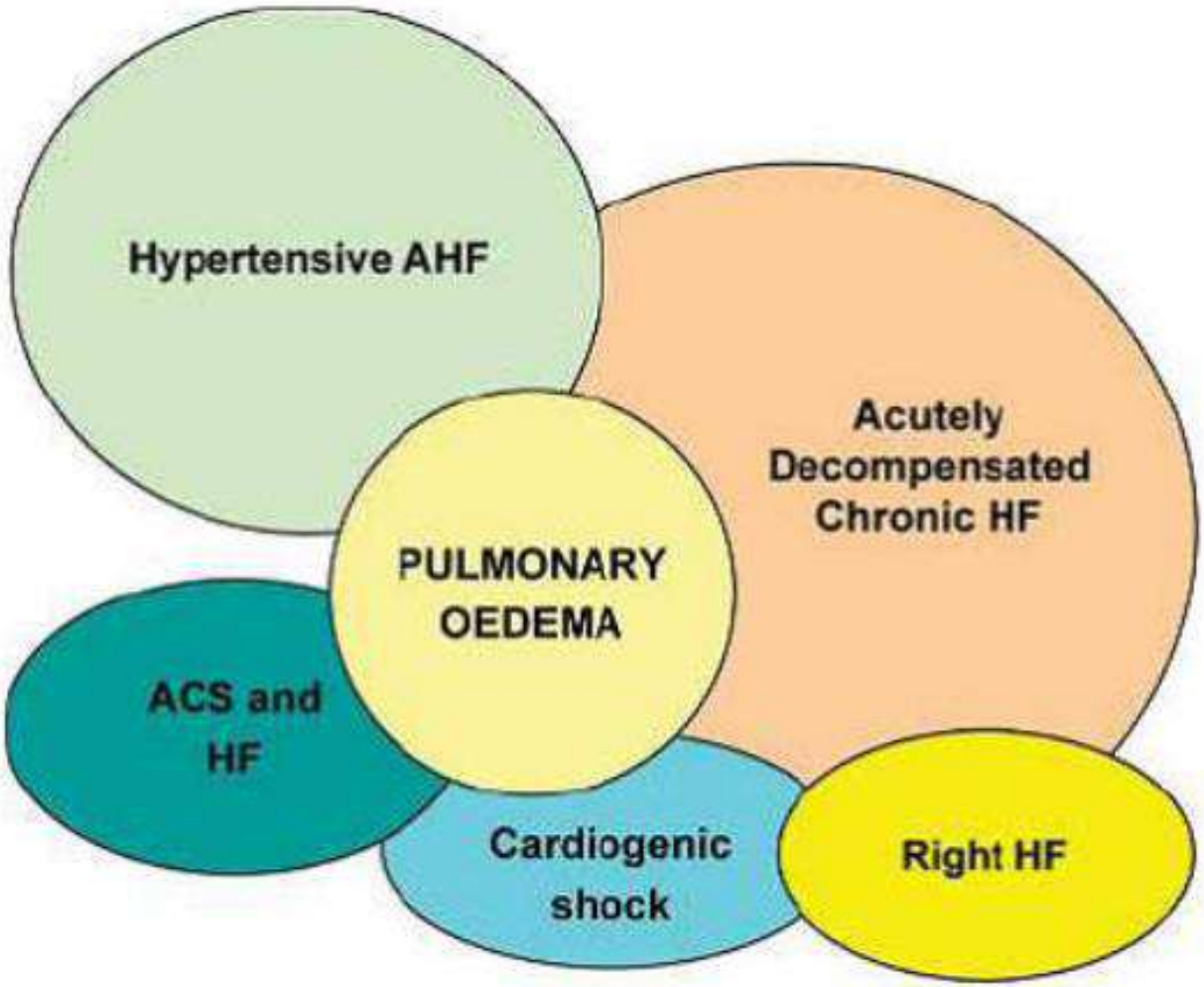
պրոֆ. Հ.Ս. Սիսակյան
Հերացի թիվ 1 համալսարանական հիվանդանոց, ԵՊԲՀ

Սուր սրտային անբավարարություն.ուղեցույցային և պերսոնիզացված բուժում

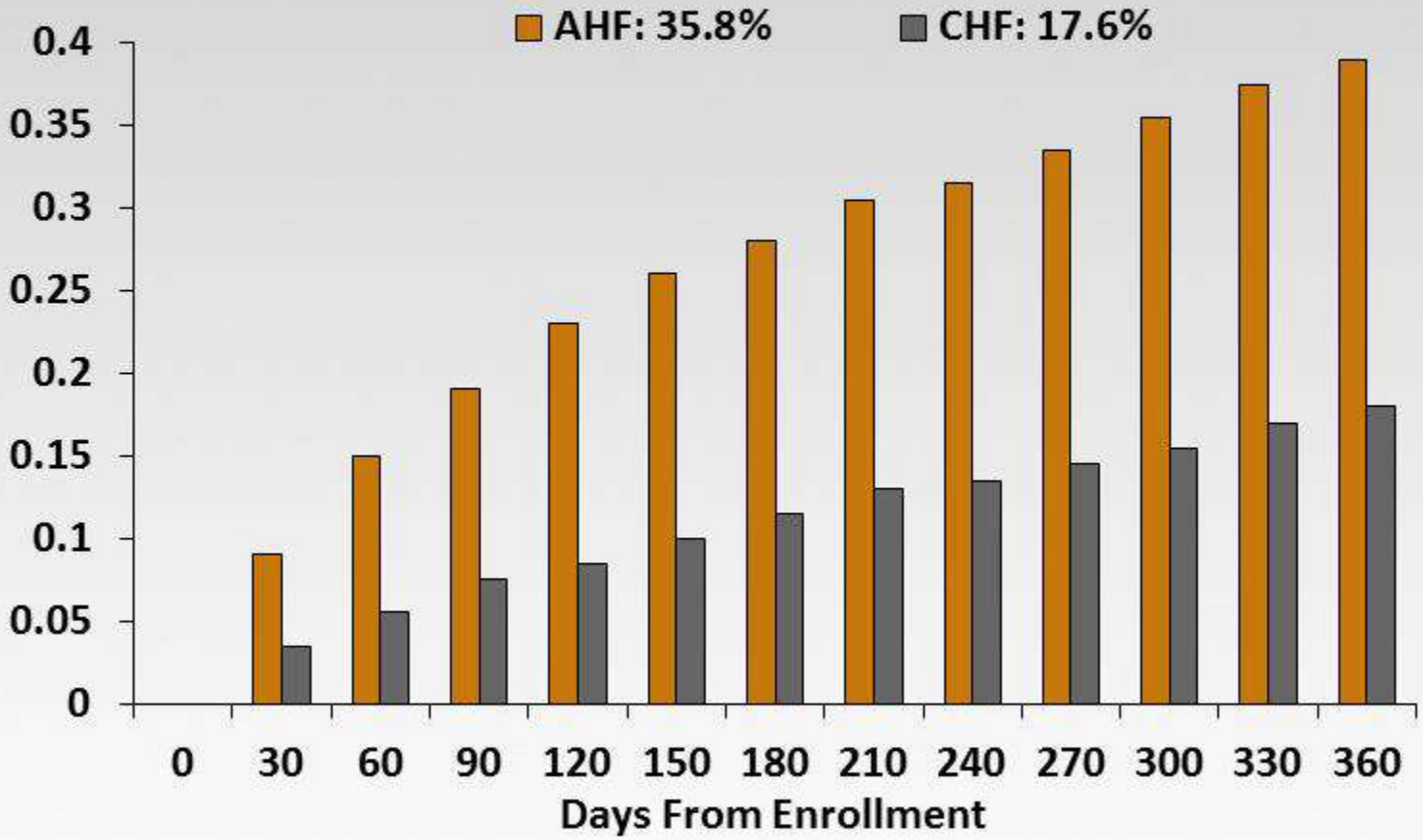


Clinical classification of acute heart failure. Modified from reference 205.

ESC Guidelines for the Diagnosis and Treatment of Acute and Chronic Heart Failure
Eur Heart J 2008;29:2388-2442

All-Cause Death or HF Hospitalization

(1892 patients with AHF; 3226 patients with CHF)



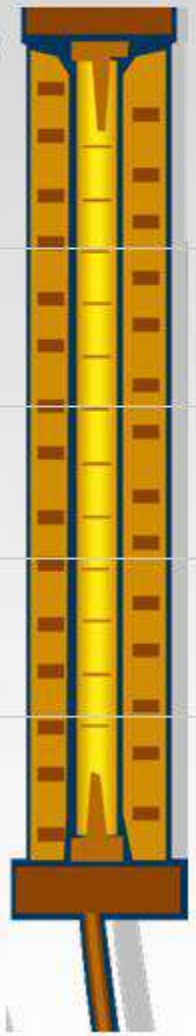
Maggioni AP, et al. *Eur J Heart Fail.* 2013;15(7):808-817.

Six Clinical Scenario of Admission: AHFS

- CS1: dyspnoea and/or other signs of congestion + elevated SBP (> 150 mmHg)
- CS2: dyspnoea and/or other signs of congestion + normal SBP (110-150 mmHg)
- CS3: dyspnoea and/or other signs of congestion + low SBP (< 110 mmHg)
- CS4: Signs of ACS + dyspnoea
- CS5: Isolated RVF
- CS6: AHF without dyspnoea

Systolic BP in AHF: Higher Is Better?

Admission Systolic BP Deciles	In-hospital Mortality
189-300 mm Hg	1.6%
169-188 mm Hg	2.0%
157-168 mm Hg	2.0%
148-156 mm Hg	2.3%
140-147 mm Hg	2.7%
132-139 mm Hg	3.2%
124-131 mm Hg	3.7%
115-123 mm Hg	4.6%
105-114 mm Hg	5.6%
50-104 mm Hg	9.6%



N=48,567

Heart failure

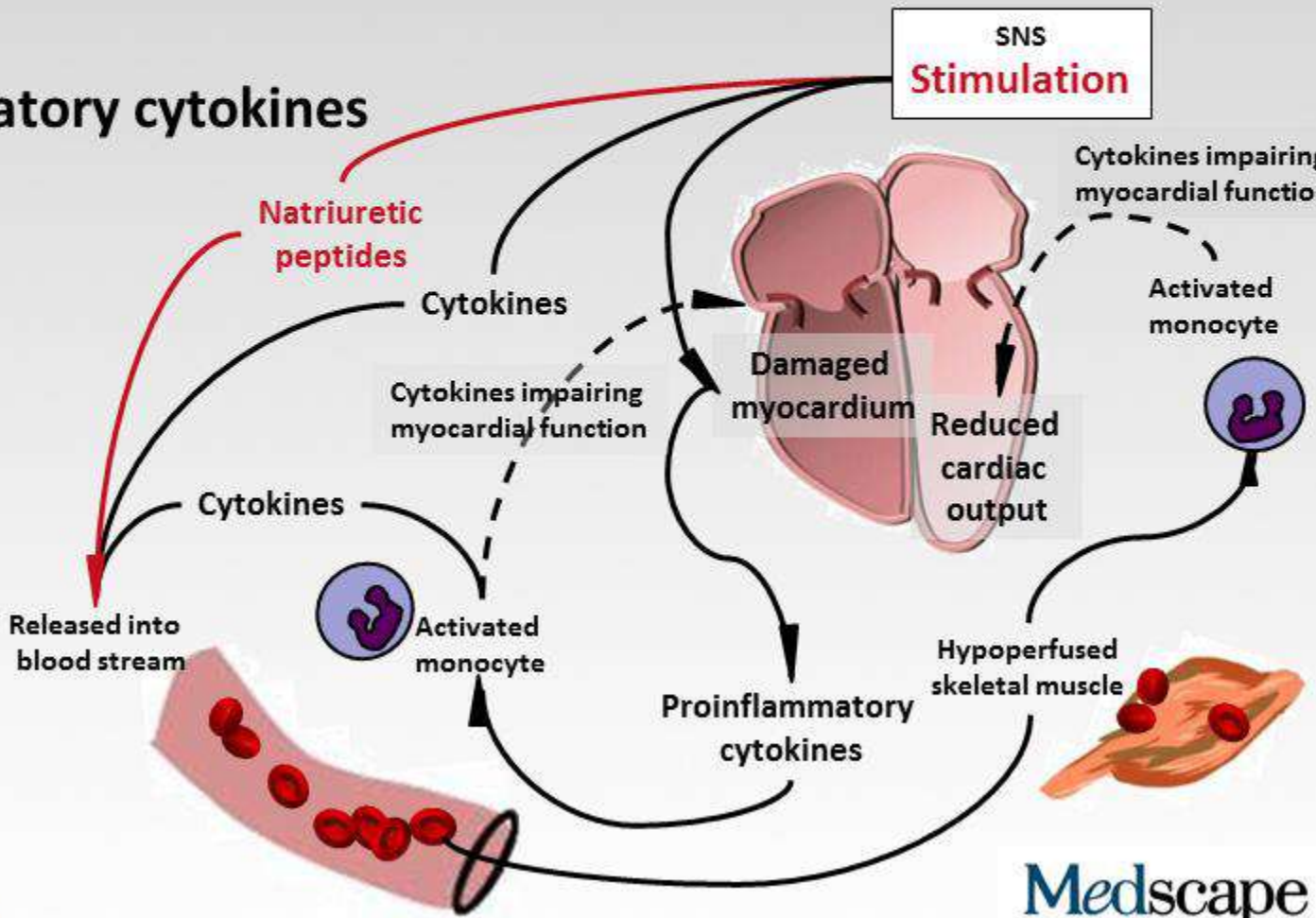
Gheorghiade M, et al. *JAMA*. 2006;296(18):2217-2226.

