KATHOLIEKE UNIVERSITEIT
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LV unloading in Cardiogenic Shock (with or without ECMO)

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ECMO in Acute Cardiogenic Shock

The advantage of ECMO:

- ECMO = the first choice acute shock treatment
  - Immediate restauration of hemodynamics
  - Oxygenation
  - Technical ease
  - Bedside deployment
  - Transportability

- Bridge to decision

Outcome - indications – ELSO Registry

Extracorporeal Life Support Organization Registry International Report 2016

Thiagarajan, Ravi R.; Barbaro, Ryan P.; Rycus, Peter T.; Mcmullan, D. Michael; Conrad, Steven A.; Fortenberry, James D.; Paden, Matthew L.; on behalf of the ELSO member centers
ASAIO Journal63(1):60-67, 2017.

	No. Cases	Survived ECLS, N (%)	Discharged, N (%)
Neonatal			
Respiratory	29,153	24,488 (84)	21, 545 (74)
Cardiac	6,475	4,028 (62)	2,695 (42)
ECPR	1,336	859 (64)	547 (41)
Pediatric			
Respiratory	7,552	5,036 (67)	4,371 (58)
Cardiac	8,374	5,594 (67)	4,265 (51)
ECPR	2,996	1,645 (55)	1,232 (41)
Adult			
Respiratory	10,601	6,997 (66)	6,121 (58)
Cardiac	9.025	5,082 (56)	3,721 (41)
ECPR	2,885	1,137 (39)	848 (29)
Total	78,397	54,866 (70)	45,345 (58)

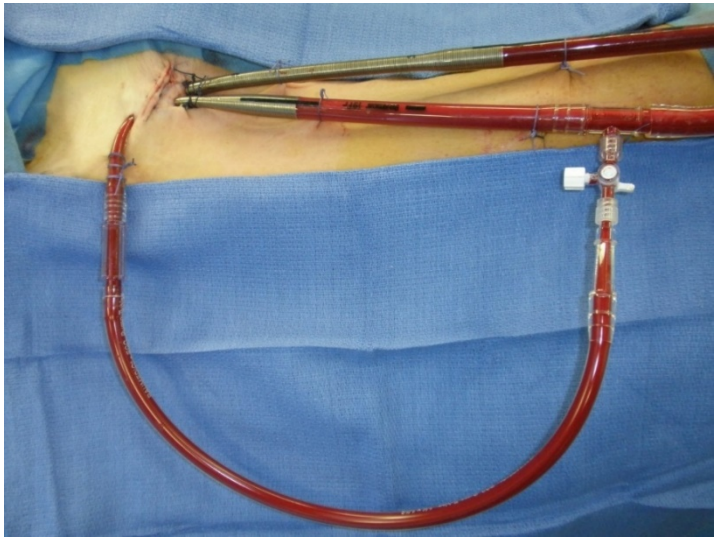
ECLS, extracorporeal life support; ECPR, ECLS to support cardiopulmonary resuscitation.

