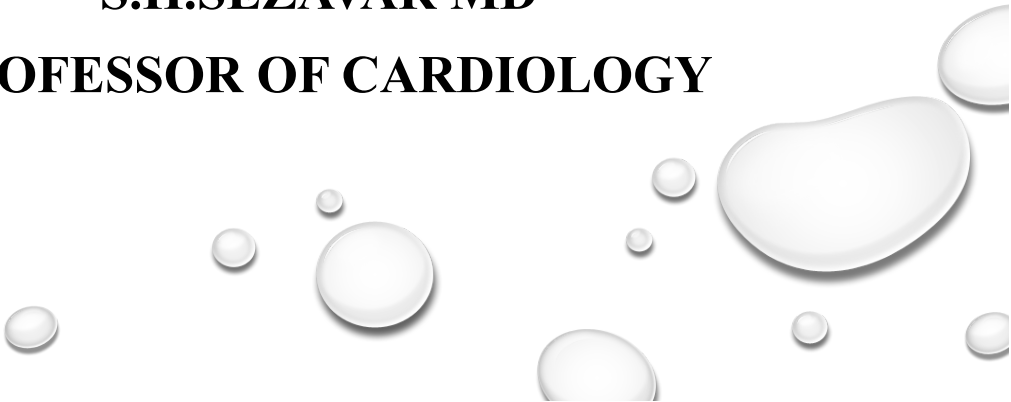


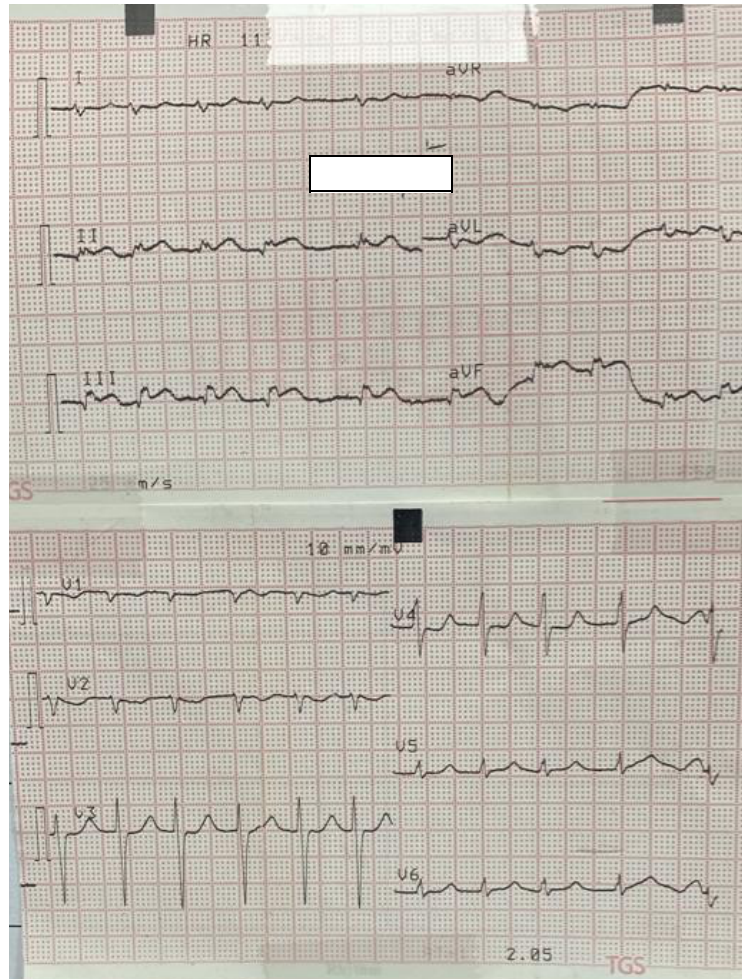


CASE PRESENTATION

S.H.SEZAVAR MD
PROFESSOR OF CARDIOLOGY



- **A 83 YEARS OLD GENTLEMAN**
- **THE PATIENT ADMITTED FOR SYNCOPE AND EPIGASTRIC PAIN**
- **ECG: AF WITH RAPID VENTRICULAR RATE**
- **BP: 50/30 MMHG**
- **HR: 140/MIN**
- **APPEARANCE : COLD SWEATING , CONFUSED**
- **LUNGS: CLEAR**