Medscape EDUCATION

Neurohormonal and Inflammatory Mechanisms

All neurohormonal axes activated in AHF

- SNS
- RAAS
- Inflammatory cytokines



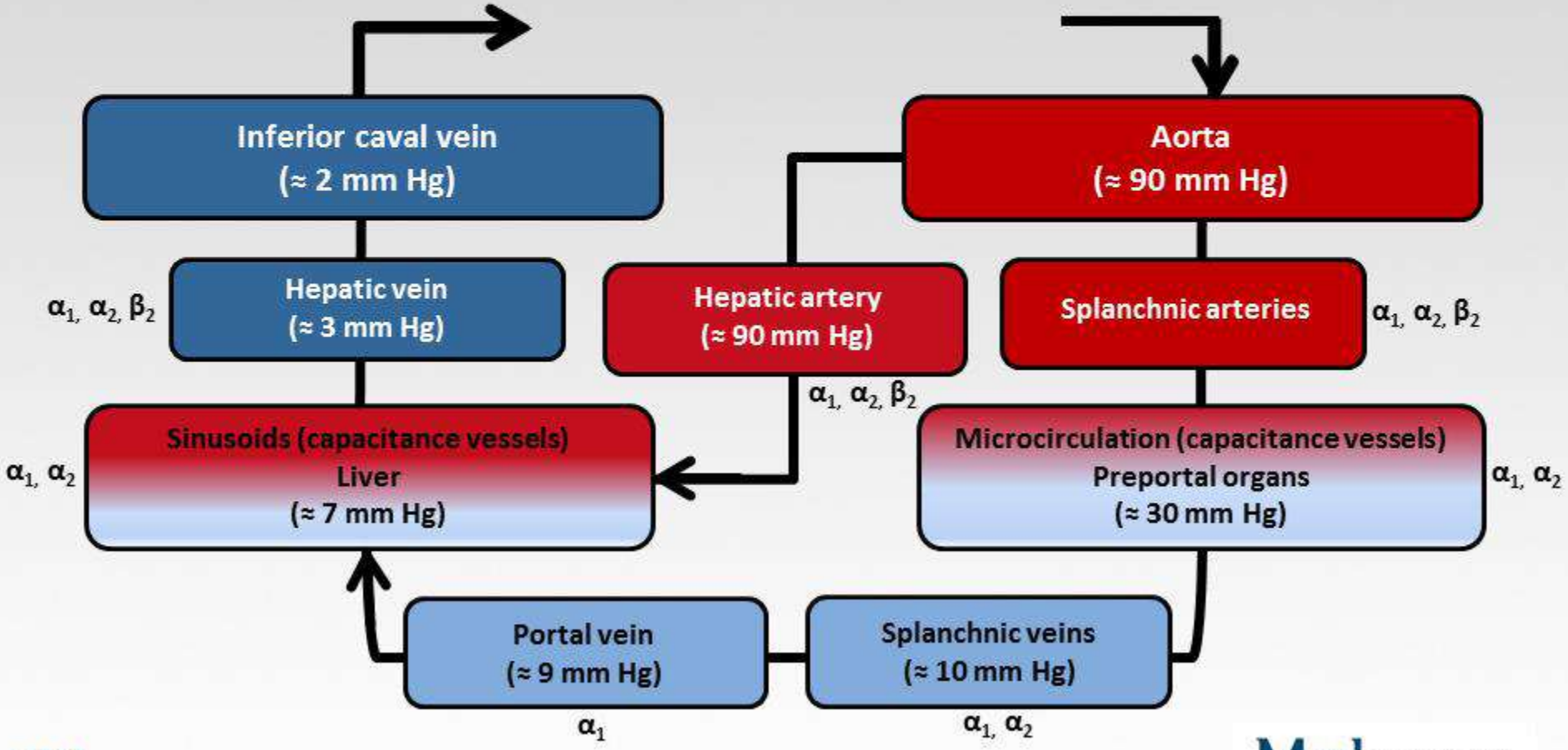
Heart failure

Adapted from Braunwald E. *N Engl J Med.* 2008;358(20):2148-2159.

Medscape EDUCATION

Resting Blood Volume Distribution

- 25% of normal blood volume in splanchnic vasculature
- Under SNS control and can be recruited rapidly (in seconds) to effective circulatory volume



Adapted from Gelman S, et al. *Anesthesiology*. 2004;100(2):434-439.

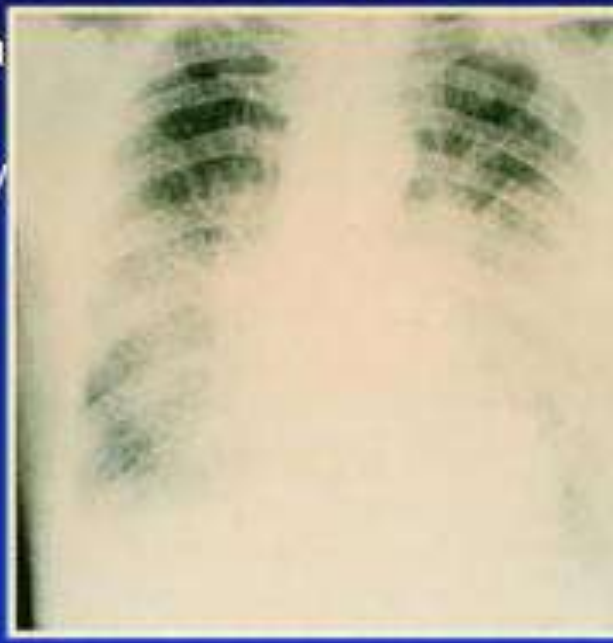
CS1: dyspnoea and/or Other Signs of Congestion + Elevated SBP (> 150 mmHg)

always

Acute pulmonary oedema

+

- dyspnoea develops abruptly
- Diffuse pulmonary oedema
- Minimal systemic oedema



It is a <u>vascular</u> illness

+ Warning !
Patient is very often
euvolemic
or hypovolemic

Acute /decompensated heart failure

High jugular venous pressure

Pulmonary congestion/oedema (high or low BP)

Peripheral vasoconstriction

Haemodynamic findings:

- Low cardiac output (CI < 2.5 L/m^2)
- High PCWP (>16 mmHg)
- High systemic vascular resistance
- Low BP → shock (oliguria, MOF)

CS2: dyspnoea + SBP 110 – 150 mmHg

Decompensated chronic heart failure

+

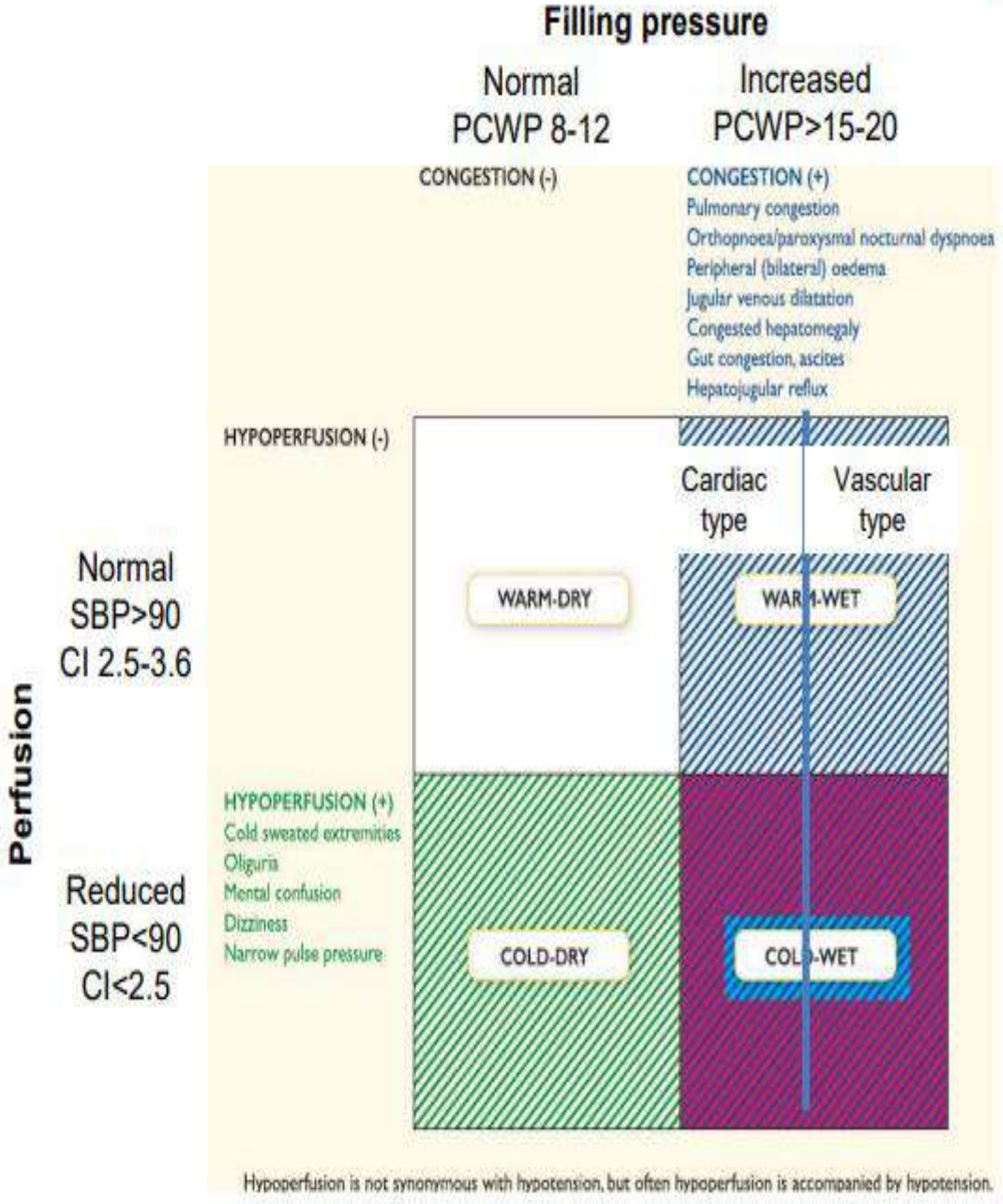
- dyspnoea develops gradually
- Gradual increase in body weight
- Systemic oedema
- Minimal pulmonary oedema

It is a systemic illness:

- Possible Renal dysfunction
- anaemia
- Low albumin
- Increased Pulmonary Congestion
- Systemic Congestion

or

Most useful classification tool: hemodynamic profiles



Backward failure:

- Dyspnea
- Rales
- S3
- Hepatojugular reflex
- Renal and liver failure from stasis
- ↑ Natriuretic peptides

Pulmonary edema at PCWP >25

Forward failure:

- SBP <90 och CI <2.5:
- Somnolence
- Prolonged capillary filling
- Low proportional pulse pressure = (SBP-DBP) / SBP <25% → CI < 2.2
- Symptomatic hypotension with RASi
- ↓ Na
- Shock: acute renal and liver failure

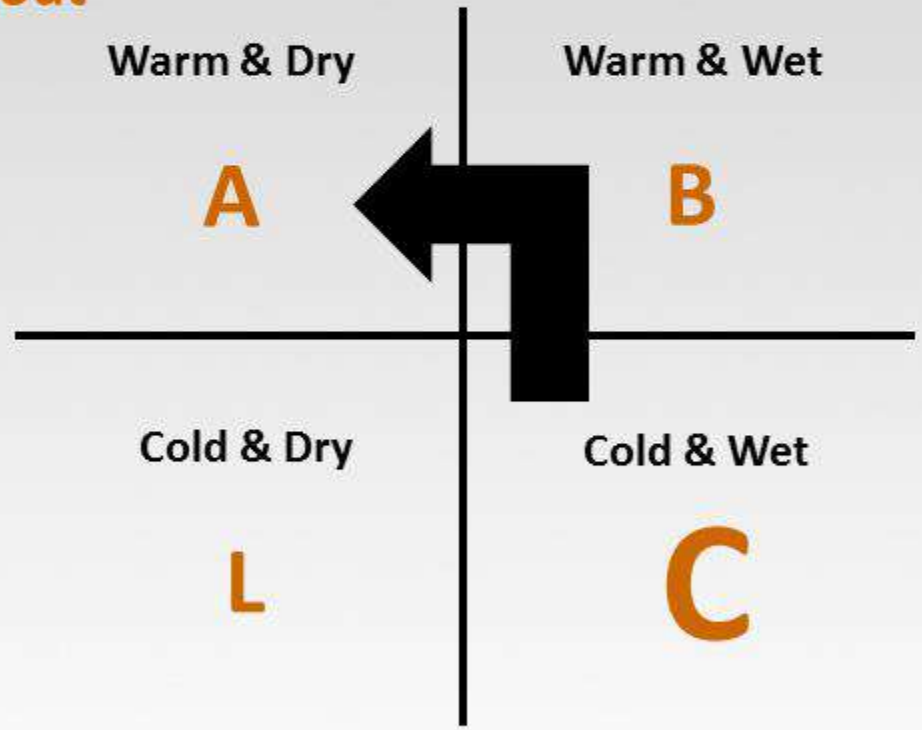
Cardiogenic shock = SBP < 90 and CI < 2,0 and PCWP >20

Initial Phase in ED/ICU/CCU: Profiling and Strategizing Care

Hemodynamic Profiles: Therapeutic Implications

Patients with hypotension, hypoperfusion, or shock

"Warm-up" & "dry-out"



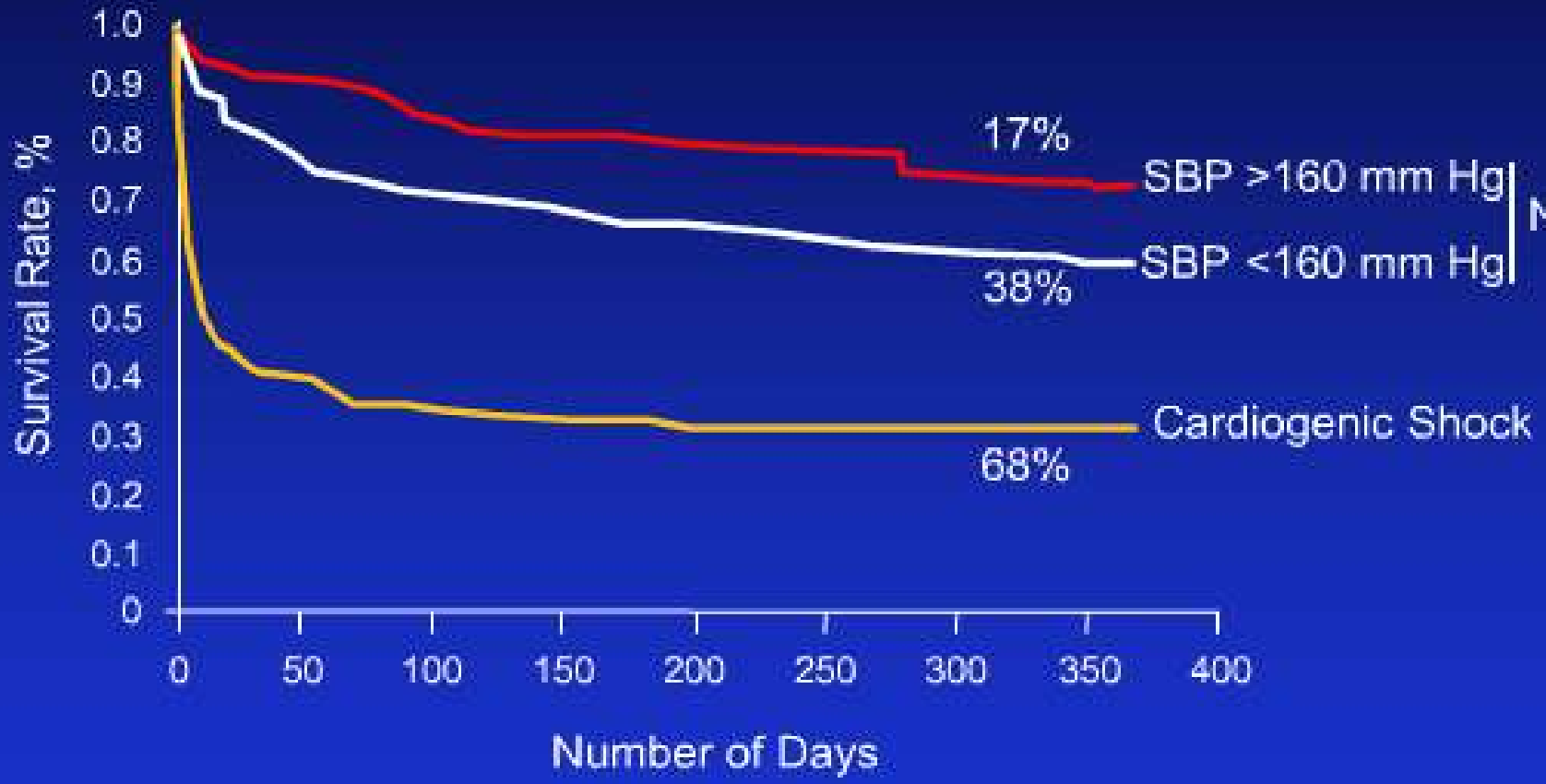
Inotropes

- Dobutamine
- Dopamine
- Levosimendan
- Nitroprusside

Heart failure

Adapted from Stevenson LW. *Eur J Heart Fail.* 2005;7(3):323-331.

