



ACVC

Association for
Acute CardioVascular Care

Edition 2025

CLINICAL DECISION MAKING TOOLKIT

Instant guidance for diagnosis, risk stratification and management



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The Clinical Decision Making Toolkit

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of the **European Society of Cardiology (ESC)**.

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The Association for Acute CardioVascular Care Clinical Decision-Making TOOLKIT

Héctor Bueno, M.D., PhD., FESC
Editor in Chief

Jorge Nuche, M.D., PhD.
Associate Editor

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ACUTE HEART FAILURE

4.1 GENERAL APPROACH TO ACUTE HEART FAILURE p.5

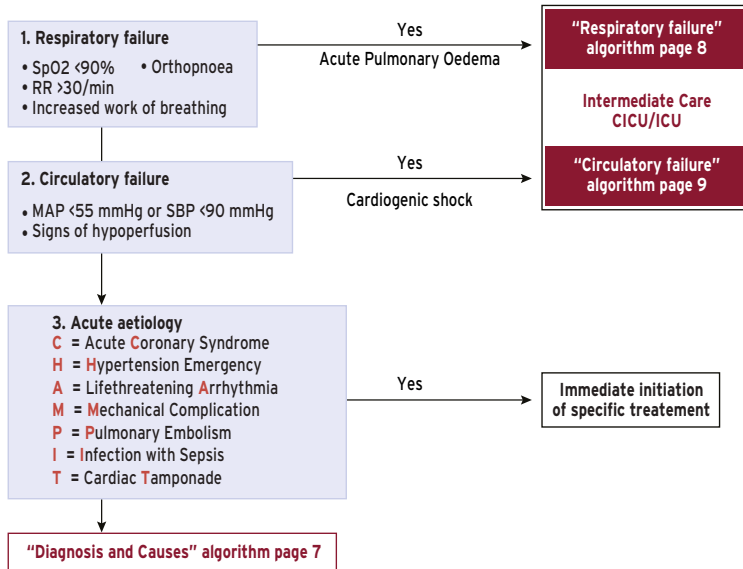
J. Masip, F.H. Verbrugge

4.2 CARDIOGENIC SHOCK p.13

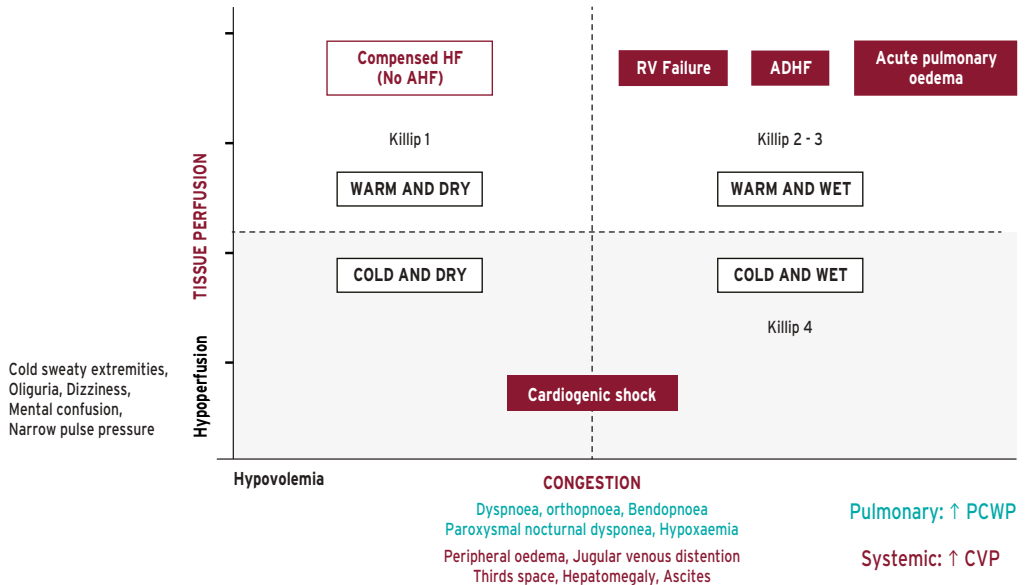
P. Vranckx, U. Zeymer & T. Balthazar

ACUTE HEART FAILURE: Initial approach

Assess vital parameters (BP, HR, SpO₂, RR) & establish venous access



ACUTE HEART FAILURE: Clinical profiles



ACUTE HEART FAILURE: Diagnosis and causes

1. Symptoms

- Dyspnoea
- Exercise intolerance
- Fatigue
- Orthopnoea/ Bendopnoea
- Cough
- Rapid weight gain

