



GUARD YOUR HEART



ACS COMPLICATIONS AND MANAGEMENT

LV DECOMPENSATION



**VENTRICULAR
ARRHYTHMIA**





VENTRICULAR ARRHYTHMIAS AND CONDUCTION DISTURBANCES IN THE ACUTE PHASE

TREATMENT RECOMMENDATION

1 2

- Intravenous beta-blocker treatment is indicated for polymorphic VT and/or VF unless contra-indicated.
- Prompt and complete revascularization is recommended to treat myocardial ischaemia that may be present in patients with recurrent VT and/or VF.
- Intravenous amiodarone is recommended for recurrent polymorphic VT.
- Correction of electrolyte imbalances (especially hypokalaemia and hypo-magnesaemia)
- Sinus bradycardia with haemodynamic intolerance or high degree AV block without stable escape rhythm:
 - i.v. positive chronotropic medication (epinephrine, vasopressin and/or atropine) is indicated,
 - temporary pacing is indicated in cases of failure to respond to positive chrono-tropic medication,
 - urgent angiography with a view to revascularization is indicated if the patient has not received previous reperfusion therapy.

Steg P, James S, Atar D, Badano L, Lundqvist C, Borger M et al. ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2012;33(20):2569-2619.



VENTRICULAR ARRHYTHMIAS AND CONDUCTION DISTURBANCES IN THE ACUTE PHASE

TREATMENT RECOMMENDATION

12

- Intravenous amiodarone should be considered for recurrent VT with haemodynamic intolerance despite repetitive electrical cardioversion.
- Transvenous catheter pace termination and/or overdrive pacing should be considered if VT cannot be controlled by repetitive electrical cardioversion.
- Prophylactic treatment with antiarrhythmic drugs is not indicated and may be harmful.
- Recurrent VT with haemodynamic repercussion despite repetitive electrical cardioversion may be treated with lidocaine if beta-blockers, amiodarone, and overdrive stimulation are not effective/applicable.
- Asymptomatic and haemodynamically irrelevant ventricular antiarrhythmic drugs.

Steg P, James S, Atar D, Badano L, Lundqvist C, Borger M et al. ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2012;33(20):2569-2619.

MANAGEMENT OF VENTRICULAR ARRHYTHMIAS AND CONDUCTION DISTURBANCES IN THE ACUTE PHASE



1 2

RECOMMENDATIONS	CLASS	LEVEL
Direct current cardioversion is indicated for sustained VT and VF.	I	C
Sustained monomorphic VT that is recurrent or refractory to direct current cardioversions; should be considered to be treated with i.v. amiodarone.	IIa	C
May be treated with i.v. lidocaine or sotalol	IIb	C
Transvenous catheter pace termination should be considered if VT is refractory to cardiovascular or frequently recurrent despite antiarrhythmic medication.	IIa	C
Repetitive symptomatic salvoes of non sustained monomorphic VT should be considered for either conservative management (watchful waiting) or treated with i.v. Beta-blocker, or sotalol, or amiodarone.	IIa	C

Risk evaluation for sudden cardiac death should be performed to assess indication for primary prevention ICD therapy by assessing LVEF (from echocardiography) at least 40 days after the acute event in patients with LVEF \leq 40%.

Steg P, James S, Atar D, Badano L, Lundqvist C, Borger M et al. ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2012;33(20):2569-2619.

MANAGEMENT OF VENTRICULAR ARRHYTHMIAS AND CONDUCTION DISTURBANCES IN THE ACUTE PHASE



12

RECOMMENDATIONS	CLASS	LEVEL
Polymorphic VT		
• Must be treated by i.v. beta-blocker	I	B
• Or i.v. amiodarone;	I	C
• Urgent angiography must be performed when myocardial ischaemia cannot be excluded;	I	C
• May be treated with i.v. lidocaine;	IIb	C
• Must be prompt assessment and correction of electrolyte disturbances consider magnesium;	I	C
• Should be treated with overdrive pacing using a temporary transvenous right ventricular lead or isoproterenol infusion	IIu	C

Risk evaluation for sudden cardiac death should be performed to assess indication for primary prevention ICD therapy by assessing LVEF (from echocardiography) at least 40 days after the acute event in patients with LVEF \leq 40%.

Steg P, James S, Atar D, Badano L, Lundqvist C, Borger M et al. ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2012;33(20):2569-2619.

MANAGEMENT OF VENTRICULAR ARRHYTHMIAS AND CONDUCTION DISTURBANCES IN THE ACUTE PHASE



1 2

RECOMMENDATIONS	CLASS	LEVEL
In cases of sinus bradycardia associated with hypotension, AV block II (Mobitz 2) or AV block III with bradycardia that causes hypotension or heart failure:		
• Intravenous atropine is indicated;	I	C
• Temporary pacing is indicated in case of failure to respond to atropine;	I	C
• Urgent angiography with a view to revascularization is indicated if the patient has not received prior reperfusion therapy.	I	C

Risk evaluation for sudden cardiac death should be performed to assess indication for primary prevention ICD therapy by assessing LVEF (from echocardiography) at least 40 days after the acute event in patients with LVEF \leq 40%.

Steg P, James S, Atar D, Badano L, Lundqvist C, Borger M et al. ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2012;33(20):2569-2619.

MANAGEMENT OF VENTRICULAR ARRHYTHMIAS AND CONDUCTION DISTURBANCES IN THE ACUTE PHASE



12

RECOMMENDATIONS	CLASS	LEVEL
Management of ventricular arrhythmias and risk evaluation for sudden death on long term		
Specialized electrophysiological evaluation of ICD implantation for secondary prevention of sudden cardiac death is indicated in patients with significant LV dysfunction, who suffer from haemodynamically unstable sustained VT or who are resuscitated from VF occurring beyond the initial acute phase.	I	A
Secondary preventive ICD therapy is indicated to reduce mortality in patients with significant LV dysfunction, and haemodynamically unstable sustained VT or survived VF, not occurring within the initial acute phase.	I	A
Risk evaluation for sudden cardiac death should be performed to assess indication for primary preventive ICD therapy by assessing LVEF (from echocardiography) at least 40 days after the acute event in patients with LVEF 40%.	I	A

Risk evaluation for sudden cardiac death should be performed to assess indication for primary prevention ICD therapy by assessing LVEF (from echocardiography) at least 40 days after the acute event in patients with LVEF \leq 40%.

Steg P, James S, Atar D, Badano L, Lundqvist C, Borger M et al. ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2012;33(20):2569-2619.



MANAGEMENT OF VENTRICULAR ARRHYTHMIAS AND CONDUCTION DISTURBANCES IN THE ACUTE PHASE

1 2 3 4

RECOMMENDATIONS	CLASS	LEVEL
Intravenous beta-blocker treatment is indicated for patients with polymorphic VT and/or VF unless contra-indicated	I	R
Prompt and complete revascularization is recommended to treat myocardial ischaemia that may be present in patients with recurrent VT and/or VF.	I	C
Intravenous amiodarone is recommended for treatment of recurrent polymorphic VT.	I	C
Correction of electrolyte imbalances (especially hypokalaemia and hypomagnesaemia) is recommended in patients with VT and/or VF.	I	C

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MANAGEMENT OF VENTRICULAR ARRHYTHMIAS AND CONDUCTION DISTURBANCES IN THE ACUTE PHASE

1 2 3 4

RECOMMENDATIONS	CLASS	LEVEL
In cases of sinus bradycardia with haemodynamic intolerance or high degree AV block without stable escape rhythm:		
<ul style="list-style-type: none">i.v. positive chronotropic medication (epinephrine, vasopressin and/or atropine) is indicated,	I	R
<ul style="list-style-type: none">temporary pacing is indicated in cases of failure to respond to positive chronotropic medication,	I	C
<ul style="list-style-type: none">urgent angiography with a view to revascularization is indicated if the patient has not received previous reperfusion therapy.	I	C

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MANAGEMENT OF VENTRICULAR ARRHYTHMIAS AND CONDUCTION DISTURBANCES IN THE ACUTE PHASE

1 2 3 4

RECOMMENDATIONS	CLASS	LEVEL
Intravenous amiodarone should be considered for recurrent VT with haemodynamic intolerance despite repetitive electrical cardioversion.	IIa	C
Transvenous catheter pace termination and/or overdrive pacing should be considered if VT cannot be controlled by repetitive electrical cardioversion.	IIa	C
Radiofrequency catheter ablation at a specialized ablation centre followed by ICD implantation be considered in patients with recurrent VT, VF, or electrical storm despite complete revascularization and optimal medical therapy.	IIa	C

Steg P, James S, Atar D, Badano L, Lundqvist C, Borger M et al. ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2012;33(20):2569-2619.



MANAGEMENT OF VENTRICULAR ARRHYTHMIAS AND CONDUCTION DISTURBANCES IN THE ACUTE PHASE

1 2 3 4

RECOMMENDATIONS	CLASS	LEVEL
Recurrent VT with haemodynamic repercussion despite repetitive electrical cardioversion may be treated with lidocaine if betablockers, amiodarone, and overdrive stimulation are not effective/applicable.	IIa	C
Prophylactic treatment with antiarrhythmic drugs is not indicated and may be harmful.	IIa	C
Asymptomatic and haemodynamically irrelevant ventricular arrhythmias should not be treated with antiarrhythmic drugs.	IIa	C

Steg P, James S, Atar D, Badano L, Lundqvist C, Borger M et al. ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2012;33(20):2569-2619.