EFICA Study
Predictive Factors of Mortality

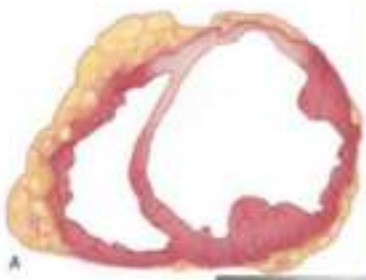


Variable	During Acute Pulmonary Edema	After Treatment
	mean ±SD	
Blood pressure (mm Hg)		
Systolic	200±26	139±17*
Diastolic	100±25	64±15*
Heart rate (beats/min)	83±14	72±12*
Mitral flow velocity (cm/sec)		
E wave	98±33	98±28
A wave	88±33	78±26*
E wave:A wave	1.31±0.80	1.51±0.97*
E-wave deceleration time (msec)	174±62	194±62*
Isovolumic relaxation time (msec)	78±19	75±25
Left ventricular volume (ml)		
End diastolic	109±43	117±50
End systolic	58±32	61±37
Left ventricular ejection fraction	0.50±0.15	0.50±0.13
Left ventricular wall thickness (mm)		
Posterior	12.8±2.9	12.8±3.1
Septal	12.5±3.7	12.9±3.6
Left ventricular dimension (mm)		
End diastolic	49.7±9.5	49.4±9.8
End systolic	38.3±10.1	38.3±10.7

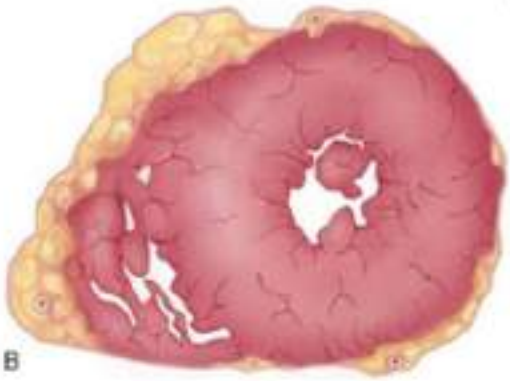
*$P<0.05$ for the comparison with the value during the acute episode.

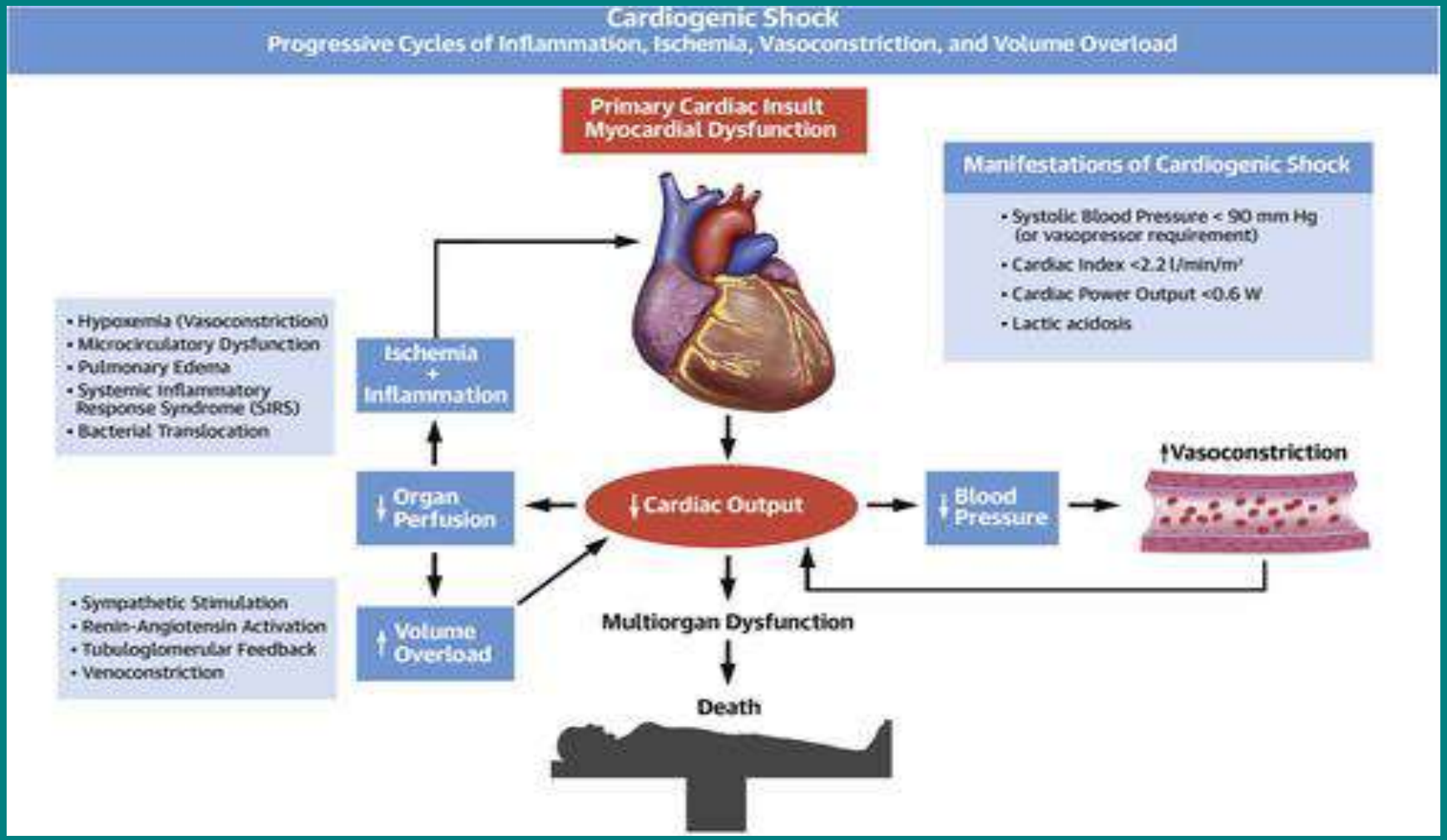
A Fundamental Issue: Are These Patients the Same or Different?

- 60-year-old man with long history of chronic HF
- 3 weeks of gradually worsening symptoms
- BP 85/40 mmHg



- 80-year-old woman with long history of hypertension
- 1 hour of sudden onset of symptoms
- BP 185/120 mmHg





A Standardized and Comprehensive Approach to the Management of Cardiogenic Shock, Volume: 8, Issue: 11, Pages: 879-891, DOI: (10.1016/j.jchf.2020.09.005)

PA (Swan-Ganz) catheter ? -- ESC Guidelines

Right heart catheterization with a pulmonary artery catheter:

- is recommended in patients with severe HF being evaluated for heart transplantation or mechanical circulatory support;
- should be considered in patients with probable pulmonary hypertension assessed by echocardiography in order to confirm pulmonary hypertension and its reversibility before the correction of valve/structural heart disease;
- may be considered in order to adjust therapy in patients with HF who remain severely symptomatic despite initial standard therapies and whose haemodynamic status is unclear.

I	C
IIa	C
IIb	C

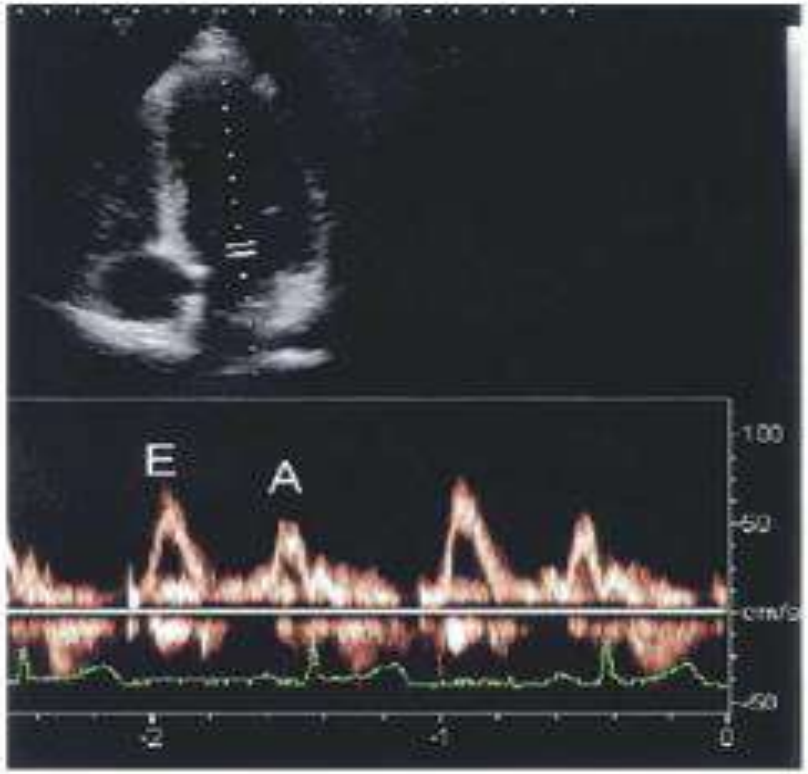
- Routine invasive haemodynamic evaluation with a pulmonary artery catheter is not indicated for the diagnosis of AHF. It may be helpful in selected cases of haemodynamically unstable patients with an unknown mechanism of deterioration. Also, routine use of an arterial line or central venous line for diagnostic purposes is not indicated.

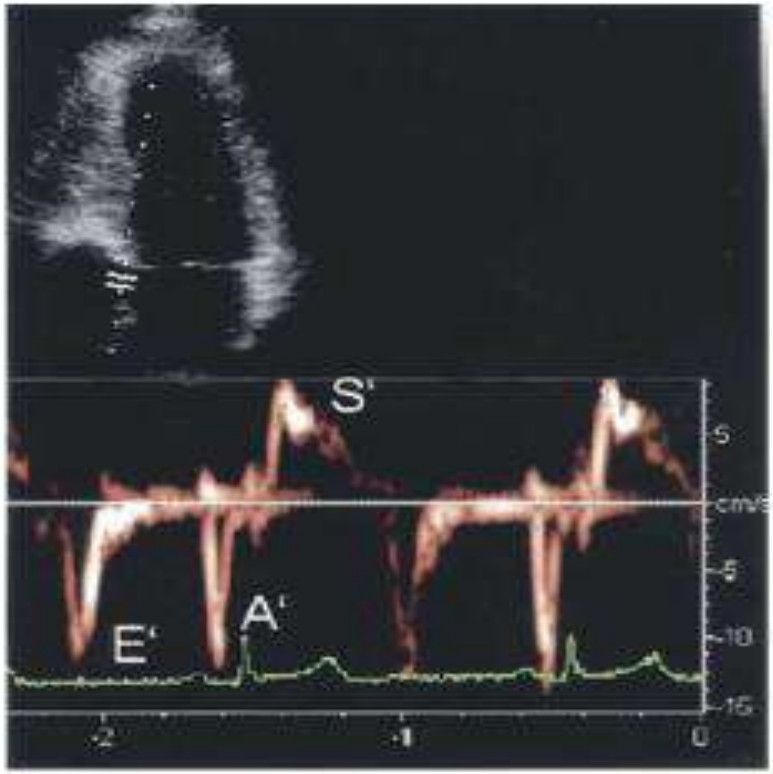
There is no agreement on the optimal method of haemodynamic monitoring in assessing and treating patients in cardiogenic shock, including pulmonary artery catheterization.