ASAIO JOURNAL

Incremental Improvements

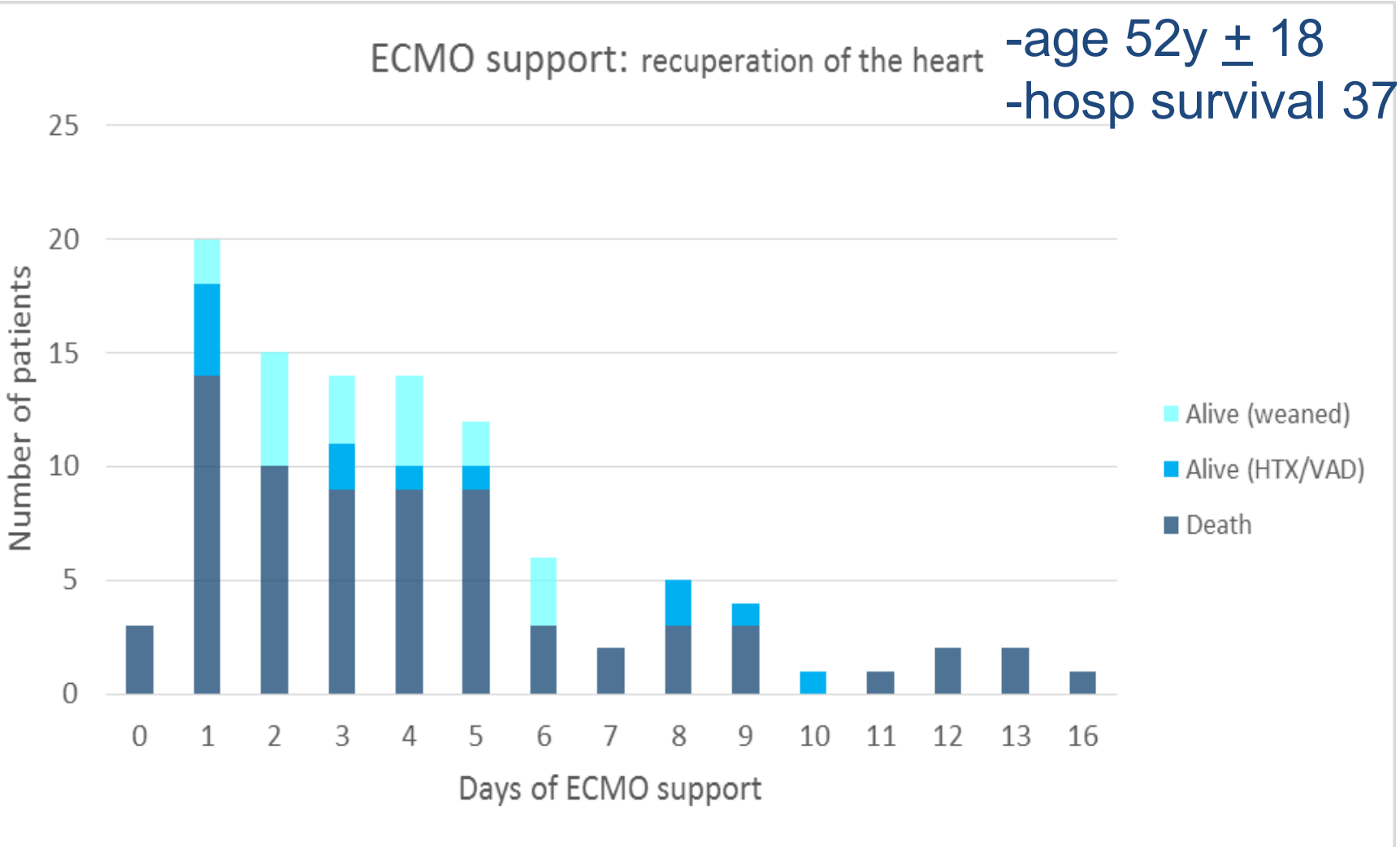
- Subgroup of ischemic –non CPR

- Oxygenators (polymethylpentene)
- Pumps (thrombosis rate, drivers, transportibility)
- Cannula's (less invasive)
- Prevention ischemia limbs (distal perfusion, monitoring)



ECMO for Acute Cardiogenic Shock
(adults)

