



NYU School of Medicine

Definitions of Cardiogenic Shock *Clinical Perspective: Is there a consensus definition? Do we need one?*

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Cardiogenic Shock Definitions

Cardiogenic shock is a high-acuity, potentially complex, and hemodynamically diverse state of end-organ hypoperfusion that is frequently associated with multisystem organ failure.

AHA Scientific Statement Contemporary Management of Cardiogenic Shock. van Diepen et al. Circulation 2017

Cardiogenic shock (CS) is a clinical condition of **inadequate tissue (end-organ) perfusion** due to **cardiac dysfunction**. The definition includes the following hemodynamic parameters: persistent hypotension (systolic blood pressure <80 to 90 mmHg or mean arterial pressure 30 mmHg lower than baseline) with severe reduction in the cardiac index (<1.8 L/min per m² without support or <2 to 2.2 L/min per m² with support) and adequate or elevated filling pressures.

UpToDate 2019 Hochman, Reyentovich

CS is a **low cardiac output state** resulting in life-threatening **end-organ hypoperfusion** and hypoxia. The clinical presentation is typically characterized by persistent hypotension (<90 mmHg systolic blood pressure [BP]) unresponsive to volume replacement and is accompanied by clinical features of peripheral hypoperfusion, such as elevated arterial lactate (>2 mmol/L).

Harrison's Principles of Internal Medicine, 20e. Chapter 298. Ingbar D, Thiele H.

Uses for CS definition

Clinical practice quality measures

- Clinical care
 - Identify patients for appropriate evidence-based care
 - Communicate among care providers
- Quality/performance metrics
 - Local/Regional/National databases
 - Reporting
 - Exclusion from publicly reported outcomes

Investigation

- Non-randomized studies
 - Selection of “controls”
 - No-treatment Concurrent Control (*usual care*)
 - External Control (*Including historical control*)
 - Epidemiologic studies, trends over time
- Randomized studies
 - Eligibility criteria
 - Generalizability

Types of cardiogenic shock

- Classic
- 'Pre-shock/ Non-hypotensive'* (low CI, high SVR, maintained BP, high PCWP)
- 'Beginning shock' **(tachycardia, relative hypotension, no hypoperfusion)
- Euvolemic shock (low CI, high SVR, low/normal PCWP)
- Mixed CS (low CI, low/normal SVR, high PCWP)

*Menon et al Am J Med. 2000;108

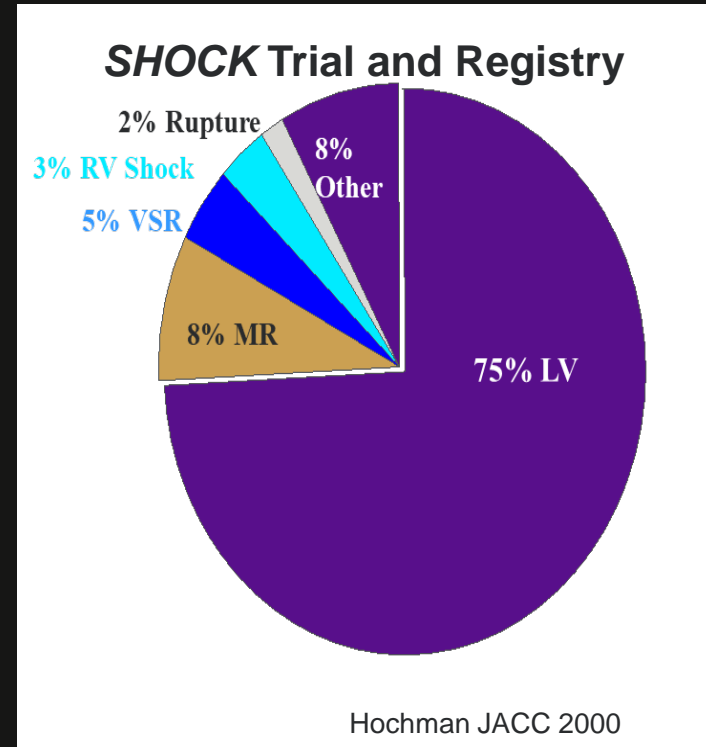
**Baran et al CCI 2019

Definitions

- CS due to...
 - Cause/Etiology
- Concurrent conditions impacting diagnosis, management and/or outcomes
- Clinical characteristics
- Hemodynamics characteristics
- Metabolic characteristics
- On or off support measures
- Stage of progression (SCAI)

