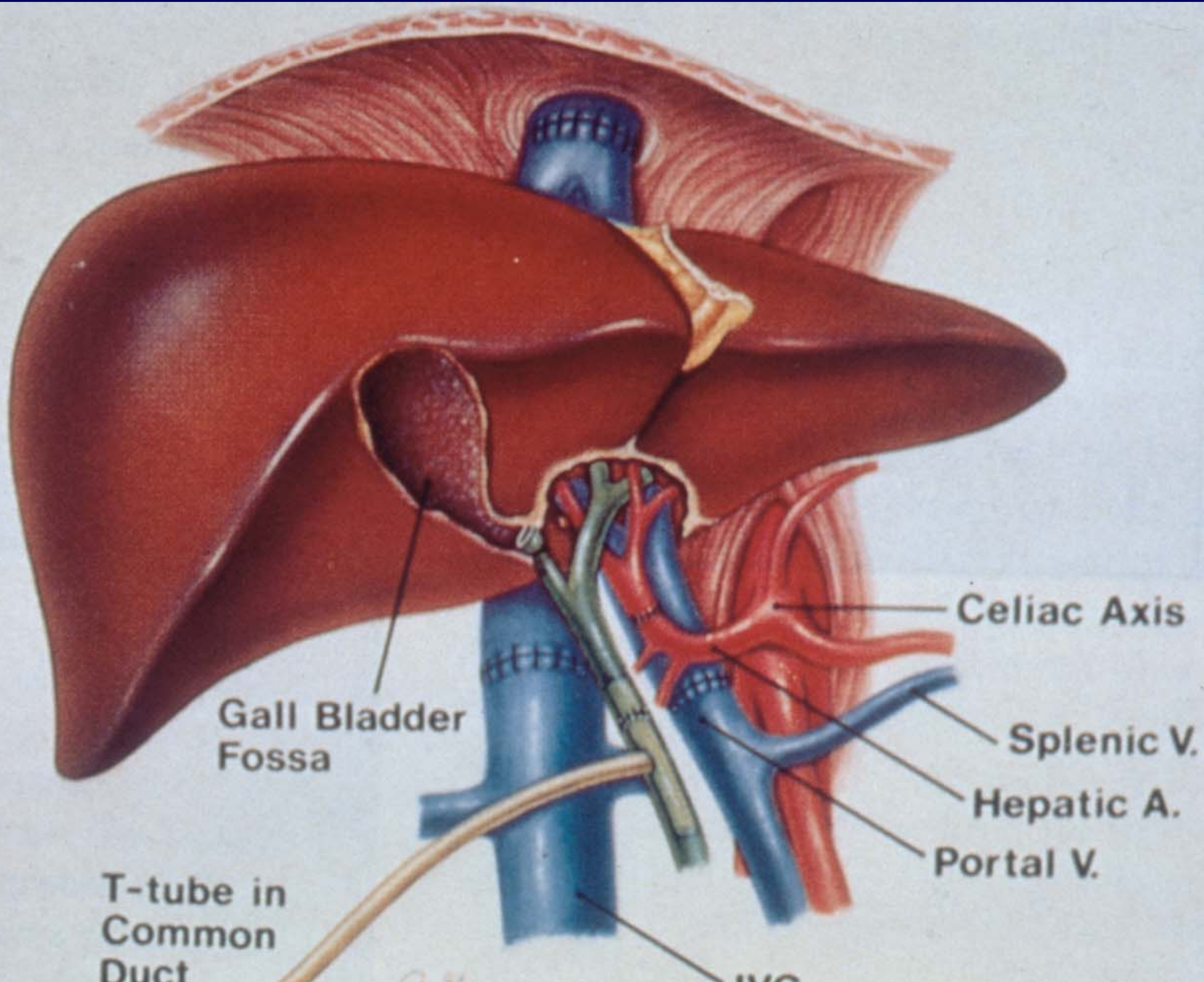
University of Colorado Health Sciences Center, Denver Colorado

********************** 1988 - 2004 *******************

Living Donor Liver Transplant
Colorado's Experience

Igal Kam, MD
Professor of Surgery
Chief of Transplant Surgery
University of Colorado Health Sciences Center

Orthotopic Liver Transplant – Whole liver

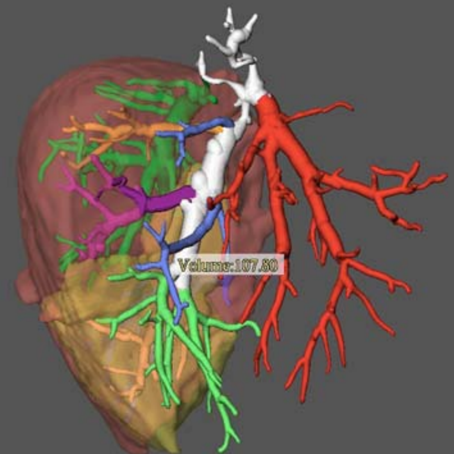


Liver Anatomy

Right hepatic vein

Left & middle hepatic vein

Common bile duct



History of live donor liver transplant

1988 Raja S, Nery JR, Mies S. Liver transplantation from liver donors. Lancet 1989;2:1042

1st attempt Adult to Pediatric (Lt. Lat. Seg)

1989 Strong RW, Lynch SV, Ong TH, et al. Successful liver transplantation from a living donor to her son. N Engl J Med. 1990 May 24;322(21):1505

1st successful Adult to Pediatric (Lt. Lat. Seg)

1994 Hashikura Y, Makuuchi M, Kawasaki S, et al. Successful living-related partial liver transplantation to an adult patient. Lancet 1994 May 14;343(8907):1233.

1st Adult Live Liver Donor Transplant (ALDLT)

- Yamaoka Y, Washida M, Honda K, Tanaka K, et al. Liver transplantation using a right lobe graft from a living related donor. Transplantation. 1994 (Apr 15;57(7):1127.

1st right lobe (ALDLT)

1997 Lo CM, Fan ST, Liu CL, Wei WI, et al. Adult-to-adult living donor liver transplantation using extended right lobe grafts. Ann Surg. 1997 Sep:226(3):261.

1997 Wachs M, Bak T, Karrer F, Everson G, et al. Adult living donor liver transplantation using a right hepatic lobe. Transplantation. 1998:10(66):1313.

1st right lobe in the Western Hemisphere

1998 Accumulative Experience

Marcos, Miller, Broelsch, and others

Liver Tx in US: UNOS Dataset

20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0

88 90 92 94 96 98 2000 2002

- EOY Wait List
- Deaths on Wait List
- OLTx Performed
- New Listings

New Listings = [(EOY2 - EOY1) + OLTx + Deaths)

The organ shortage and death of patients on the waiting list are the only justification to risk human lives as donors for organ transplantation

0041-1337/98/6610-1313$03.00/0
TRANSPLANTATION
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ADULT LIVING DONOR LIVER TRANSPLANTATION USING A RIGHT HEPATIC LOBE

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Divisions of Transplant Surgery, Gastroenterology/Hepatology, and Anesthesiology, University of Colorado Health Sciences Center, Denver, Colorado

Background. **Living donor liver transplantation has gained wide acceptance as an alternative for children with end-stage liver disease. The standard left lateral segment used in this operation does not provide adequate parenchymal mass to broaden its application to larger children or adults.**

Methods. **We report two cases of adult to adult living donor liver transplantation using a right hepatic lobe in patients with chronic liver disease.**

Results. **Both recipients experienced excellent initial graft function and have normal liver function 4 and 9 months postoperatively. Both donors are alive and well and returned to normal life 4 weeks postoperatively.**

Conclusions. **Our initial experience suggests that this technique is a safe and reliable option for adults with chronic end-stage liver disease. A conservative**

CASE REPORTS

Case 1. The first recipient was a 44-year-old Caucasian female with end-stage liver disease caused by hepatitis C infection. At the time of presentation, she was 162.5 cm tall and weighed 60 kg. Her liver volume by computed tomography (CT*) scan was 1050 ml. Her prothrombin time was 20.5 sec, bilirubin 4.0 mg/dl, and serum albumin 2.5 mg/dl. A liver biopsy confirmed cirrhosis. Her symptoms included fatigue, ascites, and peripheral edema responsive to diuretics. Her blood type was O^+, and, after completion of her evaluation, she was placed on the cadaveric waiting list.

While on the waiting list for 1 year, the patient developed worsening fluid retention, encephalopathy and profound hypersplenism (white blood cell count of 2000 and a platelet count of 1400). Despite her worsening condition, she did not meet the criteria for either "hospital-bound" or "intensive care unit-dependent." Her deteriorating condition prompted discussions with the patient and her family