-2008-2015
-n=102
-age 52y ± 18
-hosp survival 37%



ECMO does not unload the heart

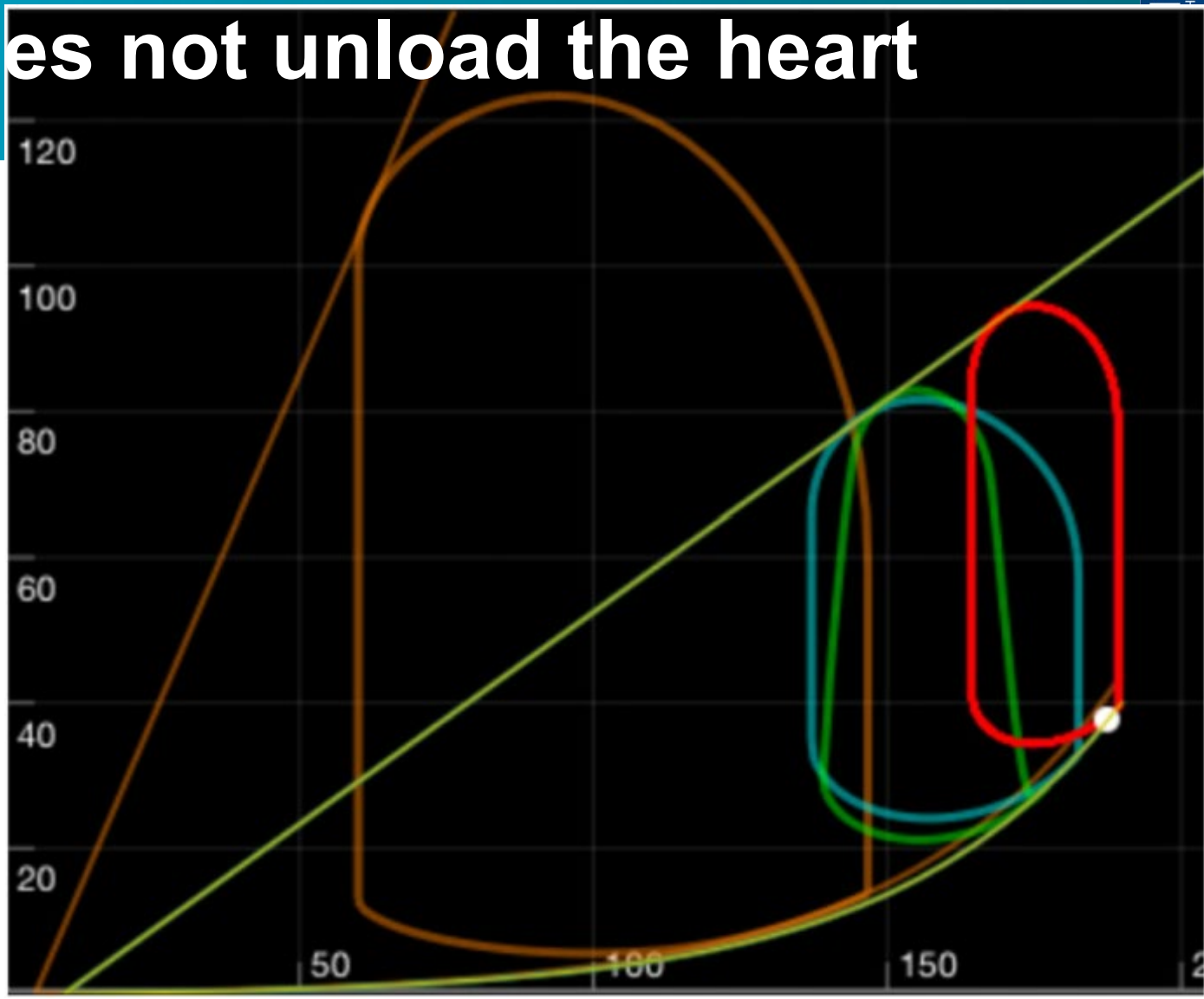


Fig. 3. Pressure–volume loop: Normal conditions (brown), Acute Heart Failure without hemodynamic support (blue), with Impella CP support (green) and with ECMO support (red). The loop area is an estimate of the mechanical work performed by the ventricle. Note the area reduction (work reduction) by the Impella device and the characteristic oblique vertical lines in the latter, indicating continuous emptying of the ventricle even in the “isovolumic” phases.

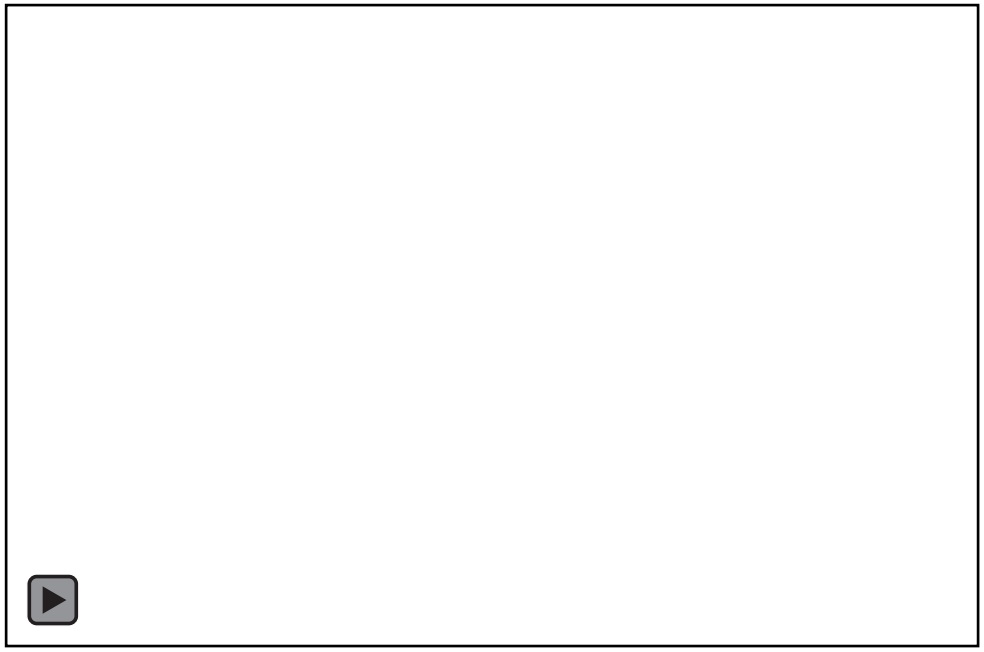
Impella ventricular support in clinical practice: collaborative viewpoint from a European expert user group.
Burzotta et al.
Int J Cardiol 2015

How Unloading Failing LV on ECMO?

- Apical drainage catheter
- Impella
- Pulmonary drainage catheter
- Transaortic drainage catheter
- Patent Foramen Ovale
- Reducing the ECMO flow
- …

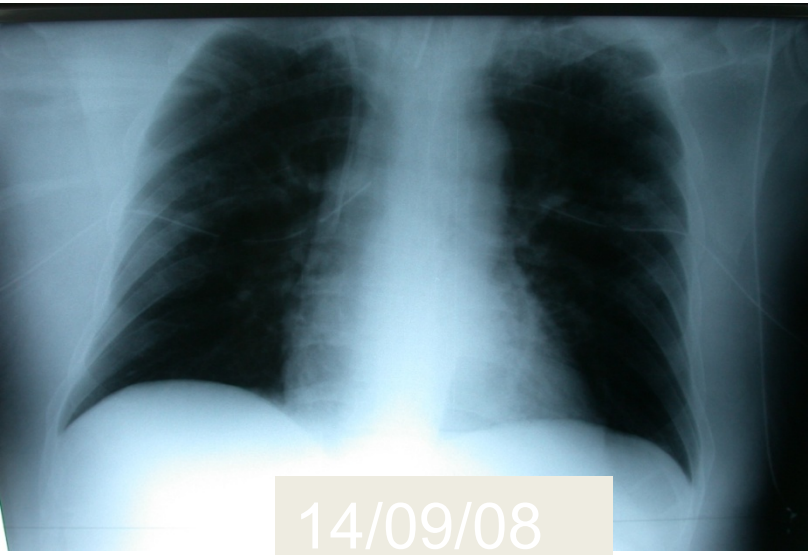
Why unloading in shock ?