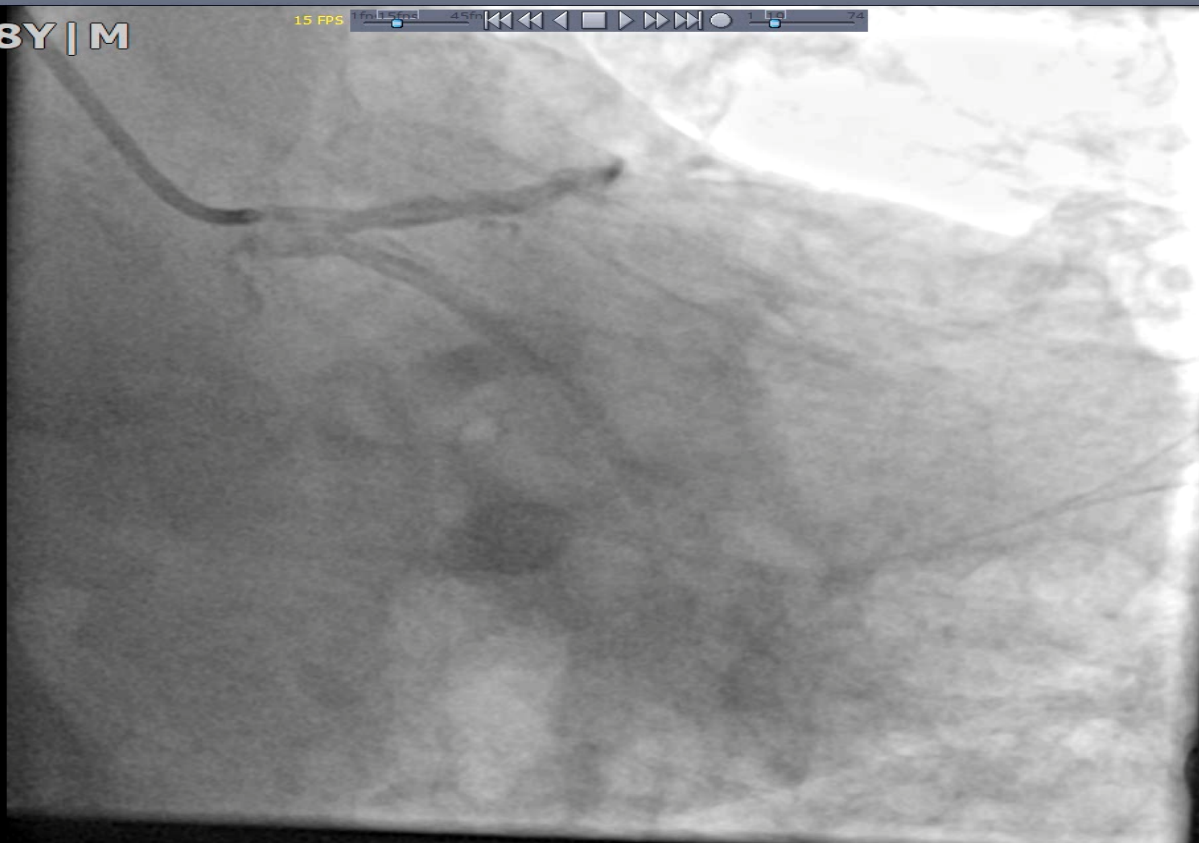


Patient transferred to Cath lab

ALL

078Y | M

15 FPS



LL

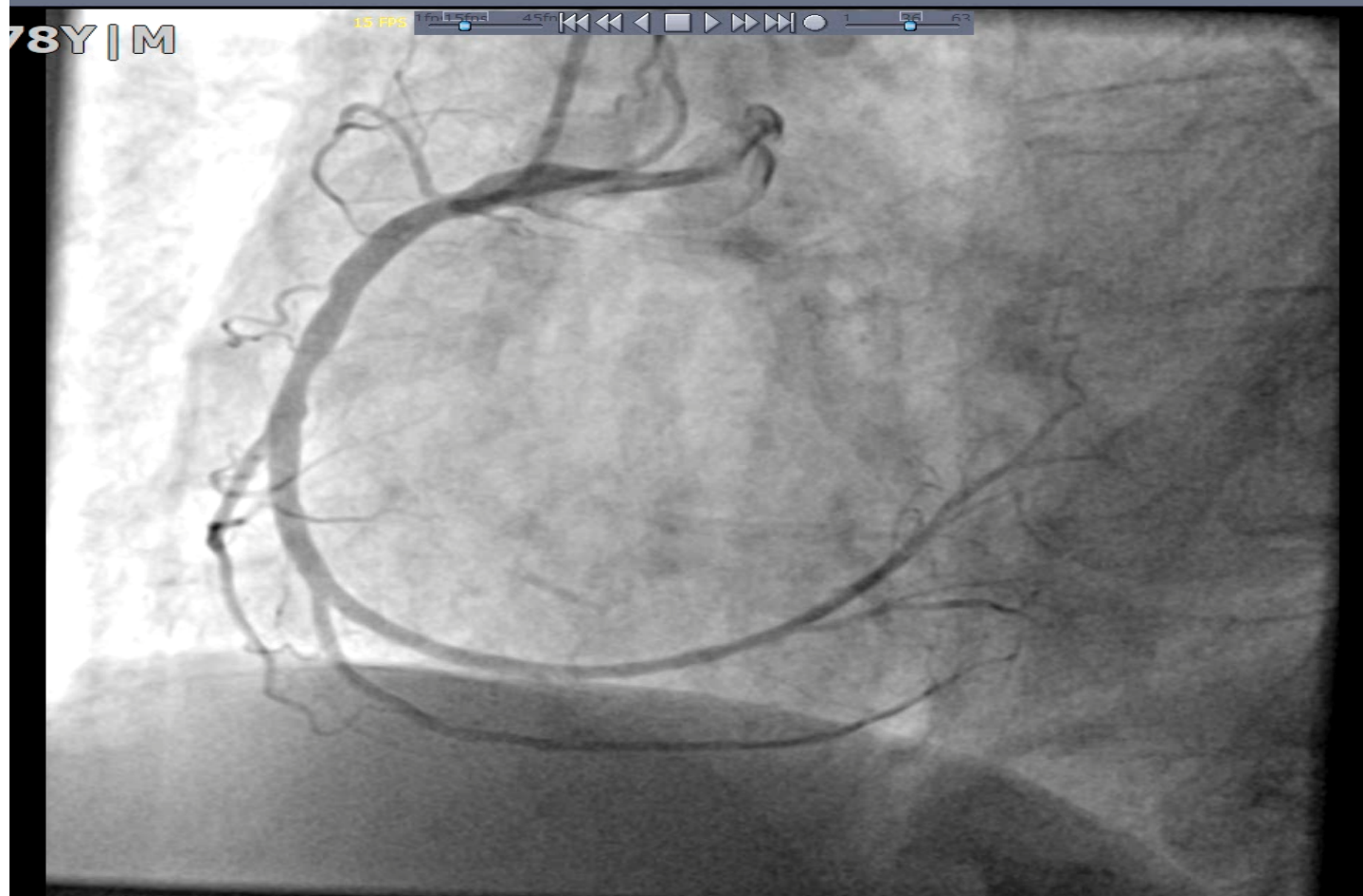
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15 FPS



