

Evolution of LDLT and How to Expand Responsibly

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Living donation

Disclosures

- No relevant financial conflicts



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Learning Objectives

1. To learn the history of solid organ transplantation and living donation
2. To learn the history of living donor liver transplantation
3. To understand current approaches to expand living donor liver transplantation responsibly
 1. Nondirected donors
 2. Paired exchange



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Early attempts at solid organ transplantation

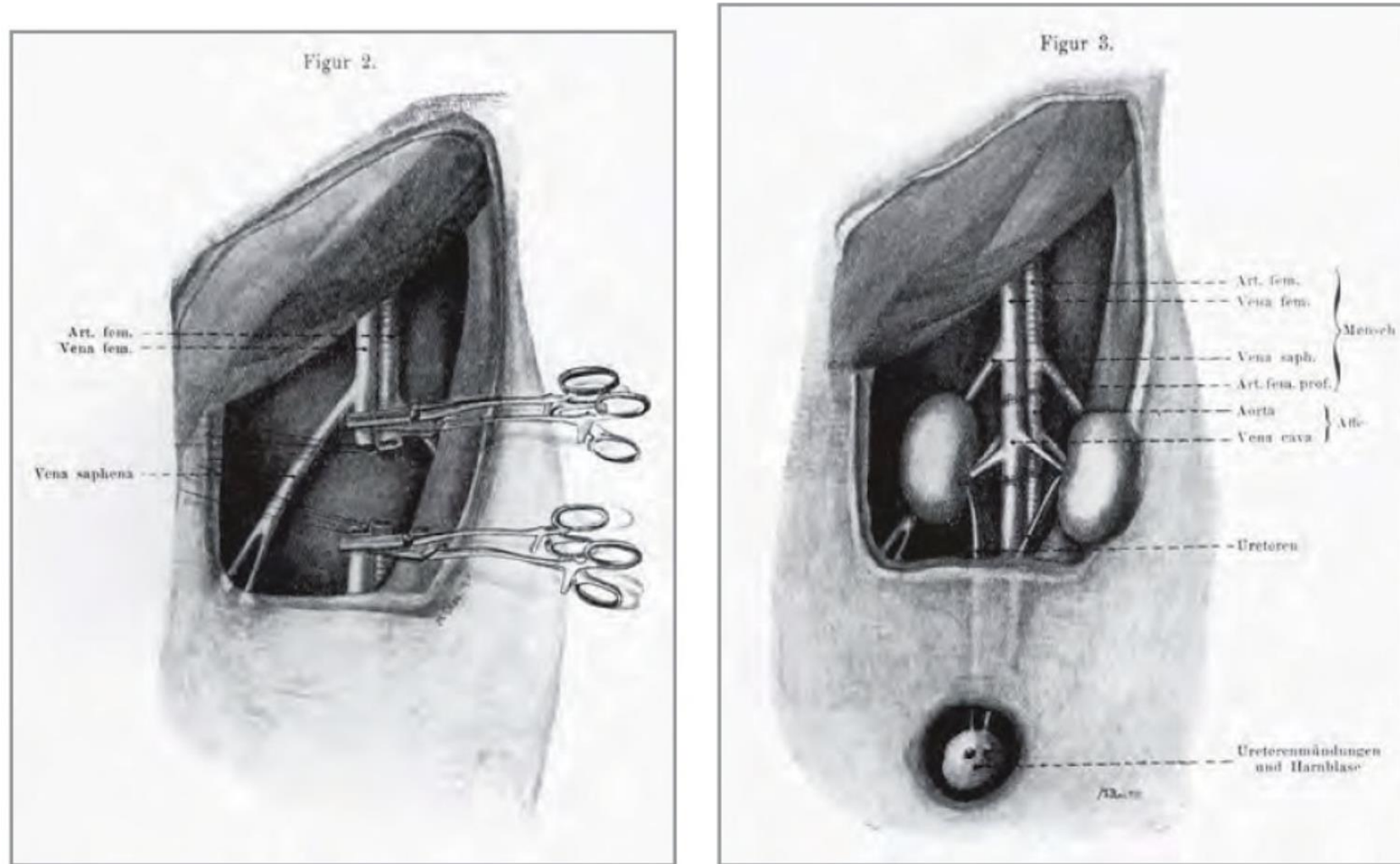
Date Location Surgeon	Donor	Human Recipient	Surgery	Outcome
1905 France Princetau	Rabbit	16yo female	Pieces of rabbit kidney placed into her kidney	Patient survived two weeks
1906 France Jaboulay	Pig	Female	Transplanted to arm	Patient died after one hour
1909 Germany Unger	Primate	Male	Two Rhesus kidneys transplanted into groin	Patient died after 32 hours
1933 Ukraine Voronoy	60yo prisoner	23yo F with renal failure due to toxic ingestion	-ABO mismatch -6h warm ischemic time -Transplanted into thigh	graft functioned for 21hr, patient died at 48hr (patent vessels on autopsy)



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Unger: Primate to Human Kidney Transplant



Solid organ transplant research: Joseph Murray

- Harvard trained plastic surgeon
- Served in World War II, also involved in treatment of burn patients
- Returned to the Brigham Hospital after the war in 1947
- Clinical plastic surgeon and director of Harvard Surgical Research Labs
- Experimental kidney transplantation in dogs (>100 dogs in the first two years)
- Close research relationship with Medawar's group



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Clinical Solid Organ Transplantation: Early 1950s

- Paris group reported 16 cases of clinical renal allotransplantation in 1950
- Chicago group published a single case in 1951
- 9 patients transplanted at the Brigham between March 1951-February 1953

EXPERIENCES WITH RENAL HOMOTRANSPLANTATION IN
THE HUMAN: REPORT OF NINE CASES ¹

By DAVID M. HUME, JOHN P. MERRILL, BENJAMIN F. MILLER, AND
GEORGE W. THORN

(From the Departments of Surgery and Medicine, Harvard Medical School and the Peter Bent Brigham Hospital, Boston, Mass.)

(Submitted for publication April 14, 1954; accepted September 8, 1954)



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Clinical Solid Organ Transplantation: Brigham Experience

- It was our aim in this investigation to study the subject of homotransplantation of the human kidney-not to offer a therapeutic procedure. We agree with Dempster that “it is quite out of the question that kidneys should be homotransplanted in man just in case a permanent survival might be obtained.”
- Goals:
 - Determine if underlying renal disease affected transplanted kidney
 - Determine if human allografts behaved similarly to animal models

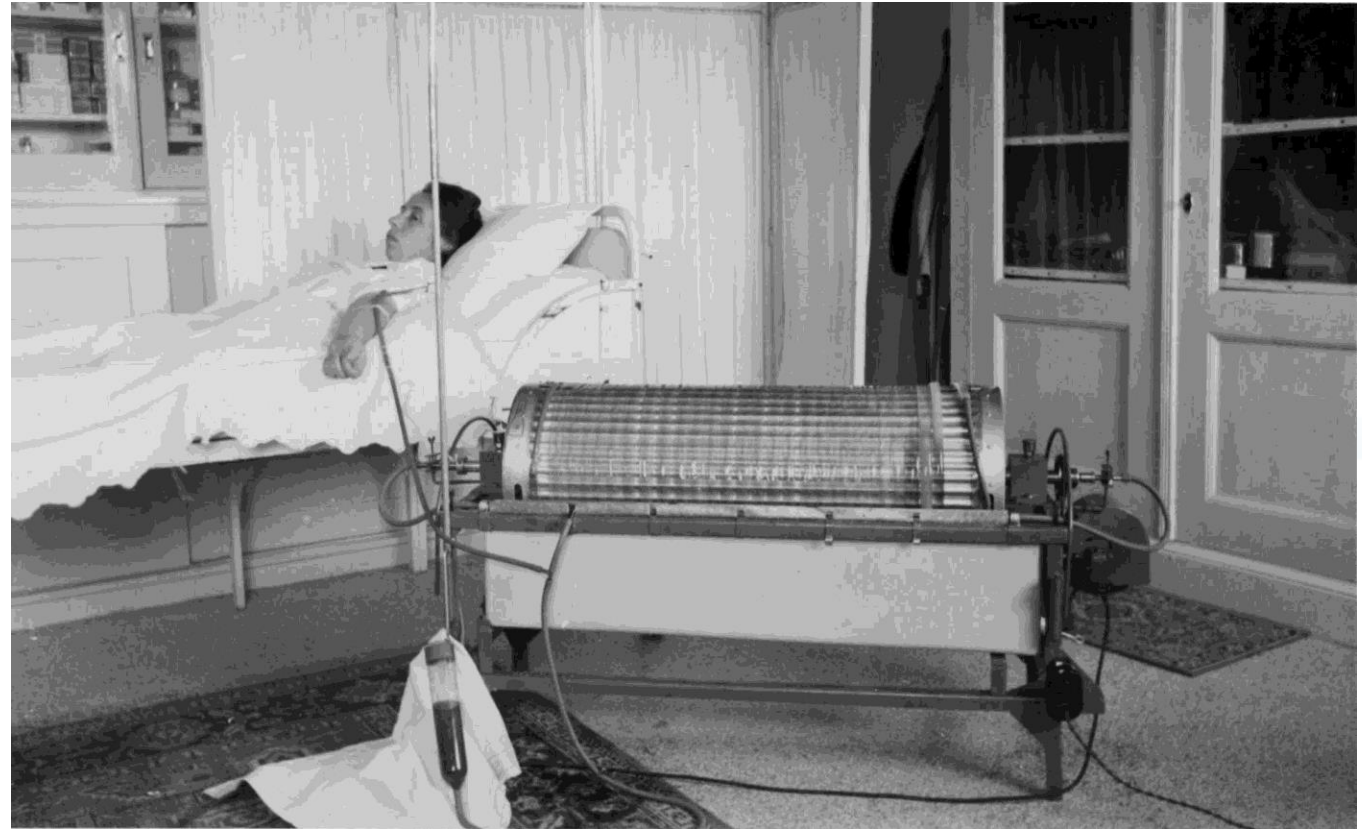


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Clinical Solid Organ Transplantation: Kolff-Brigham artificial kidney

- Developed by Dutch physician, Willem Kolff, during World War II
- First functional machine in 1943
- First life-saving treatment in 1946
- Only useful as a short-term therapy
- Cumbersome drum-like design
- First units in US in 1948-1950
 - Cleveland Clinic
 - Mt Sinai
 - Brigham Hospital



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<http://www.lib.utah.edu/img/kolff-1.jpg>

Clinical Solid Organ Transplantation: Brigham Experience

- Donors:
 - 6 cadaveric donors
 - 2 'healthy' donors
 - Average 3.5 hr of warm ischemic time

RENAL HOMOTRANSPLANTATION IN THE HUMAN

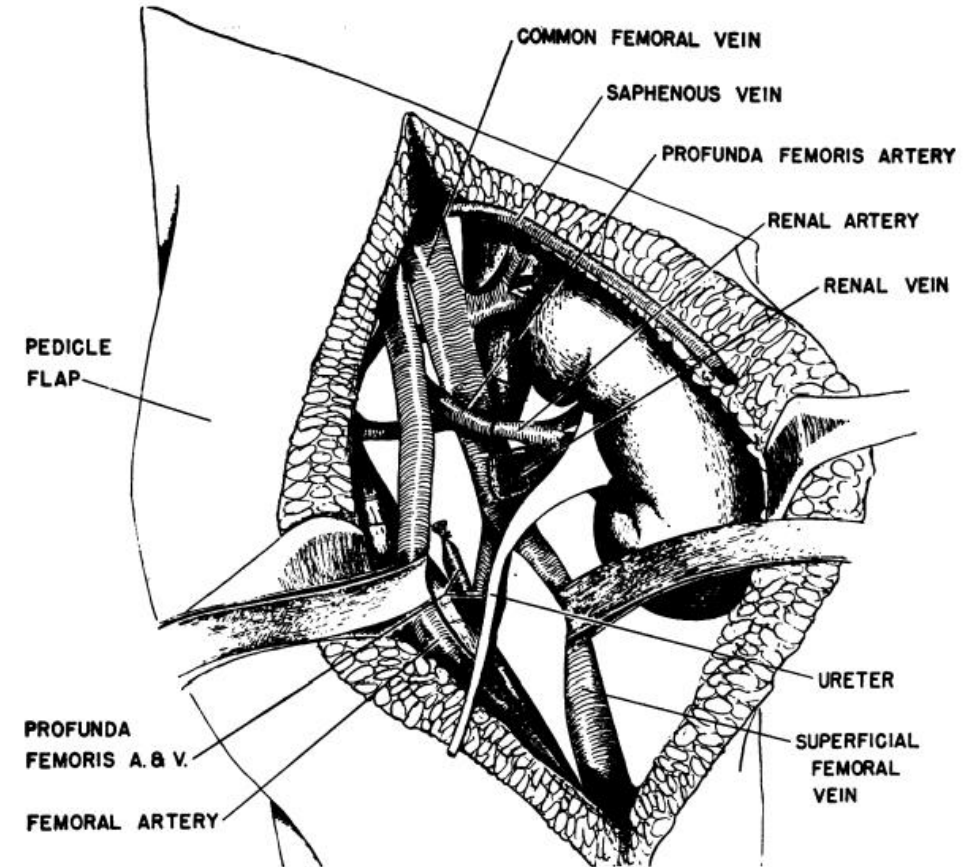


FIG. 1. THE METHOD OF PLACING THE RENAL TRANSPLANT IN THE RIGHT THIGH



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Clinical Solid Organ Transplantation: Brigham Experience

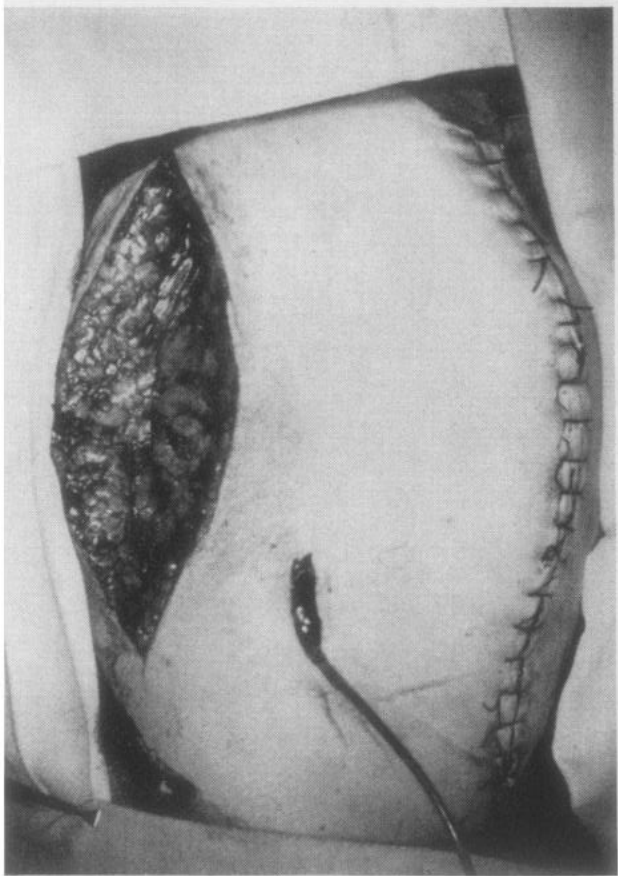


FIG. 13. B. B., CASE NO. 4—THE 83RD DAY
A retrograde pyelogram of the transplanted kidney shows no evidence of obstruction or distortion of the calyces, pelvis, or ureter.



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Hume et al. *J Clin Invest.* 1955;34(2):327-382

Brigham Experience: Results

- Four of the nine transplants developed measureable function. The kidneys secreted urine for 37 to 180 days.
- Of the four that worked, all had delayed graft function (8-19 days).
- The general pathologic picture which accompanies homograft failure in the human is qualitatively similar to that seen in experimental animals, but appears much more slowly.



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Brigham Experience: Intention to treat

- Fall of 1953:
 - 22y.o. Richard Herrick developed renal failure while working in the Coast Guard
 - Rapidly progressing uremia
 - Noted to have an identical twin brother



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Hamilton, D. *A History of Organ Transplantation.*

Brigham Experience: First successful kidney transplant

- Extensive internal ethics review, primarily related to using healthy living donor
- Confirmation of being monozygotic twins:
 - Fingerprinting
 - Skin grafts with biopsy
- Operation was rehearsed on cadavers on December 21, 1954
- December 23, 1954: Simultaneous OR for donor and recipient

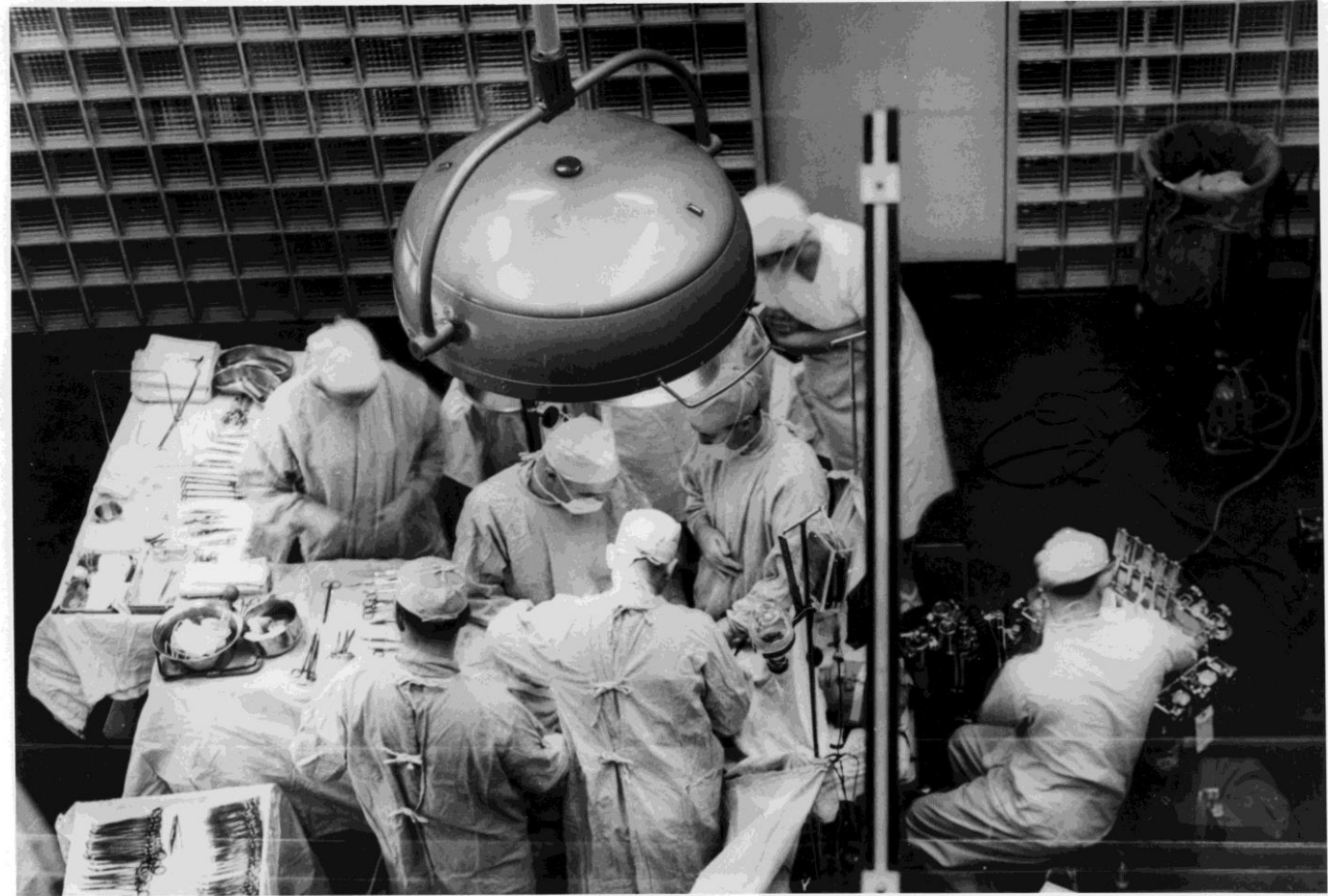


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Brigham Experience: First successful kidney transplant

- The donor artery was severed, the kidney was allowed to empty itself of blood and then the renal vein was clamped and divided. No attempt was made to cool or perfuse the kidney.
- The ureter had previously been separated. A polythene catheter was left in the ureter going to the renal pelvis and emerging with a cystostomy tube.



