Joint Congress of The 6th Biennial Congress of the Asian-Pacific Hepato-Pancreato-Biliary Association
The 29th Meeting of Japanese Society of Hepato-Biliary-Pancreatic Surgery

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Special Program: East Meets West
Historical Perspective 2017 in HPB Surgery and Interventional Approach

Evolution of living donor liver transplantation: A global perspective

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Topics

- From deceased donor to living donor liver transplantation (LDLT): How did it take place?
- Surgical innovations and controversies in LDLT
  - ✓ Various types of grafts
  - ✓ Vascular/bile duct reconstruction
  - ✓ Small-for-size syndrome
  - ✓ ABO incompatible
- Current status of LDLT worldwide

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- Current status of LDLT worldwide

World's first LT in U.S.

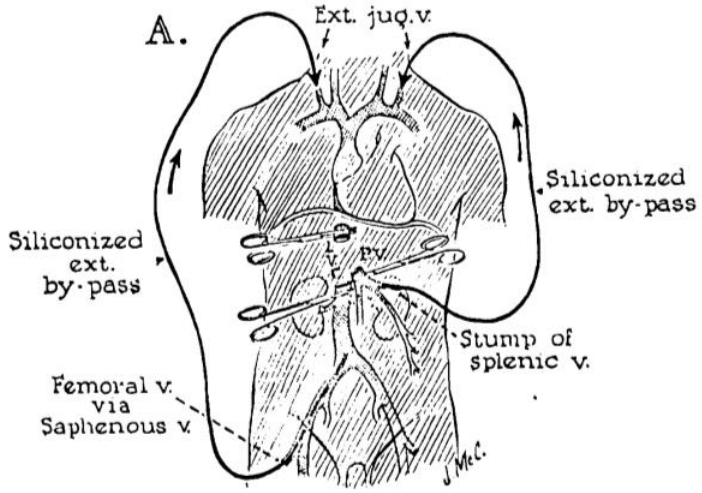
HOMOTRANSPLANTATION OF THE LIVER IN HUMANS

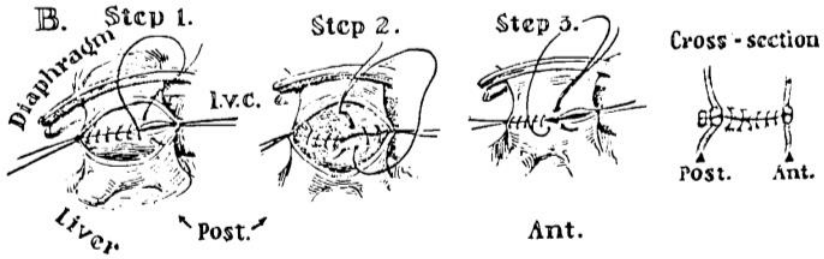
T. E. STARZL, M.D., F.A.C.S., T. L. MARCHIORO, M.D., K. N. VON KAULLA, M.D., G. HERMANN, M.D., R. S. BRITTAIN, M.D., and W. R. WADDELL, M.D., F.A.C.S., Denver, Colorado

AN IDEAL TREATMENT for several kinds of liver disease would be removal of the diseased organ and orthotopic replacement with a hepatic homograft. Patients with primary carcinoma of the liver, congenital atresia of the bile ducts, and terminal cirrhosis would all be candidates. The application of such therapy depends, first, upon the employment of a satisfactory operative procedure and, second, upon the use of suitable measures to prevent the immunologic rejection of the will be described. The first attempt resulted in failure at the operating table. The course of the second 2 patients establishes the feasibility of such an operation in humans, despite the fact that death occurred 22 and 7½ days after transplantation from pulmonary emboli.

METHODS

Recipient patients. Patient 1 was a 3 year old white male with congenital biliary atresia





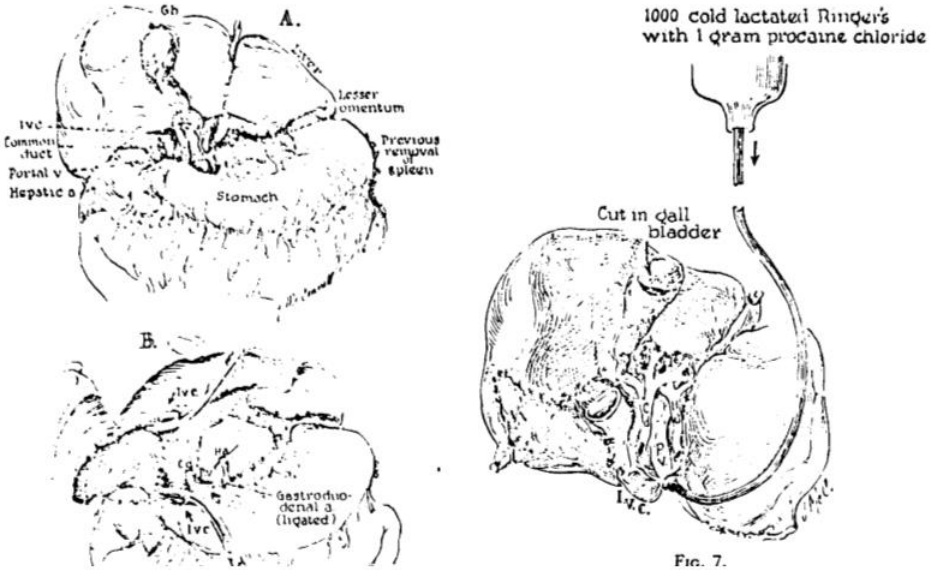


FIG. 7.

Failed Attempts at Liver Replacement

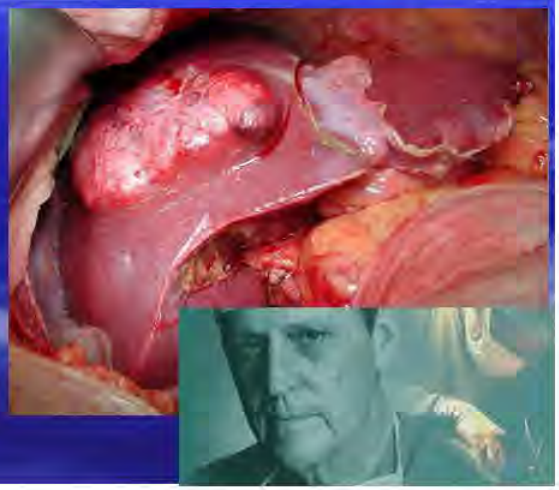
First trials of orthotopic liver transplantation					
No.	City	Age (yrs)	Disease	Survival (days)	Cause of Death
1	Denver	3	Extrahepatic BA	0	Hemorrhage
2	Denver	48	HCC	22	PE
3	Denver	68	Duct cell CA	7.5	Sepsis
4	Denver	52	HCC	6.5	PE
5	Boston	58	Metastatic Colon CA	11	Hepatic failure
6	Denver	29	HCC	23	Sepsis
7	Paris	4	Metastatic Colon CA	0	Hemorrhage

Starzl, *Hepatology*, 1982

1967: First successful LT in U.S.

July 23, 1967:

- First extended survival of a human recipient
- OLT for HCC
- Survival: 13 months



anastomosis, is not in danger of injury. Egress of the perfusion fluid is provided by the venotomy in the suprahepatic inferior vena cava. Bile is washed from the gallbladder through the cholecystotomy. For the adult donor (Case 7), the liver was cooled by total body extracorporeal perfusion, and the flushing carried out after completion of the hepatectomy.

lecular weight dextran, through a cannula inserted into the superior mesenteric vein (Fig. 2). With the latter method, egress for the fluid was provided by incising the inferior vena cava. In order to prevent autolysis the gallbladder was opened at its dome and irrigated with saline to remove all bile.

The aorta was removed in continuity

hepatic arterial branch.

The transplantations were performed with the previously described technic,[22] with the exception of some important details. Biliary drainage was provided by cholecystoduodenostomy (Fig. 4) instead of choledochocholedochostomy. Another extremely significant change, as recently reported,[20] was the omission of bypasses to decompress the splanchnic and systemic venous systems during the anhepatic phase. In the seven patients, the portal vein and inferior vena cava were simultaneously occluded for 50 to 90 minutes. The maximum resulting fall in arterial blood pressure was 20 mm. Hg. The intestines became slightly dusky in

in two cases, all four vessels had been reconstructed.

In five patients, the homograft hepatic artery or celiac axis was anastomosed to the recipient proper or common hepatic artery (Fig. 4A). In the other two, a separate branch to the right lobe rose from the superior mesenteric artery. The first time the anomaly was encountered (Case 2), the two vessels were individually connected to the right and left branches of the recipient proper hepatic artery (Fig. 4B). The next time (Case 5), the distal donor aorta was anastomosed end-to-side to the upper abdominal aorta of the recipi-

the last 9 months, inasmuch as seven consecutive patients treated with orthotopic liver transplantation from July 23, 1967 to March 17, 1968 all passed through this previously lethal operative and postoperative period. Three of the recipients are still alive after 9, 2⅓, and 1 months; the others died after 2, 3½, 4⅓, and 6 months.

Methods

The Recipients. Summary information for the seven patients is given in Table 1. Their ages were 13 months to 16 years. Six were females. The indications for transplantation, which had been established by earlier explorations at other hospitals, were in Denver, examination revealed renal failure with oliguria, proteinuria, and a blood urea nitrogen (BUN) of 70 mg./100 ml. A few hours before operation massive gastrointestinal hemorrhage developed, probably from esophageal varices. The bleeding continued until after the transplantation had been completed.

This child and the other four with extrahepatic biliary atresia had preoperative serum bilirubin concentration of 16.1 to 30.9 mg./100 ml. and alkaline phosphatase levels of 88 to 632 international units (normal 50 to 150). Other biochemical measures of hepatic metabolism were typical of this disease[14, 18] with retention of mod-

1968: First LT in Europe

Introduction

iver can be transplanted to the normal anatomical position
otopic) or to an abnormal situation (heterotopic). A variety
terotopic techniques have been described (Starzl *et al.*,
, but none is ideal. It is difficult to accommodate an
liver in the abdomen in such a way that it receives arterial

the preservation apparatus is being prepared, it may be he
to cool the cadaver by means of a heart–lung machine w
refrigeration unit (Marchioro *et al.*, 1963).

Organization

It follows from the above remarks that the requirement

Br J Med 1968

agents. He is now well, having returned to work six weeks after the operation.

Though the first patient showed no evidence of rejection, it is concluded that patients receiving liver allografts should receive immunosuppressive therapy.

Introduction

Our experience of the technical and organizational aspects of liver transplantation in five clinical cases is discussed in the previous article (Calne and Williams, 1968). We report here details of two adult patients suffering from primary malignancy of the liver who received orthotopic liver allografts. In each

brush in the later films.

When readmitted to hospital in April 1968 she was deeply jaundiced, with a large hard hepatic mass extending four finger-breadths below the costal margin. The white cell count by this time had fallen to 2,300/cu. mm, and over a further few days dropped to 600/cu. mm. Her haemoglobin was 7 g./100 ml. and platelet count 72,000/cu. mm. She had florid thrush in her mouth and fauces, and her sputum also contained *Candida albicans*. Chlorambucil was stopped and ampicillin and amphotericin B were given. Her white cell count and general clinical condition improved but the liver function tests became increasingly abnormal; the serum bilirubin rose to a maximum of 42 mg./100 ml. and the serum alkaline phosphatase to 159 King–Armstrong units/100 ml.

