Transplantace plic pro PAH

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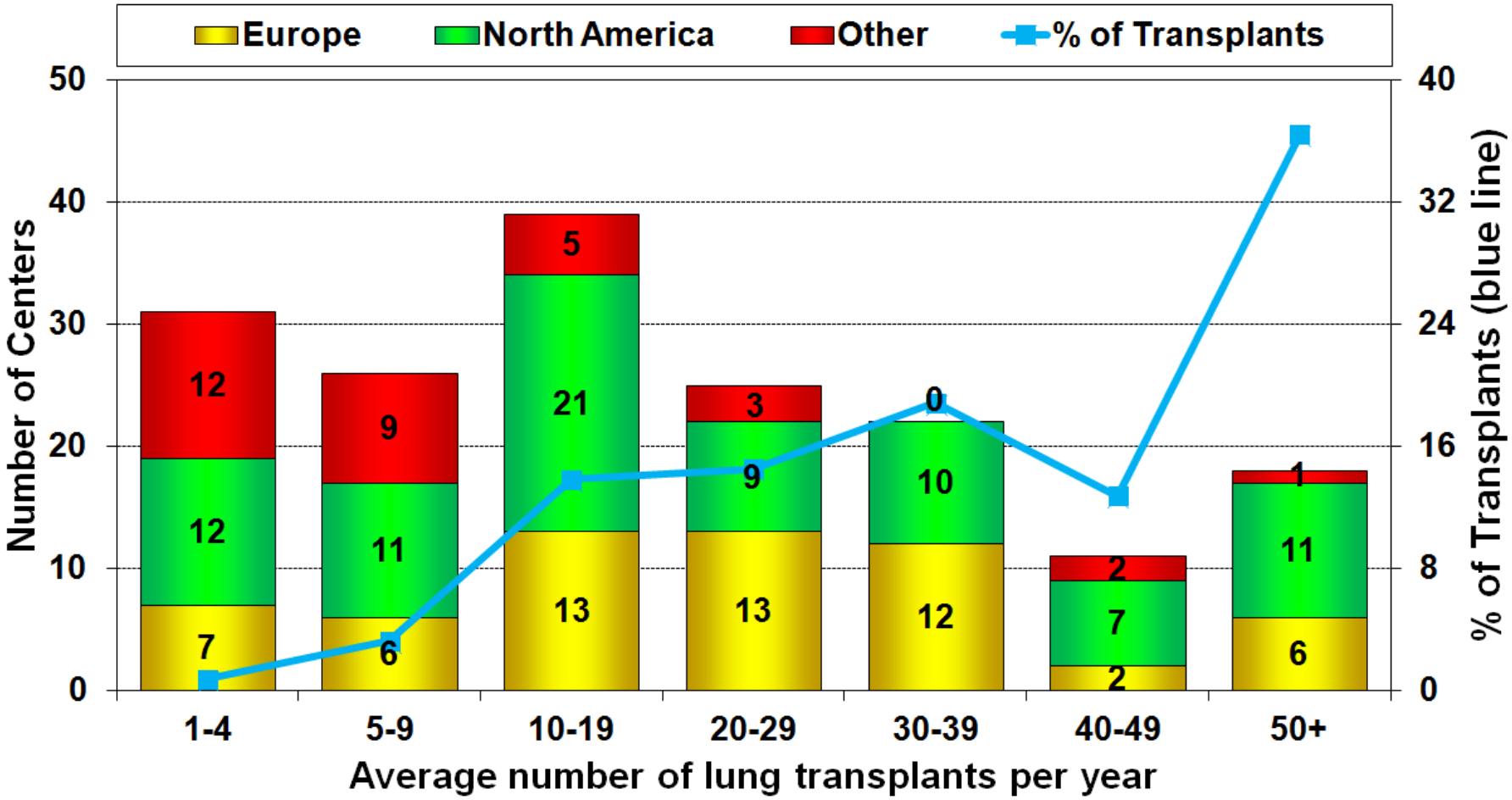
III. chirurgická klinika 1. LF UK a FN Motol
Prague National Lung Transplant Programme
Transplantační centrum FN Motol

XXVII.výroční sjezd ČKS, BRNO, 14.5.2019

Adult Lung Transplants
Average Center Volume by Location
(Transplants: January 2009 – June 2017)



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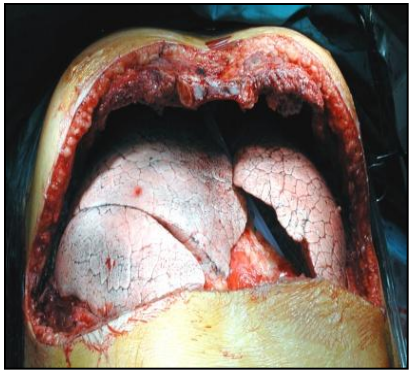
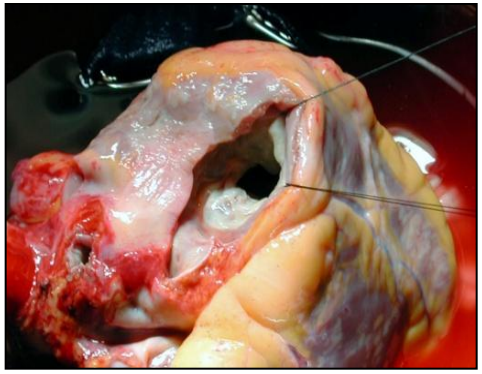
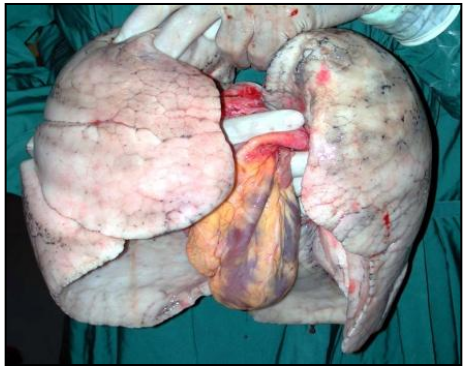
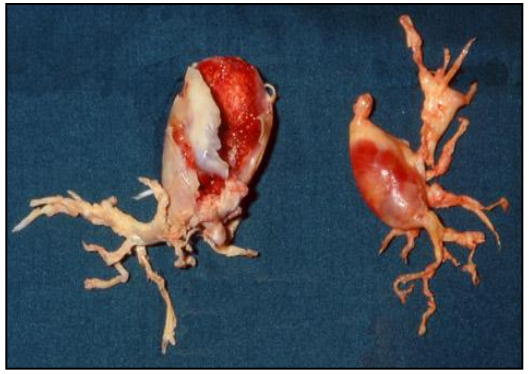
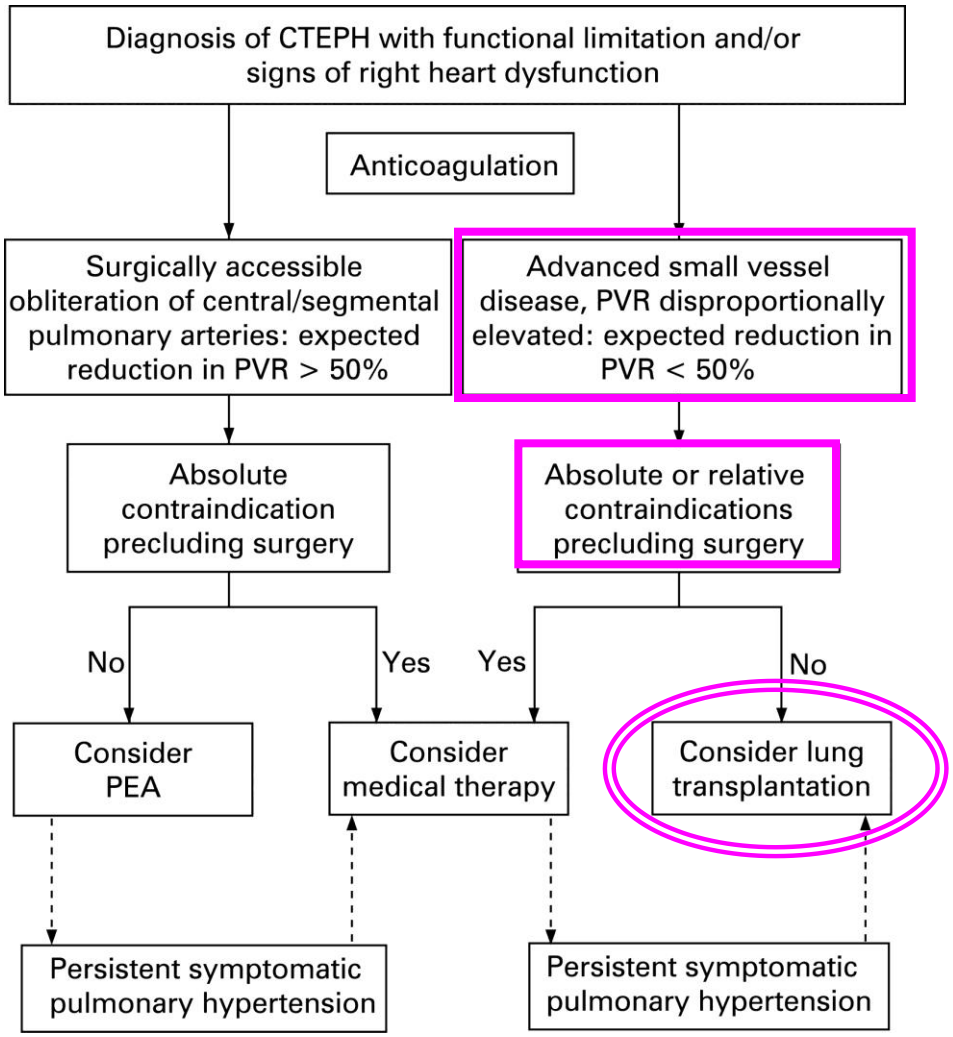
2018
JHLT. 2018 Oct; 37(10): 1155-1206

Chirurgická léčba pro Plicní Hypertenzi

iPAH	Jednoduché srdeční vady	Komplexní srdeční vady	CTEPH
DLTX	DLTX + korekce	HLTX	PEA

Algorithm for the management of patients with chronic thromboembolic pulmonary hypertension (CTEPH).



Thorax 2008;63:ii1-ii41

LTx pro iPAH

iPAH má nejvyšší udávanou časnou poop mortalitu ze všech indikací (ISHLT registr):

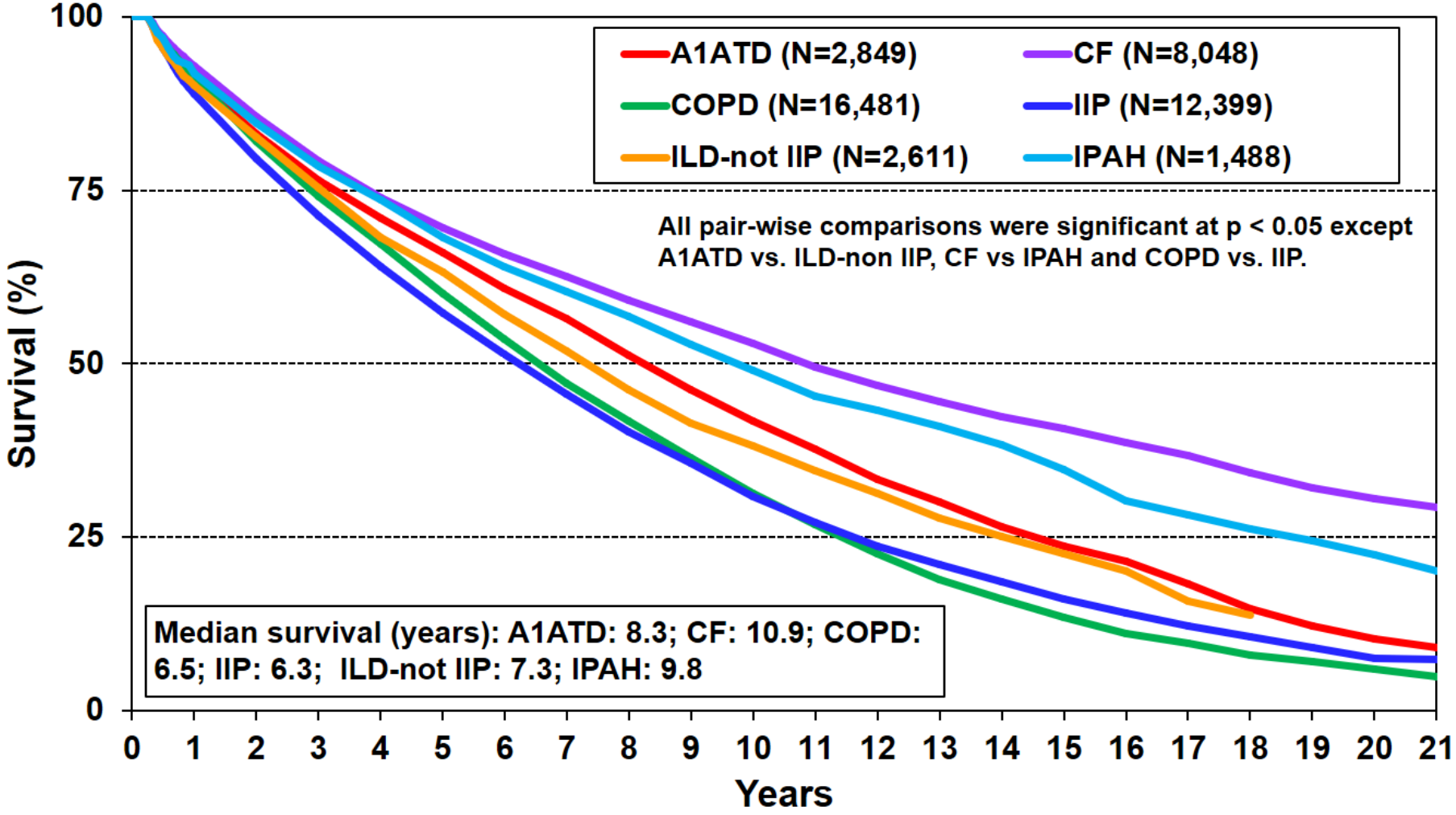
→ významné komorbidity příjemců

→ komplexní a složitá perioperační péče

- Vysoké riziko MODS / MOF
- Vysoké riziko PGD → CLAD
- Dlouhodobá UPV + rizika
- ECMO + rizika

Adult Lung Transplants

Kaplan-Meier Survival by Major Diagnosis Conditional on Survival to 3 Months (Transplants: January 1990 – June 2016)



