

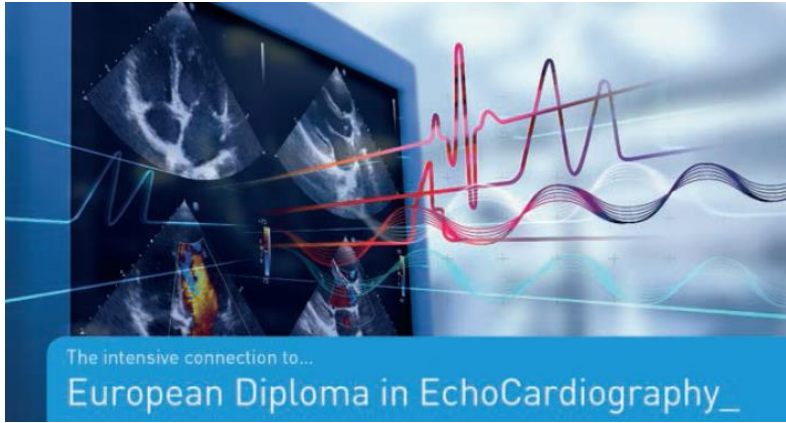


ECLS in shocked patients

Martin Balik

Complex Cardiac Center, Dept. of Anesthesiology and Intensive Care
1st Faculty of Medicine, Charles University General University Hospital, Prague, EU

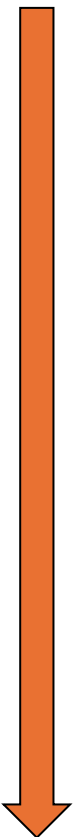
e-mail: martin.balik@vfn.cz

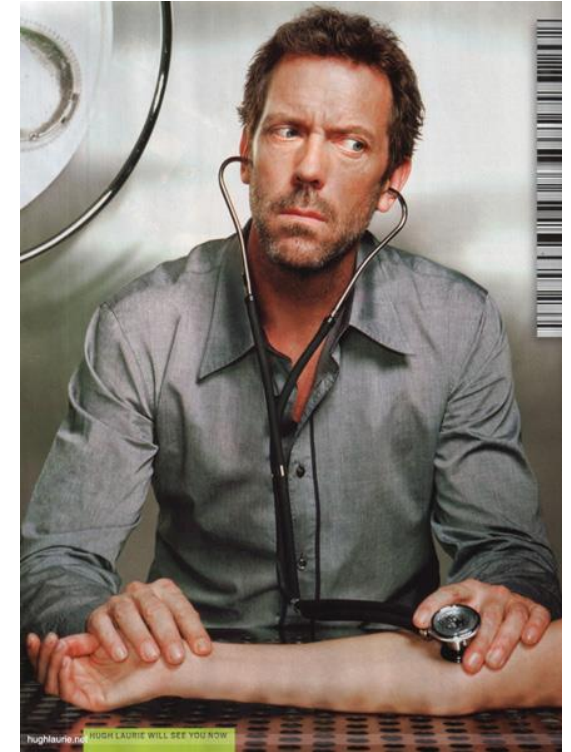
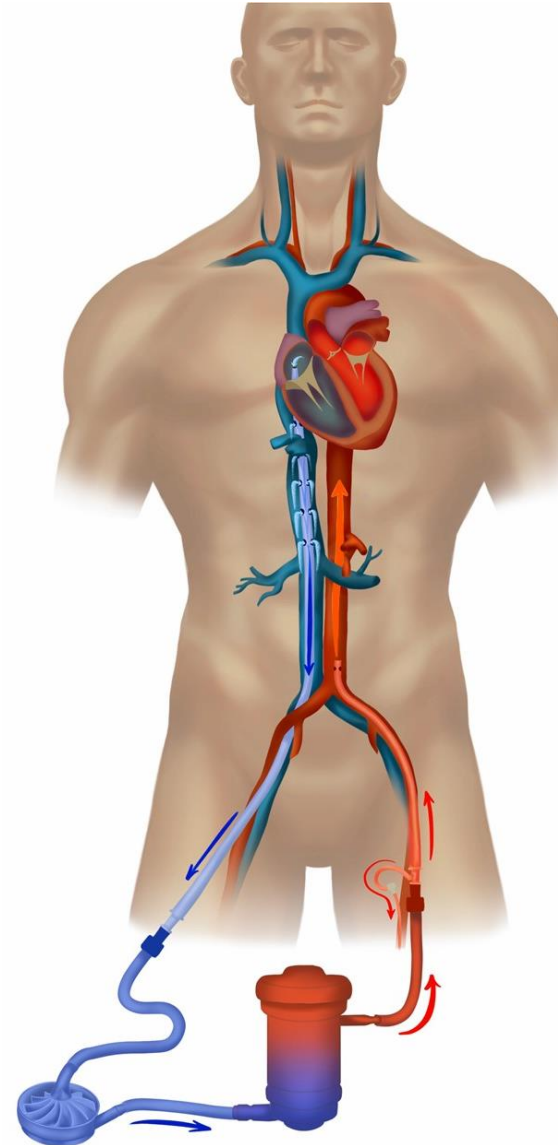


Conflict of interest

- Research grants: AZV 18-06-00417 (Prospective randomized double-blind study of efficacy and safety of 1c class antiarrhythmic agent (propafenone) for supraventricular arrhythmias in septic shock), AZV NU22-B-147 (Impact of SARS-CoV-2 viral load estimate on therapeutic effects of remdesivir), Gilead Sciences 2021-22 (Immune boosting in severe Covid19)
- Research support: ESICM Stoutenbeek Award (Dutch Society of Critical Care)
- Inventor and patent holder: Lactocitrate[®], EU patent (EP2609915B1), Canadian patent (No.2799624)
- Speaker Fees: FMC, GML-Biomedica, Gilead Sciences, BBraun, AOP Orphan
- Grant to organize educational meetings: None
- Advisory board: AOP Orphan

Refractory shock requiring ECLS

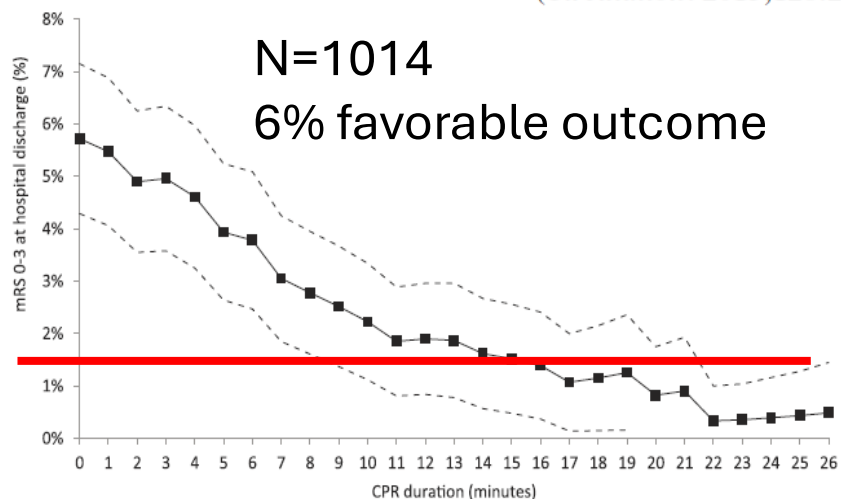
- 
- Obstructive
 - Cardiogenic
 - Hypothermia
 - Cardiac drug poisoning
 - Hypovolaemic
 - Distributive
 - Septic
 - Anaphylaxis
 - Neurogenic
 - Intoxications
 - Endocrine (hypoadrenal, hypothyroid, DKA)



Duration of Resuscitation Efforts and Functional Outcome After Out-of-Hospital Cardiac Arrest When Should We Change to Novel Therapies?

Joshua C. Reynolds, MD, MS; Adam Frisch, MD, MS; Jon C. Rittenberger, MD, MS;
Clifton W. Callaway, MD, PhD

(*Circulation*. 2013;128:2488-2494.)



...>15 min CPR....CPS 1-2 in < 15% !

age<70, witnessed arrest

Time to CPR < 5 min, bystander CPR

Shockable rhythm, ETCO₂ ≥ 10 mmHg

Debaty G: Resuscitation 2017, Reynolds JC: Resuscitation 2017

ASAIO Journal 2021



ELSO Guidelines

Extracorporeal Cardiopulmonary Resuscitation in Adults. Interim Guideline Consensus Statement From the Extracorporeal Life Support Organization

ALEXANDER (SACHA) C. RICHARDSON, MD, FCICM,* JOSEPH E. TONNA^{ID}, MD, MS,† VINODH NANJAYYA, MD,*

- E-CPR triggered at 10-15 min of refractory CA + cannulation 10-20 min = ≤60 min
- early notification crucial, centralisation of care – E-CPR bundles !
- FATE+FAST (20% of CPR non-cardiac causes): obstruction, hypovolaemia, AR, Ao dissection
- Early PCI (OR 1.7 for good neurol outcome, Wang 2018)
- distal perfusion cannula to be completed in up to 4 hours



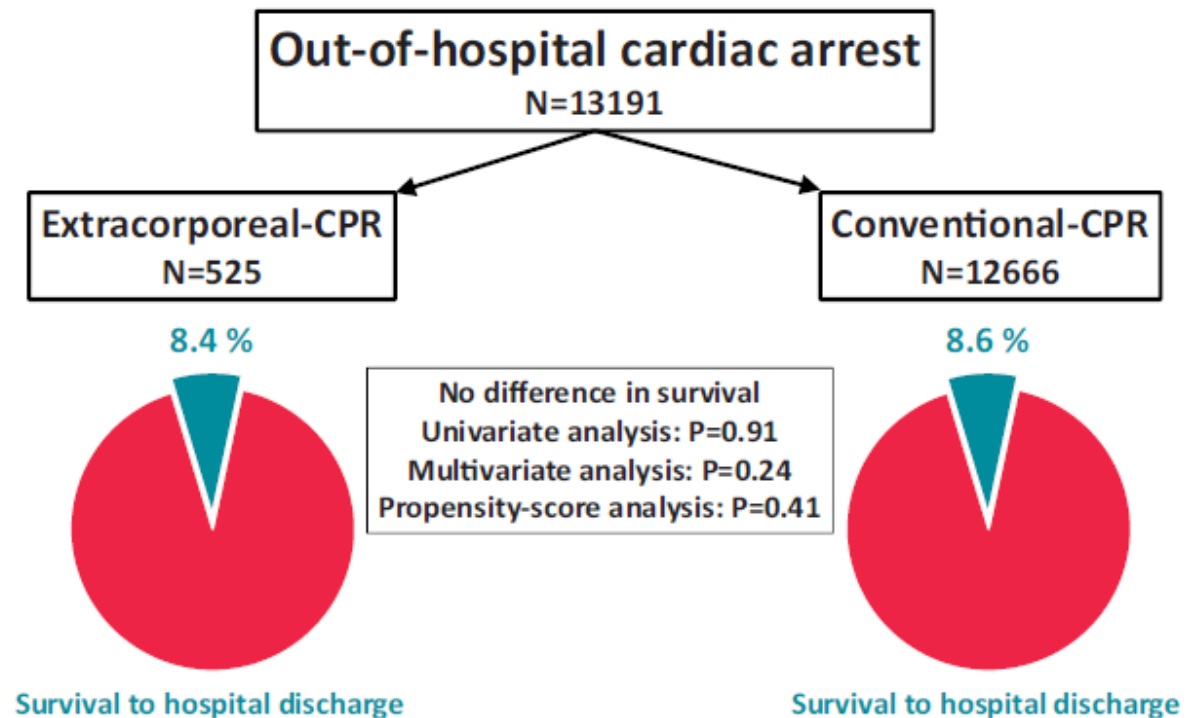
How to achieve it ?

.....ECMO-to-OHCA

- All OHCA under 70 years
 - Bystander CPR overall 50%
 - Time to CPR >5 min in 41%
 - Time to decision:
 - Survival (CPS 1-2) from 8% to 29% ($p < 0.001$)
- if decision point for E-CPR
from 30 min to 20 min of
refractory cardiac arrest

Extracorporeal cardiopulmonary resuscitation in out-of-hospital cardiac arrest: a registry study

Wulfran Bougouin ^{1,2,3,4}, Florence Dumas^{1,3,5,6}, Lionel Lamhaut ^{1,3,4,5,7},



3.9% of all CPR selected for E-CPR

or, rather,.....patient-to-ECMO ?

JAMA | Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

Effect of Intra-arrest Transport, Extracorporeal Cardiopulmonary Resuscitation, and Immediate Invasive Assessment and Treatment on Functional Neurologic Outcome in Refractory Out-of-Hospital Cardiac Arrest A Randomized Clinical Trial

Jan Belohlavek, MD, PhD; Jana Smalcova, MD; Daniel Rob, MD; Ondrej Franek, MD; Ondrej Smid, MD; Milana Pokorna, MD, PhD; Jan Horák, MD; Vratislav Mrazek, MD; Tomas Kovarnik, MD, PhD; David Zemanek, MD, PhD; Ales Kral, MD, PhD; Stepan Havranek, MD, PhD; Petra Kavalkova, PhD; Lucie Kompelentova, MD; Helena Tomkova, MD; Alan Mejstrik, MSc; Jaroslav Valasek, MD; David Peran, MSc; Jaroslav Pekara, MSc; Jan Rulisek, MD, PhD; Martin Balik, MD, PhD; Michal Huptych, PhD; Jiri Jarkovsky, PhD; Jan Malik, MD, PhD; Anna Valerianova, MD, PhD; Frantisek Mlejnsky, MSc, PhD; Petr Kolouch, MD; Petra Havrankova, MD, PhD; Dan Romportl, MD; Arnost Komarek, PhD; Ales Linhart, MD, PhD; for the Prague OHCA Study Group

- E-CPR 124 patients vs CPR 132 patients
- Survival with CPC 1-2 at 180d 31.5% vs 22% (p=0.09)
- Cardiac recovery 43.5% vs 34.1% (p=0.12)

Time from collapse to EMS arrival, median (IQR), min	8 (7-11)	9 (7-11)
Time from collapse to randomization, median (IQR), min	24 (21-30)	26 (19-31)
Time to ECLS, median (IQR), min	61 (55-70) [n = 81]	62 (51-73) [n = 10]
Time of implantation (door to ECLS), median (IQR), min	12 (9-15) [n = 80]	16 (11-17) [n = 10]

6% of all CPR selected for E-CPR

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 JANUARY 26, 2023 VOL. 388 NO. 4

