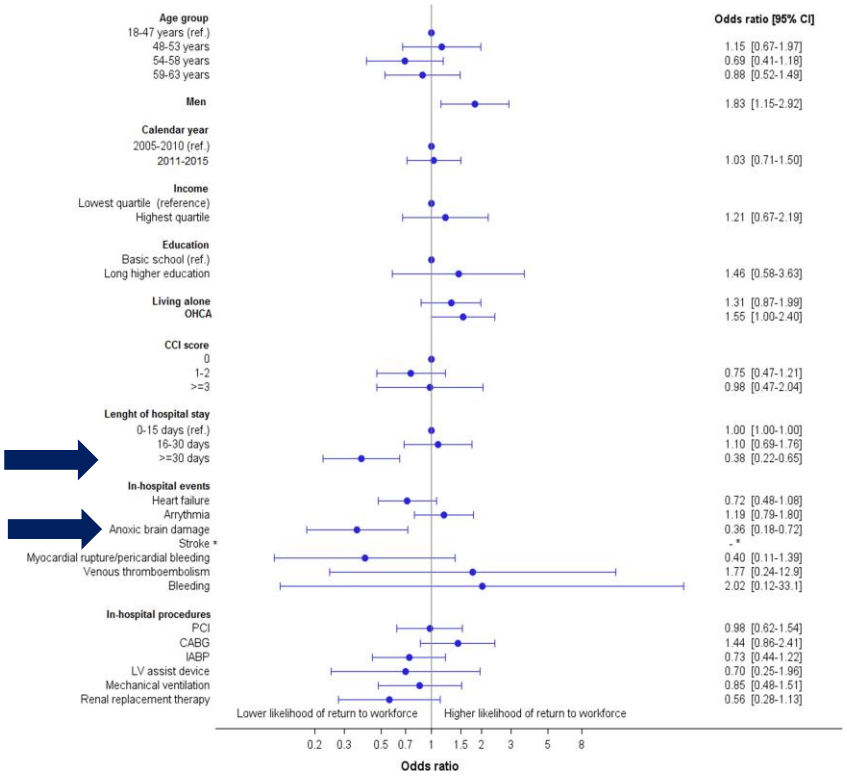
Compared to ICU Survivors of AMI Survivors Without Shock (n = 22 948)

No Difference in New Mental Health Diagnosis
HR 0.99 (95% CI of 0.94-1.03)

Intensive Care Med (2024) 50:901–912

Treating and monitoring complications:
Physical Deconditioning





Eur Heart J Acute Cardiovasc Care 2022, 11(5): 397–406.

Photos by Stephen Alvarez @salvarezphoto Instagram

Conclusions

- Management of post-ICU CS remains a challenge.
- Despite all efforts, mortality remains high.
- More efforts are needed to identify tailored therapies for CS patients.
- Multidisciplinary teamwork is crucial to improve outcomes.
- Innovative developments in biomarkers and use of artificial intelligence might enhance personalized care in CS patients globally.

Treatment considerations for patients with AMI-cardiogenic shock

Level 2 shock centre

Assess cause
- Clinical examination
- ECG
- Point of care echo
- Invasive angiography

Assess severity
- Lactate
- Urine output/creatinine
- SCAI classification
- IABP-SHOCK II score
- ± invasive haemodynamics

Initial stabilisation
- Oxygenation/ventilator support
- Fluid challenge if no overt overload
- Inotropes/Vasopressors
- Early culprit artery revascularisation
- Repair of mechanical complications

Level 1 shock centre

Consideration of MCS
- Multidisciplinary shock team consideration
- Assessment of vascular access
- CPO <0.6 W
- CI <2.2 L/min/m^2
- Arterial lactate
- Norepinephrine equivalent/Vasoactive-inotropic score
- Anoxic brain injury/irreversible end-organ failure

Cardiac intensive care unit admission

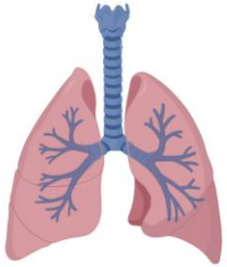
CICU
- Lung protective ventilation
- Renal replacement therapy *if indicated*
- Thromboprophylaxis
- Norepinephrine if vasopressor required
- Gastric protection
- Glycaemic control
- Hb >7 g/dl
- Treat infections *if required*

Weaning → Discharge to ward

No weaning possible → LVAD as destination therapy vs transplant ↕ Palliative care