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Brigham Experience: First successful kidney transplant

Richard died of a heart
attack 8 years later, with a
functioning graft

Ronald lived to be 82

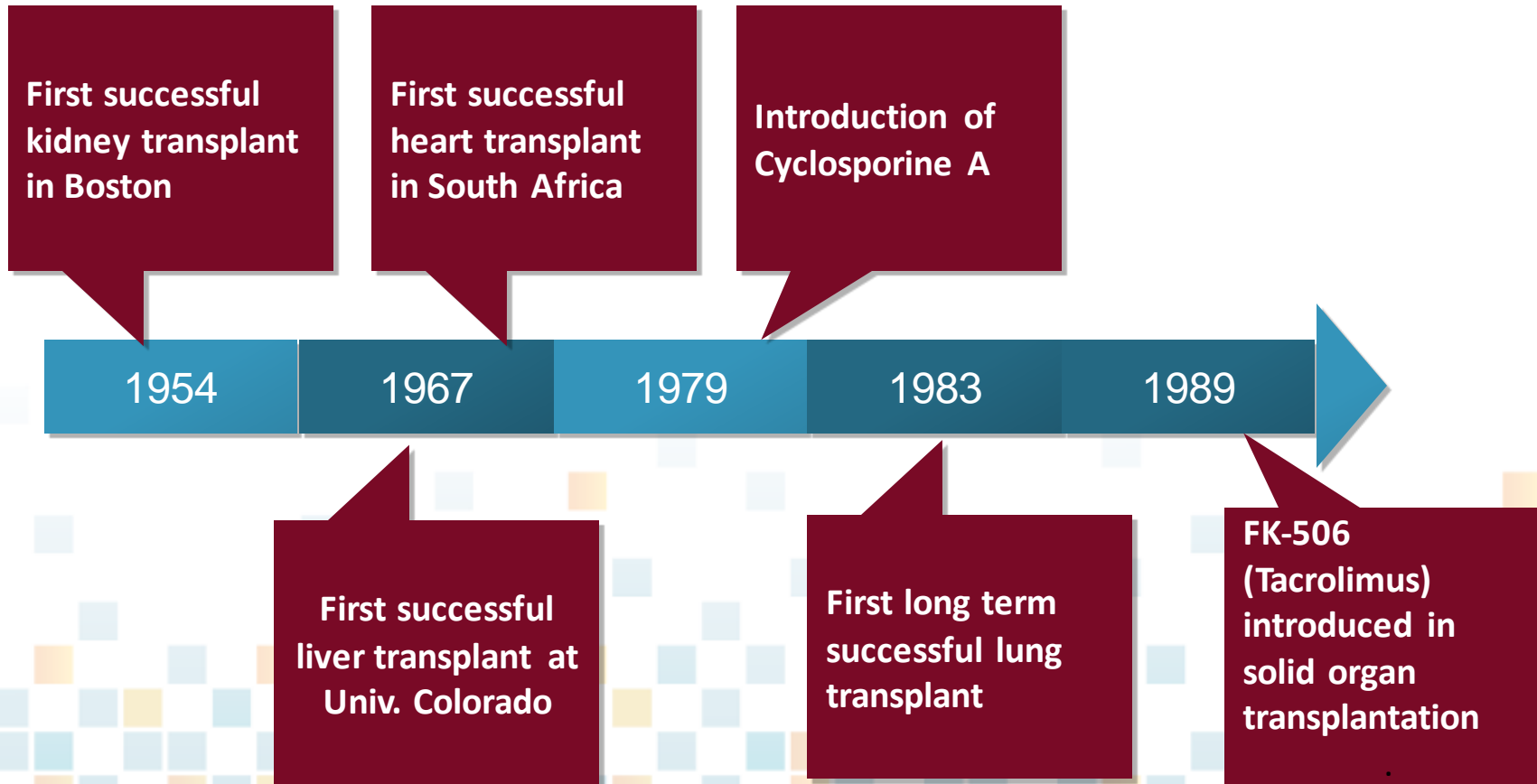


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Hamilton, D. *A History of Organ Transplantation.*

Timeline of Organ Transplantation



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Learning Objectives

1. To learn the history of solid organ transplantation
2. To understand current practice for adult liver transplantation



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Father of Liver Transplantation: Tom Starzl

(March 11, 1926 – March 4, 2017)

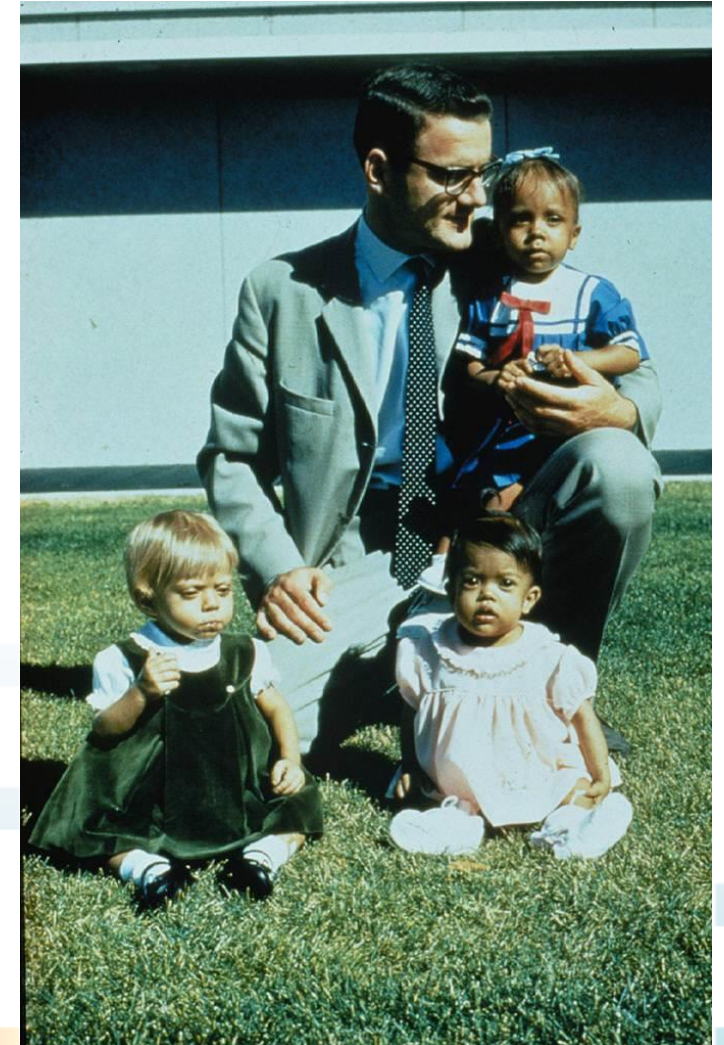


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History of Liver Transplantation

- **First attempted liver transplant in 1963 was in a child**
 - Dr. Starzl in Denver, CO
 - 3yo with biliary atresia
- **First successful series in 1968**
 - 8 total children
- **Better outcomes with introduction of Cyclosporine in 1980 lead to worldwide expansion of both pediatric and adult liver transplantation**



<http://www.starzl.pitt.edu/people/groth.html>

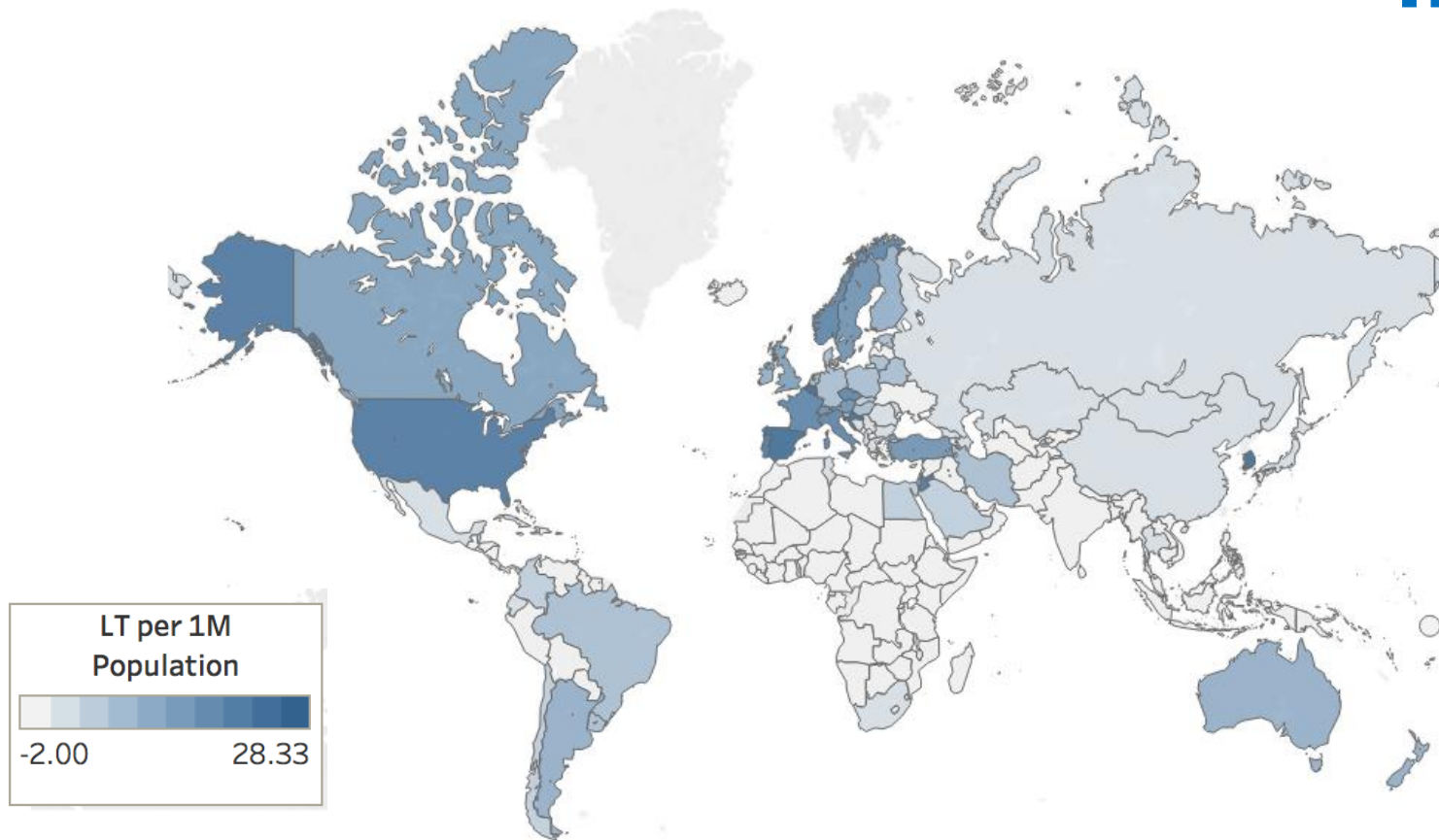


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Worldwide Distribution of Liver Transplantation, 2018

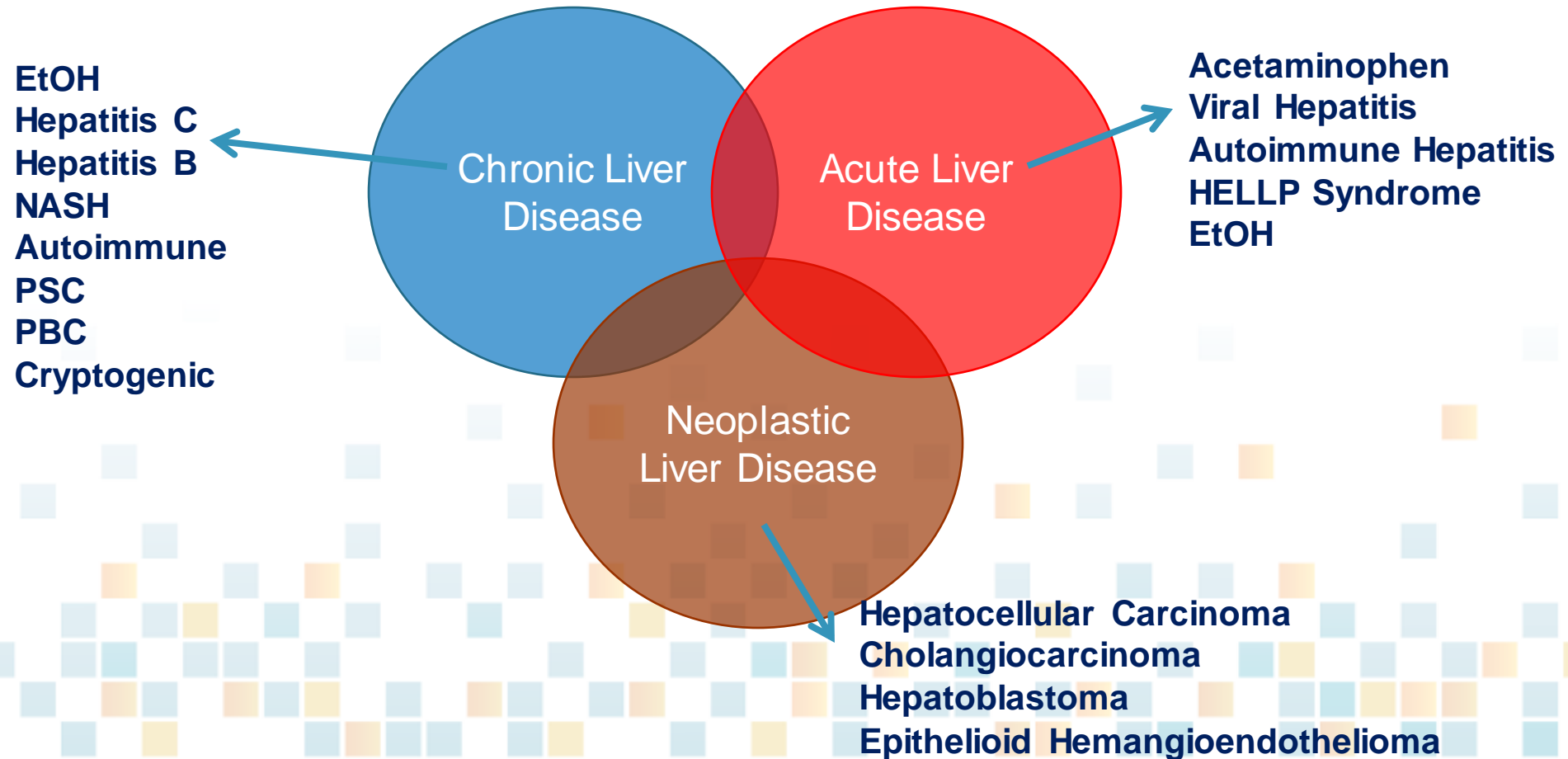
~32,000 LT
in 2017



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Indications for Liver Transplantation



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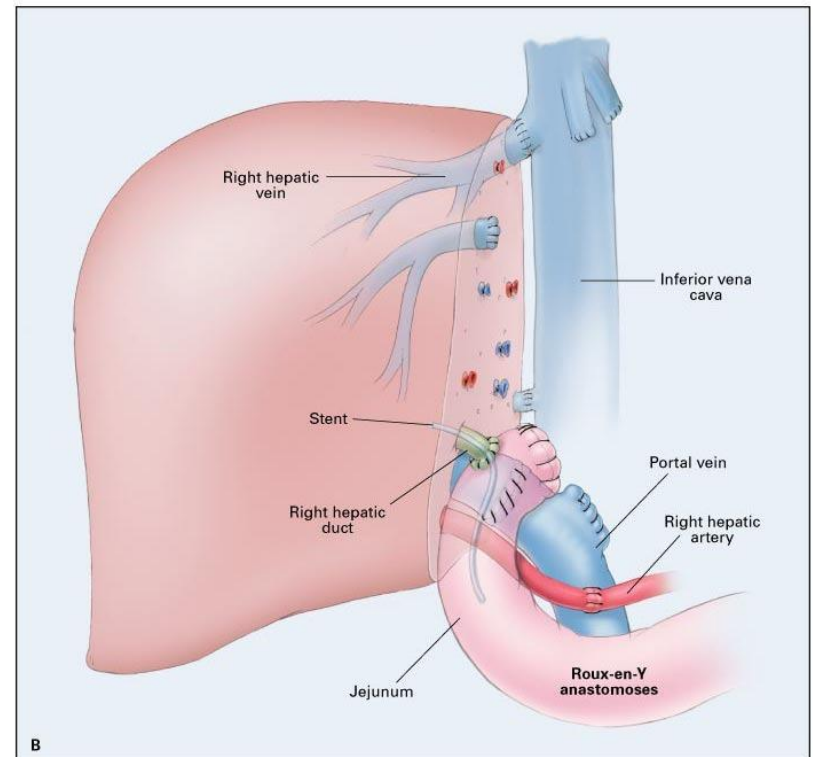
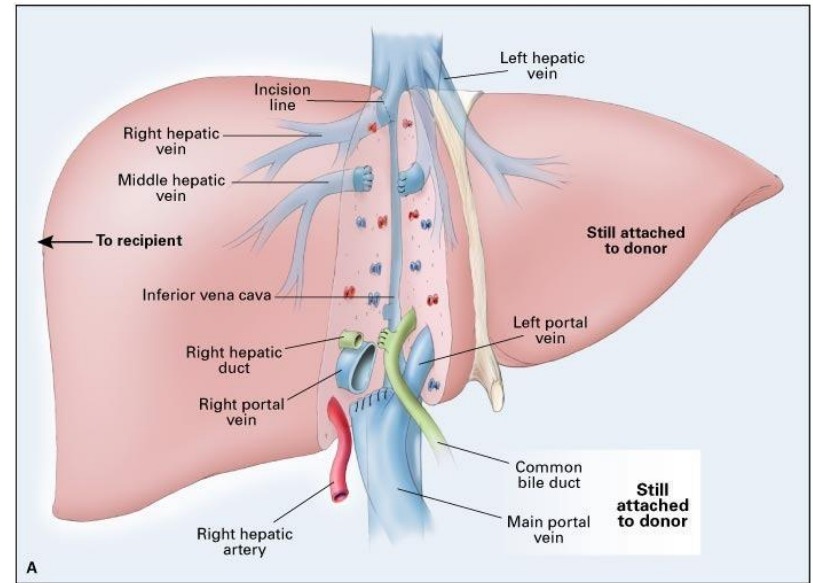
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Living Donor Liver Transplantation