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Indikace k zařazení na WL

- Vzhledem k málo predikovatelnému průběhu onemocnění, pacienti s PAH by měli být odesláni do centra ke zvážení k Tx v relativně časném stadiu
- Zařazení na WL když: neadekvátní odpověď na maximální farmakologickou TH (i.v.prostanoidy) cardiac index < 2L.min-¹.m-² , RAP > 15mmHg, 6MW < 350m, známky pravostranného kardiálního selhání
- Pacienti by neměli být zařazeni dříve, než je vyčerpána veškerá konzervativní léčba (risk/benefit ve prospěch Tx)
- Vždy se snažit předejít extrémnímu scénáři, kterým je zařazení pacienta v terminální fázi iPAH, nebo ve fázi vyžadující bridge k Tx pomocí ECLS

REVEAL (U.S. Registry to Evaluate Early and Long-Term PAH disease Management)

↑ MORTALITA na WL	NYHA IV, Muž > 60let, ↑ PVR, PAH s portální hypertenzí RA pozitivní na PAH
	NYHA III, ↑ střední RAP, ↑ SF, ↓ 6MW, ↑ BNP renální insuficience, perikardiální výpotek, ↓ DLCO

A consensus document for the selection of lung transplant candidates: 2014—An update from the Pulmonary Transplantation Council of the International Society for Heart and Lung Transplantation

Postup u iPAH:

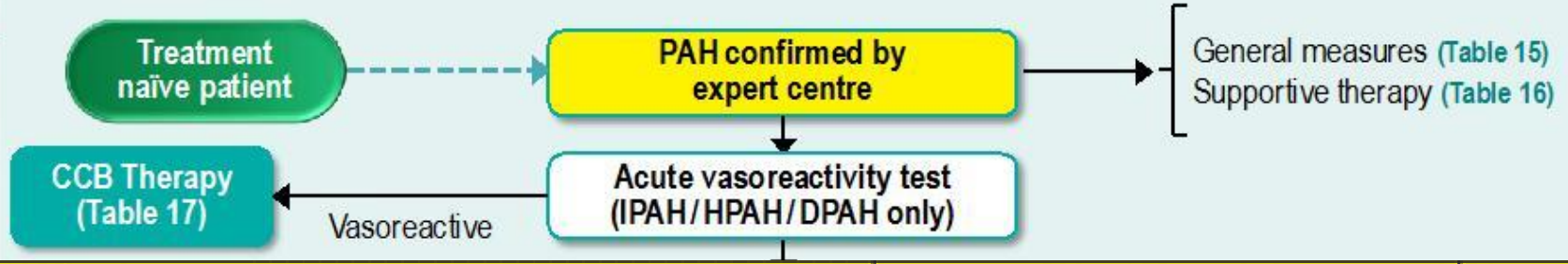
A. Kdy pacienta odeslat do centra PH

- NYHA III / IV a přetrvávající symptomy při eskalované farmakoth
- Rychle progredující onemocnění
- Cílená IV farmakoth PH bez ohledu na NYHA klasifikaci

Včas zařazený a vhodný kandidát transplantace je důležitým faktorem, předurčujícím výsledek transplantace

- NYHA III / IV po 3m kombinované TH obsahující prostanoidy
- mRAP > 15mmHg
- 6MWT < 350m
- Signifikantní hemoptýza, perikardiální výpotek, nebo známky PSS (renální insuficience, ↑ Bili, ↑ BNP, recidivující ascites)

Treatment Algorithm for Pulmonary Arterial Hypertension



Measure/treatment	Class[a]-Level[b]						Ref.[c]
	WHO-FC II		WHO-FC III		WHO-FC IV		
Hospitalization in ICU is recommended in PH patients with high heart rate (>110 beats/min), low blood pressure (systolic blood pressure <90 mmHg), low urine output and rising lactate levels due or not due to co-morbidities	–	–	–	–	I	C	[257]
Inotropic support is recommended in hypotensive patients			I	C	I	C	
Lung transplantation is recommended soon after inadequate clinical response on maximal medical therapy	–	–	I	C	I	C	[270]
BAS may be considered where available after failure of maximal medical therapy	–	–	IIb	C	IIb	C	[253, 254]

(Table 21)

European Heart Journal 2016:37;67–119 -doi:10.1093/eurheartj/ehv317
European Respiratory Journal 2015 46: 903-975;

Pulmonary Hypertension
The Role of Lung Transplantation

Samir Sultan, DO[a], Steve Tseng, DO[a], Anna Agnese Stanziola, MD[b,1], Tony Hodges, MD[a], Rajan Saggar, MD[c], Rajeev Saggar, MD[a,*]

Table 1
Prognostic markers: suggested listing criteria for transplantation/pulmonary hypertension

Clinical Domains	Prognostic Markers	Outcomes[a]
Serology and markers of right heart failure	NT-pro-BNP (Δ500 pg/mL)	↑ mortality [HR 1.13][13]
	Bilirubin >1.2	↑ mortality [HR = 13.3][14]
	Renal insufficiency	↑ mortality [HR 1.2–3.3][15]
Symptoms/physical examination (associated with RHF)	Hemoptysis	↑ mortality[16]
	Recurrent ascites	[17]
Functionality	6MWD <150 m	1-y survival 68.4%[18]
	NYHA II-IV	3-y survival 29%–66%[19]
Hemodynamics	mRA >15 mm Hg	↑mortality [HR 2.28][20]
	CI <2.5 L/min/m^2	↑mortality [HR 3.89][21]
Noninvasive imaging	Echocardiogram TAPSE <15 mm	↑ mortality [HR = 3.17][22]
	MRI RVEF <35%	↑ mortality[23]
	MRI RVEDV >84 mL/m^2	↑ mortality[24]

Abbreviations: 6MWD, 6-minute walk distance; CI, cardiac index; eRAP, echocardiogram right atrial pressure; HR, hazard ratio; LTx, lung transplant; mRA, mean right atrial pressure; NT- pro-BNP, brain naturetic peptide; RHF, right heart failure; RV, right ventricle; RVEF, right ventricular ejection fraction; TAPSE, tricuspid annular planar systolic excursion.

[a] All hazard ratios, $P<.05$.

DLTx nebo HLTx ?

Indikace závisí na:

- pokročilosti onemocnění (RVF, LVF)

  RVEF 25-10%, LVEF 50-35%

  CI > 2.2 L/min/m², PCWP > 15mmHg → DLTx
- alokačních kritériích dárcovského programu – výrazně kratší čekací doba pro DLTx příjemce
- zkušenosti centra – komplexní složitá časná pooperační péče u pacientů s pokročilou PH po DLTx (ECMO, IABP, CRRT)
- příjemce na UPV / ECMO ?

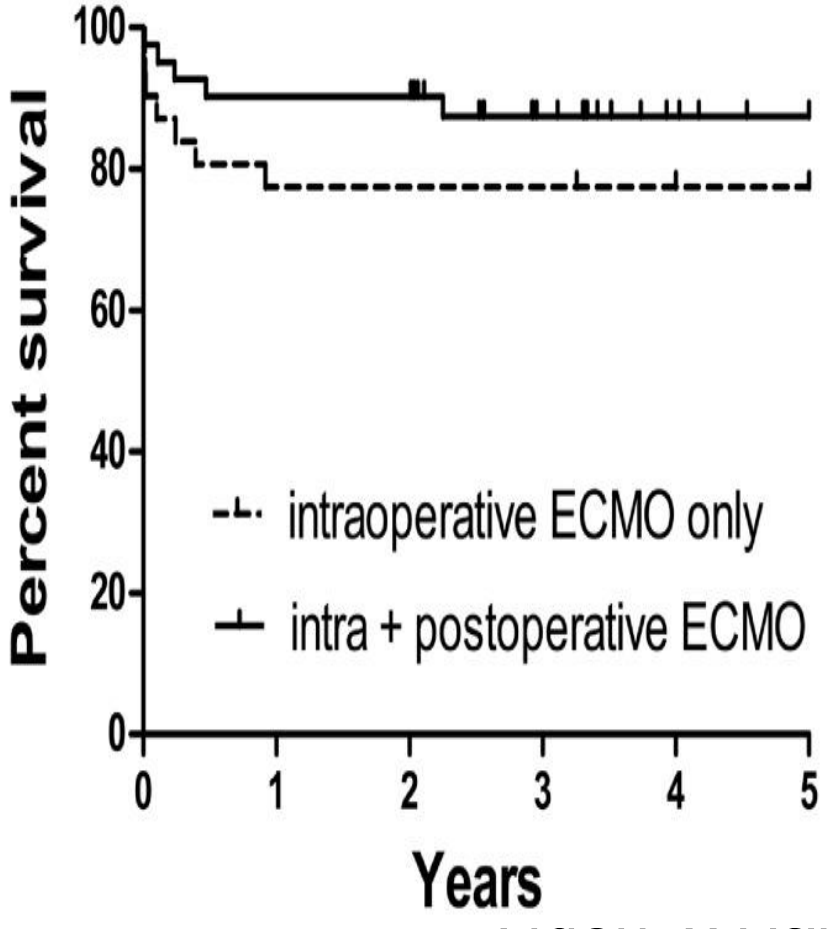
Platí pravidlo: včas zařazený kandidát má výrazně vyšší šanci na Tx (DLTx) než pozdě zařazený (HLTx)

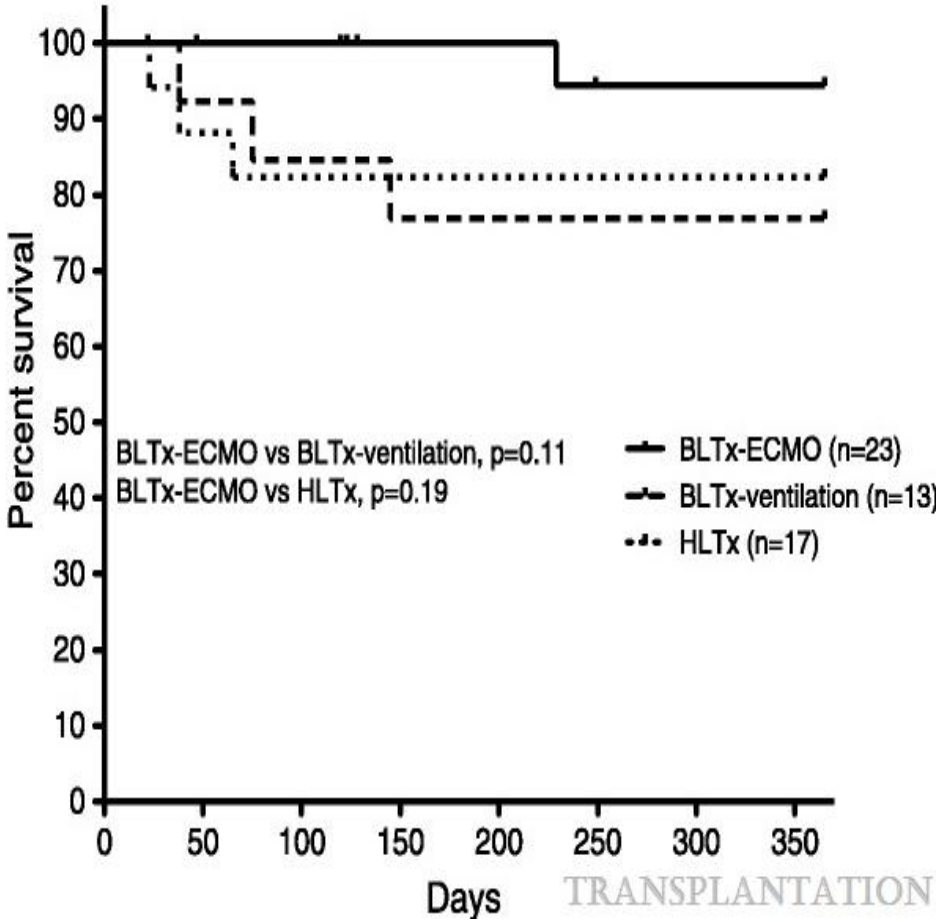
STANDARDNÍ POSTUP při DLTx u iPAH ve FNM

- **Kardioanesteziolog**
- **Hrudní chirurg** / kardiochirurg
- Aktuální klinický stav / TTE na sále
  → rozhodnutí o periferní x centrální kanylaci ECMO v LA / CA
- **Biluminální intubace / TEE / PAC (**Swan Ganz**)**
- Bilaterální AL THT / Clamshell THT
- **Periferní ECMO** → vyhovuje → výkon pokračuje
  → nedostačuje → Harlequin syndrom → přechod na VA ECMO s centrální kanylací do kořene Ao
- U většiny pacientů **prolongované ECMO** → ponechání periferních kanyl AF / VF a zrušení centrální kanyly Ao → přechod na periferní VA ECMO
- **ARO**: umožňuje-li stav, extubace a awake ECMO
- odpojení od ECMO na ARO
- **Indukční IS**: alemtuzumab i.v.

Odběr: standardní technika, Perfadex, antero- a retrográdní perfúze

Pooperační péče u pac po Tx pro iPAH





Vídeň

Hannover

ROZŠÍŘENÍ INDIKAČNÍCH KRITÉRIÍ **PŘÍJEMCE**

Kandidátem TX je i pacient:

Rizikové faktory dlouhodobé UPV a sedace – plicní záněty, bartorauma, bronchiální mukostáza, delirium, abstinenční syndrom a zejména významná neuromuskulární dekondice a atrofie

- musí být zařazen na WL
- přísně selektovaný kandidát

ECMO u Px s iPAH jako bridge k TX

- Indikováno u Px s iPAH a dysfunkcí PK, která nereaguje na farmakoterapii
- V době možnosti periferní kanylace a možnosti awake ECMO, odpadá rizikový vliv agresivní UPV na hemodynamiku
- VA ECMO, periferní kanylace AF / VF
- VA ECMO centrální kanylace PA / LA

- Selhání jednoho orgánu
- Není septický
- Není kolonizovaný multirezistentními bakteriemi
- Neurologicky intaktní

Pacient před TX aktivní na WL

Splňuje kritéria zařazení

NE → vyřadit

ANO

- MODS
- Sepse
- Kolonizace multirezistent bakteriemi
- Narůstající FDI, hypoalbimuniemie
- Neurologický deficit
- UPV > 7dní
- BMI > 30, BMI < 15

Patofyziologický deficit

Hyperkapnie	Hypoxemie + mírná PH	Hypoxemie + střední záv.PH	Hypoxemie + těžká PH
2. Dvoucestná kanyla VJI	2. AF, VF 3. Centrální kanylace		3. Centrální kanylace 4. Dvoucestná VJI + tepna (AS, AF)

Systém může být kdykoliv změněn na základě klinického stavu a hemodynamických parametrů

Nejčastěji přechod z VV na VA ECMO:

1. narůstající KA podpora
2. závažná trvající hypotenze
3. narůstající sLAC

CRRT používáme liberálně jako metodiku přesného bilancování tekutin při ECMO

Další postup

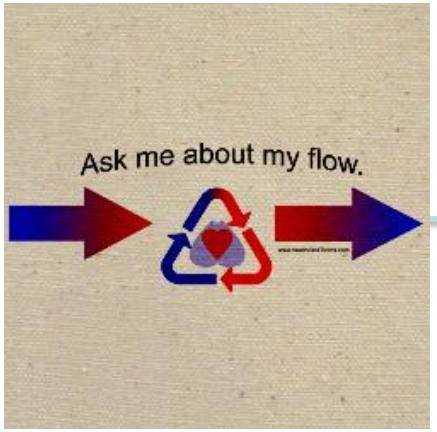
Úprava PF deficitu ? Klinické zlepšení ?

