

Contemporary Look At The Treatment Of Cardiogenic Shock

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Objectives

- ▶ Definition of Cardiogenic shock
- ▶ Identify diagnostic Criteria of Cardiogenic Shock
- ▶ Identify Management of Cardiogenic Shock
- ▶ Identify **Peripheral** Ventricular Assist Devices
 - IABP (Intra-Aortic Balloon Pump)
 - TandemHeart PVAD
 - (Impella) Axial Flow Catheter
 - ECMO (Extracorporeal Membrane Oxygenation)

Cardiogenic shock

- ▶ A condition in which the heart can't pump enough blood to meet the body's needs.
- ▶ The overall incidence 7.9% (n=157 892)
- ▶ Despite advances in the treatment of myocardial infarction (MI), the incidence of cardiogenic shock in-hospital mortality is still estimated to be about 50%.



Diagnostic Criteria of Cardiogenic Shock

Cardiogenic Shock

Hypotension:

Systolic blood pressure <90 mmHg for >30 min, or

Vasopressors required to achieve a blood pressure \geq 90 mmHg

Elevated Left Ventricular Filling Pressures:

Pulmonary congestion, or

Adequate or elevated filling pressures (wedge pressure >20 mmHg)

Signs of impaired organ perfusion (at least one of the following):

Altered mental status

Cold, clammy skin

Oliguria

Increased serum lactate levels

Management of Cardiogenic Shock

AMI

- If no pulmonary oedema, IV fluid challenge
- If pulmonary oedema
 - Aggressive I.V diuretics therapy
 - Dopamine- will increase HR and thus cardiac work
 - Dobutamine- may drop blood pressure
 - Combination therapy may be more effective
- PCI or thrombolytic therapy

RV infarct

- Fluids and Dobutamine (no NTG)

Acute mitral regurgitation or VSD

- Pressors (Dobutamine and Nitroprusside)

On occasion an intra aortic balloon pump

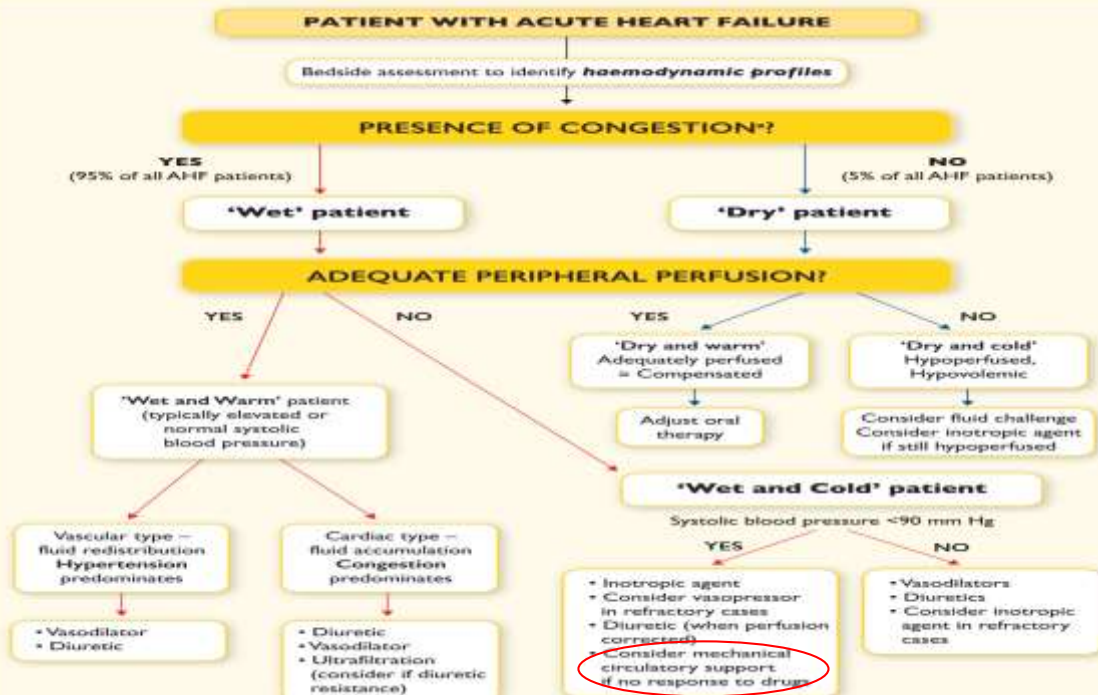
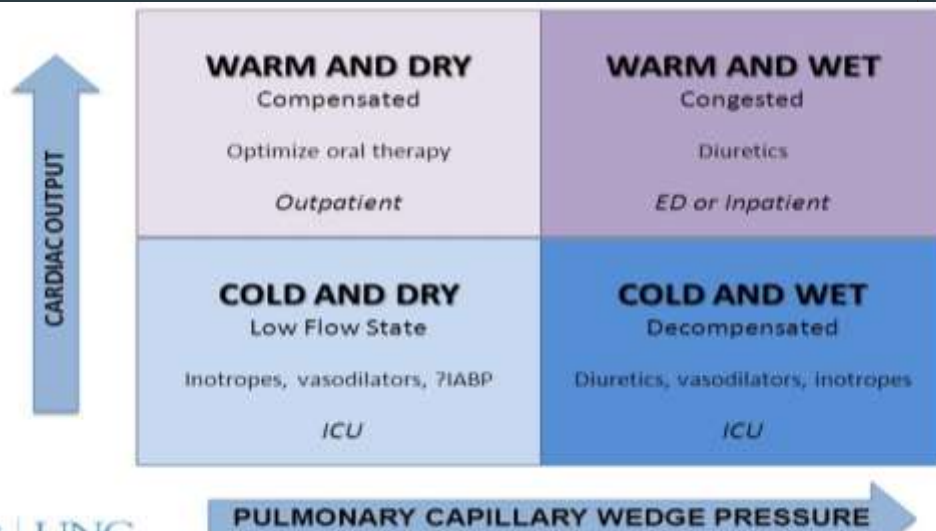
Thought and consideration must be given to the family and friends