Early Extracorporeal CPR for Refractory Out-of-Hospital Cardiac Arrest

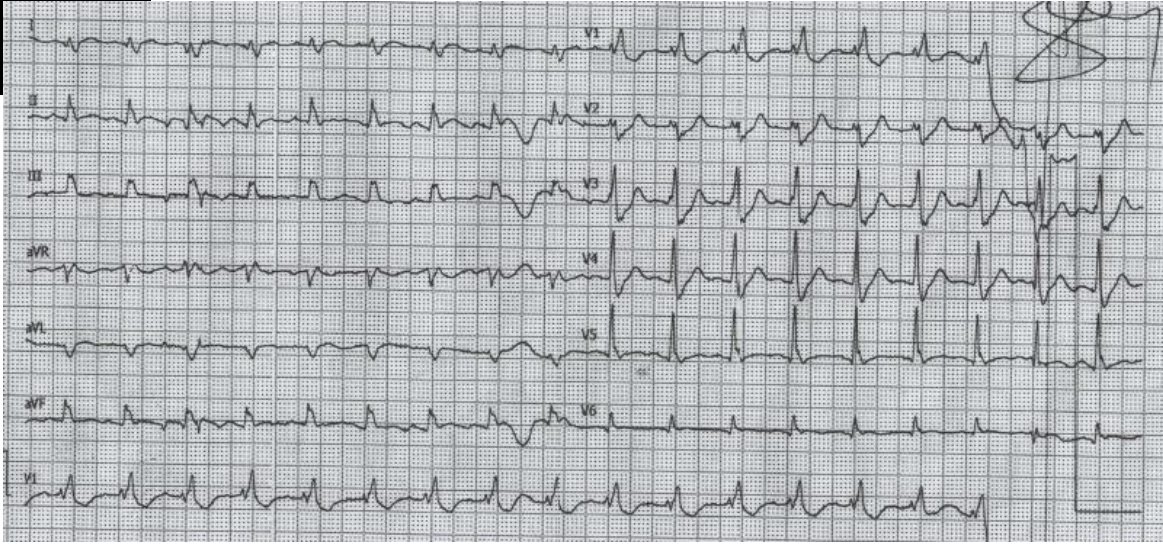
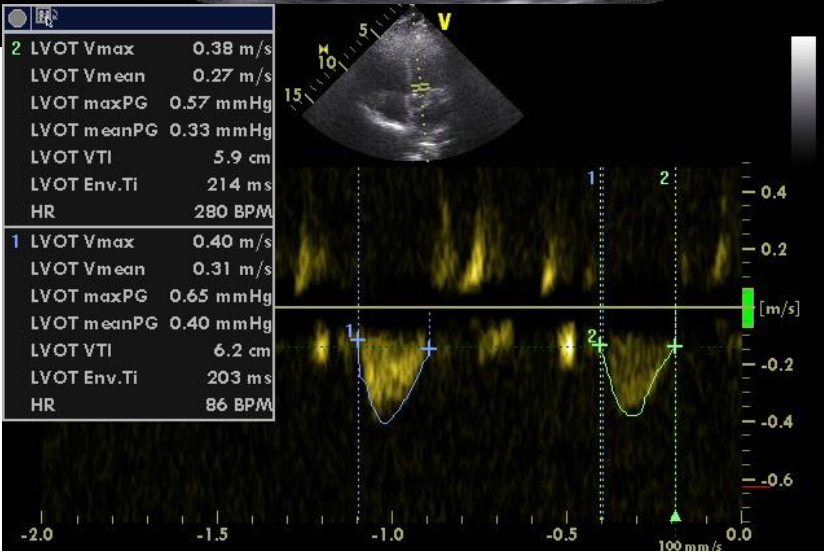
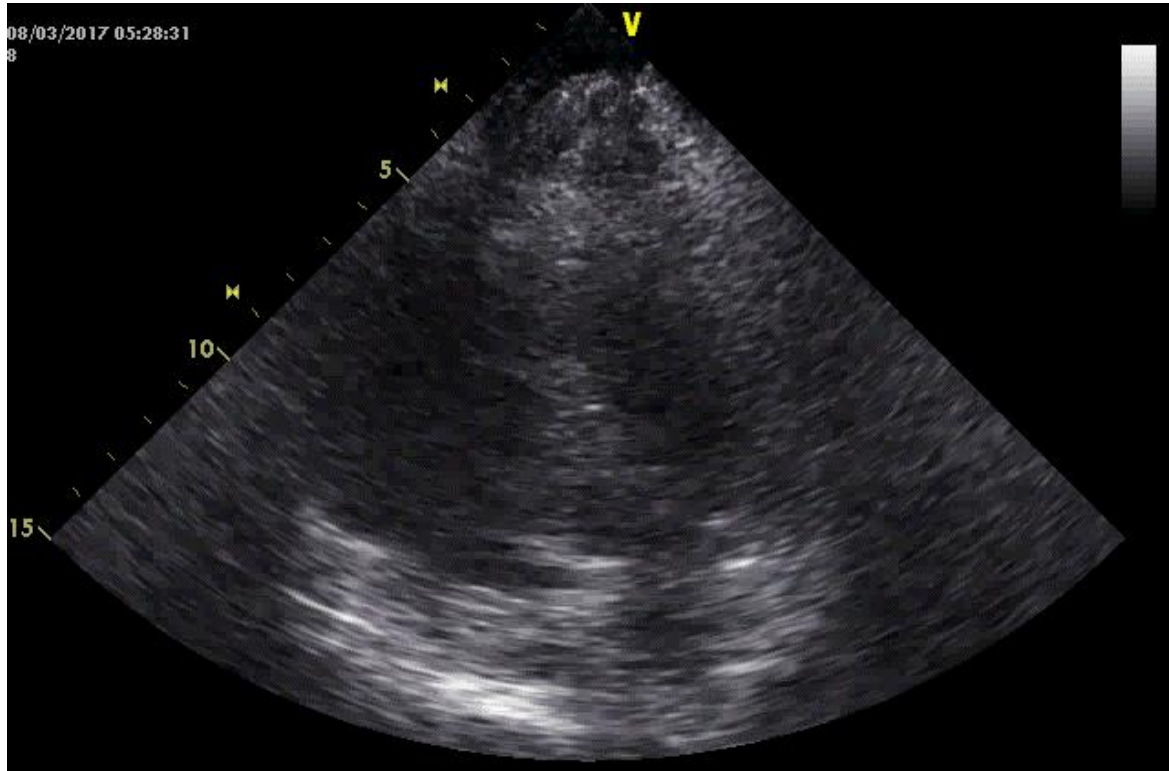
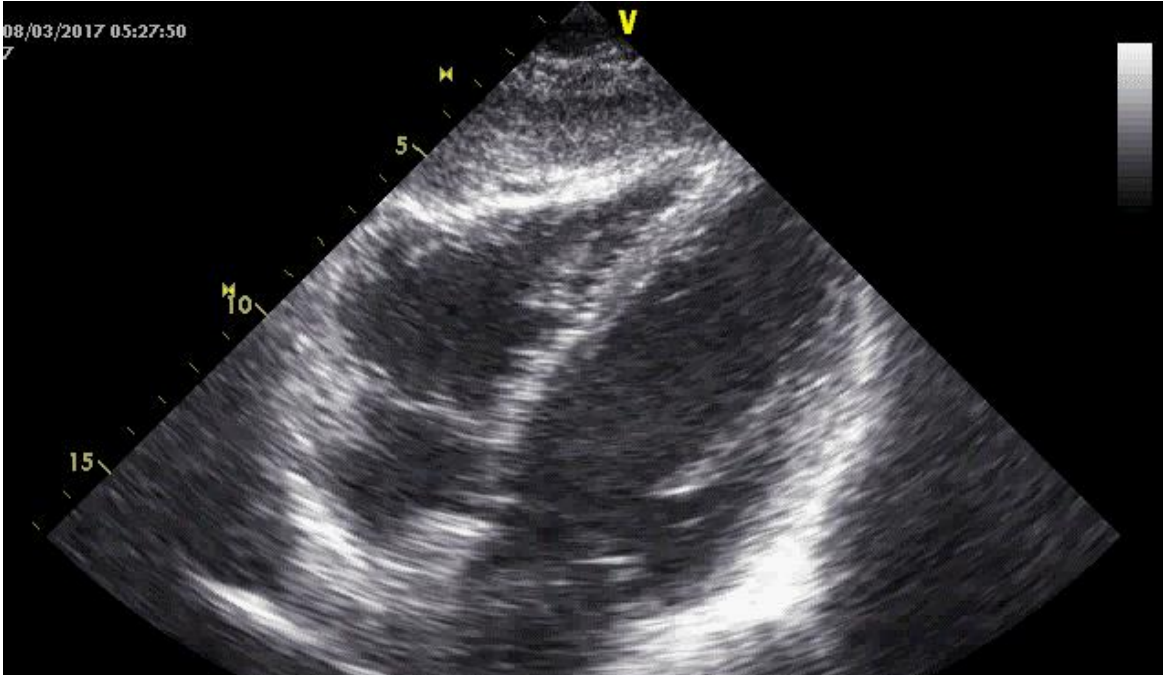
M.M. Suverein, T.S.R. Delnoij, R. Lorusso, G.J. Brandon Bravo Bruinsma, L. Otterspoor, C.V. Elzo Kraemer, A.P.J. Vlaar, J.J. van der Heijden, E. Scholten, C. den Uil, T. Jansen, B. van den Bogaard, M. Kuijpers, K.Y. Lam, J.M. Montero Cabezas, A.H.G. Driessen, S.Z.H. Rittersma, B.G. Heijnen, D. Dos Reis Miranda, G. Bleeker, J. de Metz, R.S. Hermanides, J. Lopez Matta, S. Eberl, D.W. Donker, R.J. van Thiel, S. Akin, O. van Meer, J. Henriques, K.C. Bokhoven, L. Mandigers, J.J.H. Bunge, M.E. Bol, B. Winkens, B. Essers, P.W. Weerwind, J.G. Maessen, and M.C.G. van de Poll

- E-CPR 70 patients vs CPR 64 patients
- Survival with CPC 1-2 at 30d 20% (14) vs 16% (10) (p=0.52)

Interval	Extracorporeal CPR (N=70)	Conventional CPR (N=64)
Start of arrest to EMS arrival — no. of patients (min)	69 (8±4)	63 (8±4)
Start of arrest to start of EMS transport to hospital –	67 (21±9)	55 (25±9)
Start of arrest to randomization — no. of patients (n	70 (32±10)	64 (34±12)
Start of arrest to start of ECLS flow	44	2§
No. of patients	74 (63 to 87)	NA
Median interval (IQR) — min		

5% of all CPR selected for E-CPR

Female 35 years, recurrent VF



ECLS yes or no ?

- In light of the new EBM - ECMO is not indicated...as it has no impact on outcome in CS
- ECLS Shock with problematic definition of CS (no echo or CO/CI) – impact ?
- Prague CS validated the indication to ECLS in a CS non-responsive to therapy
- Beware of pragmatic trials....we need EBM + 😊

ORIGINAL ARTICLE

Circulation

ORIGINAL RESEARCH ARTICLE

Extracorporeal Membrane Oxygenation in the Therapy of Cardiogenic Shock: Results of the ECMO-CS Randomized Clinical Trial

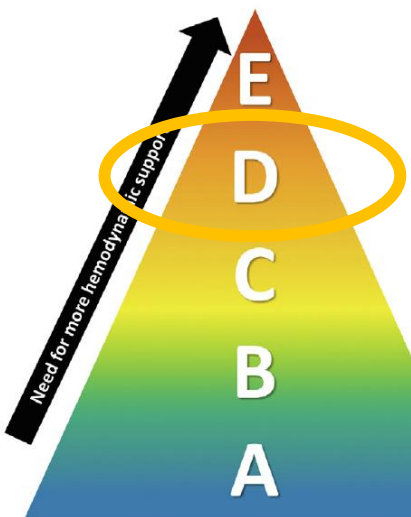
Petr Ostadal¹, MD, PhD; Richard Rokytá, MD, PhD; Jiri Karasek, MD, PhD; Andreas Kruger, MD, PhD;

Extracorporeal Life Support in Infarct-Related Cardiogenic Shock

H. Thiele, U. Zeymer, I. Akin, M. Behnes, T. Rassaf, A.A. Mahabadi, R. Lehmann, I. Eitel, T. Graf, T. Seidler, A. Schuster, C. Skurk, D. Duerschmied, P. Clemmensen, M. Hennersdorf, S. Fichtlscherer, I. Voigt, M. Seyfarth, S. John, S. Ewen, A. Linke, E. Tigges, P. Nordbeck, L. Bruch, C. Jung, J. Franz, P. Lauten, T. Goslar, H.-J. Feistritz, J. Pöss, E. Kirchhof, T. Ouarrak, S. Schneider, S. Desch, and A. Freund, for the ECLS-SHOCK Investigators*

ECLS – when to cannulate ?

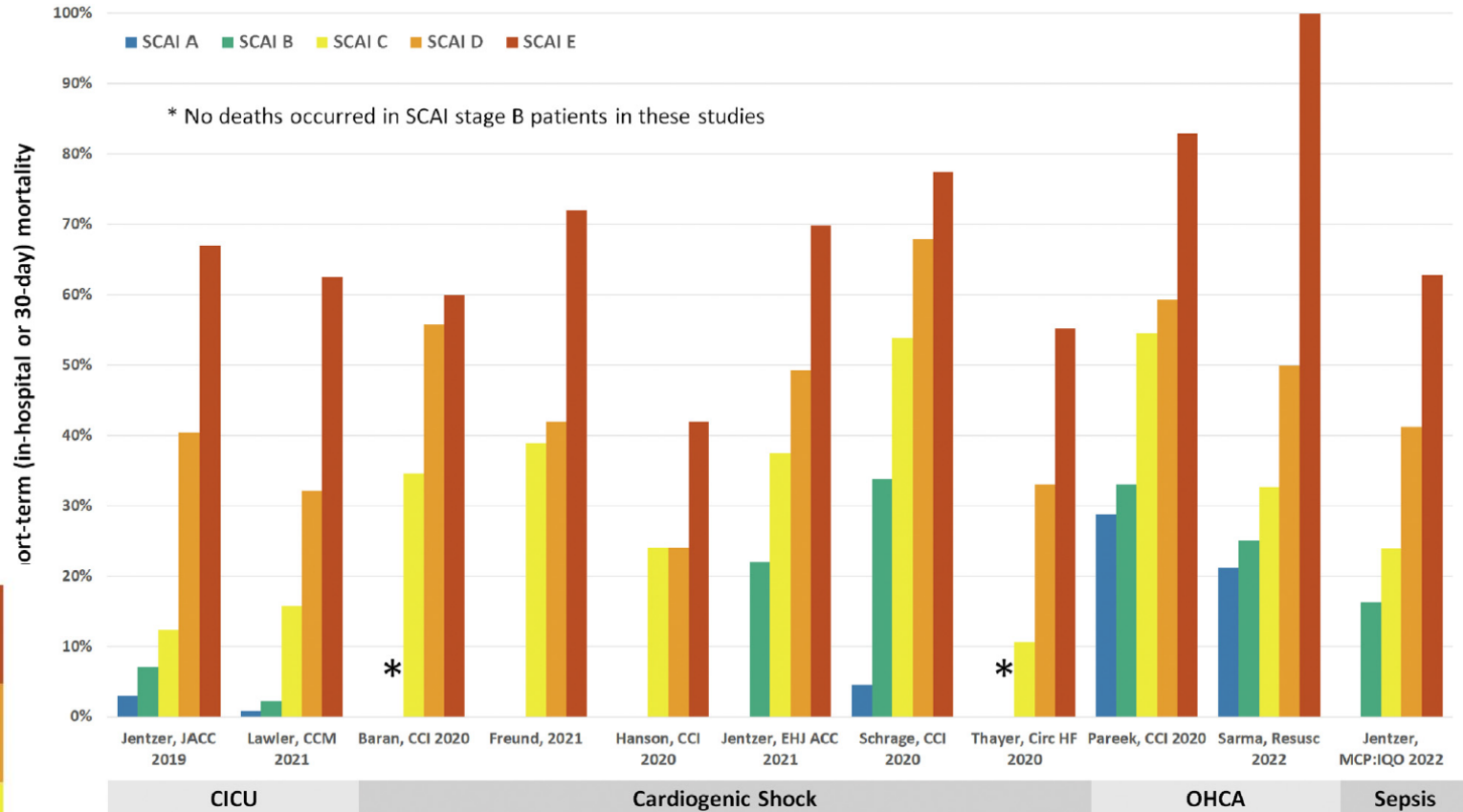
- Stage of shock ?
- Duration „in shock“ ?
- Impact on reperfusion injury
- Are „hypotension, clammy extremities and lactate“ enough to decide ?
- Or, rather, a volume corrected SV/CO/CI ?