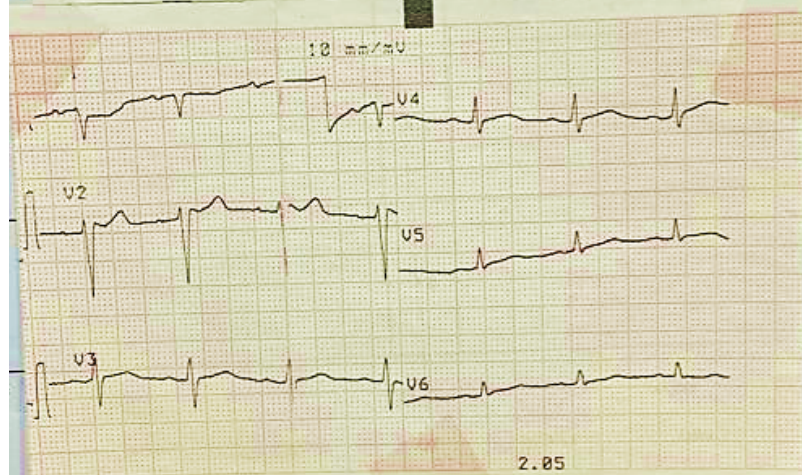
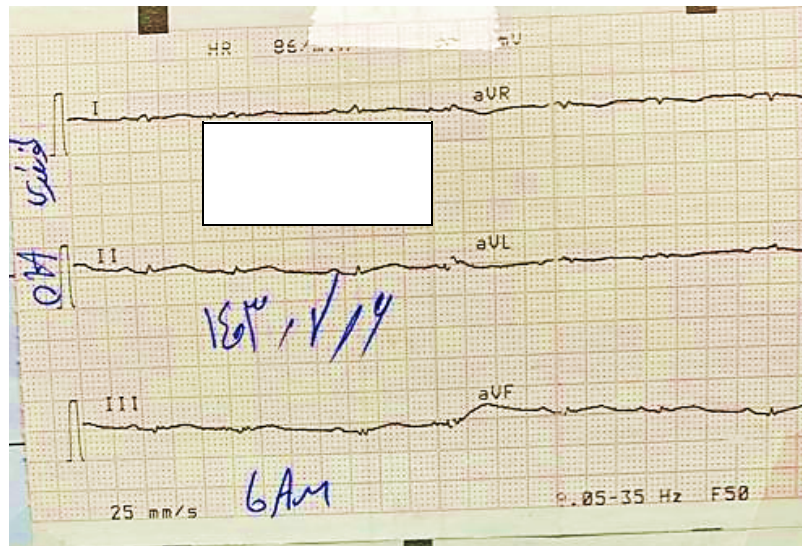
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15 FPS



WBC	9.7	×10 ³ /micL	Ca serum	7.0	mg/dl
Hb	11.5	g/dl	Mg	2.2	mg/dl
Plt	120	10 ³ /mm ³	Urea	90	mg/dl
BS	198	mg/dl	BUN	42.1	mg/dl
Cr	1.48	mg/dl	Troponin (HS)	4623	ng/L
Na	138	mEq/L			
K	4.6	mEq/L			

- AF RHYTHM CONVERTED WITH 200 J BIPHASIC SYNCHRONIZED SHOCK TO SINUS RHYTHM
- BP INCREASED TO 98/56 AND HR: 70/MIN
- ECG AFTER CARDIOVERSION: NSR



- LVEF: UP TO 30%
- NORMAL LV SIZE WITH SEVERE DYSFUNCTION
- INFERIOR, POSTERIOR AND BASE OF INFEROSEPTAL ARE AKINETIC
- NORMAL RV SIZE AND MILD DYSFUNCTION
- MILD TO MODERATE MR, MILD TR
- MILD PERICARDIAL EFFUSION
- NO AS, NO MS

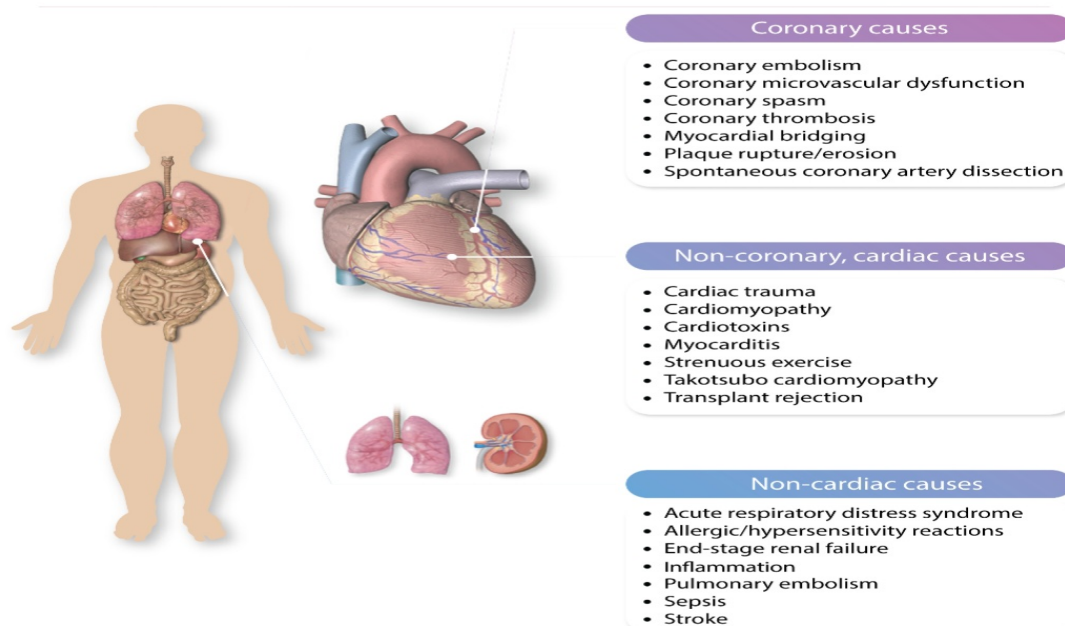
- PATIENT TRANSFERRED TO ICU UNDER CARDIAC MONITORING
- THE PATIENT IS ALERT AND ORIENTED
- COMPLAINED FROM EPIGASTRIC PAIN AND ANOREXIA
- BP: 80/50 MMHG
- HR: 70/MIN
- O2SAT: 86%
- LUNG: BILATERAL RALES IN BASE
- REPEAT ECHO: MILD PE, LVEF: 30 %,NO MECHANICAL COMPLICATIONS

What is the diagnosis ?

MINOCA

- MYOCARDIAL INFARCTION WITH NON OBSTRUCTIVE CORONARY ARTERIES (MINOCA) REFERS TO
- CLINICAL SITUATION WHEN A PATIENT PRESENTS WITH SYMPTOMS SUGGESTIVE OF ACS
- DEMONSTRATE TROPONIN ELEVATION
- AND HAS NON-OBSTRUCTIVE CORONARY ARTERIES
CORONARY ARTERY STENOSIS < 50% IN ANY MAJOR EPICARDIAL VESSELS

Figure 14 Underlying causes for patients with a working diagnosis of myocardial infarction with non-obstructive coronary arteries.