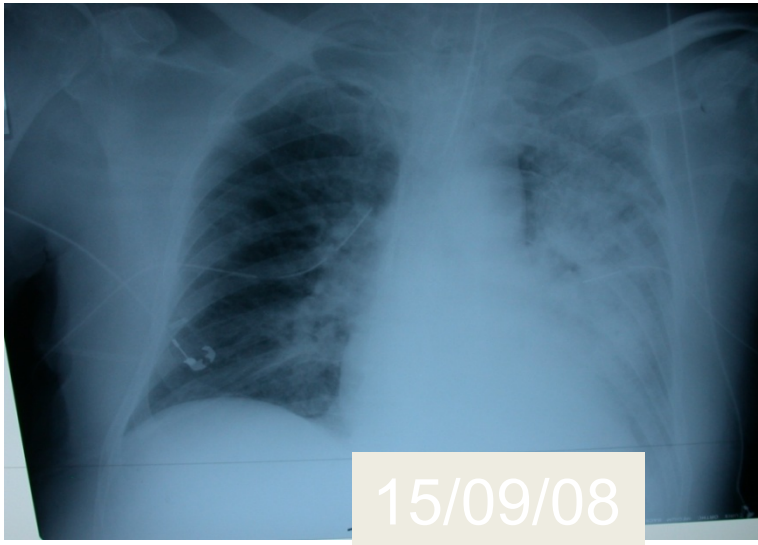
1. To avoid pulmonary congestion
2. To reduce risk for thrombus formation
3. To improve myocardial recovery

