



Use of Cytosorb in ECMO patients – our experiences

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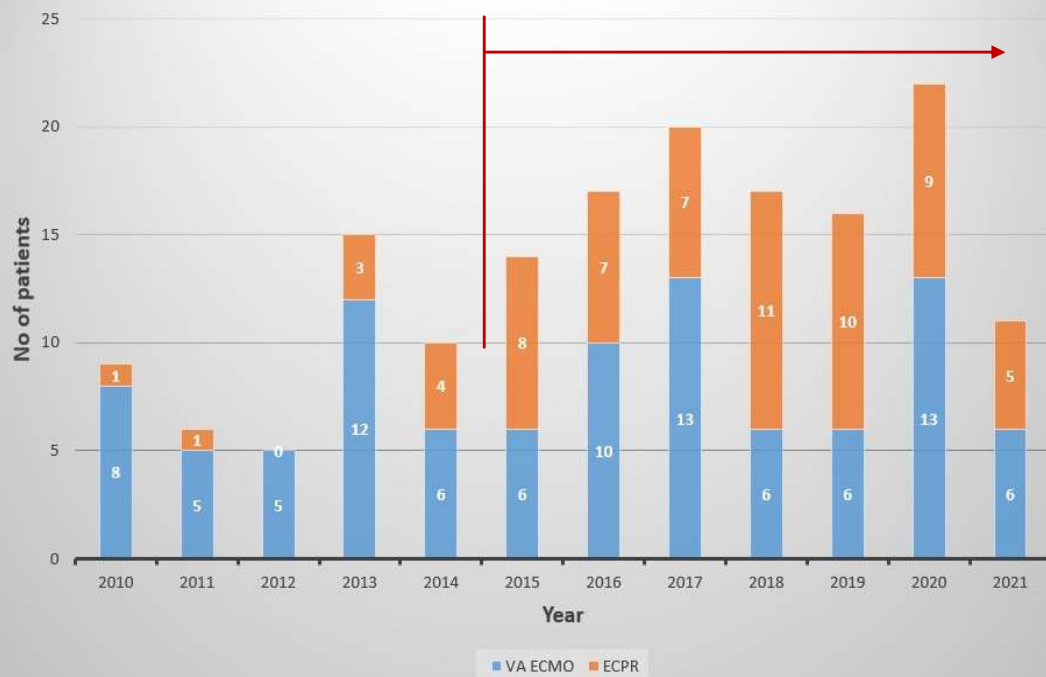


ECMO in KOIIM, UMC Ljubljana

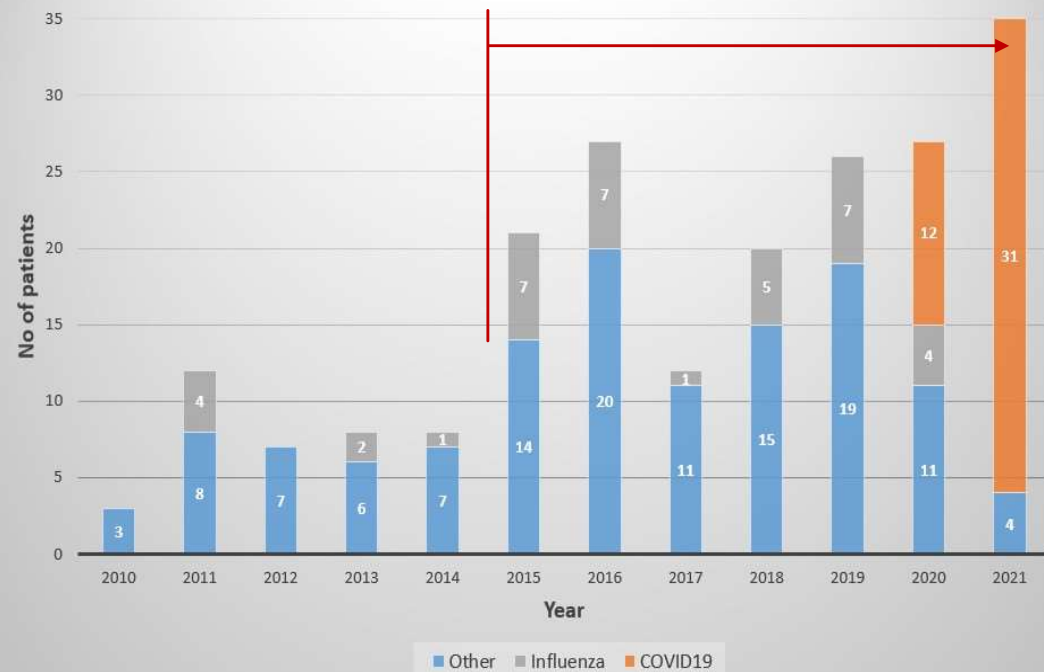
- 14 beds
- 1000 admissions per year



VA ECMO patients (N = 162)



VV ECMO patients (N = 168)



ECMO in KOIIM, UMC Ljubljana

2009 -----> 2022



ECMO in KOIIM, UMC Ljubljana

2009 -----> 2022

VA ECMO

BOLNIK IMA ...

- ✓ akutni miokardni infarkt ali
- ✓ dekompenzacija kroničnega srčnega popuščanja ali
- ✓ miokarditis ali
- ✓ postkardiotomijski šok ali
- ✓ peripartalna kardiomiopatija...

... IN HKRATI NIMA

- Irreverzibilna okvara srca brez možnosti za presaditev srca
- Napredovala maligna bolezen
- Pomembna aortna regurgitacija

RELATIVNE KONTRAINDIKACIJE

- Starost nad 70 let
- Kontraindikacija za antikoagulacijo
- Slaba bolnikova kompenzacija
- Ekstremna debelost
- Kronična prizadetost drugih organov (KOPB, jetna ciroza, kronična ledvična bolezen, napredovala nevrološka bolezen, PAOB)

✓ KARDIOGENI ŠOK

Ki vztraja kljub optimalnemu standardnemu zdravljenju (intubacija, mehanska ventilacija, vazopresorja in inotropna medikamentozna podpora, intraaortna balonska črpalčka)

MOŽEN KANDIDAT ZA VA ECMO

KLJUČI ECMO CENTRI!
01/522 89 52

01/522 89 52
KLJUČI ECMO CENTRI

VV ECMO

BOLNIK IMA ...

- ✓ ARDS kot posledica okužbe dihal, sepe, travme, SIRS, ... ali
- ✓ Primarna bolezen pljuč (cistična fibroza, pljučna fibroza)
- ✓ Irreverzibilna bolezen pljuč
- ✓ Bolnik je kandidat za transplanto

... IN HKRATI NIMA

- smetna ventilacija z visokimi tlačnimi nastavitvami in visokim PEO2 > 7 dni
- Irreverzibilna okvara pljuč brez

ECPR

BOLNIK IMA ...

- ✓ primarni zastoj srca (VF / VT)
- ✓ zastoj pred pričami in takojšen pričetek TPO

... IN HKRATI NIMA

- Pomembne komorbidnosti
- Demenca, napovednost
- Sekundarni srčni zastoj

DOBRO JE VEDETI...

Za lažje odločanje o načinu zdravljenja z ECMO ob konzultaciji potrebujemo naslednje podatke o bolniku:

- Akutna anamneza, komorbidnosti, višina in teža (BMI), vitalne funkcije
- Trenutna terapija
- Laboratorijski izvidi (PNAK, elektroliti, dušični retenti, jetni encimi, troponini, hemogram, koagulacija)
- Parametri ventilacije in trajanje ventilacije
- EKG
- RTG prsnice ali CT prsnega koša
- UZ srca
- Možni bližnji pristopi (pri VV ECMO kanili praviloma vstavljamo preko desne jugularne in femoralne vene, pri VA ECMO pa preko desne femoralne vene in arterije)

ECMO center je smiselno klicati zgodaj v poteku zdravljenja, saj je transport z ECMO zahteven, vstavitve ECMO v regionalni bolnišnici pa manj vama.

V primeru, da bolnik potrebuje vstavitve ECMO v regionalni bolnišnici, je potrebna dostopnost UZ (TEE) ali rentgenske diakopije.

Transport kandidatov za ECMO je zahteven in povezan s pogostimi zapletmi, zato je smiselno kontaktirati

Službo helikopterskega medbolnišničnega transporta –
041/648 782.

