

## DO WE NEED CIRCULATORY ASSIST DEVICES AFTER PPCI FOR STEMI WITH CARDIOGENIC SHOCK?



• David Kettles  
St Dominics and Frere Hospitals  
East London, ZA

### CARDIOGENIC SHOCK

Myocardial contractile dysfunction results in  
inadequate end-organ (tissue) perfusion:


Clinical manifestations: cool peripheries, oligo-  
anuria, altered mentation

Persistent hypotension

CI <1.8 l/min/m<sup>2</sup> (2.2 l/min)

Adequate/elevated filling pressures (PCWP 15-18)

STEMI commonest cause



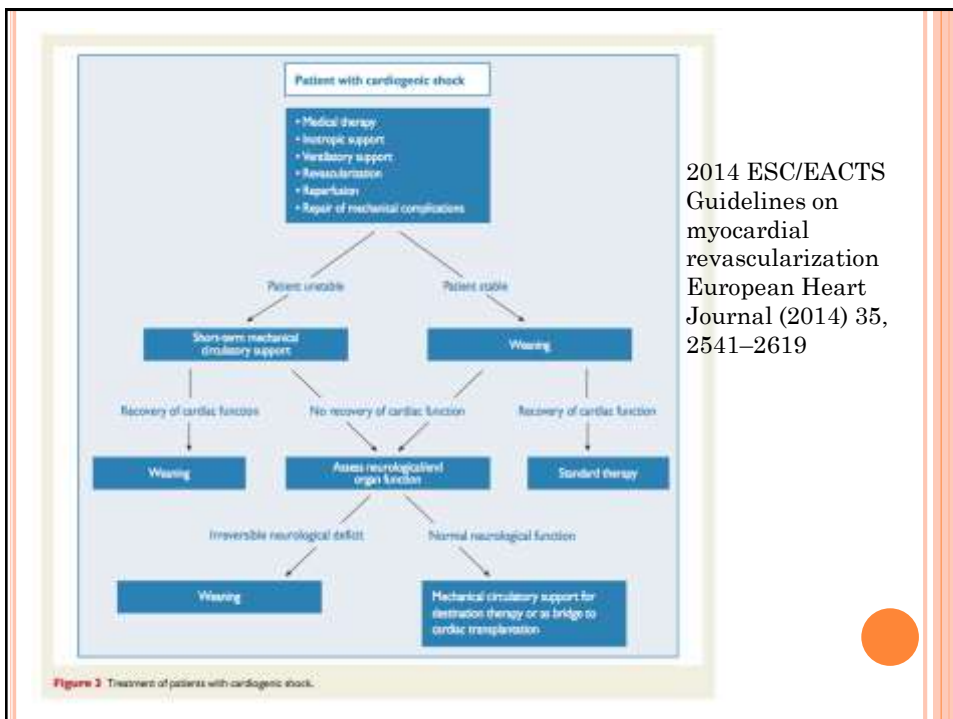
## CS IN STEMI: WHO AND HOW?

STEMI: around 4-8% develop cardiogenic shock  
(NSTEMI around 2%)

50% 3 vessel disease, 15% LMS disease

Worst outcome in vein graft STEMI

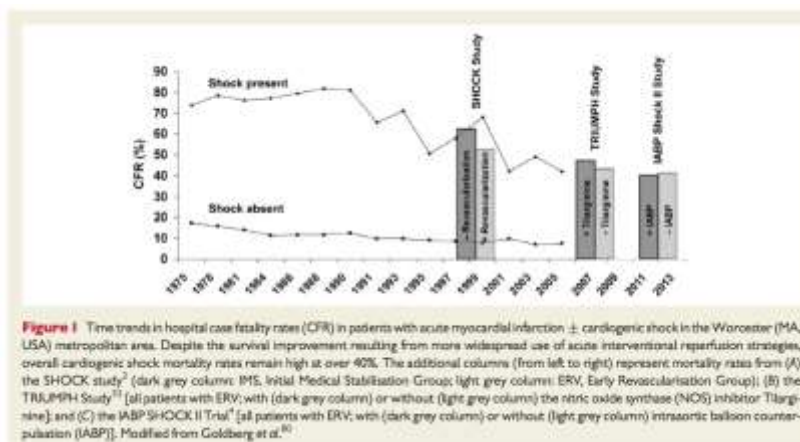
In STEMI CS patients: LV failure in about 80%,  
(rest are mechanical complications: mitral  
regurgitation with papillary muscle rupture,  
septal rupture and free wall rupture)



## WHAT IS THE BEST TREATMENT?

# Timeous reperfusion of the infarct related artery

## CASE FATALITY RATES ARE DECLINING:



Werdan, Gielan, et al. E H J (2014) 35, 156–167

## CAN WE PREDICT THE OUTCOME?

- Markers of MODS (eg APACHE score) and
- Biomarkers of SIRS (eg IL6, RAGES)
  - Better predictor of outcome than haemodynamics
- Fixing haemodynamics may not work unless we can reverse the multi-organ dysfunction and systemic inflammatory responses.