Trends in Managing Acute MI Complicated by Cardiogenic Shock: National Registry of Myocardial Infarction, 1995 to 2004

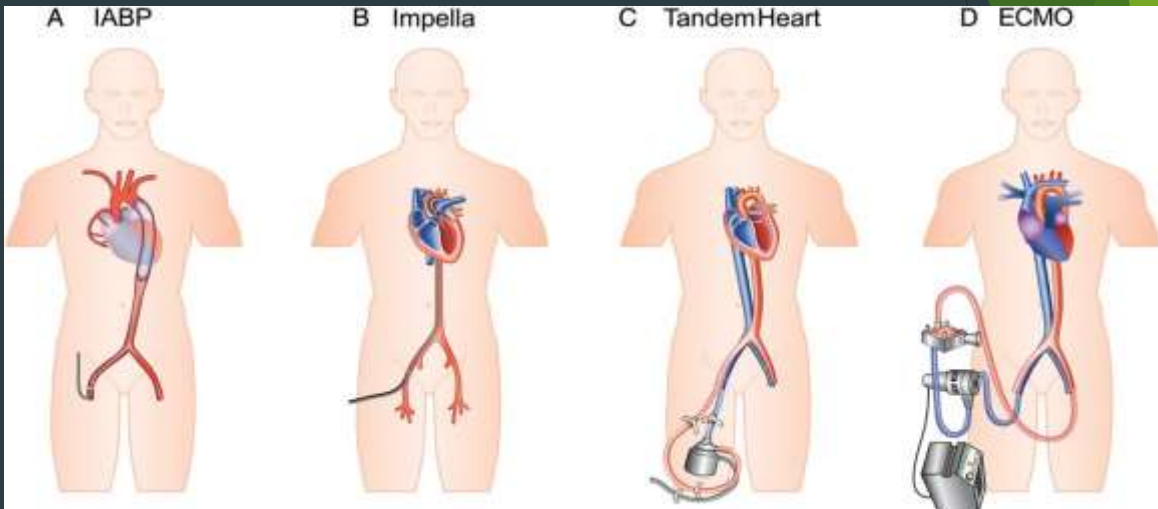
	1995	2004
Cardiac catheterization (%)	51.5	74.4
Intra-aortic balloon pump use (%)	39.2	39.2
Fibrinolytic therapy (%)	19.9	5.6
Percutaneous coronary intervention		
Primary (%)	27.4	54.4
Total (%)	34.3	64.1
Coronary artery bypass graft surgery (%)	11.5	8.8