ORIGINAL ARTICLES

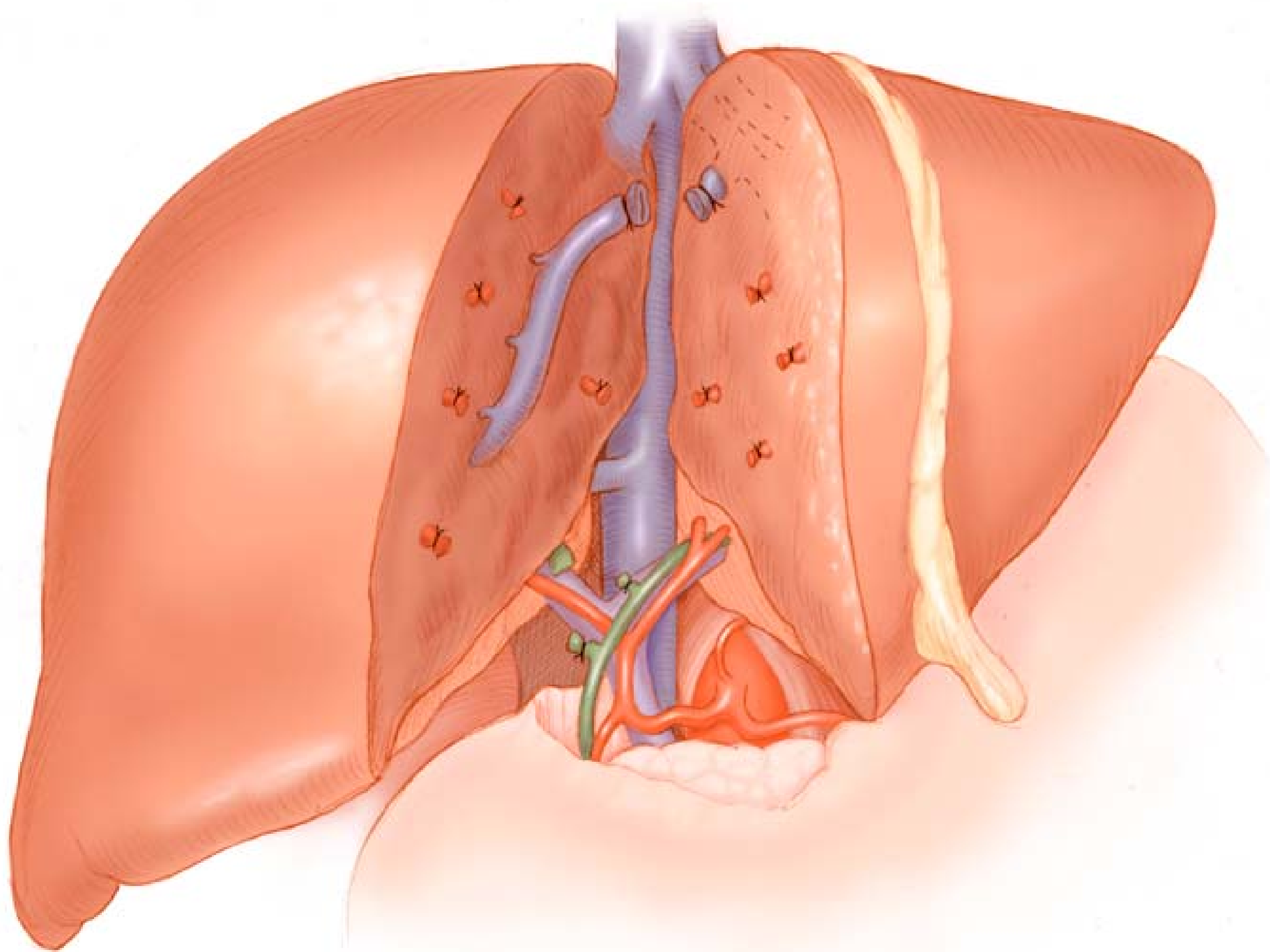
Adult-to-Adult Living Donor Liver Transplantation Using Right-Lobe Grafts: Results and Lessons Learned From a Single-Center Experience

Thomas Bak, Michael Wachs,* James Trotter,† Gregory Everson,† Thomas Trouillot,† Marcelo Kugelmas,† Tracy Steinberg,* and Igal Kam**

Living donor liver transplantation (LDLT) for adults is now a practical alternative to cadaveric liver transplantation. Use of right-lobe grafts has become the preferred donor procedure. Because of the complexity of this operation, a learning curve is to be expected. We report the outcome of our first 41 LDLTs at the University of Colorado Health Sciences Center (Denver, CO). We also discuss the lessons learned and the resultant modifications in the procedure that evolved during our series. Patient records were retrospectively reviewed between August 1997 and February 2001 for the following end points: recipient survival, graft survival, and donor and recipient complications. Thirty-eight of 41 living donor liver transplant recipients (93%) are alive and well postoperatively with a mean follow-up of 9.6 months. Four patients required retransplantation secondary to technical problems (9.8%); all 4 patients were in our initial 11 cases. Modification of the donor liver plane of transection resulted in venous outflow improvement. Also, biliary management was modified during the series. Donor complications are listed; all 41 donors have returned to normal pretransplantation activity. Our results indicate that LDLT can be performed safely with excellent donor and recipient outcomes. Dissemination of our experience can help shorten the learning curve for other institutions. (*Liver Transpl 2001;7:680-686.*)

mulated to date a series of 41 adult-to-adult right-lobe LDLTs. The results of this series and the lessons learned from these cases are presented to show that this can be a safe and effective procedure.

Justification for the use of adult-to-adult liver transplantation is based on the critical shortage of adult organs available for cadaveric transplantation. A growing number of people are being listed for transplantation, whereas the availability of cadaveric donor organs is remaining fairly constant. The increasing use of marginal donor organs may increase this number, but what cost this will have on short- and long-term survival of the organs is yet to be determined. Waiting-list mortality remains a problem and is approximately 10% per year.[7] Using LDLT has been shown to decrease waiting time on the list for the transplant recipients while freeing organs for the remainder of the recipient pool who may not have potential living donors.[8] When introduced for the pediatric population, LDLT reduced mortality and waiting times for pediatric liver recipients.[9] Applying this concept to adults remained difficult because left lateral segments would not provide sufficient liver mass to meet an adult transplant recipi-



Recipient Selection for LDLT Important Principles

- Must meet UNOS criteria for liver transplantation
- Optimal candidates are UNOS status 2B, ($\geq$ 10 childs points) especially with small hepatomas, not at the top of cadaveric list
- Status 1, 2A are possible candidates
- Recipient with a poor predicted outcome should be excluded (multiple-organ failure)
- Recipient listed as UNOS status 3 should be excluded

Donor selection criteria

- Voluntary
- Identical/compatible blood type
- No significant medical problems
- Long-term significant relationship with recipient

Donor Evaluation

- Medical Evaluation
  - Physical exam
  - Blood tests, x-rays and EKG
  - Psychiatric evaluation if indicated
- Radiological evaluation
  - CTA, MRC

Outcome of ALDLT evaluation

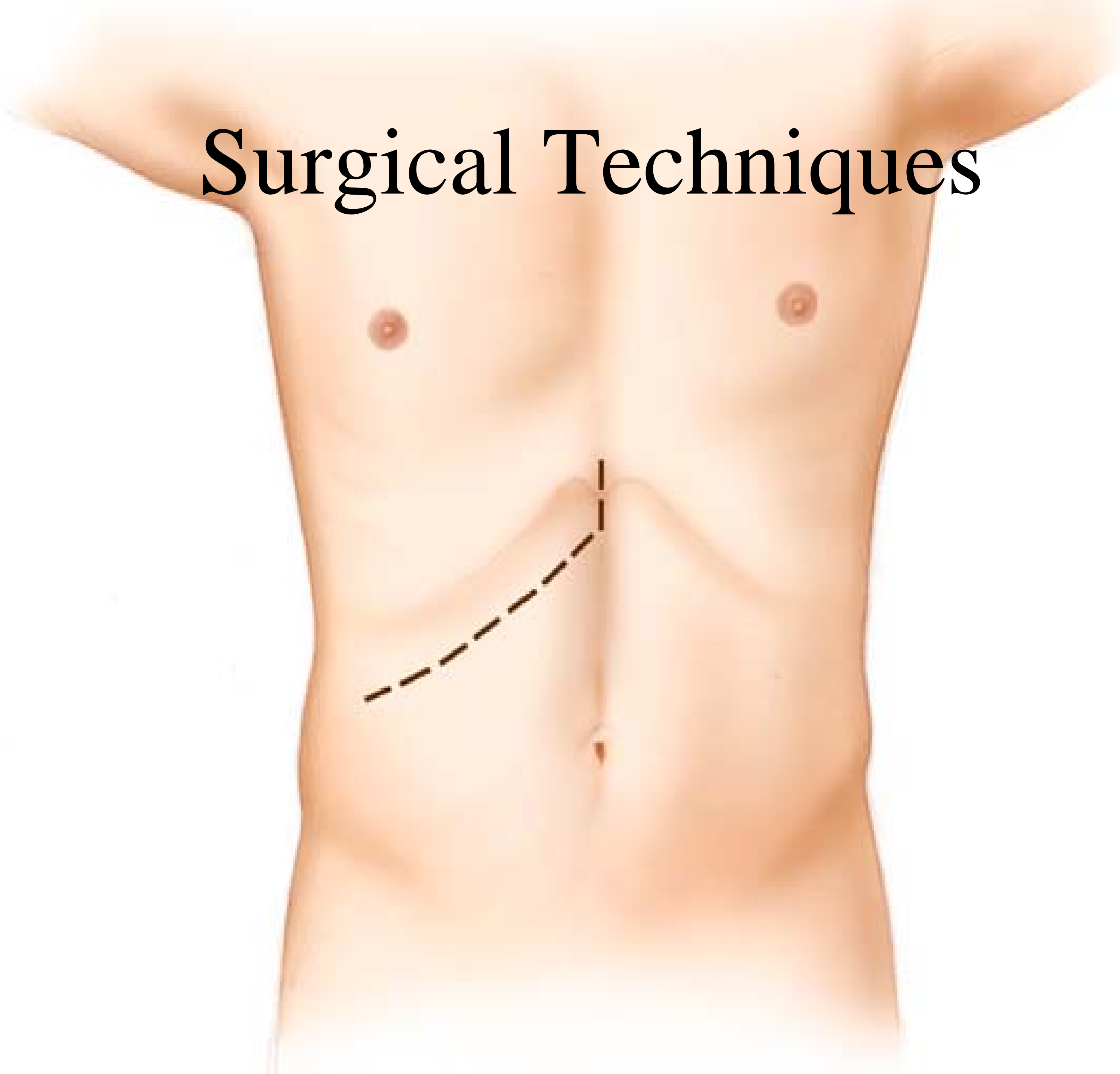
- 100 pts listed for cadaveric OLT
  - 51 rejected for recipient issues
  - 49 accepted for LDLT
    - 24 unable to find donor
    - 25 able to find donor
      - 15 with suitable donor
      - 10 with unsuitable donor

