

Indikace k ECLS u onkologických a imunokompromitovaných pacientů

Martin Balík

KARIM VFN a 1. LFUK Praha

Akutní respirační selhání u imunokompromitovaných pacientů

- **Nejčastější příčina nechirurgická příčina příjmu na ICU**
hematoonkologických a imunosuprimovaných pacientů
- **Nejčastější příčina úmrtí** hematoonkologických pacientů (vyjma relapsu)
- Postihne 5% pacientů se solidními tumory, 20% hematoonkologických pacientů a až 50% pacientů s transplantací kostní dřeně (Azoulay E, Schlemmer B. Diagnostic strategy in cancer patients with acute respiratory failure.

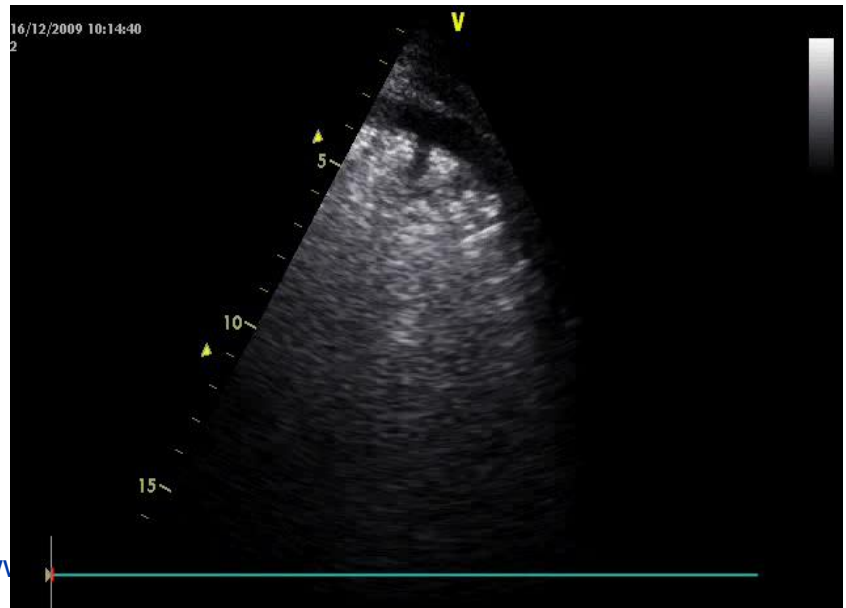
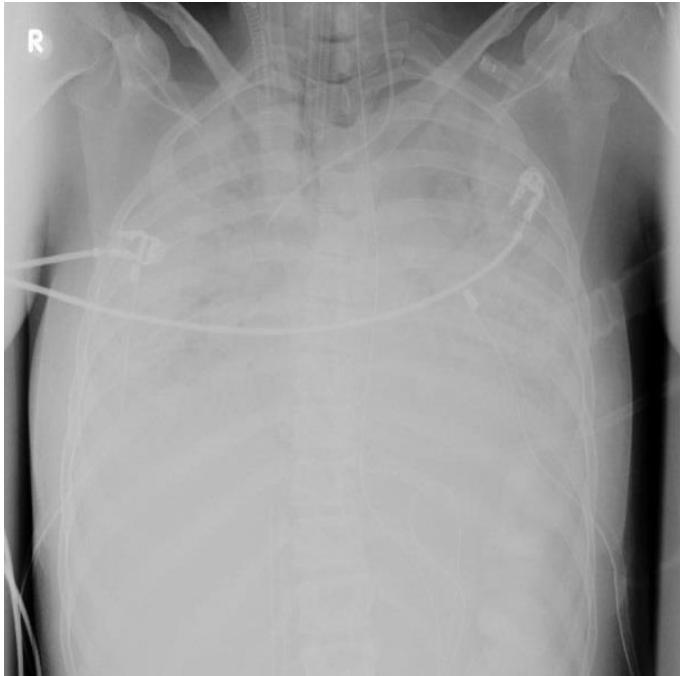
Intensive Care Med, 2006;32:808-22)

Indications to ECMO „bridge“

- **1.) Cardiogenic shock, CPR**
 - Reversible LV or RV failure
- **2.) Critical oxygenation failure:**
 - ARDS
- **3.) Hypercapnic respiratory failure**
 - Reversible retention of CO_2 , lung protection
- **4.) Barotrauma, bronchopleural communication**
 - Lowering of Paw , Ptp
- **5.) Airway obstruction**
 - Time to dg. and treatment
- **6.) On waiting list for lung Tx**
 - Avoiding intubation and complications, bridge to Tx



Hypoxaemia and hypercapnia – when nothing works



www

Indications to ECMO – ELSO guidelines

Hypoxic respiratory failure:

- Estimated mortality > 50%

$\text{PaO}_2/\text{FiO}_2 < 150$, Murray 2-3

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- Estimated mortality > 80%

$\text{PaO}_2/\text{FiO}_2 < 80$, Murray 3-4

VV-ECMO insertion

Retention CO_2 , $\text{PaCO}_2 > 80$ mmHg

Air-leak (barotrauma)

Age < 65 years

IPPV up to 7 days

Blocked airway

Cardiorespiratory collapse

Reparable lung disease



Extracorporeal Life Support Organization (ELSO)

Patient Specific Supplements to the ELSO General Guidelines

ECMO.....in/on time !



Survival %

Contraindications to VV ECMO:

Absolute:

- IC bleeding, stroke
- hypoxic cardiac arrest
- irreversible lung damage, incurable disease
- severe heart failure, cardiogenic shock
- severe pulmonary hypertension (PAPm > 50 mmHg)

Relative:

- age > 75 years
- obesity with a BMI over 40
- aggressive IPPV ≥ 7 days
- advanced liver disease
- trauma with extensive bleeding
- hemorrhagic diathesis and severe thrombocytopenia

Fig. 3
(MV)
days o

Patr

Extracorporeal Membrane Oxygenation for 2009 Influenza A(H1N1) Acute Respiratory Distress Syndrome

The Australia and New Zealand Extracorporeal Membrane

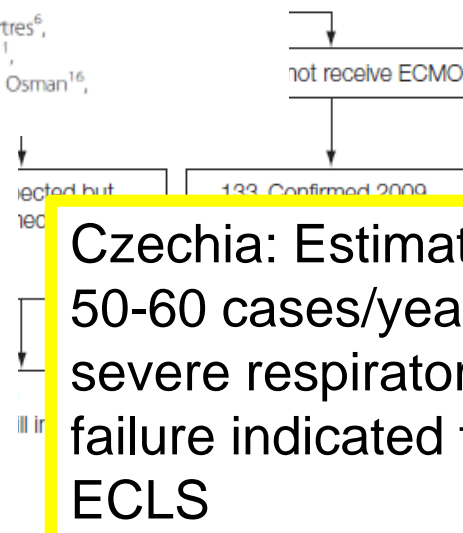
Context The novel influenza A(H1N1) pandemic affected Australia and New Zealand during the 2009 southern hemisphere winter. It caused an epidemic of critical y distress syndrome (ARDS) ition (ECMO).

Extracorporeal life support for patients with acute respiratory distress syndrome: report of a Consensus Conference

Richard et al. *Annals of Intensive Care* 2014, 4:15

Christian Richard^{1*}, Laurent Argaud², Alice Blet³, Thierry Boulain⁴, Laetitia Contentin⁵, Agnès Dechartres⁶, Jean-Marc Dejode⁷, Laurence Donetti⁸, Muriel Fartoukh⁹, Dominique Fletcher¹⁰, Khaldoun Kuteifan¹¹, Sigismond Lasocki¹², Jean-Michel Liet⁷, Anne-Claire Lukaszewicz¹³, Hervé Mal¹⁴, Eric Maury¹⁵, David Osman¹⁶, Hervé Outin¹⁷, Jean-Christophe Richard¹⁸, Francis Schneider¹⁹ and Fabienne Tamion²⁰

Freed DH, Henzler D, et al, Canadian Critical Care Trials Group. Can J Anaesth 2010: 168 pts with confirmed H1N1 resp. failure, 6 (3.6%) on ECLS, mean 15 days. 66% long term survival