Source: Cardiosource © 2006 by the American College of Cardiology Foundation

Decompensated Heart Failure



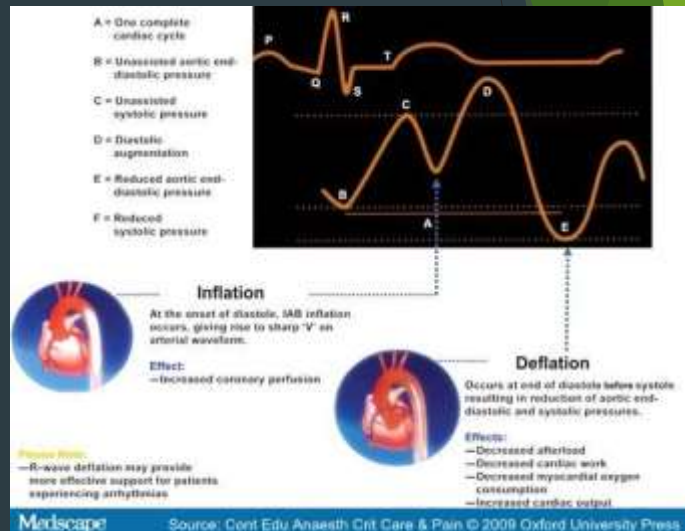
Peripheral Ventricular Assist Devices



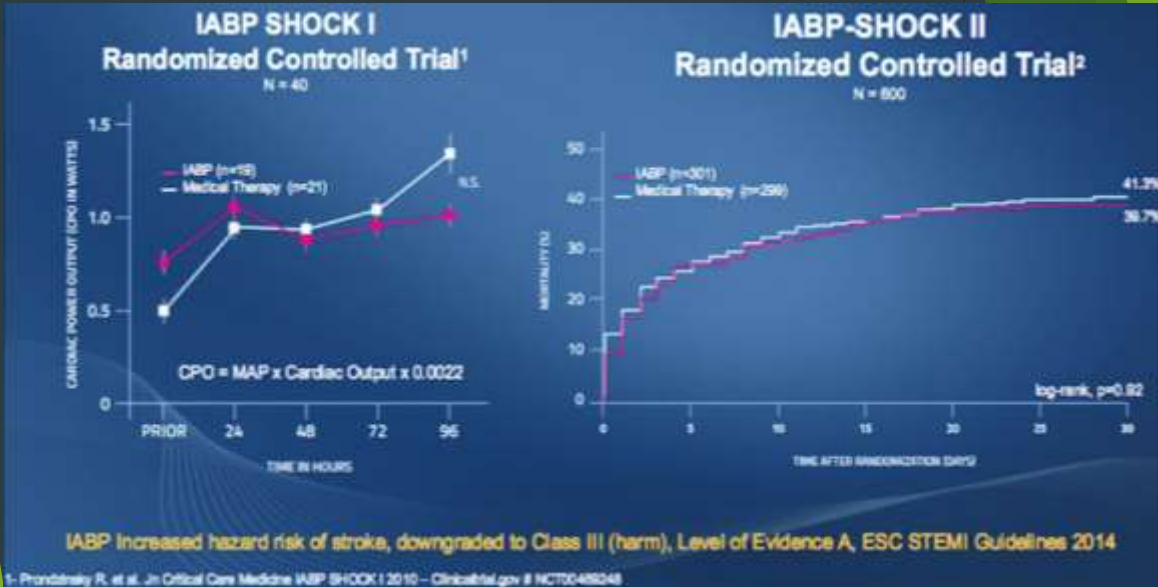
(A) Intra-aortic balloon counterpulsation; (B) The Impella is inserted percutaneously and positioned across the aortic valve in the left ventricle; (C) The TandemHeart ventricular assist device, which is placed in the left ventricle using a trans-septal cannula; (D) The venous access is connected to an extracorporeal membrane oxygenation (ECMO) system with an integrated centrifugal pump and membrane oxygenator (artificial lung) and connected to the arterial inflow access. From Werdan et al.³ With permission.

