VA vs VV-ECMO physiology

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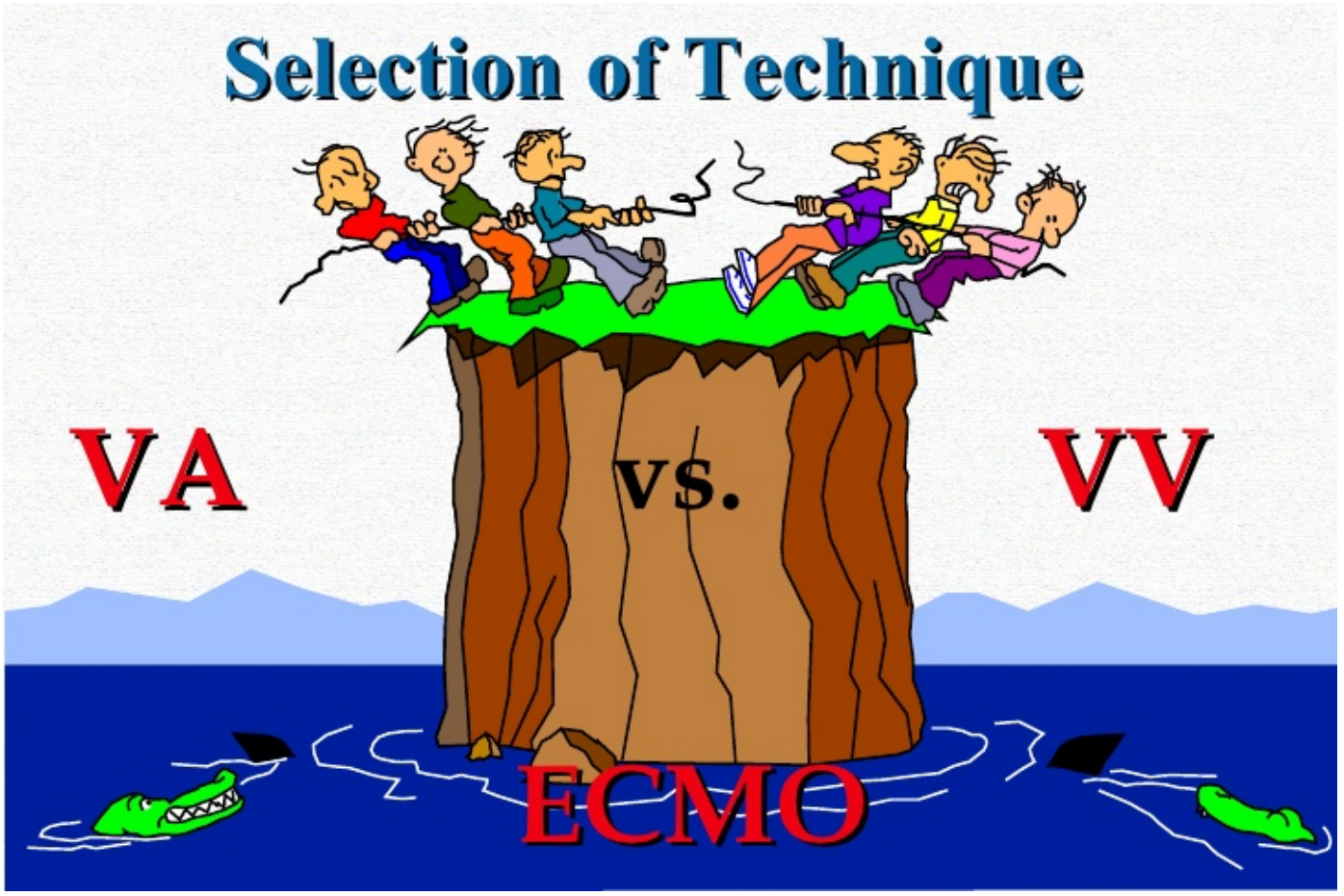
BEYOND THE SLIDES 2015

1st UDINE ECMO WORKSHOP

Selection of Technique



ECMO indications

- VA
  - Cardiac Support
- VV
  - Respiratory Support

First Adult ECLS Case

- 24 y/o man
- Blunt trauma with aortic and orthopedic injuries
- Underwent aortic repair post injury
- Severe ARDS by post-op day 5 (PaO2/FiO2 38)

- Femoral venoarterial cannulation
- Partial bypass with 6 m^2 membrane lung
- 3.0-3.5 L/min bypass
- 75 hour bypass time
- Recovery of lung function and discharge from hospital

Hill JD: *New Engl J Med* 1972; 286: 629-34

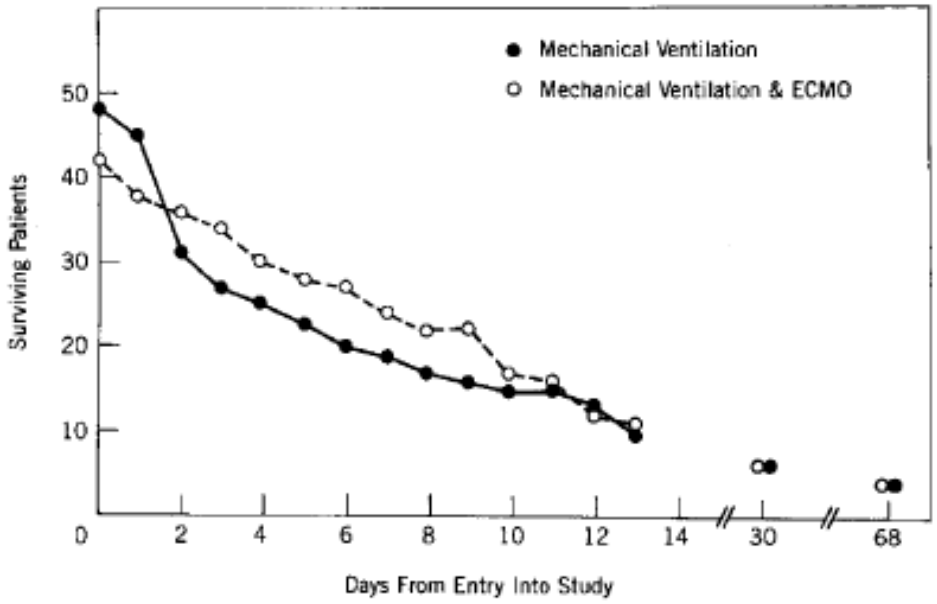
From Conrad S.A. Slide from internet

Extracorporeal Membrane Oxygenation in Severe Acute Respiratory Failure

A Randomized Prospective Study

Warren M. Zapol, MD; Michael T. Snider, MD, PhD; J. Donald Hill, MD; Robert J. Fallat, MD; Robert H. Bartlett, MD; L. Henry Edmunds, MD; Alan H. Morris, MD; E. Converse Peirce II, MD; Arthur N. Thomas, MD; Herbert J. Proctor, MD; Philip A. Drinker, PhD; Philip C. Pratt, MD; Anna Bagniewski, MA; Rupert G. Miller, Jr, PhD