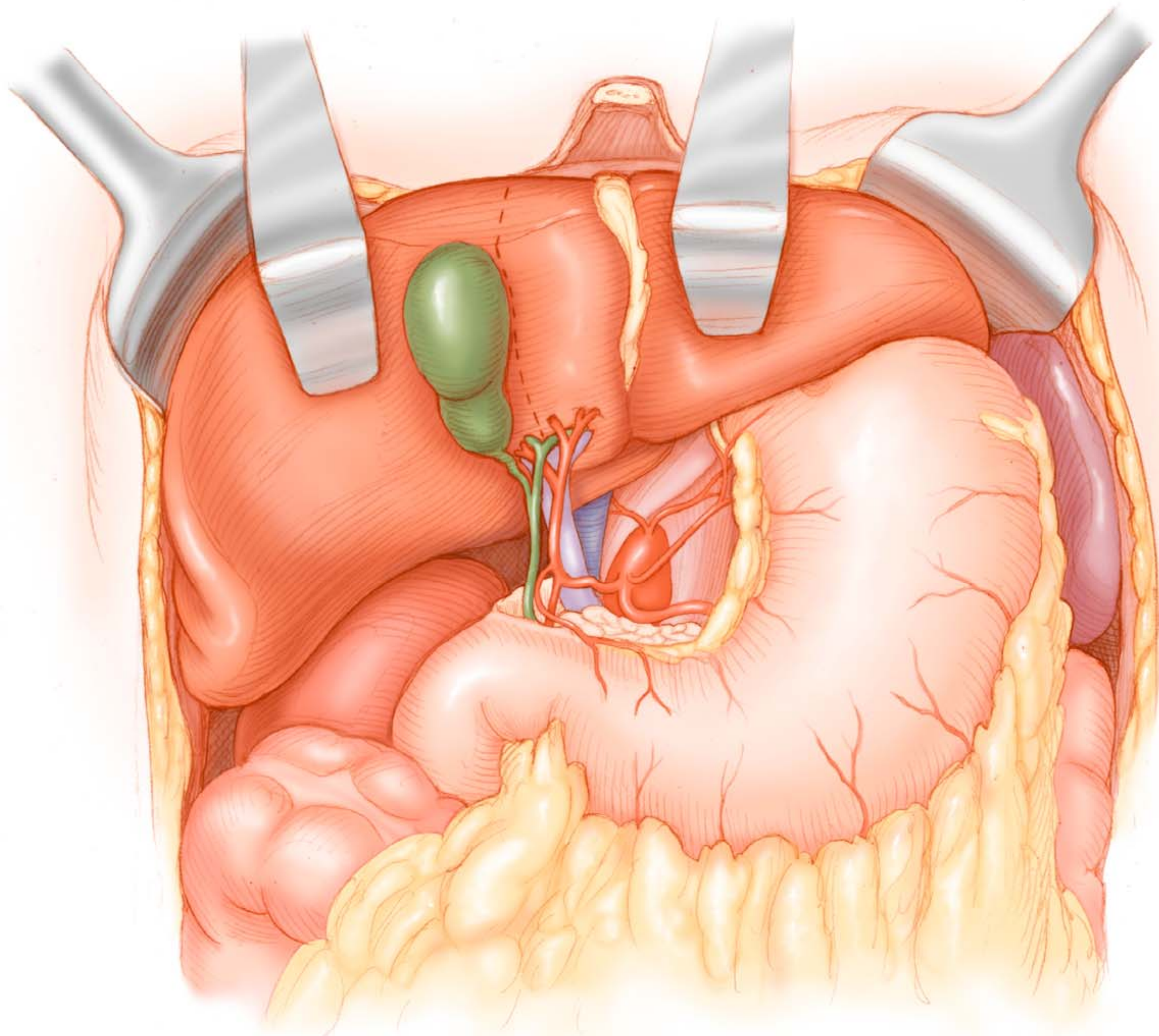
Trotter, et al. Liver Transpl 2000;6:290-295.

Impact on US Liver Transplantation

Flowchart	Remaining
18,000 patients listed	100 %
5000 decompensated / 13,000 compensated	25 %
2500 suitable / 2500 rejected	12.5 %
1250 no donor / 1250 w/donor	6.25 %
750 suitable donor / 500 rejected donor	+/- 5 %

Surgical Techniques

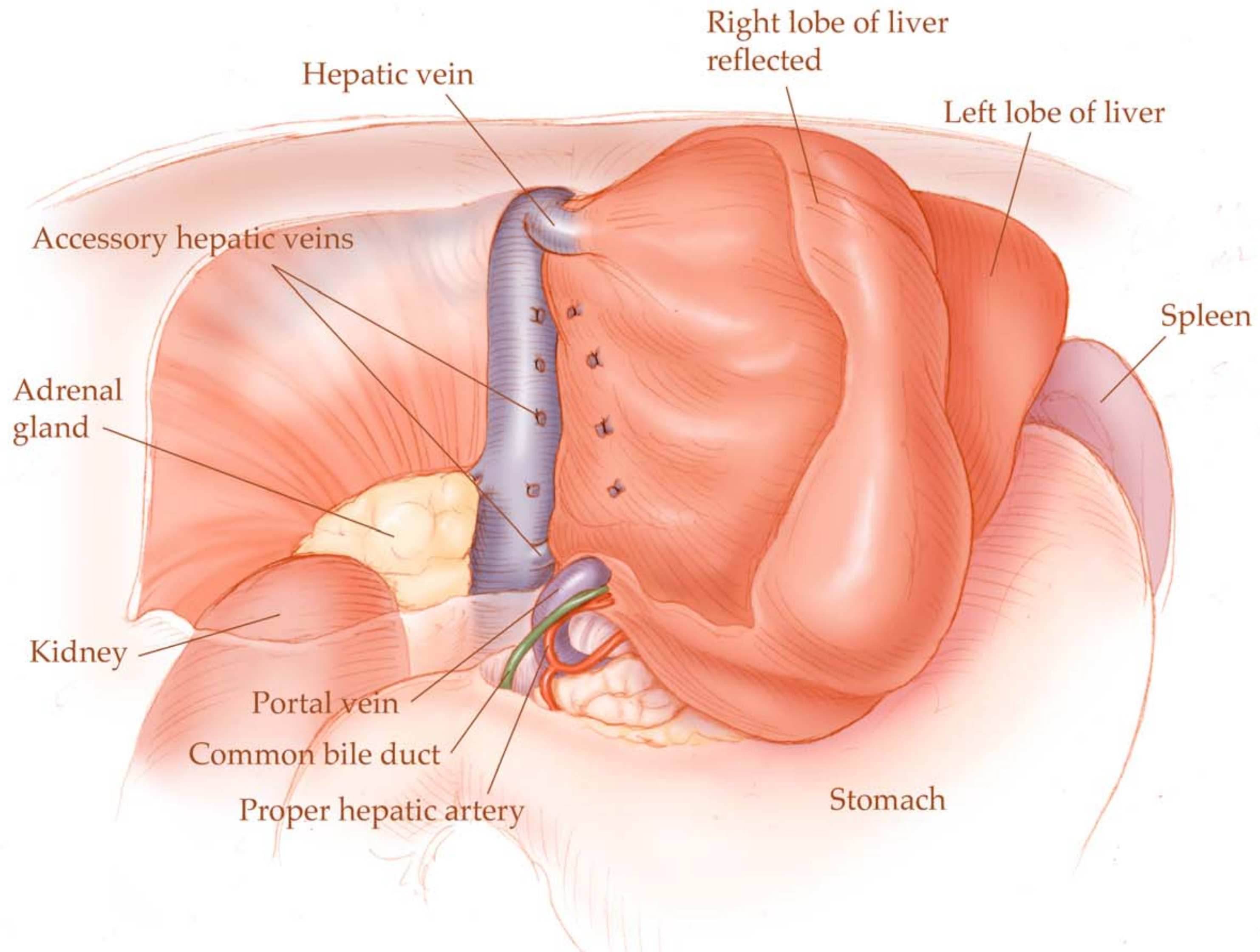




Donor Surgery

- Caval dissection
- Hilar dissection with intra-operative cholangiogram
- Parenchymal dissection