Etiologies of Cardiogenic Shock

- Acute Myocardial Infarction
 - LV failure
 - LV/RV failure
 - RV failure
 - Ventricular Septal Rupture
 - Papillary muscle/chordal rupture - severe MR
 - Ventricular free wall rupture with subacute tamponade
- Acute fulminant myocarditis
- Peri-partum Cardiomyopathy
- Endstage cardiomyopathy
- Post-cardiotomy
- Refractory sustained tachy/bradyarrhythmias



How much data are needed to “define” CS

Wide range of expected mortality based on clinical and hemodynamic characteristics

SHOCK Trial and Registry

Mortality scoring system before pulmonary artery catheterization

	Points
Anoxic brain damage	30
Age, y 86-90	22
Age, y <45	0
Severe Hypoperfusion	14
Systolic BP < 55 mm Hg*	12
Systolic BP 105-110 mm Hg*	1
Prior CABG	7
Shock on admission	6
Creatinine ≥1.9 mg/dL	5
Noninferior MI	3

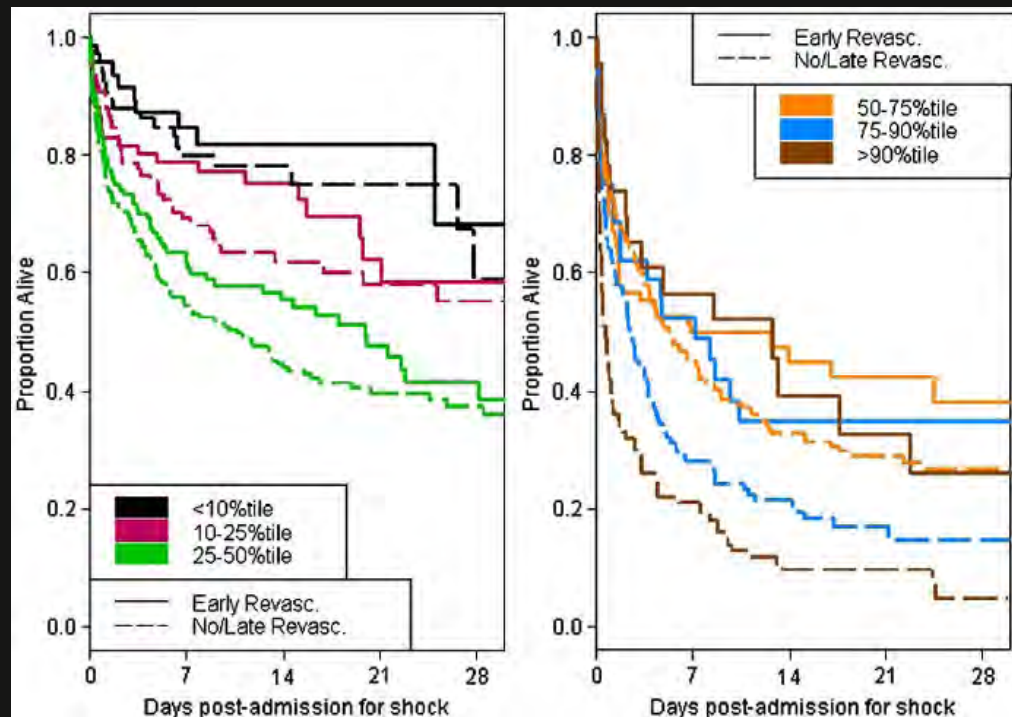
*on support

Multivariate mortality model, including PAC hemodynamics (n=872)

Variable	p-value
Stroke Work	<.0001
LVEF	<.00001
Age	<.0001
Anoxic Brain Damage	.002
Severe Systemic Hypoperfusion	.0002

SHOCK trial

Early revascularization was beneficial across the risk spectrum



Thirty-day mortality by Stage I clinical severity score quantile and revascularization status. Early revascularization is defined as ≤ 18 hours of shock diagnosis.