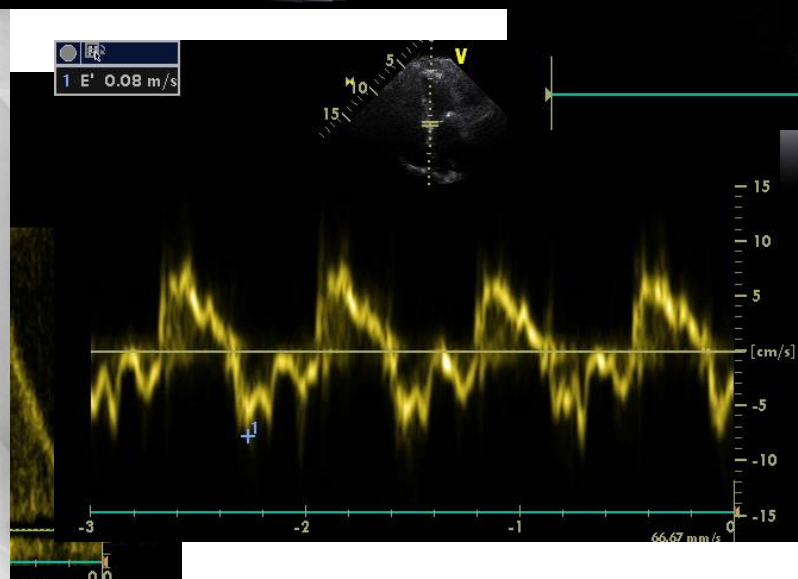
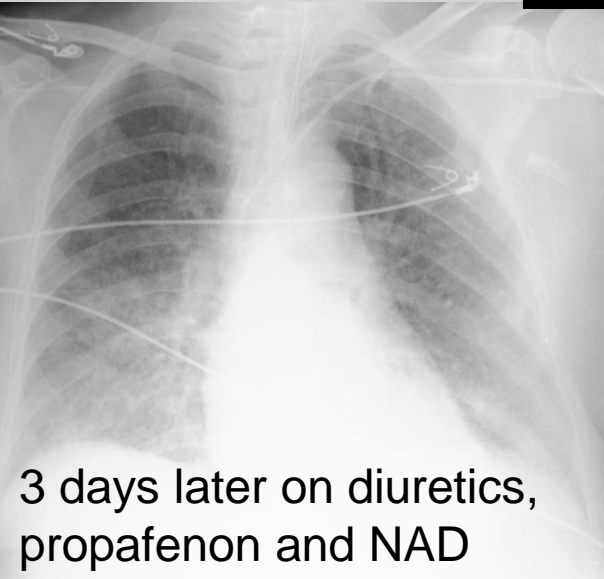
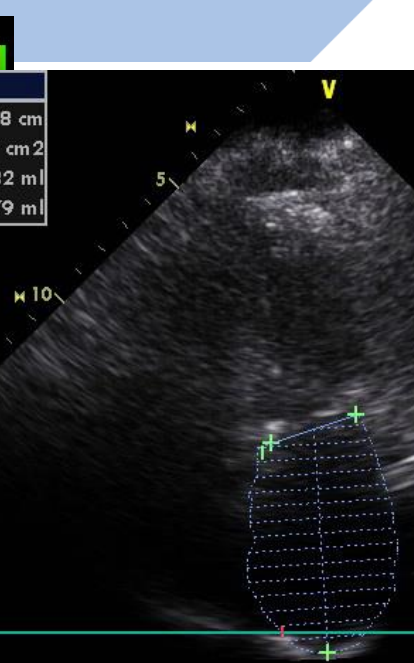
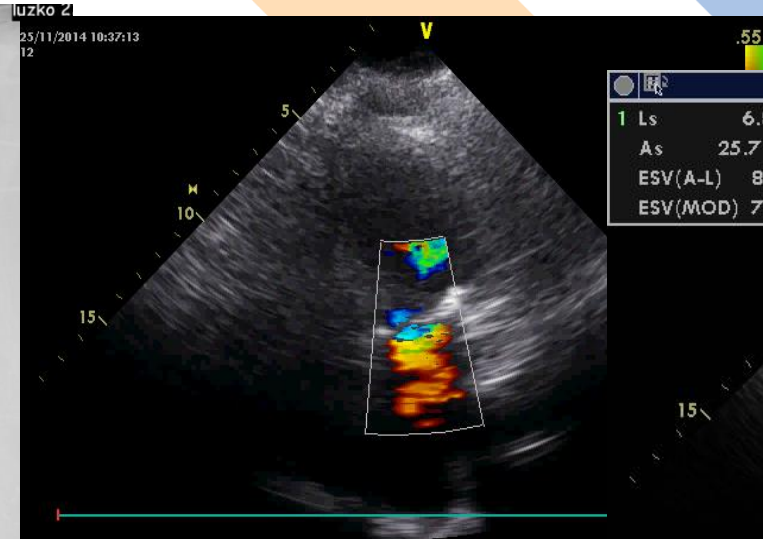


Czechia: Estimated 50-60 cases/year of severe respiratory failure indicated to ECLS

ECMO indicates extracorporeal membrane oxygenation; ICU, intensive care unit.

2.6 ECMO cases per milion population

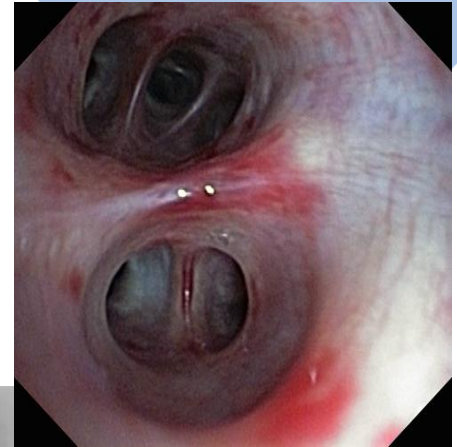
Diastolic heart failure referred as ARDS to ECMO



- LA ESV
50 ml/m²
- E/E' 21

Severe cardiorespiratory failure: VV or VA ?

- Viral myocarditis, pericarditis – viral replication in heart muscle (Greaves K, et al: Arch Intern Med 2004)
- Relation to „sudden heart failures“ in patients with H1N1



Paris grippé



VV or VA cannulation ?

Viral pneumonitis – primary ARDS

Pneumococcal or G- sepsis (2011...)

-typically in immunocompromised

-Pneumococcus, Klebsiella, Staph. aureus....

Ris **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



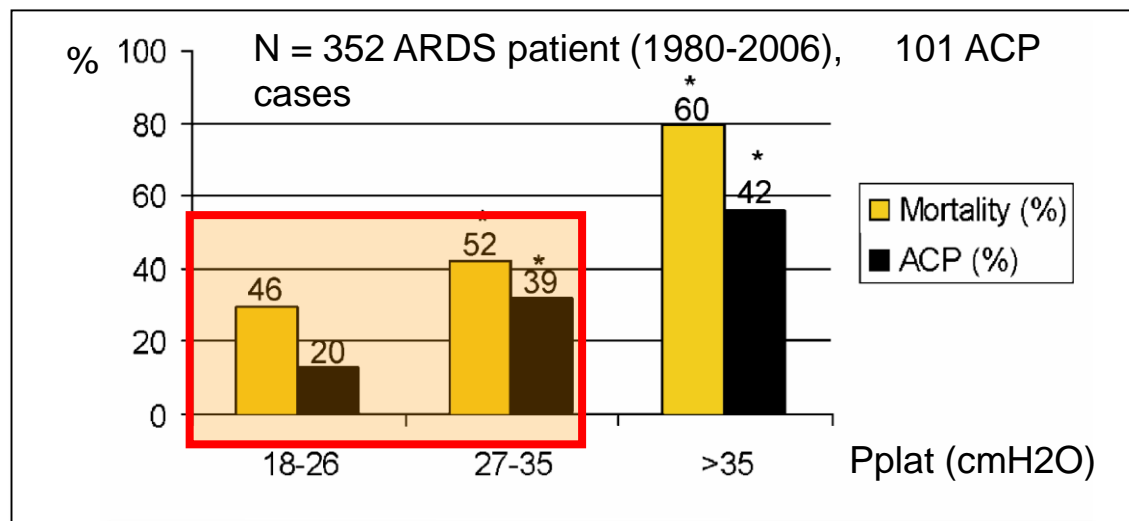
Successful Use of Extra-corporeal Membrane Oxygenation in a Patient with Streptococcal Sepsis: A Case Report and Review of Literature

Pořízka M.¹, Kopecký P.¹, Prskavec T.², Kunstýř J.¹., Rulíšek J.¹, Balík M.¹

Prague Medical Report 2015, 116(1):57-63.

Right ventricular failure: Primary or obstructive, secondary to severe respiratory failure

- ARDS: ACP up to 33% (Jardin F, Intensive Care Med 2007)
- Pplat < 27 mbar only 13%
- Survival on IPPV linearly related to EF_RV (Steltzer H, et al: Anaesthesia 1994)
- **ACP as an indication to VA-ECMO !**



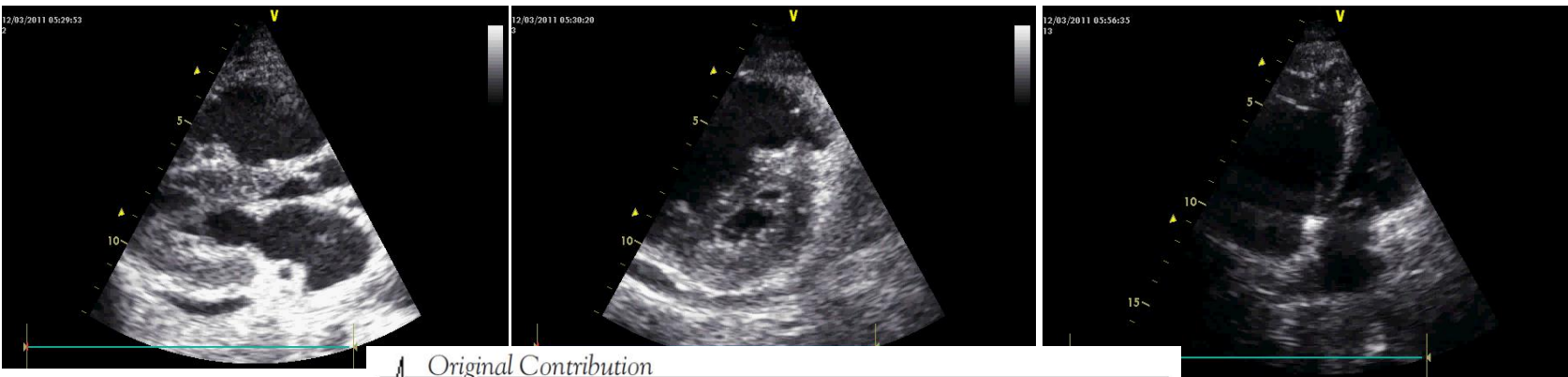
N = 352 ARDS patient (1980-2006),
101 ACP cases

ACP 13%
for Pplat < 27
cmH2O

Jardin F, Vieillard-Baron A. INT CARE MED 2007

www.karim-vfn.cz

ACP during conventional therapy of ARDS – indication to VA-ECMO



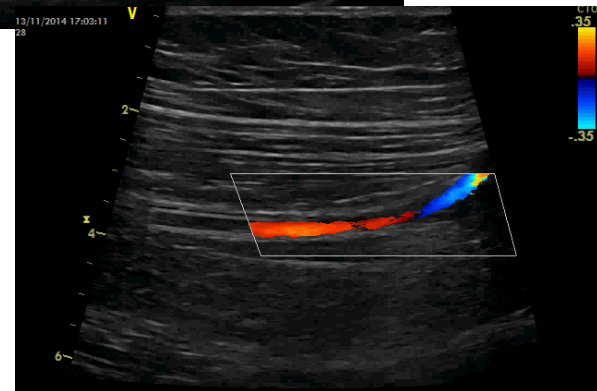
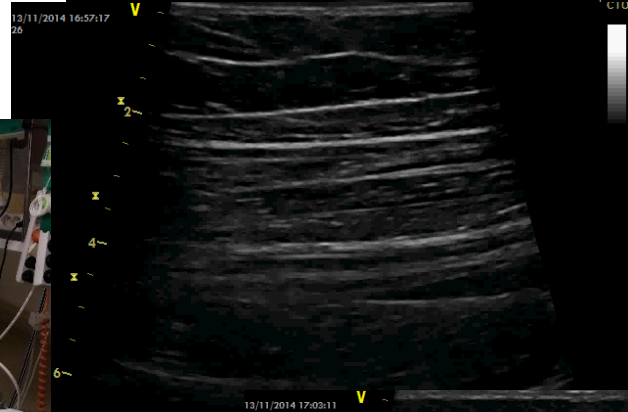
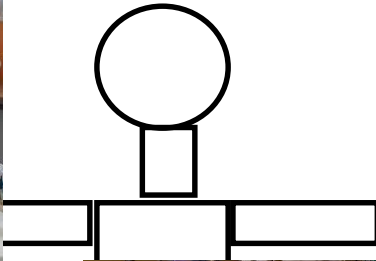
Original Contribution