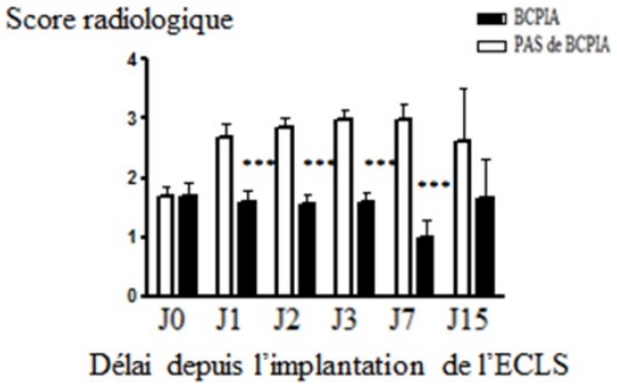


Myocarditis on VA ECMO

1. Avoid pulmonary congestion





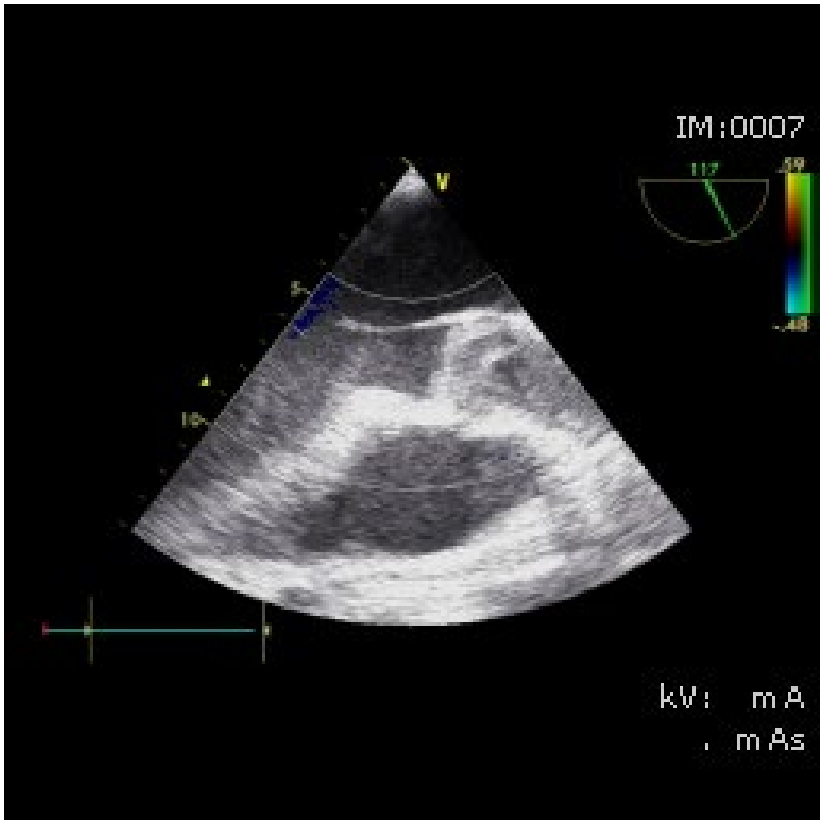


VA ECMO n=90
Cardiogenic shock
With and without IABP

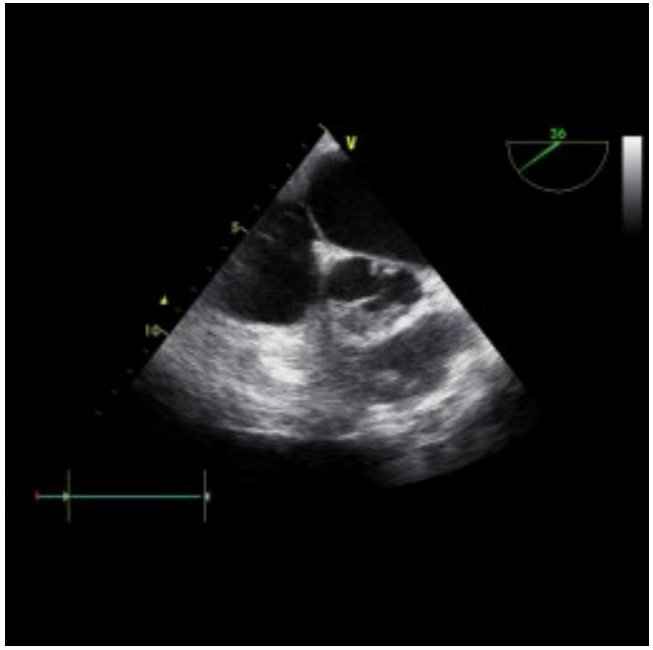
Thesis Dr P Demondion
La Pitié – Paris – Pr. Leprince

2. Reduce risk thrombus formation

-44 y. male
-sudden shock
