Modified hepatic outflow tract reconstruction in piggyback liver transplantation

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OBJECTIVE: To summarize the experience in modified reconstruction of the hepatic outflow tract during piggyback liver transplantation at our hospital.

METHODS: The clinical data on 67 patients undergoing piggyback liver transplantation with modified hepatic outflow tract reconstruction from January 1999 to October 2002 were analyzed retrospectively.

RESULTS: In this group, 7 patients (10.45%) died perioperatively. Complications included: pulmonary infection (38 patients); multiple organ system failure (10), intraperitoneal bleeding (6), acute respiratory distress syndrome (14), thrombosis of the hepatic artery (1), and bile leakage (1). No hepatic outflow occluded. Two recipients survived for over 3 years, 8 over 2 years, and 19 over a year.

CONCLUSION: Modified hepatic outflow reconstruction in piggyback liver transplantation may increase the success rate of liver transplantation and decrease technical complications.

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Key words: piggyback liver transplantation; hepatic outflow tract; reconstruction

Introduction

Liver transplantation has been widely adopted in the treatment of patients with end-stage liver diseases worldwide and piggyback liver transplantation is a favorite choice because of its advantage that the inferior vena cava can be kept intact in the period after removal of the liver. But traditional reconstruction of the superior and inferior vena cava and hepatic vein in piggyback liver transplantation is easy to induce outflow occlusion. That is why piggyback liver transplantation has not been well utilized in China.[1-3] To improve the operative procedures of piggyback liver transplantation is essential to the progress of liver transplantation in China. We present our experience in outflow reconstruction in piggyback liver transplantation.

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Methods

Patients

General information

This group comprised 67 patients, 60 men and 7 women, aged from 18 to 69 years (average 43.6). Their blood types were as follows: O: 21 patients; A, 23; B, 13; and AB, 10. Emergency liver transplantation was performed in 15 patients, selective operation in 50, combined liver-kidney transplantation in different stage in 1, and combined liver-spleen-duodenum transplantation in 1. Blood type of donors and recipients was the same in 53 patients. Different blood type but unified blood transfusion principle was noted in 14 patients.

Hepatic function before operation (Tables 1 and 2)

Hepatic function before operation was evalua-

Table 1. Hepatic function of 67 patients before piggyback liver transplantation (Child-Pugh scores)

Child-Pugh scores	Patients	Ratio (%)
A (4)	6	8.96
B (5–8)	20	29.85
C (9–12)	41	61.19

Table 2. Hepatic function of 67 patients before piggyback liver transplantation (UNOS status)

UNOS status	Patients	Ratio (%)
1	15	22.39
2A	20	29.85
2B	16	23.88
3	10	14.93
7	6	8.96

Table 3. Primary diseases and output of 67 patients undergoing piggyback liver transplantation

Primary disease	Patients	Perioperative death	Mortality (%)
Fulminant hepatic failure	8	2	25
Chronic severe hepatitis B	13	2	16
Posthepatitis cirrhosis	20	1	5
Alcoholic cirrhosis	3	0	0
Drug-induced cirrhosis	1	0	0
Biliary cirrhosis	3	0	0
Caroli's disease with biliary cirrhosis	1	1	100
Hepatic echinococcosis	2	0	0
Amyloidosis of liver and kidney	1	0	0
Hepatic cirrhosis with cancer	5	0	0
Hepatocellular carcinoma	10	1	10

ted with Child-Pugh scores and united network for organ sharing (UNOS) status.

Primary diseases

Primary diseases included acute severe hepatic failure, chronic severe hepatitis B, posthepatitis cirrhosis, alcoholic cirrhosis, drug-induced cirrhosis, Caroli's disease with biliary cirrhosis, and amyloidosis of the liver and hepatocellular carcinoma. In 5 patients with posthepatitis cirrhosis, hyperplastic nodes were found operatively in the liver, and proved to be malignant pathologically. 54 patients showed HBV marker positive (Table 3).

Surgical procedures

Graft harvesting

Donor liver was cut and dual-way infused with 1000–2000 ml UW (University of Wisconcin, USA) fluid. Warm ischemic time was less than 10 minutes, and cold ischemic time less than 12 hours.

Reconstruction of the blood outflow tract

Two methods were used. First, end-to-end anastomosis was made between the suprahepatic inferior vena cava of the donor liver and the hepatic veins of the recipient liver (Figs. 1 and 2). Three hepatic veins of the recipient were trimmed with a shared open end of 5 mm in length, while the suprahepatic inferior vena cava was trimmed just close to the upper edge of the donor liver. In this way, no twist will happen after anastomosis. Second, side-to-side anastomosis of the inferior vena cava of the donor and recipient livers (Figs. 3–6) was made to suture both ends of the inferior vena cava of the donor liver, partially block the recipient's inferior vena cava, and make a 6-cm longitudinal oval incision at the front wall of the recipient's inferior vena cava and the back wall of the donor liver's vena cava. The upper end of the incision must be close to the junction of the main hepatic vein and the inferior vena cava. In 13 patients, the trimmed left, middle, right hepatic veins were anastomosed end-to-end with the suprahepatic inferior vena cava of the donor liver. In 4 patients, the trimmed left, middle hepatic veins were anastomosed end-to-end with the suprahepatic inferior vena cava of the donor liver. In 1 patient, the trimmed right, middle hepatic veins were anastomosed end-to-end with the suprahepatic inferior vena cava of the donor liver. In 49 patients, the inferior vena cava of the donor and recipient livers were anastomosed side-by-side.