Veno-Arterial ECMO in Severe Acute Right Ventricular Failure with Pulmonary Obstructive Hemodynamic Pattern

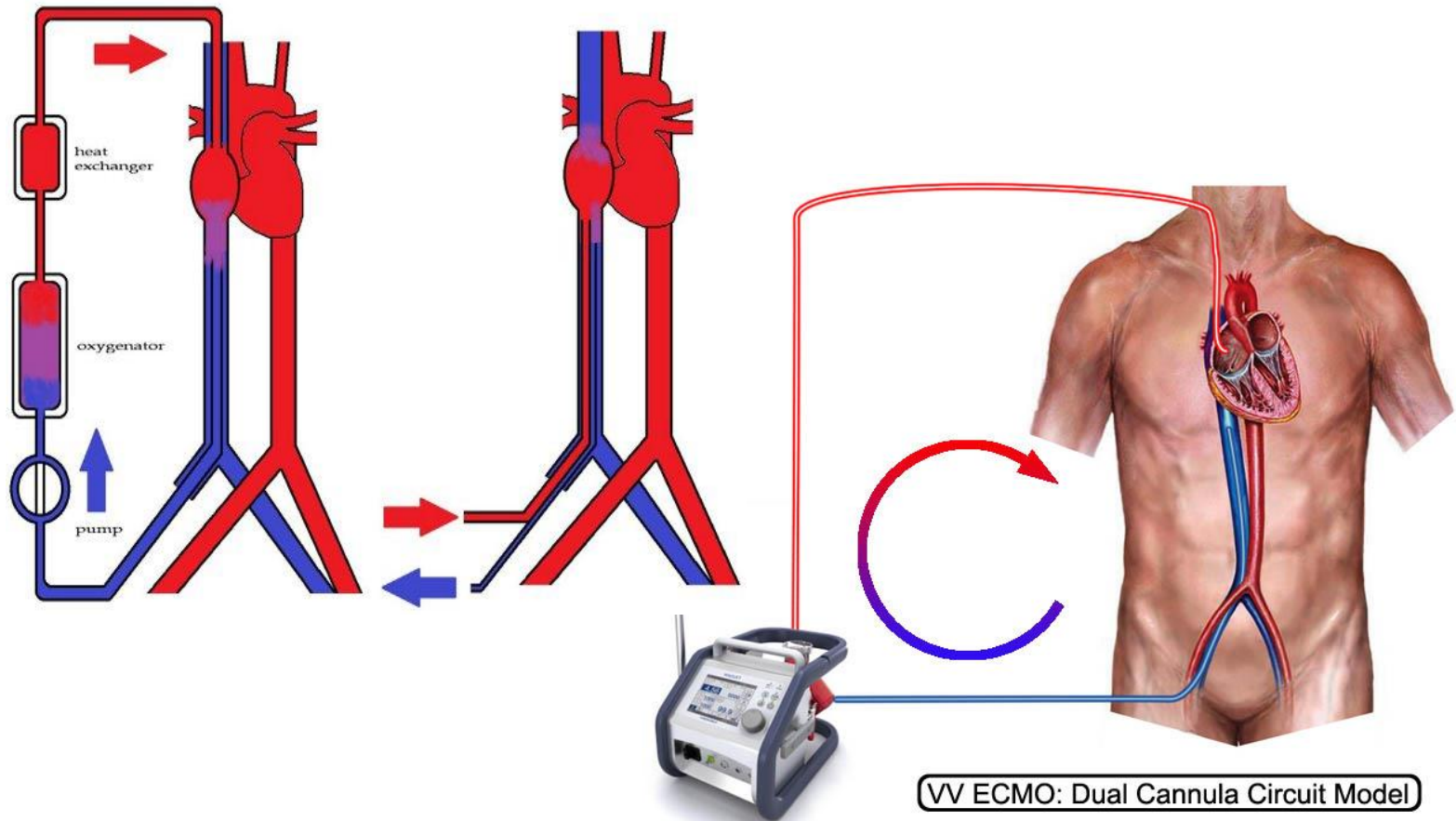
Jan Belohlavek, MD, PhD[§], Vilem Rohn, MD, PhD^{*}, Pavel Jansa, MD[§], Jan Tosovsky, MD, PhD^{*}, Jan Kunstyr, MD, PhD[†], Michal Semrad, MD, PhD^{*}, Jan Horak, MD, PhD[§], Michal Lips, MD[†], Frantisek Mlejnsky, Mgr^{*}, Martin Balik, MD, PhD[†], Andrew Klein, MD[™], Ales Linhart, MD, PhD[§], Jaroslav Lindner, MD, PhD^{*}



ECLS as a combined haemodynamic and respiratory support: VA-ECMO



VV ECMO, Qb 3-7 l/min



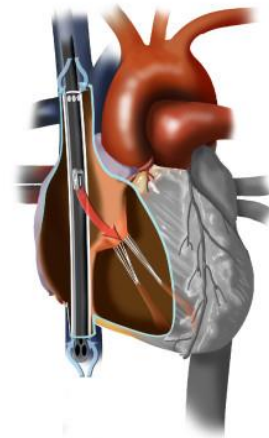
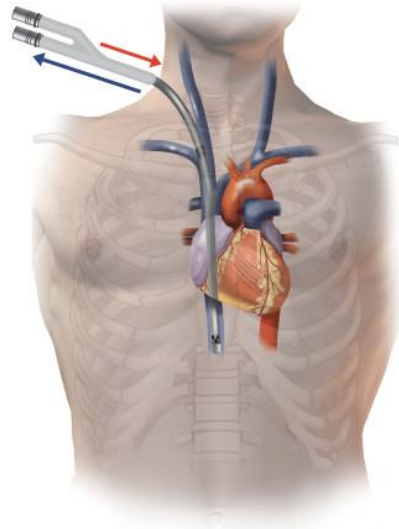
VV ECMO cannulation

