Transplantace plic
pohledem chirurga

Robert Lischke
III. chirurgická klinika 1. LF UK a FN Motol
1. Edukační symposium ČTS 2019

Transplantace plic pohledem chirurga

- Indikace
- Dárce
- Alokace
- Objem centra
- Technika transplantace
- ECMO
- Výsledky

Indikace

Indikace k transplantaci plic

- zcela etablovaná metoda léčby pro některá plicní onemocnění v terminální fází respiračního selhání po vyčerpání všech možností konzervativních léčby
- chybějící kvalita života, závislost na inhalaci kyslíku a zvyšující se imobilita
- očekávaná doba přežití 12-18 měsíců
- metoda, která prodlužuje život a zcela zásadně mění kvalitu života

- CHOPN
- Plicní fibróza, IPP
- Cystická fibróza
- Idiopatická plicní hypertenze
- Retransplantace při chronické dysfunkci štěpu

Indikační a kontraindikační kritéria

ELSEVIER

The Journal of Heart and Lung Transplantation
http://www.jhlonline.org

ISHLT CONSENSUS

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

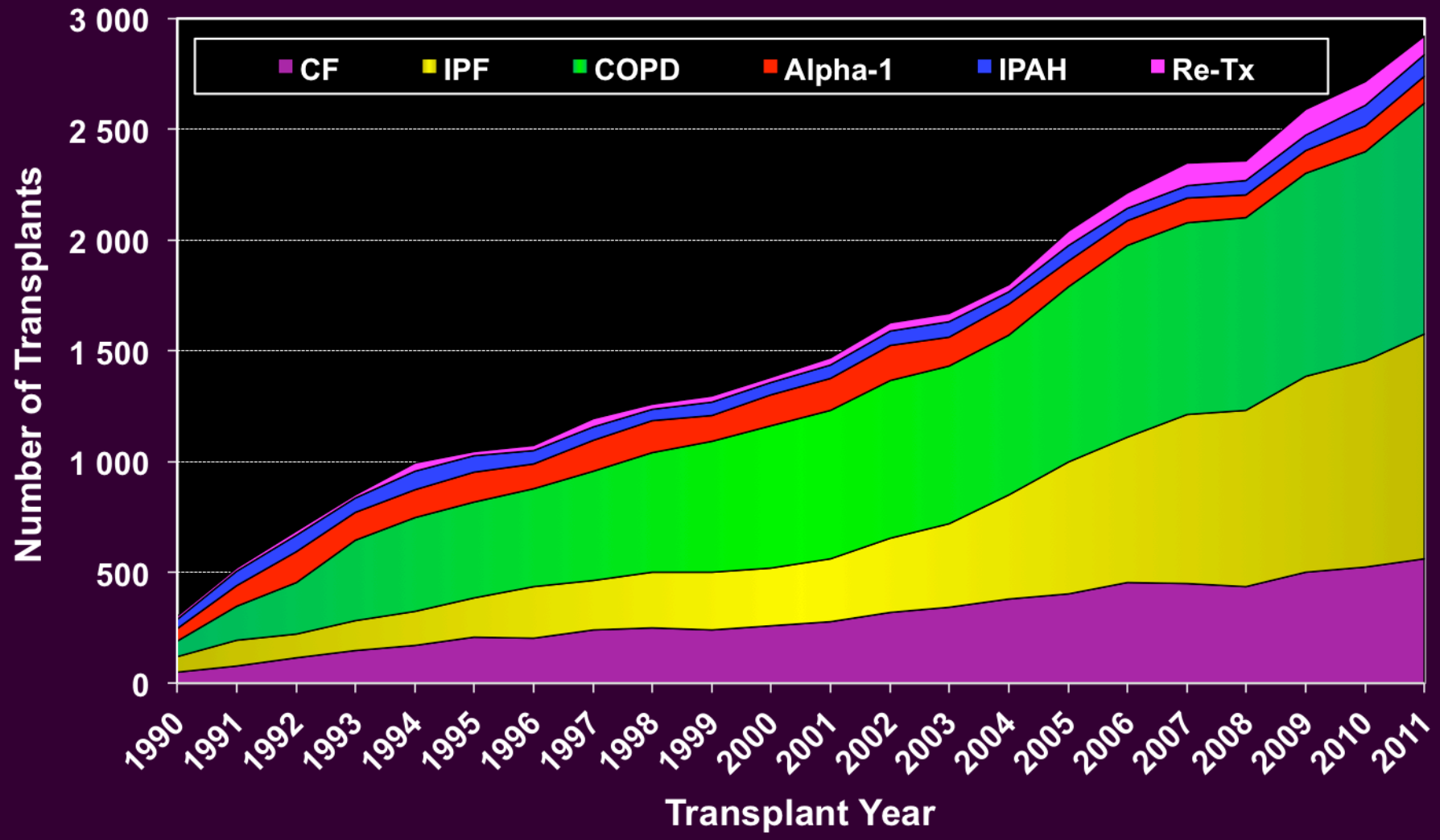
David Weill, MD (Committee Chairs),[a] Christian Benden, MD (Committee Members),[c] Paul A. Corris, MD (Committee Members),[d] John H. Dark, FRCS (Committee Members),[d] R. Duane Davis, MD (Committee Members),[e] Shaf Keshavjee, MD (Committee Members),[f] David J. Lederer, MD (Committee Members),[g] Michael J. Mulligan, MD (Committee Members),[h] G. Alexander Patterson, MD (Committee Members),[i] Lianne G. Singer, MD (Committee Members),[j] Greg I. Snell, MD (Committee Members),[k] Geert M. Verleden, MD, PhD (Committee Members),[l] Martin R. Zamora, MD (Committee Members),[m] and Allan R. Glanville, MBBS, MD (Committee Chairs)[b]

From the [a]Stanford University, Stanford, California; [b]St. Vincent's Hospital, Sydney, New South Wales, Australia; [c]University Hospital Zurich, Zurich, Switzerland; [d]Freeman Hospital, Newcastle-upon-Tyne, United Kingdom; [e]Duke University, Durham, North Carolina; [f]University of Toronto, Toronto, Ontario, Canada; [g]Columbia University, New York, New York; [h]University of Washington, Seattle, Washington; [i]Washington University, St. Louis, Missouri; [j]University of Toronto, Toronto, Ontario, Canada; [k]The Alfred Hospital, Melbourne, Victoria, Australia; [l]University Hospital Gasthuisberg, Leuven, Belgium; and the [m]University of Colorado, Denver, Colorado.

KEYWORDS:
lung transplantation;
interstitial lung

The appropriate selection of lung transplant recipients is an important determinant of outcomes. This consensus document is an update of the recipient selection guidelines published in 2006.
The Pulmonary Council of the International Society for Heart and Lung Transplantation (ISHLT)

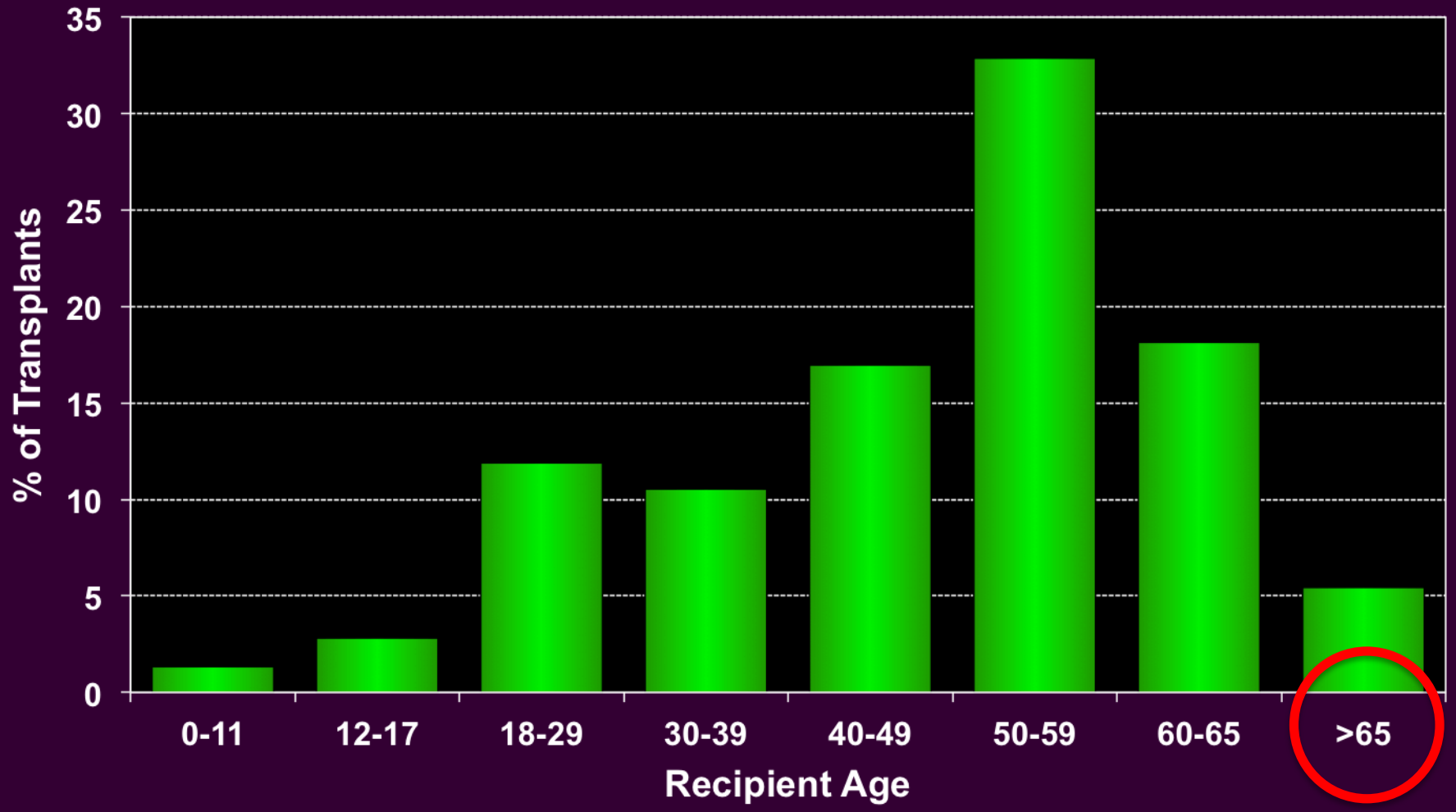
Adult Lung Transplants
Major Indications By Year (Number)



ISHLT • INTERNATIONAL SOCIETY FOR HEART AND LUNG TRANSPLANTATION
2013
JHLT. 2013 Oct; 32(10): 965-978

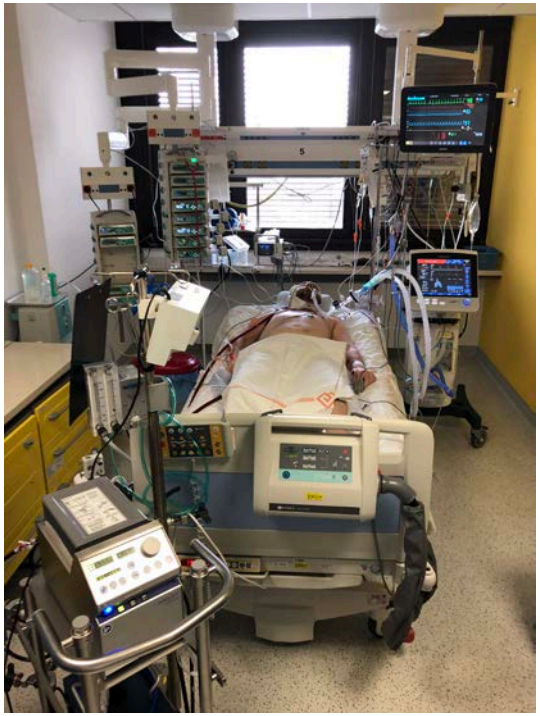
Adult and Pediatric Lung Transplants

Recipient Age Distribution (Transplants: January 1985 – June 2012)



ISHLT • INTERNATIONAL SOCIETY FOR HEART AND LUNG TRANSPLANTATION
2013
JHLT. 2013 Oct; 32(10): 965-978

Indikace
Kdo? Kdy?



Indikace a selekce pacientů k transplantaci je klíčový moment pro dobrý výsledek a správnou alokaci orgánů

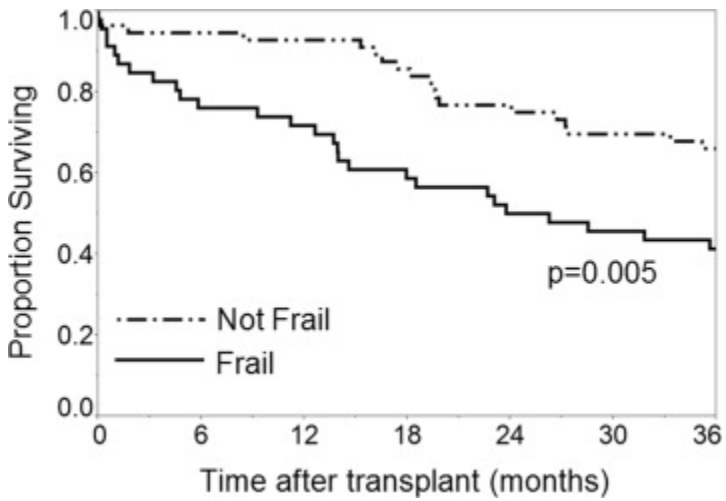
Základem je zkušenost centra

Změny v indikaci

- u jednotlivých diagnóz - s cílem včasného referování kandidáta
- multiorgánové TX, retransplantace, kontroverzně vnímané indikace k LuTX (kolonizace *Burkholderia cenopepacia*, syst. sklerodermie, adenokarcinom in situ…)
- BMI nad 35 kg/m^2 se posunula do absolutních kontraindikací k LuTX
- nově absolutní kontraindikací těžký funkční stav s nízkým rehabilitačním potenciálem – frailty
- přípustné transplantovat pacienty s hepatitidou B, C a HIV (avšak s urč. předpoklady následné péče – v centrech se zkušeným hepatologickým týmem, se zkušenostmi s péčí o HIV pozitivní nemocné…)

Indikace u „frailty“ sy

- Vyhodnocení efektu frailty sy (dg. pretransplantačně) na mortalitu pacientů po transplantaci plic
- 102 pacientů
- Pre-transplantační frailty byla nezávisle asociovaná se sníženým přežíváním po transplantaci plic



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The Journal of Heart and Lung Transplantation
http://www.jhltonline.org

Pretransplant frailty is associated with decreased survival after lung transplantation

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From the [a]Division of Pulmonary and Critical Care Medicine; [b]Division of Cardiovascular Diseases; [c]Department of Health Sciences Research; and the [d]William J. von Liebig Mayo Transplant Center, Mayo Clinic, Rochester, Minnesota.

KEYWORDS:
frailty;
frailty deficit index;
pre-transplant;
lung transplant;
survival;
health outcomes;
adults

BACKGROUND: Frailty is a condition of increased vulnerability to adverse health outcomes. Although frailty is an important prognostic factor for many conditions, the effect of frailty on mortality in lung transplantation is unknown. Our objective was to assess the association of frailty with survival after lung transplantation.

METHODS: We performed a retrospective cohort analysis of all adult lung transplant recipients at our institution between 2002 and 2013. Frailty was assessed using the frailty deficit index, a validated instrument that assesses cumulative deficits for up to 32 impairments and measures the proportion of deficits present (with frailty defined as >0.25). We examined the association between frailty and survival, adjusting for age, sex, and bilateral (vs single) lung transplant using Cox proportional hazard regression models.

RESULTS: Among 144 lung transplant patients, 102 (71%) completed self-reported questionnaires necessary to assess the frailty deficit index within 1 year before lung transplantation. Frail

Indikace a stav výživy

Obesity and Underweight Are Associated with an Increased Risk of Death after Lung Transplantation

David J. Lederer[1,2], Jessie S. Wilt[1,2], Frank D'Ovidio[2,3], Matthew D. Bacchetta[2,3], Lori Shah[1,2], Shankari Ravichandran[2,3], Jenny Lenoir[2], Brenda Klein[2], Joshua R. Sonett[2,3], and Selim M. Arcasoy[1,2]

[1]Department of Medicine, [2]New York Presbyterian Lung Transplant Program, and [3]Department of Surgery, College of Physicians and Surgeons, Columbia University, New York, New York

Rationale: Obesity is considered a relative contraindication to lung transplantation, based on studies that have not accounted for key confounders. Little is known about the risk of death for underweight candidates after transplantation.
Objectives: To examine the associations of pretransplant obesity and underweight with the risk of death after lung transplantation.
Methods: We examined 5,978 adults with cystic fibrosis, chronic obstructive pulmonary disease, and diffuse parenchymal lung disease who underwent lung transplantation in the United States between 1995 and 2003. We used Cox models and generalized additive models to examine the association between pretransplant body mass index and the risk of death after lung transplantation with adjustment for donor and recipient factors.
Measurements and Main Results: The median follow-up time was 4.2 years. Compared with normal weight recipients, the multivariable-adjusted rates of death were 15% higher for underweight recipients

AT A GLANCE COMMENTARY

Scientific Knowledge on the Subject

Obesity has been linked to higher mortality rates after lung transplantation in studies that have not adequately controlled for potential confounding factors. The impact of underweight after lung transplantation is largely unknown.

What This Study Adds to the Field

Both obesity and underweight are independent risk factors for death after lung transplantation, accounting for up to 12% of deaths in the first year after transplantation.

- retrospektivně zhodnoceno 5,978 příjemců z období 95-03
- ve srovnání s příjemci s normální hmotností bylo riziko smrti po TX o 15% vyšší u malnutričních, o 15% vyšší u příjemců s nadváhou a o 22% vyšší u obézních příjemců
- tento vztah perzistoval i při rozdělení dle diagnóz.

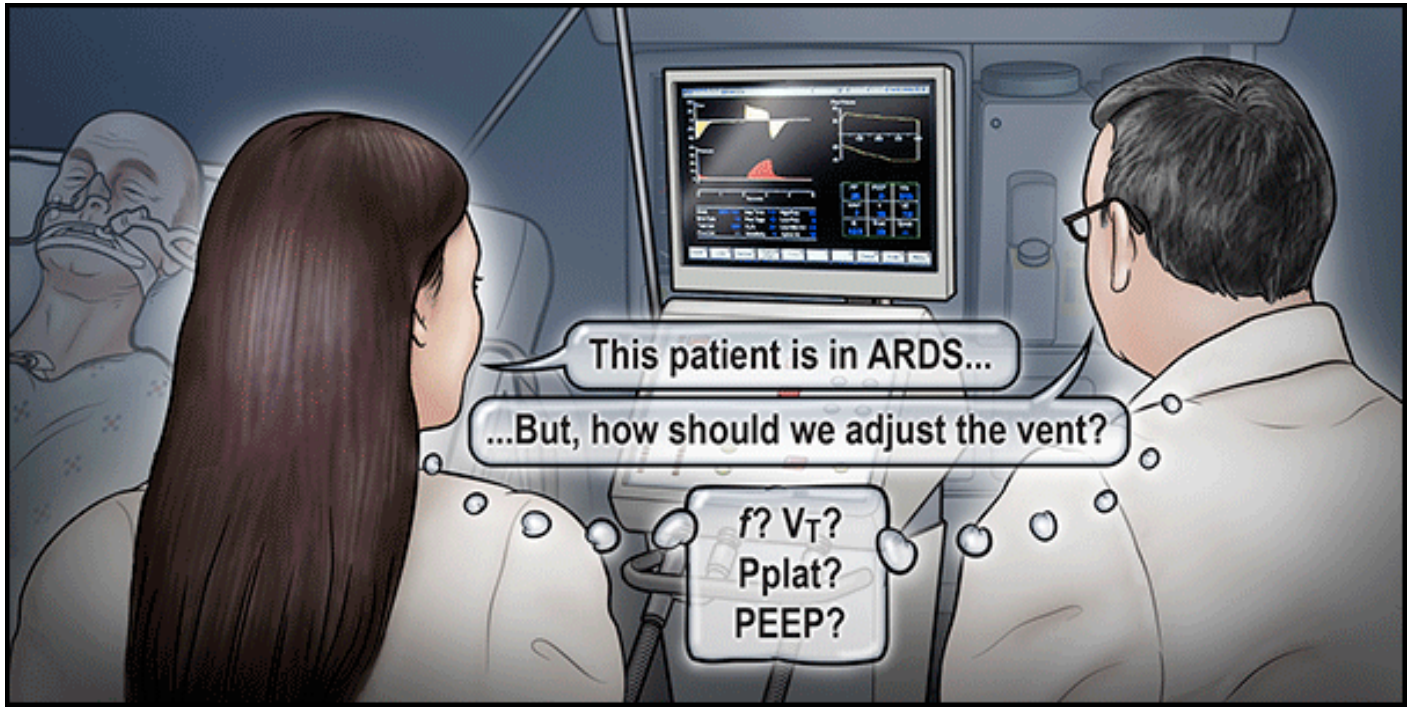
- ***Zá: Obezita i podváha jsou nezávislým rizikovým faktory pro smrt po transplantaci plic.***

U pacientů s pokročilým plicním onemocněním by měla být podporována zdravá váha dlouho předtím, než přichází v úvahu transplantace.

Indikace a most k Tx –”bridging”

Akutní zhoršení pacienta na čekací listině s nutnostní umělé plicní ventilace

- ~~Ventilátor~~
- NovaLung
- ECMO



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, for the first time, applied the novel pumpless interventional lung assist NovaLung for bridge to lung transplantation in patients with severe ventilation-refractory hypercapnia. We report on our initial experience.

Methods: Between March 2003 and March 2005, 176 lung transplantations were performed, of which 60% were high-urgency lung transplantations. Twelve of the high-urgency recipients had sev
tory acidosis. These patients w
lung assist NovaLung for bridg

Results: The length of intervent
(4-32 days). Pa_{O_2}, pH, and Pa_{CO_2}
assist NovaLung implantation
mm Hg, respectively. Six hour
tation, Pa_{O_2}, pH, and Pa_{CO_2} lev
0.1 ($P < .05$), and 52 ± 5 mm
multiorgan failure, 2 patients b
of 12 patients were successfully
(1-year survival, 80%).

Conclusions: This report sugge
tation is an effective bridge
ventilation-refractory hypercap

From the Hannover Thoracic Transplant Program, Division of Thoracic and Cardiovascular Surgery,[a] and the Department of Respiratory Medicine, Hannover Medical School,[b] Hannover, Germany.