This figure outlines some of the potential differential diagnoses in patients with a working diagnosis of **MINOCA** after coronary angiography, but this list is not exhaustive.

- HEPARIN INFUSION : 800 U/HR IV
- AMIODARONE PROTOCOL INFUSION CONTINUED WITH TABLET 200 MG/BID
- ATORVASTATIN 40 MG/DAILY
- BISOPROLOL 2.5 MG/DAILY
- SPIRONOLACTONE 12.5 MG/DAILY
- CAPTOPRIL 6.25 MG/BID
- ASA: 100 MG/DAILY
- LASIX 20 MG/BID

- DECREASED O2 SATURATION, COUGH AND DYSPNEA

- SPIRAL LUNG CT SCAN:

BILATERAL GROUND GLASS OPACITY AND PLEURAL
EFFUSION

- LEVOFLOXACIN 500 MG/ DAILY INITIATED

- COVID AND FLU PCR CHECKED

SARS COVID	Not detected	WBC	21.1 ×10 ³ /micl	Cr	1.85	mg/dl
Influenza (A and B)	Not detected	Neut	67	Na	134	mEq/L
ProBNP	>35000 pg/mL	Lymph	27	K	3.46	mEq/L
CTnI	13396 ng/L	AST	416 U/L	BUN	54.7	mg/dl
D-Dimer	0.62 Micgr/ml FEU	ALT	352 U/L	Urea	117	mg=dl
Lactate serum	14.3 mg/dl	Alkp	854 U/L			

- OLIGURIC
- INCREASE CREATININE 2.6 MG/DL TO 3.6 MG/DL
- LACTATE 54 MG/DL
- C TROPONIN INCREASED TO : 30220
- D-DIMER: 11.8
- WBC: 31600
- PLT : DECREASED TO 50000

Echocardiography was done again

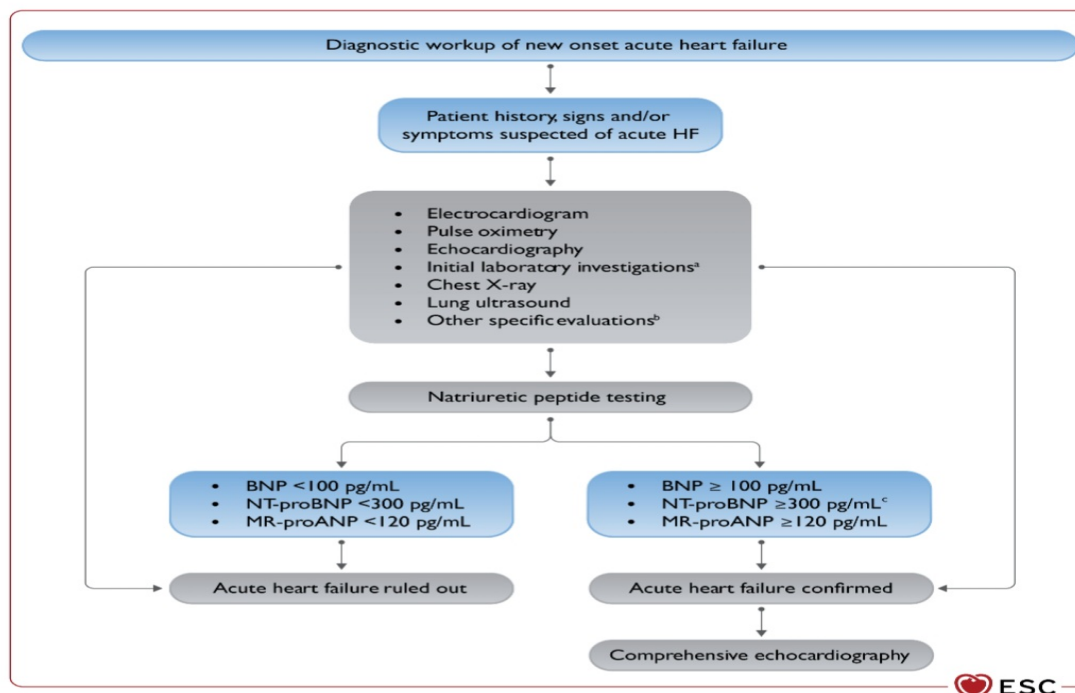
- EF was 30% with inferior akinesia and diffuse myocardial edema
- mild to moderate TR, PAP 40 mmhg
- There was mild PE posterior to LV

AST	13805	U/L	Cr	3.6	mg/dl
ALT	5094	U/L	Na	134	mEq/L
Alp	7336	U/L	K	5	mEq/L
Bili total	1.8		Plt	50	10*3/mm*3
Bili D	1.1		WBC	31.5	×10*3/mcl
Bili ind	0.7		Hb	10.7	g/dl

History taking again

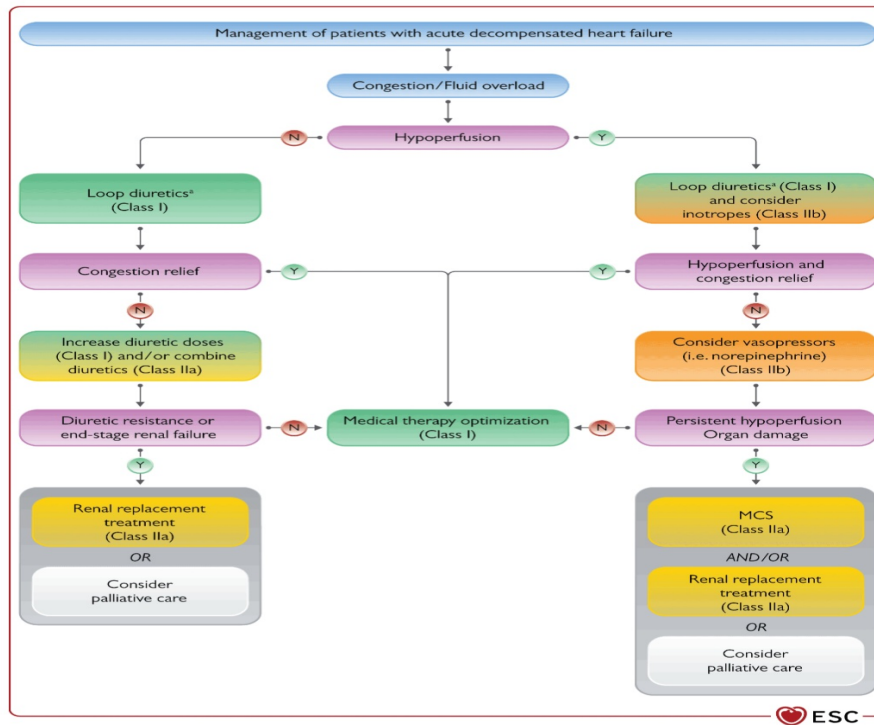
What is the diagnosis ?