2. Signs

- Tachypnoea, tachycardia, hepatomegaly JVD or elevated CVP
- S3/S4, Pulmonary rales
- Third space: Leg oedema, Ascites, Pleural effusion

3. 12-lead electrocardiogram

- Search for wide QRS, hypertrophy, Q waves, other
- Exclude Arrhythmia and Acute Coronary Syndrome

4. Oxygenation / Blood gases

- SpO2 in all patients
- ABG / VBG if significant respiratory or circulatory failure

5. Chest X-ray or lung ultrasound

Assess pulmonary congestion & identify pleural effusions

6. Laboratory - Natriuretic peptide levels

Blood count, electrolytes, creatinine, troponin, glucose, CRP, TSH, liver enzymes. Natriuretic peptides: exclude AHF if NTproBNP <300 pg/mL or BNP <100 pg/mL

7. Point-of-care ultrasonography

- Echocardiography: cavity dimensions, LV / RV /function,
- Valvular dysfunction, E/A, E/E', IVC, RV-RA Δ , pericardium
- VEXUS

Acute heart failure triggers

C = Acute Coronary Syndrome

H = Hypertension Emergency

A = Lifethreatening Arrhythmia

M = Mechanical Complication

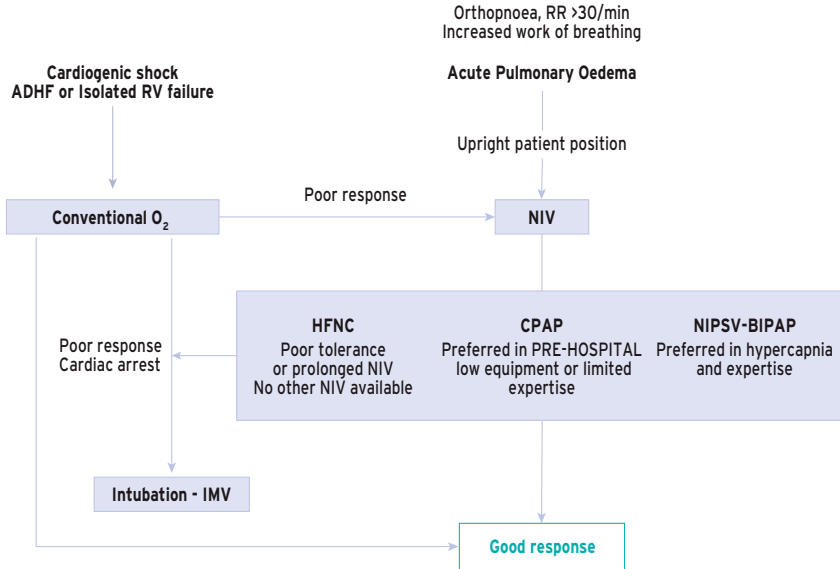
P = Pulmonary Embolism