- First developed for children (left lateral segment)
- Introduced in late 1990s
- Most growth in regions without access to deceased donors



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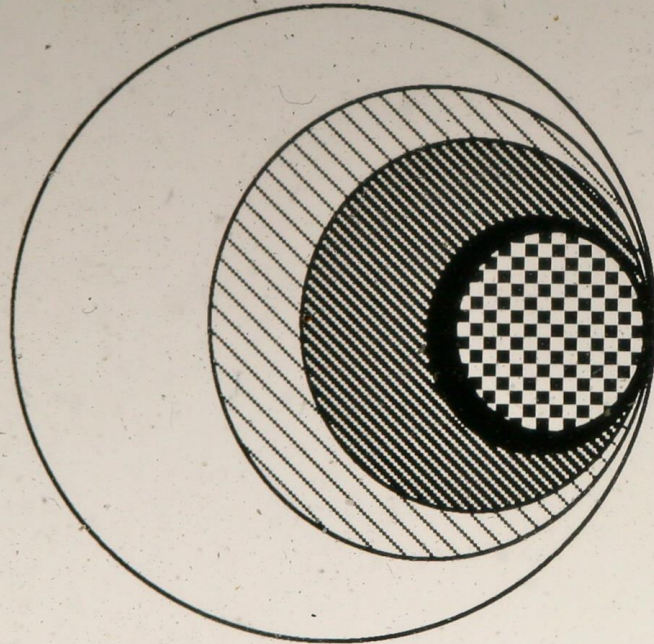


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Pediatric liver disease:

Application of liver transplantation: Limits and logistics

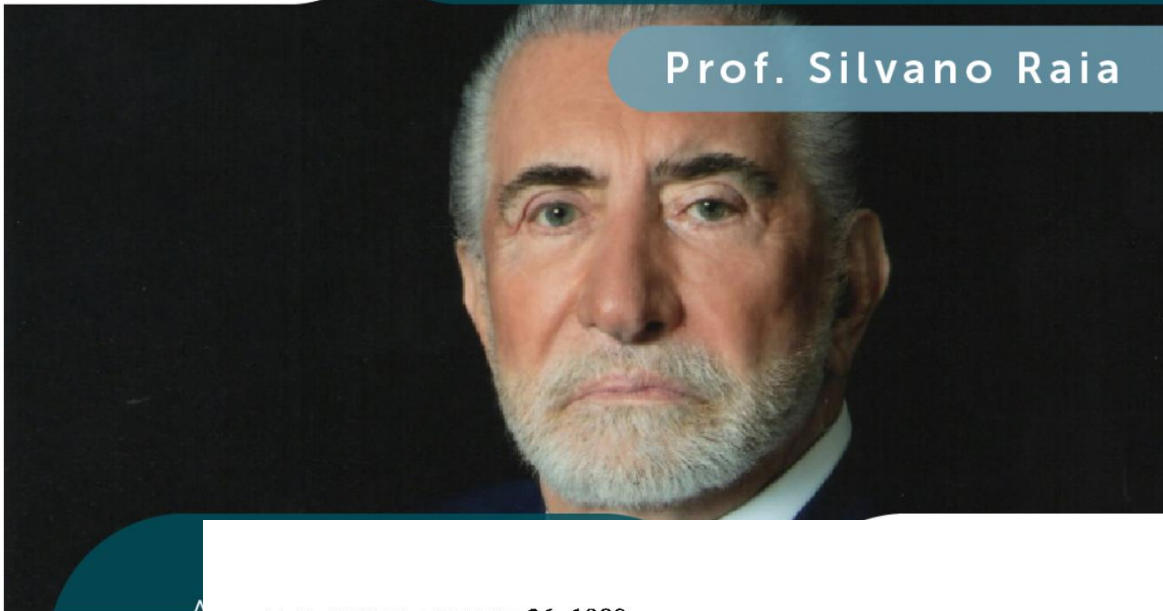


- Children with liver disease
- ◌ Referred for transplantation
- ◌ Waiting list
- Received OLT
- ◌ Survived OLT



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Prof. Silvano Raia

THE LANCET, AUGUST 26, 1989

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Letters to the Editor

LIVER TRANSPLANTATION FROM LIVE DONORS

SIR,—A liver transplant programme in Brazil began in September, 1985, but by November, 1988, only 15 adults and 4 children had been transplanted due to shortage of cadaveric organ donors, a problem faced in many other countries. By the end of the 3rd year of our programme the probability that a potential recipient would die while on the waiting list was 50% for adults and 73% for children.

A technique for liver transplantation from live donors has been developed at our laboratory. Hepatic segments II and III (left lateral) are resected and transplanted to the recipient, whose liver has already been removed with preservation of the entire inferior vena cava. The graft is placed in the hepatic fossa in an obverse position, which favours perfect alignment of the vascular stumps. The risk of haemorrhage in the donor is reduced by a simple device, described elsewhere.¹

HLA-DQ β NON-ASP-57 ALLELE AND INCIDENCE OF DIABETES IN CHINA AND THE USA

SIR,—Children in the United States are about twenty times more likely to acquire insulin-dependent diabetes mellitus (IDDM) than children in China, incidence rates for white children in Allegheny County, Pennsylvania,¹ and for children in Tianjin² being 15.8 and 0.7 per 100 000 per year, respectively. This huge variation in incidence is unexpected but may be due, in part, to genetic differences across populations and specifically associated with the polymorphism in position 57 of the HLA-DQ β chain.

Genetic susceptibility (or resistance) to IDDM in whites is strongly related to variation in a short segment of the HLA-DQ β chain gene.^{3,4} The presence of at least one allele leading to aspartic acid in position 57 (Asp-57 or *A*) of this chain seems to protect against IDDM, while a non-charged amino acid in the same position (non-Asp-57 or *NA*) is associated with increased susceptibility. Among probands in the IDDM registries in Allegheny County, 96% were *NA/NA*, 4% were heterozygous, and none was *A/A* (table). *NA* homozygosity was significantly associated with IDDM, with an estimated relative risk of 107.³

The contribution of the non-Asp-57 genetic marker to IDDM in non-US populations has not been well studied. To see if variations



ORIGINAL ARTICLE BRIEF REPORT

Successful Liver Transplantation from a Living Donor to Her Son

Russell W. Strong, M.B.B.S., Stephen V. Lynch, M.B.B.S., Tat Hin Ong, M.B.B.S., Hidetoshi Matsunami, M.D., Yuichi Koido, M.D., and Glenda A. Balderson, B.Sc.

[Article](#) [Figures/Media](#)

[15 References](#) [579 Citing Articles](#)

May 24, 1990

N Engl J Med 1990; 322:1505-1507

DOI: 10.1056/NEJM199005243222106



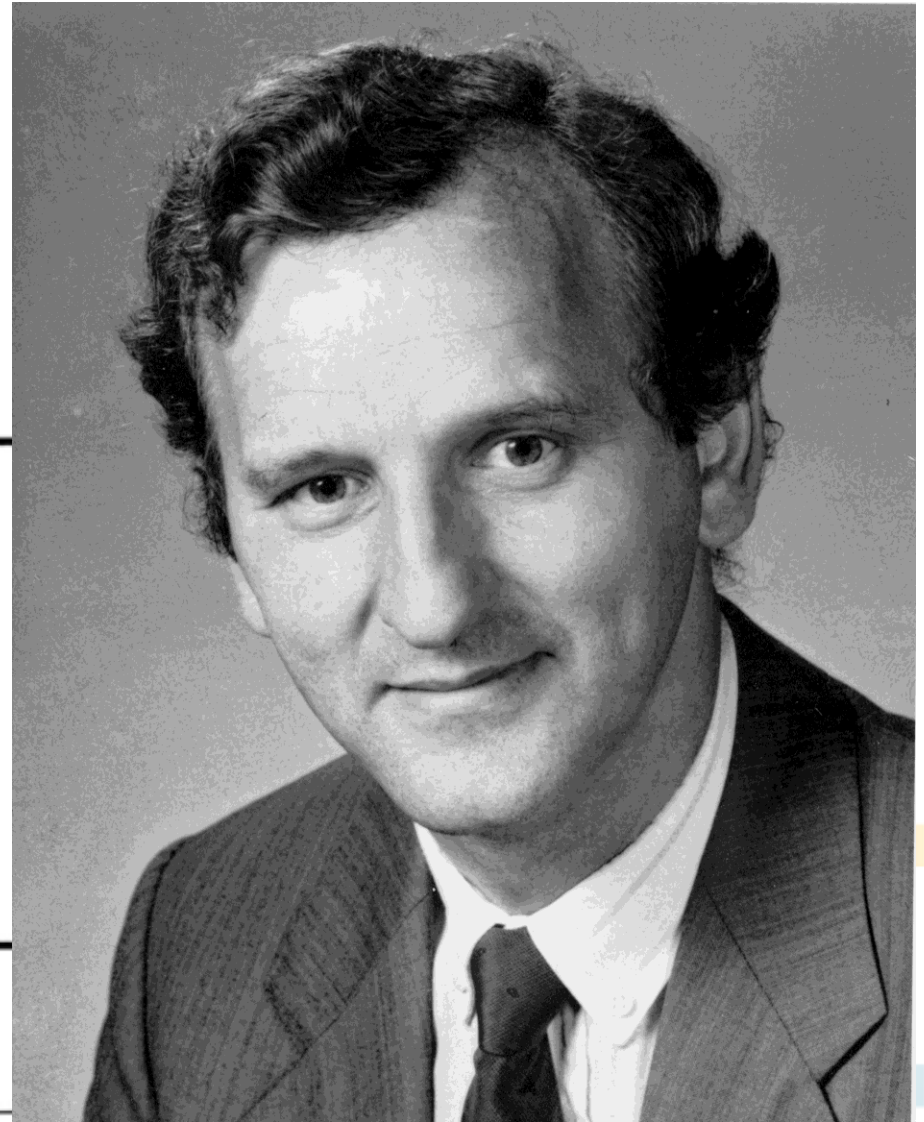
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Liver Transplantation in Children From Living Related Donors

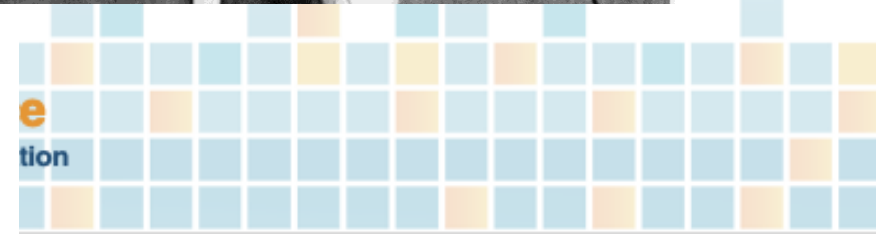
Surgical Techniques and Results

CHRISTOPH E. BROELSCH, M.D., Ph.D., PETER F. WHITINGTON, M.D., JEAN C. EMOND, M.D.,
THOMAS G. HEFFRON, M.D., J. RICHARD THISTLETHWAITE, M.D., Ph.D., LARRY STEVENS, M.D.,
JAMES PIPER, M.D., SUSAN H. WHITINGTON, and J. LANCE LICHTOR, M.D.



Pediatric liver transplantation with reduced size donor organs (RLT) has evolved into a standard clinical procedure increasing the choices of recipients for their treatment. Nevertheless organ availability remains a major problem. The authors therefore have proposed to study the use of hepatic segments from living related

From the Departments of Surgery, Pediatrics and Anesthesiology, The University of Chicago Pritzker School of Medicine and The Wyler Children's Hospital, Chicago, Illinois



Ethical foundation for LDLT

- Ethical imperative to address donor shortage
- Clinical foundation to assure safety and efficacy
- Informed consent and multidisciplinary protection of donor



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Segmental Liver Transplantation from a Living Donor

By BLANCA SMITH

SEGMENTAL LIVER TRANSPLANTATION FROM LIVING DONOR

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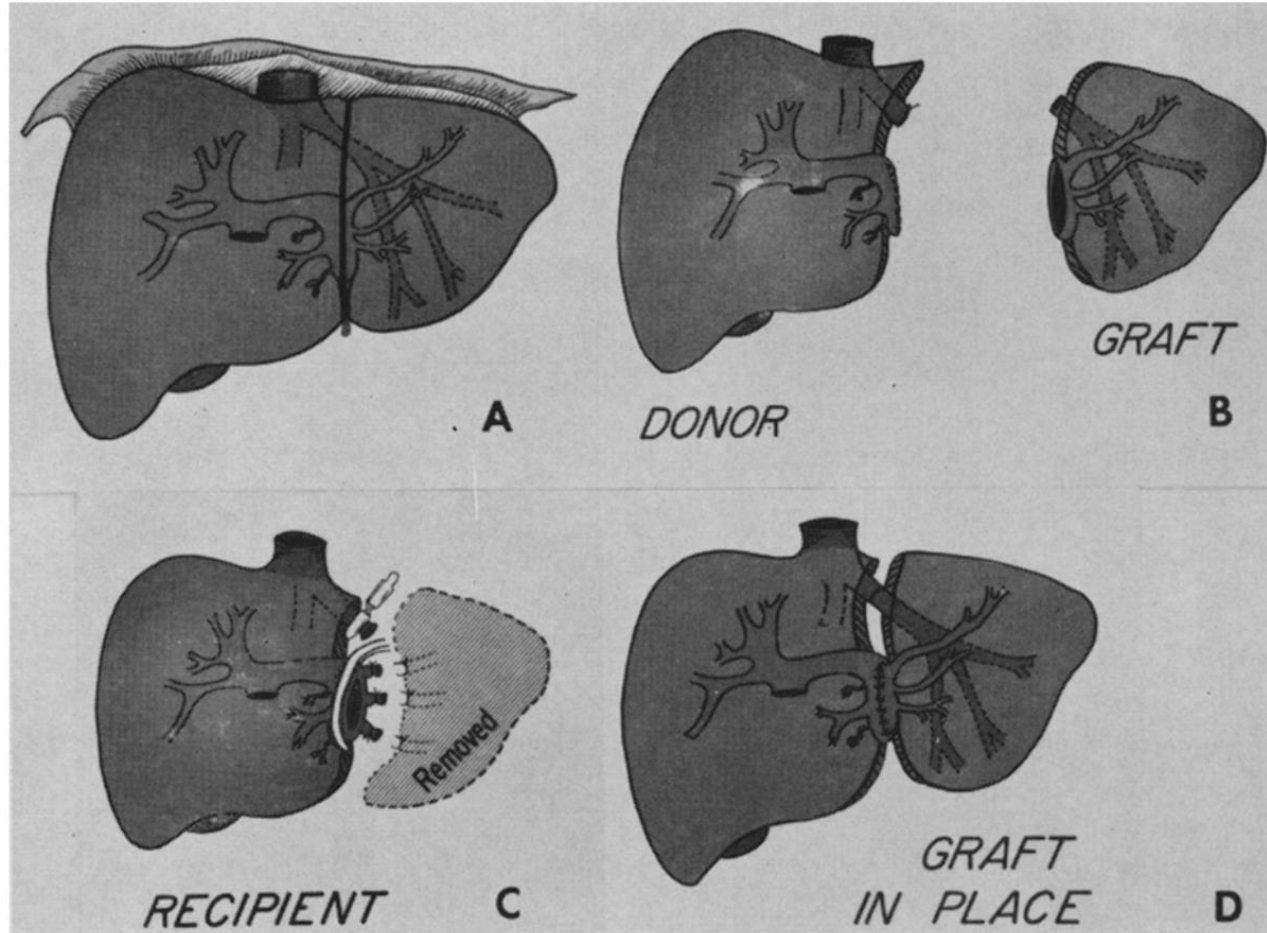


Fig. 1.—Left lateral segment of the liver showing portal and hepatic veins.



Reduced-sized orthotopic liver graft in hepatic transplantation in children

H. Bismuth, M.D., and D. Houssin, M.D., Villejuif, France

Because of the rarity of child donors, in cases of adult donors room requirement for the liver graft is a major technical obstacle to liver transplantation in children. To overcome this difficulty in a child, the authors performed an orthotopic transplantation with an adult liver that had been reduced to the left lobe. The absence of technically-related complications suggests that this procedure might facilitate the performance of liver transplantation in children.

From the Unité de chirurgie hépato-biliaire and Groupe de Recherche de chirurgie hépatique, INSERM U17, Hôpital Paul Brousse, Villejuif, France

THE LIVER is the largest organ in humans. In some cases, the large size of the liver graft renders transplantation technically difficult or impossible. This is particularly the case for heterotopic liver transplantation when there is not enough room in the abdomen for a normal-sized liver graft or for orthotopic liver transplantation in children when the liver graft comes from an older donor.

was normal. Histologic examination of the liver revealed a severe cholestasis with normal interlobular bile ducts. Biliary canaliculi appeared to be dilated under the electron microscope. The following evolution was marked by progressively increased jaundice and pruritus and by a severe alteration of the growth.