On 2 May orthotopic liver transplantation was performed, the donor being a 5-year-old child who had died of mumps encephalitis. Details of the operation are given elsewhere (Calne and Williams,

Br J Med 1968

The Lancet · Saturd

Summary 34 patients treated with cyclosporin A received 36 cadaveric organ allografts (32 kidneys, 2 pancreases, and 2 livers). 26 kidneys are still supporting life, 3 after more than a year; the pancreases and livers are also functioning. 20 patients are not receiving steroids, and 15 of these have not had any additional immunosuppressive agents. In these patients infectious complications have not been severe, but a gastroduodenal lymphoma has developed in 1 patient. 6 patients were given 'Cytimun' (a cyclophosphamide derivative) and steroids in addition to cyclosporin A: 5 of these died of infections and 1 also had a lymphoma. 11 patients received additional steroids: 1 of these died from septicæmia and lymphoma. Nephrotoxicity can be avoided by perioperative hydration and forced diuresis. Cyclosporin A is effective on its own and is a very

CYCLOSPORIN A INITIALLY AS THE ONLY IMMUNOSUPPRESSANT IN 34 RECIPIENTS OF CADAVERIC ORGANS: 32 KIDNEYS, 2 PANCREASES, AND 2 LIVERS

R. Y. CALNE

K. ROLLES
S. THIRU
P. MCMASTER
G. N. CRADDOCK
S. AZIZ
D. J. G. WHITE
D. B. EVANS
D. C. DUNN
R. G. HENDERSON
P. LEWIS

Lancet 1979

1983: LT is no more a trial

selection of patients who may benefit from liver transplantation; the stage of their liver disease at which transplantation should be performed; survival and clinical condition of patients beyond the initial year after transplantation; and overall long-range benefits and risks of transplantation in the management of specific liver diseases.

In order to resolve some of these questions, the National Institutes of Health on June 20–23, 1983, convened a Consensus Development Conference on Liver Transplantation. After 2 days of expert presentation of the available data, a Consensus Panel consisting of hepatologists, surgeons, internists, pediatrician, immunologists, biostatisticans, ethicists, and public representatives considered the offered evidence to arrive at answers to the

following conditions:

- *Extrahepatic biliary atresia* is the most common cause of bile duct obstruction in the young infant. Patients who fail to respond to hepatoportoenterostomy (Kasai procedure) often benefit from liver transplantation. Recent data suggest that as many as two-thirds of these patients survive for 1 year or more after transplantation.
- *Chronic active hepatitis* is caused by viral infections or drug reactions, but many cases remain unexplained. Some patients with progressive liver failure are candidates for transplantation. Currently, exceptions seem to include drug-induced chronic active hepatitis, which usually responds to removal of the chemical agent, and hepatitis B-induced disease in

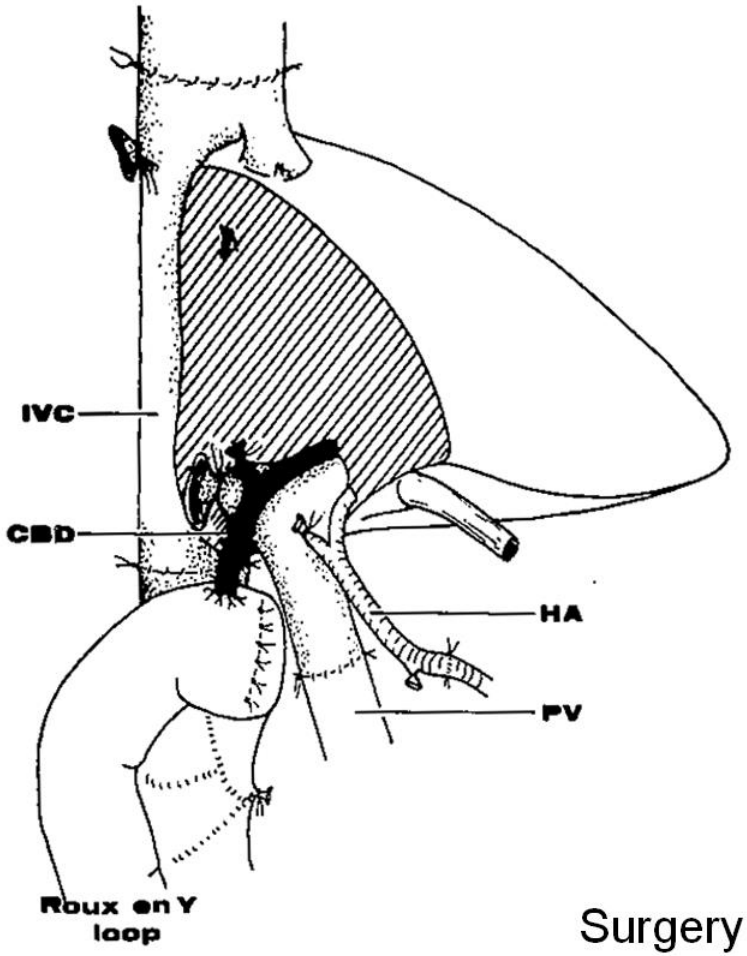
bility and desirability of randomized clinical trials of liver transplantation should be explored for suitable subgroups of patients with specific liver diseases.

High priority also should be given to research projects related to several aspects of the transplant procedure itself. Means should be developed to improve preservation of human liver *ex vivo* and criteria should be established to evaluate its viability. Improved control of organ rejection requires urgent attention; this includes thorough evaluation of the benefits and risks of cyclosporin as an immunosuppressive agent in liver transplantation. The design of the hemodynamic support system during transplantation needs evaluation and potential improve-

Because of the small number of pediatric donors, mortality rate of children on the waiting list reached 20%–50%: Reduced-size LT launched in Europe

Reduced-sized orthotopic liver graft in hepatic transplantation in children

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



Surgery 1984

23. Orthotope Transplantation von Lebersegmenten bei Kleinkindern mit Gallengangsatresien

Orthotopic Transplantation of Hepatic Segments in Infants with Biliary Atresia

Ch. E. Brölsch[1], P. Neuhaus[1], M. Burdelski[2], U. Bernsau[1] und R. Pichlmayr[1]

[1]Klinik für Abdominal- und Transplantationschirurgie der Medizinischen Hochschule Hannover
[2]Zentrum für Kinderheilkunde der Medizinischen Hochschule Hannover

Summary

Orthotopic transplantation of hepatic segments provides the possibility of permanent hepatic functional support. Pediatric recipients with biliary atresia can be treated with hepatic lobes, if urgent indication requires transplantation. Appropriate surgical technique of hepatic segments can avoid lethal complications. In the physiologic orthotopic position, a long-lasting functional support is provided and regeneration is completed within a few weeks.

Chirurgisches Forum 1984

Reduced-size LT paved the way to split LT

Langenbecks Arch Chir (1988) 373: 127–130

Langenbecks Archiv für Chirurgie

Transplantation einer Spenderleber auf zwei Empfänger (Splitting-Transplantation) – Eine neue Methode in der Weiterentwicklung der Lebersegmenttransplantation*

R. Pichlmayr, B.

Klinik für Abdomina
Konstanty-Gutschow

ıle Hannover,

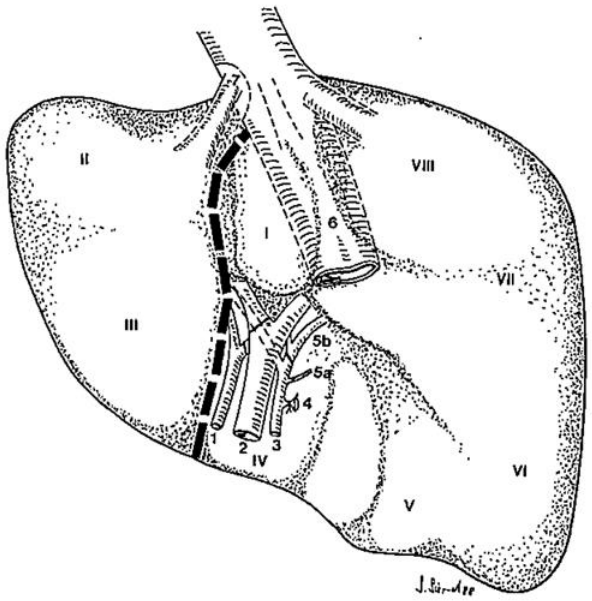


Abb. 1. Schematische Darstellung der Teilung der Leber *1*, A. hepatica propria; *2*, Vena portae; *3*, Choledochus; *4*, Ductus cysticus; *5a* und *5b*, rechte Hepaticusäste; *6*, intrahepat. Vena cava inferior; *7*, Cava-Patch mit einmündender linken Vena hepatica

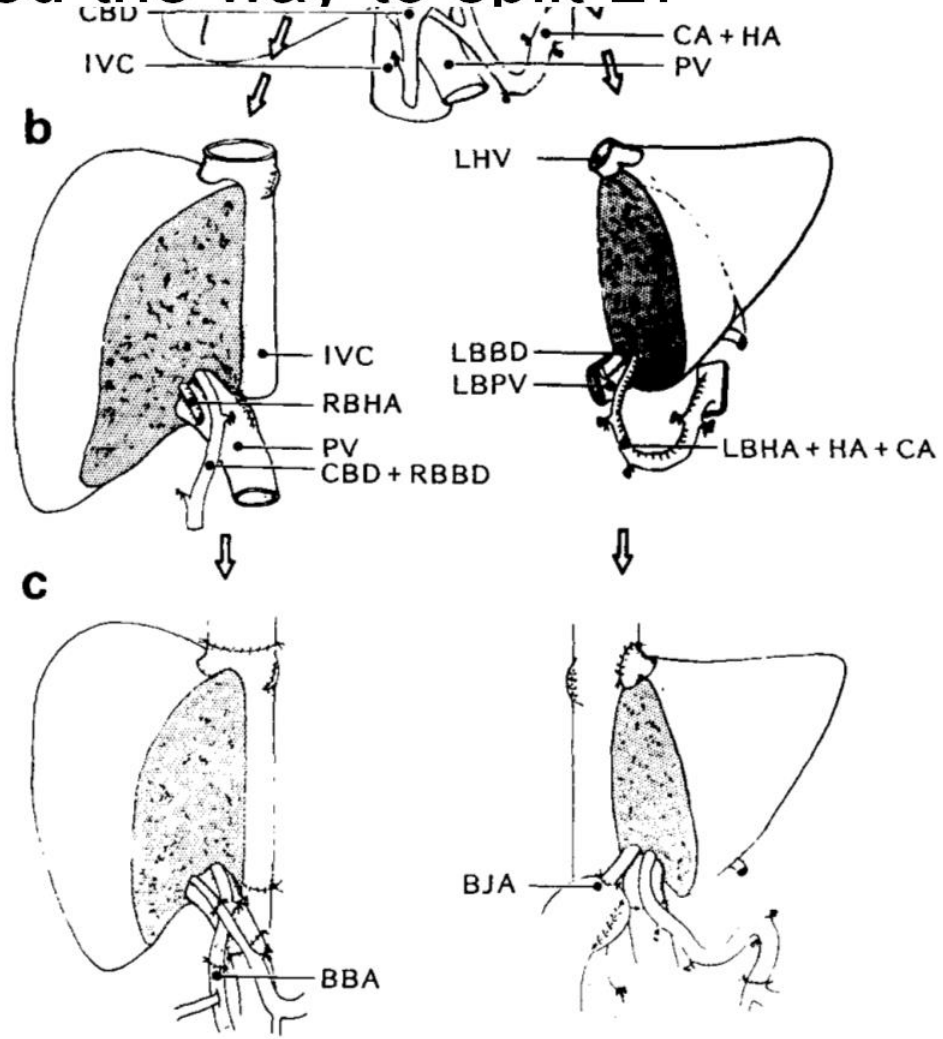


Figure 1 *Technique of division of the donor liver to obtain two functional hemigrafts.* **a** *The segments and major structures of the entire normal liver are labelled;* **b** *division of the liver into two hemigrafts: right hemigraft (segments 5–8) and left hemigraft (segments 2–4);* **c** *implantation of the hemigrafts. IVC, inferior vena cava; PV, portal vein; CBD, common bile duct; CA, coeliac axis; HA, hepatic artery; RBHA, right branch of hepatic artery; RBBD, right branch of bile duct; LBBD, left branch of bile duct; LBPV, left branch of portal vein; LBHA, left*