NE → VV ECMO

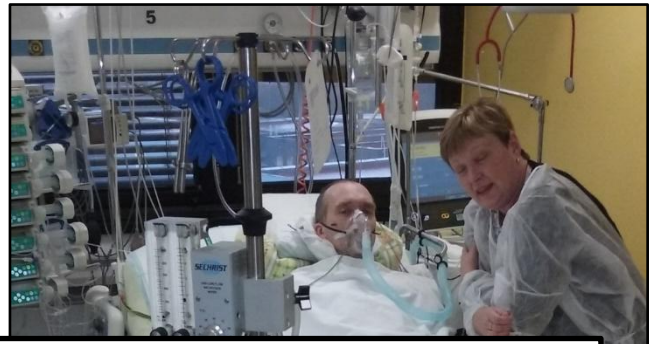
ANO → Transplantace

NE → Vyřadit

ANO → Změnit na VA ECMO



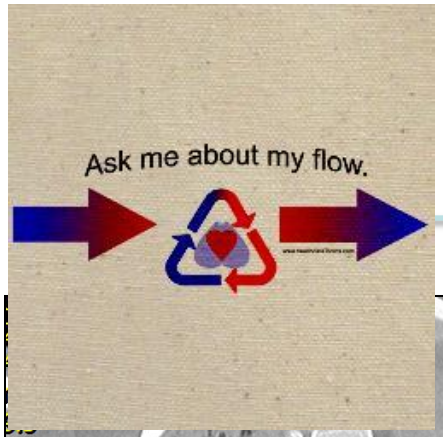
ECMO – bridge k Tx

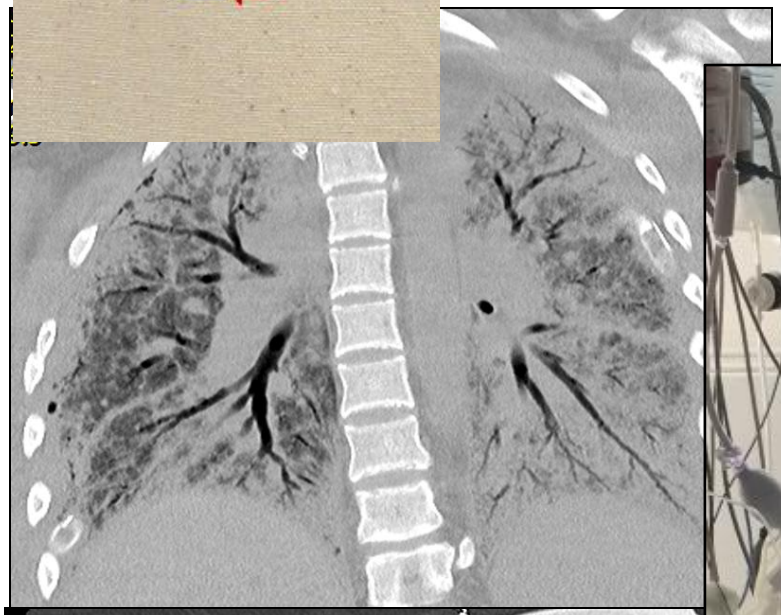


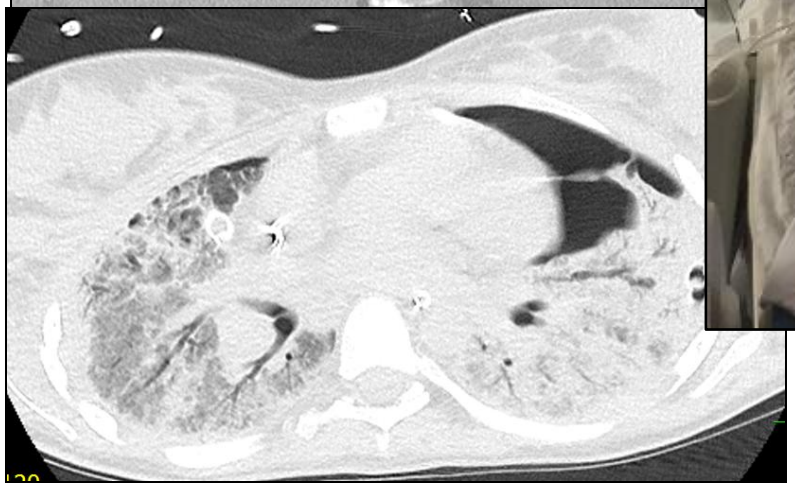
Kriteria AWAKE ECMO:

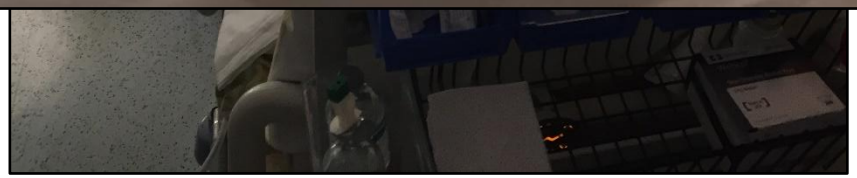
1. Hemodynamicky stabilní pacient
2. Zajištěné kanyly bez známek krvácení
3. Bez celkových krvácivých komplikací
4. Kooperující pacient

ECMO – most k Tx









ECMO v. UPV

Mechanical Ventilation of ECMO Patients Is Associated with Decreased Post-Transplant Survival G.J. Bittle, P.G. Sanchez, Z.N. Kon, K. Rajagopal, S. Pham, B.P. Griffith. Cardiac Surgery, University of Maryland, Baltimore, MD.

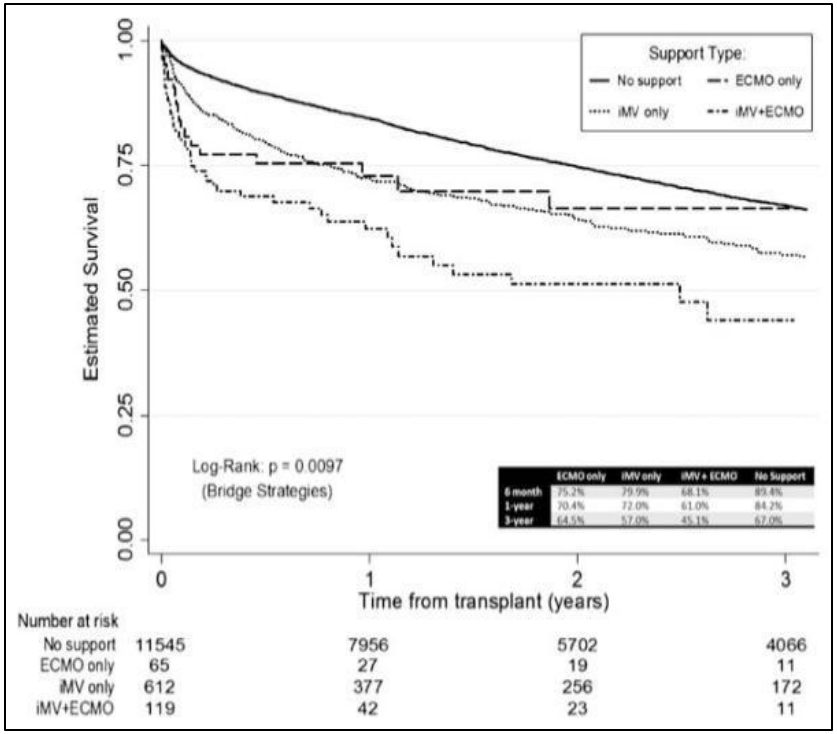
Results: In total, 149 patients who were on ECMO at the time of transplantation were identified. Of these, 56 (38%) were managed on ECMO alone, while the remaining 93 (62%) were also mechanically ventilated. Median follow up among patients surviving to the end of the study period was 367 days. Both groups were similar with regard to age, gender, and body mass index. Ventilated patients were somewhat more likely to have idiopathic pulmonary fibrosis (38% vs 30%) or cystic fibrosis (23% vs 16%), while ECMO-only patients were more likely to have chronic obstructive pulmonary disease (9% vs 5%) or primary pulmonary arterial hypertension (7% vs 0%). Pulmonary capillary wedge pressures were similar in both groups (11 mmHg), but mean pulmonary arterial pressures were higher in the ECMO-only group (33 vs 28 mmHg) with no differences in pre-transplant pO2, pCO2. Lung allocation score were similar with mean values in the low 80s. **30-day and 1-year survival were improved in the ECMO-only group (90% vs 78%, 72% vs 52%, p>0.033).** These remained significant even when accounting for established predictors of mortality in regression analysis.

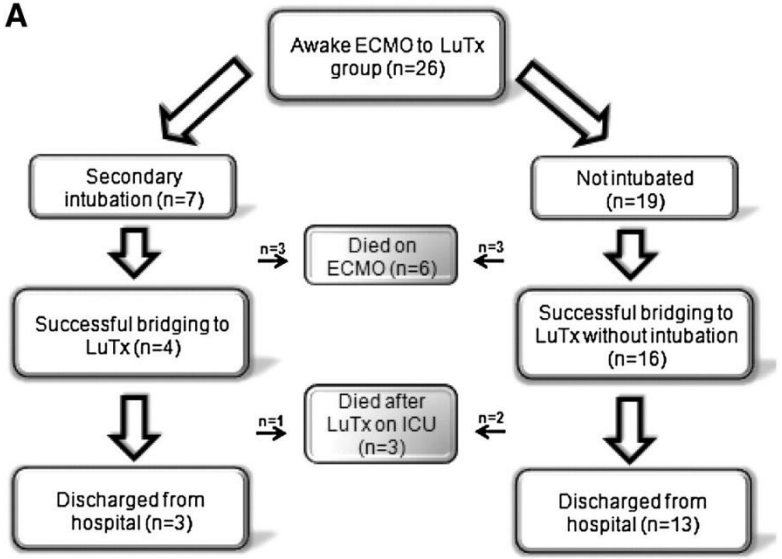
Conclusion: Even in the high-acuity ECMO population, mechanical ventilation is associated with markedly decreased short term post-transplantation survival.

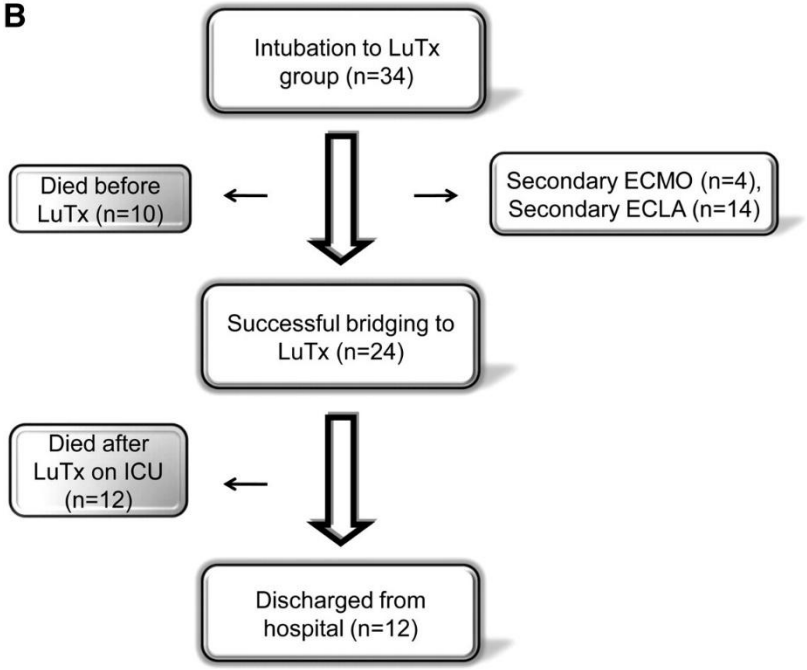
Spontaneously Breathing Extracorporeal Membrane Oxygenation Support Provides the Optimal Bridge to Lung Transplantation.

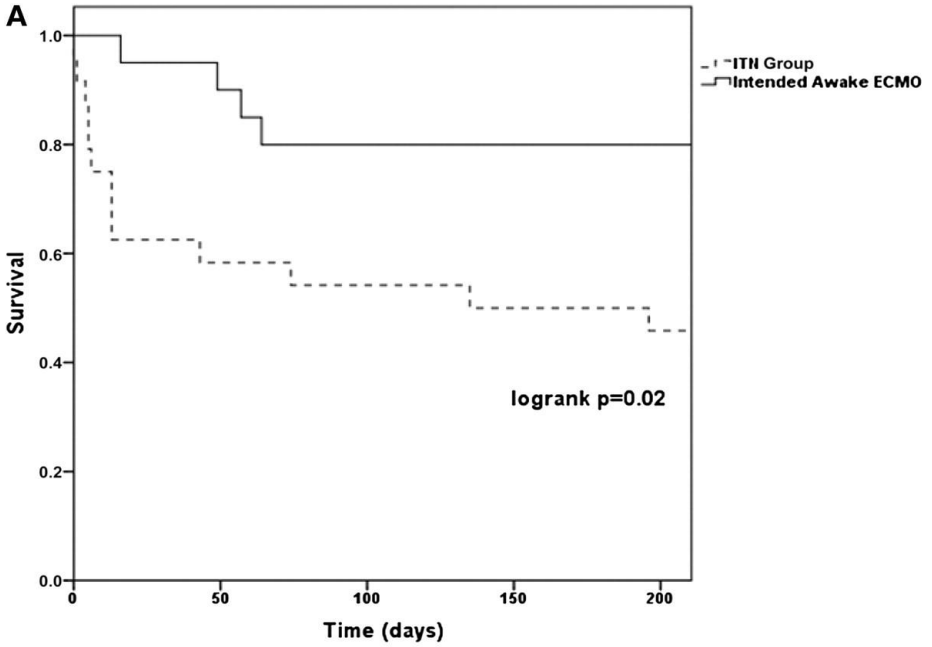
Schechter MA(1), Ganapathi AM, Englum BR, Speicher PJ, Daneshmand MA, Davis RD, Hartwig MG.