I = Infection with Sepsis

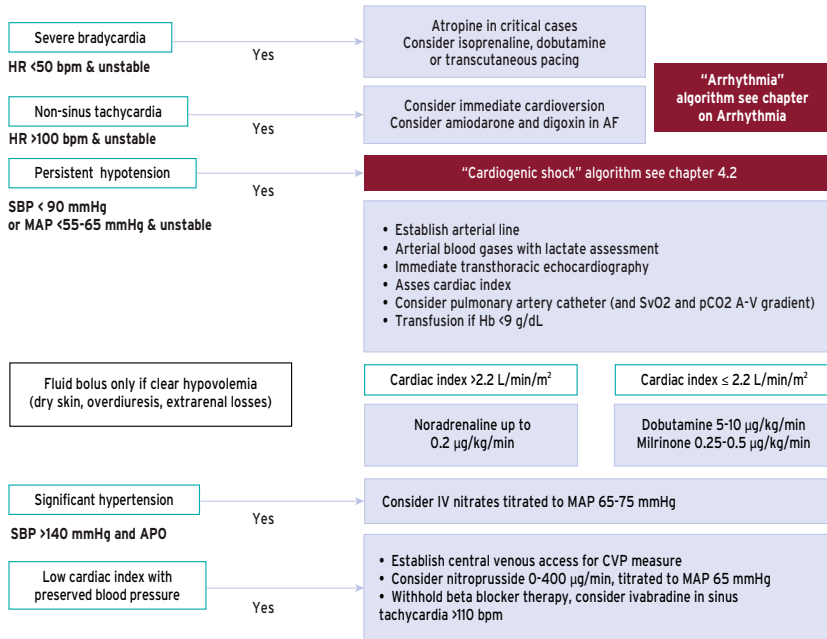
T = Cardiac Tamponade

- Excessive salt intake
- Non-adherence with GDMT
- Drugs (e.g. NSAIDs, negative inotropic drugs, cardiotoxic or nephrotoxic drugs)
- Excessive sympathetic drive
- Metabolic/hormonal cause (e.g. Thyroid dysfunction, adrenal dysfunction)
- Pregnancy & peripartum
- Neurological insult

ACUTE HEART FAILURE with Respiratory failure ($\text{SpO}_2 < 90\%$)

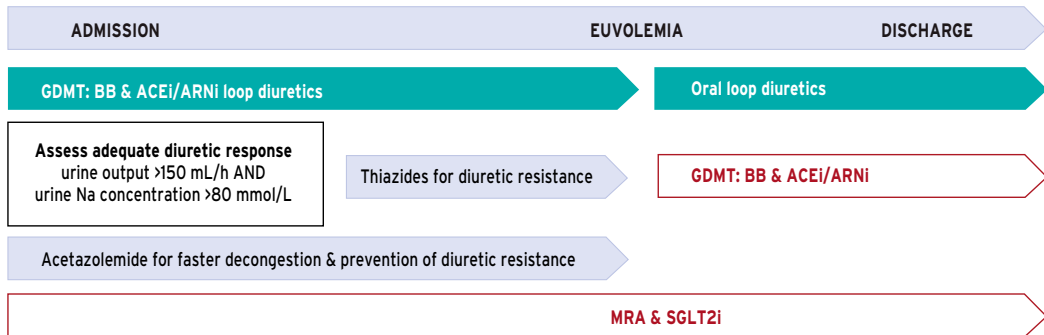


ACUTE HEART FAILURE with Circulatory failure

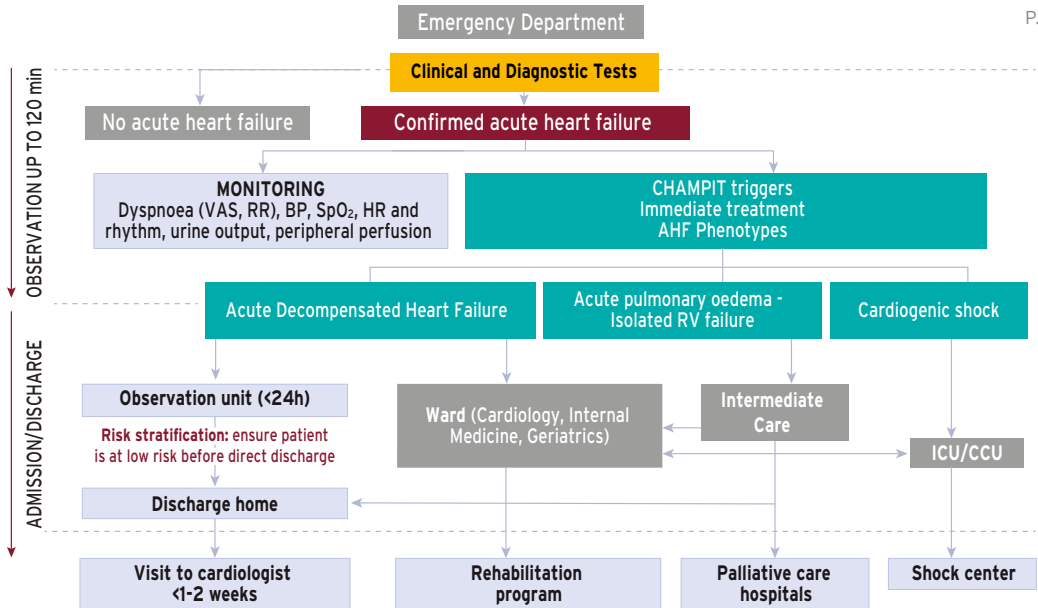


ACUTE HEART FAILURE: Treating congestion

	Cardiac filling pressures Normal	Cardiac filling pressures Elevated	
No signs of fluid overload	TARGET	Vasodilators Consider: Revascularization Fix valve lesions	Loop diuretic therapy <ul style="list-style-type: none"> Intravenous Bolus dose ↑ with worse kidney function Bolus frequency ↑ and doset with more fluid overload
Signs of fluid overload (oedema, ascites, pleural effusion, 3th space)	SLOW DIURESIS	RAPID DIURESIS	