JAMA, Nov 16, 1979—Vol 242, No. 20

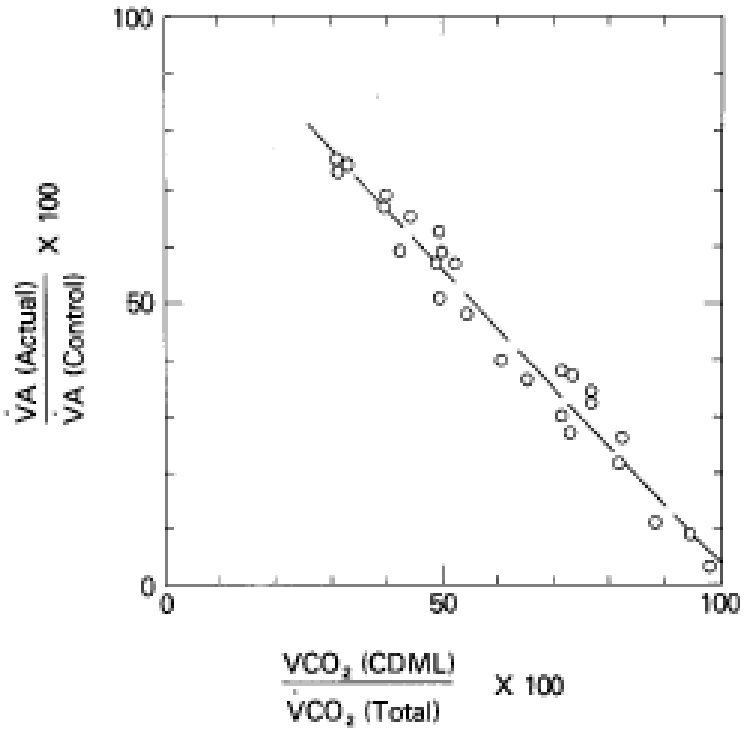


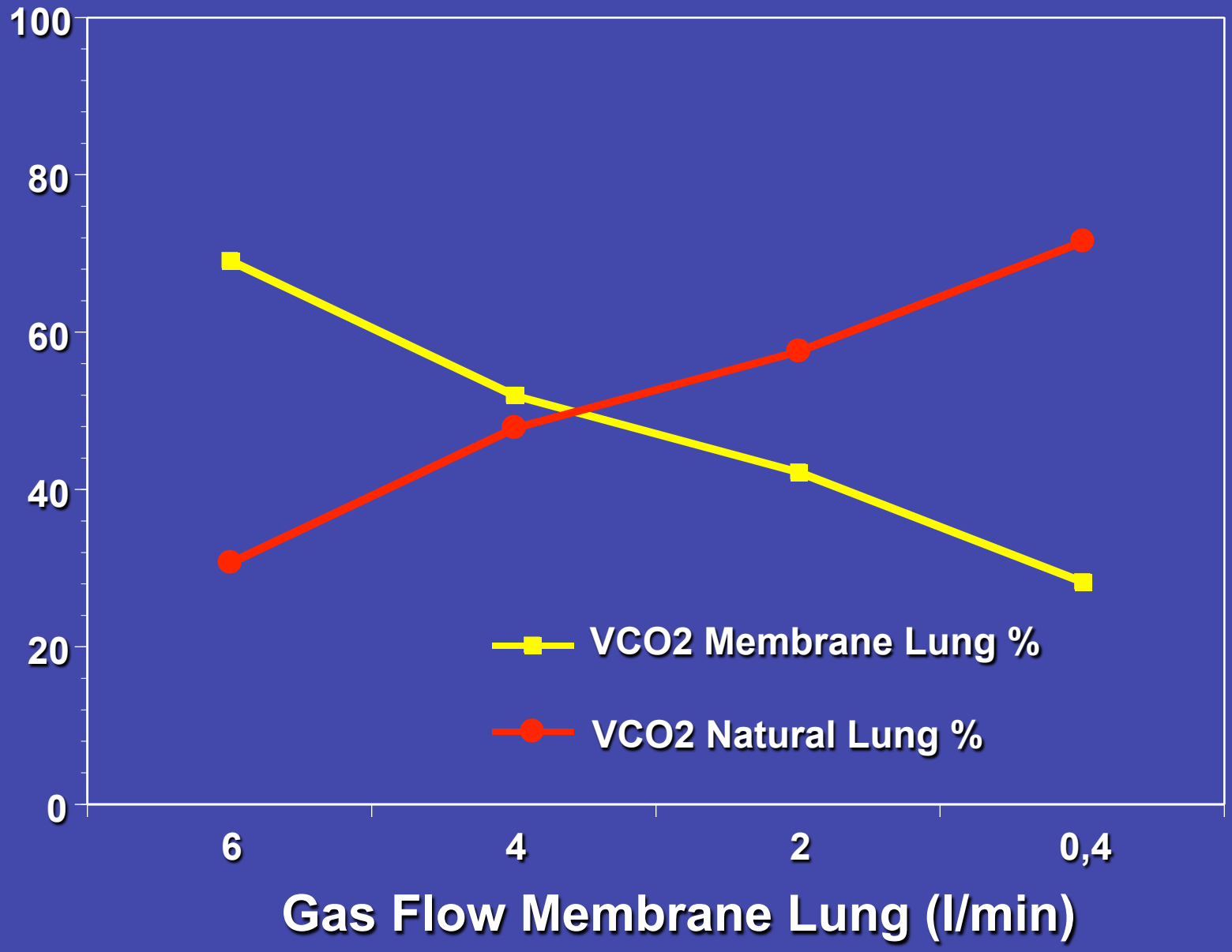
VA-ECMO for respiratory support

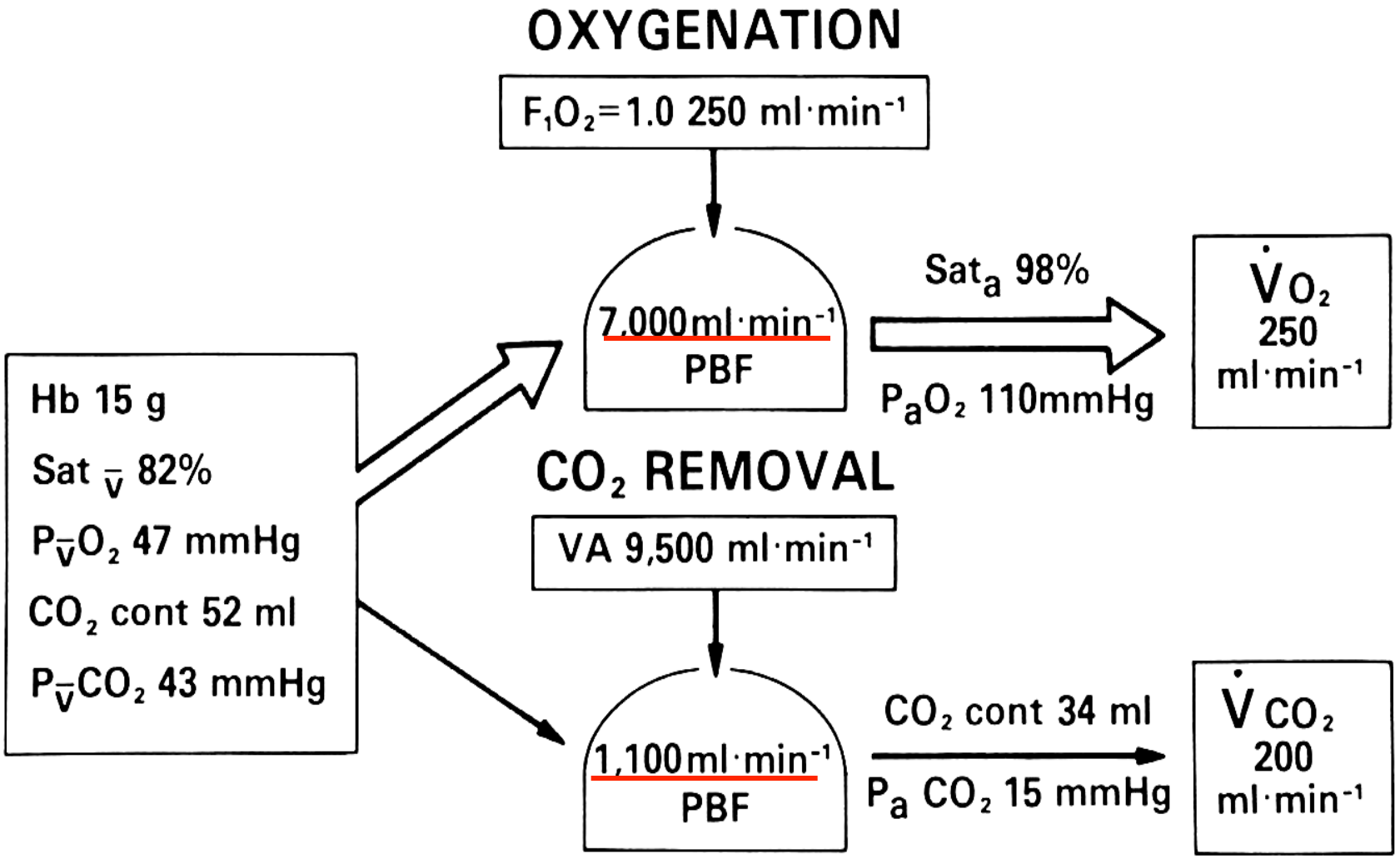
THE CARBON DIOXIDE MEMBRANE LUNG (CDML): A NEW CONCEPT