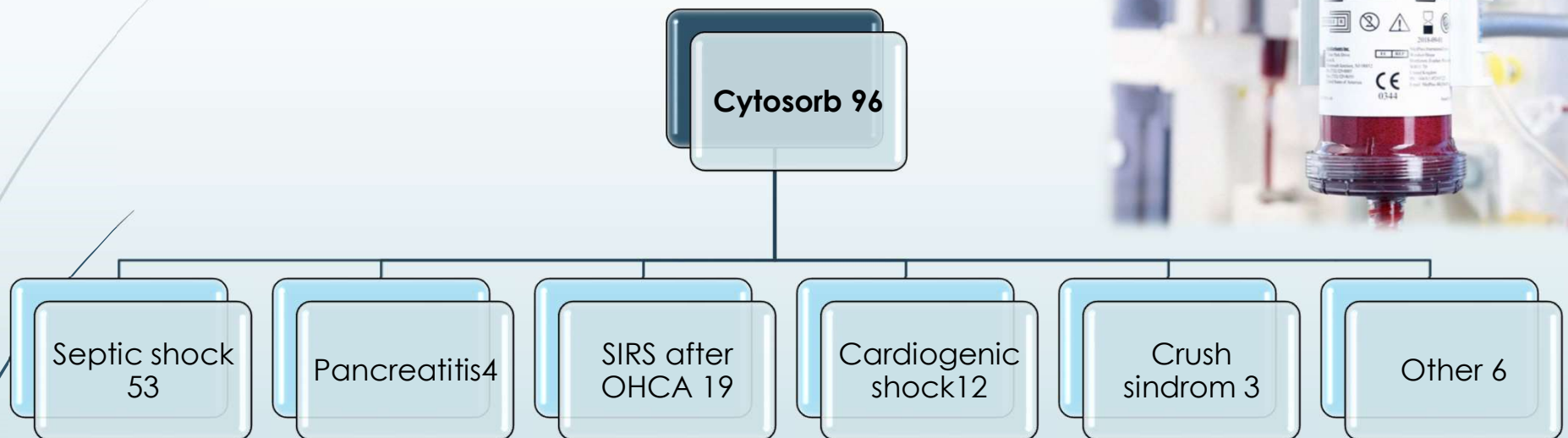
MURRAY SCORE – povprečje seštevka vseh 4 parametrov

parameter/točka	0	1	2	3	4
PaO ₂ /FIO ₂ ob FIO ₂ 100%	≥ 40 kPa	30-40	23-30	13-23	< 13
RTG prsni	normalen	1 točka za vsak infiltrat kvadrant			
PEEP (cm H ₂ O)	≤ 5	6-8	9-11	12-14	≥ 15
kompenzacija (ml/cm H ₂ O)	≥ 80	60-79	40-59	20-39	≤ 19