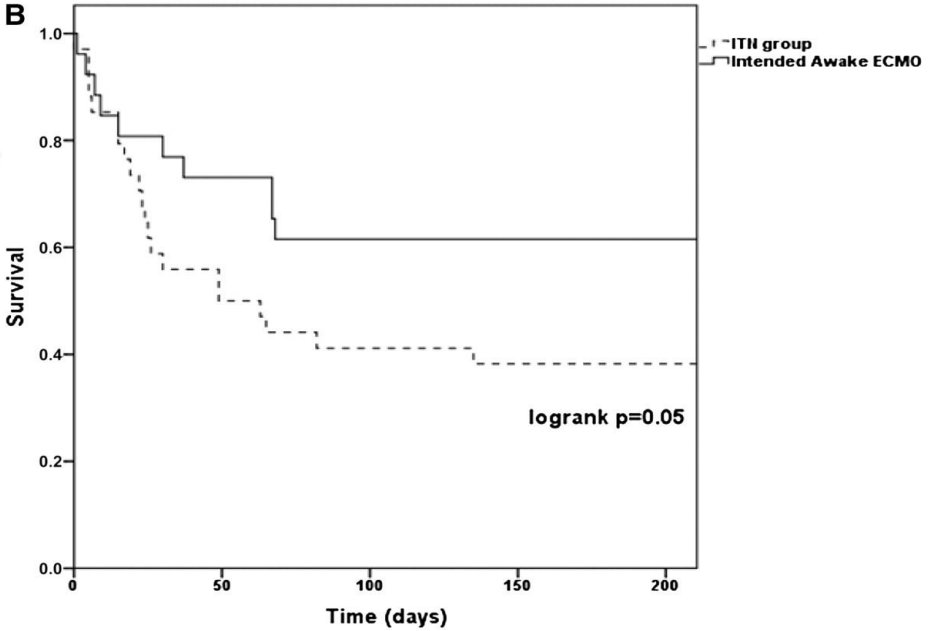
Department of Surgery, Duke University Medical Center, Durham, NC

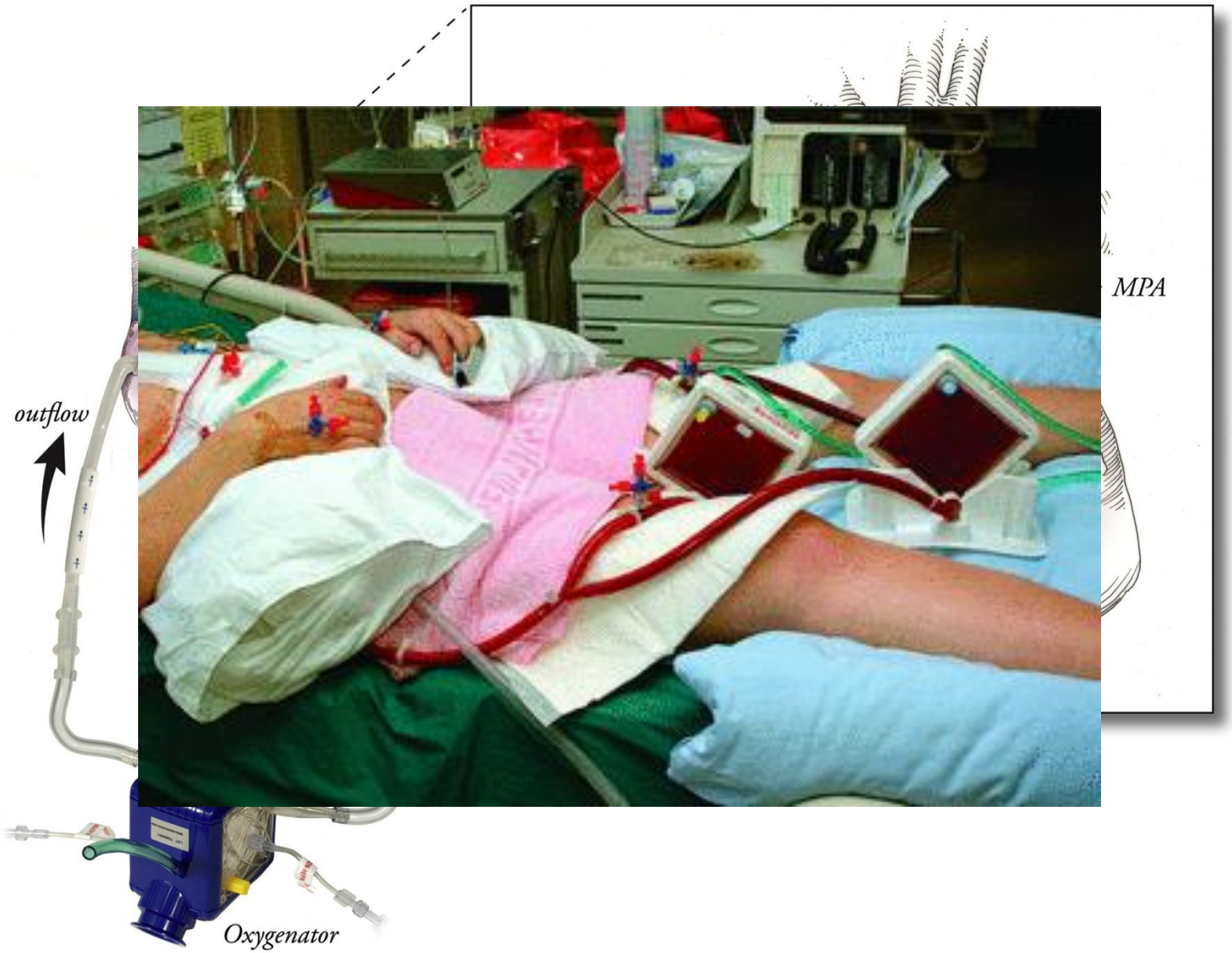



A
Awake ECMO to LuTx group (n=26)
Secondary intubation (n=7)
Not intubated (n=19)
n=3
Died on ECMO (n=6)
n=3
Successful bridging to LuTx (n=4)
Successful bridging to LuTx without intubation (n=16)
n=1
Died after LuTx on ICU (n=3)
n=2
Discharged from hospital (n=3)
Discharged from hospital (n=13)


B
Intubation to LuTx group (n=34)
Died before LuTx (n=10)
Secondary ECMO (n=4), Secondary ECLA (n=14)
Successful bridging to LuTx (n=24)
Died after LuTx on ICU (n=12)
Discharged from hospital (n=12)

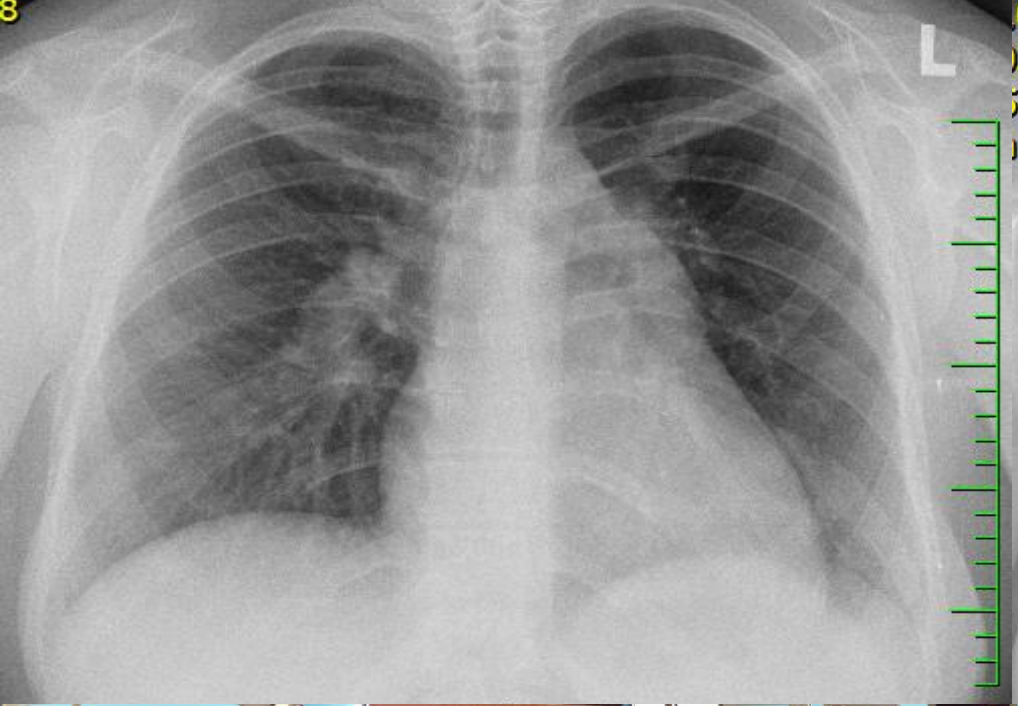

A
Survival
1.0
0.8
0.6
0.4
0.2
0.0
0
50
100
150
200
Time (days)
ITN Group
Intended Awake ECMO
logrank p=0.02

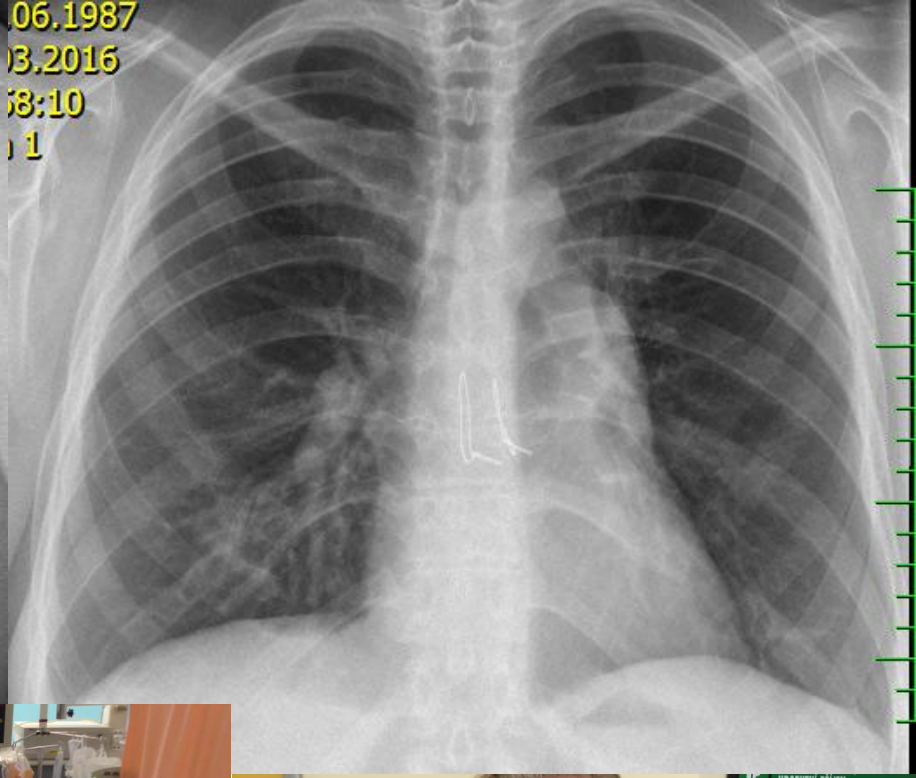

B
Survival
1.0
0.8
0.6
0.4
0.2
0.0
0
50
100
150
200
Time (days)
ITN group
Intended Awake ECMO
logrank p=0.05