Cannulas SVC 18-23F, IVC 22-29F

2x single lumen

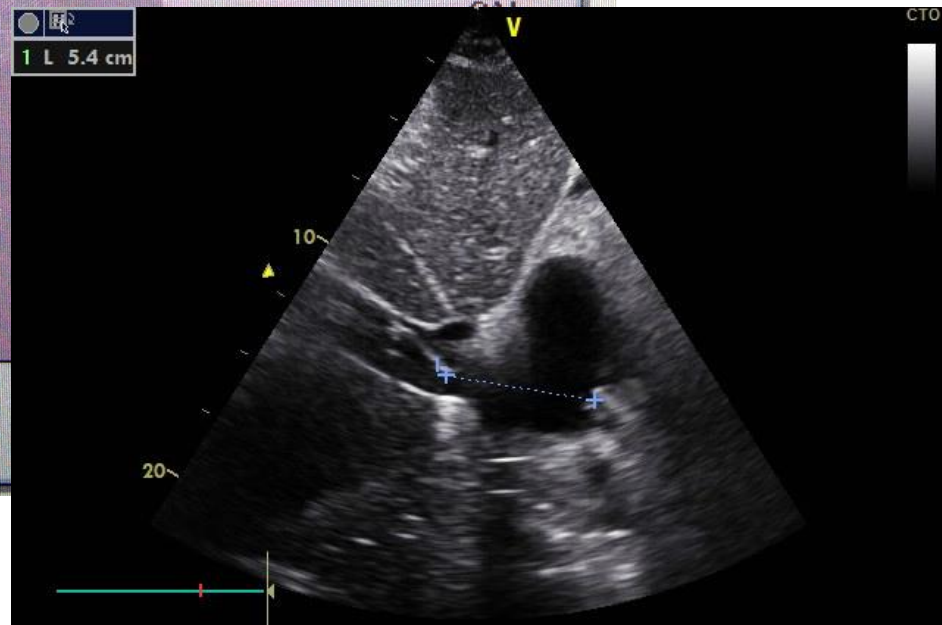
or

1x double lumen



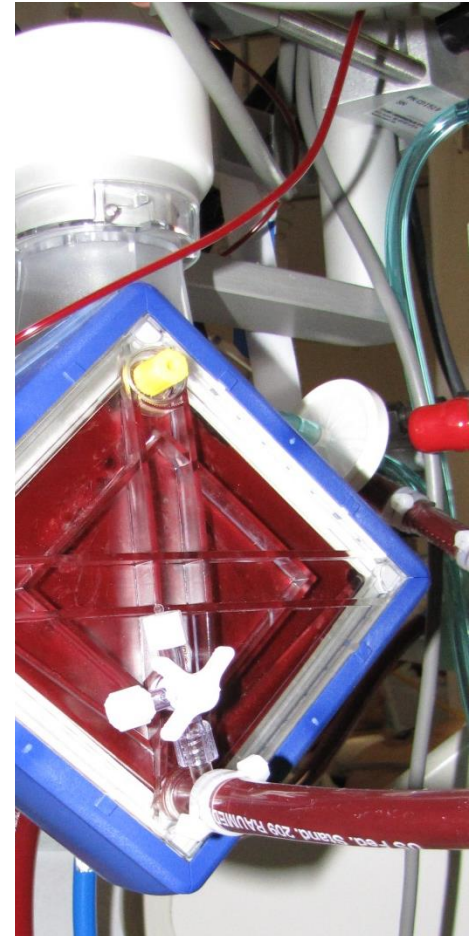
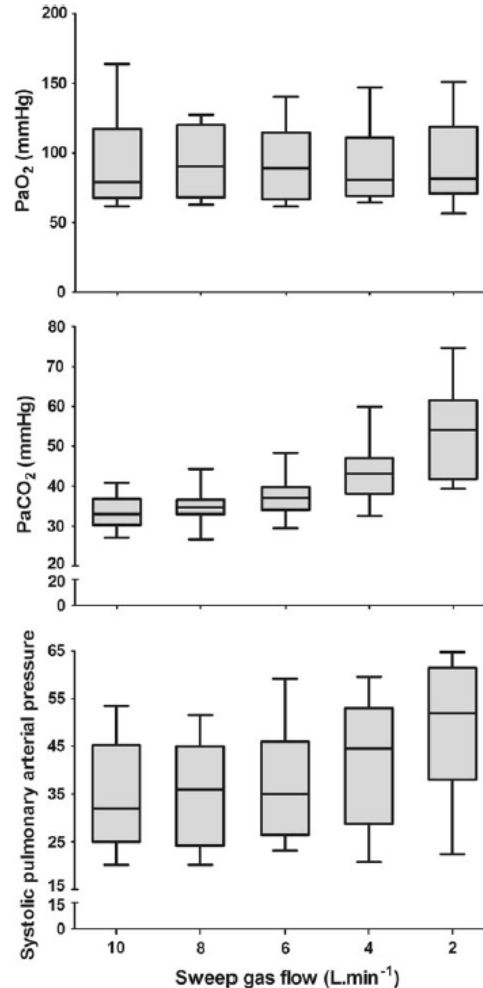
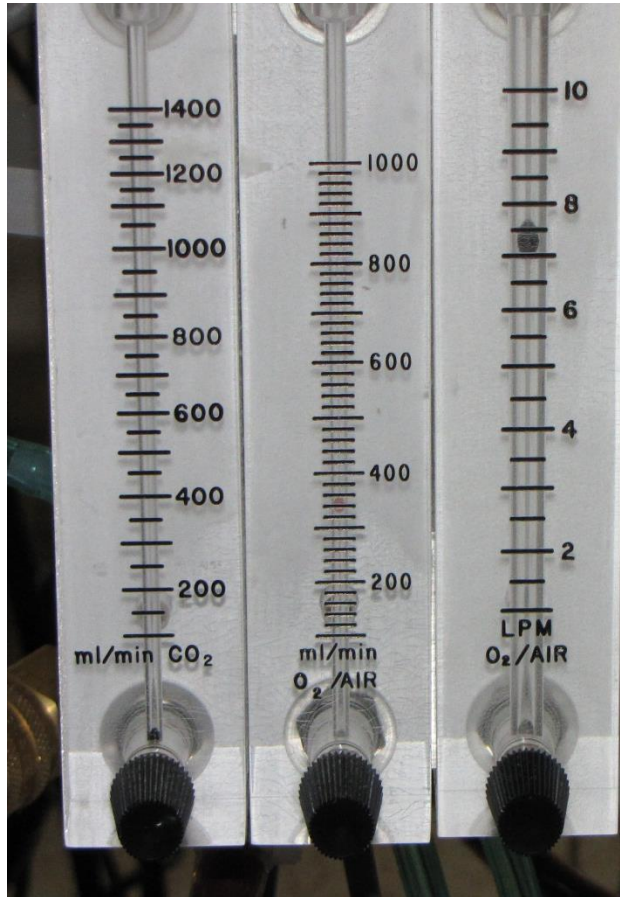
Avoiding recirculation of oxygenated blood – echocardiographic monitoring

pH	7.47	HCT	32 %
PCO ₂	33 mmHg	Hgb	10.7 g/dl
PO ₂	483 mmHg	SO ₂	82 %
Temp	36.3 °C		
HCO ₃	24 meq/l		
BE	1 meq/l		
calc SO ₂	100 %		



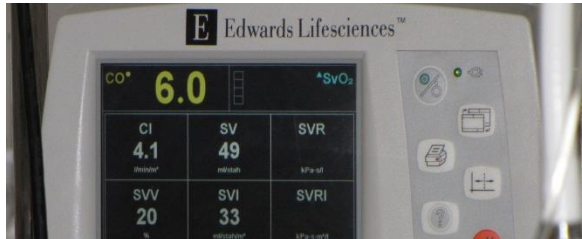
Ventilation and CO₂: SGF flow

Oxygenation: FiO₂



Qb and gases: ECMO / CO (target > 60%)

- impact on peripheral DO_2
- increase of $CO_2 < 2.5-3$ l/min

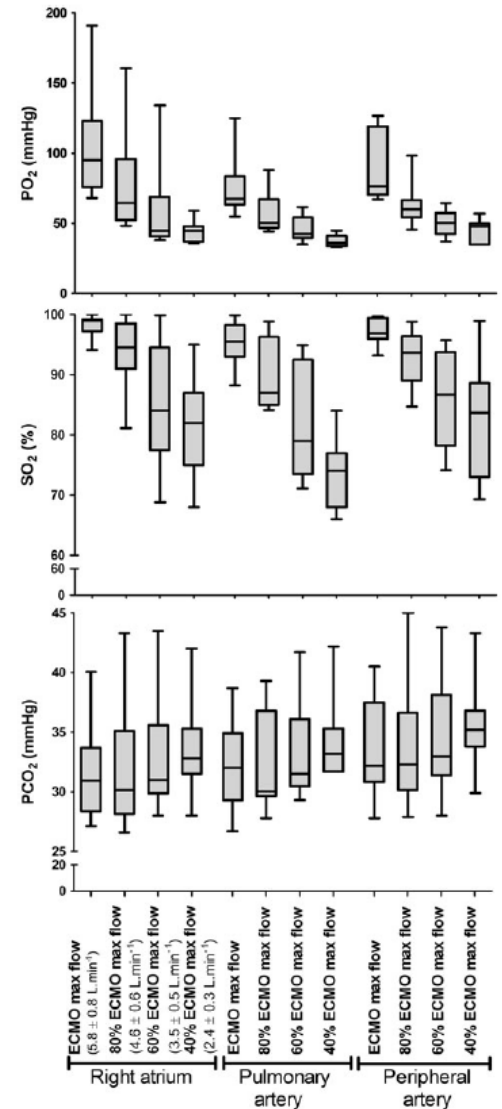


Intensive Care Med (2013) 39:838–846
DOI 10.1007/s00134-012-2785-8

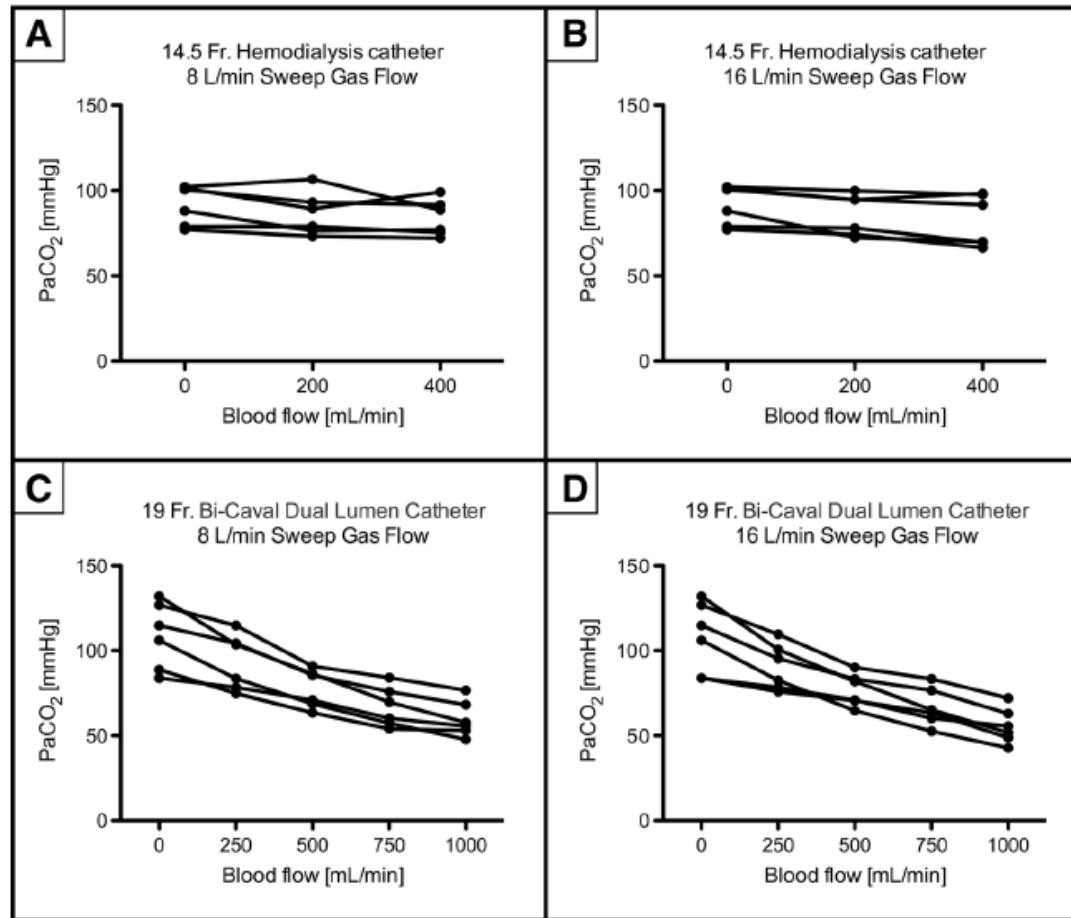
ORIGINAL

Matthieu Schmidt
Guillaume Tachon
Christine Devilliers
Grégoire Muller
Guillaume Hekimian

**Blood oxygenation and decarboxylation
determinants during venovenous ECMO
for respiratory failure in adults**



CO₂ and SGF !.....but 700-1000 mL/min Qb as a minimum (PALP Maquet, 0.98 m², polymethylpenten)