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.

The authors have no financial interest in any products presented in this article.

Received for publication June 27, 2005; revisions accepted Sept 22, 2005; accepted for publication Oct 10, 2005.

Address for reprints: Martin Strueber, MD, Director, Hannover Thoracic Transplant and Cardiac Assist Program, Division of Thoracic and Cardiovascular Surgery, Hannover Medical School, Carl-Neuberg-Strasse 1, 30625 Hannover, Germany (E-mail: strueber@dig.mh-hannover.de).

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0022-5223/$32.00

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doi:10.1016/j.jtcvs.2005.10.050

Lung transplantation (LT
patients with end-stage
dures annually performe
of patients listed for LTx is als
available donor organs. As a co
and, dependent on the underlyin
up to 40% after 2 years of li
waiting times are too long for

Dárce

Nedostatek vhodných plic k Tx

- Plíce jsou vhodné k odběru pouze v **22-61%** případů multiorgánového odběru
- Plíce jsou obzvláště náchylné k funkčnímu zhoršení během doby péče o dárce orgánů
- Nejčastější důvod odmítnutí – špatná funkce štěpu
- 10-35% mortalita čekatelů na čekacích listinách před Tx plic

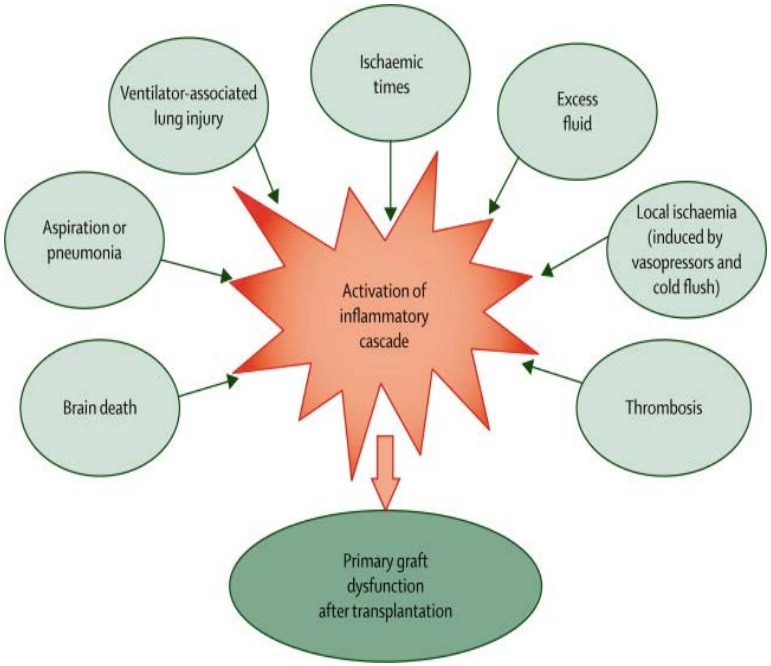
Strategie ke zvýšení počtu dárců plic

- Marginální dárce
- Aktivní vyhledávání dárců
- Agresivní management dárce
- LVRS štěpu
- Lobární transplantace
- Dárce s nebijícím srdcem

Multiorgánový dárce a plíce

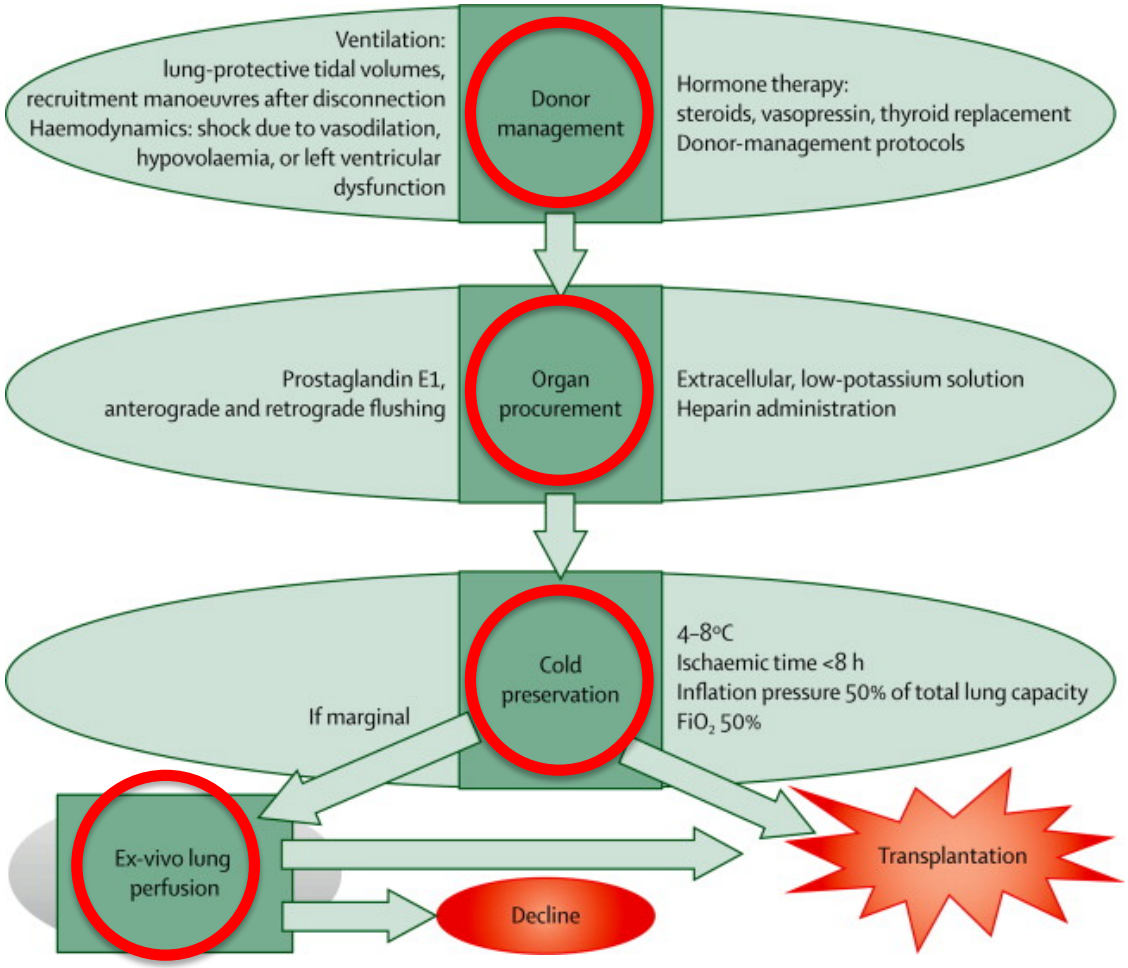
- Po smrti mozku jsou plíce ve srovnání s ostatními orgány výjimečně křehké
- Vysoký potenciál přímého poškození plic
  - Smrt mozku – neurogenní plicní edém
  - Resuscitace
  - Overload tekutin
  - Aspirace, pneumonie
  - Ventilator-associated lung injury
  - Lokální ischemie vasopresory
  - Trombóza

Aktivace zánětlivé kaskády
Primární dysfunkce štěpu po Tx



Donor management and lung preservation for lung transplantation
Munshi, Laveena et al.
The Lancet Respiratory Medicine , 2013

Od stanovení smrti k transplantaci



Donor management and lung preservation for lung transplantation
Munshi L.
The Lancet Respiratory Medicine, 2013

Strategie ke zvýšení počtů orgánů

- Agresivní péče o dárce plic
- Využití marginálních dárců
- Ex vivo perfúze a rekondice plic
- DCD dárce
- Transplantace plic od živých dárců (2/3 Tx plic v Japonsku)
- Operační technika
  - Neanatomické resekce plic
  - Lobární transplantace
  - Split lung transplantace
  - Chirurgická rekonstrukce špatně odebraného orgánu

Maximizing the Utilization of Donor Organs Offered for Lung Transplantation

ELI GABBAY, TREVOR J. WILLIAMS, ANNE P. GRIFFITHS, LOUISE M. MACFARLANE, TOM C. KOTSIMBOS, DONALD S. ESMORE, and GREGORY I. SNELL

Heart and Lung Replacement Services and Department of Respiratory Medicine, Alfred Hospital, Prahran, Victoria, Australia

The number of patients awaiting lung transplantation (LT) and waiting time for surgery is increasing. In Australia, LT rates are 4.6/million population/yr, which despite low organ donation rates, are the highest published in the world. The Australian organ allocation system allows identification of marginal donors and therapeutic manipulation where appropriate. This study aims to assess the impact of utilization of marginal donors and aggressive donor management. A comparison between published donor criteria and local practice is made, allowing assessment of the effect of using marginal donors on outcome. Donor management included antibiotic therapy, strict fluid management, phys-

Dárci se špatnou funkcí plic **by primárně neměli být považování za nevhodné dárce,**
až u 35% může být dosaženo zlepšení PaO2/FiO2 ≥ 300 mmHg po agresivní „resuscitaci“ plic

Pa_{O_2}/FI_{O_2} ratio in 20 donors (Group 3) who would not otherwise have been used. Immediate and 24 h postoperative gas exchange and length of intensive care unit (ICU) stay was not different for recipients from donors from all three groups. Overall survival was 94% at 30 d, 83% at 1 yr, 70% at 2 yr, and 62% at 3 yr and was not significantly different from the three groups. We conclude that organ utilization can be maximized by therapeutic manipulation and utilization of marginal donors without compromising results from transplantation. **Gabbay E, Williams TJ, Griffiths AP, Macfarlane LM, Kotsimbos TC, Esmore DS, Snell GI. Maximizing the utilization of donor organs offered for lung transplantation.**

AM J RESPIR CRIT CARE MED 1999;160:265–271.

TX

Aggressive management of lung donors classified as unacceptable: Excellent recipient survival one year after transplantation

Michaela Straznicka, MD[a]
David M. Follette, MD[a]
Mark D. Eisner, MD[b]
Peter F. Roberts, MD[a]
Rebecca L. Menza, RN[c]
Wayne D. Babcock, RN[c]

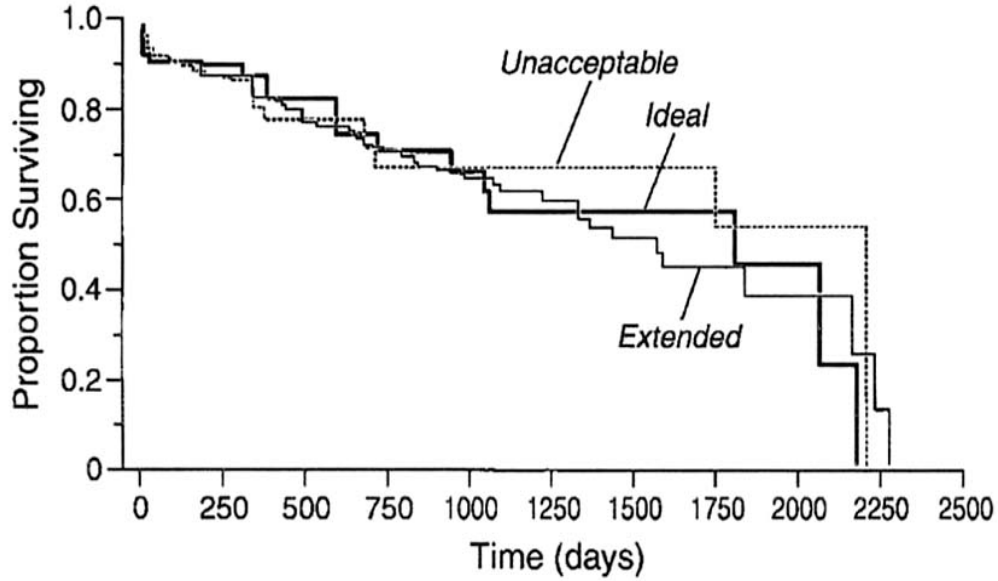


Figure 1. Kaplan-Meier survival curves comparing recipients of lungs from unacceptable, acceptable, and ideal donors. Note that there were no significant survival differences by donor group.

thesized that
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donors who
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ses.

f 194 donors
cceptable for
col. We used
ective review
were treated
fluid restric-
als at 30 days
acceptable. In
ecipients with
vith those of
causes to see
tality.

ratios of Pao_2
mine require-
procurement
There were no
r 1 year after
ties of recipi-
matic causes.

onors initially
considered unacceptable may increase the number of lungs available for transplantation.

cation Dec 7, 2001.

Straznicka M et al. J Thorac Cardiovasc Surg. 2002

Continued Successful Evolution of Extended Criteria Donor Lungs for Transplantation

Sakhee Kotecha, FRACP, Jamie Hobson, RN, Jeremy Fuller, BS, Eldho Paul, BS, MS, Bronwyn J. Levvey, RN, B Ed Studies, Helen Whitford, FRACP, Miranda Paraskev MD, FRACP, and Glen P. Westall, P

Lung Transplant Service, A cine, Monash University, Melbourne; Department of Surgery, Alfred Hospital, Melbourne, Australia

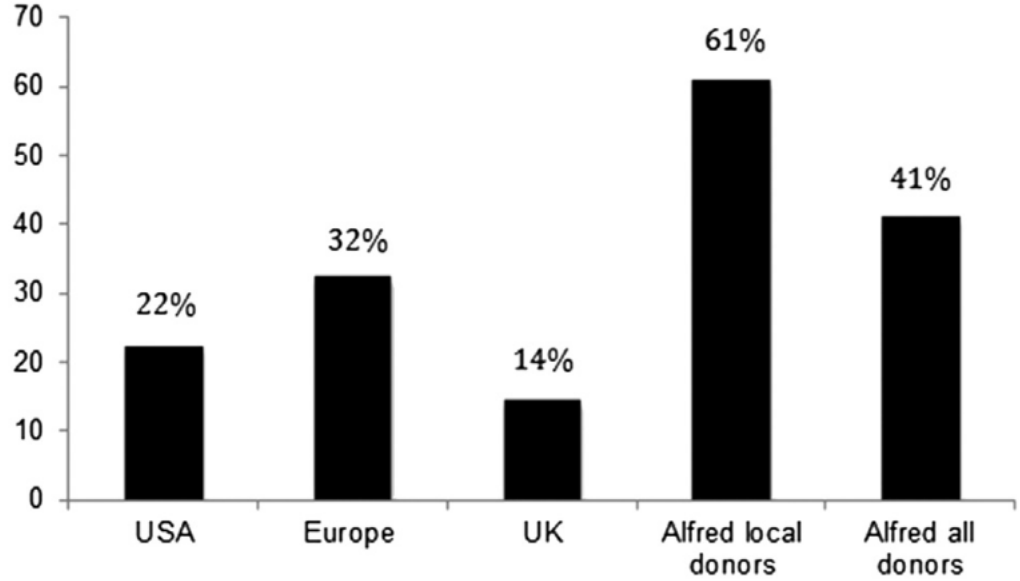

Fig 1. Donor used rate (%) of available donors offered.

Background. In an e r offers, 129 resulted in perfusion (EVLP) use, i , with an overall donor what outcomes can be a no correlation between an aggressive approach ecipient outcomes, and transplantation. ger-term survival was

Methods. Data for all examining lung trans- the Alfred Hospital i LP must consider the collected for 2012 to 201 ieved by using marginal and calculated into a p anagement. It is impor- score. Lung transplant the following: primary graft dysfunction; duration of mechanical ventilation; need for cardiopulmonary bypass extracorporeal membrane oxygenation; intensive care and hospital length of stay; 30-day, 1-year, and 3- to 4-year survival rates; rates of acute rejection and chronic lung allograft dysfunction; and peak and 12-month lung function (forced expiratory volume in 1 second).

tant to consider that adopting a strategy of perioperative lung donor evaluation and intervention allows use of what are considered marginal lungs to achieve promising results.

(Ann Thorac Surg 2017;104:1702–9)
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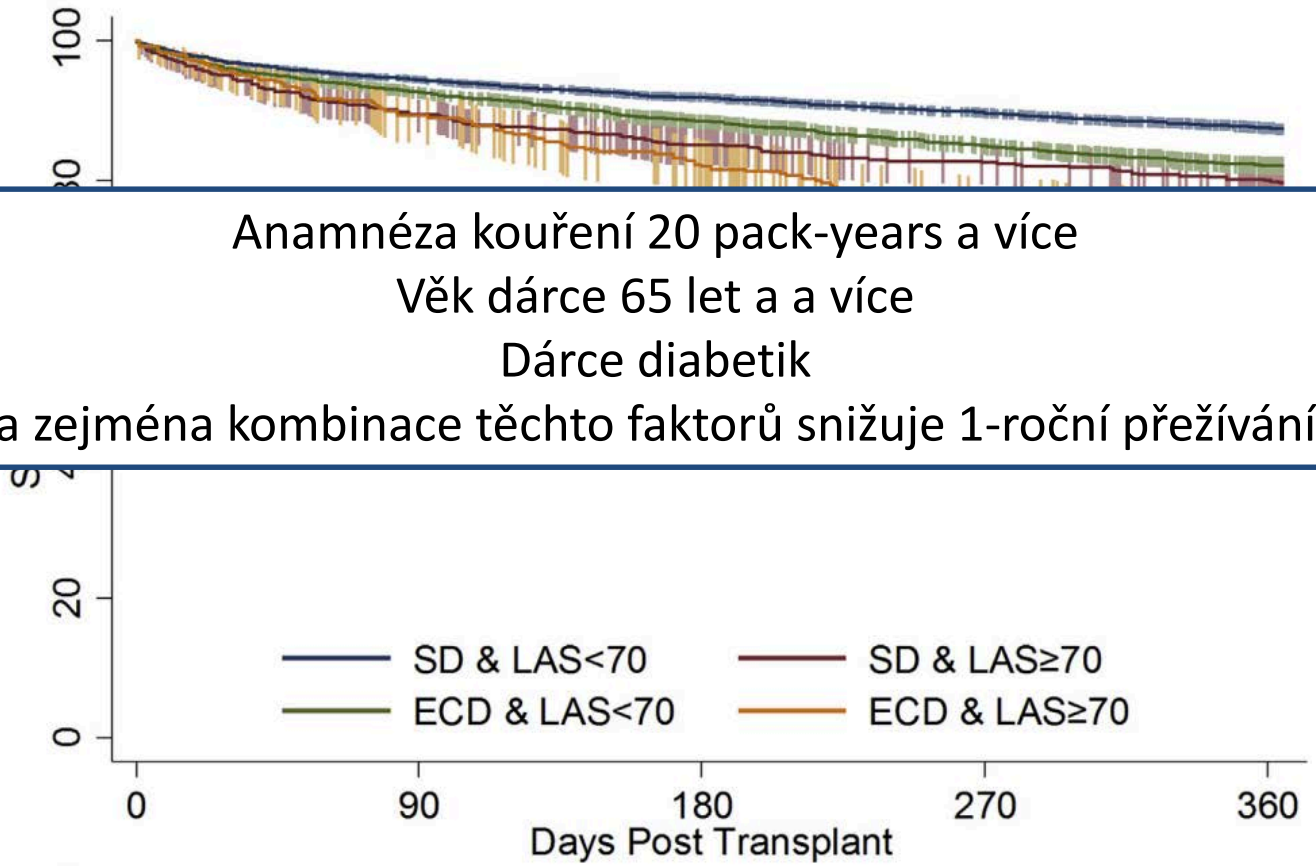
The use of extended criteria donors decreases one-year survival in high-risk lung recipients: A review of the United Network of Organ Sharing Database

Matthew J. Mulligan, BA,[a] Pablo G. Sanchez, MD, PhD,[b] Charles F. Evans, MD,[b] Yan Wang, BM, DrPH,[c] Zachary N. Kon, MD,[b] Keshava Rajagopal, MD, PhD,[b] Aldo T. Iacono, MD,[d] James S. Gammie, MD,[b] Bartley P. Griffith, MD,[b] and Si M. Pham, MD[b]



Anamnéza kouření 20 pack-years a více
Věk dárce 65 let a a více
Dárce diabetik
a zejména kombinace těchto faktorů snižuje 1-roční přežívání

J Thorac Cardiovasc Surg. 2016

Chest computed tomography imaging improves potential lung donor assessment

Jason M. Gauthier, MD,[a] Andrew J. Bierhals, MD, MPH,[b] Jingxia Liu, MS, PhD,[c] Keki R. Balsara, MD,[d] Christine Frederiksen, MS,[a] Emily Gremminger, BA,[a] Ramsey R. Hachem, MD,[e] Chad A. Witt, MD,[e] Elbert P. Trulock, MD,[e] Derek E. Byers, MD, PhD,[e] Roger D. Yusen, MD, MPH,[e] Patrick R. Aguilar, MD,[e] Gary Marklin, MD,[f] Ruben G. Nava, MD,[a] Benjamin D. Kozower, MD, MPH,[a] Michael K. Pasque, MD,[a] Bryan F. Meyers, MD, MPH,[a] G. Alexander Patterson, MD,[a] Daniel Kreisel, MD, PhD,[a,g] and Varun Puri, MD, MSCI[a]

ABSTRACT

Objective: Chest computed tomography (CT) imaging is being increasingly used for potential lung donor assessment. However, the efficacy of CT imaging in this setting remains unknown. We hypothesize that chest CT imaging independently affects the decision-making process in donor lung utilization.

Methods: We conducted a retrospective cohort study of all adult donation after brain death donors managed through our local organ procurement organization from June 2011 to November 2016. An experienced thoracic radiologist independently reviewed donor chest CT and chest x-ray images in a blinded, standardized manner to determine the presence of structural lung disease (eg, emphysema, interstitial lung disease [ILD]) and acute abnormalities (eg, traumatic lung injury [TLI]). Distinct models of lung utilization were fit to groups with initial partial pressure of oxygen ($iPaO_2$) $\leq$300 mm Hg (suboptimal) and $iPaO_2$ >300 mm Hg (optimal).