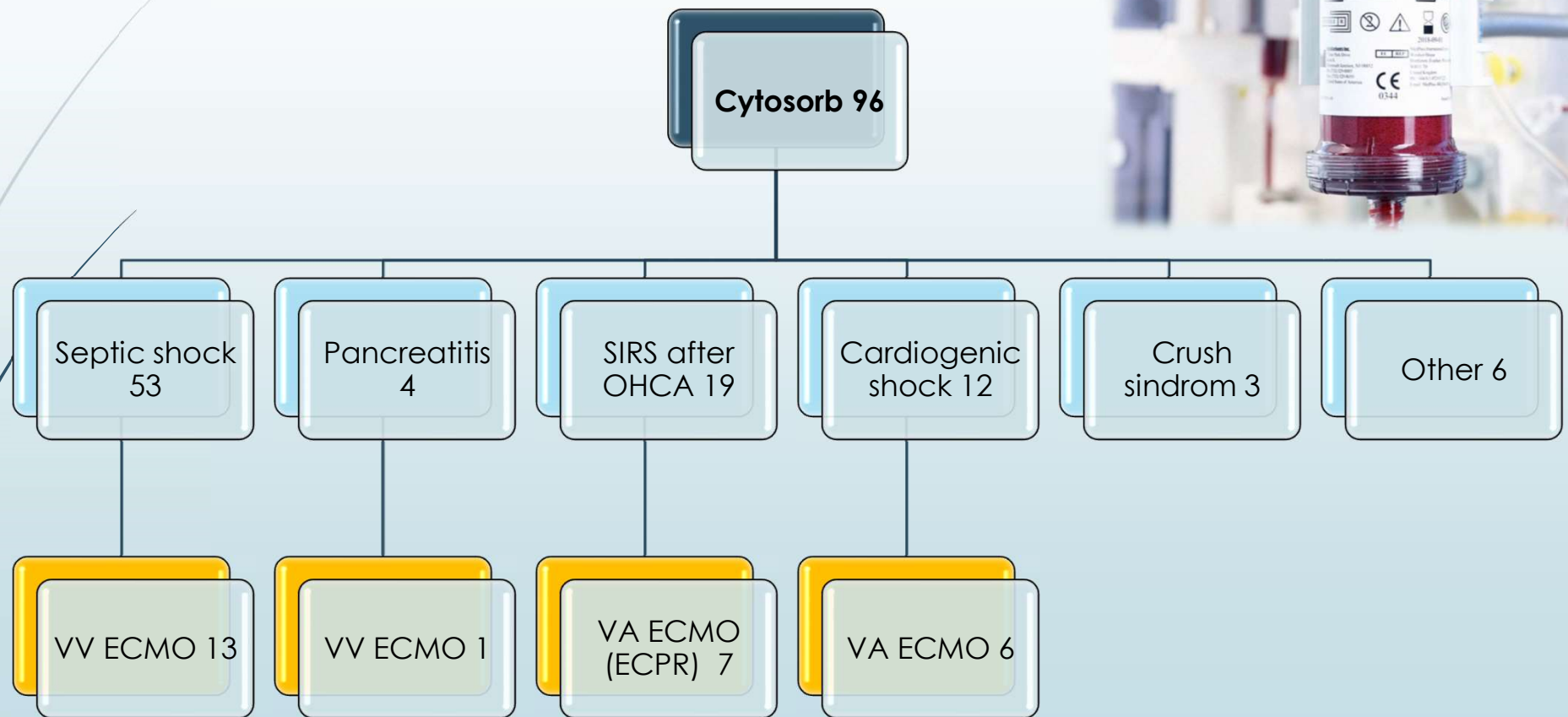
Cytosorb in KOIIM

March 2017 – April 2022

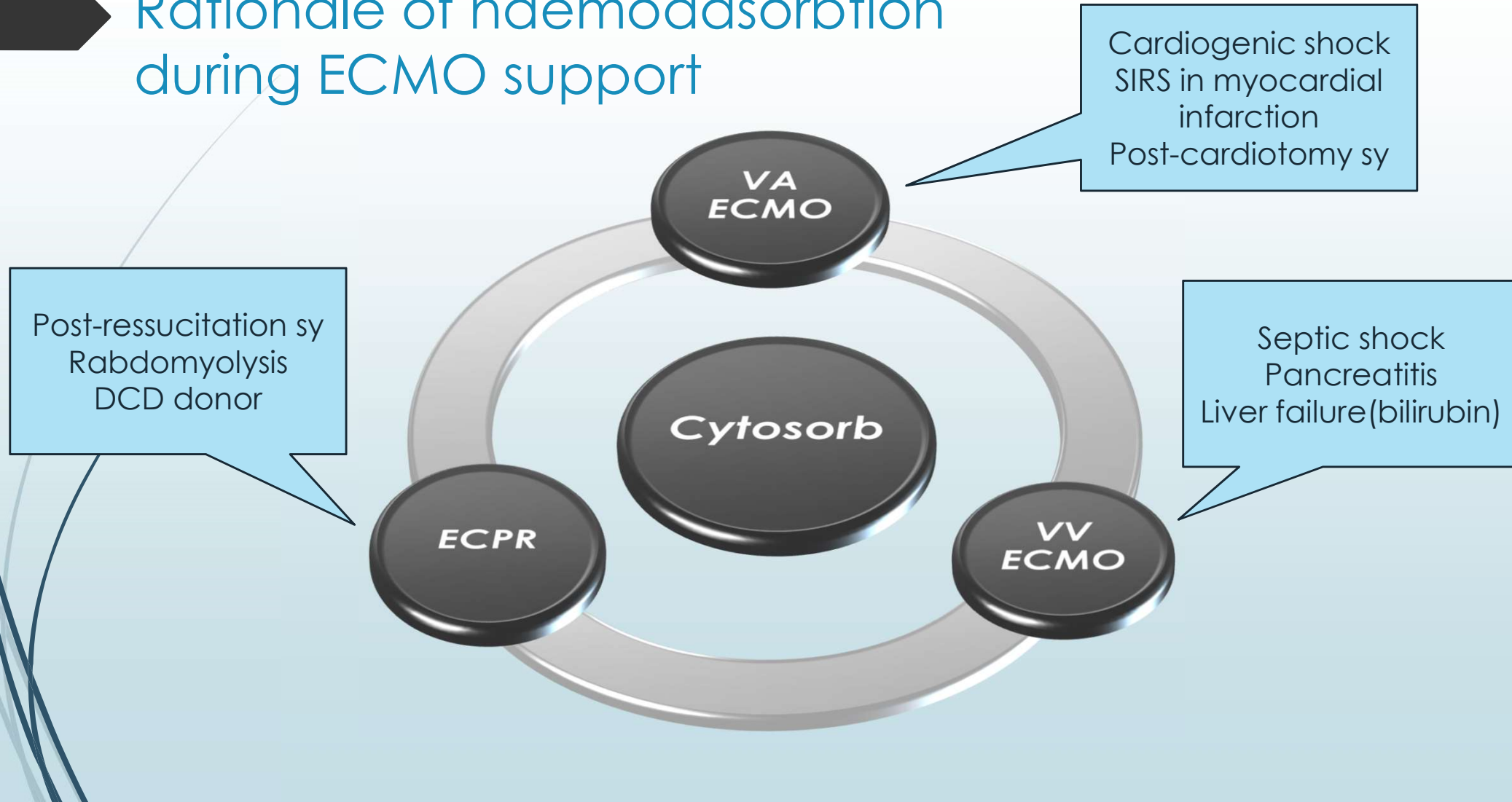


Cytosorb in KOIIM

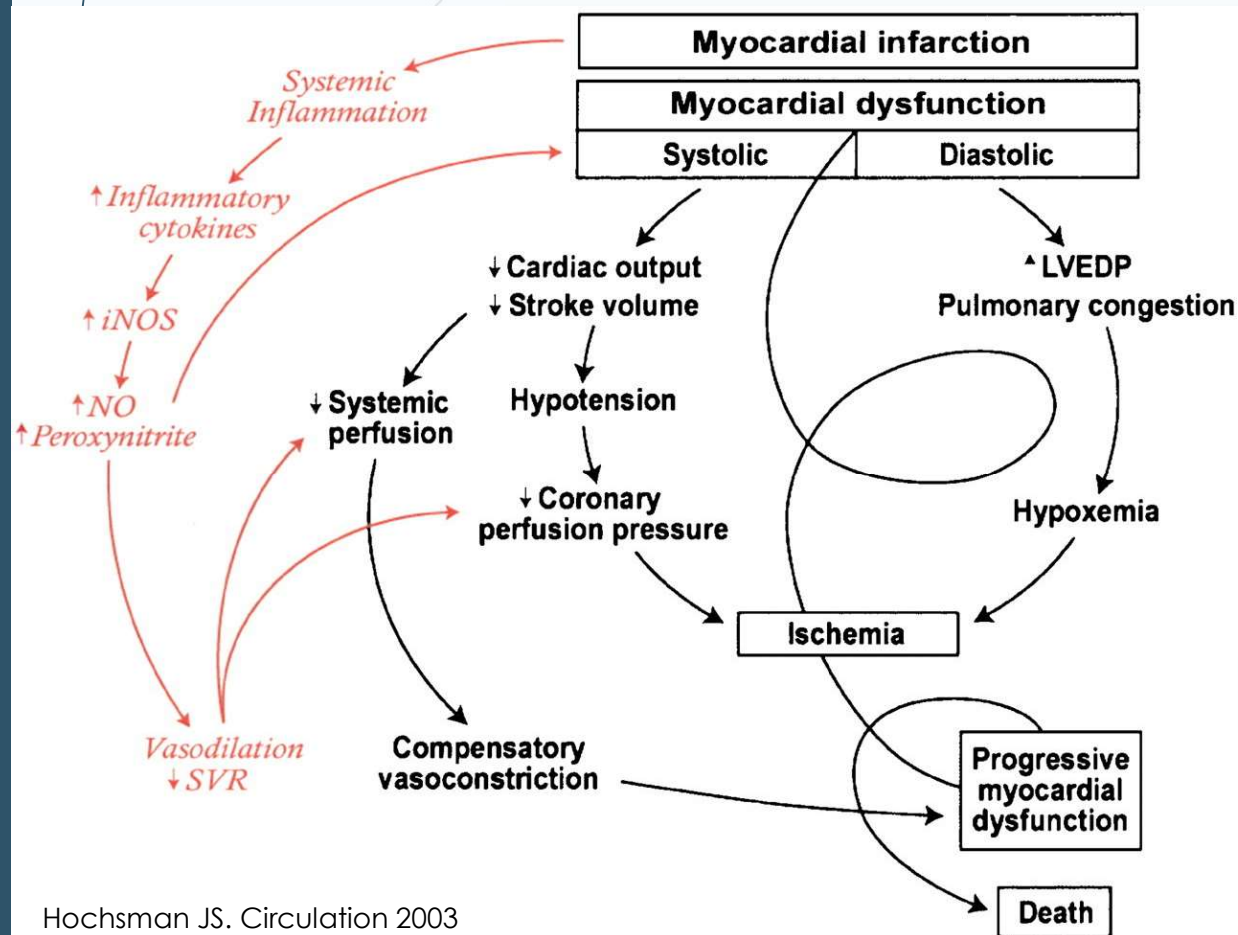
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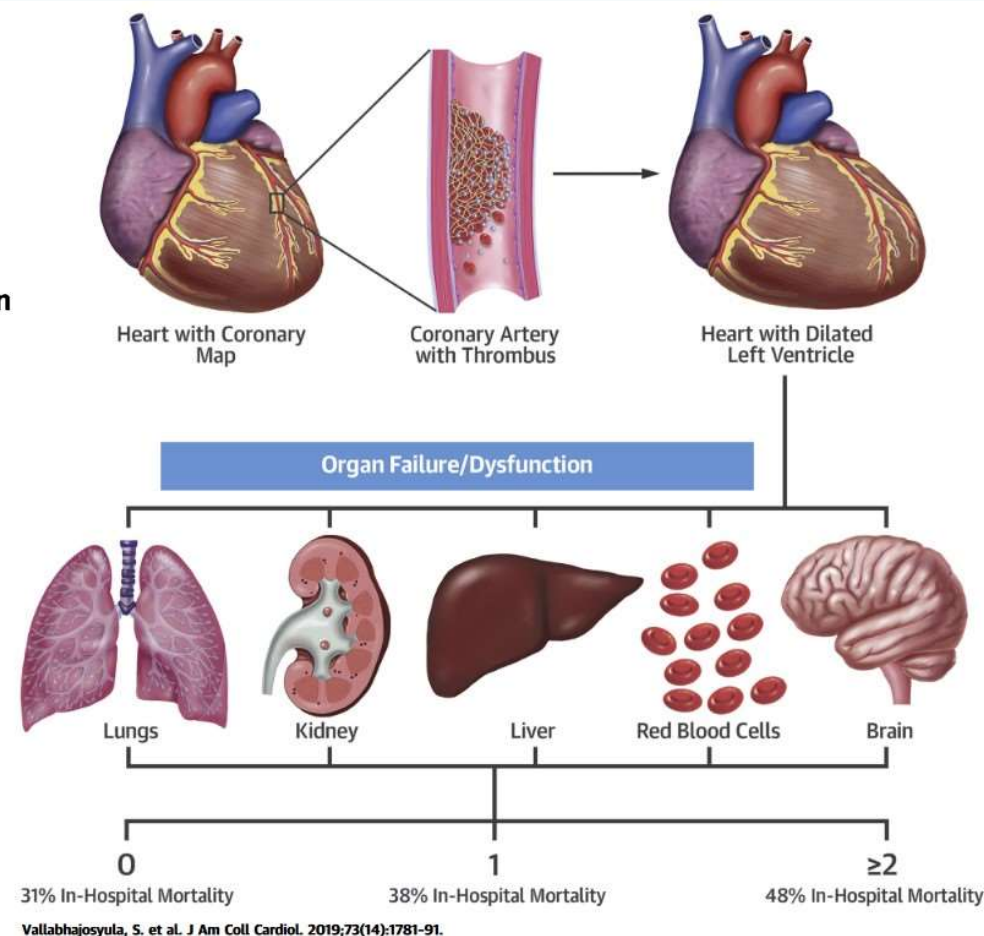
Rationale of haemoabsorption during ECMO support



SIRS and MOF in cardiogenic shock



Hochsman JS. Circulation 2003



Vallabhajosyula, S. et al. J Am Coll Cardiol. 2019;73(14):1781-91.

An iceberg floating in the ocean, with the tip above water and a much larger, jagged mass submerged below. The water is a deep blue, and the sky is a lighter blue with some clouds. The iceberg's surface is textured with various cracks and ridges.