LONG-TERM MANAGEMENT OF VENTRICULAR ARRHYTHMIAS AND RISK EVALUATION FOR SUDDEN DEATH

RECOMMENDATIONS

CLASS

LEVEL

ICD therapy is recommended to reduce sudden cardiac death in patients with symptomatic heart failure (NYHA class II—III) and LVEF <35% despite optimal medical therapy for >3 months and at least 6 weeks after MI who are expected to survive for at least 1 year with good functional status.

I

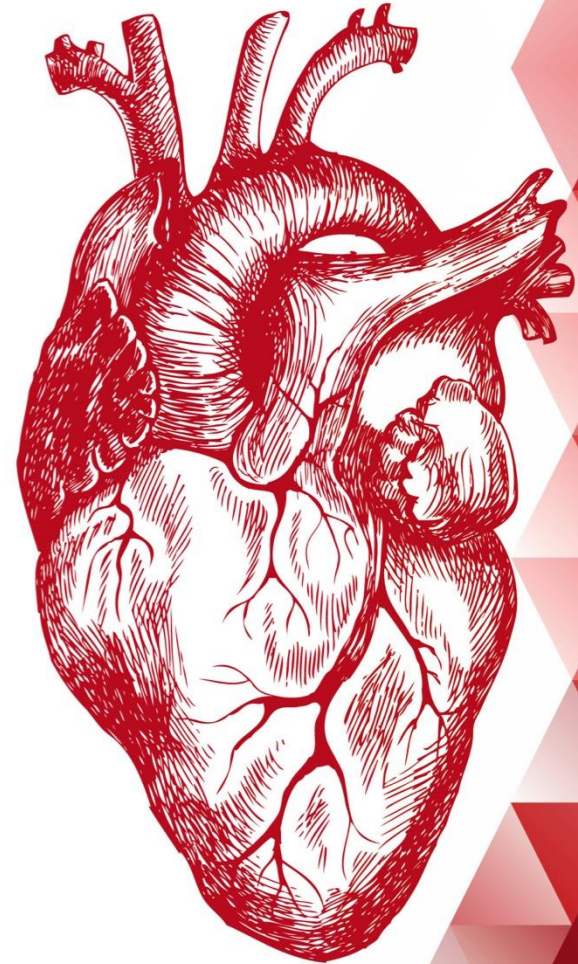
A

ICD implantation or temporary use of a wearable cardioverter defibrillator may be considered <40 days after MI in selected patients (incomplete revascularization, pre-existing LVEF dysfunction, occurrence of arrhythmias >48 hours after STEMI onset, polymorphic VT or VF).

IIb

C

**MANAGEMENT OF
LEFT VENTRICULAR
DYSFUNCTION
AND ACUTE HEART
FAILURE IN
ST-ELEVATION
MYOCARDIAL
INFARCTION**



MANAGEMENT OF LEFT VENTRICULAR DYSFUNCTION AND ACUTE HEART FAILURE



1 2

TREATMENT RECOMMENDATION AND RATIONALE

ACE inhibitor (or if not tolerated, ARB) therapy is indicated as soon as haemodynamically stable for all patients with evidence of LVEF \leq 40% and/or heart failure

to reduce the risk of hospitalization and death.

Beta-blocker therapy is recommended in patients with LVEF \leq 40% and/or heart failure after stabilization

to reduce the risk of death, recurrent MI, and hospitalization for heart failure.

An MRA is recommended in patients with heart failure and LVEF \leq 40% with no severe renal failure or hyperkalaemia

to reduce the risk of cardiovascular hospitalization and death.

Loop diuretics are recommended in patients with acute heart failure with symptoms/signs of fluid overload

to improve symptoms.

Nitrates are recommended in patients with symptomatic heart failure with SBP > 90 mmHg

to improve symptoms and reduce congestion

Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177.

MANAGEMENT OF LEFT VENTRICULAR DYSFUNCTION AND ACUTE HEART FAILURE



1 2

TREATMENT RECOMMENDATION AND RATIONALE

Oxygen is indicated in patients with pulmonary oedema with SaO ₂ <90%	to maintain a saturation >95%.
Patient intubation is indicated in patients with respiratory failure or exhaustion, leading to hypoxaemia, hypercapnia, or acidosis, and if non-invasive ventilation is not tolerated.	
Non-invasive positive pressure ventilation (continuous positive airway pressure, biphasic positive airway pressure) should be considered in patients with respiratory distress (respiratory rate >25 breaths/min, SaO ₂ <90%) without hypotension	
Intravenous nitrates or sodium nitroprusside should be considered in patients with heart failure and elevated SBP	to control blood pressure improve symptoms.
Opiates may be considered to relieve dyspnoea and anxiety in patients with pulmonary oedema and severe dyspnoea. Respiration should be monitored.	
Inotropic agents may be considered in patients with severe heart failure with hypotension refractory to standard medical treatment.	



MANAGEMENT OF LEFT VENTRICULAR DYSFUNCTION AND ACUTE HEART FAILURE IN ST-ELEVATION MYOCARDIAL INFARCTION

1 2 3

RECOMMENDATIONS	CLASS	LEVEL
Nitrates are recommended in patients with symptomatic heart failure with SBP >90 mmHg to improve symptoms and reduce congestion.	I	C
Oxygen is indicated in patients with pulmonary oedema with SaO ₂ <90% to maintain a saturation >95%.	I	C
Patient intubation is indicated in patients with respiratory failure or exhaustion, leading to hypoxaemia, hypercapnia, or acidosis, and if non-invasive ventilation is not tolerated.	I	C
Non-invasive positive pressure ventilation (continuous positive airway pressure, biphasic positive airway pressure) should be considered in patients with respiratory distress (respiratory rate >25 breaths/min, SaO ₂ <90%) without hypotension.	IIa	B

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MANAGEMENT OF LEFT VENTRICULAR DYSFUNCTION AND ACUTE HEART FAILURE IN ST-ELEVATION MYOCARDIAL INFARCTION

1 2 3

RECOMMENDATIONS	CLASS	LEVEL
ACE inhibitor (or if not tolerated, ARB) therapy is indicated as soon as haemodynamically stable for all patients with evidence of LVEF \leq 40% and/or heart failure to reduce the risk of hospitalization and death.	I	A
Beta-blocker therapy is recommended in patients with LVEF \leq 40% and/or heart failure after stabilization, to reduce the risk of death, recurrent MI, and hospitalization for heart failure.	I	A
An MRA is recommended in patients with heart failure and LVEF \leq 40% with no severe renal failure or hyperkalaemia to reduce the risk of cardiovascular hospitalization and death.	I	B
Loop diuretics are recommended in patients with acute heart failure with symptoms/signs of fluid overload to improve symptoms	I	C

Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177.



MANAGEMENT OF LEFT VENTRICULAR DYSFUNCTION AND ACUTE HEART FAILURE IN ST-ELEVATION MYOCARDIAL INFARCTION

1 2 **3**

RECOMMENDATIONS

CLASS

LEVEL

Intravenous nitrates or sodium nitroprusside should be considered in patients with heart failure and elevated SBP to control blood pressure and improve symptoms.

IIb

C

Opiates may be considered to relieve dyspnoea and anxiety in patients with pulmonary oedema and severe dyspnoea. Respiration should be monitored.

IIb

B

Inotropic agents may be considered in patients with severe heart failure with hypotension refractory to standard medical treatment.

Ib

C

Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177.



ATRIAL **FIBRILLATION**



ATRIAL FIBRILLATION



TREATMENT RECOMMENDATION

Acute rate control - no clinical signs of acute heart failure or hypotension:

- Intravenous beta-blockers
- Intravenous amiodarone

Acute rate control - in the presence of concomitant acute heart failure and hypotension:

- Intravenous amiodarone

Cardioversion

- Immediate electrical cardioversion is indicated when adequate rate control cannot be achieved promptly with pharmacological agents in patients with AF and ongoing ischaemia, severe haemodynamic compromise or heart failure.
- Intravenous amiodarone is indicated to promote electrical cardioversion and/or decrease risk for early recurrence of AF after electrical cardioversion in unstable patients with recent onset of AF.
- In patients with documented de novo AF during the acute phase of STEMI, long-term oral anticoagulation should be considered depending on CHA₂DS₂-VASc score and taking concomitant antithrombotic therapy into account.
- Digoxin is ineffective in converting recent onset AF to sinus rhythm and is not indicated for rhythm control.
- Calcium channel blockers and beta-blockers including SAotalol are ineffective in converting recent onset AF to sinus rhythm.
- Prophylactic treatment with antiarrhythmic drugs to prevent AF is not indicated



MANAGEMENT OF ATRIAL FIBRILLATION

12

RECOMMENDATIONS	CLASS	LEVEL
Rhythm control should be considered in patients with atrial fibrillation secondary to a trigger or substrate that has been corrected (e.g. ischaemia).	IIa	C
Acute rate control of atrial fibrillation		
Intravenous beta-blockers or non-dihydropyridine CCB (e.g. diltiazem, verapamil) are indicated if there are no clinical signs of acute heart failure.	I	A
Amiodarone or i.v. digitalis is indicated in case of rapid ventricular response in the presence of concomitant acute heart failure or hypotension.	I	B

Recommended doses of anti-arrhythmic agents are given in Guidelines for management of patients with atrial fibrillation. CCB = calcium-channel blocker; i.v. = intravenous; LoA = level of evidence; LV = left ventricular.