ACUTE HEART FAILURE: General course and management

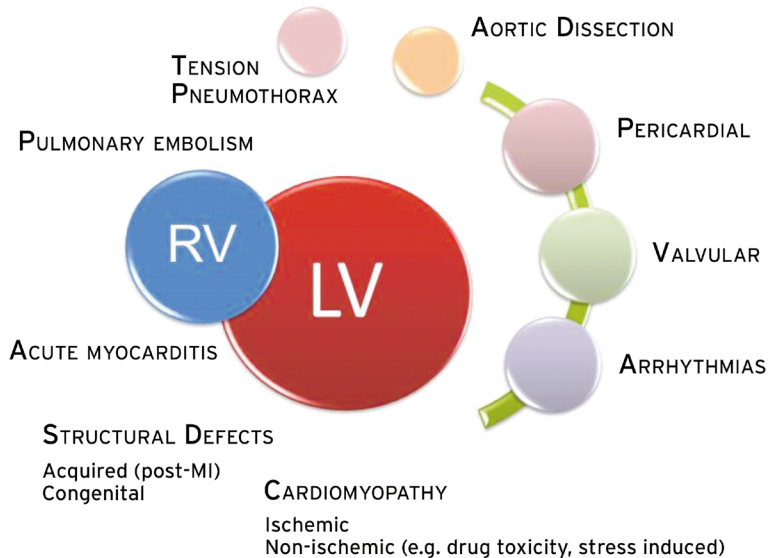


HEART FAILURE DRUGS in the immediate postacute phase (0-48 h)

Renin-angiotensin blockers & angiotensin-neprilysin inhibitors	<ul style="list-style-type: none"> • Stop or downtitrate in case of: <ul style="list-style-type: none"> - Hypotension (MAP <60-65 mmHg) - AKI with oliguria (<0.5 mL/Kg/h) - eGFR < 20 mL/min/1.73m² - [K+] > 5.5 mmol/L • Otherwise maintain current dose • Consider starting/uptitration if MAP >70 mmHg
Beta blockers	<ul style="list-style-type: none"> • Stop or downtitrate in case of hypoperfusion with low CO or HR <50-55 bpm • Otherwise maintain current dose • Consider starting/uptitrate after adequate decongestion if no hypotension or HR <50 bpm
Mineralocorticoid receptor antagonists	<ul style="list-style-type: none"> • Continue or start if hemodynamic stability, eGFR >30 mL/min/1.73m² and [K+] <4.8 mmol/L • Stop if eGFR <20 mL/min/1.73m² or [K+] >5.5 mmol/L
ISGLT-2 inhibitors (Dapagliflozin or empagliflozin)	<ul style="list-style-type: none"> • Continue or start if hemodynamic stability and eGFR >20 mL/min/1.73m² • Be wary of euglycaemic keto-acidosis, especially when gastro-intestinal symptoms present
Oral diuretics	<ul style="list-style-type: none"> • If no reversible trigger or improvement in the GDMT, consider increased doses • If improvement in the GDMT & adequate decongestion, consider reduced doses
Other vasodilators	<ul style="list-style-type: none"> • Stop in case of hypotension with SBP <100 mmHg
Other rate controlling drugs (digoxin, amiodarone, non-dihydropyridine CCB, ivabradine)	<ul style="list-style-type: none"> • Stop in case of significant or symptomatic bradycardia
Thrombosis prophylaxis	<ul style="list-style-type: none"> • Maintain unless bleeding diathesis or oral anticoagulation

CARDIOGENIC SHOCK: Causes

LV pump failure is the primary insult in most forms of CS, but other parts of the circulatory system contribute to shock with inadequate compensation or additional defects