SCAI Shock stage E: Rescue / salvage therapy
• Treat reversible causes of refractory shock
• Escalate temporary MCS, consider ECMO support
• Management of metabolic complications
SCAI Shock stage D: Treatment of deteriorating shock
• Transfer to shock center, assess LVAD candidacy
• Initiate or escalate temporary MCS
• Doubtful benefit of IABP (inadequate support)
SCAI Shock stage C: Initial management of shock
• Transfer to CICU, consult shock team
• Invasive hemodynamic monitoring
• Initiate vasoactive drugs or temporary MCS
SCAI Shock stage B: Early intervention for pre-shock
• Consider invasive monitoring, check lactate
• Consider initiation of vasoactive drugs
• Possible role for IABP in selected patients
SCAI Shock stage A: Disease-targeted therapy
• Revascularization for acute coronary syndrome
• Guideline-directed medical therapy
• Monitoring for early hemodynamic instability

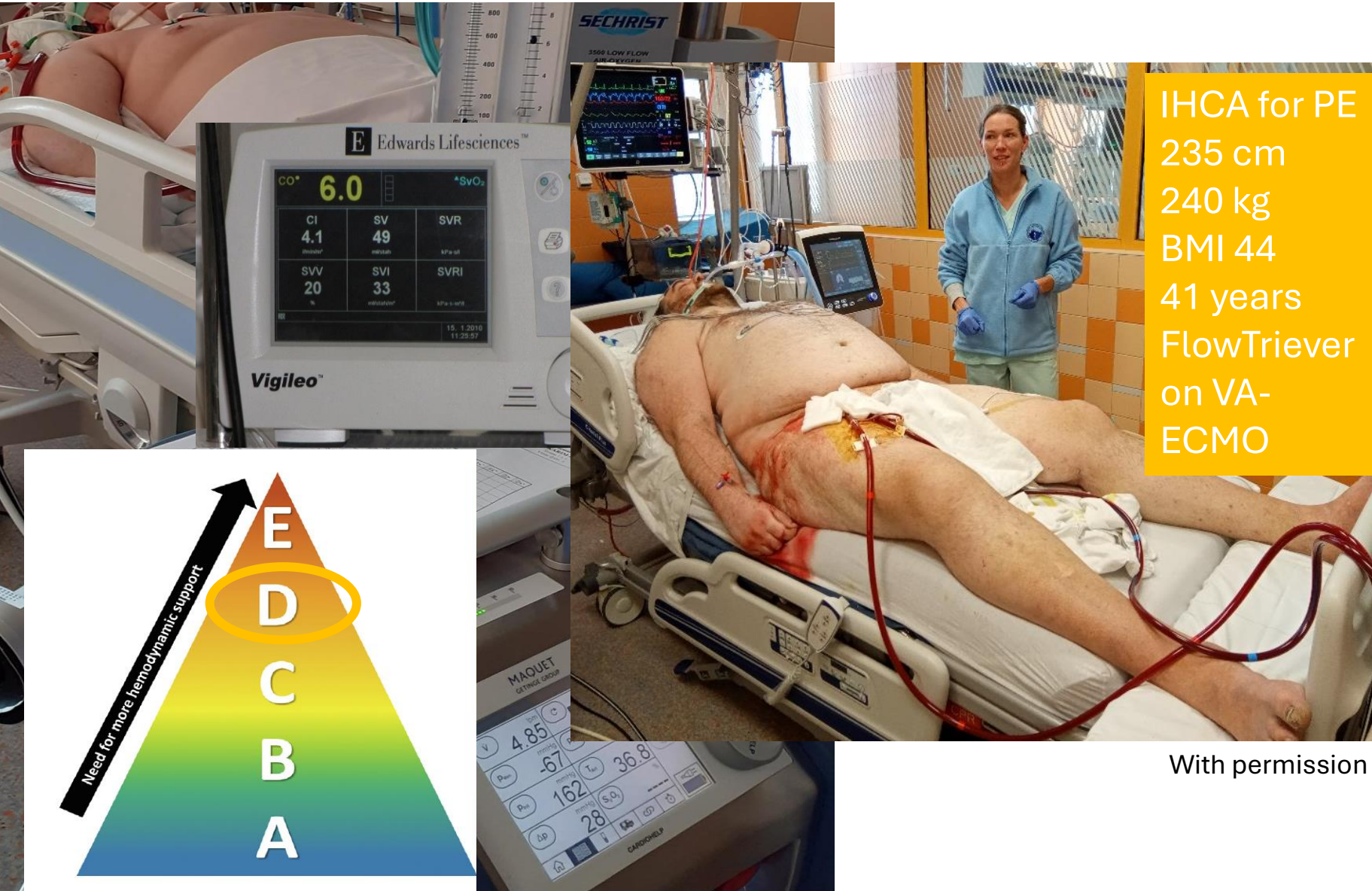
Jentzer *et al*
Advances in the Staging and Phenotyping of Cardiogenic Shock

JACC: ADVANCES, VOL. 1, NO. 4, 2022
OCTOBER 2022:100120



Stage E mortality $\geq$ 50%

Impact of BMI (circulating stress volume) on required Qb: Stage E or D ? cannula size: peripheral circulatory support and oxygenation

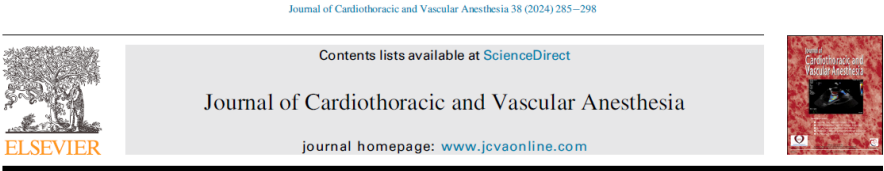
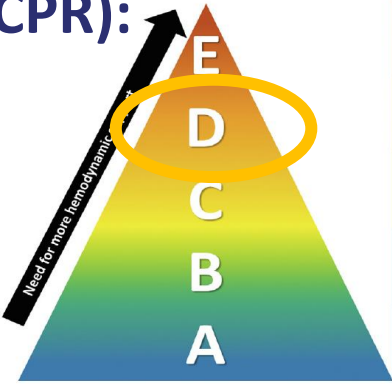
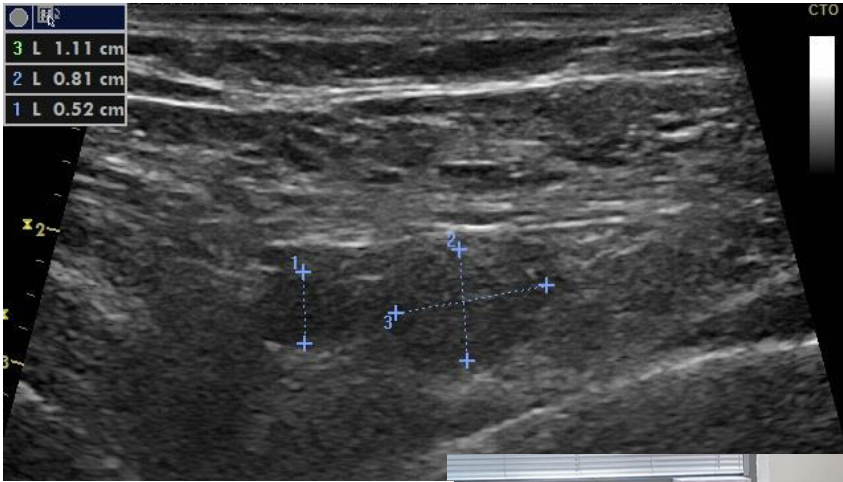


With permission



Obesity paradox reported for VV but not for VA at Stage E (profound shock, E-CPR): high BMI and circulating stress volume...

- Vessel diameter to estimate cannula size
 - BMI
 - severity and duration of shock (SVR)
 - severity of hypoxia
- Obesity (BMI ≥ 40...50 ?) is not a contraindication....beware of small caliber vessels in severe hypoxia
- Access to groins and jugulum



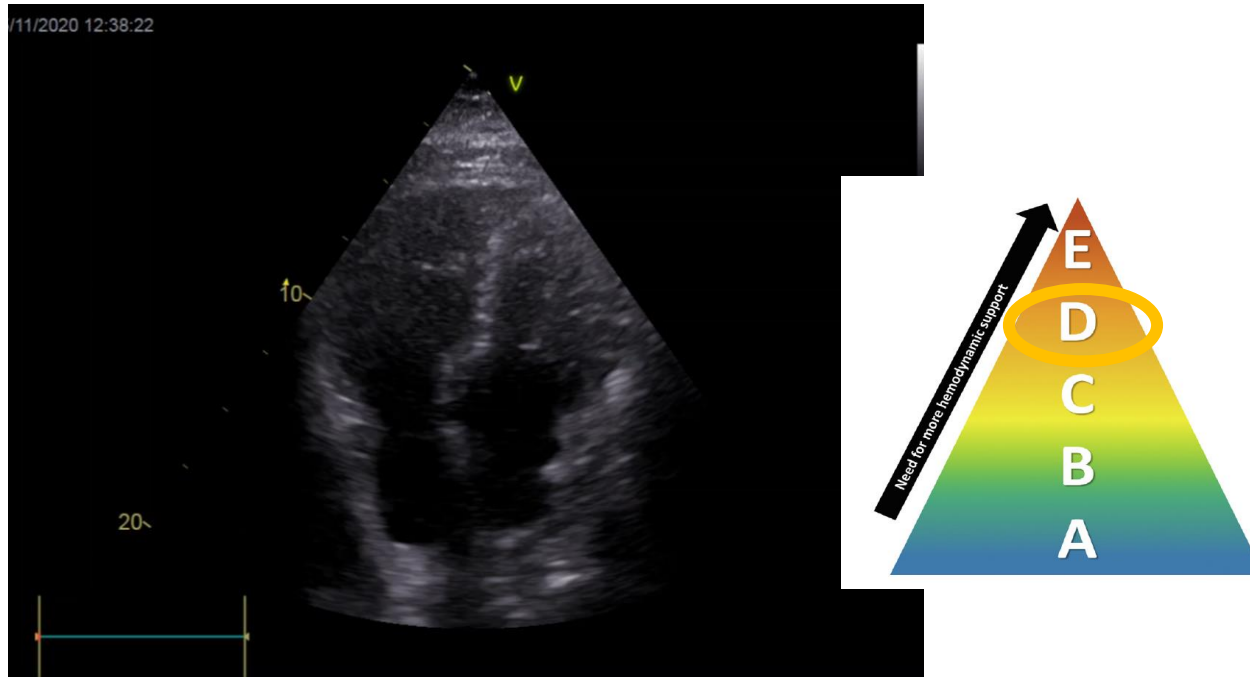
The impact of obesity on the outcome of severe SARS-CoV-2 ARDS in a high volume ECMO centre: ECMO and corticosteroids support the obesity paradox

M. Balik ^{a,*}, E. Svobodova ^a, M. Porizka ^a, M. Maly ^a, P. Brestovansky ^a, L. Volny ^a, T. Brozek ^a, T. Bartosova ^a, I. Jurisinova ^a, Z. Mevaldova ^a, O. Misovic ^a, A. Novotny ^a, J. Horejsek ^a, M. Otahal ^a, M. Flaksa ^a, Z. Stach ^a, J. Rulisek ^a, P. Trachta ^a, J. Kolman ^a, R. Sachl ^a, J. Kunstyr ^a, P. Kopecky ^a, S. Romaniv ^a, M. Huptych ^b, M. Svarc ^c, G. Hodkova ^c, J. Fichtl ^c, F. Mlejnsky ^c, T. Grus ^d, J. Belohlavek ^c, M. Lips ^a, J. Blaha ^a

Patient's treatment.

	BMI > 30 (n = 171)	BMI ≤ 30 (n = 121)	P-value
VV ECMO	45% (77)	34.7% (42)	0.087
- ECMO drainage cannula (F)	29 (25–29)	27 (25–29)	0.503
- ECMO return cannula (F)	23 (21–23)	23 (21–23)	0.726
- Initial blood flow (l/min)	4.7 (4.2–5.2)	4.6 (4.2–5)	0.631
- Initial sweep gas flow (l/min)	3 (2.5–4)	3 (2.5–3.5)	0.459

RV echocardiography parameters as indicators for ECMO – to prevent shock progression

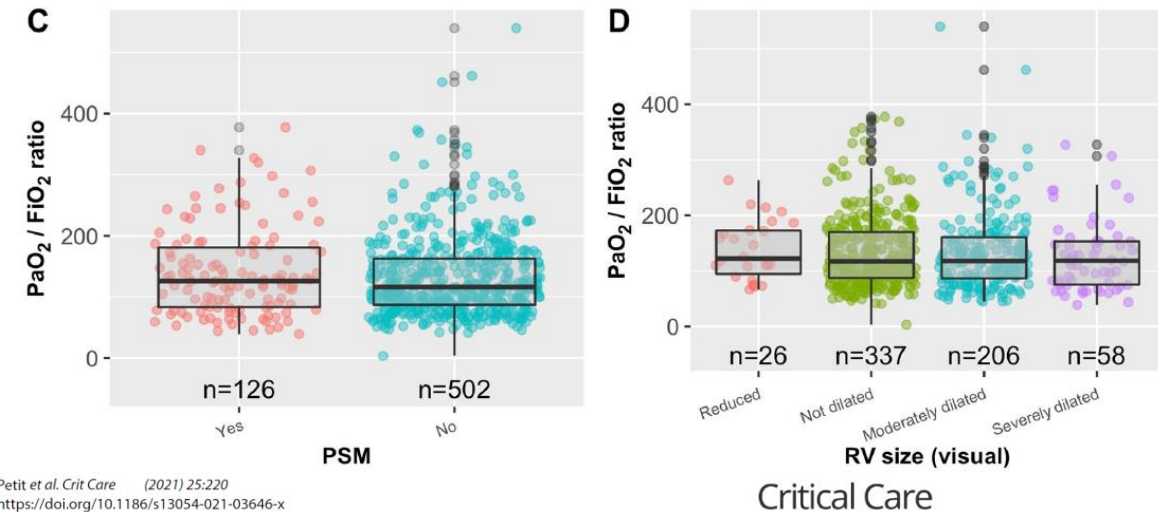


- No relation between RV echo and ELSO criteria for VV-ECMO
- Progression of ACP towards CS and a need for VA-ECMO with HR for outcome especially in higher BMI
- Related to mortality, OR 4.5, $p=0.005$ (Argulian E, JACC 2020, 13:2459-60), SV arrhythmias in 44%

ORIGINAL

Echocardiography findings in COVID-19 patients admitted to intensive care units: a multi-national observational study (the ECHO-COVID study)

Stephen Huang¹, Philippe Vignon², Armand Mekontso-Dessap³, Ségolène Tran⁴, Gwenael Prat⁵, Michelle Chew⁶, Martin Balik⁷, Filippo Sanfilippo⁸, Gisele Banauch⁹, Fernando Clau-Terre¹⁰, Andrea Morelli¹¹, Daniel De Backer¹², Bernard Chollet¹³, Michel Slama¹⁴, Cyril Charron⁴, Marine Goudelin², Francois Bagate³, Pierre Bailly⁵, Patrick-Johansson Blixt⁶, Paul Masi³, Bruno Evrard², Sam Orde¹, Paul Mayo¹⁵, Anthony S. McLean¹ and Antoine Vieillard-Baron^{4,16*} on behalf of the ECHO-COVID research group



Petit et al. Crit Care (2021) 25:220
<https://doi.org/10.1186/s13054-021-03646-x>

RESEARCH LETTER

Open Access

Evaluation of right ventricular function and driving pressure with blood gas analysis could better select patients eligible for VV ECMO in severe ARDS

Matthieu Petit^{1,2*}, Armand Mekontso-Dessap^{3,4,5}, Paul Masi^{3,4}, Annick Legras⁷, Philippe Vignon⁶ and Antoine Vieillard-Baron^{1,2}



LIVES
2024
37TH ANNUAL CONGRESS
05-09 OCTOBER
BARCELONA

VA-ECMO in stress cardiomyopathy: TTS

- Apical (70-80%), midventricular (10-20%), basal (5%)
- Right sided, biventricular TTS
- stress cardiomyopathy (...hypoxia, sepsis, arrhythmias, catecholamines, microthrombi)
- critical in primary respiratory failure with high BMI