Donor Surgery



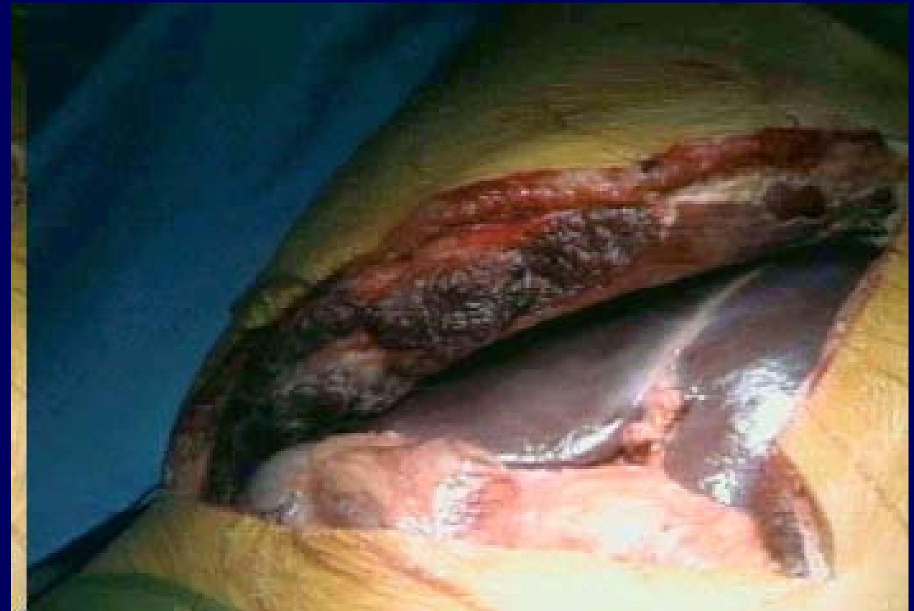
Caval Dissection

Donor Surgery

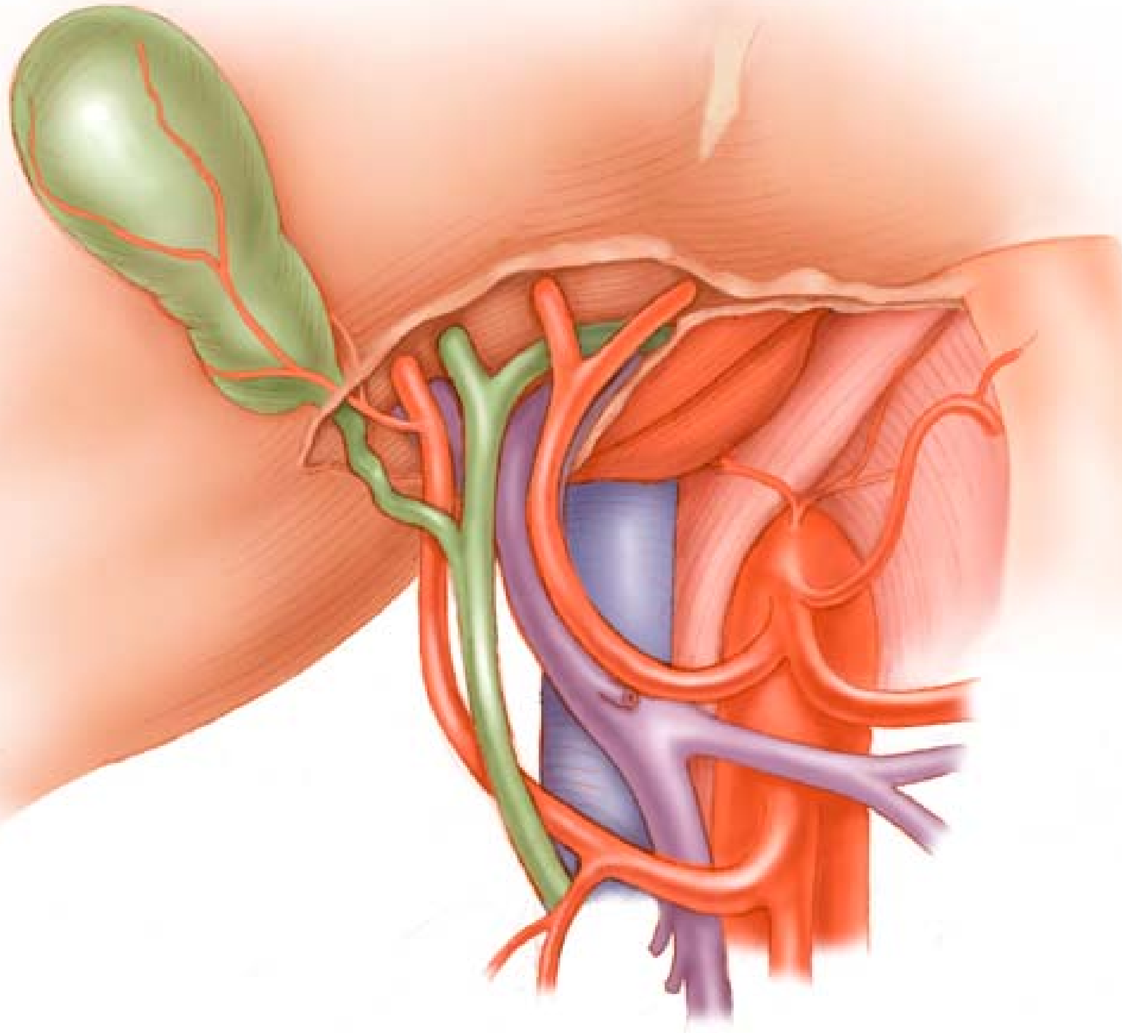
Caval dissection

Hilar dissection with intra-operative cholangiogram

Parenchymal dissection



Donor Surgery



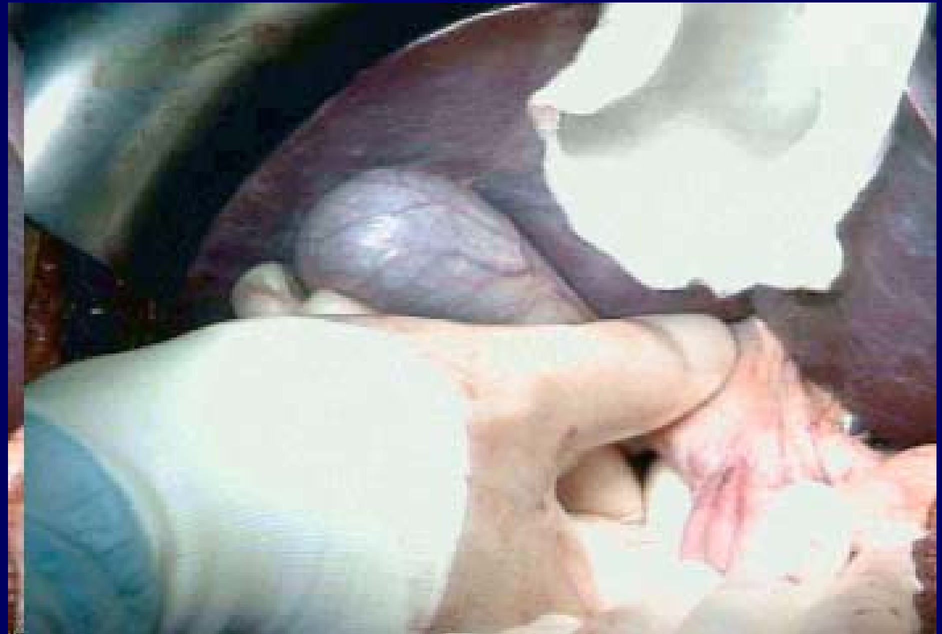
Hilar Dissection

Donor Surgery

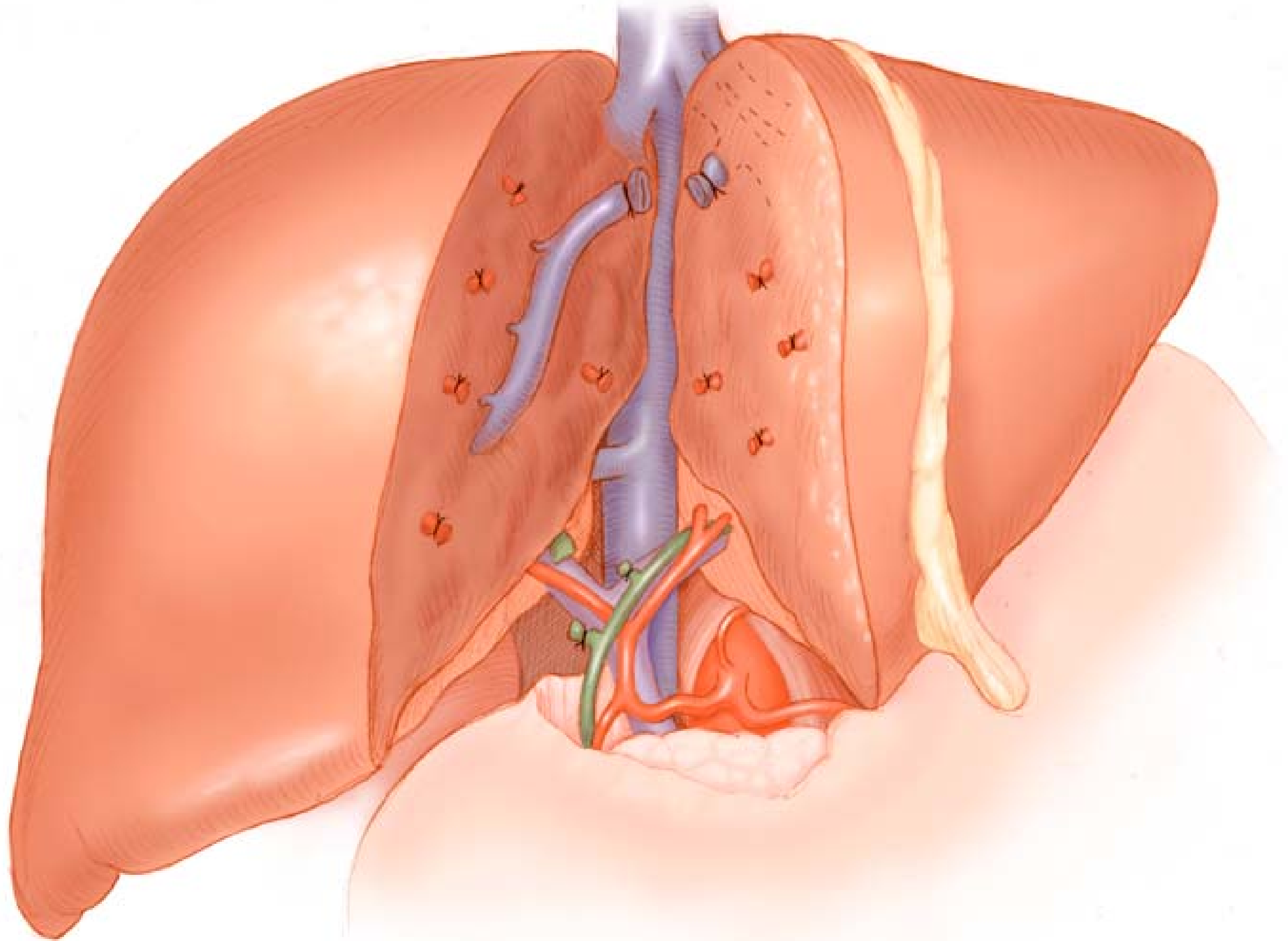
Caval dissection

Hilar dissection

