

Abiomed Workshop, December 9, 2021
BENEFIT OF IMPELLA IN ICU PATIENTS



When to unload the LV? *Quand décharger le VG?*

Philippe GAUDARD

DAR Arnaud De Villeneuve

CHU de MONTPELLIER

PhyMedExp, Université de Montpellier



Conflicts of interest

Consultant fees:

Abiomed

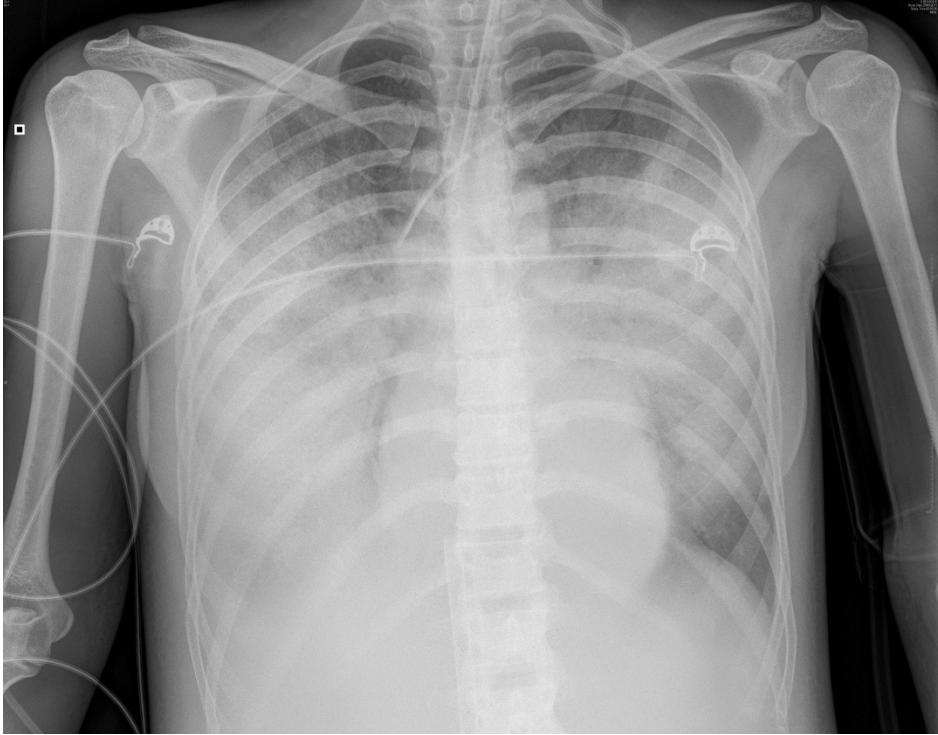
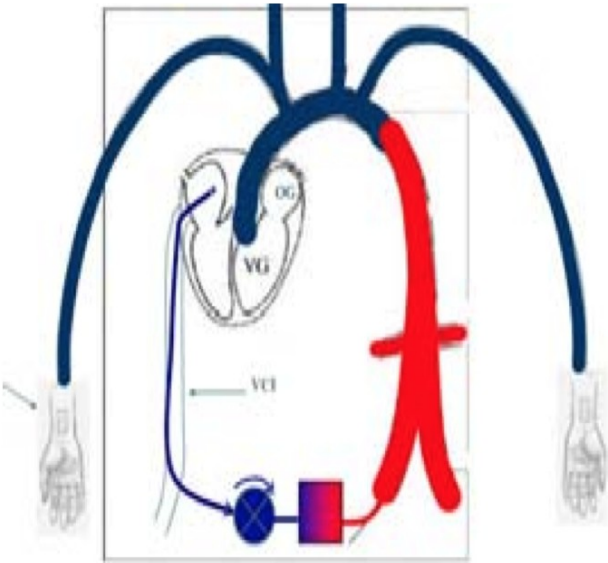
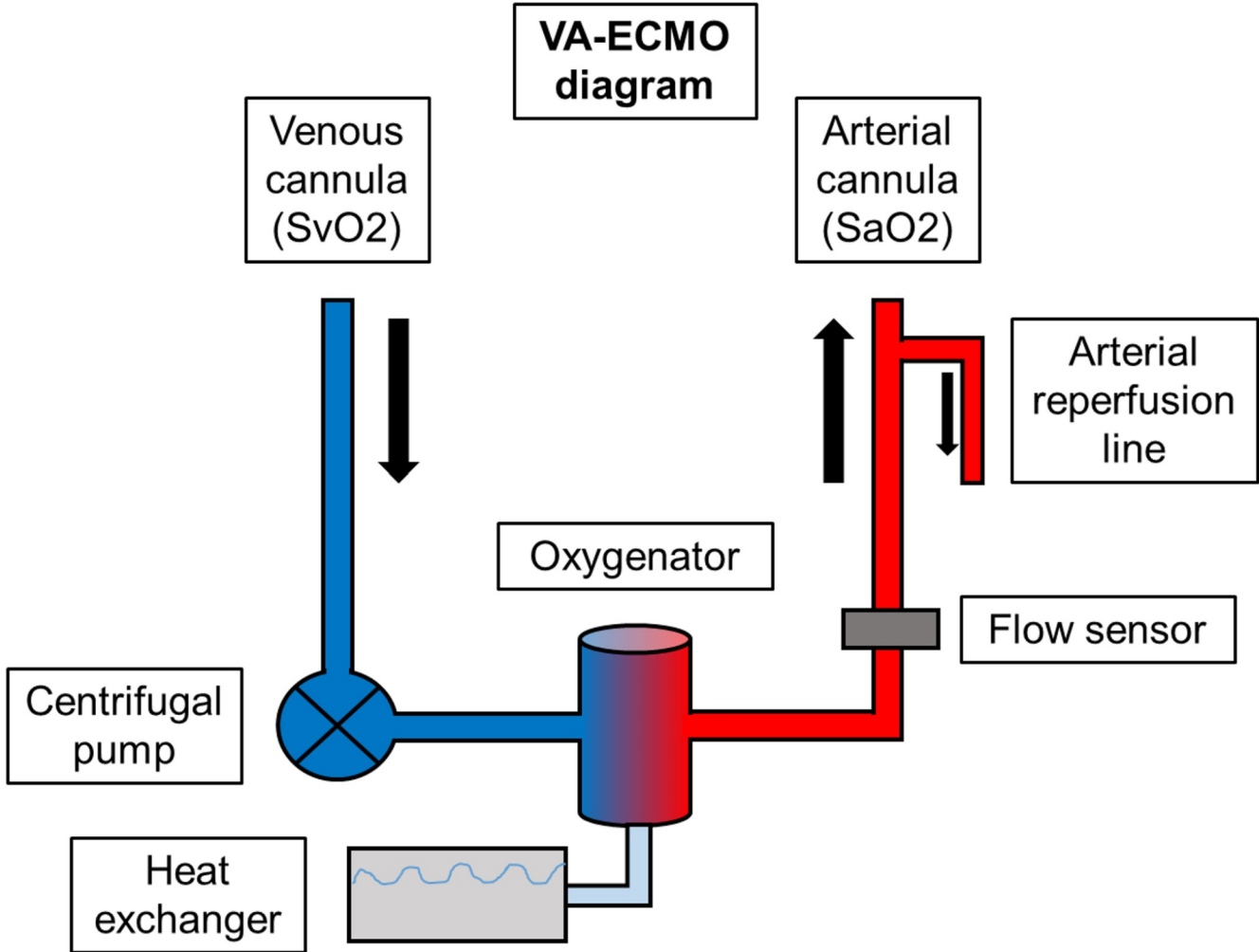
Abbott

Amomed

Nordic

Air Liquide Healthcare

Background



Case report, man 58 yo

DCM (MRI: LVEF 15% & RVEF 15%)

Worsening status 15d

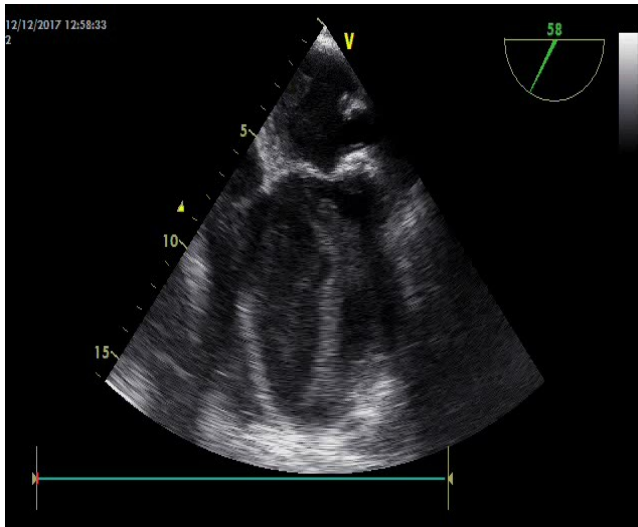
ICU admission: cardiogenic shock

- VTI = 11; CI = 1,8; Lactate 3,6; Creat 150; CRP 350
- Stabilized / Dobu + Norep & referred to CHU
- Abdominal pain +++
- AF with high rate, VT => VA-ECMO as bridge to decision for HT