1989: First attempt of LDLT in Brazil

advanced liver failure due to biliary atresia. Her 25-year-old mother, a healthy ABO-identical woman, was the donor. The operation took 18 h. The donor did not need any blood or blood derivatives and was discharged on the 4th postoperative day. The child recovered well at first and the graft started to produce bile soon after the operation. Severe haemolysis resulted from haemolytic antibodies inadvertently transfused in two bags of plasma, with ensuing anuric renal failure. The child died 6 days after the operation during haemodialysis to control metabolic disturbances and fluid overload.

Patient 2

On July 21, 1989, we operated on a 19-month-old girl, blood type A, with hepatic fibrosis and Caroli's disease. No donor suitable on vascular criteria could be found among her relatives studied by angiography. A 40-year-old, blood type O healthy man volunteered for organ donation. The operation lasted 16 h. The donor was discharged on the 5th day, and again no blood or blood products were used. The recipient was alert soon after the operation, being extubated on the 1st day. The graft showed signs of preservation injury, manifest by delayed production of bile. Coagulation and biochemical indices of hepatic function improved until the 4th post-transplant day, when a severe episode of acute cellular rejection was noticed. This event was controlled by OKT-3 monoclonal antibody (Ortho, Raritan, New Jersey). By Aug. 16

Letters to the Editor

1989: First successful LDLT in Australia

cases, together with an extensive experience of liver resections for benign and malignant conditions, led to the development of the concept of an orthotopic reduced-size liver transplantation from a living related donor.

In July 1989, the transplantation of a liver graft from a living related donor was successfully performed; the donor was a 29-year-old woman and the recipient her 17-month-old son. This case illustrates

Table 1. Results of Liver-Function Tests in the Recipient and the Donor.*

INDEX	ON REFERRAL	BEFORE TRANSPLANTATION	AFTER TRANSPLANTATION			
			DAY 1	DAY 7	1 MONTH	5 MONTHS
Recipient						
Bilirubin (μmol/liter)	287	510	244	474	59	10
Albumin (g/liter)	31	26	41	32	39	39
AST (U/liter)	230	267	1040	82	41	75
Prothrombin time (sec)	21	25	21	18	17	16
Donor						
Bilirubin (μmol/liter)	—	5	24	9	—	5
Albumin (g/liter)	—	46	33	40	—	44
AST (U/liter)	—	23	84	64	—	34
Prothrombin time (sec)	—	13	17	14	—	13

*AST denotes aspartate aminotransferase. Normal values are as follows: bilirubin, 10 to 20 μmol per liter; albumin, 35 to 50 g per liter; AST, 0 to 40 U per liter; and prothrombin time, 13

The recipient's early postoperative course was uneventful. The liver graft functioned well, with good bile flow. Liver function was similar to that in recipients of reduced-size grafts from cadaver donors. Six days after transplantation, acute rejection, confirmed by liver biopsy, responded to pulsed steroid therapy.

Forty days after transplantation the child was discharged from the hospital, with nearly normal liver function. Five months later, the mother and child were at home in good health. The results of liver-function tests are presented in Table 1.

DISCUSSION

Anatomically, the liver consists of paired structures, joined together. Safely separating the liver into its right and left halves requires considerable experience. We have performed 200 liver resections, of which 45 were left hemihepatectomies. The mortality rate for elective resections in nonjaundiced patients

d PC perfusion catheter.

rate of children waiting for transplants has result-

1989: First LDLT in Japan–recipient died on POD 285

W５－８　　生体部分肝移植の経験

島根医科大学第２外科
永末直文、河野仁志、松尾　進、張　玉川、
谷浦博之、山野井　彰、内田正昭、木許健生、
竹本好成、中村輝久

平成元年11月13日に行われた父子間の生体部分肝移植の全経過を報告する。

患者：レシピエントは１才、男児である。39週で正常分娩で誕生するも、１ケ月検診で強い黄疸を指摘された。先天性胆道閉鎖症（ Ⅲ-C-V ）の診断で、生後49日、95日後に２度の肝門部十二指腸吻合を受ける。しかし、その後黄疸は増強し、脾腫、腹壁静脈怒張が出現した。入院時検査では、総ビリルビン28.8mg/dl 、アルブミン2.4g/dl、AST862、ALT330。

一方、ドナーは26才の父親で術前肝機能は正常であった。CT検査ではレシピエント肝は360cm³、ドナーの肝左外側区は365cm³であった。

ドナー手術：全麻下、両側季肋下切開にて開腹する。左三角靭帯、肝鎌状靭帯を切離後、肝門部処理に入る。左肝動脈、左門脈、左肝管を剥離、次いで左肝静脈の十分な剥離を行う。肝鎌状靭帯より約１cm右側に

147(347)

W５－８　　生体部分肝移植の経験

島根医科大学第２外科
永末直文、河野仁志、松尾　進、張　玉川、
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1994: World's first adult-to-adult LDLT (Shinshu Univ)

and 2·9 in the man compared with contralateral uninvolved skin.

In both patients, PUVA bath therapy was started with a 20 min bath in 150 L of an 8-MOP water solution (1·0 mg/L), immediately followed by UVA irradiation (0·2 J/cm^2). PUVA bath therapy was done once daily four times per week over five weeks (20 treatments), then two times per week for an additional five weeks resulting in a total of 30 treatments. UVA doses were gradually increased at every third therapy up to a maximum single dose of 20 J/cm^2. After 20 treatments, sclerotic lesions had softened greatly in both patients with a striking improvement of joint mobility in the man. After 30 treatments, skin lesions were almost completely cleared. Histopathological analysis of biopsy

consciousness 10 h after the operation. Volumetric analysis showed rapid enlargement of the graft to 1141 mL as early as 2 weeks after the operation. Both the patient and donor were discharged from the hospital and are now leading normal lives.

In Japan, because of the legal difficulties associated with

Topics

- From deceased donor to living donor liver transplantation (LDLT): How did it take place?
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  - ✓ Various types of grafts
  - ✓ Vascular/bile duct reconstruction
  - ✓ Small-for-size syndrome
  - ✓ ABO incompatible
- Current status of LDLT worldwide

1994: First description of right liver graft (switched from left to right intraoperatively due to extra-small left hepatic arteries: Kyoto Univ)

Vol. 57, 1127–1141, No. 7, April 1994
Printed in U.S.A.

Transplantation®

BRIEF COMMUNICATIONS

LIVER TRANSPLANTATION USING A RIGHT LOBE GRAFT FROM A LIVING RELATED DONOR[1]

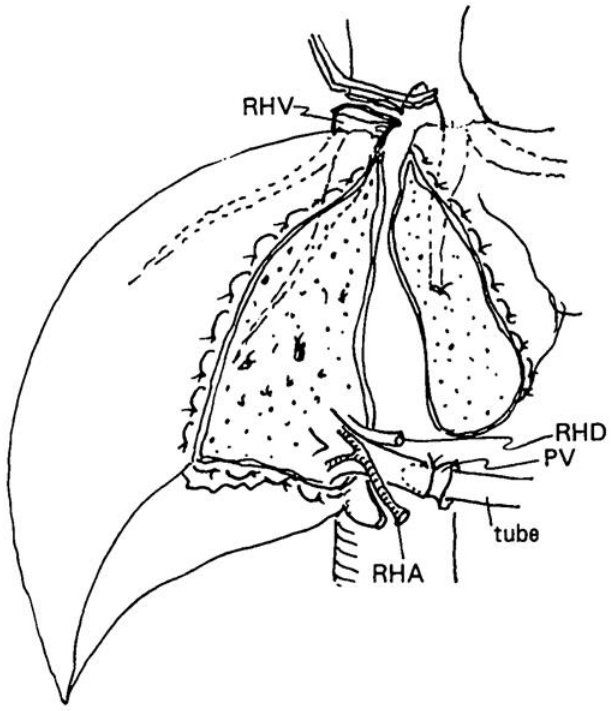

FIGURE 2. Harvesting the right lobe: A cannula was inserted into the right portal vein, through which the right lobe was perfused in situ with lactate Ringer's solution and UW solution. RHV, right hepatic vein; RHD, right hepatic duct; PV, right portal vein; RHA, right hepatic artery.