Results: The organ procurement organization managed 753 donors during the study period, with a lung utilization rate ([lung donors/all organ donors] $\times$ 100) of 36.5% (275 of 753). Four hundred forty-five (59.1%) donors received chest CT imaging, revealing emphysema (13.7%), ILD (2.5%), and TLI (7.2%). In univariate analysis, findings of TLI (odds ratio [OR], 2.23; 95% confidence interval [CI], 1.08-4.61) were positively associated with lung utilization, whereas findings of emphysema (OR, 0.18; CI, 0.08-0.40) were negatively associated with utilization. In multivariate analysis, CT findings of emphysema (OR, 0.21; CI 0.08-0.54) remained negatively associated with utilization. No potential donors with CT findings of ILD became lung donors. After controlling for chest x-ray findings, chest CT imaging findings of structural lung disease remained negatively associated with utilization ($P = .0001$). Lung utilization rate in the suboptimal and optimal $iPaO_2$ populations was 35.1% and 41.4%, respectively, and CT findings of emphysema had a significant association with nonutilization in both groups.

CT findings of structural lung disease are negatively associated with lung utilization.

Central Message

Chest CT imaging is an important adjunct to conventional lung donor assessment criteria, because findings of structural lung disease (eg, emphysema) have a significant negative association with lung utilization.

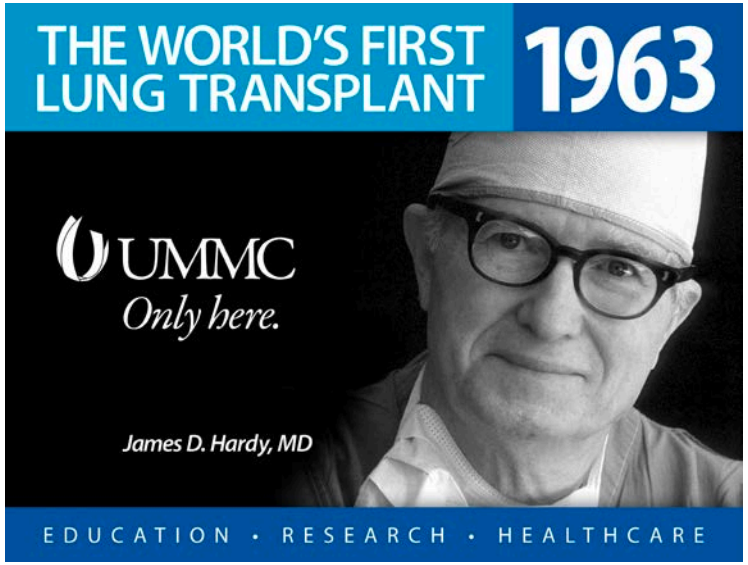
Perspective

Chest CT imaging is being increasingly used for potential lung donor assessment, however, the efficacy of CT in this setting remains unknown. We analyzed the data from 753 potential lung donors to identify determinants of lung utilization.

See Commentary on page XXX.

DCD dárce u Tx plic

James D. Hardy
University of Mississippi Medical Center
1963 – první transplantace plic a první transplantace plic od DCD dárce



Dr. Hardy in a typical OR scene in the old surgery suite.

Lung Homotransplantation in Man

Report of the Initial Case

James D. Hardy, MD; Watts R. Webb, MD; Martin L. Dalton, Jr., MD; George R. Walker, Jr., MD

JAMA. 1963;186(12):1065-1074.

DCD dárce u Tx plic

- Překvapivě – plíce jsou relativně rezistentní k ischemii
- Dobrá tolerance teplé ischemie do 60-90 min
- Metabolické nároky plic jsou relativně malé
  - Plíce jsou vyplněny dobře saturovanou krví
  - Alveoly jsou vyplněny vzduchem s vysokým podílem O2

Egan TM, Lambert CJ Jr, Reddick R, Ulicny KS Jr, Keagy BA, Wilcox BR. A strategy to increase the donor pool: use of cadaver lungs for transplant- ation. Ann Thorac Surg 1991;2:1113–20.

Loehe F, Mueller C, Annecke T, Siebel A, Bittmann I, Messemer KF et al. Pulmonary graft function after long-term preservation of non-heart-beating donor lungs. Ann Thorac Surg 2000;69:1556–62.

Van Raemdonck DE, Jannis NC, De Leyn PR, Flameng WJ, Lerut TE. Warm ischemic tolerance in collapsed pulmonary grafts is limited to 1 hour. Ann Surg 1998;228:788–96.

TRANSPLANT INTERNATIONAL

Transplant International ISSN 0934-0874

REVIEW

DCD lung donation: donor criteria, procedural criteria, pulmonary graft function validation, and preservation

Michiel E. Erasmus,[1] Dirk van Raemdonck,[2] Mohammed Zeeshan Akhtar,[3] Arne Neyrinck,[2] David Gomez de Antonio,[4] Andreas Varela[4] and John Dark[5]

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2 Department of Thoracic Surgery, University Hospitals Leuven, Leuven, Belgium
3 Nuffield Department of Surgical Sciences, Oxford Transplant Centre, University of Oxford, Oxford, UK
4 Thoracic Department, Hospital Universitario Puerta de Hierro Majadahonda, Madrid, Spain
5 Institute of Cellular Medicine, Newcastle University, Newcastle upon Tyne, UK

Keywords
donation after cardiac death, donation after circulatory death, guidelines, lung, nonheart beating donation, review.

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Summary

In an era where there is a shortage of lungs for transplantation is increased utilization of lungs from donation after circulatory death (DCD) donors. We review the reports of 11 controlled and 1 uncontrolled DCD programs focusing on donor criteria, procedural criteria, graft assessment, and preservation techniques including the use of *ex vivo* lung perfusion. We have formulated conclusions and recommendations for each of these areas, which were presented at the 6th International Conference on Organ Donation. A table of recommendations, the grade of recommendations, and references are provided.

Lung Focused Resuscitation at a Specialized Donor Care Facility Improves Lung Procurement Rates

Stephanie H. Chang, MD, Daniel Kreisel, MD, PhD, Gary F. Marklin, MD, Lindsey Cook, BSN, Ramsey Hachem, MD, Benjamin D. Kozower, MD, MPH, Keki R. Balsara, MD, Jennifer M. Bell, BSN, Christine Frederiksen, MS, Bryan F. Meyers, MD, MPH, G. Alexander Patterson, MD, and Varun Puri, MD, MSCI

Division of Cardiothoracic Surgery, Department of Surgery, Washington University School of Medicine in St. Louis, St. Louis; Mid-America Transplant, St. Louis; and Division of Pulmonary Medicine, Department of Medicine, Washington University School of Medicine in St. Louis, St. Louis, Missouri

Background. Lung procurement for transplantation occurs in approximately 20% of brain dead donors and is a major impediment to wider application of lung transplantation. We investigated the effect of lung protective management at a specialized donor care facility on lung procurement rates from brain dead donors.

Methods. Our local organ procurement organization instituted a protocol of lung protective management at a freestanding specialized donor care facility in 2008. Brain dead donors from 2001 to 2007 (early period) were compared with those from 2009 to 2016 (current period) for lung procurement rates and other solid-organ procurement rates using a prospectively maintained database.

Results. An overall increase occurred in the number of brain dead donors during the study period (early group, 791; late group, 1,333; $p < 0.0001$). The lung procurement rate (lung donors/all brain dead donors) improved markedly after the introduction of lung protective management (early group, 157 of 791 [19.8%]; current group, 452 of 1,333 [33.9%]; $p < 0.0001$). The overall organ procurement rate (total number of organs procured/donor) also increased during the study period (early group, 3.5 organs/donor; current group, 3.8 organs/donor; $p = 0.006$).

Conclusions. Lung protective management in brain dead donors at a specialized donor care facility is associated with higher lung utilization rates compared with conventional management. This strategy does not adversely affect the utilization of other organs in a multiorgan donor.

(Ann Thorac Surg 2018;105:1531–6)
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Standalone Facility
Mid-America Transplant
Barnes Jewish Hospital
St.Louis
ICU, 2 OS, katetrizační sál, LAB

Alokace

- Alokace založená na akcentu na léčebný výsledek
- **Lung allocation score (LAS)** zavedené v USA v roce 2005
- Skóre založené na riziku mortality na čekací listině v kombinaci s predikovatelným přežívaním 1 rok po transplantaci pro jednotlivé diagnózy
- Surgeon based decision system
- Pro vytvoření systému je dále nutno vzít v úvahu minimálně:
  - počet transplantací/milion obyvatel
  - poměr využitých orgánu k indentifikovaným potencionálním dárcům
  - mortalita na čekací listině
  - krátkodobé a dlouhodobé přežívaní

OPTN: Organ Procurement a
optn.transplant.hrsa.gov/resources/professionalResources.asp?index=88
Seznam - Najdi ...am, c... Kabelový kanál - kabel... kabelové lišty - Vyhledá... Nová karta Normothermic Ex Vivo ... http://www.slideshare....
Tato stránka je v jazyce angličtina Chcete ji přeložit? Přeložit Ne Možnosti

DOB:*

Height:* ft in cm

Weight:* lbs kg

Lung Diagnosis Code:*

Functional Status:

Diabetes:

Assisted Ventilation:

Requires supplemental O_2:

Amount: L/min %

Percent Predicted FVC: %

Pulmonary Artery Systolic Pressure: mm Hg

Mean Pulmonary Artery Pressure: mm Hg

Pulmonary Capillary Wedge Mean: mm Hg

Current PCO_2: mm Hg

Highest PCO_2: mm Hg

Lowest PCO_2: mm Hg

Change in PCO_2: %

Six minute walk distance: feet

Serum Creatinine: mg/dl

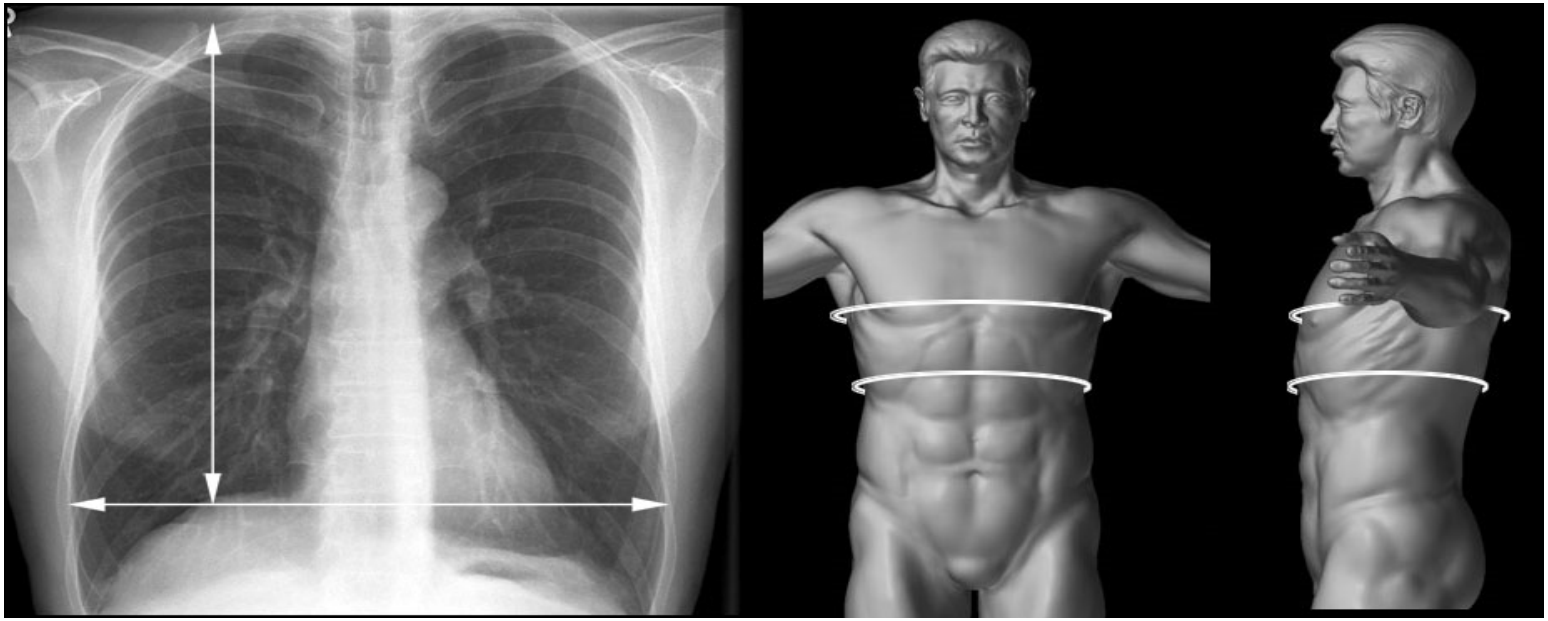
Reset Calculate → **LAS Score**

Start Robert Lischke - ... 4 Google Chr... Chorobopis xViewer E:\ EVLP vědecká ra... brno.ppt 12:57

Kompatibilita dárce a příjemce

Systém ABO

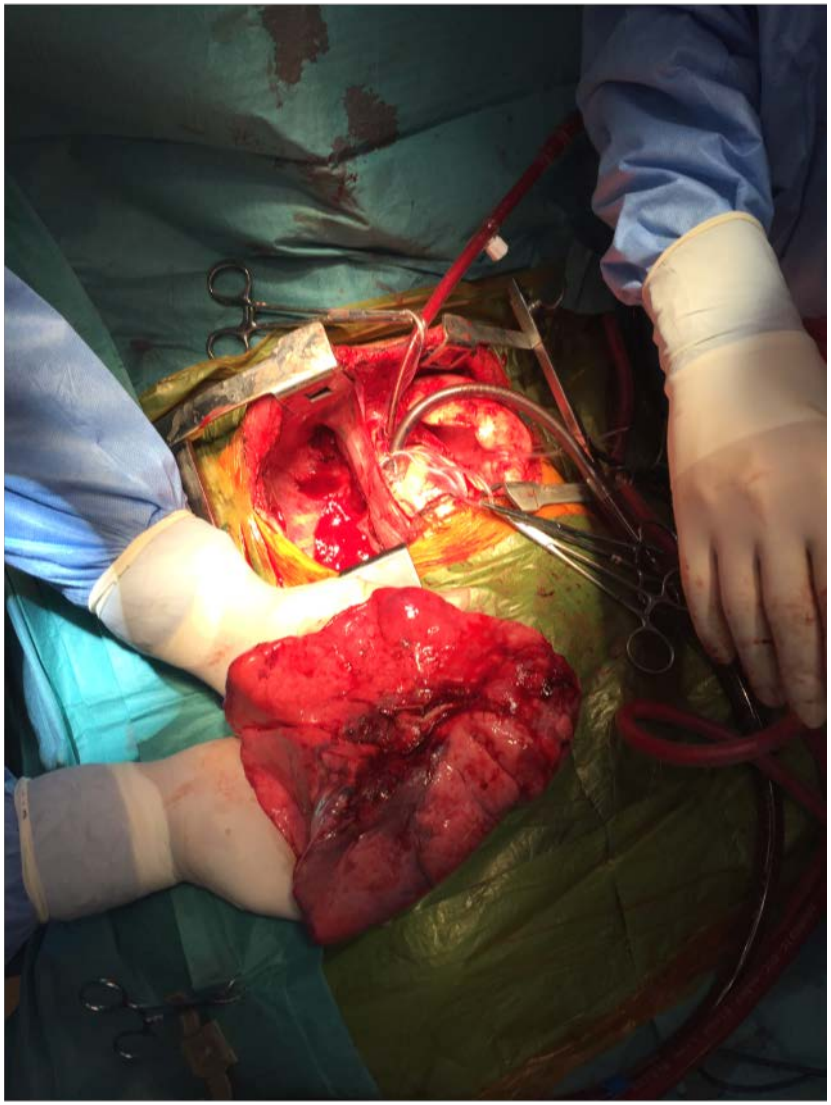
Velikost – porovnání výšky pacienty a velikosti rtg snímků

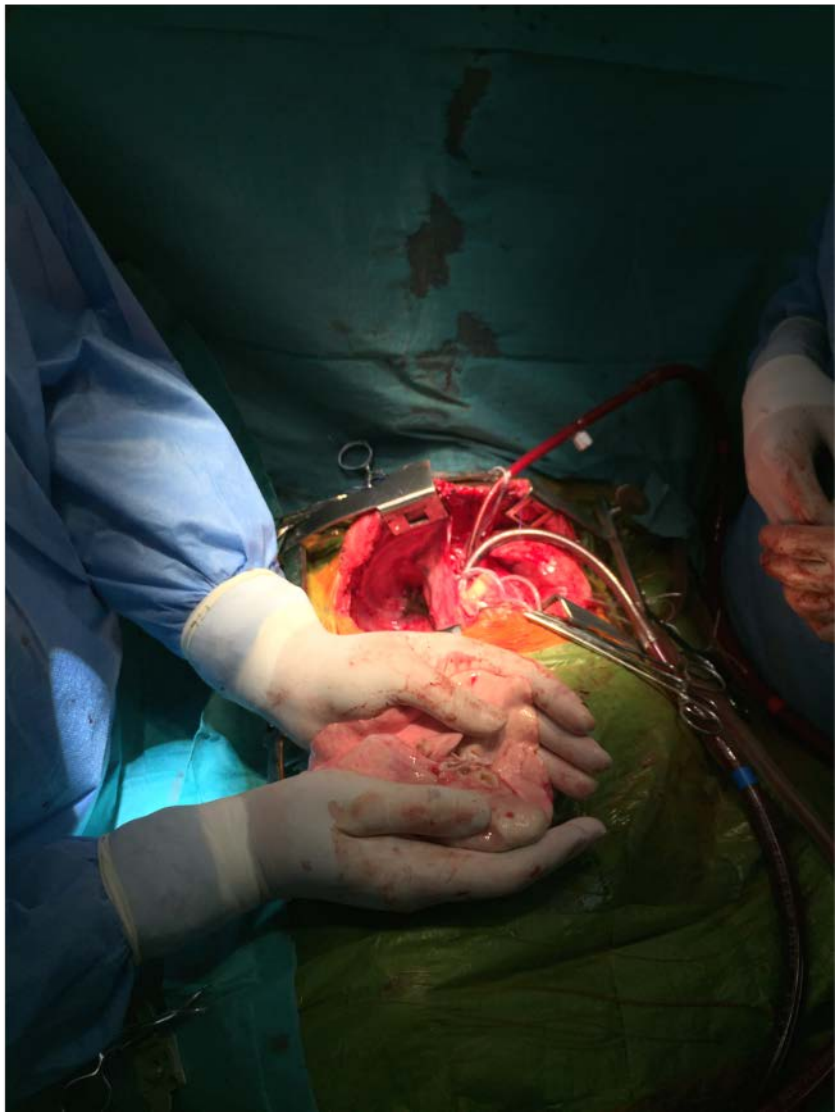


Marginální příjemce pro marginálního dárce ?????

Starý dárce pro starého příjemce ?????

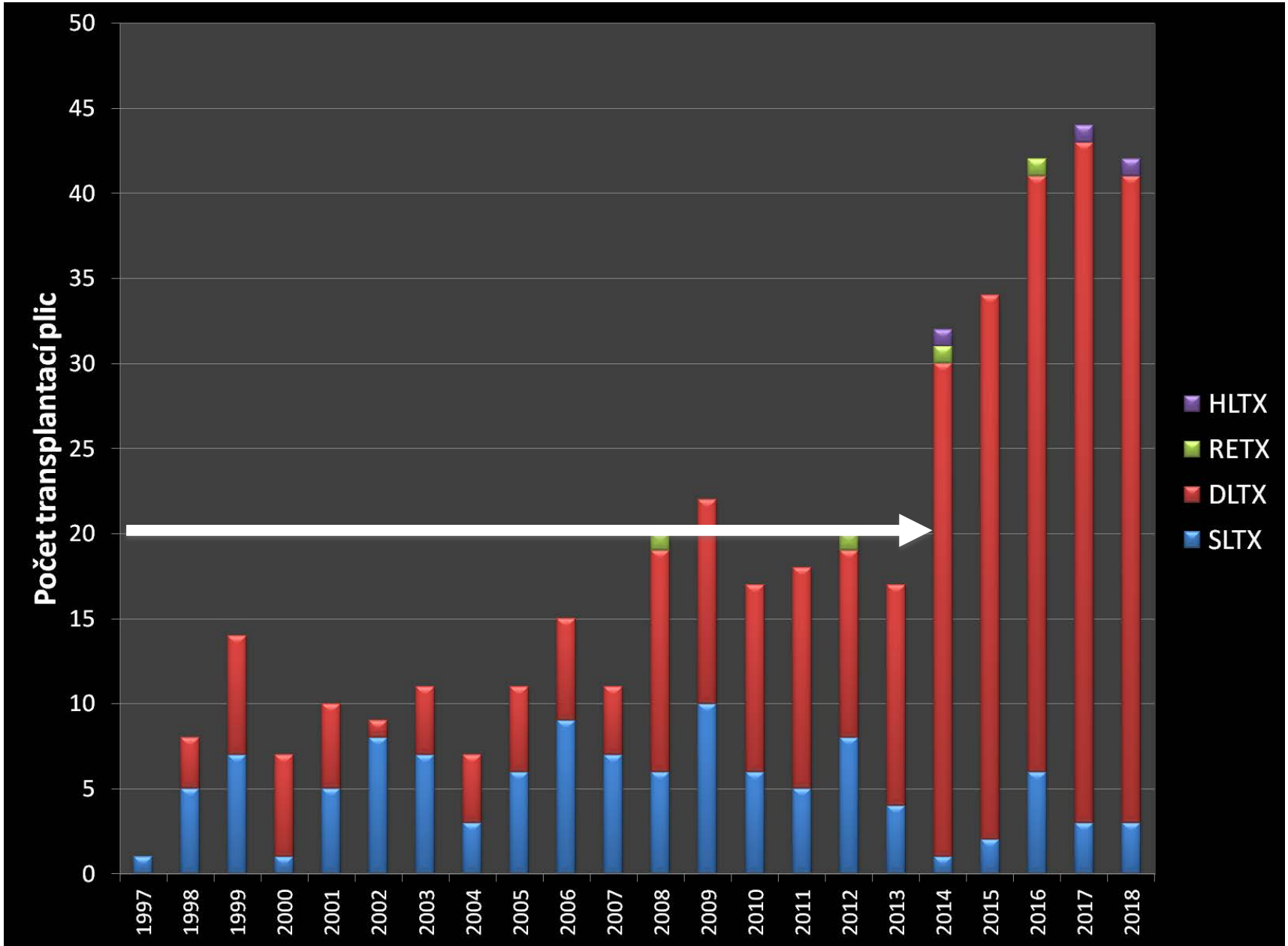
Impact of donors aged 60 years or more on outcome after lung transplantation: Results of an 11-year single center experience, DePerrot et al JTCVS 2007;