Cardiac arrest

ISCHEMIA

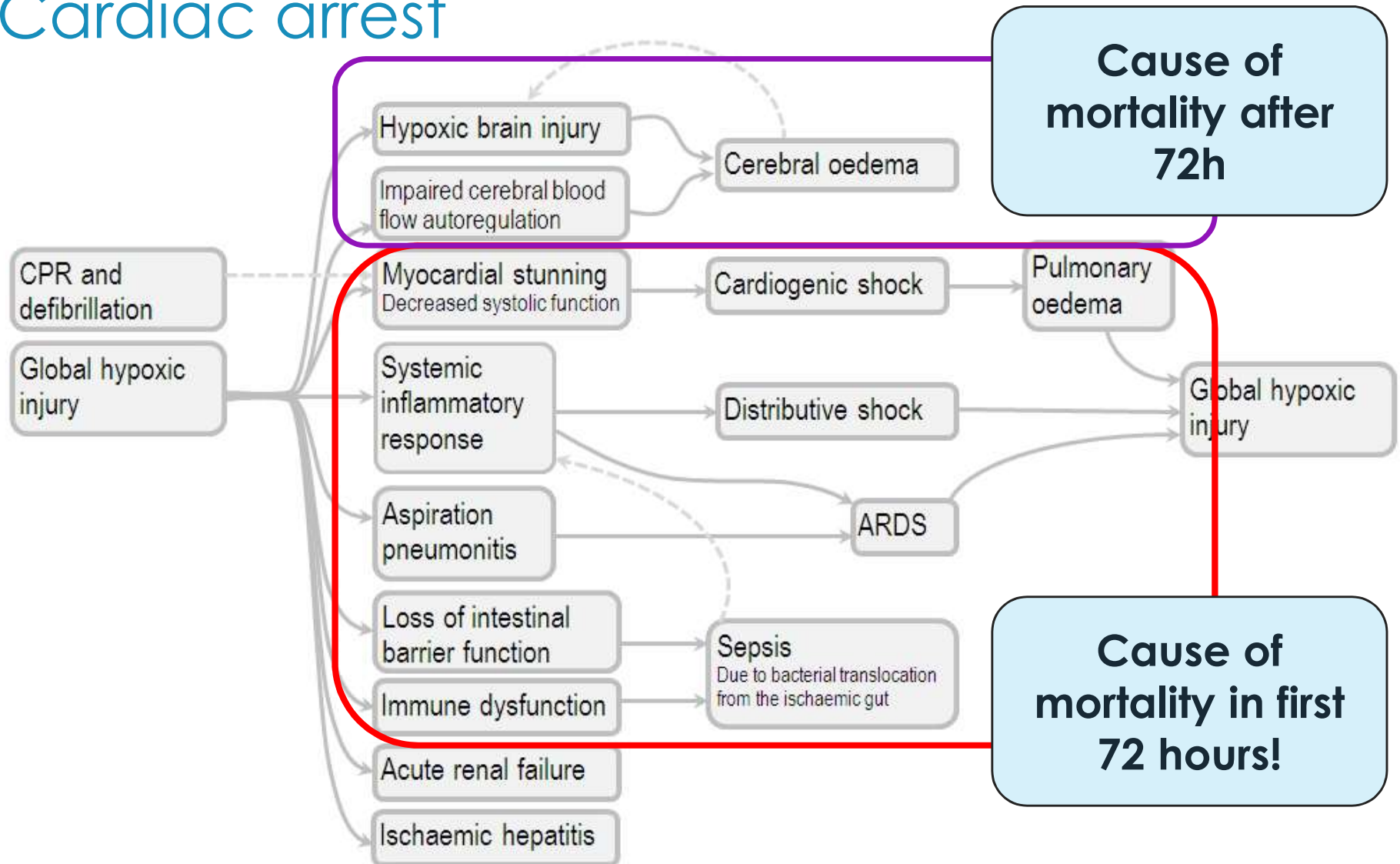
- ❖ Metabolic alterations
- ❖ pH alterations
- ❖ Endothelium alterations
- ❖ Proinflammatory state

ROSC

REPERFUSION

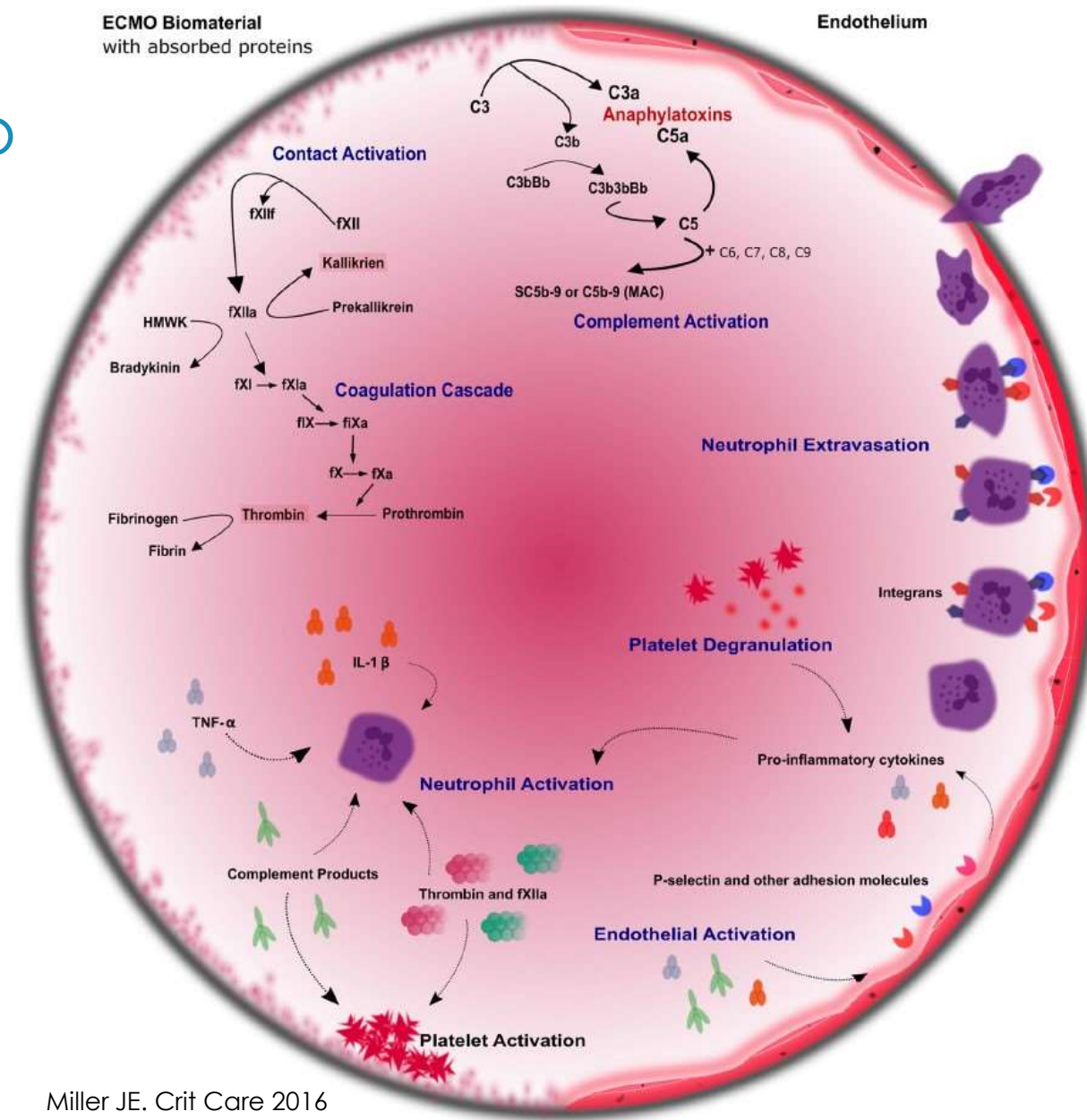
- Formation of ROS (Reactive oxygen species)
 - Leukocyte activation and chemotaxis
- Inflammatory cytokines and chemokines production
 - Complement and endothelium activation
- Endotoxin intestinal translocation
 - Adrenal insufficiency
 - SIRS
 - MOF

Cardiac arrest



Inflammatory response to ECMO membrane

- Complement activation
- Coagulation cascade activation
- Activation of leukocytes, trombocytes and endothelial cells





Evolution



- ↓ hemolysis
- ↓ activation of inflammatory response
- ↓ risk of air embolism
- ↓ need for anticoagulation
- ↓ haemodilution



Vasoplegic shock?

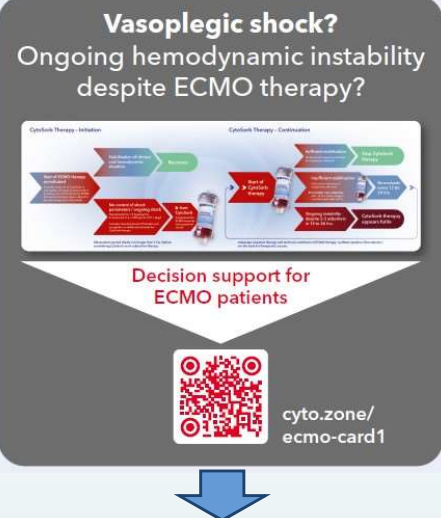
Ongoing hemodynamic instability despite ECMO therapy?