In September 1981 physical examination revealed an underdeveloped child (26 kg per 1.21 m) with intense



C. COUINAUD

LE FOIE

ÉTUDES ANATOMIQUES ET CHIRURGICALES

PRÉFACES

des Professeurs A. DELMAS & J. PATEL



MASSON & Cie

C. COUINAUD

Chirurgien-assistant des Hôpitaux de Paris
Chargé de recherches à l'Institut National d'Hygiène

LE FOIE

ÉTUDES ANATOMIQUES
ET CHIRURGICALES

PRÉFACES

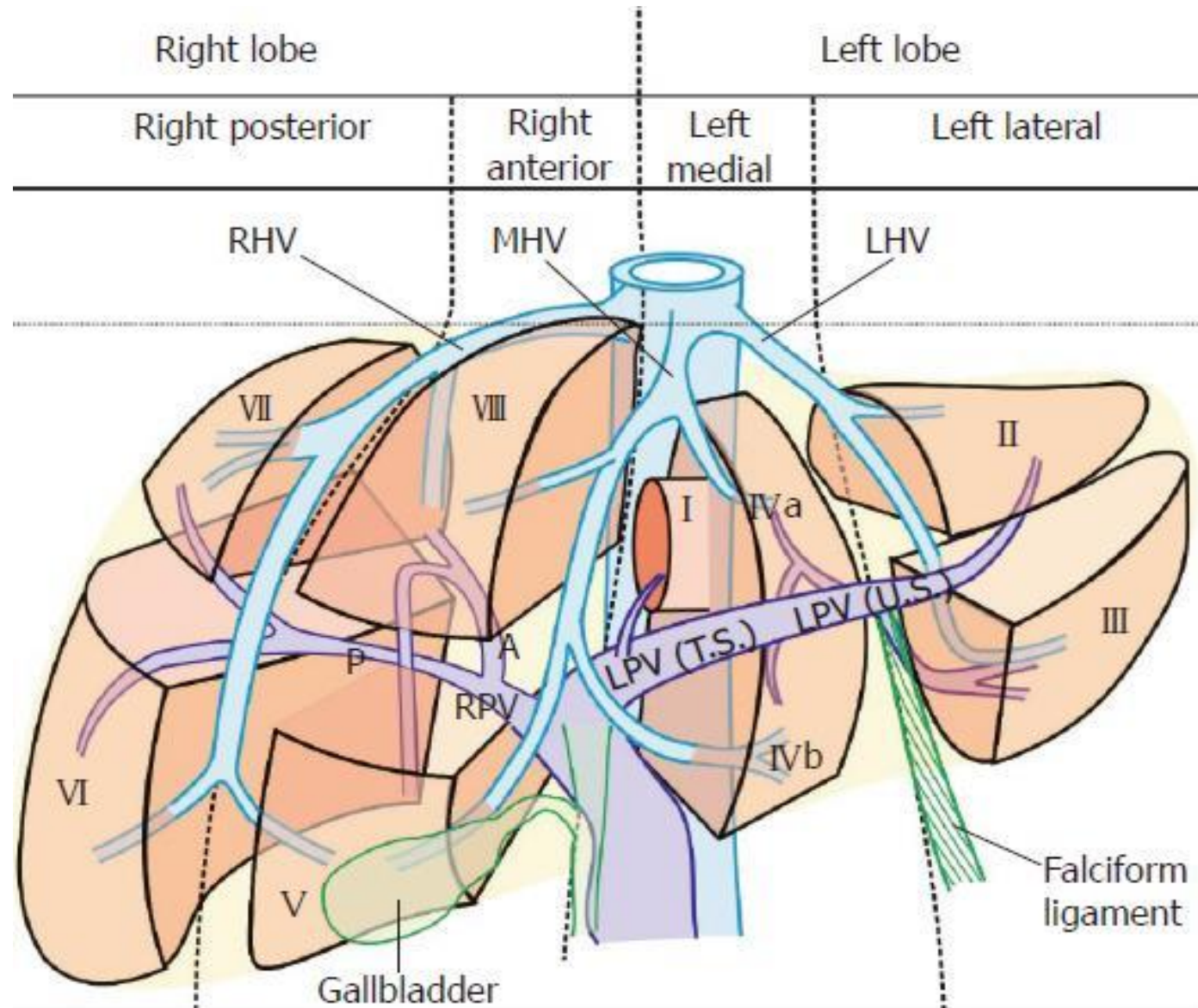
des Professeurs A. DELMAS et J. PATEL

MASSON & C^{ie}, ÉDITEURS
LIBRAIRES DE L'ACADÉMIE DE MÉDECINE
120, Boulevard Saint-Germain, PARIS (VI^e)
1957

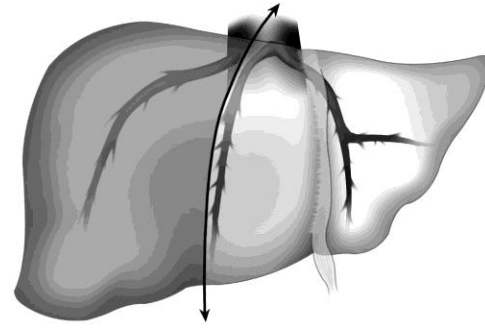


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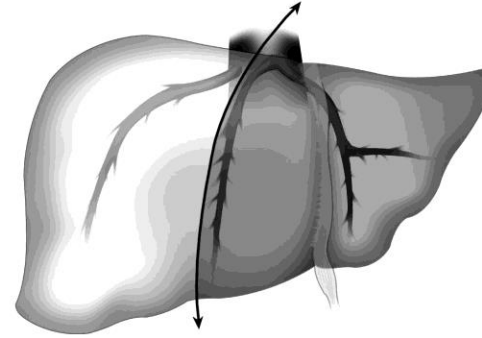
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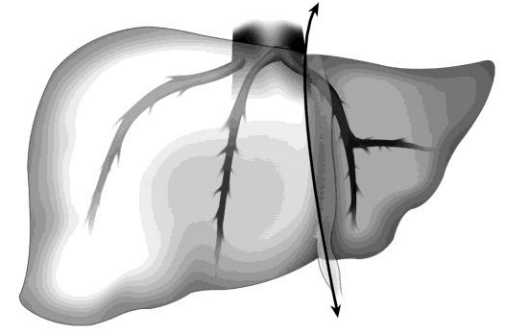
Different types of LDLT grafts



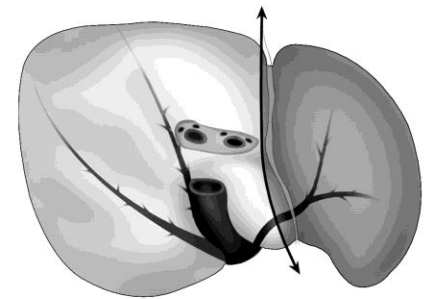
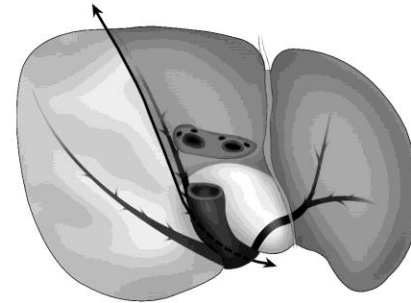
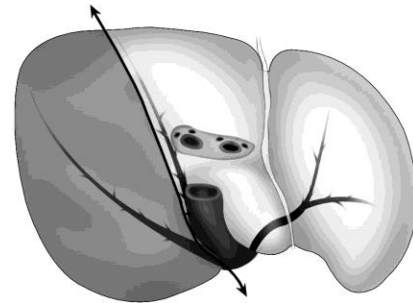
RH



LH



LL

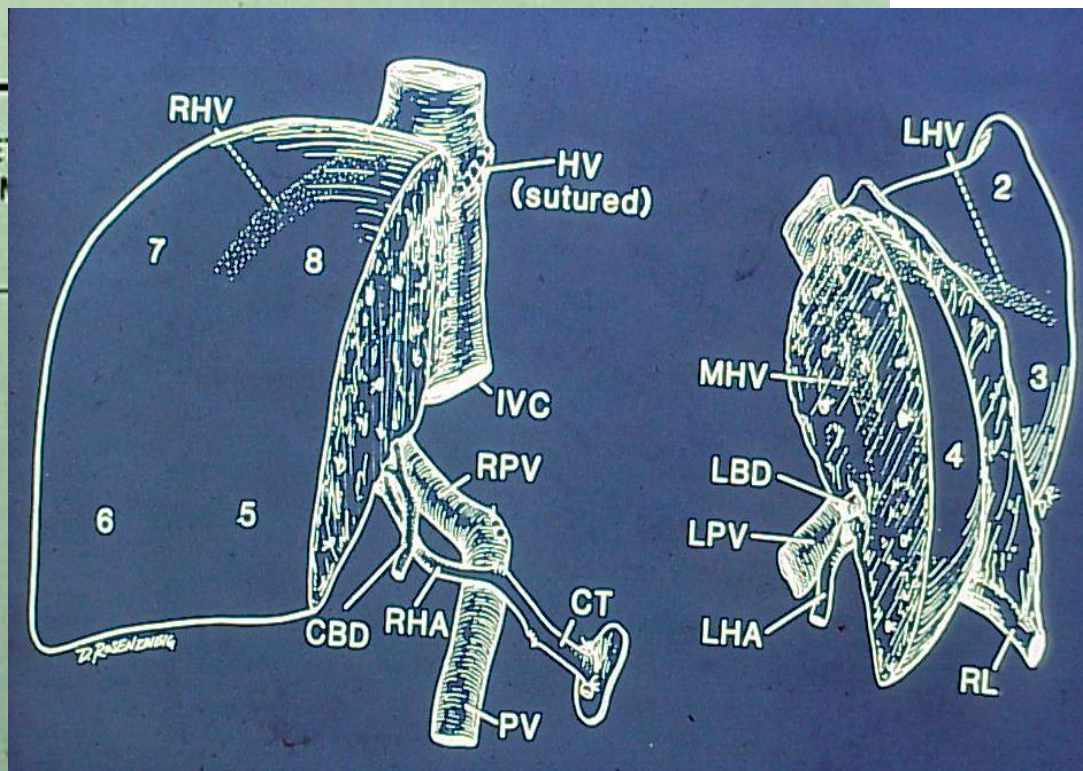


Transplantation of Two Patients with One Liver

Analysis of a Preliminary Experience with 'Split-liver' Grafting

J. C. EMOND, M.D., P. F. WHITINGTON, M.D., J. R. THISTLE,
E. A. ALONSO, M.D., I. S. WOODLE, M.D., P. VOGELBACH, M.D.,
A. R. ZUCKER, M.D., and C. E. BROELSCH, M.D., Ph.D.

Surgical reduction of donor livers to treat small children has been performed successfully in several centers. While this procedure improves the allocation of livers, it does not increase the organ supply. We have extended reduced-size orthotopic liver transplantation (OLT) to treat 18 patients with 9 livers, accounting for 26% of our transplants during a 10-month period and have evaluated the results. In 18 split liver OLTs, patient survival was 67% and graft survival was 50%. In comparison, for 34 patients treated with full-size OLT during the same period, patient survival was 84% ($p = 0.298$) and graft survival was 76% ($p = 0.126$). Biliary complications were significantly more frequent in split liver transplantation.



The surgical laboratory: anatomic preparation

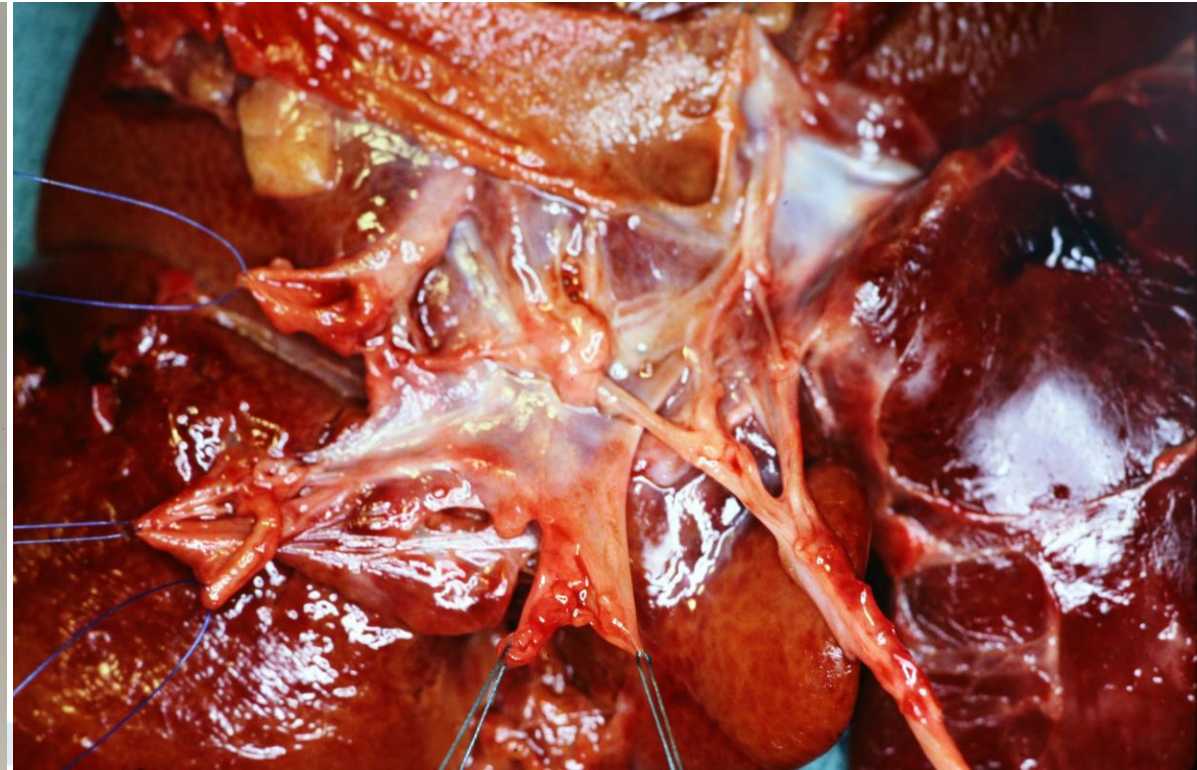
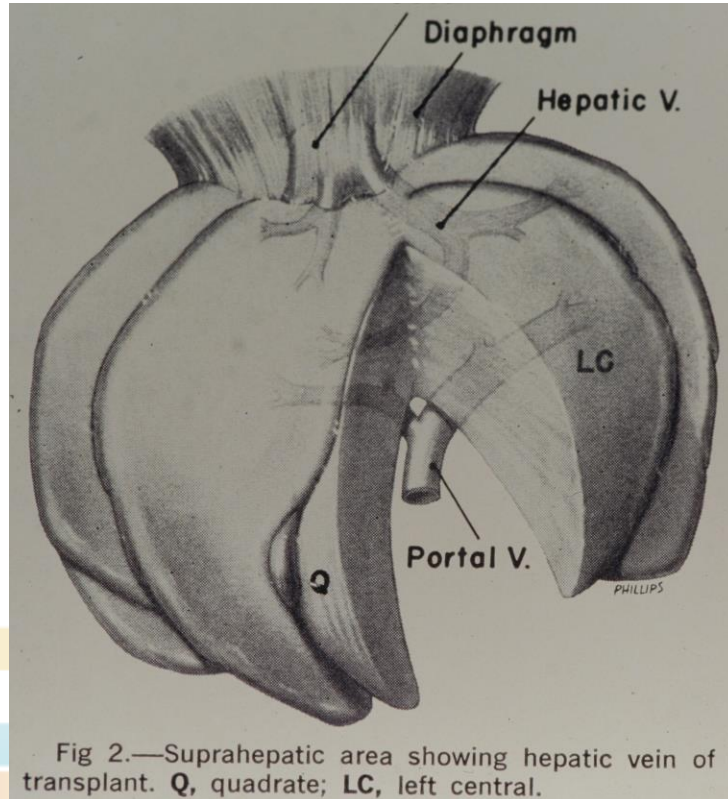
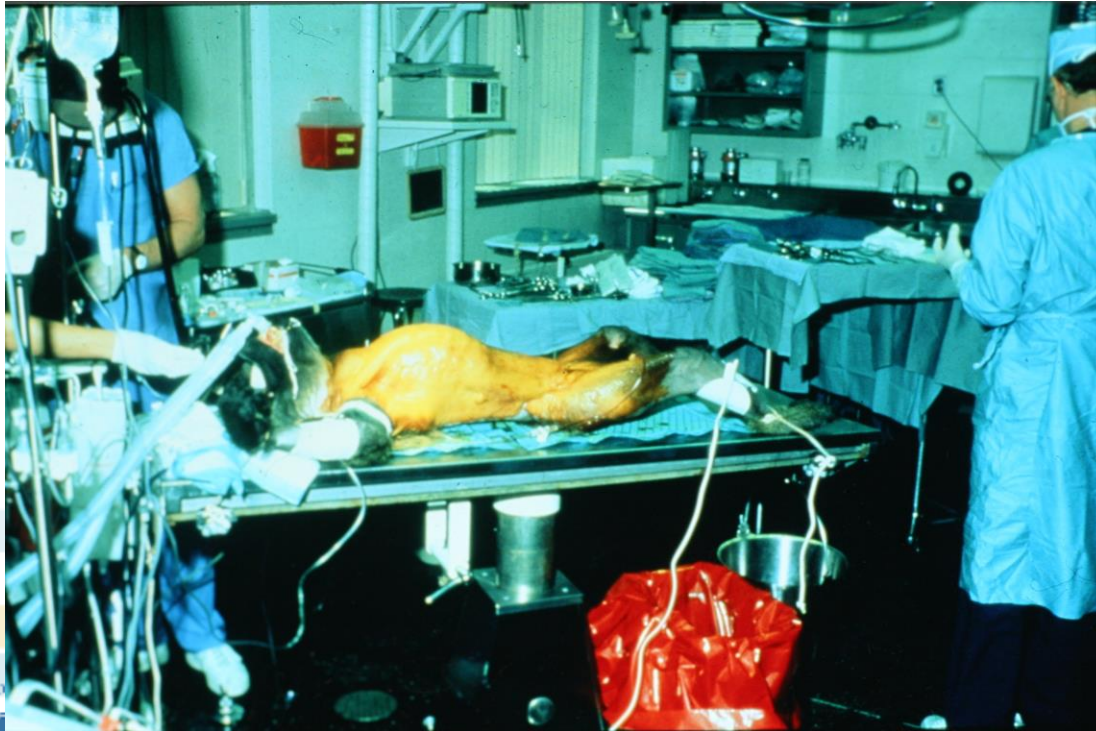


Fig 2.—Suprahepatic area showing hepatic vein of transplant. Q, quadrate; LG, left central.