ECMO a krvácivé komplikace

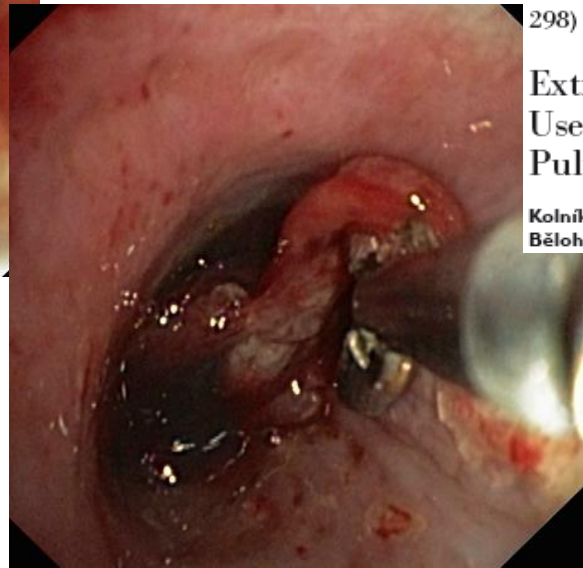
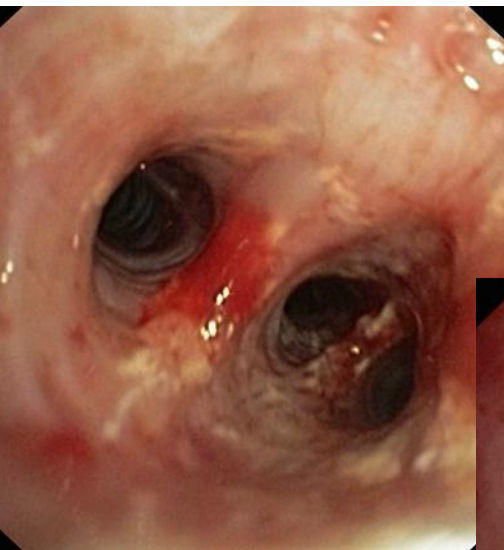
Intensive Care Med (2012) 38:62–68
DOI 10.1007/s00134-011-2370-6

ORIGINAL

Claudia Hellmann
Ulrich Geisen
Friedhelm Beyersdorf

Acquired von Willebrand syndrome in patients with extracorporeal life support (ECLS)

- Capping of UFH infusion at 15 IU/kg.h
- Arlt M, et al, Resuscitation 2010: 10 patients at high risk of bleeding on **heparin free** VV-ECMO, 60% long term survival



298) Prague Medical Report / Vol. 113 (2012) No. 4, p. 298–301

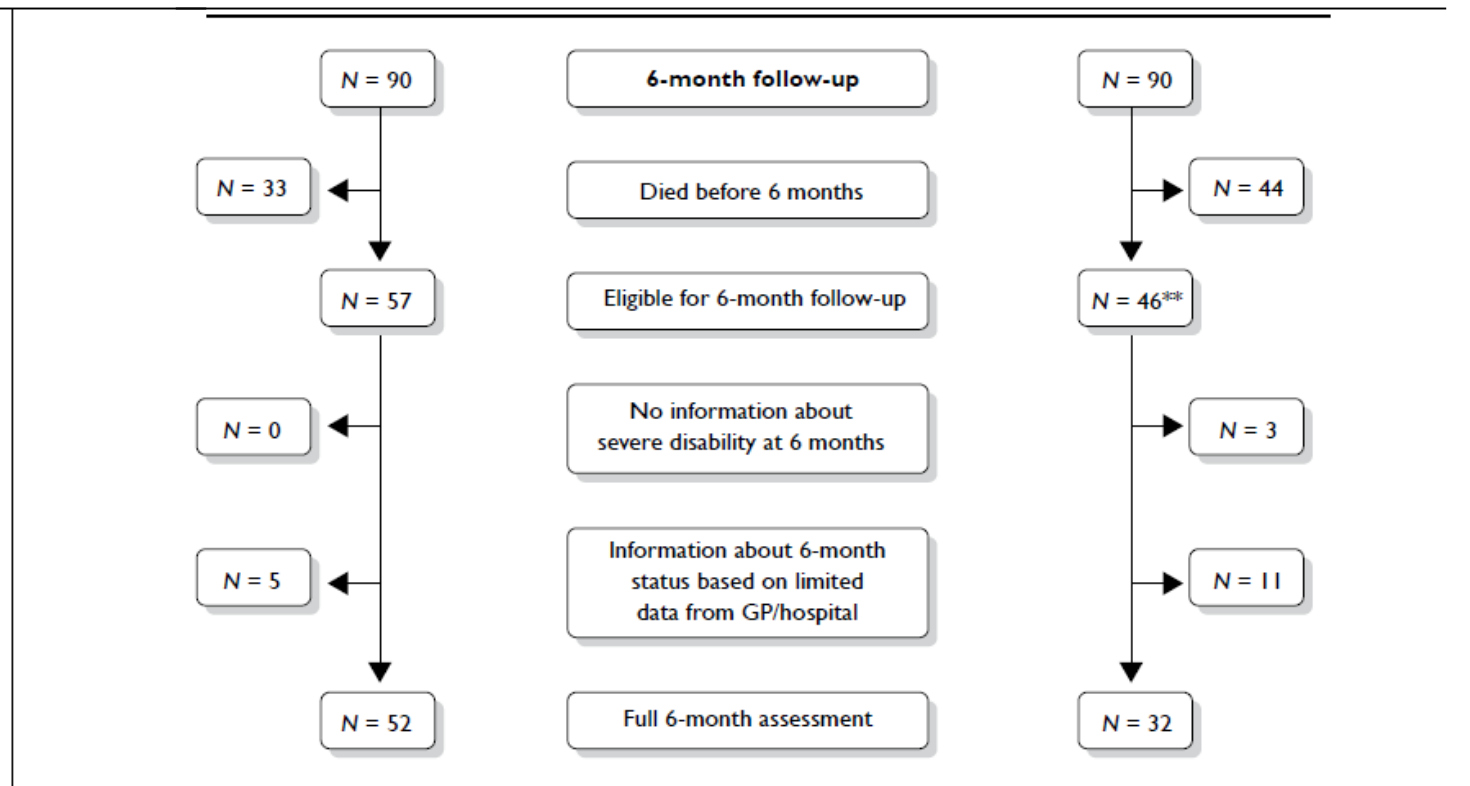
Extracorporeal Membrane Oxygenation
Used in a Massive Lung Bleeding Following
Pulmonary Endarterectomy

Kolníková I.¹, Kunštyř J.¹, Lindner J.², Lipš M.¹, Kopecký P.¹, Rulíšek J.¹,
Bělohlávek J.³, Balík M.¹

CESAR study: 6 months follow up

Peek GJ, Lancet 2009

Conventional Ventilation or
ECMO for
Severe
Adult
Respiratory Failure



67%

versus

47%

VV-ECMO u H1N1

CARING FOR THE
CRITICALLY ILL PATIENT

ONLINE FIRST

Referral to an Extracorporeal Membrane Oxygenation Center and Mortality Among Patients With Severe 2009 Influenza A(H1N1)

British 4 ECMO centers demonstrated 25% hospital mortality in VV-ECMO vs 50% in the conservative arm

Conclusion For patients with H1N1-related ARDS, referral and transfer to an ECMO center was associated with lower hospital mortality compared with matched non-ECMO-referred patients.

Intensive Care Med (2011) 37:1447–1457
DOI 10.1007/s00134-011-2301-6

ORIGINAL

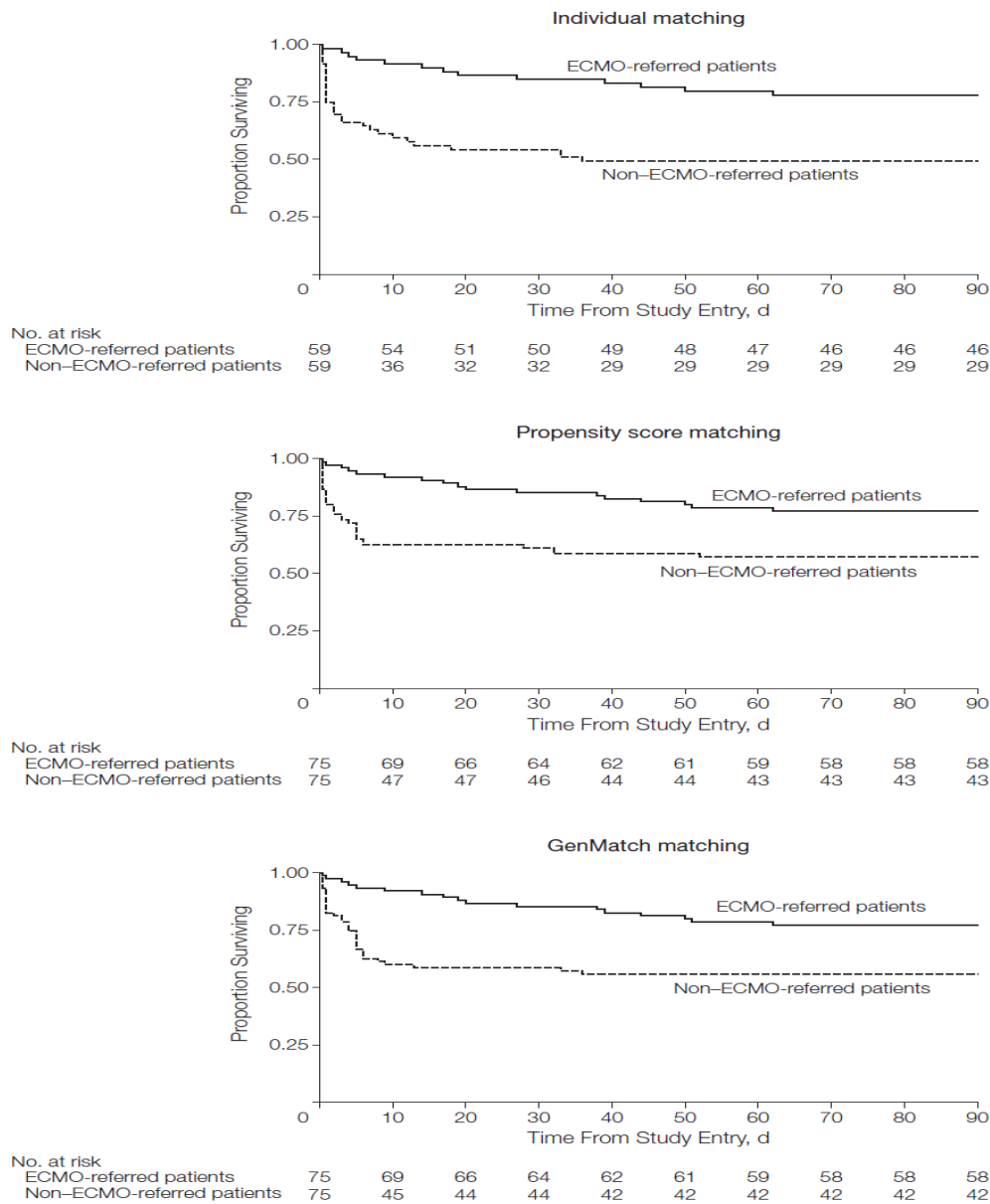
JAMA. 2011;306(15):doi:10.1001/jama.2011.1471