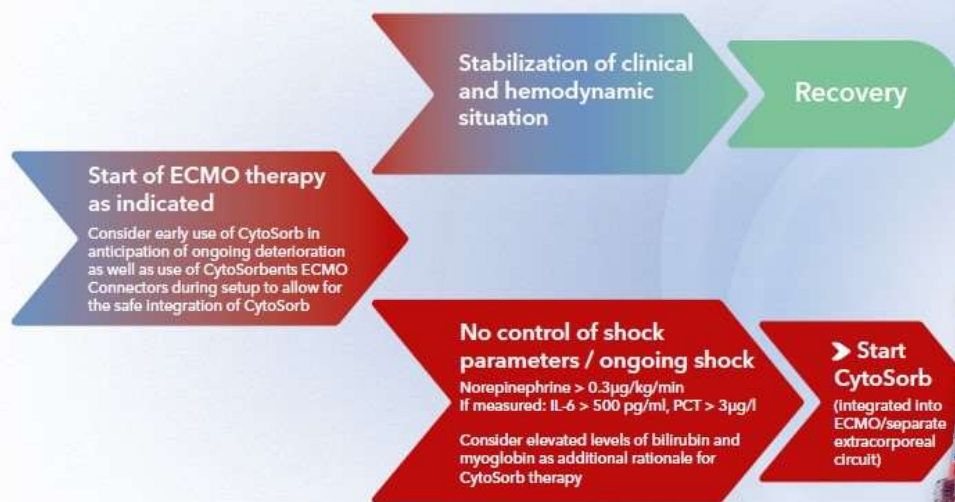
Decision support for
ECMO patients



cyto.zone/
ecmo-card1



CytoSorb Therapy - Initiation



Observation period ideally not longer than 6 hrs. before considering CytoSorb as an adjunctive therapy

CytoSorb Therapy - Continuation



Adequate causative therapy and technical conditions of ECMO therapy (catheter position, flow rate etc.) are the base for therapeutic success



Our protocol

Indications

- refractory shock after 6 hours of standard therapy
- raising values of lactate
- increasing vasopressor requirements (0.5 mcg/kgTT/min)

Duration of treatment and discontinuation

- **One treatment:**
 - 12 hours at least, if positive clinical effect
 - If no effect: 24 hours and reevaluation according to clinical condition
- **Discontinuation:**
 - Vasopressor reduction to 50% of starting value
 - No clinical response to treatment after 24 hours (increasing or no change in vasopressor, increasing lactate)

Our patients

VA ECMO	13
ECPR in OHCA due to anterior STEMI	3
ECPR in IHCA due to acute in-stent thrombosis of LM/LAD	3
Cardiogenic shock due to anterior wall MI	3
ECPR in IHCA due to phenytoin overdose	1
Cardiogenic shock in calcium channel blockers overdose	1
Cardiogenic shock after periprocedural IHCA in EP study	1
Cardiogenic shock in severe AS/MS complicating influenza A infection	1

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VV ECMO	12
ARDS in pneumococcal pneumonia	3
ARDS in pneumococcal pneumonia complicating influenza A	3
ARDS in legionella pneumonia	2
ARDS in S. aureus pneumonia complicating influenza A	1
Leptospirosis	1
Aspiration pneumonia	1
ARDS in pancreatitis	1

Results

	VA ECMO (N = 13)	VV ECMO (N = 12)
Patient characteristics		
Age, years	54 ± 9	58 ± 13
Male gender	12 (92%)	9 (75%)
BMI, kg/m ²	30 ± 3	27.5 ± 3
Ischaemic heart disease	5 (39%)	2 (16.7%)
Diabetes	2 (15%)	2 (16.7%)
Chronic kidney disease	1 (8%)	0

Results

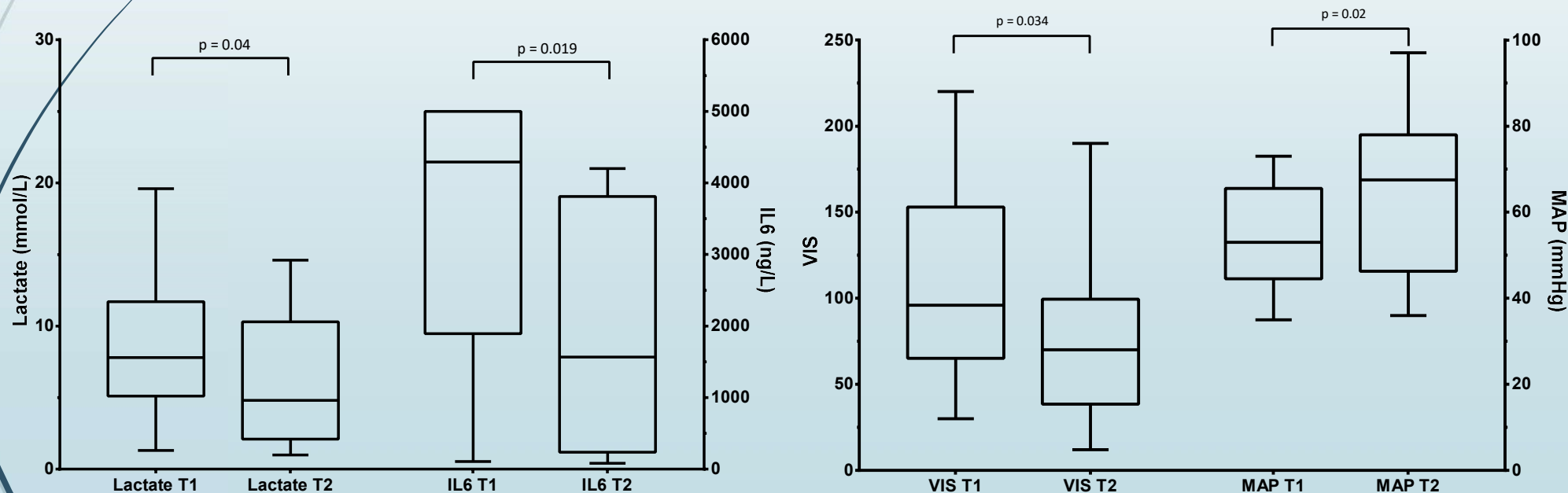
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Disease severity scores/organ dysfunction		
APACHE	26 (18 – 36)	28 (27 – 34)
predicted mortality, %	69 (38 – 85)	68 (63 – 82)
SAPS	57 (51 – 70)	53.5 (51 – 67.5)
predicted mortality, %	62 (49 – 84)	54 (49 – 80)
SOFA	12 (11 – 14)	15.5 (13 – 18.75)
predicted mortality, %	50 (50 – 71)	85 (60 – 90)

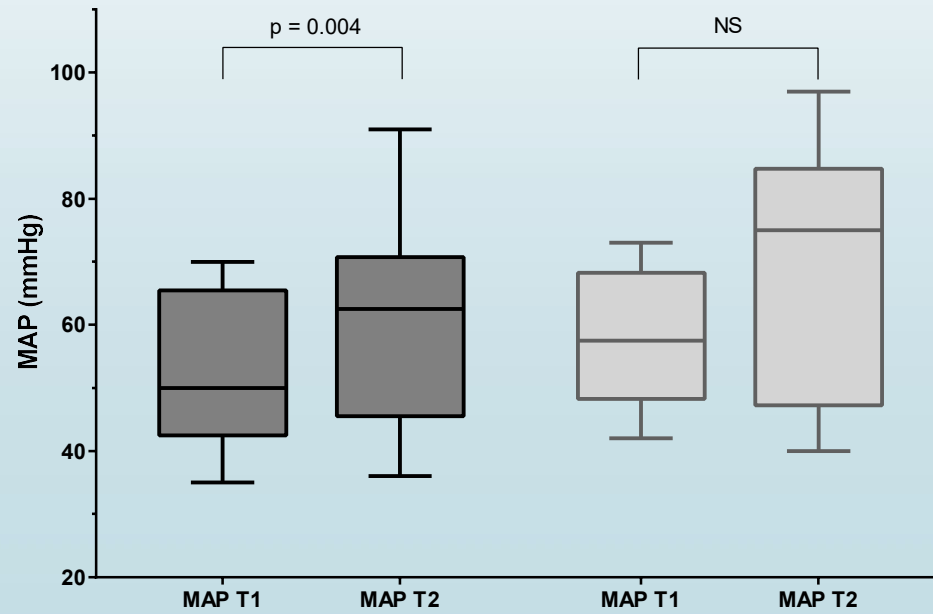
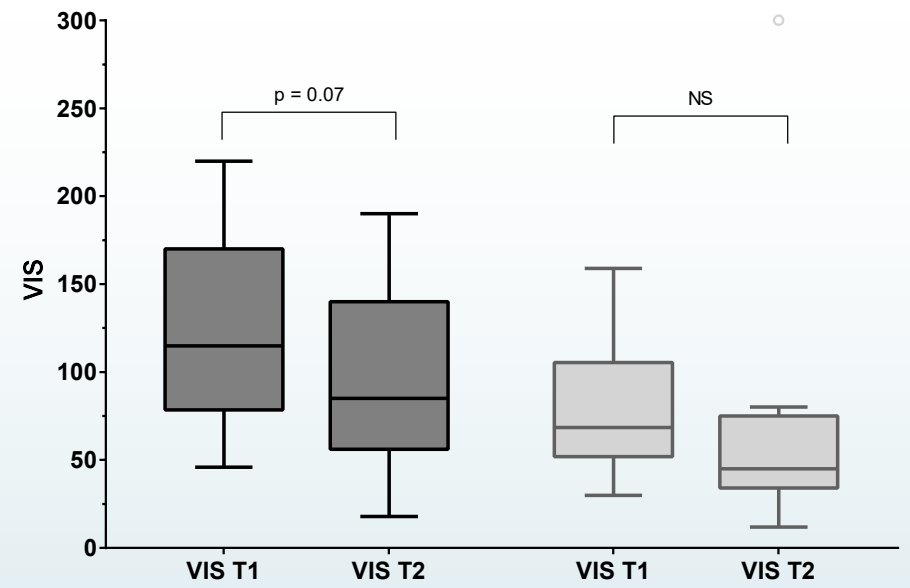
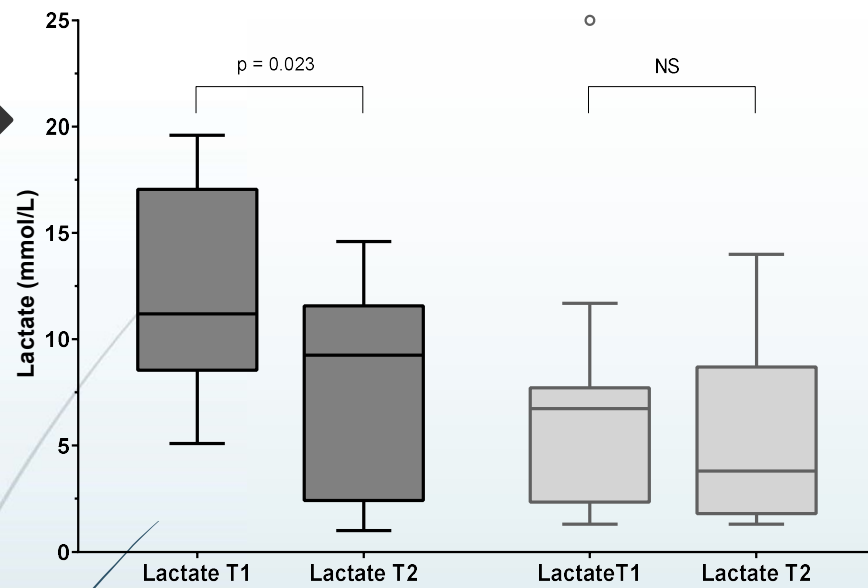
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predicted mortality, %	50 (50 – 71)	85 (60 – 90)
VIS score	115 (67 – 170)	68 (52 – 105)
MAP, mmHg	50 (42 – 65)	57 (48 – 68)
Acute kidney failure	12 (92%)	10 (83%)
Acute liver failure	10 (77%)	9 (75%)
Acute heart failure	13 (100%)	2 (17)