Received 23 June
accepted for publi

cussed and defined the standards for extracorporeal lung

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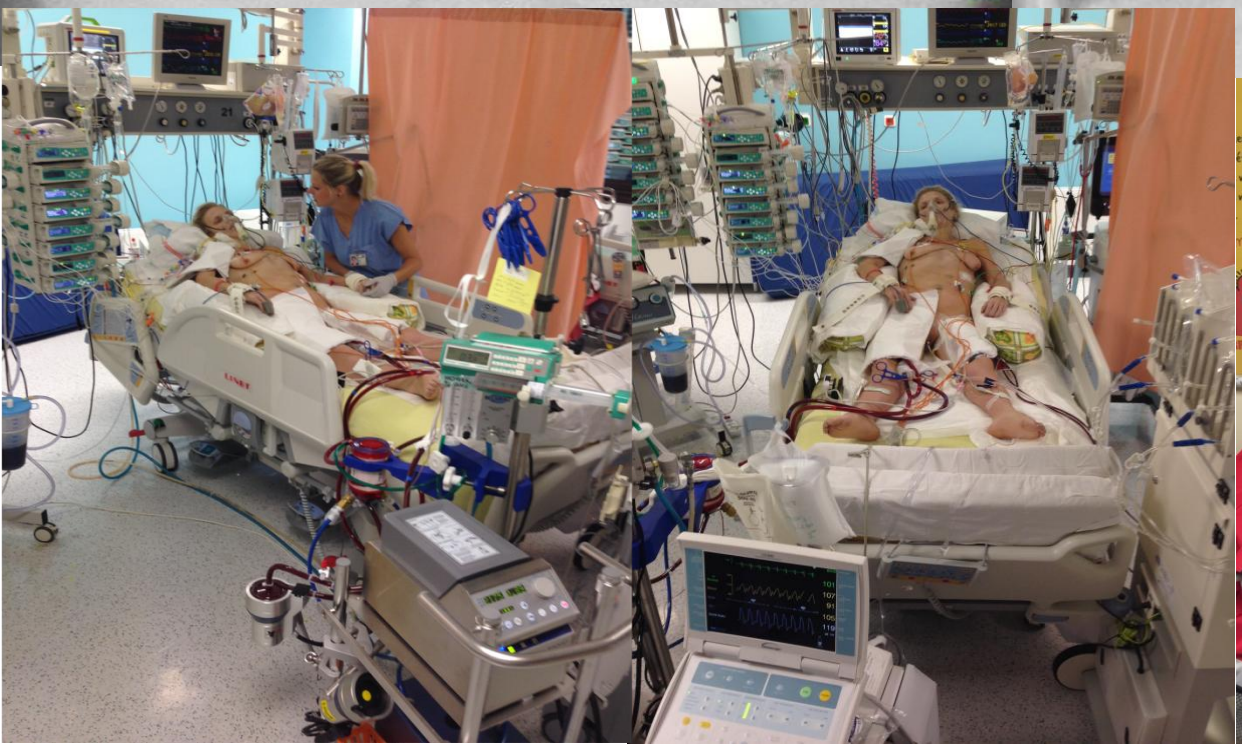
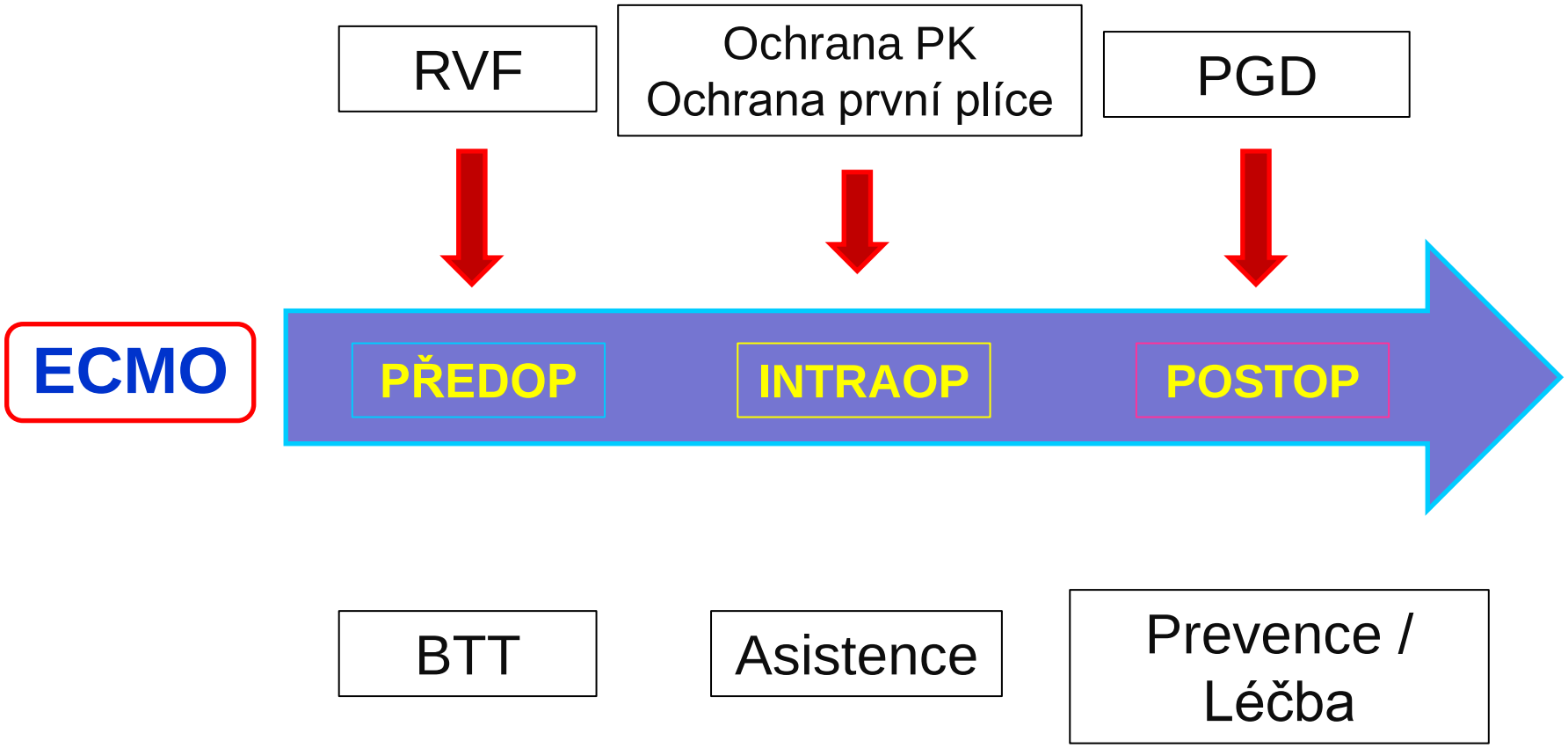
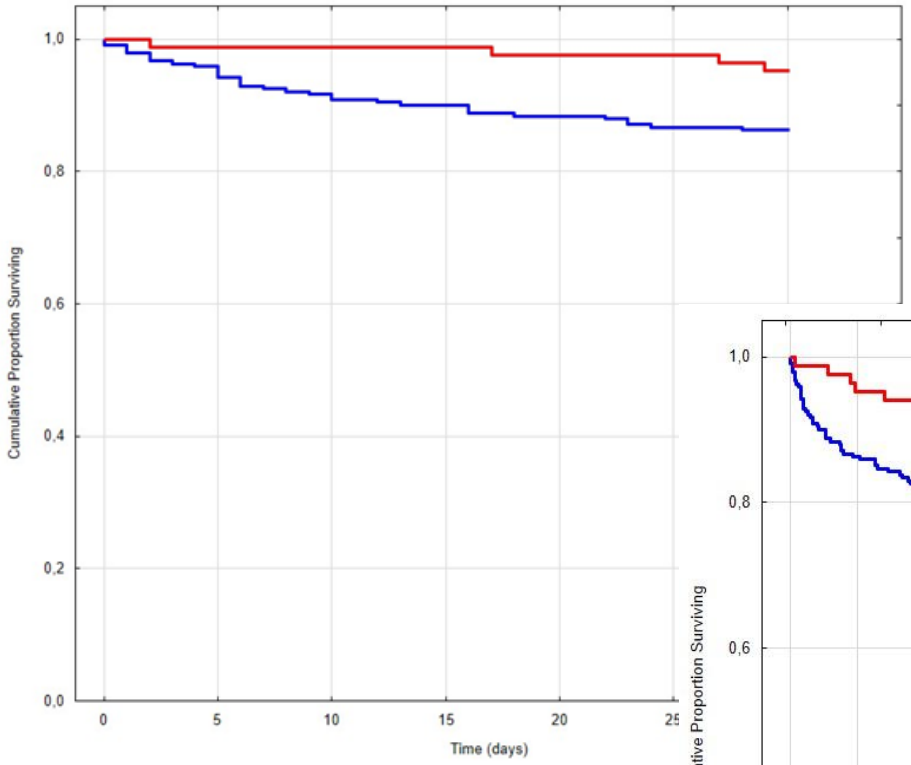



URGENTNÍ PŘÍJEM
-1
RENTGEN - POLIKLINIKA
KLINIKA REHABILITACE
MAMOGRAFIE
-2
ZDRAVOTNICKÝ MATERIÁL - SKLADY
ŠATNY
-3
TECHNICKÉ PODLAŽÍ
-4
TECHNICKÉ PODLAŽÍ

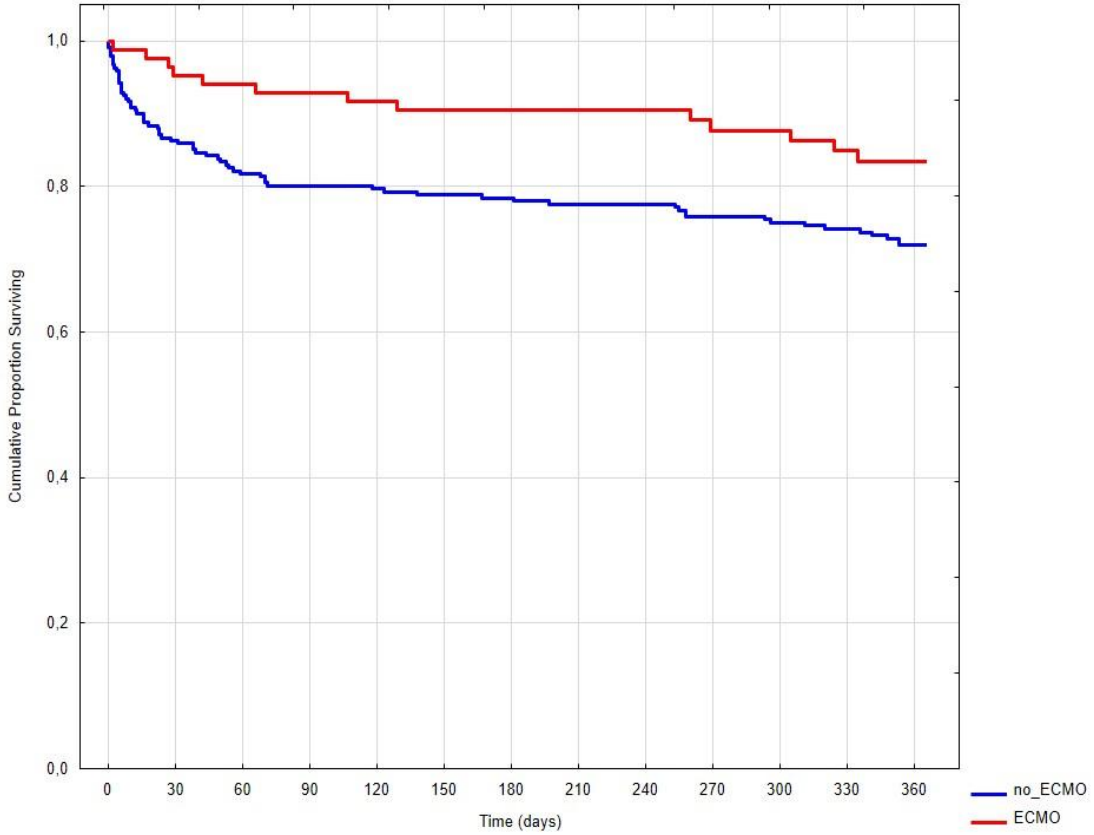
ECMO u LTx pro iPAH



Výsledky Tx plic ECMO v. non ECMO



Log-Rank Test: P = 0.023



Log-Rank Test: P = 0.025

III.chirurgická klinika:
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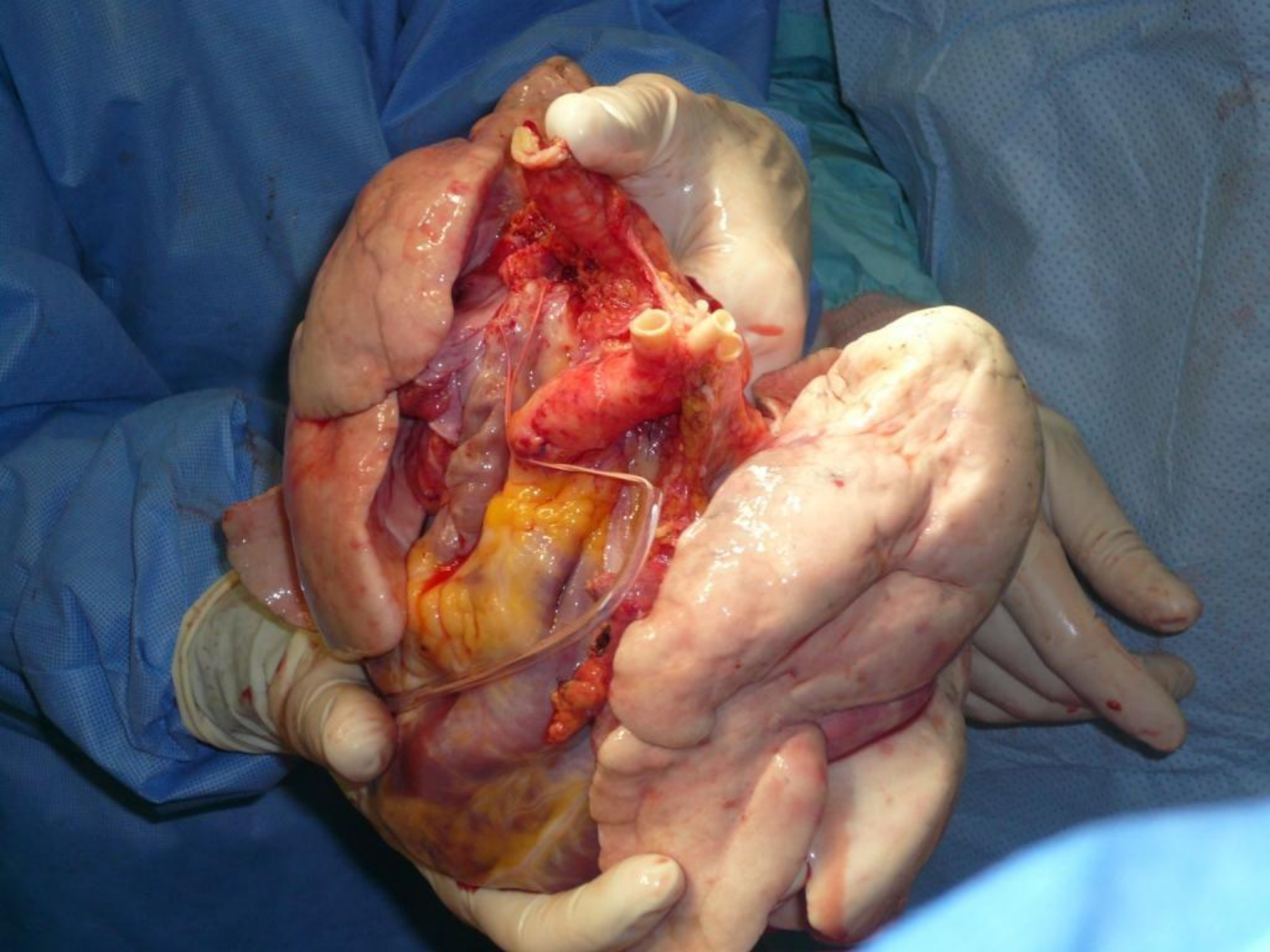