## WHY PURSUE MECHANICAL RESCUE?

- Inotropes, and vasopressors at best are palliative treatments that counteract low cardiac output and poor peripheral perfusion
- Mortality benefit? Some agents may increase mortality.
- Arrhythmias/vasoconstriction etc...



## IF WE WILL USE A MECHANICAL DEVICE, WHAT SHOULD IT BE LIKE?

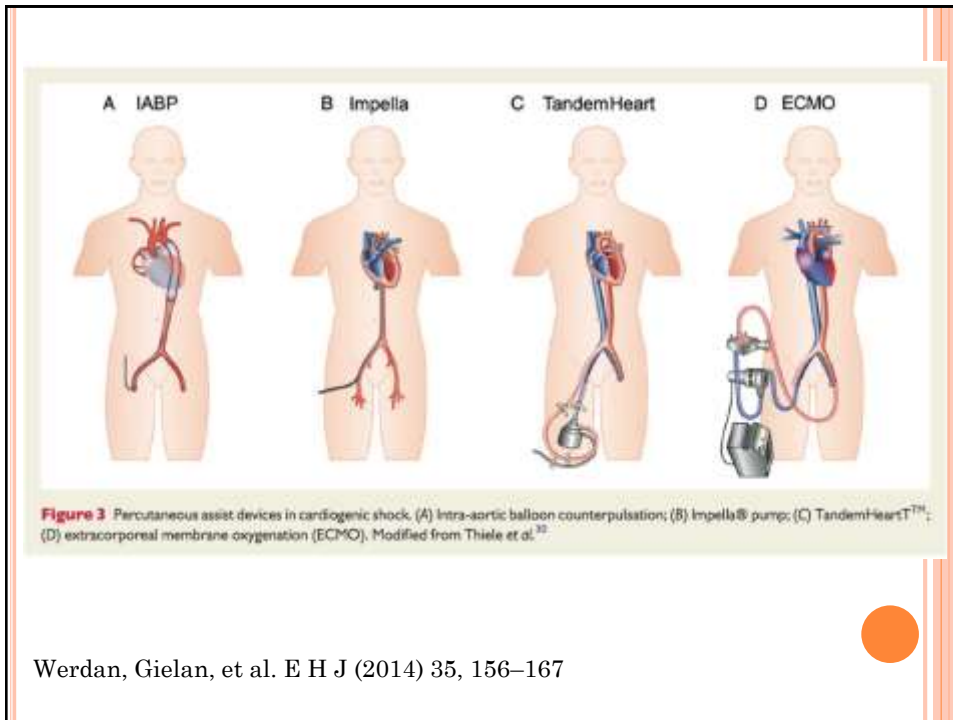
- Percutaneous implant (acute emergency)
- Haemodynamic support
- Myocardial protection
- Low complication risk
  - Limb ischaemia
  - Embolisation
  - Haemorrhage
  - Infection
  - Haemolysis



## CATEGORY OF MECHANICAL SUPPORT:

- Pressure unload the LV: IABP
- Volume unload the LV: impella/tandem heart
- Biventricular support: eg modified tandem heart for RV, and LV device (Impella)
- BiV support with oxygenation:ECMO





Werdan, Gielan, et al. E H J (2014) 35, 156–167

## MECHANICAL ASSIST DEVICES

	IABP	ECMO	TandemHeart
Pump mechanism	Pneumatic	Centrifugal	Centrifugal
Cannula size	7.9 Fr	18–21 Fr inflow; 15–22 Fr outflow	21 Fr inflow; 15–17 Fr outflow
Insertion technique	Descending aorta via the femoral artery	Inflow cannula into the right atrium via the femoral vein, outflow cannula into the descending aorta via the femoral artery	21 Fr inflow cannula into left atrium via femoral vein and transeptal puncture and 15–17 Fr outflow cannula into the femoral artery
Haemodynamic support	0.5 – 1.0 L min <sup>-1</sup>	>4.5 L min <sup>-1</sup>	4 L min <sup>-1</sup>
Implantation time	+	++	+++
Risk of limb ischaemia	+	+++	+++
Anticoagulation	+	+++	+++
Haemolysis	+	++	++
Post-implantation management complexity	+	+++	++++
Optional active cooling in post-cardiopulmonary resuscitation patients	No	Yes	(Yes)