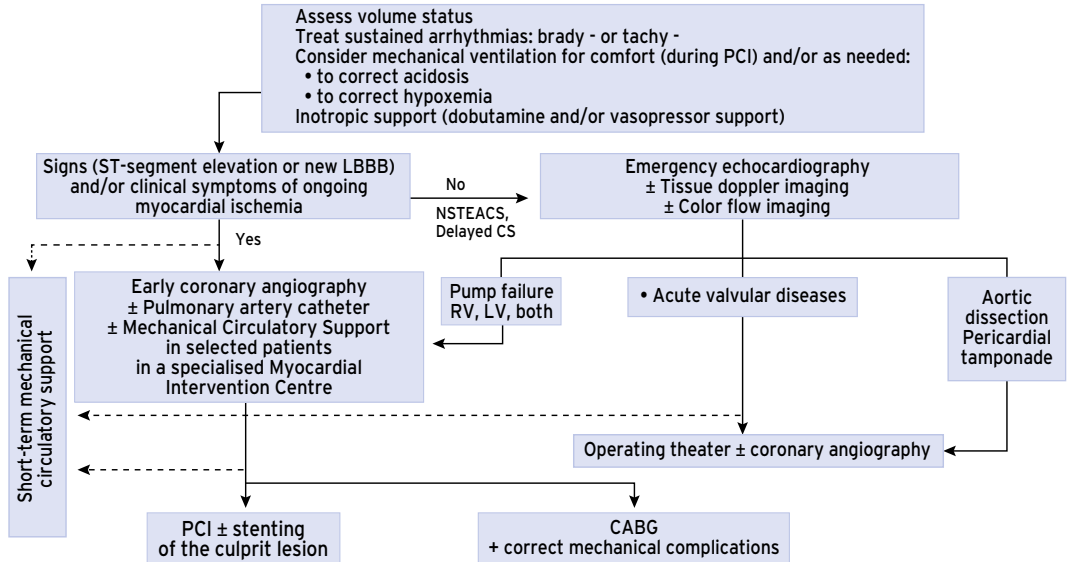


CARDIOGENIC SHOCK: Initial triage and management

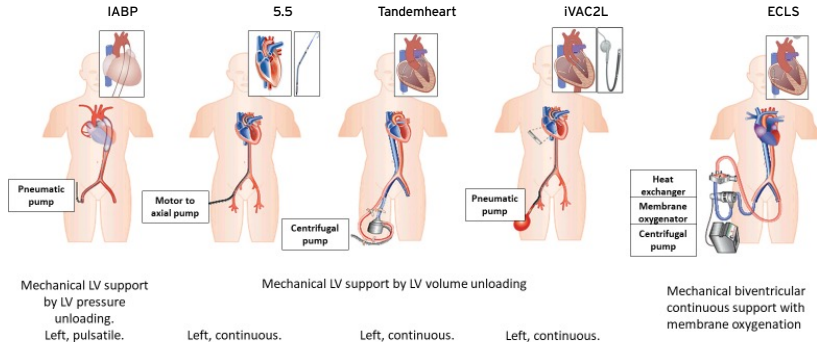
This protocol should be initiated as soon as cardiogenic shock/end organ hypoperfusion is recognised and should not be delayed pending intensive care admission.

EMERGENCY DEPARTMENT	0 min	CARDIAC INTENSIVE CARE UNIT	EARLY TRIAGE & MONITORING Start O ₂ Establish i.v. access	<ul style="list-style-type: none">• Age: 65-74, ≥75• Heart rate >100 beats per minute• Systolic blood pressure <100 mmHg• Proportional pulse pressure ≤25 % (CI <2.2 l/min/m²)• Orthopnea (PCWP >22 mmHg)• Tachypnea (>20/min), >30/min (!)• Killip class IV• Clinical symptoms of tissue hypoperfusion/hypoxia:<ul style="list-style-type: none">- cool extremities- decreased urine output (urine output <40 ml/h)- decreased capillary refill or mottling - alteration in mental status
	5 min			
	15 min			
	60 min			
			INITIAL RESUSCITATION <ul style="list-style-type: none">• Arterial and a central venous catheterization with a catheter capable of measuring central venous oxygen saturation• Early coronary angiography in specialized myocardial intervention centre when signs and/or symptoms of ongoing myocardial ischemia (e.g. ST-segment elevation myocardial infarction).	<ul style="list-style-type: none">• CORRECT: hypoglycemia & hypocalcemia,• TREAT: sustained arrhythmias: brady- or tachycardia• Isotonic saline - 200-300 ml over 30 min period to achieve a central venous pressure of 8 to 12 mmHg or until perfusion improves (with a maximum of 500 ml)• CONSIDER ADDITIONAL RESPIRATORY SUPPORT (HFNC, NIV) for comfort (fatigue, distress) or as needed:<ul style="list-style-type: none">- To correct acidosis- To correct hypoxemia• INOTROPIC SUPPORT (dobutamine, levosimendan and/or vasopressor support)
			TREATMENT GOALS <ul style="list-style-type: none">• a mean arterial pressure of 60 mmHg or above,• a mean pulmonary artery wedge pressure of 18 mmHg or below,• a central venous pressure of 8 to 12 mmHg,• a urinary output of 0,5 ml or more per hour per kilogram of body weight• an arterial pH of 7.3 to 7.5• a central venous saturation (ScvO₂) ≥70% (provided SpO₂ ≥93% and Hb level ≥9 g/dl)	In persistent drug-resistant cardiogenic shock, consider mechanical circulatory support