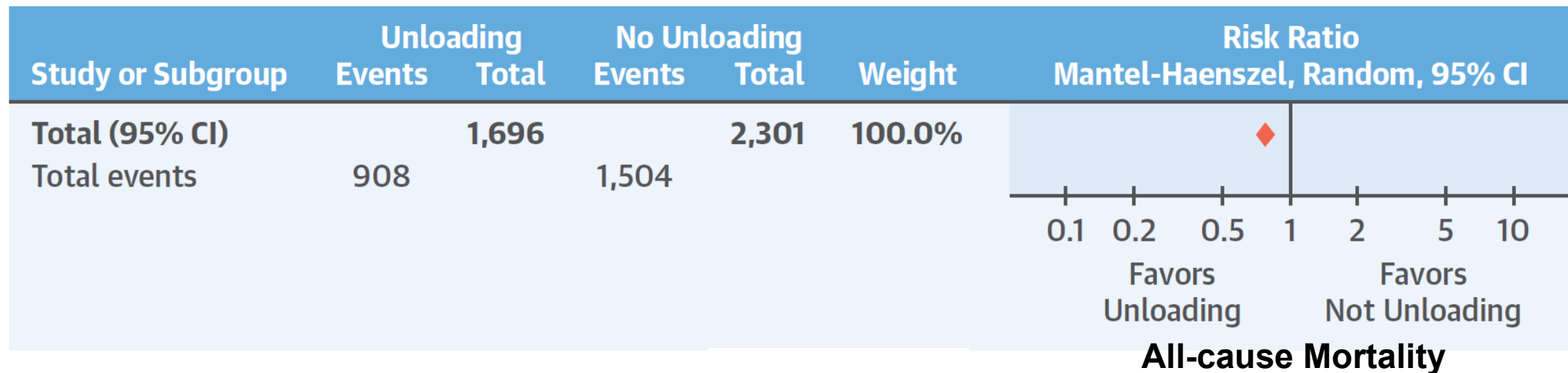
Evolution under VA-ECMO

- Appendicular peritonitis
- Emergency abdominal surgery
- Septic shock (ECMO 6L/Min)
- LV sludge and PAE

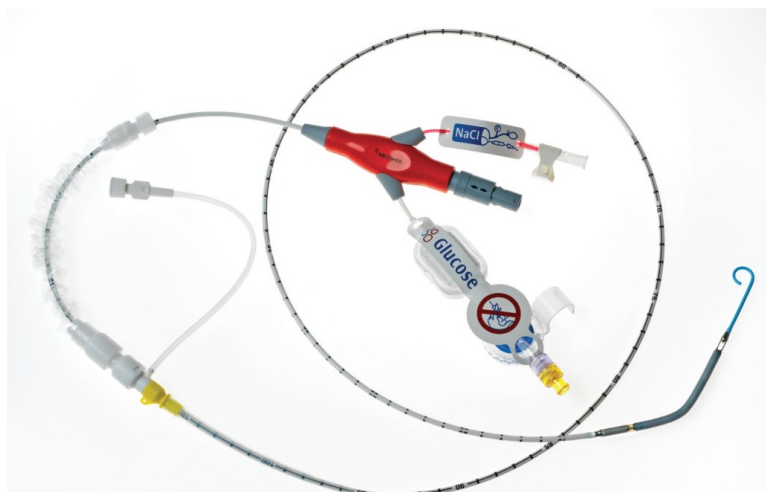
=> Axillary Impella 5.0 at day 2



LV unloading during VA-ECMO



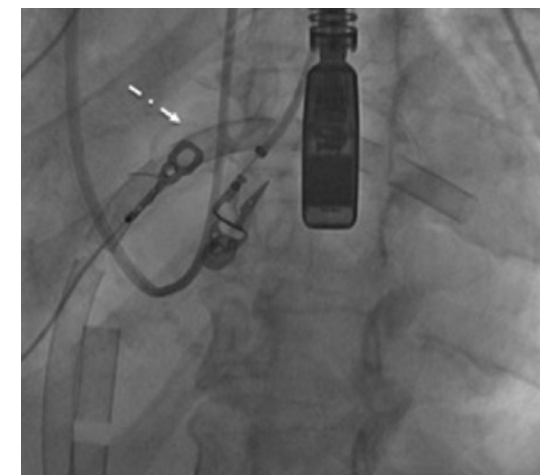
Russo, J.J. et al. J Am Coll Cardiol. 2019;73(6):654-62.



