LIVER PAIRED EXCHANGE

Sezai YILMAZ
Inonu University
Liver Transplantation Institute
MALATYA-TURKIYE

Bu sunuda herhangi bir çıkar çatışmam yoktur

İNÖNÜ UNIVERSITY
LIVER TRANSPLANT INSTITUTE
2011

Canlı donör adaylarının yalnızca %30-40'ı donör olmaya uygundur

ELSEVIER CrossMark

Evaluation of Potential Donors in Living Donor Liver Transplantation

A. Dirican, A. Baskiran, M. Dogan, M. Ates*, V. Soyer, B. Sarıcı, F. Ozdemir, Y. Polat, and S. Yilmaz

Department of General Surgery and Liver Transplantation Institute, Inonu University, Malatya, Turkey

ABSTRACT

Introduction. Correct donor selection in living donor liver transplantation (LDLT) is essential not only to decrease the risks of complications for the donors but also to increase the survival of both the graft and the recipient. Knowing their most frequent reasons of donor elimination is so important for transplantation centers to gain time. In this study we evaluated the effectiveness of potential donors in LDLT and studied the reasons for nonmaturation of potential liver donors at our transplantation center.

Patients and Methods. We studied the outcomes of 342 potential living donor candidates for 161 recipient candidates for liver transplantation between January 2013 and June 2014. Donor candidates' gender, age, body mass index (BMI), relationship with recipient, and causes of exclusion were recorded.

Results. Among 161 recipients, 96 had a LDLT and 7 had cadaveric liver transplantation. Twelve of the 342 potential donors did not complete their evaluation; 106 of the remaining 330 donor candidates were accepted as suitable for donation (32%) but 10 of these were excluded preoperatively. The main reasons for unsuitability for liver donation were small remnant liver size (43%) and fatty changes of the liver (38.4%). Other reasons were arterial anatomic variations, ABO incompatibility, and Gilbert syndrome. Only 96 of the candidates (29% of the 330 candidates who completed the evaluation) underwent donation. Effective donors were 29% of potential and 90.5% of suitable donors.

Conclusions. In our center, 106 of 330 (32%) donor candidates were suitable for donation and the main reasons for unsuitability for liver donation were small remnant liver size and fatty changes of the liver.

THERE is a disproportion between the increase in liver transplant candidates and cadaveric organ donors, so that the number of patients who die or are excluded from the waiting list for transplantation increases. Alternative treatment modalities have been studied such as living donor liver transplantation (LDLT) [1]. The outcomes improve feasibility of this treatment option and encourage both the recipients and donors. Selection of a suitable donor is very important for successful LDLT. The goal of donor evaluation is to determine whether or not the donor is medically and psychologically suitable for living donation. Donor evaluation is essential not only to decrease the risks of complications for the donors but also to increase the survival of both the graft and the recipient. Therefore, strict donor selection criterias are used for successful LDLT in transplantation clinics. The main causes of donor elimination are changed from center to center. Knowing their most frequent reason of donor elimination is so important for a transplantation center to gain time during the donor evaluation process. In this study, we evaluated causes of donor elimination and effectiveness of potential donor selection in our transplantation center.

PATIENTS AND METHODS

We studied the outcomes of 342 potential donor candidates for 161 recipient candidates for liver transplantation between January 2013 and June 2014. Donor candidates' gender, age, body mass index (BMI), relationship with the recipient, and causes of exclusion were recorded. Donor candidates were divided into accepted and non-accepted groups. Variables of the 2 groups were compared.

*Address correspondence to Mustafa Ates, MD, Department General Surgery, School of Medicine, Inonu University, 44315 Malatya, Turkey. E-mail: drmustafaates@hotmail.com

0041-1345/15
http://dx.doi.org/10.1016/j.transproceed.2015.04.045

Outcomes of Donor Evaluation in Adult-to-Adult Living Donor Liver Transplantation

James F. Trotter,[1] Karen A. Wisniewski,[2] Norah A. Terrault,[3] James E. Everhart,[4] Milan Kinkhabwala,[5] Robert M. Weinrieb,[6] Jeffrey H. Fair,[7] Robert A. Fisher,[8] Alan J. Koffron,[9] Sammy Saab,[10] Robert M. Merion,[2] and the A2ALL Study Group

The purpose of donor evaluation for adult-to-adult living donor liver transplantation (LDLT) is to discover medical conditions that could increase the donor postoperative risk of complications and to determine whether the donor can yield a suitable graft for the recipient. We report the outcomes of LDLT donor candidates evaluated in a large multicenter study of LDLT. The records of all donor candidates and their respective recipients between 1998 and 2003 were reviewed as part of the Adult-to-Adult Living Donor Liver Transplantation Cohort Study (A2ALL). The outcomes of the evaluation were recorded along with demographic data on the donors and recipients. Of the 1011 donor candidates evaluated, 405 (40%) were accepted for donation. The donor characteristics associated with acceptance ($P < 0.05$) were younger age, lower body mass index, and biological or spousal relationship to the recipient. Recipient characteristics associated with donor acceptance were younger age, lower Model for End-stage Liver Disease score, and shorter time from listing to first donor evaluation. Other predictors of donor acceptance included earlier year of evaluation and transplant center. *Conclusion:* Both donor and recipient features appear to affect acceptance for LDLT. These findings may aid the donor evaluation process and allow an objective assessment of the likelihood of donor candidate acceptance. (HEPATOLOGY 2007;46:1476-1484.)

Donor evaluation is one of the most important aspects of adult-to-adult living donor liver transplantation (LDLT).[1-3] The evaluation process is designed to reveal any condition that may increase the risk of complications for the donor. In addition, the transplant team should determine whether the donor will yield a suitable graft for the recipient. The evaluation process typically proceeds in a stepwise fashion so that unsuitable donors can be identified as early as possible. Acceptance of donors by the evaluating team implies that they have met all relevant medical, surgical, psychosocial, and informed consent criteria necessary to proceed with donor right hepatic lobectomy.

The Adult-to-Adult Living Donor Liver Transplantation Cohort Study (A2ALL) is a multicenter project

Abbreviations: A2ALL, Adult-to-Adult Living Donor Liver Transplantation Cohort Study; BMI; body mass index; DDLT, deceased donor liver transplant; LDLT, living donor liver transplantation; MELD, Model for End-stage Liver Disease score; SRTR, Scientific Registry of Transplant Recipients.

From the [1]Department of Surgery, University of Colorado, Denver, CO; [2]Department of Surgery, University of Michigan, Ann Arbor, MI; [3]Department of Medicine, University of California at San Francisco, San Francisco, CA; [4]National Institute of Diabetes and Digestive and Kidney Diseases, National Institutes of Health, Bethesda, MD; [5]Department of Surgery, Columbia University Presbyterian Medical Center, New York, NY; [6]Department of Psychiatry, University of Pennsylvania, Philadelphia, PA; [7]Department of Surgery, University of North Carolina, Chapel Hill, NC; [8]Department of Surgery, Medical College of Virginia Hospitals, Virginia Commonwealth University, Richmond, VA; [9]Department of Surgery, Northwestern University Medical School, Chicago, IL; and the [10]Department of Medicine, University of California Los Angeles, Los Angeles, CA.

Received March 27, 2007; accepted May 31, 2007.

Presented in part at the World Transplant Congress, Boston, MA, July 2006.

Supported in part by the National Institutes of Health (NIDDK grant numbers U01-DK62536, U01-DK62444, U01-DK62467, U01-DK62483, U01-DK62484, U01-DK62494, U01-DK62496, U01-DK62498, U01-DK62505, U01-DK62531), the American Society of Transplant Surgeons, and the U.S. Department of Health and Human Services, Health Resources and Services Administration.

This is publication number 5 of the Adult-to-Adult Living Donor Liver Transplantation Cohort Study.

Address reprint requests to: James F. Trotter, M.D., University of Colorado Hospital, 1635 N. Ursula, Campus Box 154, Aurora, CO 80262. E-mail: james.trotter@uchsc.edu; fax: 720-848-2246.

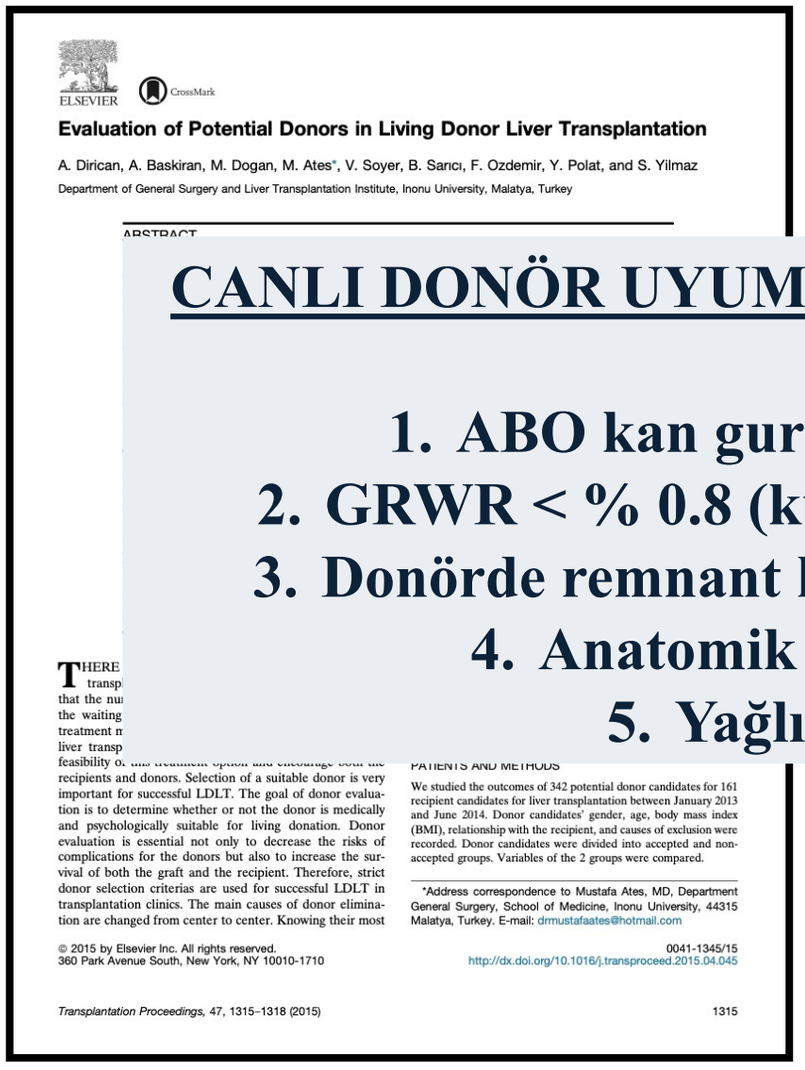
Published online in Wiley InterScience (www.interscience.wiley.com).

DOI 10.1002/hep.21845

Potential conflict of interest: Dr. Trotter is a consultant for and received grants from Novartis. He is on the speakers' bureau of and received grants from Roche. He is also on the speakers' bureau of Astellas. He also received grants from Cellzdirect, Aventis-Sanofi, and Abbott.

İNÖNÜ UNIVERSITY
LIVER TRANSPLANT INSTITUTE
2011

Canlı donör adaylarının yalnızca %30-40'ı donör olmaya uygundur



ELSEVIER CrossMark

Evaluation of Potential Donors in Living Donor Liver Transplantation

A. Dirican, A. Baskiran, M. Dogan, M. Ates*, V. Soyer, B. Sarıcı, F. Ozdemir, Y. Polat, and S. Yilmaz
Department of General Surgery and Liver Transplantation Institute, Inonu University, Malatya, Turkey

ABSTRACT

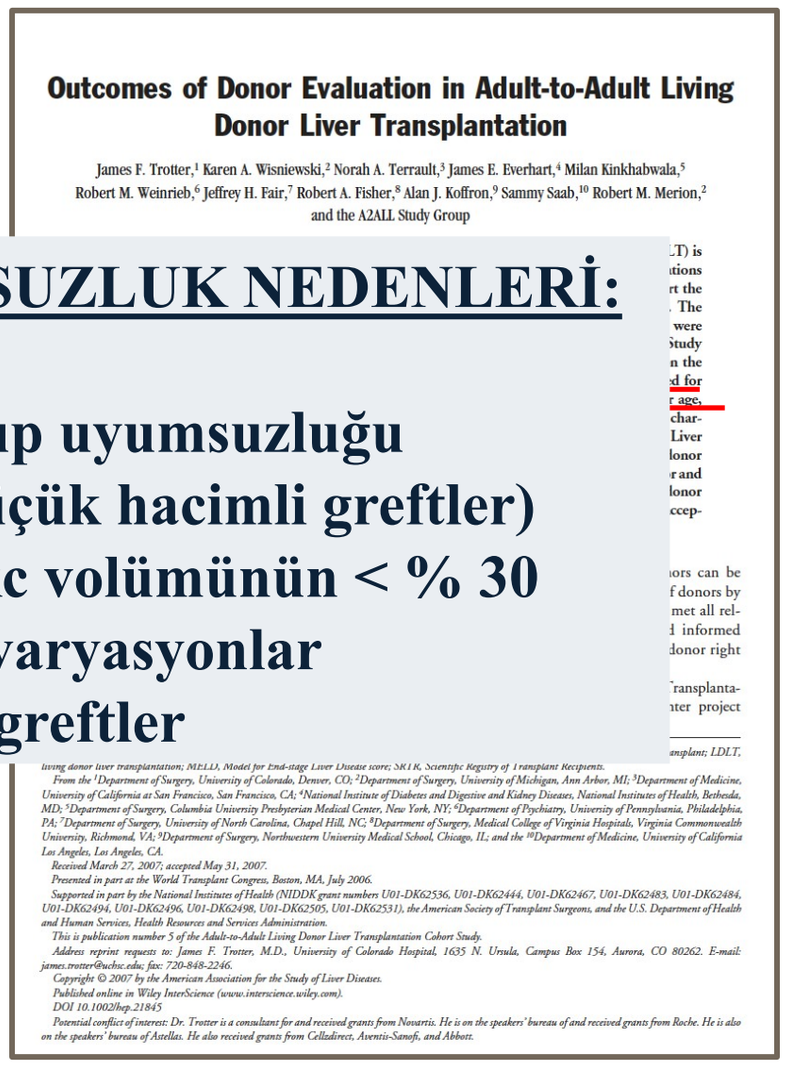
THERE
transp
that the nu
the waiting
treatment n
liver transp
feasibility o
recipients and donors. Selection of a suitable donor is very important for successful LDLT. The goal of donor evaluation is to determine whether or not the donor is medically and psychologically suitable for living donation. Donor evaluation is essential not only to decrease the risks of complications for the donors but also to increase the survival of both the graft and the recipient. Therefore, strict donor selection criterias are used for successful LDLT in transplantation clinics. The main causes of donor elimination are changed from center to center. Knowing their most

PATIENTS AND METHODS

We studied the outcomes of 342 potential donor candidates for 161 recipient candidates for liver transplantation between January 2013 and June 2014. Donor candidates' gender, age, body mass index (BMI), relationship with the recipient, and causes of exclusion were recorded. Donor candidates were divided into accepted and non-accepted groups. Variables of the 2 groups were compared.

*Address correspondence to Mustafa Ates, MD, Department General Surgery, School of Medicine, Inonu University, 44315 Malatya, Turkey. E-mail: drmustafaates@hotmail.com

0041-1345/15
http://dx.doi.org/10.1016/j.transproceed.2015.04.045



Outcomes of Donor Evaluation in Adult-to-Adult Living Donor Liver Transplantation

James F. Trotter,[1] Karen A. Wisniewski,[2] Norah A. Terrault,[3] James E. Everhart,[4] Milan Kinkhabwala,[5] Robert M. Weinrieb,[6] Jeffrey H. Fair,[7] Robert A. Fisher,[8] Alan J. Koffron,[9] Sammy Saab,[10] Robert M. Merion,[2] and the A2ALL Study Group

.T) is
tions
rt the
. The
were
Study
n the
d for
r age,
char-
Liver
lonor
r and
lonor
ccep-

iors can be
f donors by
met all rel-
d informed
donor right

Transplanta-
nter project

ansplant; LDLT,

living donor liver transplantation; MELD, Model for End-stage Liver Disease score; SRTR, Scientific Registry of Transplant Recipients.

*From the [1]Department of Surgery, University of Colorado, Denver, CO; [2]Department of Surgery, University of Michigan, Ann Arbor, MI; [3]Department of Medicine, University of California at San Francisco, San Francisco, CA; [4]National Institute of Diabetes and Digestive and Kidney Diseases, National Institutes of Health, Bethesda, MD; [5]Department of Surgery, Columbia University Presbyterian Medical Center, New York, NY; [6]Department of Psychiatry, University of Pennsylvania, Philadelphia, PA; [7]Department of Surgery, University of North Carolina, Chapel Hill, NC; [8]Department of Surgery, Medical College of Virginia Hospitals, Virginia Commonwealth University, Richmond, VA; [9]Department of Surgery, Northwestern University Medical School, Chicago, IL; and the [10]Department of Medicine, University of California Los Angeles, Los Angeles, CA.

Received March 27, 2007; accepted May 31, 2007.
Presented in part at the World Transplant Congress, Boston, MA, July 2006.
Supported in part by the National Institutes of Health (NIDDK grant numbers U01-DK62536, U01-DK62444, U01-DK62467, U01-DK62483, U01-DK62484, U01-DK62494, U01-DK62496, U01-DK62498, U01-DK62505, U01-DK62531), the American Society of Transplant Surgeons, and the U.S. Department of Health and Human Services, Health Resources and Services Administration.
This is publication number 5 of the Adult-to-Adult Living Donor Liver Transplantation Cohort Study.
Address reprint requests to: James F. Trotter, M.D., University of Colorado Hospital, 1635 N. Ursula, Campus Box 154, Aurora, CO 80262. E-mail: james.trotter@uchsc.edu; fax: 720-848-2246.

Published online in Wiley InterScience (www.interscience.wiley.com).
DOI 10.1002/hep.21845
Potential conflict of interest: Dr. Trotter is a consultant for and received grants from Novartis. He is on the speakers' bureau of and received grants from Roche. He is also on the speakers' bureau of Astellas. He also received grants from Celltedirect, Aventis-Sanofi, and Abbott.

CANLI DONÖR UYUMSUZLUK NEDENLERİ:

1. ABO kan gurup uyumsuzluğu
2. GRWR < % 0.8 (küçük hacimli greftler)
3. Donörde remnant kc volümünün < % 30
4. Anatomik varyasyonlar
5. Yağlı greftler

Uyumsuz Canlı Donör Sorununu Çözme Stratejileri

- **Graft inflow modulation**
- **Dual lob LDLT**
- **Donör liver steatozunu önlemek için sıkı kilo kaybı rejimleri**
- **ABO-i LDLT**
- **LPE (Liver Paired Exchange)**

İNÖNÜ UNIVERSITY
LIVER TRANSPLANT INSTITUTE
2011

Karaciğer Naklinde Uyumsuz Canlı Donör Sorununun Çözümü

ABO-uyumsuz karaciğer nakli

Hepatobiliary & Pancreatic Diseases International 19 (2020) 342–348

Contents lists available at ScienceDirect

Hepatobiliary & Pancreatic Diseases International

journal homepage: www.elsevier.com/locate/hbpd

Review Article on Living Donor Liver Transplantation

Challenge to ABO blood type barrier in living donor liver transplantation

Hiroto Egawa

Department of Gastroenterology, Tokyo Women's Medical University, Tokyo, Japan

ARTICLE INFO

Article history:
Received 10 June 2020
Accepted 20 June 2020
Available online 30 June 2020

Keywords:
ABO blood type
Living donor liver transplantation
Antibody mediated rejection

ABSTRACT

ABO incompatible living donor liver transplantation has the potential to expand the donor pool for patients with end stage liver diseases on the expense of challenges to overcome immunological barriers across blood type. There is a profound impact of age on incidence and severity of antibody mediated rejection (AMR). Even children older than 1 year have chances of AMR; children aged 8 years or older have risks of hepatic necrosis similar to adult liver recipients. The mechanism of AMR is based on circulatory disturbances secondary to inflammation and injury of the vascular endothelium caused by an antibody-antigen-complement reaction. The strategy to overcome ABO blood type barrier is based on both pre-transplant desensitization and adequate treatment of this phenomenon. Nowadays, rituximab is the standard means of desensitization but unfortunately an insufficient aid to treat AMR. Because of low incidence (less than 5% in the rituximab era), in practice of AMR only some case reports about the treatment of clinical AMR are available in the literature. Initial experiences revealed that the proteasome inhibitor, bortezomib might be a promising treatment based on its capacity to deplete plasma cell agents. Although ABO blood type barrier has been counteracted in 95% of patients by applying "rituximab-desensitization", many issues, such as prediction of high-risk patients of infection and AMR and secure treatment strategies for evoked AMR, remain to be resolved.

Original Paper

Abo-Incompatible Liver Transplantation in Acute and Acute-On-Chronic Liver Failure

Sezai Yilmaz[1], Cemalettin Aydin[1], Buraklsik[1], Cuneyt Kayaalp[1], Mehmet Yilmaz[1], Cengiz Ara[1], Ramazan Kutlu[2], Yasar Bayindir[3] and Veysel Ersan[1]

[1]Department of General Surgery, [2]Department of Radiology, and [3]Department of Infectious Diseases and Clinical Microbiology, Inonu University, School of Medicine, Malatya, Turkey

Corresponding author: Prof. Sezai Yilmaz MD, Department of General Surgery, Inonu University, School of Medicine, Turgut Ozal Medical Center, 44315, Malatya, Turkey; Tel.: +90-422-3410-660 (ext.3707), Fax: +90-422-3410-229; E-mail: sezai.yilmaz@inonu.edu.tr

ABSTRACT

Background/Aims: ABO-incompatible (ABO-I) liver transplantation (LTx) may be mandatory in urgent conditions such as acute liver failure (ALF) or acute-on-chronic liver failure (ACLF) when deceased donor (DD) is unavailable or living donor (LD) selection is limited. This study specifically addresses the problem of urgent ABO-I LTx in critically ill adult patients having ALF or severely decompensated end-stage liver disease. **Methodology:** This series included 16 patients, 10 underwent ABO-I LD LTx and 6 underwent 7 ABO-I DD LTx. Multiple sessions of plasmapheresis reduced isoagglutinin titres to 1/16 or below, before and after LTx. **Results:** Mean follow-up period was 10.37 months (1 to 38). Median for MELD scores was 22.5 (17 to 30). Median survival was 9 months and mean survival was 19.5 months. Hospital mortality was 3 (18.7%). Two patients died due to small for size graft syndrome and cerebrovascular bleeding respectively. Hepatic artery thrombosis developed in 3 patients. Two of them died at postoperative 4th and 9th months. Third patient is still alive with hepatic necrosis problem. **Conclusions:** ABO-I LTx remains an important and unavoidable therapeutic option in adult patients with ALF or ACLF and urgent need for an allograft without the possibility to allocate a blood group compatible liver graft.

Key Words: ABO incompatible; Acute; Acute-on-chronic; Liver failure; Liver transplantation.

Abbreviations: ABO-Incompatible (ABO-I); Liver Transplantation (LTx); Antibody Mediated Rejection (AMR); Living Donor (LD); Deceased Donor (DD); Plasmapheresis (PE).

INTRODUCTION

ABO-Incompatible (ABO-I) liver transplantation (LTx) is an inevitable problem in liver transplantation (LTx) in emergency conditions, because either deceased donor (DD) is not available or living donor (LD) selection is limited. Refusing ABO-I LTx may lead to expeditious death of the patient. Therefore, the use of grafts from ABO-I donors might be the only available option.Initial experiences have shown that while ABO-I living donor (LD) LTx can be performed with relative safety in infants of <1 year-old, adult patients remain at considerable risk of early mortality (1). In these cases, causes of death were infection secondary to antibody mediated rejection (AMR) or over-immunosuppression, which usually presents as hepatic necrosis or intrahepatic biliary complications (2). ABO-I LTx has been most frequently performed for two indications, namely emergency transplantation for acute liver failure or acute-on-chronic liver failure, when no ABO-compatible donor is available (3). This study specifically addresses the problem of emergency LTx in critically ill adult patients having acute liver failure or severely decompensated end-stage liver disease.

METHODOLOGY

This series included sixteen patients, of which ten underwent ABO-I LD LTx and six underwent seven ABO-I DD LTx, over the 9 year period between 2002 and 2011. Two patients had undergone ABO-compatible LD LTx before ABO-I DD LTx, because of hepatic artery thrombosis. Clinical characteristics of the patients, donor-recipient blood group match, and outcomes are shown in **Table 1**.The study was conducted under the institutional review board and all transplants were performed at the University of Inonu at Malatya.

Multiple sessions of plasmapheresis (PE) were used to reduce isoagglutinin titers to 1:16 or lower before and after the transplantation. A final preoperative PE was performed for each patient on the day of transplantation. In all patients, isoagglutinin titers were lowered below 1:16 by a maximum of 2 PE sessions before transplantation. In the first 30 days after transplantation, rising titer levels above threshold of 1:16 lead to repeated PE. The mean of necessity of PE after transplantation was 6.7 (range 4-9). Regarding PE technique, dual needle PE procedures were performed using a cell separator (Com.Tec, Fresenius HemoCare GmbH, Bad Homburg, Germany), single-stage channel filler and TPE disposable set (PI.1, Fresenius Kabi AG, Bad Homburg, Germany). Uniformly, vascular access was *via* a double lumen dialysis type catheter from internal jugular vein, by an experienced radiologist, Ramazan Kutlu. The inlet flow rate was between 60 and 100mL/min. The replacement fluids for plasma exchanges (fresh frozen plasma, 5% human albumin and normal saline) and their ratios were determined on the basis of the patient's coagulation parameters. Fresh frozen plasma used was always AB fresh frozen plasma that presumably did not contain anti-A and anti-B antibodies.Splenectomy was carried out after the graft reperfusion to suppress antibody production in the last seven cases. No splenectomy was performed in the first nine patients. Instead, splenic artery ligation was performed. Pneumococcal polysaccharide vaccine was given to all recipients.No patient was given portal or intra-arterial intrahepatic infusion therapy.

The standardimmunosuppressive regimen consisted of induction therapy with IL-2 receptor antagonist

Hepato-Gastroenterology 2013; 60:00-00 doi 10.5754/hge 11289

ABO-incompatible Karaciğer Nakli Protokolü

- **LTx'den 2 hafta önce Rituximab**
- **B-cell depletion yetersiz ise ilave doz Rituximab**
- **CD19(+) mononükleer h kullanarak B-cell popülasyonunu tayin edersiniz**
- **LTx'de 7 gün önce Tacrolimus ve MMF başla**
- **2-3 session plazmaferez (antikor titresini 256'nın altına düşür)**
- **LTx donrası antifungal ve CMV tedavisi**
- **IV immünglobulin LTx sonrası 5 gün proflaktik**
- **Portal venden lokal tedaviler (methyl prednizolon, PGE1, gabexelat mesilat)**
- **Acil LTx'de splenektomi**

Received: 28 December 2022 | Revised: 27 February 2023 | Accepted: 5 March 2023

DOI: 10.1111/ctr.14968

Clinical TRANSPLANTATION
The Journal of Clinical and Translational Research
WILEY

ORIGINAL ARTICLE

Advances and innovations in living donor liver transplant techniques, matching and surgical training: Meeting report from the living donor liver transplant consensus conference

Mark Sturdevant[1] | Swaytha Ganesh[2] | Benjamin Samstein[3] | Elizabeth C. Verna[4] | Manuel Rodriguez-Davalos[5] | Vineeta Kumar[6] | Marwan Abouljoud[7] | Oya Andacoglu[8] | Medhat Askar[9] | Dieter Broering[10] | Juliet Emamaullee[11] | Jean C. Emond[4] | Christine E. Haugen[4] | Michelle T. Jesse[7] | Mureo Kasahara[12] | AnnMarie Liapakis[13] | Didier Mandelbrot[14] | Anjana Pillai[15] | Garrett R. Roll[16] | Nazia Selzner[17] | Sukru Emre[18] | on behalf of the AST LDLT Consensus Conference Working Group

[1]University of Washington Medical Center, Seattle, Washington, USA
[2]University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania, USA
[3]Weill Cornell Medicine, New York, New York, USA
[4]Center for Liver Disease and Transplantation, Columbia University, New York City, New York, USA
[5]Intermountain Healthcare, Salt Lake City, Utah, USA
[6]Comprehensive Transplant Institute, University of Alabama at Birmingham, Birmingham, Alabama, USA
[7]Henry Ford Transplant Institute, Detroit, Michigan, USA
[8]University of Oklahoma, Oklahoma, Oklahoma, USA
[9]Baylor University Medical Center, Dallas, Texas, USA
[10]King Faisal Specialist Hospital & Research Centre, Riyadh, Saudi Arabia
[11]University of Southern California, Los Angeles, California, USA
[12]National Center for Child Health and Development, Tokyo, Japan
[13]Yale School of Medicine and Yale New Haven Transplant Center, New Haven, Connecticut, USA
[14]Department of Medicine, University of Wisconsin, Madison, Wisconsin, USA
[15]University of Chicago Medicine, Chicago, Illinois, USA
[16]Department of Surgery, University of California San Francisco, San Francisco, California, USA
[17]Ajmera Transplant Center, University of Toronto, Toronto, Canada
[18]University School of Medicine, Izmir, Turkey

Correspondence
Mark Sturdevant, Department of Surgery, University of Washington, 1959 NE Pacific, Seattle, WA 98195, USA.
Email: sturde@uw.edu

Mark Sturdevant and Swaytha Ganesh are co-first authors.

Nazia Selzner Sukru Emre are co-senior authors.

Abstract

The practice of LDLT currently delivers limited impact in western transplant centers. The American Society of Transplantation organized a virtual consensus conference in October 2021 to identify barriers and gaps to LDLT growth, and to provide evidence-based recommendations to foster safe expansion of LDLT in the United States. This article reports the findings and recommendations regarding innovations and advances in approaches to donor-recipient matching challenges, the technical aspects of the

TABLE 1 (Continued)

#Priority importance of barrier strategy(ies)	Consensus responses mean (SD); median (IQR)	
#9 Role for alloantibody testing in liver transplantation, and LDLT, remains unclear.	*Importance:*	6.54 (1.62); 6.5 (5.75, 8)[a]
• Pre-transplant HLA Immunologic risk evaluation should not exclude an otherwise acceptable donor from LDLT	*Impact:* *Feasibility:*	6.81 (1.79); 7 (6, 8)[a] 6.70 (1.86); 7 (5, 8)
• HLA Immunological risk stratification in certain donor/recipient pairs may guide-post transplant immunosuppression minimization and optimize long term outcomes	*Impact:* *Feasibility:*	6.68 (1.67); 7 (6, 8)[a] 6.62 (1.54); 7 (6, 7)[a]
• For recipients with high immunologic risk, LDLT may offer an opportunity to optimize immunologic-related outcomes	*Impact:* *Feasibility:*	6.91 (1.74); 7 (6, 8)[a] 6.70 (1.57); 7 (6, 7)[a]
• Data regarding LDLT in recipients with high immunologic risk should be disseminated via educational webinars, list serves, and lecture series.	*Impact:* *Feasibility:*	6.81 (1.66); 7 (6, 8)[a] 6.60 (1.74); 7 (6, 8)[a]

Note: Barriers ordered from highest to lowest rated priority. Response options rated from 9 = very important, very impactful, or very feasible to 1 = unimportant, not impactful, or not feasible.
[a]Indicates consensus was not met across responses, based upon above outlined consensus methods.

Conference participants agreed that Western centers need to start collecting granular data about the reasons potential LLDs are ruled out, because currently this process is opaque and therefore cannot be studied adequately (Table 1). The opinion of the consensus conference was that exclusion based on potential LLD age is currently an important barrier to expansion of LDLT. There was agreement that upper age cutoffs vary among centers, outcomes in recipients of grafts from older living donors are generally acceptable, and the donor operation is safe in properly selected older living donors. The group did not reach a consensus regarding the feasibility of recommendations for utilization of older living donors in the setting of recipient characteristics (MELD score, age). There was also no consensus that LPE could be a potential solution to match older living donors to appropriate recipients if age is the sole criterion to exclude a potential LLD.

2.4 | ABO incompatibility is an absolute contraindication to LDLT in most transplant programs

ABOi is a frequent cause for potential LLD exclusion in the Western world. In Asian countries with limited access to deceased liver donors, initial outcomes in ABOi LDLT were poor, but with the advent of desensitization with rituximab in the early 2000s, outcomes improved dramatically.[29,30]

Despite these advances, the risk of antibody mediated rejection resulting in diffuse ischemic cholangiopathy in approximately 5–7% of cases, for which there are limited treatment options outside re-transplantation, has resulted in significant reluctance to undertake ABOi LDLT in the West. Adding to this hesitance is the lack of consensus about an optimal ABOi protocol. Currently, only a single US center performs ABOi LDLT, and they have done only a small number of these transplants to date. However, ABOi LDLT may be an option for patients in the United States without access to LPE.

There was clear consensus that ABOi LDLT does not increase risk in infants, but there was reluctance to support widespread utilization of ABOi LDLT in older children or adult recipients currently (Table 1). There was concern that, like the Western experience with ABOi kidney transplant, unforeseen immune challenges in Western populations might occur more frequently than the 5–7% rate seen in Asian populations. Also, a recipient in the United States with diffuse intrahepatic cholangiopathy has limited access for re-transplant. Consensus conference participants also commented that variability in insurance reimbursement for desensitization might be a barrier for centers interested in starting an ABOi program. The group recommended best practices surrounding these health care insurance issues could be gleaned from centers performing ABOi living donor kidney transplantation, and that significantly more data was needed from the small number of ABOi LDLTs at Western centers in the form of a registry. In addition, centers would be more likely to consider ABOi LDLT if a clearly defined antibody titer cut-off was established, and a single protocol for desensitization and monitoring after transplant could be agreed upon. Last, there was concern that centers would be reluctant to consider ABOi LDLT unless the United Network for Organ Sharing (UNOS) granted exception points for recipients with graft loss due to diffuse ischemic cholangiopathy, to allow expedient access to re-transplant.

2.5 | Role of HLA antibody testing in liver transplantation

Several reports have associated a high-level preexisting and de novo post-transplant donor-specific antibodies (DSA) with worse liver transplant outcomes, including ductopenia and fibrosis, plasma cell hepatitis, biliary strictures, accelerated fibrosis associated with recurrent liver disease as well as worse graft and patient survival.[31–36]

However, these reports are mainly based on studies in deceased donor liver transplantation (DDLT), whereas the role of HLA antibodies in LDLT is less studied. Therefore, pre-transplant DSA assessment can be utilized as an immunologic risk stratification measure, to guide post-transplant transfusion and immunosuppression management,[37–39] rather than an exclusion criterion of an otherwise acceptable donor for LDLT. HLA antibody-based risk stratification in LDLT recipients with

Received: 28 December 2022 | Revised: 27 February 2023 | Accepted: 5 March 2023

DOI: 10.1111/ctr.14968

Clinical TRANSPLANTATION
The Journal of Clinical and Translational Research
WILEY

ORIGINAL ARTICLE

Advances and innovations in living donor liver transplant techniques, matching and surgical training: Meeting report from the living donor liver transplant consensus conference

Mark Sturdevant[1] | Swaytha Ganesh[2] | Benjamin Samstein[3] | Elizabeth C. Verna[4] | Manuel Rodriguez-Davalos[5] | Vineeta Kumar[6] | Marwan Abouljoud[7] | Oya Andacoglu[8] | Medhat Askar[9] | Dieter Broering[10] | Juliet Emamaullee[11] |

[12]National Center for Child Health and Development, Tokyo, Japan

[13]Yale School of Medicine and Yale New Haven Transplant Center, New Haven, Connecticut, USA

[14]Department of Medicine, University of Wisconsin, Madison, Wisconsin, USA

[15]University of Chicago Medicine, Chicago, Illinois, USA

[16]Department of Surgery, University of California San Francisco, San Francisco, California, USA

[17]Ajmera Transplant Center, University of Toronto, Toronto, Canada

[18]University School of Medicine, Izmir, Turkey

Correspondence
Mark Sturdevant, Department of Surgery, University of Washington, 1959 NE Pacific, Seattle, WA 98195, USA.
Email: sturde@uw.edu

Mark Sturdevant and Swaytha Ganesh are co-first authors.