Table from Werdan, Gielan, et al. E H J (2014) 35, 156–167

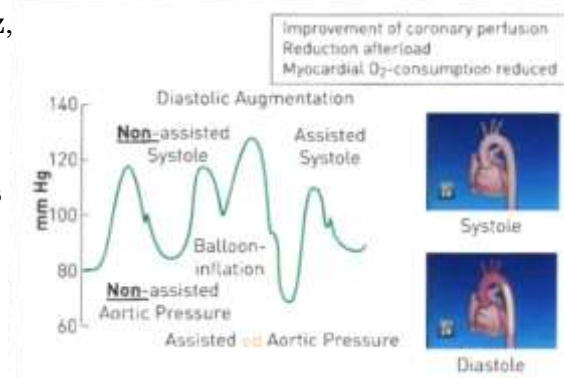
## MECHANICAL ASSIST DEVICES

	Impella 2.5	Impella 5.0
Pump mechanism	Axial flow	Axial flow
Cannula size	13 Fr	22 Fr
Insertion technique	12 Fr catheter placed retrogradely across the aortic valve via the femoral artery	21 Fr catheter placed retrogradely across the aortic valve via a surgical cutdown of the femoral artery
Haemodynamic support	2.5 L min <sup>-1</sup>	5.0 L min <sup>-1</sup>
Implantation time	++	++++
Risk of limb ischaemia	++	++
Anticoagulation	+	+
Haemolysis	++	++
Post-implantation management complexity	++	++
Optional active cooling in post-cardiopulmonary resuscitation patients	No	No

Table from Werdan, Gielan, et al. E H J (2014) 35, 156–167

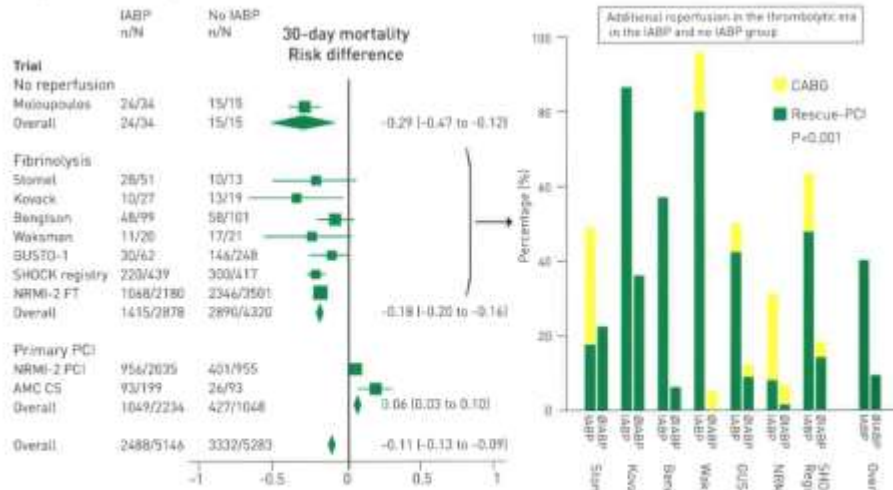
## INTRA-AORTIC BALLOON PUMP

- Dr Adrian Kantrowitz, late 1960's
- Initially used by surgeons
- Still used by surgeons