JACC REVIEW TOPIC OF THE WEEK

Pathological Evidence for SARS-CoV-2 as a Cause of Myocarditis

JACC Review Topic of the Week

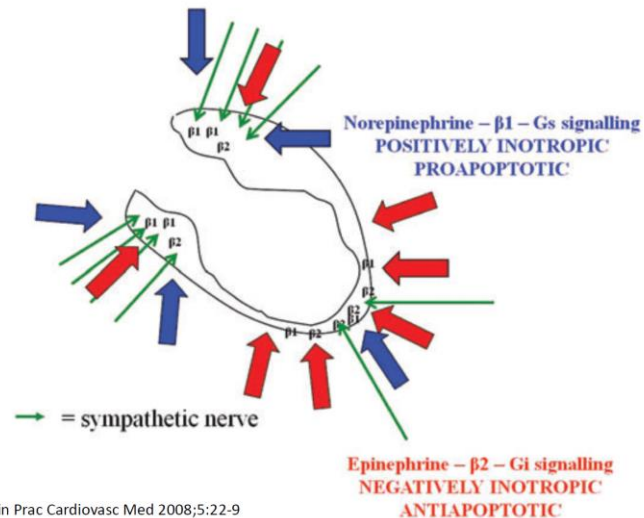
Rika Kawakami, MD,^{a,*} Atsushi Sakamoto, MD,^{a,*} Kenji Kawai, MD,^a Andrea Gianatti, MD,^b Dario Pellegrini, MD,^b
myocarditis only 4.5% of heart failures



IN DEPTH

Takotsubo Syndrome: Pathophysiology, Emerging Concepts, and Clinical Implications

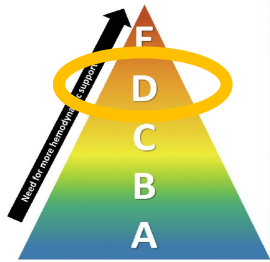
Trisha Singh¹, BM; Hilal Khan², MB BCh BAO, MRCP; David T. Gamble, MPharm, MBBS; Caroline Scally, MBChB; David E. Newby³, DM, PhD; Dana Dawson⁴, MD, DPhil



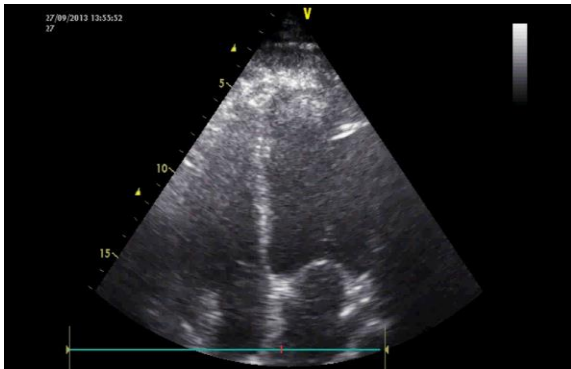
Lyon et al. Nat Clin Prac Cardiovasc Med 2008;5:22-9



VA-ECMO in septic TTS – substituting CO and chasing SVR..... (MAP = CO x SVR)



- Hypodynamic septic shock
- VA or V-AV ECMO according to „inadequate cardiac output“
- If cannulated at CI 1.5 l/min.m²: ECMO RR for mortality 0.57, p=0.03
- ICU survival 70-75% - unless CPR (stage E CS) – HR 4.6 (p=0.006) for mortality



Venoarterial Extracorporeal Membrane Oxygenation Support for Refractory Cardiovascular Dysfunction During Severe Bacterial Septic Shock*

Nicolas Bréchet, MD, PhD¹; Charles-Edouard Luyt, MD, PhD¹; Matthieu Schmidt, MD¹; Pascal Leprince, MD, PhD²; Jean-Louis Trouillet, MD¹; Philippe Léger, MD²; Alain Pavie, MD²; Jean Chastre, MD¹; Alain Combes, MD, PhD¹

Venoarterial extracorporeal membrane oxygenation to rescue sepsis-induced cardiogenic shock: a retrospective, multicentre, international cohort study

Lancet 2020; 396: 545-52

Nicolas Bréchet, David Hajage, Antoine Kimmoun, Julien Demiselle, Cara Agerstrand, Santiago Montero, Matthieu Schmidt,

Ling et al. *Crit Care* (2021) 25:246
<https://doi.org/10.1186/s13054-021-03668-5>

Critical Care

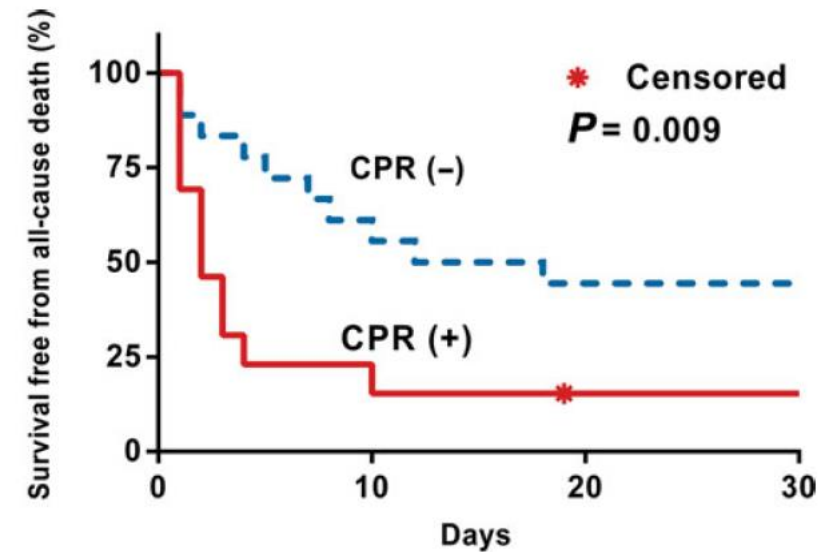
RESEARCH

Open Access

Venoarterial extracorporeal membrane oxygenation as mechanical circulatory support in adult septic shock: a systematic review and meta-analysis with individual participant data meta-regression analysis

Ryan Ruiyang Ling^{1†}, Kollengode Ramanathan^{1,2†}, Wynne Hsing Poon¹, Chuen Seng Tan³, Nicolas Brechet^{4,5}, Daniel Brodie⁶, Alain Combes^{4,7} and Graeme McLaren^{1,2}

European Journal of Cardio-Thoracic Surgery 47 (2015) e68–e74
doi:10.1093/ejcts/ezu462 Advance Access publication 25 November 2014



CPR (-)	18	11	9	9
CPR (+)	14	3	2	2

Predicted hospital survival by SAVE score risk class 30% (30 to 42)

Discharged alive from ICU 9/12 (75%)
Discharged alive from hospital 9/12 (75%)
Alive at follow-up 9/12 (75%)

BARCELONA

VA-ECMO for profound vasoparalysis ? (hyperdynamic septic shock)

- From hypodynamic to hyperdynamic septic shock (+72-96h from drop of SV/CI)
- $MAP = CO * SVR$
- Chasing MAP with high CO !
- Evidence in children (low BMI)
- Adults require high ECMO blood flows and cannulas up to 51F (central ECMO with sternotomy)
- Adding another peripheral ECMO.....?

Echocardiography in extracorporeal life support: A key player in procedural guidance, tailoring and monitoring

Refractory septic shock in children: a European Society of Paediatric and Neonatal Intensive Care definition



Luc Morin¹, Samiran Ray², Clare Wilson³, Solenn Remy⁴, Mohamed Rida Benissa¹, Nicolaas J. G. Jansen⁵, Etienne Javouhey⁴, Mark J. Peters², Martin Kneyber^{6,7}, Daniele De Luca⁸, Simon Nadel³, Luregn Jan Schlapbach^{9,10,11}, Graeme Maclaren^{12,13}, Pierre Tissieres^{1,14*} and ESPNIC Refractory Septic Shock Definition Taskforce the Infection Systemic Inflammation Sepsis section of ESPNIC¹⁵

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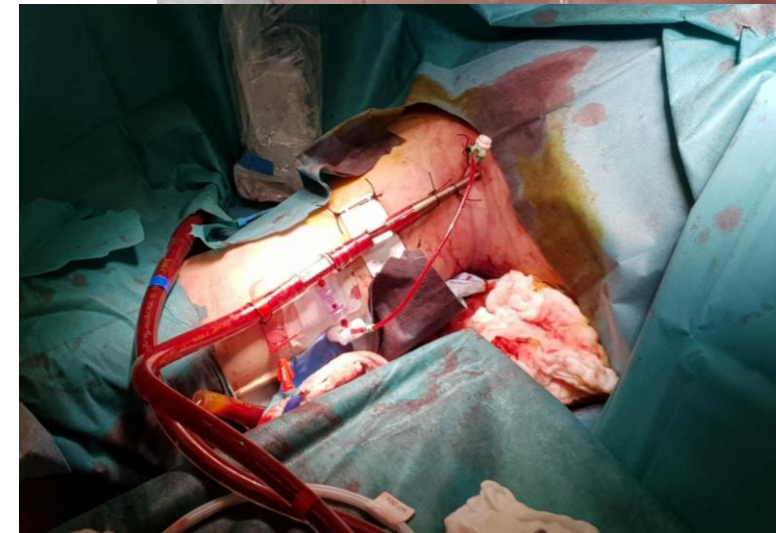
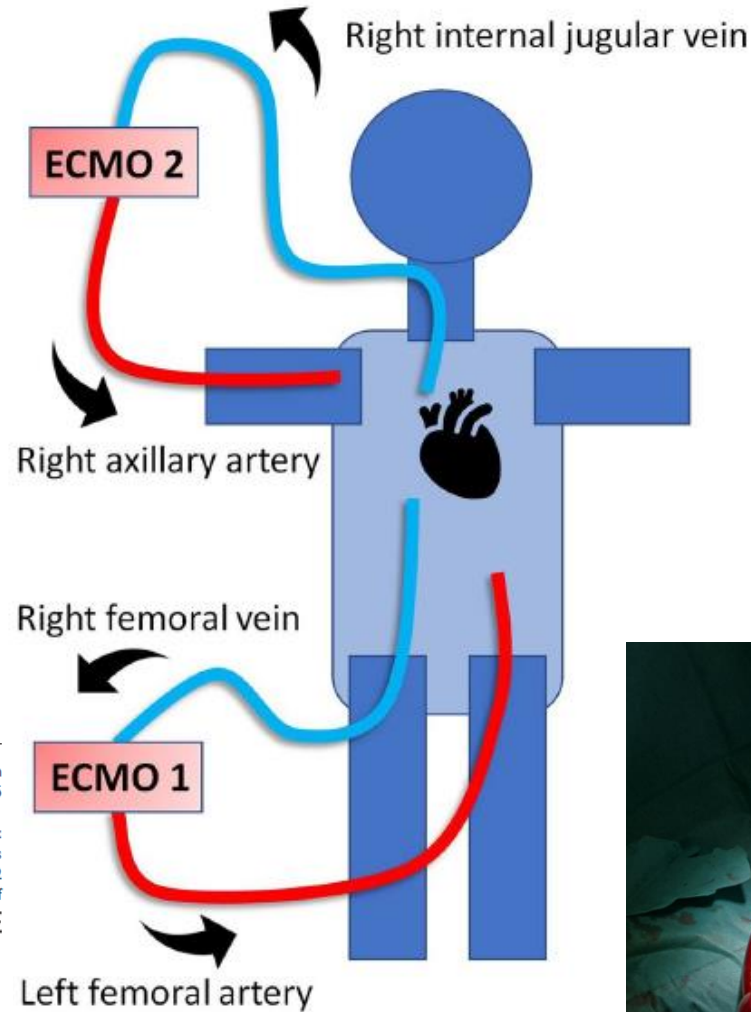
Perfusion
1-11

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DOI: 10.1177/0267659118766438
journals.sagepub.com/home/prf



Dual VA-ECMO for profound vasoparalysis ?

- Rescue for a refractory hyperdynamic septic shock (+72-96h..)
- $MAP = CO * SVR$
- Chasing MAP with high CO (12-15 l/min)
- Axillar VA-ECMO added (3.5 l/min CO)
- No sternotomy
- Weaning and reversal: 2x VA-ECMO:
 - V-AV with 1.5 l/min return via SVC
 - later to VV-ECMO...explant



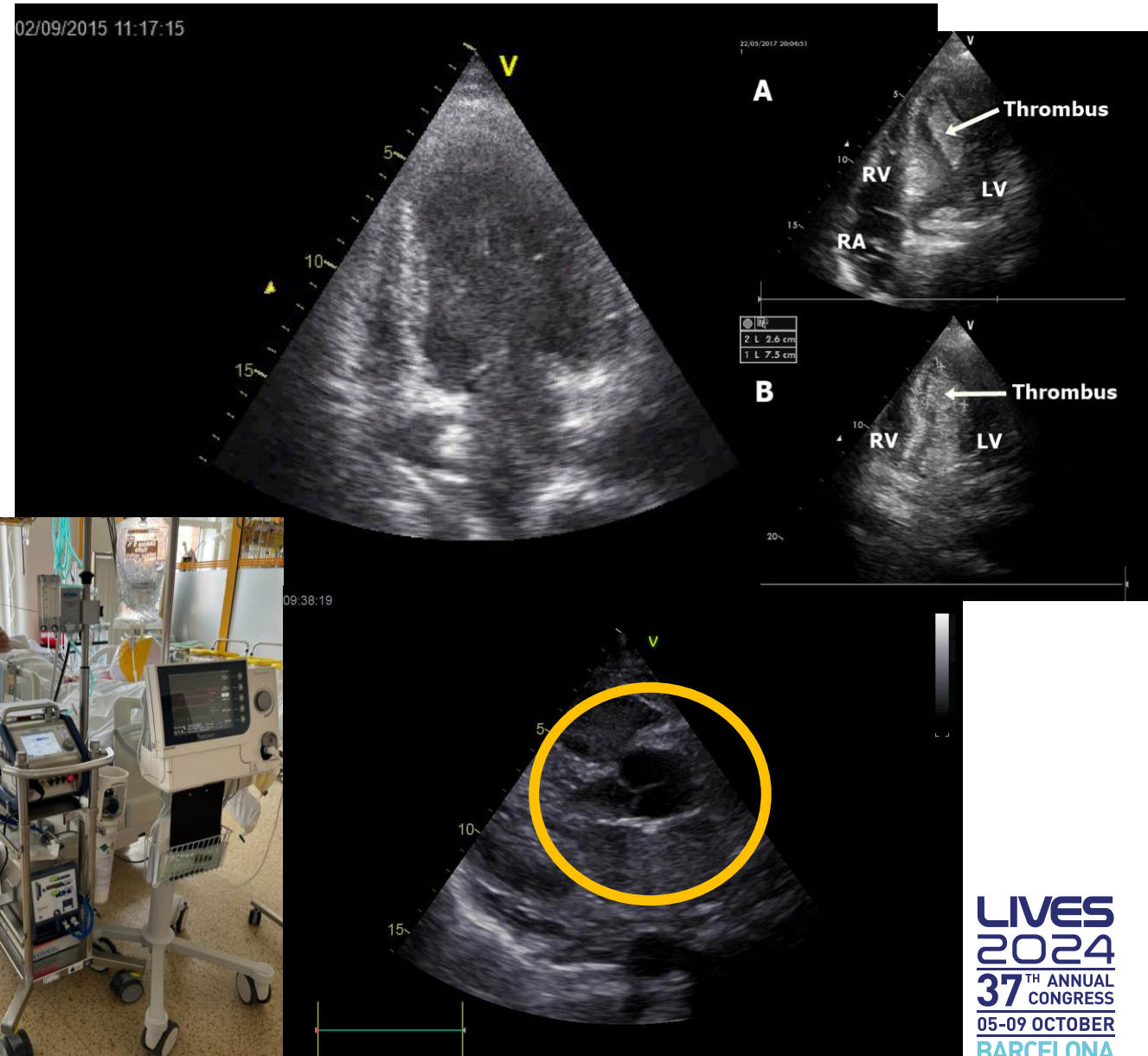
Perfusion
1-5
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DOI: 10.1177/0267659121998962
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SAGE

Dual veno-arterial extra-corporeal membrane oxygenation support in a patient with refractory hyperdynamic septic shock: a case report

Michal Porizka,¹ Jan Rulisek,¹ Marek Flaksa,¹ Michal Otahal,¹
Michal Lips,¹ Jan Belohlavek² and Martin Balik¹

VA with no or minimal heart unloading (...<10-30% of VA-ECMO cases)

- Minimum CO of 1-2 l/min on VA-ECMO
- If not: risk of thrombus formation LV/LA
- Coronary flow dependent solely on the VA-ECMO.....
 - LVEDP↑+ catecholamines
 - ...myocardial DO_2/VO_2 mismatch
- Pulmonary edema
- Unloading
 - Impella
 - Atrial trans-septal vent
 - PA drainage
 - Surgical vent of LV/LA
 - IABP