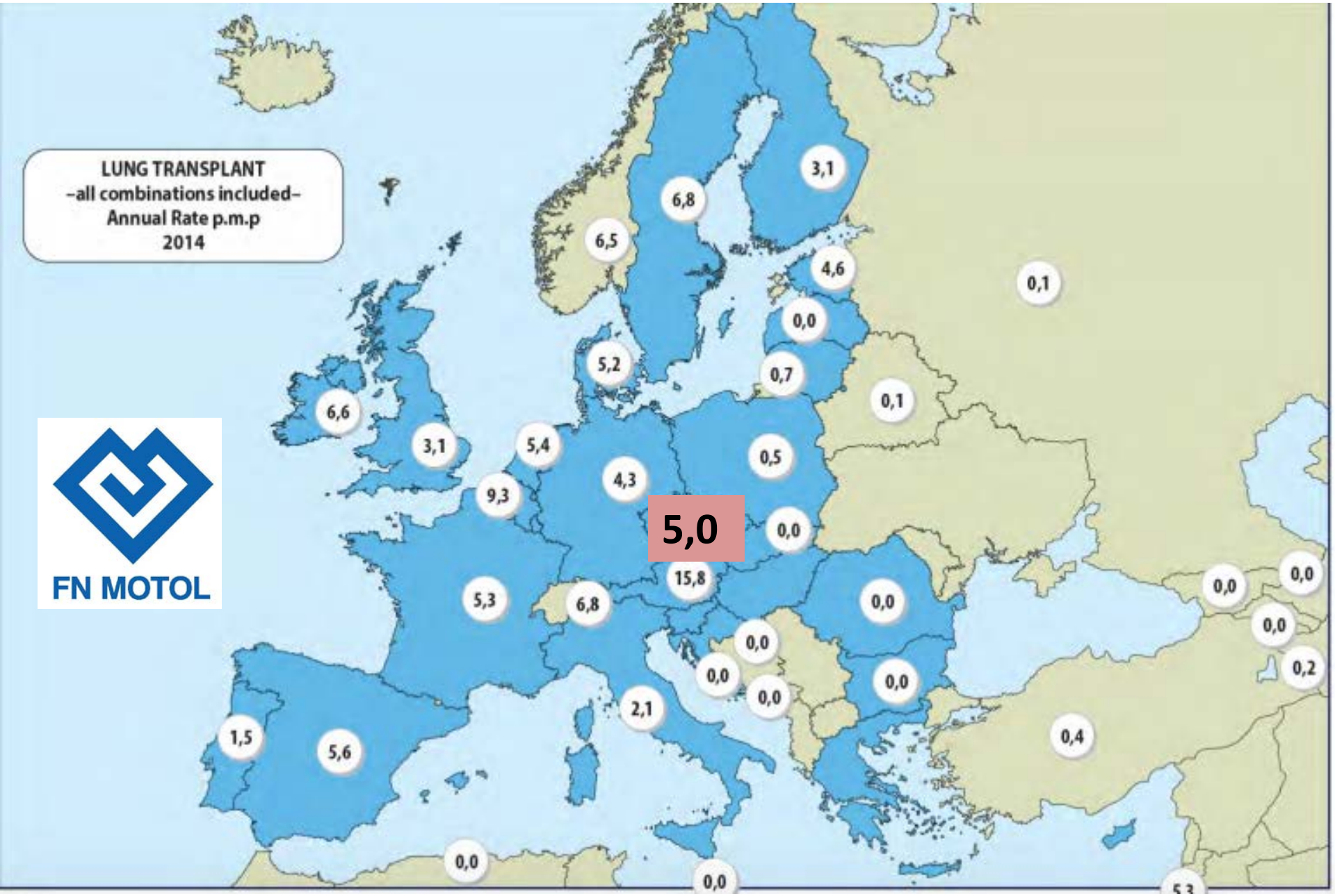




Objem centra

PRAGUE NATIONAL LUNG TRANSPLANT PROGRAM




LUNG TRANSPLANT
-all combinations included-
Annual Rate p.m.p
2014
FN MOTOL
3,1
6,8
6,5
4,6
0,1
0,0
5,2
0,7
0,1
6,6
3,1
5,4
0,5
4,3
9,3
5,0
0,0
15,8
0,0
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5,3
6,8
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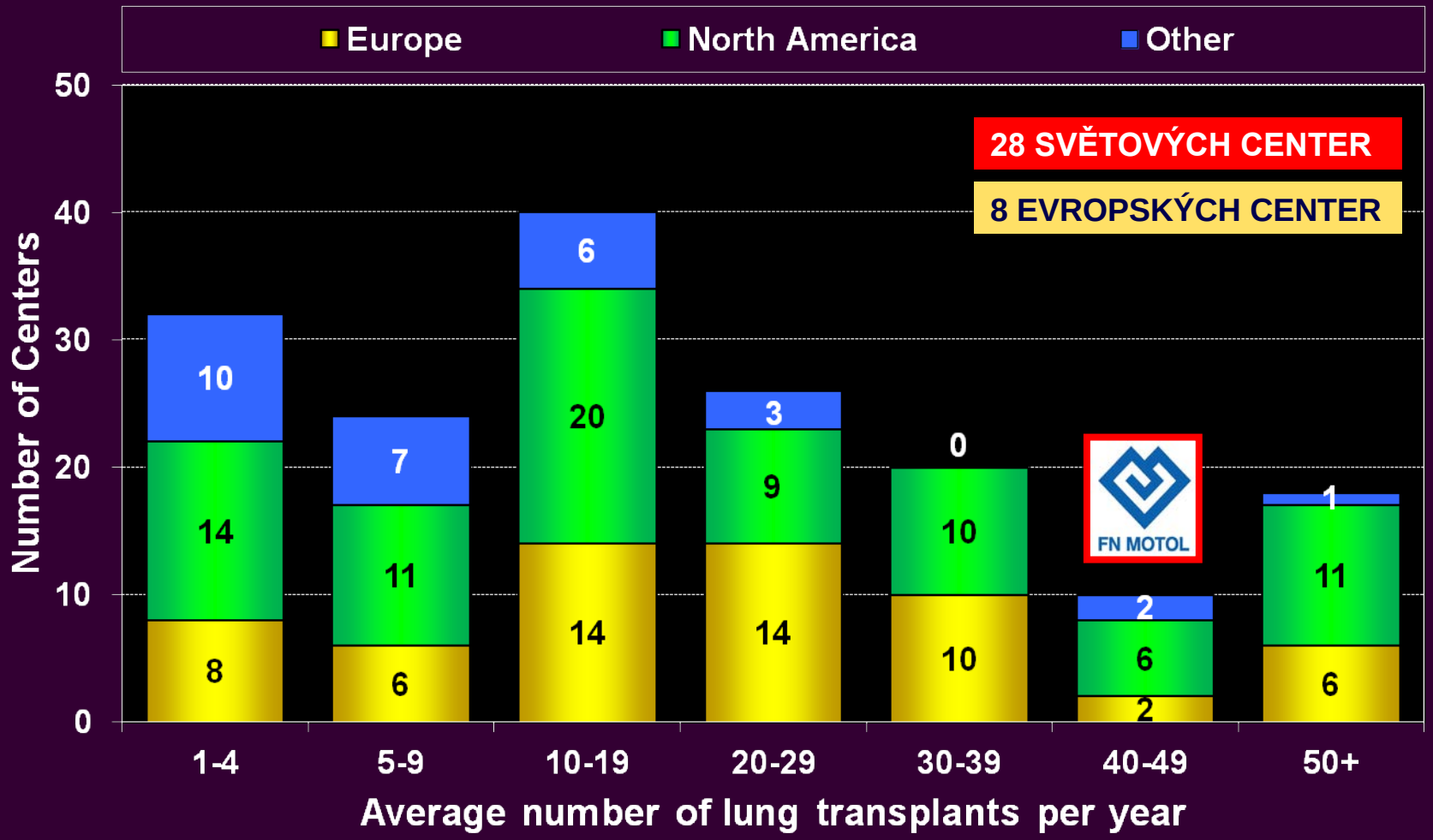
Adult Lung Transplants
Average Center Volume by Location
(Transplants: January 2009 – June 2016)



JHLT. 2017 Oct; 36(10): 1037-1079

LEVA PL

Od ledu k normotermické perfúzi

EDITORIAL COMMENT

Time to think out of the (ice) box

Jacques Pirenne

Abdominal Transplant Surgery, Leuven, Belgium

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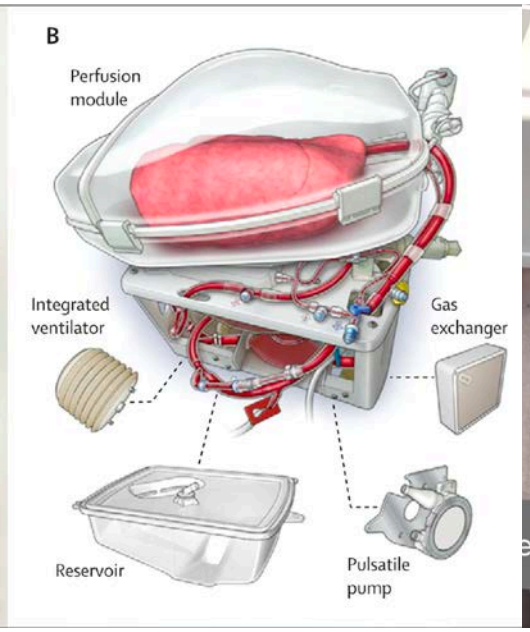
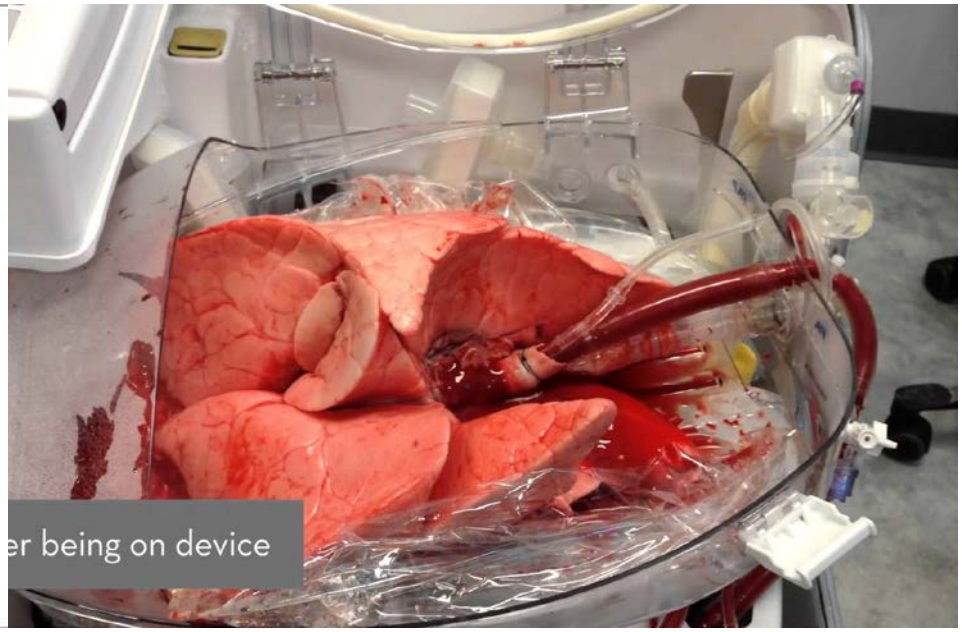
Tel: +32 16 34 87 26; fax: +32 16 34 87 43;
e-mail: jacques.pirenne@uzleuven.be, www.uzleuven.be/txsurgery

Current Opinion in Organ Transplantation 2010, 15:147–149





The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Normothermic Ex Vivo Lung Perfusion in Clinical Lung Transplantation

Marcelo Cypel, M.D., Jonathan C. Yeung, M.D., Mingyao Liu, M.D., Masaki Anraku, M.D., Fengshi Chen, M.D., Ph.D., Wojtek Karolak, M.D., Masaaki Sato, M.D., Ph.D., Jane Laratta, R.N., Sassan Azad, C.R.A., Mindy Madonik, C.C.P., Chung-Wai Chow, M.D., Cecilia Chaparro, M.D., Michael Hutcheon, M.D., Lianne G. Singer, M.D., Arthur S. Slutsky, M.D., Kazuhiro Yasufuku, M.D., Ph.D., Marc de Perrot, M.D., Andrew F. Pierre, M.D., Thomas K. Waddell, M.D., Ph.D., and Shaf Keshavjee, M.D.

Ex vivo perfúze a rekondice plic

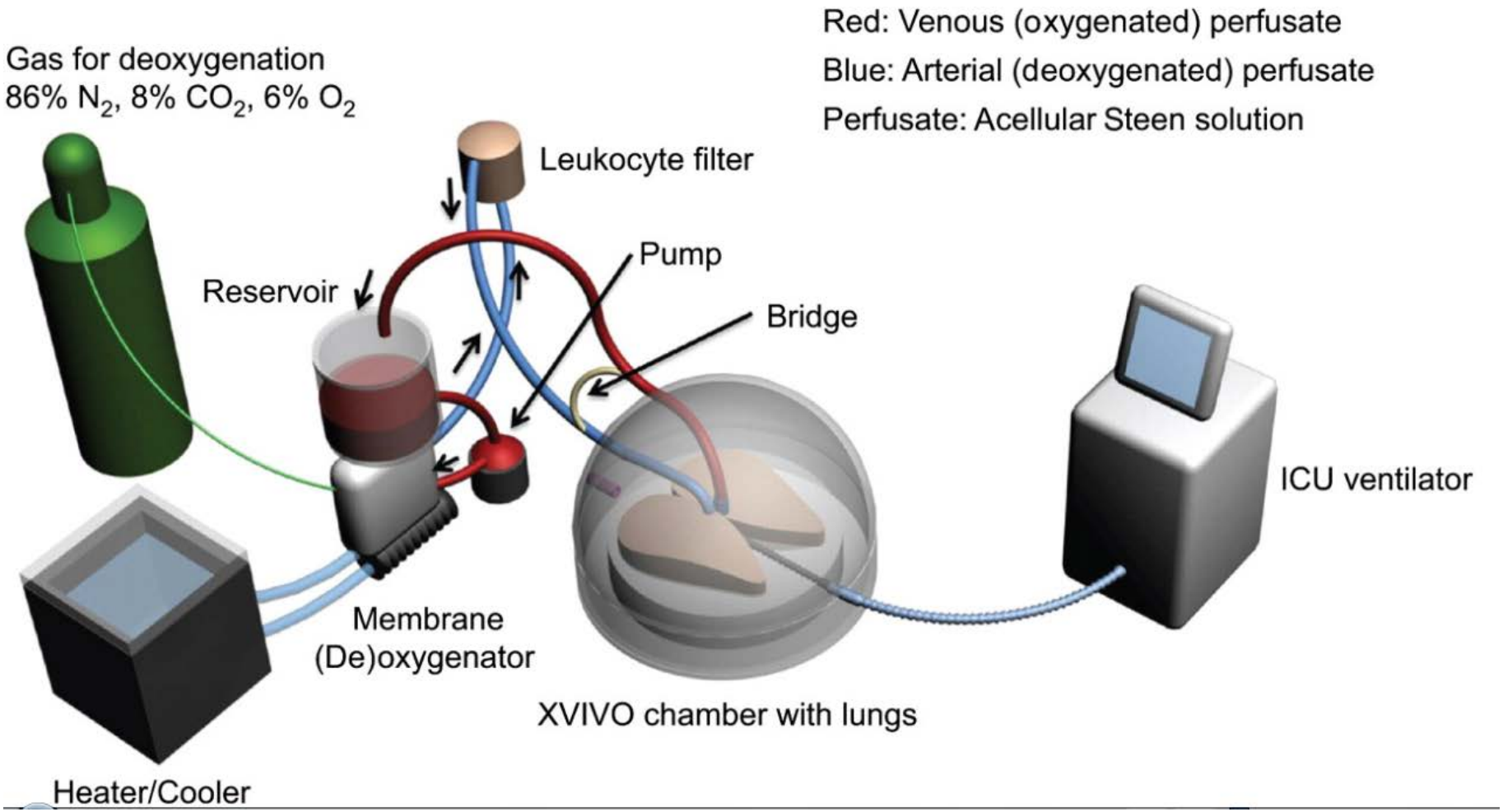
v podmínkách ex vivo
normotermie, kontrolovaná perfúze a ventilace

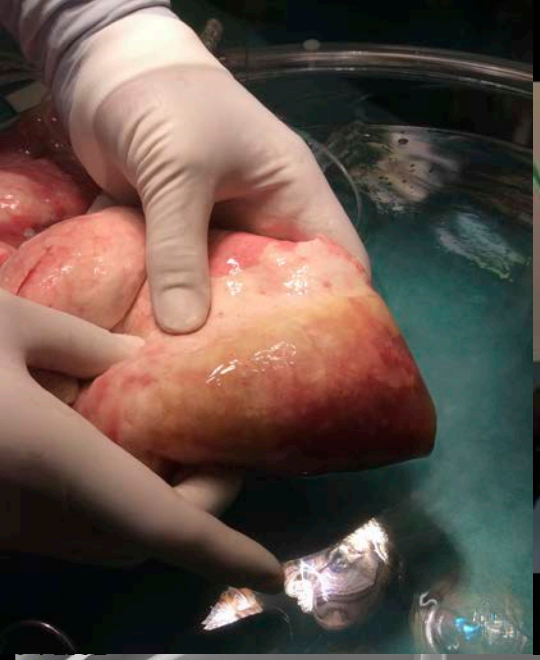
- posoudit funkci orgánu
- funkci orgánu ovlivnit – optimalizace funkce a možnost ex vivo léčby orgánu

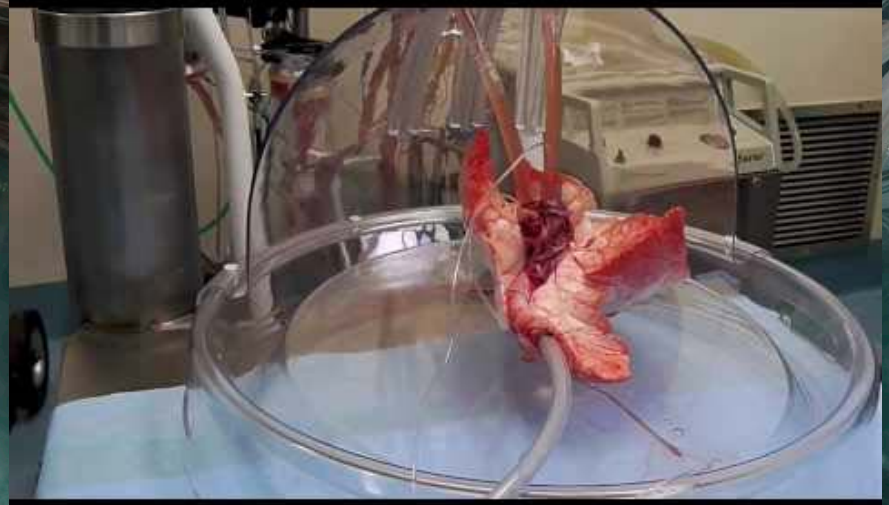
Předpokládaný přínos:

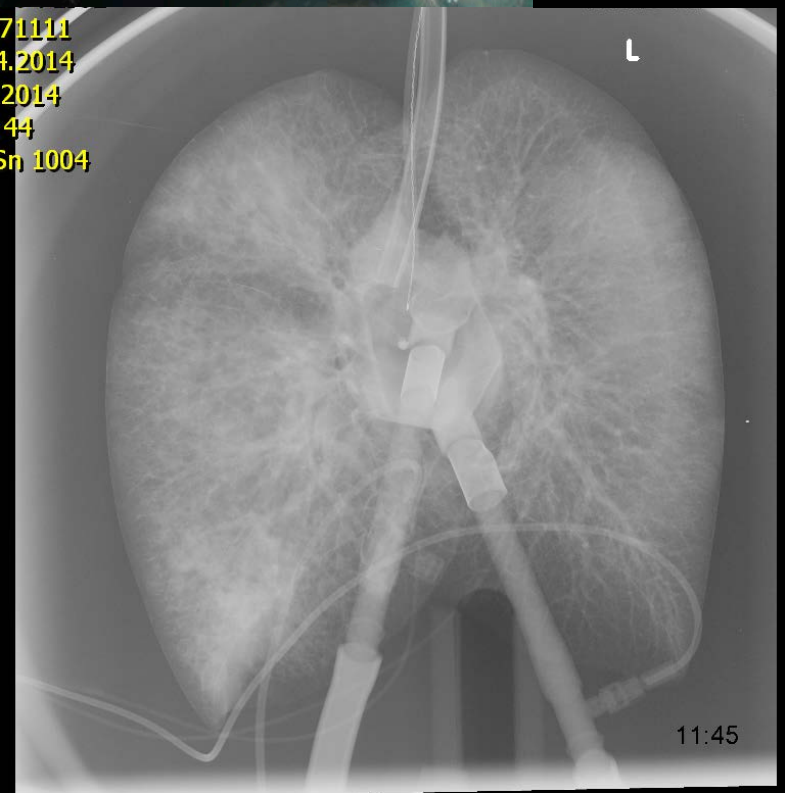
- snížení mortality na čekací listině
- zvýšení nízké prediktibility výsledků transplantace plic