YOSHIO YAMAOKA[2]
MASANOBU WASHIDA
KAZUO HONDA
KOICHI TANAKA
KEIICHIRO MORI
YASUYUKI SHIMAHARA
SHINGO OKAMOTO
MIKIKO UEDA
MICHIHIRO HAYASHI
AKIRA TANAKA
TAISUKE MORIMOTO
KAZUE OZAWA
Second Department of Surgery
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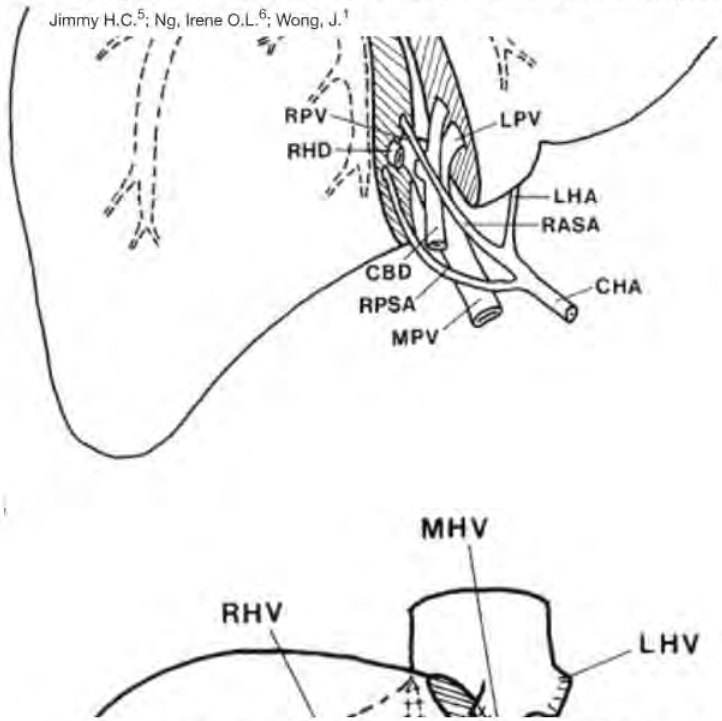
Kyoto University
Sakyo-ku, Kyoto 606, Japan

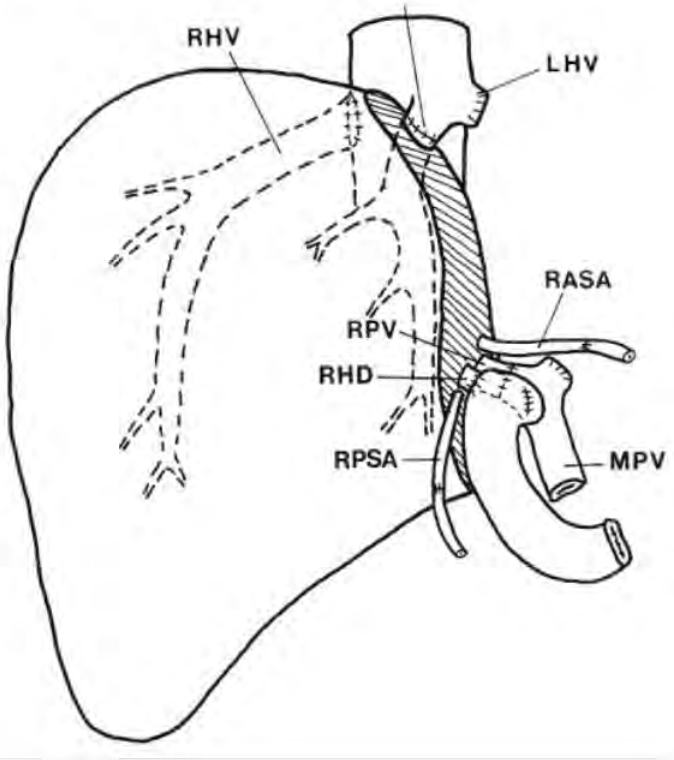
1997: Introduction of right liver graft with middle hepatic vein as a standardized procedure (Hong Kong)

EXTENDING THE LIMIT ON THE SIZE OF ADULT RECIPIENT IN LIVING DONOR LIVER TRANSPLANTATION USING EXTENDED RIGHT LOBE GRAFT

Lo, Chung-Mau[1,2]; Fan, Sheung-Tat[1]; Liu, Chi-Leung[1]; Lo, Ronald J.W.[3]; Lau, George K.K.[4]; Wei, William I[1]; Li, Jimmy H.C.[5]; Ng, Irene O.L.[6]; Wong, J.[1]



Transplantation 1997



ADULT LIVING DONOR LIVER TRANSPLANTATION USING A RIGHT HEPATIC LOBE

Wachs, Michael E.[1,2]; Bak, Thomas E.[1]; Karrer, Frederick M.[1]; Everson, Gregory T.[3]; Shrestha, Roshan[3]; Trouillot, Thomas E.[3]; Mandell, M. Susan[4]; Steinberg, Tracy G.[1]; Kam, Igal[1]

Transplantation 1998

RIGHT LOBE GRAFT IN LIVING DONOR LIVER TRANSPLANTATION 1,2

Inomata, Yukihiro34; Uemoto, Shinji3; Asonuma, Katsuhiro3; Egawa, Hiroto3; Kiuchi, Tetsuya3; Fujita, Shiro3; Hayashi, Michihiro3; Kawashima, Mayumi3; Tanaka, Koichi3

Transplantation 2000

1999: Congestion of the right anterior sector in right liver graft (Korea)

0041-1337/01/7106-812/0
TRANSPLANTATION
Vol. 71, 812–817, No. 6, March 27, 2001
Printed in U.S.A.

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BRIEF COMMUNICATIONS

CONGESTION OF RIGHT LIVER GRAFT IN LIVING DONOR LIVER TRANSPLANTATION

SUNGGYU LEE,[2,6] KWANGMIN PARK,[2] SHIN HWANG,[2] YOUNGJOO LEE,[2] DONGNAK CHOI,[2] KIHOON KIM,[2] KYUNGSUCK KOH,[3] SANGHOON HAN,[3] KYUTAEK CHOI,[4] KYUSAM HWANG,[4] MASATOSHI MAKUUCHI,[5] YASUHIKO SUGAWARA,[5] AND PYUNGCHUL MIN[2]

Department of General Surgery, Plastic Surgery, Anesthesiology, Asan Medical Center, Ulsan University, Seoul, Korea and Department of Artificial Organ and Transplantation Division, Department of Surgery, Graduate School of Medicine, University of Tokyo, Tokyo, Japan

대한이식학회지 : 제 13 권 제 2 호
Vol. 13, No. 2, December, 1999

□원 저□

우엽을 이용한 성인간의 생체부분간이식에서 이식편의 부분 울혈괴사와 이에 대한 대책

울산대학교 의과대학 서울중앙병원 일반외과학교실

이승규 · 이영주 · 박광민 · 황 신 · 최동락
김기훈 · 정재한 · 안철수 · 민병철

= Abstract =

Anterior Segment Congestion of a Right Liver Lobe Graft in Living Donor Liver Transplantation and its Strategy to Prevent Congestion

Sung Gyu Lee, Young Joo Lee, Kwang Min Park, Shin Hwang, Dong Rak Choi, Ki Hun Kim, Jae Han Jeong, Chul Soo Ahn, and Pyung Chul Min

Department of General Surgery, Asan Medical Center, Ulsan University, Seoul, Korea

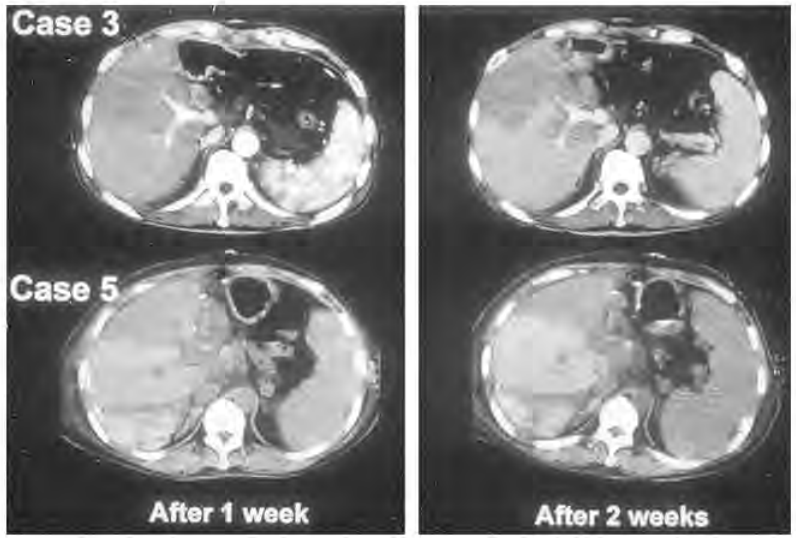
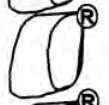


FIGURE 1. Postoperative computed tomography in patients 3 and 5.

Table 2. Results of living donor liver transplantation using a *right lobe graft*

No./urgency	Recipient	Donor	Graft			Result	
	Disease	Relation	Weight (gm)	% of SLV	Anatomical variation of the hepatic veins	Complications/	Survival
1. Elective	Hepatitis B cirrhosis	wife	667	55		ascites	*alive*
2. Urgent	*Fulminant hepatic failure*	mother	650	48		sepsis	*alive*
3. Elective	Hepatitis B cirrhosis	brother	1000	83		*massive ascites*	*alive*
4. Urgent	*Fulminant hepatic failure*	wife	870	72		ascites	*alive*
5. Elective	Secondary biliary cirrhosis	daughter	770	76		*hepatic dysfunction, sepsis*	*dead*

Ⓡ: Right hepatic vein, Ⓜ: Middle right hepatic vein, Ⓘ: Inferior right hepatic vein, ⑤: Hepatic vein of subsegment 5 (V5), ⑧: Hepatic vein of subsegment 8 (V8).

Reconstruction techniques of RHV and its tributaries

Evaluation of Hepatic Venous Congestion: Proposed Indication Criteria for Hepatic Vein Reconstruction

Keiji Sano, MD,* Masatoshi Makuuchi, MD, PhD,* Kenji Miki, MD,* Atsushi Maema, MD,* Yasuhiko Sugawara, MD,* Hiroshi Imamura, MD,* Hidetoshi Matsunami, MD,† and Tadatoshi Takayama, MD*

Ann Surg 2002

＊Univ Tokyo

0041-1337/03/7503-358/0
TRANSPLANTATION
Copyright © 2003 by Lippincott Williams & Wilkins, Inc.
Vol. 75, 358–360, No. 3, February 15, 2003
Printed in U.S.A.

HEPATIC VENOPLASTY IN LIVING-DONOR LIVER TRANSPLANTATION USING RIGHT LOBE GRAFT WITH MIDDLE HEPATIC VEIN

CHUNG-MAU LO, SHEUNG-TAT FAN, CHI-LEUNG LIU, AND JOHN WONG

＊Hong Kong

A modified triangular venoplasty for reconstruction of middle hepatic vein tributaries in living donor liver transplantation