Impella or ECPella

- Archimedes pump
- Improves flow in aortic root and coronary circulation
- LVEDP -10mmHg
- Reduces afterload effect
- Impella CP 3.5 – peripheral insertion – distal leg perfusion
- Impella 5.5 – subcl. prosthesis – bridge to recovery, LVAD, HTx
- Not suitable in AR or LV thrombus
- VA-ECMO weaned first

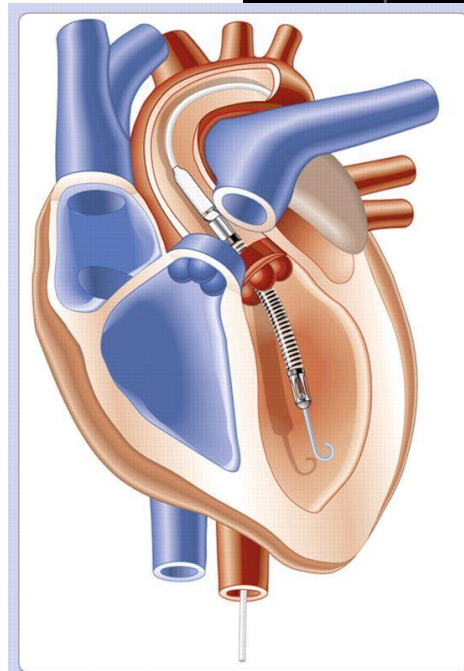
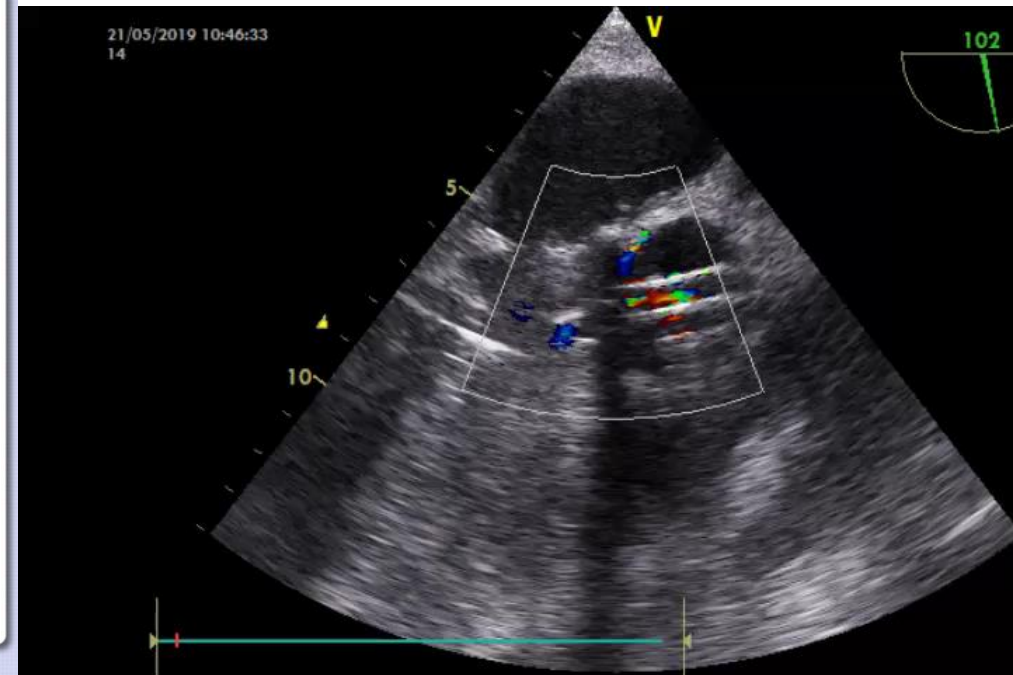


Image courtesy ABIOMED Inc, Danvers, Massachusetts



Impact of LV unloading on outcome: early vs routine vs patient tailored ?

ORIGINAL ARTICLE

Optimal Strategy and Timing of Left Ventricular Venting During Veno-Arterial Extracorporeal Life Support for Adults in Cardiogenic Shock

A Systematic Review and Meta-Analysis

Abdulrahman A. Al-Fares, MD*; Varinder K. Randhawa, MD, PhD*; Marina Englesakis, MLIS; Michael A. McDonald, MD; A. Dave Nagpal, MD, MHSc; Jerry D. Estep, MD; Edward G. Soltesz, MD, MPH; Eddy Fan, MD, PhD

Venting side effects

- Malposition
- Haemolysis
- RRT and ARF
- Bleeding, sepsis, limb ischaemia
- Longer VA support and IPPV

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Microaxial Flow Pump or Standard Care in Infarct-Related Cardiogenic Shock

J.E. Møller, T. Engstrøm, L.O. Jensen, H. Eiskjær, N. Mangner, A. Polzin,



European Journal of Heart Failure (2023) 25, 2037–2046
doi:10.1002/ehf.3014

RESEARCH ARTICLE

Early left atrial venting versus conventional treatment for left ventricular decompression during venoarterial extracorporeal membrane oxygenation support: The EVOLVE-ECMO randomized clinical trial

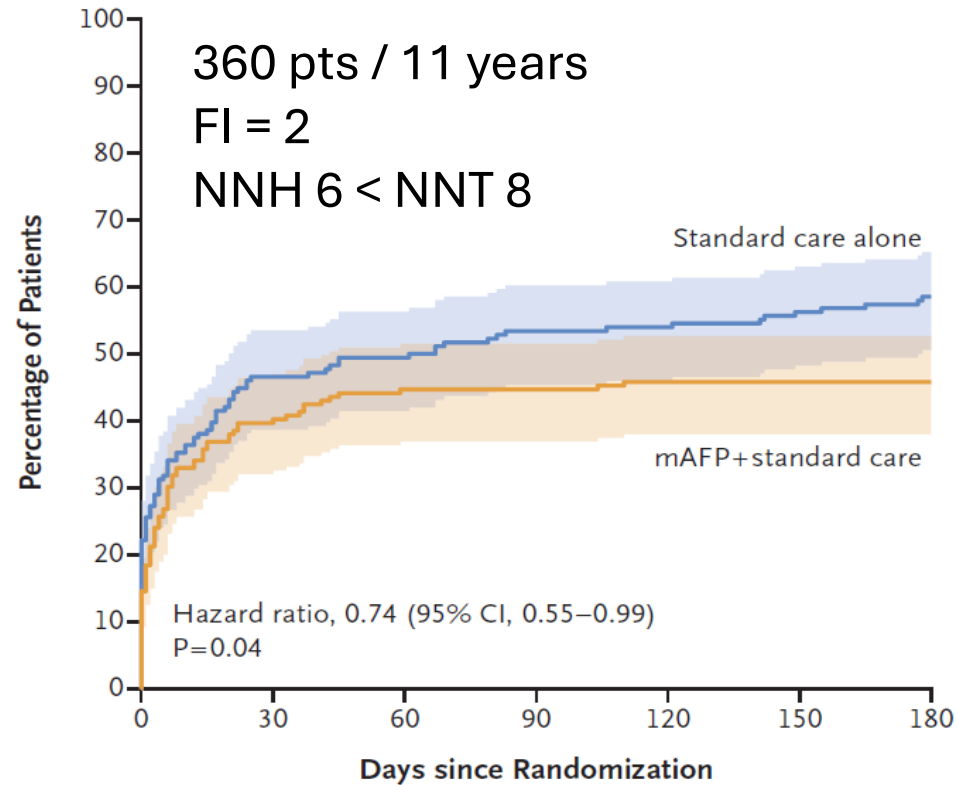
Hanbit Park^{1,2}, Jeong Hoon Yang³, Jung-Min Ahn¹, Do-Yoon Kang¹, Pil Hyung Lee¹,

Early Left Ventricular Unloading or Conventional Approach After Venoarterial Extracorporeal Membrane Oxygenation: The EARLY-UNLOAD Randomized Clinical Trial

Min Chul Kim, Yongwhan Lim, Seung Hun Lee, Yoonmin Shin, Joon Ho Ahn, Dae Young Hyun, Kyung Hoon Cho, Doo Sun Sim, Young Joon Hong, Ju Han Kim, Myung Ho Jeong, ... See all authors

Originally published 18 Oct 2023 |
<https://doi.org/10.1161/CIRCULATIONAHA.123.066179> |
Circulation. 2023;148:1570–1581

A Death from Any Cause

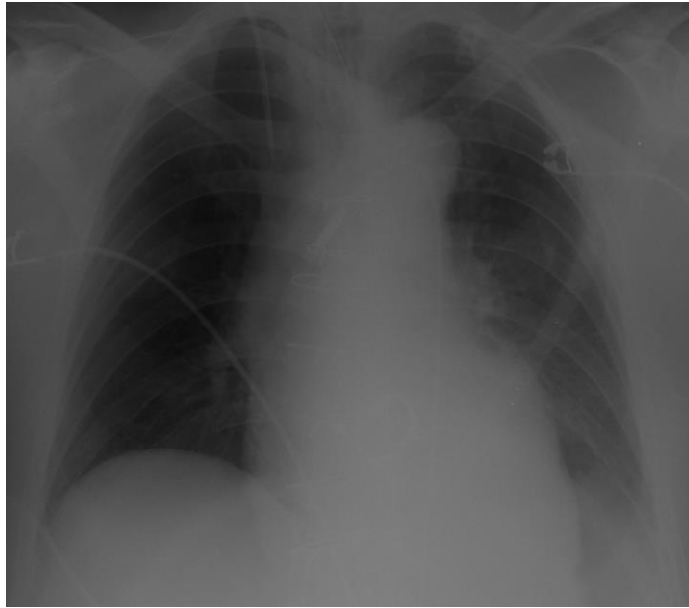


No. at Risk

Standard care	176	94	89	82	81	77	72
mAFP+standard care	179	108	99	99	97	97	97



Impella malposition: echocardiography and impact on unloading



ESC
European Society
of Cardiology

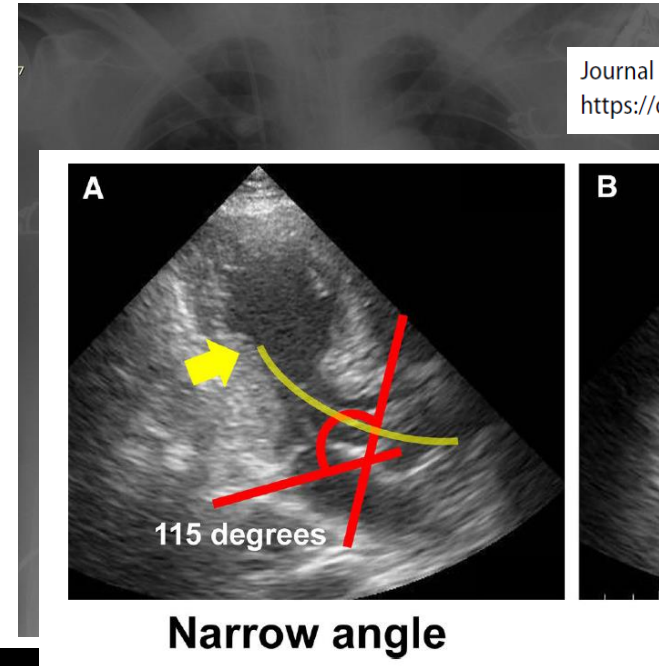
European Heart Journal - Cardiovascular Imaging (2024) 00, 1–16
<https://doi.org/10.1093/ehjci/ehae219>

EACVI DOCUMENT

Imaging in acute percutaneous mechanical circulatory support in adults: a clinical consensus statement of the Association for Acute CardioVascular Care (ACVC) of the ESC, the European Association of Cardiovascular Imaging (EACVI) of the ESC and the European branch of the Extracorporeal Life Support Organization (EuroELSO)

Guido Tavazzi^{1,2,§†}, Susanna Price^{3,4†}, Jan Otto Beitnes⁵, Caroline Bleakley⁶, Martin Balik⁷, Stijn Lochy⁸, Jacob Eifer Moller⁹, Fabio Guarracino¹⁰, Erwan Donal¹¹, Dirk W. Donker^{12,13}, Jan Belohlavek¹⁴, and Christian Hassager¹⁵

Journal of Artificial Organs (2020) 23:207–213
<https://doi.org/10.1007/s10047-020-01172-1>



Narrow angle

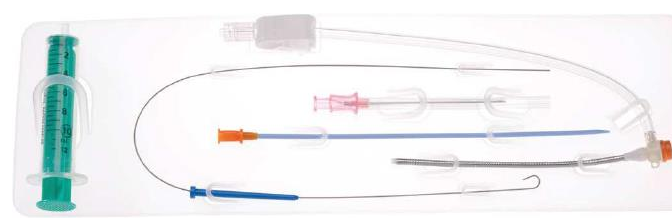
Wide angle



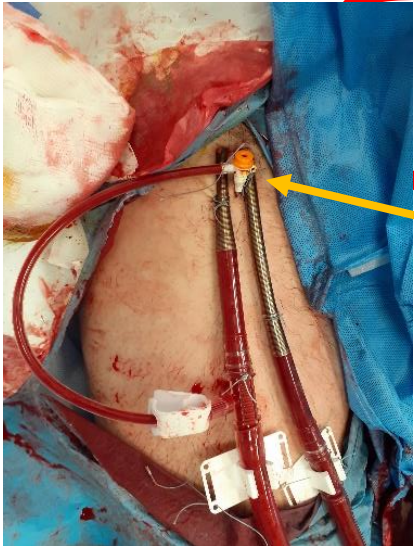
- Malposition – depth 3.5 cm (CP) to 4.5-5 cm (5.5)
- Malrotation (MV apparatus)
- ! MV to AV angle $\leq 127^\circ$ in A2C
- IV septum position – RV function, volaemia

Distal leg perfusion and Ecpella

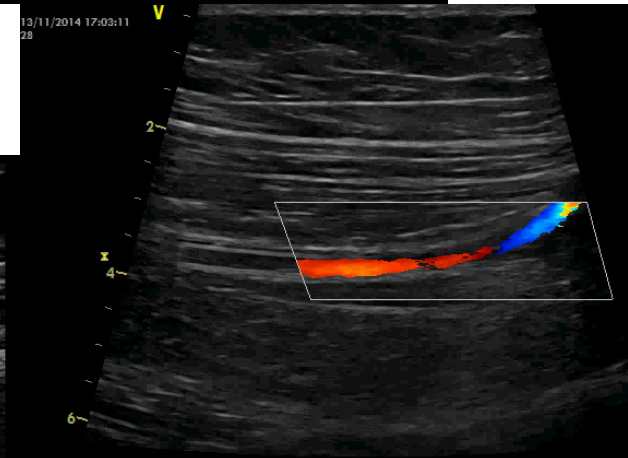
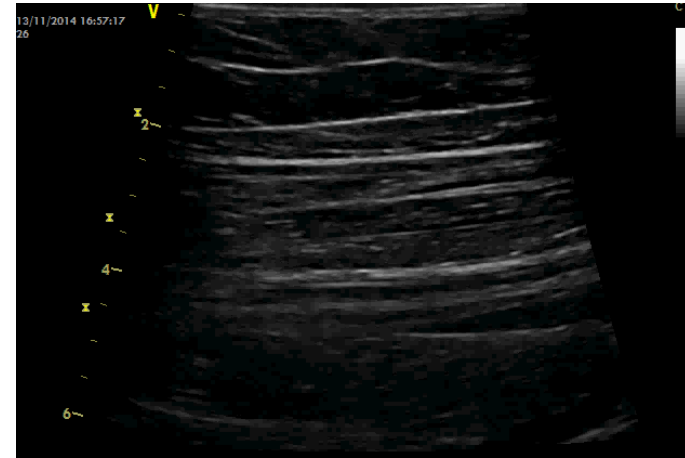
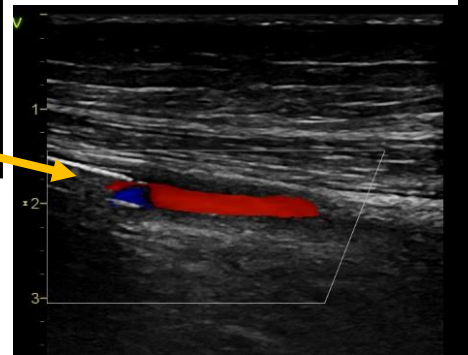
- Routine on VA-ECMO
- Ecpella may require a cross-over distal perfusion
- weaning: last 0.5 l/min Qb for limited time (critical leg hypoperfusion)
- alternatives
 - leg NIRS when thin return aortic cannula
 - a. dors. pedis pressure curve monitoring