Nazia Selzner Sukru Emre are co-senior authors.

Abstract

The practice of LDLT currently delivers limited impact in western transplant centers. The American Society of Transplantation organized a virtual consensus conference in October 2021 to identify barriers and gaps to LDLT growth, and to provide evidence-based recommendations to foster safe expansion of LDLT in the United States. This article reports the findings and recommendations regarding innovations and advances in approaches to donor-recipient matching challenges, the technical aspects of the

TABLE 1 (Continued)

#Priority importance of barrier strategy(ies)	Consensus responses mean (SD); median (IQR)	
#9 Role for alloantibody testing in liver transplantation, and LDLT, remains unclear.	*Importance:*	6.54 (1.62); 6.5 (5.75, 8)[a]
• Pre-transplant HLA Immunologic risk evaluation should not exclude an otherwise acceptable donor from LDLT	*Impact:* *Feasibility:*	6.81 (1.79); 7 (6, 8)[a] 6.70 (1.86); 7 (5, 8)
• HLA Immunological risk stratification in certain donor/recipient pairs may guide post-transplant immunosuppression minimization and optimize long term outcomes	*Impact:* *Feasibility:*	6.68 (1.67); 7 (6, 8)[a] 6.62 (1.54); 7 (6, 7)[a]
• For recipients with high immunologic risk, LDLT may offer an opportunity to optimize immunologic-related outcomes	*Impact:* *Feasibility:*	6.91 (1.74); 7 (6, 8)[a] 6.70 (1.57); 7 (6, 7)[a]
• Data regarding LDLT in recipients with high immunologic risk should be disseminated via educational webinars, list serves, and lecture series.	*Impact:* *Feasibility:*	6.81 (1.66); 7 (6, 8)[a] 6.60 (1.74); 7 (6, 8)[a]

Note: Barriers ordered from highest to lowest rated priority. Response options rated from 9 = very important, very impactful, or very feasible to 1 = unimportant, not impactful, or not feasible.

[a]Indicates consensus was not met across responses, based upon above outlined consensus methods.

1. **Diffüz iskemik kolanjiopati ile sonuçlanan AMR'nin en önemli nedenlerinden biri**
2. **Optimal ABO-i protokolü yok**
3. **Re-transplantasyon dışında tedavi seçenekleri sınırlı**
4. **Batıda ABO-i LDLT yapmaya isteksizlik var**
5. **US'de 1 merkez az sayıda ABO-i LDLT yapıyor**
6. **LPE olanağı yoksa ABO-i LDLT bir seçenek olabilir**

ABOi is a frequent cause for potential LLD exclusion in the Western world. In Asian countries with limited access to deceased liver donors, initial outcomes in ABOi LDLT were poor, but with the advent of desensitization with rituximab in the early 2000s, outcomes improved dramatically.[29,30]

Despite these advances, the risk of antibody mediated rejection resulting in diffuse ischemic cholangiopathy in approximately 5-7% of cases, for which there are limited treatment options outside re-transplantation, has resulted in significant reluctance to undertake ABOi LDLT in the West. Adding to this hesitance is the lack of consensus about an optimal ABOi protocol. Currently, only a single US center performs ABOi LDLT, and they have done only a small number of these transplants to date. However, ABOi LDLT may be an option for patients in the United States without access to LPE.

There was clear consensus that ABOi LDLT does not increase risk in infants, but there was reluctance to support widespread utilization of ABOi LDLT in older children or adult recipients currently due to diffuse ischemic cholangiopathy, to allow expedient access to re-transplant.

2.5 | Role of HLA antibody testing in liver transplantation

Several reports have associated a high-level preexisting and de novo post-transplant donor-specific antibodies (DSA) with worse liver transplant outcomes, including ductopenia and fibrosis, plasma cell hepatitis, biliary strictures, accelerated fibrosis associated with recurrent liver disease as well as worse graft and patient survival.[31–36]

However, these reports are mainly based on studies in deceased donor liver transplantation (DDLT), whereas the role of HLA antibodies in LDLT is less studied. Therefore, pre-transplant DSA assessment can be utilized as an immunologic risk stratification measure, to guide post-transplant transfusion and immunosuppression management,[37–39] rather than an exclusion criterion of an otherwise acceptable donor for LDLT. HLA antibody-based risk stratification in LDLT recipients with

İNÖNÜ UNIVERSITY
LIVER TRANSPLANT INSTITUTE
2011

Karaciğer Naklinde Uyumsuz Canlı Donör Sorununun Çözümü

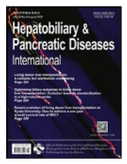
- **ABO-uyumsuz Karaciğer Nakli**
- **Liver Paired Exchange (Çapraz Karaciğer Nakli)**

Hepatobiliary & Pancreatic Diseases International 19 (2020) 342–348

Contents lists available at ScienceDirect

Hepatobiliary & Pancreatic Diseases International

journal homepage: www.elsevier.com/locate/hbpd



Review Article on Living Donor Liver Transplantation

Challenge to ABO blood type barrier in living donor liver transplantation

Hiroto Egawa

Department of Gastroenterology, Tokyo Women's Medical University, Tokyo, Japan

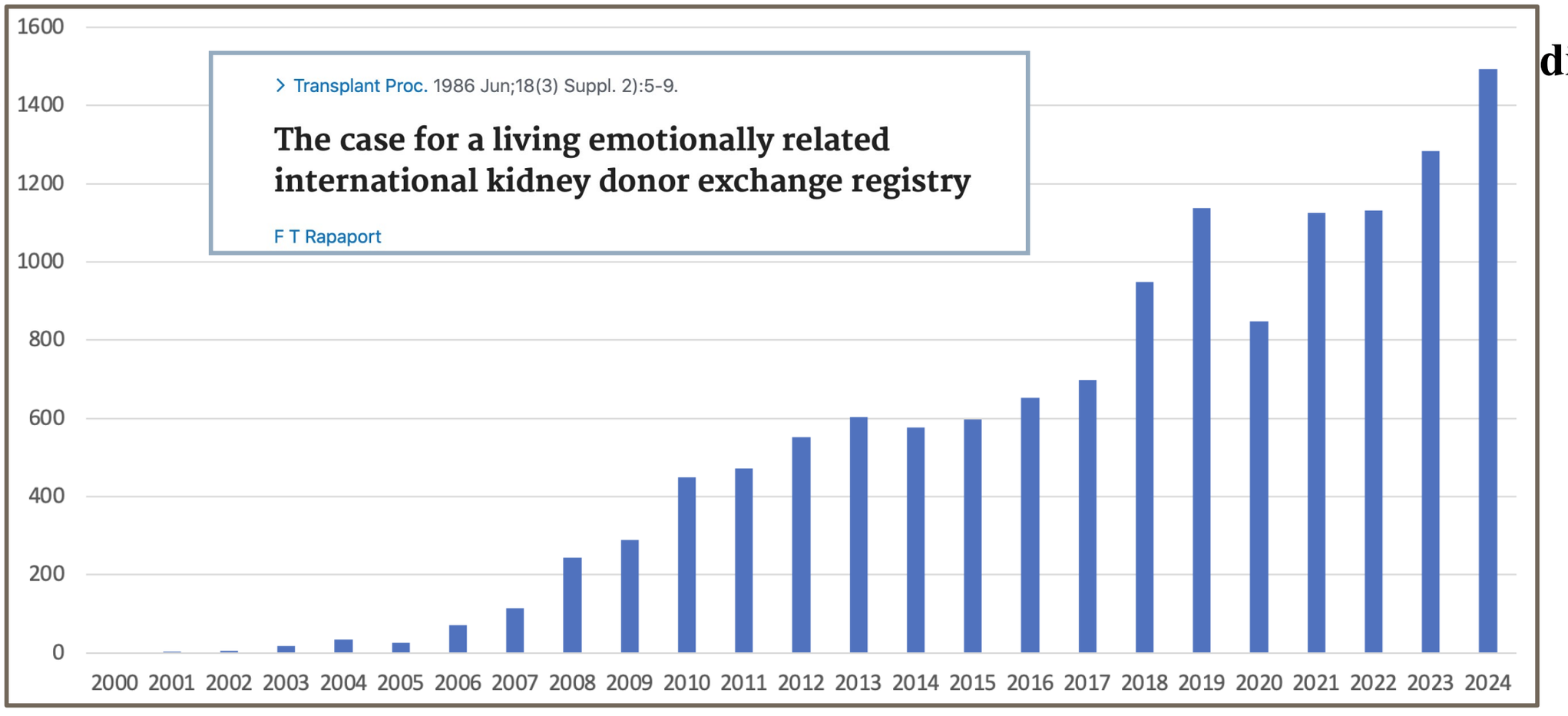
ARTICLE INFO

Article history:
Received 10 June 2020
Accepted 20 June 2020
Available online 30 June 2020

Keywords:
ABO blood type
Living donor liver transplantation
Antibody mediated rejection

ABSTRACT

ABO incompatible living donor liver transplantation has the potential to expand the donor pool for patients with end stage liver diseases on the expense of challenges to overcome immunological barriers across blood type. There is a profound impact of age on incidence and severity of antibody mediated rejection (AMR). Even children older than 1 year have chances of AMR; children aged 8 years or older have risks of hepatic necrosis similar to adult liver recipients. The mechanism of AMR is based on circulatory disturbances secondary to inflammation and injury of the vascular endothelium caused by an antibody-antigen-complement reaction. The strategy to overcome ABO blood type barrier is based on both pre-transplant desensitization and adequate treatment of this phenomenon. Nowadays, rituximab is the standard means of desensitization but unfortunately an insufficient aid to treat AMR. Because of low incidence (less than 5% in the rituximab era), in practice of AMR only some case reports about the treatment of clinical AMR are available in the literature. Initial experiences revealed that the proteasome inhibitor, bortezomib might be a promising treatment based on its capacity to deplete plasma cell agents. Although ABO blood type barrier has been counteracted in 95% of patients by applying "rituximab-desensitization", many issues, such as prediction of high-risk patients of infection and AMR and secure treatment strategies for evoked AMR, remain to be resolved.



> Transplant Proc. 1986 Jun;18(3) Suppl. 2):5-9.

The case for a living emotionally related international kidney donor exchange registry

F T Rapaport

dir ve

- **ABD’de KPE yoluyla yapılan yıllık nakil sayısı 2024 yılında yaklaşık 1.500’e ulaşmıştır. Bu, canlı donörden yapılan tüm böbrek nakillerinin yaklaşık %20’sini oluşturmaktadır ve 2000’li yılların başına kıyasla 100 katın üzerinde bir artış anlamına gelmektedir.**

Kidney Paired Exchange

ABO-i veya HLA-i canlı donörlere sahip iki veya daha fazla böbrek yetmezlikli hastanın, donörlerini takas ederek biyolojik olarak uyumlu donörlere sahip olması

Liver Paired Exchange

- **Çapraz karaciğer nakilleri, “canlı donör uyumsuzluk” sorunlarının üstesinden gelmek için, hastaların uyumsuz canlı donörlerini takas etmek suretiyle transplantasyonuna olanak sağlayan yenilikçi bir yaklaşımdır**

Two-way Exchange

Ahmet is a blood type A liver patient. His wife, Bahar, is willing to donate a lobe of her liver to Ahmet. However, having blood type B, Bahar cannot donate...

Three-way Exchange

Cüneyt is a liver patient with blood type O. Alp is willing to donate a liver lobe to his brother Cüneyt, but due to blood type incompatibility (his blood type...

Four-way Exchange

This example closely follows the world's first 4-way liver paired exchange that occurred in our institution in July 2022. Deniz is a pediatric liver patient with blood type A, weighing...

Liver Paired Exchange (LPE)

- **2010'ların ortalarında, dünya genelinde KPE programları olgunlaşmaya başladıkça, piyasa tasarımcılarının ilgisi LPE kaydı. LPE ile KPE'ye kıyasla çok daha büyük sağlık kazanımları elde edilebiliyordu.**
  - İlk LPE 2003 yılında Seul, Kore'de gerçekleştirildi (Hwang ve ark., 2010).
  - 2003–2022 arasındaki yirmi yıllık dönemde, dünya genelinde yayınlanmış toplam LPE nakil sayısı 250'nin altındaydı ve bunların çoğu Hindistan ile Güney Kore'den raporlanmıştı.

ECONOMETRICA: MAY, 2020, VOLUME 88, ISSUE 3

Efficient and Incentive-Compatible Liver Exchange

https://doi.org/10.3982/ECTA16400
p. 965-1005

Haluk Ergin, Tayfun Sönmez, M. Utku Ünver

Liver Paired Exchange: Indications

- ABO-incompatibility
- Suboptimal graft volume
- Suboptimal remnant liver volume
- Anatomical variations that may reduce the success of transplantation
- Altruistic compatible pairs

LPE in Inonu University - Malatya

- **In the late 2010s, market designer in Boston began searching for liver-transplant centers willing to pilot their ideas**

- **Five simultaneous living donor liver transplantations were performed in Malatya, in June 2019, as a reherseal to LPE**

- **After visiting of the market designers in July 2019, two foundation signed an agreement to launch a joint liver-exchange program**

ELSEVIER

Multiple Swaps Tested: Rehearsal for Triple and Five-Liver Paired Exchanges

Sezai Yilmaz*, Ahmet Kizilay, Nuru Bayramov, Ahmet Tekin, and Sukru Emre

Department of Surgery and Liver Transplantation Institute, Inonu University, Malatya, Turkey

ABSTRACT

Despite several advances in living donor liver transplant (LDLT), many potential living liver donors cannot donate their organs to their relatives because of blood group incompatibility and unsuitable anatomy. Liver paired exchange (LPE) can be used to overcome incompatibilities between living donor–recipient pairs. In this study, we report the early and late results of 3 and 5 LDLTs performed simultaneously to initiate the more complex LPE program. By demonstrating that our center is capable of performing up to 5 LDLTs, we have taken an essential step for establishing a complex LPE program.

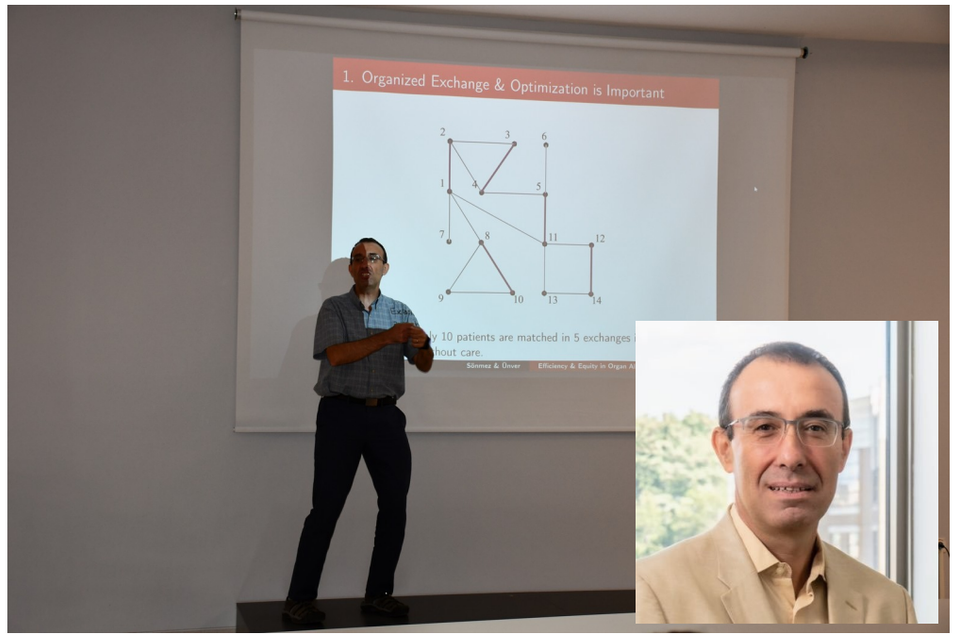
A major challenge in the liver transplantation field is the insufficient number of donors compared with the growing demand by transplant candidates. Many strategies to overcome the organ shortage have been developed, including extended criteria donors and living donor liver transplant (LDLT). The advent of LDLT, which started in the late 1980s, became a standard operation of liver transplantation centers after a decade. This was especially true for Asian countries because deceased donor donation is very scarce due to cultural problems. Similarly, transplant centers in Turkey have been performing LDLT with an increasing frequency [1]. Because LDLT provides equal or even better results for both chronic and acute liver failure, transplant surgeons are faced with an obligation to perform multiple LDLT procedures, including both planned and emergency LDLT, simultaneously. A few centers have published that they performed a very high volume of liver transplants (LTs) in 1

MATERIALS AND METHODS

Between March 2002 and September 2021, a total of 3053 LT procedures were performed in our liver transplantation institute. Of these, 2571 (84.2%) were LDLTs and 482 (15.8%) were deceased donor LTs. Until the second half of 2019, multiple LDLTs in same day were tried twice. To summarize, in June 2018, we performed 3 simultaneous LDLTs on the same day. Demographic and clinical features of the recipients are given in Table 1. Three simultaneous LDLTs was probably a world first. Until then, some days we had 3, 4, or even 5 LTs in different time periods on the same day. However, not all of them were LDLTs; 1 or 2 were deceased donor LTs. These multiple transplants were made because of urgent patient needs. For a liver transplantation center to achieve these, it must have enough highly experienced surgical, anesthesia, and nurse teams; technical equipment; and the physical facility including the operating rooms and intensive care units. Inonu University Liver Transplantation Institute has 12 operating theatres, 3 intensive care units (each with a capacity of 12 patients), and 116 inpatient beds.

İNÖNÜ UNIVERSITY
LIVER TRANSPLANT INSTITUTE
2011

Prof Tayfun Sönmez
Boston College MA, US
August 2019



Prof Utku UNVER
Boston College, MA, US
August 2022

Boston College'den ekonomi tasarımcılarıyla birlikte çalışarak çoklu (multi-way) LPE programını geliştirdik.

En uygun donör-alıcı eşleşmelerini oluşturmak için «running matching algorithm» model kullanıldı.

BANU BEDESTENCİ SÖNMEZ KARACİĞER ÇAPRAZ NAKİL SİSTEMİ
İNÖNÜ ÜNİVERSİTESİ

Türkiye’de Liver Paired Exchange ile ilgili Günceller

- **Üç yıllık COVID gecikmesinin ardından, Ekim 7, 2021’de başlayan programımız, üç kez yapılan 2-way LPE sonrası, dünyanın ilk 4’lü (4-way) LPE nakilleri pilot programın ilk yılında, Malatya’yı vuran yıkıcı 7,8 büyüklüğündeki depremden önce gerçekleştirildi (Temmuz 5, 2022).**

- **BBS-LPE sistemi öncesinde, hiçbir sistem, hepsi 2-way LPE olmak üzere, bir yıl içinde 10’dan fazla karaciğer değişim nakli bildirmemişti (sadece Pakist**

Figure 2. (a, b) City center after the earthquake. **(a)** Grand Mosque, **(b)** Grand Bazaar.

İNÖNÜ UNIVERSITY
LIVER TRANSPLANT INSTITUTE
2011

2022 July
4-way liver paired exchange / swap liver transplantation
(First in the World)

İNÖNÜ UNIVERSITY
LIVER TRANSPLANT INSTITUTE
2011

First 3-way Liver Paired Exchange
(March 17, 2022)

Launching Liver Exchange and the First 3-Way Liver Paired Donation

Saad Salman, MD, MPH; Muhammad Arsalan, MBBS; Faisal Saud Dar, MBBS

What Is the Innovation?

There is a shortage of transplantable organs almost everywhere in the world. In the US, about 6000 transplant candidates die waiting each year.[1] In Pakistan, 30% to 50% of patients who needed a liver transplant are unable to secure a compatible donor, and about 10 000 people die each year waiting for a liver.[2] Kidney paired donations, supported by Nobel Prize–winning kidney exchange (KE) algorithms,[3] have enabled living donor kidneys to become an important source of kidneys. Exchanges supported by algorithms that systematically identify the optimal set of paired donations has yet to take hold for liver transplant.

The innovation reported here is the successful implementation of a liver exchange mechanism[4] that also led to 3 liver allotransplants and 3 hepatectomies between 3 incompatible patient-donor pairs with living donor–patient ABO/size incompatibilities. These were facilitated by one of the world's first documented 3-way liver paired donations (LPD) between patient-donor pairs.

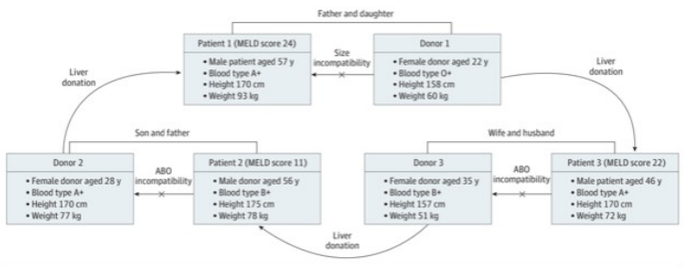
Since 2018 and 2019, we have explored LPD as a strategy to overcome barriers for liver failure patients in Pakistan in collaboration with economist Alex Chan, MPH.[2] With LPD, the incompatibility issues with relative donors can be solved by exchanging donors. The Pakistan Kidney and Liver Institute (PKLI) adopted a liver exchange algorithm developed by Chan[4] to evaluate LPD opportunities that prioritizes clinical urgency (Model for End-stage Liver Disease [MELD] scores) while maximizing transplant-enabling 2-way or 3-way swaps that ensures that hepatectomies for every donor within each swap has comparable ex ante risk (to ensure fairness). As of March 2022, 20 PKLI liver transplant candidates had actively coregistered living and related but incompatible liver donors. Evaluating these 20 incompatible patient-donor pairs with the algorithm,[4] we found 7 potential transplants by two 2-way swaps and the 3-way swap reported. In contrast to ad hoc manual identification of organ exchange opportunities, the hallmark of a scalable organ exchange program is the regular deployment of algorithms to systematically identify possible exchanges. Regular deployment of LPD algorithms is novel.

A total of 6 procedures took place on March 17, 2022. Patient 1, a 57-year-old man, received a right liver lobe from donor 2, a 28-year-old coregistered donor of patient 2 (56-year-old man), who in turn received a right liver lobe from donor 3, a 35-year-old woman who was a coregistered donor of patient 3. Patient 3, a 46-year-old man, received a right liver lobe from donor 1, a 22-year-old woman who was a coregistered donor of patient 1, completing the cycle (**Figure**). Five PKLI consultant surgeons and 7 senior registrars led the hepatectomies and liver allotransplants; 6 operating rooms were used simultaneously. One month post-surgery, all patients and donors are robust with no graft rejection. All the donors are doing well in the follow-up visits and have shown no psychological issues.

What Are the Key Advantages Over Existing Approaches?

Currently, there are a handful of cases of LPDs in Asia and North America (all high-income countries) and arranged manually involving only 2 incompatible patient-donor pairs at a time.[5-7] The focus on only 2-way liver exchanges was probably necessitated by the manual approach and concerns with the logistics of organizing 6 simultaneous procedures. Matching mechanisms tailored to the practical needs of liver transplant and the operational experience to facilitate LPD were not available before the innovation outlined. We achieved a proof-of-concept in medical operations in a low- and middle-income country that can provide a template for how to proceed for transplant centers around the world, including the US.

Figure. Three-Way Liver Exchange on March 17, 2022



MELD indicates Model for End-stage Liver Disease.

KEs have not been applied to LPD because of some differences between livers and kidneys. First, a liver donation can involve the donor's left lobe or the right lobe. Resecting the latter carries a 5-fold greater risk of postoperative complications, so LPD must identify exchanges that do not expose one donor to much higher risks than the other donor within a swap. Second, patients with liver failure do not have the outside option of dialysis. While the primary objective of KEs is to maximize the number of swaps, LPD needs to prioritize exchanges based on potential patient mortality. LPD algorithms[2] differ from KE algorithms by accounting for MELD score and graft size and optimizing to look for the most MELD score–weighted swaps (swaps involving the most patients with the highest MELD scores) that are same-lobe exchanges (left lobe for left lobe or right lobe for right lobe).

How Will This Affect Clinical Care?

As more than 90% of liver transplants in Pakistan and many Asian countries depend on living donors,[2] LPD can increase access to liver transplant. Anecdotes of patients in low- and middle-income countries with no legal compatible donor having to travel abroad to undergo liver transplant under dubious circumstances, often engaging black markets for organs, are common. LPD can offer a safe, legal alternative to these people.

Is There Evidence Supporting the Benefits of The Innovation?

As of March 2022, 20 PKLI liver transplant candidates had actively coregistered living and related but incompatible liver donors. These patients were aged 21 to 70 years. No transplant could readily result from direct donations among these pairs, and deceased donors are scant. Patients with liver failure with only incompatible donors face grim prospects. LPD can increase access to liver transplant as it did for these 20 patients, with the potential to lower waitlist mortality.

What Are the Barriers to Implementing This Innovation More Broadly?

Donors might be less comfortable donating a liver lobe to a stranger even if it will lead to a life-saving surgery for a loved one. Adopting a multidisciplinary approach that incorporates social workers, psychologists, and clergy to educate and support patients and donors will be a prerequisite. It is best practice to take additional measures to ensure donor psychologic safety after donation (to an unrelated patient).

Logistics might pose challenges because of the multiple simultaneous procedures, especially if the LPD took place across multiple transplant centers. While our experience is with a single center, the experience with KE encourages us to be optimistic that LPD can be scaled to multiple centers or even nations.

In What Time Frame Will This Innovation Likely Be Applied Routinely?

Currently, LPD facilitated by a systematic and regular liver exchange mechanism is already active in Pakistan. In other countries with experience in manually identifying LPD opportunities, adopting a mechanism like ours and exploring 3-way exchanges will be a natural next step soon.

ARTICLE INFORMATION

Author Affiliations: Harvard School of Public Health, Harvard University, Boston, Massachusetts (Salman); Pakistan Kidney and Liver Institute, Lahore, Pakistan (Arsalan, Dar).

Corresponding Author: Saad Salman, MD, MPH, Harvard School of Public Health, Harvard University, 665 Huntington Ave, Boston, MA 02115 (saad.salman@mail.harvard.edu).

Section Editor: Justin B. Dimick, MD, MPH.

Published Online: December 7, 2022. doi:10.1001/jamasurg.2022.5440

Conflict of Interest Disclosures: None reported.

Additional Contributions: We thank the patients for granting permission to publish this information. We thank Alex Chan, MPH (Stanford University, Palo Alto, California), whose initiative and expertise in economics were the key driving forces for launching liver exchange. We thank Ihsan Ul Haq, MBBS, Sohail Rashid, MBBS, M. Yasir Khan, MBBS, and Siraj Haider, MBBS (Pakistan Kidney and Liver Institute, Lahore, Pakistan), who led the procedures as part of the 3-way liver paired donations reported here. Contributors were compensated for their work.

Submissions: Authors should contact Justin B. Dimick, MD, MPH, at jdimick@med.umich.edu if they wish to submit Surgical Innovation papers.

REFERENCES

1. Chan A, Roth AE. Regulation of organ transplantation and procurement: a market design lab experiment. Accessed April 28, 2022. https://www.alexchan.net/_files/ugd/a47645_99b1d4843f2f42beb95b94e43547083b.pdf

2. Salman S, Gurev S, Arsalan M, Dar F, Chan A. Liver exchange: a pathway to increase access to transplantation. Accessed April 1, 2022. http://www.hhpronline.org/articles/2021/1/14/liver-exchange-a-pathway-to-increase-access-to-transplantation

3. Henderson D. On marriage, kidneys and the Economics Nobel. *Wall Street Journal*. October 15, 2012. Accessed March 5, 2022. https://www.wsj.com/articles/SB10000872396390443675404578058773182478536

4. Chan A. Optimal liver exchange with equipoise. Accessed April 23, 2022. https://www.alexchan.net/_files/ugd/a47645_36e252f4df0c4707b6431b0559b03143.pdf

5. Hwang S, Lee SG, Moon DB, et al. Exchange living donor liver transplantation to overcome ABO incompatibility in adult patients. *Liver Transpl*. 2010;16(4):482-490. doi:10.1002/lt.22017

6. Patel MS, Mohamed Z, Ghanekar A, et al. Living donor liver paired exchange: a North American first. *Am J Transplant*. 2021;21(1):400-404. doi:10.1111/ajt.16137

7. Braun HJ, Torres AM, Louie F, et al. Expanding living donor liver transplantation: report of first US living donor liver transplant chain. *Am J Transplant*. 2021;21(4):1633-1636. doi:10.1111/ajt.16396

İNÖNÜ UNIVERSITY
LIVER TRANSPLANT INSTITUTE
2011

Second 3-way Liver Paired Exchange

(September 11, 2022)

Letter to the Editor

ILTS

Simultaneous 3-way Paired Exchange Liver Transplantation Without Nondirected Donation: Novel Strategy to Expand the Donor Pool

A.S. Soin, MS, FRCS,[1] Prashant Bhangui, MS,[1] Amit Rastogi, MS,[1] Tarun Piplani, MD,[2] Narendra Choudhary, DM,[1] Swapnil Dhampalwar, DM,[1] Fysal Kollantavalappil, MS,[1] Kamal Yadav, MS,[1] Ankur Gupta, MS,[1] Nikunj Gupta, MD,[3] Nishant Sharma, MD,[3] Pooja Bhangui, MD,[3] Manish Aneja, MD,[3] Vijay Vohra, MD,[3] and Neeraj Saraf, MD[1]

ABO incompatibility, donor liver steatosis, and low graft-to-recipient body weight ratio (GRWR) are the most common reasons for rejection of living liver donors. Apart from ABO-incompatible and dual-lobe living-donor liver transplantation (LDLT), the problems of blood group incompatibility and low GRWR can be overcome with paired exchange (PE)-LDLT. PE-LDLT between 2 recipient-donor pairs has been performed at many high-volume centers including ours (experience of 44 pairs to date) for over a decade,[1,2] as a strategy to expand the donor pool, by exchanging livers from medically fit donors who are blood group incompatible or have a small-for-size graft for their own relatives. In India, the Human Organ Transplantation Act does not permit nondirected donation[3] and allows PE-LDLT only between recipient–donor pairs who are spouses or first-degree relatives. We introduce a concept whereby 3 (or potentially more) such recipient–donor pairs can participate in a chain of transplants, with all the recipients benefitting by either receiving ABO-compatible grafts or adequate GRWR (Figure 1).

We recently performed India's first 3-way PE-LDLT without a nondirected donor, wherein 2 recipient–donor pairs participated to overcome ABO incompatibility, while in the third pair (recipient AB/donor O blood groups), the estimated GRWR with the right lobe was too low (0.57%) but was adequate for another recipient who sought a blood group–matched donor.

Table 1 illustrates how the 3-way PE benefitted all the recipients in the present report.

R1/D1 (recipient 1/donor 1) were husband and wife, R2/D2 (recipient 2/donor 2) were mother and son, and R3/D3 (recipient 3/donor 3) were husband and wife.

Table 2 shows the recipient and donor pretransplant status and posttransplant outcome parameters.

A thorough systemic, biochemical, imaging, and psychiatric pretransplant recipient and donor evaluation was performed for all the 3 pairs. As required for all LDLTs in India, an Ethics Committee (Authorization Committee) clearance was duly obtained.

All LDLTs were elective, modified right lobe transplants in stable recipients, and donors were all <50 y with no significant hepatic steatosis, and adequate future liver remnant. Two of the recipients and all 3 donors recovered uneventfully. The third recipient suffered a posttransplant hemorrhagic stroke that led to prolonged intensive care unit and hospital stay but is now functionally independent at home with normal liver graft function.

A simultaneous 3-way PE-LDLT poses significant ethical, logistic, and technical challenges. The ethical challenge is to ensure fairness in donor safety and recipient outcome for all the participating recipient–donor pairs.[4] With regard to logistics and technical expertise, we have a liver operating room complex comprising 6 operating rooms, a team of 19 liver transplant surgeons (9 surgical consultants and 10 fellows), enough trained anesthesiologists, and intensive care unit facilities to simultaneously manage 3 LDLTs perioperatively. Having previously performed 3 LDLTs on the same day a few times, we felt we were adequately equipped and hence proceeded with it.

Although all PE-LDLT recipients benefit from the exchange, we try to match the recipients for expected outcomes, such as excluding emergency transplants especially for acute liver failure where outcomes in recipients may not be comparable to elective LDLTs in stable recipients, and families may not have an adequate cooling-off period to understand the implications of their decision. We match potential PE recipient–donor pairs from a database of ABO mismatched pairs, and those with AB recipients or O group donors where the estimated GRWR is <0.7% for sick recipients.

Received 1 November 2022. Revision received 17 January 2023.

Accepted 2 February 2023.

[1] Medanta Institute of Liver Transplantation and Regenerative Medicine, Medanta-The Medicity, Delhi NCR, India.

[2] Department of Radiodiagnosis and Interventional Radiology, Medanta-The Medicity, Delhi NCR, India.

[3] Department of Liver Transplant and GI Anaesthesia, Medanta-The Medicity, Delhi NCR, India.

The authors declare no funding or conflicts of interest.

A.S.S. contributed to the concept, design, data analysis, writing, and critical review of the article. Pr.B. contributed to the concept, design, data collection and analysis, writing, and critical review of the article. A.R., T.P., N.C., S.D., F.K., K.Y., A.G., N.G., N.S., Po.B., M.A., V.V., and N.S. contributed to critical review of the article.

Correspondence: Prashant Bhangui, MS, Medanta Institute of Liver Transplantation and Regenerative Medicine, Medanta-The Medicity, Gurugram, Delhi NCR, India 122001. (pbhangui@gmail.com; prashant.bhangui@medanta.org)

ISSN: 0041-1337/20/1076-e175

DOI: 10.1097/TP.0000000000004578

American Journal of Transplantation xxx (xxxx) xxx

Contents lists available at ScienceDirect

American Journal of Transplantation

journal homepage: www.amjtransplant.org

Brief Communication

The first 4-way liver paired exchange from an interdisciplinary collaboration between health care professionals and design economists

Sezai Yilmaz [1,*], Tayfun Sönmez [2], M. Utku Ünver [2,3], Volkan Ince [1], Sami Akbulut [1], Burak Isik [1], Sukru Emre [1]

[1] *Inonu University Liver Transplant Institute, Malatya, Turkey*
[2] *Boston College, Department of Economics, Chestnut Hill, Massachusetts, USA*
[3] *Deakin University, Professorial Research Fellow, Burwood, Victoria, Australia*

ARTICLE INFO

Keywords:
liver paired exchange
liver paired donation
liver transplantation
living donors
living donor liver transplantation
economic design
4-way liver exchange

ABSTRACT

We report initial results of a liver paired exchange (LPE) program established at the Liver Transplant Institute at Inonu University through collaboration with design economists. Since June 2022, the program has been using a matching procedure that maximizes the number of living donor liver transplants (LDLTs) to the patients in the pool subject to the ethical framework and the logistical constraints of the program. In 1 4-way and 4 2-way exchanges, 12 LDLTs have been performed via LPE in 2022. The 4-way exchange, generated in the same match run with a 2-way exchange, is a first worldwide. This match run generated LDLTs for 6 patients, revealing the value of the capacity to carry out larger than 2-way exchanges. With only 2-way exchanges, only 4 of these patients would receive a LDLT. The number of LDLTs from LPE can be increased by developing the capacity to perform larger than 2-way exchanges in either high-volume centers or multicenter programs.