Results

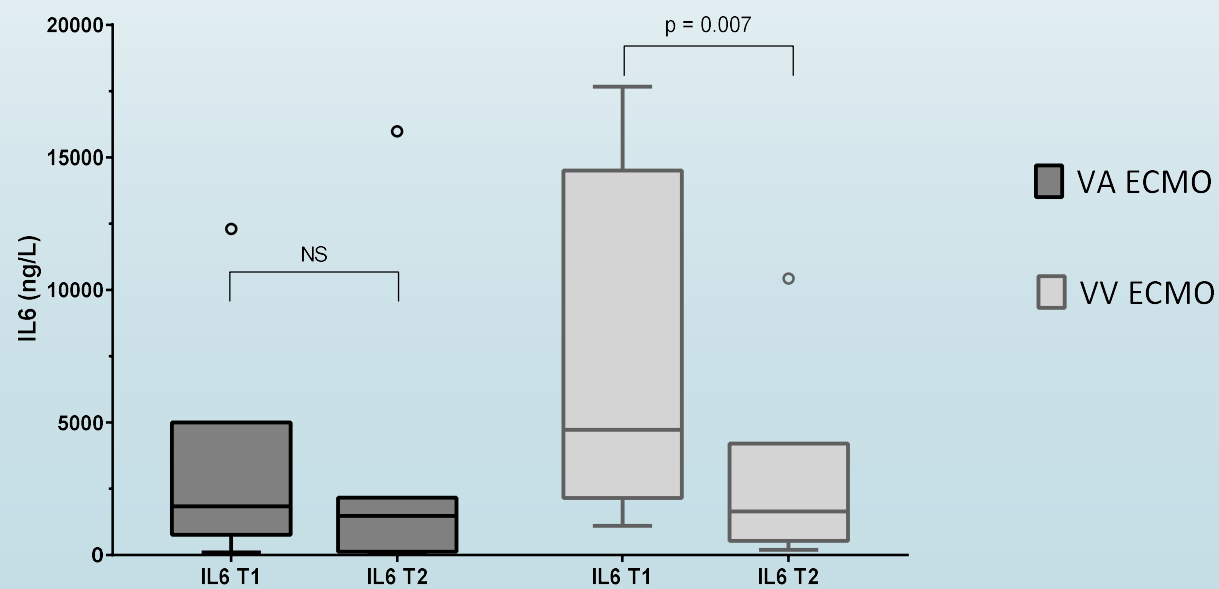
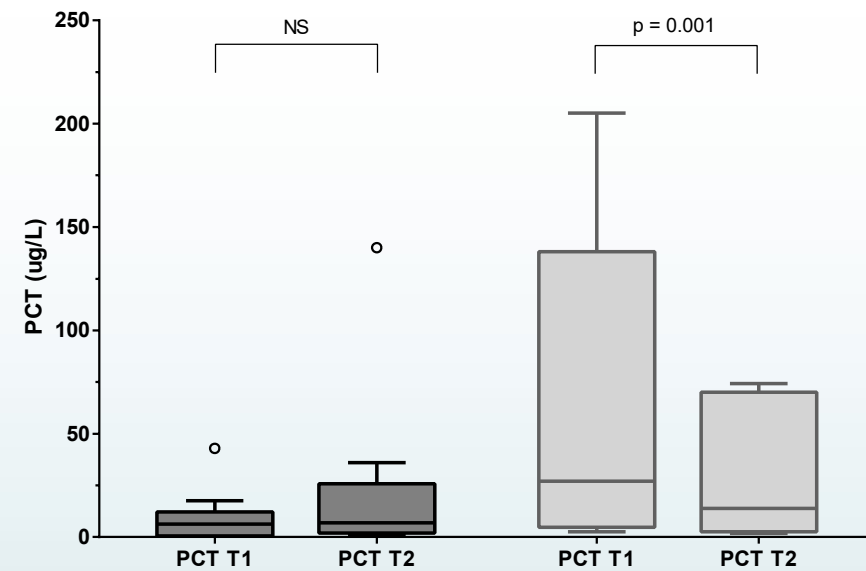
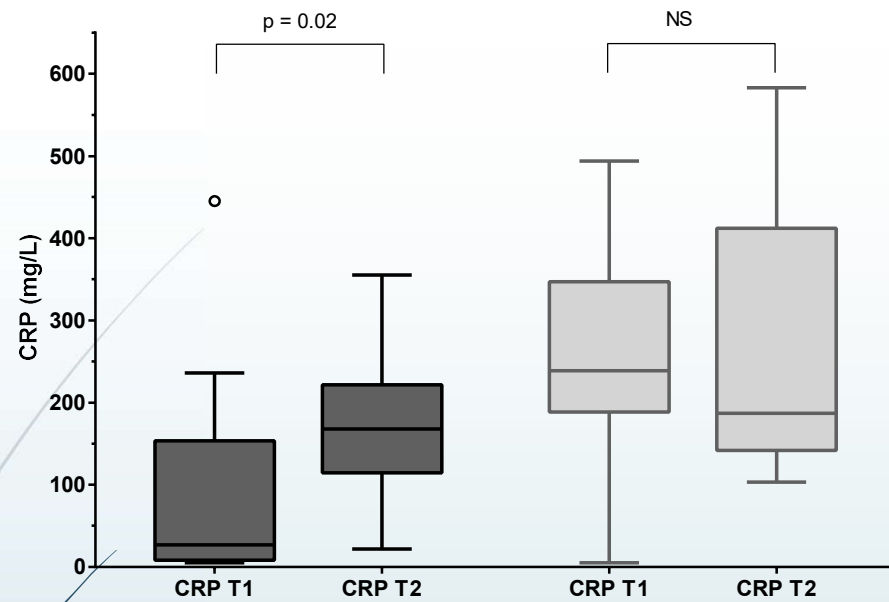
	VA ECMO (N = 13)	VV ECMO (N = 12)
LAB results before haemoadsorption		
Lactate, mmol/L	11.2 (8.6 – 17)	6.7 (2.3 – 7.7)
pH	7.2 (7.07 – 7.26)	7.2 (7.16 – 7.26)
CRP, mg/L	27 (8 – 153)	238 (188 – 347)
PCT, µg/L	6.3 (0.5 – 12.1)	27 (4.7 – 138)
IL6, ng/L	1833 (762 – 5000)	4728 (2155 – 14503)