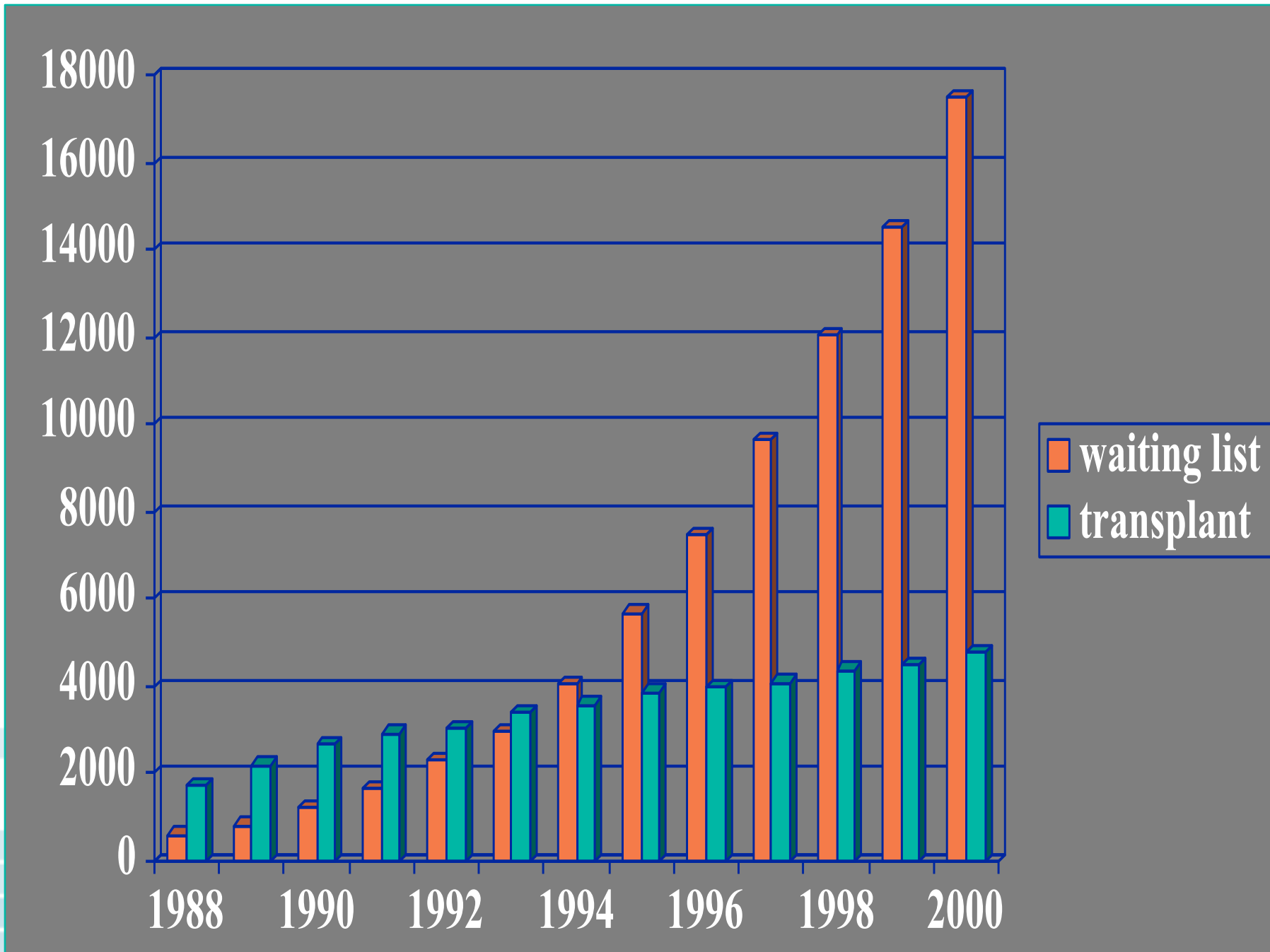
SEGMENTAL LIVER TRANSPLANTATION FROM LIVING DONORS Report of the Technique and Preliminary Results in Dogs

DANIEL CHERQUI*, JEAN C. EMOND, ANDREA PIETRABISSA,



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“Informed consent for a living donor is impossible in a Judeo-Christian society”



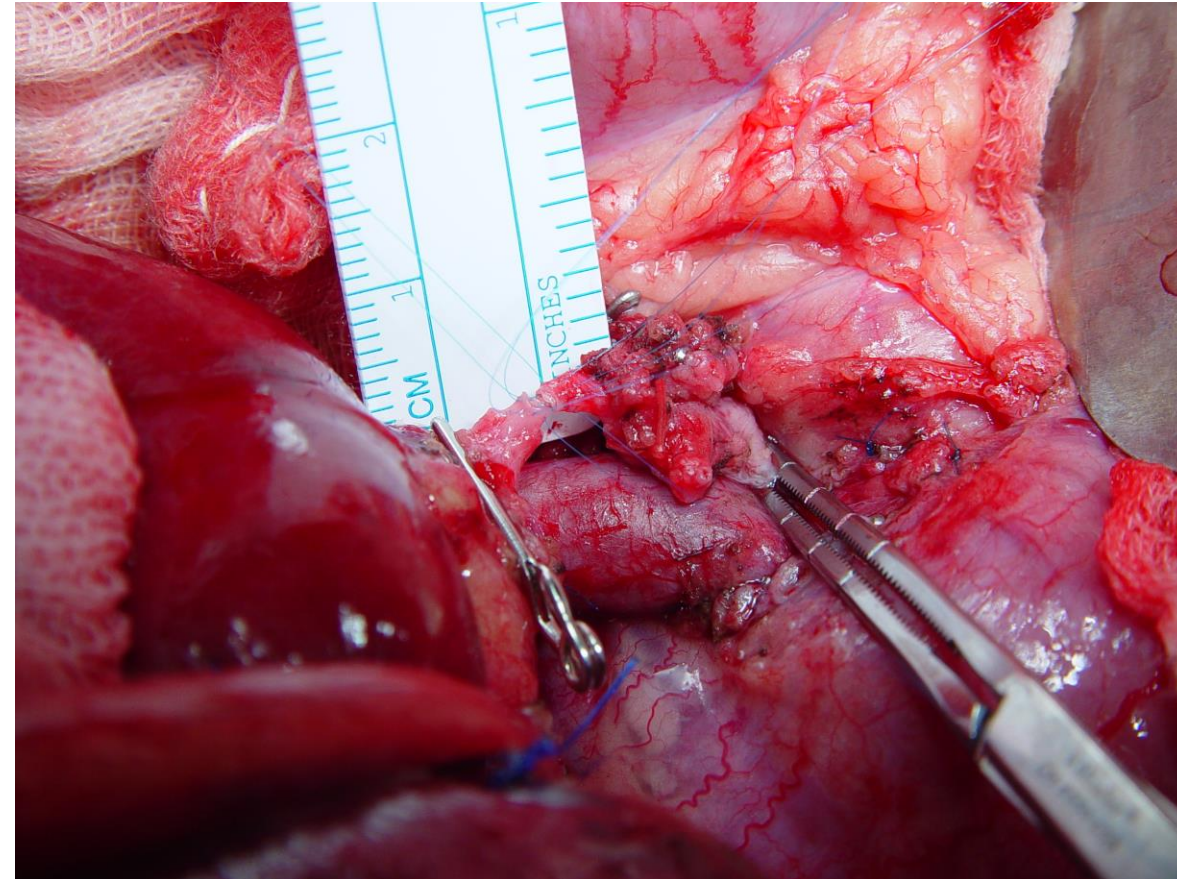
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Living related liver transplantation

K Tanaka ¹, S Uemoto, Y Tokunaga, S Fujita, K Sano, E Yamamoto, H Kato, Y Yamaoka, K Ozawa

Koichi Tanaka



Professor, Department of Transplantation
and Immunology

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Liver Transplantation in Children From Living Related Donors

Surgical Techniques and Results

CHRISTOPH E. BROELSCH, M.D., Ph.D., PETER F. WHITINGTON, M.D., JEAN C. EMOND, M.D.,
THOMAS G. HEFFRON, M.D., J. RICHARD THISTLETHWAITE, M.D., Ph.D., LARRY STEVENS, M.D.,
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From the Departments of Surgery, Pediatrics and Anesthesiology, The University of Chicago Pritzker School of Medicine and The Wyler Children's Hospital, Chicago, Illinois



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Improved results of living-related liver transplantation with routine application in a pediatric program.

[Emond JC](#), [Heffron TG](#), [Kortz EO](#), [Gonzalez-Vallina R](#), [Contis JC](#), [Black DD](#), [Whittington PF](#).

45 LTX in children 4/91-4/92

- Graft source
 - 18 LDLT
 - 27 from deceased donors (60%)
 - 12/27 reduction (44%)
- Patient survival
 - 17/18 LDLT (94%)
 - 21/24 DDLT (88%)



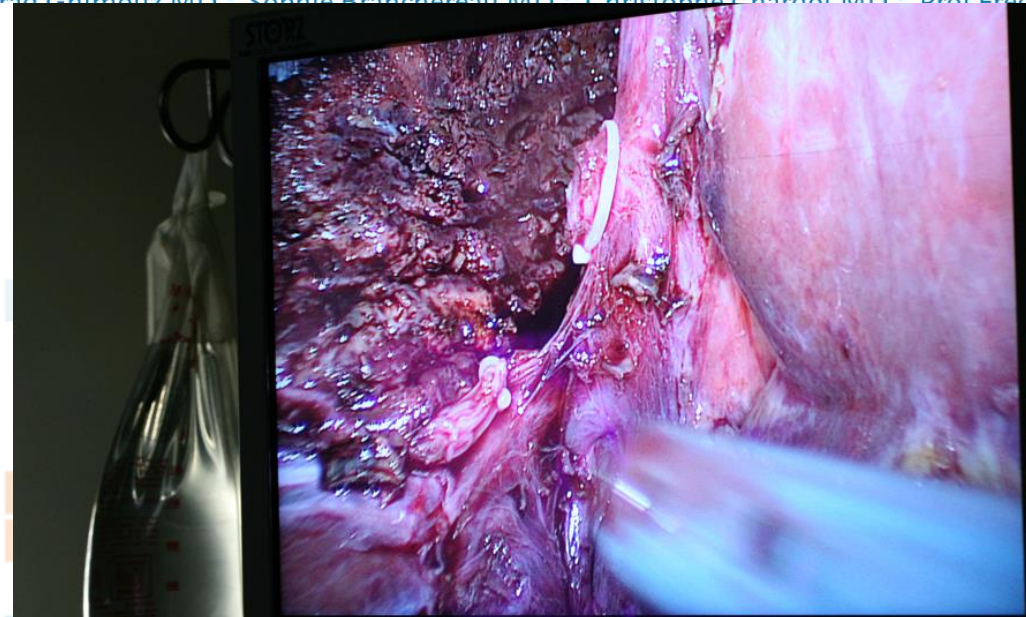
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Articles

Laparoscopic living donor hepatectomy for liver transplantation in children

Prof Daniel Cherqui MD^a ✉, Prof Olivier Soubrane MD^b, Emmanuel Husson MD^a, Eric Barshasz MD^c, Olivier Vignaux MD^d, Mourad Chimouz MD^e, Sophie Branchereau MD^e, Christophe Chardot MD^e, Prof Frédéric



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Adult to adult living donor liver transplantation:

Larger hepatectomy for donor and smaller graft for recipient

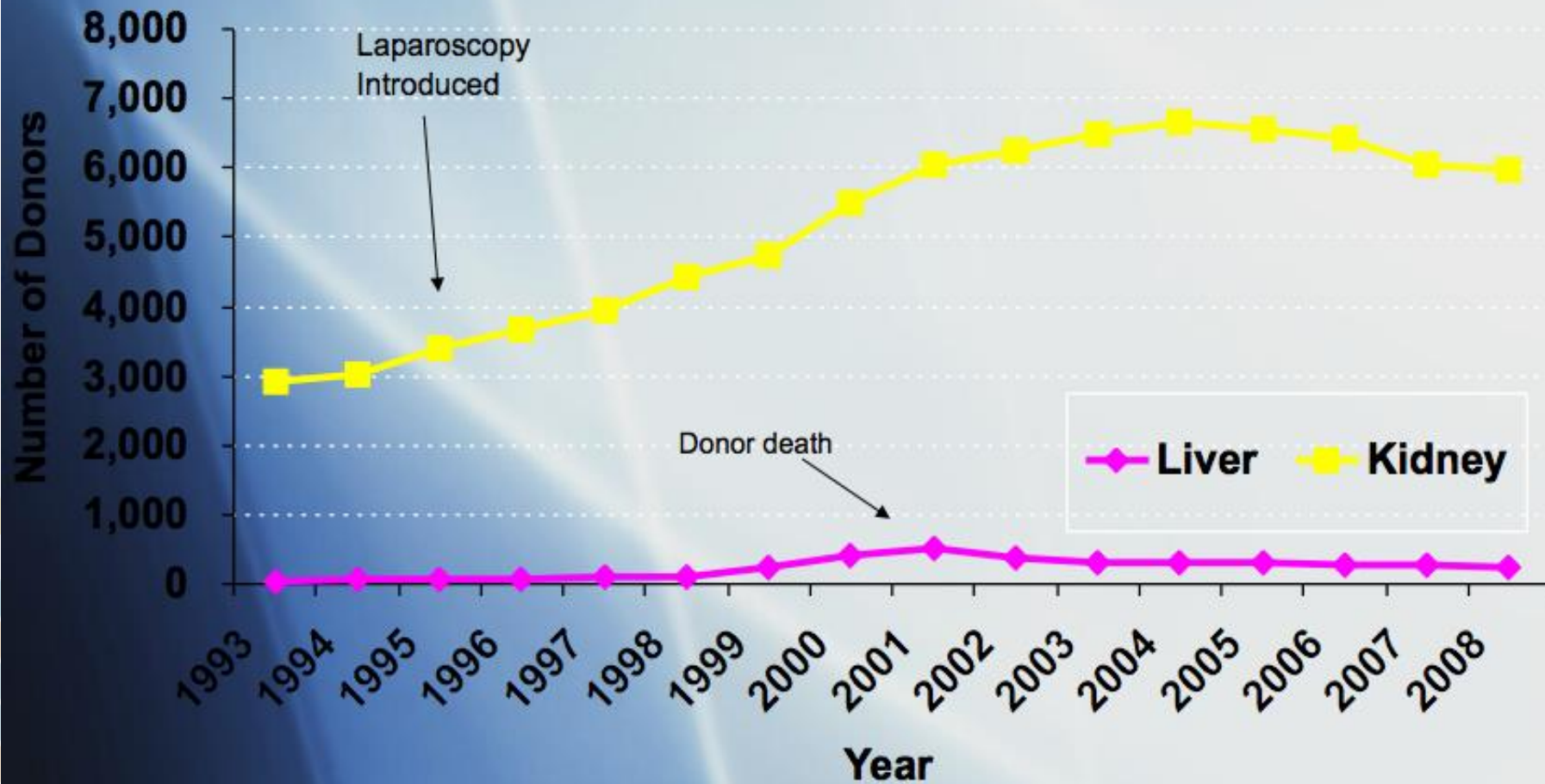


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Living Donors, Kidney and Liver

1994 - 2008



LDLT in USA: 1989-2014

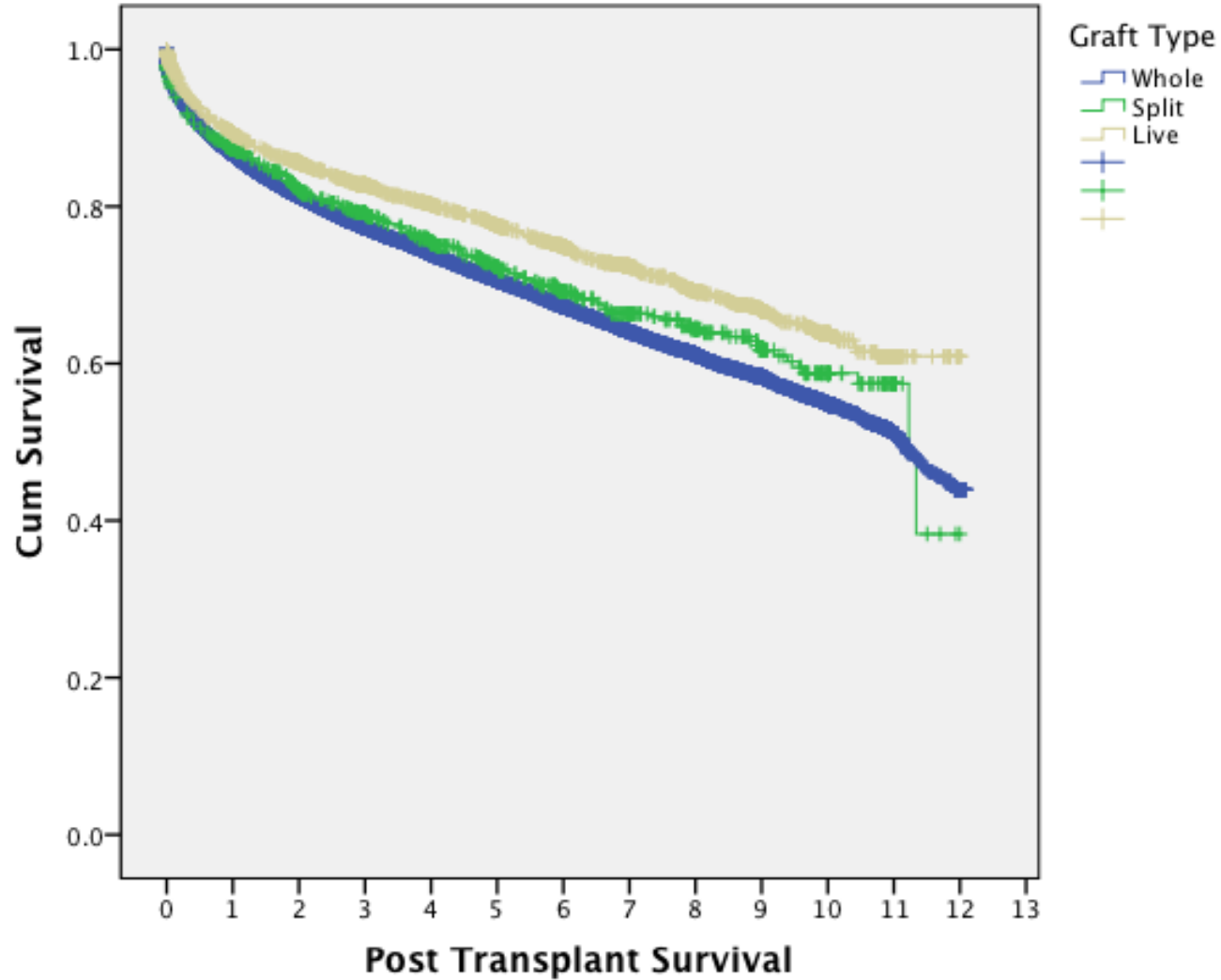
	Pediatric era	1997-2001	Total LDLT	Total OLT	Percent LDLT
Peds	213	490	1512	14324	10.5%
Adults	5	886	3601	113992	3.1%



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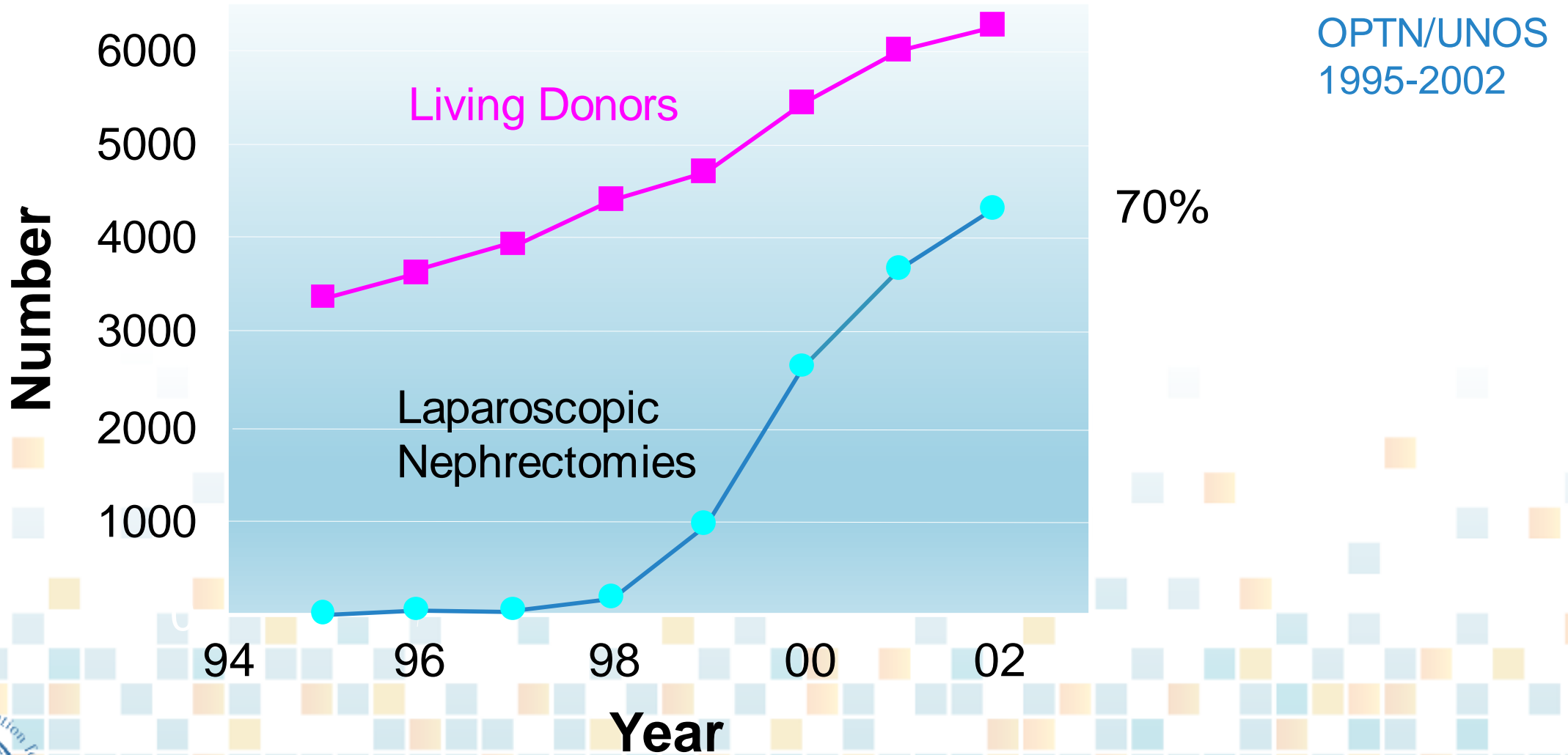
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Patient Survival – Adult