1. Introduction

In kidney paired exchange (KPE), 2 or more patients with ABO-incompatible (ABOi) or -human leukocyte antigen incompatible living donors exchange their donors to receive a transplant from a biologically compatible donor. A KPE with N $\geq$ 2 patient–donor pairs is called an N-way exchange. In order to mitigate kidney donor shortage for patients with end-stage renal disease, several regions and countries have adopted KPE programs since the early 1990s.[1–6] Although KPE was first proposed in 1986 by a health care professional,[7] starting with the mid-2000s, the number of transplants from KPE increased

Abbreviations: ABOc, ABO compatible; ABOi, ABO incompatible; ABOid, ABO identical; GRWR, graft-to-recipient weight ratio; HBV, hepatitis B virus; HCC, hepatocellular carcinoma; HCV, hepatitis C virus; HRS, hepatorenal syndrome; KPE, kidney paired exchange; LDLT, living-donor liver transplantation; LL, left lobe; LPE, liver paired exchange; MELD, model for end-stage liver disease; NASH, nonalcoholic steatohepatitis; PBC, primary biliary cholangitis; PELD, pediatric end-stage liver disease; RL, right lobe; SEG 2-3, segments 2 and 3 of the left lobe.

* Corresponding author. Sezai Yilmaz, Inonu University Liver Transplant Institute, Malatya, Turkey.
E-mail address: sezai.yilmaz@inonu.edu.tr (S. Yilmaz).

https://doi.org/10.1016/j.ajt.2023.06.016
Received 27 March 2023; Received in revised form 5 June 2023; Accepted 26 June 2023
Available online xxxx

- **Yilmaz ve ark. (2023) tarafından yayınlanan dünyanın ilk 4-way LPE'in, Temmuz 2023'te kamuoyuna duyurulması, sistemi tetikledi ve bu duyuru, bir dizi çığır açıcı gelişmenin önünü açtı. Temmuz 2023 duyurusundan sonra neler oldu?**

- **Ekim 2023'te dünyanın ilk 5-way LPE'i gerçekleştirildi**

- **Ocak 2024'te dünyanın ilk 6-way LPE'i gerçekleştirildi**

- **Mart 2024'te dünya genelinde 100 LPE naklini aşan ilk program olundu**

- **Temmuz 2024'te dünyanın ilk 7-way LPE'i gerçekleştirildi**

- **Ekim 2024'te bir takvim yılı içinde 100 LPE naklini tamamlayan ilk program olundu**

- **Mayıs 2025'te BBS-LPE öncesi 20 yıllık küresel toplamla eşleşecek şekilde 250 LPE naklini aşan ilk program olundu**

Analysis of kidney and liver exchange transplantation in India (2000–2025): a multicentre, retrospective cohort study

Vivek B. Kute,[a,**] Himanshu V. Patel,[a] Subho Banerjee,[a] Feroz Aziz,[b,c] Suraj M. Godara,[d] Shyam B. Bansal,[e] Anil K. Bhalla,[f] Pranjal Modi,[g] Ashish Sharma,[h] Viswanath Billa,[i] Sajith Narayanan,[b] Priyadarshi Ranjan,[j,k] Manish Singla,[l] Arvinder S. Soin,[m] Subhash Gupta,[n] Sandeep Guleria,[o] Prashant Bhangui,[m] Ankur Gupta,[m] Deepak S. Ray,[p] Divyesh P. Engineer,[a] Jamal Rizvi,[g] Vishal Parmar,[a] Madan M. Bahadur,[q] Sarbpreet Singh,[h] Ashay P. Shingare,[q] Bharat V. Shah,[r] Benil Hafeeq,[c] Ismail N. Aboobacker,[c] Shriganesh Barnela,[s] Munish Chauhan,[t] Santosh Varughese,[t] Dinesh Khullar,[u] Mohamed Rela,[v] Jatin Kothari,[i] Shrirang Bichu,[i,w] Dinesh Kumar,[e] Pratik Das,[p] Jyotish Chalil Gopinathan,[b,c] Jeethu Joseph Eapen,[t] Sushree Sashmita Das,[p] Sunil Prakash,[x] Anil Kumar BT,[y] Shriniwas Ambike,[z] Ravi Angral,[aa] Sanjiv Saxena,[ab] Suhas Bavikar,[ac] Vidyanand Tripathi,[ad] Sanjay Srinivasa,[ae] Umapati Hegde,[af] Vishwanath Siddini,[ag] Nisith Mohanty,[ah] Kim Jacob Mammen,[ai] Abi Abraham M,[aj] Divya Bajpai,[ak] Sanshriti Chauhan,[a] Anil Kumar,[al] Manish R. Balwani,[am,an,at,*] Hari Shankar Meshram,[a,at] Ravi Mohanka,[ao] Surendran Sudhindran,[ap] Gaurav Chaubal,[aq] Thiagarajan Srinivasan,[ar] and Ashwin Rammohan,[v] ISOT swap collaboration[as]

[a]Department of Nephrology, Smt. G R Doshi and Smt. K M Mehta Institute of Kidney Diseases and Research Center, and Dr. H L Trivedi Institute of Transplantation Sciences (IKDRC-ITS), Ahmedabad, Gujarat, India
[b]Department of Nephrology, Aster MIMS Hospital, Kozhikode, Kerala, India
[c]Department of Nephrology, IQRAA International Hospital and Research Centre, Kozhikode, Kerala, India
[d]Department of Nephrology, Mahatma Gandhi Medical College & Hospital, Jaipur, Rajasthan, India
[e]Department of Nephrology, Kidney & Urology Institute, Medanta, The Medicity, Gurgaon, Haryana, India
[f]Department of Nephrology, Sir Ganga Ram Hospital, New Delhi, India
[g]Department of Urology and Transplantation Surgery, IKDRC-ITS, Gujarat University of Transplantation Sciences (GUTS) Ahmedabad, Ahmedabad, Gujarat, India
[h]Department of Renal Transplant Surgery, Postgraduate Institute of Medical Education and Research, Chandigarh, India
[i]Department of Nephrology, Apex Kidney Foundation, Mumbai, Maharashtra, India
[j]Department of Transplant Surgery Fortis and Shalby Hospital Mohali, Punjab, India
[k]Department of Transplant Surgery Meliora Kidney and Urology Institute, Chandigarh, India
[l]Department of Nephrology, Max Super Specialty Hospital, Mohali, Punjab, India
[m]Institute of Liver Transplantation & Regenerative Medicine, Medanta - The Medicity, Gurugram, Haryana, India
[n]Liver Transplant and Gastrointestinal Surgery, Centre for Liver and Biliary Sciences, Max Super Speciality Hospital, Saket, New Delhi, India
[o]Department of Nephrology, Indraprastha Apollo Hospitals, New Delhi, India
[p]Department of Nephrology, Rabindranath Tagore International Institute of Cardiac Sciences, Kolkata, West Bengal, India
[q]Department of Nephrology, Jaslok Hospital and Research Centre, Mumbai, Maharashtra, India
[r]Department of Nephrology, Institute of Renal Sciences, Global Hospital, Mumbai, Maharashtra, India
[s]Department of Nephrology, Kamalnayan Bajaj Hospital, Aurangabad, Maharashtra, India
[t]Department of Nephrology, Christian Medical College and Hospital, Vellore, Tamil Nadu, India
[u]Department of Nephrology, Max Super Speciality Hospital, Saket, New Delhi, India
[v]The Institute of Liver Disease and Transplantation, Dr Rela Institute and Medical Centre, Bharath Institute of Higher Education and Research, Chennai, India
[w]Department of Nephrology, Bombay Hospital Institute of Medical Sciences, Mumbai, Maharashtra, India
[x]Department of Nephrology, BLK-Max Hospital, New Delhi, India
[y]Department of Nephrology, BGS Global Hospital, Bengaluru, Karnataka, India
[z]Department of Nephrology, Jehangir Hospital, Pune, Maharashtra, India
[aa]Department of Transplant Surgery Kidney Hospital and Lifeline Medical Institutions, Jalandhar, Punjab, India
[ab]Department of Nephrology, Pushpawati Singhania Research Institute Hospital, New Delhi, India
[ac]Department of Nephrology, MIT Hospital and Research Institute, Aurangabad, Maharashtra, India
[ad]Department of Nephrology, Bansal Hospital Bhopal, Madhya Pradesh, India
[ae]Department of Nephrology, Centre for Kidney and Diabetes Care, Bengaluru, Karnataka, India
[af]Department of Nephrology, Muljibhai Patel Urological Hospital, Nadiad, Gujarat, India
[ag]Department of Nephrology, Manipal Hospital, Bengaluru, Karnataka, India
[ah]Department of Nephrology, Apollo Hospitals Bhubaneshwar, Odisha, India

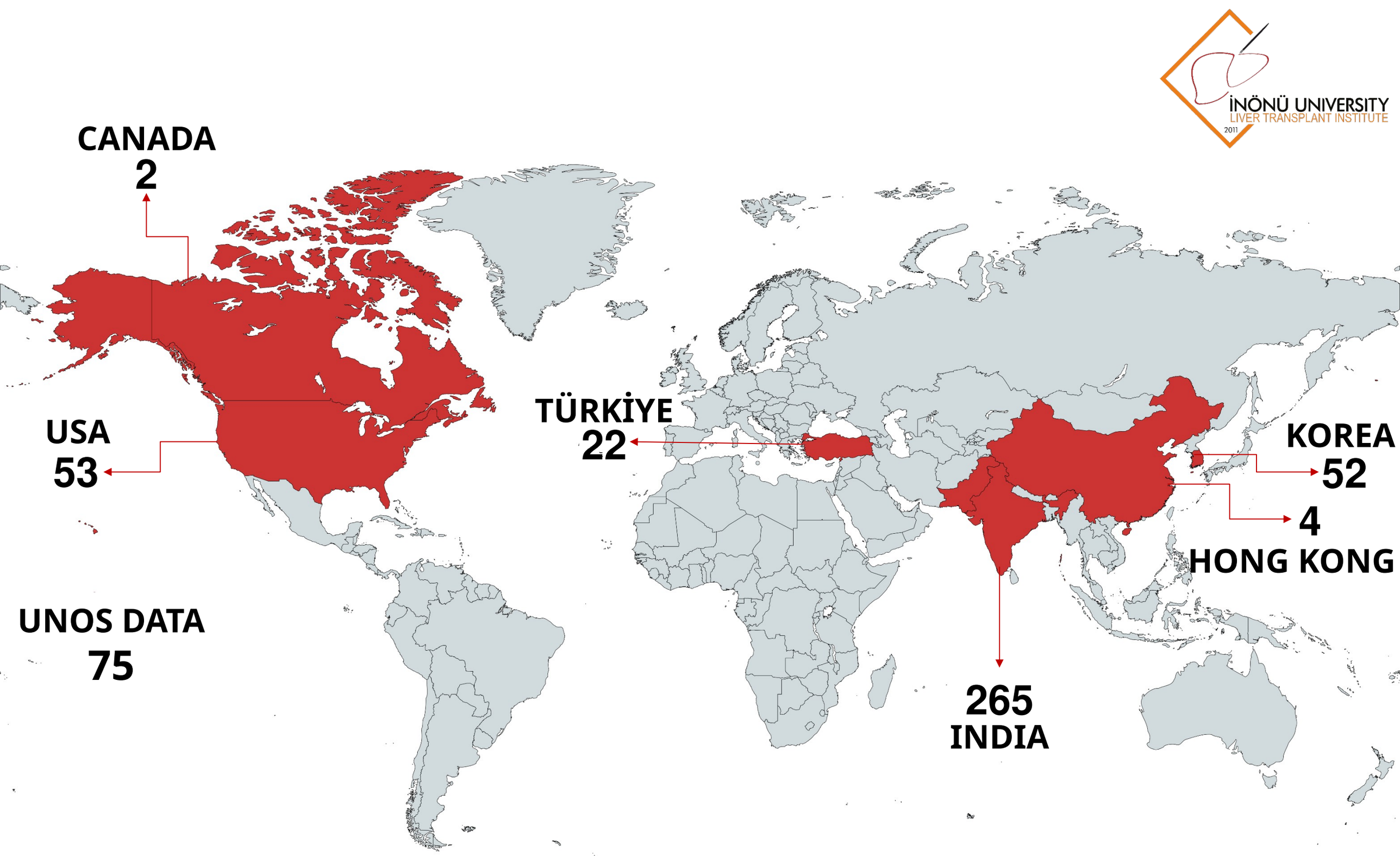
*Corresponding author. Department of Nephrology, Jawaharlal Nehru Medical College, Datta Meghe Institute of Higher Education and Research, Wardha, Maharashtra, India.
**Corresponding author. Department of Nephrology, Smt. G R Doshi and Smt. K M Mehta Institute of Kidney Diseases and Research Center, and Dr. H L Trivedi Institute of Transplantation Sciences (IKDRC-ITS), Ahmedabad, Gujarat, India.
E-mail addresses: balwani.manish@yahoo.com (M.R. Balwani), drvivekkute@rediffmail.com (V.B. Kute).
[as]Collaborating authors are listed at the Acknowledgements section.
[at]Senior Author.

İNÖNÜ UNIVERSITY
LIVER TRANSPLANT INSTITUTE
2011

- **2007-2025 (18 yıl)**
- **9 merkezde 265 LPE**
- **125 kez 2-way LPE (250)**
- **3 kez 3-way LPE (9)**

- **En fazla yapan merkez**
- **57 kez 2-way LPE (104),**
- **3 kez 3-way LPE (9)**

İNÖNÜ UNIVERSITY
LIVER TRANSPLANT INSTITUTE
2011

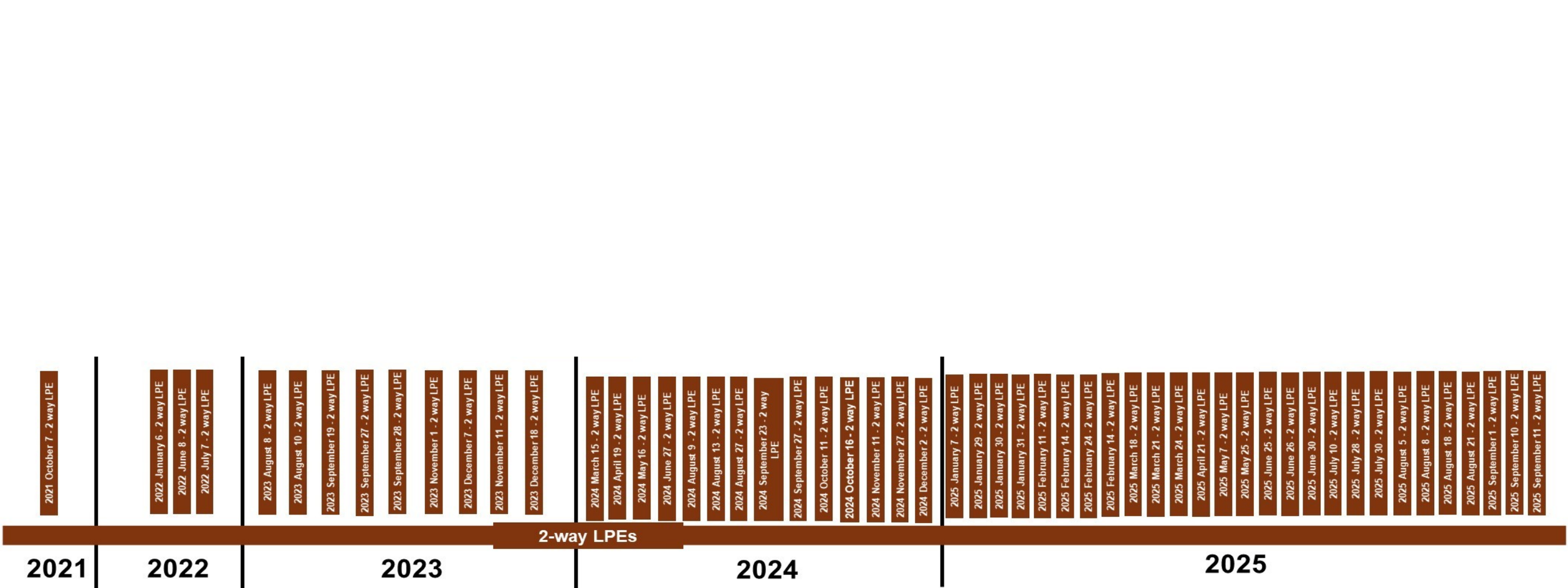



398 LPE
2003
2025

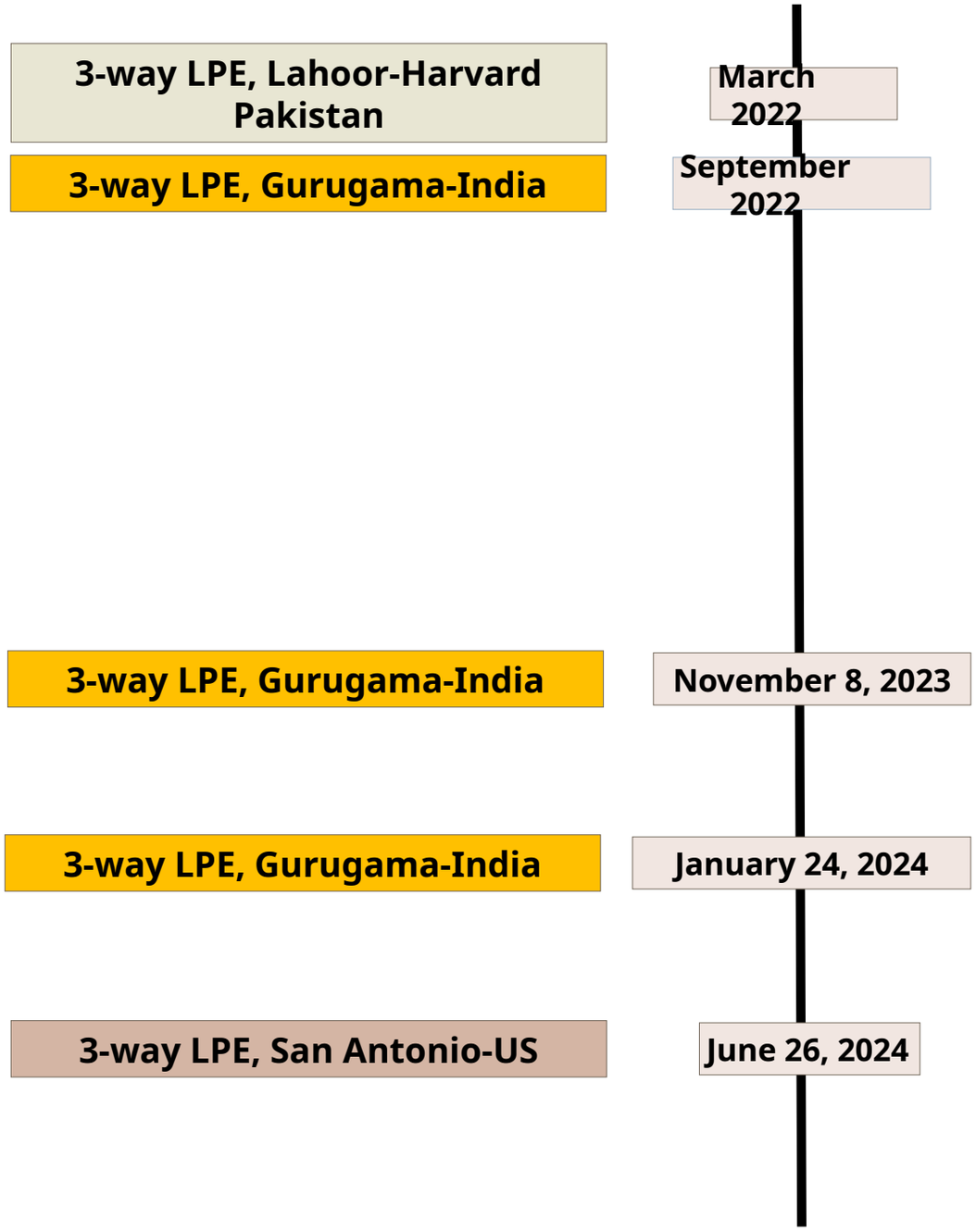

323 LPE
2022
2025

İNÖNÜ UNIVERSITY
LIVER TRANSPLANT INSTITUTE
2011

56 times 2-way LPEs were performed in Malatya

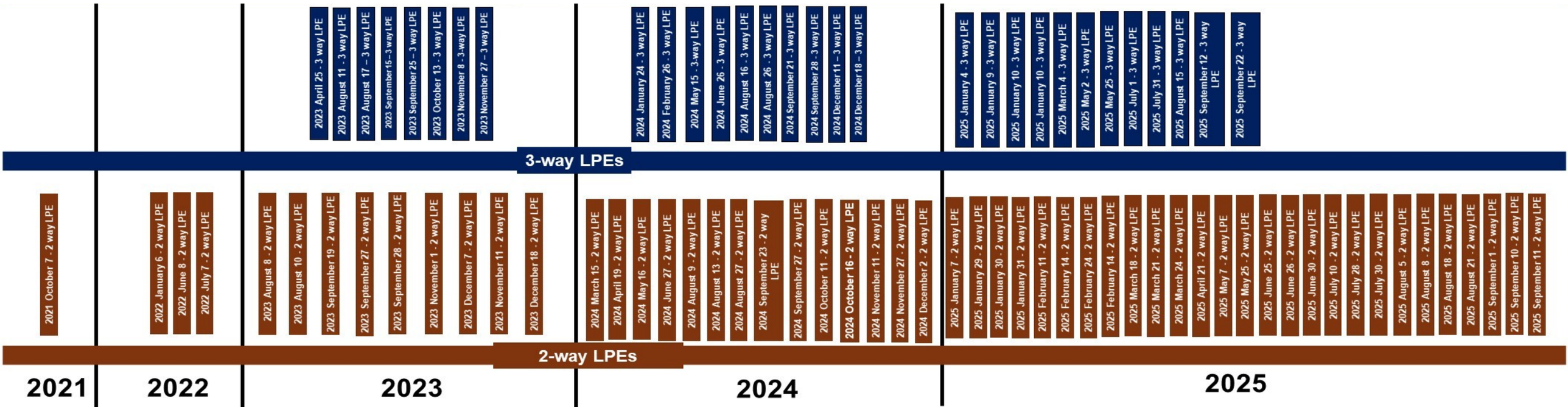


3-way Liver Paired Exchanges



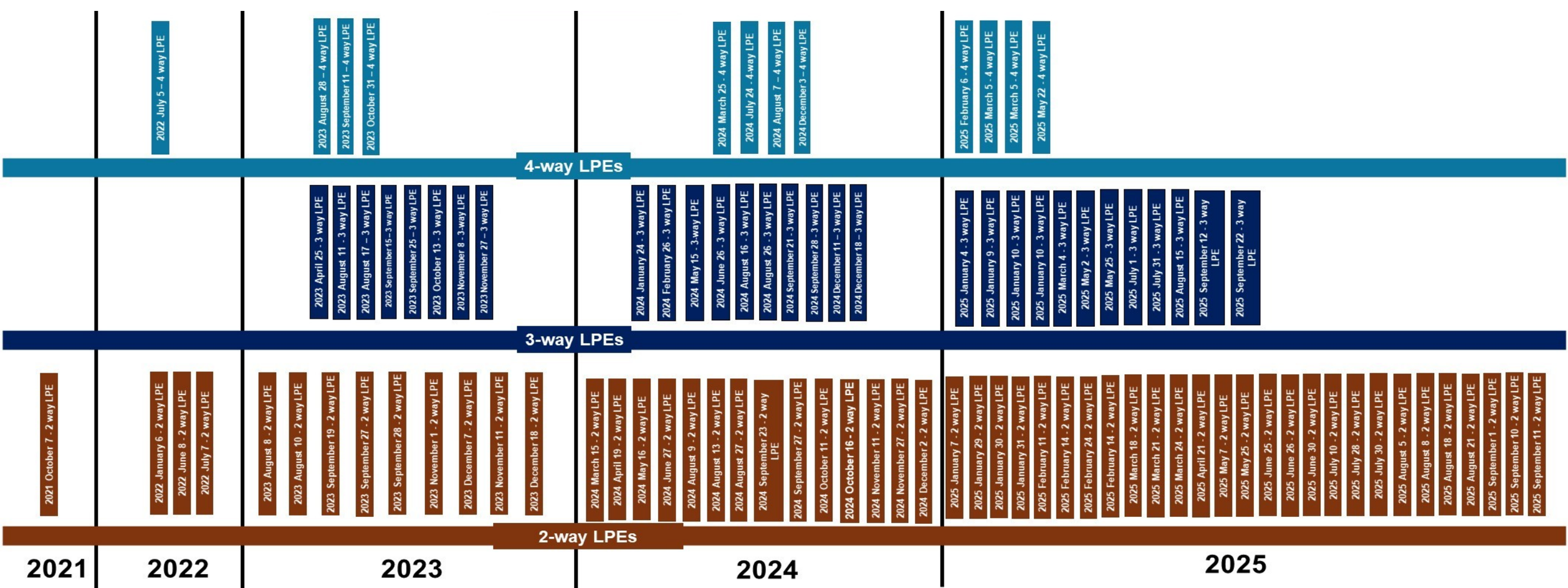
İNÖNÜ UNIVERSITY
LIVER TRANSPLANT INSTITUTE
2011

30 of the 35 reported 3-way LPEs were performed in Malatya



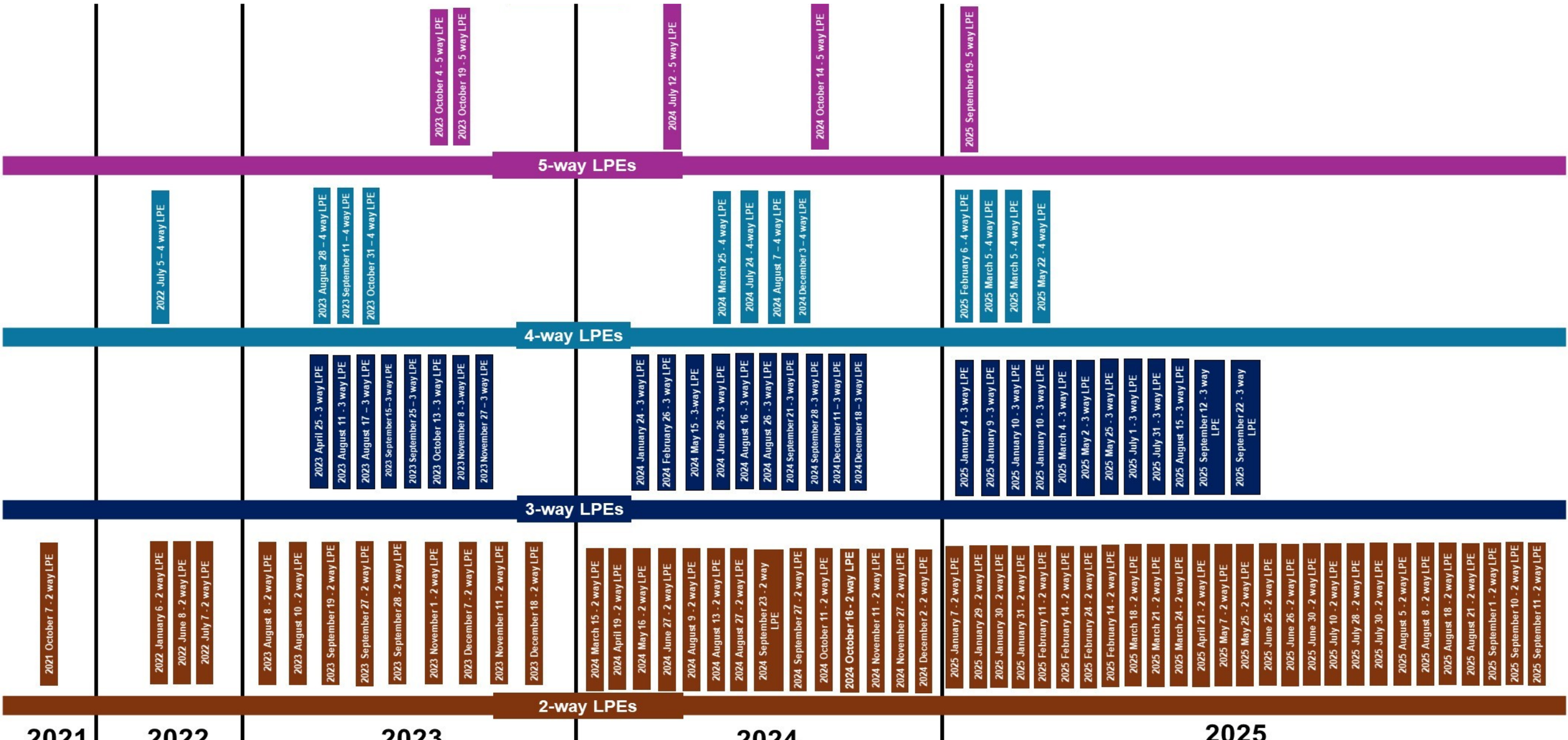
İNÖNÜ UNIVERSITY
LIVER TRANSPLANT INSTITUTE
2011

All of 12 times 4-way LPEs were performed in Malatya



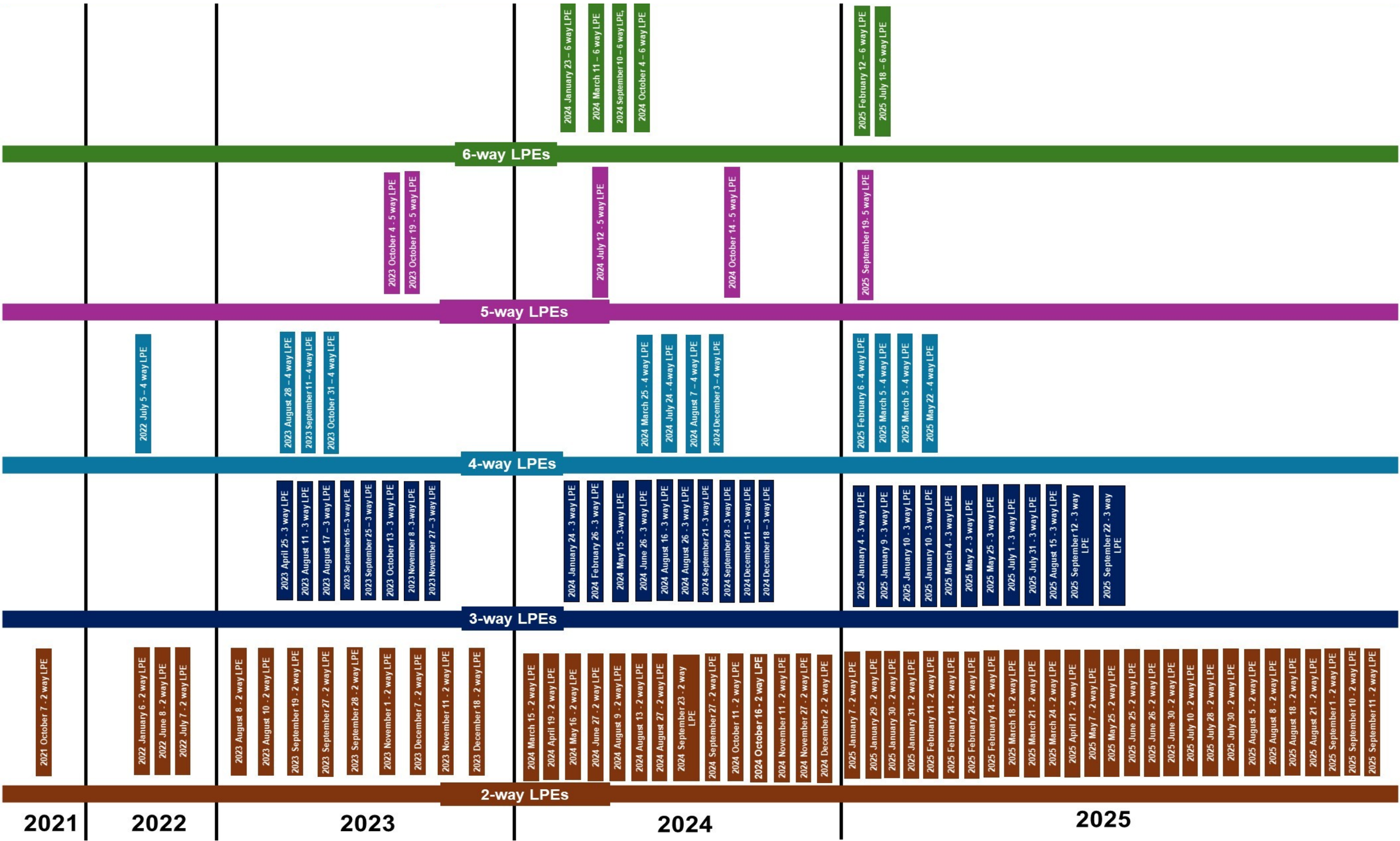
İNÖNÜ UNIVERSITY
LIVER TRANSPLANT INSTITUTE
2011

All of 5 times 5-way LPEs were performed in Malatya



İNÖNÜ UNIVERSITY
LIVER TRANSPLANT INSTITUTE
2011

All of 6 times 6-way LPEs were performed in Malatya



Both of 2 times 7-way LPE were performed in Malatya

İNÖNÜ UNIVERSITY
LIVER TRANSPLANT INSTITUTE
2011

7-way LPEs
- 2024 July 2 – 7 way LPE
- 2024 September 19 - 7 way LPE

6-way LPEs
- 2024 January 23 – 6 way LPE
- 2024 March 11 – 6 way LPE
- 2024 September 10 – 6 way LPE
- 2024 October 4 – 6 way LPE
- 2025 February 12 – 6 way LPE
- 2025 July 18 – 6 way LPE

5-way LPEs
- 2023 October 4 - 5 way LPE
- 2023 October 19 - 5 way LPE
- 2024 July 12 - 5 way LPE
- 2024 October 14 - 5 way LPE
- 2025 September 19- 5 way LPE

4-way LPEs
- 2022 July 5 – 4 way LPE
- 2023 August 28 – 4 way LPE
- 2023 September 11 – 4 way LPE
- 2023 October 31 – 4 way LPE
- 2024 March 25 - 4 way LPE
- 2024 July 24 - 4-way LPE
- 2024 August 7 – 4 way LPE
- 2024 December 3 – 4 way LPE
- 2025 February 6 - 4 way LPE
- 2025 March 5 - 4 way LPE
- 2025 March 5 - 4 way LPE
- 2025 May 22 - 4 way LPE