Xvivo Toronto





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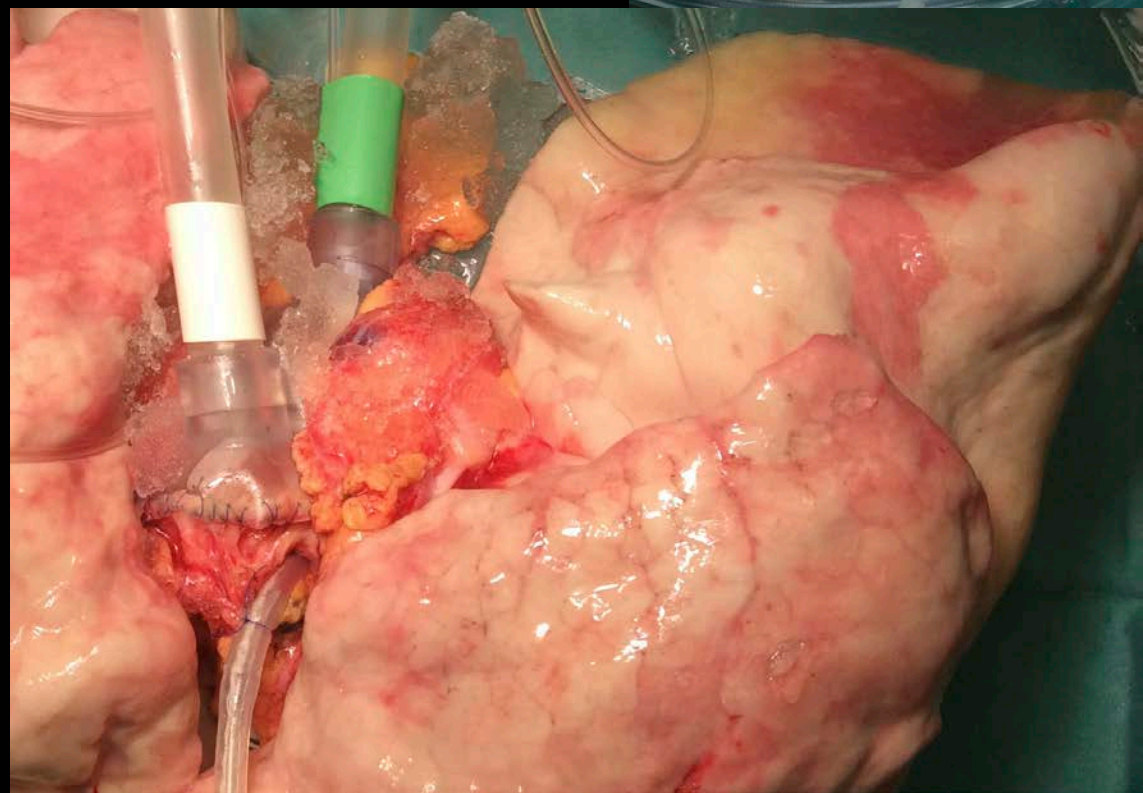

pH
7.06
PCO2
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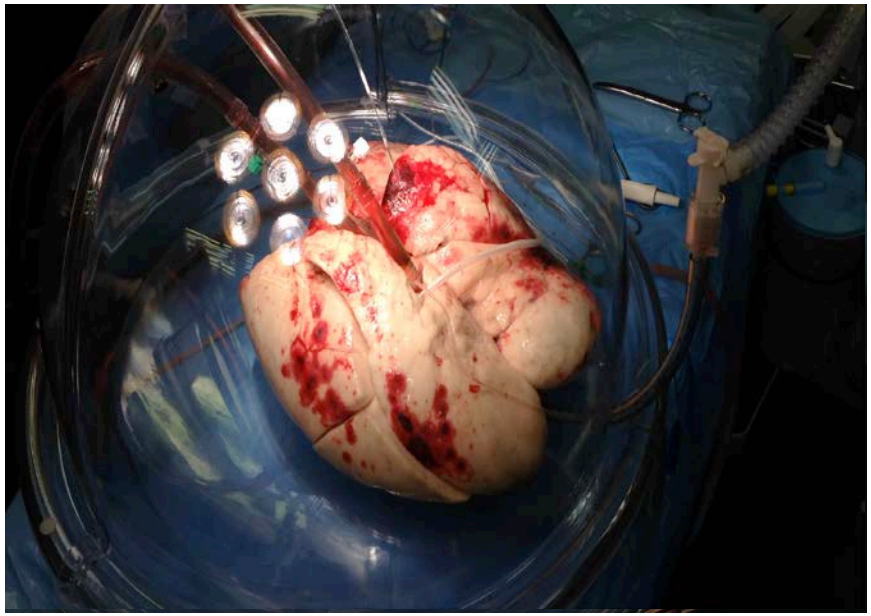
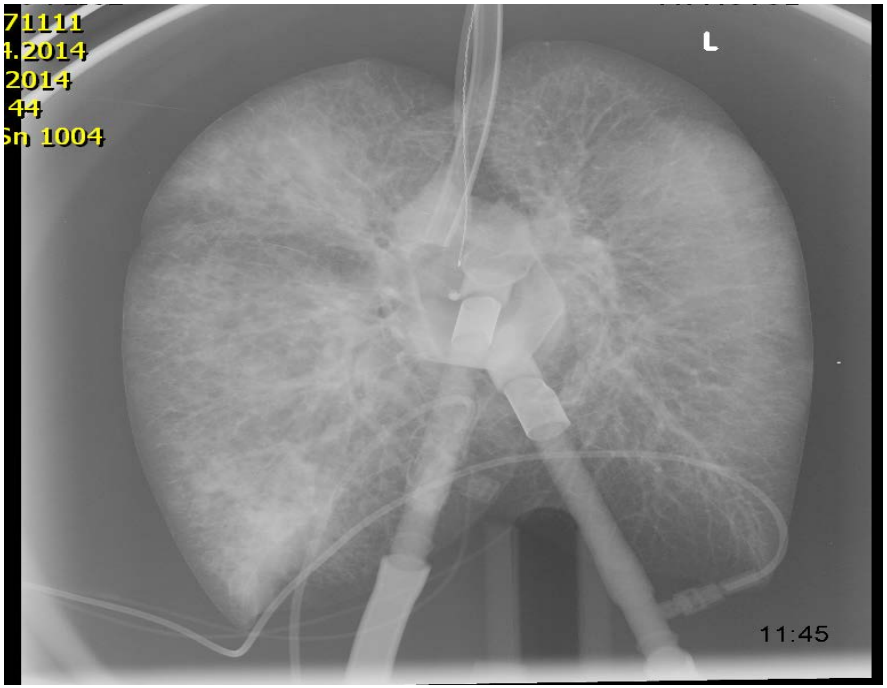
PO2
84
Temp
34.8

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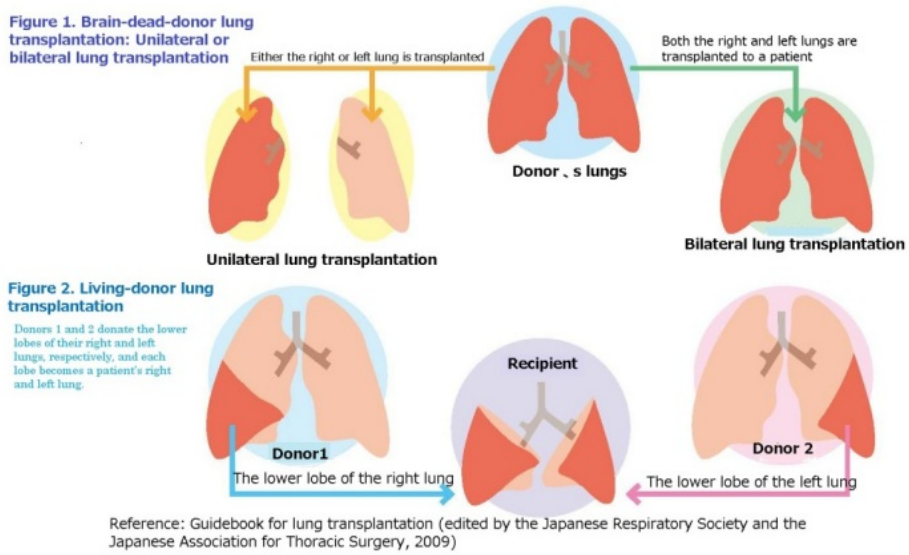
Technika

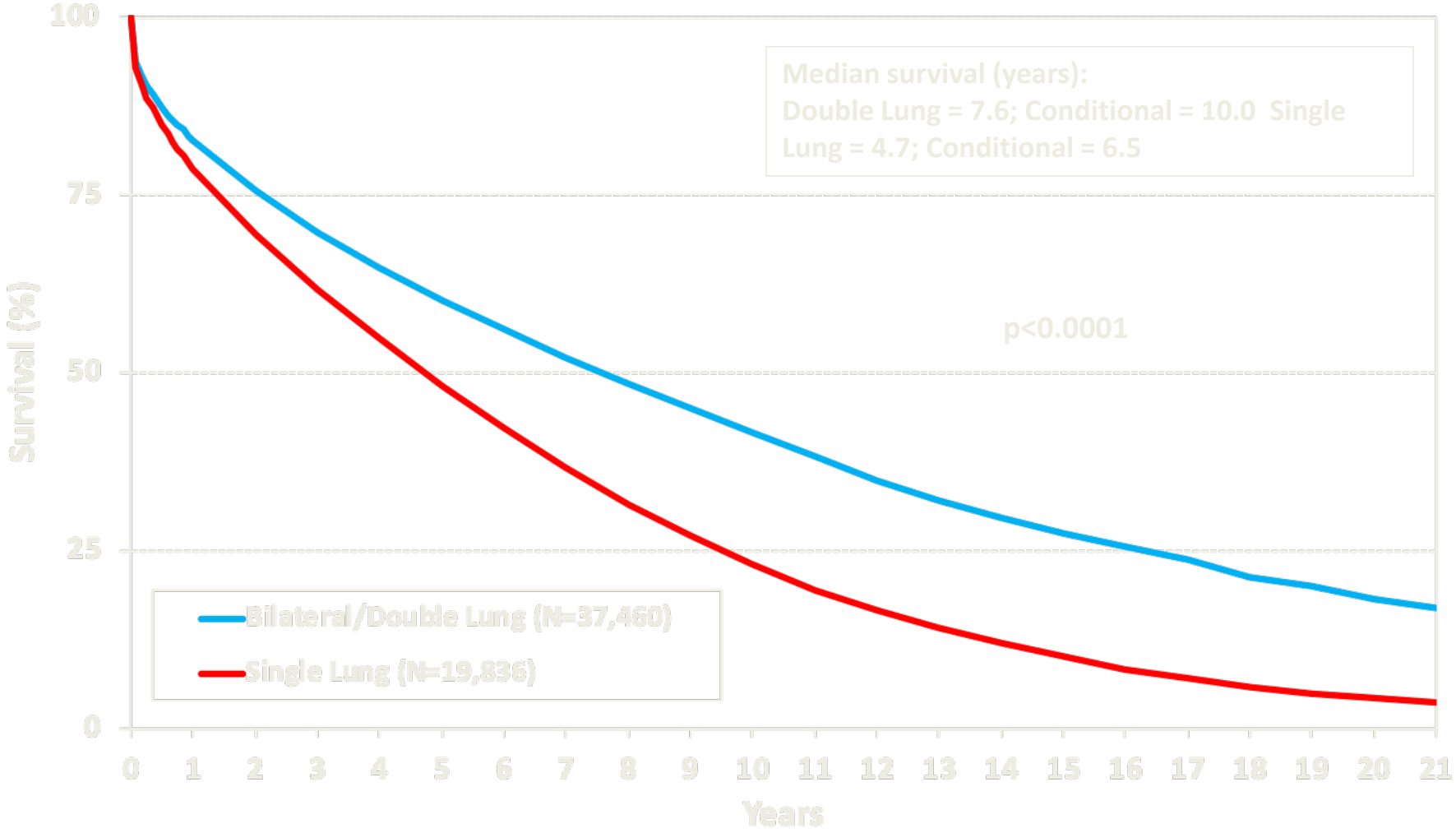
Technika transplantace



- Jednostranná transplatace
- Oboustranná transplantace
- Lobární transplantace
- Lobární transplantace od živých dárců

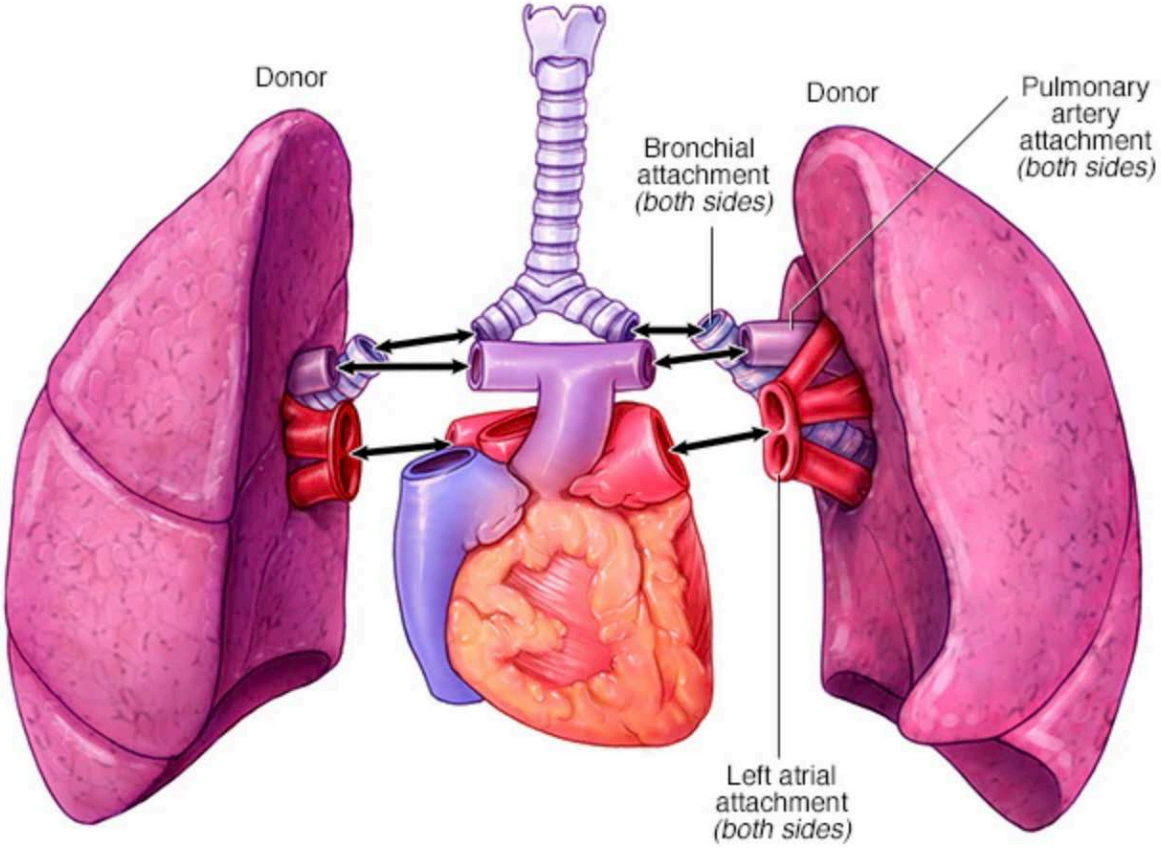
Adult Lung Transplants

Kaplan-Meier Survival by Procedure Type for Primary Transplant Recipients (Transplants: January 1990 – June 2016)



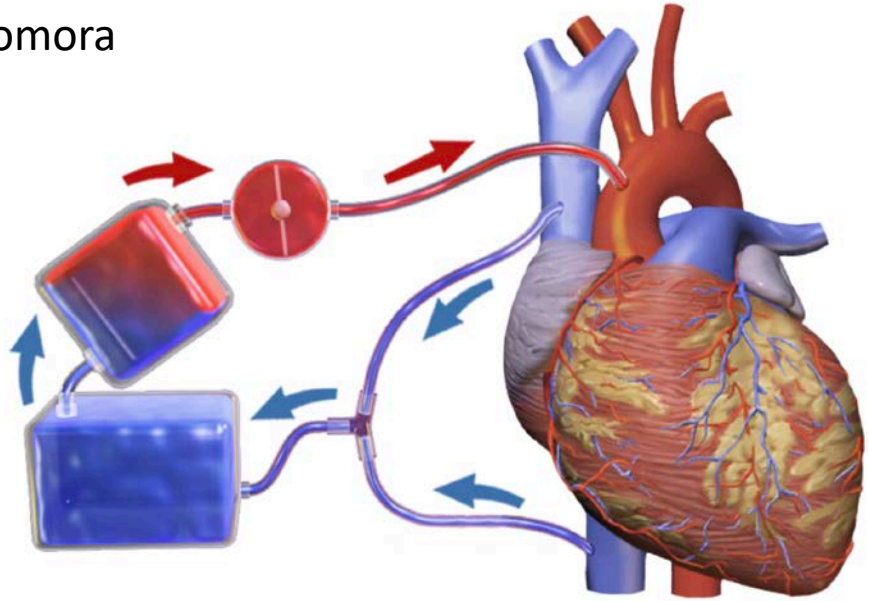
ISHLT • INTERNATIONAL SOCIETY FOR HEART AND LUNG TRANSPLANTATION

Technika transplantace



Mimotělní oběh u Tx plic

- Vysoká plicní hypertenze
- Hypertrofická/dilatovaná pravá komora
- IPAH
- Nemožnost selektivní ventilace



CPB versus ECMO???

ECMO

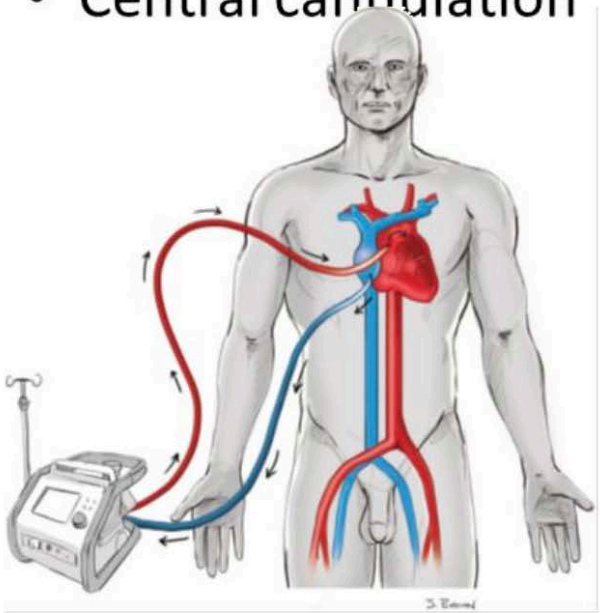
- Heparin 50j/kg
  ACT 160-180s – minimalizace krvácení
- Možnost pokračovat po operaci při dysfunkci štěpu nebo srdce

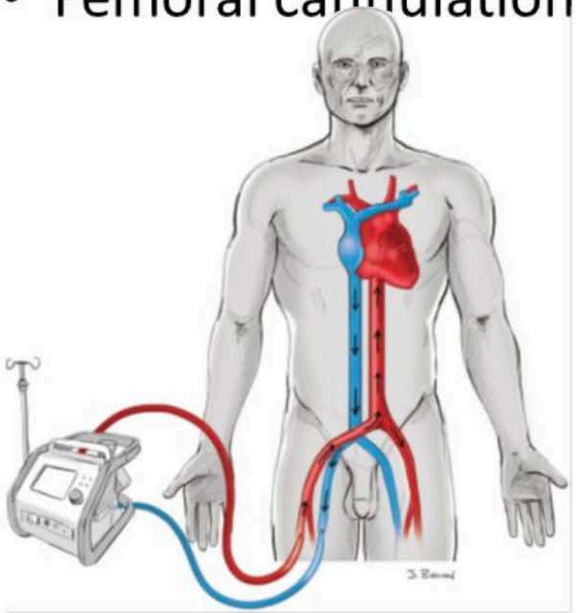
ECMO

ECMO - kanylace u Tx plic

V-A ECMO Cannulation Options

- Central cannulation
- Femoral cannulation



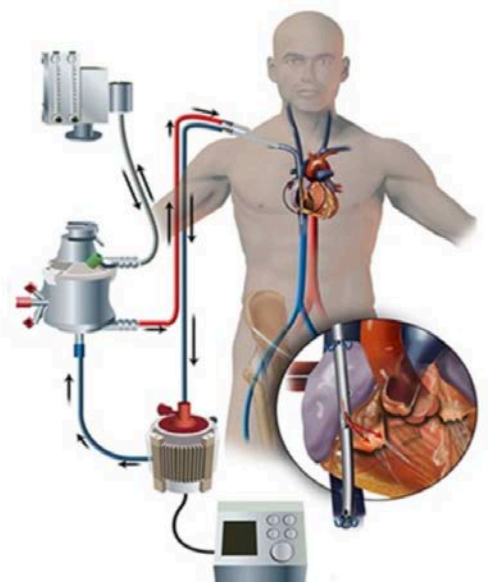


Problem with ***peripheral*** VA ECMO:

- Lower body receives better perfusion
  - Possible poor perfusion of coronary and cerebral vessels
- Oxygenated blood returned to aorta so lungs get little O_2 rich blood -> may exacerbate lung ischemia

ECMO u Tx plic

- předoperační ECMO - bridging to Tx
- peroperační ECMO
- pooperační ECMO
  - plánovaně
  - akutně (PGD)
- VA ECMO, VV ECMO, VAV ECMO
- centrální x periferní kanylace