T. Kolobow, L. Gattinoni, T. Tomlinson,
D. White, J. Pierce, and G. Iapichino

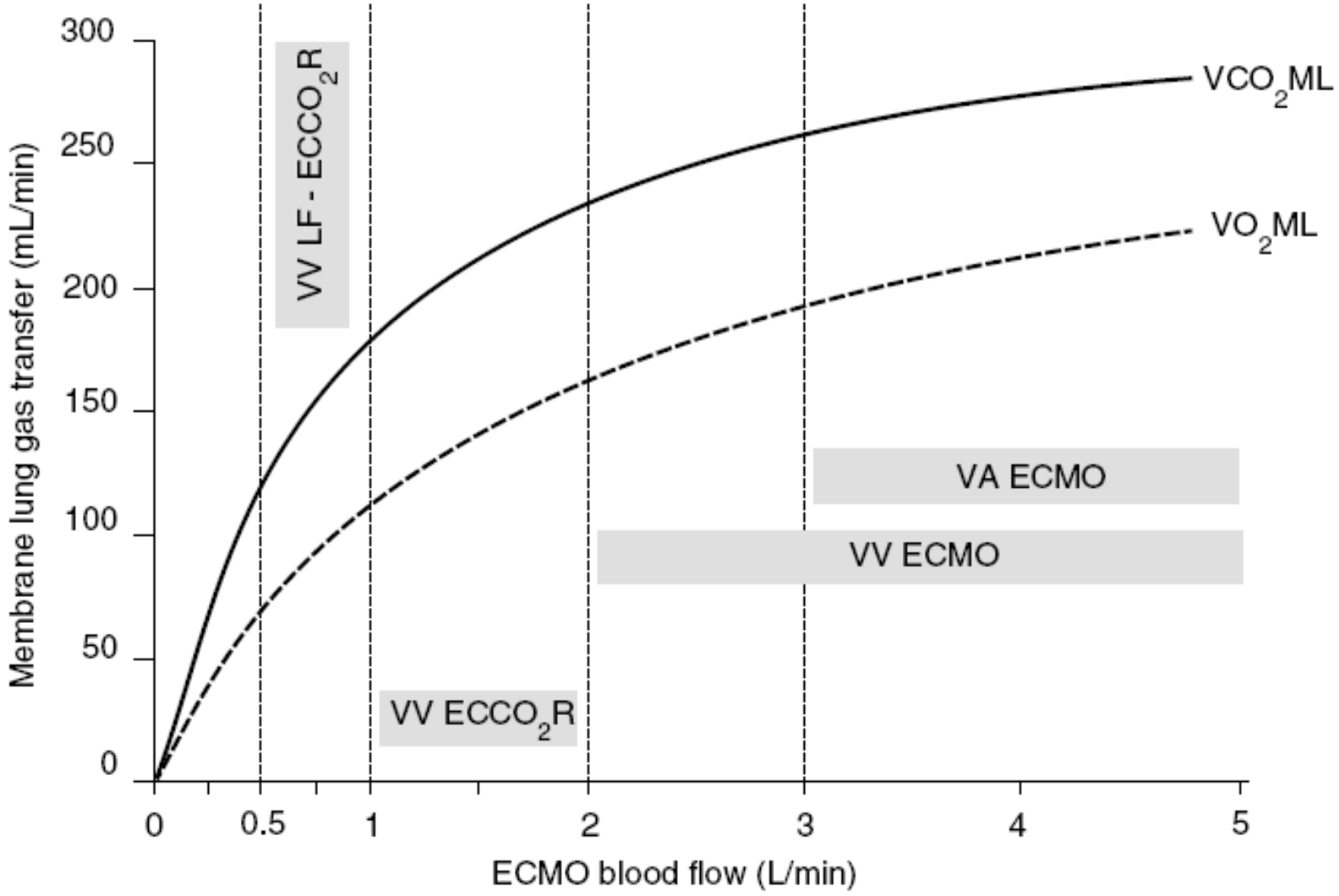
Vol.XXIII Trans.Am.Soc.Artif.Intern.Organs,1977




100
80
60
40
20
0
6
4
2
0,4
VCO2 Membrane Lung %
VCO2 Natural Lung %
Gas Flow Membrane Lung (l/min)

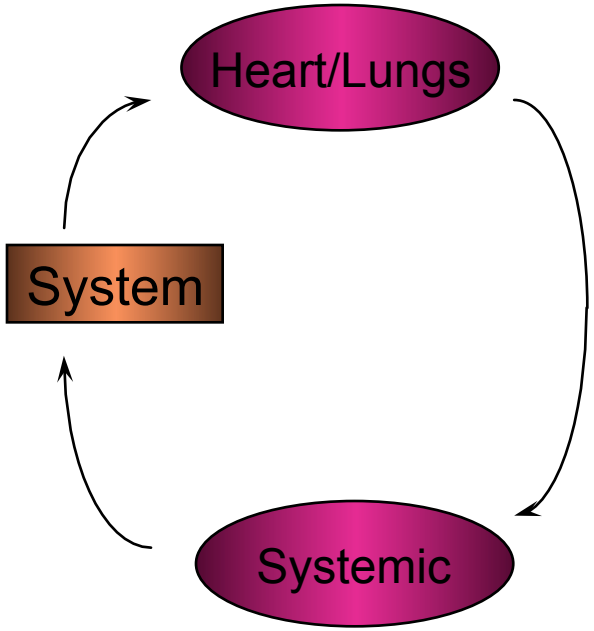

OXYGENATION
F_1O_2=1.0 250 ml·min^{-1}
7,000ml·min^{-1}
PBF
Sat_a 98%
P_aO_2 110mmHg
$\dot{V}O_2$
250
ml·min^{-1}
Hb 15 g
$Sat_{\bar{v}}$ 82%
$P_{\bar{v}}O_2$ 47 mmHg
CO_2 cont 52 ml
$P_{\bar{v}}CO_2$ 43 mmHg
CO_2 REMOVAL
VA 9,500 ml·min^{-1}
1,100ml·min^{-1}
PBF
CO_2 cont 34 ml
P_a CO_2 15 mmHg
$\dot{V}CO_2$
200
ml·min^{-1}

VO2ML and VCO2ML as a function of ECMO blood flow (BF)