RISK SCORES

SHOCK Trial and Registry & IABP-SHOCK II

Wide range of expected mortality based on characteristics

SHOCK trial and Registry	Points
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Sleeper et al. AHJ 2010

Common variables across both studies
Clinical
Age
Clinical signs of severe hypoperfusion
Creatinine
Neuro (stroke or anoxia)
Anglo
MV CAD
Post-PCI TIMI flow

IABP-SHOCK II	Points
Age >73	1
History of stroke	2
Glucose >10.6 mmol/l (191 mg/dl)*	1
Creatinine >1.5 mg/dl*	1
Arterial lactate >5mmol/l*	2
TIMI flow grade <3 after PCI	2
Oliguria**	
Cold, clammy extremities**	
Multivessel CAD	

*At admission

**6-year outcomes

Cardiogenic Shock Stages

A system describing stages of cardiogenic shock from A to E was developed.

A is “at risk” for cardiogenic shock

B is “beginning” shock,

C is “classic” cardiogenic shock

D is “deteriorating”

E is “extremis”

The difference between stages B and C is the presence of hypoperfusion which is present in stages C and higher. Stage D implies that the initial set of interventions chosen have not restored stability and adequate perfusion despite at least 30 minutes of observation and stage E is the patient in extremis, highly unstable, often with cardiovascular collapse.

SCAI clinical expert consensus statement on the classification of cardiogenic shock. Baran et al. Catheter Cardiovasc Interv. 2019