Steg P, James S, Atar D, Badano L, Lundqvist C, Borger M et al. ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2012;33(20):2569-2619.



MANAGEMENT OF ATRIAL FIBRILLATION

12

RECOMMENDATIONS	CLASS	LEVEL
Cardioversion		
Immediate electrical cardioversion is indicated when adequate rate control cannot be achieved promptly with pharmacological agents in patients with atrial fibrillation and on-going ischaemia, severe haemodynamic compromise or heart failure.	I	C
Intravenous amiodarone is indicated for conversion to sinus rhythm in stable patients with recent onset atrial fibrillation and structural heart disease.	I	A
Digoxin (LoE A), verapamil, sotalol, metoprolol (LoE B) and other beta-blocking agents (LoE C) are ineffective in converting recent onset atrial fibrillation to sinus rhythm and should not be used for rhythm control (although beta-blockers or digoxin may be used for rate control).	iii	A B C

Recommended doses of anti-arrhythmic agents are given in Guidelines for management of patients with atrial fibrillation. CCB = calcium-channel blocker; i.v. = intravenous; LoA = level of evidence; LV = left ventricular.

Steg P, James S, Atar D, Badano L, Lundqvist C, Borger M et al. ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2012;33(20):2569-2619.



MANAGEMENT OF ATRIAL FIBRILLATION

12

RECOMMENDATIONS	CLASS	LEVEL
Acute rate control of AF		
Intravenous beta-blockers are indicated for rate control if necessary and there are no clinical signs of acute heart failure or hypotension.	I	C
Intravenous amiodarone is indicated for rate control if necessary in the presence of concomitant acute heart failure and no hypotension.	I	A
Intravenous digitalis should be considered for rate control if necessary in the presence of concomitant acute heart failure and hypotension.	iii	A B C
Cardioversion		
Immediate electrical cardioversion is indicated when adequate rate control cannot be achieved promptly with pharmacological agents in patients with AF and ongoing ischaemia, severe haemodynamic compromise or heart failure.	I	C

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MANAGEMENT OF ATRIAL FIBRILLATION

12

RECOMMENDATIONS	CLASS	LEVEL
Cardioversion		
Intravenous amiodarone is indicated to promote electrical cardioversion and/or decrease risk for early recurrence of AF after electrical cardioversion in unstable patients with recent onset AF.	I	C
In patients with documented de novo AF during the acute phase of STEMI, long-term oral anticoagulation should be considered depending on CHA ₂ DS ₂ -VASc score and taking concomitant antithrombotic therapy into account.	IIa	C
Digoxin is ineffective in converting recent onset AF to sinus rhythm and is not indicated for rhythm control.	III	B
Calcium channel blockers and beta-blockers including sotalol are ineffective in converting recent onset AF to sinus rhythm.	III	B
Prophylactic treatment with antiarrhythmic drugs to prevent AF is not indicated.	III	B

Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177.



CARDIAC ARREST

RECOMMENDATIONS	CLASS	LEVEL
A primary PCI strategy is recommended in patients with resuscitated cardiac arrest and an ECG consistent with STEMI.	I	B
Targeted temperature management is indicated early after resuscitation of cardiac arrest patients who remain unresponsive.	I	B
It is indicated that healthcare systems implement strategies to facilitate transfer of all patients in whom a myocardial infarction is suspected directly to the hospital offering 24/7 PCI-mediated reperfusion therapy via one specialized EMS.	I	C

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CARDIAC ARREST

RECOMMENDATIONS	CLASS	LEVEL
It is indicated that all medical and paramedical personnel caring for suspected myocardial infarction have access to defibrillation equipment and are trained in basic cardiac life support.	I	C
Urgent angiography (and PCI if indicated) should be considered in patients with resuscitated cardiac arrest without diagnostic ST-segment elevation but with a high suspicion of ongoing myocardial ischaemia. ¹	I	C
Prehospital cooling using a rapid infusion of large volumes of cold i.v. fluid immediately after return of spontaneous circulation is not recommended. ²	I	B

1. Steg P, James S, Atar D, Badano L, Lundqvist C, Borger M et al. ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. *European Heart Journal*. 2012;33(20):2569-2619.

2. Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. *European Heart Journal*. 2017;39(2):119-177.



TREATMENT OF MILD HF (KILLIP CLASS II)

RECOMMENDATIONS	CLASS	LEVEL
Oxygen is indicated to maintain a saturation > 95%.	I	C
Loop diuretics, e.g. furosemide: 20-40 mg i.v., is recommended and should be repeated at 1-4 h intervals if necessary.	I	C
i.v. nitrates or sodium nitroprusside should be considered in patients with elevated systolic blood pressure.	IIa	C
An ACE inhibitor is indicated in all patients with signs or symptoms of heart failure and/or evidence of LV dysfunction in the absence of hypotension, hypovolaemia, or renal failure.	I	A
An ARB (valsartan) is an alternative to ACE inhibitor particularly if ACE inhibitors are not tolerated.	L	B
An aldosterone antagonist (eplerenone) is recommended in all patients with signs or symptoms of heart failure and/or evidence of LV dysfunction provided no renal failure or hyperkalaemia.	I	B
Hydralazine and isosorbide dinitrate should be considered if the patient is intolerant to both ACE inhibitors and ARB.	IIa	C

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TREATMENT OF MILD HF (KILLIP CLASS III)

12

RECOMMENDATIONS	CLASS	LEVEL
Oxygen is indicated.	I	C
Ventilatory support should be instituted according to blood gasses.	I	C
Loop diuretics, e.g. furosemide: 20-40 mg i.v., are recommended and should be repeated at 1-4 h intervals if necessary.	I	C
Morphine is recommended. Respiration should be monitored. Nausea is common and an antiemetic may be required. Frequent low-dose therapy is advisable.	I	A
Nitrates are recommended if there is no hypotension.	I	B
Inotropic agents: <ul style="list-style-type: none">• Dopamine• Dobutamine (inotropic)• Levosimendan (inotropic/vasodilator)	IIa IIa IIb	C C C

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TREATMENT OF MILD HF (KILLIP CLASS III)

12

RECOMMENDATIONS	CLASS	LEVEL
An aldosterone antagonist such as spironolactone or eplerenone must be used if < LVEF 40%.	I	B
Ultrafiltration should be considered.	IIa	B
Early revascularisation must be considered if the patient has not been previously revascularized.	I	C

Steg P, James S, Atar D, Badano L, Lundqvist C, Borger M et al. ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2012;33(20):2569-2619.



CARDIOGENIC SHOCK





CARDIOGENIC SHOCK: DEFINITION

Clinical condition defined as the inability of the heart to deliver an adequate amount of blood to the tissues to meet resting metabolic demands as a result of impairment of its pumping function.¹

HEMODYNAMIC CRITERIA TO DEFINE CARDIOGENIC SHOCK

Systolic blood pressure
<80 to 90 mmHg or mean
arterial pressure 30mmHg
lower than baseline

Severe reduction in cardiac
index:
<1.8 L/min/m² without
support or
<20 to 2.2 L/min/m² with
support

Adequate or elevated filling
pressure: Left ventricular end
-diastolic pressure > 18 mmHg
or Right ventricular end
-diastolic pressure > 10
to 15 mmHg²

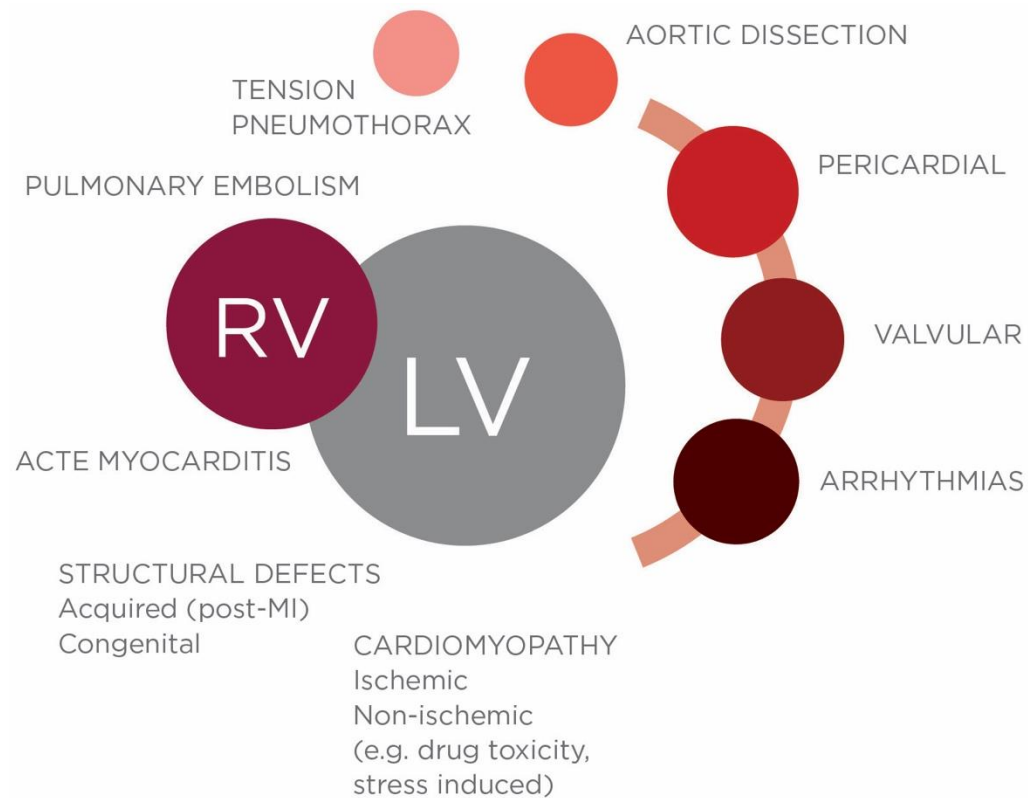
1. Cardiogenic Shock | National Heart, Lung, and Blood Institute (NHLBI) [Internet]. Nhlbi.nih.gov. 2019 [cited 3 March 2019]. Available from: <https://www.nhlbi.nih.gov/health-topics/cardiogenic-shock>