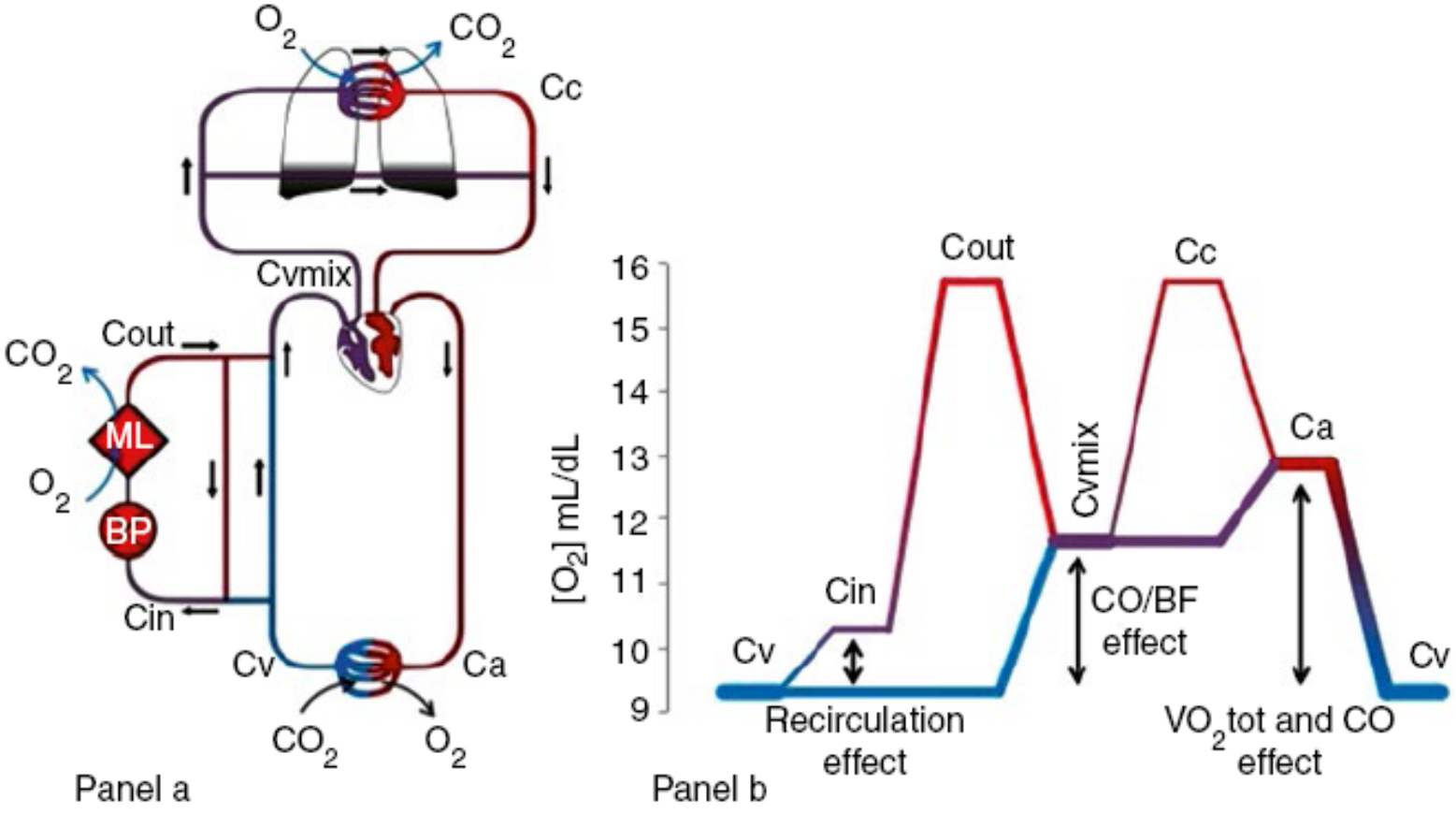
ECLS Configuration (VV)

Venovenous

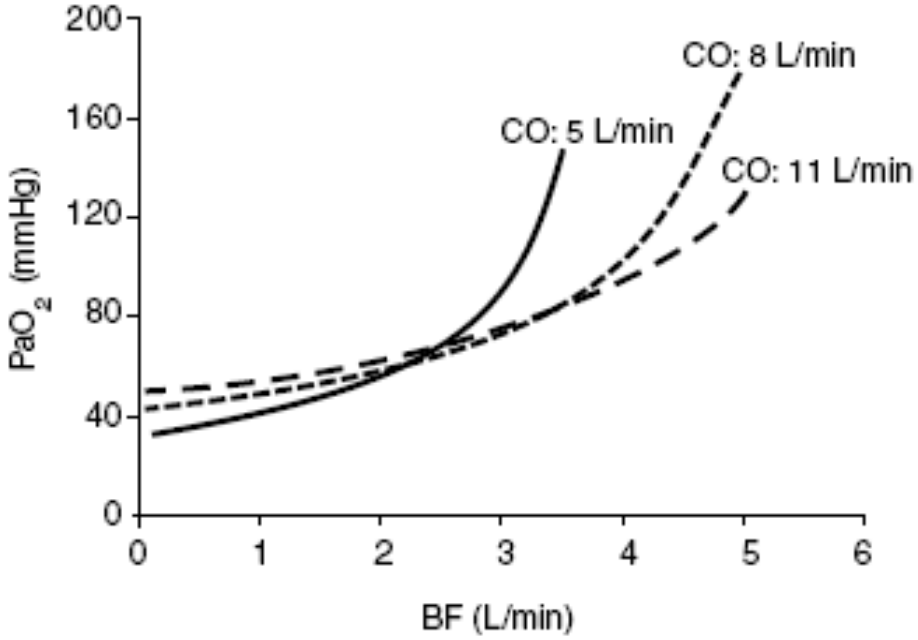


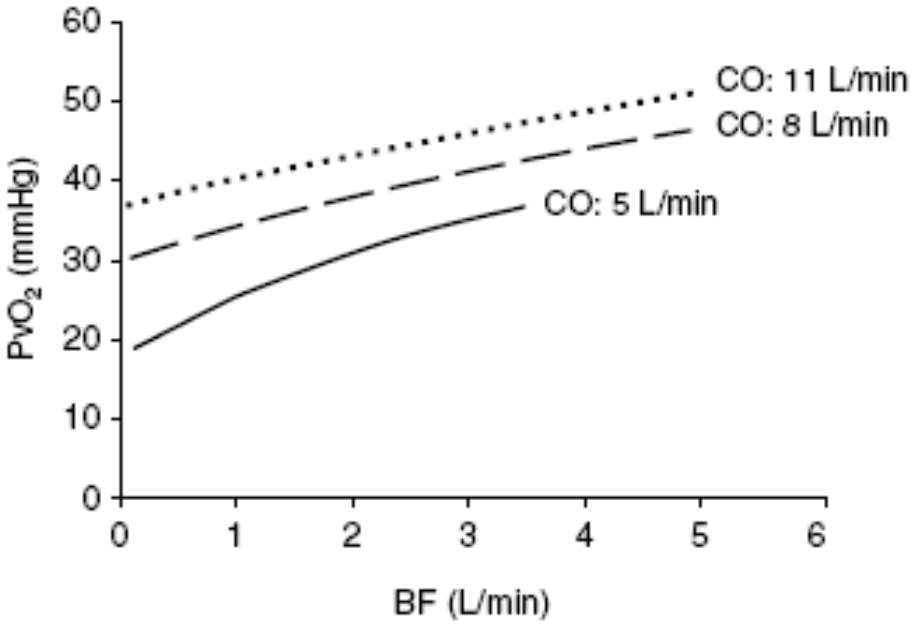
- Series with heart and lungs
- No cardiopulmonary bypass
- Maintains pulmonary blood flow
- Provides no cardiac support
- Venous access only