Treating and monitoring complications: Inflammation

Treating and monitoring complications



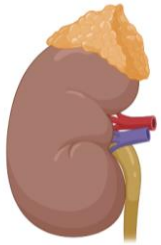
Pulmonary Edema

ARDS

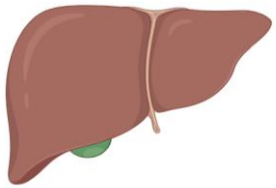
Pneumonia

Pulmonary Embolism

Respiratory Insufficiency

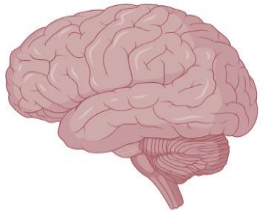


Acute kidney injury



Hypoxic hepatitis

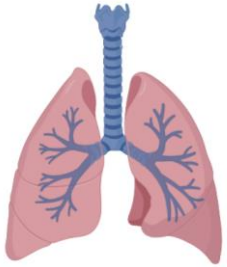
Impaired coagulation factors synthesis



Stroke

Cognitive Impairment

Treating and monitoring complications



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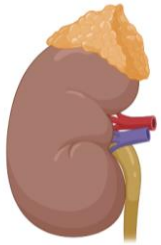

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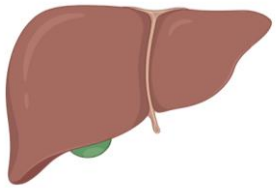

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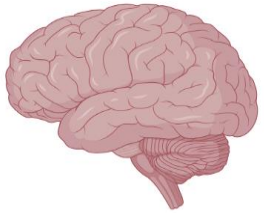

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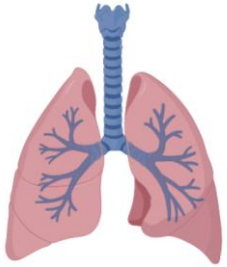

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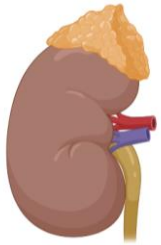

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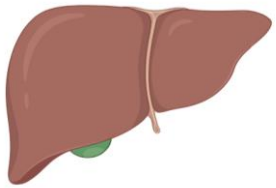

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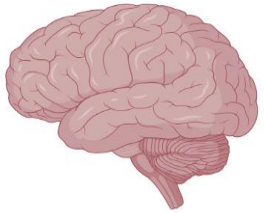