Parenchymal dissection



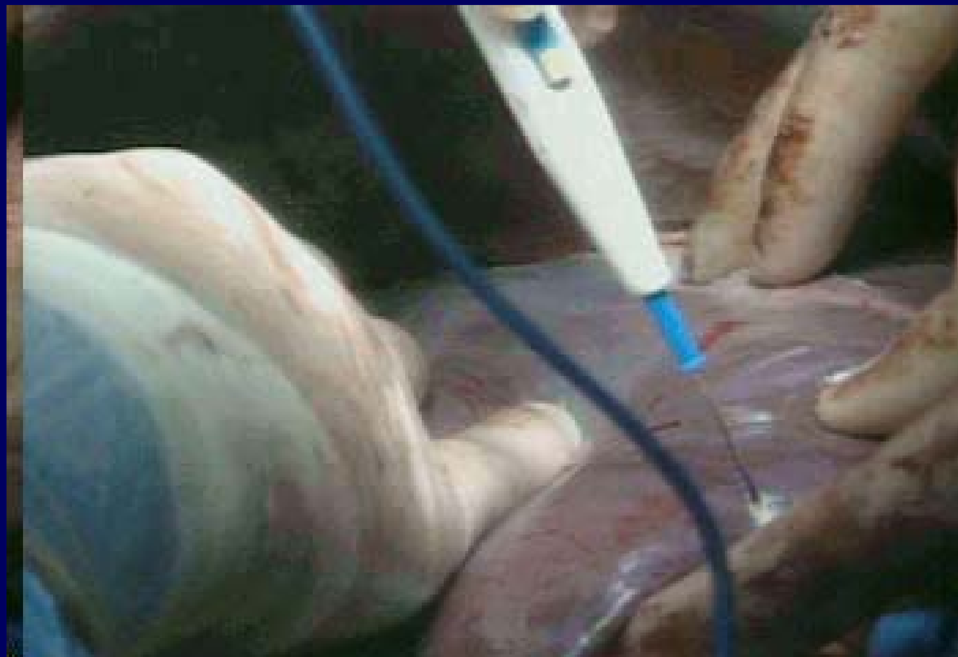
Donor Surgery

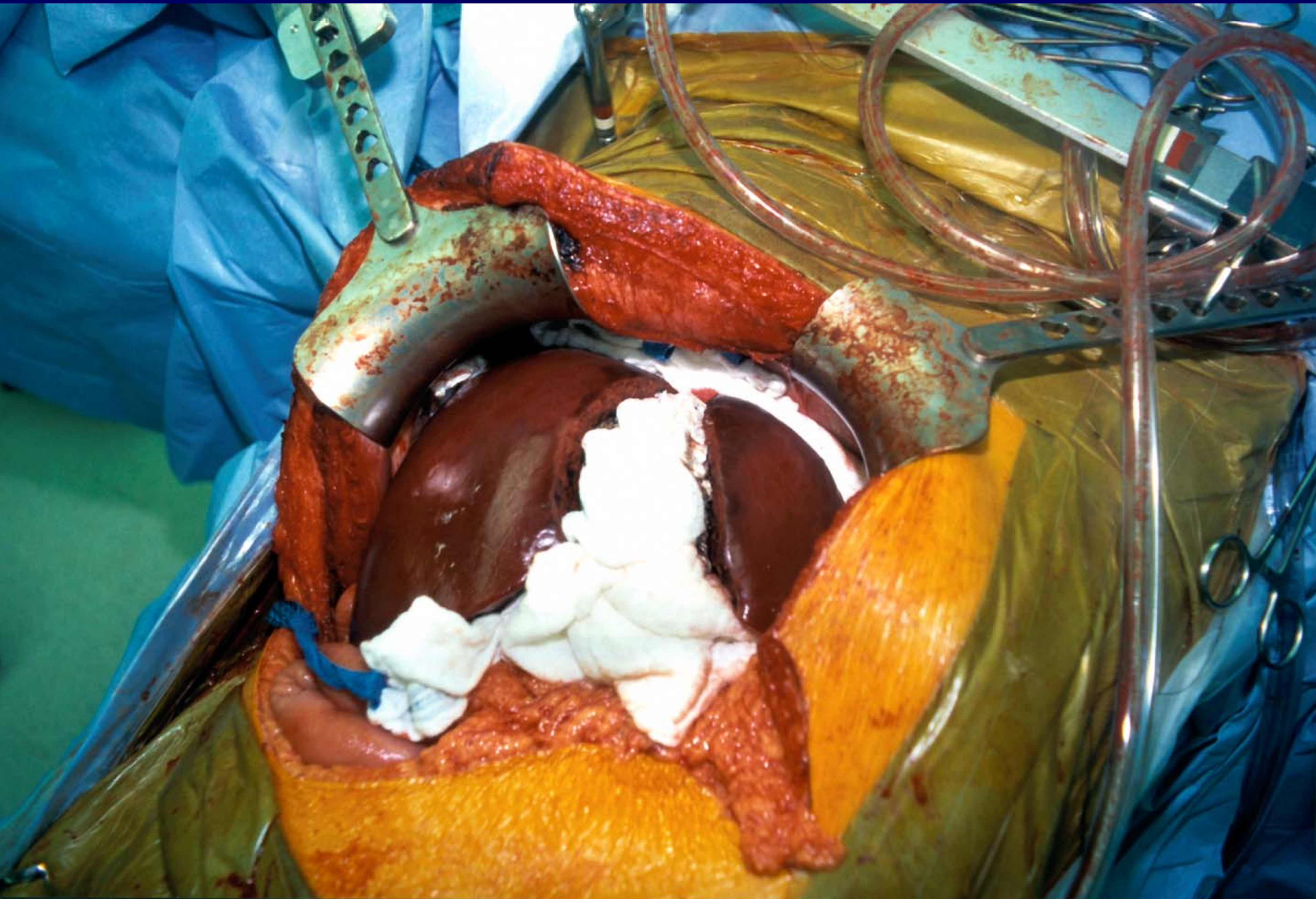


Parenchymal dissection

Donor Surgery

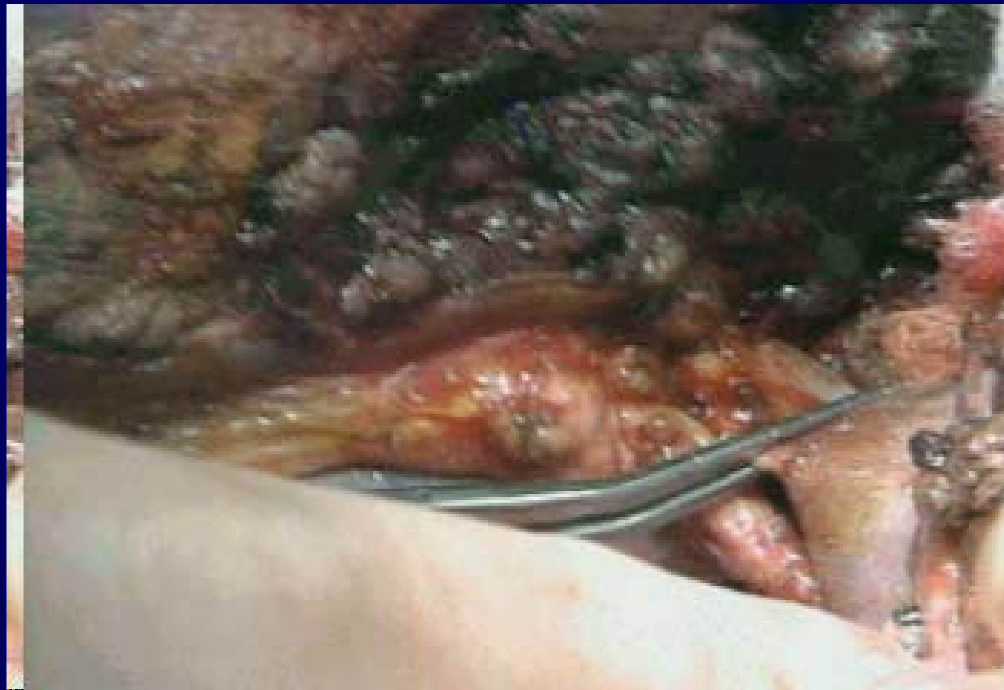
- Caval dissection
- Hilar dissection with intra-operative cholangiogram
- Parenchymal dissection





Removal of Donor Liver

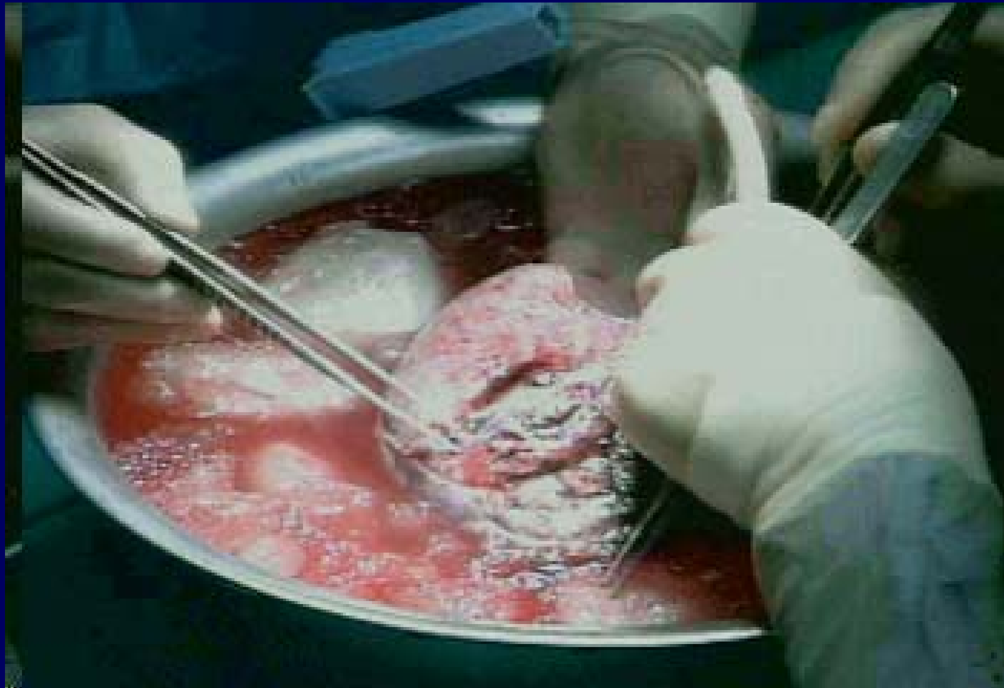
- Clamping of vessels
- Removal of right lobe



