Human Orthotopic Liver Transplantation: Surgical Aspects in 393 Consecutive Grafts

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RESULTS of orthotopic liver transplantation (OLT) have dramatically improved due to better immunosuppression and to standardization of surgical techniques.[1,2] Technical problems are, however, still responsible for significant postoperative morbidity and mortality.[3]

MATERIALS AND METHODS

Between March 1, 1980, and December 31, 1984, 313 patients including 177 adults and 136 children received a primary OLT under the cyclosporine-steroid regimen. Sixty-eight patients underwent a second transplant during the same time period; 12 required a third tranplant.

All patients were followed for at least 1 year after OLT or until death. The intraoperative and perioperative mortality rate is 3.8% (12 of 313 patients). Two hundred eighty patients (89.4%) lived for more than 3 months postoperatively. The techniques of donor and recipient operations have been thoroughly described.[4,5] Technical adjustments were necessary in nine (2.9%) and 51 (16.3%) recipients presenting with preexisting inferior caval and portal vein (PV) abnormalities, respectively.[6] In case of caval vein abnormalities the recipient operation is actually simpler than usual. In case of PV thrombosis (PVT) or hypoplasia, OLT is made possible by thrombectomy or by retrograde dissection of the abnormal vessel to the splenomesenteric confluence.

In five patients portal inflow was restored after interposition of a free vein graft. Fourteen (66.6%) of 21 patients who underwent previous operations on the PV and the splanchnic circulation had a major abnormality of the PV. Four patients died, and three developed PVT after OLT as a direct consequence of these abnormalities.

Ninety of the 393 (22.9%) allografts had a complex arterial reconstruction consisting of the use of an iliac graft (39 times), a fold-over technique[7] (26 times), and abdominal (14 times) and thoracic (eight times) aortic conduits.[8] In three patients the use of an iliac graft was combined with the fold-over technique.[2]

Biliary reconstruction consisted of primary choledochocholedochostomy over a T tube (CC-T) if both donor and recipient ducts were suitable. If preexisting biliary tract disease, or inadequate or mismatched size of the bile ducts does not permit a direct duct-to-duct anastomosis or the introduction of T tube, a choledochojejunostomy over an internal stent (RYCJ-S) is performed.[9]

Other methods of biliary tract reconstruction are rarely used anymore because of high complication rates.

RESULTS

Technical complications occurred in 92 of the 393 (24.4%) grafts and were responsible for the loss of 41 grafts (10.4%) and 26 patients (8.3%). Twenty-six retransplantations (re-OLT) were performed for technical failures of a previous graft, 15 of which were successful (Table 1).

Biliary tract complications (BTC) occurred in 52 of 393 grafts (13.3%) and thus accounted for 56.5% of the 92 technical failures. There were 17 failures in pediatric grafts (10.0%) and 35 failures in adult grafts (16.2%). The incidence of BTC has declined significantly from 24.4% during 1980 to 1982 to 8% in 1984.[9] BTC are described in Table 2 according to the technique of reconstruction. Biliary leakage occurs most frequently and is mainly revealed by septicemia. Eleven leaks at the T tube exit site of CC-T were simply closed or drained. Anastomotic leakage resulted in four deaths and one regrafting. Conversion of a leaking CC to an RYCJ-S was successful in five of seven patients.

Seven obstructions of CC resolved after transcutaneous or surgical removal of the T tube or internal stent.

Percutaneous balloon dilation (PBD) of an obstructed CC resulted twice in delayed stone formation of the bile duct; in a third patient conversion to RYCJ-S was necessary because of a recurrent stricture.

The smallest and youngest children had the lowest complication rate. They nearly all had

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Table 1. Technical Complications in 393 OLTs

Complication	Grafts (393)	Patients (313)	Re-OLTs		Deaths	
			Successful	Failed	Unrelated	Related
Biliary tract	52* (13.2%)	52* (16.6%)	3	1	2	5 (9.6%)
HAT	27† (6.8%)	25†‡ (7.9%)	11	8	—	16‡ (64.0%)
Hepatic artery aneurysm	4 (1.9%)	4‡ (1.2%)	—	—	—	3‡ (75.0%)
PVT	6 (1.5%)	6 (1.9%)	—	1	1	2 (40.0%)
PV stenosis	2*† (0.5%)	2*† (0.6%)	—	—	—	—
PV and inferior vena cava thrombosis	1 (0.3%)	1 (0.3%)	1	—	—	—
Inferior vena thrombosis	2 (0.5%)	2 (0.6%)	—	1	1	1 (50.0%)
Total	92 (24.4%)	89 (28.4%)	15	11§	4§	26§ (8.3%)

Abbreviation: HAT, hepatic artery thrombosis.