O₂
oxygenator

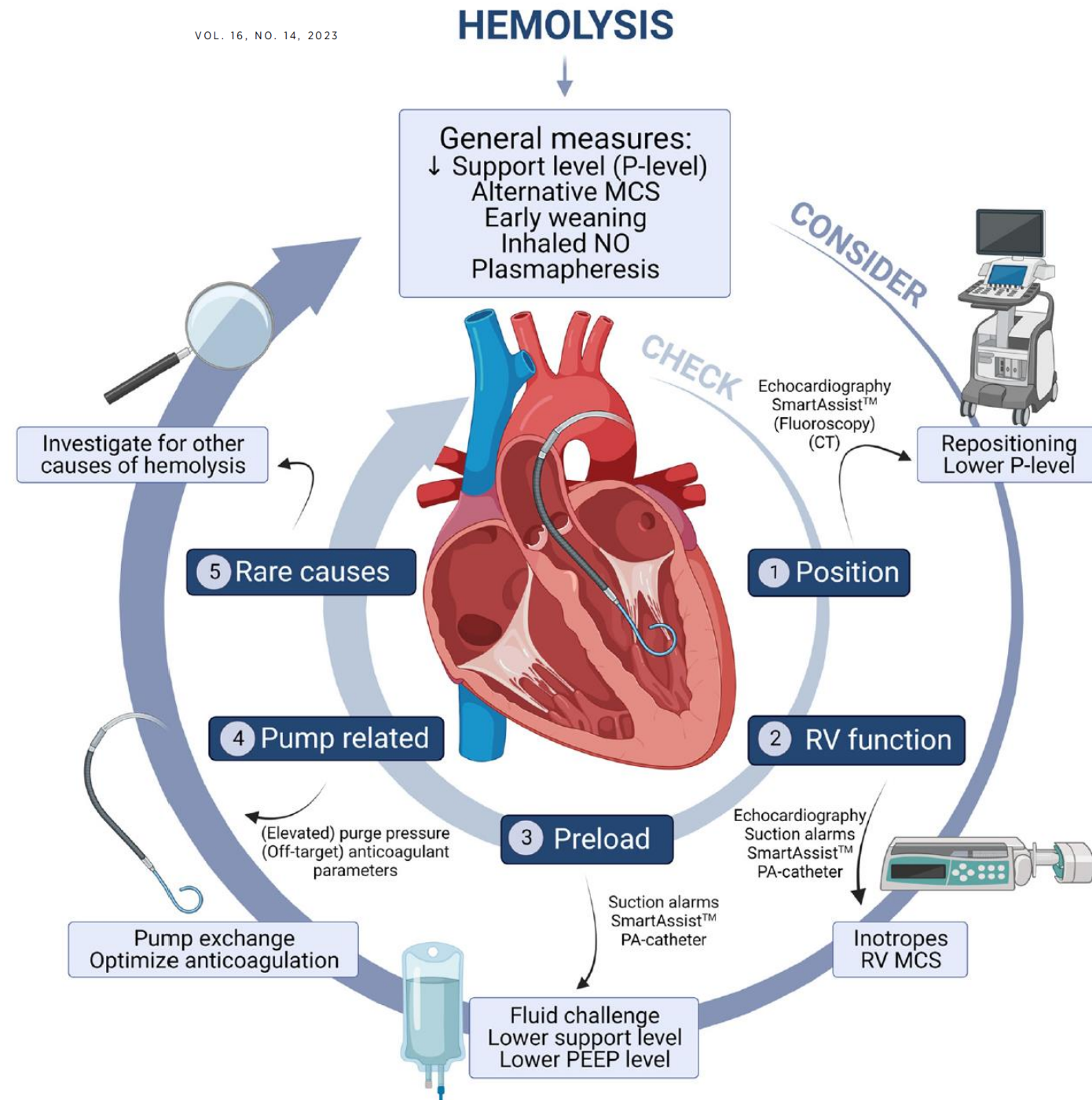


a. fem.

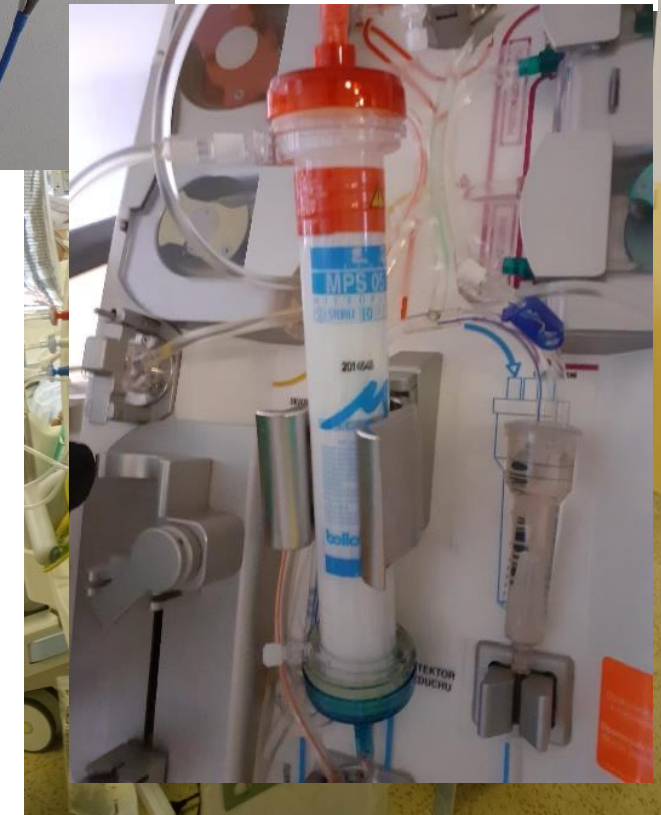
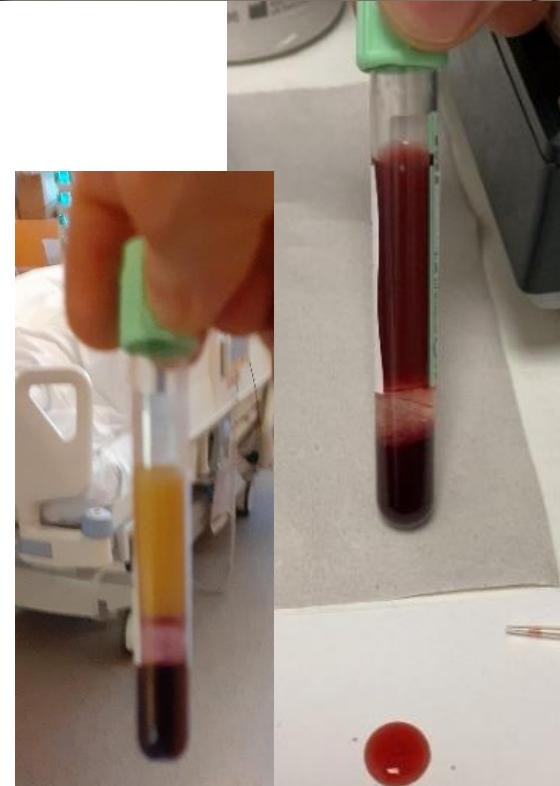


Haemolysis

- fHb reduces NO (consumption, blocks iNOS) – when haptoglobin saturated
- Vasoconstriction, platelet activation, thrombosis
- Acquired vWf syndrome
- Pigment nephropathy, ATN, ARF
- NOMI – bact. translocation and sepsis
- Purge solution – 25.000 IU UFH/1000 ml crystalloid or 25 ml 8.4% bicarbonate
- Prevention of thrombus – increases fHb



-



VA-ECMO (heart and lung assist) is circulatory support - not a heart replacement,...neither is Impella

- Progressing refractory cardiogenic shock, „stage D“: $CI < 1.8 \text{ l/min.m}^2$

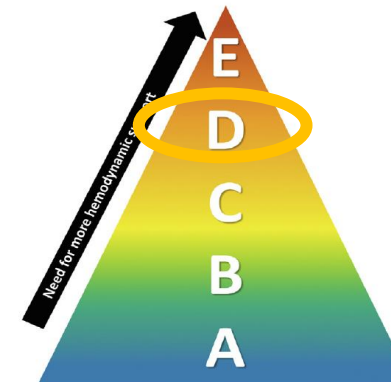
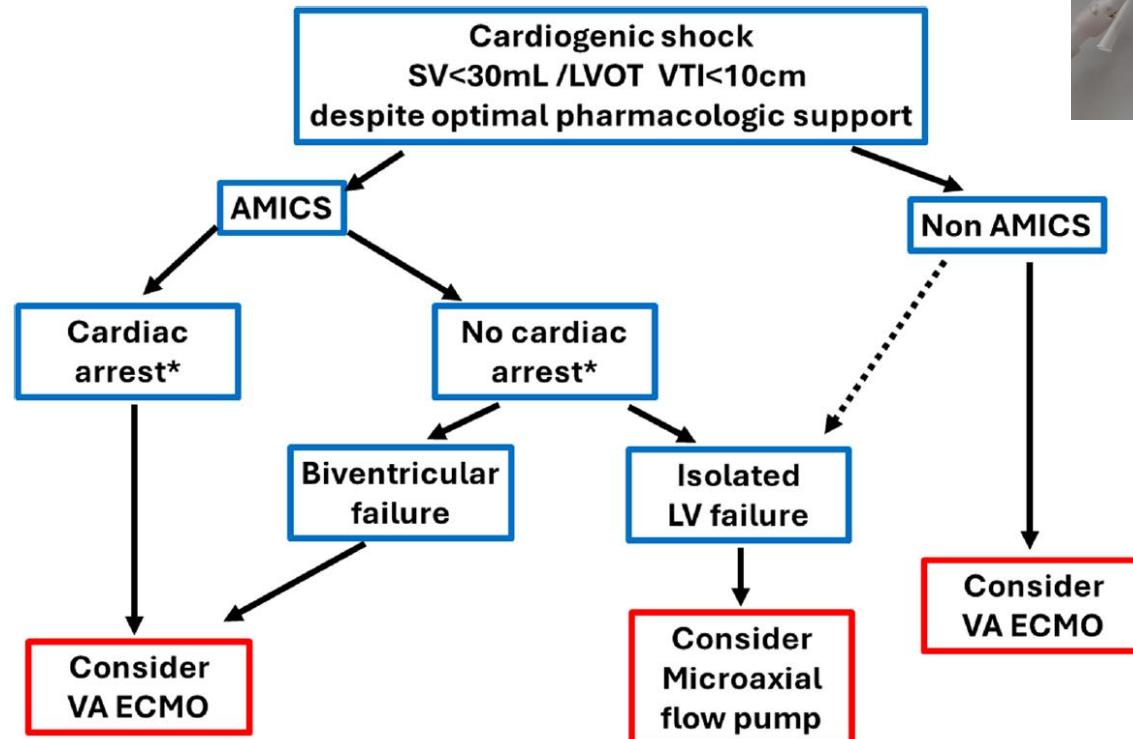
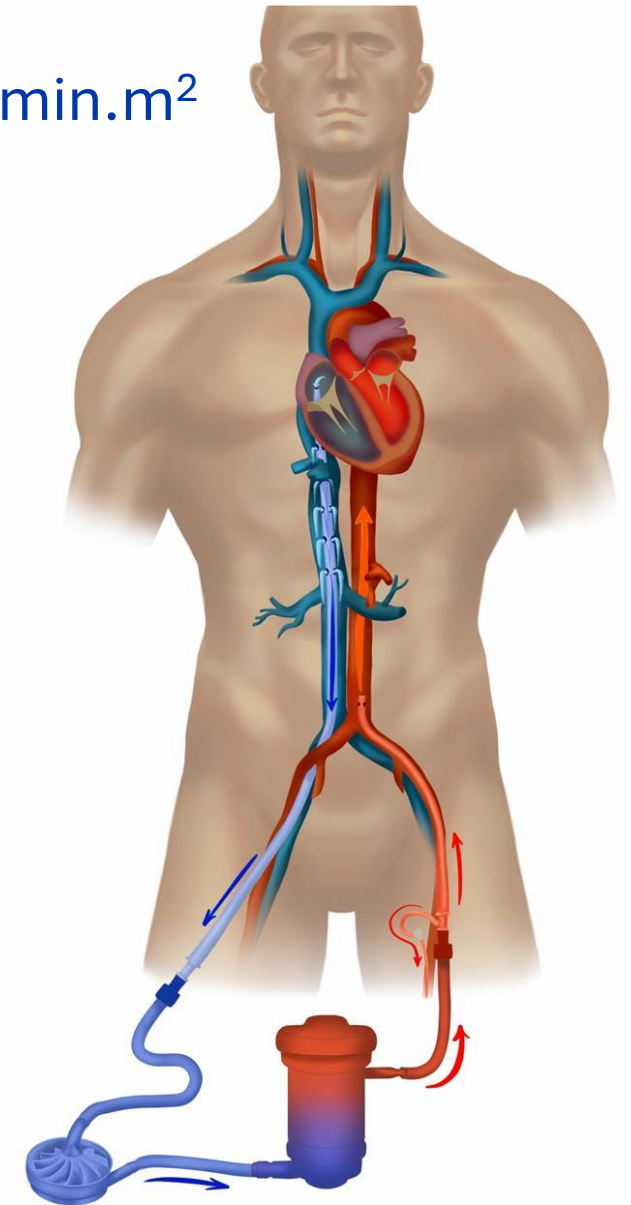
COMMENT

Open Access



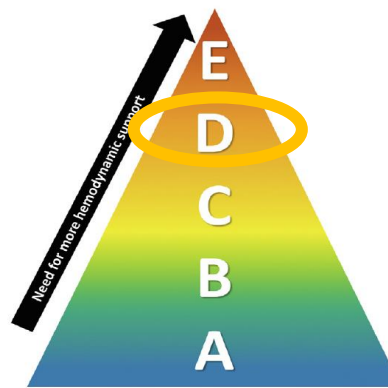
Mechanical circulatory support in cardiogenic shock: microaxial flow pumps for all and VA-ECMO consigned to the museum?