Recommendations regarding monitoring of clinical status of patients hospitalized due to acute heart failure

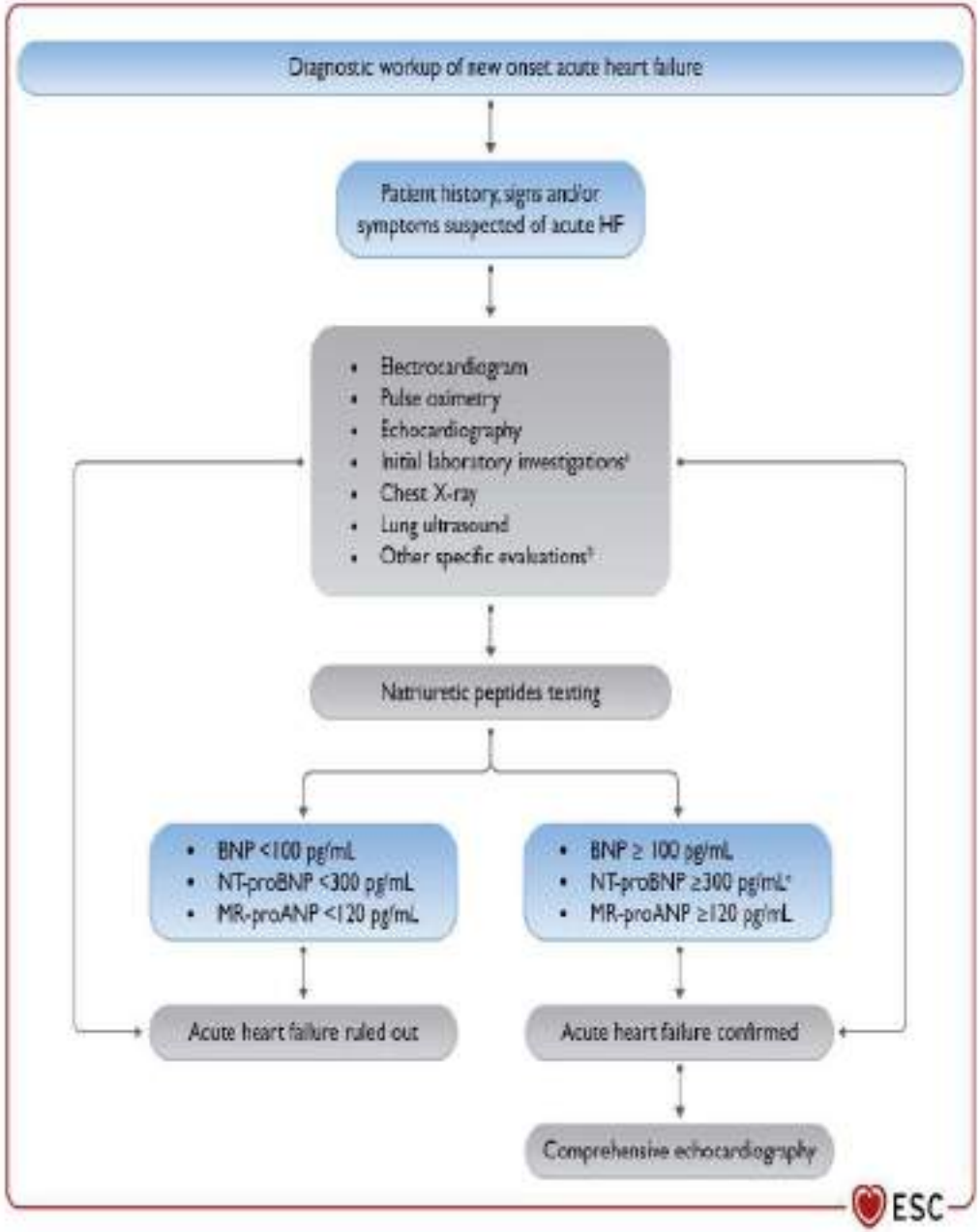
Recommendations	Class[a]	Level[b]
Standard non-invasive monitoring of heart rate, rhythm, respiratory rate, oxygen saturation and blood pressure is recommended.	I	C
It is recommended that patients should be weighed daily and have an accurate fluid balance chart completed.	I	C
It is recommended to evaluate signs and symptoms relevant to HF (e.g. dyspnoea, pulmonary rales, peripheral oedema, weight) daily to assess correction of fluid overload.	I	C
Frequent, often daily,measurement of renal function (blood urea, creatinine) and electrolytes (potassium, sodium) during i.v. therapy and when renin-angiotensin-aldosterone system antagonists are initiated is recommended.	I	C
Intra-arterial line should be considered in patients with hypotension and persistent symptoms despite treatment.	IIa	C
Pulmonary artery catheter may be considered in patients who, despite pharmacological treatment present refractory symptoms (particularly with hypotension and hypoperfusion).	IIb	C

Monitoring: biomarkers or pulmonary artery catheter?





Diagnostic work up of new onset acute heart failure



ACS = acute coronary syndrome; BNP = B-type natriuretic peptide; CT = computed tomography; HF = heart failure; MR-proANP=mid-regional pro-atrial natriuretic peptide; NT-proBNP = N-terminal pro-B-type natriuretic peptide; TSH = thyroid-stimulating hormone.

[a]Initial laboratory exams include troponin, serum creatinine, electrolytes, blood urea nitrogen or urea, TSH, liver function tests as well as D-dimer and procalcitonin when pulmonary embolism or infection are suspected, arterial blood gas analysis in case of respiratory distress, and lactate in case of hypoperfusion.

[b]Specific evaluation includes coronary angiography, in case of suspected ACS, and CT in case of suspected pulmonary embolism.

cRule-in values for the diagnosis of acute HF: >450 pg/mL if aged <55 years, >900 pg/mL if aged between 55 and 75 years and >1800 pg/mL if aged >75 years

www.escardio.org/guidelines

2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure (European Heart Journal 2021 – doi:10.1093/eurheartj/ehab368)

Diagnostic tests in patients with acute heart failure (1)

Exam	Time of measurement	Possible findings	Diagnostic value for AHF	Indication
ECG	Admission, during hospitalization,[a,b] pre-discharge	Arrhythmias, myocardial ischaemia	None	Recommended
Chest-X ray	Admission, during hospitalization[a]	Congestion, lung infection	Confirmatory	May be considered
LUS	Admission, during hospitalization[a] pre-discharge	Congestion	Confirmatory	May be considered
Echocardiography	Admission, during hospitalization,[a] pre-discharge	Congestion, cardiac function, mechanical causes	Major	Recommended
Natriuretic peptides (BNP, NT-proBNP, MR-proANP)	Admission, pre-discharge	Congestion	High negative predictive value	Should be considered
Serum troponin	Admission	Myocardial injury	Exclusion of ACS	Recommended
Serum creatinine	Admission, during hospitalization,[a] pre-discharge	Renal function	None	Recommended for prognostic assessment

ACS = acute coronary syndrome; AHF = acute heart failure; BNP = B-type natriuretic peptide; ECG = electrocardiogram; LUS = lung ultrasound; MR-proANP = mid-regional pro-atrial natriuretic peptide; NT-proBNP = N-terminal pro-B-type natriuretic peptide; TSH = thyroid-stimulating hormone.

[a]Based on clinical conditions.

[b]Continuous ECG monitoring can be considered based on clinical conditions.

2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure
(European Heart Journal 2021 – doi:10.1093/eurheartj/ehab368)

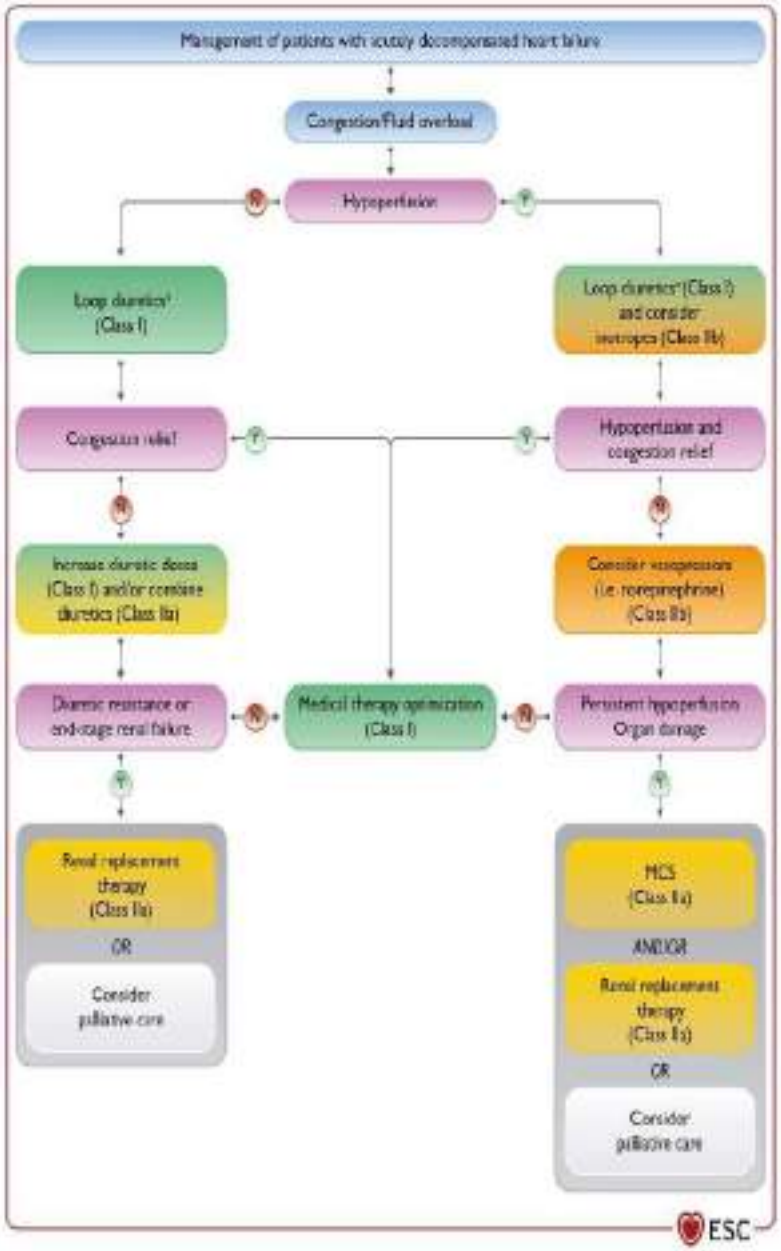
Diagnostic tests in patients with acute heart failure (2)

Exam	Time of measurement	Possible findings	Diagnostic value for AHF	Indication
Serum electrolytes (sodium, potassium, chloride)	Admission, during hospitalization,[a] pre-discharge	Electrolyte abnormalities	None	Recommended for prognostic assessment and treatment
Iron status (transferrin, ferritin)	Pre-discharge	Iron status	None	Recommended for prognostic assessment and treatment
TSH	Admission	Hypo- hyperthyroidism	None	Recommended for treatment
D-dimer	Admission	Pulmonary embolism	Excludes pulmonary embolism	Recommended when pulmonary embolism is suspected
Pro-calcitonin	Admission	Pneumonia	Useful for diagnosis of pneumonia	May be done when pneumonia is suspected
Lactate	Admission, during hospitalization[a]	Lactic acidosis	Useful to assess perfusion status	Recommended when peripheral hypoperfusion is suspected
Pulse oximetry and arterial blood gas analysis	Admission, during hospitalization[a]	Respiratory failure	Useful to assess respiratory function	Recommended when respiratory failure is suspected

ACS = acute coronary syndrome; AHF = acute heart failure; BNP = B-type natriuretic peptide; ECG = electrocardiogram; LUS = lung ultrasound; MR-proANP = mid-regional pro-atrial natriuretic peptide; NT-proBNP = N-terminal pro-B-type natriuretic peptide; TSH = thyroid-stimulating hormone. [a]Based on clinical conditions. [b]Continuous ECG monitoring can be considered based on clinical conditions.

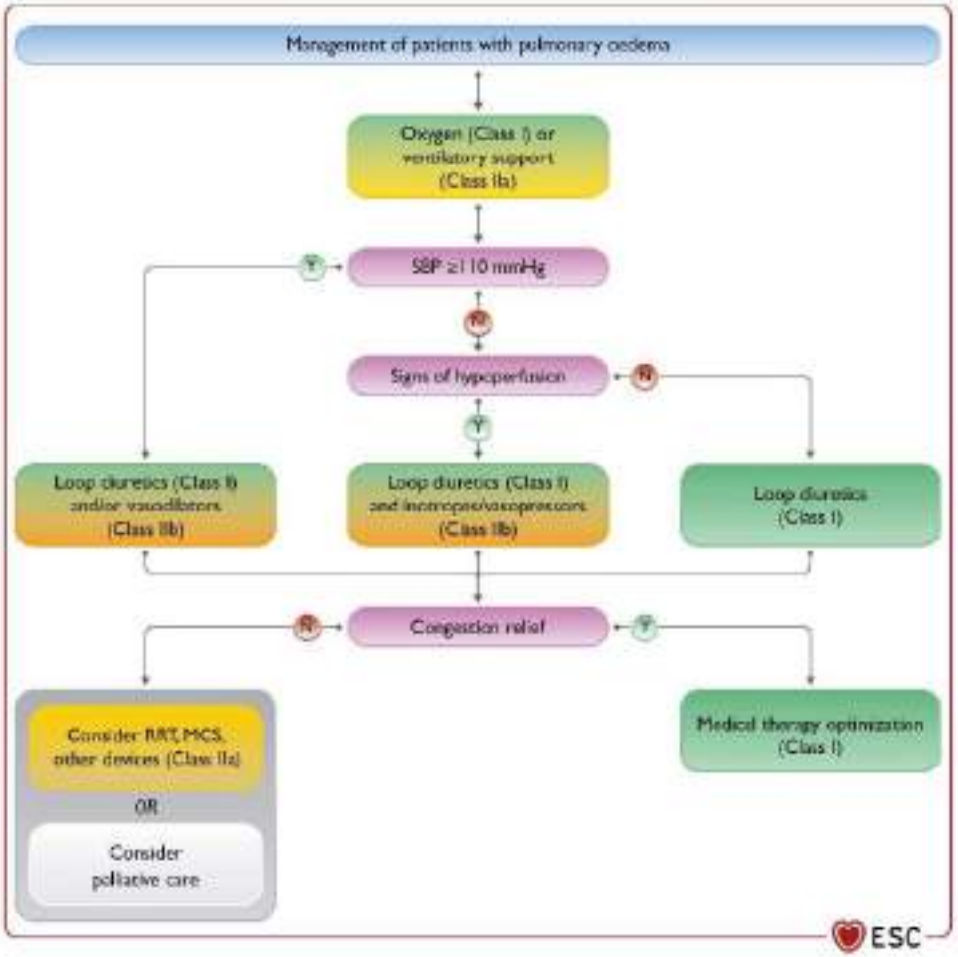
2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure
(European Heart Journal 2021 – doi:10.1093/eurheartj/ehab368)

Management of acute decompensated heart failure



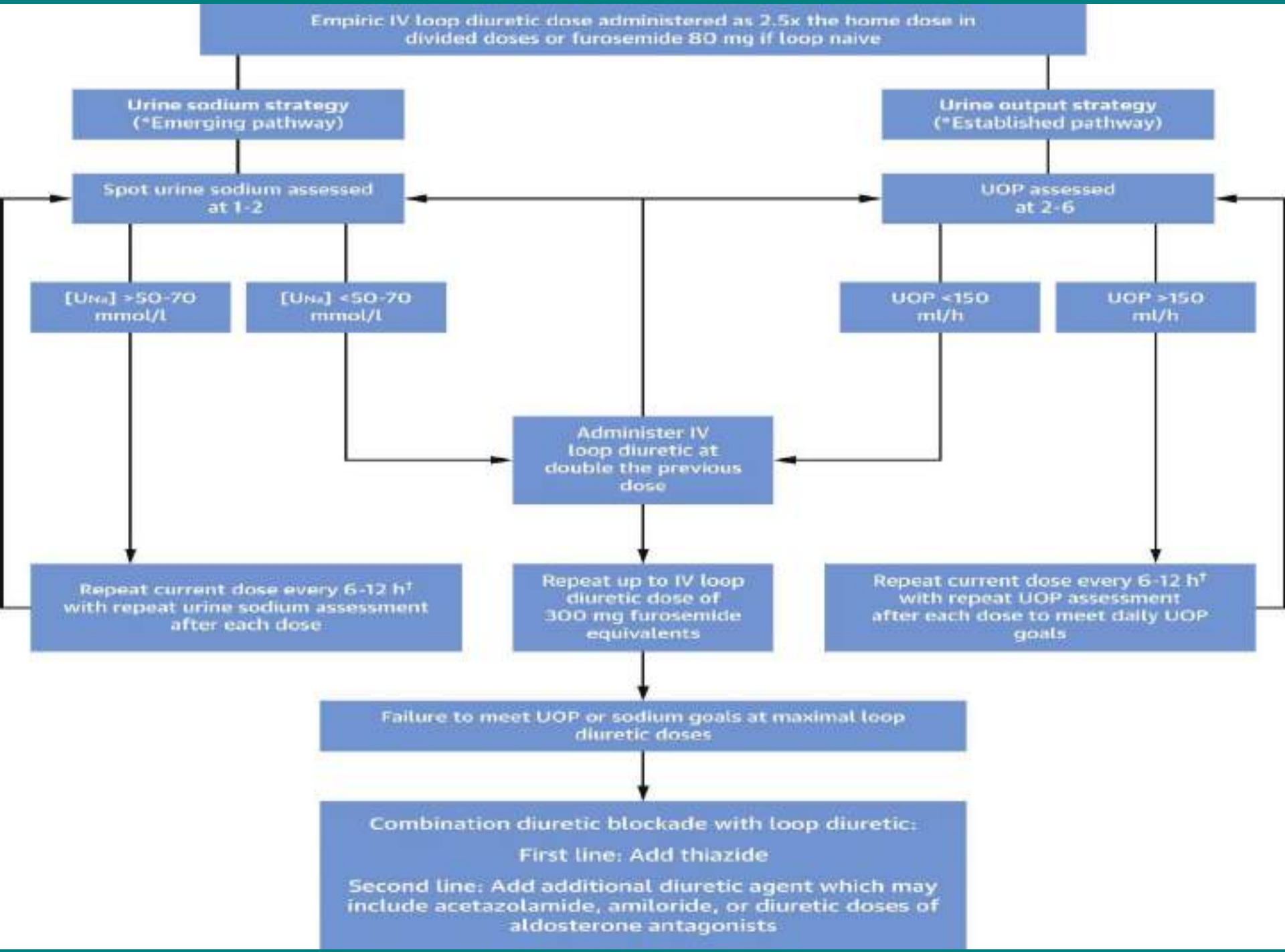
MCS=mechanical circulatory support.
[a]Adequate diuretic doses to relieve congestion and close monitoring of diuresis is recommended (see Figure13) regardless of perfusion status.