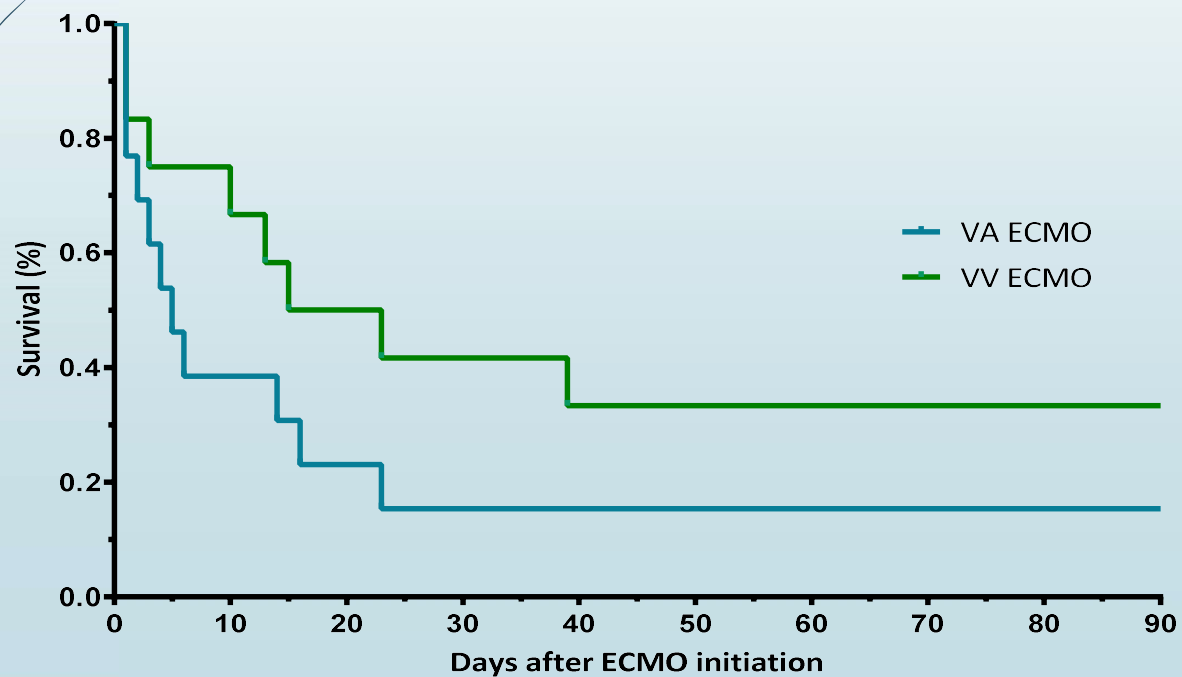
VA ECMO

VV ECMO



Results

	VA ECMO (N = 13)	VV ECMO (N = 12)
Outcome		
Cytosorb duration	12 (8 – 22)	14 (12 – 26)
Weaning of ECMO	4 (31%)	7 (58%)
ECMO duration, days	3 (2 – 6)	11 (4 – 15)
ICU LOS, days	5 (2 – 13)	13 (3 – 24)
Hospital mortality	11 (85%)	8 (67%)



ECMO and Cytosorb use (selection)

Supady et al 2021 ¹⁶	34 patients with COVID-19 and V-V ECMO randomized to CytoSorb or control. CytoSorb had no significant effect on IL-6 levels. Mortality was higher in the CytoSorb group	VV
Lebreton et al 2021 ¹⁸	22 patients with COVID-19 on ECMO, of which 11 received CytoSorb. Decrease of inflammatory mediators during ECMO support with and without CytoSorb	VV
Rieder et al 2021 ¹⁹	Nine patients with ARDS, V-V ECMO + CytoSorb. Reduction of vasopressor demand and decrease of lactate levels during CytoSorb, which was not observed in a historical matched control group without CytoSorb	VV
Supady et al 2021 ²⁰	23 patients with ECMO for extracorporeal resuscitation and CytoSorb, compared to a propensity-matched historical control group with ECMO but without CytoSorb. No significant differences in lactate levels, need for vasopressors and fluid therapy between groups	VA
Zickler et al 2021 ²¹	Four patients with intoxication-induced cardiac arrest and V-A ECMO + CytoSorb, strong decline of overdose drug levels	VA
Scharf et al 2021 ²²	14 patients with V-A ECMO and 29 without ECMO. CytoSorb with RRT for rhabdomyolysis, strong decline of myoglobin	VA
Akil et al 2021 ²³	13 patients with pneumogenic sepsis, ARDS, V-V ECMO and CytoSorb. Survival 100% and faster weaning off catecholamines, compared to 43% survival in a historical control group (N = 7)	VV
Rieder et al 2020 ²⁴	Eight patients with COVID-19 and V-V ECMO, of which four received CytoSorb. Stronger decline of IL-6 levels with CytoSorb than without.	VV
Kogelmann et al 2020 ²⁵	Seven patients with ARDS and septic shock, V-V ECMO and CytoSorb. Strong decline in vasopressor use and lactate levels	VV
Träger et al 2020 ²⁶	23 patients with V-A ECMO, RRT and CytoSorb. Reduction of inflammatory mediators, catecholamine use and lactate levels	VA
Calabro et al 2019 ²⁷	40 patients with cardiogenic or septic shock, ARDS or liver failure. 19 patients with ECMO. Bilirubin, lactate, CK and LDH levels decreased, and survival was higher as expected	VV/VA

Cytokine adsorption in patients with severe COVID-19 pneumonia requiring extracorporeal membrane oxygenation (CYCOV): a single centre, open-label, randomised, controlled trial

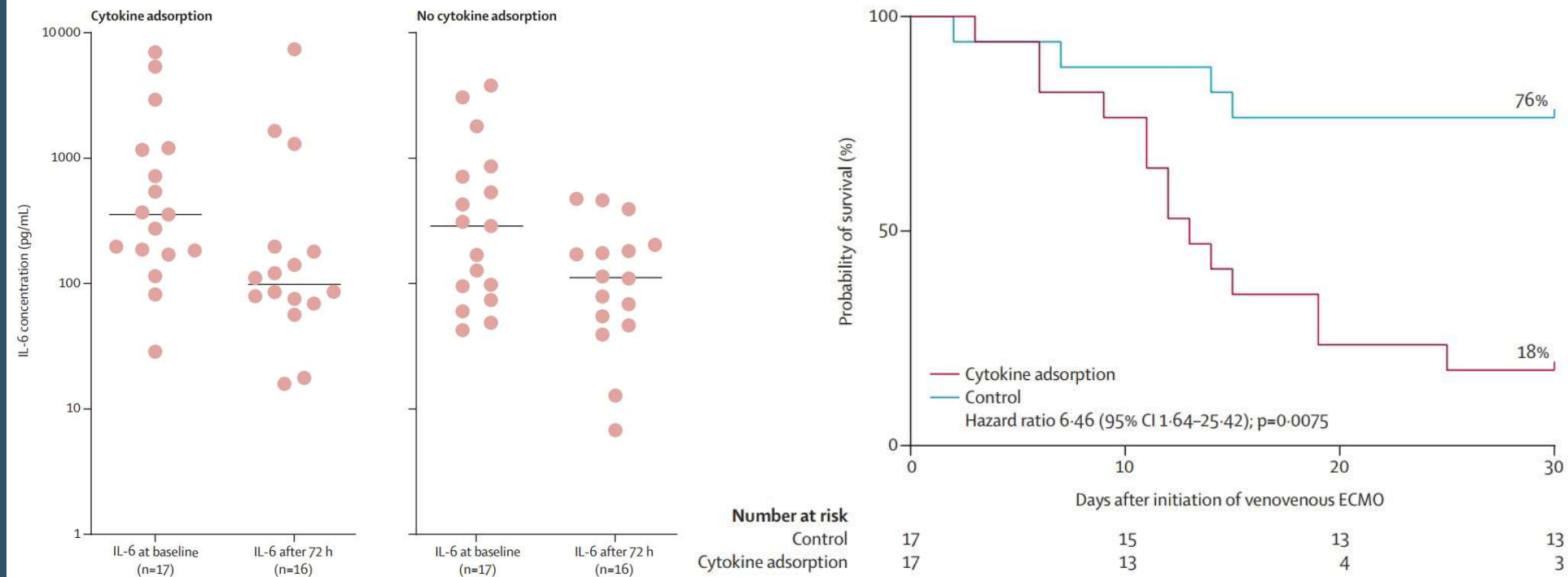


Alexander Supady, Enya Weber, Marina Rieder, Achim Lothar, Tim Niklaus, Timm Zahn, Franziska Frech, Sissi Müller, Moritz Kuhl, Christoph Benk, Sven Maier, Georg Trummer, Annabelle Flügler, Kirsten Krüger, Asieb Sekandarzad, Peter Stachon, Viviane Zotzmann, Christoph Bode, Paul M Biever, Dawid Staudacher, Tobias Wengenmayer, Erika Graf, Daniel Duerschmied

Summary

Background We sought to clarify the benefit of cytokine adsorption in patients with COVID-19 supported with venovenous extracorporeal membrane oxygenation (ECMO).