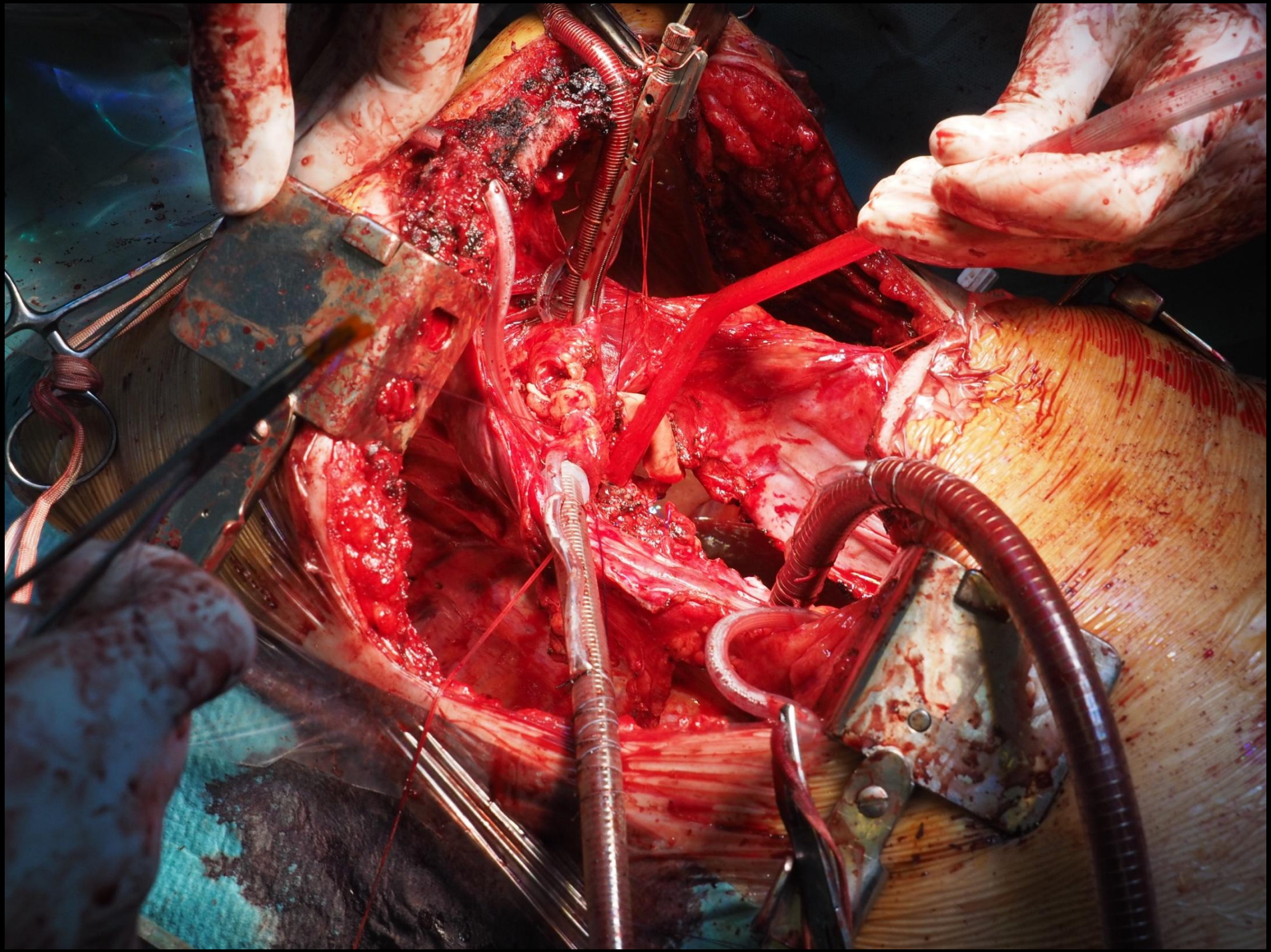

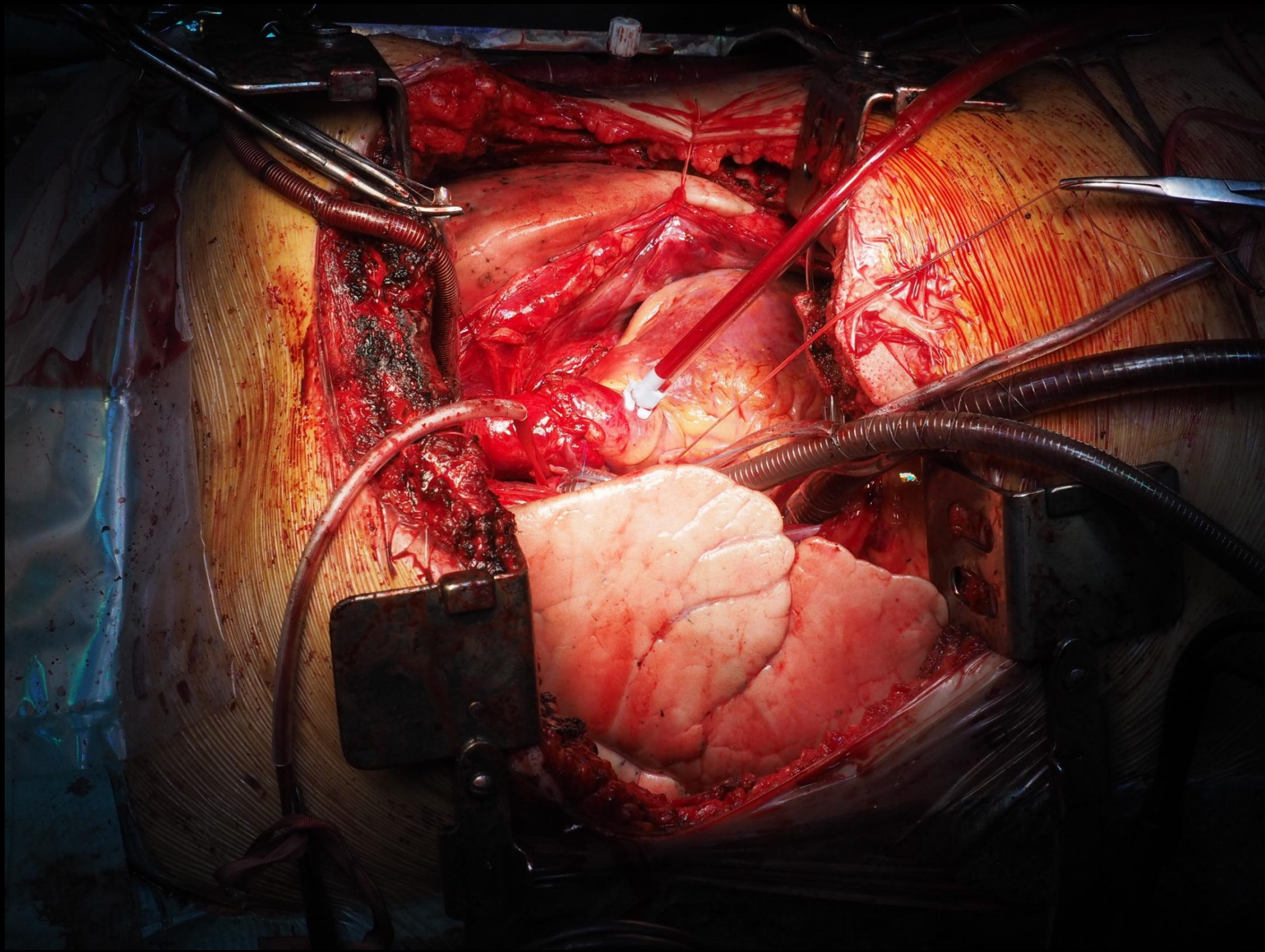

29. 11. 2014

Bridge to lung transplantation with the novel pumpless interventional lung assist device NovaLung

Stefan Fischer, MD, MSc,[a] Andre R. Simon, MD,[a] Tobias Welte, MD,[b] Marius M. Hoeper, MD,[b] Anne Meyer, MD,[a] Rene Tessmann, MD,[a] Bernhard Gohrbandt, MD,[a] Jens Gottlieb, MD,[b] Axel Haverich, MD,[a] and Martin Strueber, MD[a]

Background: Worsening of lung failure in patients awaiting a lung transplantation might lead to ventilation-refractory hypercapnia and respiratory acidosis. Most transplant centers consider pretransplantation extracorporeal membrane oxygenation as a contraindication for lung transplantation because of the poor outcome. We have
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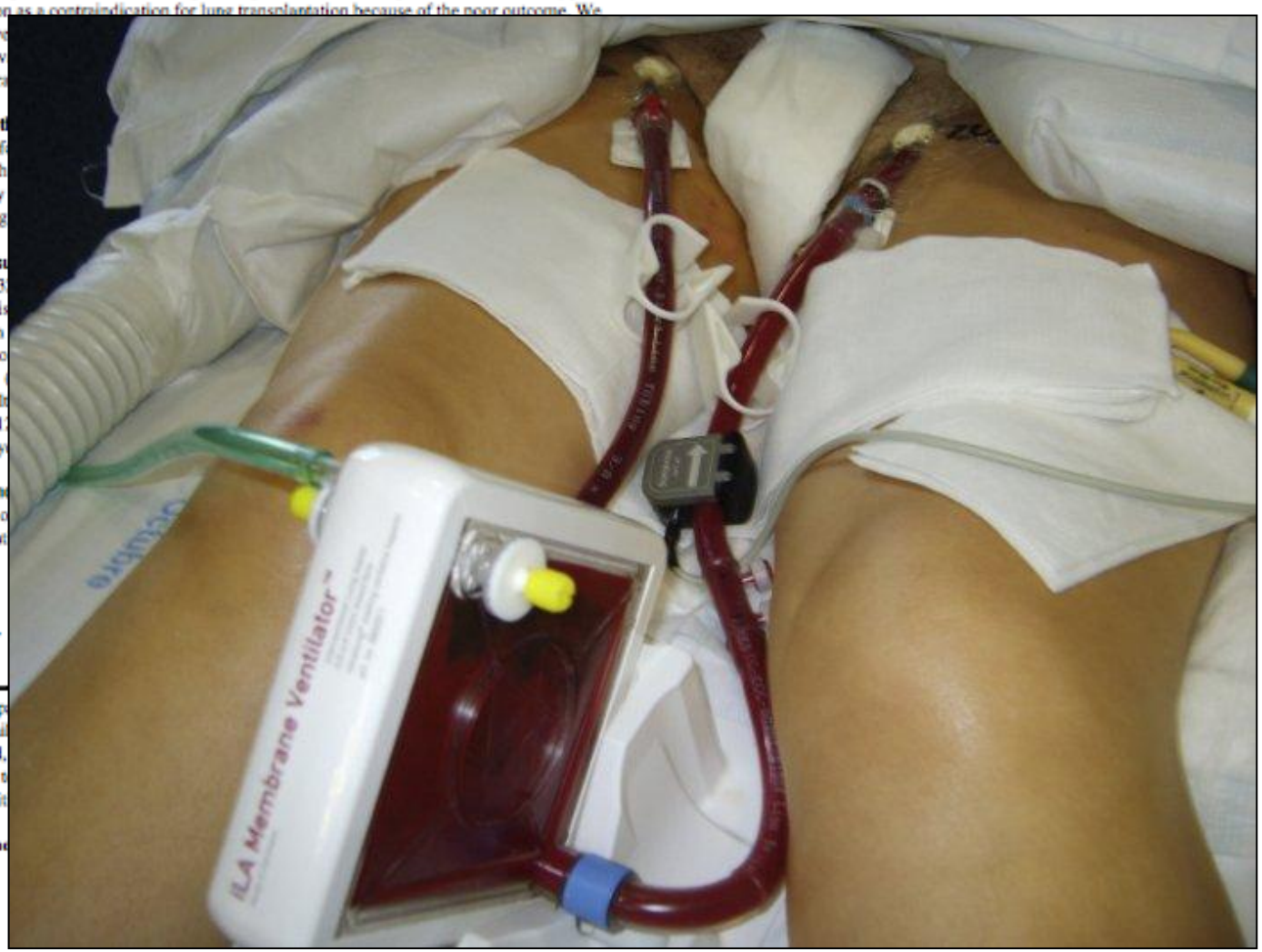

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The results of this study were presented as a featured abstract during a plenary session at the 25th anniversary meeting and scientific sessions of the International Society for Heart and Lung Transplantation (ISHLT), April 6-9, 2005, Philadelphia, Pa.

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0022-5223/$32.00

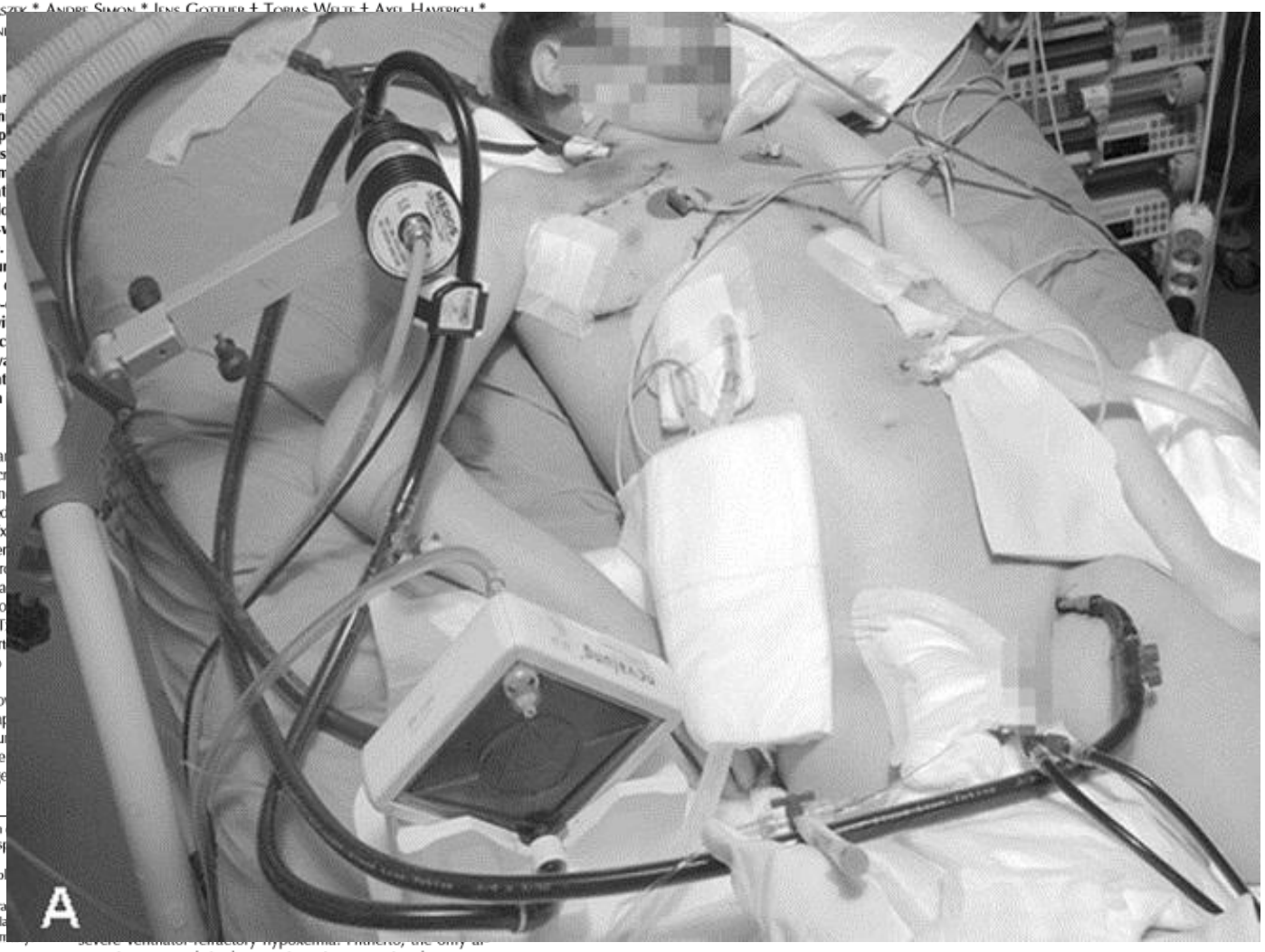
doi:10.1016/j.jtcvs.2005.10.050

Bridge to Lung Transplantation With the Extracorporeal Membrane Ventilator Novalung in the Veno-Venous Mode: The Initial Hannover Experience

Stefan Fischer,* Marius M. Hoeper,† Sandra Tomaszek,* Andre Simon,* Jens Gottlieb,† Tobias Welte,† Axel Haverich,* and

Conventional extracorporeal membrane oxygenation ar chanical ventilation have both been identified as sign risk factors for post–lung transplant mortality when app a bridge to lung transplantation. We have previous scribed the successful use of the extracorporeal mem ventilator Novalung as a bridge to lung transplantat patients with severe hypercapnia and respiratory acidc this setting the Novalung was connected in the arterio-v mode without support of a mechanical blood pump. ever, in patients with predominant hypoxemia, this pu mode does not achieve sufficient blood oxygenation limited blood flow. Thus, such patients require pump- support. Here we describe our initial experience wi Novalung extracorporeal membrane ventilator, whic originally designed for pumpless carbon dioxide remova bridge to lung transplantation in patients with vent refractory hypoxemia in the veno-venous pump-driven *ASAIO Journal* 2007; 53:168–170.