Graft Type	5 Yr Survival
Whole	70.6%
Split	72.4%
Live	77.5%

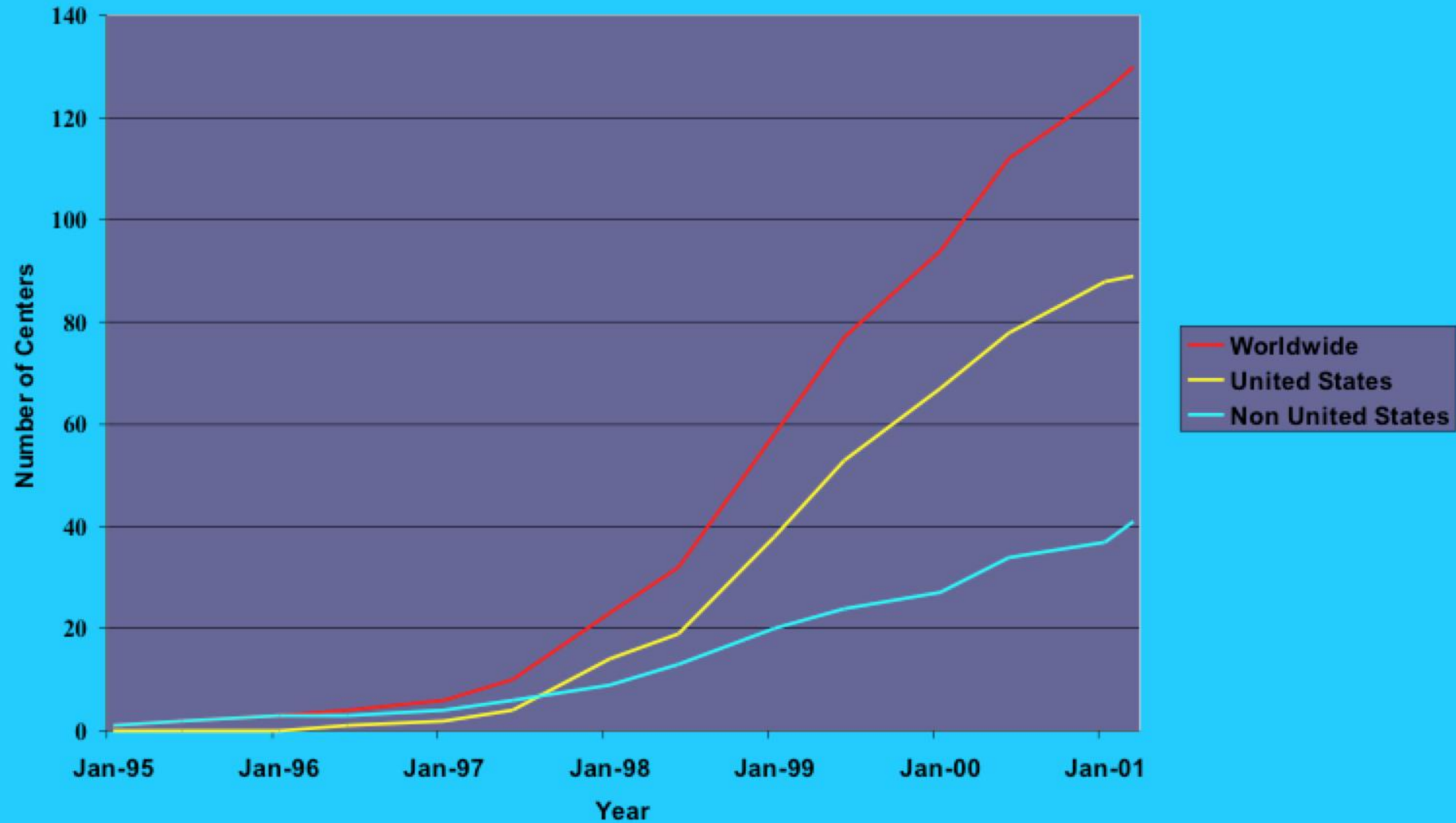
Laparoscopic Nephrectomy



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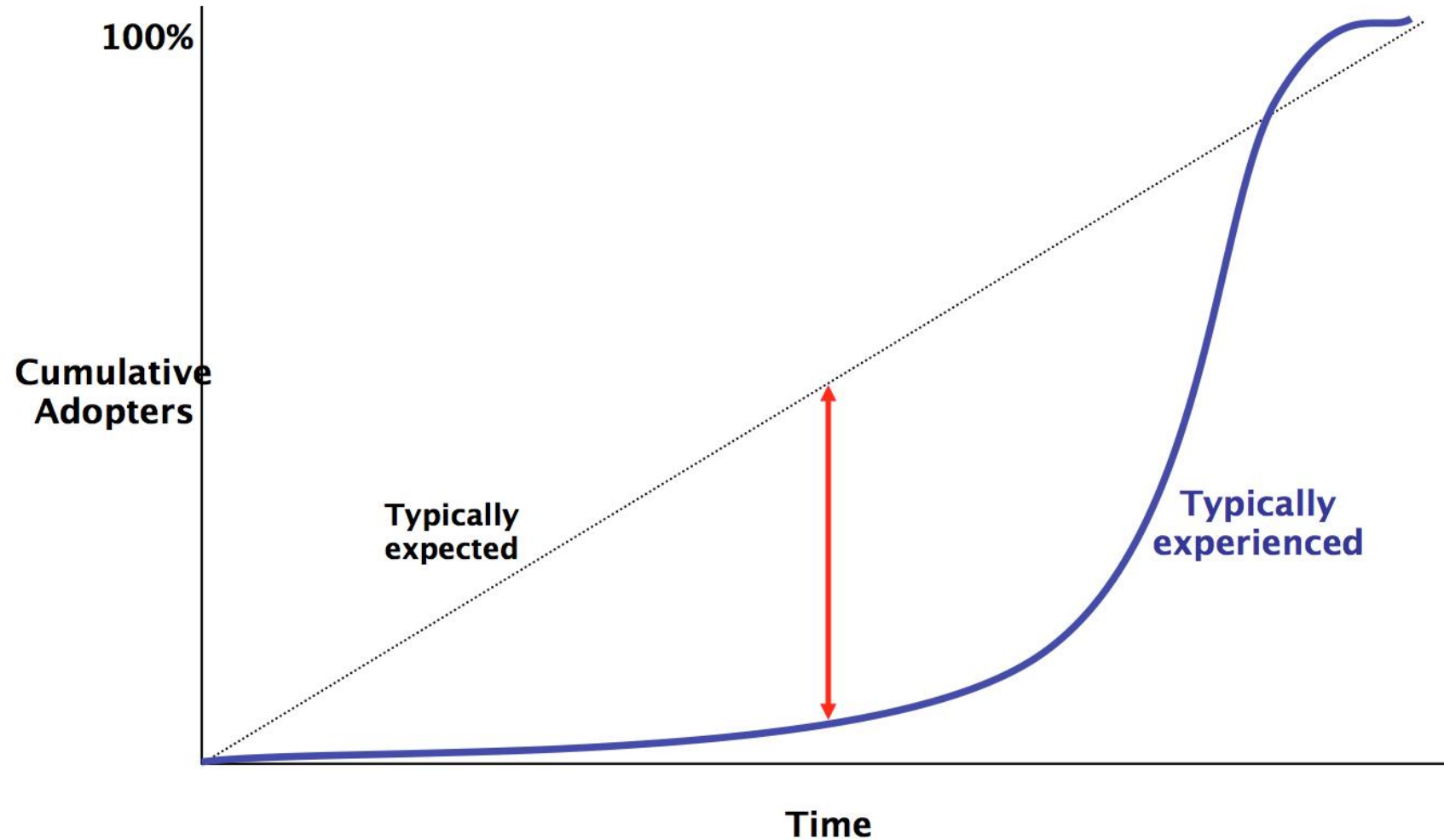
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Adoption of Laparoscopic Live Donor Nephrectomy



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Cumulative Adoption Curve



Factors affecting shape of adoption curve

- Difficulty of the proposed innovation
- Real and perceived risk
- Existence of alternatives



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Donor dies after live liver transplant at CU Hospital



From left to right: Shannon Arnold, Ryan Arnold, Chad Arnold. (July 29, 2010)

LAHEY

Lahey cleared in death of liver donor

Posted by Gideon Gil August 5, 2010 05:36 PM

[E-mail](#) | [Link](#) | [Comments \(2\)](#)

By **Liz Kowalczyk, Globe Staff**

State and federal health officials who investigated the death of a liver donor at Lahey Clinic said that they have not uncovered any problems with the quality of care at the hospital or other deficiencies that may have led to the tragedy.

The state Department of Public Health has completed its review of the May 24 fatality, as has the US Centers for Medicare and Medicaid Services, Roseanne Pawelec, a spokeswoman



Accueil > Société

Greffe du foie : mort d'un donneur

ERIC FAVEREAU 20 MARS 2007 À 06:44 (MIS À JOUR : 20 MARS 2007 À 06:44)

En France, c'est le second décès suite à un prélèvement depuis 1994.

Le professeur Jacques Belghiti est effondré. Chef de service de chirurgie digestive à l'hôpital Beaujon près de Paris, l'homme est chaleureux, attachant, à mille lieux des clichés sur les chirurgiens maladroits. Qui plus est, c'est l'un des meilleurs spécialistes français des greffes de foie. Et en particulier, des greffes à partir d'un donneur vivant. Il en a effectué près de 150. Là, il ne sait quoi dire. Le 15 mars, un



Living donor risk: USA*

	Total cases	Deaths	Transplants	Total risk
Pediatric	1337	1 (.07%)	0	1 (.07%)
Adults	2915	4 (.13%)	4 (.13%)	8 (.26%)

•Deaths and transplants immediately related to surgery



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Kidney donor mortality is 0.03%

Perioperative Mortality and Long-term Survival Following Live Kidney Donation

Dorry L. Segev, MD, PhD

Abimereki D. Muzaale, MD, MPH

Brian S. Caffo, PhD

Shruti H. Mehta, PhD

Andrew L. Singer, MD, PhD

Sarah E. Taranto

Maureen A. McBride, PhD

Robert A. Montgomery, MD, DPhil

WITH A SIGNIFICANT organ shortage in the United States and with minimal expansions of the deceased donor pool in recent decades, many patients with end-stage re-

Context More than 6000 healthy US individuals every year undergo nephrectomy for the purposes of live donation; however, safety remains in question because longitudinal outcome studies have occurred at single centers with limited generalizability.

Objectives To study national trends in live kidney donor selection and outcome, to estimate short-term operative risk in various strata of live donors, and to compare long-term death rates with a matched cohort of nondonors who are as similar to the donor cohort as possible and as free as possible from contraindications to live donation.

Design, Setting, and Participants Live donors were drawn from a mandated national registry of 80 347 live kidney donors in the United States between April 1, 1994, and March 31, 2009. Median (interquartile range) follow-up was 6.3 (3.2-9.8) years. A matched cohort was drawn from 9364 participants of the third National Health and Nutrition Examination Survey (NHANES III) after excluding those with contraindications to kidney donation.

Main Outcome Measures Surgical mortality and long-term survival.

Results There were 25 deaths within 90 days of live kidney donation during the study period. Surgical mortality from live kidney donation was 3.1 per 10 000 donors (95% confidence interval [CI], 2.0-4.6) and did not change during the last 15 years



LDLT in Asia

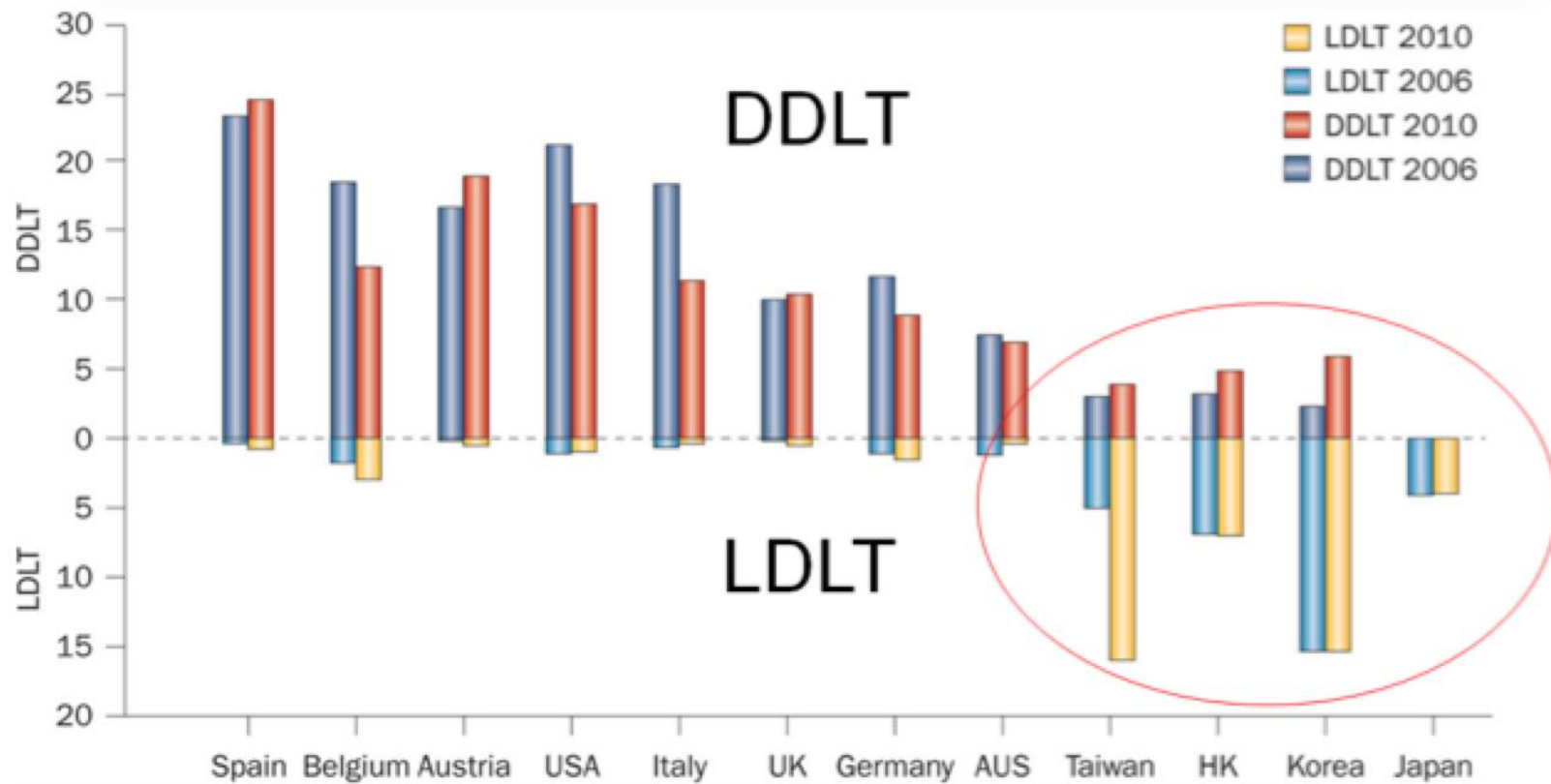
- High burden of liver disease
- Superior tradition of advanced liver surgery
- Advanced technology
- Religious and cultural obstacles to DDLT



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Worldwide Liver Transplant Activity



Liver transplant activity per million of the population												
LDLT 2010	0.70	3.00	0.50	0.95	0.40	0.50	1.50	0.40	16.00	7.00	17.00	4.00
LDLT 2006	0.40	1.80	0.20	1.00	0.60	0.20	1.00	1.10	5.00	6.90	12.90	4.10
DDLT 2010	24.50	12.50	19.00	17.00	11.50	10.50	9.00	7.00	4.00	5.00	6.00	0.05
DDLT 2006	23.50	18.60	16.80	21.30	18.50	10.10	11.80	7.50	3.10	3.30	2.40	0.05



Chen CL et al. (2013) Why does living donor liver transplantation flourish in Asia? Nat Rev Gastroenterol Hepatol 10:746-751

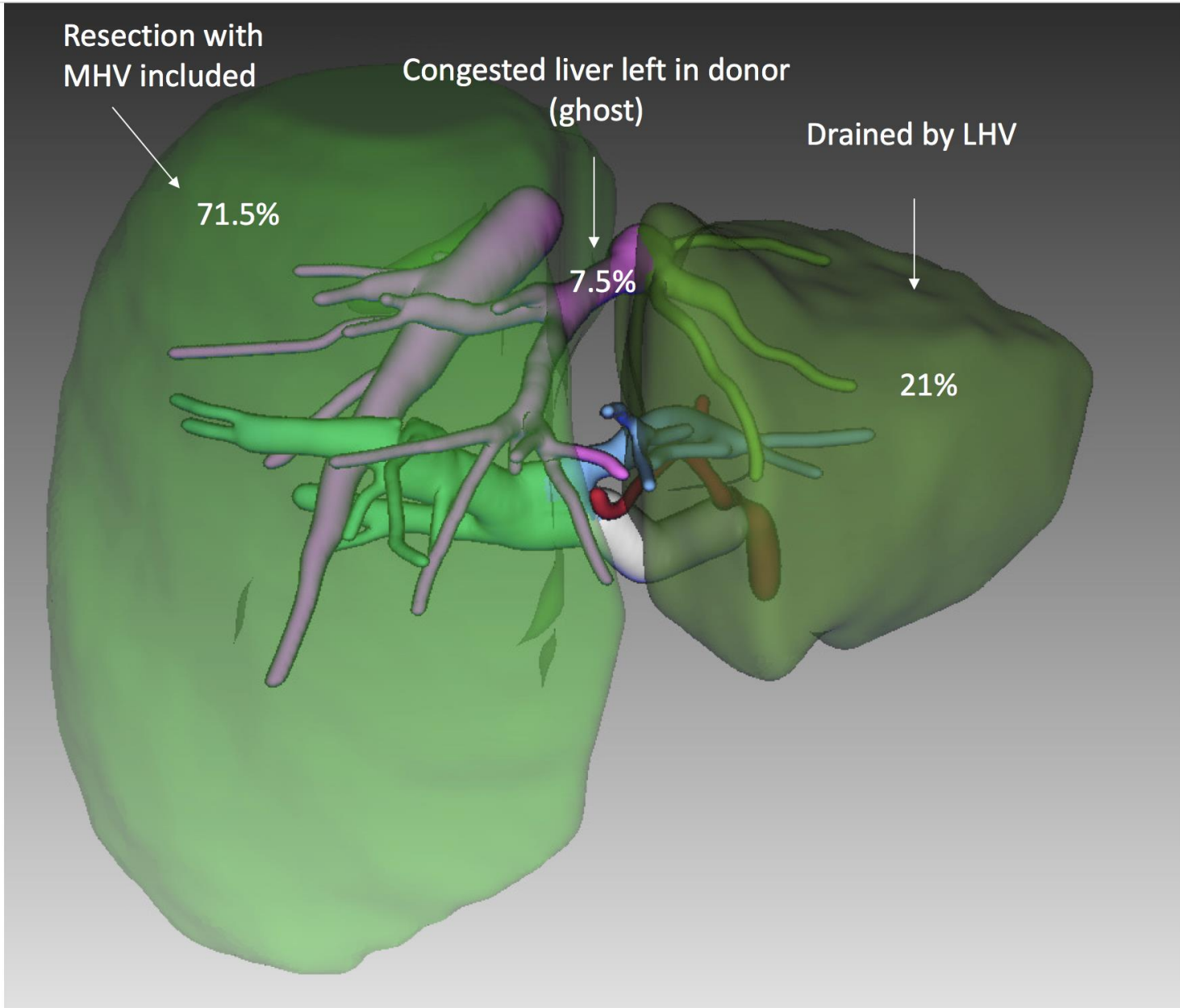
LD utilization and access type (5-year experience at Columbia)