ECMO u Tx plic

- předoperační ECMO - bridging to Tx
- peroperační ECMO
- pooperační ECMO
  - plánovaně
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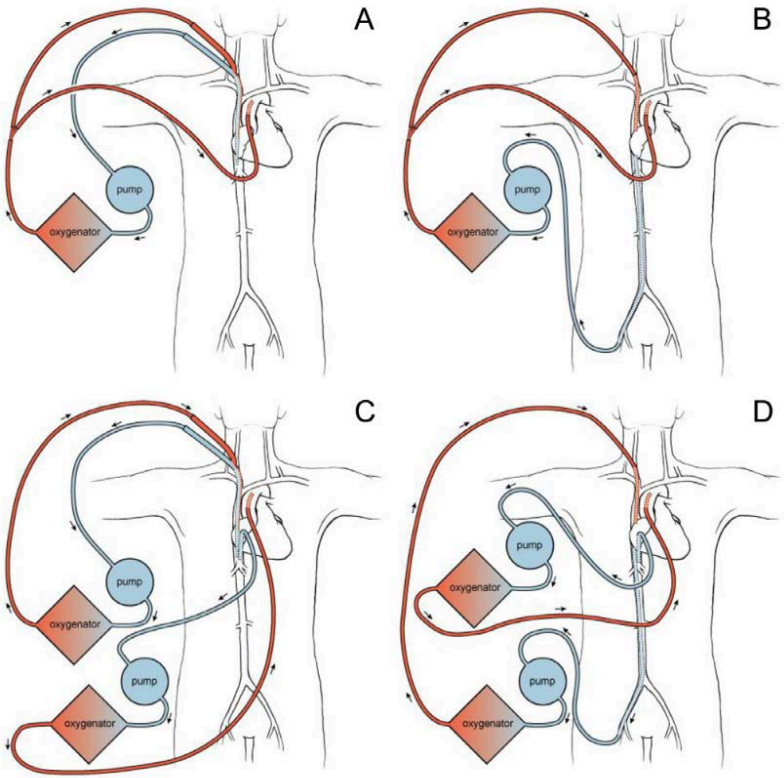
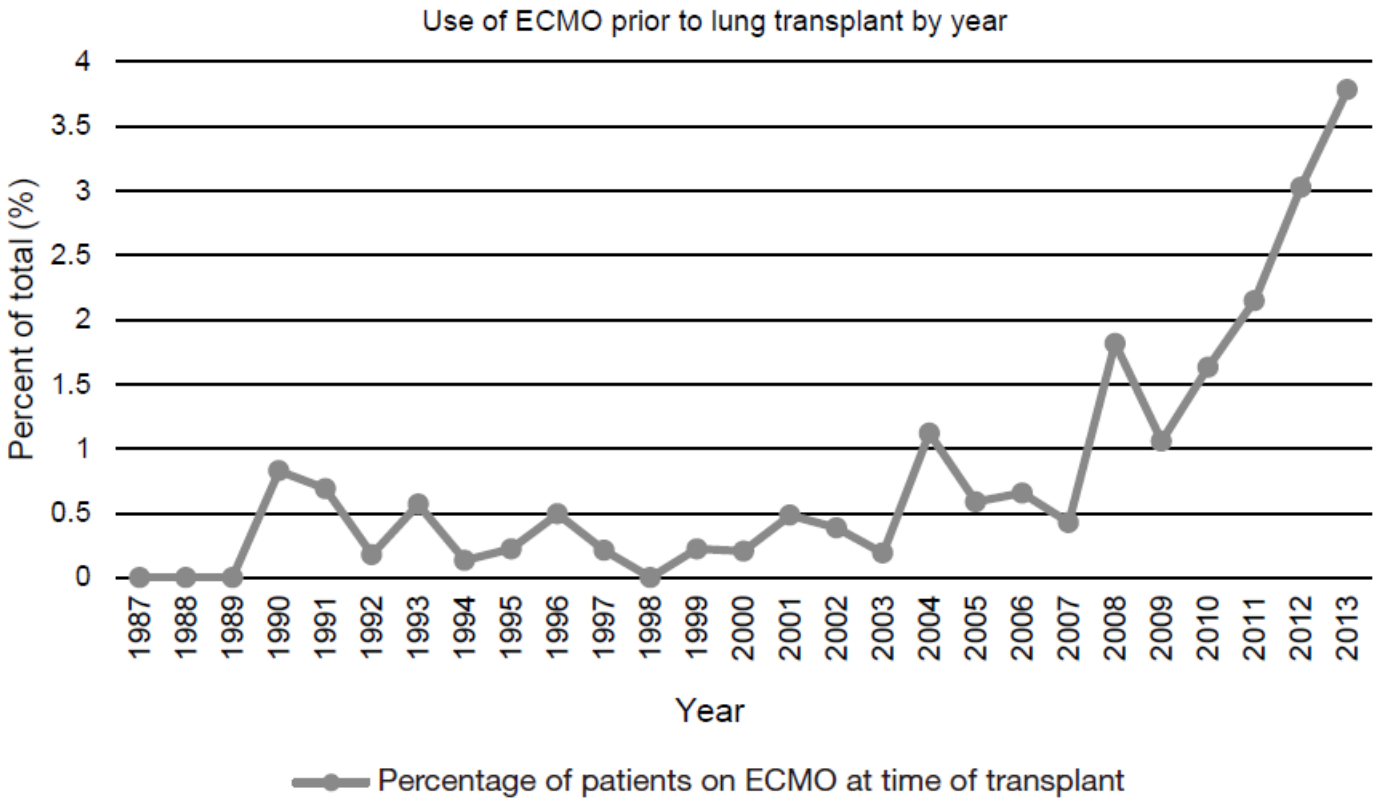
- VA ECMO, VV ECMO, VAV ECMO
- centrální x periferní kanylace



ECMO u Tx plic - bridge



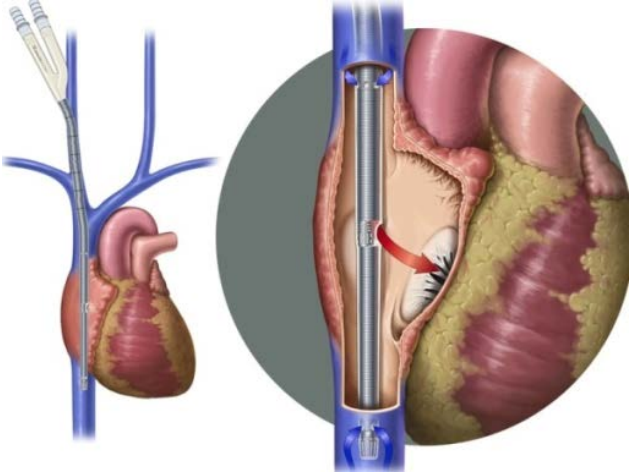
Journal of Thoracic Disease, 2014

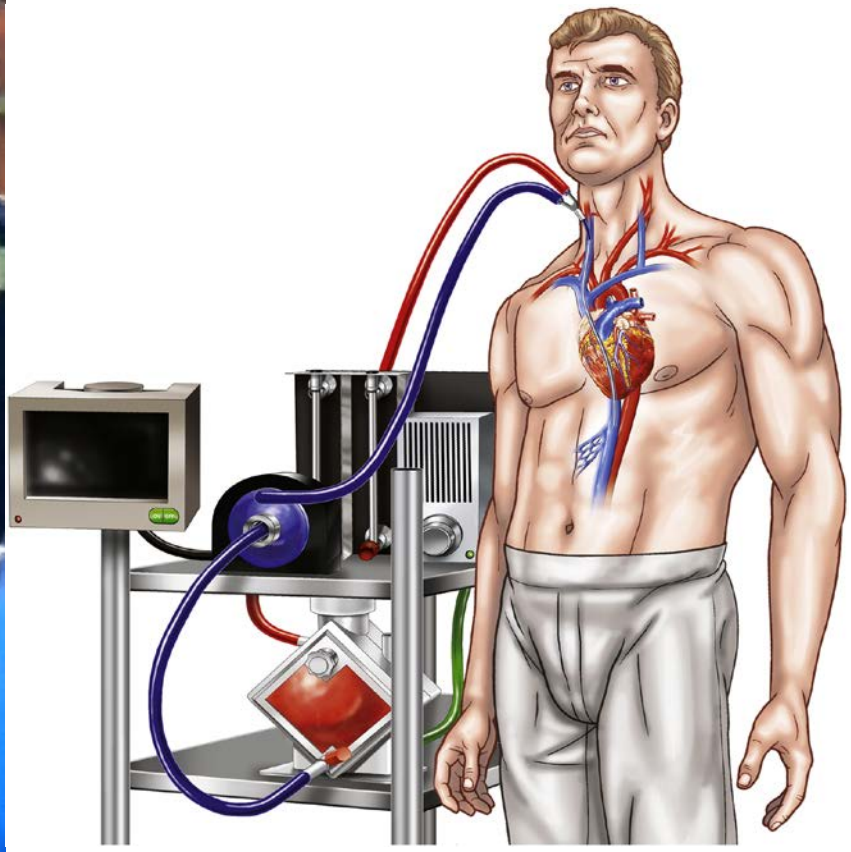
Extracorporeal Membrane Oxygenation in Awake Patients as Bridge to Lung Transplantation

Thomas Fuehner[1], Christian Kuehn[2], Johannes Hadem[3], Olaf Wiesner[1], Jens Gottlieb[1], Igor Tudorache[2], Karen M. Olsson[1], Mark Greer[1], Wiebke Sommer[2], Tobias Welte[1], Axel Haverich[2], Marius M. Hoeper[1], and Gregor Warnecke[2]

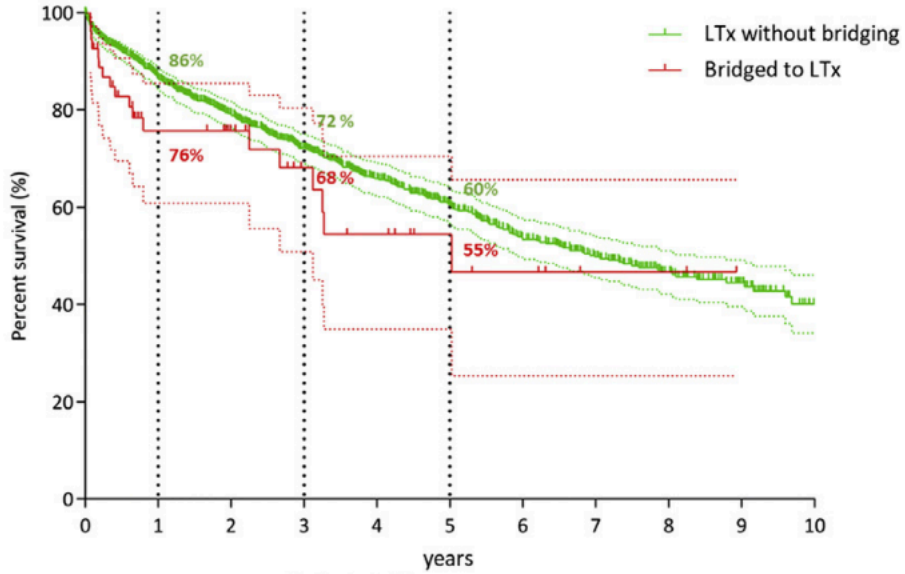
[1]Department of Respiratory Medicine, [2]Department of Cardiothoracic, Transplant and Vascular Surgery, and [3]Department of Gastroenterology, Hepatology and Endocrinology, Hannover Medical School, Hannover, Germany

Rationale: The use of extracorporeal membrane oxygenation (ECMO) in patients who are awake and spontaneously breathing may represent a novel bridging strategy toward lung transplantation (LuTx).
Objectives: To evaluate the outcomes of patients treated with the "awake ECMO" concept as bridge to transplantation.
Methods: We performed a retrospective, single-center, intention-to-treat analysis of consecutive LuTx candidates with terminal respiratory or cardiopulmonary failure receiving awake ECMO support. The outcomes were compared with a historical control group of patients treated with conventional mechanical ventilation (MV group) as bridge to transplant.
Measurements and Main Results: Twenty-six patients (58% female; median age, 44 yr; range, 23–62) were included in the awake ECMO group and 34 patients (59% female; median age, 36 yr; range, 18–59) in the MV group. The duration of ECMO support or MV, respectively, was comparable in both groups (awake ECMO: median, 9 d; range, 1–45. MV: median, 15 d; range, 1–71; $P = 0.25$). Six (23%) of 26 patients in the awake ECMO group and 10 (29%) of 34 patients in the MV group died before a donor organ was available ($P = 0.20$). Survival at 6 months after LuTx was 80% in the awake ECMO group versus 50% in the MV group ($P = 0.02$). Patients in the awake ECMO group required shorter postoperative MV ($P = 0.04$) and showed a trend toward a shorter postoperative hospital stay ($P = 0.06$).
Conclusions: ECMO support in patients who are awake and nonintubated represents a promising bridging strategy, which should be further evaluated to determine its role in patients with end-stage lung disease awaiting LuTx.





Toronto Lung Transplant Program
2006-2016 1111 Tx
71/63 bridge



Patients at risk

LTx without bridging	1007	775	612	489	371	279	200	152	98	58	20
Bridged to LTx	54	28	23	15	11	7	5	2	2	0	0

A

J Thorac Cardiovasc Surg 2017

Kontraindikace k „bridging to Tx“

Table 1 Contraindications (both absolute and relative) to bridging to lung transplant with ECMO (9,10,37,39,40)
Absolute contraindication
Untreated infection
Organ failure (other than pulmonary)
Recent malignancy
Active substance abuse
Poor social support system
History of nonadherence
Relative contraindication
Advancing age
Small institutional experience
Poor pre-ECMO functional status
Severe obesity (BMI >30)

Journal of Thoracic Disease, 2014

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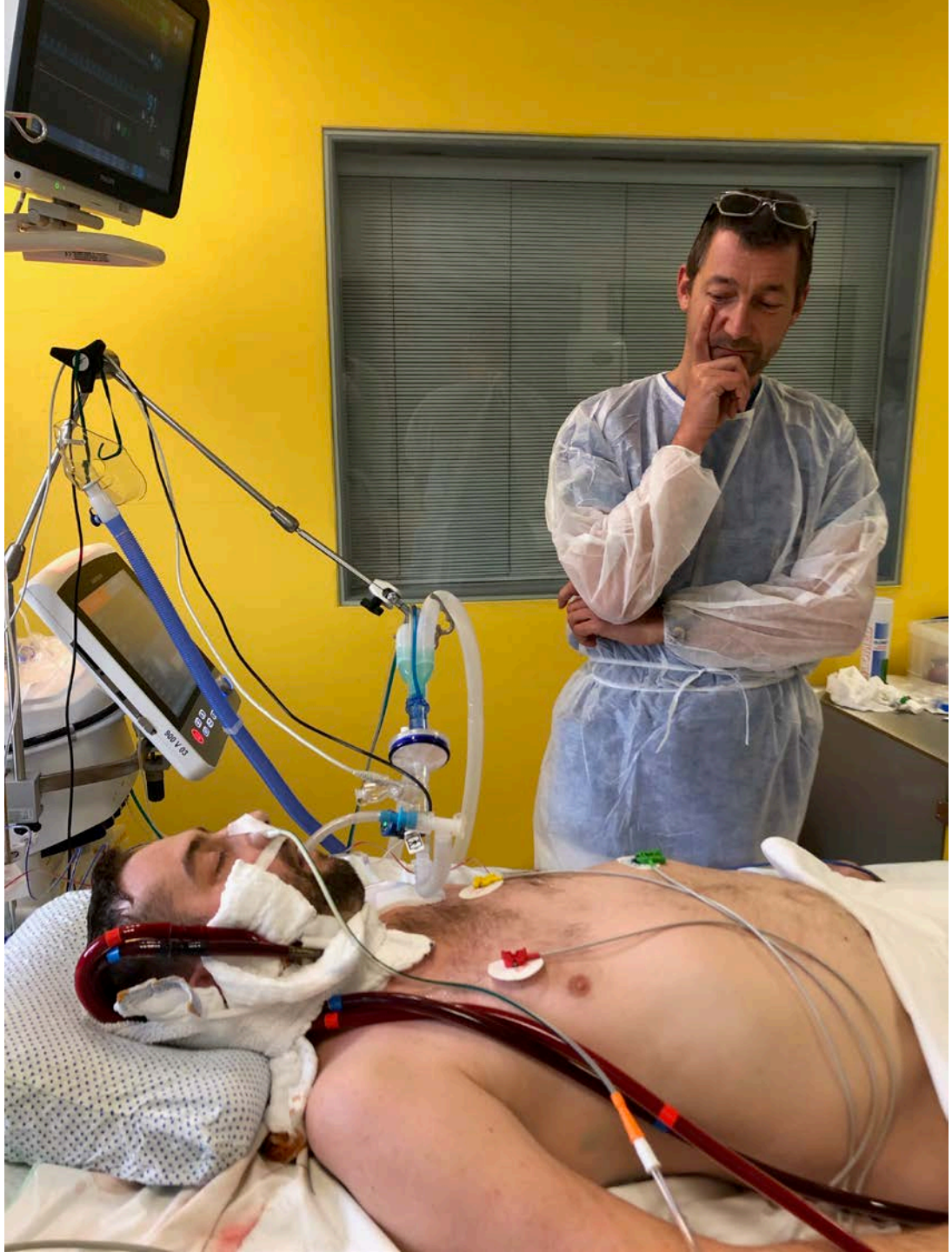


PHILIPS

“Bridging to Tx” ČR– vysoká urgence

- Při zařazení pacienta nutno rozhodnout, zda bude indikován k “Bridge to Tx” nebo ne
  - věk, frailty, komorbidity atd.

- Zhoršení stavu
  - Ventilátor/ECMO
- Překlad do transplantačního centra FN Motol
  - Možnost každodenního vyhodnocování transplantability

- Urgentní transplantace x vyřazení z čekací listiny

Adult-Heart Lung Transplants

Cause of Death (Deaths: January 1992 – June 2016)

CAUSE OF DEATH	0-30 Days (N=472)	31 Days - 1 Year (N=360)	>1 Year - 3 Years (N=294)	>3 Years - 5 Years (N=175)	>5 Years (N=535)
OB/BOS	0	14 (3.9%)	69 (23.5%)	38 (21.7%)	110 (20.6%)
ACUTE REJECTION	7 (1.5%)	6 (1.7%)	5 (1.7%)	1 (0.6%)	3 (0.6%)
LYMPHOMA	0	7 (1.9%)	12 (4.1%)	8 (4.6%)	11 (2.1%)
MALIGNANCY, OTHER	1 (0.2%)	8 (2.2%)	13 (4.4%)	7 (4.0%)	43 (8.0%)
CMV	0	2 (0.6%)	2 (0.7%)	1 (0.6%)	1 (0.2%)
INFECTION, NON-CMV	80 (16.9%)	126 (35.0%)	84 (28.6%)	45 (25.7%)	115 (21.5%)
GRAFT FAILURE	127 (26.9%)	76 (21.1%)	44 (15.0%)	32 (18.3%)	78 (14.6%)
CARDIOVASCULAR	39 (8.3%)	15 (4.2%)	22 (7.5%)	18 (10.3%)	53 (9.9%)
TECHNICAL	110 (23.3%)	12 (3.3%)	3 (1.0%)	3 (1.7%)	7 (1.3%)
MULTIPLE ORGAN FAILURE	51 (10.8%)	54 (15.0%)	15 (5.1%)	7 (4.0%)	36 (6.7%)
OTHER	57 (12.1%)	40 (11.1%)	25 (8.5%)	15 (8.6%)	78 (14.6%)

Early Institution of Extracorporeal Membrane Oxygenation for Primary Graft Dysfunction After Lung Transplantation Improves Outcome

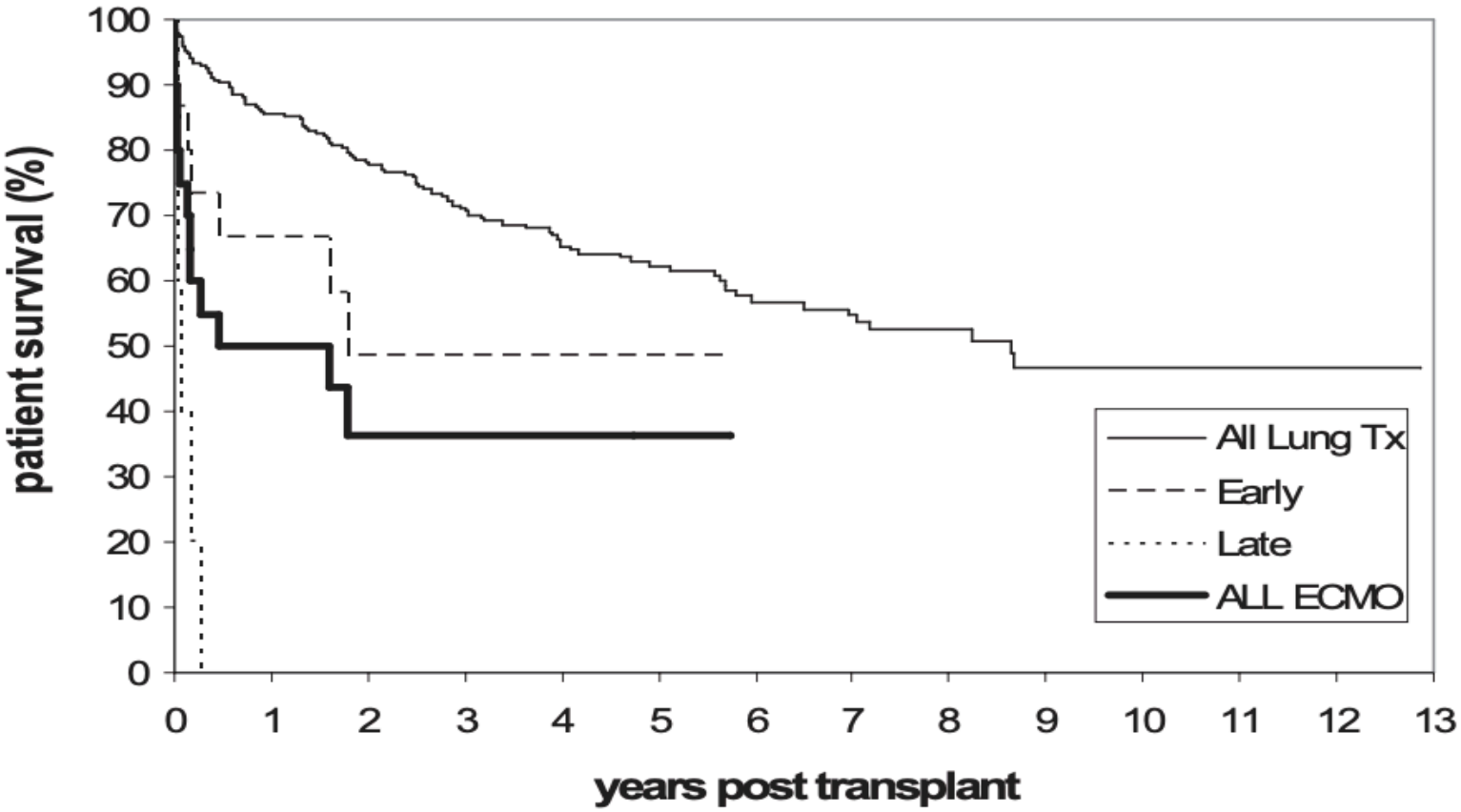
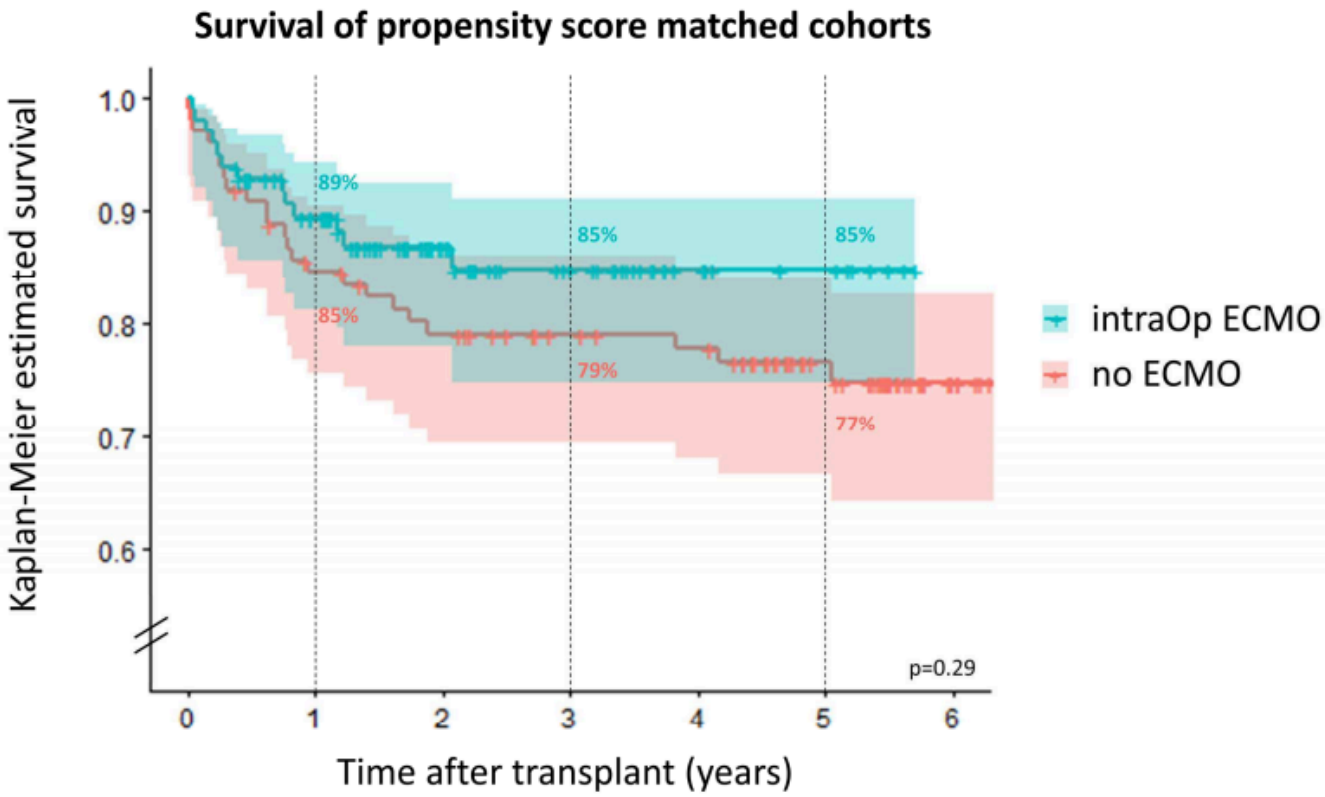


Figure 1. Kaplan–Meier survival curves. Extracorporeal membrane oxygenation support cohorts after lung transplantation with severe PGD compared with all lung transplant recipients without severe PGD.