3-way LPEs
- 2023 April 25 - 3 way LPE
- 2023 August 11 - 3 way LPE
- 2023 August 17 – 3 way LPE
- 2023 September15 – 3 way LPE
- 2023 September 25 – 3 way LPE
- 2023 October 13 - 3 way LPE
- 2023 November 8 - 3-way LPE
- 2023 November 27 – 3 way LPE
- 2024 January 24 - 3 way LPE
- 2024 February 26 - 3 way LPE
- 2024 May 15 - 3-way LPE
- 2024 June 26 - 3 way LPE
- 2024 August 16 - 3 way LPE
- 2024 August 26 - 3 way LPE
- 2024 September 21 - 3 way LPE
- 2024 September 28 - 3 way LPE
- 2024 December 11 – 3 way LPE
- 2024 December 18 – 3 way LPE
- 2025 January 4 - 3 way LPE
- 2025 January 9 - 3 way LPE
- 2025 January 10 - 3 way LPE
- 2025 January 10 - 3 way LPE
- 2025 March 4 - 3 way LPE
- 2025 May 2 - 3 way LPE
- 2025 May 25 - 3 way LPE
- 2025 July 1 - 3 way LPE
- 2025 July 31 - 3 way LPE
- 2025 August 15 - 3 way LPE
- 2025 September 12 - 3 way LPE
- 2025 September 22 - 3 way LPE

2-way LPEs
- 2021 October 7 - 2 way LPE
- 2022 January 6 - 2 way LPE
- 2022 June 8 - 2 way LPE
- 2022 July 7 - 2 way LPE
- 2023 August 8 - 2 way LPE
- 2023 August 10 - 2 way LPE
- 2023 September 19 - 2 way LPE
- 2023 September 27 - 2 way LPE
- 2023 September 28 - 2 way LPE
- 2023 November 1 - 2 way LPE
- 2023 December 7 - 2 way LPE
- 2023 November 11 - 2 way LPE
- 2023 December 18 - 2 way LPE
- 2024 March 15 - 2 way LPE
- 2024 April 19 - 2 way LPE
- 2024 May 16 - 2 way LPE
- 2024 June 27 - 2 way LPE
- 2024 August 9 - 2 way LPE
- 2024 August 13 - 2 way LPE
- 2024 August 27 - 2 way LPE
- 2024 September 23 - 2 way LPE
- 2024 September 27 - 2 way LPE
- 2024 October 11 - 2 way LPE
- **2024 October 16 - 2 way LPE**
- 2024 November 11 - 2 way LPE
- 2024 November 27 - 2 way LPE
- 2024 December 2 - 2 way LPE
- 2025 January 7 - 2 way LPE
- 2025 January 29 - 2 way LPE
- 2025 January 30 - 2 way LPE
- 2025 January 31 - 2 way LPE
- 2025 February 11 - 2 way LPE
- 2025 February 14 - 2 way LPE
- 2025 February 24 - 2 way LPE
- 2025 February 14 - 2 way LPE
- 2025 March 18 - 2 way LPE
- 2025 March 21 - 2 way LPE
- 2025 March 24 - 2 way LPE
- 2025 April 21 - 2 way LPE
- 2025 May 7 - 2 way LPE
- 2025 May 25 - 2 way LPE
- 2025 June 25 - 2 way LPE
- 2025 June 26 - 2 way LPE
- 2025 June 30 - 2 way LPE
- 2025 July 10 - 2 way LPE
- 2025 July 28 - 2 way LPE
- 2025 July 30 - 2 way LPE
- 2025 August 5 - 2 way LPE
- 2025 August 8 - 2 way LPE
- 2025 August 18 - 2 way LPE
- 2025 August 21 - 2 way LPE
- 2025 September 1 - 2 way LPE
- 2025 September 10 - 2 way LPE
- 2025 September 11 - 2 way LPE

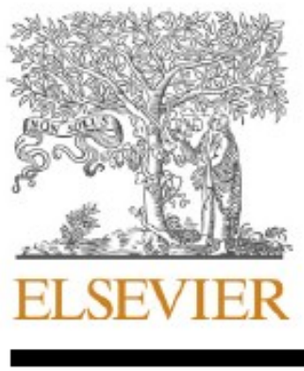
2021 2022 2023 2024 2025

9th Malatya – Giessen Transplantation Days

July 26, 2024

World's first 7-way swap liver transplantations were announced
Donors and recipients were introduced to the press

American Journal of Transplantation xxx (xxxx) xxx



Contents lists available at ScienceDirect

American Journal of Transplantation

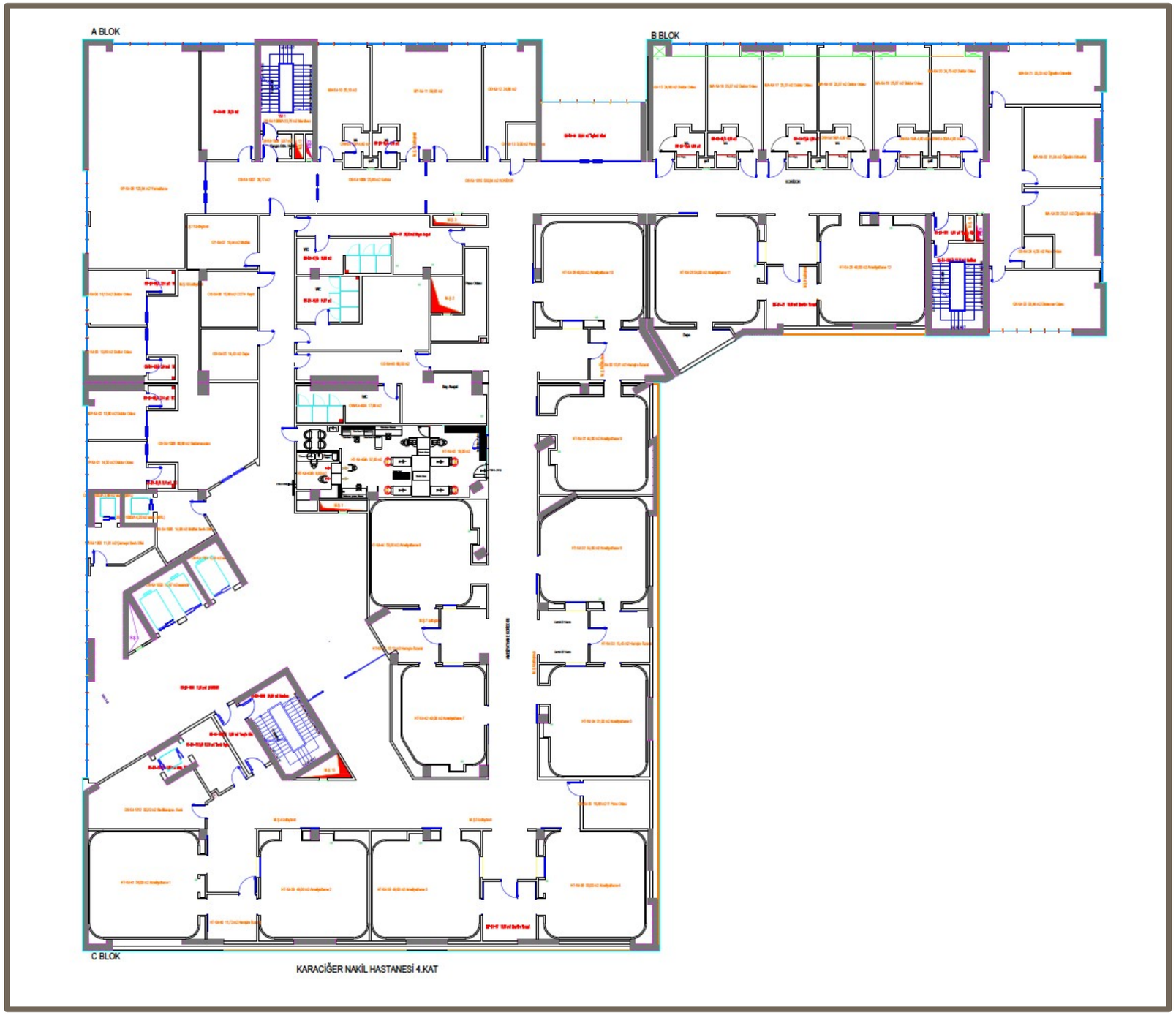
journal homepage: www.amjtransplant.org

Brief Communication

Enhanced role of multipair donor swaps in response to size incompatibility: The first two 5-way and the first 6-way liver paired exchanges

Sezai Yilmaz [1,*], Tayfun Sönmez [2], M. Utku Ünver [2], Volkan Ince [1], Sami Akbulut [1], Kemal Baris Sarici [1], Burak Isik [1]

[1] *Department of Surgery and Liver Transplantation, Inonu University Liver Transplant Institute, Malatya, Turkey*
[2] *Department of Economics, Boston College, Chestnut Hill, Massachusetts, USA*



KARACİĞER NAKİL HASTANESİ 4.KAT

İNÖNÜ UNIVERSITY
LIVER TRANSPLANT INSTITUTE
2011

Table 3: 6-way Exchange

Recipients												Transplant Details									
Recipient ID	**Age (year)**	**Blood Type**	**Weight (kg)**	**Sex**	**Min/Max Graft Volume Required (cc)**	**MELD Score**	**Diagnosis**	**Reason for Exchange**	**Received Graft**	**Received from**	**Recipient Entry Date**	**Transplant Date**	**Start Time**	**End Time**	**Cold ischemia time (h,m)**	**Operating Room No**	**Surgery Team**	**Surgeon in hepatic artery anastomosis**	**Post-Transplant Complications**	**Clavien-Dindo classification**	**Live/ Ex**
R11	38	AB+	71	M	568 (min.) 1420 (max.)	16	Cryptogenic cirrhosis	Altruistic	RL; ABO-id; GRWR: 0.97%	D16	24-Ara-23	23-Oca-24	10:45	18:25	2 h	2	9-F-F	9	Biliary leak, stricture (ERCP-stenting)	IIIb	Live
R12	62	A-	78	F	624 (min.) 1560 (max.)	22	Hepatocellular carcinoma	Altruistic	RL; ABO-id; GRWR: 1.19%	D11	18-Oca-24	23-Oca-24	11:00	21:00	3 hr	4	4-F-F	1	Biliary leak (Reoperation)	IIIb	Live
R13	10	O+	38	M	380 (min.)* 760 (max.)	22	Hepatocellular carcinoma	Altruistic	RL; ABO-id; GRWR: 1.68%	D12	16-Oca-24	23-Oca-24	11:10	18:40	2 h 25 m	6	19-F-F	9			Live
R14	53	O+	73	M	584 (min.) 1460 (max.)	16	HBV-related cirrhosis	Altruistic	RL; ABO-id; GRWR: 0.96%	D13	15-Dec-23**	23-Oca-24	10:35	20:45	3 h	8	3-F-F	13			Live
R15	39	O+	82	M	656 (min.) 1640 (max.)	19	Alcoholic Cirrhosis	ABO incompatible	RL; ABO-id; GRWR: 1.27%	D14	10-Kas-23	23-Oca-24	11:10	22:10	3 h 20 m	10	10-17-F	1			Live
R16	59	A+	100	M	800 (min.) 2000 (max.)	16	NASH-related cirrhosis	ABO & Size incompatible (too small)	RL; ABO-id; GRWR: 1.00%	D15	29-Ara-22	23-Oca-24	11:15	20:20	2 h 50 m	12	13-F-R	13	Small for Size Syndrome (Medical treatment)	II	Live

Donors												Hepatectomy Details									
Donor ID	**Age (year)**	**Blood Type**	**Weight (kg)**	**Sex**	**Graft Volume (cc)**	**LL Remnant**	**GRWR for Paired Recipient**	**Reason for Exchange**	**Further Explanation**	**Donated to**	**Donor Entry Date**	**Hepatectomy Date**	**Start Time**	**End Time**		**Operating Room No**	**Surgery Team**	**Back-Table Procedure Team**	**Post-Hepatectomy Complications**	**Clavien-Dindo classification**	**Live/ Ex**
D11	34	A+	77	F	RL: 930	%38	1,31%	Altruistic	ABO-c with Paired Recipient	R12	24-Ara-23	23-Oca-24	8:10	15:30		3	5-16-F	8-N			Live
D12	38	O+	61	F	RL: 640	%40	0,82%	Altruistic	ABO-c with Paired Recipient	R13	18-Oca-24	23-Oca-24	8:20	13:30		5	18-F-F	1-N			Live
D13	28	O+	62	F	RL: 700	%34	1,84%	Altruistic	ABO-id with Paired Recipient	R14	16-Oca-24	23-Oca-24	8:30	15:00		7	7-F-F	6-N			Live
D14	25	O+	85	M	RL: 1040	%37	1,42%	Altruistic	ABO-id with Paired Recipient	R15	15-Dec-23*	23-Oca-24	8:15	15:10		9	14-15-F	1-N			Live
D15	36	A+	86	F	RL: 1000	%40	1,22%	ABO incompatible	Paired Recipient Blood Type: O+	R16	10-Kas-23	23-Oca-24	8:40	14:00		11	11-F-F	12-N			Live
D16	23	AB+	73	F	RL: 690	%37	0,69%	ABO & Size incompatible (too small)	Paired Recipient Blood Type: A+ GRWR: 0.69% < 0.8%	R11	29-Ara-22	23-Oca-24	8:10	14:00		1	2-F-R	8-N			Live

In every operating room there are eight medical staff member including three surgeons, one operating room nurse, one circulation nurse, one assistant personnel, one anesthesiologist, one anesthesiology technician. One surgeon and one nurse take part in a back-table procedure. Time permitting, some surgeons may take part on two back-table procedures. Thus, around 10 medical personnel take part in each operation. Distinct ID numbers under the "Surgery Team", "Surgeon in hepatic artery anastomosis", and "Back-Table Procedure Team" columns denote different surgeons while each "F" refers to a distinct "fellow" surgeon, each "R" refers to a distinct "resident" surgeon, and each "N" refers to a distinct "nurse" present during the back-table procedure. Also two-three additional surgeons, three-four additional fellows and residents, and four-five additional nurses are ready to participate in any of the procedures in case of emergencies. Also all operation start and end times are in Turkish Time (GMT +3). Liver density = 1 gr/cc is used in GRWR calculation.

RL: Right lobe, ABO-id: ABO identical, ABO-c: ABO compatible but not identical, GRWR: Graft-to-recipient weight ratio, MELD: Model for end-stage liver disease score, NASH: Non-alcoholic steatohepatitis, HBV: Hepatitis B virus, ERCP: Endoscopic retrograde cholangiopancreatography

*: 1% minimum is used for children due to using

**: Recipient R14 and his compatible paired donor D14 originally entered the system on 27-Oct-23 but then they exited on 31-Oct-23, to enter again on 15-Dec-23

İNÖNÜ UNIVERSITY
LIVER TRANSPLANT INSTITUTE
2011

Inonu University
Liver Transplantation Institute

152 Bed

116 Patient room

3 Lab

36 Intensive Care Room

12 Operating Room

3 Outpatient Department

İNÖNÜ UNIVERSITY
LIVER TRANSPLANT INSTITUTE
2011

Surgical Team of Liver Transplant Institute

1. **Sezai YILMAZ, Prof**
2. **Cengiz ARA, Prof**
3. **Tolga SAHIN, Prof**
4. **Sami AKBULUT, Prof**
5. **Fatih OZDEMIR, Prof**
6. **Volkan INCE, Prof**
7. **Adil BASKIRAN, Prof**
8. **Emrah OTAN, Prof**
9. **Bora BARUT, Assoc Prof**
10. **Cemalettin KOC, Assoc Prof**
11. **Koray KUTLUTURK, Assoc Prof**
12. **Baris SARICI, Assoc Prof**
13. **Serdar KARAKAS, Assoc Prof**
14. **Arife SIMSEK, Assoc Prof**
15. **Sertac USTA, Assist Prof**
16. **Ertugrul KARABULUT, Assist Prof**
17. **Huseyin KOCAASLAN, Assist Prof**
18. **Yasin DALDA, Assist Prof**
19. **Egemen CICEK, Assist Prof**
20. **Muhammed JANAZRAH**
21. **Neslihan ÇELİK**

Donor

1. Sezai YILMAZ
2. Fatih OZDEMIR
3. Adil BASKIRAN
4. Sami AKBULUT
5. Baris SARICI
6. Ertugrul KARABULUT
7. Huseyin KOCAASLAN
8. Muhammed JANAZRAH

Recipient

1. Sezai YILMAZ
2. Cengiz ARA
3. Tevfik Tolga SAHIN
4. Volkan INCE
5. Bora BARUT
6. Cemalettin KOC
7. Koray KUTLUTURK
8. Serdar KARAKAS
9. Sertac USTA
10. Egemen CICEK
11. Yasin DALDA
12. Neslihan ÇELİK

Back table

1. Sezai YILMAZ
2. Tolga SAHIN
3. Volkan INCE
4. Adil BASKIRAN

Hepatic Artery

1. Sezai YILMAZ
2. Cemalettin KOC
3. Koray KUTLUTURK

Preop Preparation Team

1. Sezai YILMAZ
2. Baris SARICI
3. Ertugrul KARABULUT

Intensive Care Unit Team

1. Emrah OTAN
2. Arife SIMSEK
3. Ertugrul Karabulut
4. Yasin DALDA
5. Volkan INCE
6. Cemalettin KOC

İNÖNÜ UNIVERSITY
LIVER TRANSPLANT INSTITUTE
2011

Bu Cerrahi Ekip Üyeleri Ortalama 15 Yıldır Birlikte Çalışıyorlar (7–22 Years)

İnönü Üniversitesi'nin Başarısının Teknik Nedenlerinden Bazıları

- **Boston College'daki KPE/LPE öncüleriyle yapılan olağanüstü iş birliği sayesinde optimal bir eşleştirme algoritmasının uygulanması**

- **7'li değişimlere kadar (up to 7-way) LPE gerçekleştirme kapasitesi**

- **Daha büyük LPE'ler, yalnızca açık bir yarar olduğunda, örneğin acil durumu olan bir hastanın eşleşmesi gerektiğinde, tercih edilir**

- **Greft volüm uyumsuzlukları nedeniyle, daha büyük çaplı değişimler özellikle LPE için önemlidir. Bizim ideal greft volümümüz, %1–1,2 GRWR**

- **Uyumlu çiftlerin de (ABO-compatible) programa dahil edilmesi, ABO-identical greft, ABO-uyumlu greften daha çok tercih edilir**

- **Donör baskısını önlemek için yerleşik bir "makul inkâr (plausible deniability)" sistemi uygulanmaktadır. Bu sayede, donörlerin vazgeçme oranı, bazı Asya programlarında bildirilen oranlardan çok daha düşüktür**

Altruistic Uyumlu Çiftler

- **LPE programlarının etkinliğini artıran en önemli faktörlerden biri, uyumlu çiftlerin (compatible pairs) LPE havuzuna katılımıdır.**

- **Uyumlu çiftlerin LPE havuzuna katılımını teşvik etmek için üç strateji benimsenmiştir:**

1. **Altruism (özgecilik): Diğer hastalara yardım etme isteği**

2. **ABO-c yerine ABO-id greft alma olasılığı: Birçok çalışma, ABO-identical greftlerin, ABO-compatible greftlere göre («minor ABO-i») daha iyi sağkalım avantajı sağladığını göstermiştir.**

3. **İdeal greft boyut aralığına yakın greft alma potansiyeli: Yetişkin hastalarda canlı donör karaciğer nakli için ideal GRWR oranımız %1–1,2'dir. Bu aralığın dışında kalan çiftler, LPE havuzuna katılmaya teşvik edilir.**

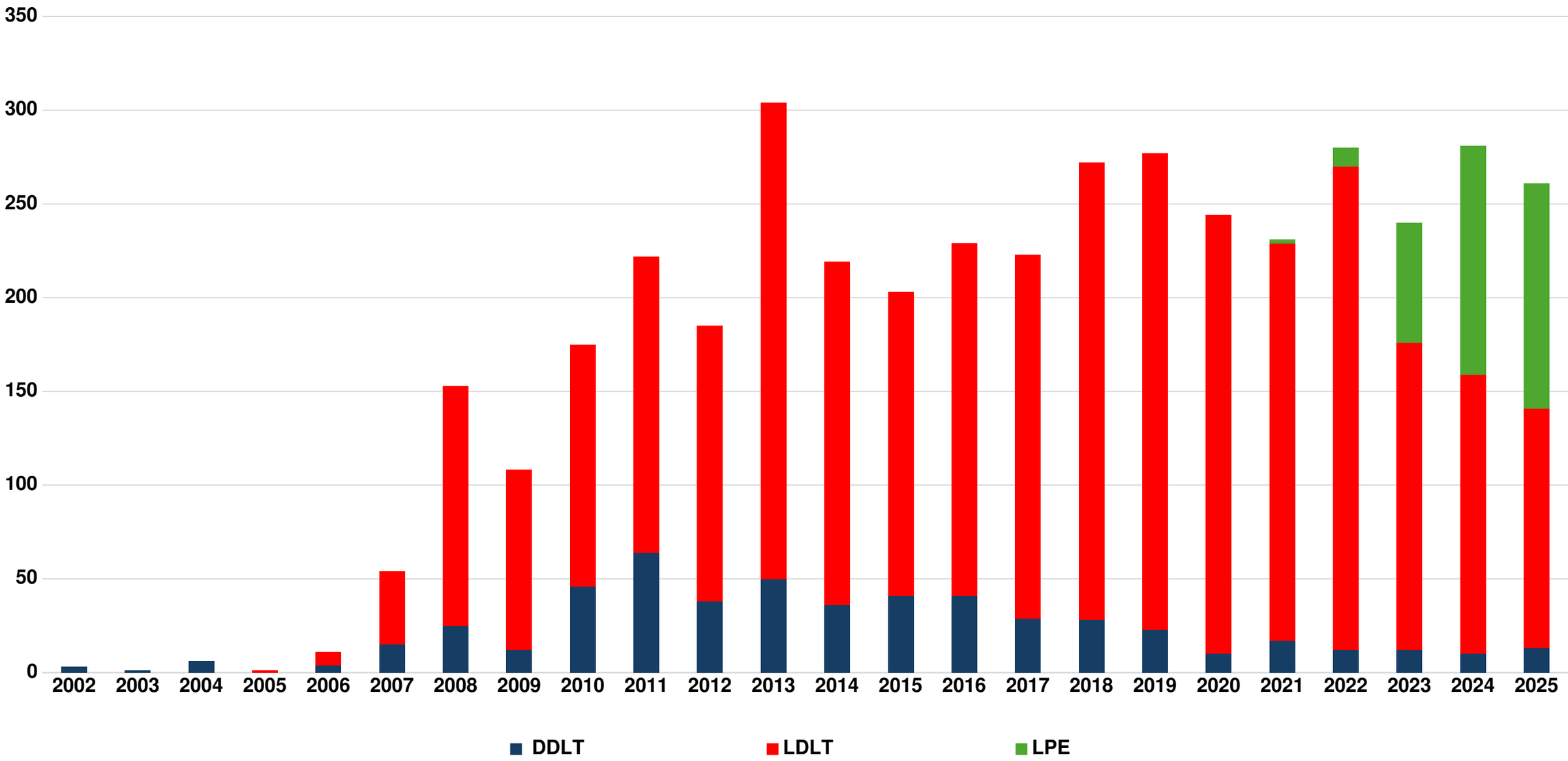
LPE Havuzunda Hastaların Bekleme Süreleri

DAYS	Waiting-time if INC	Waiting time if COM
Median	14	6
Max	472	57
Min	1	1
Mean	37.06	9.40
Std	66.56	10.21

İNÖNÜ UNIVERSITY
LIVER TRANSPLANT INSTITUTE
2011

LIVER TRANSPLANTATION – MALATYA EXPERIENCE

DDLT since 2002, LDLT since 2005, more than 4200 LTx (87% LDLT)



LPE in 2024: Cementing Global Leadership

- **In 2024, the LPE system enabled 122 LPE transplants, accounting for 45.2% of the year's 270 LDLTs. Toplam 281 LTx**

- **Incompatible pairs: 86**

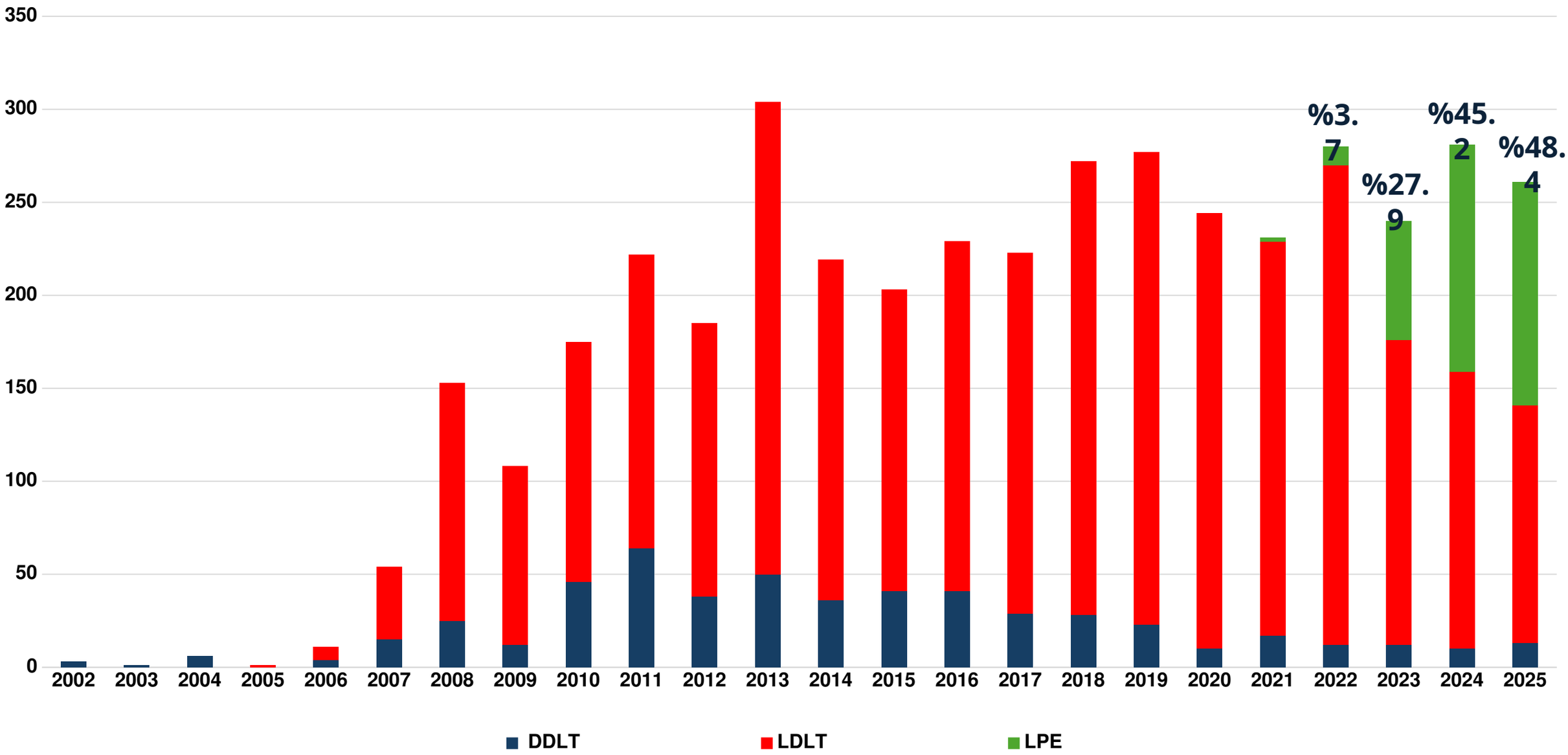
  - **Resulted in a 46.7% net increase in LDLTs, an unprecedented surge for any donor-exchange program, including KPE**

- **Compatible pairs: 36**

  - **Entered the LPE pool either to obtain a more favorable graft or to altruistically expand options for incompatible pairs by including compatible pairs,**

İNÖNÜ UNIVERSITY
LIVER TRANSPLANT INSTITUTE
2011

LIVER TRANSPLANTATION – MALATYA EXPERIENCE



Liver Paired Exchange: Ethical Principles

- **Utilitarianism (faydalanma, yararlanma)**
  - **Transplantasyondan yararlanacak hasta sayısını artırmaya çalışmak**
- **Simultaneous operations**
  - **Aynı gün yapılmayan operasyonlarda, donörün vazgeçme riski**
- **Pareto principle**
  - **Hiçbir hasta daha az avantajlı bir graft almamalı ve hiçbir donör daha yüksek riskli bir ameliyata girmemelidir**

Yilmaz S, et al. Am J Transplant 2023;23(10):1612

Ethical problems – Equality of Grafts

- **To achieve complete equality among donors changed is difficult**
  - **Same lobe, number of bile duct, hepatic artery, and APVB**
- **Complete equality in 2-way LPE: 19/55 (34.5 %)**
- **Complete equality in 3-way LPE: 3/30 (10 %)**
- **Complete equality in total: 45/320 (14 %)**

İNÖNÜ UNIVERSITY
LIVER TRANSPLANT INSTITUTE
2011

The First 7-way LPE in the World

July 2, 2024

Donor-7
Age: 19
B Rh+
RL: 580 cc
LL: 410 cc
Remnant: 41%

Pair - 7

SIZE INCOMPATIBLE

GRWR: 0.67%
< 0.8%

Recipient-7
Age: 52
B Rh+
Weight: 87 kg

ABO-id
GRWR: 0.92%

RL Graft Transplanted

ABO-id
GRWR: 3.15%

LL Graft Transplanted

Recipient-1
Age: 4
B Rh+
Weight: 13 kg

Pair - 1

ABO INCOMPATIBLE

Donor-1
Age: 40
AB Rh+
RL: 670 cc
Remnant: 30%

ABO-id
GRWR: 1.46%

RL Graft Transplanted

Recipient-2
Age: 30
AB Rh+
Weight: 46 kg

Pair - 2

COMPATIBLE

ABO-c
GRWR: 1.91

Donor-2
Age: 24
A Rh+
RL: 880 cc
Remnant: 37%

ABO-id
GRWR: 0.81%

RL Graft Transplanted

Recipient-3
Age: 65
A Rh+
Weight: 109 kg

SIZE INCOMPATIBLE

LL Remnant: 27%
LL GRWR: 0.48%
< 0.8%

Pair - 3

Donor-3
Age: 26
A Rh+
RL: 1380 cc
LL: 520 cc
Remnant: 27%

ABO-id
GRWR: 3.71%

LL Graft Transplanted

Recipient-4
Age: 5.5
A Rh+
Weight: 14 kg

SIZE INCOMPATIBLE

RL GRWR: 5.5%

LL Anatomic -Vascular Incompatibl

Pair - 4

Donor-4
Age: 35
A Rh+
RL: 770 cc
Remnant: 30%

ABO-id
GRWR: 0.93%

RL Graft Transplanted

Donor-5
Age: 33
O Rh+
RL: 800 cc
Remnant: 33%

COMPATIBLE

ABO-c
GRWR: 0.96%

Recipient-5
Age: 64
A Rh+
Weight: 83 kg

Pair - 5

RL Graft Transplanted

Donor-6
Age: 38
B Rh+
RL: 800 cc
Remnant: 33%

Pair - 6

ABO INCOMPATIBLE

Recipient-6
Age: 62
O Rh+
Weight:99 kg

ABO-id
GRWR: 0.81%

RL Graft Transplanted

7-way #1 LPE conducted through the BBS-LPE System at the Liver Transplant Institute, Inonu University, Malatya

RL: Right lobe, ABO-id: ABO identical, ABO-c: ABO compatible but not identical, GRWR: Graft-to-recipient weight ratio

7-way LPE #1

İNÖNÜ UNIVERSITY
LIVER TRANSPLANT INSTITUTE
2011

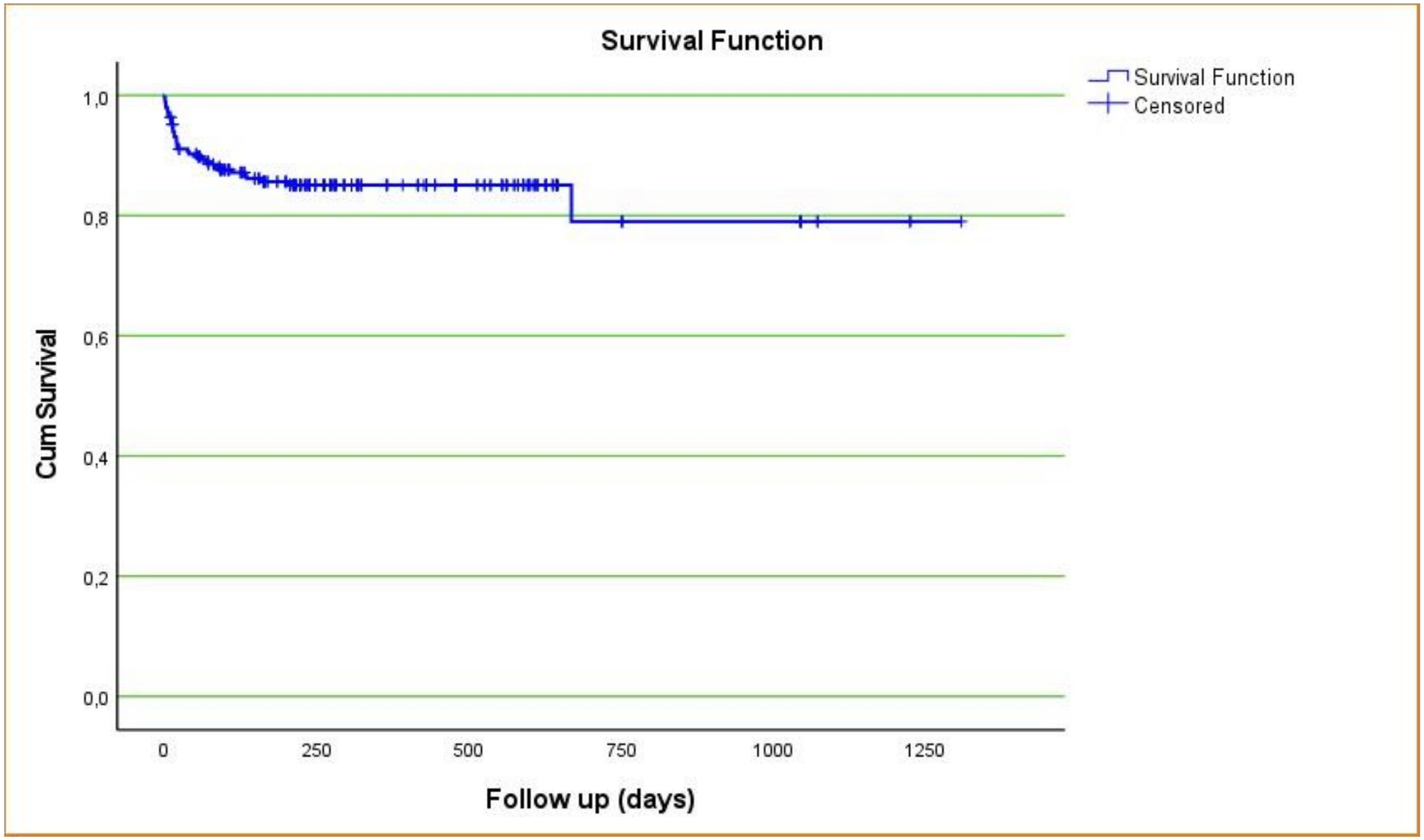
Donor-1	Donor-2	Donor-3	Donor-4	Donor-5	Donor-6	Donor-7
Age:40 AB Rh+ RL: 670cc Remnant: 30%	Age:24 A Rh+ RL: 880cc Remnant: 37%	Age:26 A Rh+ RL: 1380cc LL: 520 Remnant: 37%	Age:35 A Rh+ RL: 770cc Remnant: 30%	Age:33 O Rh+ RL: 800cc Remnant: 33%	Age:33 B Rh+ RL: 800cc Remnant: 33%	Age:19 B Rh+ RL: 580cc LL: 410cc Remnant: 41%
Recipient-1 Age:4 B Rh+ Weight: 13 kg	Recipient-2 Age:30 AB Rh+ Weight: 46 kg	Recipient-3 Age:65 A Rh+ Weight: 109 kg	Recipient-4 Age:5.5 A Rh+ Weight: 14 kg	Recipient-6 Age:64 A Rh+ Weight: 83 kg	Recipient-6 Age:62 O Rh+ Weight: 99 kg	Recipient-7 Age:52 B Rh+ Weight: 87 kg
ABO INCOMPATIBLE	**ABO-c GRWR: 1.91%**	**SIZE INCOMPATIBLE LL GRWR: 0.48% LL Remnant: 27%**	**SIZE INCOMPATIBLE RL GRWR: 5.5% VASCULAR INCOMP. LL Anatomic variation**	**ABO-c GRWR: 0.96%**	**ABO INCOMPATIBLE**	**SIZE INCOMPATIBLE GRWR: 0.67%**