Management of pulmonary oedema

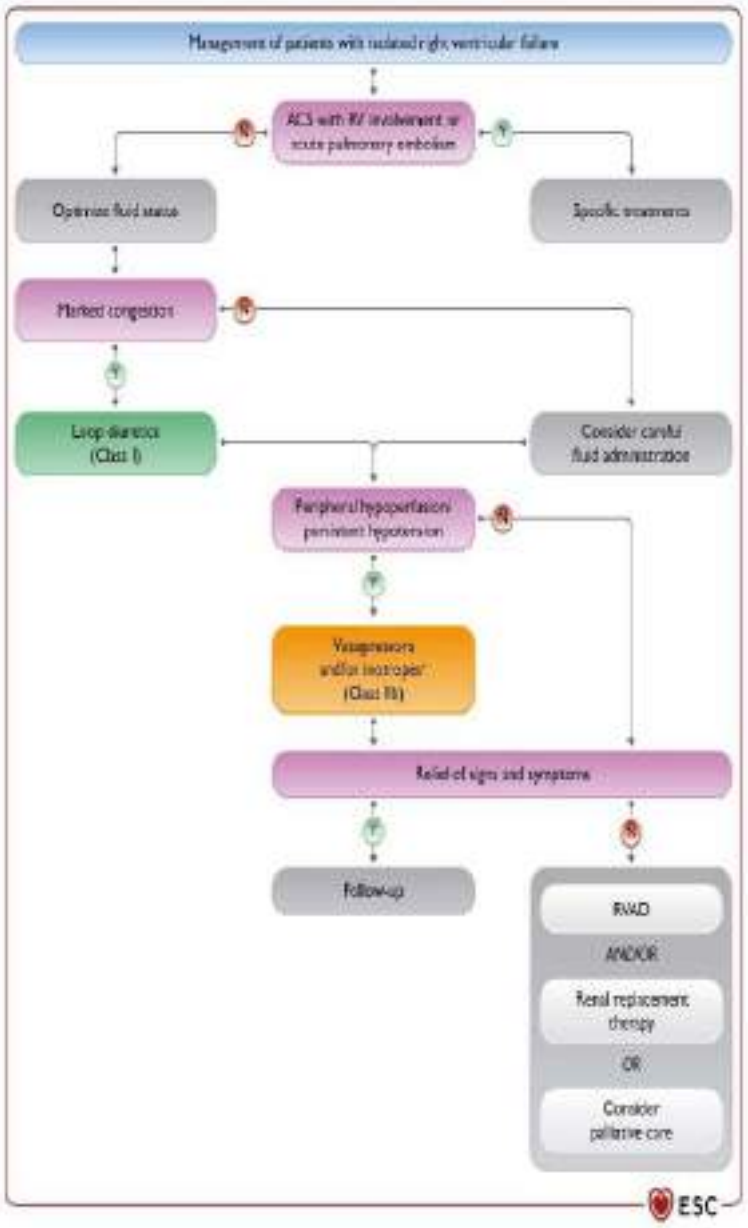


MCS=mechanical circulatory support; RRT= renal replacement therapy; SBP=systolic blood pressure.

2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure (European Heart Journal 2021 – doi:10.1093/eurheartj/ehab368)


Empiric IV loop diuretic dose administered as 2.5x the home dose in divided doses or furosemide 80 mg if loop naive
Urine sodium strategy (*Emerging pathway)
Urine output strategy (*Established pathway)
Spot urine sodium assessed at 1-2
UOP assessed at 2-6
[UNa] >50-70 mmol/l
[UNa] <50-70 mmol/l
UOP <150 ml/h
UOP >150 ml/h
Administer IV loop diuretic at double the previous dose
Repeat current dose every 6-12 h† with repeat urine sodium assessment after each dose
Repeat up to IV loop diuretic dose of 300 mg furosemide equivalents
Repeat current dose every 6-12 h† with repeat UOP assessment after each dose to meet daily UOP goals
Failure to meet UOP or sodium goals at maximal loop diuretic doses
Combination diuretic blockade with loop diuretic:
First line: Add thiazide
Second line: Add additional diuretic agent which may include acetazolamide, amiloride, or diuretic doses of aldosterone antagonists

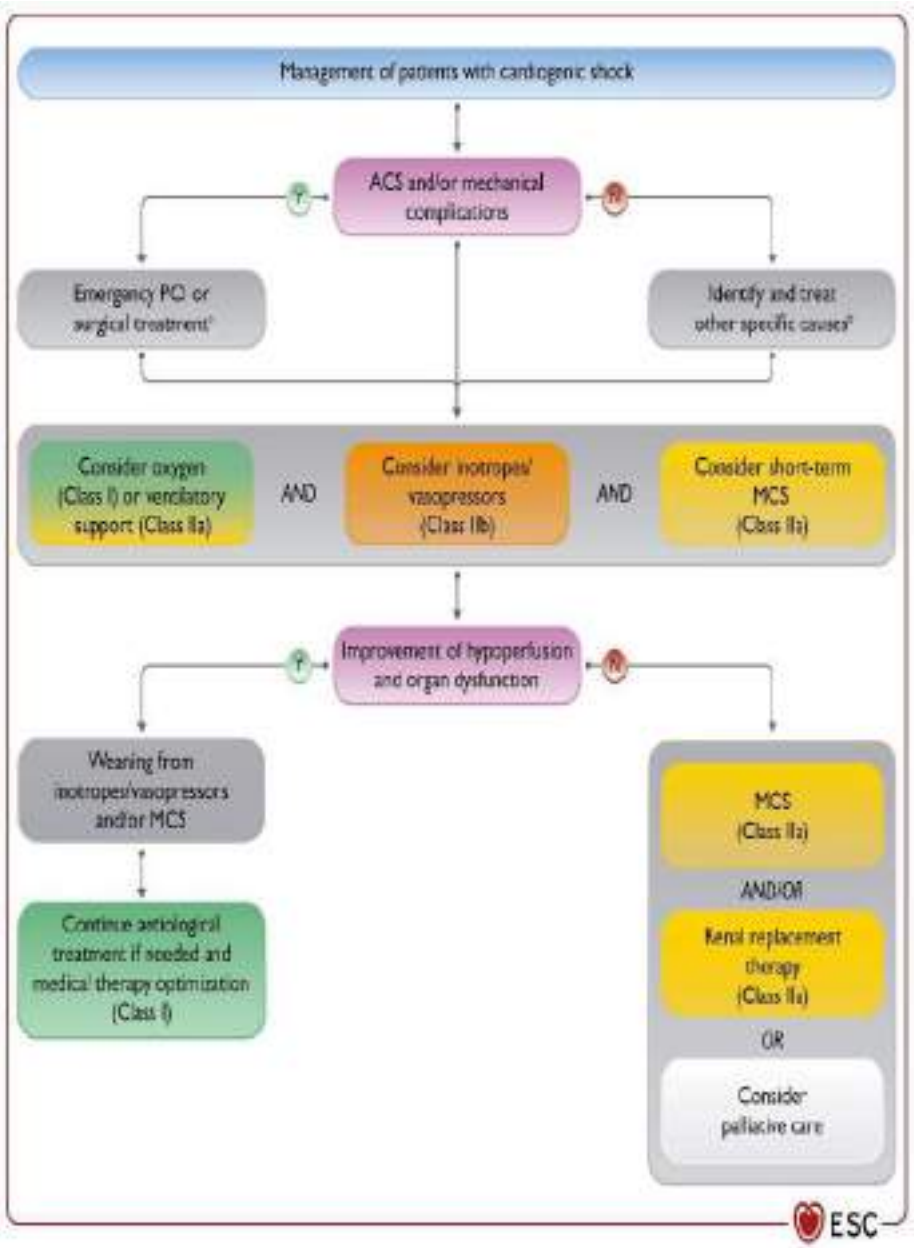
Management of right ventricular failure



ACS=acute coronary syndrome; RV=right ventricular; RVAD=right ventricular assist device.
*Inotropes alone in case of hypoperfusion without hypotension.

2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure
(European Heart Journal 2021 – doi:10.1093/eurheartj/ehab368)

Management of cardiogenic shock



ACS = acute coronary syndrome; BTT = bridge to transplantation; MCS = mechanical circulatory support; PCI = percutaneous coronary intervention.

[a]PCI in ACS, pericardiocentesis in tamponade, mitral valve surgery in papillary muscle rupture. In case of interventricular septum rupture, MCS as BTT should be considered.

[b]Other causes include acute valve regurgitation, pulmonary embolism, infection, acute myocarditis, arrhythmia.

Recommendations for the initial treatment of acute heart failure (1)

Recommendations	Class	Level
Oxygen and ventilatory support		
Oxygen is recommended in patients with SpO_2 <90% or PaO_2 <60 mmHg to correct hypoxaemia.	I	C
Intubation is recommended for progressive respiratory failure persisting in spite of oxygen administration or non-invasive ventilation.	I	C
Non-invasive positive pressure ventilation should be considered in patients with respiratory distress (respiratory rate >25 breaths/min, SpO_2 <90%) and started as soon as possible in order to decrease respiratory distress and reduce the rate of mechanical endotracheal intubation.	IIa	B

PaO_2 = partial pressure of oxygen; SpO_2 =transcutaneous oxygen saturation.

2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure
(European Heart Journal 2021 – doi:10.1093/eurheartj/ehab368)

Recommendations for the initial treatment of acute heart failure (2)

Recommendations	Class	Level
Diuretics		
Intravenous loop diuretics are recommended for all patients with AHF admitted with signs/symptoms of fluid overload to improve symptoms.	I	C
Combination of a loop diuretic with thiazidetype diuretic should be considered in patients with resistant oedema who do not respond to an increase in loop diuretic doses.	IIa	B
Vasodilators		
In patients with AHF and SBP >110 mmHg, i.v. vasodilators may be considered as initial therapy to improve symptoms and reducecongestion.	IIb	B

AHF = acute heart failure; i.v. = intravenous; SBP = systolic blood pressure.

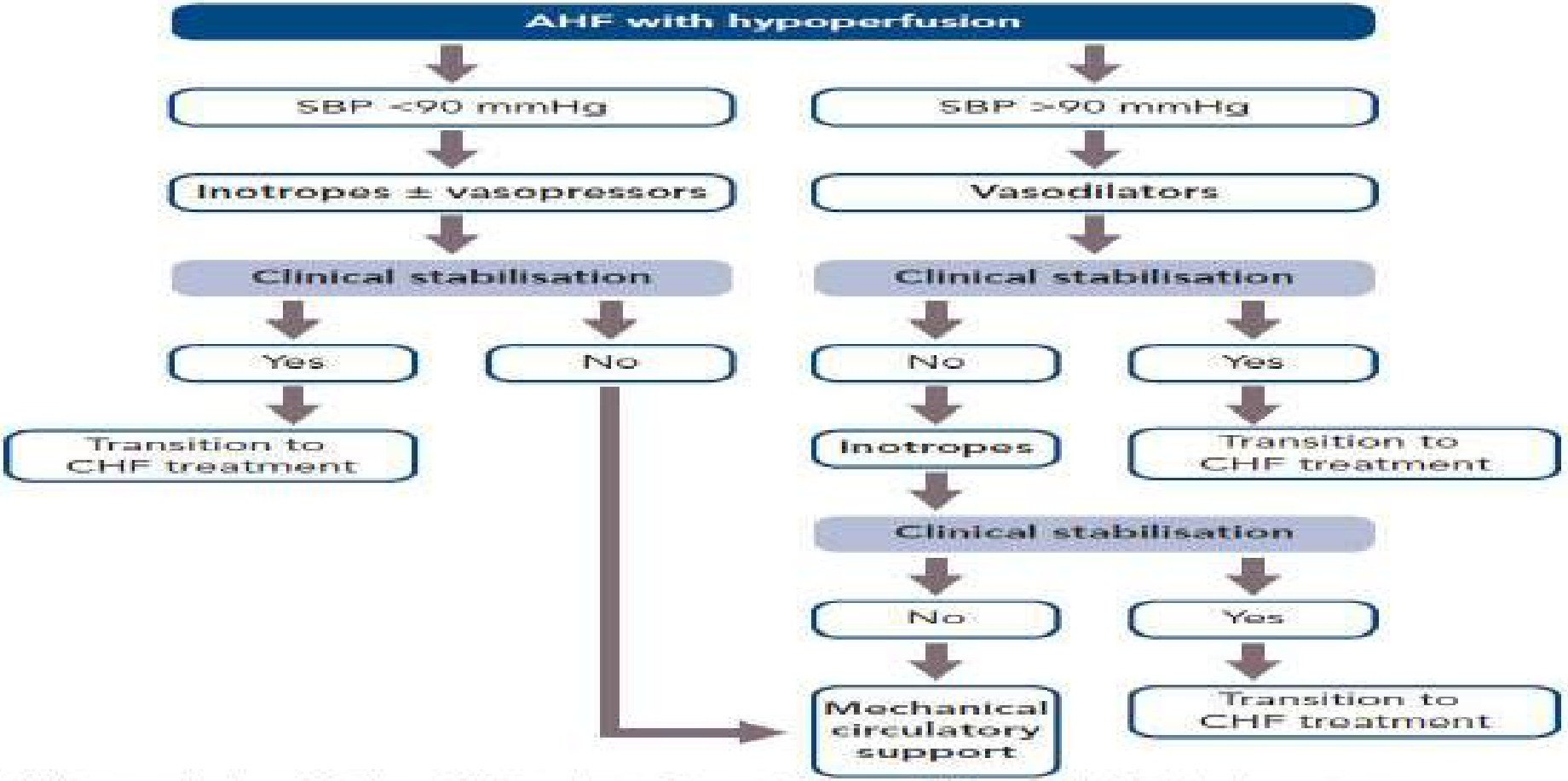
2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure
(European Heart Journal 2021 – doi:10.1093/eurheartj/ehab368)

Administration of positive inotropic agents

	Class/level	Bolus	Infusion rate
Dobutamine	II a, c	No	2 to 20 μg/kg/min (β+)
Dopamine	II b, c	No	<3 μg/kg/min: renal effect (δ+) 3-5 μg/kg/min: inotropic (β+) >5 μg/kg/min: (β+), vasopressor (α+)
Milrinone	II b, c	25-75 μg/kg/min over 10-20 min	0.375-0.75 μg/kg/min
Enoximone	II b, c	0.25-0.75 μg/kg	1.25-7.5 μg/kg/min
Levosimendan	II a, b	12 μg/kg/min* over 10 min	0.1 μg/kg/min which can be decreased to 0.05 or increased to 2 μg/kg/min
Norepinephrine		No bolus	0.2-1.0 μg/kg/min
Epinephrine		Bolus: 1 mg can be given i.v. at resuscitation, may be repeated after 3-5 min, endotracheal route is not favoured	0.05-0.5 μg/kg/min

*Current recommended dosing. In patients with hypotension, therapy should be started without a bolus.