IABP intra-aortic balloon pump

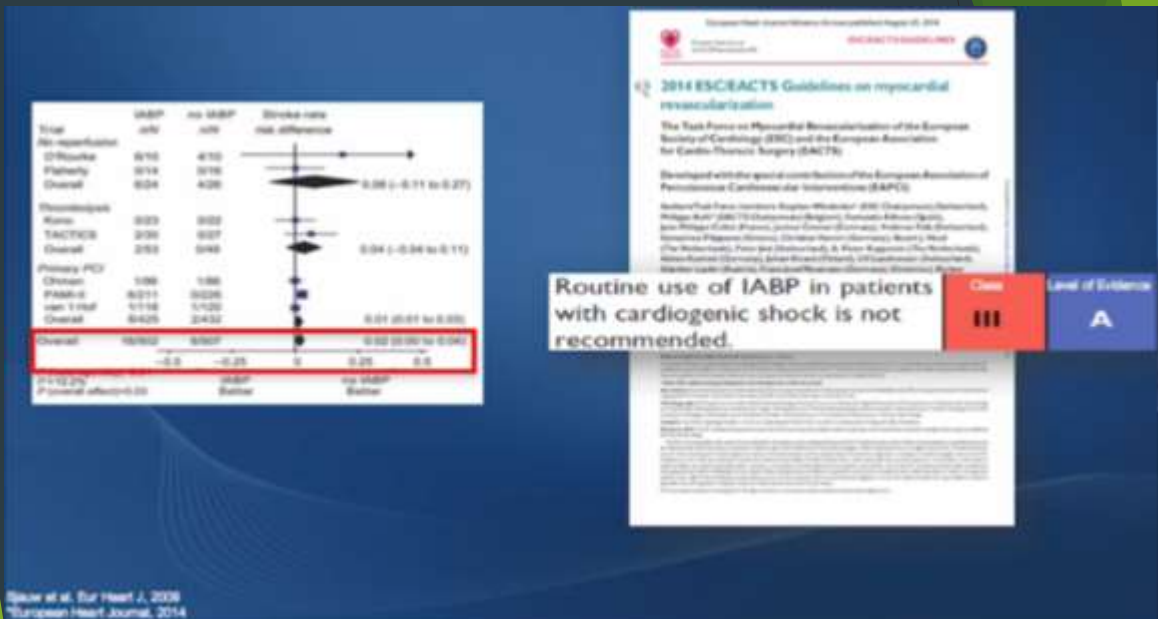
- ▶ placed in the emergency department (ED) for Support during high-risk percutaneous coronary intervention (PCI) or as a bridge to coronary artery bypass grafting (CABG).
- ▶ To decrease myocardial workload and to improve end-organ perfusion.



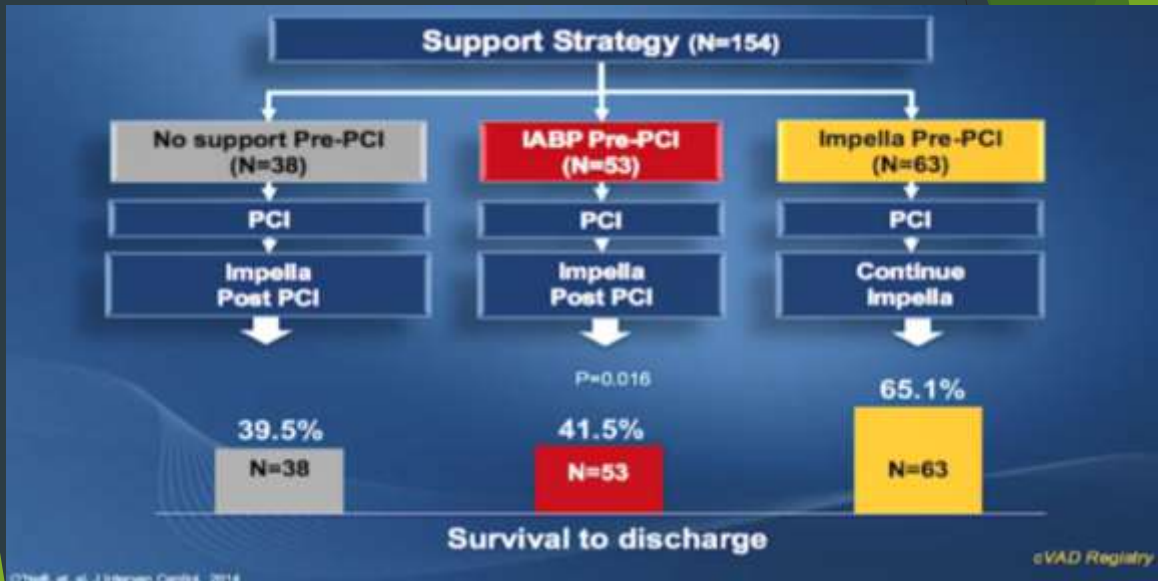
IABP in AMI Cardiogenic Shock: No Hemodynamic or Survival Benefit