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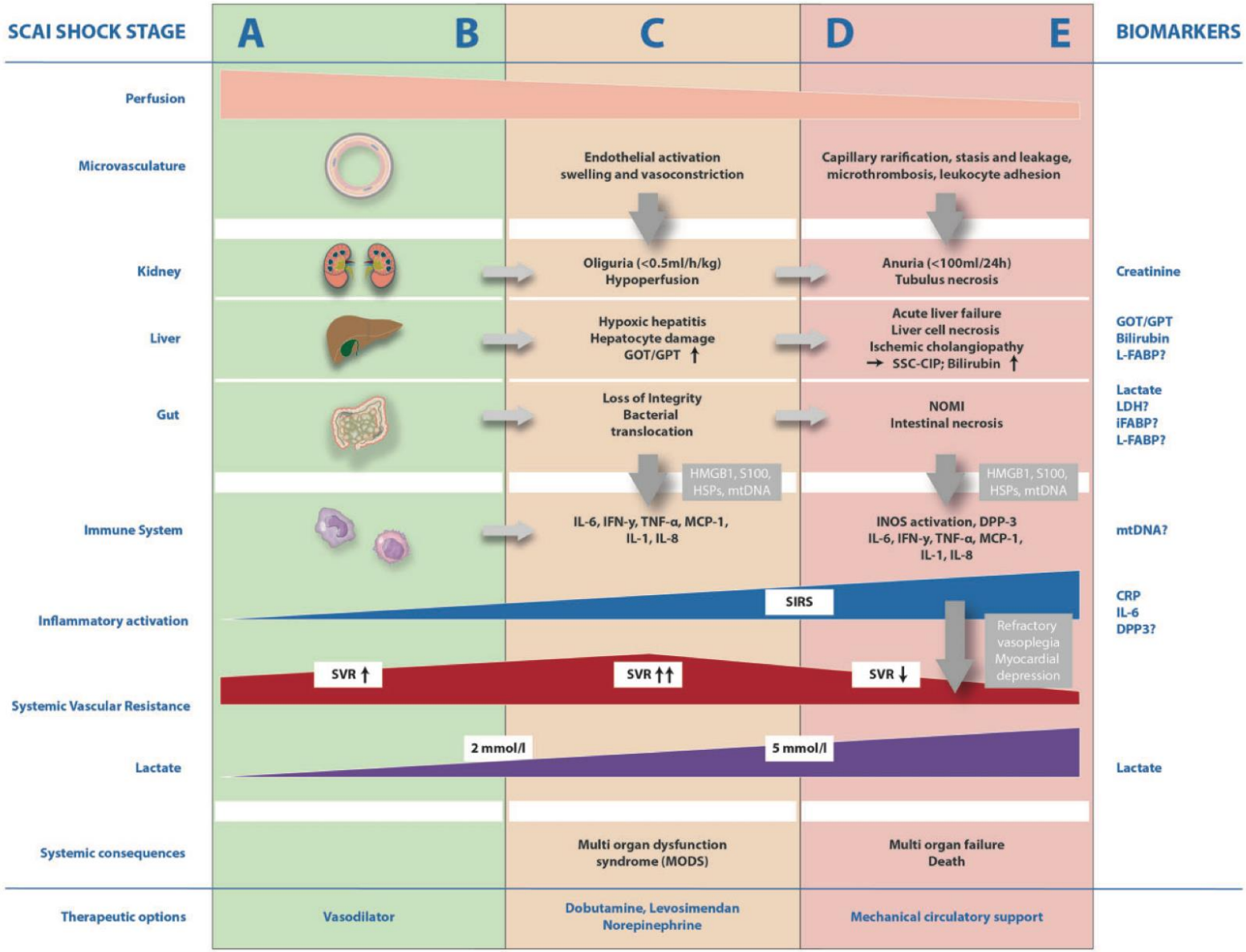
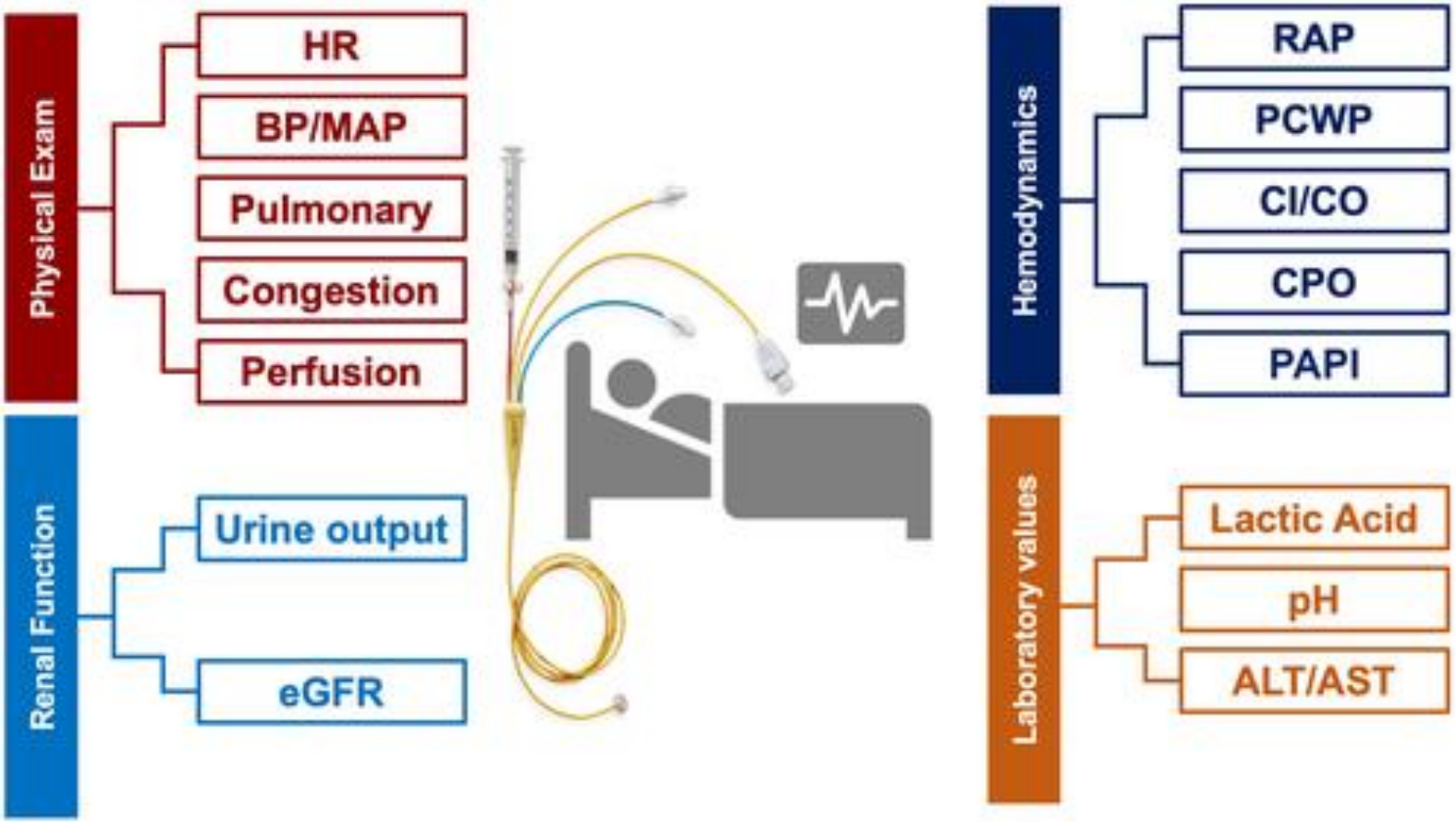


European Heart Journal: Acute Cardiovascular Care (2022) 11, 356–365

Parameters to Monitor in Patients with Cardiogenic Shock in the Critical Care Unit



Nikhil Narang et al. *J Am Coll Cardiol HF* 2023; 11:845-851