-VA ECMO + Venting day 3
-Acute myocarditis
-Thrombosed aortic root
-Thrombosed coronaries



-67y male
-AMI – CPR at home
-Emergent VA ECMO
-Apical Venting Catheter



Day 3 on ECMO
Embolized and stroked

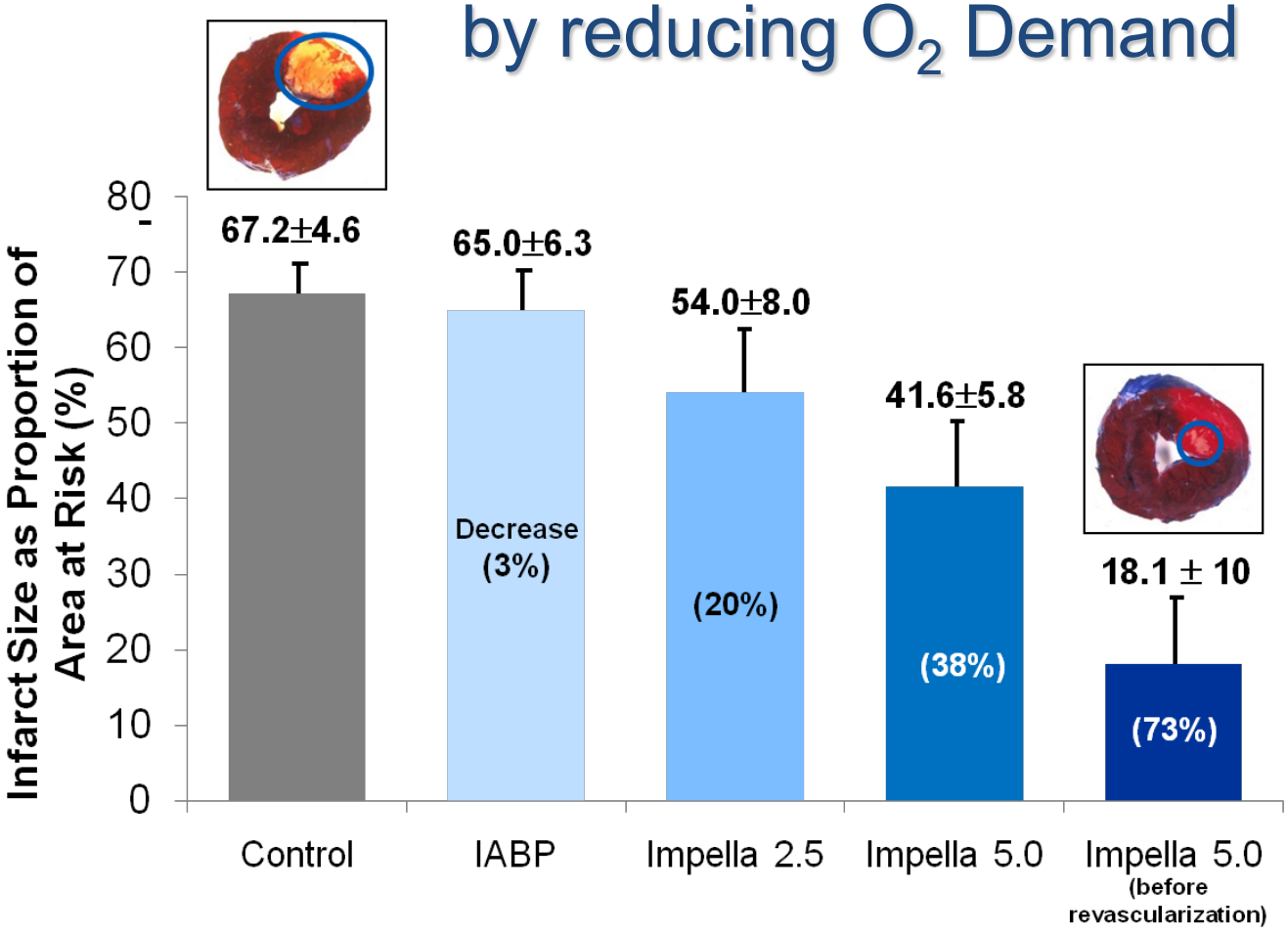
-73y female
-AMI
-Postinfarction VSD - shock
-Corrective surgery, failure to wean
-ECMO + surgical vent