Increasing numbers of patients listed for lung transpla (LTx), but a steady number of donor organs lead to incr waiting times, and, consequently, waiting list morbidity an tality.[1] As a consequence, more patients require advanced ratory support as a bridge to LTx. Given the high risk of LTx such circumstances, many programs may not consider patients as transplant candidates. Previously reported appr to bridge to LTx include mechanical ventilation and extra real membrane oxygenation (ECMO). Ventilator suppo ECMO have both been identified as risk factors of postLT tality when applied preLTx.[1] We have previously report successful use of the pumpless Novalung as a bridge to patients with severe ventilator-refractory hypercapnia.[2] pumpless mode, the device achieves sufficient CO_2 remo not oxygenation due to limited blood flow, which is ap mately 20% of the cardiac output.[2] Therefore, in the pu arterio-venous mode, this device is not suitable as a bridge in patients with predominant *hypoxemia*. Sufficient oxyge



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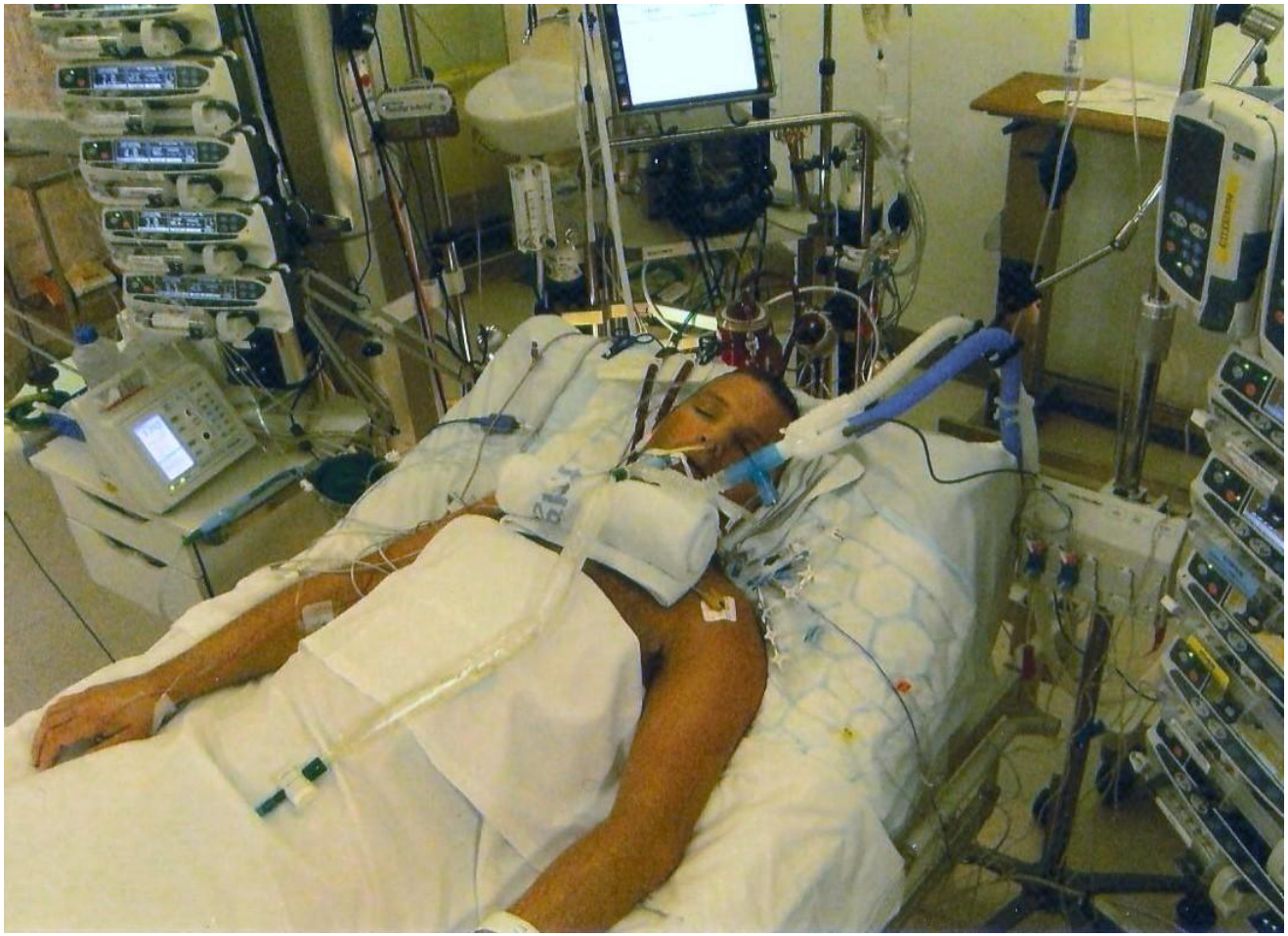
severe ventilator-refractory hypoxemia. Patients, the only al- ternative approach in these patients is conventional extracor-

ECMO



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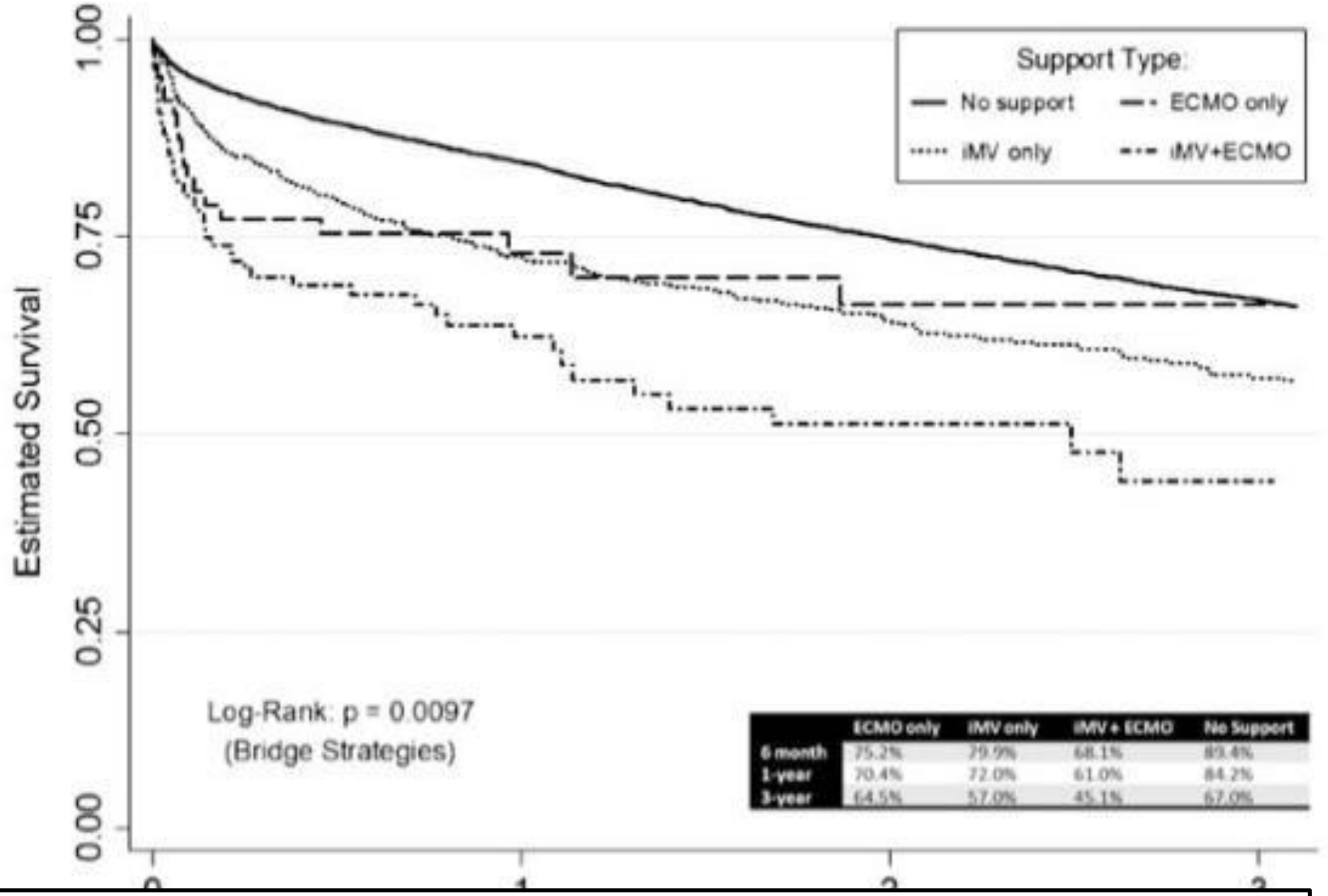
Matthew Adam S
Speicher, MD[1], **M**
MD[1]
[1] Department of S

Abstract

Background–
bridge to lung t
using ECMO in
mechanical ven

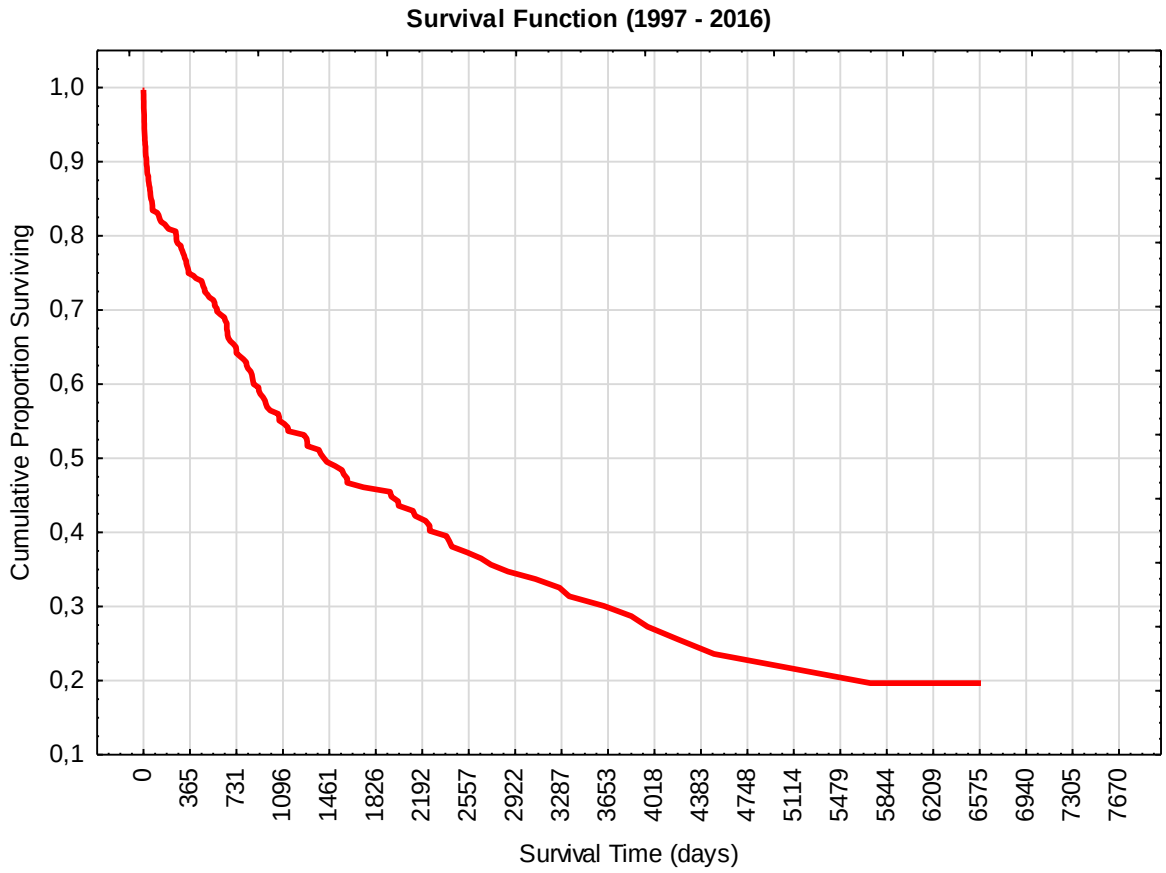
Methods—Us
isolated lung tra
were categorize
mechanical ven
rank testing was
regression mod
associated with

Results—App
analysis. Sixty-



pouze iMV : hazard ratio [HR] = 1.46; iMV + ECMO = 2.26,
P < 0.0001 pro obě skupiny)