Intraoperative ECMO and the possibility of postoperative prolongation improve survival in bilateral lung transplantation

Figure 4



J Thorac Cardiovasc Surg. 2018 May

Lung Transplantation for Severe Pulmonary Hypertension—Awake Extracorporeal Membrane Oxygenation for Postoperative Left Ventricular Remodelling

Tudorache, Igor[1]; Sommer, Wiebke[1]; Kühn, Christian[1]; Wiesner, Olaf[2]; Hadem, Johannes[3]; Fühner, Thomas[2]; Ius, Fabio[1]; Avsar, Murat[1]; Schwerk, Nicolaus[4]; Böthig, Dietmar[1]; Gottlieb, Jens[2,5]; Welte, Tobias[2,5]; Bara, Christoph[1]; Haverich, Axel[1,5]; Hoeper, Marius M.[2,5]; Warnecke, Gregor[1,5]

Transplantation: February 2015 - Volume 99 - Issue 2 - p 451–458
doi: 10.1097/TP.0000000000000348
Original Clinical Science

FREE

Abstract | In Brief | Author Information | Article Outline | Article Metrics

Background Bilateral lung transplantation (BLTx) is an established treatment for end-stage pulmonary hypertension (PH). Ventilator weaning failure and death are more common as in BLTx for other indications. We hypothesized that left ventricular (LV) dysfunction is the main cause of early postoperative morbidity or mortality and investigated a weaning strategy using awake venoarterial extracorporeal membrane oxygenation (ECMO).

Methods In 23 BLTx for severe PH, ECMO used during BLTx was continued for a minimum of 5 days (BLTx-ECMO group). Echocardiography, left atrial (LA) and Swan-Ganz catheters were used for monitoring. Early extubation after transplantation was attempted under continued ECMO.

Results Preoperatively, all patients had severely reduced cardiac index (mean, 2.1 L/min/m^2). On postoperative day 2, reduction of ECMO flow resulted in increasing LA and decreasing systemic blood pressures. On the day of ECMO explantation (median, postoperative day 8), LV diameter had increased; LA and blood pressures remained stable. Survival rates at 3 and 12 months were 100% and 96%, respectively. Data were compared to two historic control groups of BLTx without ECMO (BLTx ventilation) or combined heart-lung transplantation for severe PH.

Conclusion Early after BLTx for severe PH, the LV may be unable to handle normalized LV preload. This can be effectively bridged with awake venoarterial ECMO.

Lung Transplantation for Severe Pulmonary Hypertension—Awake Extracorporeal Membrane Oxygenation for Postoperative Left Ventricular Remodelling

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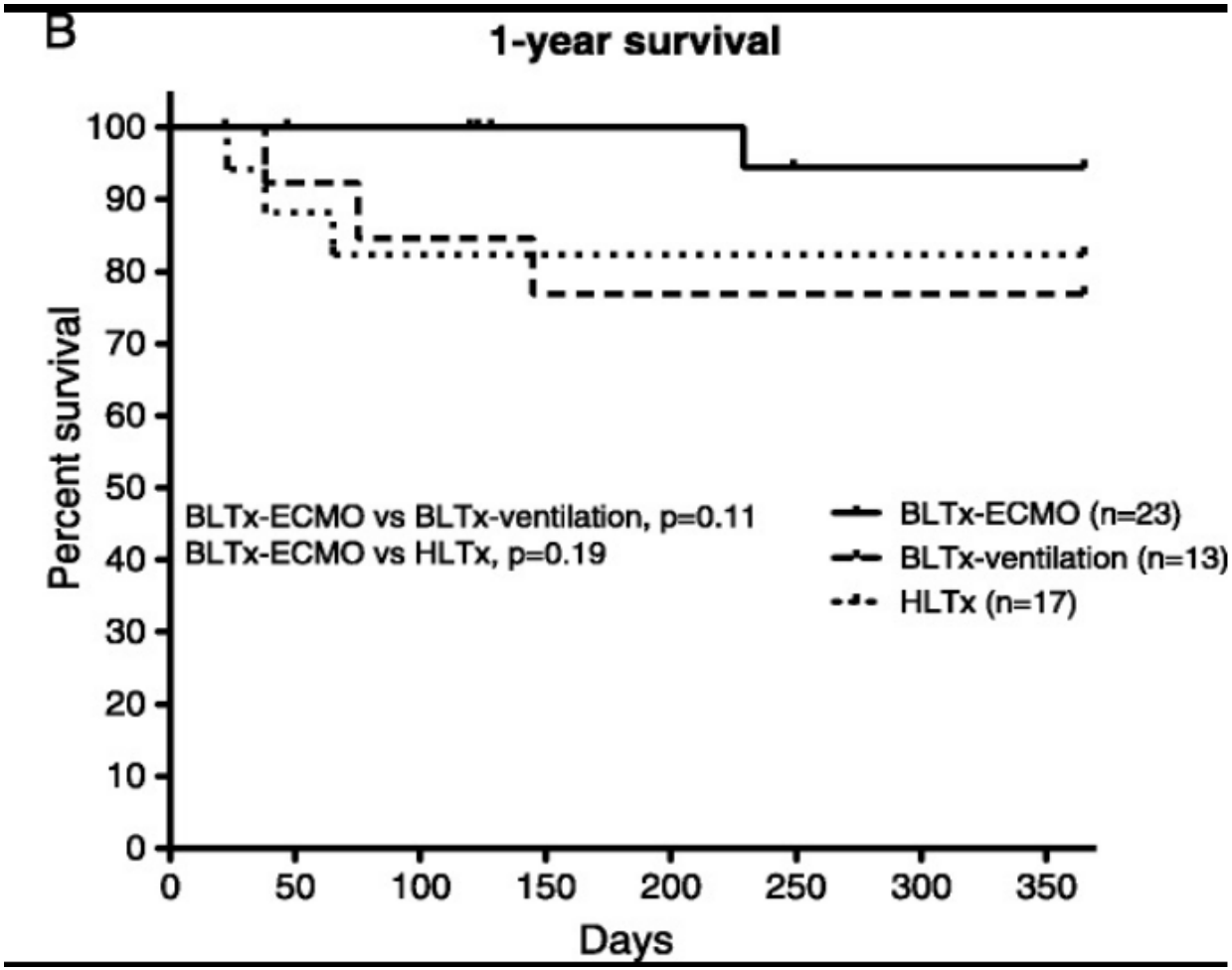
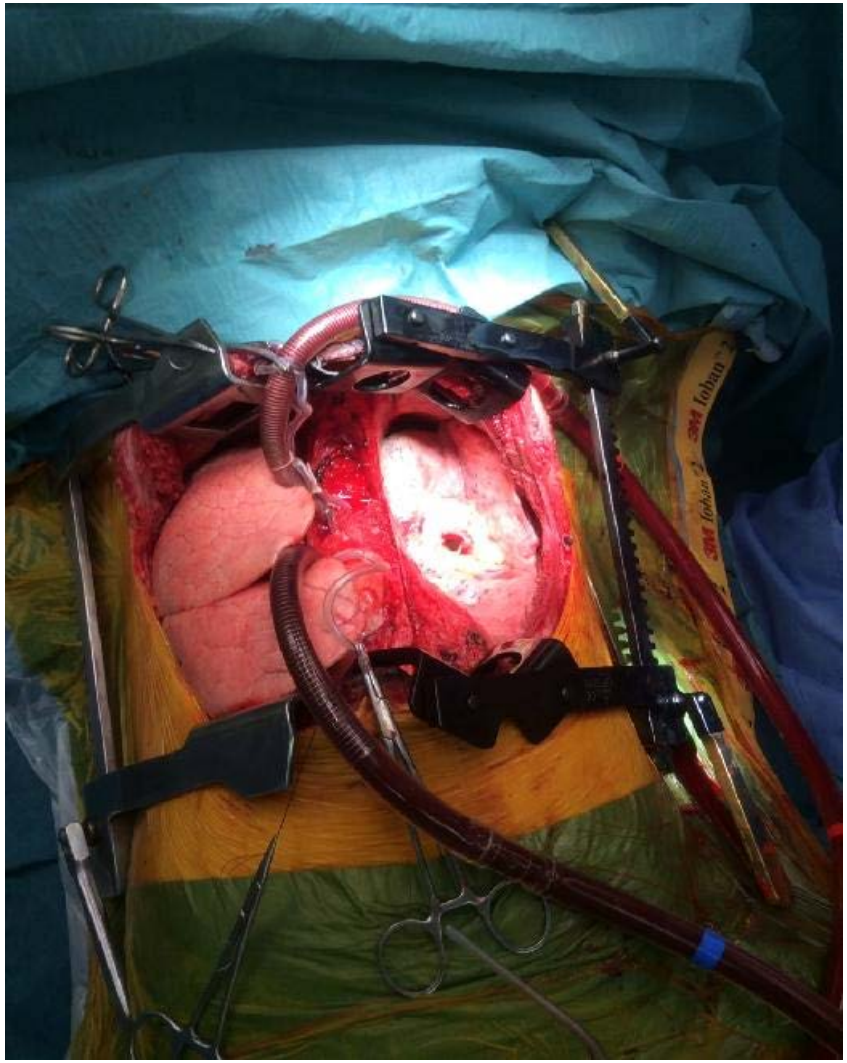


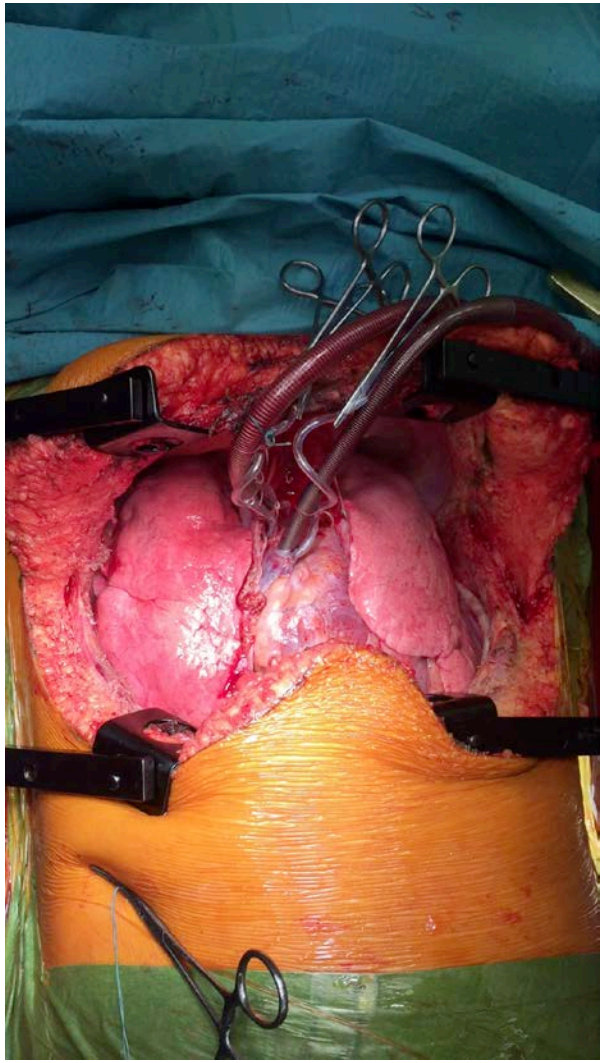
Program transplantace plic Praha

Strategické rozhodnutí v roce 2014:

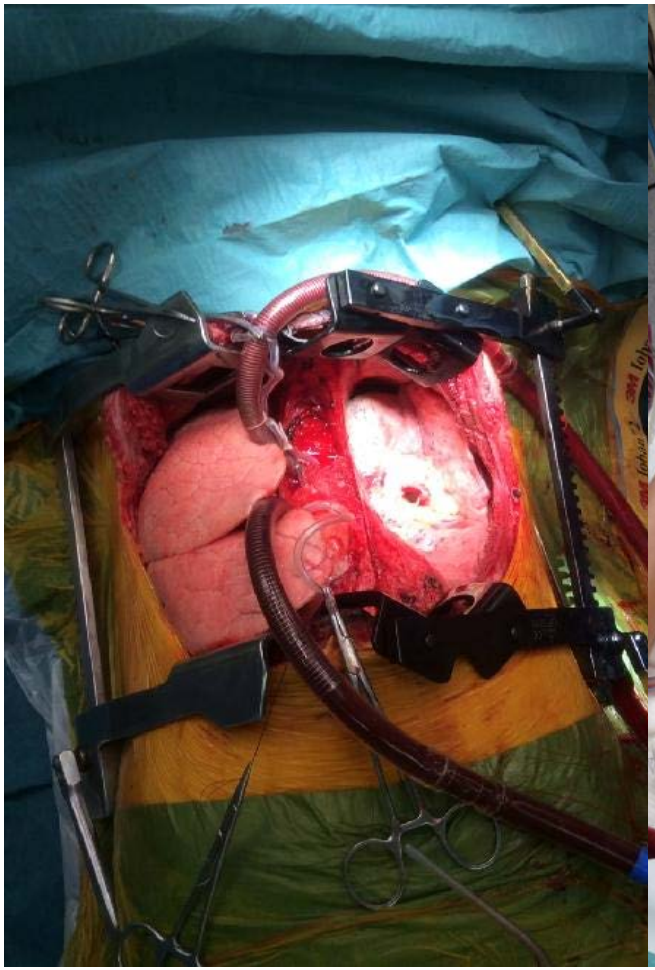
- Rutinní využití ECMO peroperačně
  - Bez ECM0 pouze u pacientů bez PH a zdravým srdcem
  - Při náznaku oběhové nestability okamžitý přechod na ECMO

Program Tx plic Praha

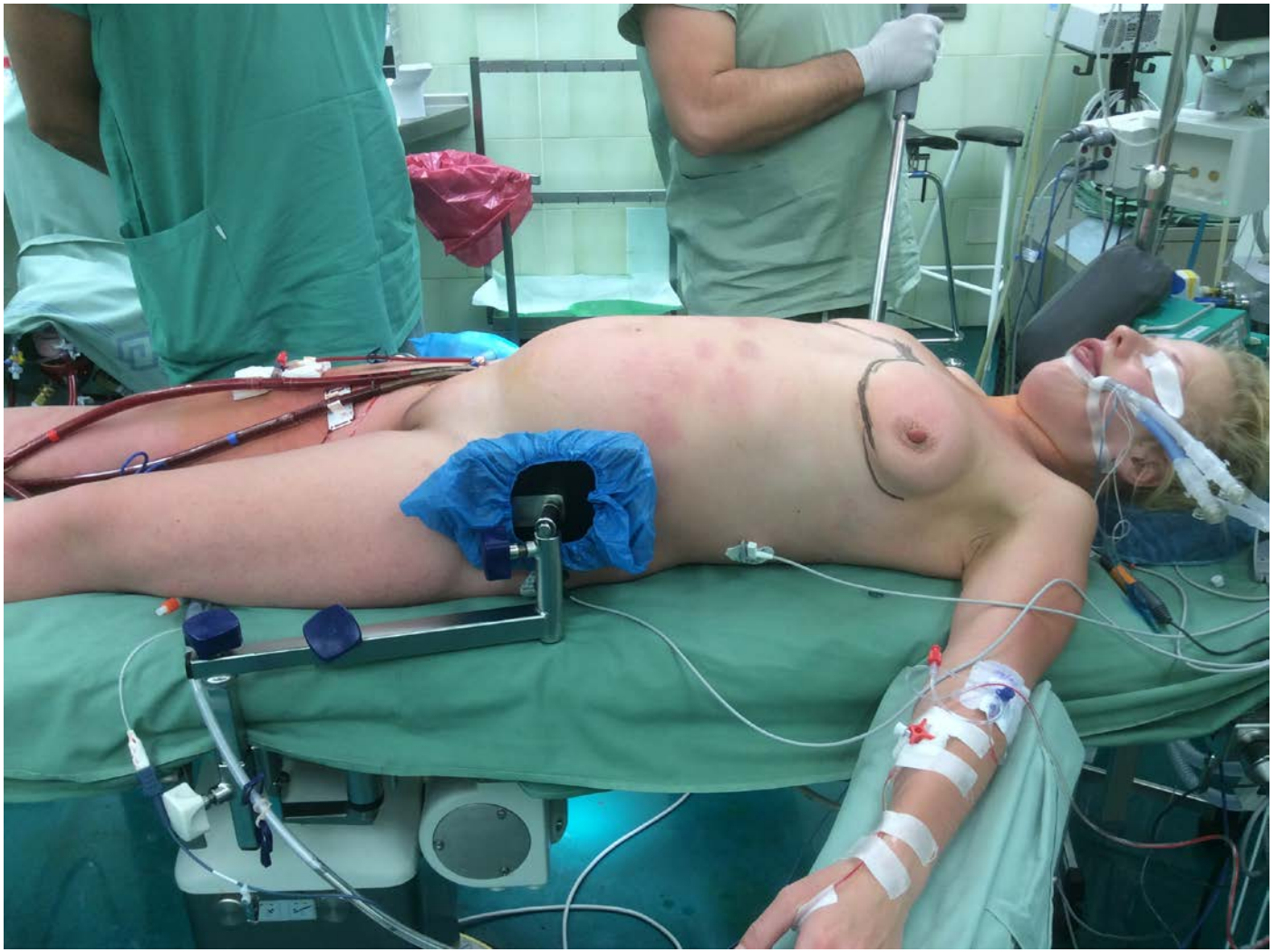


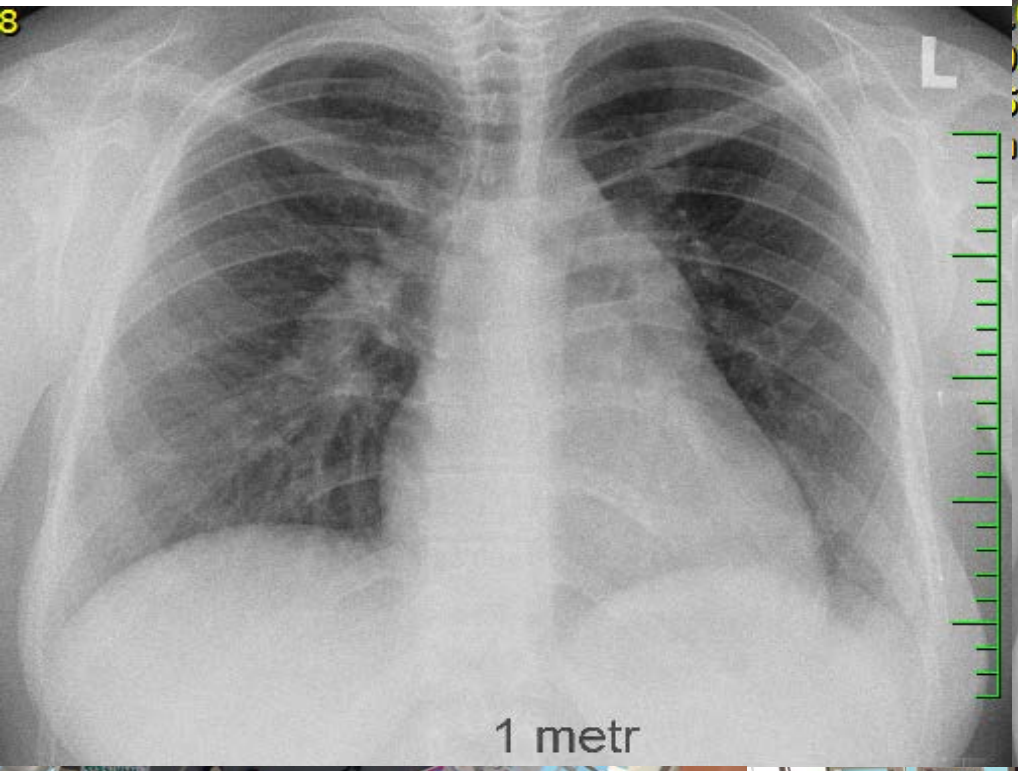


ECMO u Tx plic



Bridge k Tx pro IPAH

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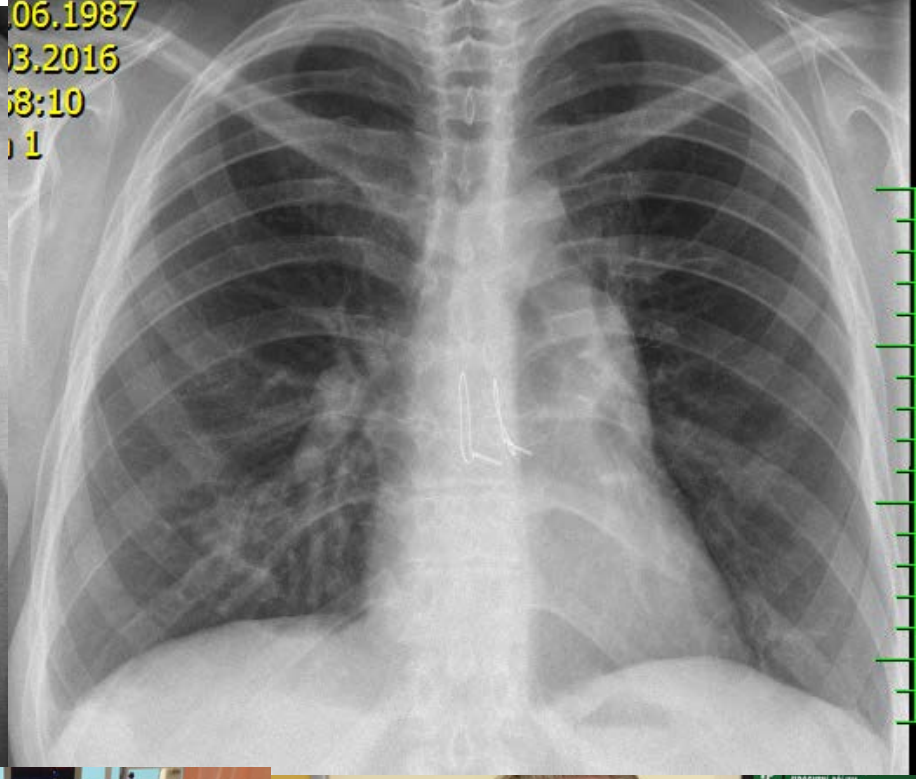