7-way LPE #1

İNÖNÜ UNIVERSITY
LIVER TRANSPLANT INSTITUTE
2011

Donor-7	Donor-1	Donor-2	Donor-3	Donor-4	Donor-5	Donor-6
Age:19	Age:40	Age:24	Age:26	Age:35	Age:33	Age:33
B Rh+	AB Rh+	A Rh+	A Rh+	A Rh+	O Rh+	B Rh+
RL: 580cc	RL: 670cc	RL: 880cc	RL: 1380cc	RL: 770cc	RL: 800cc	RL: 800cc
LL: 410cc	Remnant: 30%	Remnant: 37%	LL: 520	Remnant: 30%	Remnant: 33%	Remnant: 33%
Remnant: 41%			Remnant: 37%			
↓	↓	↓	↓	↓	↓	↓
Recipient-1	Recipient-2	Recipient-3	Recipient-4	Recipient-6	Recipient-6	Recipient-7
Age:4	Age:30	Age:65	Age:5.5	Age:64	Age:62	Age:52
B Rh+	AB Rh+	A Rh+	A Rh+	A Rh+	O Rh+	B Rh+
Weight: 13 kg	Weight: 46 kg	Weight: 109 kg	Weight: 14 kg	Weight: 83 kg	Weight: 99 kg	Weight: 87 kg
ABO-id	**ABO-id**	**ABO-id**	**ABO-id**	**ABO-id**	**ABO-id**	**ABO-id**
GRWR: 3.15	**GRWR: 1.46**	**GRWR: 0.81**	**GRWR: 3.71**	**GRWR: 0.93**	**GRWR: 0.81**	**GRWR: 0.92**

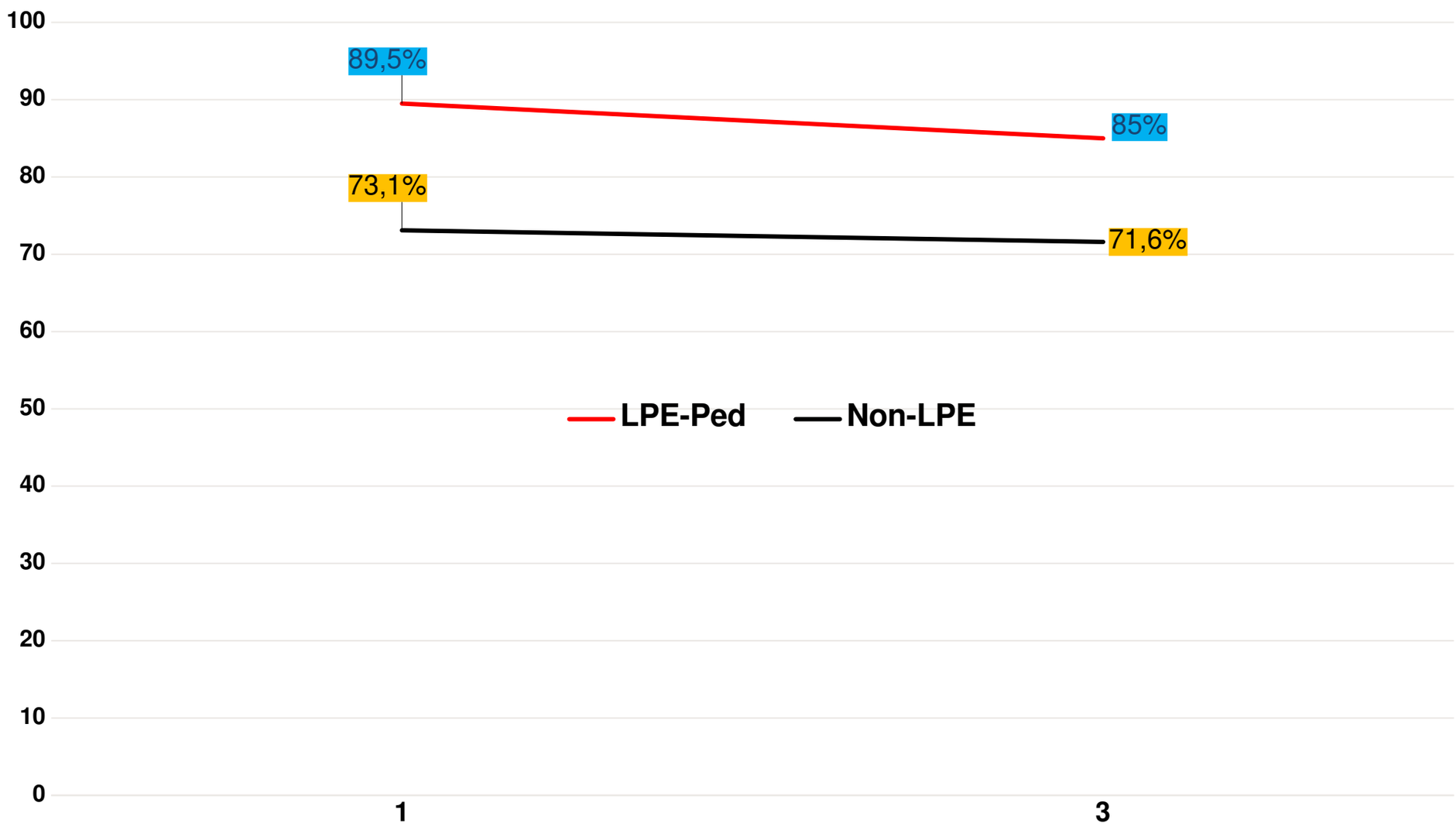
LPE and Survival



1 Year Survival 86 %
3 Years Survival 80.2 %
Mean Survival (mean± Std Error) = 1081 ± 47.1 days (%95 CI= 988-1173 days)

İNÖNÜ UNIVERSITY
LIVER TRANSPLANT INSTITUTE
2011

Pediatric LPE and Survival



Risks of LPE (Etik Konular)

- **Donör baskısı (coercion) riskinin artması: Bu riski önlemek için ayrıntılı bir "makul inkâr edilebilirlik (plausible deniability)" oluşturulmuştur.**

- **Bazı çiftlerin son anda geri çekilmesi (revocation): Bu durumun önüne geçmek için sistemli bir şekilde iletişim ve onay süreci yürütülür.**

- **Beklenmedik donör anatomisi veya recipientin kaybı nedeniyle işlemin iptal edilme olasılığının artması: (örneğin "no-go donor hepatectomy" durumları).**

- **LPE zamanlamasına ilişkin belirsizlik: Uyumlu çiftler, birkaç ay içinde uygun bir eşleşme bulunamazsa LPE'den vazgeçebilir. Uyumlu olmayan çiftler için medyan bekleme süresi 14 gün, altruistic uyumlu çiftler için ise 6,5 gündür.**

- **O kan gurubu donörlerin, AB kan gurubu recipientlerin LPE sistemine dahil edilememesi**

UNOS launches first national liver paired donation pilot program

Jan 13, 2023 | Liver/intestine, News, Trending

An innovative approach to matching livers to patients in need aims to increase lifesaving transplants by expanding the number of living liver donations. United Network for Organ Sharing (UNOS) has launched the UNOS Liver Paired Donation (LPD) pilot program, the first nation-wide initiative facilitating liver paired donation matches; the project is led by UNOS Labs in collaboration with transplant and donation professionals from across the country.

Working to increase living liver transplants by pairing living donors and recipients

More than 10,000 people are currently waiting for a liver transplant, and increasing paired donation can make a difference. “The community recognized a critical need,” said Ruthanne Leishman, who manages UNOS paired donation programs. “While the idea of swapping livers is new, transplant programs have successfully been swapping kidneys since 2002.” Leishman was part of the UNOS team that initiated the Organ Procurement and Transplantation Network (OPTN) Kidney Paired Donation (KPD) pilot program in 2010, at a time when there were fewer living liver donor transplants. Since that time

Thursday, November 30, 2023

UNOS ends its liver exchange pilot program

UNOS has shuttered it's liver exchange pilot program, after less than a year, without having performed any liver exchange transplants. (My understanding is that this wasn't part of UNOS's OPTN contract, but part of its activities as a private company.)

A colleague forwarded me this announcement:

"After careful consideration and evaluation, we regret to announce the discontinuation of the UNOS Liver Paired Donation Pilot Program (LPDPP).

The UNOS LPDPP was launched with the noble goal of matching candidates in need of a liver transplant with living donors from across the United States. Top-tier transplant programs from around the country participated in the program, entering pairs to be matched for transplantation.

Despite the enthusiasm and dedication of the UNOS LPDPP Steering Committee, participating hospitals, a visionary funder and UNOS Labs staff, we must acknowledge that the program faced significant challenges. Regrettably, ***no matches were made, and no transplants occurred during the course of the pilot****.*

This decision to discontinue the program is a result of several factors, primarily the depletion of funding allocated to the pilot and other barriers to widespread adoption. While practical constraints have led us to this difficult decision, we are still committed to uncovering key insights that may help future efforts toward a national liver paired donation program and apply to other challenges facing the organ donation and transplant community.

We would like to express our heartfelt gratitude to the Steering Committee, participating transplant programs' staff, candidates and donors who agreed to be entered and the generous living liver recipient who funded this endeavor. Your dedication to saving lives through organ transplantation is truly commendable. These efforts have yielded valuable data and insights that will allow our community to continue to advance.

While this chapter may be closing, our commitment to increasing the number of lives saved through organ donation and transplant remains unwavering. We will continue to explore innovative ways to improve access to organ transplants for those in need. We will be doing more investigation into the program's barriers to success, unexpected challenges and opportunities for improvement, and we plan to share our discoveries with the community so we may all learn from the results.

The program will officially end November 30, 2023, with the last match run on September 30, 2023."

##########

Earlier:

Friday, January 27, 2023

Liver exchange pilot program at UNOS

see also, from UNOS:
Liver paired donation – LPD

and this, from Medscape:
Can a Nationwide Liver Paired Donation Program Work? by Lucy Hicks, January 30, 2023

"It is possible that the 1-year pilot program could run without performing any paired transplants, but that's unlikely if multiple pairs are enrolled in the system, the spokesperson said. At the time of this story's publication, the one enrolled pair are a mother and daughter who are registered at the UCHealth Transplant Center in Colorado.

...

"The pilot program requires that the donor bring one support person with them if they need to travel for the surgery, but undergoing major abdominal surgery from a transplant team they are not familiar with may be stressful, said Peter Abt, MD, a transplant " at the Hospital of the University of Pennsylvania and the Children's Hospital of Philadelphia. "That's a big ask," he said, "and I'm not sure many potential donors would be up to that."

"John Roberts, MD, a transplant surgeon at the University of California, San Francisco, agreed that the travel component may put additional stress on the donor, but "if it's the only way for the recipient to get a transplant, then the donor might be motivated," he added.

...

"Leishman agreed that the travel aspect appears to one of the greatest barriers to participants entering the program but noted that a goal of the pilot program is to understand better what works – and what doesn't – when considering a liver paired donation program on a national scale. "[Our] steering committee has put together a really nice framework that they think will work, but they know it's not perfect. We're going to have to tweak it along the way," she said."

American Journal of Transplantation xxx (xxxx) xxx

Contents lists available at ScienceDirect

American Journal of Transplantation

journal homepage: www.amjtransplant.org

Comprehensive review

Practical and ethical considerations in kidney paired donation and emerging liver paired exchange

Neetika Garg [1,*], Joe Habbouche [2], Elisa J. Gordon [3], AnnMarie Liapakis [4], Michelle T. Jesse [5,†], Krista L. Lentine [6,†]

[1] Division of Nephrology, Department of Medicine, University of Wisconsin School of Medicine and Public Health, Madison, Wisconsin, USA
[2] Department of Surgery, Henry Ford Hospital, Detroit, Michigan, USA
[3] Department of Surgery, and Center for Biomedical Ethics and Society, Vanderbilt University Medical Center, Nashville, Tennessee, USA
[4] Langone Transplant Institute, New York University, New York, NY, USA
[5] Behavioral Health, Wellstar Health System, Marietta, Georgia, USA
[6] Division of Nephrology, Department of Internal Medicine, Saint Louis University, St Louis, Missouri, USA

ARTICLE INFO

Keywords:
kidney donation
living donation
living donor transplantation
paired donation
nondirected donation
risks
ethics
informed consent

ABSTRACT

Since the first kidney paired donation (KPD) transplant in the United States in 1999, the volume and scope of KPD has expanded substantially, accounting for nearly 20% of living donor kidney transplants in 2021-2022. This review article discusses the practical and ethical issues specific to paired donor exchange that patients, transplant centers, and exchange programs commonly encounter. Access to paired donor exchange and education of candidates regarding the potential benefits, risks, and logistics of KPD are important considerations. Transplant centers and patients must consider practical issues including wait times, allocation and matching strategies, assessment of organ quality, complex donors, cold ischemia time, and risks of broken chains. Protections available to donors from current KPD programs, the potential psychosocial effects, and the ethical concerns related to variable access and the proprietary nature of private exchange programs are also discussed. More detailed, timely data collection at a national level, and ability to merge national data with individual donor exchange registries will enable the analysis of the impact and outcomes of future trends in paired donation. KPD experience and key concepts may inform liver paired exchange, which has been used internationally to expand living donor liver transplantation and is emerging in the United States.

Abbreviations: APKD, Alliance for Paired Kidney Donation; CIT, cold ischemia time; EC, end-chain; KPD, kidney paired donation; LDLT, living donor liver transplantation; LPD, liver paired donation; NDAD, nondirected anonymous donor; NKR, National Kidney Registry; OPTN, Organ Procurement and Transplantation Network.

İNÖNÜ UNIVERSITY
LIVER TRANSPLANT INSTITUTE
2011

In March 2022, the first 3-way LPD facilitating 6 LDLTs was reported by the Pakistan Kidney and Liver Institute, which used a liver exchange algorithm that was developed with an economist at Stanford University, Stanford, California.[84] In a world-wide first study, Yilmaz et al[85] at the Liver Transplant Institute at Inonu University in Turkey generated a 4-way exchange in the same match run with a 2-way exchange, which led to LDLT for 6 patients. This was accomplished via an interdisciplinary collaboration between health care professionals and design economists at the Department of Economics, Boston College, Massachusetts. Their experience highlights that the number of LDLTs from LPD can be increased by developing the capacity to perform larger than 2-way exchanges in either high-volume centers or multicenter programs.[85] This team continues to perform LPD of this capacity, reporting in October 2024 the first two 5-way and the first 6-way liver paired exchanges and noting that since the launch of their single-center liver paired exchange program at Inonu University Liver Transplant Institute in Malatya, Turkey, they have conducted thirteen 2-way, nine 3-way, four 4-way, two 5-way, and one 6-way LPE through February 2024.[86] In 2023, their program facilitated 64 LDLTs, constituting 27.7% of the total 231 LDLTs performed.[86] This experience is unique to this resource-rich institution with a significantly experienced sizable surgical team at this time.

- Dünya çapında ilk kez gerçekleştirilen bir çalışmada ise, Türkiye'de İnönü Üniversitesi Karaciğer Nakli Enstitüsü'nden Yılmaz ve arkadaşları aynı eşleştirme turunda bir 4'lü (4-way) ve bir 2'li (2-way) değişimi eşzamanlı olarak gerçekleştirerek toplam 6 hastada LDLT yapılmasını sağlamıştır. Bu başarı, sağlık profesyonelleri ile Boston College (Massachusetts) Ekonomi Bölümü'ndeki tasarım ekonomistleri arasındaki disiplinler arası bir iş birliğiyle gerçekleştirilmiştir.

- **Bu deneyim, yüksek hacimli merkezlerde veya çok merkezli programlarda iki taraflı değişimlerin ötesine geçilerek daha büyük çaplı değişimlerin yapılabilmesinin, canlı donörlü karaciğer nakillerinin sayısını artırabileceğini göstermektedir.**

- Bu ekip, bu kapasitedeki LPD'leri gerçekleştirmeye devam etmekte olup, Ekim 2024'te ilk iki 5'li (5-way) ve ilk 6'lı (6-way) karaciğer eşleştirme değişimlerini rapor etmiştir. Ayrıca, Malatya'daki İnönü Üniversitesi Karaciğer Nakli Enstitüsü'nde kendi tek merkezli LPD programlarının başlatılmasından Şubat 2024'e kadar toplam on üç 2'li, dokuz 3'lü, dört 4'lü, iki 5'li ve bir 6'lı LPE gerçekleştirdiklerini bildirmişlerdir. 2023 yılında programları 231 LDLT'nin %27,7'sine karşılık gelen 64 LDLT'nin LPE yoluyla yapılmasını sağlamıştır.

- **Bu deneyim, mevcut dönemde oldukça donanımlı altyapıya ve geniş deneyimli bir cerrahi ekibe sahip bu kaynak-zengini kurum için benzersizdir.**

Çıkarımlar

- **LPE, ABO-uyumsuzluğu (ABOi) ve greft hacim uyumsuzluğunu aşmak için adil ve yasal bir yöntemdir. LPE'ye erişimi ve katılımı artırmak için elde edilen dersler ve uygulanan en iyi yöntemler (best practices) küresel ölçekte paylaşılmalıdır.**

- **LPE'ye özgü bazı etik kaygılar bulunmaktadır; donör baskısı (coercion), donörün bağıştan vazgeçmesi (revocation), donör riski ve greft adaleti (graft equity) yer alır.**

- **Eşzamanlı (simultaneous) LPE'ler, donörün son anda bağıştan vazgeçme riskini azaltır. Ayrıca merkezlerin lojistik süreçler üzerinde daha fazla kontrol sağlamasına ve donör ile alıcı ekiplerinin daha iyi koordine olmasına olanak tanır.**

- **LPE programlarının etkinliğini artıran iki ana faktör:**

1. Çoklu (multi-way) LPE nakillerini gerçekleştirebilme kapasitesi

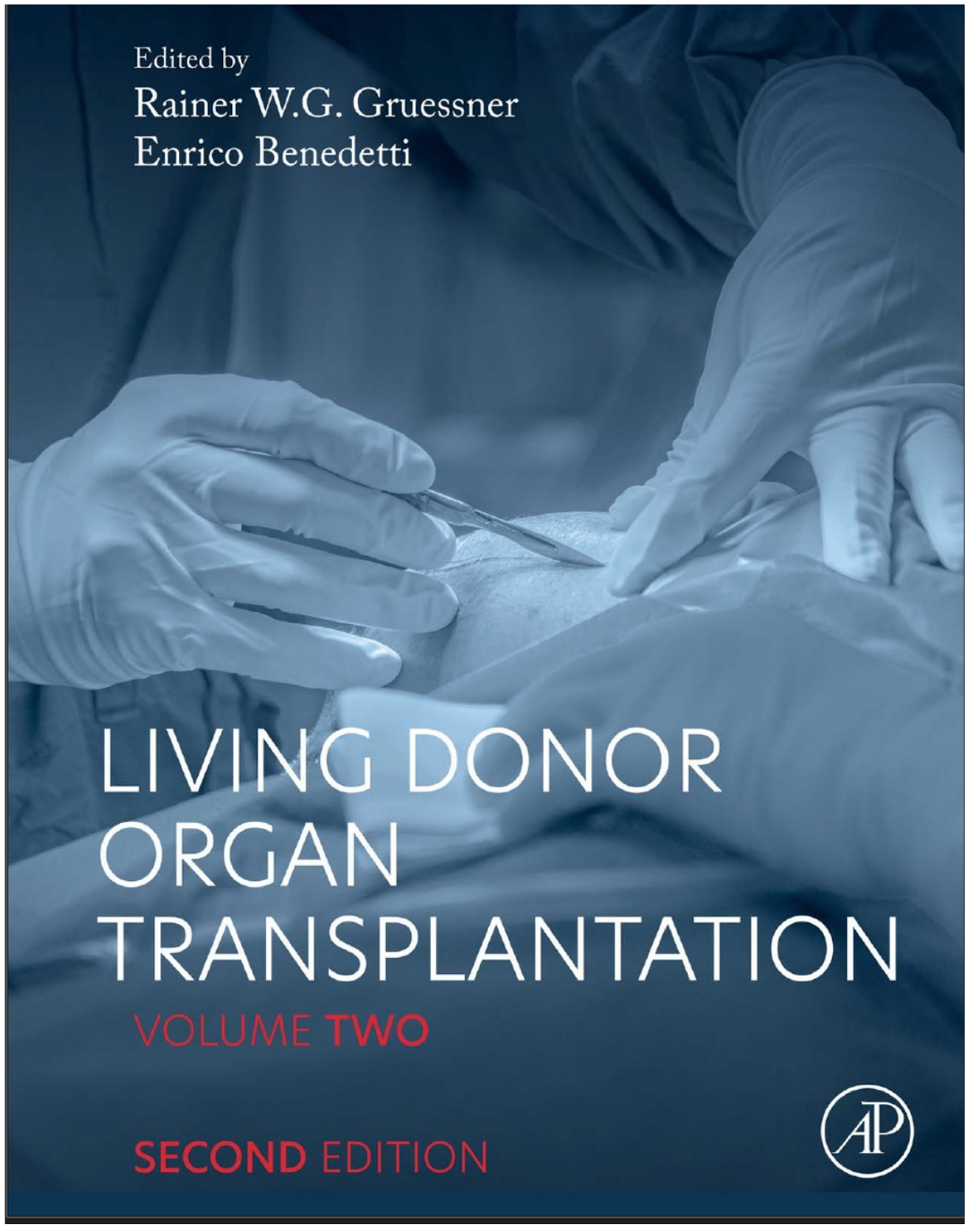
2. Uyumlu çiftlerin (compatible pairs) programa katılımı

Çıkarımlar

- **LPE programlarının tesis edilmesi disiplinler arası işbirliğini, beraber çalışmayı gerektirir**

- **LDLT uygulayan merkezler arasında donör değişimi olmazsa, LPE programları dünya çapında nispeten az sayıda yüksek hacimli LDLT merkeziyle sınırlı olacaktır**

- **Ülkemizdeki yüksek volümlü transplant merkezlerini kapsayan «Liver Paired Exchange Projesi» Sağlık Bakanlığı tarafından, en azından bir pilot program olarak, hayata geçirilmelidir**



33. Song GW, Lee SG, Hwang S, et al. Successful experiences of ABO-incompatible adult living donor liver transplantation in a single institute: no immunological failure in 10 consecutive cases. *Transplant Proc*. Jan-Feb 2013;45(1):272–275. https://doi.org/10.1016/j.transproceed.2012.06.079.
34. Kawagishi N, Satoh K, Enomoto Y, et al. New strategy for ABO-incompatible living donor liver transplantation with anti-CD20 antibody (rituximab) and plasma exchange. *Transplant Proc*. March 2005;37(2):1205–1206. https://doi.org/10.1016/j.transproceed.2004.12.114.
35. Yoon YI, Song GW, Lee SG, et al. Outcome of ABO-incompatible adult living-donor liver transplantation for patients with hepatocellular carcinoma. *J Hepatol*. June 2018;68(6):1153–1162. https://doi.org/10.1016/j.jhep.2018.02.002.
36. Song GW, Lee SG, Moon DB, et al. Dual-graft adult living donor liver transplantation: an Innovative surgical Procedure for live liver donor pool Expansion. *Ann Surg*. July 2017;266(1):10–18. https://doi.org/10.1097/SLA.0000000000001776.
37. Song GW, Lee SG, Hwang S, et al. Dual living donor liver transplantation with ABO-incompatible and ABO-compatible grafts to overcome small-for-size graft and ABO blood group barrier. *Liver Transpl*. April 2010;16(4):491–498. https://doi.org/10.1002/lt.22016.
38. Kwon JH, Song GW, Hwang S, et al. Dual-graft adult living donor liver transplantation with ABO-incompatible graft: short-term and long-term outcomes. *Am J Transplant*. 2018;18(2):424–433. https://doi.org/10.1111/ajt.14448.
39. Sugawara Y, Makuuchi M. Advances in adult living donor liver transplantation: a review based on reports from the 10th anniversary of the adult-to-adult living donor liver transplantation meeting in Tokyo. *Liver Transpl*. June 2004;10(6):715–720. https://doi.org/10.1002/lt.20179.
40. Jung DH, Hwang S, Ahn CS, et al. Section 16. Update on experience in paired-exchange donors in living donor liver transplantation for adult patients at ASAN Medical Center. *Transplantation*. April 27, 2014;97(Suppl 8):S66–S69. https://doi.org/10.1097/01.tp.0000446280.81922.bb.
41. Patel MS, Mohamed Z, Ghanekar A, et al. Living donor liver paired exchange: a North American first. *Am J Transplant*. January 2021;21(1):400–404. https://doi.org/10.1111/ajt.16137.
42. Braun HJ, Torres AM, Louie F, et al. Expanding living donor liver transplantation: report of first United States living donor liver transplant chain. *Am J Transplant*. November 10, 2020. https://doi.org/10.1111/ajt.16396.

Chapter 34.16.2

Liver paired exchange

Sezai Yilmaz, Tayfun Sonmez, Utku Unver, Veysel Umman, Volkan Ince, Sami Akbulut, Murat Zeytunlu, Burak Isik and Sukru Emre

Introduction

Living donor liver transplantation (LDLT) has been a successful alternative to deceased donor liver transplantation, offering several advantages, including reduced waiting times, better graft quality, less or no transmission of donor-derived infections and malignancies, and improved survival rates. However, finding a well-matched living donor with suitable anatomy and a compatible blood group remains a significant challenge for many patients. Paired exchange programs have served as an innovative solution to overcome incompatibility issues and thus have a potential impact on expanding the living donor pool. In this chapter, we explore the basis, challenges, success, outcomes, considerations, and future of liver paired exchange (LPE) in LDLT by following the steps of establishing a new paired exchange program in a liver transplantation institute.

Paired exchange programs: Definition and history

LPE is an innovative approach to expanding the pool of compatible living donors for patients in need of a liver transplant (LT). This concept involves two or more donor-recipient pairs that are incompatible within their respective pairs. Donors who are incompatible with their intended recipient offer their graft to the program while receiving a compatible liver for their recipient from another donor within the program. Thus, otherwise, incompatible donors can be utilized for successful transplantation.

The kidney paired exchange (KPE) programs have been successfully used in kidney transplantation to overcome organ shortages and enable the exchange of ABO-incompatible (ABOi) and HLA-incompatible living donors by swapping between two or more pairs (see Chapter 18.17.1).[1,2] While KPE was first proposed earlier,[3] it flourished in the United States and Europe in the mid-2000s because of collaborations between members of the transplantation community and experts in the field of market design.[4–6] These collaborations materialized in the formation of centralized kidney exchange clearing houses in the United States and Europe that use tools from the fields of optimization and market design, and in 15 years, the number of patients who benefit from KPEs in the United States alone increased from a few dozen in the early 2000s to more than 1100 patients by 2021.[7] Two constraints limiting the applicability of KPE were the allocation and matching of pairs and the number of cases included in the single-run KPE, both of which have been overcome using optimal matching algorithms,[8] and the use of groups larger than two-way exchanges,[9] which created the underlying success for the increase in the number of KPEs. These collaborations also contributed to the 2012 Nobel Prize for economics won by economist Alvin Roth in the economic sciences.[10]

Likewise, LPE can mitigate the problem of incompatible donor-recipient pairs; exchanging donors to enable compatible transplants has been a subject that has been emphasized for more than a decade. The efficiency of screening potential living donors is not high, and many of

BANU BEDESTENCİ SONMEZ LIVER PAIRED EXCHANGE SYSTEM

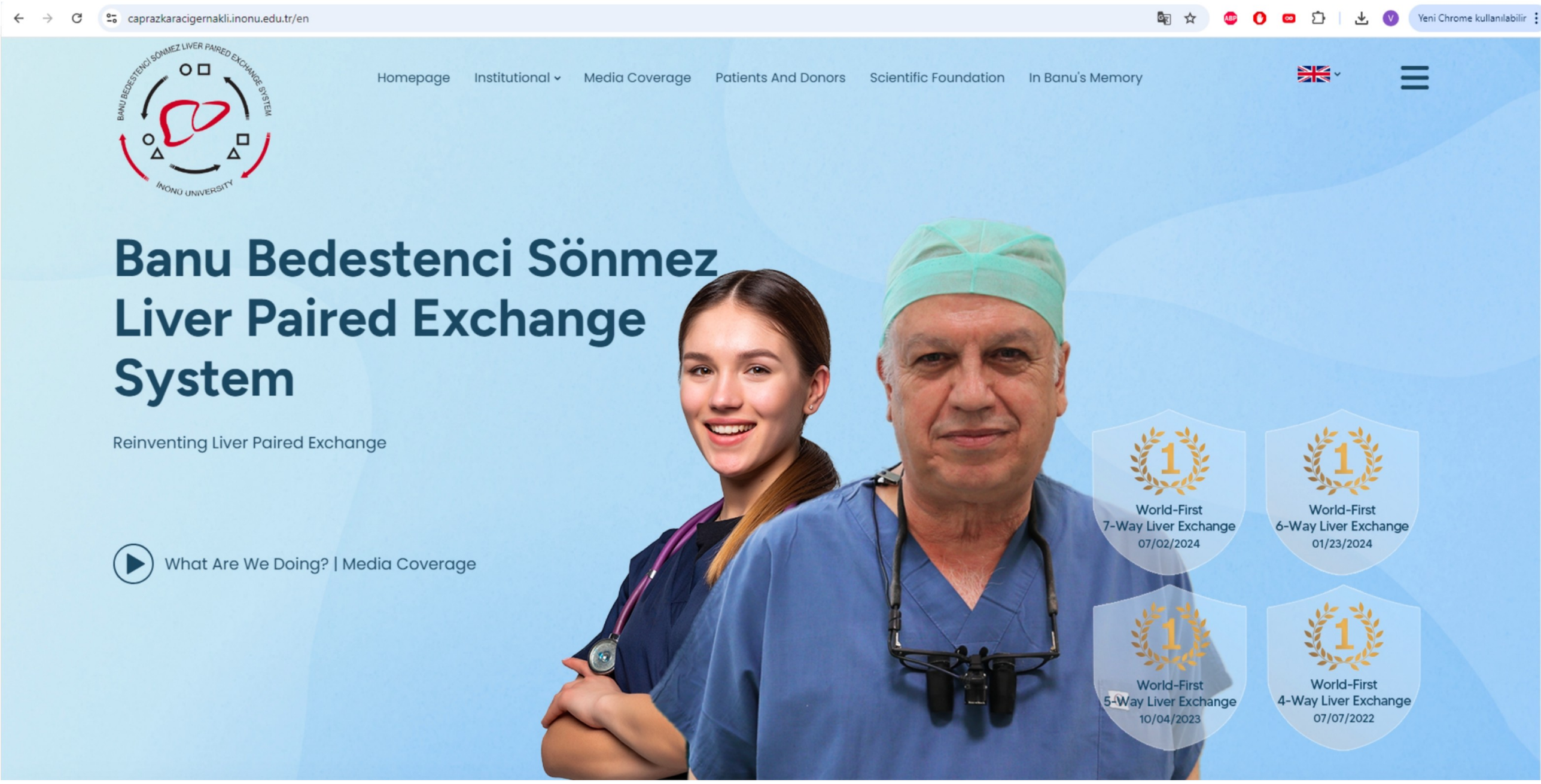
İNÖNÜ UNIVERSITY

INCOMPATIBILITY IS NOT HOPELESSNESS

Reinventing Liver Paired Exchange on the Boston-Malatya Route

İNÖNÜ UNIVERSTY
LIVER TRANSPLANT INSTITUTE
2011

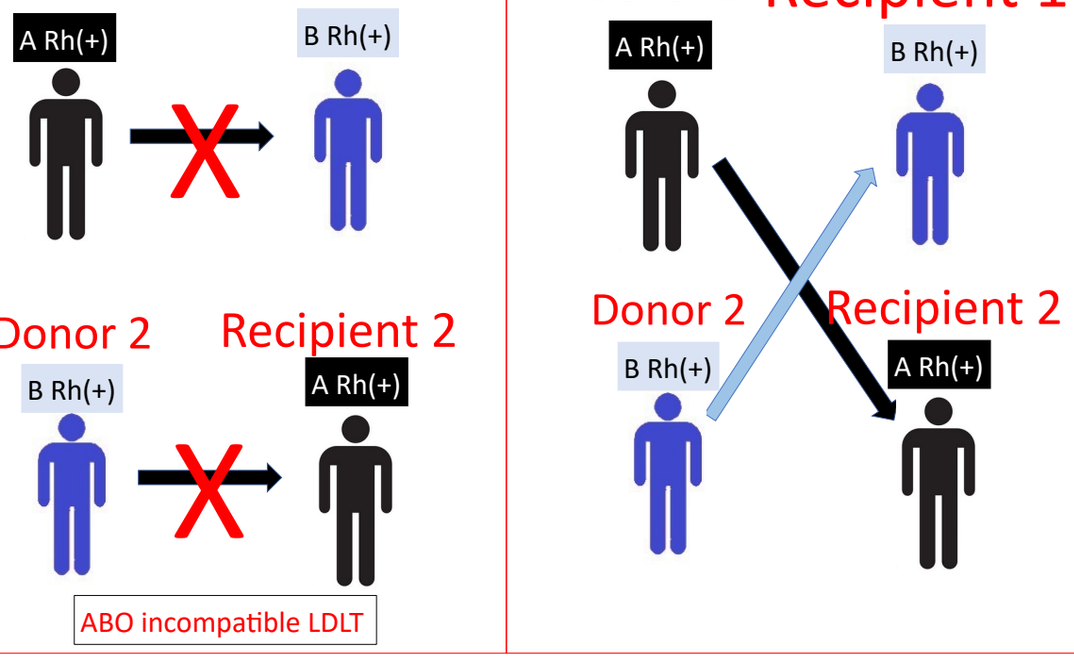
https://caprazkaracigernakli.inonu.edu.tr/en



Inonu University which is a global pioneer in LPE has been listed among the leading LDLT centers in Turkey and Europe

Living Donor Liver Transplantation

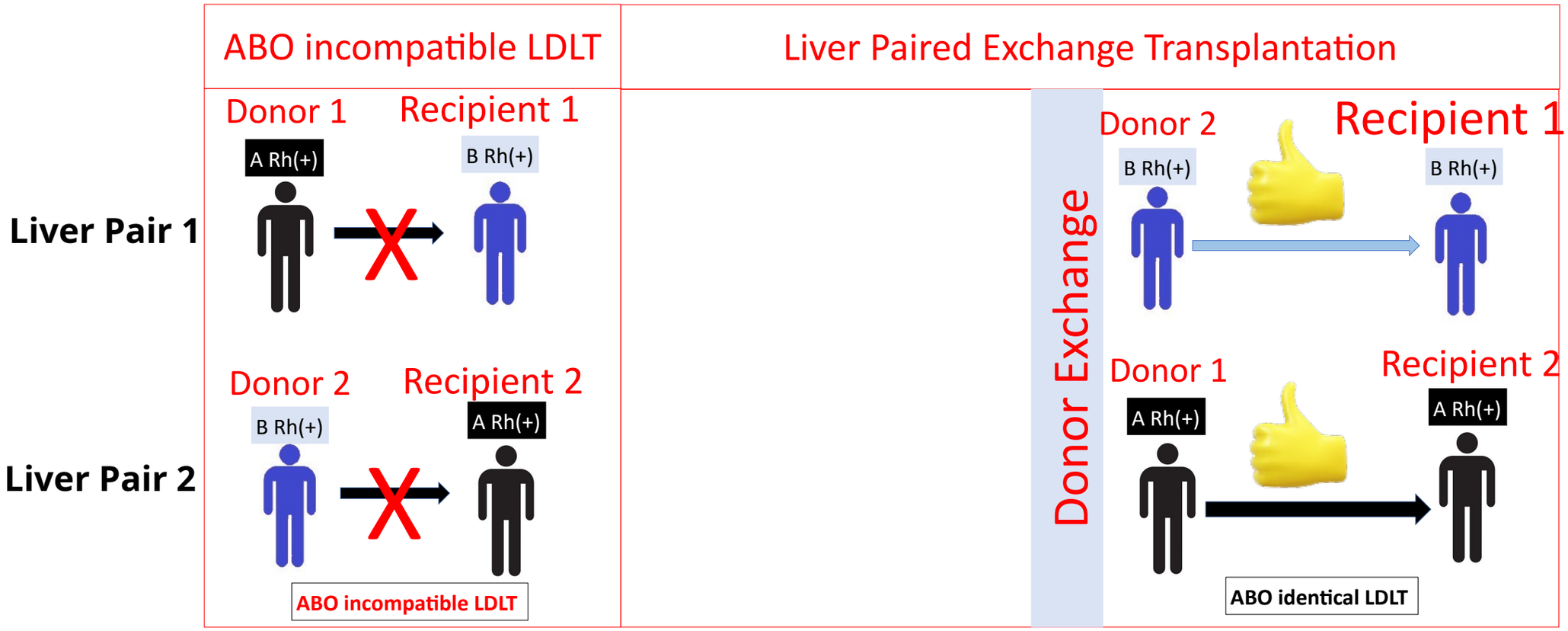
	ABO incompatible LDLT	Liver Paired Exchange Transplantation
Liver Pair 1	Donor 1 (A Rh(+)) → Recipient 1 (B Rh(+))	Donor 1 (A Rh(+)) → Recipient 1 (B Rh(+)); Donor 2 (B Rh(+)) → Recipient 2 (A Rh(+))
Liver Pair 2	Donor 2 (B Rh(+)) → Recipient 2 (A Rh(+)); ABO incompatible LDLT	



- **Only 30-40% of living donor candidates are suitable for donor hepatectomy**
- **If a donor cannot donate to their intended recipient because of ABO-i or inadequate GRWR, they might still be able to donate to another patient**

Yilmaz S, et al. Am J Transplant 2023;23(10):1612

Living Donor Liver Transplantation



2-Way LPE = 2 LDLT

- **Only 30-40% of living donor candidates are suitable for donor hepatectomy**

- **If a donor cannot donate to their intended recipient because of ABO-i or inadequate GRWR, they might still be able to donate to another patient**
- **In these cases, patients can swap donors to find a compatible transplant through a process called «liver paired exchange»**
- A LPE with n ≥ 2 patient–donor pairs is called an n-way exchange

Yilmaz S, et al. Am J Transplant 2023;23(10):1612

İNÖNÜ UNIVERSITY
LIVER TRANSPLANT INSTITUTE
2011

Kidney Paired Donation in Live-Donor Kidney Transplantation

TO THE EDITOR: An estimated 6000 patients on the waiting list for kidney transplantation in the United States have suitable living donors who are not immunologically compatible.[1] Both kidney paired donation (KPD) and desensitization are options for patients with incompatible donors. KPD, which matches a living donor with a compatible recipient in a tag-team approach among potential donor–recipient pairs, can achieve compatible transplant combinations. Although desensitization therapies have been used to achieve transplantation from an incompatible donor, such procedures are costly and may have associated complications and inferior long-term outcomes.[2,3] Computer modeling suggests that KPD is underused despite lower costs and better outcomes than desensitization.[4,5]

Our center established a KPD program enrolling all consenting recipient candidates who had incompatible donors as well as compatible pairs with donors over the age of 45 years. Since we initiated the program in March 2008, we have performed 83 KPD procedures, including 22 two-way and 13 three-way exchanges. The median time from listing in the KPD database to transplantation was 5.5 months (range, 1 to 18). All recipients had negative flow cross-matches at the time of transplantation. Of the transplant recipients in the program, 64% had cross-match incompatibility with their original donors, and 36% had blood-type incompatibility. Of the transplant recipients with cross-match incompatibility, 36% had a panel reactive antibody of more than 80%. With a median follow-up of 6 months after transplantation, there were no episodes of cellular rejection and one mild antibody-mediated rejection that was easily reversed.