CARDIOGENIC SHOCK: Management

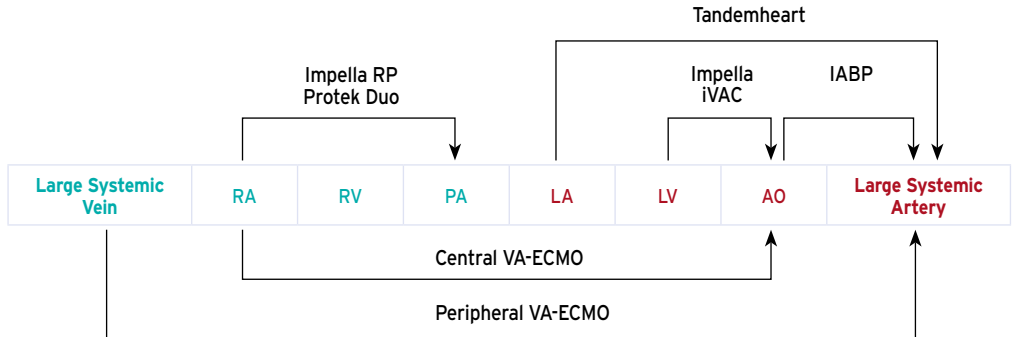


CARDIOGENIC SHOCK: Mechanical Circulatory Support



- The available devices differ in terms of the insertion technique, mechanical properties, and mode of action.
- A minimal flow rate of 70ml/kg/min, representing a cardiac index of at least 2,5L/m² is generally required to provide adequate organ perfusion. This flow is the sum of the mechanical circulatory support output and the remaining function of the heart (accounting for the fact that native heart output will decrease after device implantation).

CARDIOGENIC SHOCK: Selection of Modality



CARDIOGENIC SHOCK: What device when?

1a) Impella RP



1b) Protek-Duo



1c) ECLS (ECMO)



1) Impella } CP 5.5



2) Tandem Heart



3) ECLS (ECMO)



RV
dysfunction
predominant

LV dysfunction
predominant

Cardiogenic shock severity
a) Lactate $\uparrow\uparrow$
b) Vasopressor doses $\uparrow\uparrow$
c) Shock scores
d) Pre-MCS Cardiac Index
e) Pre-MCS filling pressure(s)

Oxygenation

No MCS considerations

a) Age
b) Futility
c) Anoxic brain injury
d) Comorbidities
e) Prolonged resuscitation

1) ECLS (ECMO)



2) Tandem Heart



CARDIOGENIC SHOCK: Mechanical Ventilation

- FiO2 set per PaO2, typically start 50-100%
- PEEP >5 cm H2O, typically 7-12 cm H2O
- **Titration by:**
 - PEEP-FiO2 table OR
 - Decremental PEEP trial (best compliance) OR
 - PV loops (between lower and higher inflection point) OR
 - Esophageal pressure (end-expiratory transpulmonary pressure 0-5 cm H2O)
- **Beware hemodynamic effects:**
 - Decreases LV afterload
 - Decreases venous return (preload)
 - Increases RV afterload if set inadequately high
- Minute Volume (7-10 ml/kg if no fever): Tidal volume X frequency
- Tidal volume: 6-8 ml/kg IBW
- Predicted body weight calculation:
 - Male: $50 + 0.91 (\text{height in cm} - 152.4)$
 - Female: $45.5 + 0.91 (\text{height in cm} - 152.4)$
- Driving Pressure < 15 cm H2O
- Plateau Pressure > 30 cm H2O

Pressure (assist) controle (more comfortable on low sedation, safe for plateau pressure) vs Volume (assist) controle (shorter breaths in obstructive patients, less guarantee for safe plateau pressure)

CARDIOGENIC SHOCK: RRT and Indications

- SLED (hemodialysis) vs CRRT: depends mainly on local options
- CRRT: hemofiltration (higher blood flows) vs hemodiafiltration (lower blood flows)
- Early vs late: generally early not shown to be beneficial, but some suggestions for populations with benefit (eg, ELAIN trial was positive and was constituted for 50% by cardiac surgery patients).