RENTGEN - POLIKLINIKA
KLINIKA REHABILITACE
ZDRAVOTNICKÝ MATERIÁL - SKLADY
ŠATNY
TECHNICKÉ PODLAŽÍ
TECHNICKÉ PODLAŽÍ

Prolongované/Záchranné ECMO

- Vídeň, Praha

  Na sále:

  •PAP > 2/3 SAP

  •PO2/FiO2 < 100

  •jasné zhoršení mezi dvěma měřeními

  Na ARO:

  •Lépe dříve než později

  •Ppeak ≥ 35 cmH20

  •Fi02 > 0,6

METODIKA

retrospektivní analýza 232 pacientů po LuTx
období 01/2008 - 02/2017

01/2008 – 12/2013
(n = 114)

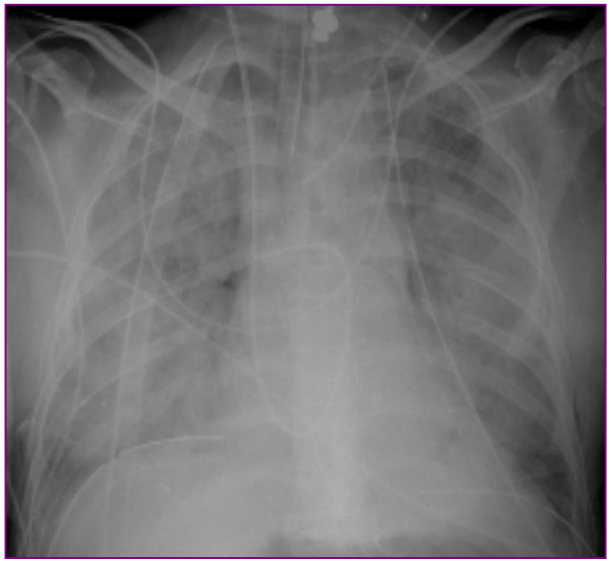
01/2014 – 02/2017
(n = 118)

ZÁKLADNÍ CHARAKTERISTIKA SOUBORU

	01/2008-12/2013	01/2014-02/2017	P value
	N = 114	N = 118	
Age (years, mean ±SD)			
Recipient	50.6 (± 13.5)	47.4 (± 15.9)	NS
Donor	40.3 (± 13.8)	43.6 (± 14.4)	NS
Gender male, n (%)	72 (63%)	60 (51%)	NS
DLTx, n (%)	75 (66%)	107 (91%)	**< 0.001**
Diagnosis, n (%)			
COPD	58 (51%)	42 (36%)	**0.02**
IPF	27 (24%)	42 (36%)	**0.047**
CF	17 (15%)	27 (23%)	NS
Other	12 (10%)	7 (6%)	NS
CMV match, n (%)			
Donor + / Recipient -	31 (27%)	36 (31%)	NS
Cold Ischemia (min, mean ±SD)			
First Lung	296 (± 78)	261 (± 58)	**< 0.001**
Second Lung	425 (± 70)	358 (± 58)	**< 0.001**
Intraoperative ECMO, n (%)	2 (1.8 %)	90 (76.2 %)	**< 0.001**

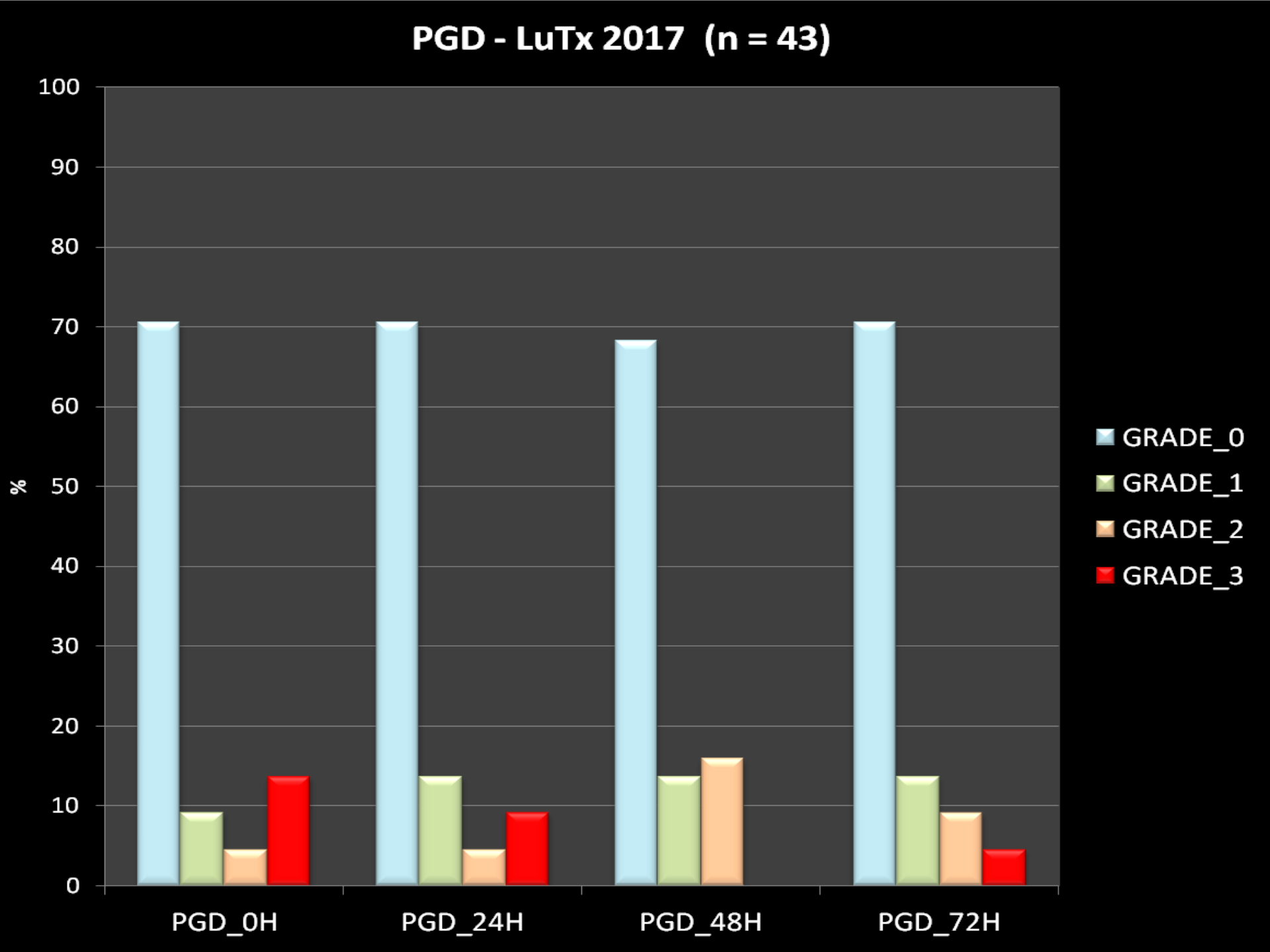
Primární dysfunkce štěpu

Jak můžeme predikovat funkci štěpu bezprostředně po implantaci?

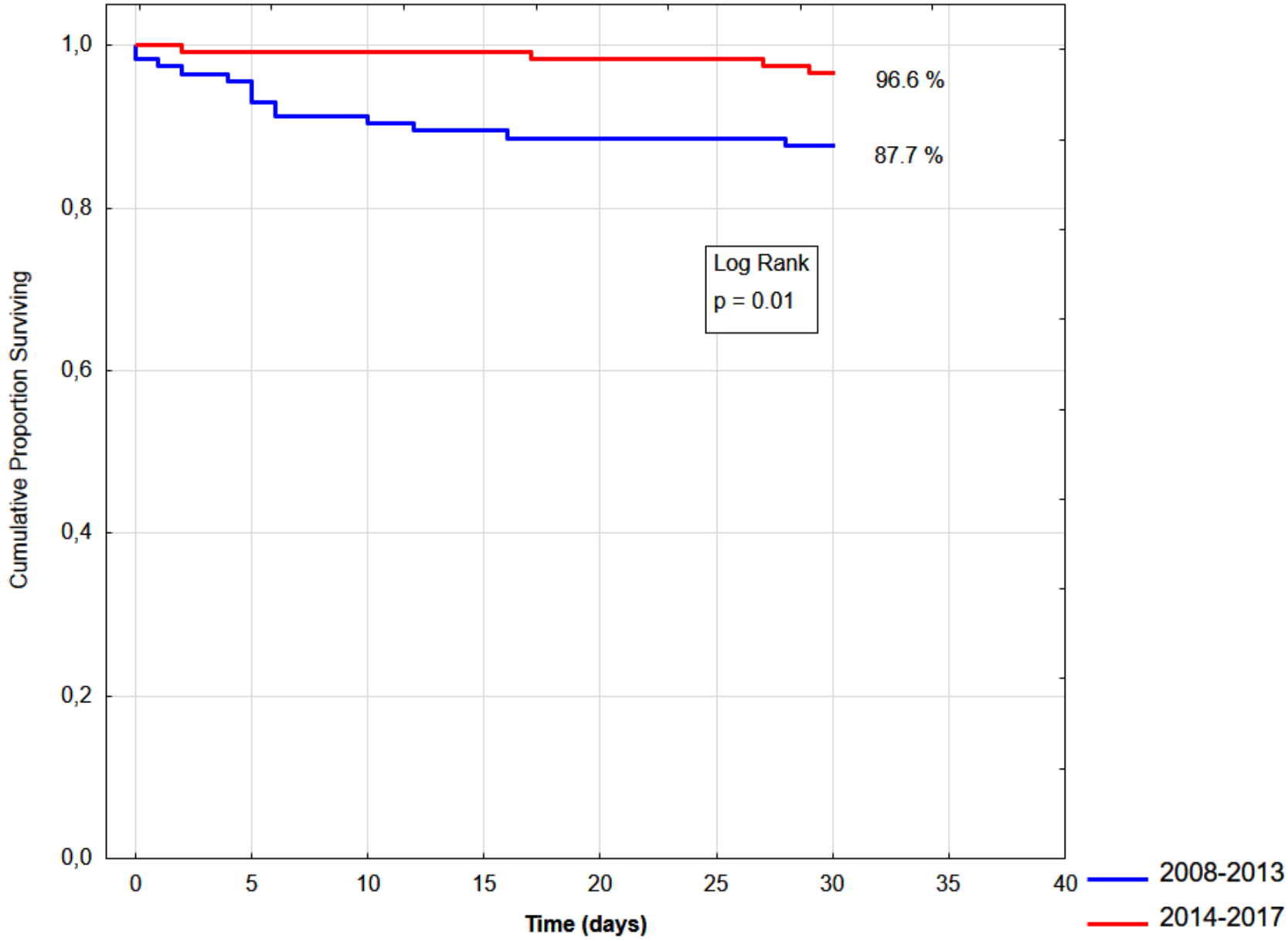


- Smrt mozku
- Neurogenní edém
- Teplá ischémie
- Studená ischemie
- Prezervace
- Reperfúzní poškození
- Incidence 10-25 %

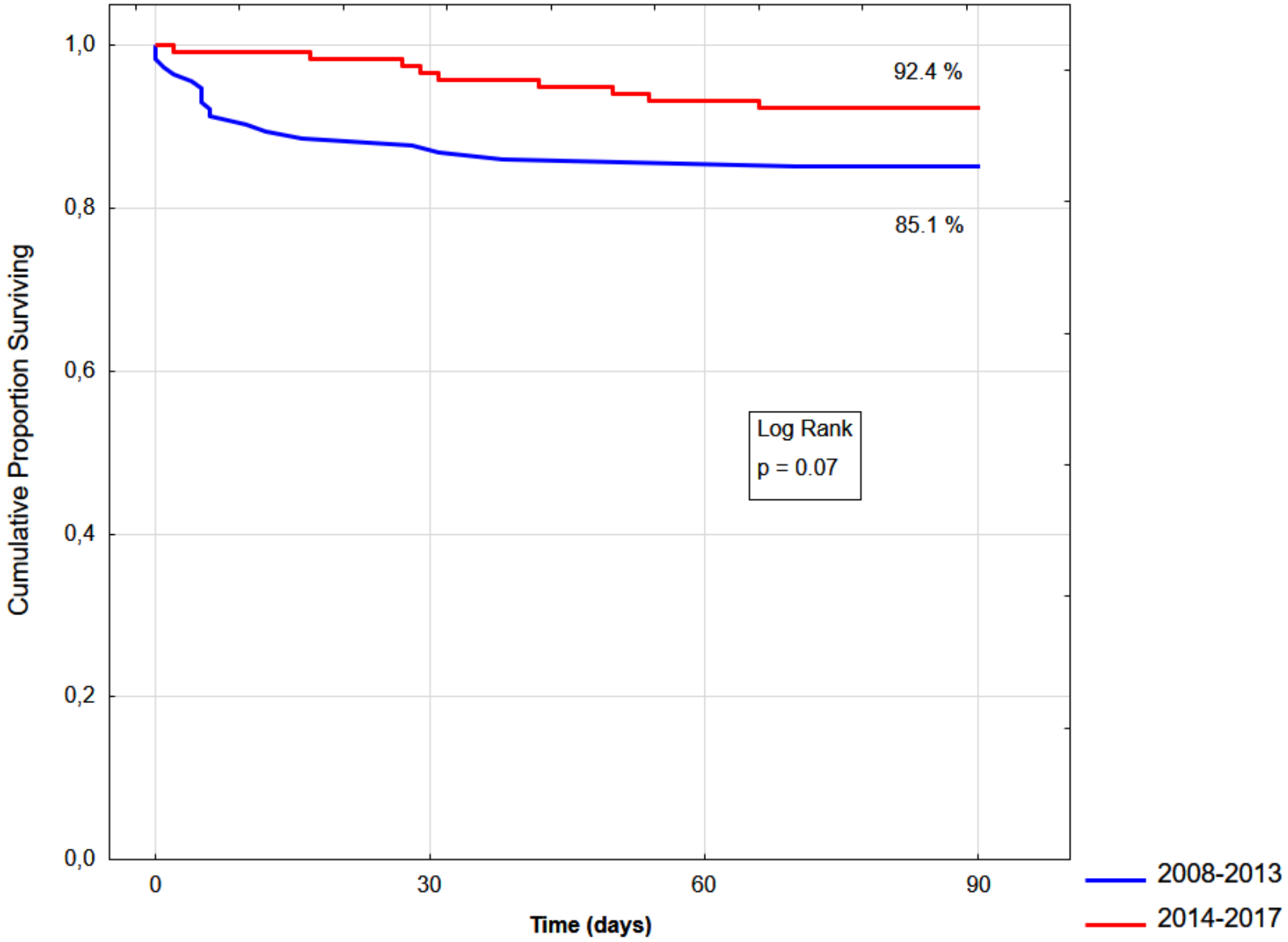
Lee and Christie: Primary Graft Dysfunction
PROCEEDINGS OF THE AMERICAN THORACIC SOCIETY VOL 6 2009


PGD - LuTx 2017 (n = 43)
100
90
80
70
60
50
40
30
20
10
0
%
PGD_0H
PGD_24H
PGD_48H
PGD_72H
GRADE_0
GRADE_1
GRADE_2
GRADE_3

1-MĚSÍČNÍ PŘEŽITÍ



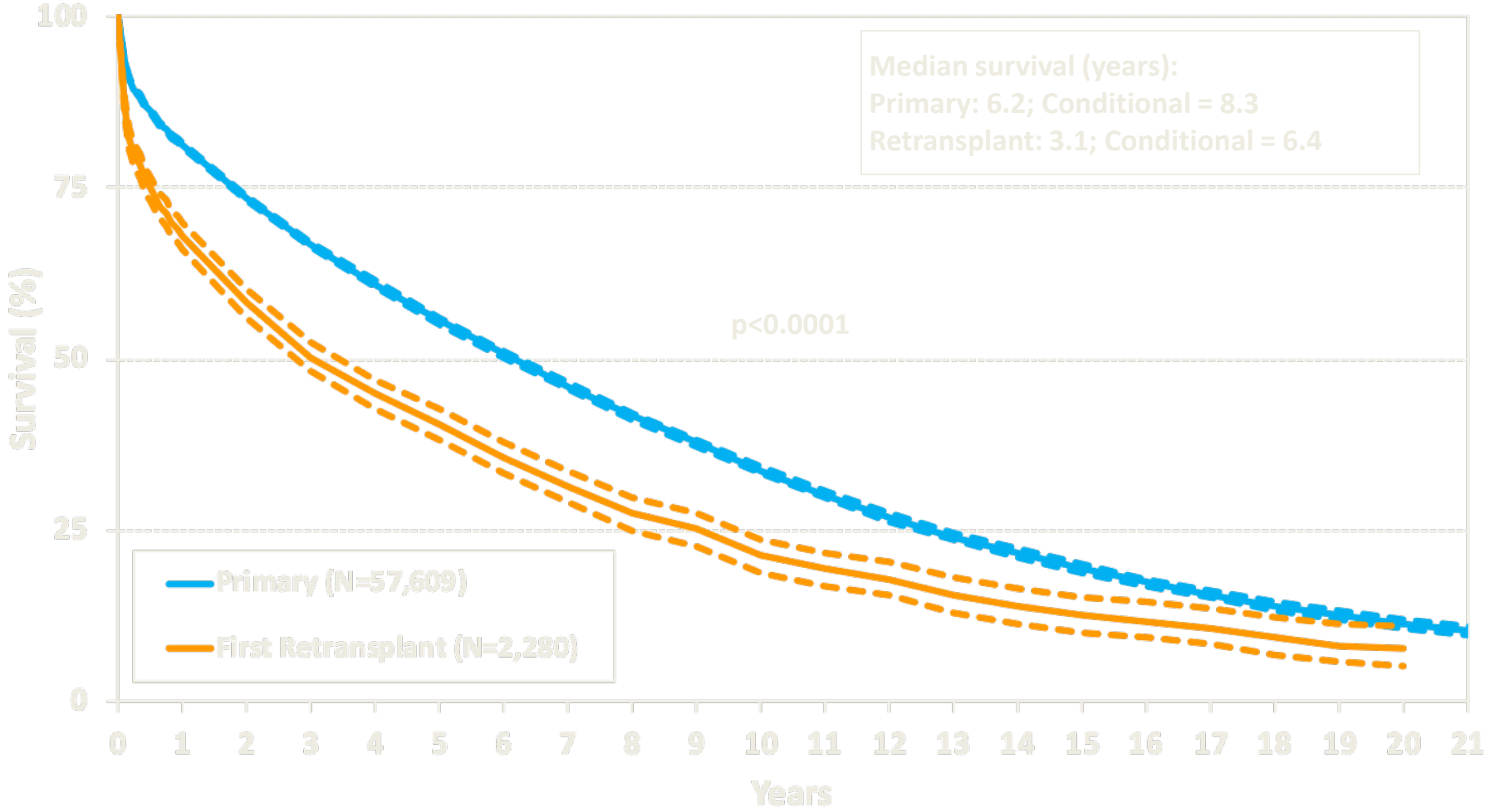
3-MĚSÍČNÍ PŘEŽITÍ



Retransplantace

- Pečlivá selekce kandidátů
- Riziko retransplantace vyšší
- Extrémní nedostatek orgánů
- U RAS pro špatnou prognózu rychleji

Adult Lung Transplants
Kaplan-Meier Survival by Transplant Type
(Transplants: January 1990 – June 2016)



ISHLT • INTERNATIONAL SOCIETY FOR HEART AND LUNG TRANSPLANTATION

2018

- **Program Tx plic pro Slovensko**

- Eurotransplant požádal Program transplantace plic Praha FN Motol o převzetí sloveských pacientů indikovaných k tx plic

Závěr

Transplantace plic

Etablovaná klinická metoda,
ale s řadou problémů

- Nedostatek vhodných orgánů
  - vysoká mortalita na čekacích listinách
- Primární dysfunkce štěpu
  - nízká prediktibilita funkce štěpu
- Akutní dysfunkce štěpu
- Chronická dysfunkce štěpu
  - limit dlouhodobého přežívání