www.jama.com

Nicolò Patroniti
Alberto Zangrillo
Federico Pappalardo
Adriano Peris
Giovanni Clanchi
Antonio Braschi
Giorgio A. Iotti
Antonio Arcadipane
Giovanna Panarello
V. Marco Ranieri
Pierpaolo Terragni
Massimo Antonelli
Luciano Gattinoni
Fabrizio Oleari
Antonio Pesenti

The Italian ECMO network experience during the 2009 influenza A(H1N1) pandemic: preparation for severe respiratory emergency outbreaks

Figure 2. Survival Curves for ECMO-Referred Patients vs Matched Non-ECMO-Referred Patients



- Noah MA, et al:
JAMA 2011,
306: 1659-1668
- **Matching based on**
 - Demographic data
 - Physiological data
 - Comorbidities

Extracorporeal Membrane Oxygenation for Severe Acute Respiratory Distress Syndrome The EOLIA trial

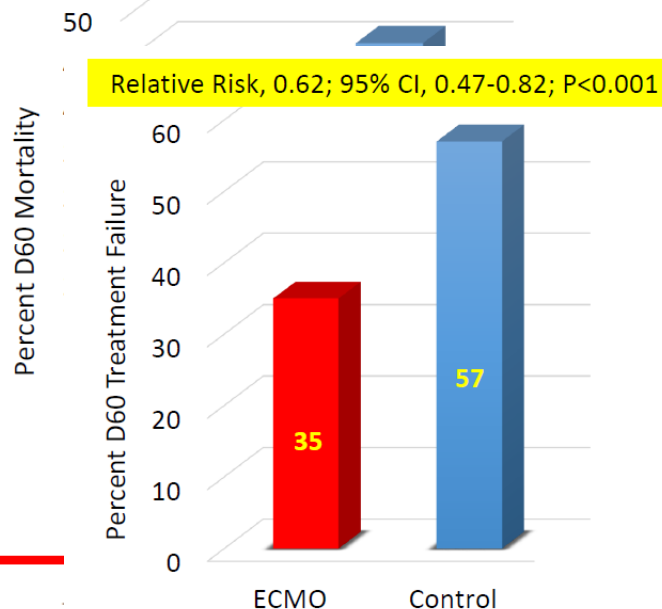
Alain Combes, David Hajage, Gilles Capellier, Alexandre Demoule, Sylvain Lavoué, Christophe Guervilly, Daniel Da Silva, Lara Zafrani, Patrice Tirot, Benoit Veber, Eric Maury, Bruno Levy, Yves Cohen, Christian Richard, Pierre Kalfon, Lila Bouadma, Hossein Mehdaoui, Gaëtan Beduneau, Guillaume Lebreton, Laurent Brochard, Niall D. Ferguson, Eddy Fan, Arthur S. Slutsky, Daniel Brodie, and Alain Mercat

On behalf of the EOLIA Trial Group, Réseau Européen en Ventilation Artificielle (REVA)
and the International ECMO Network (ECMONet)

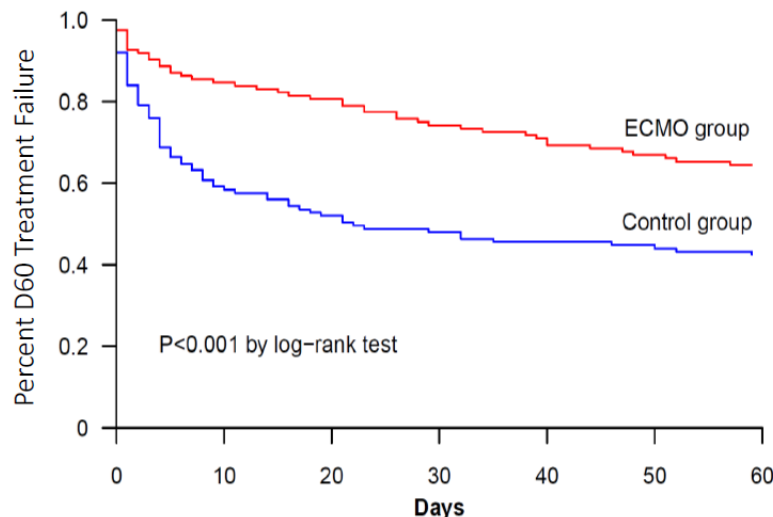
EURO ELSO meetin 2018 – Prague, Cz

Relative Risk, 0.76, 95% CI, 0.55-1.04; P=0.087

Hazard Ratio, 0.70; 95% CI, 0.47-1.04, P=0.074 by log-rank test



Hazard ratio, 0.48; 95% CI, 0.34-0.70, P <0.001 by log-rank test



Death in ECMO group patients; Death or Crossover to ECMO in control patients

RESEARCH

Open Access

Extracorporeal membrane oxygenation in adult patients with hematologic malignancies and severe acute respiratory failure

Philipp Wohlfarth¹, Roman Ullrich², Thomas Staudinger¹, Andja Bojic¹, Oliver Robak¹, Alexander Hermann¹, Barbara Lubczyk², Nina Worel³, Valentin Fuhrmann⁴, Maria Schoder⁵, Martin Funovics⁵, Werner Rabitsch¹, Paul Knoebl¹, Klaus Laczika¹, Gottfried J Locker¹, Wolfgang R Sperr¹, Peter Schellongowski^{1*} and Arbeitsgruppe für hämato-onkologische Intensivmedizin der Österreichischen Gesellschaft für Internistische und Allgemeine Intensivmedizin und Notfallmedizin (ÖGIAIN)

- 14 HO pacientů (17 setů) - 3x VA ECMO, 11x VV ECMO
- věk 31 let (22 – 51)
- median trombo 35 (26 – 51), leuko 2,1 (1,8 – 25,5)
- 5/14 krvácivé komplikace
- ICU přežití 59%, přežití do dimise 50%, follow up s mediánem 36 měsíců - 100%

Table 1 Individual characteristics and outcomes

Patient number	Malignancy	Therapy status (days since therapy)	Etiology of ARF	SAPS II	LIS	ECMO days	Bleeding	ICU and hospital outcome
1	CNS NHL	Chemotherapy (51)	Pneumonia	45	3.7	9	Minor	Died
2	Hodgkin lymphoma	Allo SCT (111)	Pneumonia	34	3.3	28 ^b	Major	Died
3	ALL	Consolidation (13)	Abdominal sepsis	78	2.3	4 ^c	-	Alive
4	ALL ^a	Induction on ECMO	TRALI	62	3.3	3	-	Alive
5	Burkitt lymphoma	Induction (16)	Pneumonia	63	3.8	8	-	Alive
6	ALL	Allo SCT (31)	Pneumonia	39	3.5	7	Major	Died
7	Hodgkin lymphoma	Allo SCT (33)	Pneumonia	65	3.3	18	-	Died
8	ALL	Allo SCT (203)	Pneumonia	68	3.3	10	-	Died
9	DLBCL	Induction on ECMO	Pneumonia	102	4.0	4	-	Died
10	Multiple myeloma	Auto SCT (789)	Pneumonia	43	3.7	9	Major	Alive
11	Anaplastic T-cell NHL ^a	Induction on ECMO	Pneumonia	46	3.0	25 ^d	Major	Alive
12	DLBCL ^a	Induction on ECMO	NHL	36	3.3	3 ^c	-	Alive
13	AML	Consolidation (34)	Pneumonia	48	3.3	34	Major	Died
14	DLBCL ^a	Induction on ECMO	NHL	56	2.3	4 ^d	-	Alive

- 100% ICU mortalita u AlloSCT on ECMO
-48% ICU mortalita „IPPV bez ECMO“ AlloSCT KARIM VFN

ECMO u pediatrických HO pacientů

- 29 pacientů z ELSO registru < 18 let
- VA u 17, VV u 11, z toho 3 konverze z VV do VA
- Mortalita 90%
 - 23 (79%) na ECMO
 - 6 (21%) dekanylováno
 - 3 propuštění z nemocnice (10%)

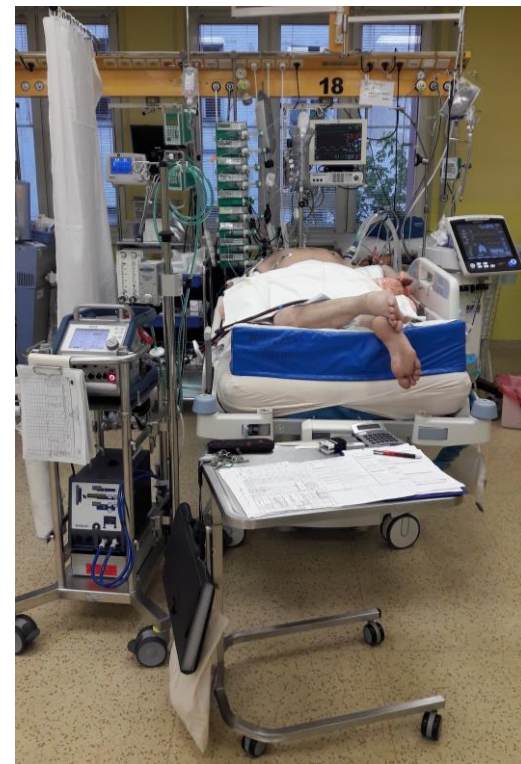
Matteo Di Nardo
Franco Locatelli
Kenneth Palmer
Antonio Amodeo
Roberto Lorusso
Mirko Belliato
Corrado Cecchetti
Daniela Perrotta
Sergio Picardo
Alice Bertaina
Sergio Rutella
Peter Rycus
Vincenzo Di Ciommo
Bernhard Holzgraefe