Eguchi S et al. Surgery 2007

＊Nagasaki Univ

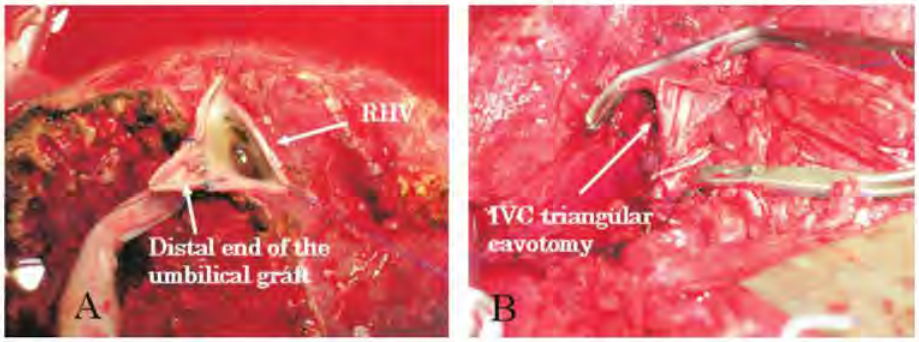


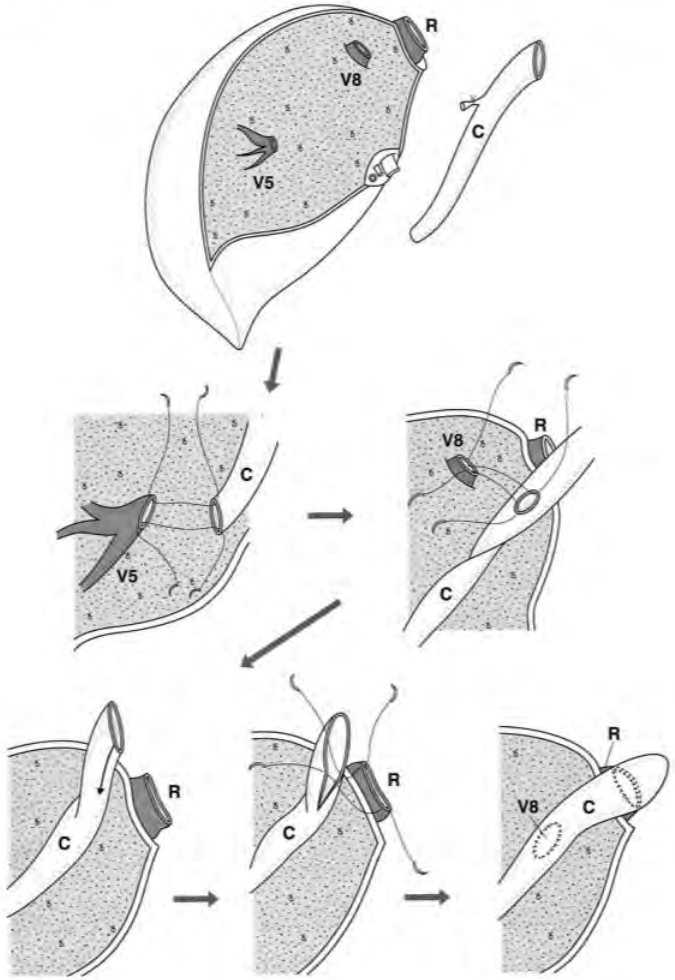
Figure. A, Triangle-shaped venoplasty between the recanalized umbilical vein graft, which was anastomosed to the V5 and right hepatic vein. **B,** Wide triangular cavotomy was made under cross-clamping of the inferior vena cava.

Vein Reconstruction in Modified Right Liver Graft for Living Donor Liver Transplantation

Yasuhiko Sugawara, MD, Masatoshi Makuuchi, MD, Keiji Sano, MD, Hiroshi Imamura, MD, Junichi Kaneko, MD, Takao Ohkubo, MD, Yuichi Matsui, MD, and Norihiro Kokudo, MD

＊Univ Tokyo

Ann Surg 2003



Various types of liver grafts

Living-Related Transplantation of Left Liver Plus Caudate Lobe

Univ Tokyo

Tadatoshi Takayama, MD, Masatoshi Makuuchi, MD, Keiichi Kubota, MD, Keiji Sano, MD, Yasushi Harihara, MD, Hideo Kawarasaki, MD

J Am Coll Surg 2000

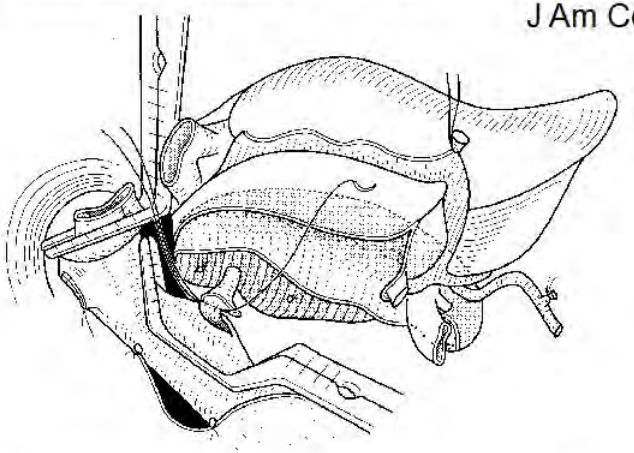


Figure 2. Recipient hepatic venous reconstruction. The caudate lobe hepatic vein with a caval cuff is anastomosed end-to-side to the vena cava.

RIGHT LATERAL SECTOR GRAFT IN ADULT LIVING-RELATED LIVER TRANSPLANTATION

Sugawara Y et al. Transplantation 2002

Univ Tokyo

Monosegmental Living Donor Liver Transplantation

M. Kasahara, K. Uryuhara, S. Kaihara, K. Kozaki, Y. Fujimoto, Y. Ogura, K. Ogawa, F. Oike, M. Ueda, H. Egawa, and K. Tanaka

Kyoto Univ

TRANSPLANT INTERNATIONAL

Transplant International ISSN 0934-0874

CASE REPORT

Living donor liver transplantation using a left liver extended to right anterior sector

Kyung-Suk Suh, Suk-Won Suh, Jeong-Moo Lee, Young Rok Choi, Nam-Joon Yi and Kwang-Woong Lee

Department of Surgery, College of Medicine, Seoul National University, Seoul, Korea

Korea

2000: Introduction of dual graft (Korea)

Surgical technique

Surgery
Volume 129, Number 5

An adult-to-adult living donor liver transplant using dual left lobe grafts

SungGyu Lee, MD, Shin Hwang, MD, KwangMin Park, MD, YoungJoo Lee, MD, DongLak Choi, MD, ChulSoo Ahn, MD, YangWon Nah, MD, KyungSuck Koh, MD, SangHoon Han, MD, SangHoon Park, MD, *and* **PyungChul Min, MD,** *Seoul, Korea*

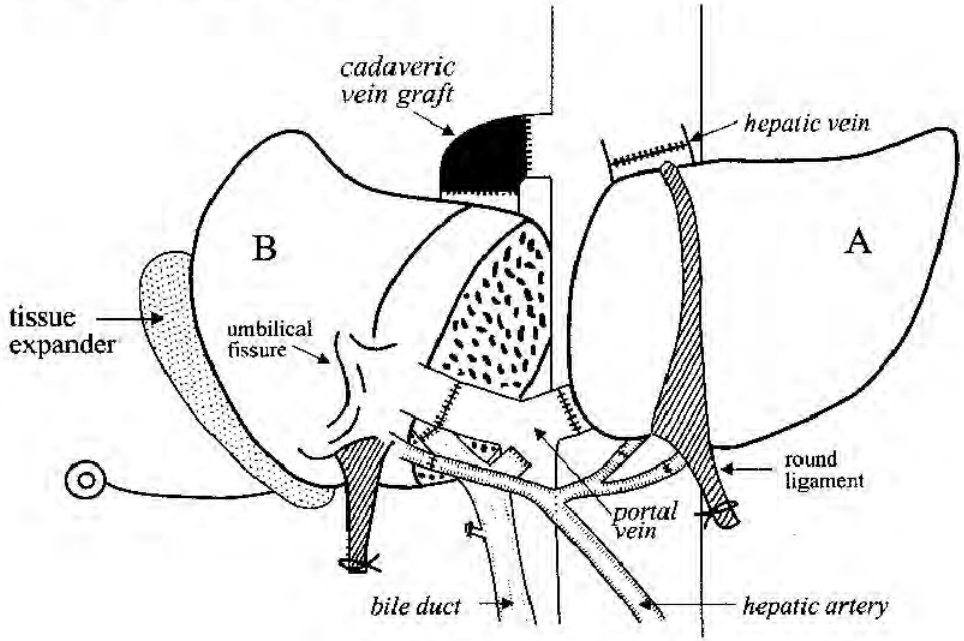


Fig 1. Living donor liver transplant using dual left lobe grafts. **A,** Orthotopically implanted first left lobe graft. **B,** Heterotopically implanted 180° rotated second left lobe graft.

Microsurgical reconstruction: hepatic artery (Kyoto Univ)

0041-1337/92/5402-0263$03.00/0
TRANSPLANTATION

Vol. 54, 263–268, No. 2, August 1992
Printed in U.S.A.

THE INTRODUCTION OF MICROVASCULAR SURGERY TO HEPATIC ARTERY RECONSTRUCTION IN LIVING-DONOR LIVER TRANSPLANTATION—ITS SURGICAL ADVANTAGES COMPARED WITH CONVENTIONAL PROCEDURES[1]

KEIICHIRO MORI,[2,5] IZUMI NAGATA,[3] SEN YAMAGATA,[3] HIROKAZU SASAKI,[2] FUMIO NISHIZAWA,[2] YASUTSUGU TAKADA,[2] FUMINORI MORIYASU,[4] KOICHI TANAKA,[2] YOSHIO YAMAOKA,[2] KAORU KUMADA,[2] HARUHIKO KIKUCHI,[3] AND KAZUE OZAWA[2]

Microsurgical reconstruction: bile duct (Taiwan)

LIVER TRANSPLANTATION 15:1766-1775, 2009

ORIGINAL ARTICLE

Routine Microsurgical Biliary Reconstruction Decreases Early Anastomotic Complications in Living Donor Liver Transplantation

Tsan-Shiun Lin,[1,2]* Allan M. Concejero,[1,2]* Chao-Long Chen,[1,2] Yuan-Cheng Chiang,[1,2] Chih-Chi Wang,[1,2] Shih-Ho Wang,[1,2] Yueh-Wei Liu,[1,2] Chin-Hsiang Yang,[1,2] Chee-Chien Yong,[1,2] Bruno Jawan,[1,3] and Yu-Fan Cheng[1,4]

[1]Liver Transplantation Program and Departments of [2]Surgery, [3]Anesthesiology, and [4]Diagnostic Radiology, Chang Gung Memorial Hospital-Kaohsiung Medical Center, Chang Gung University College of Medicine, Kaohsiung, Taiwan

Small-for-size syndrome: “Shifting the risk from the donor to the recipient”

became available following a fatal motor vehicle accident
December, 2000. We prepared the donor liver for standa
split transplantation by right hepatectomy but fou
a large intraparenchymal haematoma in the right l
during transection. We transplanted the left lobe wh
weighed 430 g, corresponding to a GRWR of 0·61
In the first step of the recipient operation, we construc

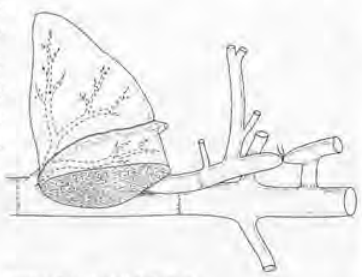


Figure 1: **Transplantation diagram**

*Mesocaval shunt with SMV ligation
France (Lancet 2002)

Modulation of Portal Graft Inflow: A Necessity in Adult Living-Donor Liver Transplantation?