PŘEŽÍVÁNÍ PACIENTŮ PO TX PLIC



3M přežití pacientů po Tx je **84 %.**

1R přežití pacientů po Tx je ***77 %.***

5R přežití pacientů po Tx je **47 %.**

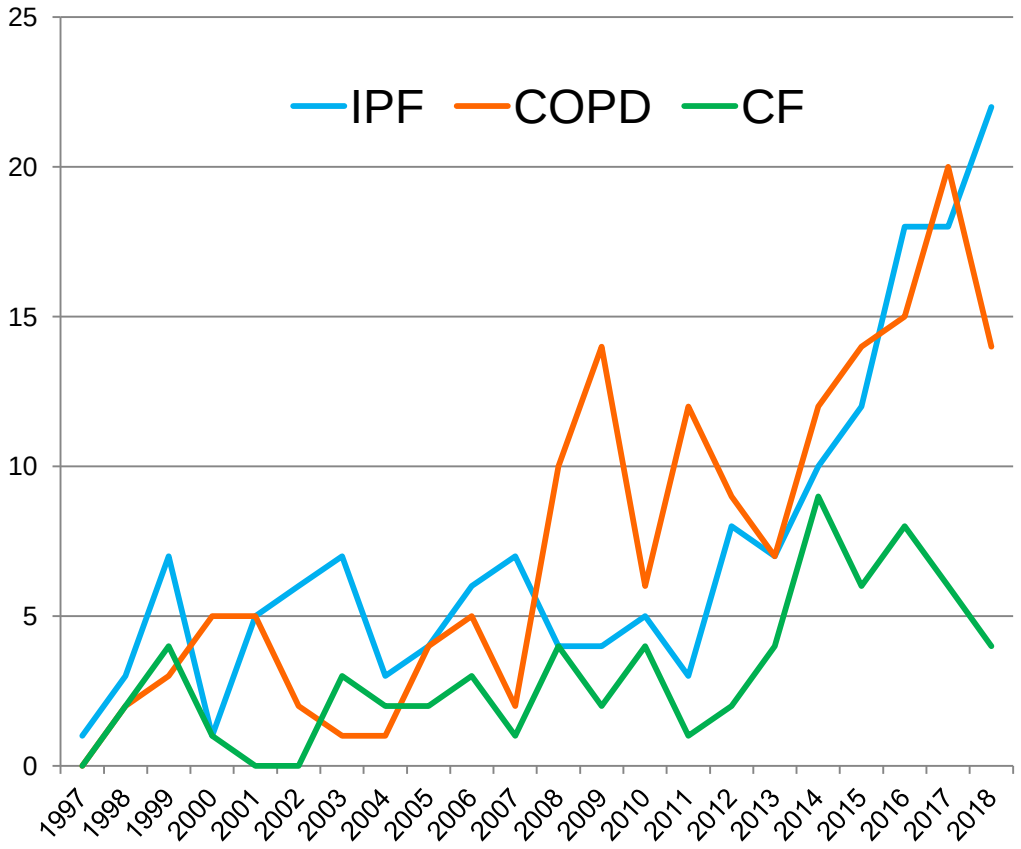
10R přežití pacientů po Tx je **31%.**

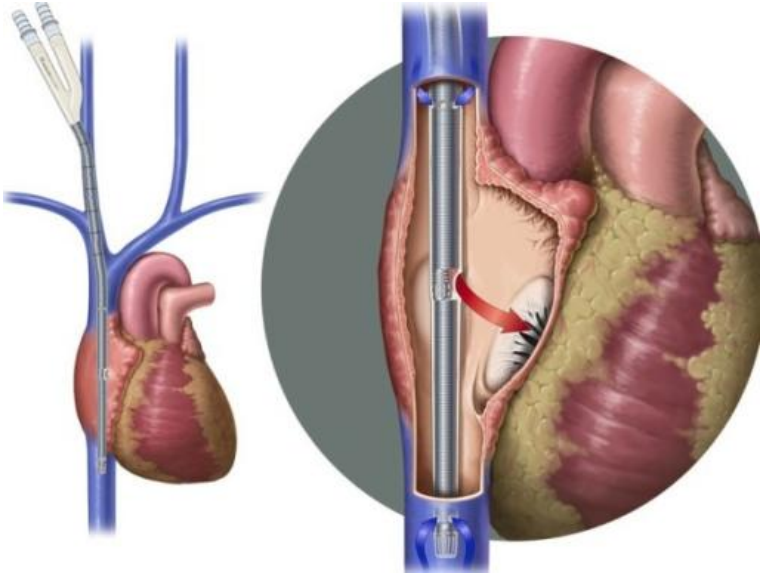
Hlavní DG

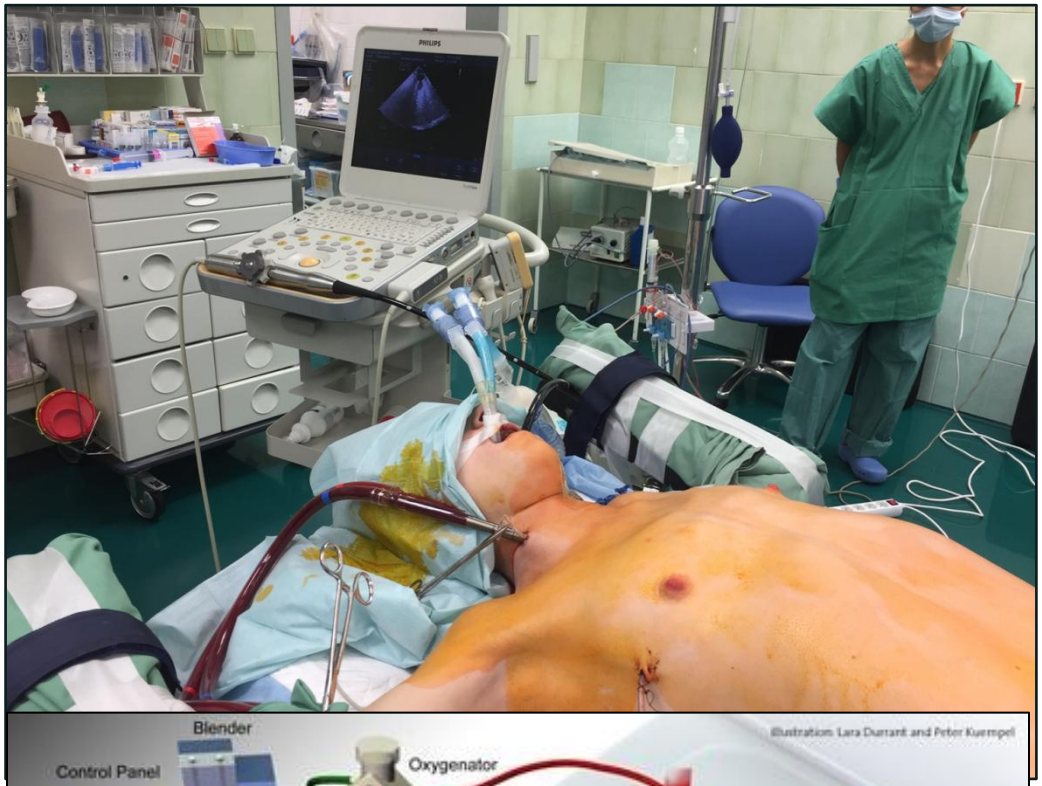
ZASTOUPENÍ DG

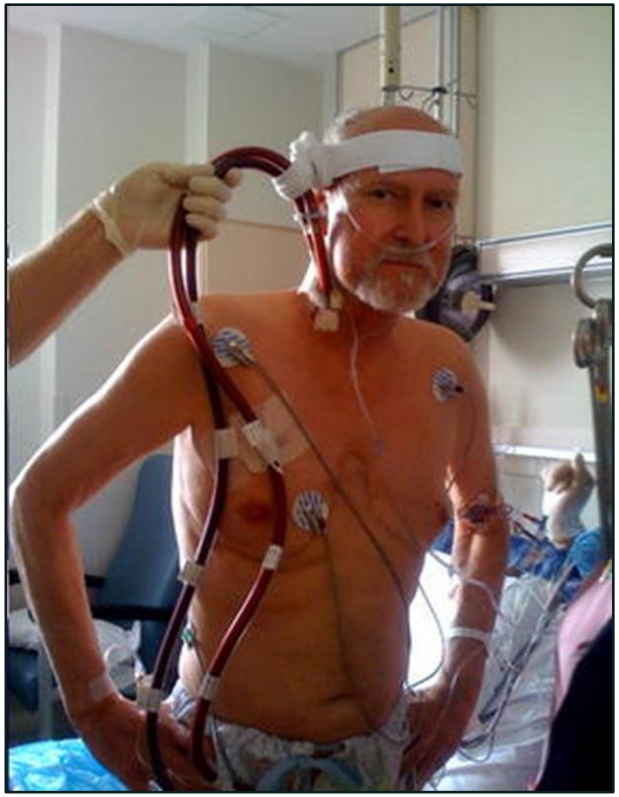
- CHOPN 159 (38,6%)
- IPF 158 (38,3%)
- CF 68 (16,5%)
- PAH 5 (1,2%)
- LAM 16 (3,9%)
- Ostatní 6 (1,4%)
- re-TX 4 (1,0%)
- HLTx 3 (0.7%)

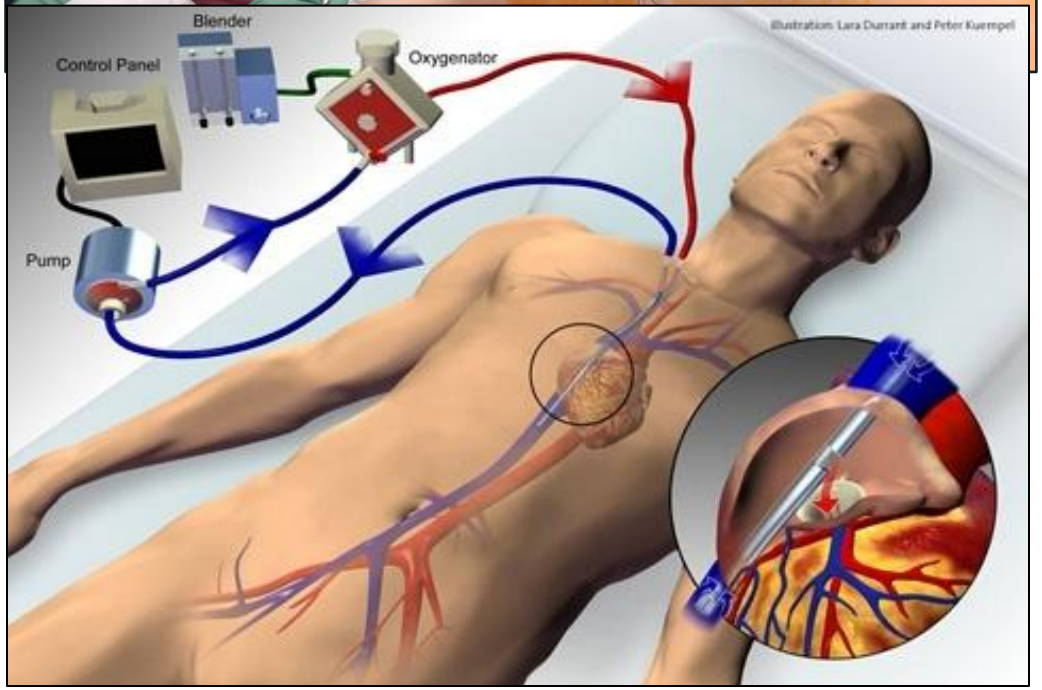
VÝVOJ V LETECH

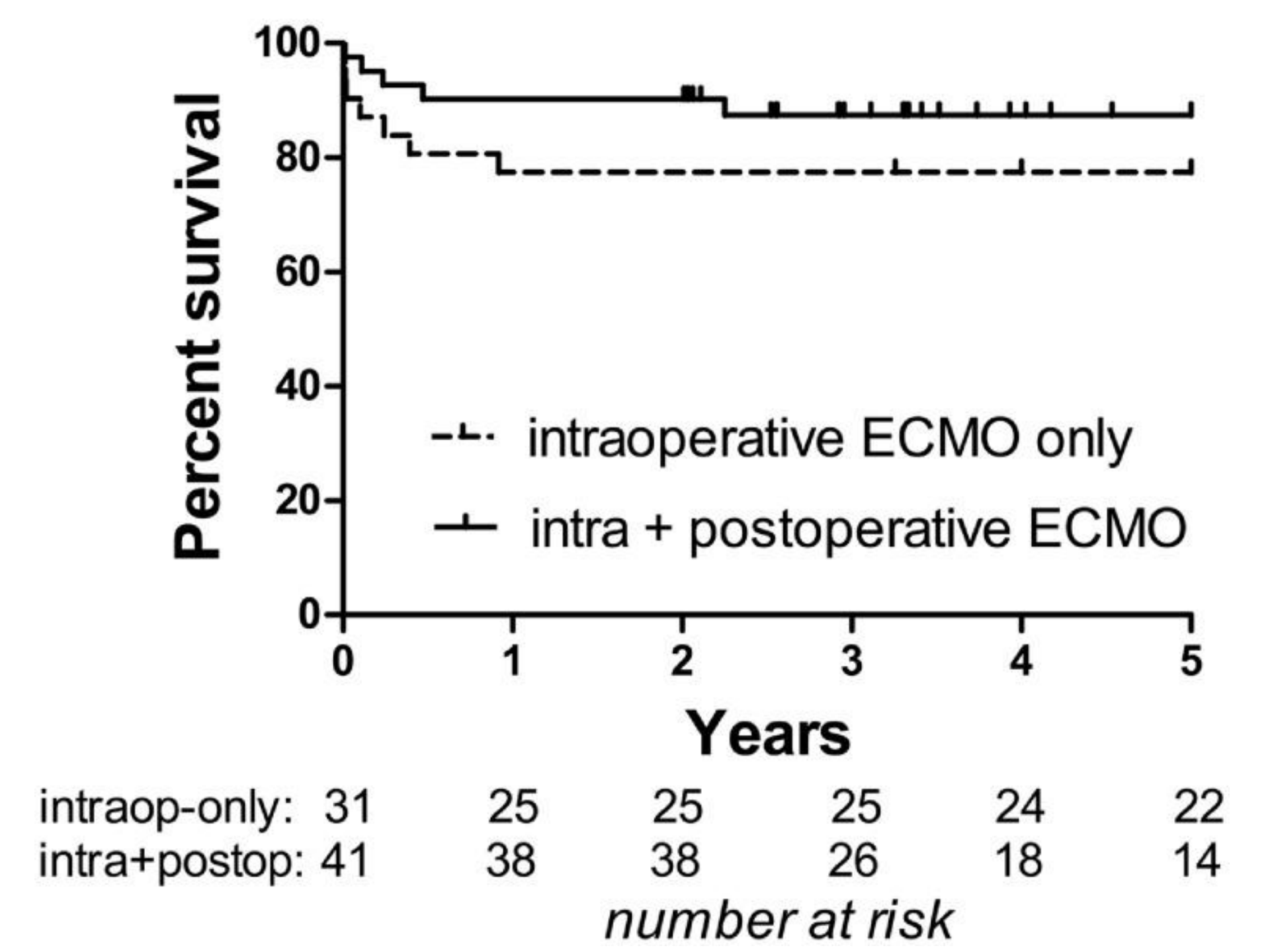









Blender
Control Panel
Oxygenator
Pump
Illustration: Lara Durrant and Peter Kuerpel


Percent survival
100
80
60
40
20
0
intraoperative ECMO only
intra + postoperative ECMO
0
1
2
3
4
5
Years
intraop-only: 31 25 25 25 24 22
intra+postop: 41 38 38 26 18 14
number at risk