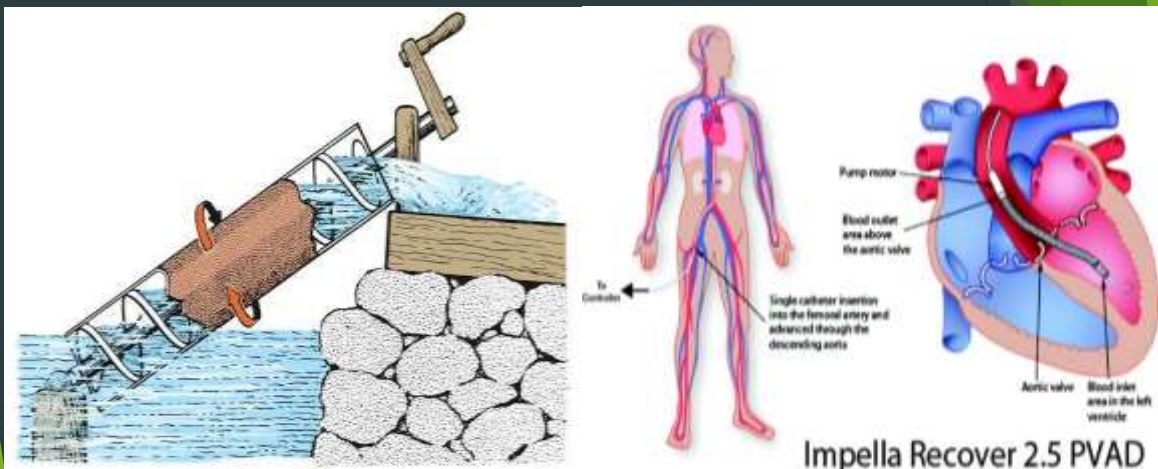
Higher Stroke with IABP in AMI Cardiogenic Shock



Clinical outcomes by support strategy

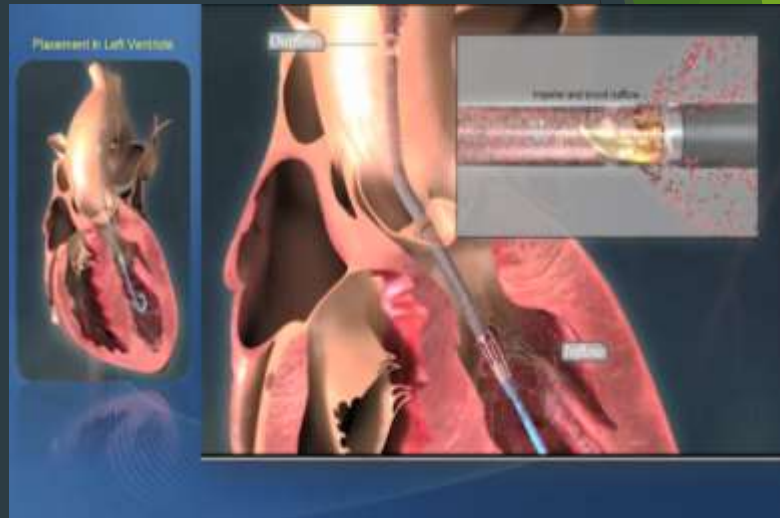


Archimedes Screw: Is Impella the Future of Mechanical Circulatory Support?