2. Bueno H, Vranckz P, Bonnefoy E. Acute Cardiovascular Care Association Clinical Decision Making Toolkit [Internet]. Escardio.org. 2015 [cited 3 March 2019]. Available from: https://www.escardio.org/static_file/Escardio/Subspecialty/ACCA/TOOLKIT_V2.pdf



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.



Reynolds H, Hochman J. Cardiogenic Shock. Circulation. 2008;117(5):686-697.

MANAGEMENT OF CARDIOGENIC



SHOCK IN ST-ELEVATION MYOCARDIAL INFARCTION





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

5 min

15 min

60 min

CARDIAC INTENSIVE CARE UNIT

EARLY TRIAGE & MONITORING

Start high flow O₂
Establish i.v. access

- Age: 65-74. >75
- Heart rate >100 beats per minute
- Systolic blood pressure <100 mmHg
- Proportional pulse pressure <25 mmHg
- (CI <2.21/min/m²)
- Orthopnea (PCWP >22 mmHg)
- Tachypnea (>20/mm). >30min (!)
- Killip II-IV
- Clinical symptoms of tissue hypoperfusion/hypoxia:
 - cool extremities
 - decreased urine output (urine putput <40ml/h)
 - decreases capillary refill or mottling
 - alteration in mental status

INITIAL RESUSITATION

- Arterial and a central venous cathereization with a catheter capable of measing central venous oxygen saturation
- Standard transthoracic echocardiogram to assess left (and right) ventricular function and for the detection of potential mechanical complications following MI
- Early coronary angiography in specialized myocardial intervention center when signs and /or symptoms of ongoing myocardial ischemia (e.g. ST segment elevation myocardial infarction)

CORRECT: hypoglycemic & hypocalcemia
TREAT: sustained arrhythmias: brady-or tachy

Isotonic saline-fluid challenge of 20 to 30ml per kilogram of body weight over a 30-minute period to achieve a central venous pressure of 8 to 12 mmHg or until perfusion improves (with a maximum of 500ml)

CONSIDER NIVmechanical ventilation for comfort (fatigue, distress) or as needed:
- To correct acidosis
- To correct hypoxemia

INOTROPIC SUPPORT (dobutamin and/or vasopressor support)

In persistent drug-resistant cardiogenic shock, consider mechanical circulatory support

TREATMENT GOALS

- a mean arterial pressure of 60mmHg or above
- a mean pulmonary artery wedge pressure of 18mmHg or below
- a central venous pressure of 8 to 12mmHg
- a urinary output of 0.5ml or more per hour per kg 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)



CARDIOGENIC SHOCK: TREATMENT AND VENTILATOR PROCEDURES

Ventilator mode
Tidal Volume goal
Plateau Pressure goal
Anticipated PEEP levels
Ventilator rate and pH goal
Inspiration: Expiration time
Oxygen goal:

- PaO₂
- SpO₂

Pressure assist/control
Reduced tidal volume to 6-8 ml/kg lean body weight
< 30 cm H₂O
5-10 cm H₂O
12-20, adjusted to achieve a pH ≥ 7.30 if possible
1:1 to 1:2

50-80 mmHg
> 90%

Predicted body weight calculation:

Male: $50 + 0.91 (\text{height in cm} - 152.4)$

Female: $45.5 + 0.91 (\text{height in cm} - 152.4)$

Some patients with CS will require increased PEEP to attain functional residual capacity and maintain oxygenation, and peak pressure 30cm H₂O to attain effective tidal volumes of 6-8ml/kg with adequate CO₂ removal.



TREATMENT OF CARADIOGENIC SHOCK (KILLIP CLASS IV)

1²

RECOMMENDATIONS	CLASS	LEVEL
Oxygen/mechanical respiratory support is indicated according to blood gasses.	I	C
Urgent echocardiography/Doppler must be performed to detect mechanical complications, assess systolic function and loading conditions	I	C
High-risk patients must be transferred early to tertiary centres.	I	C
Emergency revascularization with either PCI or CABG in suitable patients must be considered.	I	B
Fibrinolysis should be considered if revascularization is unavailable.	Ia	C
Intra-aortic balloon pumping may be considered.	Ia	B
LV assist devices may be considered for circulatory support in patients in refractory shock.	Ila	C

Steg P, James S, Atar D, Badano L, Lundqvist C, Borger M et al. ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2012;33(20):2569-2619.



TREATMENT OF CARADIOGENIC SHOCK (KILLIP CLASS IV)

12

RECOMMENDATIONS	CLASS	LEVEL
Haemodynamic assessment with balloon floating catheter may be considered	lib	B
Inotropic/vasopressor agents should be considered: <ul style="list-style-type: none">• Dopamine;• Dobutamine;• Norepinephrine (preferred over dopamine when blood pressure is low).	IIa IIa IIb	C C B



MANAGEMENT OF CARDIogenic SHOCK

TREATMENT RECOMMENDATION AND RATIONALE

Immediate PCI is indicated for patients with cardiogenic shock if coronary anatomy is suitable. If coronary anatomy is not suitable for PCI, or PCI has failed, emergency CABG is recommended.

to control blood pressure
improve symptoms.

Oxygen/mechanical respiratory support is indicated according to blood gases.

Fibrinolysis should be considered in patients presenting with cardiogenic shock if a primary PCI strategy is not available within 120 mm from STEMI diagnosis and mechanical complications have been ruled out.

Inotropic/vasopressor agents may be considered in patients in refractory shock.



MANAGEMENT OF CARDIogenic SHOCK IN ST-ELEVATION MYOCARDIAL INFARCTION

1 2 3

RECOMMENDATIONS	CLASS	LEVEL
Immediate PCI is indicated for patients with cardiogenic shock if coronary anatomy is suitable. If coronary anatomy is not suitable for PCI, or PCI has failed, emergency CABG is recommended.	I	B
Invasive blood pressure monitoring with an arterial line is recommended.	I	C
Immediate Doppler echocardiography is indicated to assess ventricular and valvular functions, loading conditions, and to detect mechanical complications.	I	C
It is indicated that mechanical complications are treated as early as possible after discussion by the Heart Team.	I	C
Oxygen/mechanical respiratory support is indicated according to blood gases.	I	C

Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177.



MANAGEMENT OF CARADIOGENIC SHOCK IN ST-ELEVATION MYOCARDIAL INFARCTION

1 2 3

RECOMMENDATIONS	CLASS	LEVEL
Fibrinolysis should be considered in patients presenting with cardiogenic shock if a primary PCI strategy is not available within 120 mm from STEMI diagnosis and mechanical complications have been ruled out.	IIa	C
Complete revascularization during the index procedure should be considered in patients presenting with cardiogenic shock	IIa	C
Intra-aortic balloon pumping should be considered in patients with haemodynamic instability/cardiogenic shock due to mechanical complications.	IIa	C
Haemodynamic assessment with pulmonary artery catheter may be considered for confirming diagnosis or guiding therapy.	IIb	B

Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177.