Impella



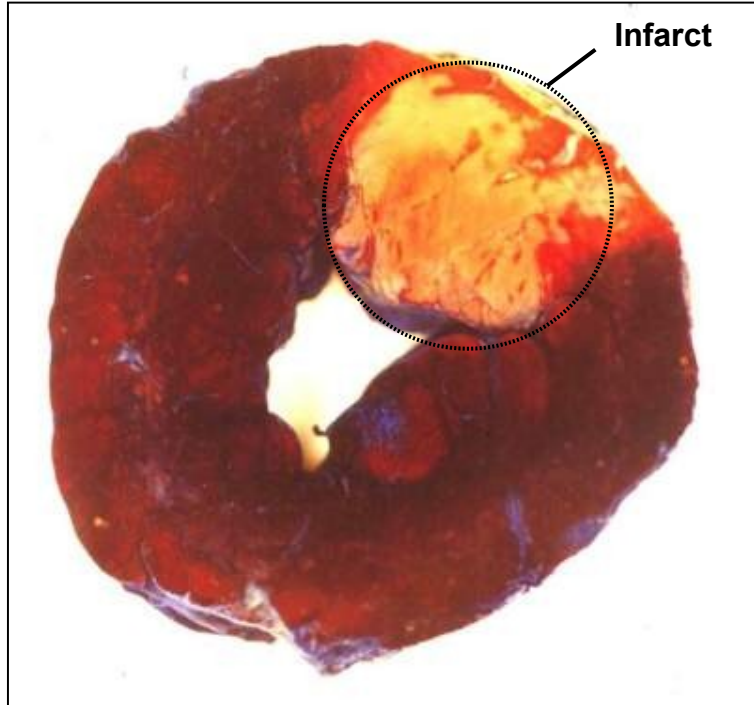
IABP



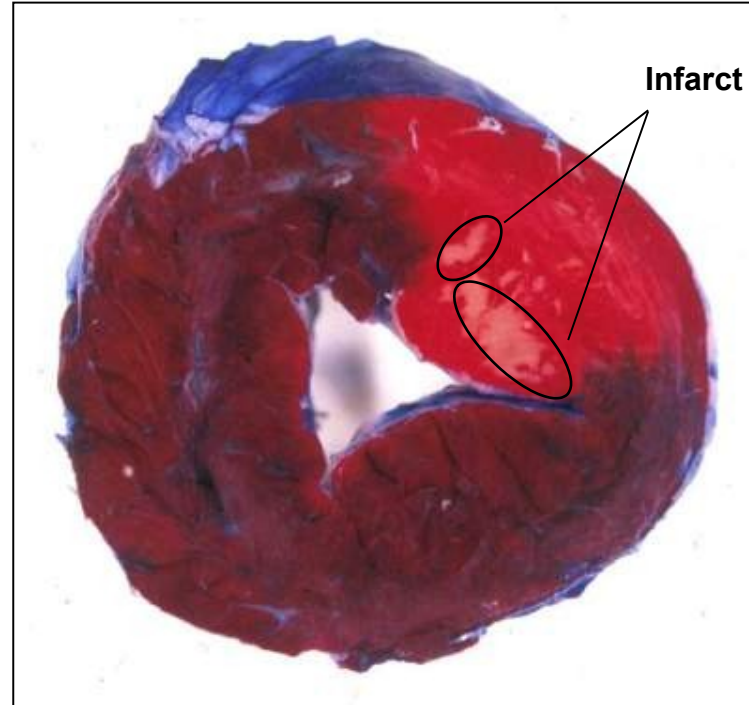
Transseptal LA cannula

Potential Reduction of Infarct Size

LAD occlusion in Animal model



**Without
Impella Support**

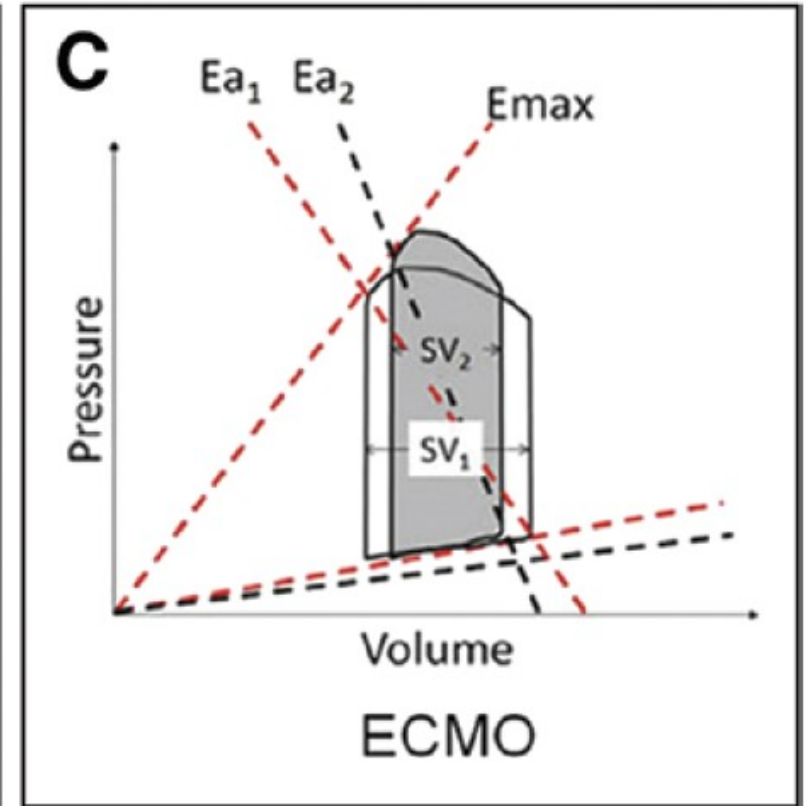
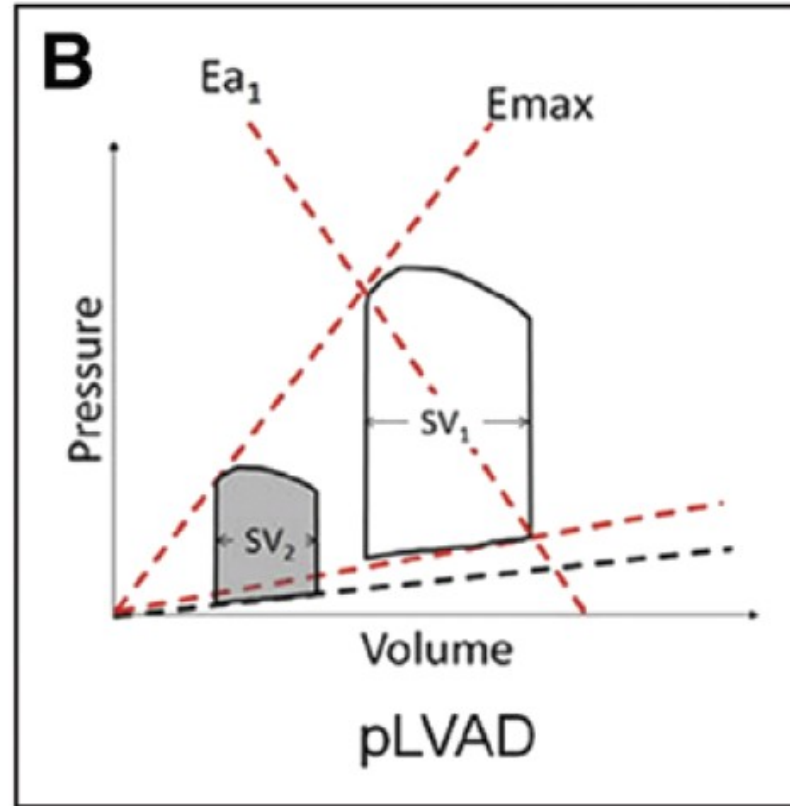
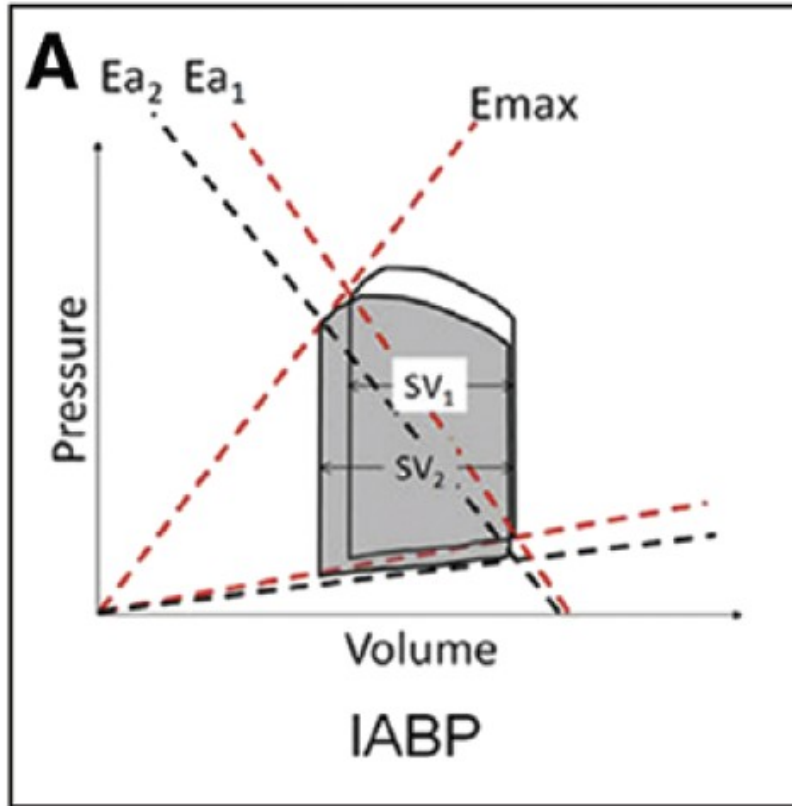


**With
Impella Support**



Impella study – Flameng et al 2000

PV loops during TCS : decrease of cardiac workload by Impella



Advanced Percutaneous Mechanical Circulatory Support Devices for Cardiogenic Shock

P. Elliott Miller, MD¹; Michael A. Solomon, MD^{1,2}; Dorothea McAreavey, MD¹

(*Crit Care Med* 2017; 45:1922–1929)

Unload LV to protect myocardium and enhance myocardial recovery

	Controls (N = 41)	LV-Protect (N = 26)	p
Acute myocardial infarction (N = 67)			
Successful weaning (SW) from TCS at D7 after the end of support	12 (29.3)	16 (61.5)	.009
[SW + discharged from ICU + Alive] at D30	7 (17.1)	13 (50.0)	.004
Mortality D90	30 (73.2)	9 (34.6)	.002

Tableau 3. Facteurs associés à la mortalité à J90

	Univariée		Multivariée	
	Odds Ratio (95% CI)	p	OR-ajusté (95% CI)	p
Age	1.04 (0.99-1.10)	.129	1.04 (0.98-1.10)	0.204
IGS 2	1.01 (0.99-1.03)	.386	-	-
ACR pré-ACMt	0.91 (0.35-2.36)	.841	-	-
Lactate J0 ACMt	1.08 (0.96-1.21)	.191	-	-
SOFA	1.01 (0.87-1.17)	.900	-	-
Score ENCOURAGE	1.06 (0.99-1.13)	.111	-	-
Stratégie LV-Protect	0.30 (0.11-0.80)	.017	0.32 (0.11-0.87)	.025

LV-Protect:

- Within first 48h of TCS
- Mechanical LV unloading (Impella alone or added to VA-ECMO)
- And/or Pharmacological unloading without drugs increasing MVO2 (Levosimendan)

Gaudard, retrospective study. *Abstract SFAR 2019*

Unload LV and restore transpulmonary blood flow

Pulmonary artery catheter

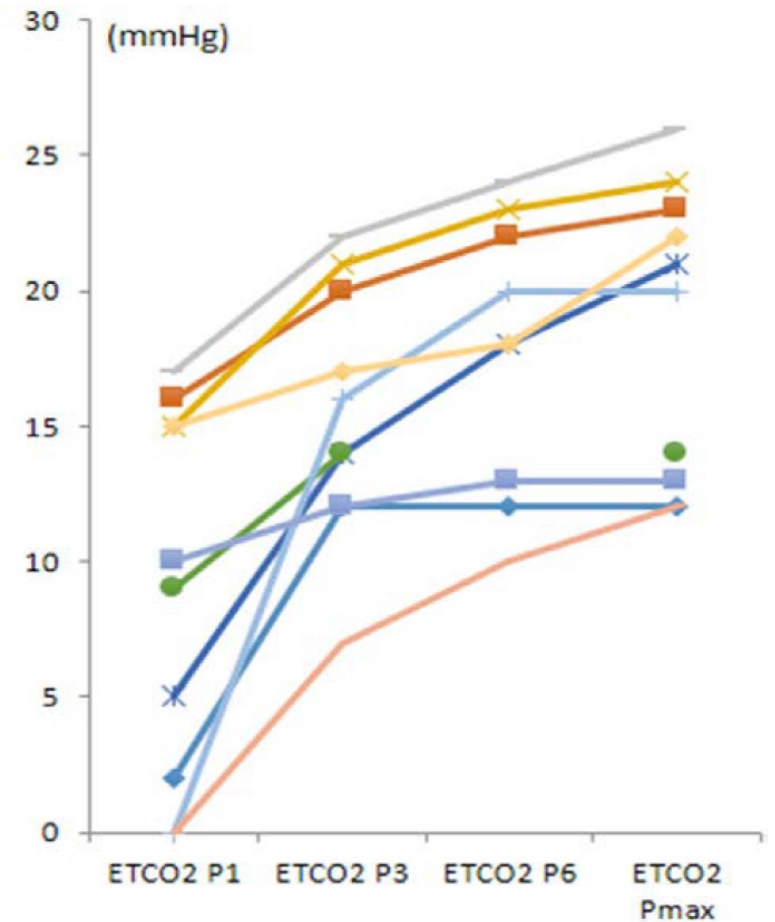
- CO by thermodilution
 - Difficult if very low (<1 to 1.5L/min)
 - False if tricuspid regurgitation (may be increased by ECMO)
- Pulmonary artery occlusion pressure and mixed venous saturation not affected

Monitoring of EtCO₂ on mechanical ventilation

- Indicate participation of pulmonary circulation on gaze exchange

Pulse pressure

- Indicate LV stroke volume
- Not correlated to transpulmonary BF in case of LV unloading device



ASAIO Journal 2017

Adult Circulatory Support

Effect of Impella During Veno-Arterial Extracorporeal Membrane Oxygenation on Pulmonary Artery Flow as Assessed by End-Tidal Carbon Dioxide

JACOB ELIET,* PHILIPPE GAUDARD,*† NORDDINE ZEROUAL,* PHILIPPE ROUVIÈRE,‡ BERNARD ALBAT,‡ MARC MOURAD,* AND PASCAL H. COLSON*§

Predictive value of EtCO₂ and pulse pressure for native CO < 1L/min

Mourad et al. *Critical Care* (2020) 24:569
<https://doi.org/10.1186/s13054-020-03280-z>