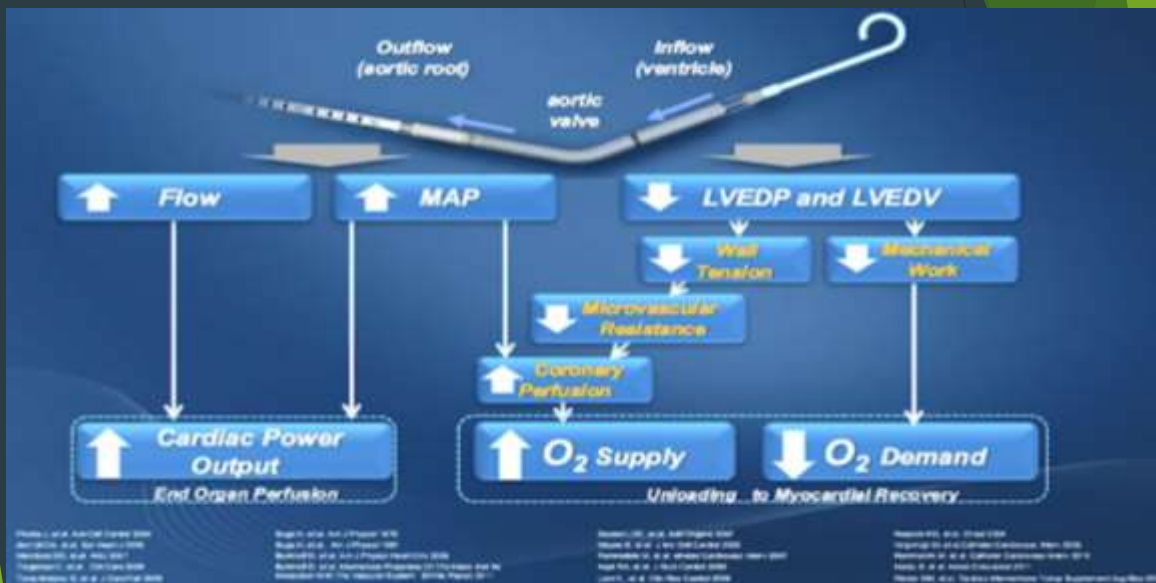


Axial Flow Catheter (Impella)

- ▶ A motor drive in the device rotates at a maximum speed of 51,000 rpm, drawing blood out of the left ventricle.
- ▶ Impella 2.5
- ▶ Impella CP
- ▶ Impella 5.0



Hemodynamic Effects of Impella Support



Clinical Society Guidelines for Impella Therapy

Clinical Society Guideline Populations (SCAI, ACCF, HFSA, STS, ISHLT, HRS)	Class	Latest Update	FDA Approval
PCI in Cardiogenic Shock	I	2013	2016
Multi-organ failure, Cardiogenic Shock	I	2013	2016
PCI in Low Ejection Fraction, Complex CAD	Iib	2011*	2015
Bridge to Recovery or Decision, Cardiogenic Shock	Iia	2013	2016
STEMI and Cardiogenic Shock	Iib	2013	2016
STEMI and Urgent CABG	Iia	2013	2016
Acutely Decompensated Heart Failure	Iia	2012	TBD
Consensus Document on Hemodynamic Support	N/A	2015	2015/16

** Categories referencing Impella include Percutaneous LVAD, PVAD, Non-durable MCS, TCS and percutaneous MCSO
* Excludes Protect II Randomized Controlled Trial, and FDA PMA approval studies due to timing of available data in 2011

Impella Reduces Need for Inotropes/Pressors

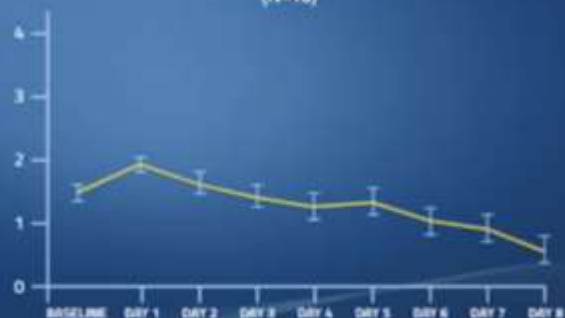
Impella 2.5 Reduction in Inotropes/Pressors in 24 Hours