Roberto Troisi, MD,* Guy Cammu, MD,† Giuseppe Militerno, MD,* Luc De Baerdemaeker, MD,† Johan Decruyenaere, MD,‡ Eric Hoste, MD,‡ Peter Smeets, MD,§ Isabelle Colle, MD,¶ Hans Van Vlierberghe, MD, PhD,¶ Mirko Petrovic, MD,‖ Dirk Voet, MD,‖ Eric Mortier, MD, DSc,† Uwe J. Hesse, MD, PhD,* and Bernard de Hemptinne, MD, FACS*

*Splenic artery ligation if graft portal flow >250 ml/min/100 g liver
Belgium (Ann Surg 2003)

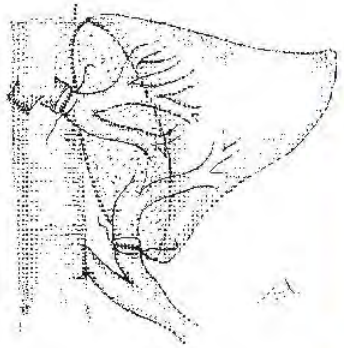
Living Donor Liver Transplantation with Left Liver Graft

*Porto-systemic shunt and splenectomy for GV/SLV 20% graft
Italy (Am J Transplant 2004)

Left Lobe Adult-to-Adult Living Donor Liver Transplantation: Small Grafts and Hemiportocaval Shunts in the Prevention of Small-for-Size Syndrome

Jean F. Botha,[1] Alan N. Langnas,[1] B. Daniel Campos,[1] Wendy J. Grant,[1] Christopher E. Freise,[1] Nancy L. Ascher,[2] David F. Mercer,[1] and John P. Roberts[1]

U.S. (Liver Transpl 2010)



Sato Y, Yamamoto S, Oya H, et al. Splenectomy for reduction of excessive portal hypertension after adult living-related donor liver transplantation.
Niigata Univ (Hepatogastroenterology 2002)

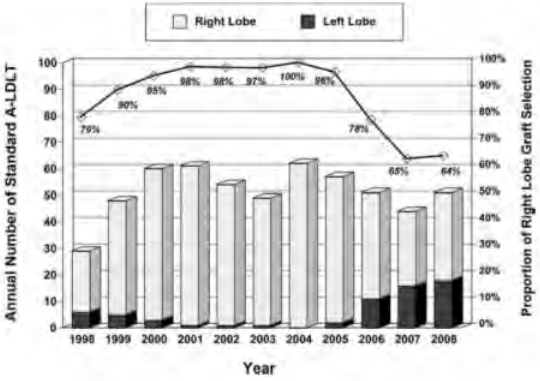
End-to-Side Portocaval Shunting for a Small-for-Size Graft in Living Donor Liver Transplantation

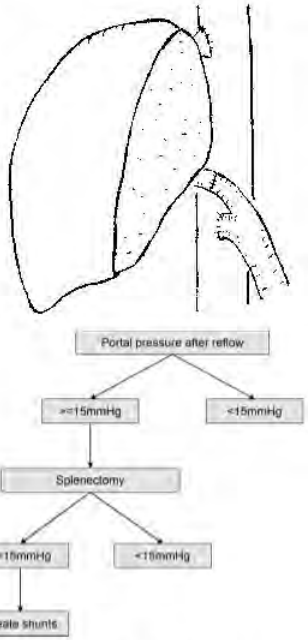
Yasutsugu Takada,[1] Mikiko Ueda,[1] Yukika Ishikawa,[2] Yasuhiro Fujimoto,[1] Hideaki Miyauchi,[3] Yasuhiro Ogura,[1] Takenori Ochiai,[2] and Koichi Tanaka[1]

Kyoto Univ (Liver Transpl 2004)

Portal Pressure <15 mm Hg Is a Key for Successful Adult Living Donor Liver Transplantation Utilizing Smaller Grafts than Before

Yasuhiro Ogura, Tomohide Hori, Walid M. El Moghazy, Atsushi Yoshizawa, Fumitaka Oike, Akira Mori, Toshimi Kaido, Yasutsugu Takada, and Shinji Uemoto





Kyoto Univ (Liver Transpl 2010)

Optimal graft selection algorithm and countermeasures for small-for-size syndrome has yet to be defined.

The International Liver Transplant Society Guideline on Living Liver Donation

Charles M. Miller, MD,[1] Francois Durand, MD,[2] Julie K. Heimbach, MD,[3] Leona Kim-Schluger, MD,[4] Sung-Gyu Lee, MD,[5] Jan Lerut, MD, PhD,[6] Chung-Mau Lo, MD,[7] Cristiano Quintini, MD,[8] and Elizabeth Anne Pomfret, MD, PhD[8]

Donor Evaluation and Selection

2. It is generally recommended that the recipient GRBWR is not lower than 0.8% (2C); however, lower GRBWR can be considered in selected cases. (2C)

Right Lobe Without Middle Hepatic Vein

1. Donor safety is improved with the lowest possible loss of hepatic parenchyma (1C) and retention of the MHV in the remnant. (2C)

Right Lobe With MHV

1. A right liver graft with MHV has optimal venous drainage and could provide a better recipient outcome, especially in recipients with significant portal hypertension or for those whose graft size is relatively small. (2B)
2. Inclusion of the MHV in a right liver graft does not seem to increase the risks for a living donor. (2B)
3. Preservation of the segment 4b hepatic vein will reduce congestion in the donor liver remnant. (1C)

Left Lobe

2. Outcomes for left liver living donor transplantation may be improved by graft inflow modulation. (2B)
4. The usefulness of including the caudate lobe in left liver procurement to increase the liver mass needs further study. (2C)

Right Posterior Sector Graft

1. The RPS graft can be used to expand the living liver donor pool and to minimize the donor morbidity rate occurring with the right lobe graft. (2B)
2. When the portal vein, hepatic artery, and bile duct to RPS are branching off extrahepatically, the procurement of RPS graft accompanies minimum morbidity in both donor and recipient. (2B)

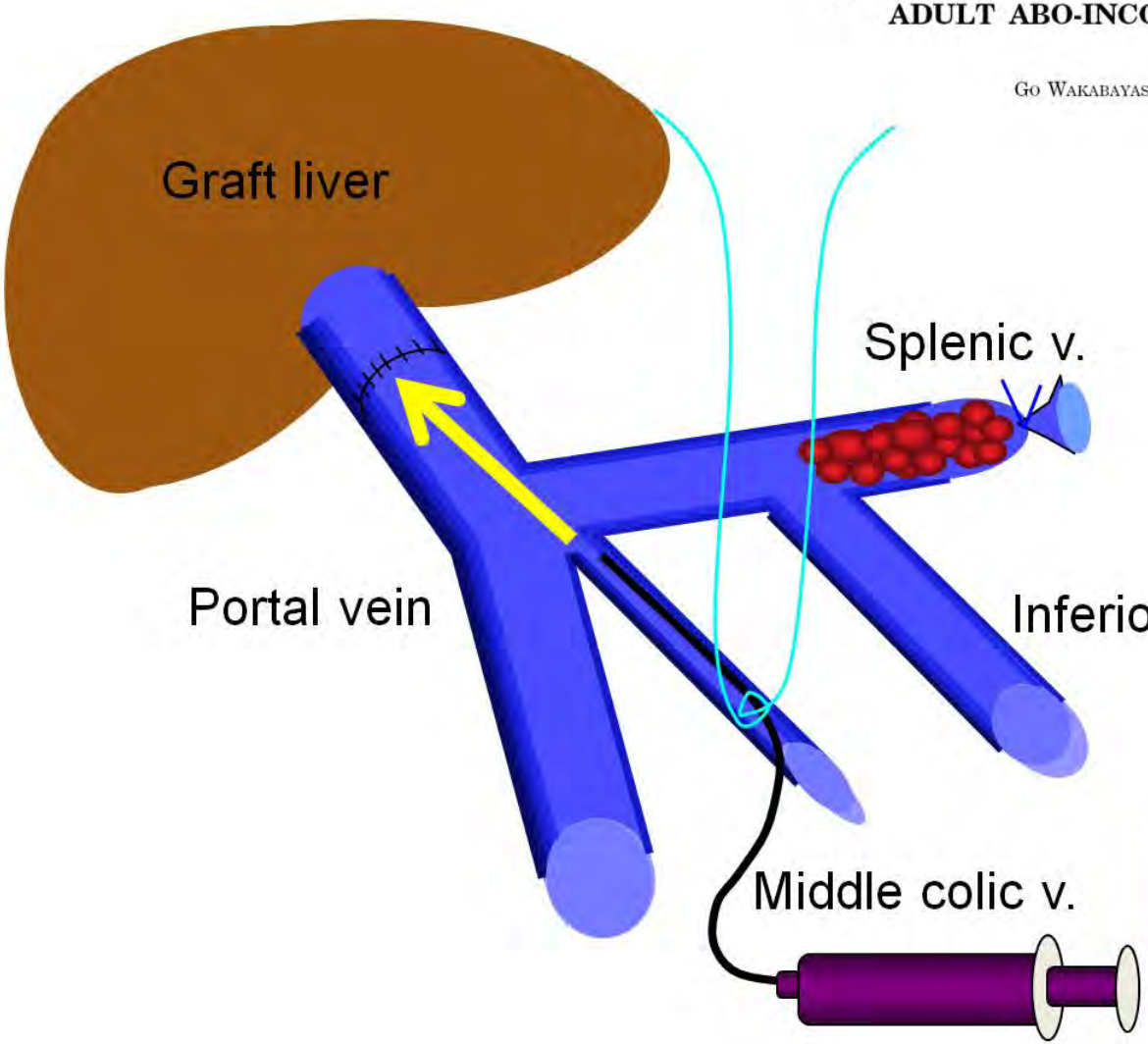
Merely a description of each center's policy

2002: First description of an effective desensitization protocol in ABO incompatible LDLT

INTRAPORTAL INFUSION THERAPY AS A NOVEL APPROACH TO ADULT ABO-INCOMPATIBLE LIVER TRANSPLANTATION[1]

Minoru Tanabe,[2,3] Motohide Shimazu,[2]
Go Wakabayashi, Ken Hoshino, Shigeyuki Kawachi, Tomohisa Kadomura, Hiroaki Seki,
Yasuhide Morikawa, and Masaki Kitajima

Keio Univ (Transplantation 2002)



Portal infusion
- ✧ Methylprednisolone
- ✧ Prostaglandin E1
- ✧ Gabexate Methylate

New Protocol of Immunosuppression for Liver Transplantation Across ABO Barrier: The Use of Rituximab, Hepatic Arterial Infusion, and Preservation of Spleen

*Kyoto Univ (Transplant Proc 2005)

A. Yoshizawa, S. Sakamoto, K. Ogawa, M. Kasahara, K. Uryuhara, F. Oike, M. Ueda, Y. Takada, H. Egawa, and K. Tanaka

Rituximab, IVIG, and Plasma Exchange Without Graft Local Infusion Treatment: A New Protocol in ABO Incompatible Living Donor Liver Transplantation

Toru Ikegami, Akinobu Taketomi, Yuji Soejima, Tomoharu Yoshizumi, Hideaki Uchiyama, Noboru Harada, Tomohiro Iguchi, Naotaka Hashimoto, and Yoshihiko Maehara

*Kyushu Univ (Transplantation 2009)

American Journal of Transplantation 2014; 14: 102–114
Wiley Periodicals Inc.

doi: 10.1111/ajt.12520

Impact of Rituximab Desensitization on Blood-Type-Incompatible Adult Living Donor Liver Transplantation: A Japanese Multicenter Study