Oxygen delivery and consumption during VV-ECMO

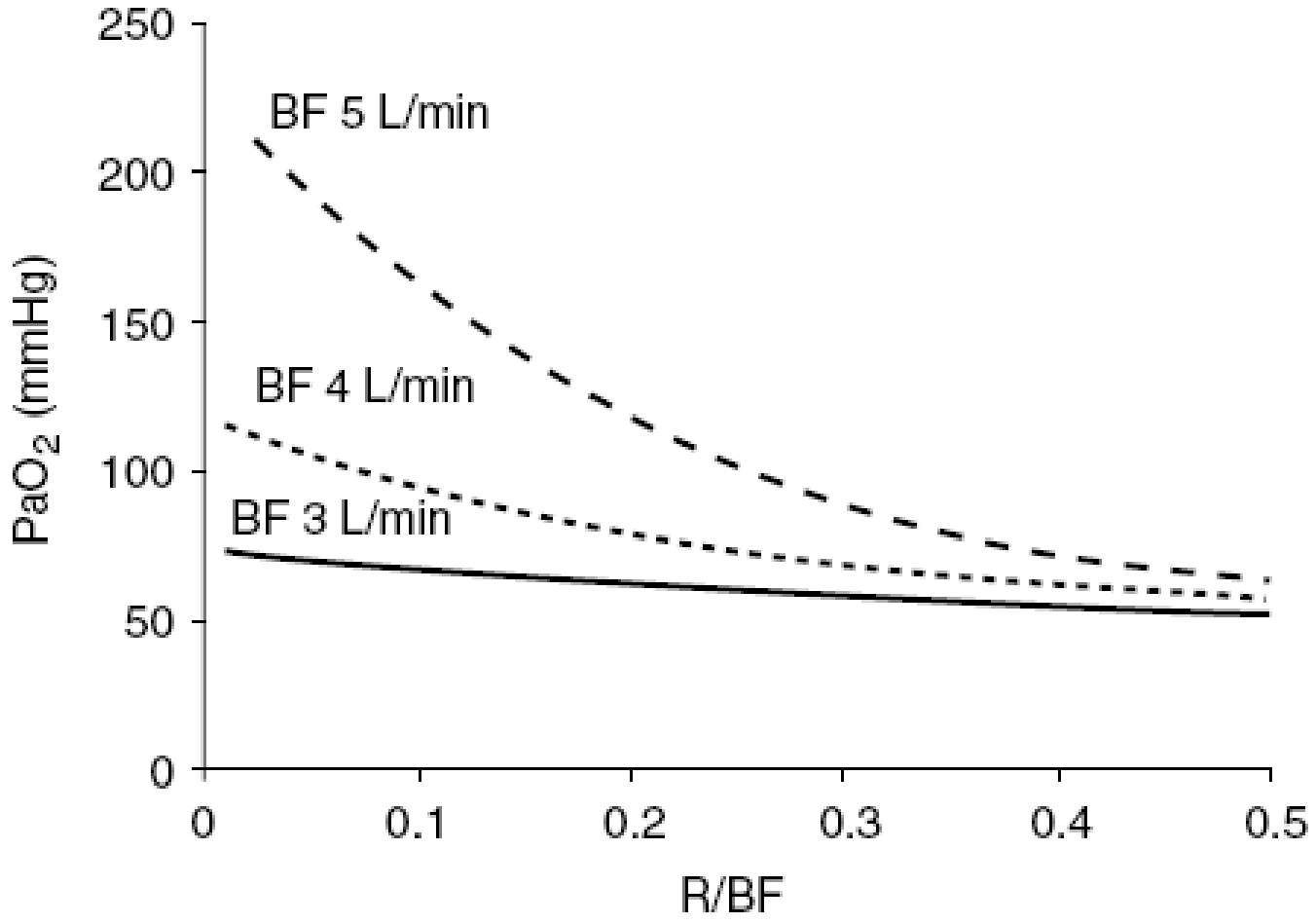


Interaction between CO and BF

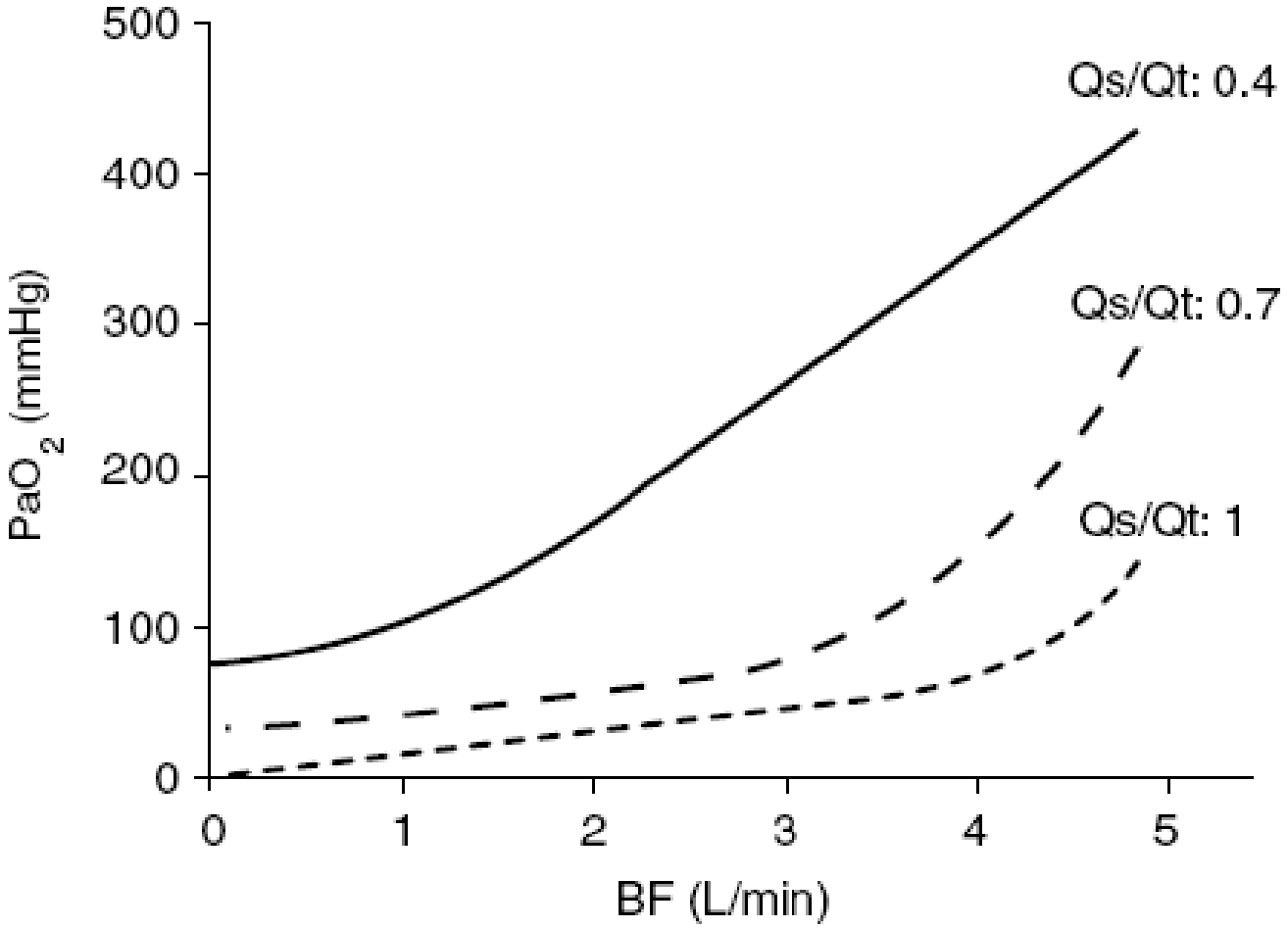




PaO2 as a function of the fraction of the R/BF

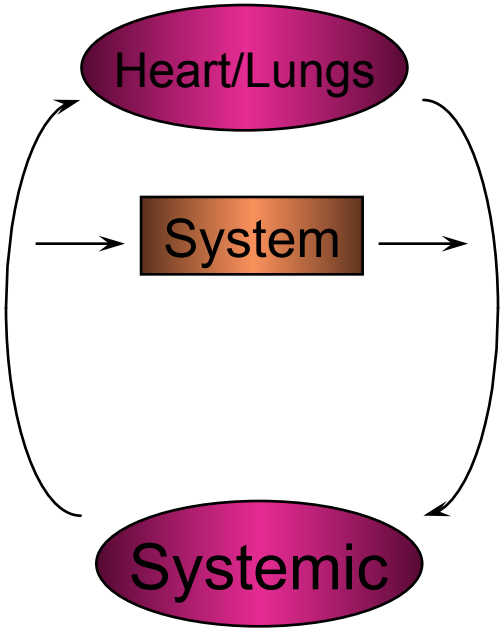