Lancet Respir Med 2021;
9: 755–62

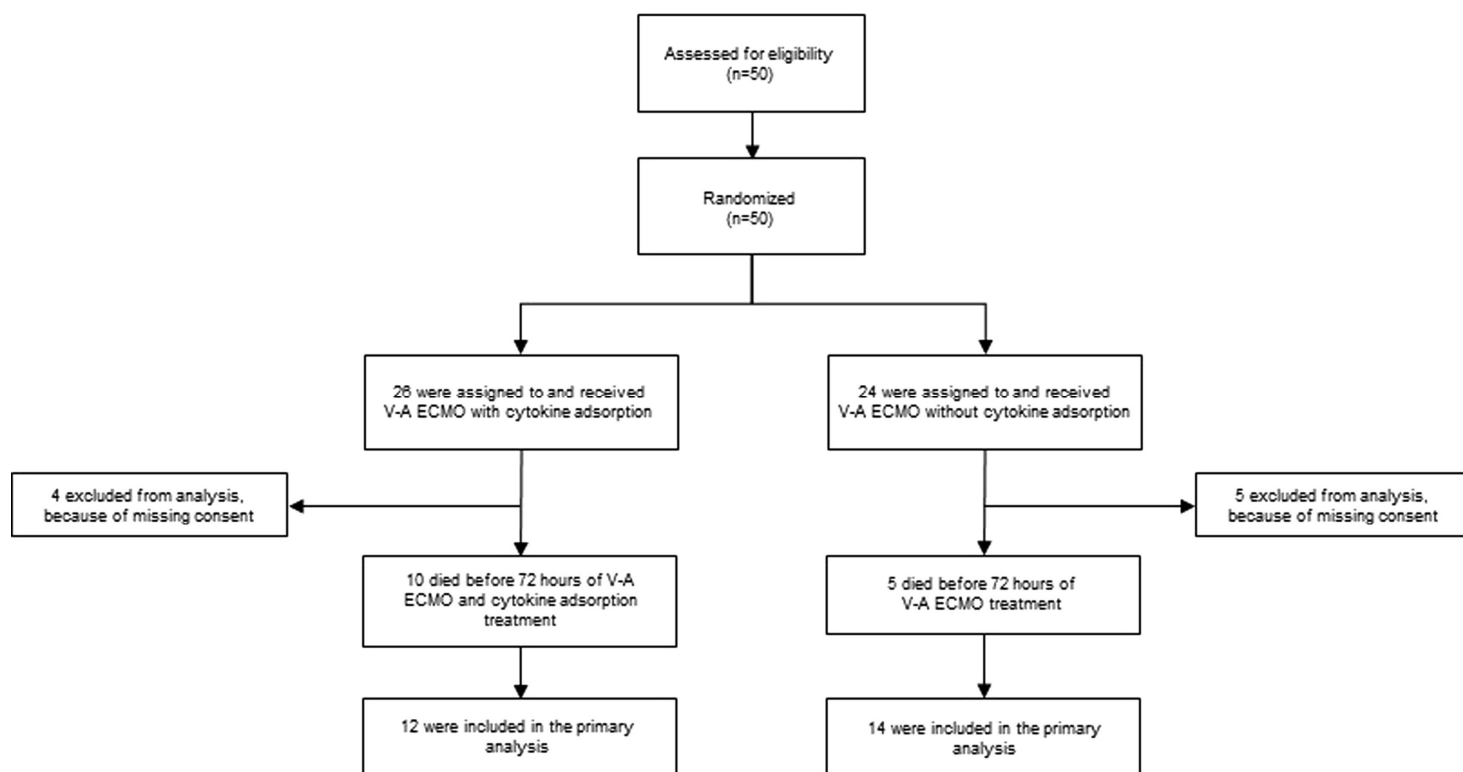


CLINICAL PAPER | VOLUME 173, P169-178, APRIL 01, 2022

Cytokine adsorption in patients with post-cardiac arrest syndrome after extracorporeal cardiopulmonary resuscitation (CYTER) – A single-centre, open-label, randomised, controlled trial

Alexander Supady   • Timm Zahn • Moritz Kuhl • ... Dawid L. Staudacher • Tobias Wengenmayer • Daniel Duerschmied • [Show all authors](#)

Published: February 07, 2022 • DOI: <https://doi.org/10.1016/j.resuscitation.2022.02.001> •

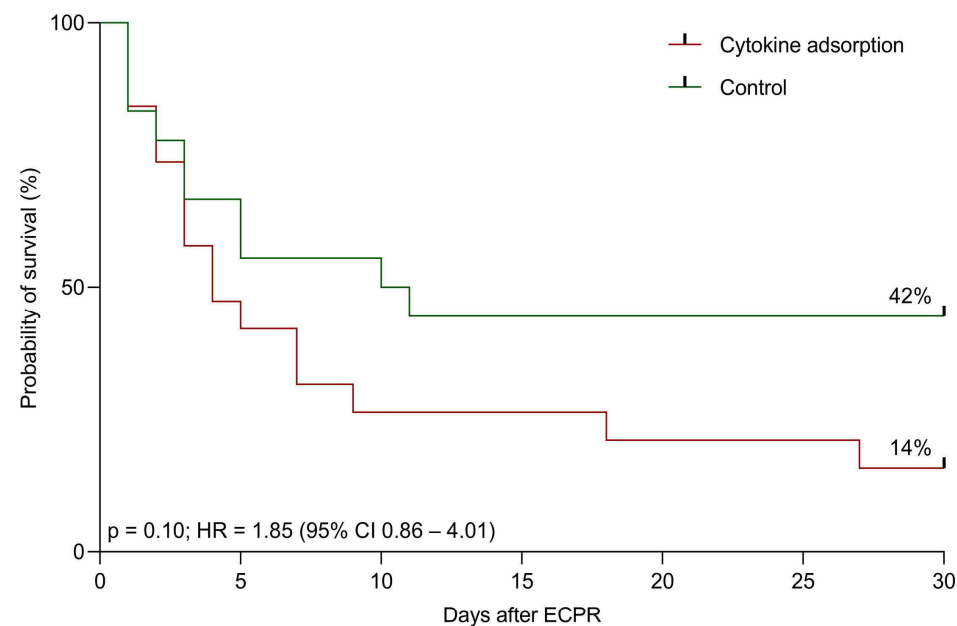
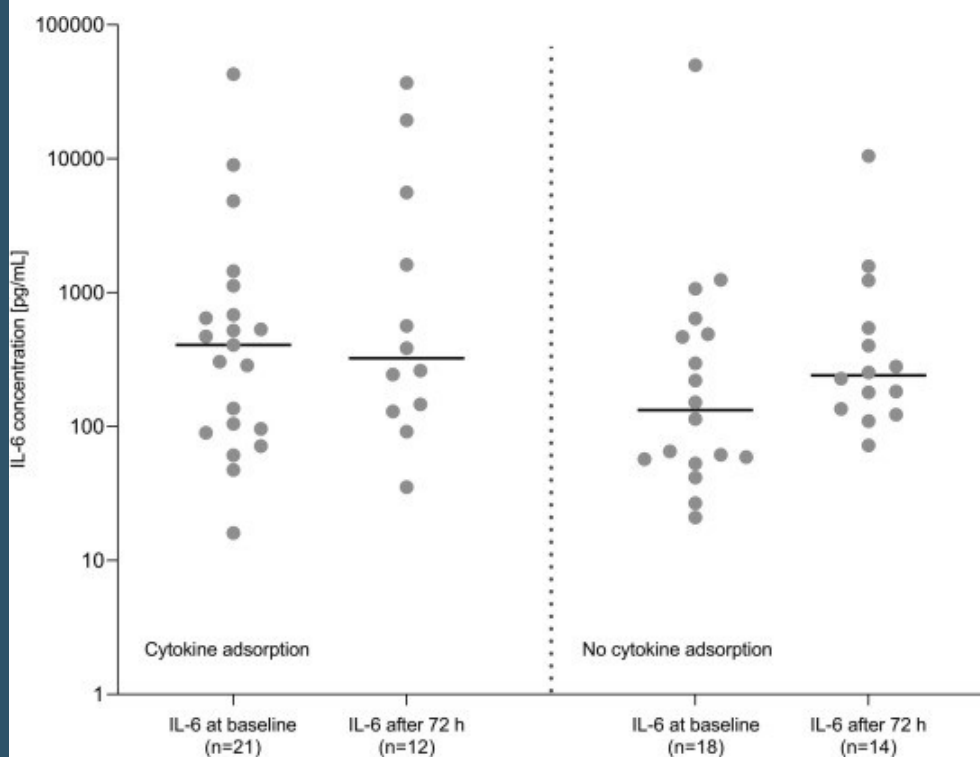


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Number at risk

Cytokine adsorption	22	6	5	3
Control	19	10	9	8

Use of Cytosorb in ECMO patients ...

- No technical problems and complications during therapy
- Effect on haemodynamic parameters and stabilisation (VA ECMO)
- Effect on inflammatory markers reduction (VV ECMO)
- Conclusions about survival benefit not possible
- Non-selective routine use is discouraged
- How to identify patients that benefit most?
- Which clinical and laboratory findings to use?





Hvala/Thank you!