Figure 6 Diagnostic work-up of acute heart failure



ACS= acute coronary syndrome; AHF = acute heart failure; BNP = B-type natriuretic peptide; ECG = electrocardiogram; HF = heart failure; LUS = lung ultrasound; MR-proANP = mid-regional pro atrial natriuretic peptide; NP =

Figure 7 Management of patients with acute decompensated heart failure

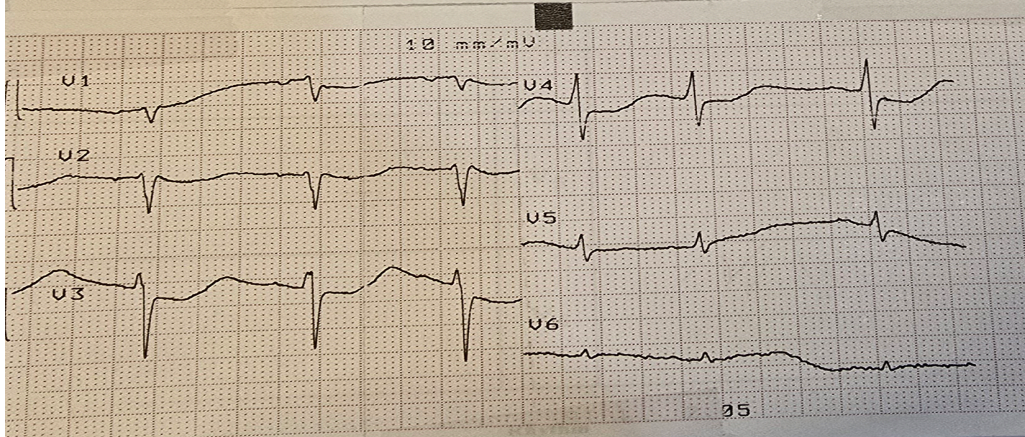
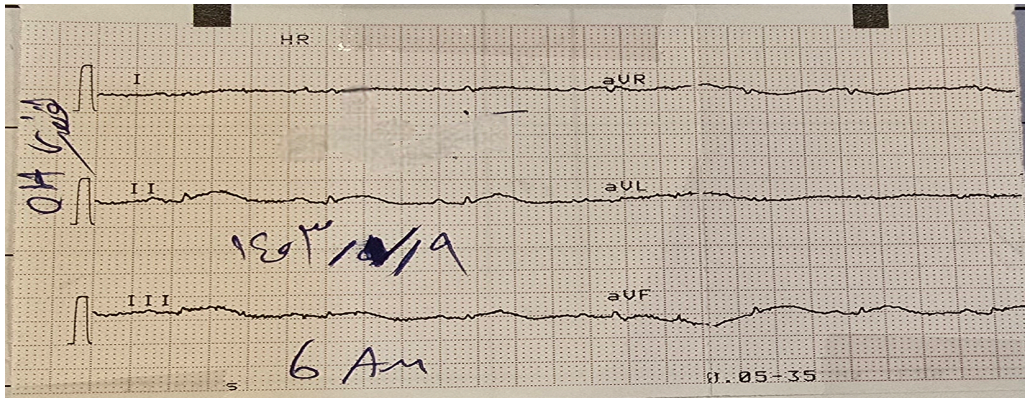


HF = heart failure; MCS = mechanical circulatory support;
MT = medical therapy.

^aAdequate diuretic doses to relieve congestion and close monitoring of diuresis are recommended regardless of

*****INITIATION OF :**

- **METHYL PREDNISOLONE PULSE 500 MG × 3 TIMES**
- **MILRINONE 0.3 MCG/ KG/ MIN**
- **MIDODRINE 5 MG/TDS**
- **LEVOFLUXACIN : D/C**
- **MEROPENEM 500 MG/BID**



- CRRT INITIATED FOR ANURIA
- IABP INSERTED BECAUSE OF CARDIOGENIC SHOCK
- MILRINONE REPLACED WITH NOREPINEPHRINE
INFUSION
- TPM INSERTED BECAUSE OF BRADYCARDIA

9.5. Evaluation and Management of Cardiogenic Shock

Recommendations for Evaluation and Management of **Cardiogenic Shock**
Referenced studies that support the recommendations are summarized in the **Online Data Supplements**.

COR	LOE	Recommendations
1	B-NR	1. In patients with cardiogenic shock, intravenous inotropic support should be used to maintain systemic perfusion and preserve end-organ performance. ¹⁻⁸
2a	B-NR	2. In patients with cardiogenic shock, temporary MCS is reasonable when end-organ function cannot be maintained by pharmacologic means to support cardiac function. ⁹⁻¹⁷
2a	B-NR	3. In patients with cardiogenic shock, management by a multidisciplinary team experienced in shock is reasonable. ¹⁷⁻²²
2b	B-NR	4. In patients presenting with cardiogenic shock, placement of a PA line may be considered to define hemodynamic subsets and appropriate management strategies. ²³⁻²⁷
2b	C-LD	5. For patients who are not rapidly responding to initial shock measures, triage to centers that can provide temporary MCS may be considered to optimize management. ¹⁷⁻²²

Table 10 Conditions associated with trigger-induced AF

Acute conditions

Infections (bacterial and viral)

Pericarditis, **myocarditis**

Emergency conditions (burn injury, severe trauma, shock)