PaO2 as a function of BF at different pulmonary Qs/Qt



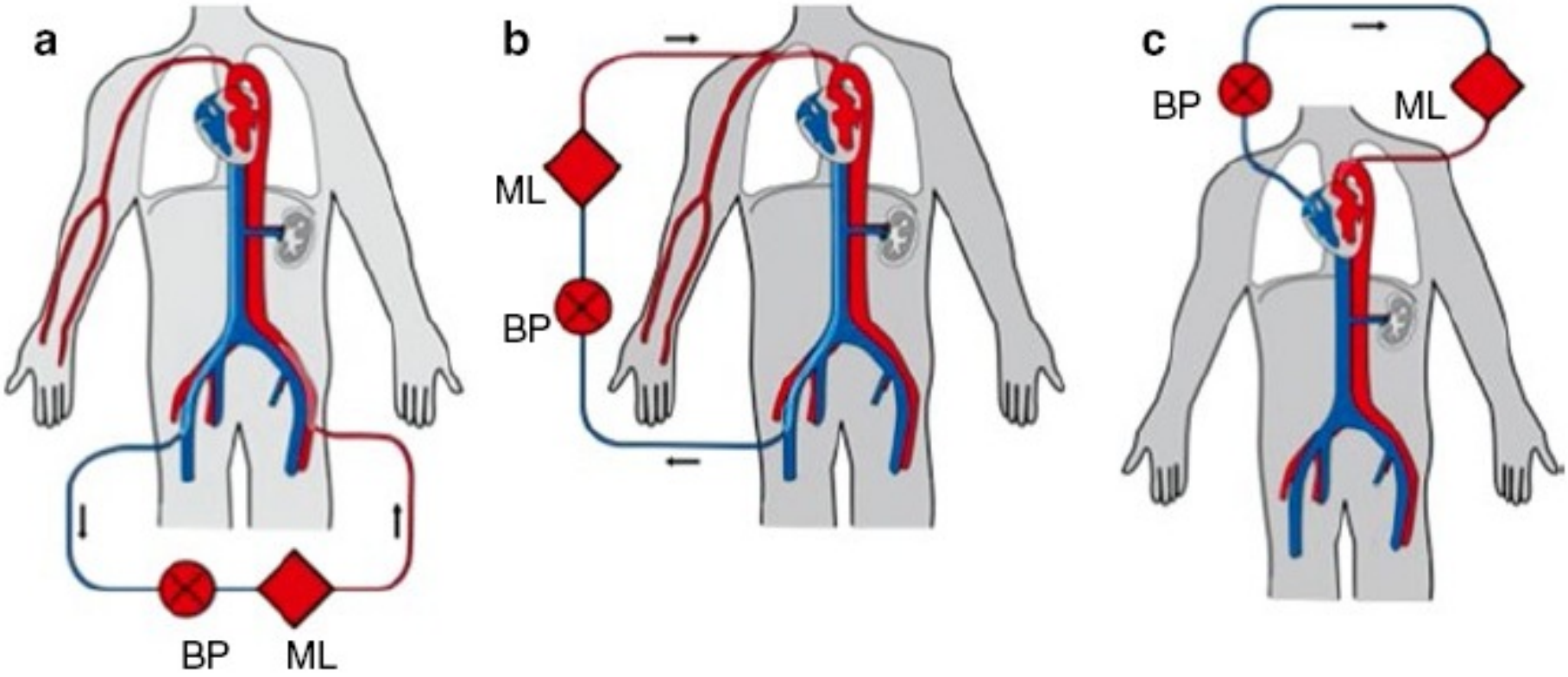
ECLS Configuration (VA)

Venoarterial



- Parallel to heart and lungs
- Variable degree of cardiopulmonary bypass
- Decreases pulmonary blood flow
- Provides cardiac support
- Access to aorta needed