ISAR-SHOCK RCT¹
N=25



Impella 5.0 Reduction in Inotropes/Pressors Over days

RECOVER I FDA IDE Study²
(N=16)

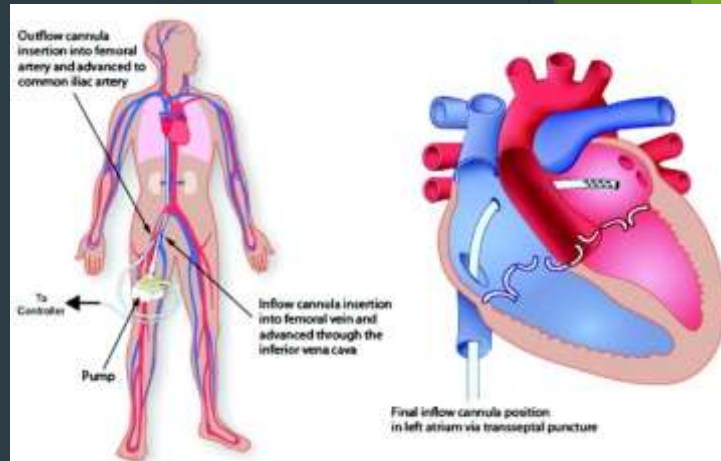


1- Beyersdt et al. JACC 2008
2- Griffith et al. J Thorac Cardiovasc Surg 2012

TandemHeart pVAD

- ▶ Provides short-term support from a few hours up to 14 days.
- ▶ The system provides localized anticoagulation to the blood inside the pump, reducing the need for systemic anticoagulation.

The TandemHeart™ Percutaneous Ventricular Assist Device (pVAD)



ECMO Extracorporeal Membrane Oxygenation

Advantages

- ▶ Can be placed percutaneously anywhere
- ▶ Provides full heart and lung support
- ▶ Allows for bridge to decision

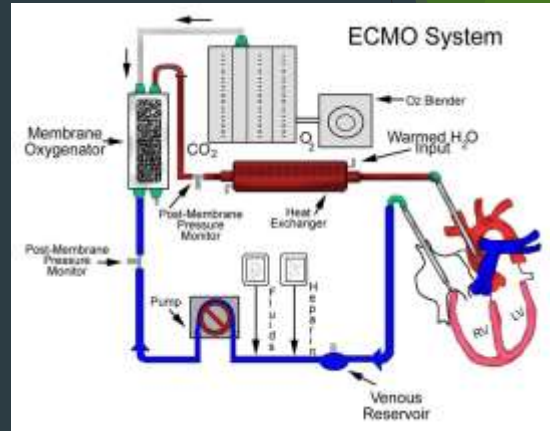
Disadvantages

- ▶ Must be removed surgically
- ▶ Need trained staff to monitor and adjust 24 hrs/day while on support
- ▶ Have increased bleeding and vascular complications

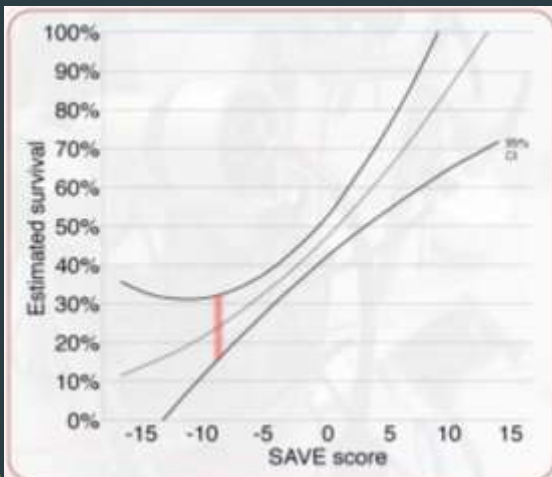


ECMO Extracorporeal Membrane Oxygenation

- ▶ Using a large international cohort of 3846 patients treated with ECMO for cardiogenic shock
- ▶ Based on the findings, the SAVE-score and its online calculator ([http://www.save-score.com](#)) offer a validated tool to predict survival for patients receiving ECMO for refractory cardiogenic shock.