Critical Care

RESEARCH

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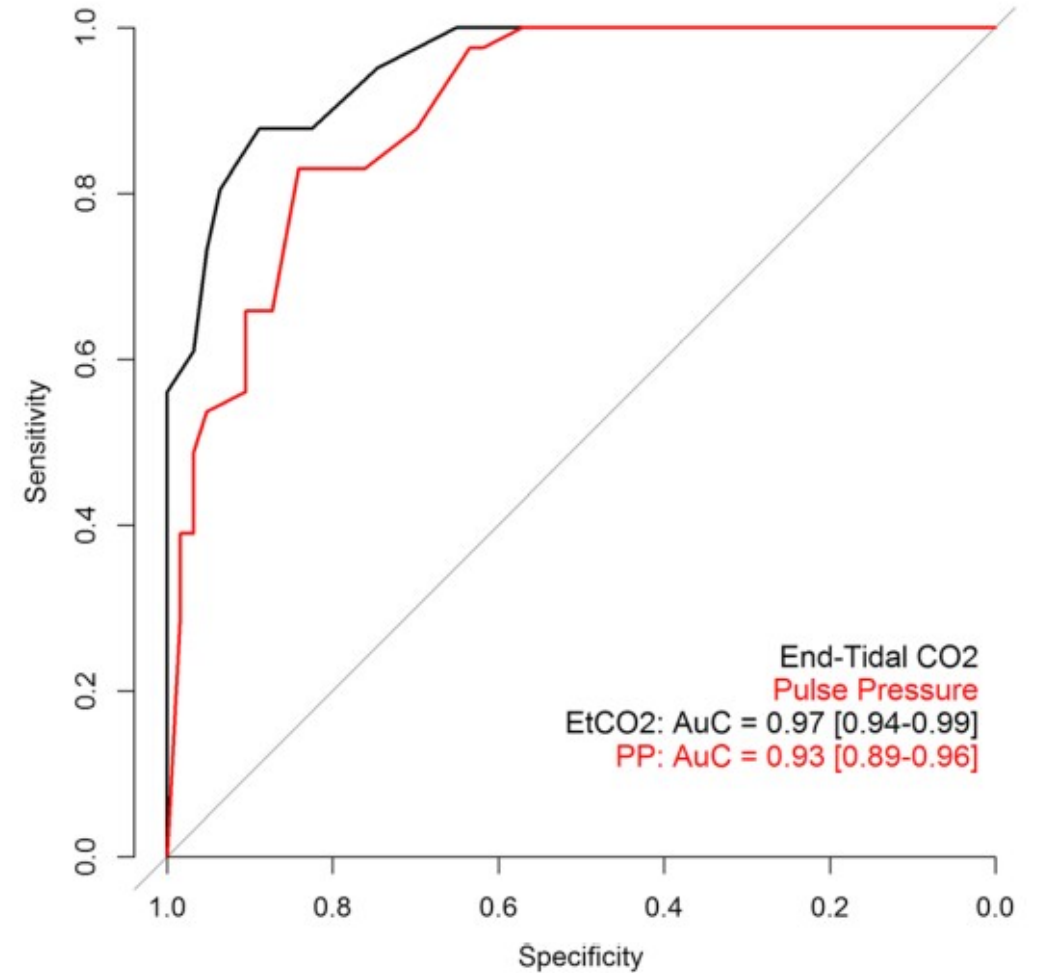
Pulse pressure and end-tidal carbon dioxide for monitoring low native cardiac output during veno-arterial ECLS: a prospective observational study

Marc Mourad^{1*}, Jacob Eliet¹, Norddine Zeroual¹, Marine Saour¹, Pierre Sentenac¹, Federico Manna², Nicolas Molinari², Thomas Gandet³, Pascal H. Colson^{1,4†} and Philippe Gaudard^{1,5†}

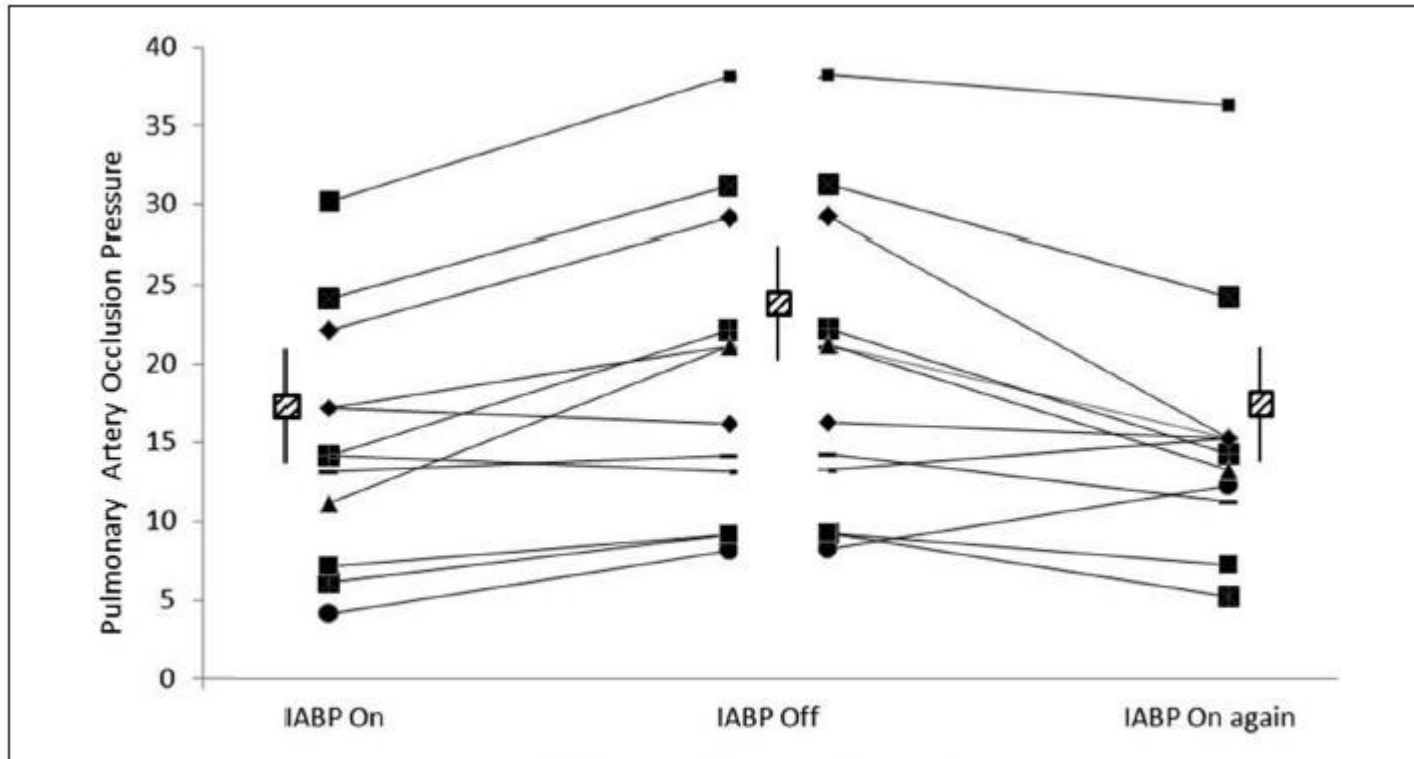
Cut-off values

EtCO₂ = 14

PP = 15



Thibaut Petroni, MD¹; Anatole Harrois, MD, PhD²; Julien Amour, MD, PhD³;
Guillaume Lebreton, MD⁴; Nicolas Brechot, MD, PhD¹; Sébastien Tanaka, MD²;
Charles-Edouard Luyt, MD, PhD¹; Jean-Louis Trouillet, MD¹; Jean Chastre, MD¹;
Pascal Leprince, MD, PhD⁴; Jacques Duranteau, MD, PhD²; Alain Combes, MD, PhD¹