INDICATIONS:

A) Maintenance/correction of intravascular volume (low dose possible): inadequate diuretic response in hypervolemic patients, despite high dose IV diuretics

B) Correction of underlying acid-base/ion disturbance (High dose needed):

- Acidosis (pH <7.1; beware: very limited elimination of lactic acid compared to production)
- Hyperkalemia
- Hyperphosphatemia
- Uremic signs (pericarditis, encephalopathy)

C) Elimination of Toxins (consider adding hemadsorption for some):

- Anti-epileptics
- Metformin
- Lithium
- Some beta-blockers (atenolol, metoprolol, sotalol)...

SUGGESTED INITIAL SETTINGS CVVH:

- Blood flow 150-200 ml/min
- Dose 25 ml/kg/h of effluent
- Ultrafiltration depending on need for fluid removal between 0-1000 ml/h (usually 0-500 ml/h)

Abbreviations

APTT = Activated partial thromboplastin time
AB = Airway and breathing
ABG = Arterial blood gas
AADs = Antiarrhythmic drugs
AAS = Acute aortic syndrome
ACEI = Angiotensin converting enzyme inhibitor
ACLS = Advanced cardiovascular life support
ACS = Acute coronary syndrome
ACT = Activated clotting time
AD = Aortic Dissection
AED = Automated external defibrillator
AF = Atrial fibrillation
ANA = Antinuclear antibodies
Ao = Aortic
aPTT = Activated partial thromboplastin time
ARB = Angiotensin receptor blockers
AS = Aortic stenosis
AV = Atrioventricular
AVB = Atrioventricular conduction block
AVN = Atrioventricular node
AVNRT = Atrioventricular nodal re-entrant tachycardia

AVNT = Atrioventricular nodal tachycardia
BID = Twice a day
BBB = Bundle branch block
BLS = Basic life support
BNP = Brain natriuretic peptide
BP = Blood pressure
CABG = Coronary artery bypass grafting
CAD = Coronary artery disease
Cath Lab = Catheterisation laboratory
CCB = Calcium channel blockers
CCU = Coronary care unit
CHF = Congestive heart failure
CMR = Cardiovascular magnetic resonance
COPD = Chronic obstructive pulmonary disease
CPAP = Continuous positive airway pressure
CPR = Cardiopulmonary resuscitation
Cr = Creatinine blood level (mg/dL)
CrCl = Creatinine clearance
CRP = C-reactive protein
CS = Cardiogenic shock
CSM = Carotid sinus massage
CSNRT = Corrected sinus node recovery time

Abbreviations (Cont.)

CSS = Carotid sinus syndrome

CT = Computed tomography

CT-angio = Computed tomography angiography

cTn = Cardiac troponin

CUS = Compression venous ultrasound

CV = Cardiovascular

CVA = Cerebrovascular accident

CXR = Chest X-ray

DAPT = Dual antiplatelet therapy

DD = Diastolic dysfunction

DM = Diabetes mellitus

dTT = Diluted thrombin time

DVT = Deep vein thrombosis

ECG = Electrocardiogram

Echo = Echocardiogram

ECMO = Extracorporeal membrane oxygenation

ECT = Ecarin clotting time

ED = Emergency department

EF = Ejection fraction

EG = Electrograms

eGFR = Estimated glomerular filtration rate
(ml/min/1.73 m²)

EMB = Endomyocardial biopsy

EMS = Emergency medical services

EPS = Electrophysiological study

ERC = European Resuscitation Council

ESR = Erythrocyte sedimentation rate

ETT = Exercise treadmill testing

FFP = Fresh frozen plasma

FMC = First medical contact

GER = Gastroesophageal reflux

GFR = Glomerular flow rate

GI = Gastrointestinal

GP = Glycoprotein

Hb = Haemoglobin

HF = Heart failure

HIT = Heparin-induced thrombocytopenia

HOCM = Hypertrophic obstructive cardiomyopathy

HTN = Hypertension

HR = Heart rate

hsTn = High-sensitive troponin

IABP = Intra-aortic balloon pump

ICC = Intensive cardiac care

ICCU = Intensive cardiac care unit

Abbreviations (Cont.)