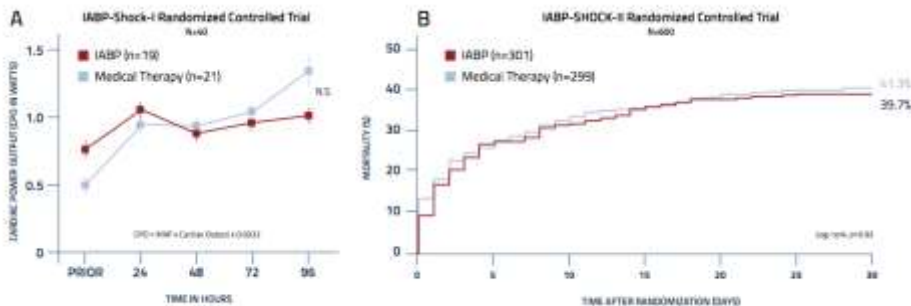
The PCR-EAPCI textbook

## THE PROBLEM WITH IABP



The PCR-EAPCI textbook

## THE PROBLEM WITH IABP



Prondzinsky R, Unverzagt S, Russ M, et al, *Shock*. 2012;37(4):378-384.  
 Thiele H, Zeymer U, Neumann FJ, et al, *Lancet*. 2013;382(9905):1638-1645.



## IABP SHOCK II

- 600 patients, with STEMI and cardiogenic shock, randomized to IABP or no IABP
- Primary endpoint: 30 day mortality, 39.7 vs 41.3%, no significant difference
- No long term benefit either.



## ESC guideline for revascularisation, 2014

IABP insertion should be considered in patients with haemodynamic instability/cardiogenic shock due to mechanical complications.	<b>IIa</b>	<b>C</b>	
Patients with mechanical complication after acute myocardial infarction require immediate discussion by the Heart Team.	<b>I</b>	<b>C</b>	
Short-term mechanical circulatory support in ACS patients with cardiogenic shock may be considered.	<b>IIb</b>	<b>C</b>	
Percutaneous repair of VSD may be considered after discussion by the Heart Team.	<b>IIb</b>	<b>C</b>	
Routine use of IABP in patients with cardiogenic shock is not recommended.	<b>III</b>	<b>A</b>	332,333

## IMPELLA

Microaxial flow pump capable of delivering 2.5-5 lpm of blood flow

Pigtail at the tip stabilised device, across Ao V in the LV

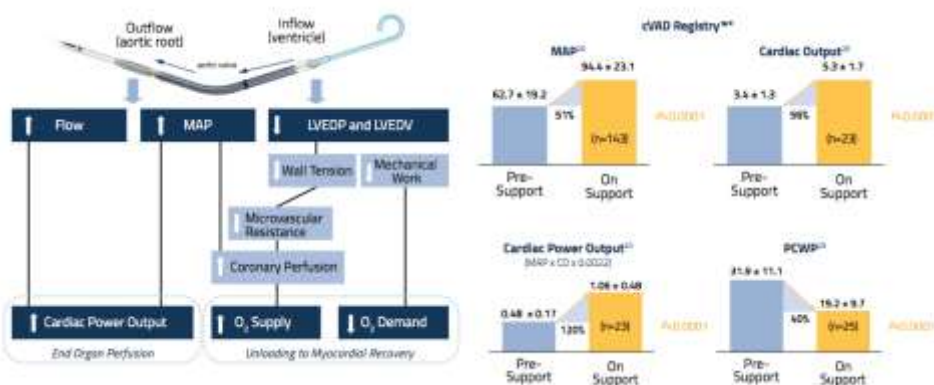
Better haemodynamic support than IABP.