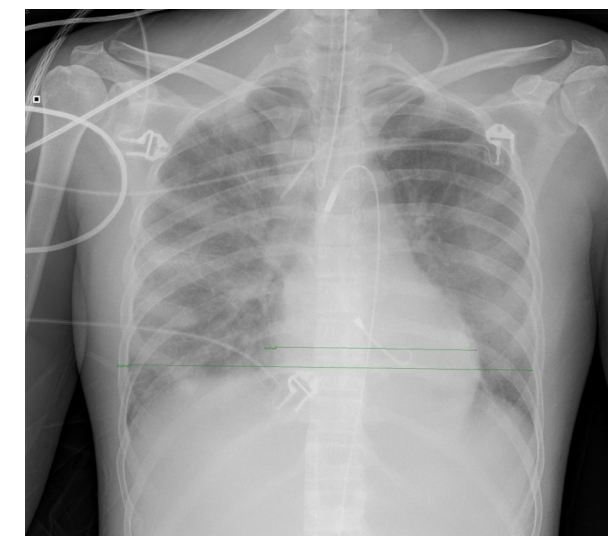
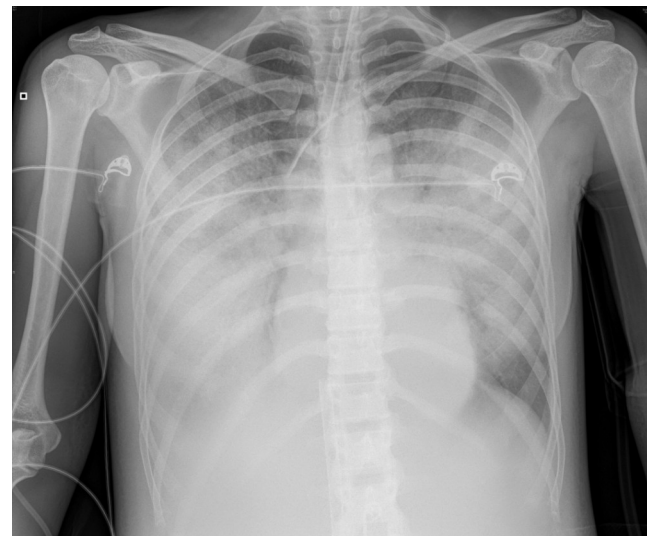
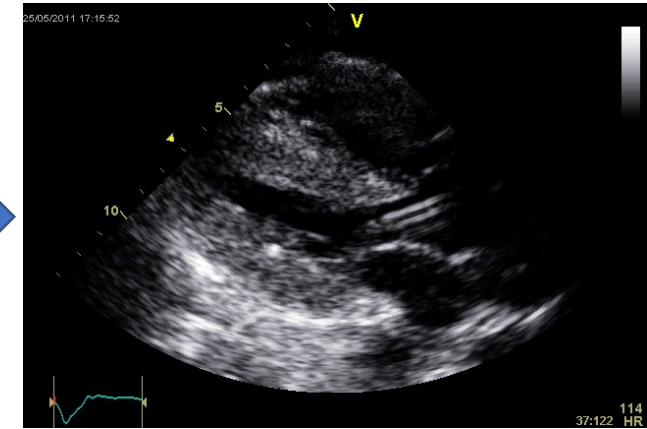
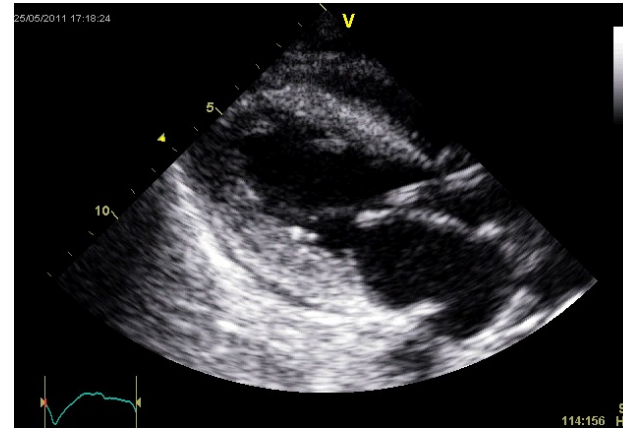
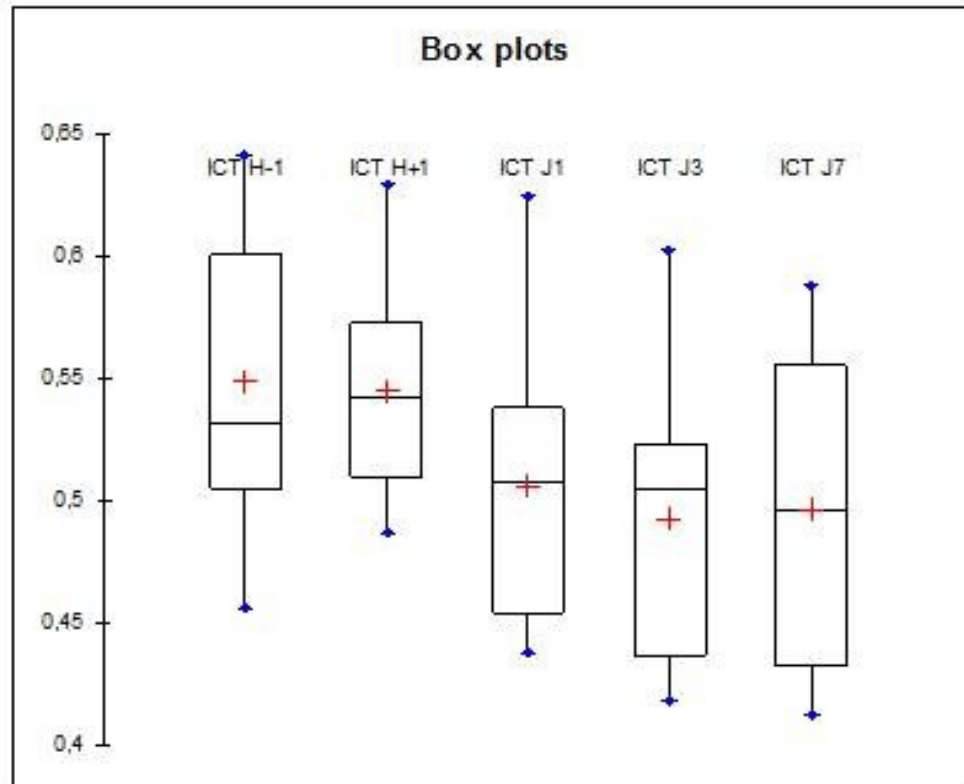
Crit Care Med 2014; 42:2075-82

Figure 1. Pulmonary artery-occlusion pressure before and 30 min after interrupting and restarting intra-aortic balloon pump (IABP) in the 12 patients on extracorporeal membrane oxygenation. The three *squares* represent the mean \pm SD.

Efficacy of unloading with percutaneous Impella

10 patients Impella 2.5 added to va ECMO

Cardiothoracic ratio decreased significantly from **0.55** (H-1) to **0.49** (J3) ($p = 0.002$)



Efficacy of unloading with percutaneous Impella 5.0

	Before implantation	6 Hours	24 Hours	48 Hours
Vasoactive-Inotropic score	51 [13-117]	43 [18-82]	24 [8-56]*	9 [0-32]*
Inotrope score	9.3 [2-14]	1 [0-9]*	0 [0-4]*	0 [0-0.4]*
Pulse pressure (mmHg)	31 [11-42]	5 [0-30]*	10 [0-24]*	17 [0-26]
Blood lactate (mmol/L)	3.4 [1.7-5]	2.7 [1.5-3.6]	1.6 [1.2-2.8]*	1.5 [1-2.1]*
Cardiothoracic ratio	0.58 [0.52-0.66]	-	0.55 [0.49-0.6]*	0.54 [0.49-0.59]*
NT-proBNP (ng/L)	3736 [1436-8024]	-	1638 [799-5689]*	1780 [745-3931]*

Median values; NT-proBNP, N-terminal pro-brain natriuretic peptide.

*, $p < 0.05$ compared to values before Impella implantation, paired Wilcoxon test.

Gaudard et al. *Critical Care* (2015) 19:363
DOI 10.1186/s13054-015-1073-8



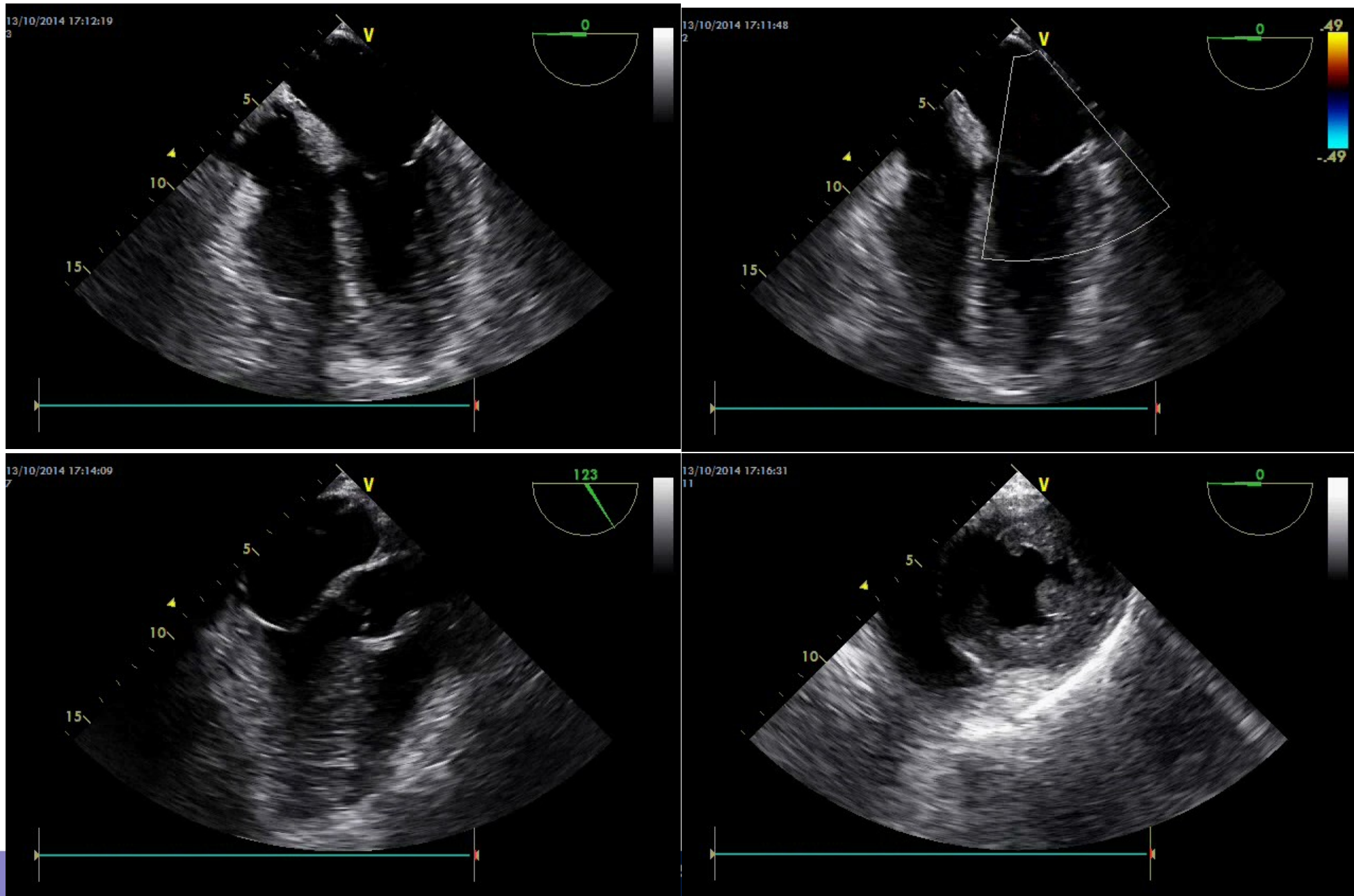
RESEARCH

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Management and outcome of patients supported with Impella 5.0 for refractory cardiogenic shock