-Improving cardiac function
-Aortic root thrombus

-Insufficient neurologic recovery
-Sepsis

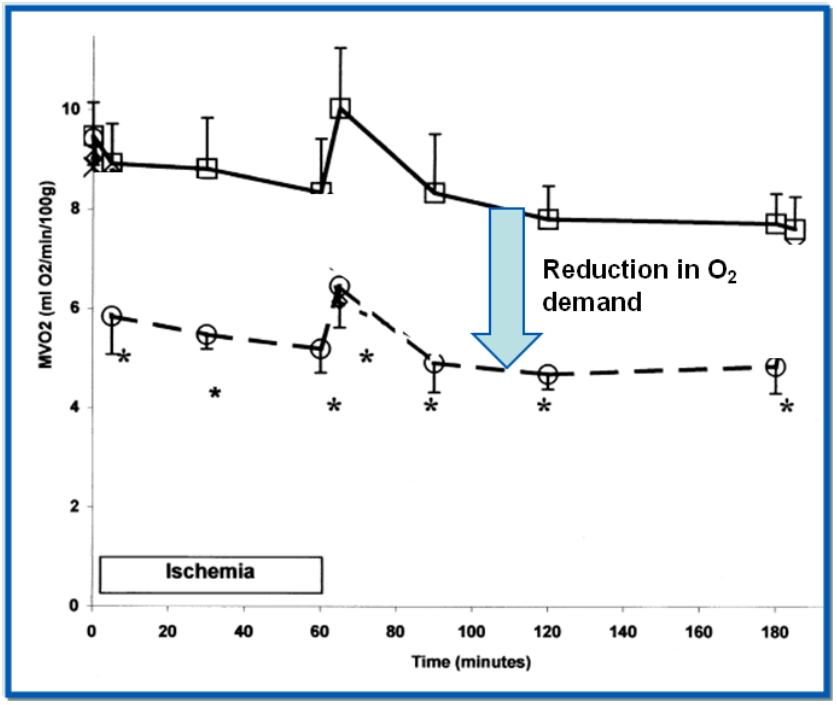
3. Improve myocardial recovery in AMI

Unloading Reduces infarct size by reducing O_2 Demand

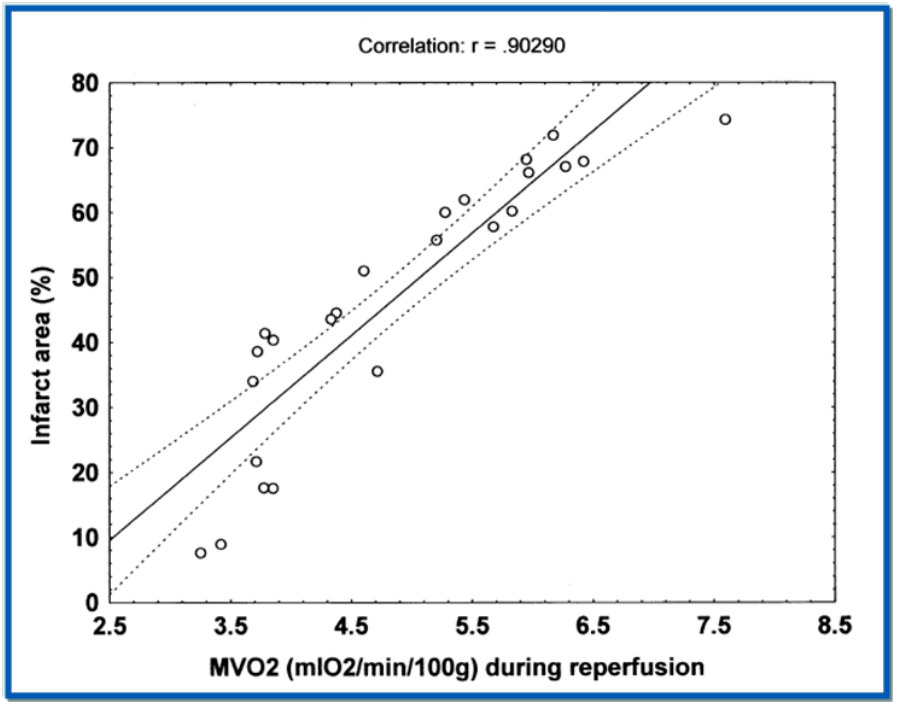


Unloading Reduces O_2 Demand & Infarct Size … Meyns, Stolinski, Leunens et al., JACC,2003

Unloading Reduces infarct size by reducing O_2 Demand



Ventricular unloading during ischemia & reperfusion decreases O_2 demand

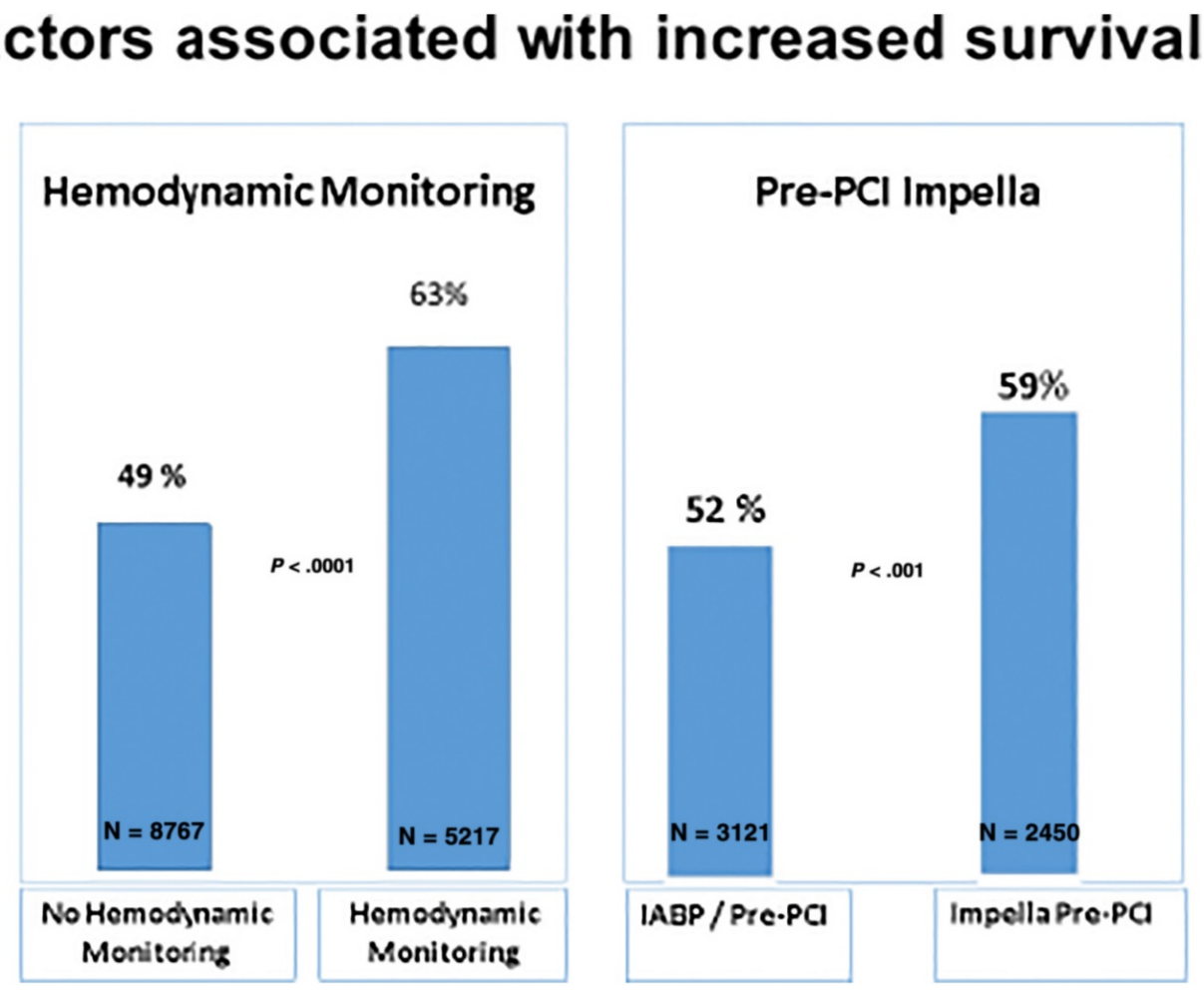


Infarct size correlates with O_2 demand, r = 0.90290

Unloading Reduces O_2 Demand & Infarct Size … Meyns, Stolinski, Leunens et al., JACC,2003

Analysis of outcomes of 15,259 US patients with AMI cardiogenic shock supported with the Impella device.