Binge alcohol consumption

Drug use, including methamphetamines, cocaine, opiates, and cannabis

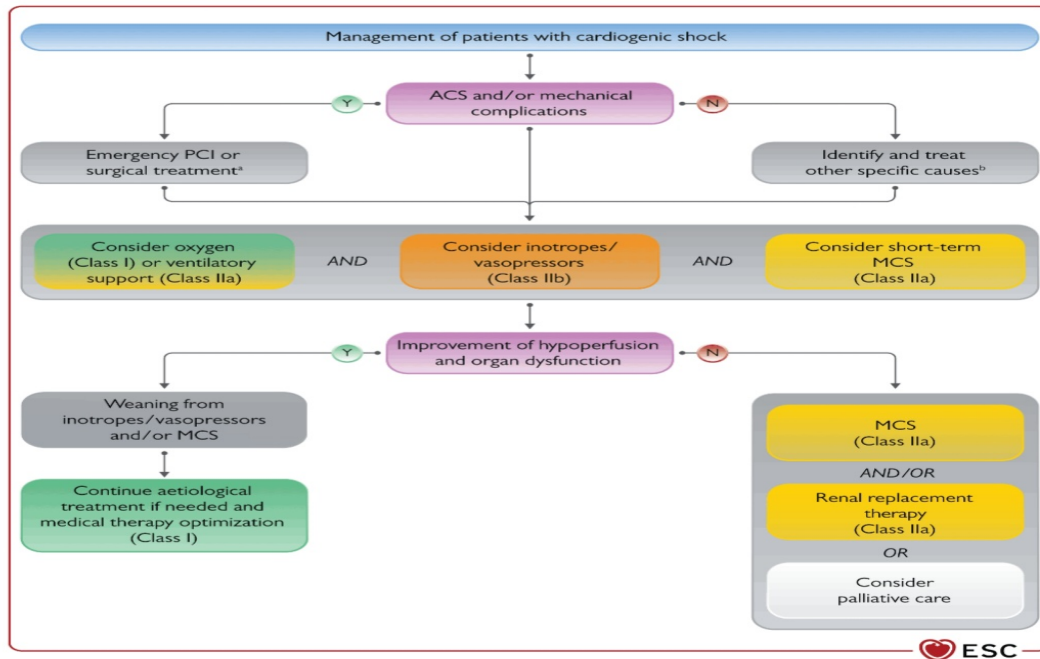
Acute interventions, procedures, and surgery

Endocrine disorders (thyroid, adrenal, pituitary, others)

Table 9 Clinical presentations of acute heart failure

	Acute decompensated heart failure	Acute pulmonary oedema	Isolated right ventricular failure	Cardiogenic shock
Main mechanisms	LV dysfunction Sodium and water renal retention	Increased afterload and/or predominant LV diastolic dysfunction Valvular heart disease	RV dysfunction and/or pulmonary hypertension	Severe cardiac dysfunction
Main cause of symptoms	Fluid accumulation, increased intraventricular pressure	Fluid redistribution to the lungs and acute respiratory failure	Increased central venous pressure and often systemic hypoperfusion	Systemic hypoperfusion
Onset	Gradual (days)	Rapid (hours)	Gradual or rapid	Gradual or rapid
Main haemodynamic abnormalities	Increased LVEDP and PCWP ^a Low or normal cardiac output Normal to low SBP	Increased LVEDP and PCWP ^a Normal cardiac output Normal to high SBP	Increased RVEDP Low cardiac output Low SBP	Increased LVEDP and PCWP ^a Low cardiac output Low SBP
Main clinical presentations	Wet and warm OR Dry and cold	Wet and warm ^b	Dry and cold OR Wet and cold	Wet and cold
Main treatment	Diuretics Inotropic agents/vasopressors (if peripheral hypoperfusion/hypotension) Short-term MCS or RTT if needed	Diuretics Vasodilators ^b	Diuretics for peripheral congestion Inotropic agents/vasopressors (if peripheral hypoperfusion/hypotension) Short-term MCS or RTT if needed	Inotropic agents/vasopressors Short-term MCS RTT

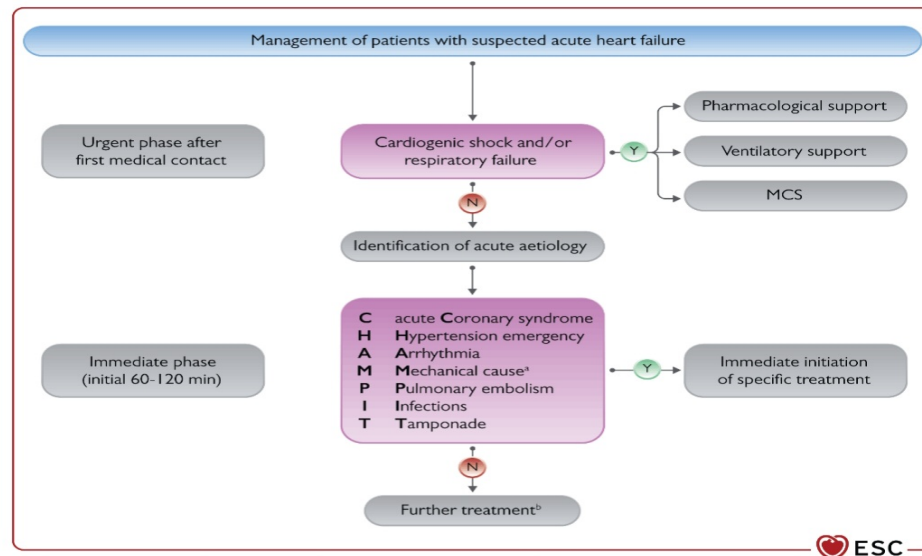
Figure 10 Management of patients with cardiogenic shock



ACS = acute coronary syndrome; BTT = bridge to transplantation; MCS = mechanical circulatory support; MT = medical therapy; PCI = percutaneous coronary intervention; STEMI = ST-elevation myocardial infarction.

^aPCI in ACS, pericardiocentesis in tamponade, mitral

Figure 11 Management of patients with suspected acute heart failure



MCS = mechanical circulatory support.

^aAcute mechanical cause: myocardial rupture complicating acute coronary syndrome (free wall rupture, ventricular septal defect, acute mitral regurgitation), chest trauma or cardiac intervention, acute native or prosthetic valve incompetence secondary to endocarditis, aortic dissection or thrombosis.