MANAGEMENT OF CARDIogenic SHOCK IN ST-ELEVATION MYOCARDIAL INFARCTION

1 2 **3**

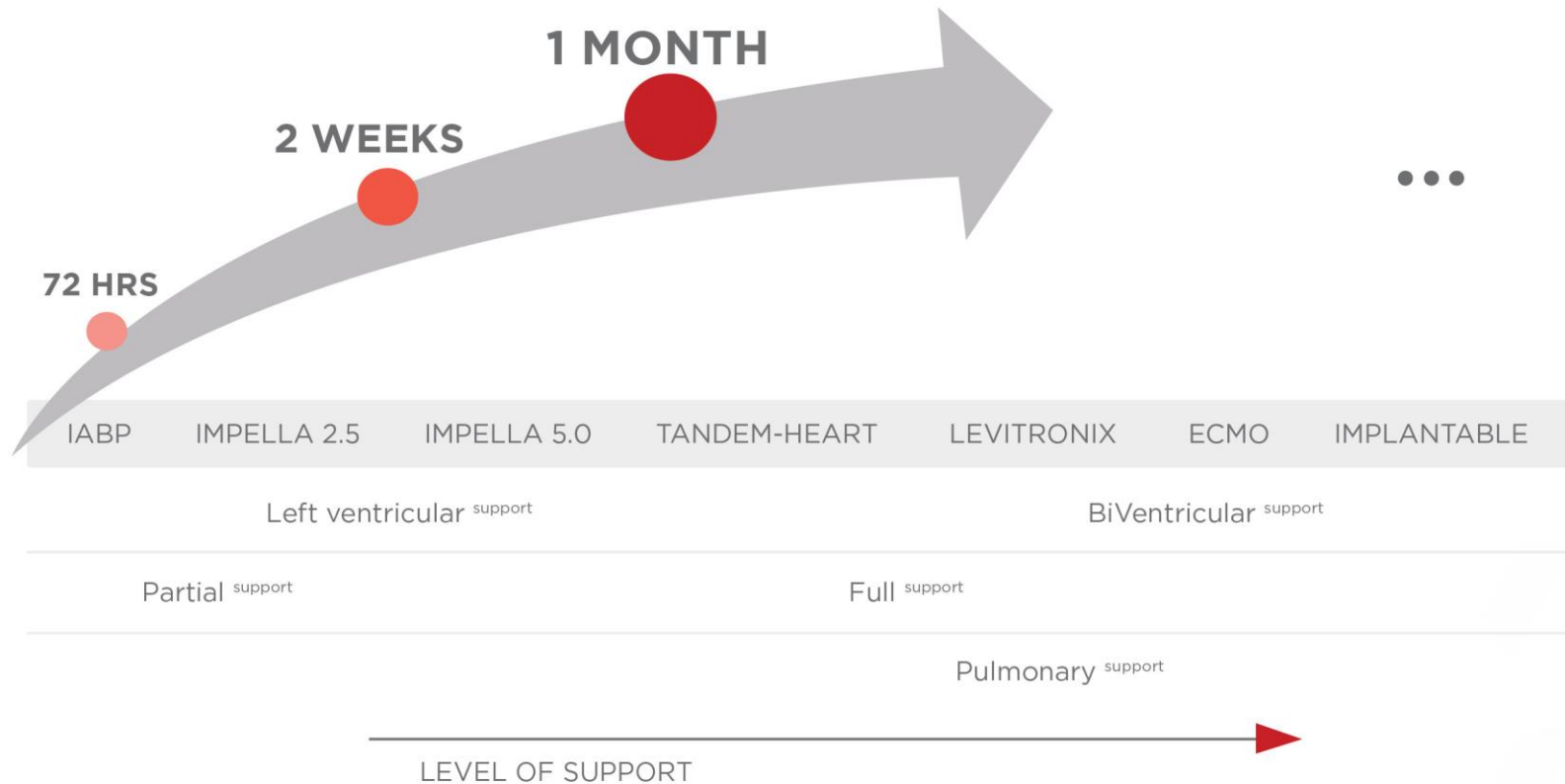
RECOMMENDATIONS	CLASS	LEVEL
Ultrafiltration may be considered for patients with refractory congestion, who failed to respond to diuretic-based strategies.	IIb	B
Inotropic/vasopressor agents may be considered for haemodynamic stabilization.	IIb	C
Short-term mechanical support may be considered in patients in refractory shock.	IIb	C
Routine intra-aortic balloon pumping is not indicated.	III	B

Ibanez B, James S, Agewall S, Antunes M, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. European Heart Journal. 2017;39(2):119-177.



CARDIOGENIC SHOCK:

MECHANICAL CIRCULATORY SUPPORT, BASIC CHARACTERISTICS



Bueno H, Vranckz P, Bonnefoy E. Acute Cardiovascular Care Association Clinical Decision Making Toolkit [Internet]. Escardio.org. 2015 [cited 3 March 2019]. Available from: https://www.escardio.org/static_file/Escardio/Subspecialty/ACCA/TOOLKIT_V2.pdf



	TYPE	SUPPORT	ACCESS
Intra-aortic balloon pump	Balloon Counterpulsation	Pulsatile flow <0.5 L	Arterial: 7.5 French
Impella Recover LP 2.5 CP LP 5.0	Axial flow	Continuous flow <2.5 L <4.0 L <5.0 L	Arterial: 12 French Arterial: 14 French Arterial: 21 French
Tandemheart	Centrifugal flow	<5.0 L	Venous: 21 French Arterial: 15-17 French
Cardiohelp		<5.0 L	Venous: 15-29 French Arterial: 15-29 French

Different systems for mechanical circulatory support are available to the medical community. The available devices differ in terms of the insertion procedure, mechanical properties, and mode of action. A minimal flow rate of 70 mL/kg/min, representing a cardiac index of at least 2.5 L/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.

The SAVE-score may be a tool to predict survival for patients receiving ECMO for refractory cardiogenic shock.¹

INTRODUCTION

INCIDENCE

Complicates AMI in 5-15% of cases

MORTALITY

40-50%



PATHOPHYSIOLOGY

- Ischaemia causes impaired contractility
- Decreased Cardiac output
- Hypotension
- Peripheral vasoconstriction
- Tissue hypoperfusion
- Pathologic vasodilatation
- Systemic inflammatory response
 - Capillary leakage
 - Bleeding





MANAGEMENT IN CATHETERIZATION LAB

REVASCULARIZATION

- Early revascularization is the most important strategy!!
- Multi vessel disease
 - PCI vs CABG
 - Current guidelines suggest PCI of all lesions
 - No evidence base for this
 - CULPRIIT SHOCK trial is currently enrolling
- Interventional pharmacology
 - Enteral absorption is reduced
 - Role of Gpiibiiia inhibitors
 - Role of Cangrelor



MANAGEMENT IN ICU

FLUIDS

- Volume should be estimated according to physiological needs

INOTROPES

- Limited data suggest that Norepinephrine has better outcomes
- No longer term prognostic data
- Keep mean BP @ 65-70mmHg
- Shortest time and lowest dose
- Dobutamine may be added to Noradrenaline

MULTI ORGAN DYSFUNCTION

- Ventilation
- Continuous dialysis

MONITORING

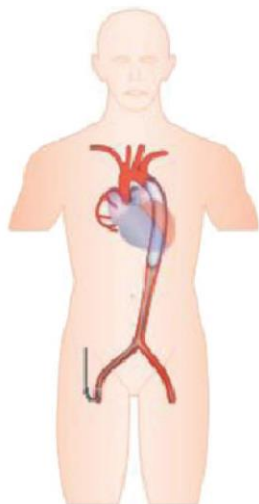
- Pulmonary artery catheters
- Pulse contour cardiac output monitors

THERAPEUTIC HYPOTHERMIA

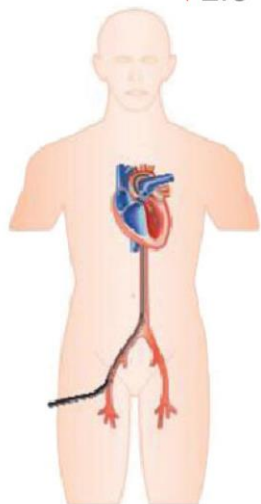


MECHANICAL SUPPORT

IABP

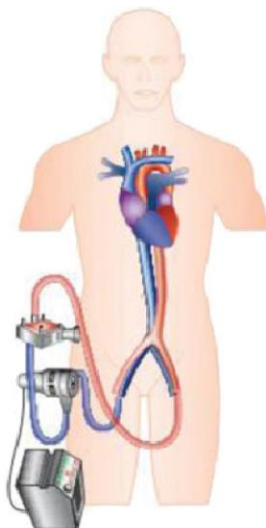


IMPELLA

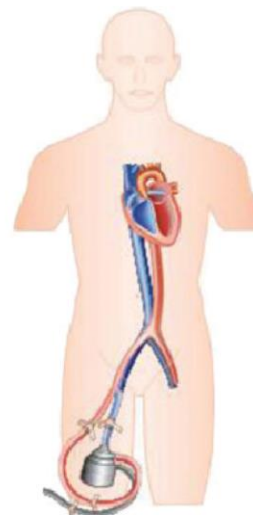


2.5
3.5
2.0

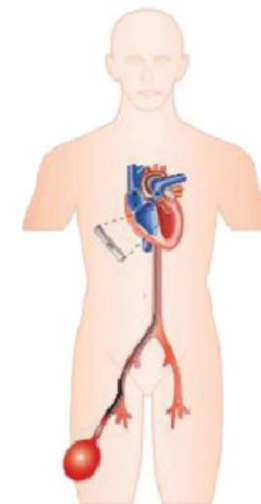
ECLS
(ECMO)



TANDEM
HEART



iVAC 2L



Schematic drawings of current percutaneous mechanical support devices for CS. intraaortic balloon pump (A), Impella (B), TandemheartTH, (C) extracorporeal life support (D) iVAC 2L.