	Transplants	Adults	Children
Total	539	414	125
Living donor	107	64	43
%Living donor	19.85%	15.46%	34.40%
Laparoscopy	65	22	43
%laparoscopy	60.75%	34.38%	100.00%



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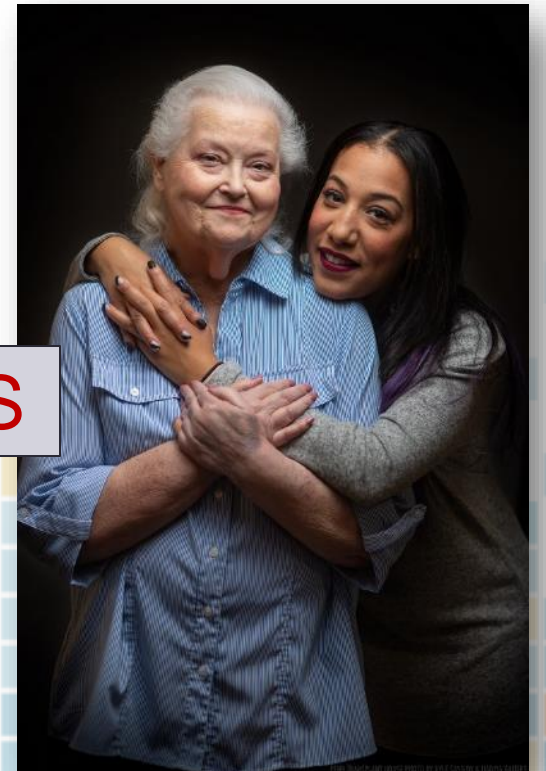
This is a study of if we took MHV. We will not do this.



The LDLT Advantage...

LDLT should **offer an overall advantage to the recipient when compared to waiting** for an acceptable DD organ to become available for transplantation.

The decision to proceed with a LDLT should be made after a **careful analysis of the recipient risk to benefit ratio.**



NOT LIMITED BY ALLOCATION RULES

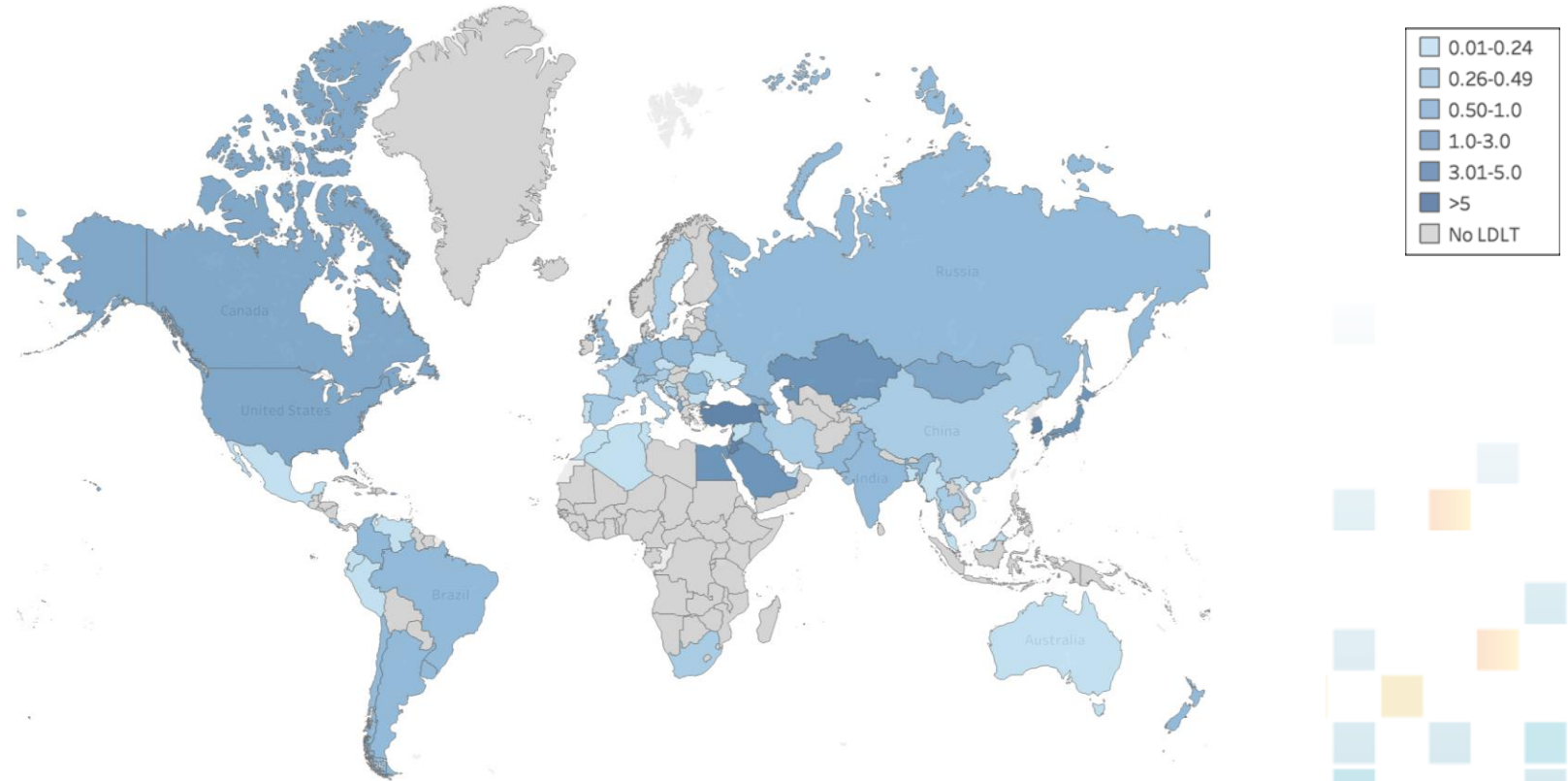


ation Conference
for Donation and Transplantation

LDLT Per Million Population

US #18

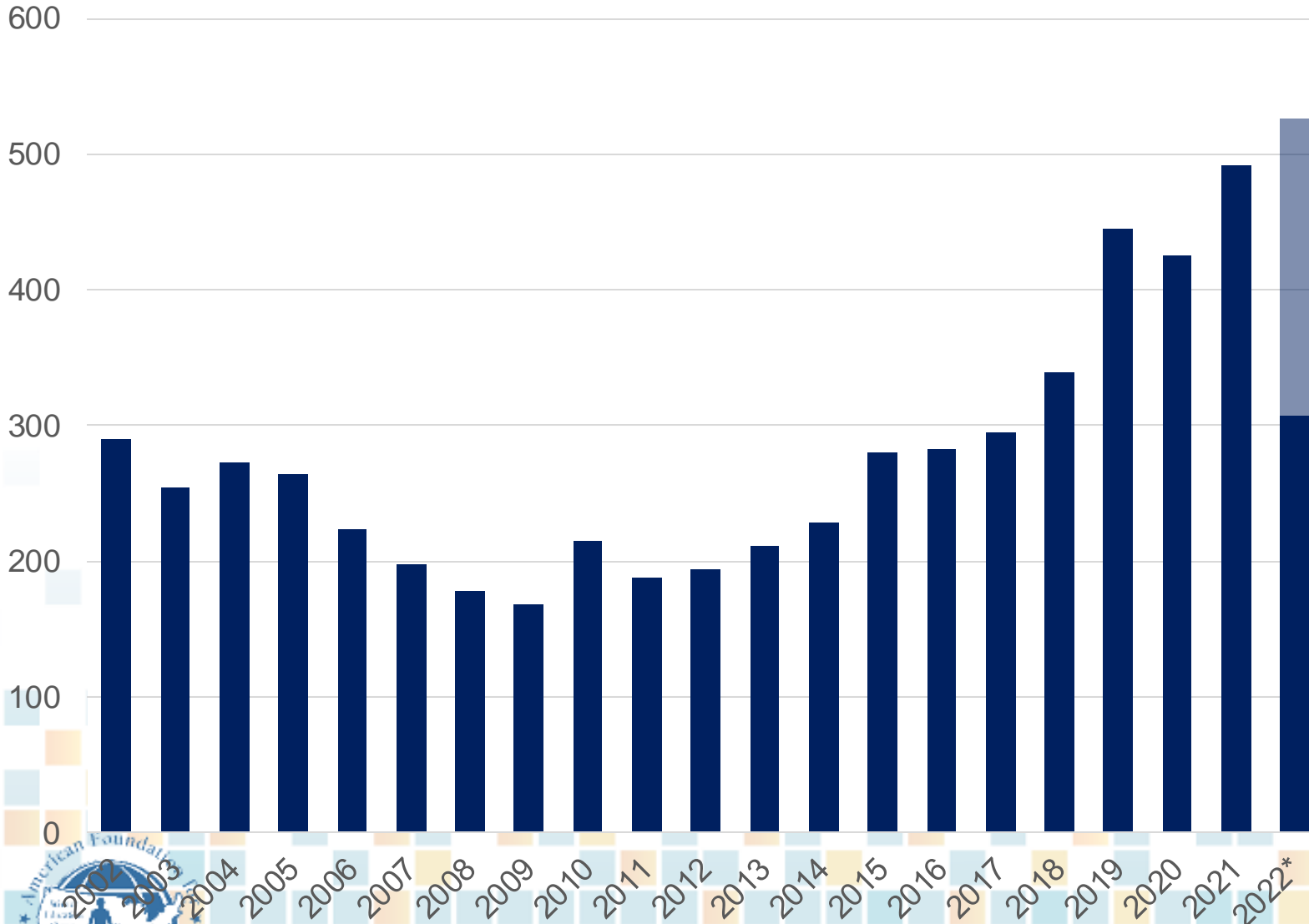
**68 countries
with reported
LDLT cases**



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US Adult LDLT Procedure Volume Over Time



USA

- Based on OPTN data as of 7/31/2022
- **Adult** - age 18+ at the time of listing

Percentage of Adult LT

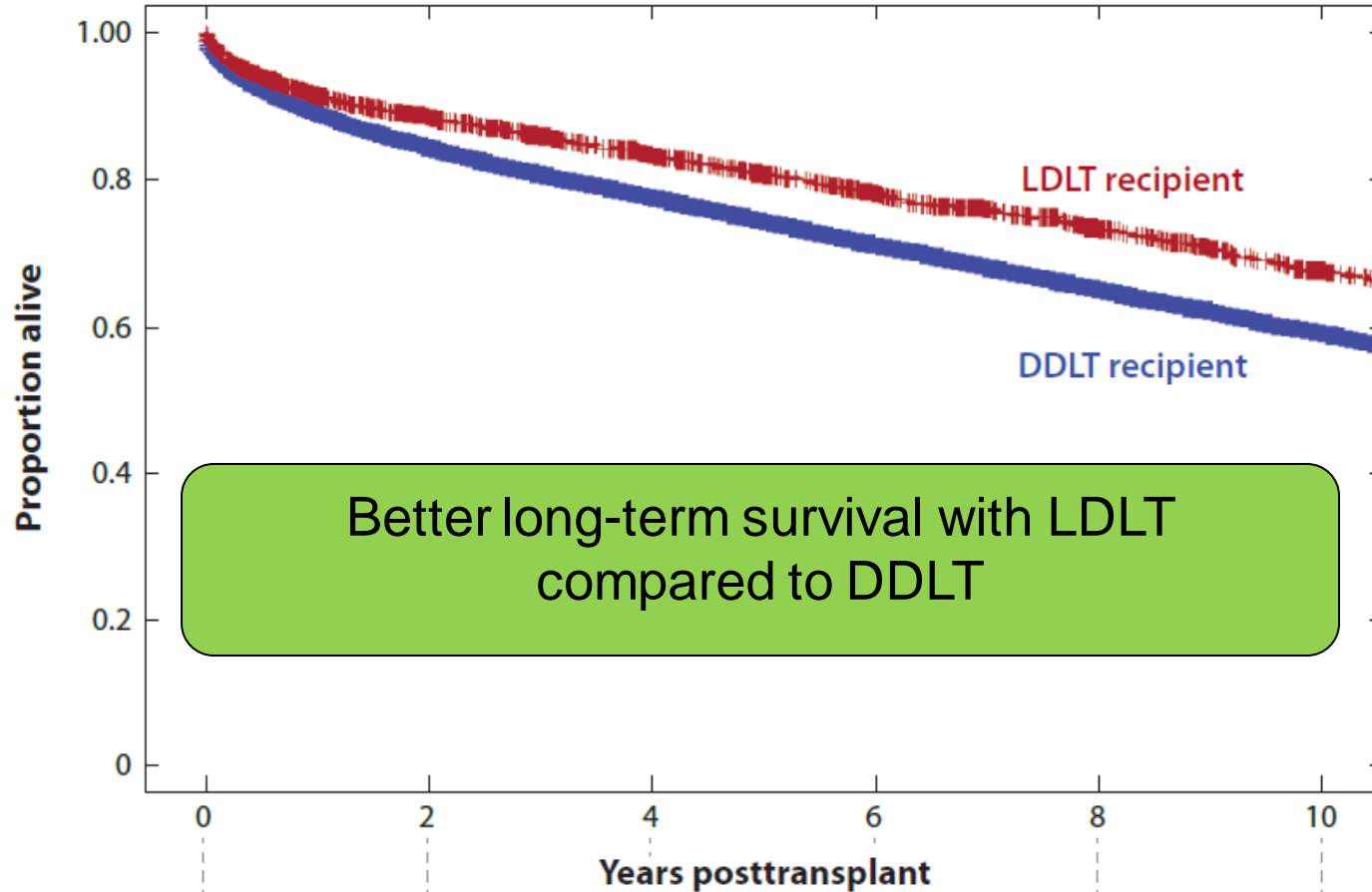
- 2008-2013: 3.3%
- 2014-2019: 4.3% (pre-pandemic)
- 2020: 5.5%
- **2021: 6.1% (567 total)**



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Long-term Survival LDLT vs DDLT



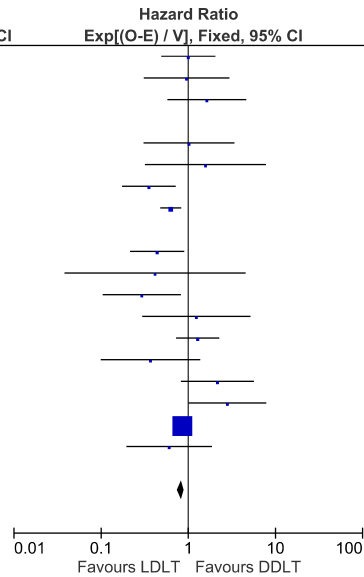
DDLT	80,315	51,599	37,916	27,184	18,342	11,504
LDLT	3,781	2,493	1,879	1,433	1,045	728



Excellent outcomes observed in Adult LDLT, regardless of geography

A. 1 Year Patient Survival

Study or Subgroup	LDLT		DDLT		O-E	Variance	Weight	Hazard Ratio	
	Events	Total	Events	Total				Exp[(O-E) / V], Fixed, 95% CI	Exp[(O-E) / V], Fixed, 95% CI
Al Sebayel, 2015	14	222	16	269	0	7.46	1.4%	1.00 [0.49, 2.05]	
Barbas, 2017	4	48	12	128	-0.139	3	0.6%	0.95 [0.31, 2.96]	
Bhangui, 2011	5	36	12	120	1.73	3.53	0.7%	1.63 [0.58, 4.63]	
Chen, 2014	0	0	0	0	0	0		Not estimable	
Chen, 2015	4	34	8	72	0.049	2.67	0.5%	1.02 [0.31, 3.38]	
Chok, 2017	6	54	2	40	0.68	1.5	0.3%	1.57 [0.32, 7.80]	
E. Kim, 2017	12	109	21	76	-7.96	7.64	1.4%	0.35 [0.17, 0.72]	
Hu, 2016	51	389	1670	6470	-23	49.49	9.2%	0.63 [0.48, 0.83]	
Jiang, 2013	0	0	0	0	0	0		Not estimable	
Kim JM, 2017	20	146	12	35	-6.18	7.5	1.4%	0.44 [0.21, 0.90]	
Kim, 2014	1	21	2	29	-0.589	0.67	0.1%	0.42 [0.04, 4.55]	
Lee, 2012	6	48	9	23	-4.42	3.6	0.7%	0.29 [0.10, 0.82]	
Lei, 2013	3	31	5	52	0.397	1.875	0.3%	1.24 [0.30, 5.17]	
Li, 2011	20	128	29	221	2.92	11.84	2.2%	1.28 [0.72, 2.26]	
Liu, 2006	4	124	5	56	-2.22	2.22	0.4%	0.37 [0.10, 1.37]	
Reichman, 2013	10	145	7	145	3.17	4.12	0.8%	2.16 [0.82, 5.67]	
Schmeding, 2007	4	17	38	269	3.73	3.62	0.7%	2.80 [1.00, 7.85]	
SRTR 2005-2017	440	2750	13368	58120	-67.49	426	78.9%	0.85 [0.78, 0.94]	
Wan, 2014	4	40	12	80	-1.52	3	0.6%	0.60 [0.19, 1.87]	
Total (95% CI)		4342		66205			100.0%	0.83 [0.76, 0.90]	
Total events	608		15228						
Heterogeneity: Chi ² = 33.11, df = 16 (P = 0.007); I ² = 52%									
Test for overall effect: Z = 4.34 (P < 0.0001)									



ORIGINAL ARTICLE

AJT

Meta-analysis and meta-regression of outcomes for adult living donor liver transplantation versus deceased donor liver transplantation

Arianna Barbetta^{1,2} | Mayada Aljehani³ | Michelle Kim^{1,2} | Christine Tien² | Aaron Ahearn^{1,2} | Hannah Schilperoort⁴ | Linda Sher^{1,2} | Juliet Emamaullee^{1,2}



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Current State in the US: Overall benefit of LDLT