ICD = Implantable cardioverter defibrillator

ICI = Immune checkpoint inhibitors

IHD = Ischemic heart disease

IMH = Intramural hematoma

IRF = Immediate-release formulation

ISFC = International Society and Federation of Cardiology

i.o. = Intraosseous

IV = Invasive ventilation

i.v. = Intravenous

KD = Kidney disease

LBBS = Left bundle branch block

LD = Loading dose

LGE = Late gadolinium enhancement

LMWH = Low-molecular weight heparin

LOC = Loss of consciousness

LV = Left ventricular

LVAD/Bi-AD = left ventricular, bi-ventricular assist device

LVD = Left ventricular dysfunction

LVEF = Left ventricular ejection fraction

LVH = Left ventricular hypertrophy

LVSD = Left ventricular systolic dysfunction

MCS = Mechanical circulatory support

MD = Maintenance dose

MDCT = Computed tomography with >4 elements

MI = Myocardial infarction

MRA = Mineralocorticoid receptor antagonist

MRI = Magnetic resonance imaging

Mvo = Microvascular obstruction

NIV = Non-invasive ventilation

NOAC = New oral anticoagulants

NSAID = Non-steroidal anti-inflammatory drugs

NSVT = Non-sustained ventricular tachycardia or recurrent

NSTE-ACS = Non ST-segment elevation acute coronary syndrome

NSTEMI = Non ST-segment elevation myocardial infarction

NTG = Nitroglycerin

NT-proBNP = N-terminal pro brain natriuretic peptide

NVAF = Non-valvular atrial fibrillation

NYHA = New York Heart Association

OH = Orthostatic hypotension
PAP = Pulmonary arterial pressure
PAU = Penetrating aortic ulcer
PCI = Percutaneous coronary intervention
PCM = Physical counter-measures
PCP = Pulmonary capillary pressure
PE = Pulmonary embolism
PEA = Pulmonary endarterectomy
PEEP = Positive end expiratory pressure
PPC = Prothrombin complex concentrate
PR = Pulmonary regurgitation
PRECISE-DAPT = PREdicting bleeding
 Complications In patients undergoing Stent
 implantation and subsequent Dual Anti Platelet
 Therapy
PRF = Prolonged-release formulation
ProCT = Procalcitonin
PRN = Pro re nata
PS-PEEP = Pressure support-positive end-
 expiratory pressure
PSVT = Paroxysmal supraventricular tachycardia
QD = Once a day

QPM = Every evening
rFVIIa = Recombinant factor VIIa
rtPA = Recombinant tissue plasminogen activator
RV = Right ventricular
RVOT-VT = Right ventricular outflow tract
 ventricular tachycardia
SBP = Systemic blood pressure
s.c = Subcutaneous
SIRS = Systemic inflammatory response syndrome
SLE = Systemic lupus erythematosus
SMU = Syncope management units
STE-ACS = ST-segment elevation acute
 coronary syndrome
STEMI = ST-segment elevation myocardial infarction
SVT = Supraventricular tachycardia
Spo₂ = Oxygen saturation
TEE = Transesophageal echocardiography
TEVAR = Thoracic endovascular aortic repair
TIA = Transient ischemic attack
TID = Three times a day
TLOC = Transient loss of consciousness
TOE = Transoesophageal echocardiography

Abbreviations (Cont.)

TSH = Thyroid-stimulating hormone

TTE = Transthoracic echocardiography

UA = Unstable angina

UFH = Unfractionated heparin

ULN = Upper limit of normal

VBGA = venous blood gas analysis

VF = Ventricular fibrillation

VR = Vascular resistance

VT = Ventricular tachycardia

VTE = Venous thromboembolism

VVS = Vasovagal syncope

WBC = white blood cell count

WHO = World Health Organization

WPW = Wolff-Parkinson-White

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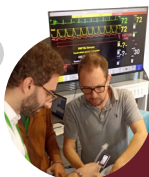
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• **Together saving lives**

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