O'Neill WW, Grines C, Schreiber T et al. Am Heart J 2018



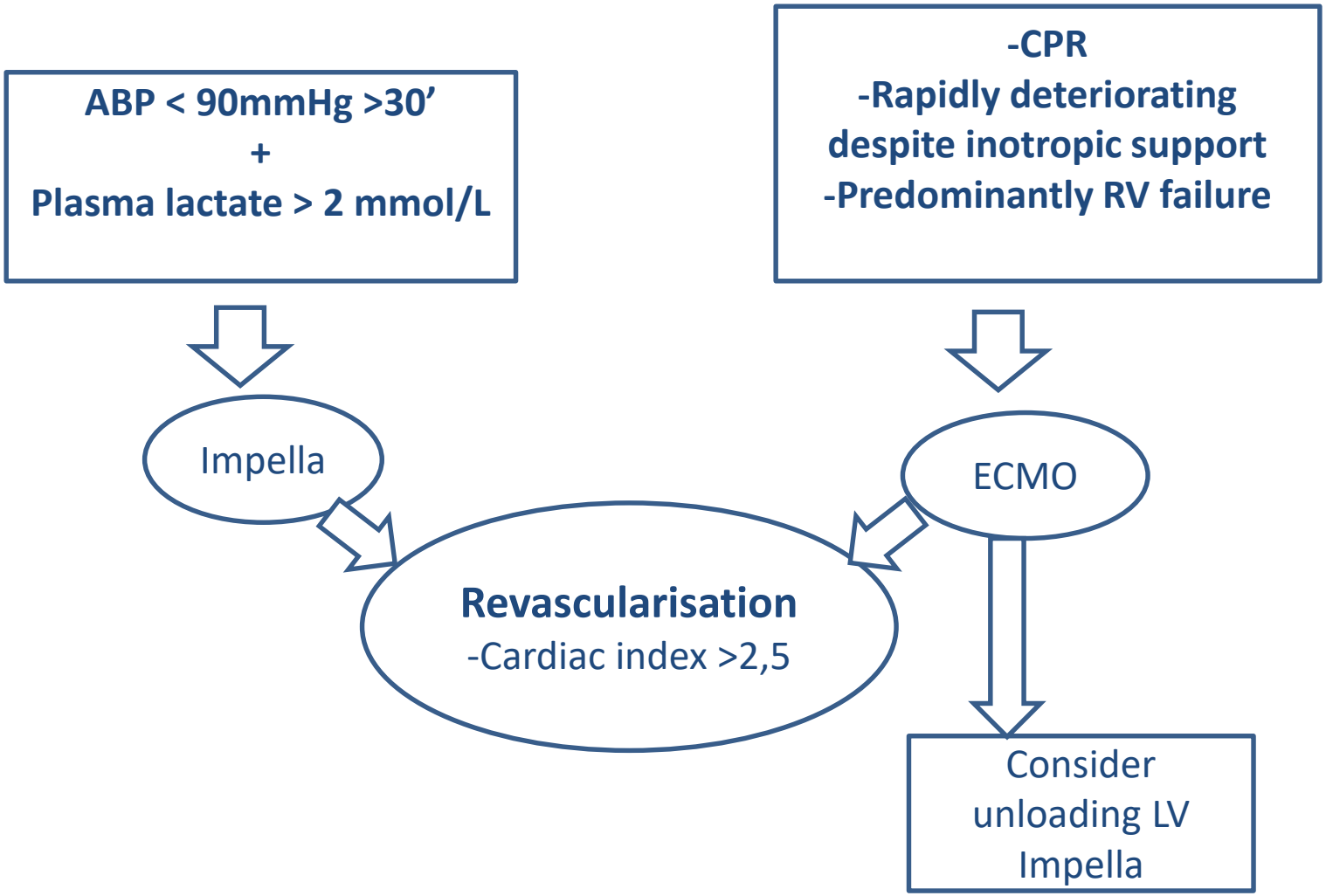
Advantages of Unloading by Impella

- **Unloading reduces pulmonary congestion**
- **Unloading prevents thrombus in LV or AoRoot**
- **In AMI, unloading reduces infarct size**
  - The earlier the better – even before reperfusion
  - The more the better
  - Mechanism = reduction in O2 consumption
- **Allows ECMO wean first, longer support**

Disadvantages of Unloading by Impella

- **Impella only is insufficient support for severe biventricular failure**
  - CPR
  - Predominantly RV failure
- **Need for fluoroscopy (or TEE) for placement**
- **More expensive**

Acute Cardiogenic Shock



Conclusion

- **Personalized approach ECMO ± Impella**
- **Unloading in cardiogenic shock**
  - Avoids pulmonary congestion
  - Reduces risk for thrombus formation
  - Reduces infarct size in AMI
- **Longer support can lead to**
  - Late recovery
  - Bridging to VAD