Number at Risk

R	10	8	8	6	4
RI	81	72	66	60	56
RIS	137	118	111	100	95
RS	30	27	25	23	20

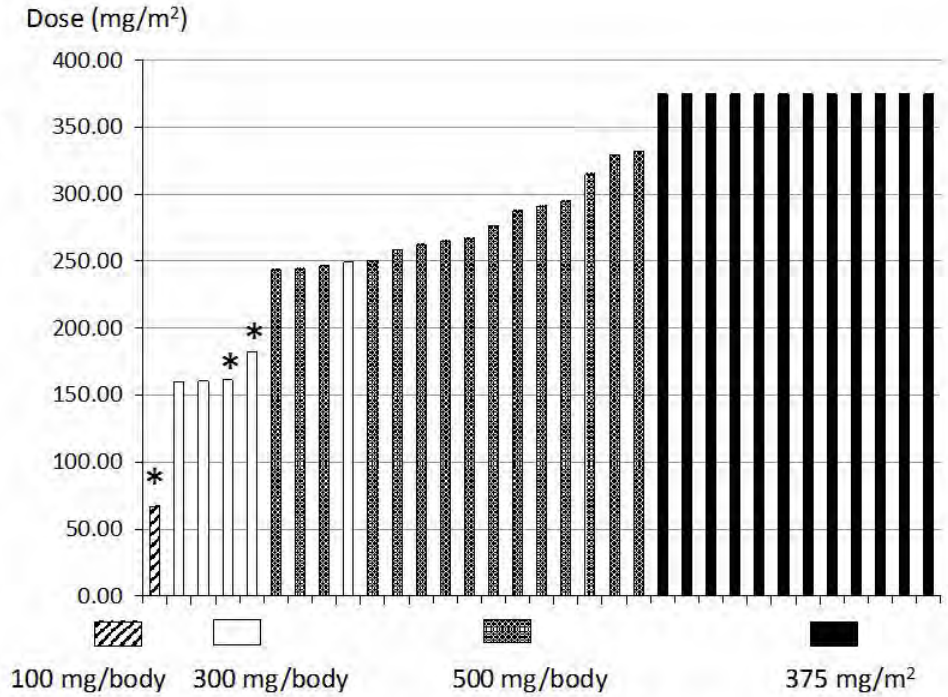
Egawa Am J Transplant 2014

J Hepatobiliary Pancreat Sci (2017) 24:89–94
DOI: 10.1002/jhbp.419

ORIGINAL ARTICLE

Optimal dosage regimen for rituximab in ABO-incompatible living donor liver transplantation

Hiroto Egawa · Koji Umeshita · Shinji Uemoto



Egawa J Hepatobiliary Pancreat Sci 2017

- ✓ Various attempts to simplify the desensitization protocol after the introduction of rituximab
- ✓ Optimal dose: 375 mg/m^2 or 500 mg/body

American Journal of Transplantation 2016; 16: 157–170
Wiley Periodicals Inc.

doi: 10.1111/ajt.13444

ABO-Incompatible Adult Living Donor Liver Transplantation Under the Desensitization Protocol With Rituximab

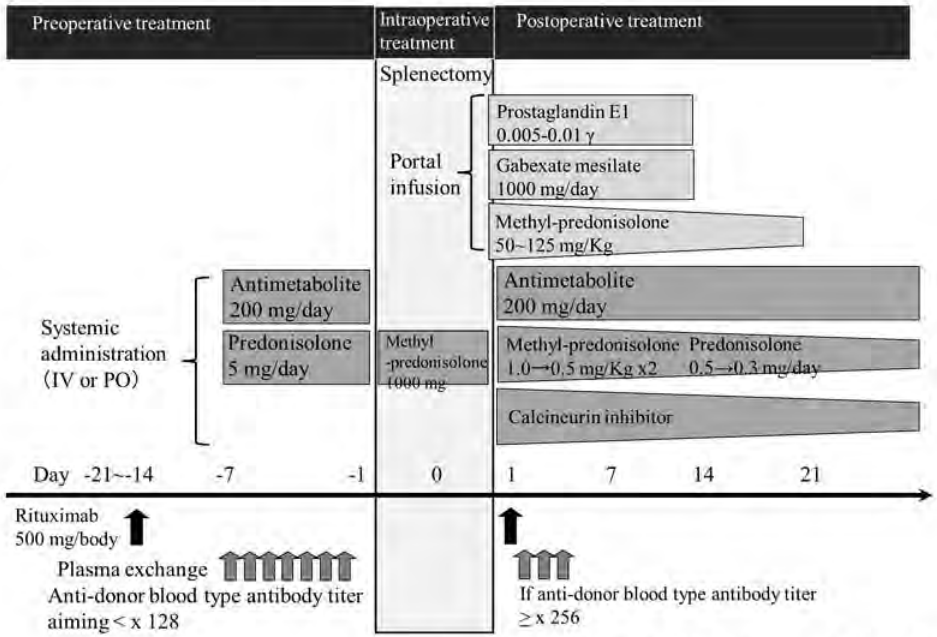
Song Am J Transplant 2016

Table 5: Comparison of post–liver transplantation morbidities between ABO-incompatible and -compatible adult living donor liver transplantation recipients

Variable	ABO-incompatible group (n = 235)	ABO-compatible group (n = 1301)	p value
BPACR	19 (8.1)	122 (9.4)	0.176
CR	2 (0.9)	10 (0.9)	0.641
AMR	17 (7.2)	0 (0.0)	<0.001

Asan Medical Center:
Rituximab 300–375 mg/m^2 and plasma exchange (no local infusion/splenectomy)
Antibody-mediated rejection (AMR):
17/235 (7.2%) ABOi-LDLT
One-year survival of patients with AMR: 56% (without AMR: 99%, p <0.001)

Keio Protocol: "Full-course" desensitization
Rituximab + Plasma exchange + Splenectomy + Portal infusion



Tanabe Eur J Clin Invest 2010

No AMR (0%) over 50 consecutive ABOi cases (36 adult and 14 pediatric patients)

ABO-incompatible LDLT remains an unfinished product

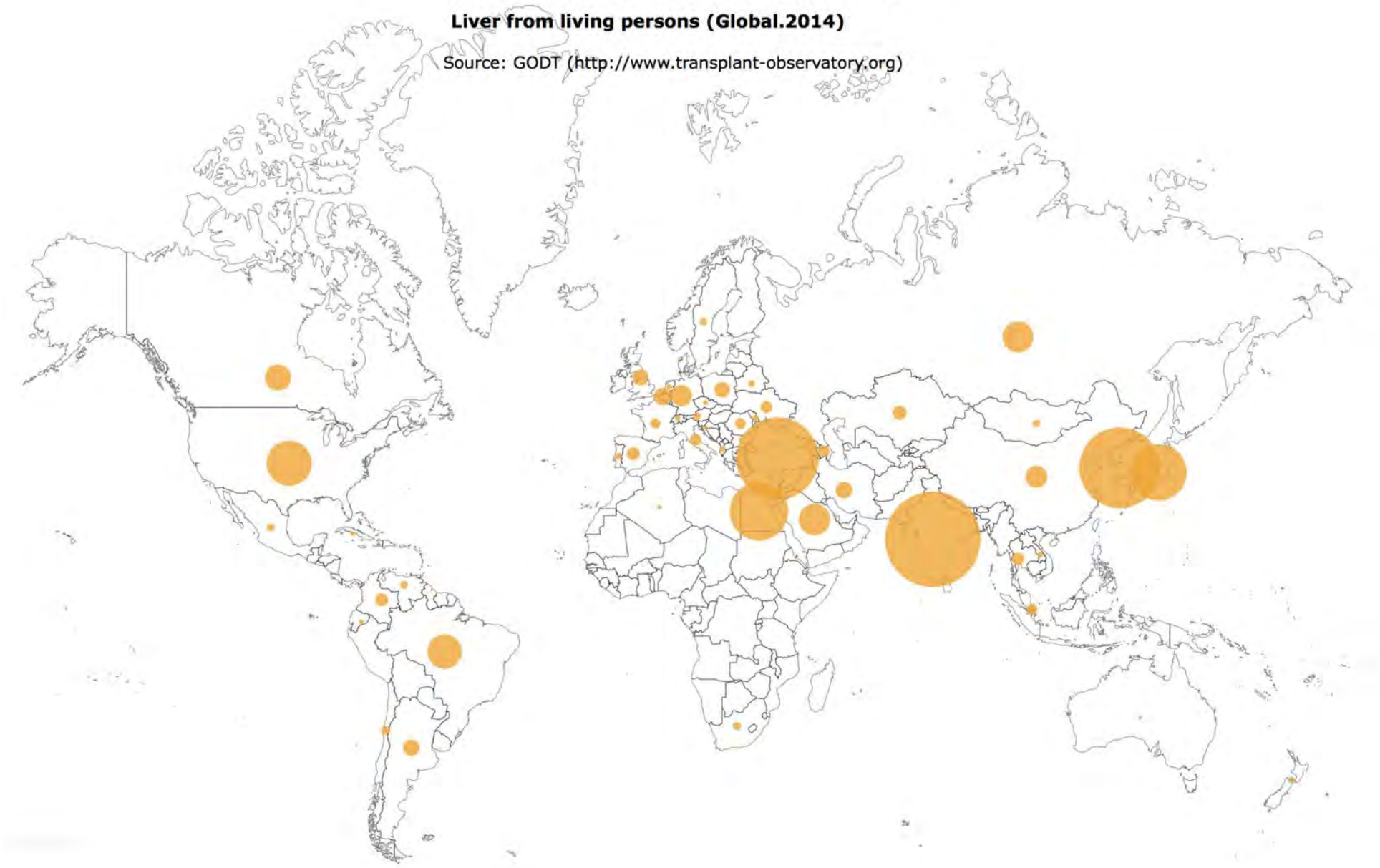
Topics

- From deceased donor to living donor liver transplantation (LDLT): How did it take place?
- Surgical innovations and controversies in LDLT
  - ✓ Various types of grafts
  - ✓ Vascular/bile duct reconstruction
  - ✓ Small-for-size syndrome
  - ✓ ABO incompatible
- Current status of LDLT worldwide