Figure 1: Practical Recommendations on the Use of Inotropes in Patients with Acute Heart Failure and Hypoperfusion



AHF = acute heart failure; CHF = chronic heart failure; SBP = systolic blood pressure.

Cardiac Failure Review 2019;5(3):133–9.

CFR Cardiac Failure Review

Recommendations for the initial treatment of acute heart failure (3)

Recommendations	Class	Level
Other drugs		
Thromboembolism prophylaxis (e.g. with LMWH) is recommended in patients not already anticoagulated and with no contraindication to anticoagulation, to reduce the risk of deep venous thrombosis and pulmonary embolism.	I	A
Routine use of opiates is not recommended, unless in selected patients with severe/intractable pain or anxiety.	III	C

LMWH= low-molecular-weight heparin.

Recommendations for the use of short-term mechanical circulatory support in patients with cardiogenic shock

Recommendations	Class	Level
Short-term MCS should be considered in patients with cardiogenic shock as a BTR, BTD, BTB. Further indications include treatment of the cause of cardiogenic shock or long-term MCS or transplantation.	IIa	C
IABP may be considered in patients with cardiogenic shock as a BTR, BTD, BTB, including treatment of the cause of cardiogenic shock (i.e. mechanical complication of acute MI) or longterm MCS or transplantation.	IIb	C
IABP is not routinely recommended in post-MI cardiogenic shock.	III	B

BTB = bridge to bridge; BTD = bridge to decision; BTR = bridge to recovery; IABP = intra-aortic balloon pump; MCS = mechanical circulatory support; MI = myocardial infarction.

2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure
(European Heart Journal 2021 – doi:10.1093/eurheartj/ehab368)

CICU Management of Cardiogenic Shock

Serial Assessment

- Lactate
- Fick + thermodilution CO/CI
- CPO and PAPi

and if MCS

- Serial echocardiograms
- Assess for hemolysis
- Neurovascular assessments

*Criteria for Refractory Shock

- CPO <0.6W
- CI <2.2 l/min/m²
- ↑ Lactate

Contraindications To MCS

- Anoxic brain injury
- Irreversible end organ failure
- Prohibitive vascular access
- DNR

CPO = MAP x CO/451
PAPi = (sPAP-dPAP)/RA

Treatment Objectives

- Wean vasopressors/inotropes
- Early escalation for refractory shock
- Heart recovery

Refractory Shock*

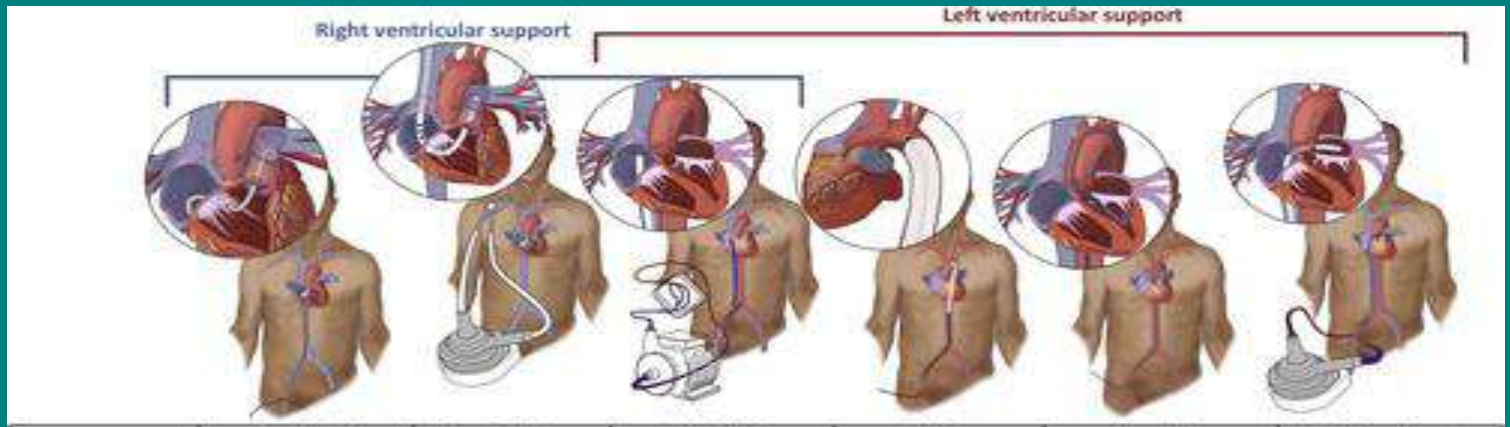
- **No** → CPO >0.6W, PAPi >1.0, RA <15 mm Hg, PCWP <15 mm Hg → Wean vasopressors/inotropes and assess for heart recovery
- **Yes** → Bi-V CS (CPO <0.6W, PAPi <1.0, RA >15 mm Hg, PCWP >15 mm Hg); LV-dominant CS (CPO <0.6W, PAPi >1.0, RA <15 mm Hg, PCWP >15 mm Hg); RV-dominant CS (CPO <0.6W, PAPi <1.0, RA >15 mm Hg, PCWP <15 mm Hg)

→ Multidisciplinary Shock Team Consultation

→ Assess Candidacy for Temporizing MCS

Hypoxemia	Yes	No
Bi-V CS	R + L pVAD with Oxygenator or VA-ECMO +/- LV Vent	R + L pVAD
LV-dominant CS	L pVAD with Oxygenator or VA-ECMO +/- LV Vent	L pVAD
RV-dominant CS	R pVAD with Oxygenator or VA-ECMO +/- LV Vent	R pVAD

A Standardized and Comprehensive Approach to the Management of Cardiogenic Shock, Volume: 8, Issue: 11, Pages: 879-891, DOI: (10.1016/j.jchf.2020.09.005)



	Impella RP	TandemHeart RA-PA	VA-ECMO	IABP	Impella (2.5, CP, 5.0, 5.5)	TandemHeart LA-FA
Flow	max 4.0 l/min	max 4.0 l/min	max 7.0 l/min	0.5 l/min	2.5 - 5.5 l/min	max 4.0 l/min
Pump Speed	33000 rpm	max 7500 rpm	max 5000 rpm	NA	max 51,000 rpm	max 7500 rpm
Mechanism	Axial flow continuous pump (RA-to-PA)	Centrifugal flow continuous pump (RA-to-PA)	Centrifugal flow continuous pump (RA-to-AO)	Balloon inflation-deflation (AO)	Axial flow continuous pump (LV-to-AO)	Centrifugal flow continuous pump (LA-to-AO)
Cannula Size	22 F venous	29 F venous	14-19 F arterial 17-21 F venous	7-8 F arterial	13-21 F arterial	12-19 F arterial 21 F venous
Insertion/Placement	Femoral vein	Internal jugular vein	Femoral vein Femoral artery	Femoral artery Axillary artery	Femoral artery Axillary artery	Femoral artery Femoral vein
LV Unloading	-	-	-	+	+ to +++	++
RV Unloading	+	+	++	-	-	-
Cardiac Power	-	-	↑↑	↑	↑↑	↑↑
Afterload	-	-	↑↑	↓	↓↓	↑
Coronary Perfusion	-	-	-	↑	↑	-
Considerations	• *RECOVER RIGHT: 73% survival-to-30 days in RVF post LVAD, AMI or cardiotomy* • *May 2019 - FDA post-approval study: 33% survival-to-30 days*	• *IJ access may facilitate early ambulation*	• *Bi-V + oxygenation support for CS following:* - *AMI, ADHF or cardiac arrest* - *Cardiotomy* - *Myocarditis* - *Allograft rejection*	• *Requires stable cardiac rhythm and native heart function* • *May consider in select cases of post-AMI mechanical complications*	• *June 2008 – FDA 510(k) approval for HR-PCI* • *April 2016: Expanded indication for CS* • *Contraindicated with mechanical aortic valve, LV thrombus*	• *Requires transseptal access* • *Oxygenator may be added to the circuit*

A Standardized and Comprehensive Approach to the Management of Cardiogenic Shock, Volume: 8, Issue: 11, Pages: 879-891, DOI: (10.1016/j.jchf.2020.09.005)

Trends in MCS Use and Hospital Mortality

- Patients with AMI and non-infarction-related cardiogenic shock
  - 144,254 cases of cardiogenic shock
  - 55.4% of cases were associated with an AMI
- Patients with CS complicating AMI had lower hospital mortality vs non-AMI related CS
  - (45% vs 48.2%; $P < .001$)

IABP use	IMP use	ECMO use
• Overall decline • 29.8% to 17.7%*	• Uptrend in use • 0.1% to 2.6%*	• Uptrend in use • 0.3% to 1.8%*

*ptrend < 0.01

Shah M, et al. *Clin Res Cardiol*. 2018;107:287-303.

IABP-SHOCK II Trial

Largest randomized trial in patients with AMI cardiogenic shock

- Summary of findings: Use of IABP did not significantly reduce 30-day mortality in patients with AMI-CS*
- At 30 days, 119 patients in IABP group (39.7%) and 123 patients in control group (41.3%) had died†

- No randomized controlled trials in acute on chronic heart failure complicated by shock
  - Data can't be extrapolated to these patients and close monitoring is needed

*For whom an early revascularization strategy was planned. †Relative risk with IABP, 0.96;95% CI, 0.79 to 1.17;P=0.69.

Thiele H,et al. *N Engl J Med*. 2012;367:1287-1296.

Clinical Considerations for Device Selection *Short-Term MCS*

Comparison of Commercially Available Devices for Short-Term MCS

	VA-ECMO	IABP	Tandem Heart	Impella (2.5; CP; 5; RP)
Flow, L/min	4-6	0.5-1	4-6	2.5-5
Duration of support, FDA approved	6 h (limited by oxygenator durability)	9 d	21 d	4 d (2.5, CP) 6 d (5) 14 d (RP)
Ventricles supported	LV and RV	LV	LV or RV	LV or RV
Cannula size, F	Inflow 18-21 Outflow 15-22	7-9	Inflow 21 Outflow 15-17	12-21
Additional requirements	Potential need for LV venting, possible cutdown		Transseptal puncture	Surgical cutdown for Impella 5
Advantages	Highest cardiac output Complete cardiopulmonary support (including oxygenation and CO_2 removal)	Easy to place Good safety profile Fewer side effects, especially vascular	Highest cardiac output, comparable with VA-ECMO, and no LV distension	Multiple devices to choose from
Disadvantages	Requires more resources and support staff than other devices Retrograde blood flow with worsening of afterload (LV distension) Vascular complications Thrombocytopenia	Limited hemodynamic support Contraindicated in severe aortic regurgitation	Need tertiary or quaternary specialized care center Necessitates atrial transseptal puncture with its potential complications Vascular complications Retrograde blood flow	More invasive and complex to implant than the IABP Unstable position Frequent hemolysis Vascular complications

Guglin, et al. *J Am Coll Card*. 2019:698-716.

Recommendation for IABP Use
US vs European Guidelines

2013 ACCF/AHA Management of Cardiogenic Shock[a]

Class IIa Recommendation

The use of intra-aortic balloon pump counterpulsation can be useful for patients with cardiogenic shock after STEMI who do not quickly stabilize with pharmacological therapy

ESC 2017 Management of Cardiogenic Shock[b]

Class III Recommendation

Routine intra-aortic balloon pumping is not indicated.