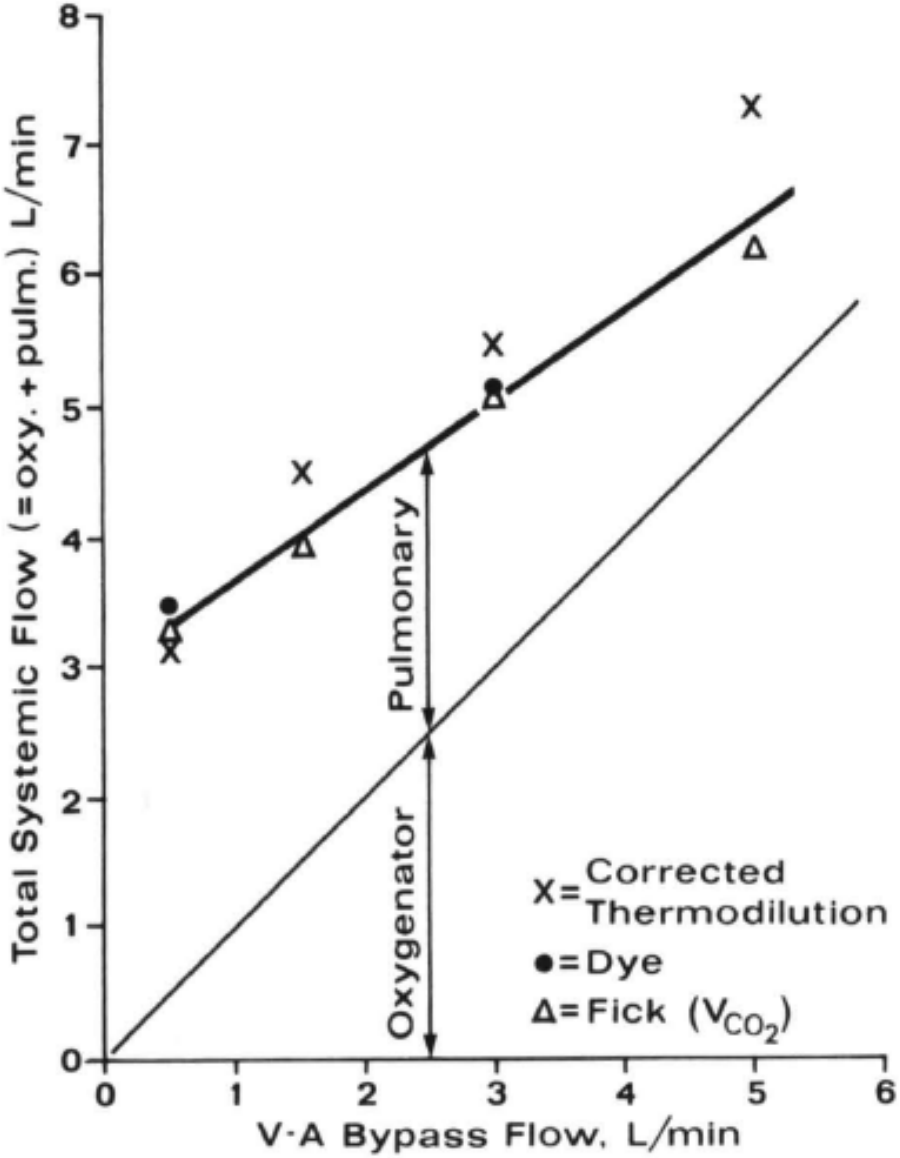
VA-ECMO circuits



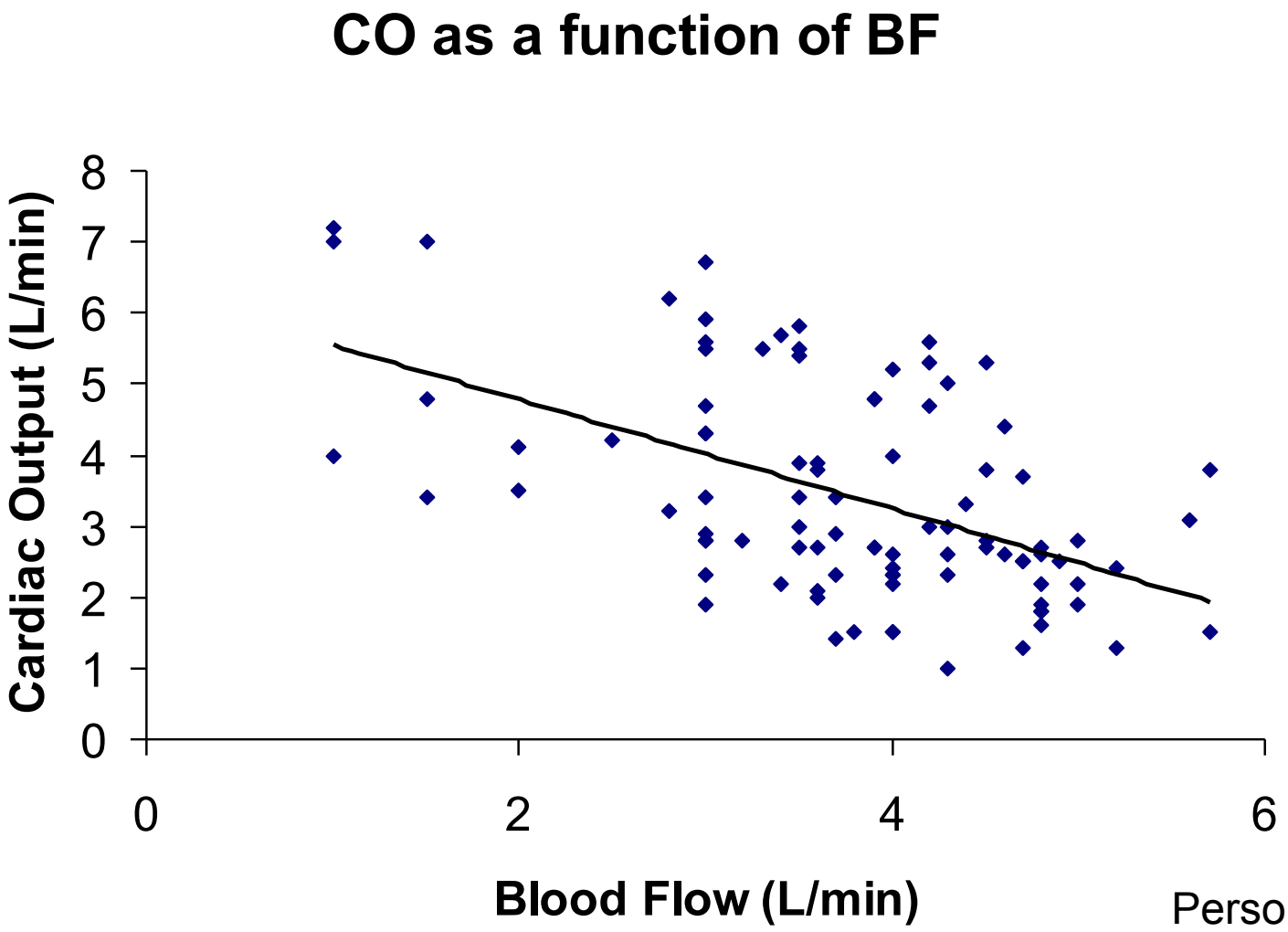
EFFECTS OF EXTRACORPOREAL MEMBRANE OXYGENATION (ECMO) ON PULMONARY HEMODYNAMICS, GAS EXCHANGE AND PROGNOSIS