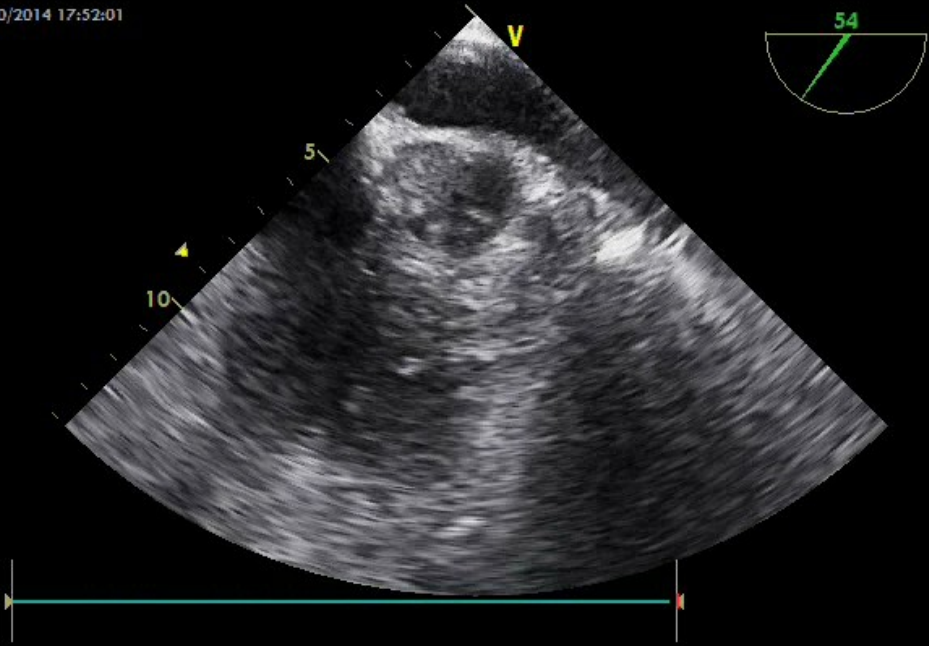
When is it time to unload?



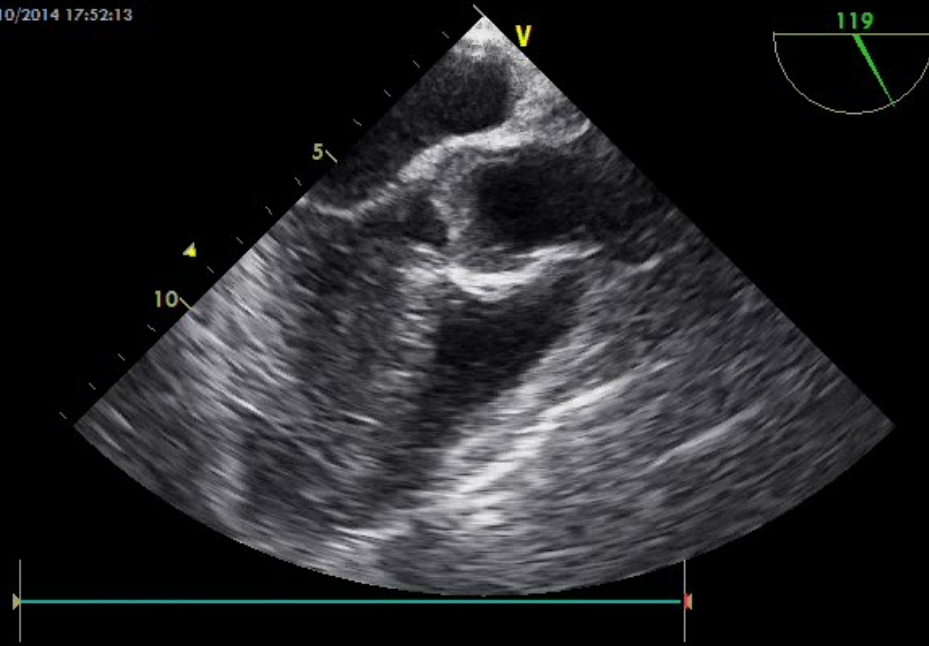
ECMO H2
(FV post-PCI, mitral regurgitation)