**Extracorporeal membrane
oxygenation in pediatric
recipients of hematopoietic
stem cell transplantation:
an updated analysis
of the Extracorporeal Life
Support Organization
experience**

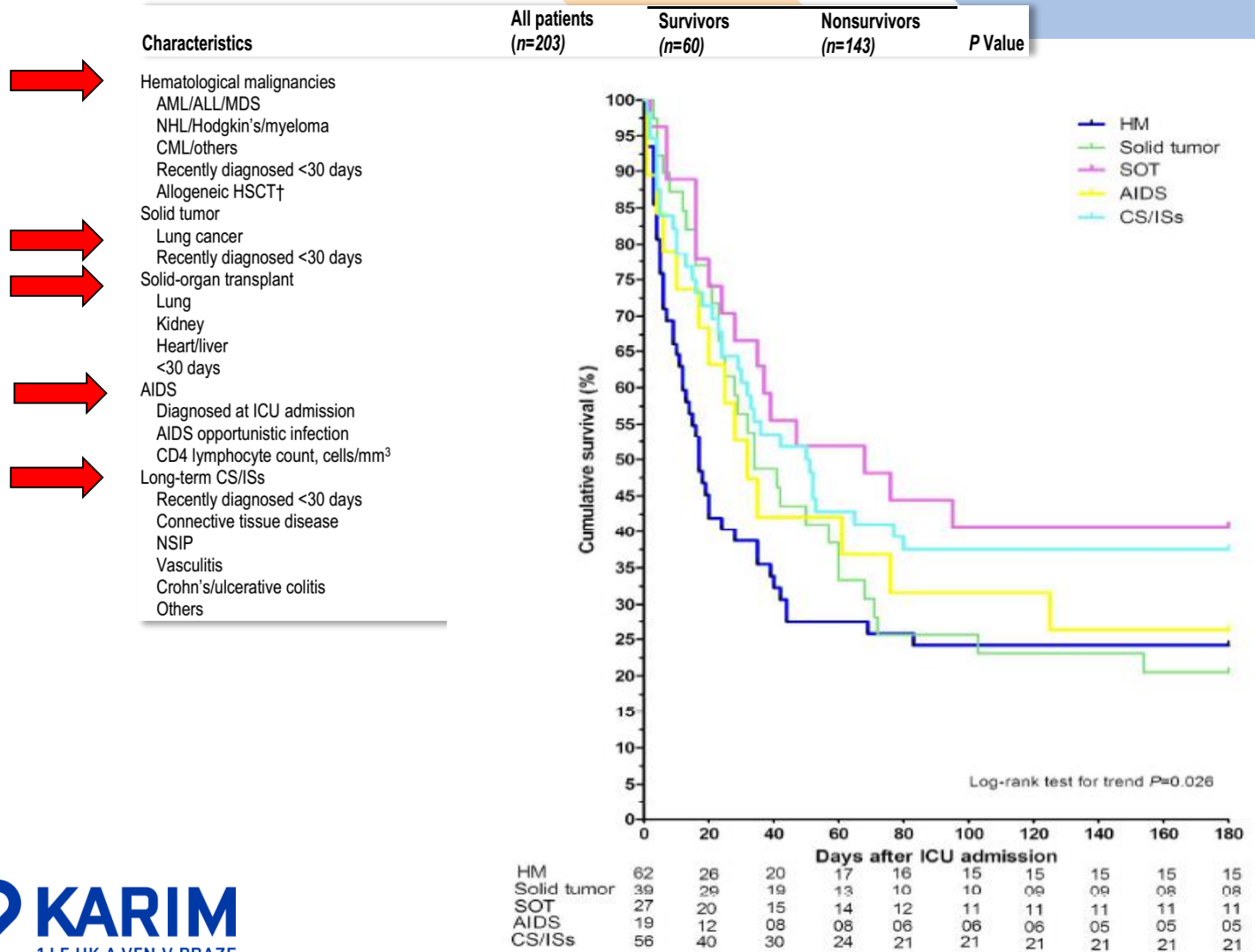
Six-month Outcome of Immunocompromised Severe ARDS Patients Rescued by ECMO. An International Multicenter Retrospective Study.

Schmidt M^{1,2}, Schellongowski P³, Patroniti N⁴, Taccone FS⁵, Reis Miranda D⁶, Reuter J⁷, Prodanovic H⁸, Pierrot M⁹, Dorget A¹⁰, Park S¹¹, Balik M¹², Demoule A¹³, Crippa IA¹⁴, Mercat A¹⁵, Wohlfarth P¹⁶, Sonnevile R¹⁷, Combes A¹⁸; International ECMO Network (ECMONet), the REVA Research Network and the IDEA Study Group.

- 7 zemí, 10 center (>20 ECMO/rok)
- zařazeno 203 pacientů/7let (192x VV ECMO, 9x VA ECMO, 2 x VAV ECMO)
- 6 měsíční přežití 30%
- ECMO < 30 dní od stanovení dg...sig. lepší prognóza
- Věk, paCO_2 , trombopenie, driving pressure ($\text{P}_{\text{plat}}\text{-PEEP}$).....sig. horší prognóza přežití



IDEA study - pazienti



IDEA study results

- 85 pacientů (42%) – odpojeno od ECMO
- 69 pacientů (34%) – propuštěno z ICU
- 60 pacientů (30%) – přežití > 6 měsíců (medián ECMO 8 dní, UPV 17 dní, v nemocnici 57 dní)
 - Orgánová transplantace – 40% přežití
 - Kortikosteroidy, imunosuprese – 37%
 - AIDS – 26%
 - Hem. onko – 24%
 - Solidní nádory – 20%
- Komplikace: krvácení – 36%, kanylová infekce 10%, VAP – 50%



IDEA study: srovnání studijní kohorty s matched non-imunosuppressed ECMO controls

- ECMO ARDS PaO₂/FiO₂ <100


[Intensive Care Medicine](#)

October 2013, Volume 39, [Issue 10](#), pp 1704–1713 | [Cite as](#)

The PRESERVE mortality risk score and analysis of long-term outcomes after extracorporeal membrane oxygenation for severe acute respiratory distress syndrome

[Authors](#)

[Authors and affiliations](#)

Matthieu Schmidt, Elie Zogheib, Hadrien Rozé, Xavier Repesse, Guillaume Lebreton, Charles-Edouard Luyt, Jean-Louis Trouillet, Nicolas Bréchet, Ania Nieszkowska, Hervé Dupont, Alexandre Ouattara, Pascal Leprince, Jean Chastre, Alain Combes 

- 136 imunokompromitovaných (**70% 6m. mortalita**) x 94 neimunokompromitovaných pacientů (**26% 6m. mortalita**)
- 80 párů dle PRESERVE score => nezávislé prediktory mortality
- Imunokompromis, OR 5.72 (95% CI 2.67–12.22); P<0.0001
- Věk
- Vyšší driving pressure

ECLS Registry Report

International Summary

January, 2018



Extracorporeal Life Support Organization
2800 Plymouth Road
Building 300, Room 303
Ann Arbor, MI 48109

Overall Outcomes

	Total Runs	Survived ECLS	Survived to DC or Transfer
Neonatal			
Pulmonary	30,844	25,922 84%	22,599 73%
Cardiac	7,718	5,011 64%	3,231 41%
ECPR	1,694	1,125 66%	694 40%

Pediatric

Pulmonary

Cardiac

ECPR

Adult

Pulmonary

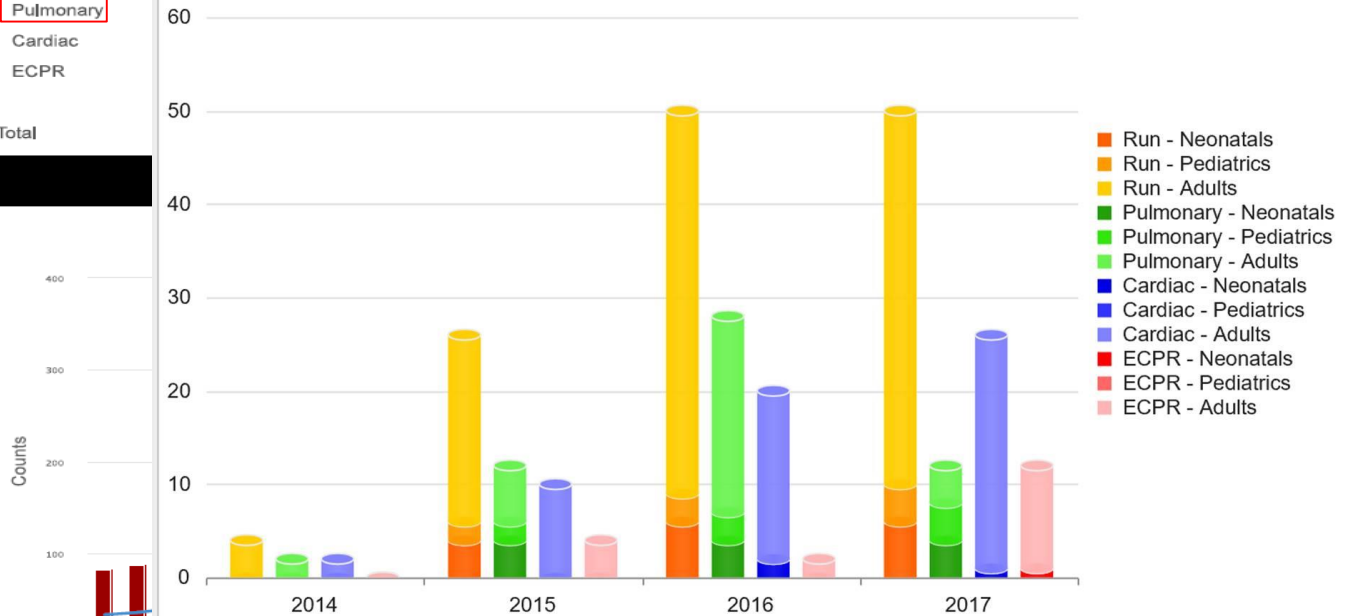
Cardiac

ECPR

Total

Center Statistics

Runs per Year



Incomplete run records (4)