Daniel De Backer^{1*}, Dirk W. Donker^{2,3}, Alain Combes⁴, Alexandre Mebazaa⁵, Jacob E. Moller^{6,7} and Jean-Louis Vincent⁸



Progressing shock in intoxications: VA-ECMO

- Antihypertensives and antiarrhythmics.....when the time window for elimination from GI tract is missed.....and external pacing + inotropic/vasopressor support fail
 - Ca-channel blockers
 - ACE inhibitors and sartans (SVR !)
 - Yew tree
 - Betablockers
 - Digoxin (on the decline...)
- Prague GUH 4-5 patients/year



Experts Consensus Recommendations for the Management of Calcium Channel Blocker Poisoning in Adults

J. Med. Toxicol. (2013) 9:54–60
DOI 10.1007/s13181-012-0281-8

REVIEW ARTICLE

Maude St-Onge, MD, PhD, FRCPC¹; Kurt Anseeuw, MD, MSc²; Frank Lee Cantrell, PharmD, DAB¹

A Review of Emergency Cardiopulmonary Bypass for Severe Poisoning by Cardiotoxic Drugs

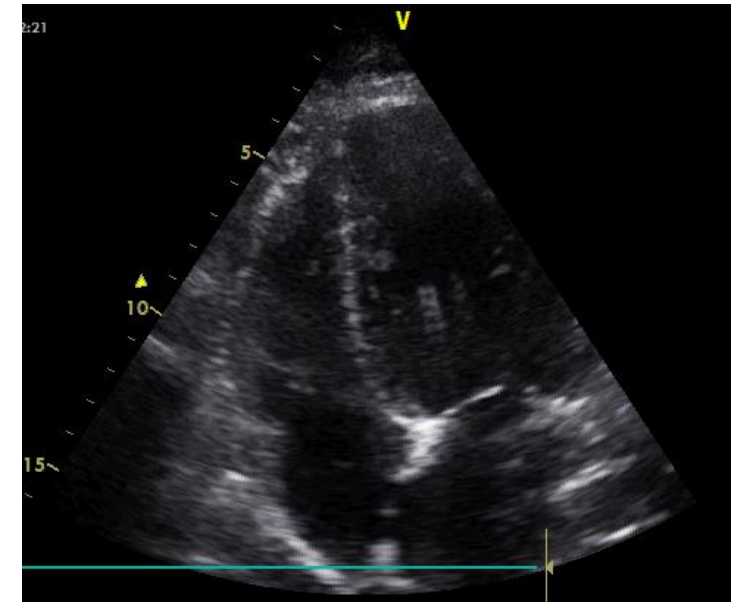
Nicholas J. Johnson • David F. Gaieski • Steven R. Allen •
Jeanmarie Perrone • Francis DeRoos

Clinical review: Aggressive management and extracorporeal support for drug-induced cardiotoxicity

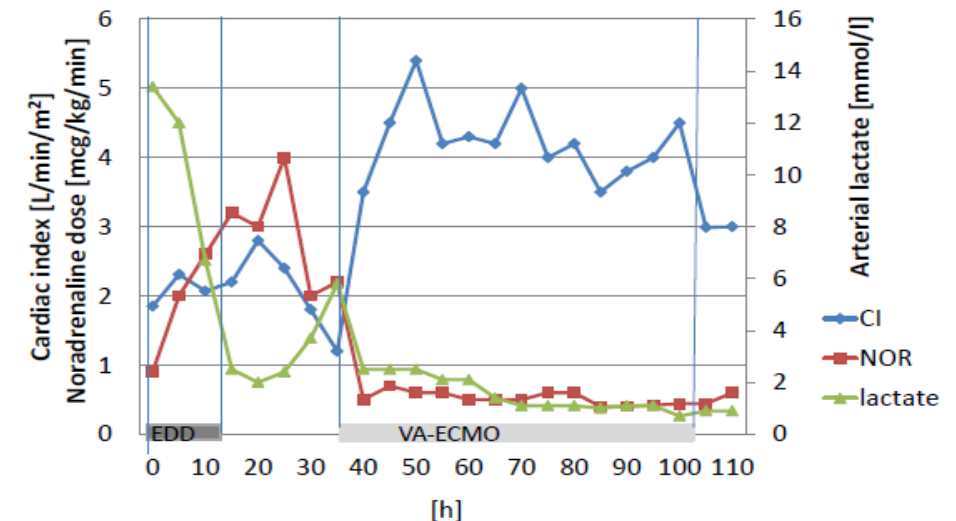
Frédéric J Baud¹, Bruno Megarbane¹, Nicolas Deye¹ and Pascal Leprince²

¹Medical and Toxicological Intensive Care Unit, Assistance Publique-Hôpitaux de Paris, University Paris 7, Hôpital Lariboisière, 75010 Paris, France

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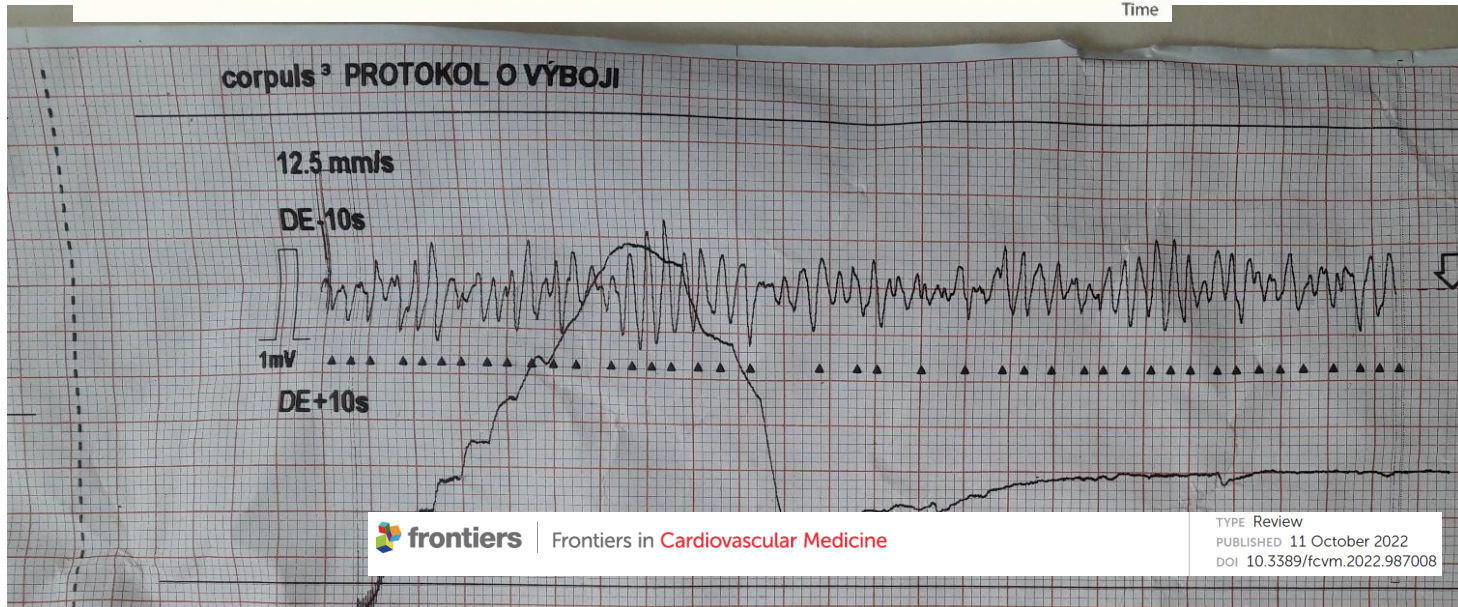
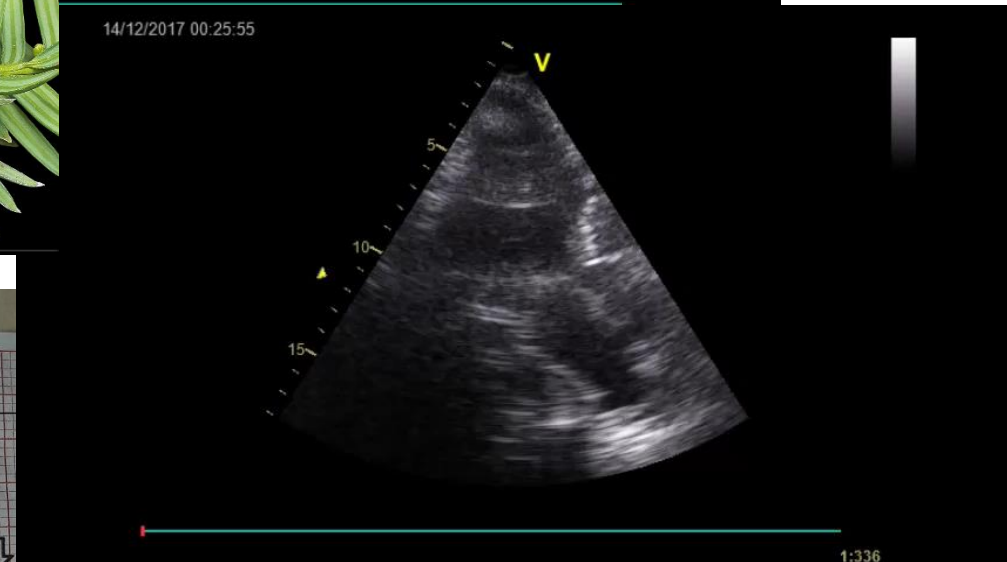
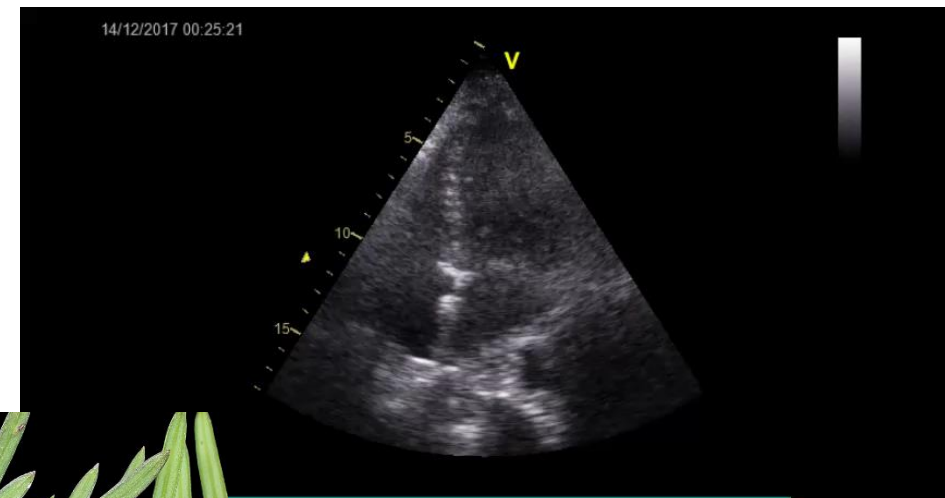
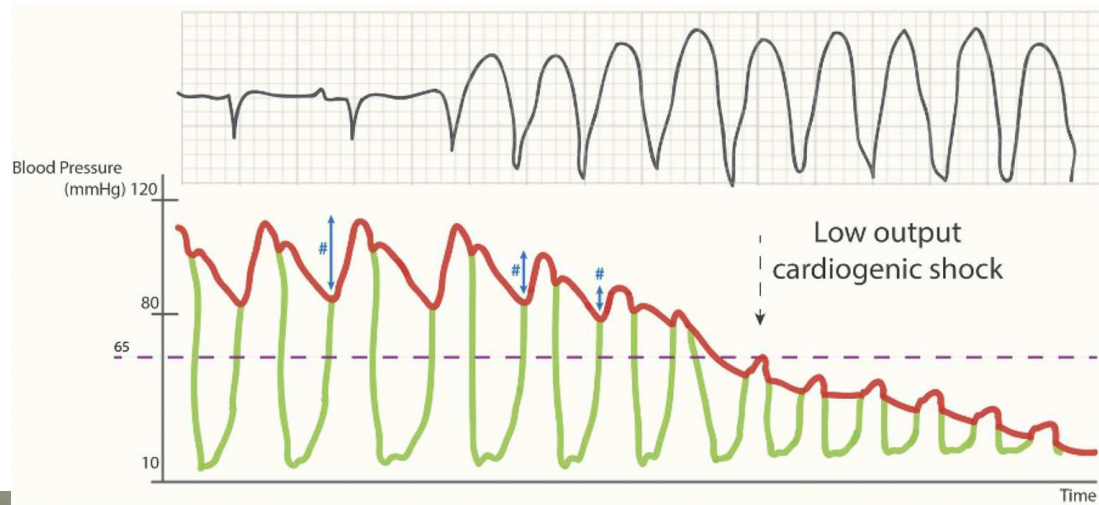


Cardiac index, noradrenaline and arterial lactate



Taxus baccata (Yew tree)

- Arrhythmogenic storm
- VA-ECMO 48-96h



Mechanical circulatory support in ventricular arrhythmias

Guido Tavazzi^{1,2*}, Valentino Dammassa^{3,4},
Costanza Natalia Julia Colombo², Eloisa Arbustini⁵,
Thomas Castelein⁶, Martin Balík⁷ and
Christophe Vandenbriele^{4,8,9}

Refractory shock: Accidental hypothermia



- Meta-analysis Resuscitation 2018: 658 pts with good neurological survival in 40.3%
- asphyxia – „chilled before hypoxic/drowned“
- Reversible $K^+ < 10-12$ mmol/l, pH > 6.5, lowest survived 13-15°C core temperature
- Perfusion 2019: Prague binge drinking weekends, VA-ECMO 3m survival CPS-1 in 90%



Resuscitation

Available online 23 March 2018

In Press, Accepted Manuscript



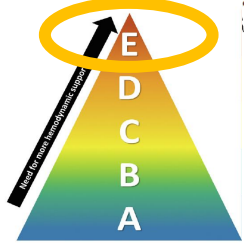
Clinical paper

Prediction of Survival in Accidental Hypothermia Requiring Extracorporeal Life Support: An Individual Patient Data Meta-Analysis

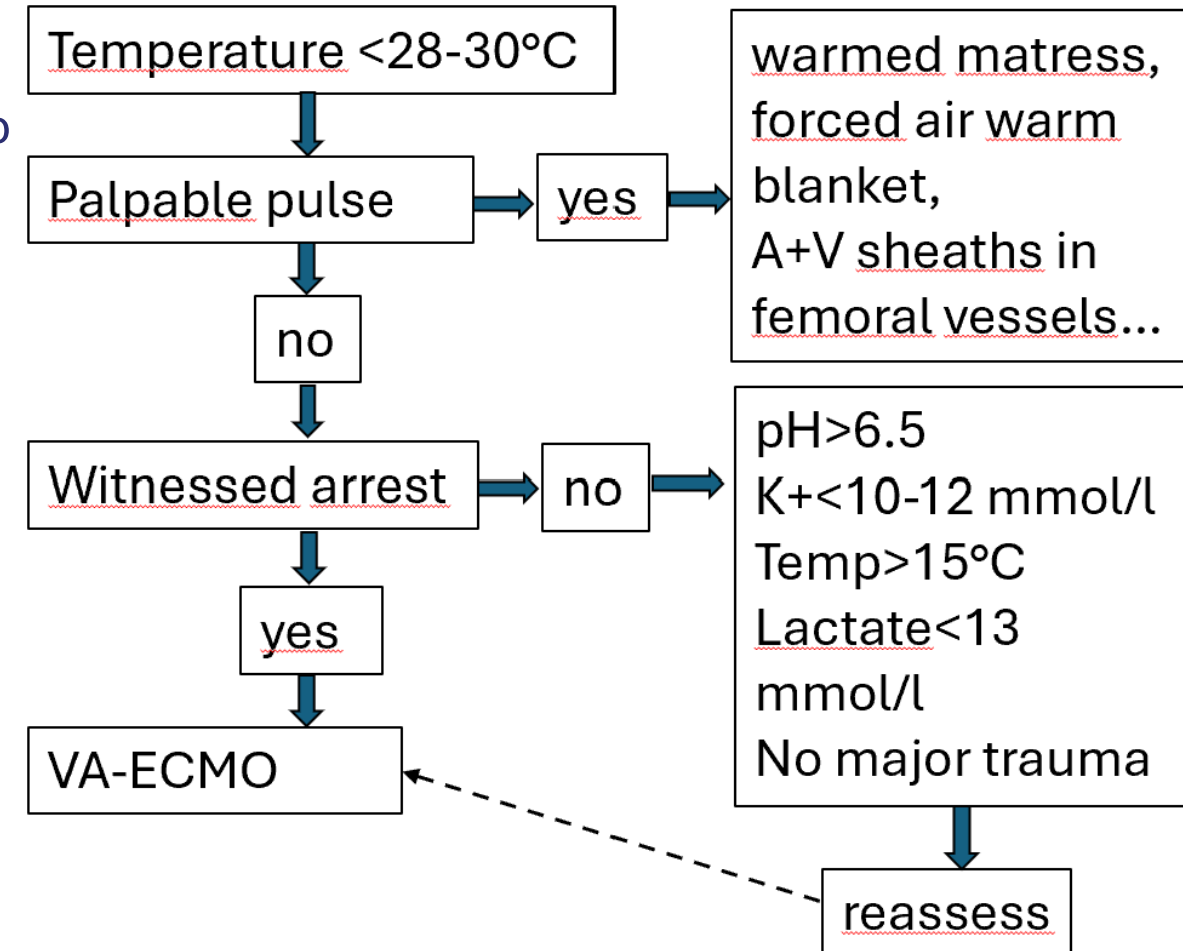
Richard S. Saczkowski^{a,*,}, Doug J.A. Brown^{b,}, Riyad B. Abu-Laban^{c,}, Guy Fradet^{a,}, Costas J. Schulze^{a, d,}, Nick D. Kuzak^{a, f, g}