*,†,‡Same patients.

§Graft loss, 41 of 393 (10.4%).

an RYCJ-S, the method yielding the lowest morbidity (5.2%) and 0% mortality rates.

BTC were directly responsible for five deaths (9.6%, 5/52 patients); four patients required re-OLT (4/52 patients, 7.7%).

Hepatic artery thrombosis (HAT) after OLT occurred in 25 patients and 27 grafts (6.8%) (Table 3). Three adults and three children had a massive hepatic necrosis. They all died despite re-OLT in three (100% mortality).

Eight patients with nine grafts developed a delayed bile leak. Three of six had a successful regraft and both unsuccessful regraft patients died of septicemia (mortality, 62.5%, five of eight patients).

Relapsing bacteremia after HAT occurred in nine children and three adults. Four of nine re-OLT and one of the three conservatively managed recipients died (mortality, 45%, 5/12 patients). A child presenting with a late stricture of RYCJ-S was successfully treated by PBD.

HAT is much more frequent in the pediatric age group (19/177 grafts [10.7%] *v* 8/216 [3.7%] in adults) and in the group of patients having a complex vascular reconstruction (15/90 grafts [16.6%] *v* 12/295 grafts [4%] with simple arterialization). Nineteen (23.2%) of the 82 re-OLT were done in 18 patients because of HAT. Eight (44.4%) survived, one died of a mycotic aneurysm, and

Table 2. Primary BTC According to Technique of Reconstruction

Parameter	Reconstruction					
	RYCJ-S	CC-T	CC-S*	Waddell-Calne	Cholecystoenterostomy	External Drainage
n	175	159	32	6	7	5
Successes	166 (94.8%)	139 (87.4%)	18 (56.2%)	5 (83.4%)	1 (14.3%)	—
Failures	9 (5.1%)	20 (12.6%)	14 (43.8%)	1 (16.6%)	6 (85.7%)	2 (40%)
Obstruction	4 (2.2%)	5 (3.1%)	5	—	5	1
Leakage		15 (9.4%)				
Anastomotic	3 (1.7%)	4 (2.5%)	7	—	—	—
Exit Site T tube	—	11 (6.9%)		—	—	—
Hemobilia	—	—	2	—	—	1
Bile Casting	1 (0.6%)	—		—	—	—
Torsion Roux Limb	1 (0.6%)	—	—	—	—	—
Intrahepatic Stricture	1 (0.6%)	—		—	—	—
Mortality	0%	2 (1.2%)	2 (1.2%)	—	1 (0.6%)	—

NOTE: RYCJ-S and CC-T reconstruction has a success rate of 92%. The other four reconstruction techniques are rarely used.

*CC with internal stent was only used in adolescents.

Table 3. Hepatic Artery Thrombosis and OLT

		Outcome	
	Grafts	Re-OLT	Death
Fulminant hepatic failure	6	3	6
Biliary leak	9**	7	5‡§
Relapsing bacteremia	12*†	9	5§
Total	27	19/27 grafts	16/25 recipients
	(6.8%)	(7)%)	(64%)

*†Same patients.
‡Death due to primary nonfunction of the second graft.
§Death due to late rupture of mycotic aneurysm.

two died because of a primary nonfunctioning of the second graft. Two (28%) of the seven non–re-OLT patients survived their complication. Despite the high re-OLT rate (19/27 grafts, 70%) the mortality of HAT was considerable (64%, 16/25 patients).

Three (1%) of four patients with an aneurysm of the allograft arterial supply died of delayed rupture (75%); the fourth had a successful vascular repair. Seven (2.2%) patients developed a PVT after OLT (Table 4). Four patients had satisfactory early convalescence. The diagnosis was made when evidence of portal hypertension including variceal hemorrhage, persistance of esophageal varices, splenomegaly, and hypersplenism developed. Revision of the portal anastomosis, sclerotherapy, and a splenorenal shunt were necessary to control esophageal varices.

One patient had a preexisting thrombosis of portal, splenic, and mesenteric veins. At the time of OLT thrombectomy was possible. Bleeding esophageal varices were initially controlled with sclerotherapy. He died 14 months later of acute liver failure; at necropsy the portal and superior mesenteric veins had clotted.