INTRA AORTIC BALLOON PUMP

MOST WIDELY USED DEVICE

HEAMODYNAMIC EFFECTS

- Lowers peak systolic BP
- Improves diastolic pressure
- No improvement in Cardiac index

SHOCK II TRIAL

- No difference in mortality
- No difference in secondary end points

CURRENT ESC GUIDELINE

- Class III indication



PERCUTANEOUS LEFT VENTRICULAR ASSIST DEVICES

3 DEVICES AVAILABLE

- Tandem heart
- Impella
- iVAC2L

HEAMODYNAMIC EFFECTS

- Higher cardiac index
- Higher arterial pressure
- Lower mean capillary wedge pressures

EVIDENCE

- Meta analysis showed no mortality benefit
- Trend towards benefit with Impella device



ECMO

EXTRA CORPOREAL LIFE SUPPORT

- Blood pump
- Heat exchanger
- Oxygenator

ADVANTAGES

- High flow rate
- Relatively low cost

DISADVANTAGES

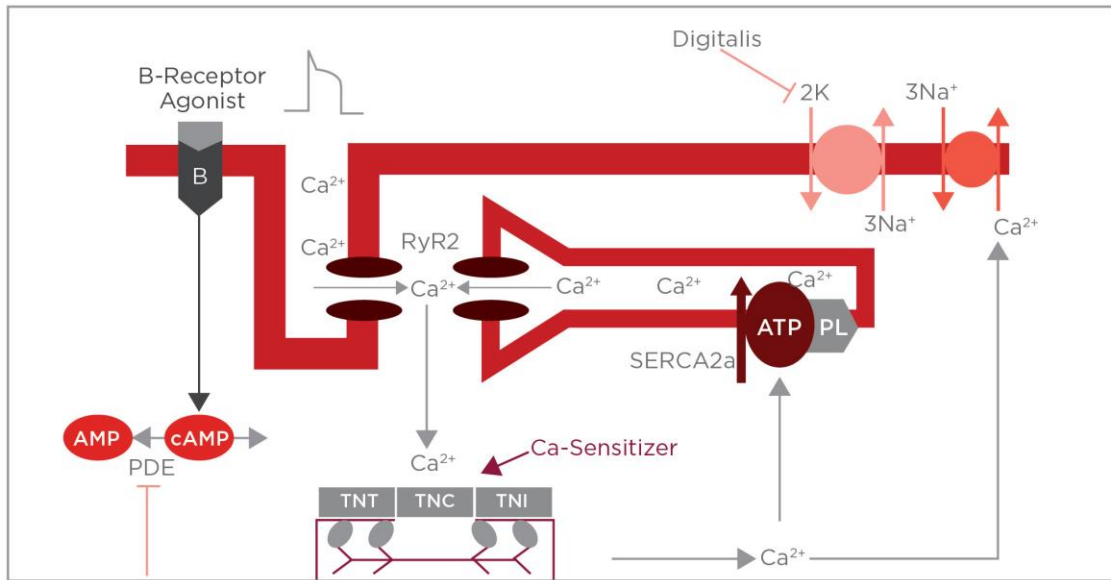
- High complication rate
- Large canula
- No unloading of the left ventricle
- Increased systemic resistance

EVIDENCE

???



CURRENT INOTROPIC AGENTS

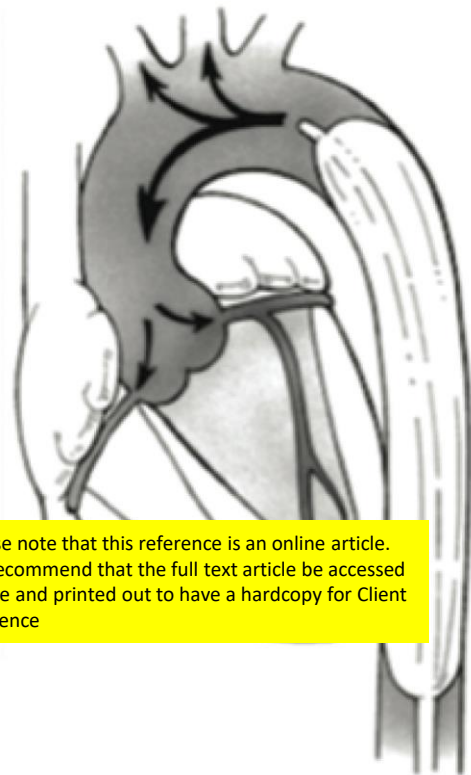


DOBUTAMINE AND MILRINONE

- ▲ Intracellular cAMP that activates protein kinase A to phosphorylate key calcium-cycling proteins:
 - L-type Ca²⁺ Channels (▲ Ca²⁺ influx → inotropic)
 - Ryanodine receptor (▲ SR Ca²⁺ release → inotropic)
 - Phospholamban (▼ inhibition SERCA ► shorter intervals between contractions (+lusitropic) and Ca²⁺ release in next action potential (+inotropic))
 - TNI (▲ rate of Ca²⁺ Dissociation from TNC ►)



INTRA-AORTIC COUNTER PULSATION

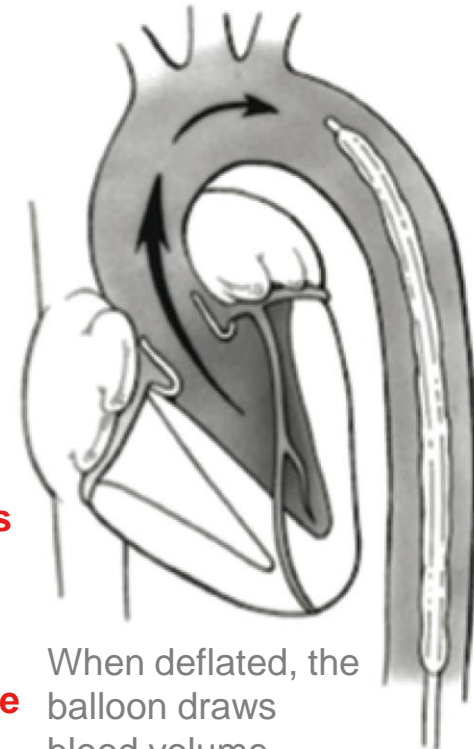


Please note that this reference is an online article. we recommend that the full text article be accessed online and printed out to have a hardcopy for Client reference

Balloon inflates immediately after LV ejection and is deflated before onset of the following systole. When balloon inflates, it displaces blood upstream towards the heart, thereby increasing early diastolic pressure.

▼ **Afterload and LV wall stress (myocardial O₂ consumption)**

▲ **Coronary perfusion pressure**

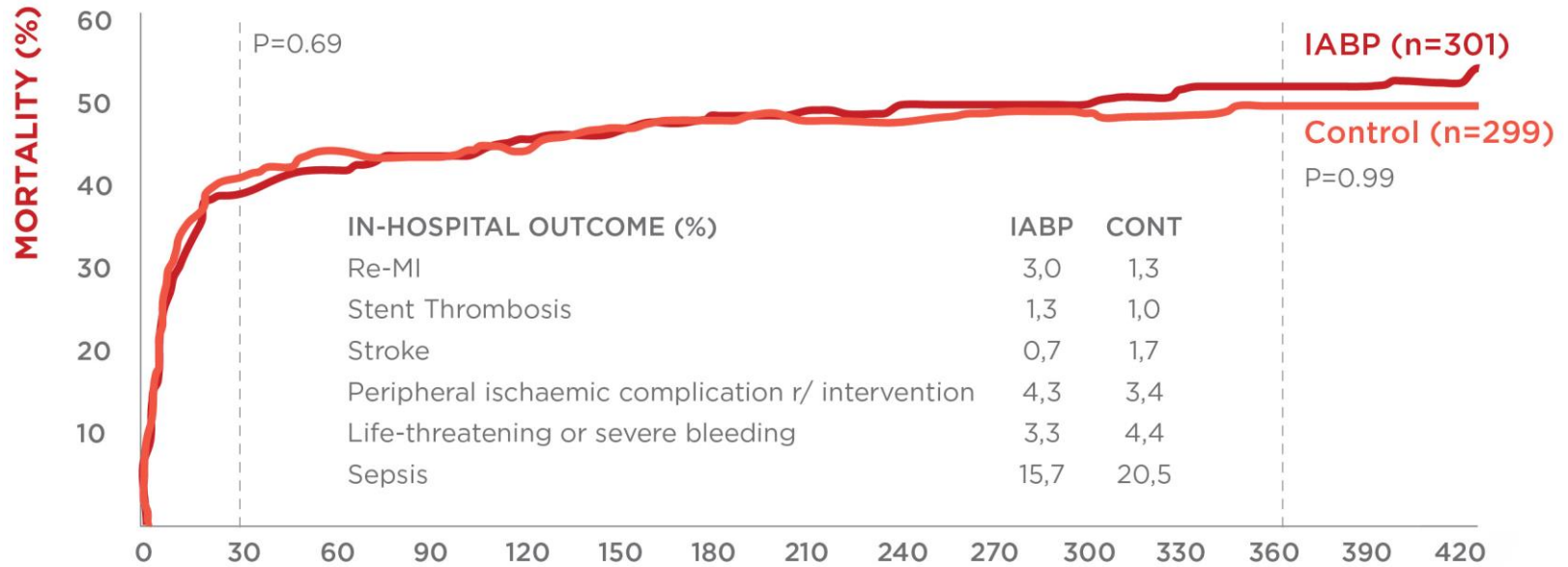


When deflated, the balloon draws blood volume



CARDIOGENIC SHOCK:

INTRA-AORTIC COUNTERPULSATION

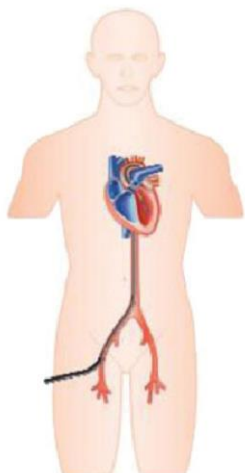


Thiele H, Zeymer U, Neumann F, Ferenc M, Olbrich H, Hausleiter J et al. Intraaortic Balloon Support for Myocardial Infarction with Cardiogenic Shock. New England Journal of Medicine. 2012;367(14):1287-1296.