Currently, 201 recipient candidates and 339 potential donors are enrolled in the KPD database. There was a strong correlation between the number of KPD transplantations and the addition of new pairs to the database, with the sharpest rise occurring after the database reached 100 recipient candidates (Fig. 1). This increase in the number of KPD procedures has substantially increased access to live-donor transplantation. One year after initiation of the program, KPD procedures accounted for 11% of live-donor transplantations at our center; by 18 months, the proportion was 31%. In the past year, 61 of 180 (34%) live-donor kidney transplantations that were performed at our center were KPD procedures, a proportion that highlights the sustainability of KPD to increase access to transplantation.

If the productivity of our KPD program were to be replicated on a national level, it would potentially result in approximately 2000 additional live-donor transplantations annually and reduce the number of patients on the waiting list. The increased use of this procedure would also probably avert many difficult desensitization therapies. No recent advance in transplantation has achieved such an apparent increase in access to live-donor transplantation, especially in sensitized patients.

KPE programı başlangıcı 2008;
2009'da KTx'lerin % 11'i KPE
2010'da % 34'ü KPE

American Journal of Transplantation 2012; 12: 2125–2132
Wiley Periodicals Inc.

doi: 10.1111/j.1600-6143.2012.04070.x

Single-Center Kidney Paired Donation: The Methodist San Antonio Experience

A. W. Bingaman[a,*], F. H. Wright Jr.[a], M. Kapturczak[a], L. Shen[a], S. Vick[a] and C. L. Murphey[b]

[a]*Methodist Specialty and Transplant Hospital, San Antonio, TX*
[b]*Southwest Immunodiagnostics Inc., San Antonio, TX*
**Corresponding author: Adam W. Bingaman, adam.bingaman@mhshealth.com*

Many potential kidney transplant recipients are unable to receive a live donor transplant due to crossmatch or blood type incompatibility. Kidney paired donation increases access to live donor transplantation but has been significantly underutilized. We established a kidney paired donation program including consented incompatible donor/recipient pairs as well as compatible pairs with older non-human leukocyte antigen identical donors. Over a 3-year period, a total of 134 paired donor transplants were performed, including 117 incompatible pairs and 17 compatible pairs. All transplants were done with negative flow cytometry crossmatches and five were done with desensitization combined with paired donation. Kidney paired donation transplants included two-way and three-way exchanges as well as three chains initiated by nondirected donors. Of the sensitized recipients transplanted by paired donation, 44% had calculated panel reactive antibody levels greater than 80%. Transplantation of females and prior transplant recipients was significantly higher with paired donation. Only three episodes of rejection occurred and no transplants were lost due to rejection. These data highlight the potential of kidney paired donation and suggest that all transplant centers should be actively engaged in paired donation to increase access to live donor transplantation.

Key words: Anti-HLA antibodies, desensitization, paired kidney donation, sensitized patients

Introduction

The kidney transplant waiting list has continued to grow due to a limited supply of deceased donor organs and an increasing number of patients with end-stage renal disease. Live donor transplantation is a favorable option for patients with acceptable donors since recipients can avoid long wait times on dialysis and outcomes for live donor transplantation are better compared to deceased donor transplantation (1, 2). In order to receive a live donor kidney transplant, the recipient must be immunologically compatible with the donor. Compatibility testing includes blood typing (ABO) as well as histocompatibility testing. It is estimated that there are at least 6000 patients on the current kidney transplant waiting list with willing healthy donors who are not compatible (3). Desensitization and kidney paired donation (KPD) are options for patients to achieve a transplant with incompatible living donors. However, desensitization techniques are expensive, may be associated with higher patient morbidity and long-term outcomes are inferior making KPD to achieve compatible transplantation the preferred option (4–6). Computer modeling suggests that KPD is underutilized despite lower costs and better outcomes compared with desensitization (7–9). Since KPD was initiated in the United States, more than 1000 KPD transplants have been performed (10–12). Johns Hopkins initiated the first large single-center KPD program in 2000 and reported their 100th KPD transplant in December 2009 (13). Between January 2004 and December 2008, the Dutch national KPD program registered 312 incompatible pairs and performed 131 exchange transplants, making the Netherlands experience the most successful national program to date (14–20).

Some transplant centers in the United States have elected to enter incompatible donor/recipient pairs into databases managed by KPD networks or alliances. UNOS has recently initiated an optional national program for KPD. The effectiveness and efficiency of these multicenter KPD programs

MEETING ABSTRACTS

400 Kidney Paired Donor Transplants at a Single Center; The Methodist San Antonio Experience

A. Bingaman,[1] M. Kapturczak,[1] I. Ashlagi,[2] C. Murphey.[3]

[1]Methodist Specialty and Transplant Hospital, San Antonio, TX
[2]Stanford University, Palo Alto, CA
[3]Southwest Immunodiagnostics, San Antonio, TX.

Meeting: 2018 American Transplant Congress

Abstract number: 449

Keywords: Kidney transplantation, Panel reactive antibodies

Session Information

Session Name: Concurrent Session: Kidney Paired Exchange

Session Type: Concurrent Session

Date: Tuesday, June 5, 2018

Session Time: 2:30pm-4:00pm

Presentation Time: 3:18pm-3:30pm

Location: Room 4B

Background: Kidney paired donation (KPD) has become the standard of care for incompatible living donor pairs. Several mature national KPD programs exist yet KPD transplants only represent about 11% of total live donor transplants in the U.S., less than predicted by computer modeling. **Methods:** We initiated a single center KPD program in 2008. Consenting pairs were entered into our KPD database with blood types, HLA types and unacceptable antigens individually assigned based upon single antigen bead analysis. **Results:** Between March 2008 and October 2017 our single center KPD program has done 400 KPD transplants, representing 26% of total living donor transplants at our center. These transplants include 57 2-way exchanges, 36 3-way exchanges, 9 4-way exchanges, 6 5-way exchanges, 2 6-way exchanges and 13 non-directed donor (NDD) initiated chains ranging in length from 3-23 recipients. 218 patients were sensitized HLA incompatible with their original donors including 111 (51%) with cPRA ≥80% and 53 (24%) with cPRA ≥99%. 62 recipients (15.5%) were re-transplant patients. A total of 43 patients underwent desensitization for positive flow crossmatch or ABO incompatibility. A total of 222 (55%) blood type O donors were utilized of which 212 (95.5%) were transplanted into blood type O recipients or non-O recipients with cPRA ≥80%. 22 blood type A2 donors were utilized, of which 15 (68%) were transplanted into non-A recipients. 51 compatible pair donors were utilized of which 48 donors (94%) were blood type O or A2, and 3 donors (6%) were blood type A1. Compatible pairs participated in a total of 155 KPD transplants. All compatible pair recipients received kidneys from younger donors. Overall one year graft survival is 98.7%. **Conclusions:** We report the largest single center KPD program in the world. With limited NDDs, KPD programs must utilize blood type A2 donors and compatible pairs in order to transplant blood type O recipients effectively. To transplant the most highly sensitized patients, combination of KPD and desensitization is very effective with excellent outcomes.

CITATION INFORMATION: Bingaman A., Kapturczak M., Ashlagi I., Murphey C. 400 Kidney Paired Donor Transplants at a Single Center; The Methodist San Antonio Experience *Am J Transplant.* 2017;17 (suppl 3).

« Back to 2018 American Transplant Congress

İNÖNÜ UNIVERSITY
LIVER TRANSPLANT INSTITUTE
2011

MEETING ABSTRACTS

Home Meetings Archive Keyword Index Resources Search

Search

400 Kidney Paired Donor Transplants at a Single Center; The Methodist San Antonio Experience

A. Bingaman,[1] M. Kapturczak,[1] I. Ashlagi,[2] C. Murp

[1]Methodist Specialty and Transplant Hospital, San Ant
[2]Stanford University, Palo Alto, CA
[3]Southwest Immunodiagnostics, San Antonio, TX.

Meeting: 2018 American Transplant Congress

Abstract number: 449

Keywords: Kidney transplantation, Panel react

400 KPE (155 compatible pair)
Total renal transplantların % 27'si
2-way KPE 57
3-way KPE 36
4-way KPE 9
5-way KPE 6
6-way KPE 2

Session Information

Session Name: Concurrent Session: Kidney Paired Exchange

Session Type: Concurrent Session

Date: Tuesday, June 5, 2018

Background: Kidney paired donation (KPD) has become the standard of care for incompatible living donor pairs. Several mature national KPD programs exist yet KPD transplants only represent about 11% of total live donor transplants in the U.S., less than predicted by computer modeling. **Methods:** We initiated a single center KPD program in 2008. Consenting pairs were entered into our KPD database with blood types, HLA types and unacceptable antigens individually assigned based upon single antigen bead analysis. **Results:** Between March 2008 and October 2017 our single center KPD program has done 400 KPD transplants, representing 26% of total living donor transplants at our center. These transplants include 57 2-way exchanges, 36 3-way exchanges, 9 4-way exchanges, 6 5-way exchanges, 2 6-way exchanges and 13 non-directed donor (NDD) initiated chains ranging in length from 3-23 recipients. 218 patients were sensitized HLA incompatible with their original donors including 111 (51%) with cPRA ≥80% and 53 (24%) with cPRA ≥99%. 62 recipients (15.5%) were re-transplant patients. A total of 43 patients underwent desensitization for positive flow crossmatch or ABO incompatibility. A total of 222 (55%) blood type O donors were utilized of which 212 (95.5%) were transplanted into blood type O recipients or non-O recipients with cPRA ≥80%. 22 blood type A2 donors were utilized, of which 15 (68%) were transplanted into non-A recipients. 51 compatible pair donors were utilized of which 48 donors (94%) were blood type O or A2, and 3 donors (6%) were blood type A1. Compatible pairs participated in a total of 155 KPD transplants. All compatible pair recipients received kidneys from younger donors. Overall one year graft survival is 98.7%. **Conclusions:** We report the largest single center KPD program in the world. With limited NDDs, KPD programs must utilize blood type A2 donors and compatible pairs in order to transplant blood type O recipients effectively. To transplant the most highly sensitized patients, combination of KPD and desensitization is very effective with

rczak M., Ashlagi I., Murphey C. 400 Kidney
Methodist San Antonio Experience *Am J*

y C. 400 Kidney Paired Donor Transplants at
xperience [abstract].
0-kidney-paired-donor-transplants-at-a-
erience/. Accessed March 30, 2024.

« Back to 2018 American Transplant Congress

Visit Our Partner Sites

American Transplant Congress (ATC)
Visit the official site for the American Transplant Congress »

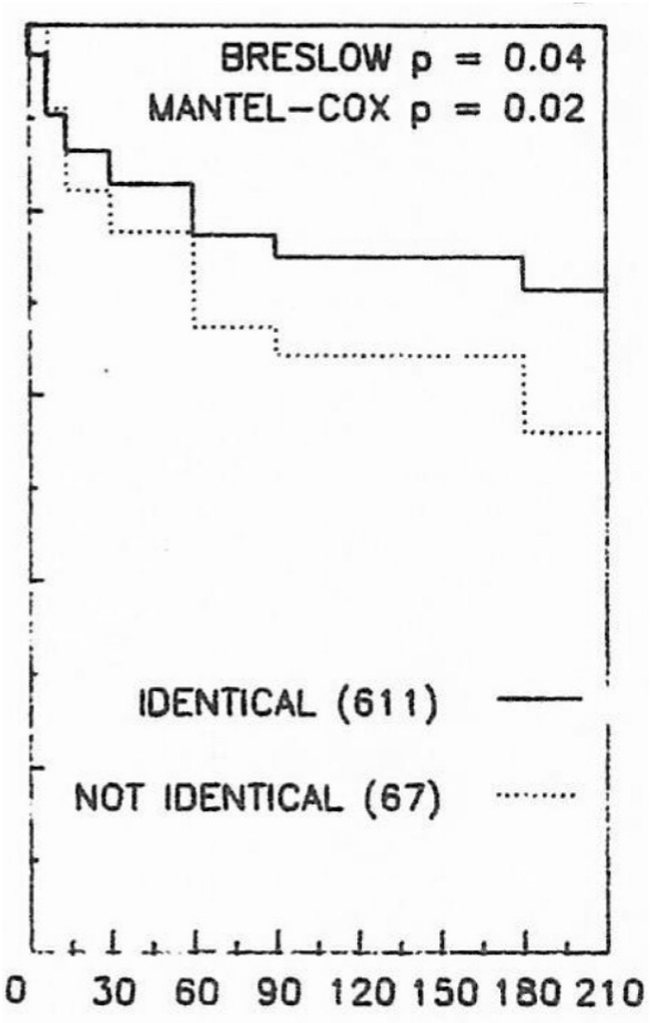
American Journal of Transplantation

Published in final edited form as:
Transplant Proc. 1987 December ; 19(6): 4575–4579.

Experience With Primary Liver Transplantation Across ABO Blood Groups

R.D. Gordon, **S. Iwatsuki**, **C.O. Esquivel**, **S. Todo**, **L. Makowka**, **A. Tzakis**, **J.W. Marsh**, and **T.E. Starzl**
Department of Surgery, University Health Center of Pittsburgh, University of Pittsburgh; and the Veterans Administration Medical Center, Pittsburgh.

THE LIVER has long been regarded as a privileged organ which can be transplanted across incompatible ABO blood groups with little risk of hyperacute rejection.[1] However, in a recent review of 671 first, second, and third liver transplants we found a significant advantage for ABO donor-recipient identity for primary liver transplants.[2] Although a large number of ABO mismatched grafts were successful, graft survival for primary liver grafts between ABO identical donor-recipient pairs was significantly better than grafts between ABO compatible but nonidentical or ABO incompatible donor-recipient pairs.



İNÖNÜ UNIVERSITY
LIVER TRANSPLANT INSTITUTE
2011

Transplant International ISSN 0934-0874

ORIGINAL ARTICLE

Outcomes after identical and compatible orthotopic liver transplantation for fulminant hepatic failure: a single center experience in UK

Ilias Koukoutsis, Riccardo Bellagamba, Appou Tamijmarane, Bridget Gunson, Vijayaragavan Muralidharan, Stephen J. Wigmore, David A. Mayer, Darius F. Mirza, John A. C. Buckels and Simon R. Bramhall

Liver Unit, Queen Elizabeth Hospital, Edgbaston, Birmingham B15 2TH, UK

Keywords
ABO-barrier, ABO-non identical, compatible liver transplantation, highly urgent transplants, liver transplant and Coomb's test, post-transplant hemolysis.

Correspondence
Mr S. R. Bramhall, Consultant HPB & Liver Transplant Surgeon, Queen Elizabeth Hospital, Edgbaston, Birmingham B15 2TH, UK. Tel.: 0121 627 2346; fax: 0121 414 1833; e-mail: simon.bramhall@uhb.nhs.uk

Received: 14 August 2006
Revision requested: 5 September 2006
Accepted: 9 January 2007

doi:10.1111/j.1432-2277.2007.00458.x

Summary

To analyze the outcomes between identical and compatible liver transplantation (OLT) for fulminant hepatic failure (FHF) from September 1984 to November 2005. The patients were divided in three groups; group 1 (identical), group 2 (compatible) and group 3 (incompatible), according to the donor-recipient blood type matching. We analyzed several outcomes regarding mortality, patient and graft survival, incidence of acute graft rejection during the first postoperative month (30 days), incidence of biliary complications and indications of re-transplantation. We also analyzed the relationship of Coomb's positive test with postoperative hemolysis to all the above mentioned factors. During the study period, 168 males and 112 females underwent their first OLT for FHF, with 37.1% overall mortality and 42.1% overall graft failure rate. The results between group 1 (203 patients) and group 2 (73 patients) were comparable. A statistically significant difference was recorded in 1 year and overall graft survival between group 1 and group 2 ($P = 0.049$ and log-rank = 0.035 respectively). Coomb's positive test did not influence the outcomes. OLT in FHF can be safely carried out whether the donor organs are identical or compatible. Hemolysis (Coomb's positive test) after identical or compatible OLT does not influence the outcomes.

Introduction

Organ transplantation causes immunological alterations in the recipient treated with life-long immunosuppressive therapy. The liver is a privileged organ with a relatively low risk of hyperacute rejection due to its resistance to antibody-mediated injury [1–3].

ABO blood group incompatibility in OLT is considered in the literature as a relative contraindication [1], because of the presence of preformed isoagglutinins in recipient serum against the donor A or B antigens which may cause hemolysis, acute renal failure, disseminated intravascular coagulation, hypotension, increased icidence of biliary and/or vascular complications and multiorgan failure with substantial morbidity and mortality [4–12]. Fulminant hepatic failure (FHF) represents 9% of all OLTs in Europe [13]. Successful management after OLT due to FHF depends on the condition of the patient before transplant and the technical and immunological aspects of the transplant itself.

The four ABO blood groups are not proportionally distributed within any population and the blood group of donor and recipient might not be similar. Therefore, patients with rapid deteriorating hepatic disease such as FHF, are candidates for receiving an ABO compatible-non identical (comp) or an incompatible (incomp) graft [13].

In this study, we review our experience and analyze the outcomes after identical or compatible OLT for FHF in the last 21 years.

1 yıllık graft survivali % 66.5 vs % 53.4; p=0.049

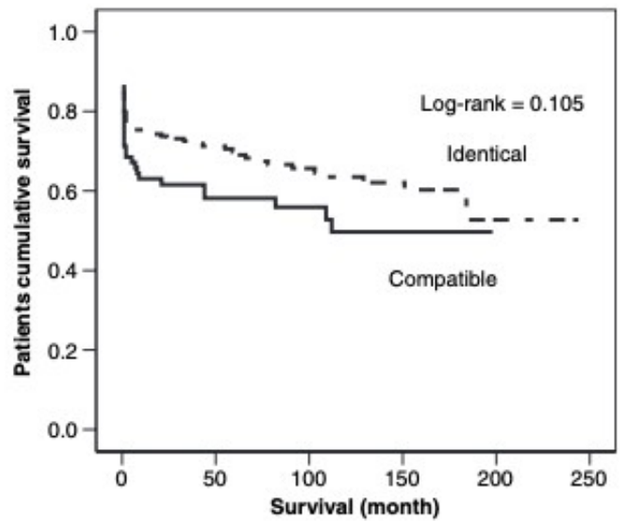


Figure 1 Kaplan–Meier overall patients survival curve.

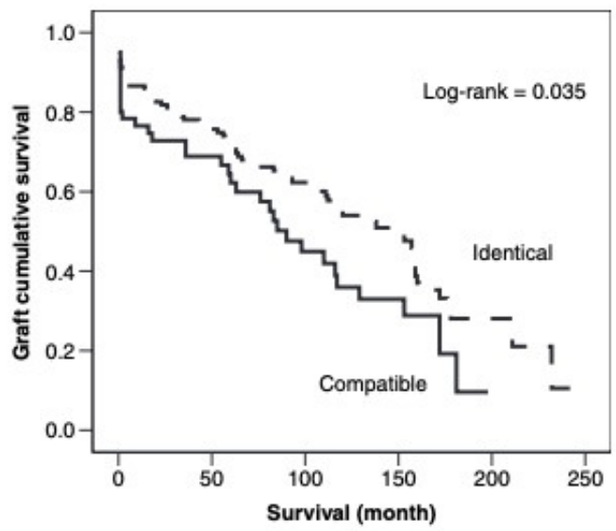


Figure 2 Kaplan-Meier overall graft survival curve.

0041-1337/03/7503-347/0
TRANSPLANTATION
Copyright © 2003 by Lippincott Williams & Wilkins, Inc.

Vol. 75, 347–353, No. 3, February 15, 2003
Printed in U.S.A.

HIGHLY URGENT LIVER TRANSPLANTATION: POSSIBLE IMPACT OF DONOR-RECIPIENT ABO MATCHING ON THE OUTCOME AFTER TRANSPLANTATION

K. BJØRO,[1,8] B. G. ERICZON,[2] P. KIRKEGAARD,[3] K. HÖCKERSTEDT,[4] G. SÖDERDAHL,[2] M. OLAUSSON,[5] A. FOSS,[6] L. E. SCHMIDT,[7] H. ISONIEMI,[4] B. BRANDSÆTER,[1] AND S. FRIMAN[5]

Background. **Survival after liver transplantation for fulminant hepatic failure has been reported to be less favorable than survival for patients with chronic liver diseases.**

Methods. **We have studied all patients (n=229) undergoing highly urgent liver transplantation from 1990 to 2001 in the Nordic countries. The impact of patient and donor characteristics, with emphasis on donor-recipient ABO matching (identical, compatible, incompatible), has been studied.**

Results. **One-year and 3-year patient survival rates were 73% and 70% for the total period and 86% and 78% for the last 4-year period. Patients receiving an ABO-compatible liver allograft had significantly lower patient survival rates than those receiving an ABO-identical donor organ (1-year patient survival rates 66% of vs. 79%, *P*=0.03). Graft survival rates varied less (1-year graft survival rates of 64% vs. 74%, *P*=0.09). Patients receiving an ABO-incompatible liver allograft had patient survival rates of 70% at 1 year and 60% at 3 years but low graft survival rates (40% and 30% at 1 and 3 years). In a multiple regression analysis, significant independent predictors of poor patient survival were early year of transplantation, ABO-compatible donor, high donor age, and waiting time more than 3 days and less than 9 days.**

Conclusion. **Survival after highly urgent liver transplantation has improved and is comparable to that observed in patients receiving a liver allograft because of chronic liver disease. Patients receiving an ABO-identical donor organ had significantly higher patient survival rates compared with those receiving an ABO-compatible donor liver.**

Fulminant hepatic failure (FHF) is a rare condition but still represents one of the major indications for liver transplantation (Ltx), comprising 9% of all transplantations in for these patients after Ltx has been reported to be poorer than for patients with chronic liver diseases who receive a liver allograft (*3–6*). On the other hand, in a smaller series of patients from Helsinki, similar patient survival rates after Ltx have been demonstrated among patients with FHF and those with liver failure caused by chronic liver disease (*7*).

Results of Ltx for FHF depend heavily on the condition of the patient at the time of transplantation. Because of the rapid progression of the disease in most cases of FHF (*8,9*), the time aspect is paramount. Thus the availability of a donor organ will to a great extent decide the outcome.

The rapid deterioration frequently observed in patients listed for a highly urgent liver transplantation (HULtx) increases the possibility that the transplant team will accept marginal donor organs, in some cases even ABO-incompatible livers (*10*). In the present study we have assessed outcome after HULtx in the Nordic countries during a 12-year period, with special emphasis on the impact of both donor and recipient ABO blood type.

PATIENTS AND METHODS

Organization

Ltx are performed in five centers in the Nordic countries: Copenhagen (Denmark), Helsinki (Finland), Oslo (Norway), and Stockholm and Gothenburg (Sweden). All these centers have been active throughout the study period of 1990 to 2001. Ltx were performed in Aarhus (Denmark) from 1993 to 1994 and in Uppsala (Sweden) from 1995 to 1996 and from 2001 to the present. All patients listed for Ltx in the five Nordic countries (Denmark, Finland, Iceland, Norway, and Sweden) are recorded in a donor sharing system–Scandiatransplant (*11*). There is an extensive exchange of donor organs between centers and countries. Patients with FHF are listed for HULtx and have absolute priority for any ABO-compatible or ABO-identical donor organ within 72 hr after listing. In general, the first donor

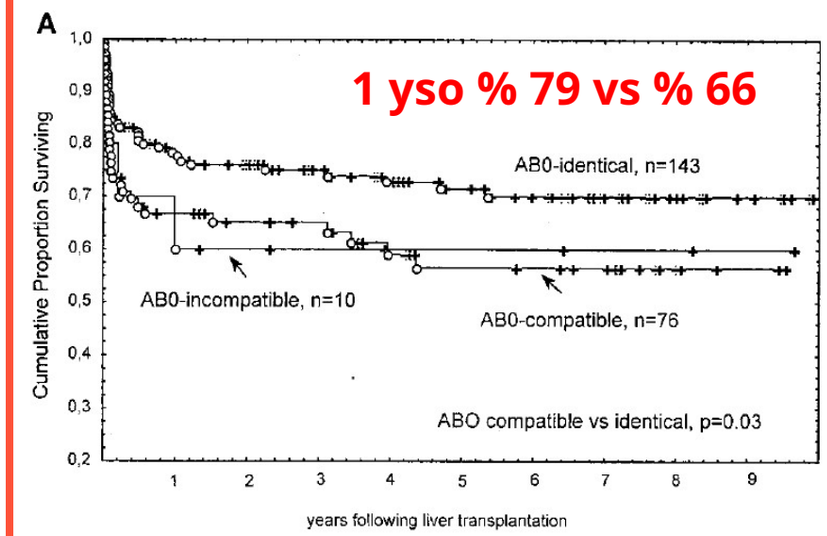


FIGURE 1. (A) Patient survival rates after Ltx according to patient and donor ABO matching. (B) Graft survival rates after Ltx according to patient and donor ABO matching.

COMPARABLE OUTCOMES FOR ABO NON-IDENTICAL AND INCOMPATIBLE GRAFTS IN LIVER TRANSPLANTATION

Maggard Melinda A.; Imagawa, David K.; Busuttil, Ronald W.

TransplantationTransplantation. 66:p S49, October 27, 1998.

Author Information

[1]UCLA Medical Center, Los Angeles, CA; [2]UCI Medical Center, Orange, CA.

Abstract 196

Background: Controversy still surrounds the use of ABO non-identical grafts in liver transplantation, due to reported higher rates of graft failure and the scarce donor supply. This study was designed to determine the effect of transplantation across the ABO blood type on liver graft and patient survival for a large single transplant center. Methods: Retrospective review of liver transplant patient records obtained from the United Network for Organ Sharing (UNOS) Scientific Registry from October 1988 to February 17, 1997. Data was complete for 1341 patients, and the analysis was limited to first grafts. Average follow-up was 2.5 years. Patient and graft survival were determined for three combinations of ABO blood type matching between donor and recipient: ABO identical (ABO-Id) 1206 pts, ABO compatible (ABO-Comp) 101 pts, and ABO incompatible (ABO-Inc) 34 pts. Estimates of patient and graft survival were computed using the method of Kaplan-Meier. Results: Overall one year graft survival was 69% with overall patient survival of 78%. Thirty-two percent of patients were UNOS status one at time of transplant. UNOS status one and two patients were combined together for survival analysis. For UNOS status one and two patients, ABO-Id grafts have a higher graft survival as compared to ABO-Comp (p=.03) see Table 1.

ABO-Id graft survival was also higher as compared to ABO-Inc, but it only approached statistical significance (p=.2), probably due to the low number of ABO-Inc patients. Survival for UNOS status three grafts was similar for the ABO-Id and ABO-Comp groups. Patient survival results were similar with ABO-Id survival being higher than for ABO-Comp and ABO-Inc groups, although not statistically significant (p>.11 for all comparisons).
Conclusions: Both graft and patient survival for liver transplant recipients are comparable for ABO-Comp and ABO-Inc mismatching. These results support the use of grafts across the ABO blood barrier in urgent situations.

Patient survival	UNOS 1+2	73.1% (529)	63.4% (73)	70.6% (34)
	UNOS 3	83.4% (677)	83.9% (28)	p=0.03
Graft survival	UNOS 1+2	63.9%	52.8%	58.8%
	UNOS 3	75.9%	73.0%	

Original Clinical Science—Liver

Offspring Versus Nonoffspring to Parent Living Donor Liver Transplantation: Does Donor Relationship Matter?

Amir Dagan, MD,[1] Rashikh A. Choudhury, MD,[1] Hillary Yaffe, MD,[1] Dor Yoeli, MD,[1] Hunter B. Moore, MD, PhD,[1] Kendra D. Conzen, MD,[1] Megan Adams, MD,[1] Michael Wachs, MD,[1] James J. Pomposelli, MD, PhD,[1] Elizabeth A. Pomfret, MD, PhD,[1] and Trevor L. Nydam, MD[1]

Background. Offspring (donor) to parent (recipient) transplant is the most common form of living donor liver transplant in the United States. In kidney transplantation, it has been suggested that female recipients of offspring living donor kidney allografts have inferior outcomes. It is unknown whether such a phenomenon also occurs following living donor liver transplantation. **Methods.** A retrospective analysis was completed of recipients of a living donor liver transplant from January 1998 to January 2018 in the Organ Procurement and Transplantation Network/United Network for Organ Sharing database. Patients were grouped as having received a living donor liver allograft from either an offspring or a nonoffspring, with exactly 3 HLA matches, as would be expected between an offspring and parent. Graft and patient survival were analyzed using Cox proportional hazards modeling. **Results.** A total of 279 offspring to parent and 241 nonoffspring donor liver transplants were included in the analysis. Female recipients of offspring liver allografts had both inferior 10-year graft (52% versus 72%; $P < 0.001$) and patient survival (52% versus 81%; $P < 0.001$) compared with female recipients of nonoffspring allografts. No such difference in outcomes was discovered among male recipients. A stratified analysis of sex of offspring donors to female recipients demonstrated that donor male gender was associated with graft failure (HR = 2.87; $P = 0.04$) and mortality (hazard ratio = 3.89; $P = 0.03$). Again, this association was not seen with male recipients. **Conclusions.** Among female recipients, offspring to parent living donor liver transplantation yields inferior long-term graft and patient survival. Furthermore, among offspring donors, male sex was strongly associated with inferior outcomes. These findings have significant implications for donor selection.

(*Transplantation* 2020;104: 996–1002).

INTRODUCTION

Experience with adult living donor liver transplant (LDLT) has grown over the past 3 decades, propelled by innovations in surgical technique and an expanding body of research guiding perioperative decision making on the matter.[1,2] Among carefully selected donors and recipients, LDLT has comparable long-term outcomes to deceased donor LT (DDLT).[3-5] However, the perioperative risk of adverse events for LDLT donors is not trivial, obligating transplant centers to carefully screen potential candidates.[6-8] Beyond optimizing donor safety, an understanding of which donors are best suited for their respective recipient represents among the most important decision-making responsibilities for a transplant surgeon.

Offspring to parent LDLT accounts for 30%–60% of all LDLTs performed.[9-11] Offspring donors tend to be young, healthy, and have excellent HLA matching to recipients, making them seemingly ideal candidates for donation.[12,13] However, there have been several studies examining this relationship in kidney transplantation, with the majority of studies suggesting inferior outcomes following offspring donation, potentially as a result of maternal-fetal allosensitization.[14-18]

The objective of this analysis was to compare offspring to nonoffspring adult LDLT with regard to long-term allograft and recipient survival outcomes. If indeed maternal-fetal alloimmunization impacts offspring to parent transplantation, it was hypothesized that offspring to parent LDLT should yield inferior outcomes. As this mechanism is only relevant for female (maternal) LDLT

Received 3 April 2019. Revision received 30 July 2019.