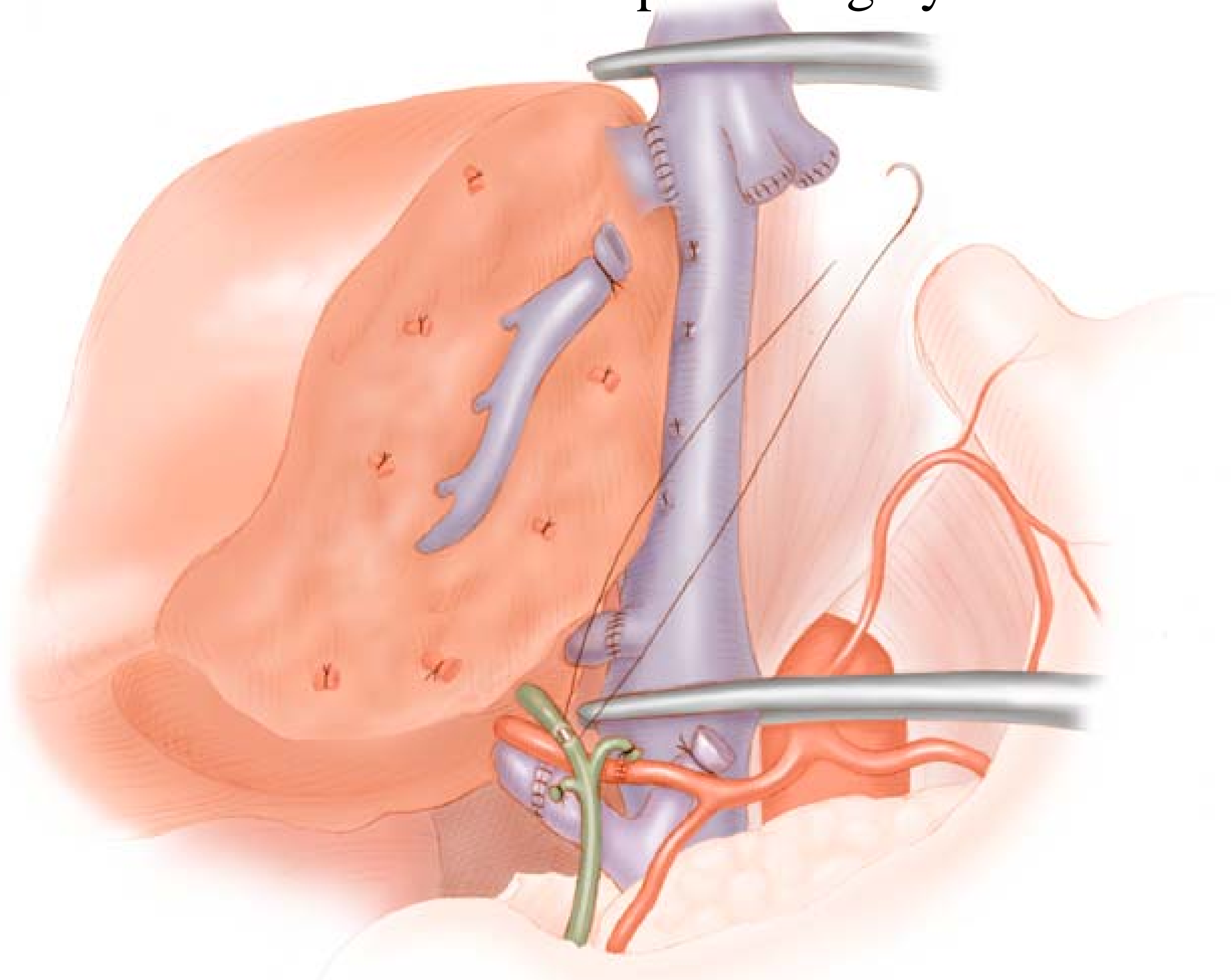
Back table preparation

Liver cold preservation

Dissection of vessels

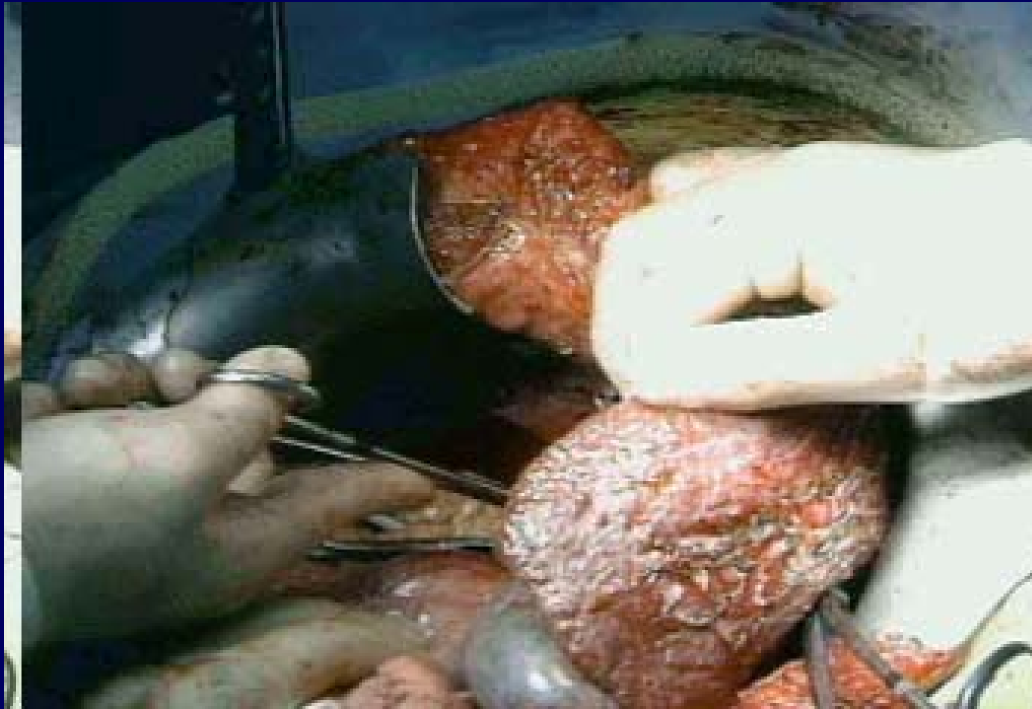


Recipient Surgery

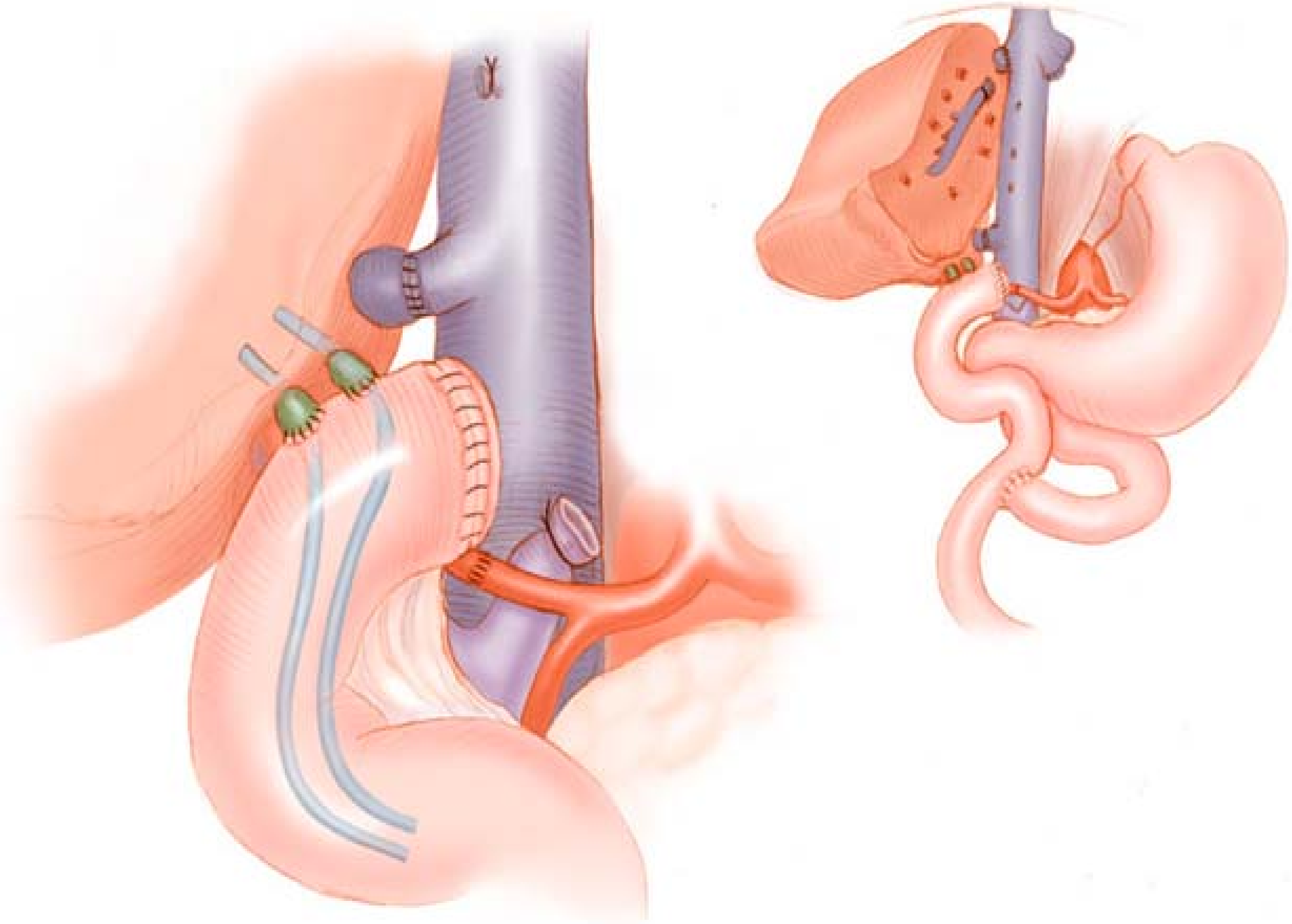


Recipient Surgery

- Recipient hepatectomy
- Vascular anastomoses
- Bile duct anastomoses



Hepatico- Jejunostomy



CU LDLT Experience

90
83
87
66
69
65
74
76
76
80

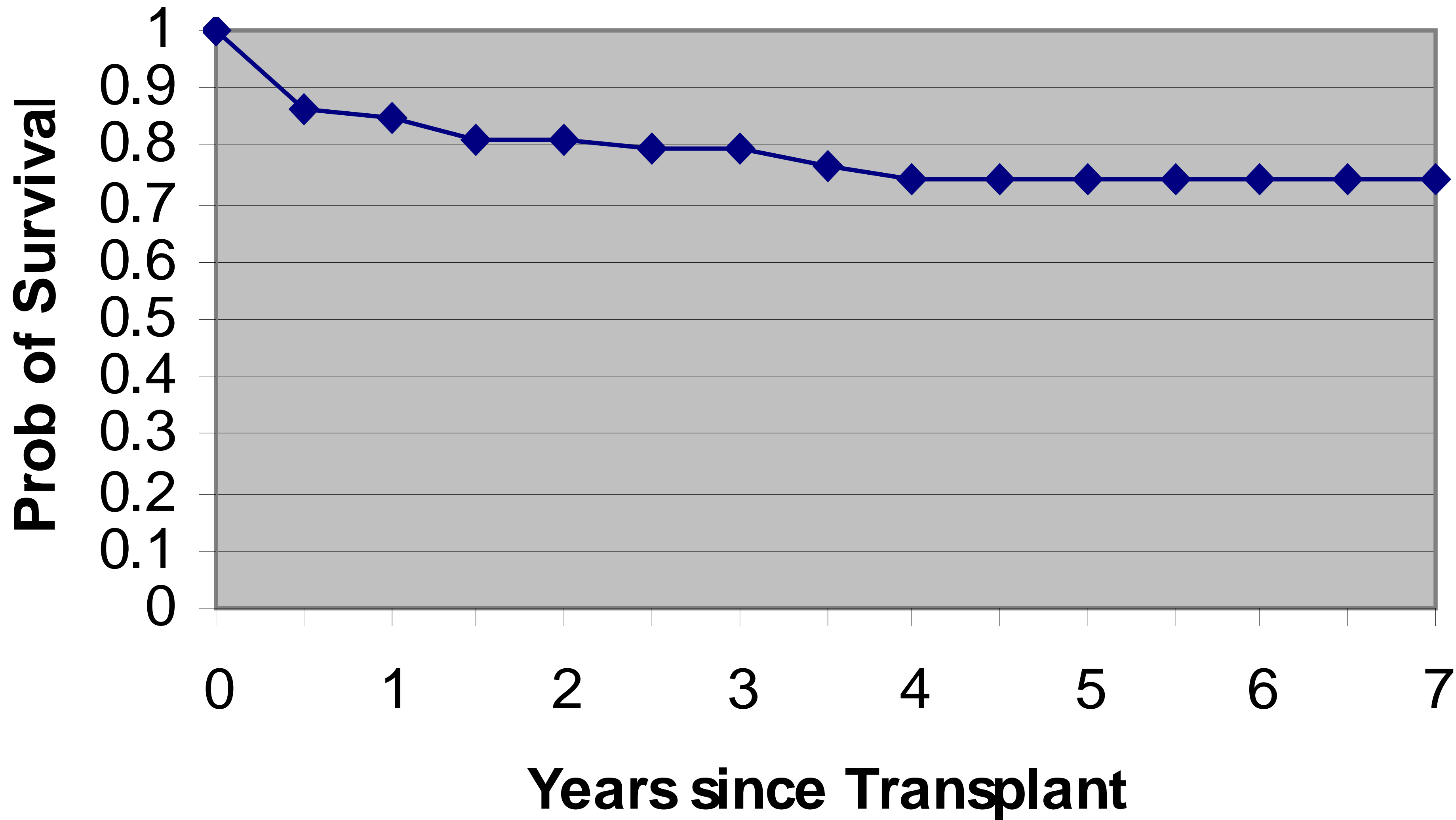
100
90
80
70
60
50
40
30
20
10
0

95
97
99
2001
2003

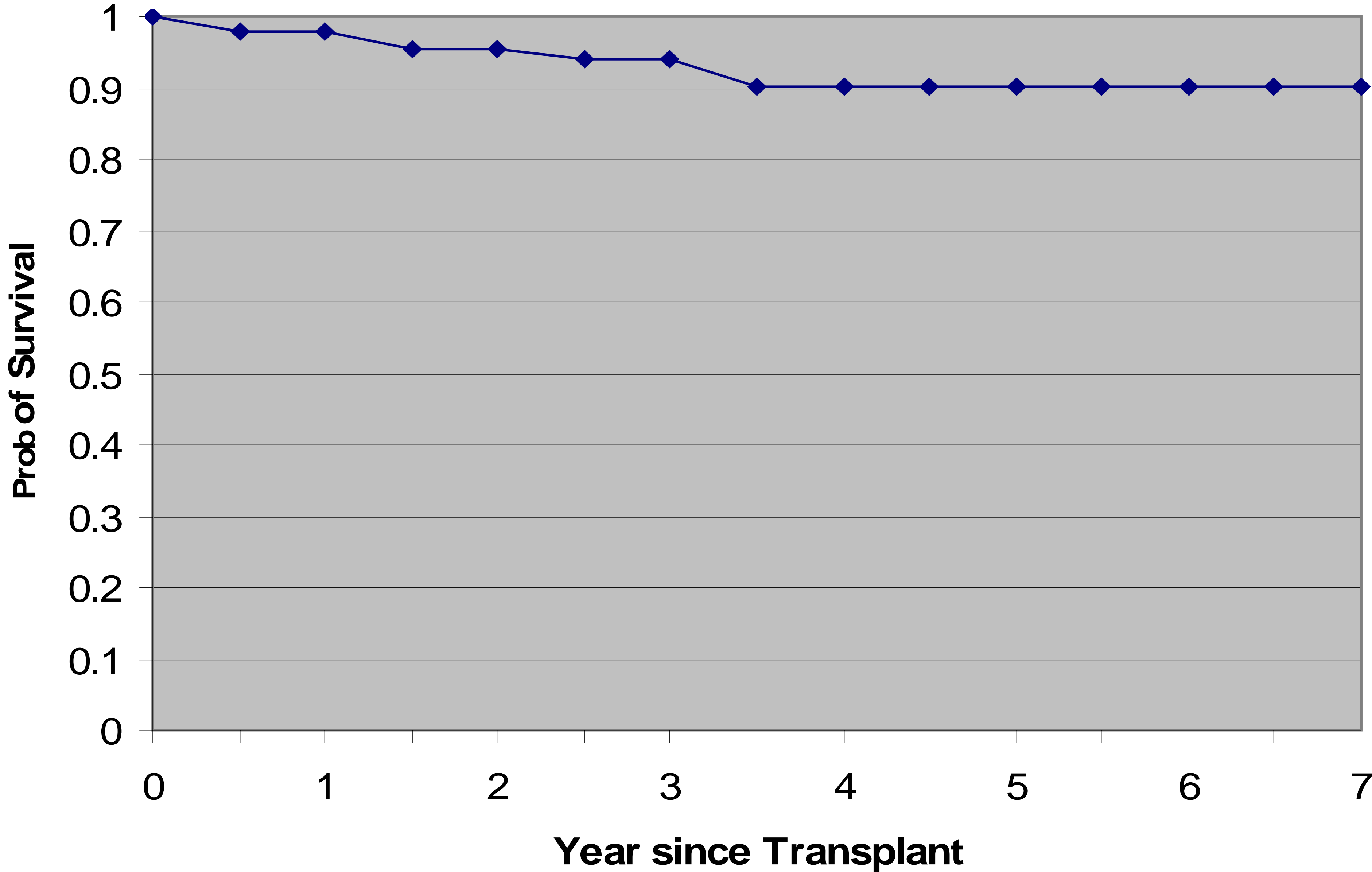
Year

LDLT
OLT-Adult
OLT-Pediatric

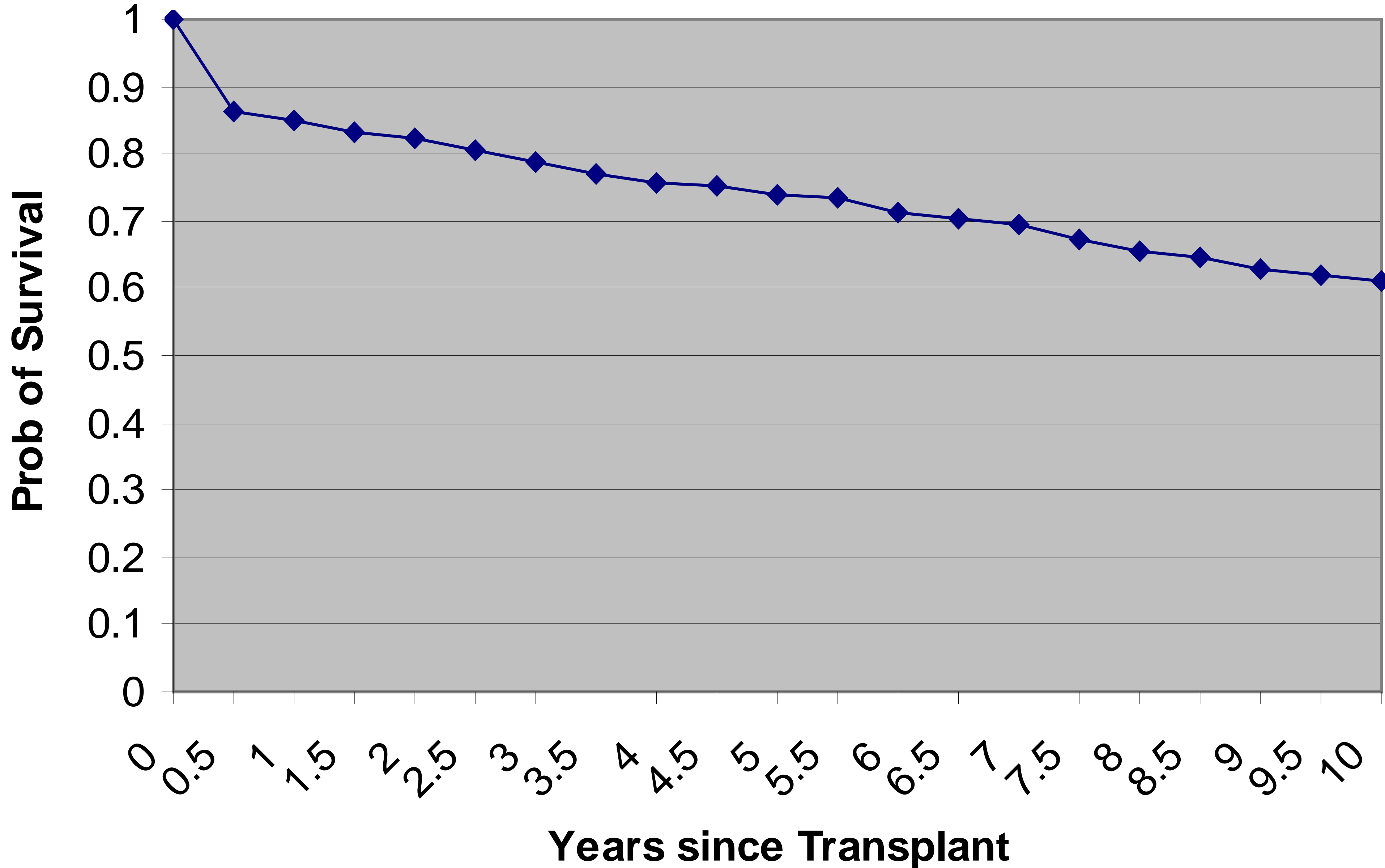
Graft Survival LDLT 12-04

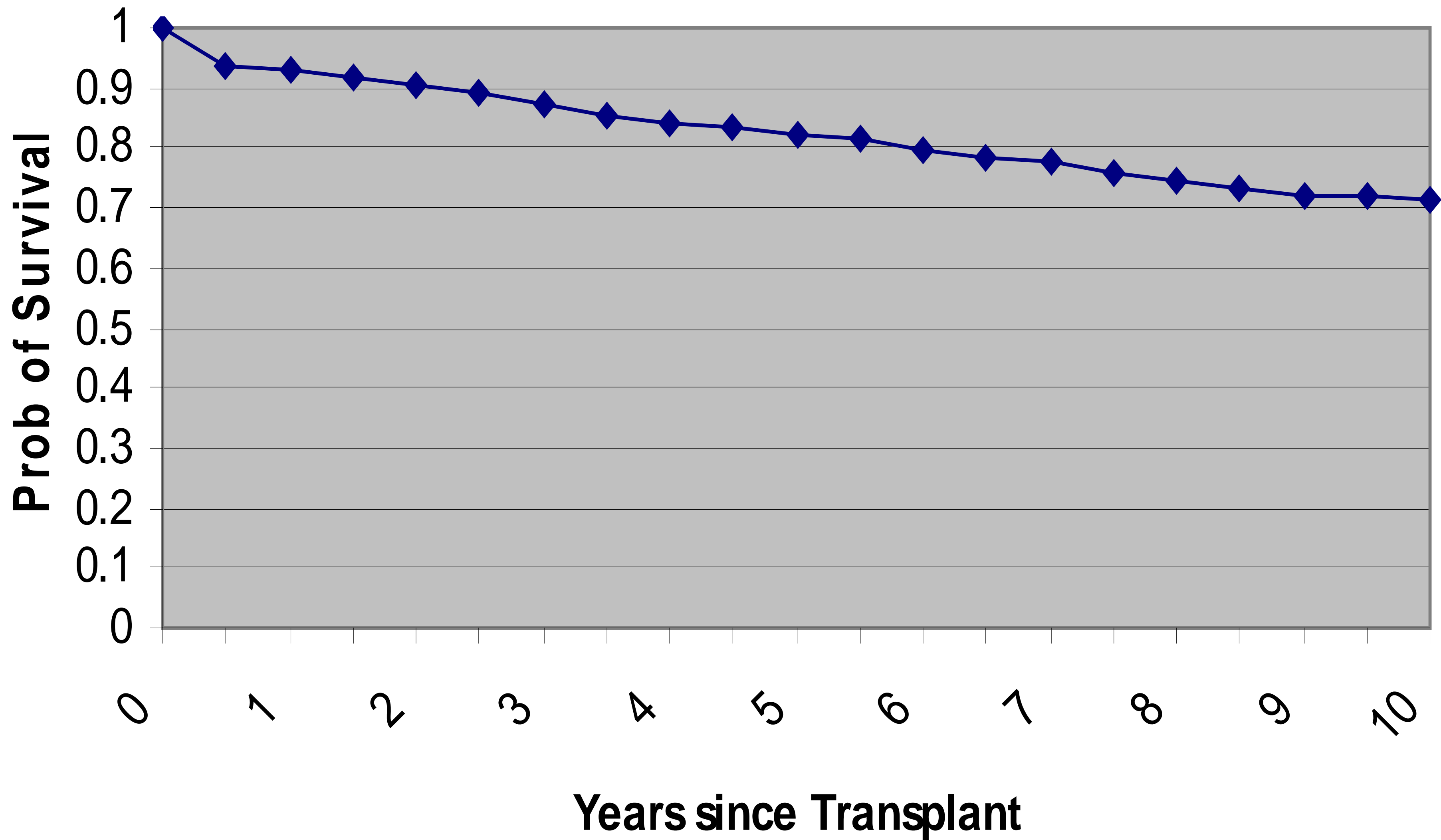


Patient Survival LDLT 12-04



Graft Survival Cadaveric 12-04




Patient Survival Cadaveric 12-04
Prob of Survival
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
1
2
3
4
5
6
7
8
9
10
Years since Transplant

U.S. LDLT volume

pts

600
500
400
300
200
100
0

adult

pediatric

Donor death

X

89 90 92 94 96 98 2000 2001 2002 2003 2004

yr

First ALDLT

Donor Mortality in LDLT

• Pediatric LDLT:	2/1500	0.13%
• Adult LDLT:	2/1000	0.20%

Conclusions

- Adult living donor liver transplant is safe and effective with careful donor and recipient selection.
- Application of this technique to some patients with end stage liver disease may significantly decrease waiting list mortality.
- Right lobe grafts provide adequate liver volume
- Right lobe grafts allow for easier vascular anastamoses .
- Right hepatectomy is well tolerated in the donor.

Conclusions

- Bile duct complications still remain the Achilles heal of this procedure.

- More studies need to be done to assess the impact of this procedure on the outcome of liver transplant.

Conclusions

- Absolute contraindication:
- Lack of team experience in major liver surgery

Son presents mother with gift of life