13/10/2014 17:52:01
15

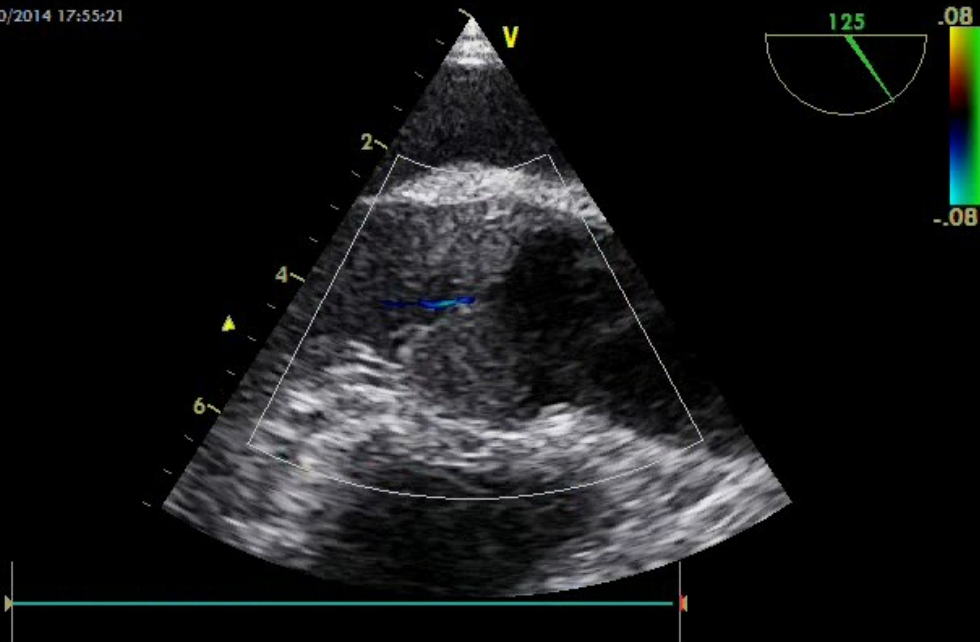


13/10/2014 17:52:13
16

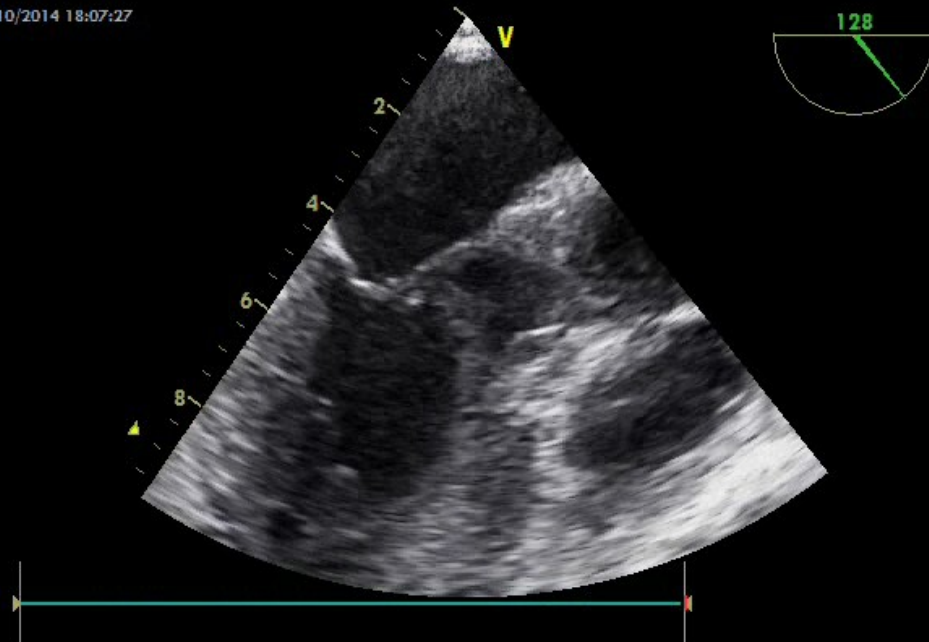


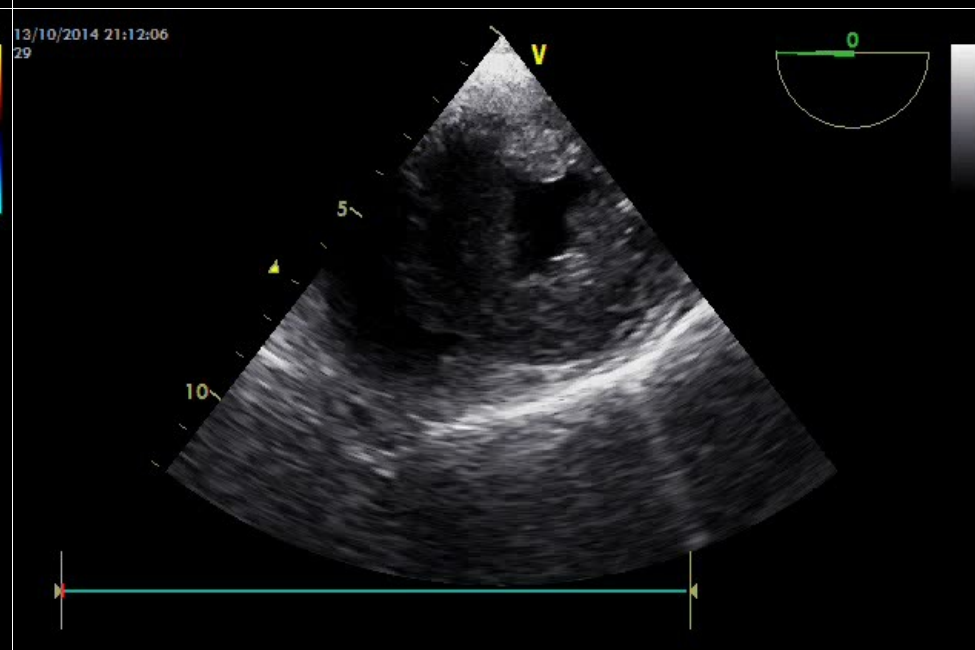
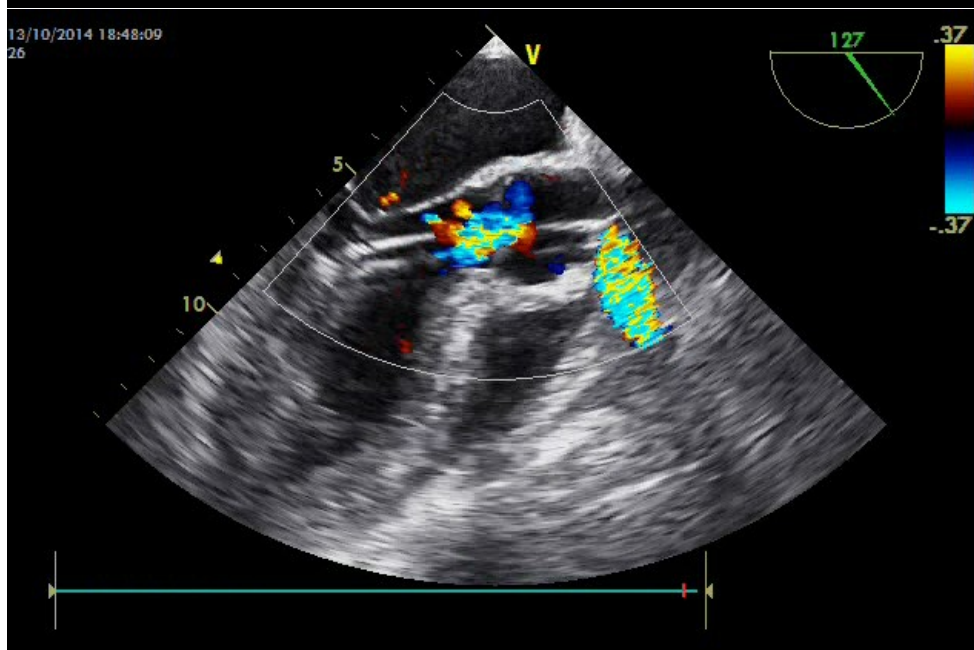
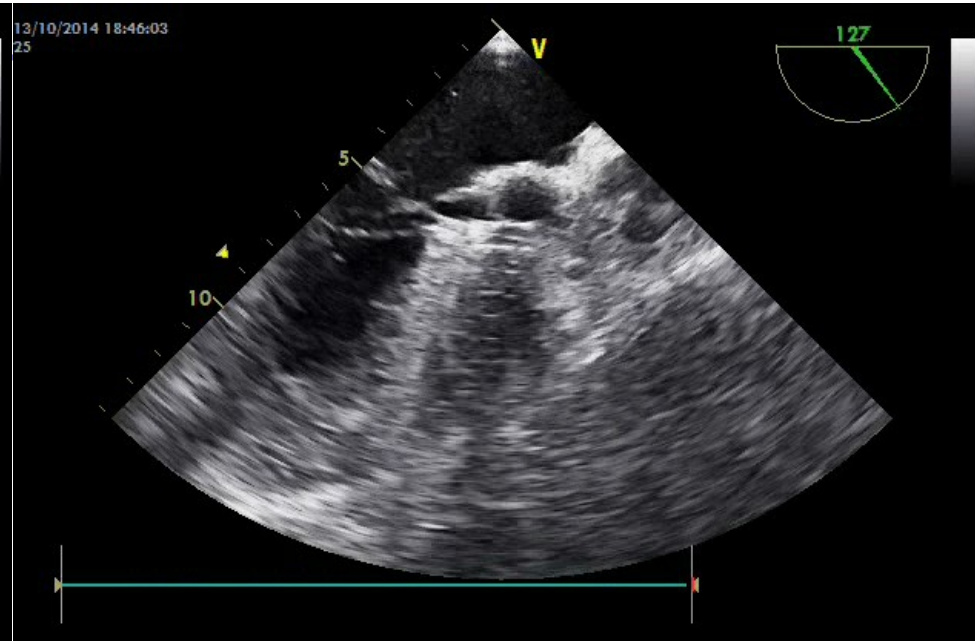
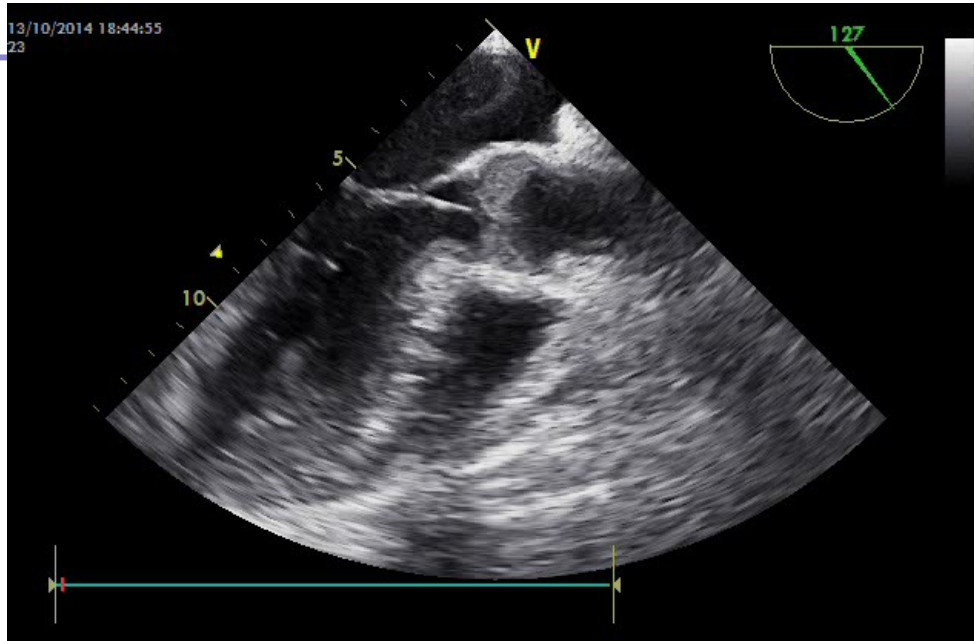
30 min
later...