Table 22. Suggested Shock Clinical Criteria^{*29}

SBP <90 mm Hg for >30 min:
a. Or mean BP <60 mm Hg for >30 min
b. Or requirement of vasopressors to maintain systolic BP ≥90 mm Hg or mean BP ≥60 mm Hg
Hypoperfusion defined by:
c. Decreased mentation
d. Cold extremities, livedo reticularis
e. Urine output <30 mL/h
f. Lactate >2 mmol/L

BP indicates blood pressure; and SBP, systolic blood pressure.
*Systolic BP and hypoperfusion criteria need to be met for the shock diagnosis.

Table 23. Suggested Shock Hemodynamic Criteria^{*29}

1. SBP <90 mm Hg or mean BP <60 mm Hg
2. Cardiac index <2.2 L/min/m ²
3. Pulmonary capillary wedge pressure >15 mm Hg
4. Other hemodynamic considerations
a. Cardiac power output [(CO x MAP)/451] <0.6 W
b. Shock index (HR/systolic BP) >1.0
c. RV shock
i. Pulmonary artery pulse index [(PASP-PADP)/CVP] <1.0
ii. CVP >15 mm Hg
iii. CVP-PCW >0.6

BP indicates blood pressure; CO, cardiac output; CVP, central venous pressure; HR, heart rate; MAP, mean arterial pressure; PADP, pulmonary artery diastolic pressure; PASP, pulmonary artery systolic pressure; PCW, pulmonary capillary wedge; RV, right ventricular; and SBP, systolic blood pressure.

*Diagnosis of shock requires ≥1 criteria to be present along with cardiac index <2.0 L/min/m² and SBP <90 mm Hg.

Table 24. Society for Cardiovascular Angiography and Interventions (SCAI) Cardiogenic Shock Criteria²⁹

Stage	Bedside Findings	Selected Laboratory Markers	Hemodynamics
A: At risk Normotensive Normal perfusion Cause for risk for shock such as large myocardial infarction or HF	Normal venous pressure Clear lungs Warm extremities Strong palpable pulses Normal mentation	Normal renal function Normal lactate	SBP >100 mm Hg Hemodynamics: Normal
B: Beginning shock ("pre-shock") Hypotension Normal perfusion	Elevated venous pressure Rales present Warm extremities Strong pulses Normal mentation	Preserved renal function Normal lactate Elevated BNP	SBP <90 mm Hg, MAP <60 mm Hg, or >30 mm Hg decrease from baseline SBP HR >100 bpm Hemodynamics: CI >2.2 L/min/m ²
C: Classic cardiogenic shock Hypotension Hypoperfusion	Elevated venous pressure Rales present Cold, ashen, livedo Weak or nonpalpable pulses Altered mentation Decreased urine output Respiratory distress	Impaired renal function Increased lactate Elevated BNP Increased LFTs Acidosis	SBP <90 mm Hg; MAP <60 mm Hg; >30 mm Hg from baseline SBP despite drugs and temporary MCS HR >100 bpm Hemodynamics: CI ≤2.2 L/min/m ² ; PCW >15 mm Hg; CPO <0.6 W; PAPI <2.0; CVP-PCW >1.0
D: Deteriorating Worsening hypotension Worsening hypoperfusion	Same as stage C	Persistent or worsening values of stage C	Escalating use of pressors or MCS to maintain SBP and end-organ perfusion in setting of stage C hemodynamics
E: Extremis Refractory hypotension Refractory hypoperfusion	Cardiac arrest CPR	Worsening values of stage C laboratories	SBP only with resuscitation PEA Recurrent VT/VF

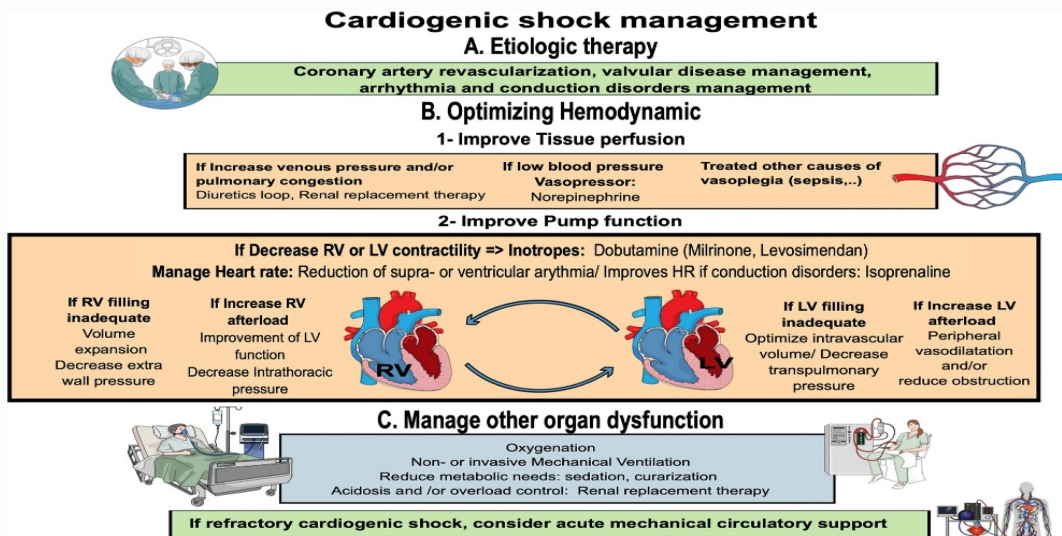
BNP indicates brain natriuretic peptide; CI, cardiac index; CPO, cardiac power output; CPR, cardiopulmonary resuscitation; CVP, central venous pressure; HR, heart rate; LFT, liver function test; MAP, mean arterial blood pressure; MCS, mechanical circulatory support; PAPI, pulmonary artery pulsatility index; PCW, pulmonary capillary wedge pressures; PEA, pulseless electrical activity; SBP, systolic blood pressure; VF, ventricular fibrillation; and VT, ventricular tachycardia.

Adapted from Baran D et al,²⁹ with permission from Wiley Periodicals, Inc.