Family celebrates living donor transplant

By Angie DeVine
Special to The Denver Post

Matthew Speed can't remember what he gave his mother for Christmas last year, but he knows he won't ever forget his gift to her this year.

That's because this Christmas, 19-year-old Matthew gave his mom half of his healthy liver as a replacement for her own deteriorating organ.

"He gave me the Garth Brooks box set last year," mom Cindy Speed remembered. "This definitely tops it."

Cindy, 42, was diagnosed three years ago with primary sclerosing cholangitis, a liver disease with an unknown cause that traps bile in the liver and damages liver cells. Medication helped control the disease until October, when her health took a turn for the worse and forced her to look into a liver transplant.

Cindy, a sixth-grade music teacher in Billings, Mont., might not have survived the wait for a donor liver. But Matthew, a Marine lance corporal, became a candidate to help when doctors determined the two had the same blood type. So, the Speeds traveled to Denver from Billings this week for a holiday transplant at University Hospital, one of 20 institutions in the country that performs living donor transplants.

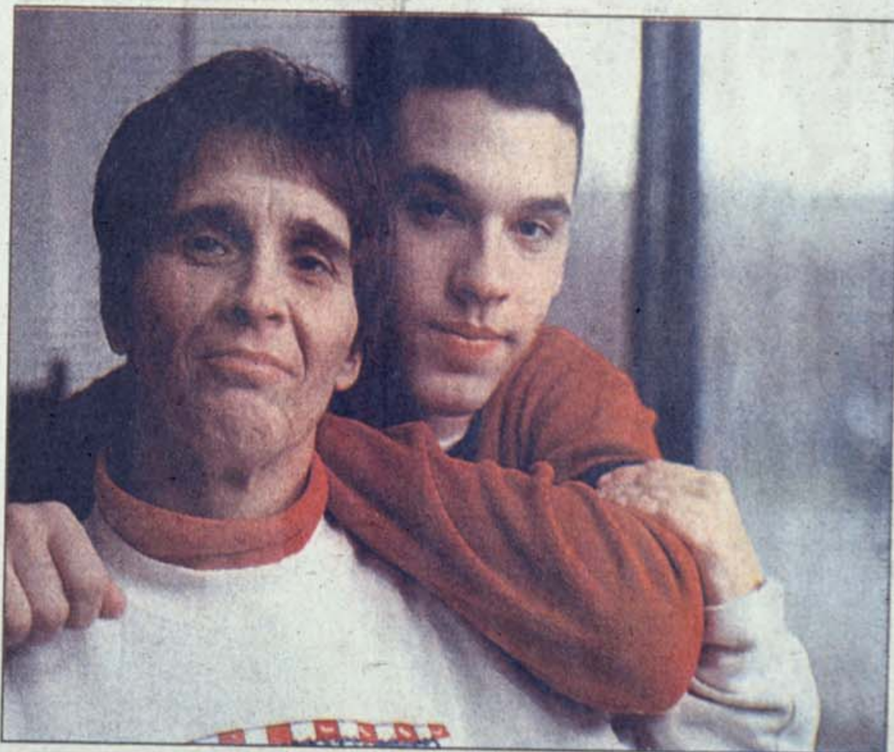
The operations took place on Tuesday. Cindy was in surgery for seven hours while her liver was removed and the right lobe of Matthew's was put in place. Matthew was in surgery for almost six hours. Both the donor and recipient pieces should grow into full organs because of the liver's ability to regenerate itself, said Dr. Igal Kam, head of transplant surgery at University, which began performing the surgery two years ago. Kam was Matthew's surgeon. Cindy's surgeon was Dr. Michael Wachs, also of University.

Between 10 and 15 percent of patients waiting for transplants die before organs become available, Kam said. Cindy's "chances of getting a donated liver in time could have been a problem," he said.