Accepted 11 August 2019.

[1] University of Colorado Hospital, Department of Surgery, Division of Transplant Surgery, Aurora, CO.

The authors declare no funding or conflicts of interest.

Coauthors involved with each segment of article listed below each requirement. All coauthors listed contributed/agree to the following requirements. A.D., R.A.C., H.Y., D.Y., H.B.M., K.D.C., M.A., M.W., J.P., E.P., and T.L.N. substantially contributed to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work. A.D., R.A.C., H.Y., D.Y., H.B.M., K.D.C., M.A., M.W., J.P., E.P., and T.L.N. participated in drafting the work or revising it critically for important intellectual content. A.D., R.A.C., H.Y., D.Y., H.B.M., K.D.C., M.A., M.W., J.P., E.P., and T.L.N. gave their final approval of the version to be published. A.D., R.A.C., H.Y., D.Y., H.B.M., K.D.C., M.A., M.W., J.P., E.P., and T.L.N. gave their agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. A.D., R.A.C., H.Y., D.Y., H.B.M., K.D.C., M.A., M.W., J.P., E.P., and T.L.N. participated in review of reviewers comments, suggestions for improvement, and review of the revised articles.

Correspondence: Rashikh A. Choudhury, MD, University of Colorado Hospital, 2749 Walnut St, Unit 424, Denver, CO 80205. (Rashikh.choudhury@ucdenver.edu).

ISSN: 0041-1337/20/1045-996

DOI: 10.1097/TP.0000000000002977

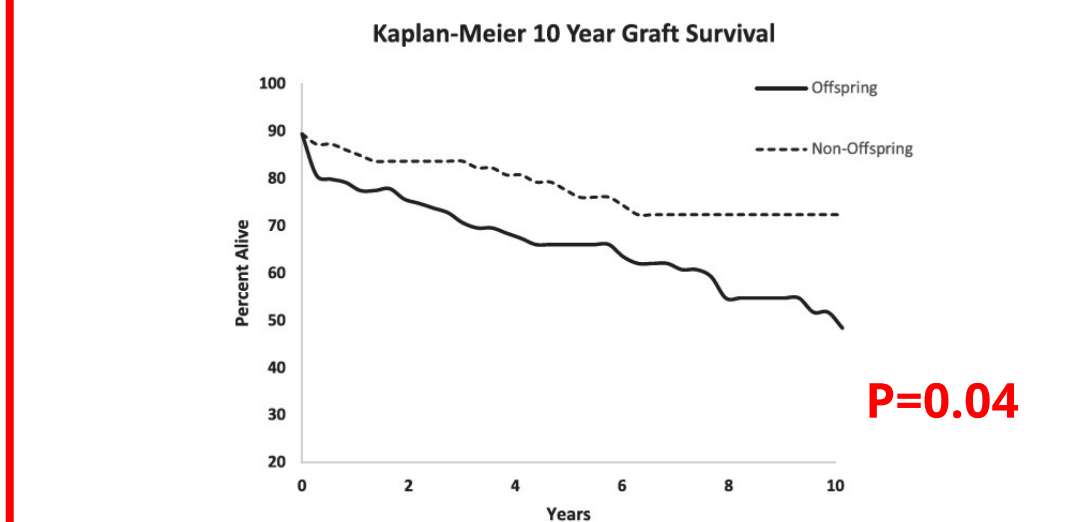


FIGURE 4. Unadjusted Kaplan-Meier 10-y graft survival of female recipients.

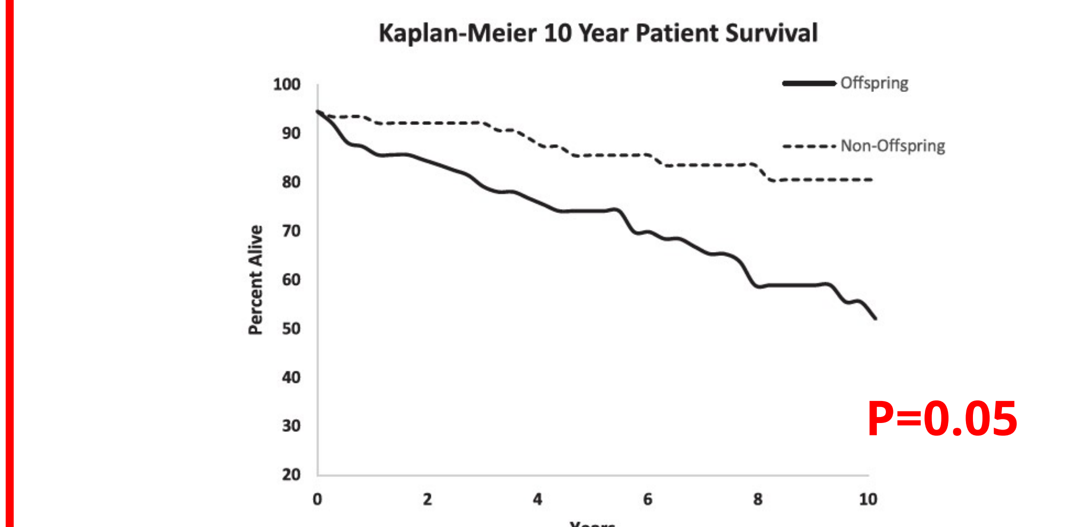
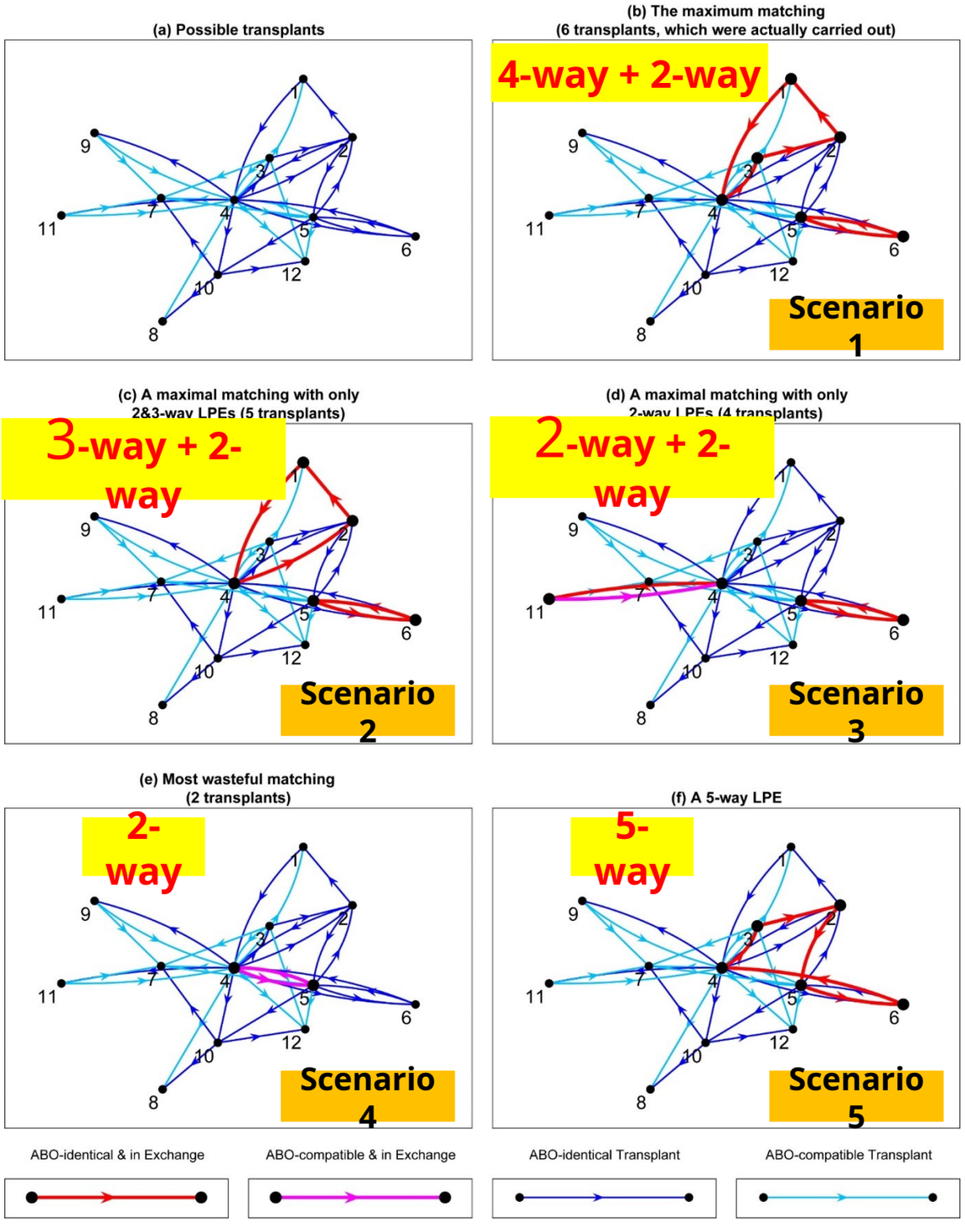
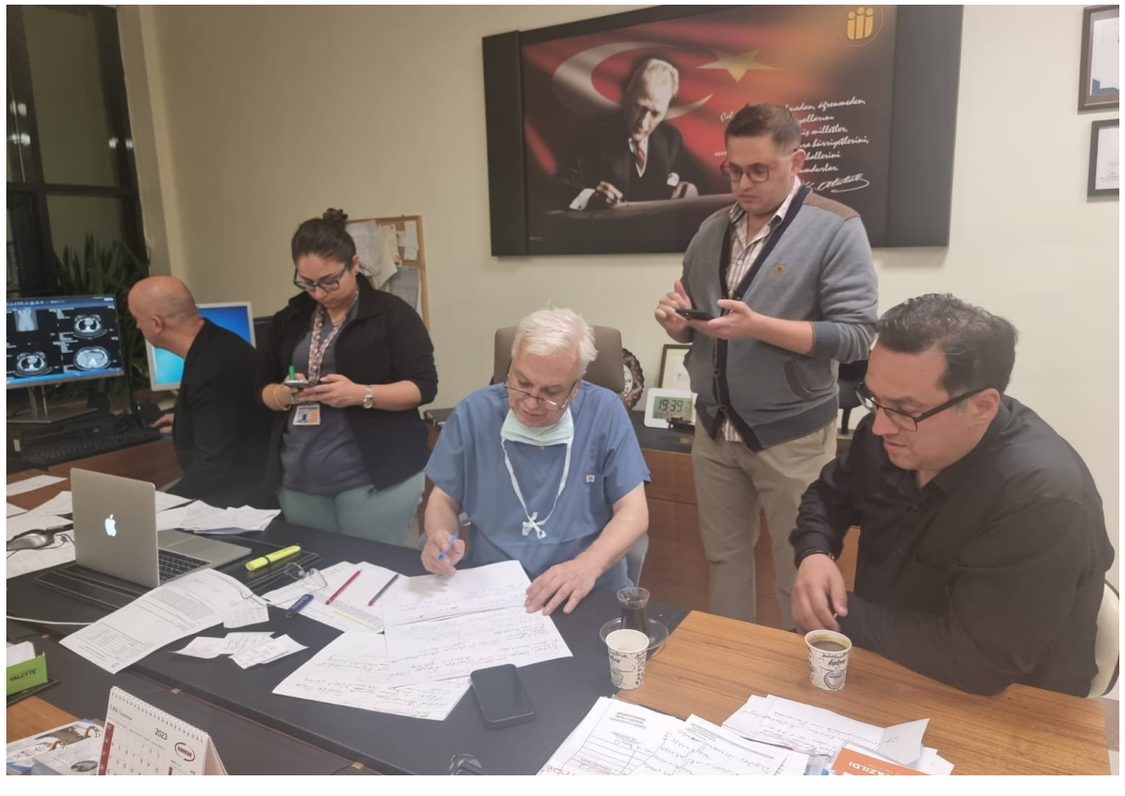


FIGURE 5. Unadjusted Kaplan-Meier 10-y patient survival of female recipients.

Özellikle erkek çocuklardan anneye graftlerde HR=2.87-3.54

İNÖNÜ UNIVERSITY
LIVER TRANSPLANT INSTITUTE
2011





İNÖNÜ UNIVERSITY
LIVER TRANSPLANT INSTITUTE
2011

Global Status of LPE

Author	Center	Time period	Liver Paired Exchange				Total LDLT at study period	Expansion Rate at study period	Pubmed ID
			n-way LPE	n-pairs	n-LDLT	Total LDLT			
Soin AS	Medanta, India		2-way 3-way	53 3	106 9	115		10%	37220342
Choi JY	S.Korea	2002-2018	2-way	26	52	52	12371	0.4%	34785324
Agrawal D	New Delhi, India	2012-2021	2-way	17	34	34	2340	1.45%	35777310
Jung DH	ASAN, S.Korea	2003-2011	2-way	13	26	26	2182	1.2%	24849838
Klair T	San Antonio, USA	2019-2023	2-way 3-way	10 1	20 3	23			38727617
Gunabushanam V Humar A	Pittsburgh, USA	2021-2022	2-way	10	10	20			35213430
Hwang S	Ulsan - Korea	2003-2009	2-way	8	16	16	1351	1.18%	20222052
Khan IAR	King Fahad	2023	2-way	1	2	2			37524584
Kwon YK	UCLA, USA	2023	2-way	1	2	2			36695680
Salman S	Lahore, Harvard	2023	3-way	1	3	3			36477814
Braun HJ	UCSF, USA	2021	2-way	2	4	4			33171017
Chan SC	Hong Kong	2010-2014	2-way	2	4	4			24463089 20373459
Patel MS	Toronto, Canada	2020	2-way	1	2	2			32524750
Yilmaz S	Inonu, Turkey	July 2022-Sept 2024	2-way 3-way 4-way 5-way 6-way 7-way	55 30 12 5 6 2	110 90 48 25 36 14	323	590	29.8%	38768752

American Journal of Transplantation xxx (xxxx) xxx

Contents lists available at ScienceDirect

American Journal of Transplantation

journal homepage: www.amjtransplant.org

Letter to the Editor

Novel 4-way simultaneous liver paired exchange: Is it generalizable?

ARTICLE INFO

Keywords:
paired exchange
living donor liver transplantation
swap transplantation
liver paired exchange
donor and recipient matching algorithm
living donor liver pool

To the Editor:

We read the world's first report on a 4-way simultaneous liver paired exchange (LPE) with great interest, performed through interdisciplinary collaboration with design economists by Yilmaz et al.[1] A total of 8 operations were completed in 8 simultaneously running operating rooms involving more than 80 health care personnel. This proof-of-concept study shows that the number of living donor liver transplantations (LDLTs) from LPE can be increased by developing the logistical capacity to perform larger than 2-way exchanges and utilizing optimal matching algorithms, which is very similar to our experience[2] of conducting 17 two-way directed simultaneous swaps (34 LDLTs) over 9 years. We congratulate the authors on this arduous task. However, we have a few essential points to note.

First, conducting 8 flawless surgeries in a 4-way simultaneous LPE requires a well-established LDLT center with a sizeable trained team and significant blood bank support. Most centers do not have such large groups, and the senior surgeon often rotates from one operating room to another to ensure the smooth conduct of all operations.

Second, in a multi-N swap, any irreversible surgical step can impact the swap's successful completion. One can only imagine a situation where the recipient of the opposite pair is left untransplanted. In such a case, rectifying an incomplete exchange is a potentially complicated subject requiring urgent consideration.

Third, in LPE, nondirected altruistic donors or deceased donors can trigger a domino LPE chain and tremendously expand the donor pool. In the nonsimultaneous extended altruistic donor chain,[3] additional pairs are added over days to months, thus enabling multiple transplantations without the burden of performing these procedures simultaneously. Also, establishing a robust pool of donor and recipient pairs through geographic expansion will increase the likelihood of matching hard-to-match pairs and facilitate more transplants. In the future, it will be interesting to study what facilitates improved matching and LDLT outcomes in the LPE: single-center simultaneous swaps versus multicentric swaps versus LPE chains.

Lastly, an ideal donor and recipient matching within the ethical framework of LPE remains a conundrum. In this context, artificial intelligence and, in particular, artificial neural networks and deep learning classifiers represent an exciting alternative to traditional donor and recipient matching.[4] Incorporating machine learning into the armamentarium of LPE bodes well with the promise of delivering an optimal outcome to all participants and increasing the utilization of LDLT.

Thus, the increasing utilization of LPE by the transplant community and the recent reports looking at the outcomes of multiple simultaneous swaps and the role of bridge donors, nondirected donors, compatible pairs, sequential donations, and multicentric LDLT are highly encouraging.[5] A simultaneous 3-way or 4-way swap can be successfully conducted in an isolated resource-rich hospital. Contrarily, LPE chains or multicentric LPEs will need to meet a unique set of challenges to be successful. Naturally, the practical way forward for the transplant community would be to amalgamate and drive all these innovations in a mutually complementary manner and prospectively check their feasibility.

https://doi.org/10.1016/j.ajt.2023.08.008
Received 27 July 2023; Received in revised form 10 August 2023; Accepted 10 August 2023
Available online xxxx

Please cite this article as: Agrawal D, Novel 4-way simultaneous liver paired exchange: Is it generalizable?, American Journal of Transplantation, https://doi.org/10.1016/j.ajt.2023.08.008

ARTICLE IN PRESS

Letter to the Editor

American Journal of Transplantation xxx (xxxx) xxx

Author contributions

D.A. drafted, revised, and edited the manuscript. K.A. edited the manuscript. S.S. approved the final version.

Funding

Nothing to disclose.

Disclosure

The authors of this manuscript have no conflicts of interest to disclose as described by the *American Journal of Transplantation.*

Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

ORCID

Dhiraj Agrawal https://orcid.org/0000-0001-9950-1312

Dhiraj Agrawal*
Department of Gastroenterology and Hepatology, PACE Hospitals, Hyderabad, Telangana, India

Kishore Kumar Ariga
Department of Nephrology, PACE Hospitals, Hyderabad, Telangana, India

Sanjiv Saigal
Department of Hepatology and Liver Transplant, Centre for Liver and Biliary Sciences, Centre of Gastroenterology, Hepatology and Endoscopy, Max Super Speciality Hospital, Saket, New Delhi, India

* Corresponding author. Dhiraj Agrawal, Department of Gastroenterology and Hepatology, PACE Hospitals, Hitech City, Hyderabad, Telangana 500081, India.
E-mail address: dhirajagrawal24@gmail.com (D. Agrawal).

References

1. Yilmaz S, Sönmez T, Ünver MU, et al. The first 4-way liver paired exchange from an interdisciplinary collaboration between health care professionals and design economists. *Am J Transplant.* 2023. https://doi.org/10.1016/j.ajt.2023.06.016.
2. Agrawal D, Saigal S, Jadaun SS, Singh SA, Agrawal S, Gupta S. Paired exchange living donor liver transplantation: a nine-year experience from North India. *Transplantation.* 2022;106(11):2193–2199. https://doi.org/10.1097/TP.0000000000004210.
3. Fumo DE, Kapoor V, Reece LJ, et al. Historical matching strategies in kidney paired donation: the 7-year evolution of a web-based virtual matching system. *Am J Transplant.* 2015;15(10):2646–2654. https://doi.org/10.1111/ajt.13337.
4. Bhat M, Rabindranath M, Chara BS, Simonetto DA. Artificial intelligence, machine learning, and deep learning in liver transplantation. *J Hepatol.* 2023;78(6):1216–1233. https://doi.org/10.1016/j.jhep.2023.01.006.
5. Agrawal D, Gupta S, Saigal S. Paired exchange living donor liver transplantation: indications, stumbling blocks, and future considerations. *J Hepatol.* 2023;78(3):643–651. https://doi.org/10.1016/j.jhep.2022.10.019.

- **Klair in makalesi 2024 LTx**
- **O kan gurubu donörleri greftin büyük veya küçük olması durumunda LPE havuzuna dahil etmişler (potansiyal favorable LPE adayları olarak yorumlamışlar)**
- **ANDD Anonim non-directed donörleri (7 adet) LPE zincirini oluşturmak için kullanmışlar**
- **Compatible pairs ve ANDD LPE zincirini başlatmışsa bunlara öncelik vermişler**
- **2019-23 arasında 11 LPE yapılmış (11 donör 11 recipient, bir 3-way LPE)**
- **Ortalama MELD 12.7 (6.9 a da LTx yapılmış)**
- **Hiçbir olgu simultan değil (1-3 hafta arayla iki operasyon yapılmış)**
- **Recipientlerde 3 ex, 1 HAT (re tx)**
- **Geniş bir RIHV den dolayı B to B'yi zincire sokmuşlar ve O B'ye B Bye vermiş !!!! Daha uzun bir recipiente vermiş**
- **O donörlerin havuza katılması non-A donörlerden O recipientlere matchi % 27'den % 71'e çıkarmış (KPE verileri)**

Review

JOURNAL
OF HEPATOLOGY

Paired exchange living donor liver transplantation: Indications, stumbling blocks, and future considerations

Dhiraj Agrawal[1], Subhash Gupta[2], Sanjiv Saigal[2,*]

Summary

The last decade has seen the increasing use of liver paired exchange (LPE) across the transplant community. LPE involves pairs of incompatible living liver donors and their intended recipients swapping livers, so that each recipient receives a compatible graft. The feasibility and benefit of LPE in providing excellent recipient outcomes and robust donor safety have been proven in uncomplicated swaps. Beginning as single-centre two-way or three-way exchanges, LPE has tremendous potential to grow into more complicated chains over days and across multiple centres. LPE is thus associated with unique technical, logistical, ethical and legislative challenges. This review discusses the indications, potential types of LPE, unique solutions to stumbling blocks in performing LPE, and the potential of LPE to expand the living donor liver pool and increase the utilisation of living donor liver transplantation.

Introduction

The last decade has seen the increasing use of liver paired exchange (LPE), also known as paired-exchange living donor liver transplantation (LDLT), by the transplant community. In LPE, incompatible living liver donors and their intended recipients swap livers, resulting in compatible transplants. The two transplant recipients can be removed from the deceased donor waiting list, shortening the list for remaining patients. The potential number of living donor and recipient pairs suitable for LPE is largely unexplored. Based on our prior experience[1] and literature review, we aim to discuss the indications, potential types of LPE, unique solutions to stumbling blocks in performing LPE, and the potential of LPE to expand the living donor liver pool and increase the utilisation of LDLT.

Worldwide experience with LPE to date

The published literature on LPE includes nine reports (five original articles and four case reports), including 74 LPEs from Asia and North America.[1–9] LPE constitutes approximately 1.2 to 8.3% of the total LDLTs performed at the relevant centres,[1–4] signifying the substantial potential of this form of LDLT to mitigate the liver allograft shortage. Table 1 compares the data on LPE from major published series to date.

It is interesting to observe the reasons behind the variable growth of LPE programmes across various time points in different regions of the world. The world's first LPE programme was established at Asan medical centre in 2003 to avoid ABO-incompatible (ABO-i) LDLT in adults. They reported their initial experience in 2010[2] and an updated experience of 26 LPEs (1.2% of 2,182 adult LDLTs) in 2014.[3] Subsequently, they launched an ABOi LDLT programme for adults in 2009. After introducing these two mutually supplementary programmes, they saw an initial increase in the matching rate for LPE. However, improving outcomes with ABOi LDLT led to a greater focus on this approach than on LPE. It was concluded that donor exchange and ABOi transplantation are both feasible options to overcome ABOi and that the decision to choose donor exchange or ABOi LDLT should be left to individual patients.

In another study, a team from the University of Pittsburgh Medical Center reviewed their experience with 10 LPEs over 3 years and reported excellent donor (100%) and recipient (85%) survival rates.[4] At the University of Pittsburgh Medical Center, the sequential algorithm in case of ABOi or size mismatch involves offering all donors an option of paired exchange with another incompatible pair, or with an ABO compatible (ABOc) pair, or initiating a pair with a non-directed donor, and lastly, the option of undergoing ABOi transplantation. During their study period, 46 (19.2%) of the total 239 LDLTs were initiated from non-directed liver donors. There were 10 incompatible pairs. LPEs using non-directed O donors were initiated for seven pairs, with LDLTs completed within 1–14 days (mean 4.8 days) of each other, while the other three pairs were matched with a compatible pair. The authors concluded that the availability of non-directed O blood group donors is critical in initiating and completing paired exchanges.

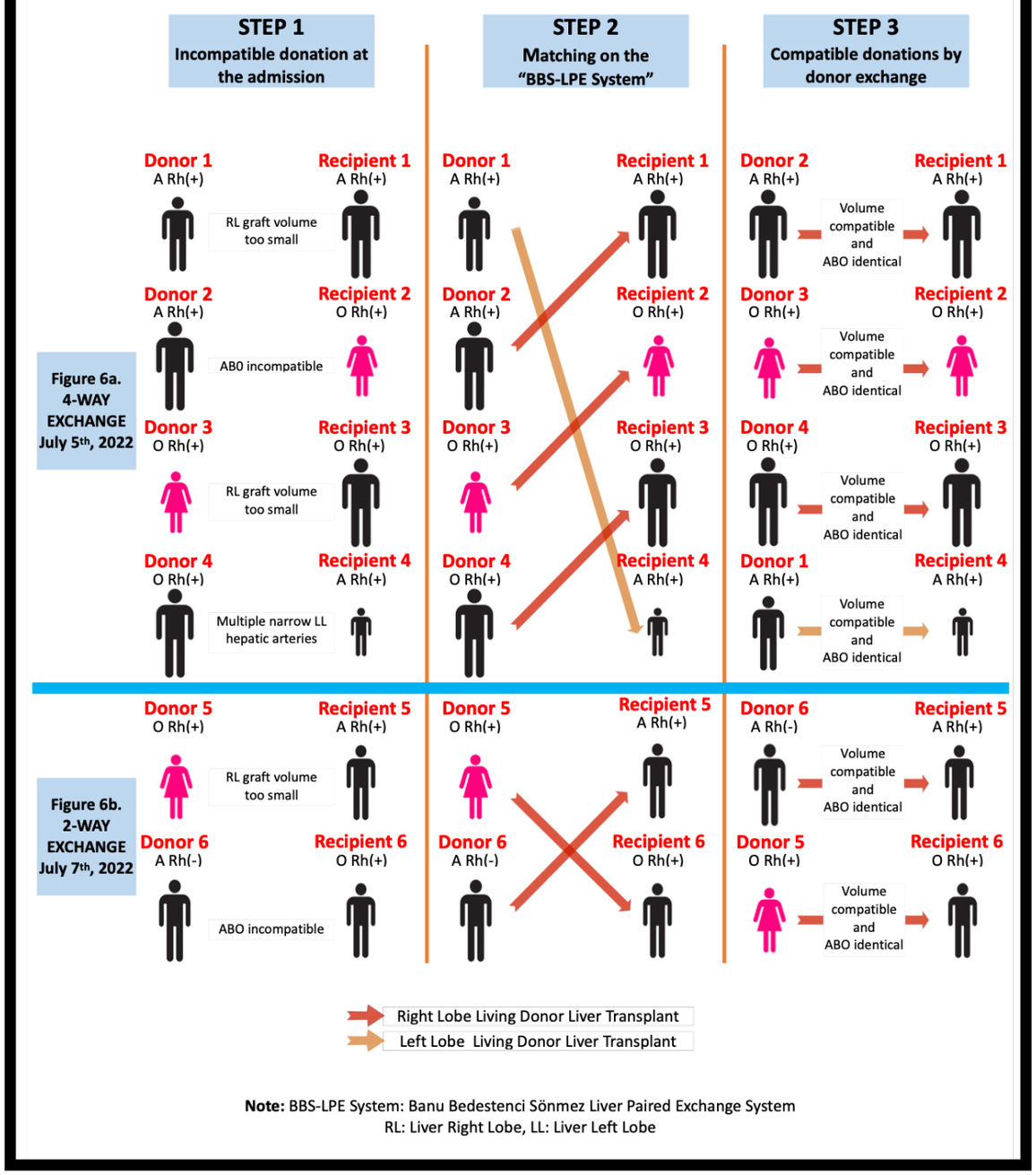
Keywords: Swap LDLT; Paired donation; Paired organ exchange; ABO incompatibility; Living donor pool; donor allograft size mismatch; Non-directed donors.
Received 28 July 2022; received in revised form 26 September 2022; accepted 17 October 2022; available online 29 October 2022
* Corresponding author. Address: Centre for Liver & Biliary Sciences, Centre of Gastroenterology, Hepatology & Endoscopy, Max Super Speciality Hospital, Saket, New Delhi, 110017, India.
E-mail address: sanjivsaigal@hotmail.com (S. Saigal).
https://doi.org/10.1016/j.jhep.2022.10.019

İNÖNÜ UNIVERSITY
LIVER TRANSPLANT INSTITUTE
2011

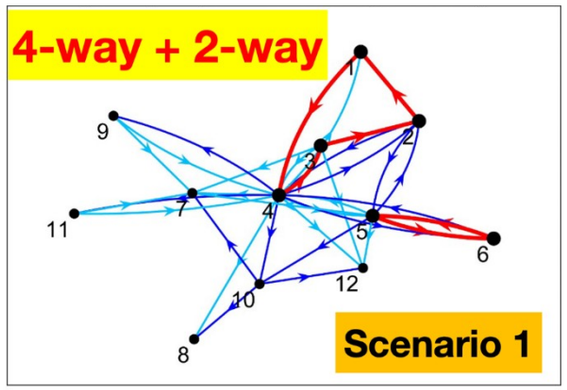
How "Banu Bedestenci Sönmez (BBS) Liver Paired Exchange System" Work?

İNÖNÜ UNIVERSITY
LIVER TRANSPLANT INSTITUTE
2011

Figure 6. The 4-way & 2-way donor exchanges conducted in early July 2022



Note: BBS-LPE System: Banu Bedestenci Sönmez Liver Paired Exchange System
RL: Liver Right Lobe, LL: Liver Left Lobe



İNÖNÜ UNIVERSITY
LIVER TRANSPLANT INSTITUTE
2011

2-way LPE: Clinical Practices (from Korean)

LIVER TRANSPLANTATION 16:482-490, 2010

ORIGINAL ARTICLE

Exchange Living Donor Liver Transplantation to Overcome ABO Incompatibility in Adult Patients

Shin Hwang,[1,2] Sung-Gyu Lee,[1,2] Deok-Bog Moon,[1] Gi-Won Song,[1] Chul-Soo Ahn,[1] Ki-Hun Kim,[1] Tae-Yong Ha,[1] Dong-Hwan Jung,[1] Kwan-Woo Kim,[1] Nam-Kyu Choi,[1] Gil-Chun Park,[1] Young-Dong Yu,[1] Young-Il Choi,[1] Pyoung-Jae Park,[1] and Hea-Seon Ha[2]

[1]Division of Liver Transplantation and Hepatobiliary Surgery, Department of Surgery, and [2]Organ Transplantation Center, Asan Medical Center, University of Ulsan College of Medicine, Seoul, Korea

ABO incompatibility is the most common cause of donor rejection during the initial screening of adult patients with end-stage liver disease for living donor liver transplantation (LDLT). A paired donor exchange program was initiated to cope with this problem without ABO-incompatible LDLT. We present our results from the first 6 years of this exchange adult LDLT program. Between July 2003 and June 2009, 1351 adult LDLT procedures, including 16 donor exchanges and 7 ABO-incompatible LDLT procedures, were performed at our institution. Initial donor-recipient ABO incompatibilities included 6 A to B incompatibilities, 6 B to A incompatibilities, 1 A to O incompatibility, 1 A+O (dual graft) to B incompatibility, 1 O to AB incompatibility, and 1 O to A incompatibility. Fourteen matches (87.5%) were ABO-incompatible, but 2 (12.5%) were initially ABO-compatible. All ABO-incompatible donors were directly related to their recipients, but 2 compatible donors were each undirected and unrelated directed. After donor reassignment through paired exchange (n = 7) or domino pairing (n = 1), the donor-recipient ABO status changed to A to A in 6, B to B in 6, O to O in 1, A to AB in 1, A+O to A in 1, and O to B in 1, and this made all matches ABO-identical (n = 13) or ABO-compatible (n = 3). Two pairs of LDLT operations were performed simultaneously on an elective basis in 12 and on an emergency basis in 4. All donors recovered uneventfully. Fifteen of the 16 recipients survived, but 1 died after 54 days. In conclusion, an exchange donor program for adult LDLT appears to be a feasible modality for overcoming donor-recipient ABO incompatibility. ***Liver Transpl 16:482-490, 2010.*** © **2010 AASLD.**

Received August 24, 2009; accepted December 23, 2009.

See Editorial on Page 423

Liver transplantation is the definitive treatment for end-stage liver diseases, with living donor liver transplantation (LDLT) developed to overcome the intracta-

Two essential prerequisites are required to be an acceptable living donor for an adult recipient: ABO blood group compatibility and safe donor liver anatomy, including interlobar volume proportions.[1] If the latter condition is acceptable but the former condition is not met, one feasible option for donor-recipient matching is ABO-incompatible LDLT. In practice, ABO-incom-

23. Blume OR, Yost SE, Kaplan B. Antibody-mediated rejection: pathogenesis, prevention, treatment, and outcomes. *J Transplant* 2012; 2012: 7.
24. Stewart ZA, Collins TE, Schlueter AJ, et al. Case report: eculizumab rescue of severe accelerated antibody-mediated rejection after ABO-incompatible kidney transplant. *Transplant Proc* 2012; 44: 3033.
25. Al Meshari K, Pall A, Elgamal H, et al. Bortezomib as an adjuvant to conventional therapy in the treatment of antibody mediated rejection (AMR): the full spectrum. *Clin Transpl* 2010: 383.
26. Bartel G, Schwaiger E, Böhmig GA. Prevention and treatment of alloantibody-mediated kidney transplant rejection. *Transpl Int* 2011; 24: 1142.
27. van den Hoogen MW, Hilbrands LB. Use of monoclonal antibodies in renal transplantation. *Immunotherapy* 2011; 3: 871.
28. Lee SG, Park KM, Lee YJ, et al. 157 adult-to-adult living donor liver transplantation. Transplant Proc 2001; 33: 1323.
29. Hwang S, Lee SG, Lee YJ, et al. Lessons learned from 1,000 living donor liver transplantations in a single center: how to make living donations safe. *Liver Transpl* 2006; 12: 920.
30. Song GW, Lee SG, Hwang S, et al. Dual living donor liver transplantation with ABO-incompatible and ABO-compatible grafts to overcome small-for-size graft and ABO blood group barrier. *Liver Transpl* 2010; 16: 491.

SECTION 16. UPDATE ON EXPERIENCE IN PAIRED-EXCHANGE DONORS IN LIVING DONOR LIVER TRANSPLANTATION FOR ADULT PATIENTS AT ASAN MEDICAL CENTER

Dong-Hwan Jung,[1] Shin Hwang,[1] Chul-Soo Ahn,[1] Ki-Hun Kim,[1] Deok-Bog Moon,[1] Tae-Yong Ha,[1] Gi-Won Song,[1] Gil-Chun Park,[1] and Sung-Gyu Lee[1,2]

Background. An exchange living donor program for liver transplantation, similar to the exchange living donor kidney program, was proposed to avoid ABO-incompatible adult living donor liver transplantation (LDLT). The objective of this study was to present updated changes in exchange adult LDLT program at our institution.

Methods. Between January 2003 and December 2011, approximately 2,182 adult LDLT cases were included in this study. During this period, 26 paired-exchange donor LDLT cases were performed (1.2%).