Management of accidental hypothermia: an established extracorporeal membrane oxygenation centre experience

Martin Balik,¹ Michal Porizka,¹ Vojtech Matousek,¹ Petr Brestovansky,¹ Eva Svobodova,¹ Marek Flaksa,¹ Jan Rulisek,¹ Frantisek Mlejnsky,² Gabriela Hodkova,² Tomas Grus,³ Vaclav Vobruba⁴ and Jan Belohlavek⁵

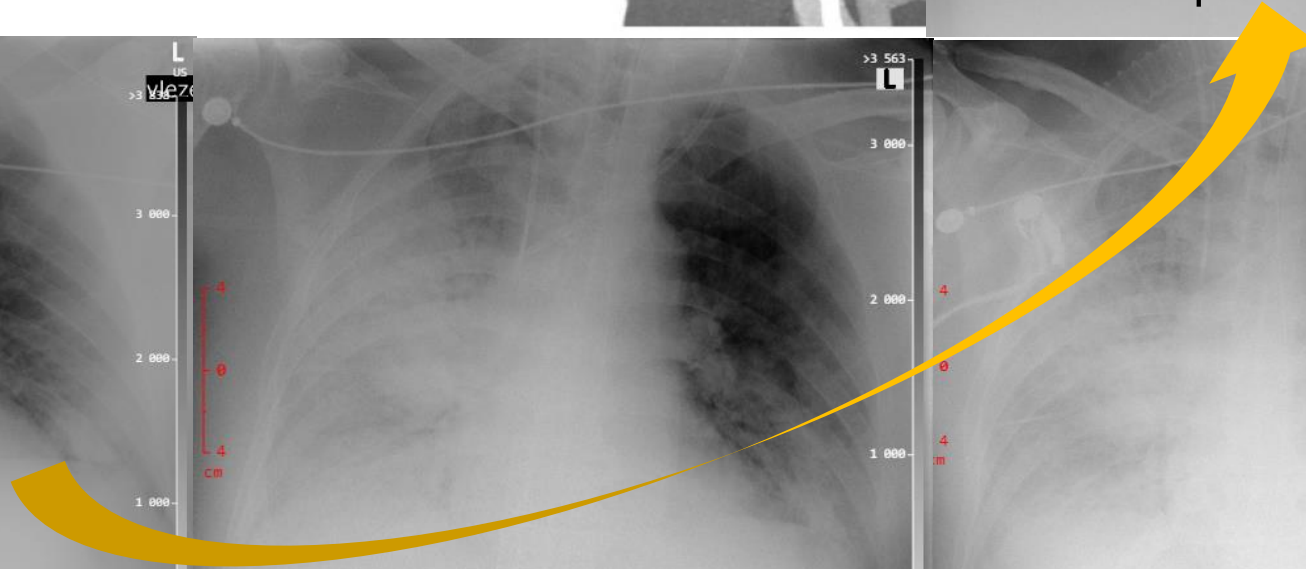
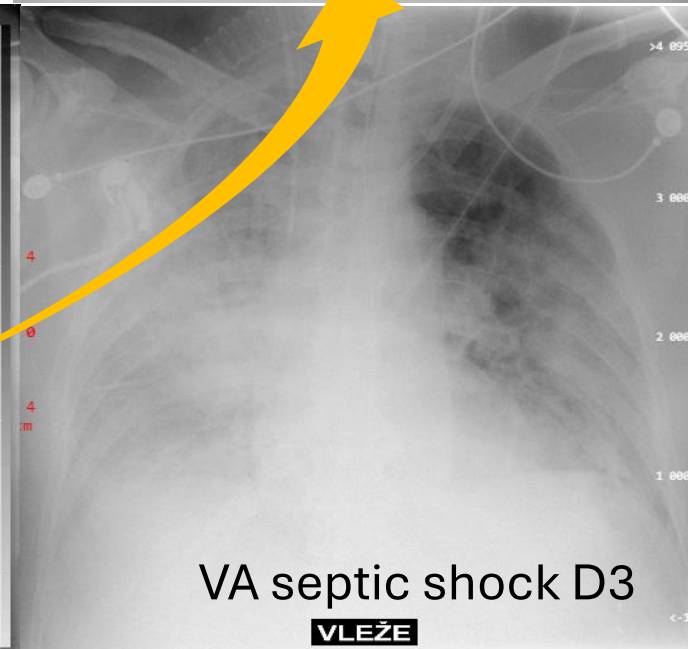
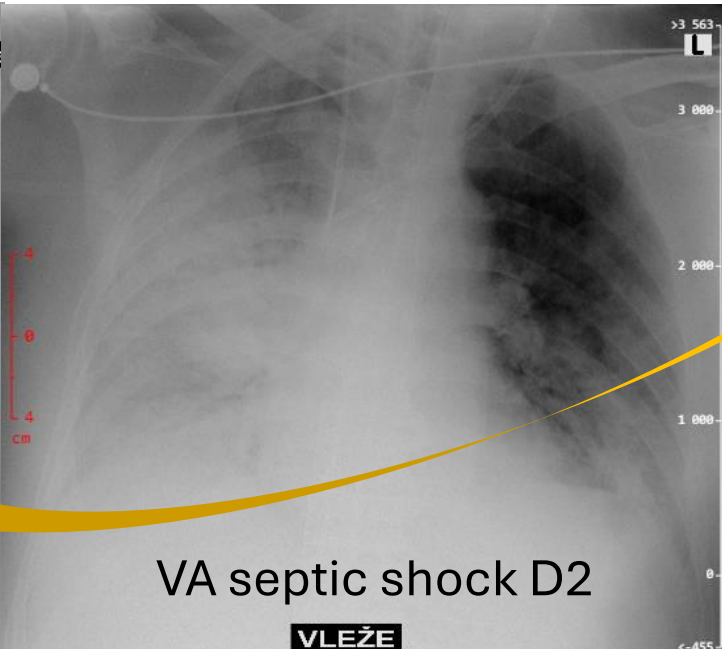
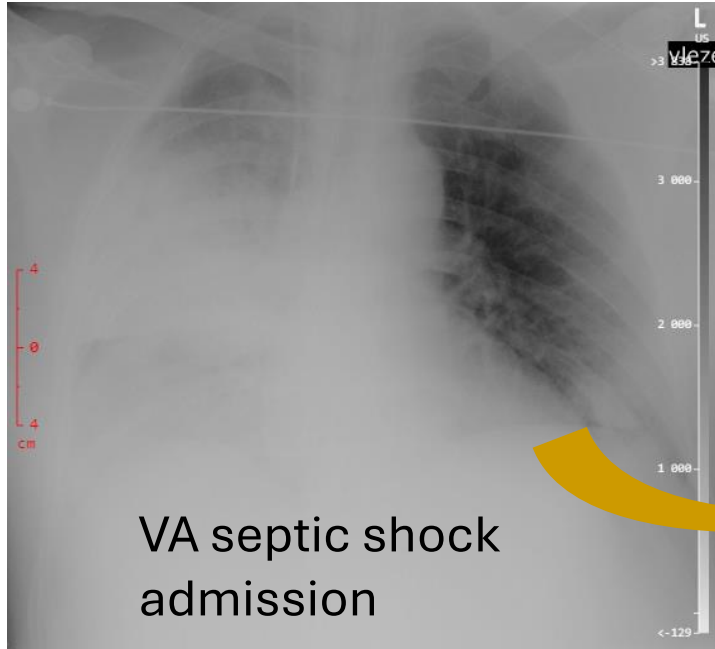
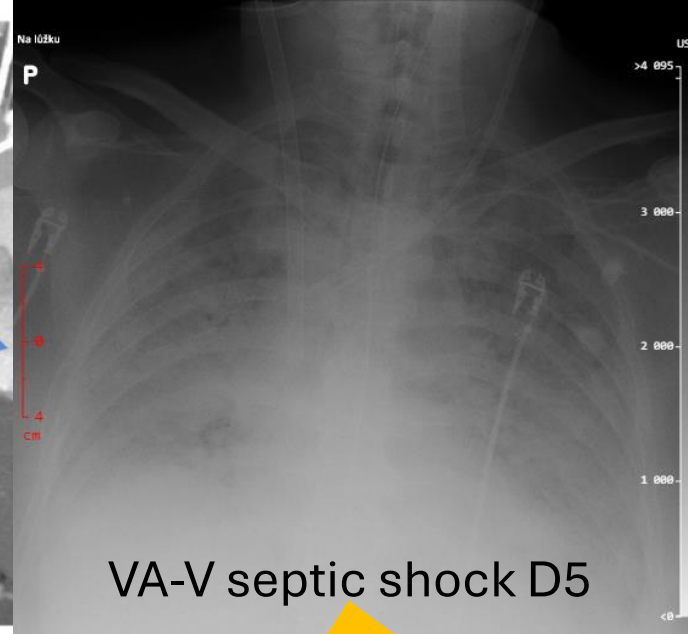
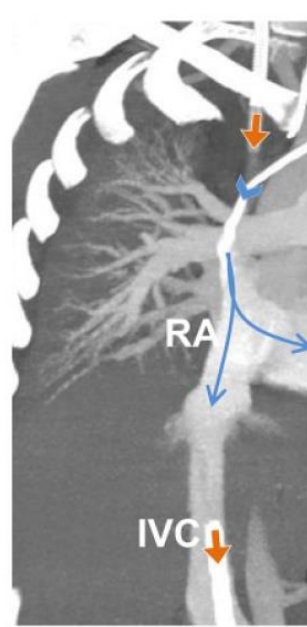


- bypasses ED into ICU with ECMO availability

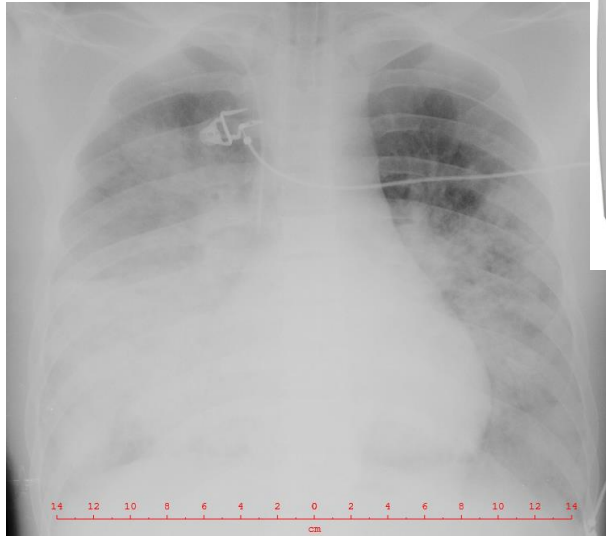


VA-ECMO: Oligemic lungs and implications for imaging

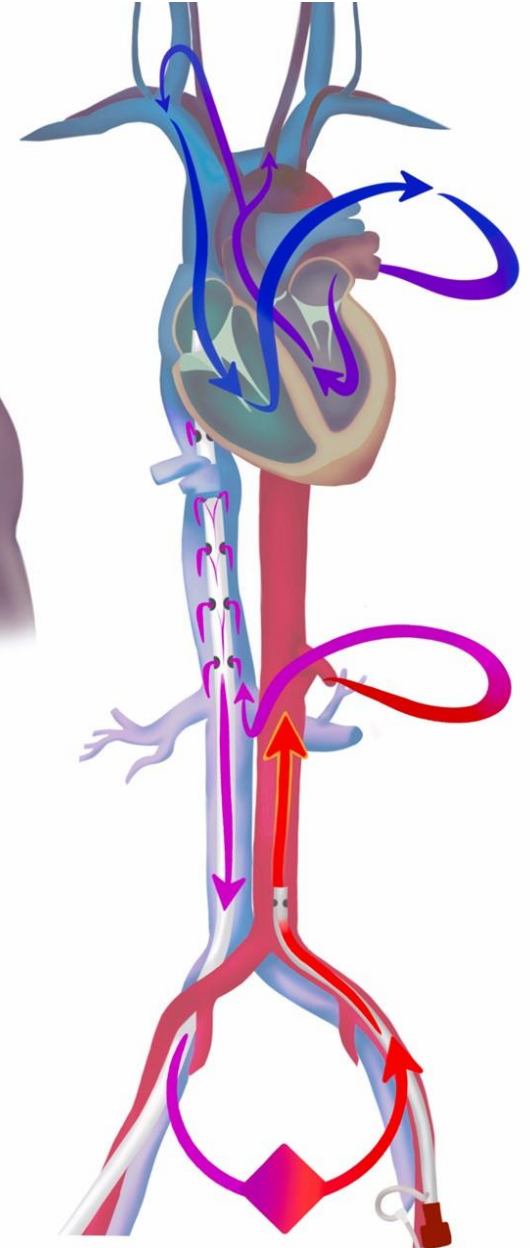
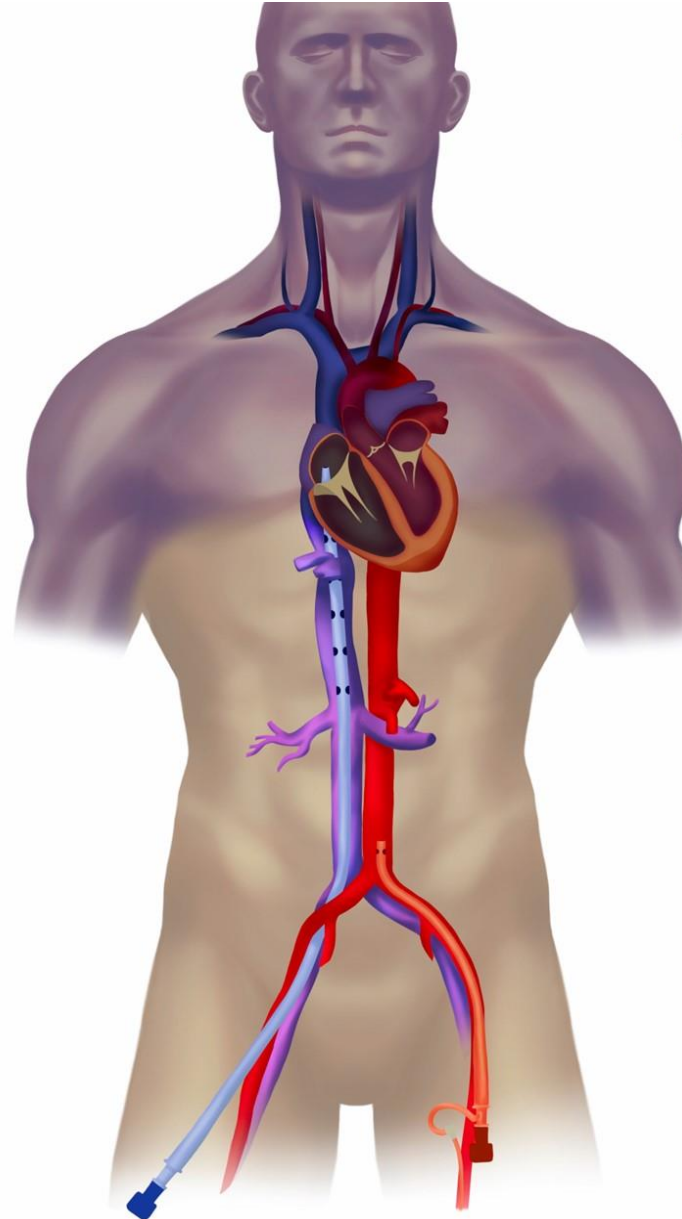
- X-ray may look falsely more aerated – pneumonic infiltrates are less dense
- CT scan with contrast may require
 - transient reduction of Qb
 - place of injection CVC
 - volume and flow of contrast



VA-ECMO: restoration of pulmonary circulation



- ETCO₂ increase, NIRS and SO₂ right hand decrease
 - septic shock and VA-ECMO for TTS
 - resolution of OHCA
- Th: V-AV ECMO
- Restores oxygenation, yet reduces ECMO circulatory support to aorta



Thank you for your attention !

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