Table 20. Intravenous Inotropic Agents Used in the Management of HF

Inotropic Agent	Dose (mcg/kg)		Drug Kinetics and Metabolism	Effects				Adverse Effects	Special Considerations
	Bolus	Infusion (/min)		CO	HR	SVR	PVR		
Adrenergic agonists									
Dopamine	NA	5–10	t _{1/2} : 2–20 min	↑	↑	↔	↔	T, HA, N, tissue necrosis	Caution: MAO-I
	NA	10–15	R, H, P	↑	↑	↑	↔		
Dobutamine	NA	2.5–20	t _{1/2} : 2–3 min H	↑	↑	↔	↔	↑/↓BP, HA, T, N, F, hypersensitivity	Caution: MAO-I; CI: sulfite allergy
PDE 3 inhibitor									
Milrinone	NR	0.125–0.75	t _{1/2} : 2.5 h H	↑	↑	↓	↓	T, ↓BP	Accumulation may occur in setting of renal failure; monitor kidney function and LFTs
Vasopressors									
Epinephrine	NR	5–15 mcg/min	t _{1/2} : 2–3 min	↑	↑	↑ (↓)	↔	HA, T	Caution: MAO-I
		15–20 mcg/min	t _{1/2} : 2–3 min	↑	↑↑	↑↑	↔	HA, T	Caution: MAO-I
Norepinephrine	NR	0.5–30 mcg/min	t _{1/2} : 2.5 min	↔	↑	↑↑	↔	↓ HR, tissue necrosis	Caution: MAO-I

From: Management of cardiogenic shock: a narrative review



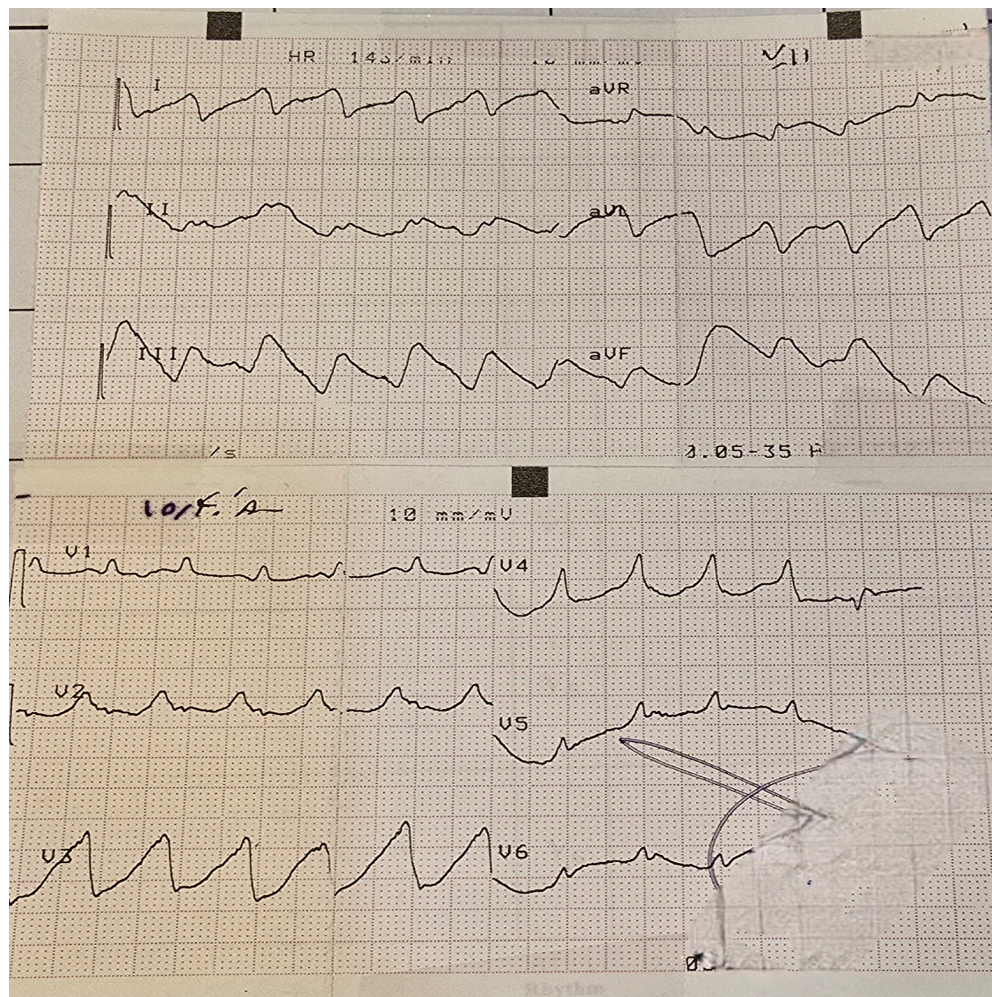
Cardiogenic shock management.

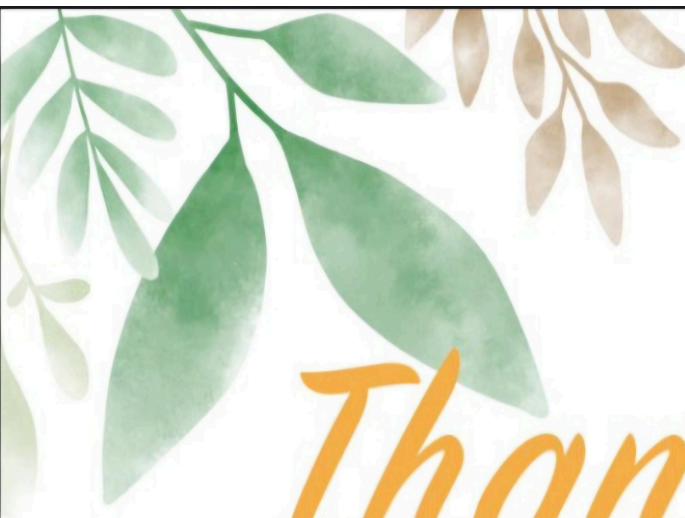
Abbreviations: AV ECMO, arteriovenous extracorporeal membrane oxygenation; HR, heart rate; LV, left ventricular; RV, right ventricular

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

Recommendations	Class ^a	Level ^b
Short-term MCS should be considered in patients with cardiogenic shock as a BTR, BTD, BTB. Further procedures 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 long-term 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





Thank You