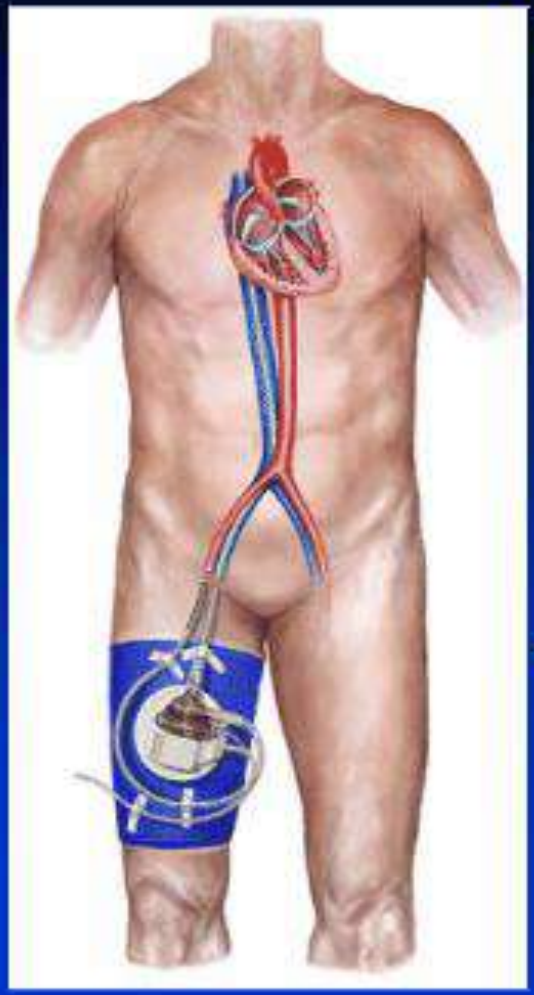
Class IIa Recommendation

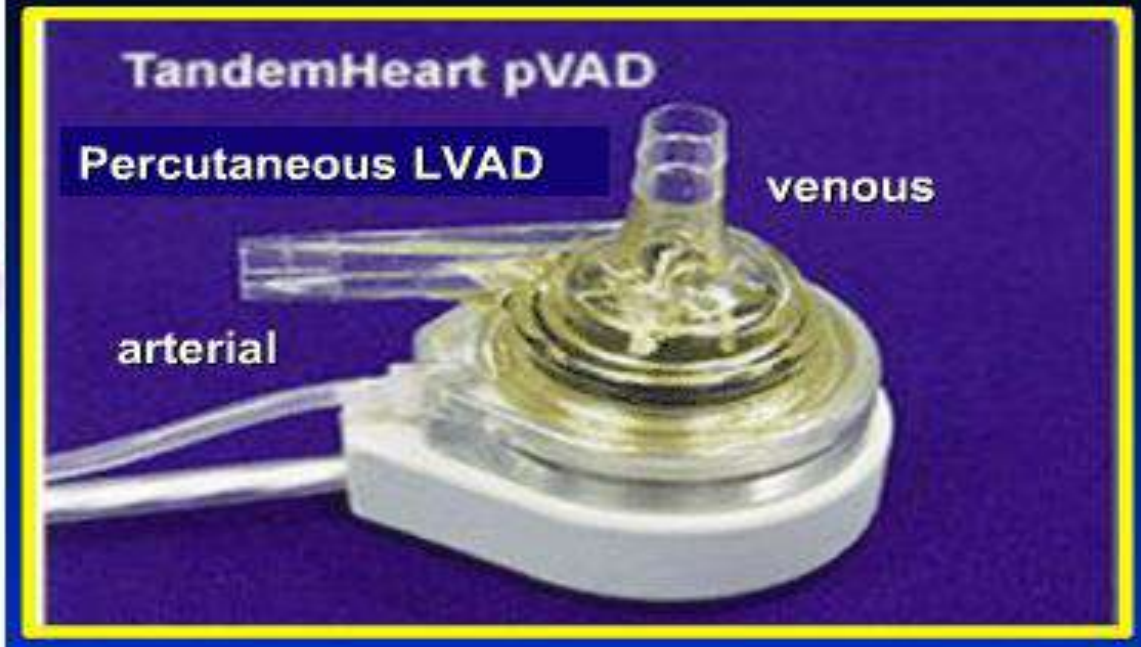
Intra-aortic balloon pumping should be considered in patients with hemodynamic instability/cardiogenic shock due to mechanical complications

a. O'Gara et al, *Circulation*.2013;127:e362-e425.
b. Ibanez et al, *Eur Heart J*, 2018.39:119-177.

Device Therapy for AHF: mechanical support, ultrafiltration & electrical therapy

TandemHeart™





By courtesy of P. Mohacsi

- Continuous-flow up to 4L/min
- Short-term circulatory support
- Transeptal and arterial cannulas

Recommendations for pre-discharge and early post-discharge follow-up of patients hospitalized for acute heart failure

Recommendations	Class	Level
It is recommended that patients hospitalized for HF be carefully evaluated to exclude persistent signs of congestion before discharge and to optimize oral treatment	I	C
It is recommended that evidence-based oral medical treatment be administered before discharge.	I	C
An early follow-up visit is recommended at 1-2 weeks after discharge to assess signs of congestion, drug tolerance and start and/or uptitrate evidence-based therapy.	I	C
Ferric carboxymaltose should be considered for iron deficiency, defined as serum ferritin <100 ng/mL or serum ferritin 100–299 ng/mL with TSAT <20%, to improve symptoms and reduce rehospitalizations.	IIa	B

HR = heart failure; TSAT = transferrin saturation.

2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure
(European Heart Journal 2021 – doi:10.1093/eurheartj/ehab368)

Oral Diuretic Rx

- Switching from IV-oral loop diuretic
  - Stable weight
    - At least 48 hours prior to discharge
    - Absence of signs of fluid retention
  - Stable renal function

Management
Adherence issues

- Fluid restriction (1.5 l/day)
- Na restriction<100mmols/day
- ? NSAIDs
  - interfere with PG synthesis by inhibiting cyclo-oxygenase and thereby antagonise the natriuretic response to loop diuretics

ESC-HF Registry described admission and discharge profiles – 40% still wet !

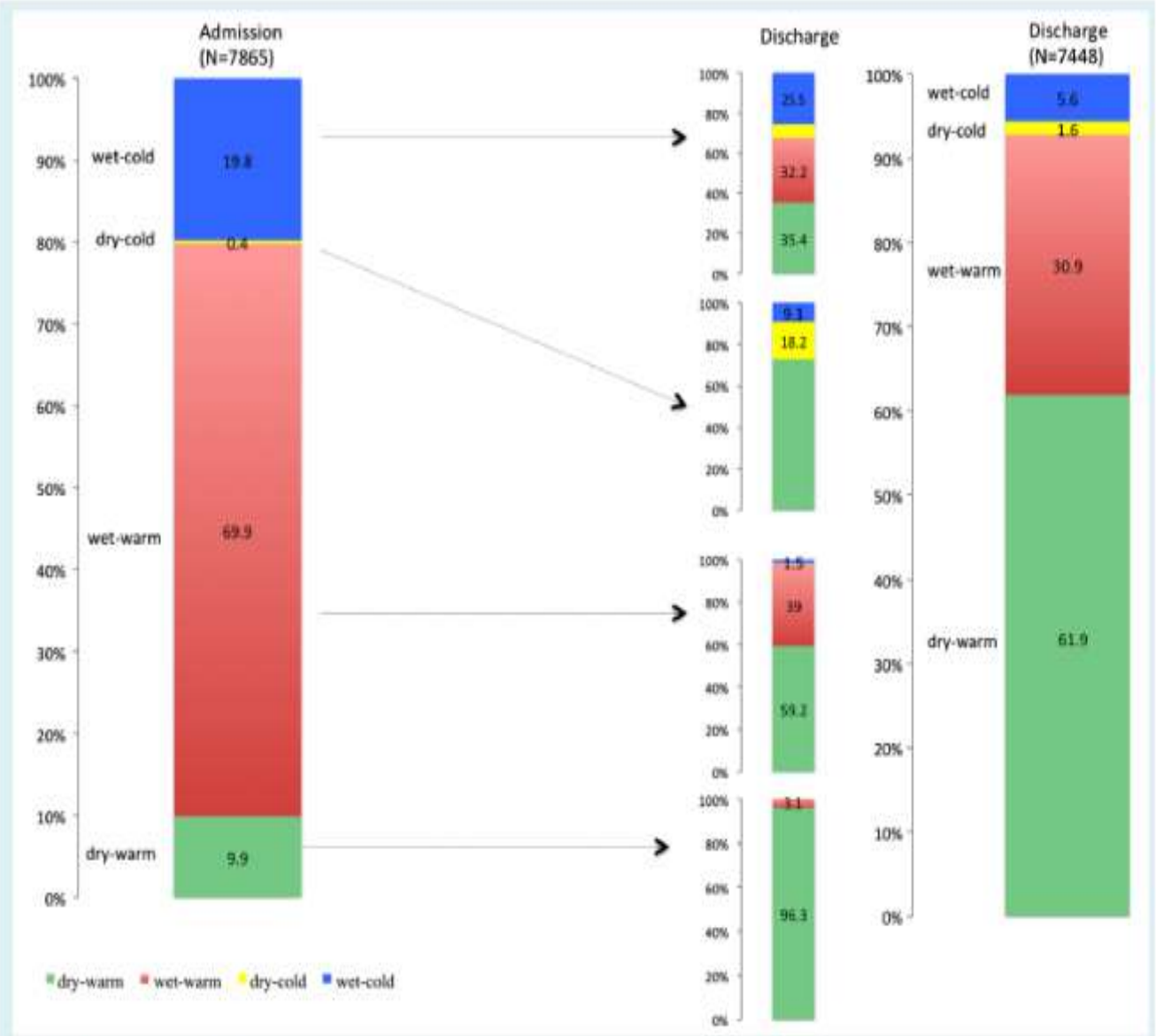


Figure 1 Classification based on congestion/hypoperfusion status assessed by clinical examination performed at admission and discharge. Classification at discharge was used in 7448 patients discharged alive.

ESC-HF Registry Chinocel EJHF 2019

Several Drugs in ADHF Not Successful

PDE inhibitors: milrinone: OPTIME-CHF[1]

Endothelin antagonists: tezosentan: VERITAS[2]

Calcium sensitizers: levosimendan; SURVIVE/REVIVE[3]

AVP antagonists: tolvaptan; EVEREST[4]

Adenosine A1-receptor antagonist: rolofylline; PROTECT[5]

Natriuretic peptides: nesiritide: ASCEND-HF[6]

ADHF = acute decompensated heart failure;
AVP = arginine vasopressin;
PDE = phosphodiesterase

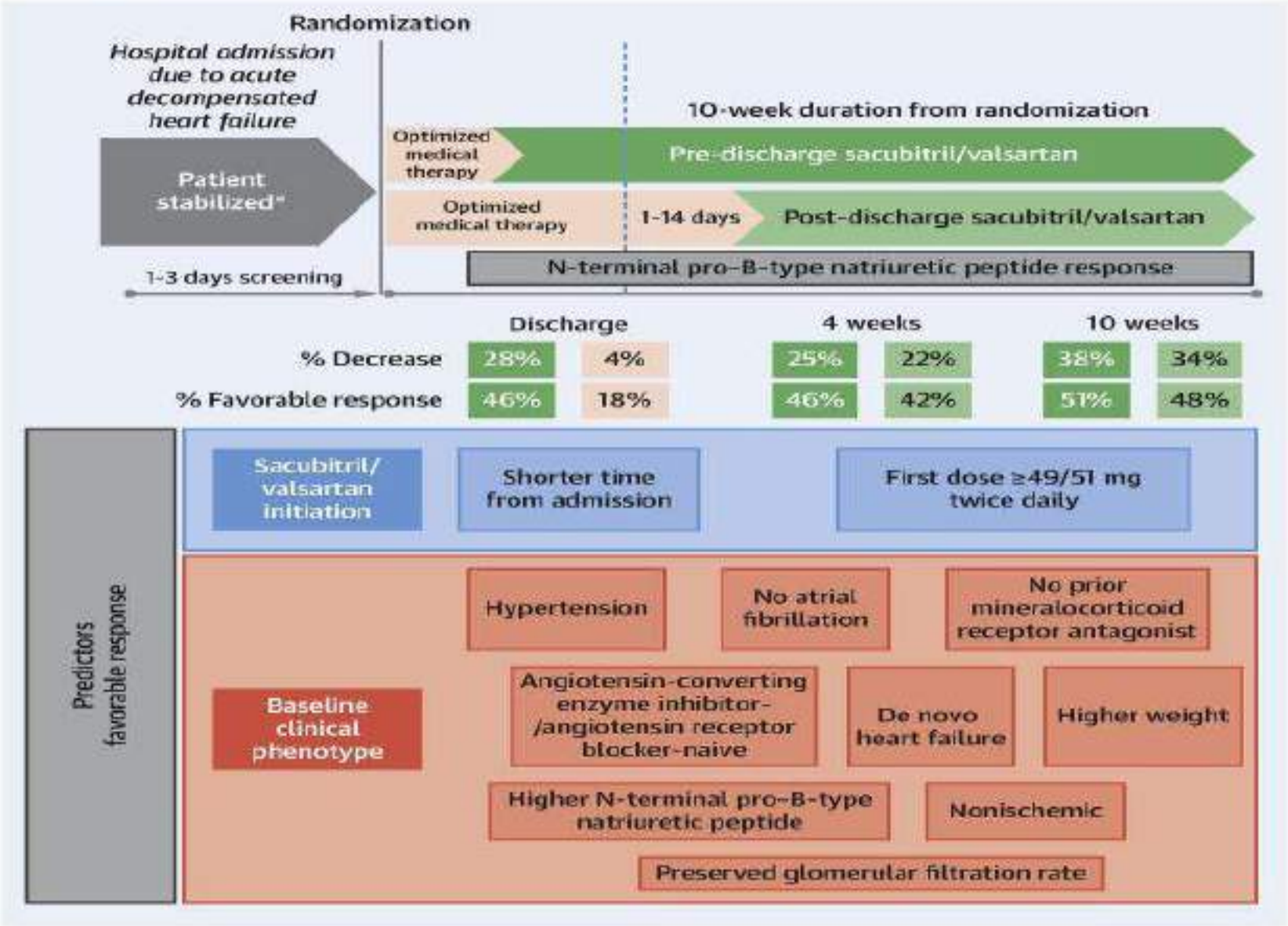
See reference list for a complete listing of citations.

SACUBITRIL VALSARTAN
New hope ?