Approved CE mark and FDA: no incentive for further research

Recover II: stopped - funding/recruitment



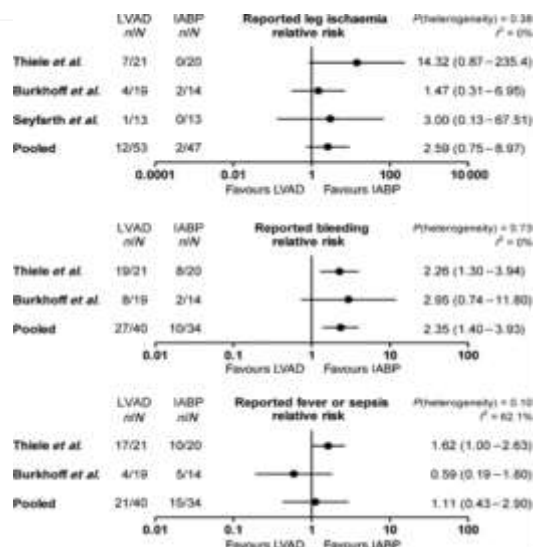
## PRINCIPLES OF IMPELLA DESIGN



## TANDEM HEART

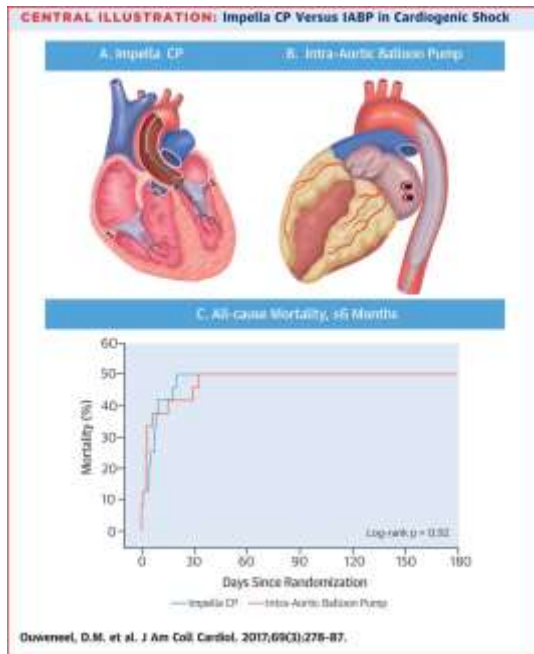
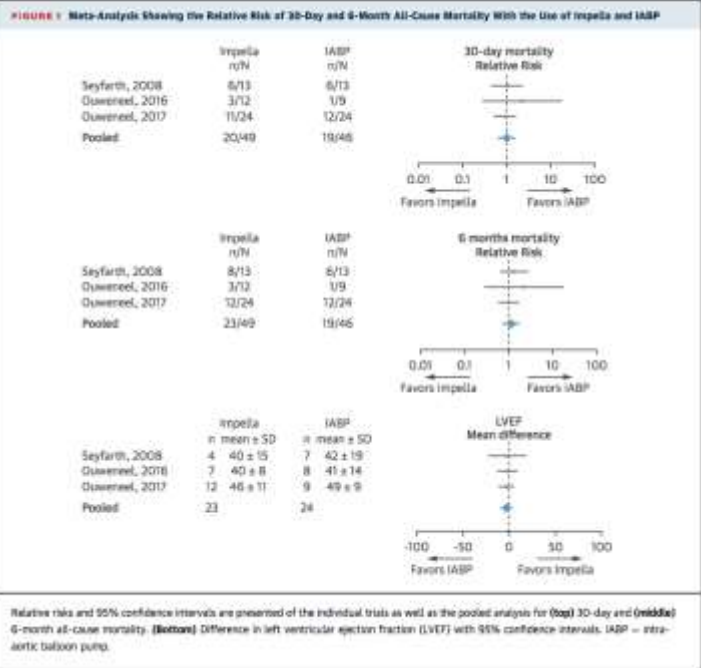
- Up to 4 lpm, centrifugal pump
- Oxygenated blood aspirated from LA, delivered to aorta
- The challenges of device insertion (21G transeptal catheter) may preclude true emergency usage

## Percutaneous LVAD vs. IABP for CS



Relative risk of adverse events





## ECMO

- Similar to cardiopulmonary bypass circuit used at surgery
- V-A ECMO provides circulatory support and oxygenation: pump + oxygenator
- Requires a machine at the bedside, Large bore A and V cannulae, full heparinisation and a perfusionist (Technician)
- Mainly used for CV collapse in the cath lab
- Approximately 25% survival rate in such patients, resuscitated
- Has been lifesaving for numbers of patients, but no big mortality studies



## ECMO

- Retrospective case comparison:
  - 219 pats treated between 2002-2009 with CS, MI, PPCI, compared with historical controls: 115 patients treated between 1993 and 2002:
  - 30-day survival was 60% compared with 35%
- European STEMI guidelines: LVAD Class 2b for refractory cardiogenic shock
- Revasc guidelines: consider ECMO for temporary support in patients who continue to deteriorate despite IABP



## ARE THERE LIMITATIONS TO WHAT WE KNOW?

YES

Subgroups may benefit

Time of initiation may make a difference

(eg Impella before revascularisation)

Remember: haemodynamics improve, complications are an issue

More likely solution: addition of other therapies may provide more holistic approach, and thus better outcomes to a multi-organ illness



## CONCLUSION

- Perhaps we are driven to implant devices because of the intuitive comfort of adding an additional active treatment to a patient with an extremely poor outcome
- Very high mortality in this patient group, even after intervention
- Mechanical support in Cardiogenic shock related to myocardial infarction cannot be a budgetary priority in low resource countries



THANK YOU.