13/10/2014 17:55:21
17



13/10/2014 18:07:27
20



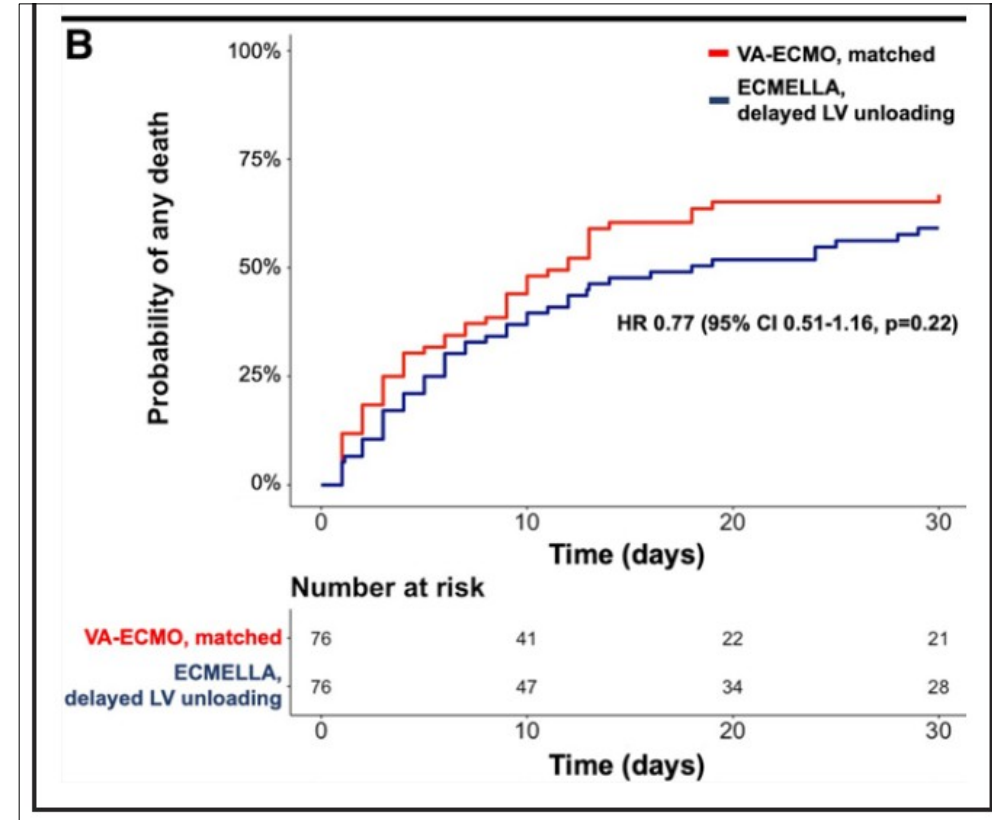
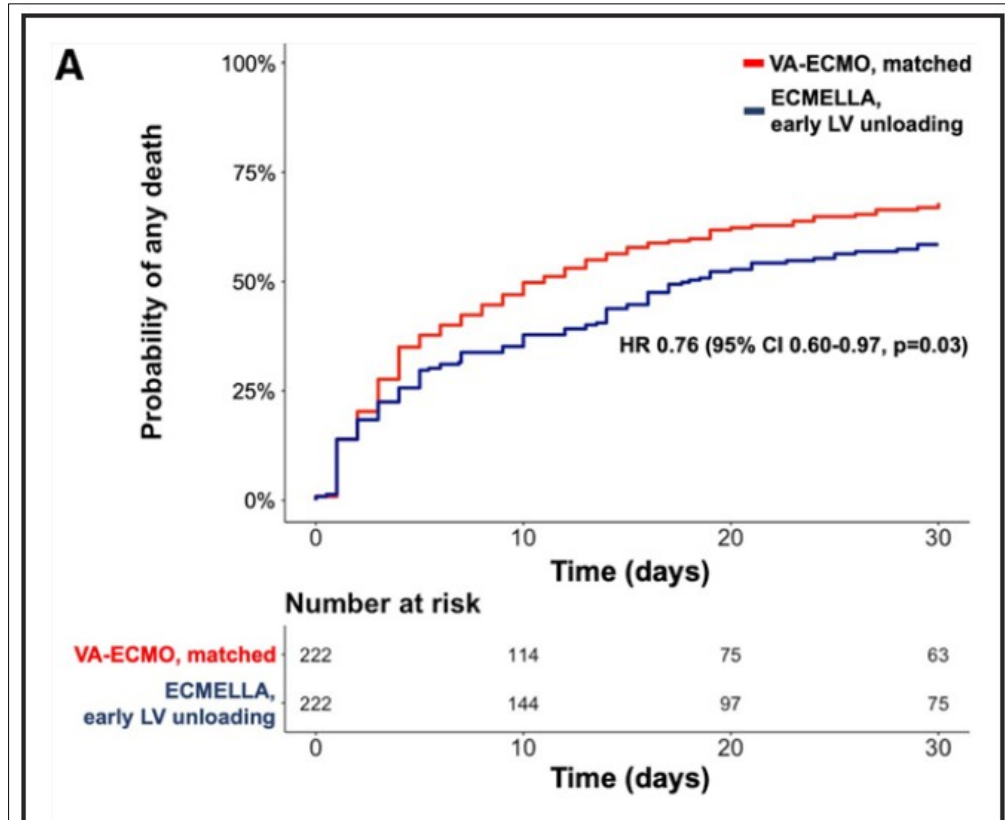


Impella 5.0
implantation



Left Ventricular Unloading Is Associated With Lower Mortality in Patients With Cardiogenic Shock Treated With Venoarterial Extracorporeal Membrane Oxygenation
 Results From an International, Multicenter Cohort Study

Circulation. 2020;142:2095–2106. DOI: 10.1161/CIRCULATIONAHA.120.048792



(Refractory) Cardiogenic Shock V-A ECMO + Impella (ECpella)

Early LV unloading: Prefer axillary Impella 5.0 or 5.5 +/- levosimendan cure ?

Progressive flow transfer from ECMO => Impella

Organ failure recovery

Transplant project

LVAD project

Recovery

List registration

No donor

**BiVAD
TAH**

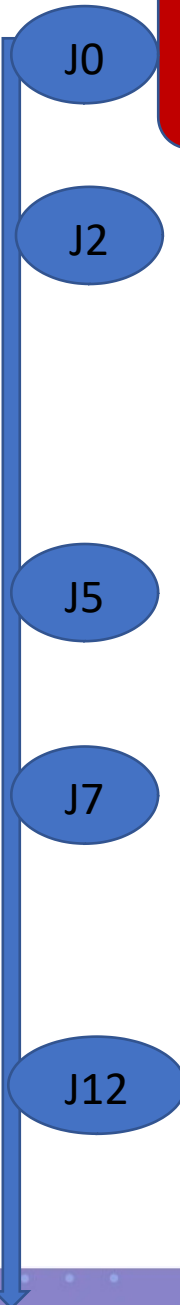
LVAD

Weaning V-A ECMO
Weaning MV
Active Rehabilitation

Simultaneous or staggered support weaning depending on TTE assessment

If failed

**ECpella:
Dual support management
and weaning project**



LV unloading: Take home message

Who ?

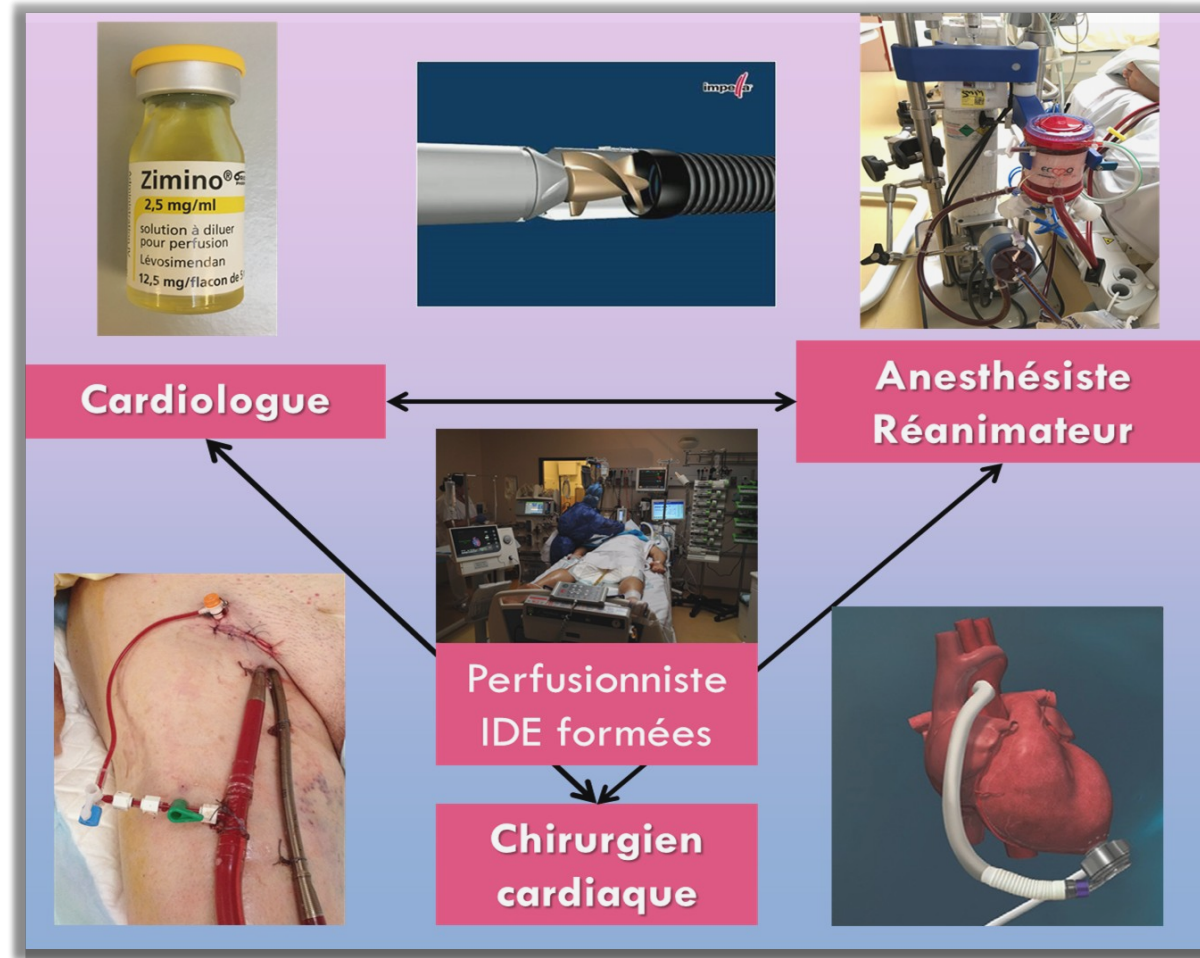
- Recovery potential (myocardial protection)
- High risk of VA-ECMO side effects (low native CO)
 - EtCO₂ < 14 or Pulse Pressure < 15 despite volume optimization and ECMO flow reduction

When ?

- Early +++
- Limited benefits after 2 days
- After assessing neurologic prognosis and futility

How ?

- IABP in prevention?
- Impella 5.0 > CP > 2.5: direct & transvalvular unloading
- Non catecholergic inotrope
- Integrated strategy in the global care plan (what's next?)



MERCI !

HEART-TEAM