VV/VA ECMO in airway obstruction

Emergency Bedside Extracorporeal Membrane Oxygenation for Rescue of Acute Tracheal Obstruction

David C Willms MD, Ruben Mendez RRT, Vanjah Norman MD, and Joseph H Chammas MD

Table 1. Prior Reported Cases of Use of ECMO for Acute Upper-Airway Obstruction

First Author	Year	Age	Obstruction	Obstruction Site	ECMO Mode	ECMO Duration	Condition Before ECMO	Definitive Procedure	Outcome
Higashi ⁵	1989	17 y	Sawdust	Trachea, bronchi	Venovenous	1.5 d	Barotrauma, respiratory failure	Fiberoptic bronchoscopy	Survived
Morneault ⁶	1996	Neonate	Pulmonary hemorrhage/clot	Trachea, bronchus	Venovenous	8.5 d	Hypoxemia, respiratory failure	Bronchoscopy	Survived
Isaacson ⁷	1996	3 wk	Subglottic stenosis	Upper trachea	Venoarterial	Operative case	Cyanosis, apnea, seizure	Tracheostomy	Survived
Rosa ⁸	1996	51 y	Thyroid lymphoma	Upper trachea	Venoarterial	Operative case	Cyanosis, respiratory distress, failed intubation	Tracheostomy, resection	Survived
Shiraishi ⁹	1997	3 y	Fibrosarcoma	Distal trachea	Venoarterial	Operative case	Respiratory distress, hypercapnia	Surgery	Survived
Stewart ¹⁰	1998	19 y	Mediastinal tumor	Distal trachea	Venoarterial	2 d	Hypoxemia, shock	Chemotherapy radiotherapy	Survived
Belmont ¹¹	1998	73 y	Thyroid lymphoma	Supra-glottic	Venoarterial	Operative case	Respiratory distress, stridor, failed intubation	Tracheostomy	Survived
Brown ¹²	2003	14 mo	Grape aspiration	Trachea, bronchi	Venoarterial	6 d	Hypoxemia, cardiac arrest	Bronchoscopy	Survived
Chao ¹³	2006	21 y	Mediastinal tumor	Distal trachea	Venovenous	3 d	Respiratory failure, hypoxemia	Chemotherapy	Survived
Ignacio ¹⁴	2006	14 mo	Bean aspiration	Distal trachea	Venoarterial	3 d	Apnea, cardiac arrest	Rigid bronchoscopy	Survived
Collar ¹⁵	2010	16 y	Papillomatosis	Distal trachea	Venovenous	Operative case	Respiratory distress, hypoxemia, orthopnea	Laser therapy	Survived
Holliday ¹⁶	2010	Not given	Food bolus	Trachea	Not given	Not given	Not given	Rigid bronchoscopy	Survived

ECMO = extracorporeal membrane oxygenation

Hypercapnic respiratory failure in obstructed airway

13:42h

pH **7,009**

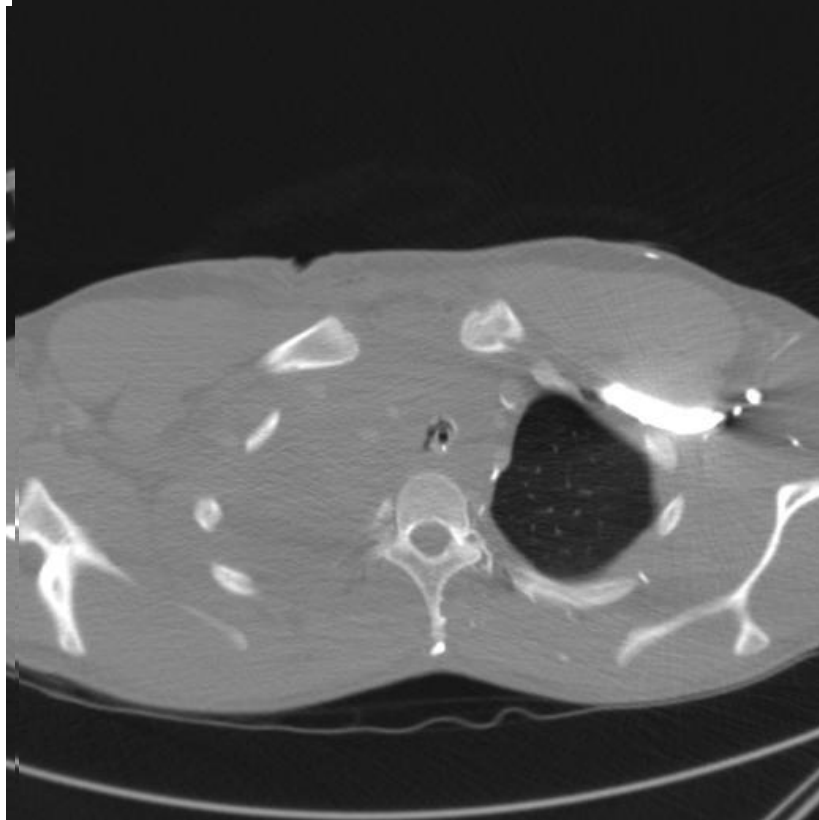
pO₂ (kPa) 27,6

pCO₂ (kPa) **15,33**

BE -9,2

HCO₃ 17,3

SpO₂ 98,6%



- ♂ 19 years
- Dysphagia, dyspnea
- Tumour of mediastinum for biopsy
- Periproced. tracheal obstruction, atelectasis R lung
- Suction cath into L main bronchus

Stenting on VV-ECMO

Emergency V-V ECMO

Excision of supraclavicular lymph nodes

Dg. T-cell lymphoma

D2: started chemotherapy
CS+CHOP

D3: Y stent, V-V ECMO
explanted

D4: extubated

D6: discharged from ICU to
haematology

D18: stent extraction

*04.03.1993

29.05.2012

10:18:44

1 Sn 8

62

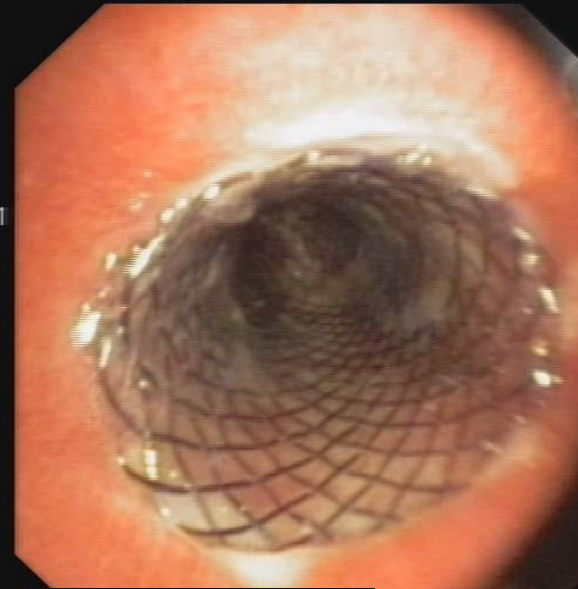
05/01/1945

29/05/2012

08:08:06

Gr:N

Er:A1



W 256
C 128

*04.03.1993

29.05.2012

10:19:03

1 Sn 18

62

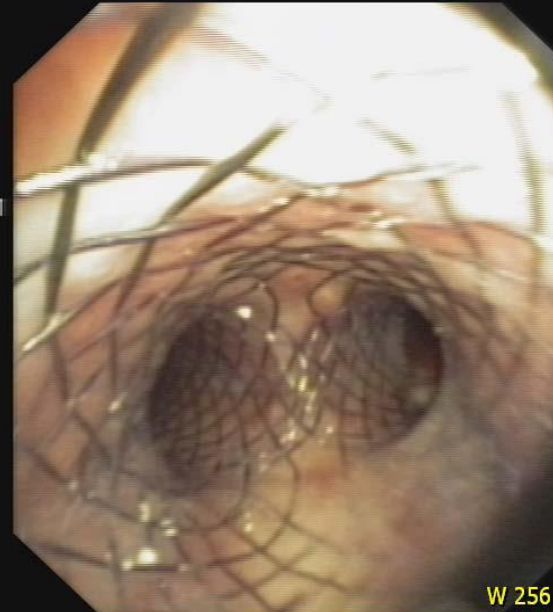
05/01/1945

29/05/2012

08:08:26

Gr:N

Er:A1



W 256
C 128

Patient on waiting list for lung transplant

- V-V ECMO: Single site access
- Prevention of
 - Sedation
 - VILI
 - VAP
- Deterioration of RV and PAH
- Fuehner T, et al: ECMO as a bridge to LTx. AmJRCCM 2012: 6 month mortality improved by 30%
- Javidfar J, et al: CurrOpinOrganTransplant 2012



ECMO u onkologického či imunosuprimovaného pacienta ANO!, ale individualizace indikací:

- Onkol plán, dependence na imunosupresi
- Trombopenie, koagulopatie
- Předpokl. čas na ECMO/ rychlost reverzibility prim. příčiny

- We recommend that for most centers, an annual volume for the entire center should be at least 20 cases per year and that at minimum of 12 ECMO cases for adult respiratory failure should be performed per year. Therefore, taking into account that potential indications may not exceed 5-10 cases per million population per year, one such center should cover a catchment area of at least 2 to 3 million population. These recommendations, as noted, are not currently based on

of Extracorporeal Membrane Oxygenation

coordination would run through the tertiary ECMO referral center. This mobile team should be available 24 hours a day, 7 days a week, and employ experienced personnel trained in the transport of critically ill patients, insertion of ECMO cannulae, as well as circuit and patient management. The

re in

The International ECMO Network (ECMONet)

www.karim-vfn.cz