SCAI Clinical Expert Consensus Statement of Classification of CS

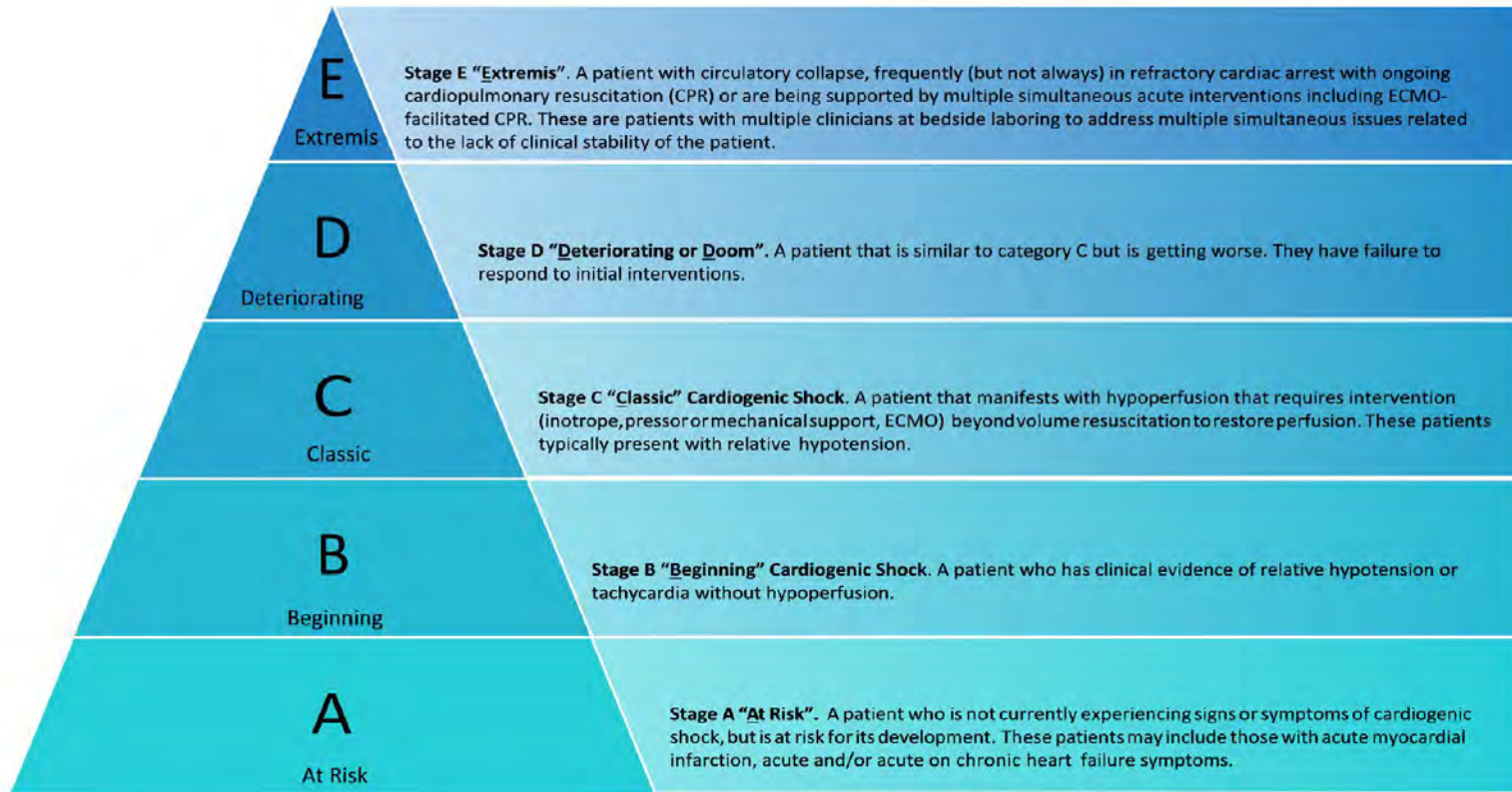


FIGURE 1 The pyramid of CS classification [Color figure can be viewed at wileyonlinelibrary.com]

SCAI Clinical Expert Consensus Statement of Classification of CS

Descriptors of CS Stages

C Classic CS	<p>A patient that manifests with hypoperfusion that requires intervention (inotrope, pressor or mechanical support, including ECMO) beyond volume resuscitation to restore perfusion. These patients typically present with relative hypotension.</p>	<p>May Include Any of:</p> <ul style="list-style-type: none"> Looks unwell Panicked Ashen, mottled, dusky Volume overload Extensive rales Killip class 3 or 4 BiPap or mechanical ventilation Cold, clammy Acute alteration in mental status Urine output <30 mL/h 	<p>May Include Any of:</p> <ul style="list-style-type: none"> Lactate ≥ 2 Creatinine doubling OR >50% drop in GFR Increased LFTs Elevated BNP 	<p>May Include Any of:</p> <ul style="list-style-type: none"> SBP <90 OR MAP <60 OR >30 mmHg drop from baseline AND drugs/device used to maintain BP above these targets Hemodynamics <ul style="list-style-type: none"> • cardiac index <2.2 • PCWP >15 • RAP/PCWP ≥ 0.8 • PAPI <1.85 • cardiac power output ≤ 0.6
D Deteriorating/ doom	<p>A patient that is similar to category C but are getting worse. They have failure to respond to initial interventions.</p>	<p>Any of stage C</p>	<p>Any of Stage C AND: Deteriorating</p>	<p>Any of Stage C AND: Requiring multiple pressors OR addition of mechanical circulatory support devices to maintain perfusion</p>
E Extremis	<p>A patient that is experiencing cardiac arrest with ongoing CPR and/or ECMO, being supported by multiple interventions.</p>	<ul style="list-style-type: none"> Near Pulselessness Cardiac collapse Mechanical ventilation Defibrillator used 	<p>“Trying to die” CPR (A-modifier) pH ≤ 7.2 Lactate ≥ 5</p>	<ul style="list-style-type: none"> No SBP without resuscitation PEA or refractory VT/VF Hypotension despite maximal support

SCAI clinical expert consensus statement on the classification of cardiogenic shock

		Volume Status	
		Dry	Wet
Peripheral Perfusion	Warm	Vasodilatory shock (not CS) Increased cardiac index, low SVRI, low/ normal PCWP	Mixed CS Low cardiac index, low / normal SVRI, Elevated PCWP
	Cold	Euvolemic CS Low Cardiac index, high SVRI, low / normal PCWP	Classic CS Low cardiac index, High SVRI, Elevated PCWP

Catheterization and Cardiovascular Interventions, Volume: 94, Issue: 1, Pages: 29-37, First published: 19 May 2019, DOI: (10.1002/ccd.28329)