SAVE Survival After Veno-arterial ECMO



Diagnosis: Myocarditis
 Refractory VT/VF
 Post heart or lung transplantation
 Congenital heart disease
 Other diagnosis

Age (years):
 15-28
 29-42
 43-62
 63-82
 83-101
 102-120
 121-140
 141-160
 161-180
 181-200
 201-220
 221-240
 241-260
 261-280
 281-300
 301-320
 321-340
 341-360
 361-380
 381-400
 401-420
 421-440
 441-460
 461-480
 481-500

Weight (kg):
 <40
 40-45
 45-50
 50-55
 55-60
 60-65
 65-70
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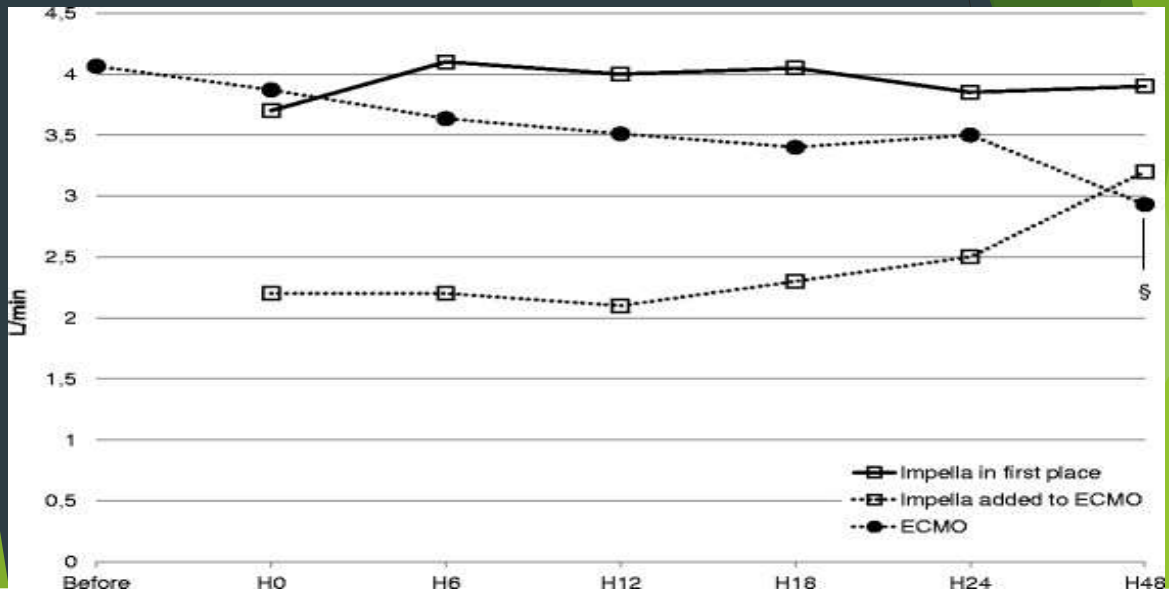
Cardiac:
 Pulse pressure pre ECMO <20 mmHg
 Diastolic BP pre ECMO <40 mmHg
 Pre-ECMO cardiac arrest

Respiratory:
 Peak inspiratory pressure >20 cmH₂O
 Intubation duration pre ECMO (>72h)

Renal:
 Acute renal failure
 Chronic renal failure
 HCO₃ pre ECMO <15 mmol/L

Other organ failures pre ECMO:
 Central nervous system dysfunction
 Liver failure

Impella added to ECMO



Soft robot helps the heart beat Sleeve attaches directly around the heart

The soft robotic sleeve twists and compresses in synch with a beating heart, augmenting cardiovascular functions weakened by heart failure.

The device may one day be able to bridge a cardiogenic shock patient to transplant.



In vivo demonstration of cardiac assist in a porcine model of acute heart failure

Key Points

- ▶ Cardiogenic shock is a life threatening condition, and a growing clinical challenge in daily practice.
- ▶ Conventional therapeutic approach using inotropic support with or without IABP has not improved outcomes.
- ▶ Establish protocols for early identification, early support, and changing the focus to myocardial recovery for better outcomes and quality of life.
- ▶ Impella is the Future of Mechanical Circulatory Support with FDA approval in cardiogenic shock.
- ▶ SAVE score is important to estimate Survival After Veno-arterial ECMO

Thank You