Diffusion of LDLT

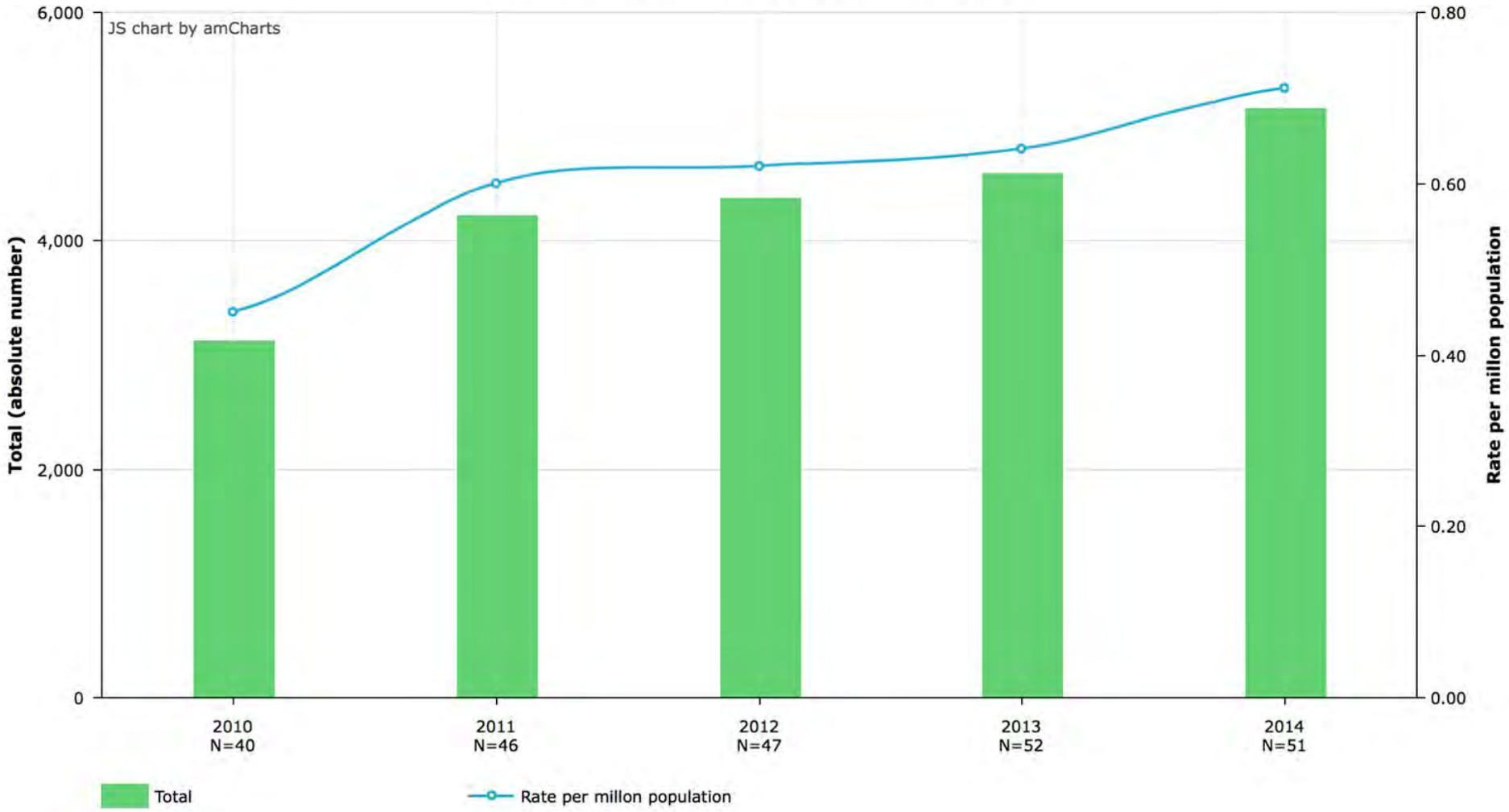
Liver from living persons (Global.2014)

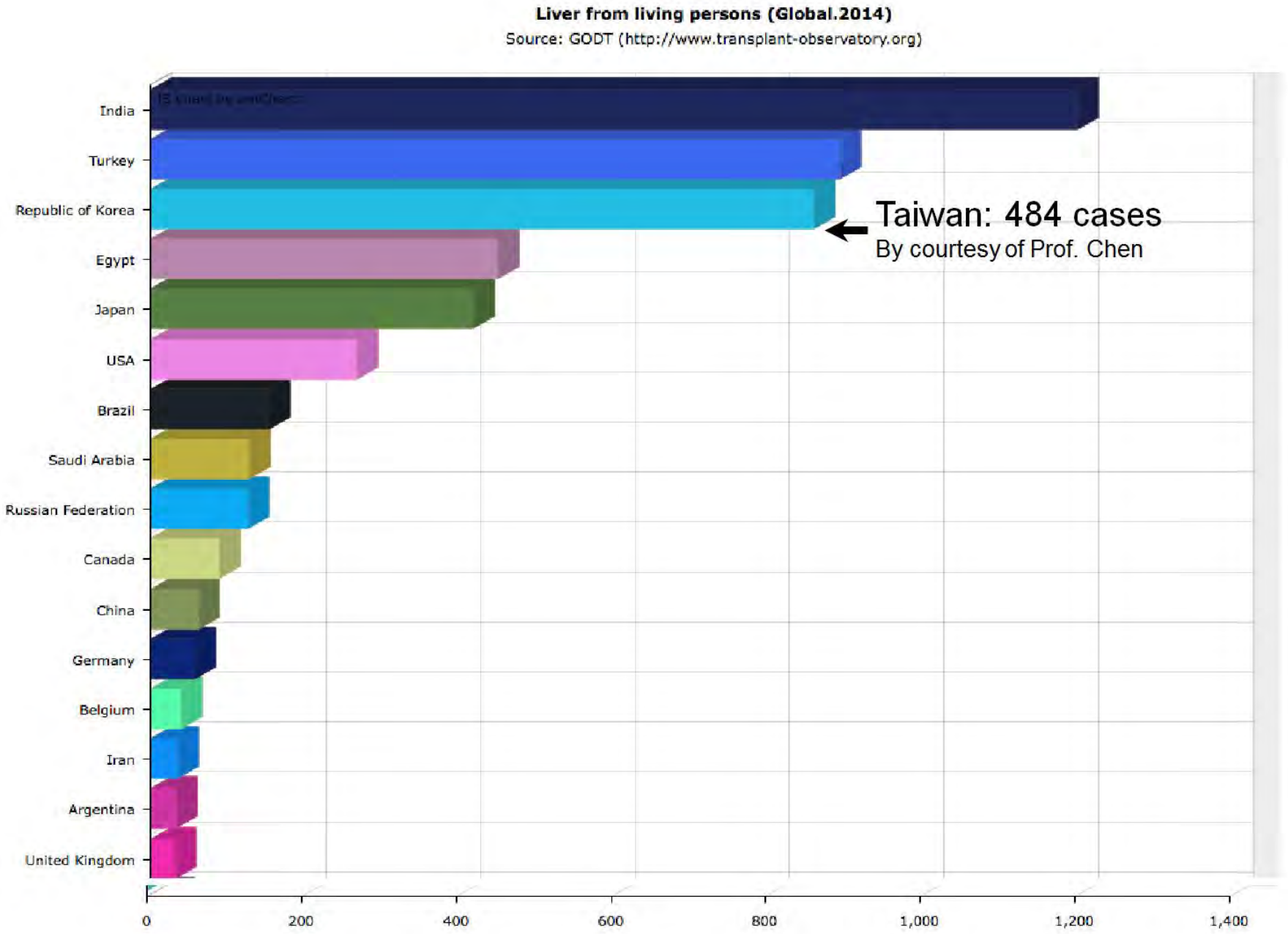
Source: GODT (http://www.transplant-observatory.org)



Total Liver from living persons (Global.2010-2014)

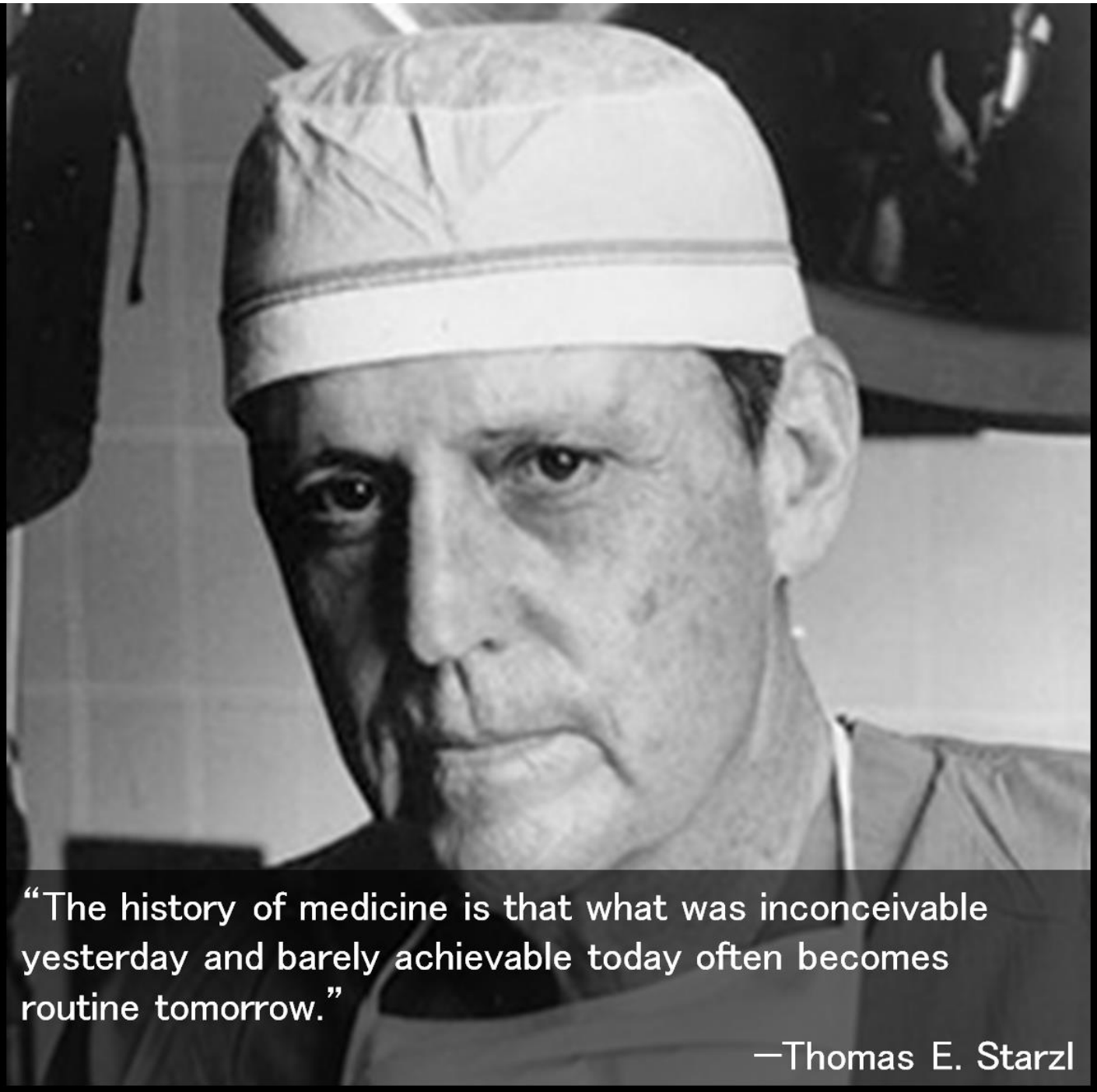
Source: GODT (http://www.transplant-observatory.org)




Liver from living persons (Global.2014)
Source: GODT (http://www.transplant-observatory.org)
India
Turkey
Republic of Korea
Egypt
Japan
USA
Brazil
Saudi Arabia
Russian Federation
Canada
China
Germany
Belgium
Iran
Argentina
United Kingdom
Taiwan: 484 cases
By courtesy of Prof. Chen
0
200
400
600
800
1,000
1,200
1,400

Future perspectives

- Unanswered questions in LDLT include graft selection (donor safety always comes first), countermeasures for small-for-size grafts, optimal immunosuppression protocol for ABO incompatible cases, etc.
- Live donation remains an important organ resource in Asia as well as in the Middle East. It is also being revisited in the U.S. and Europe due to organ shortage.
- We should strive to consolidate global efforts to safely perform LDLT as the last hope for patients who would otherwise have died.


“The history of medicine is that what was inconceivable yesterday and barely achievable today often becomes routine tomorrow.”
—Thomas E. Starzl