"Living donor transplants have opened a new era in liver transplants because they lower the waiting time and cut the mortality rate of people on the waiting list."

Beating those odds has left Cindy, and her family back in Billings, feeling thank-

Please see TRANSPLANT on 18A



Special to The Denver Post / Kristi Guerrrero

Marine Matthew Speed left his assignment in Egypt to fly to Denver's University Hospital and donate part of his liver to his mother Cindy, a Billings, Mont., resident.

Living Donation Saved My Life

A Success Story About Life and the Living Donor Liver Transplant Program at the University of Colorado Hospital

After 13 years of suffering from liver disease, my health just nose-dived. I was on the transplant waiting list, but it was unlikely that a liver from a deceased person would be found in time.

When my wife Marcia and I learned of the Living Donor Liver Transplant Program at University of Colorado Hospital in Denver, we knew it was probably my only chance for survival. Marcia immediately stepped forward as my donor and, as fate would have it, she was a perfect match.

Thanks to my wife and the expert care I received at University of Colorado Hospital, I now have a second chance at life. Marcia and I also have the honor of being the 70th living liver transplant donor and recipient at University of Colorado Hospital.

Organ donation is a gift of life. Never underestimate its value.

– Rich Gavigan, Fruita, Colorado

UNIVERSITY OF COLORADO HOSPITAL

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For information on living donation, please call 1-800-874-0089 or visit uch.uchsc.edu/sotx/

Demonstrations against the MHV reconstruction in ALDLT

Demonstrations against the MHV reconstruction in ALDLT