TRANSITION

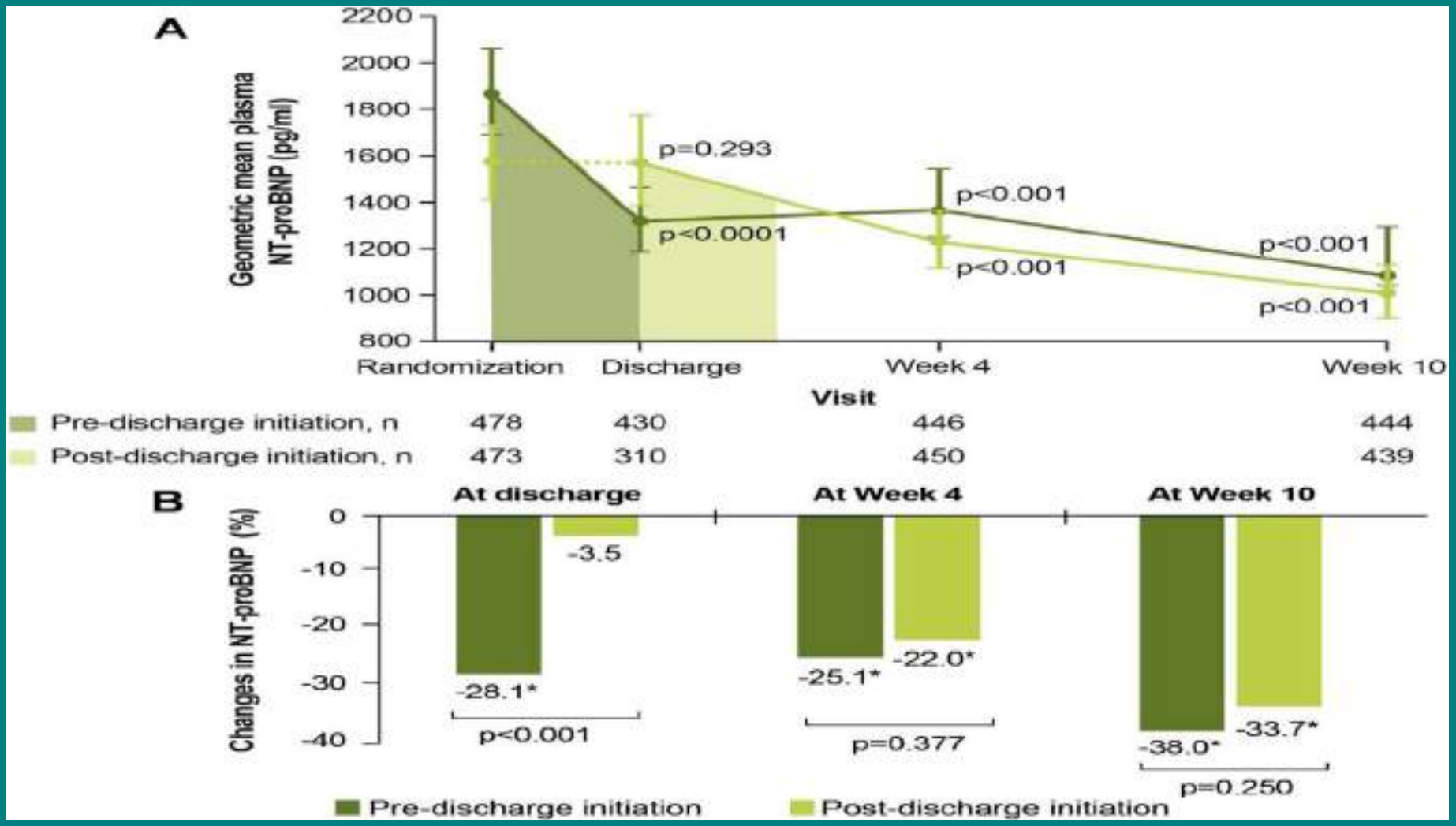
PIONEER-HF

CENTRAL ILLUSTRATION: TRANSITION Study: NT-proBNP Response to Sacubitril/Valsartan and Patient Characteristics Associated With a Favorable Reduction Response

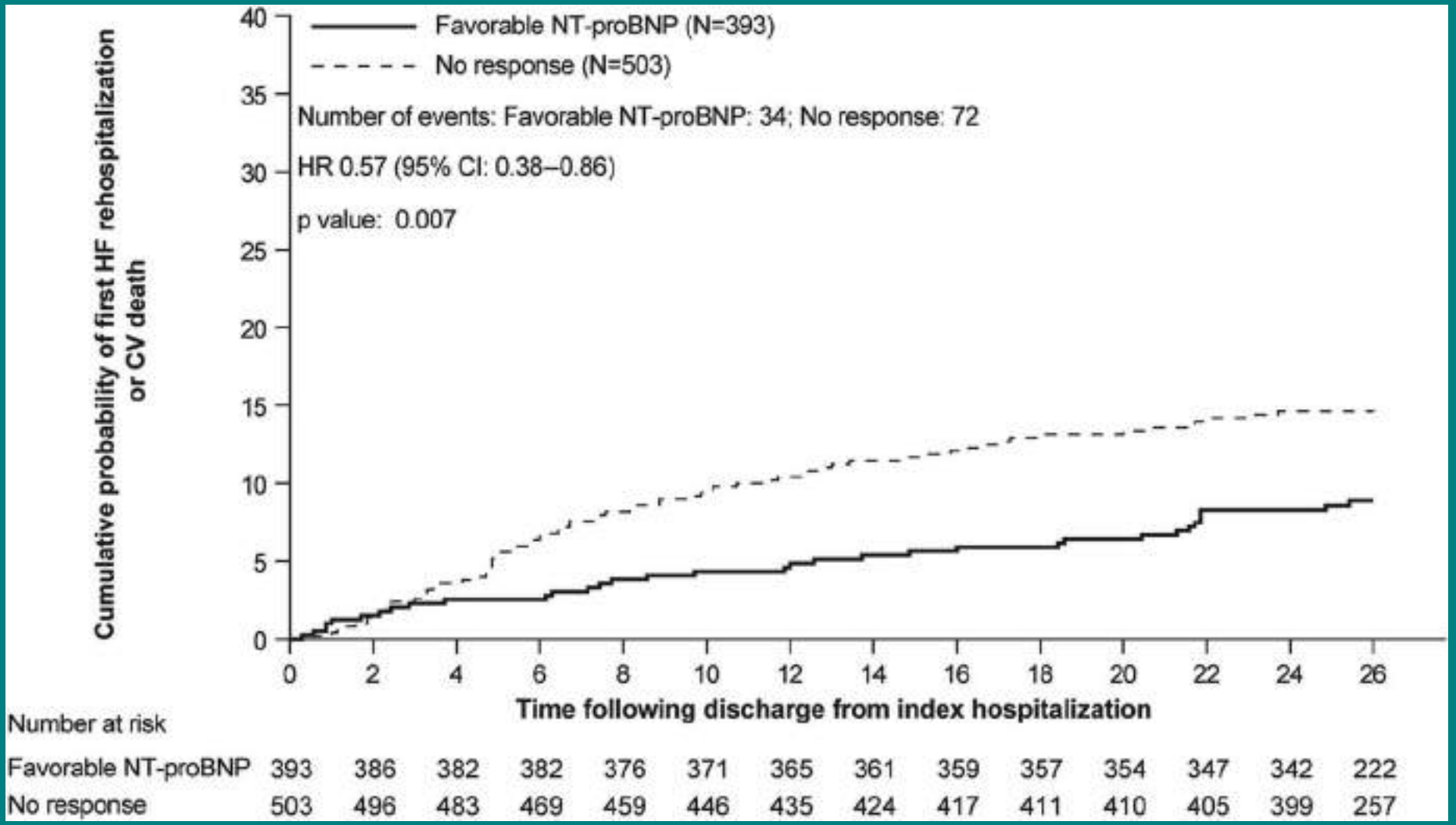


Pascual-Figal, D. et al. J Am Coll Cardiol HF. 2020;8(10):822–33.

NT-proBNP Response Following Sacubitril/Valsartan Initiation at Pre-Discharge Versus Post-Discharge



Effect of Favorable NT-proBNP Reduction Response to Sacubitril/Valsartan at Week 4 on Clinical Outcomes From Discharge Through 26 Weeks



Number at risk														
Favorable NT-proBNP	393	386	382	382	376	371	365	361	359	357	354	347	342	222
No response	503	496	483	469	459	446	435	424	417	411	410	405	399	257

AHF: Independent Predictors of All-Cause Death*

	HR	95% CI	*P*
Pulmonary/peripheral congestion at entry	2.73	1.71-4.35	<.0001
Inotropes	2.00	1.51- 2.65	< .0001
Sodium < 136 vs ≥ 136 mmol/L at entry	1.84	1.45-2.34	< .0001
EF < 40% vs ≥ 40% at entry	1.66	1.14-2.44	.009
Chronic kidney dysfunction	1.48	1.13-1.95	.004
Creatinine > 1.5 vs ≤ 1.5 mg/dL at entry	1.43	1.10-1.87	.007
Sound 3 at entry	1.37	1.05-1.80	.021
Prior HF hospitalization	1.31	1.03-1.67	.030
Age (per year)	1.03	1.02-1.04	< .0001
SBP (mm Hg) at entry	0.995	0.991-0.999	.028

*Median follow-up, 356 [325-366]

CI = confidence interval; HR = hazard ratio

Maggioni AP, et al. *Eur J Heart Fail.* 2013;15(7):808-817.

What is new (16)

Recommendations for management of patients with acute HF			
2021 HF Guidelines	**Class**	**2016 HF Guidelines**	**Class**
Combination of a loop diuretic with thiazide-type diuretic should be considered in patients with resistant oedema who do not respond to an increase in loop diuretic doses.	**IIa**	Combination of loop diuretic with either thiazide-type diuretic or spironolactone may be considered in patients with resistant oedema or insufficient symptomatic response.	**IIb**
In patients with AHF and SBP >110 mmHg, i.v. vasodilators may be considered as initial therapy to improve symptoms and reduce congestion.	**IIb**	In patients with hypertensive AHF, i.v. vasodilators should be considered as initial therapy to improve symptoms and reduce congestion.	**IIa**

2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure
(European Heart Journal 2021 – doi:10.1093/eurheartj/ehab368)

What is new (17)

Recommendations for management of patients with acute HF (continued)			
2021 HF Guidelines	**Class**	**2016 HF Guidelines**	**Class**
Routine use of opiates is not recommended, unless in selected patients with severe/intractable pain or anxiety.	**III**	Opiates may be considered for cautious use to relieve dyspnoea and anxiety in patients with severe dyspnoea but nausea and hypopnea may occur.	**IIb**
Short-term MCS should be considered in patients with cardiogenic shock as a BTR, BTD, BTB. Further indications include treatment of the cause of cardiogenic shock or long-term MCS or transplantation.	**IIa**	Short-term MCS may be considered in refractory cardiogenic shock depending on patient age, comorbidities, and neurological function.	**IIb**

2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure
(European Heart Journal 2021 – doi:10.1093/eurheartj/ehab368)

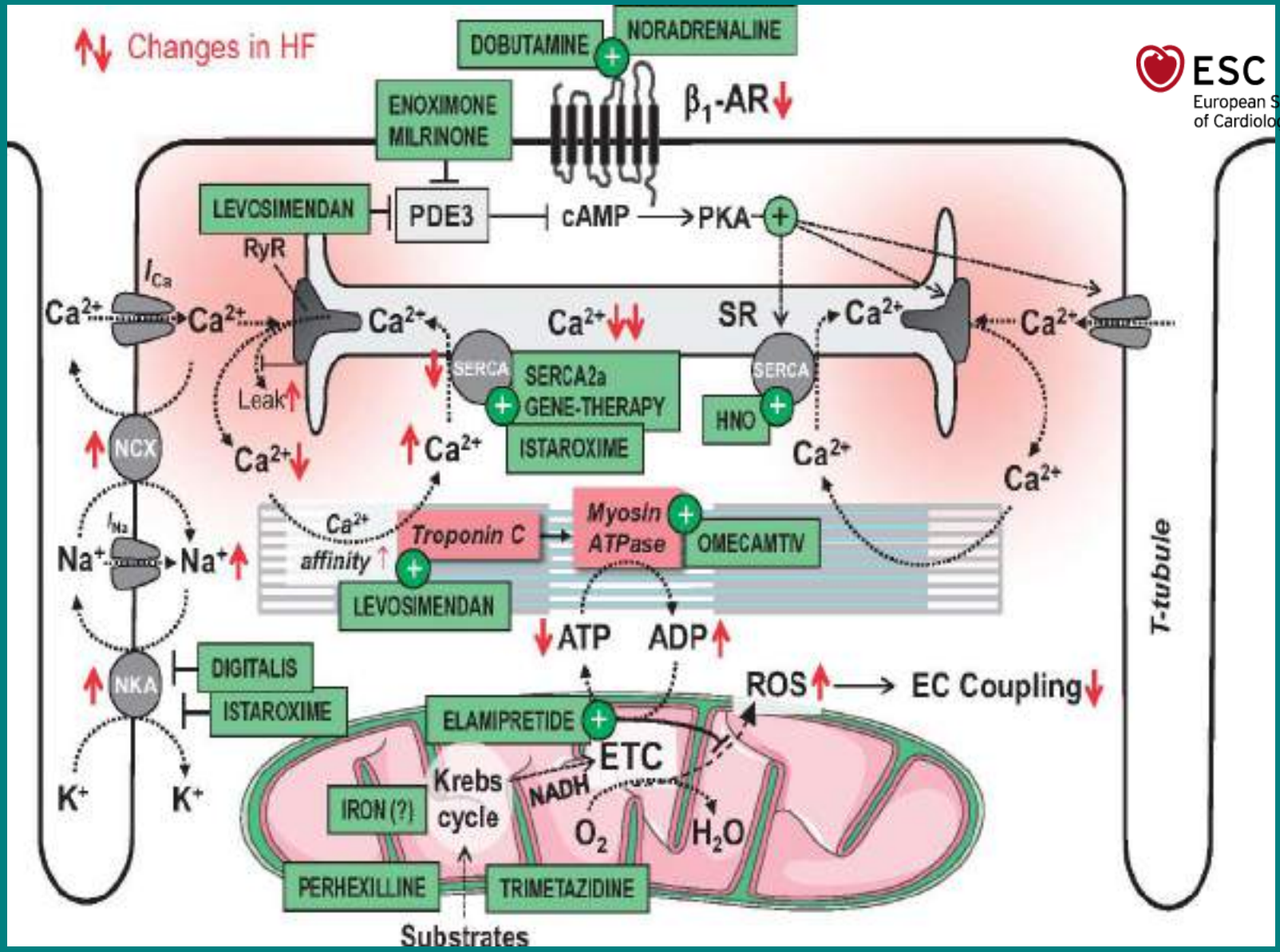
What is new (18)

Recommendations for management of patients with HF and AF			
2021 HF Guidelines	**Class**	**2016 HF Guidelines**	**Class**
DOACs are recommended in preference to VKAs in patients with HF, except in those with moderate or severe mitral stenosis or mechanical prosthetic heart valves.	**I**	For patients with HF and non-valvular AF eligible for anticoagulation based on a CHA_2DS_2-VASc score, NOACs rather than warfarin should be considered for anticoagulation as NOACs are associated with a lower risk of stroke, intracranial haemorrhage, and mortality, which outweigh the increased risk of gastrointestinal haemorrhage.	**IIa**
Beta-blockers should be considered for short- and long- term rate control in patients with HF and AF.	**IIa**	For patients in NYHA class I – III, a beta-blocker, usually given orally, is safe and therefore is recommended as firstline treatment to control ventricular rate, provided the patient is euvolaemic.	**I**

2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure
(European Heart Journal 2021 – doi:10.1093/eurheartj/ehab368)

What Every Cardiologist Needs to Know in Acute HF: Take-Home Messages

- Exclude specific causes of instability
- Base treatment on the wet/dry and warm/cold clinical presentation
  - Most of the patients are wet & warm and need diuretics and vasodilators
- Treatment is now associated with unacceptable high mortality and morbidity
- New drugs are awaited



European Heart Journal, Volume 40, Issue 44, 21 November 2019, Pages 3626–3644, https://doi.org/10.1093/eurheartj/ehy600

"The future will be better tomorrow "

1. Revascularization in ACS
2. New diuretics
3. New inotropic drugs
4. New devices

... and more

"If we don't succeed , we run the risk of failure ."