- SRTR database 2012-2021
- 119,275 candidates and recipients – 2820 received LDLT

Significant survival benefit gained by living donor transplantation even at very low MELD scores

JAMA Surgery | Original Investigation

Survival Benefit of Living-Donor Liver Transplant

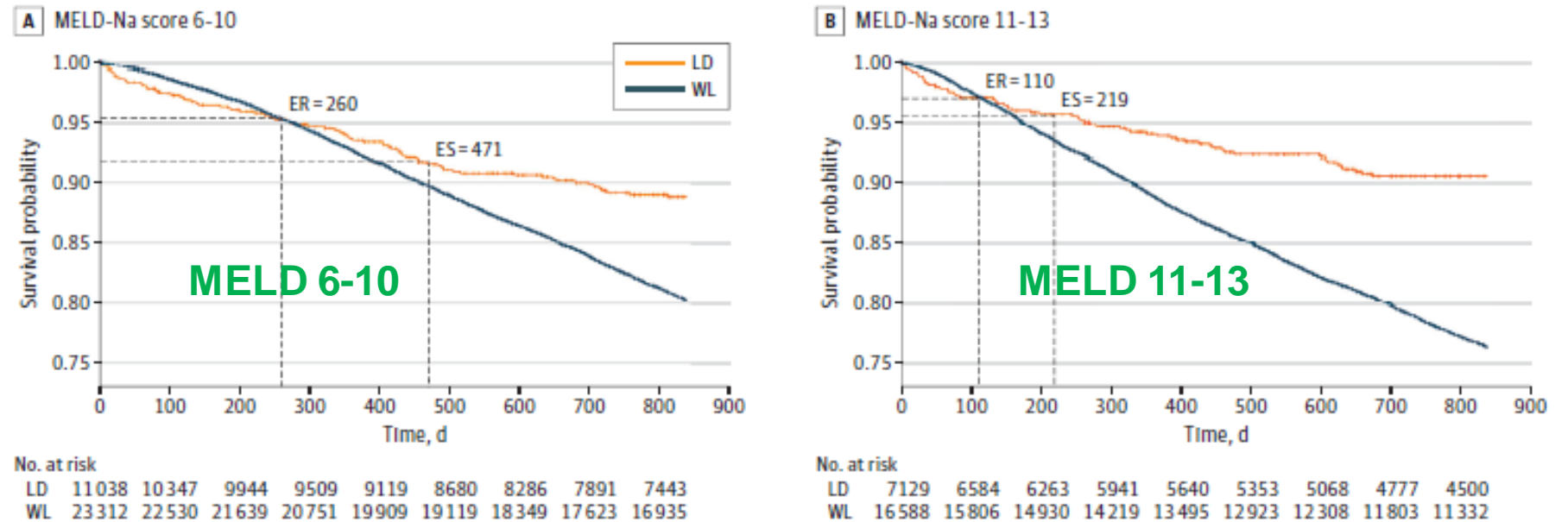
Whitney E. Jackson, MD; John S. Malamon, PhD; Bruce Kaplan, MD; Jessica L. Saben, PhD; Jesse D. Schold, PhD; James J. Pomposelli, MD, PhD; Elizabeth A. Pomfret, MD, PhD

IMPORTANCE Despite the acceptance of living-donor procedure for end-stage liver disease, it remains underutilized. Quantification of lifetime survival benefit and the magnitude of the incorporating sodium levels (MELD-Na) score range are necessary to demonstrate its safety and effectiveness.

OBJECTIVE To assess the survival benefit, life-years saved, and quality-adjusted life-years that survival benefit was obtained for individuals who received LDLT compared with those who remained on the wait list.

DESIGN, SETTING, AND PARTICIPANTS This case-control analysis of the Scientific Registry of Transplant Recipients included 119,275 transplant candidates aged 18 years or older who were on the wait list or received LDLT (N = 2820) were included. Patients who received transplant and those with prior kidney or liver transplant were excluded.

Figure 2. Survival Advantage of Living-Donor Liver Transplant (LDLT) vs Remaining on the Wait List Across 5 Model for End-stage Liver Disease Incorporating Sodium Levels (MELD-Na) Score Categories



Learning Objectives

1. To learn the history of solid organ transplantation and living donation
2. To learn the history of living donor liver transplantation
3. To understand current approaches to expand living donor liver transplantation responsibly
 1. Nondirected donors
 2. Paired exchange



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In a GMA3 Interview, a Mom Meets the Altruistic Liver Donor Who Saved Her Son's Life

What inspired a young paramedic from Massachusetts to become a living organ donor and save the life of a 2-year-old boy from North Carolina.



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OPINION AND HYPOTHESIS SECTION

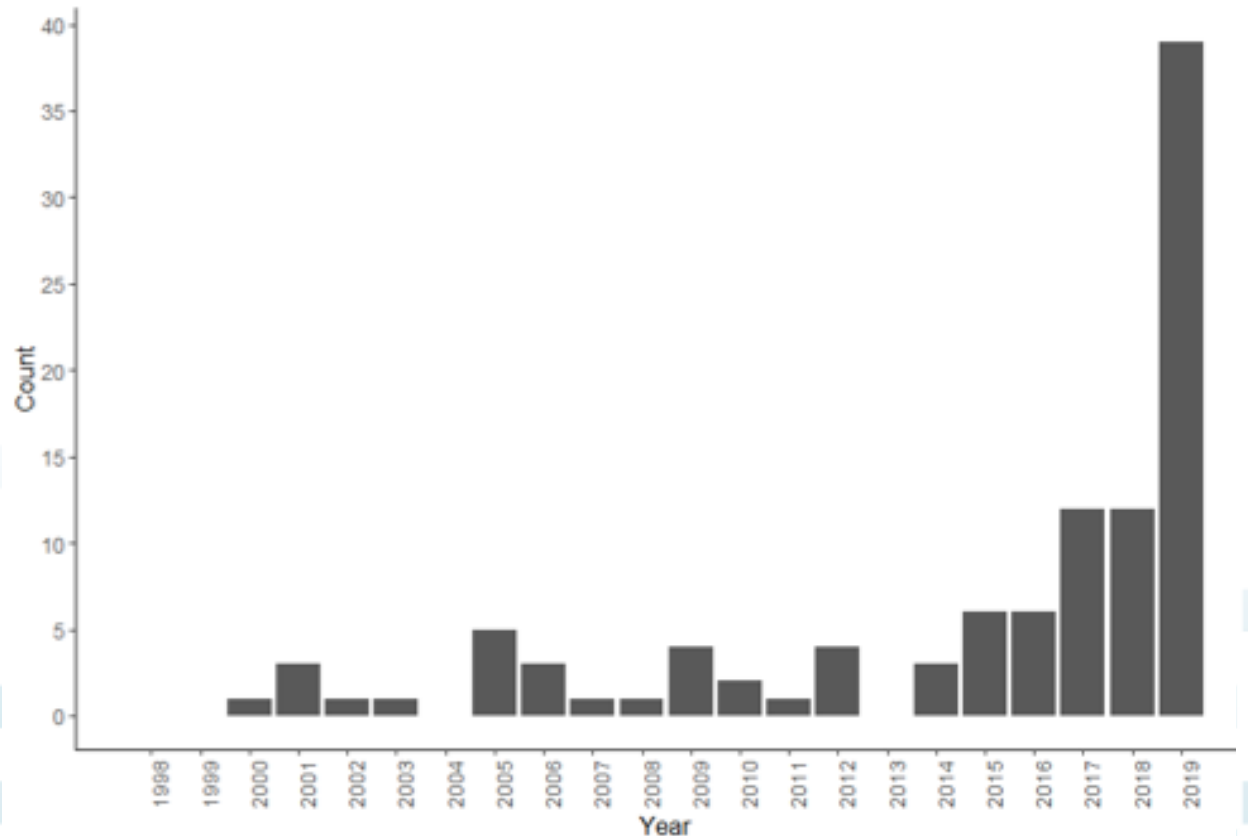
Clinical TRANSPLANTATION WILEY
The Journal of Clinical and Translational Research

Global experience and perspective on anonymous nondirected live donation in living donor liver transplantation

Muhammad H. Raza¹ | Hassan Aziz² | Navpreet Kaur^{1,2} | Mary Lo³ | Linda Sher^{1,2} |
Yuri Genyk^{1,2} | Juliet Emamaullee^{1,2} 

Nondirected living liver donor activity in the U.S.

- 105 cases from 2000-2019
- First case was right lobe to adult recipient, USC, 5/2000
- 40 cases in 2019



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Nondirected living liver donors: Demographics

- 44% allocated to pediatric recipients
- 29 patients previously living kidney donors
 - 83% at different center
 - All but one patient >1 year post-kidney donation
- One patient donated a kidney 9 months after LLS

Variable	N=105 total patients, N(%)
Age (mean ± SD), years	39.2 ± 10.3
Gender, male	51 (49)
Ethnicity	
Caucasian	98 (93)
Black	1 (1)
Asian	4 (4)
Multiracial	2 (2)
BMI (mean ± SD), kg/m²	25.2 ± 3.5
Type of donation	
Left lateral segment	33 (31)
Left lobe	19 (18)
Right lobe	46 (44)
Not reported	7 (7)
Transfusion	1 (1)
Education	
High school	13 (12)
Attended college/technical school	20 (19)
Associate/bachelor's degree	43 (41)
Graduate degree	20 (19)
Not reported	9 (9)
Employment status	
Full time	79 (89)
Part time	7 (8)
Not reported	3 (3)
Insurance status	
Medicaid	1 (1)
Medicare	2 (2)
Public – CHIP	3 (3)
Unknown	99 (94)
Current Donor Status	
Alive	89 (85)
Deceased	0
Unknown	16 (15)
Marital status	
Married	54 (55)
Single	34 (34)
Divorced/Separated/Widowed	10 (10)
Not reported	1 (1)
Donor-experienced complications	
Biliary	3 (3)
Other complications	10 (10)
Readmission	6 (6)
Not reported	7 (7)



Nondirected living liver donor: Publications

First author and year of publication	Country	Center	Year	N	Age Range	Surgery (N)
M. Jendrisak, 2006 (22)	U.S.	Washington University, Washington University Medical Center	*	1	35	LLS
L. Wright, 2007 (13)	Canada	University of Toronto, Toronto General Hospital	*	1	46	LLS
J-B. Otte, 2009 (14)	Belgium	Université Catholique de Louvain, Cliniques Saint-Luc	2004	1	50	LLS
T.W. Reichman, 2010 (15)	Canada	University of Toronto, Toronto General Hospital	2005-2009	12	20-54	RTH (7), LLS (5)
N. Goldaracena, 2019 (16)	Canada	University of Toronto, Toronto General Hospital	2005-2017	50	20-59	RTH (21), LLS (24), LL (5)



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LDLT Paired Exchange?

- ABO incompatible
- Age incompatible (donor much older than recipient)
- Size incompatible
- Immunologic concerns

Saving lives together

UNOS™

Organ donors Patients

Home » Transplant » Liver paired donation

Liver paired donation — LPD

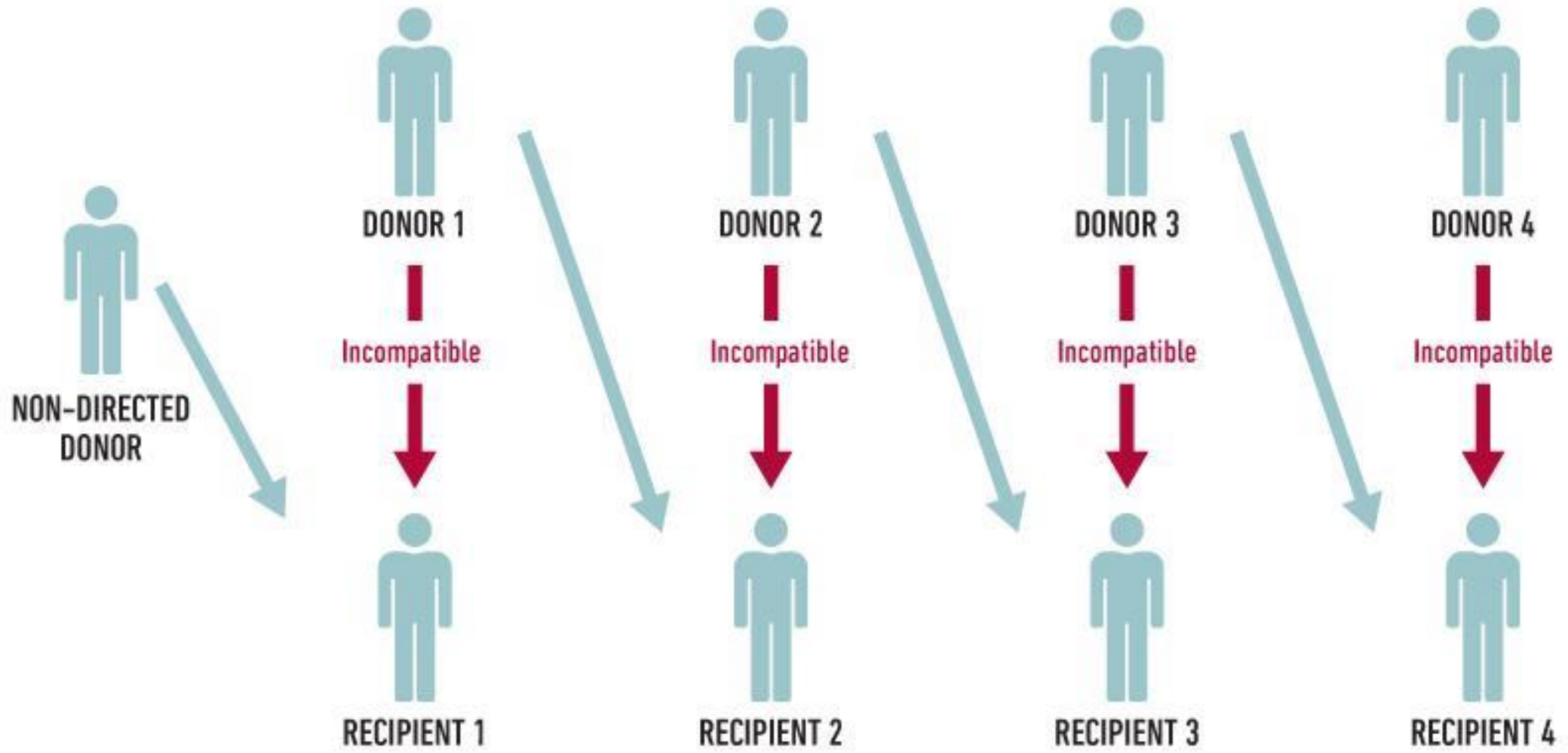
Liver paired donation

Two or more living donor/candidate pairs swapping liver segments to make a compatible match



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NALLDIG

— NORTH AMERICAN —
LIVING LIVER DONOR
INNOVATION GROUP

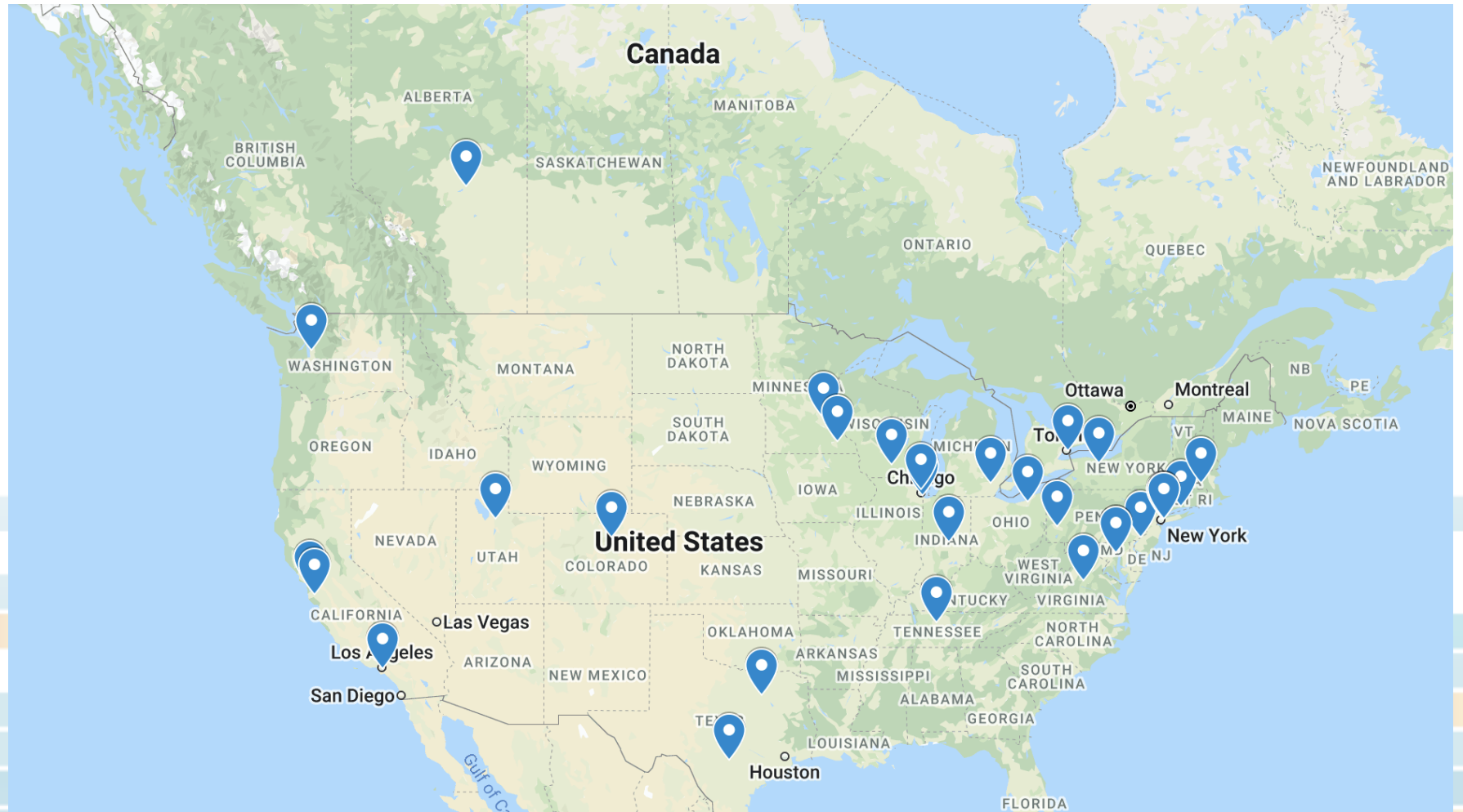
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Current NALLDIG membership

- 30 Programs
- >95% of LDLT activity in North America



Conclusions

- **Solid organ transplantation has existed for nearly 70 years and began with living donation**
- **LDLT can mitigate waitlist mortality and allow patients to get transplanted when they are less sick**
- **LDLT offers excellent overall patient, rejection-free, and graft survival for transplant recipients**
- **Living liver donation is safe in carefully selected patients**
- **LDLT is expanding in the US**
 - **Nondirected anonymous donation**
 - **Initiation of paired exchange pilot program**



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- **Dr. Kim Olthoff (UPenn)**

- **Referrals for USC LDLT Program: 323-442-5908**



Session Survey

Juliet Emamaullee, MD, PhD FRCSC FACS | April 18th 9:15 AM-10:15 AM



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