The other three patients developed acute liver failure; two received re-OLT early. One child, presenting both PVT and caval vein thrombosis (CVT), survived. Four of the seven patients whose portal vein clotted are still alive 3 to 5 years later (mortality, 42.8% [three of seven recipients]). Three have their original grafts, and one was rescued with re-OLT (graft loss, 57% [four of seven grafts]). Three inferior CVT after OLT originated at lower vena cava anastomoses that were performed under poor technical conditions. All three patients presented with a liver failure associated once to a renal failure and a lower caval vein syndrome. Two patients

Table 4. Venous Thrombosis and OLT

		Outcome		
	Grafts	Therapy	re-OLT	Death
PV				
Persistent	4	Sclerotherapy, 2		1
Recurrent		Splenorenal shunt, 1		
Portal hypertension		Phlebothrombectomy, 1		
Liver failure	3		2*	2
	7		2/7	3/7 recipients
	(1.8%)		(28.5%)	(42.8%)
Inferior Caval Vein				
Liver failure	2		1*	1
Hepatorenal failure, lower caval syndrome	1		1	1
	3		2/3	2/3 recipients
	(0.9%)			(66.6%)

*Same child successfully received re-OLT retransplanted for both CVT and PVT.

received re-OLT; only the one child presenting both PVT and CVT survived (mortality, 66% [two of three recipients]; graft loss, 100%) (Table 4).

DISCUSSION

Surgical technical complications remain in important cause of morbidity and mortality after OLT.[3] Restriction of the biliary tract reconstruction to CC-T and RYCJ-S reduced the incidence of BTC.[1,9] CC-T is the ideal method of reconstruction in the recipient with a normal native bile duct. The exit site of the T tube must be secured to avoid later leakage.[9] In case of bile leakage simple drainage or suture of the exit site will suffice. Anastomotic leakage after CC is uncommon and must be treated by conversion to RYCJ-S. Obstruction of CC must be treated by conversion to RYCJ-S. PBD indeed only has a temporary benefit. If the recipient duct is diseased or inadequate, RYCJ-S is the best alternative. This method is the most reliable method of biliary tract reconstruction in OLT (success rate, 95%). Anastomotic leakage is very rare; functional obstruction by a retained internal stent may necessitate surgical removal.

Primary BTC must be differentiated from secondary (to HAT) complications because of their completely different management and outcome. Primary BTC can usually be managed by primary repair or conversion of the anastomosis; treatment of secondary BTC, however, nearly always consists of re-OLT.[3,9] HAT of the allograft is one of the most devastating complications of OLT.[3,10] The considerable mortality of HAT, despite the high re-OLT rate, is due to a major delay in diagnosis and regrafting. Awareness of the three different types of clinical presentation of liver graft dearterialization, eg, fulminant liver necrosis, delayed bile leakage, and relapsing bacteremia, is of utmost importance. If HAT is suspected, Doppler ultrasound and/or angiography must be performed without hesitation. This is especially true in pediatric patients and patients having a complex vascular reconstruction, because they have a higher risk of developing HAT.[10] Treatment of HAT nearly invariably consists of an early re-OLT. A decision to delay re-OLT may only be considered in patients having stable liver function and well-controlled relapsing bacteremia.[10]

Aneurysms of the hepatic arterial supply occur seldom; prompt vascular repair or regrafting is necessary to avoid late fatal rupture.[3]

Postoperative inferior CVT and PVT are rare and occur nearly always in pediatric recipients. Patients submitted to previous surgery of the PV or splanchnic circulation are at high risk. Allograft PVT is manifested by persistent or recurrent portal hypertension and/or liver failure. In case of liver failure urgent regrafting is mandatory; if liver function remains normal, conventional treatment of portal hypertension can be sufficient. CVT is manifested by liver failure, which is eventually associated with renal failure or lower caval vein syndrome. Prompt re-OLT represents the only chance to rescue a patient presenting with this complication.

REFERENCES

1. Starzl TE, Iwatsuki S, Shaw BW Jr, et al: Transplant Proc 17:107, 1985 (suppl 2)

2. Starzl TE, Iwatsuki SI, Esquivel CO, et al: Semin Liver Dis 1985, 5:349, 1985

3. Gordon RD, Makowka L, Bronsther MO, et al: In Toledo-Pereyra LH (ed): In Complications of Organ Transplantation. New York, Dekker, 1987, p 329

4. Starzl TE: In Starzl TE, Putnam CW (eds): Experience in Hepatic Transplantation. Philadelphia, Saunders, 1969, p 112

5. Starzl TE, Hakala TR, Shaw BW Jr, et al: Surg Gynecol Obstet 158:223, 1984

6. Lerut J, Tzakis A, Bron K, et al: Ann Surg 205:404, 1987

7. Shaw BW Jr, Iwatsuki S, Starzl TE: Surg Gynecol Obstet 159:490, 1984

8. Gordon RD, Shaw BW Jr, Iwatsuki S, et al: Surg Gynecol Obstet 160:474, 1985

9. Lerut J, Gordon RD, Iwatsuki S, et al: Transplantation 43:47, 1987

10. Tzakis AG, Gordon RD, Shaw BW Jr, et al: Transplantation 40:667, 1985