PERCUTANEOUS LEFT VENTRICULAR ASSIST DEVICES

IMPELLA ◀ 2.5
3.5
2.0



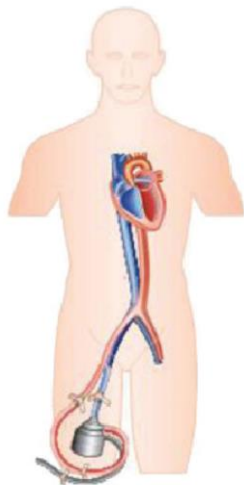
- Microaxial flow pump that directly unloads the LV and delivers blood to ascending aorta
- Provides partial to full hemodynamic support (maximal flow rate 2.5, 4.0 and 5.0 L/min)
- Powerful myocardial protective benefits
- Requires systemic anticoagulation (+)
- Recommended duration of use <10 days
- Short insertion time (10 min)
- Lower risk of complications (familiar implantation technique, sole arterial access, smaller catheter diameter), hemolysis in 5-10 % Pts

1.Thiele H, Smalling R, Schuler G. Percutaneous left ventricular assist devices in acute myocardial infarction complicated by cardiogenic shock. European Heart Journal. 2007;28(17):2057-2063.
2.Werdan K, Gielen S, Ebelt H, Hochman J. Mechanical circulatory support in cardiogenic shock. European Heart Journal. 2013;35(3):156-167.



PERCUTANEOUS LEFT VENTRICULAR ASSIST DEVICES

Tandem Heart



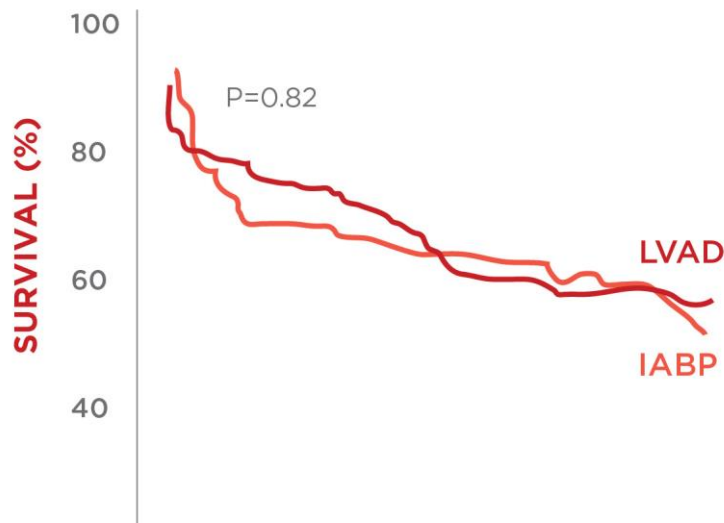
- Percutaneous LA to iliac artery bypass, powered by an external continuous flow centrifugal pump
- Provides up to 4L/min of forward flow
- Less myocardial protective benefits than with Impella:
 - ▲ mean arterial BP,
 - ▼ LVEDP, but only indirectly unloads the LV (and ▲ afterload in CS)
- Requires systemic anticoagulation (+++)
- Recommended duration of use < 14 days
- Complications:
tamponade, major bleeding (2 access sites), critical limb ischaemia, sepsis, arrhythmia, residual ASD
- Contraindications:
Aortic insufficiency, RV failure, VSD, significant peripheral vascular disease

1. Thiele H, Smalling R, Schuler G. Percutaneous left ventricular assist devices in acute myocardial infarction complicated by cardiogenic shock. European Heart Journal. 2007;28(17):2057-2063.
2. Werdan K, Gielen S, Ebel H, Hochman J. Mechanical circulatory support in cardiogenic shock. European Heart Journal. 2013;35(3):156-167.



CARDIOGENIC SHOCK

PERCUTANEOUS LEFT VENTRICULAR ASSIST DEVICES



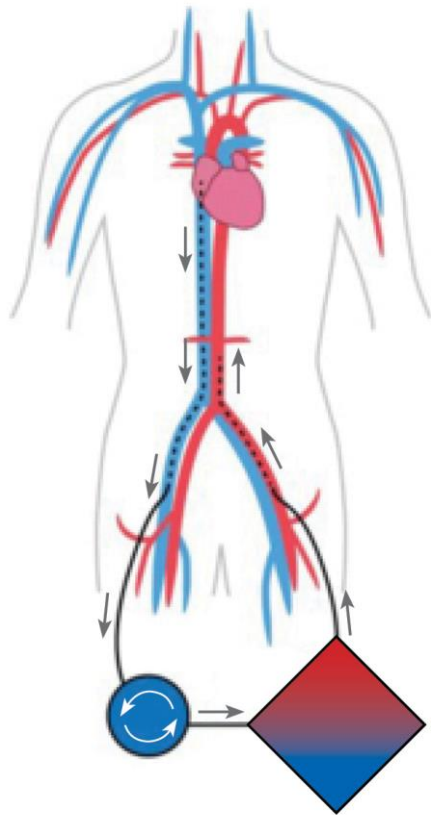
META-ANALYSIS 3 RCTS (100 PTS)]

- 2RCTs on TandemHeart and 1 RCT on Impella (ISAR-SHOCK)
- Active pLVADs demonstrated higher cardiac index, higher mean arterial pressure, and lower PCWP
- Bleeding complications more



EXTRACORPOREAL LIFE SUPPORT SYSTEMS

VENO-ARTERIAL ECMO



- Full cardiopulmonary support (up to 7.0 L/min)
- Reduces myocardial oxygen consumption, but retrograde flow increases afterload (no direct LV unloading)
- Requires systemic anticoagulation (+++) and perfusionists
- Recommended duration of use < 7 days
- Small insertion time
- Complications:
lower limb ischaemia, compartment syndrome, amputation, stroke, major bleeding, sepsis, systemic thromboembolism
- Contraindications:
significant aortic insufficiency



OPEN ISSUES IN ACTIVE CIRCULATORY SUPPORT

OPTIMAL TIMING (early, late, futility)

- Devices with low complication rate may be chosen more liberally in early stage?
- Better survival on Impella implanted before vs after PCI (USpella registry)
- Reserve more aggressive devices with higher flow rate for more severe CS?

OPTIMAL SUPPORT



- Ongoing trials in CS (STEMI)
- DanShock: will routine use of Impella CP ≥ 48 h reduce mortality?
 - ECMO-CS: will immediate ECMO reduce mortality in rapidly deteriorating or severe CS?

PATIENT SELECTION



CARDIOGENIC SHOCK

MECHANICAL CIRCULATORY SUPPORT

Routine use of IABP in patients with cardiogenic shock is **not recommended** (III-A)

IABP insertion **should be considered in** patients with hemodynamic instability/cardiogenic shock due to **mechanical complications**, as a bridge to surgery (IIa-C)

Short-term **mechanical circulatory support** in ACS patients with cardiogenic shock **may be considered** (IIb-C)



CARDIOGENIC SHOCK

SUMMARY OF KEY MESSAGES

- Cardiogenic shock is a severe manifestation of acute heart failure and is associated with a **high mortality**
- **Early revascularization** is associated with an improved long-term survival
- In patients with refractory cardiogenic shock, **mechanical circulatory support** should be considered
- There is a **need for randomized trials** to define how, when and in which patients the different techniques of mechanical circulatory support should be used.

REFERENCE HERE



ECMO INDICATIONS

- However, this modality requires a **HIGHER LEVEL OF CARE** and traditionally has remained underutilized
- **VENO-VENOUS ECMO**
for which the primary focus is gas exchange, VA-ECMO allows for blood to be drained from a central vein and returned to the arterial system

Please follow the URL to print a hardcopy of this.

1. Meta H, Eisen H, Cleveland J. Indications and Complications for VA-ECMO for Cardiac Failure - American College of Cardiology [Internet]. American College of Cardiology. 2015 [cited 4 March 2019]. Available from: <https://www.acc.org/latest-in-cardiology/articles/2015/07/14/09/27/indications-and-complications-for-va-ecmo-for-cardiac-failure>

2. Lafçı G, Budak A, Yener A, Cicek O. Use of Extracorporeal Membrane Oxygenation in Adults. Heart, Lung and Circulation. 2014;23(1):10-23.



CONTRAINDICATIONS FOR V-A ECMO

- Unrecoverable cardiac function,
- Patients who are not candidates for transplantation
- Durable mechanical support
- Chronic organ dysfunction (emphysema, Cirrhosis, Renal failure), prolonged cardiopulmonary resuscitation (CPR)
- Compliance limitations : (financial, cognitive, psychiatric, and social limitations).