Results. Of the 26 paired-exchange donor LDLT cases, 22 pairs were matched due to ABO-incompatibility, and 4 pairs were matched because of cascade allocation of unrelated donors or relatively small graft volume to the recipients. A total of 28 living donors were included in the 26 paired-exchange donor LDLT cases because of inclusion of two dual-graft transplants. Elective surgery was performed in 22 cases, and urgent operation was performed in 4 cases. The overall 1-year and 5-year patient and graft survivals were both 96.2% and 90.1%, respectively.

Conclusions. Our experience suggests that the paired-exchange donor program for adult LDLT seems to be a feasible modality to overcome donor ABO incompatibility. Reasonably acceptable indications for donor exchange LDLT will be proposed in near future.

Keywords: Donor Exchange, Liver Transplantation, Living Donor Transplantation; ABO incompatibility.

The authors declare no funding or conflicts of interest.

[1] Division of Hepatobiliary Surgery and Liver Transplantation, Department of Surgery, Asan Medical Center, University of Ulsan College of Medicine, Seoul, Korea.
[2] Address correspondence to: Sung-Gyu Lee, M.D., Ph.D., F.A.C.S., Department of Surgery, Asan Medical Center, University of Ulsan College of Medicine 388-1 Poongnap-dong, Songpa-gu, Seoul 138-736, Korea.
E-mail: sglee2@amc.seoul.kr

ISSN: 0041-1337/14/9708-00
DOI: 10.1097/TP.0000000000000060

Living donor liver transplantation (LDLT) has become more frequently performed and is settled as the dominant type of liver transplantation in Asian countries where the incidence of deceased donor liver transplantation is still low. When performing the initial screening for LDLT in adult patients with end-stage liver disease, one of the most common causes of donor rejection is ABO blood group incompatibility. An exchange living donor program for liver transplantation, similar to the exchange living donor kidney program, was proposed to avoid ABO-incompatible adult LDLT (*1*, *2*). In 2003, we started an exchange adult LDLT program to avoid potential risks associated with ABO-incompatible LDLT. Our initial experience was reported in 2010 (*2*). There was only one report on exchange LDLT from another institution so far (*3*). Currently, we present our updated experience on exchange adult LDLT program.

MATERIALS AND METHODS

We have performed ABO-incompatible LDLT for pediatric patients since 1996, but the first adult ABO-incompatible LDLT was performed in November 2008 in our institution. We started an exchange living donor program in 2003, and the first adult exchange LDLT was performed in September 2003. Thus, the study period was set between January 2003 and December 2011, and 2182 cases of adult LDLT were included during this period. Of them, 26 pairs of exchange LDLT were included.

Because there was no consanguineous or marital relationship between the donors and recipients in donor exchange LDLT, special permission from the Korean Network for Organ Sharing (KONOS) was necessary for every case and approval by KONOS required stricter qualifications than the usual blood- or marriage-related donations.

The prerequisites for our donor exchange program are equality and simultaneity (*2*). The principle of equality is intended to ensure similar outcome of recipients after donor exchange. Recipients should not be disadvantaged by unfavorable transplant outcomes in the paired recipients. The principle of simultaneity is intended to prevent potential conflicts from different recipient outcomes and prevent cancellation of a donation.

Detailed processes for living donor workup and selection criteria were described before in detail (*4*). This study protocol was approved by the institutional review board of our institution. All numerical data are presented as means and standard deviations or as medians with ranges. Graft and patient survival rates were estimated by the Kaplan-Meier method.

RESULTS

Proportion of Donor Exchange LDLT

This study included 26 pairs of donor exchange LDLT cases. After the first matched-pair adult LDLT in September 2003, there was no volume increase in donor exchange adult LDLT cases before 2008. Only after the introduction of ABO-incompatible LDLT program at our institution in 2009, that incidence of donor exchange adult LDLT increased (Fig. 1). The average proportion of donor exchange LDLT occupied 1.2% (26 of 2182 adult LDLT cases).

Commentary

Increasing Living Liver Donor Pools: Liver Paired Exchange Versus ABO-incompatible Living Donor Liver Transplantation

Jong Man Kim, MD, PhD[1]

Living donor liver transplantation (LDLT) has emerged as a strategy to address the organ shortage, but it can be difficult to find suitable living liver donors (LLDs). The most common reasons why LDLT may not be appropriate are: there is ABO incompatibility between the donor and the recipient, implanted liver graft size is too small for the recipient, and the potential remnant liver volume is too small for the donor.

Kidney paired exchange (KPE), in which 2 pairs of donors and recipients are matched to allow crossed donation from one pair to the other, was historically established to circumvent ABO/HLA-incompatibility preventing a donor-recipient pair from being transplanted.[1] The success of KPE has prompted the consideration of liver paired exchange (LPE). Although the idea seems promising, the actual matching success rate of the initial liver donor exchange program was very low (<1%).[2] LPE is inherently more complex and associated with more technical, logistical, and ethical challenges than KPE.[3] It has not been easy for both recipient families to agree on the acceptability of the prospective donor's many variables: age, graft size, body mass index, hepatic steatosis, the extent of liver resection, and future remnant liver volume. After paired transplantation, depending on the recipient's complications, it is common to compare recipient outcomes and lay blame on the donor selection. LPE experiences from Asia, like many of the global KPE programs, have performed both pairs of transplants on a single day because of the risk of a donor withdrawing consent. However, in more recent case reports published from the United States, LDLTs in a pair set were performed on consecutive days.[4,5] LPE has not expanded at a pace similar to KPE, perhaps because of the lower number of LDLTs performed globally and because donor hepatectomy is inherently more complex and has greater morbidity and mortality compared with donor nephrectomy. Additionally cross-center exchanges are logistically more difficult and have different surgical techniques that make it more difficult to achieve the principle of equity of transplant outcomes.

In this issue of *Transplantation*, Agrawal et al[6] report their experience with an LPE program in India. Two to eight LPEs were performed most years from 2012 to 2021 (with the exception of 2013 and 2015). In total, 34 LPE transplants from 17 pairs of a total of 2340 LDLTs were transplanted, representing 1.45% of transplants during this period. They were divided into R1/D1 and R2/D2 groups and compared. In many centers, it is difficult to use 4 operating rooms simultaneously for 1 LPE, but, in this high-volume center, 2 donor hepatectomies and 2 recipient surgeries were performed at the same time.

There was no living liver donor mortality after donor hepatectomies, but there were 3 serious adverse events (8.8%). Two LLDs exhibited bile leakage, and 1 donor experienced significant posthepatectomy liver dysfunction with an increase in total bilirubin up to 7.3 mg/dL. Five recipients (14.7%) died after LDLT because of sepsis or massive bleeding from surgical complications. The final 30-d and 1-y actual survival rates were 88.2% (n = 30) and 85.3% (n = 29), respectively.

In the past, adult ABO-incompatible (ABOi) LDLTs have been associated with poor graft survival and low patient survival because of hyperacute rejection and a high risk of vascular biliary complications. Various desensitization strategies have been developed to overcome the barrier of ABO incompatibility. Recent noticeable improvements in clinical outcomes after ABOi LDLTs have caused the LPE program to be less attractive than before, resulting in a decreased volume of procedures.[2] ABOi LDLTs for adult patients in poor general condition (acute liver failure, acute-on-chronic liver failure status, or high MELD score), however, have disadvantages compared with ABO-compatible LDLTs because desensitization using rituximab and total plasma exchange are associated with prolonged pretransplant periods during which there is a high risk of sepsis from infection.

Although all LPEs were performed because of ABO incompatibility in this study, a slight expansion of LLDs was observed, increasing annual LDLTs from 0% to 5.3%. Only 52 paired LLDs (0.4%) of 12,371 LLDs from 2002 to 2018 were performed in Korea. Desensitization with rituximab and total plasma exchange was used in Korea, and, reassuringly, there was no difference in bile duct

Received 2 April 2022. Revision received 30 April 2022.
Accepted 5 May 2022.

[1] Department of Surgery, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, South Korea.

The authors declare no funding or conflicts of interest.

J.M.K. participated in editorial concept and wrote the manuscript.

Correspondence: Jong Man Kim, MD, PhD, Department of Surgery, Samsung Medical Center, Sungkyunkwan University School of Medicine, 81 Irwin-ro, Gangnam-gu, Seoul 06351, South Korea. (yjongman21@gmail.com).

ISSN: 0041-1337/22/10611-2118
DOI: 10.1097/TP.0000000000004211

Total: 26 LPE (52 LDLTs)
Expansion: 1.2 %

İNÖNÜ UNIVERSITY
LIVER TRANSPLANT INSTITUTE
2011

2-way LPE: Clinical Practices (from US and Canada)

Case Reports > Ann Surg. 2020 Dec;272(6):e282-e283.
doi: 10.1097/SLA.0000000000004122.

Liver Paired Exchange Using Compatible Pairs – US Single Center Experience

Tarunjeet Klair [1], Glenn Halff, Danielle Fritze, Elizabeth Thomas, Gregory Abrahamian, Kermit Speeg, Francisco Cigarroa

2 separate days
Texas Unv, San Antonia

Received: 14 April 2020 | Revised: 12 May 2020 | Accepted: 1 June 2020
DOI: 10.1111/ajt.16137

CASE REPORT

AJT

Living donor liver paired exchange: A North American first

Madhukar S. Patel | Zubaida Mohamed | Anand Ghanekar | Gonzalo Sapisochin | Ian McGilvray | Blayne A. Sayed | Trevor Reichman | Markus Selzner | Jed A. Gross | Zita Galvin | Mamatha Bhat | Les Lilly | Mark Cattral | Nazia Selzner

Multi Organ Transplant Program, University Health Network, University of Toronto, Toronto, Canada

Correspondence
Mark S. Cattral
Email: mark.cattral@uhn.ca

Nazia Selzner
Email: nazia.selzner@uhn.ca

Paired organ exchange can be used to circumvent living donor-recipient ABO incompatibilities. Herein, we present the first case of successful liver paired exchange in North America. This 2-way swap required 4 simultaneous operations: 2 living donor hepatectomies and 2 living donor liver transplants. A nondirected anonymous living donor gift initiated this domino exchange, alleviating an ABO incompatibility in the other donor-recipient pair. With careful attention to ethical and logistical issues, paired liver exchange is a feasible option to expand the donor pool for incompatible living liver donor-recipient pairs.

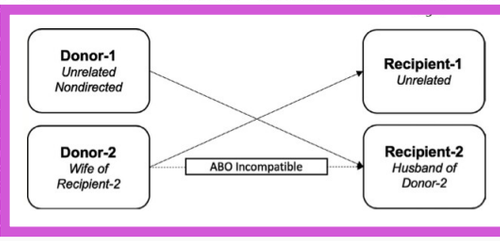
KEYWORDS
ABO incompatibility, clinical research/practice, donors and donation: living, donors and donation: paired exchange, liver transplantation/hepatology, liver transplantation: living donor

Simultaneity, same day

1 | INTRODUCTION

Living donor liver transplantation (LDLT) is a means to increase the supply of organs available for transplantation; however, only 339 (4.4%) ... 2018 w... donor a... group n... paired ... (LPE) ha...

cient in size for the intended recipient may be acceptable for a different recipient. In all these circumstances, donor and recipient pairs



Increasing Living Donor Liver Transplantation Using Liver Paired Exchange

Vikraman Gunabushanam, MBBS, FACS, Swaytha Ganesh, MBBS, Kyle Soltys, MD, George Mazariegos, MD, FACS, Armando Ganoza, MD, Michele Molinari, MD, FACS, Amit Tevar, MD, Christopher Hughes, MD, FACS, Abhinav Humar, MD, FRCS

BACKGROUND: Living donor liver transplantation (LDLT) continues to be the primary modality of liver transplantation in Asia, but it accounts for about 5% of all liver transplantations in the US. ABO incompatibility is the primary reason motivated donors are declined. Although kidney paired exchanges are common, liver paired exchange (LPE) is still evolving in the US.

STUDY DESIGN: This is a retrospective review (between January 1, 2019, and July 31, 2021) of our initial experience with LPE.

RESULTS: A total of 10 LPEs (20 LDLTs) were performed during the study period. Seven LPEs were initiated by a nondirected O donor. The other 3 pair sets involved 1 ABO compatible and 1 ABO incompatible pair. Transplantations in a pair set were completed within a mean of 4.8 (range 1–14) days of each other. All 20 donors are doing well with no major complications at 12.7 (range 1–20) months. Seventeen of 20 recipients are alive and have good allograft function. One recipient died in the early postoperative period. Two late deaths of patients with functioning allografts were due to COVID-19 (at 8 months) and peritoneal carcinomatosis and gram-negative sepsis (at 9 months).

CONCLUSIONS: LPE is feasible in a high-volume LDLT center and is a useful option to increase LDLT by overcoming ABO incompatibility. Nondirected donors can be utilized to initiate an LPE. (J Am Coll Surg 2022;234:115–120. © 2022 by the American College of Surgeons. Published by Wolters Kluwer Health, Inc. All rights reserved.)

Living donor liver transplantation (LDLT) continues to be the predominant method of liver transplantation in Asia, whereas it accounted for only 5% of liver transplantations in the US in 2020.[1] More than 3000 patients were removed from the waitlist either because of death or worsening medical condition in 2020. The benefits of LDLT in reducing waitlist mortality, with excellent recipient and allograft survival, has been demonstrated.[2] However, potential living liver donors may be declined, most commonly because of ABO incompatibility (ABOi), accounting for up to a fifth of potential liver donors.[3]

Kidney paired exchange is routinely performed in the US and currently accounts for about 12% of all living donor kidney transplants. This has increased transplantation options for patients with ABOi and human leukocyte antigen incompatible living donors. Kidney paired exchange was initiated as a simple 2-way exchange and has evolved into more complex variations involving nation-

2 separate (4.8) days
UPMC

CME questions for this article available at http://jacscme.facs.org

Disclosure Information: Authors have nothing to disclose. Timothy J Eberlein, Editor-in-Chief, has nothing to disclose. Ronald J Weigel, CME Editor, has nothing to disclose.

Disclosures outside the scope of this work: Dr Tevar is a paid consultant to CSL Behring. Dr Mazariegos received payment for development of educational presentations on intestinal failure from Medscape.

Presented virtually at the American Transplant Congress, June 2021.

Received July 2, 20... 2021.

From the Division of... Tevar, Hughes, Hu... Pittsburgh Medical ... Surgery, UPMC Ch... Mazariegos).

Correspondence a... Division of Transpla... Pittsburgh, PA 152...

https://doi.org/10.1097/XCS.0000000000000036
ISSN 1879-1190/21

Received: 30 August 2020 | Revised: 13 October 2020 | Accepted: 1 November 2020
DOI: 10.1111/ajt.16396

CASE REPORT

AJT

Expanding living donor liver transplantation: Report of first US living donor liver transplant chain

Hillary J. Braun[1] | Ana M. Torres[2] | Finesse Louie[2] | Sandra D. Weinberg[2] | Sang-Mo Kang[1,2] | Nancy L. Ascher[1,2] | John P. Roberts[1,2]

[1]Department of Surgery, University of California, San Francisco, California, USA
[2]Division of Transplantation, University of California, San Francisco, California, USA

Correspondence
John P. Roberts, Department of Surgery, University of California, San Francisco, CA, USA.
Email: john.roberts@ucsf.edu

Funding information
National Institutes of Health, Grant/Award Number: T32AI125222

Abstract

Living donor liver transplantation (LDLT) enjoys widespread use in Asia, but remains limited to a handful of centers in North America and comprises only 5% of liver transplants performed in the United States. In contrast, living donor kidney transplantation is used frequently in the United States, and has evolved to commonly include paired exchanges, particularly for ABO-incompatible pairs. Liver paired exchange (LPE) has been utilized in Asia, and was recently reported in Canada; here we report the first LPE performed in the United States, and the first LPE to be performed on consecutive days. The LPE performed at our institution was initiated by a nondirected donor who enabled the exchange for an ABO-incompatible pair, and the final recipient was selected from our deceased donor waitlist. The exchange was performed over the course of 2 consecutive days, and relied on the use and compliance of a bridge donor. Here, we show that LPE is feasible at centers with significant LDLT experience and affords an opportunity to expand LDLT in cases of ABO incompatibility or when nondirected donors arise. To our knowledge, this represents the first exchange of its kind in the United States.

KEYWORDS
clinical research/practice, liver transplantation/hepatology, liver transplantation: living donor, organ allocation, organ transplantation in general

1 | INTRODUCTION

Living donor liver transplantation (LDLT) remains the primary method of liver transplantation in Asia but continues to comprise <5% of liver transplants performed annually in the United States.[1] As of 2019, only 10 Uni... than 10 LDLT per yea...

Our center is located in Region 5, and our median model for end-stage liver disease (MELD) score at transplant is 32. Over the past 5 years, we have performed an average of 27 adult to adult LDLT per year in an effort to expand LDLT and enable transplantation in liver waitlist candidates who have a living donor and may otherwise ...aitlist. In 2017, we per-...xchange.[3] Here, we re-...r paired exchange (LPE) ...his represents the first

2 separate days
UCSF

Abbreviations: ICU, intensiv... liver transplant; LPE, liver pa... POD, postoperative day.

Total: 13 LPE (26 LDLTs)

İNÖNÜ UNIVERSITY
LIVER TRANSPLANT INSTITUTE
2011

2-way LPE: Clinical Practices (from Hong-Kong)

LIVER TRANSPLANTATION 16:478-481, 2010

ORIGINAL ARTICLE

Paired Donor Interchange to Avoid ABO-Incompatible Living Donor Liver Transplantation

See Ching Chan,[1] Chung Mau Lo,[1] Boon Hun Yong,[2] Wilson J. C. Tsui,[3] Kelvin K. C. Ng,[1] and Sheung Tat Fan[1]
[1]*Departments of Surgery,* [2]*Anesthesiology, and* [3]*Clinical Psychology, Queen Mary Hospital, University of Hong Kong, Hong Kong, China*

We report an emergency paired donor interchange living donor liver transplant performed on January 13, 2009. The 4 operations (2 liver transplants) were performed simultaneously. The aim was to avoid 2 ABO-incompatible liver transplants. One recipient in acute liver failure underwent transplantation in a high-urgency situation. The abdomen of the other recipient had severe adhesions from previous spontaneous bacterial peritonitis that rendered the recipient operation almost impossible. The ethical and logistical issues are discussed. Approaches adopted in anticipation of potential adverse outcomes are explained in view of the higher donor and recipient mortality and morbidity rates in comparison with kidney transplantation. ***Liver Transpl 16:478-481, 2010.*** © **2010 AASLD.**

Received July 16, 2009; accepted October 5, 2009.

See Editorial on Page 423

In regions in which deceased donor liver grafts are scarce, living donor liver transplantation (LDLT) is the realistic life-saving alternative for patients with end-stage liver disease. Nevertheless, over 20% of potential living donors are rejected because of ABO incompatibility (ABOI).[1] This does not include volunteers who are aware of their ABOI even before being evaluated. For ABO-incompatible LDLT, a 5-year survival rate of only 52% for adults is achieved even in a very experienced center,[2] whereas a 5-year survival rate of over 90% can be achieved for compatible LDLT.[3] In addition, ABO-incompatible graft recipients require heavy exchange LDLT has been discussed in the literature[10] and reported in a Korean journal,[11] but no case was retrievable by a thorough PubMed search. On January 13, 2009, we performed emergency donor interchange LDLT. Here we discuss the relevant practical and ethical issues of this new arrangement.

CASE REPORT

Pair 1

Recipient 1 (blood group B) was a 47-year-old male chronic hepatitis B carrier with cirrhosis. His 40-year-old wife (donor 1), who volunteered as a living donor, was, however, of blood group A and thus was

Case Report

Samaritan donor interchange in living donor liver transplantation

See Ching Chan, Kenneth SH Chok, William W Sharr, Albert CY Chan, Simon HY Tsang, Wing Chiu Dai and Chung Mau Lo
Hong Kong, China

BACKGROUND: **In order to overcome ABO blood group incompatibility, paired donor interchange has been practised in living donor liver transplantation. Liver transplantations using grafts donated by Samaritan living donors have been performed in Europe, North America, South Korea, and Hong Kong. Such practice is clearly on strong biological grounds although social and psychological implications could be far-reaching. Local experience has been satisfactory but is still limited. As few centers have this arrangement, its safety and viability are still being assessed under a clinical trial setting.**

METHODS: **Here we report a donor interchange involving an ABO-compatible pair with a universal donor and an ABO-incompatible pair with a universal recipient. This matching was not only a variation but also an extension of the donor interchange scheme.**

RESULTS: **The four operations (two donor hepatectomies and two recipient operations) were successful. All the two donors and the two recipients recovered well. Such donor interchange further supports the altruistic principle of organ donation in contrast to exchange for a gain.**

CONCLUSIONS: **Samaritan donor interchange certainly taxes further the ethical challenge of donor interchange. Although this practice has obvious biological advantages, such advantages have to be weighed against the potential increase in potential psychological risks to the subjects in the interchange. Further ethical and clinical evaluations of local and overseas experiences of donor interchange should guide future clinical practice in utilizing this potential organ source for transplantation.**

(*Hepatobiliary Pancreat Dis Int 2014;13:105-109*)

Author Affiliations: Department of Surgery (Chan SC, Chok KSH, Sharr WW, Chan ACY, Tsang SHY, Dai WC and Lo CM); and State Key Laboratory for Liver Research (Chan SC and Lo CM), The University of Hong Kong, 102 Pokfulam Road, Hong Kong, China

Corresponding Author: See Ching Chan, Li Shu Fan Medical Foundation Professor in Surgery, Department of Surgery, The University of Hong Kong, 102 Pokfulam Road, Hong Kong, China (Tel: 852-22553025; Fax: 852-28175475; Email: seechingchan@gmail.com)

doi: 10.1016/S1499-3872(14)60016-3

KEY WORDS: **orthotopic liver transplantation; living donor liver transplantation; right lobe**

Introduction

The purpose of donor interchange in living donor liver transplantation (LDLT) is to circumvent ABO incompatibility as the 5-year recipient survival rate of LDLT with ABO incompatibility is only 52% even in a very experienced center.[1] LDLTs with donor interchange have been performed in Asia at two liver transplant centers only, according to the literature.[2, 3] Here we describe a case of donor interchange in Hong Kong, in which one pair of donor and recipient was in fact ABO-compatible. In order to render another pair of donor and recipient who were ABO-incompatible suitable for LDLT, donor interchange was decided. The ethical, surgical, and logistical challenges of this arrangement are discussed.

Case report

Pair 1

The recipient was a 57-year-old man of blood group AB (recipient 1), a universal recipient. He weighed 78 kg. He was a carrier of hepatitis B virus and had Child-Pugh B cirrhosis. He had sustained multiple episodes of esophageal variceal bleeding. Surveillance computed tomography (CT) showed a 4.4-cm hepatocellular carcinoma (HCC) in liver segment 6/7. Hepatectomy was prohibited by significant portal hypertension.

His 56-year-old wife volunteered as the living liver donor (donor 1). She weighed 47.5 kg and had an unremarkable medical history. She, with blood group O, is a universal donor. Her right liver volume on CT was 670 mL, accounting for 46% of her husband's standard

2-way LPE: Clinical Practices (from India)

İNÖNÜ UNIVERSITY
LIVER TRANSPLANT INSTITUTE
2011

Original Clinical Science—Liver

Paired Exchange Living Donor Liver Transplantation: A Nine-year Experience From North India

Dhiraj Agrawal, MD, DM,[1] Sanjiv Saigal, MD, DM, MRCP, CCST,[1] Shekhar Singh Jadaun, MD, DM,[1] Shweta A. Singh, MD, DM,[1] Shaleen Agrawal, MS, MCh,[1] and Subhash Gupta, MS, MCh[1]

Background. Paired exchange liver transplantation is an evolving strategy to overcome ABO blood group incompatibility and other barriers such as inadequate graft-to-recipient weight ratio and low remnant liver volume in donors. However, for the transplant team to carry 4 major operations simultaneously is a Herculean effort. We analyzed our experience with liver paired exchange (LPE) program over the past 9 y. **Methods.** This prospective study included 34 of 2340 (1.45%) living donor liver transplantations performed between May 2012 and April 2021. The reason for LPE was ABO incompatibility in all (n = 34) patients included in the study. After donor reassignment through 2-by-2 paired exchange with directed donors, the ABO matching status changed from A to A (n = 17) and B to B (n = 17), which made all matches ABO-identical. Recipients (R) and donors (D) of each swap pair were prospectively divided into R1/D1 and R2/D2 groups for comparative and survival analyses. **Results.** The recipients (n = 34) had a median age of 45.5 y (11–59 y), and 31 were men. LPEs were performed in 4 operating rooms running simultaneously by 2 independent surgical teams. Donor survival was 100%. Baseline clinical and perioperative parameters, postoperative complications, median intensive care unit/hospital stay, and early deaths were comparable ($P > 0.1$) between the R1 and R2 groups. The median follow-up period was 27 mo (1–108 mo). The 30-d and 1-y survivals were 88.2% (n = 30) and 85.3% (n = 29), respectively. **Conclusions.** Our experience suggests that with careful attention to ethical and logistical issues, the LPE program can expand the living donor liver pool and facilitate a greater number of living donor liver transplantations.

(*Transplantation* 2022;106: 2193–2199).

INTRODUCTION

Several strategies have been proposed to facilitate living donor liver transplantation (LDLT) for patients with end-stage liver disease. There are several reasons for donor rejection, such as ABO blood group incompatibility (ABOi), inadequate graft-to-recipient weight ratio (GRWR), poor graft quality, difficult liver anatomy, and low remnant liver volume. The problem of low GRWR may be managed by graft inflow modulation or the use of dual-lobe LDLT in the recipient.[1] Donor steatosis may be reduced by following a stringent weight loss regimen.[2,3] With increasing experience, many centers, including ours, accept donors with anatomical variations.[4-6] For ABOi family donors, the need for ABO-incompatible and liver paired exchange (LPE) donation has emerged. The degree of surgical difficulty in ABOi LDLT is not different from compatible transplants but may have inferior long-term patient survival, making LPE a better option.[7-10]

Although the basic framework for LPE was adopted from the kidney paired exchange program, LPE or swap LDLT is inherently distinct, more complex, and associated with more technical, logistical, and ethical challenges.[11] Both recipient and donor surgeries are long-duration surgeries and must be flawless to ensure minimum morbidity and mortality. The living donor partial hepatectomy is associated with approximately 10 times greater mortality than living donor nephrectomy, and the morbidity ranges from 9% to 24%, depending on the type of hepatectomy performed.[12,13]

The logistics involved in a single-center simultaneous LPE are extensive with 4 simultaneous operations: 4 sets of teams of anesthetists, surgeons, nurses, and technicians. The blood bank must be equipped with requirements for major surges. For a single LDLT operation, it is estimated

Received 14 November 2021. Revision received 1 February 2022.

Accepted 3 March 2022.

[1] *Max Center for Liver and Biliary Sciences, Max Saket Hospital, New Delhi, India.*

The authors declare no funding or conflicts of interest.

D.A. contributed to the study concept and protocol design, collecting data, analysis of data, preparing the initial draft of the manuscript, and revision of the manuscript. S.S. conceived the idea of the study, contributed to the study concept, finalizing the protocol, critical revision of the manuscript for intellectual content, technical support, and study supervision. S.S.J., S.A.S., and S.A. helped in data collection, data analysis, and initial draft of the manuscript. S.G. contributed to the study concept, finalizing the protocol, critical revision of the manuscript for intellectual content, technical support, and study supervision.

Supplemental Visual Abstract; http://links.lww.com/TP/C456.

Supplemental digital content (SDC) is available for this article. Direct URL citations appear in the printed text, and links to the digital files are provided in the HTML text of this article on the journal's Web site (www.transplantjournal.com).

Correspondence: Subhash Gupta, MS, MCh, Centre for Liver and Biliary Sciences, Max Saket Hospital, 1 Press Enclave Rd, New Delhi 110 017, India. (guptasubash@hotmail.com).

ISSN: 0041-1337/20/10611-2193

DOI: 10.1097/TP.0000000000004210

Total: 17 LPE (34 LDLTs)
Expansion: 1.45 %

Roth AE, Sönmez T, Ünver MU. Pairwise kidney exchange. Journal of Economic Theory. 2005 Dec 1;125(2):151-88

Saidman SL, Roth AE, Sönmez T, Ünver MU, Delmonico FL. Increasing the opportunity of live kidney donation by matching for two-and three-way exchanges. Transplantation. 2006 Mar 15;81(5):773-82

Roth AE, Sönmez T, Ünver MU. Efficient kidney exchange: Coincidence of wants in markets with compatibility-based preferences. American Economic Review. 2007 Jun 1;97(3):828-51

Anderson R, Ashlagi I, Gamarnik D, Rees M, Roth AE, Sönmez T, Ünver MU. Kidney exchange and the alliance for paired donation: Operations research changes the way kidneys are transplanted. Interfaces. 2015 Feb;45(1): 26-42

If you pay attention, these two mathematics professors were the people who made the biggest contributions to the work of Alvin Roth, who received the Nobel Prize in 2012

Expanding Opportunities for Living Donation: Recommendations From the 2023 Santander Summit to Ensure Donor Protections, Informed Decision Making, and Equitable Access

Krista L. Lentine, MD, PhD,[1] Amy D. Waterman, PhD,[2] Matthew Cooper, MD,[3] Sanjay Nagral, MS, FACS,[4] Dale Gardiner, MD,[5] Michael Spiro, MBBS,[6] Mohamed Rela, MS, FRCS, DSc,[7] Gabriel Danovitch, MD,[8] Christopher J. E. Watson, MD,[9] David Thomson, MD,[10] Kristof Van Assche, PhD,[11] Martín Torres, MD, MS,[12] Beatriz Domínguez-Gil, MD, PhD,[13] and Francis L. Delmonico, MD[14]; On behalf of the Donation Workgroup Collaborators*

Abstract. A strategic vision toward global convergence in transplantation must encourage and remove barriers to living organ donation and transplantation. Here, we discuss deliberations of a working group of the 2023 Santander Summit charged with formulating recommendations for the safe expansion of living donor kidney transplantation and living donor liver transplantation worldwide. Living donor kidney transplantation has grown to be the preferred treatment for advanced kidney failure. Living donor liver transplantation emerged more recently as a strategy to reduce waitlist mortality, with adoption influenced by cultural factors, regional policies, clinical team experience, and the maturity of regional deceased donor transplant systems. Barriers to living donor transplantation span domains of education, infrastructure, risk assessment/risk communication, and financial burden to donors. Paired donor exchange is a growing option for overcoming incompatibilities to transplantation but is variably used across and within countries. Effectively expanding access to living donor transplantation requires multifaceted strategies, including improved education and outreach, and measures to enhance efficiency, transparency, and shared decision making in donor candidate evaluation. Efforts toward global dissemination and vigilant oversight of best practices and international standards for the assessment, informed consent, approval, and monitoring of living donors are needed. Fostering greater participation in paired exchange requires eliminating disincentives and logistical obstacles for transplant programs and patients, and establishing an ethical and legal framework grounded in World Health Organization Guiding Principles. Sharing of best practices from successful countries and programs to jurisdictions with emerging practices is vital to safely expand the practice of living donation worldwide and bring the field together globally.

(*Transplantation* 2025;109: 22–35).

Received 12 March 2024. Revision received 6 May 2024.

Accepted 24 May 2024.

[1] *Saint Louis University Transplant Center, SSM Health Saint Louis University Hospital, St. Louis, MO.*

[2] *Academic Institute, Houston Methodist Hospital, Houston, TX.*

[3] *Transplant Surgery, Medical College of Wisconsin, Milwaukee, WI.*

[4] *Jaslok Hospital and Research Centre, Mumbai, Maharashtra, India.*

[5] *Organ and Tissue Donation and Transplantation, NHS Blood and Transplant, Bristol, United Kingdom.*

[6] *Transplant Surgery, University College London, London, United Kingdom.*

[7] *Rela Institute and Medical Centre, Bharath Institute of Higher Education and Research, Chennai, Tamil Nadu, India.*

[8] *David Geffen School of Medicine, Nephrology, UCLA, Los Angeles, CA.*

[9] *Transplant Surgery, University of Cambridge, Cambridge, United Kingdom.*

[10] *Groote Schuur Hospital, University of Cape Town, Cape Town, South Africa.*

[11] *Research Group Personal Rights and Property Rights, Faculty of Law, University of Antwerp, Antwerp, Belgium.*

[12] *Instituto Nacional Central Unico de Ablación e Implante (INCUCAI), Ministry of Health, Buenos Aires, Argentina.*

[13] *Organización Nacional de Trasplantes, Madrid, Spain.*

[14] *Harvard Medical School, Massachusetts General Hospital, Boston, MA.*

Authors are volunteer members of the Organización Nacional de Trasplantes Santander Summit Living Donation Workgroup. K.L.L. is the scientific director of the Scientific Registry of Transplant Recipients (SRTR) Living Donor Collective, chair of the American Society of Transplantation Living Donor Community of Practice, and a member of the American Society of Nephrology Policy and Advocacy Committee, the National Kidney Foundation Transplant Advisory Committee, and the National Living Donor Assistance Center (NLDAC) Advisory Group. *K.L.L. receives funding for research related to organ donation and transplantation from the National Institute of Diabetes and Digestive Diseases (NIDDK; R01-DK120551) and the Mid-America Transplant Foundation. A.D.W. is deputy director of the SRTR Living Donor Collective and a member of the NLDAC Advisory Group. A.D.W. receives funding for research related to organ donation and transplantation from the NIDDK, the National Institute of Health, and the Agency for Research and Quality. S.N. is co-chair of the Declaration of Istanbul Custodian Group. Unrelated to this work, K.L.L. receives consulting fees from CareDx and speaker honoraria from Sanofi. The other authors declare no conflicts of interest.*

**A full list of Donation Workgroup Collaborators is included under the Acknowledgments.*

K.L.L. and A.D.W. are cofirst authors.

B.D.G. and F.L.D. are cosenior authors.

Supplemental visual abstract; http://links.lww.com/TP/D93.

Correspondence: Krista L. Lentine, MD, PhD, SSM Health Saint Louis University Transplant Center, 1201 S Grand Blvd, St. Louis, MO 63104. (krista.lentine@health.slu.edu).

ISSN: 0041-1337/20/1091-22

DOI: 10.1097/TP.0000000000005124

- **LPE uygulaması, Asya ve Kanada'daki raporlar ile ABD'deki sınırlı deneyimler de dâhil olmak üzere, henüz çok erken bir aşamadadır. Güncel uygulamada genellikle organ yerine donör seyahat etmektedir.**

- **KPE'nin aksine, LPE yalnızca immünolojik nedenlerle değil, hacim uyumsuzluğu veya anatomik faktörler gibi diğer nedenlerle de yapılmaktadır (örneğin, bir yetişkin için sağ lob donörünün, bir çocuk için sol lateral segment donörüyle değişimi gibi). Bu durum, donörlerin farklı risk düzeylerine sahip olduğu ("sağ lob donörünün daha yüksek risk taşıdığı" gibi) durumlarda "eşit olmayan bir değişim" olasılığını doğurur. Bu nedenle, eşleştirilmiş bağışta her iki donör ve alıcı için eşit risk ilkesini temel bir etik ilke olarak vurgulamak ve olası "ödünleşmeleri" tamamen bilgilendirilmiş karar verme sürecinin bir parçası olarak şeffaf biçimde açıklamak önemlidir.**

- **Bir kurum içinde değişim havuzları genellikle küçüktür ve bu ameliyatlar büyük ekipler gerektirir. Canlı karaciğer donör adaylarının değerlendirilmesinin ve LPE politikalarının standardizasyonu, ayrıca en iyi klinik ve teknik uygulamaların paylaşılması, LPE'nin kullanımını ve başarısını artırmak için gereklidir.**