ASAIO 1975

M. Lamy, R. C. Eberhart, R. J. Fallat,
H. P. Dietrich, J. Ratliff, and J. D. Hill



VA-ECMO
23 discharged patients 2013-2014

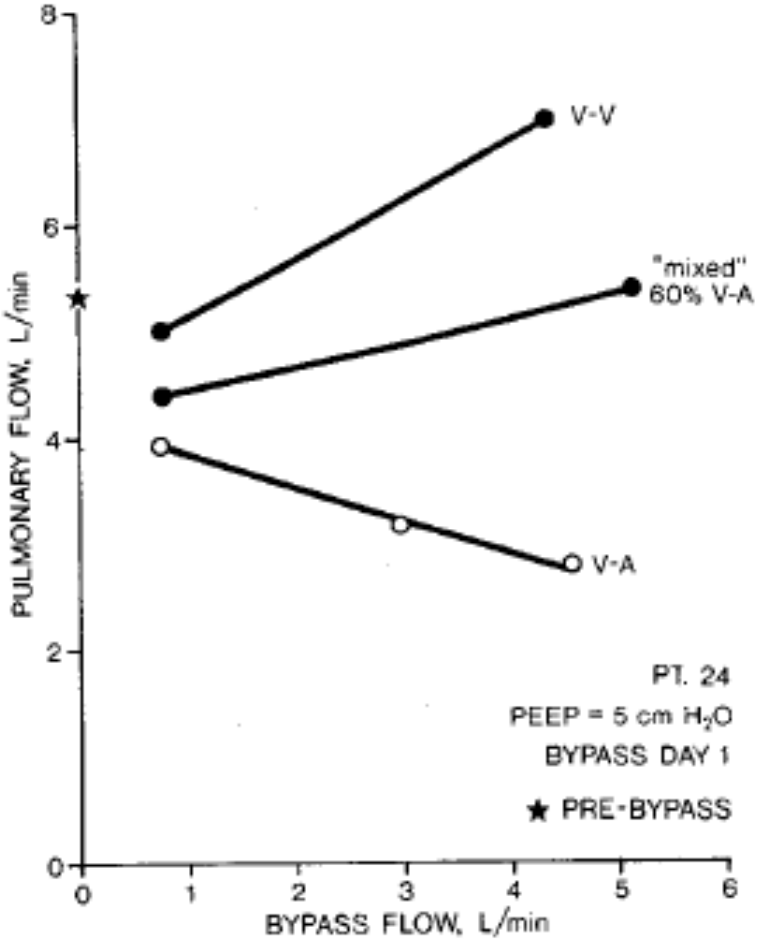


Personal data

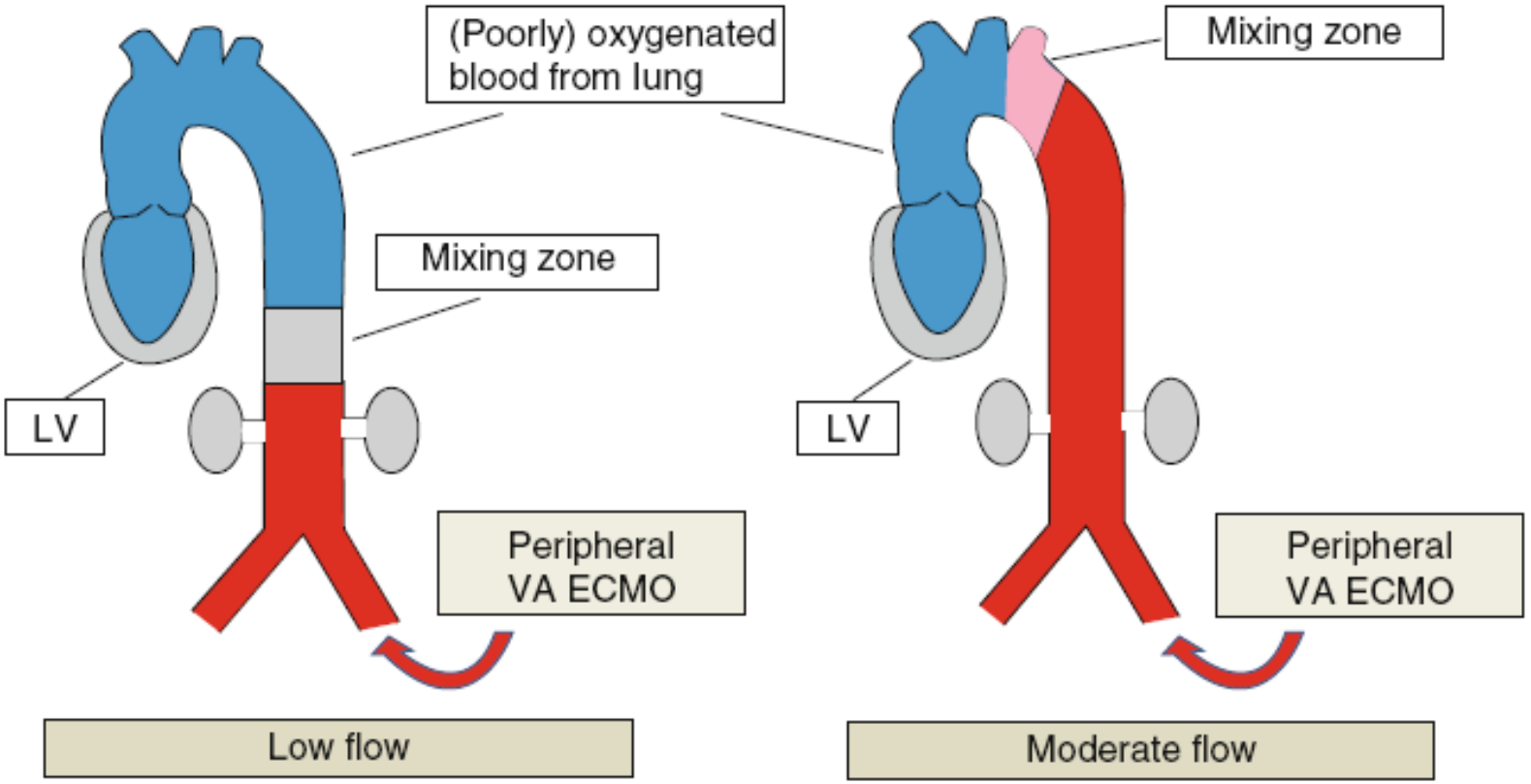
HEMODYNAMIC ASPECTS OF PROLONGED EXTRACORPOREAL OXYGENATION

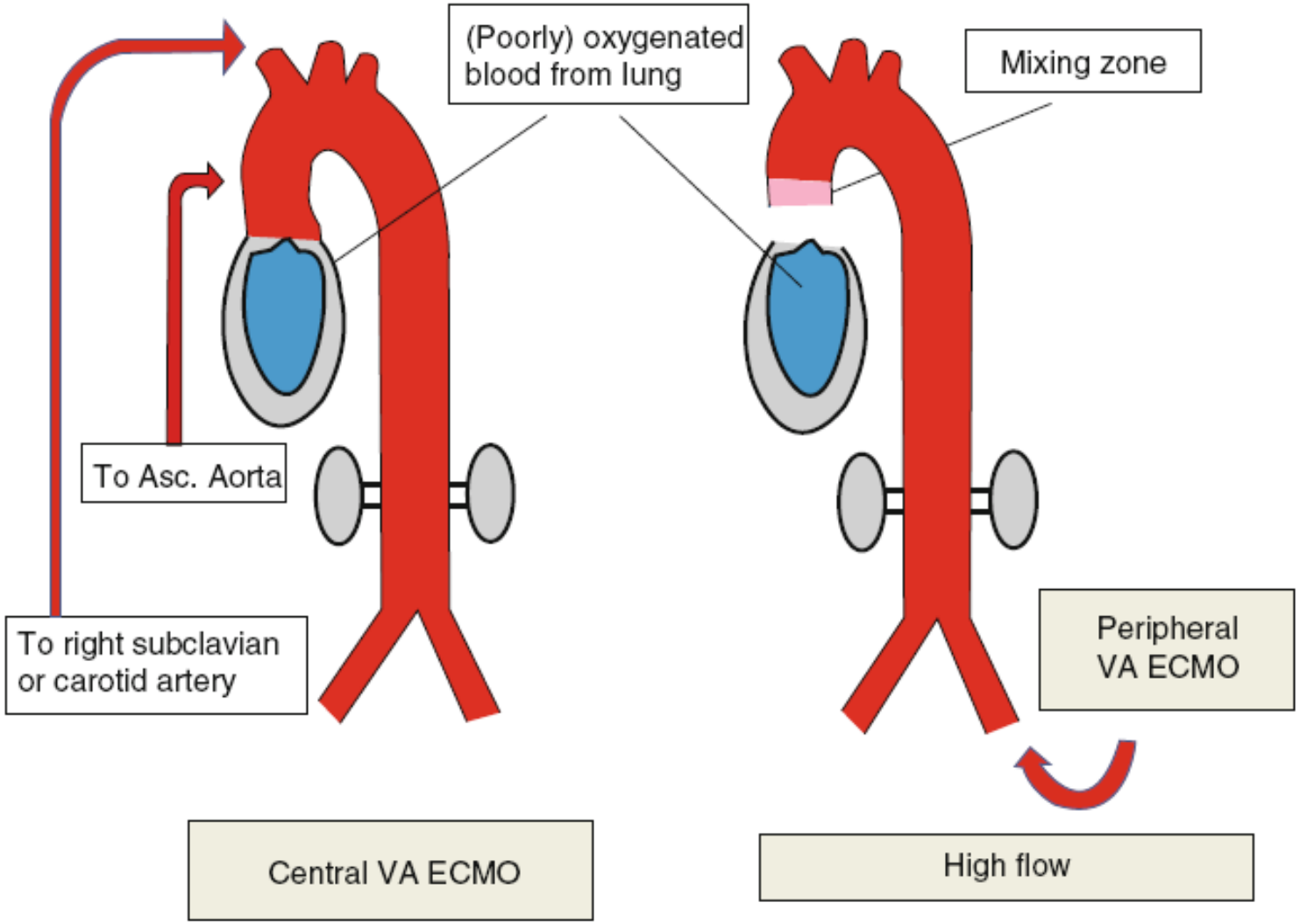
R. C. Eberhart, M. Lamy, H-P Dietrich,
J. L. Ratliff, R. J. Fallat, and J. D. Hill

ASAIO 1974



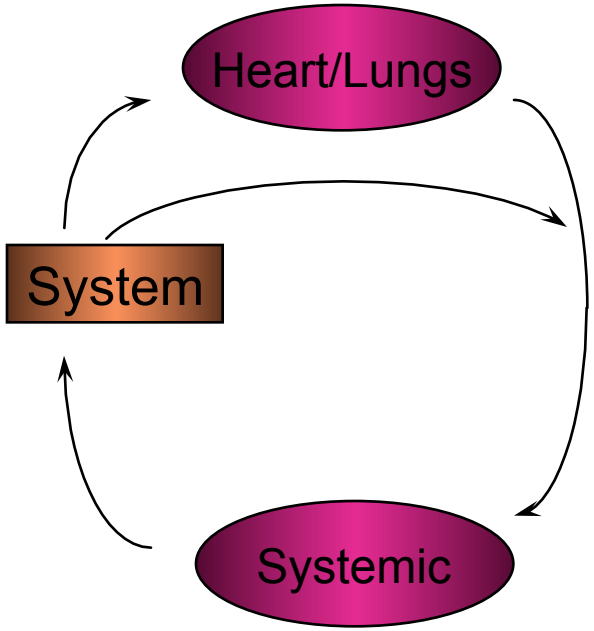
Like Harlequin syndrome




(Poorly) oxygenated blood from lung
Mixing zone
To Asc. Aorta
To right subclavian or carotid artery
Peripheral VA ECMO
Central VA ECMO
High flow

ECLS Configurations (VAV)

Venoarterial + venovenous ECLS



Conclusions

- A-V
  - Cardiac assist
  - No ricirculation
  - **Pulmonary hypoperfusion, regional alcalosis**
  - **Arterial cannulation (bleeding, ischemia, embolism)**
  - **Harlequin's syndrome**
- V-V
  - Easy to access
  - No risk of embolic events
  - **Ricirculation**
  - **No cardiac assist**

The End