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INDICATIONS FOR VENO-ARTERIAL ECMO

- Cardiogenic shock: with or without MI
- Fulminant myocarditis
- Pulmonary hypertension and right heart failure
- Pulmonary embolus with hemodynamic compromise
- Cardiac arrest (assisted CPR)
- Medication overdose
- Non ischaemic cardiomyopathy including sepsis induced cardiomyopathy
- Bridge to decision for transplant or VAD (LVAD/BiVAD)
- Support post cardiac surgery

Please follow the URL to print a hardcopy of this.

1. Meta H, Eisen H, Cleveland J. Indications and Complications for VA-ECMO for Cardiac Failure - American College of Cardiology [Internet]. American College of Cardiology. 2015 [cited 4 March 2019]. Available from: <https://www.acc.org/latest-in-cardiology/articles/2015/07/14/09/27/indications-and-complications-for-va-ecmo-for-cardiac-failure>

2. Lafçı G, Budak A, Yener A, Cicek O. Use of Extracorporeal Membrane Oxygenation in Adults. Heart, Lung and Circulation. 2014;23(1):10-23.



COMPLICATIONS OF VA-ECMO (IN PERCENT)

1 - 22%

Thrombosis

5 - 79%

Bleeding and coagulopathy, including hemolysis

13 - 25%

Limb ischaemia

17 - 49%

Infection

10 - 33%

Neurologic events



TARGETS FOR INITIAL TREATMENT

- Flow: 60-80 cc/kg/min
- FiO₂: 100%
- SaO₂: 100%
- MvO₂: 60-75%
- SpO₂: 95-100%
- pCO₂: 35-45 mm Hg
- MAP: 60-90 mm Hg
- pH: 7.35-7.45
- Platelet count: greater than 80,000
- Hematocrit: greater than 28



V-A ECMO

This is available as an Ebook which client can source:
<https://books.google.co.za/books?id=ve68AQAAQBAJ&printsec=frontcover&dq=inauthor:%22Poonam+Malhotra+Kapoor%22&hl=en&sa=X&ved=0ahUKewitoOyjoO7gAhUqRxUIHaNXAIUQ6AEIOTAD#v=onepage&q&f=false>

- The oxygen flow rate to the oxygenator should be roughly twice the ECLS flow rate. With an ECLS flow rate of approximately 2/3 the patient's cardiac output, and an oxygen flow rate of twice the pump flow, **NEARLY ALL OF THE PATIENT'S CO₂ PRODUCTION CAN BE REMOVED BY THE OXYGENATOR.**
- **MAIN LIMITATIONS** of these devices are large cannula sizes potentially causing lower limb ischaemia and bleeding complications, lack of direct left-ventricular unloading, rise in afterload, and a limited support time

ENCOURAGE SCORE





COMMON INDICATIONS FOR V-A ECMO

- 1. CARDIogenic SHOCK:** AMI and complications
 - a. wall rupture
 - b. papillary muscle rupture
 - c. refractory VT / VF (refractory to conventional therapy including IABP)
 - d. myocarditis
 - e. hypothermia

- 2. POST CARDIAC SURGERY:** unable to wean safely from cardiopulmonary bypass using conventional supports

- 3. DRUG OVERDOSE** with profound cardiac depression (poisoning)

- 4. MYOCARDITIS**

- 5. EARLY GRAFT FAILURE:** post heart / heart-lung transplant



TYPES OF ECMO

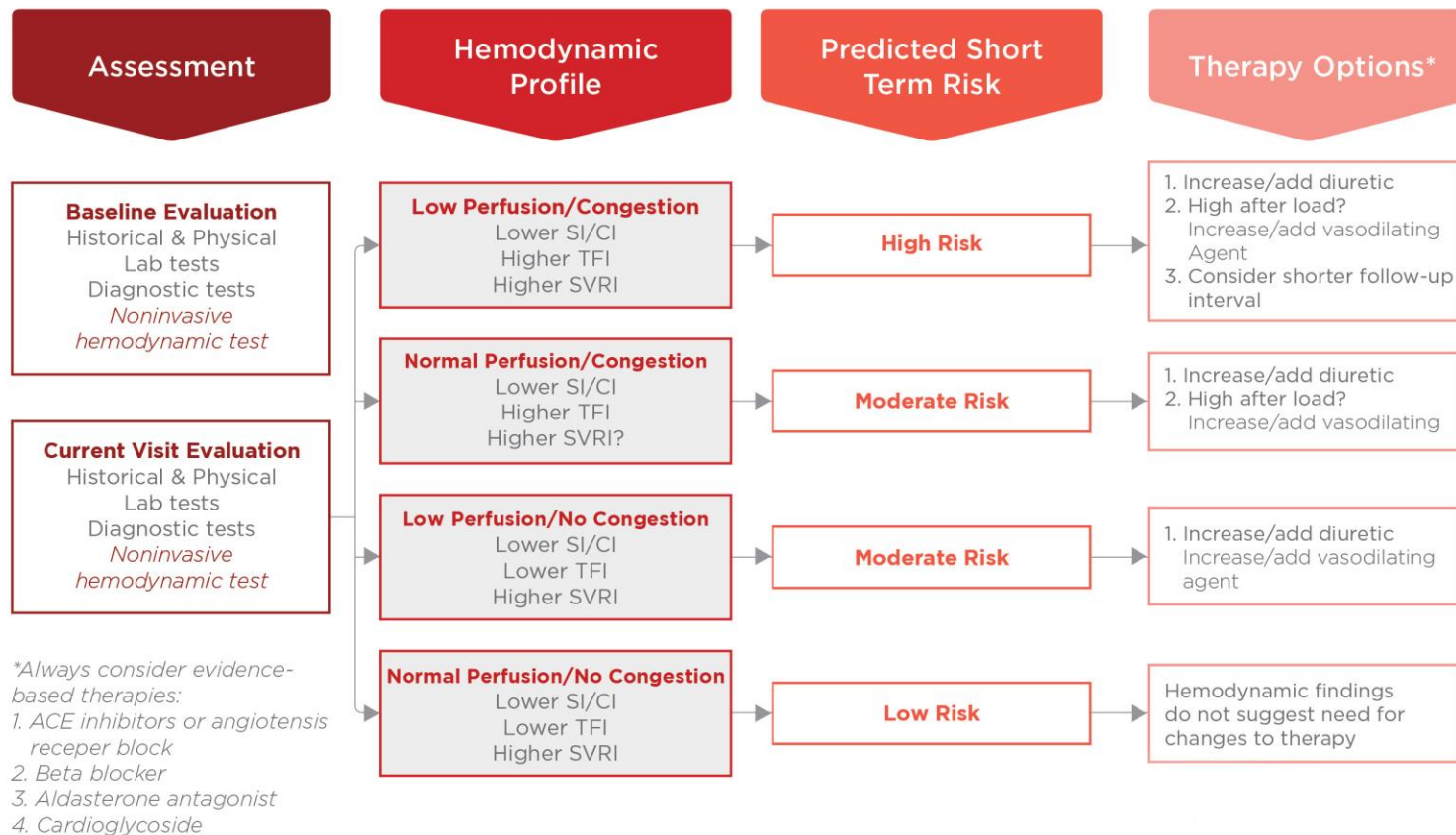
This is available as an Ebook which client can source:
<https://books.google.co.za/books?id=ve68AQAAQBAJ&printsec=frontcover&dq=inauthor:%22Poonam+Malhotra+Kapoor%22&hl=en&sa=X&ved=0ahUKewitoOyjoO7gAhUqRxUIHaNXAIUQ6AEIOTAD#v=onepage&q&f=false>

- 1. V-A ECLS:** applied for the management of cardio-respiratory failure or cardiac failure where use of a ventricular assist device (VAD) is deemed inappropriate.
 - **Central V-A ECLS:** In cases where V-A ECLS is required for cardiac support and where lung function is poor (large shunt) peripheral V-A ECLS should be avoided. This is because any native cardiac output present will deliver hypoxic blood from the pulmonary veins preferentially to the cerebral circulation (potentially causing severe cerebral hypoxia). Central V-A ECLS is most often employed in patients undergoing cardiac surgery.
 - **Peripheral V-A ECLS** is appropriate when reasonable lung function exists and cardiac surgery is not required.
- 2. Low-flow VA ECLS (CPR)** is used only in initial support and stabilization in emergent conditions requiring V-A support.
- 3. V-V ECLS** is used for isolated respiratory failure when adequate heart function for the duration of ECLS is anticipated.
- 4. HI-FLOW V-V ECLS** is used when circuit flow via a single access Cannula is inadequate to maintain safe oxygenation. This may be required if smaller access Cannula have been placed percutaneously (although 25FR percutaneous Cannula have recently become available), in which case a second venous access Cannula may be required (e.g. from an internal jugular vein).



AHA HEART FAILURE TREATMENT

HEART FAILURE TREATMENT ALGORITHM



4. Congestive Heart Failure Medications [Internet]. Information Medical Health. 2018 [cited 6 March 2019]. Available from: <http://www.adcurgentcare.us/congestive-heart-failure-medications/>