Results

Perioperative death

Seven perioperative deaths (10.45%) were due to multiple organ system failure (5), acute respiratory distress syndrome and stress ulcer (1), and disseminated intravascular coagulation (1).

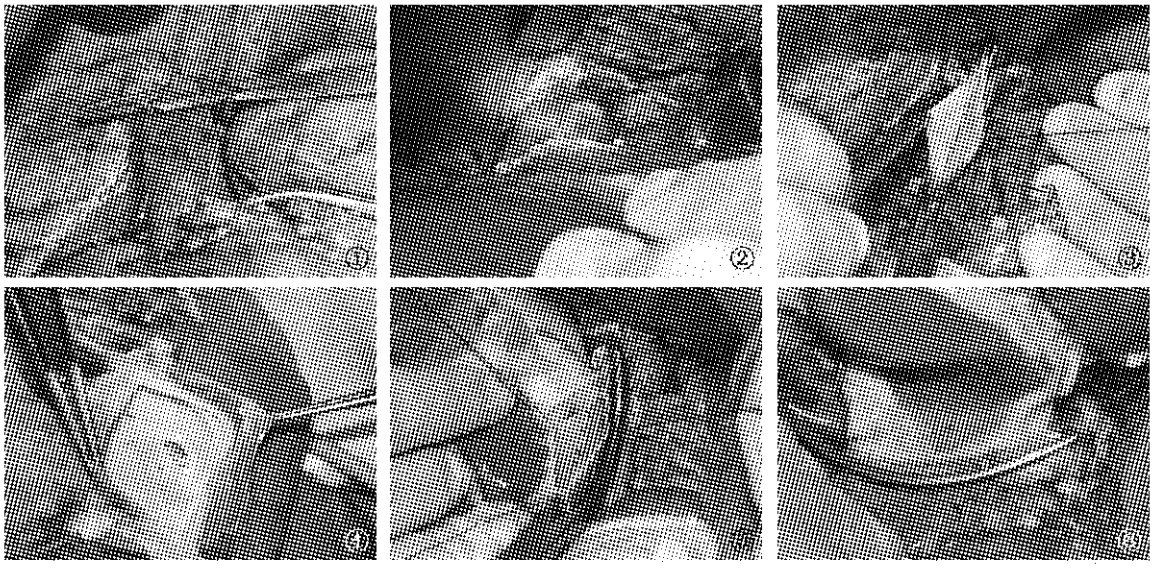

Fig. 1. The stump of the hepatic veins.
Fig. 2. The anastomosis.
Fig. 3. Longitudinal oval incision of the recipient's inferior vena cava.
Fig. 4. Longitudinal oval incision of the donor's inferior vena cava.
Fig. 5. Side-by-side anastomosis of the inferior vena cava (unfinished).
Fig. 6. Side-by-side anastomosis of the inferior vena cava (finished).

Complications

Thirty-eight patients suffered from pulmonary infection including infection of Aspergillus (1 patient), 10 multiple organ system failure, 4 intraperitoneal bleeding, 14 acute respiratory distress syndrome, 1 thrombosis of the hepatic artery, and 1 bile leakage. None of the patients developed occlusion of the hepatic outflow tract and primary nonfunction of the graft.

Life quality of survivors

Fifty-five patients resumed their normal life and work with normal hepatic function 3 months after transplantation. Of the 55 patients, 7 showed transient HBV markers positive but HBV-DNA negative. One patient with posthepatitis cirrhosis died of biliary ablation 6 months after the operation and 1 patient with hepatic cirrhosis died of fibrous cholestatic hepatitis 6 months after the transplantation. One patient with acute hepatic failure suffered from sustained cholestasis, which was proved pathologically as a drug-induced liver lesion. Two patients have been surviving for over 3 years, 8 for over 2 years, and 19 for over 1 year.

Operative time and bleeding volume

Conventional piggyback liver transplantation takes 45 minutes on average for the reconstruction of the hepatic outflow tract with an average bleeding volume of 2500 ml. Modified piggyback liver transplantation, however, consumes 20 minutes on average for the reconstruction of the hepatic outflow tract with an average bleeding volume of 800 ml.

We reconstructed the inferior vena cava by side-by-side anastomosis in 49 cases. All of them were successful and the time for the reconstruction was reduced by 25 minutes.

Discussion

Advantages of piggyback liver transplantation

During traditional liver transplantation, the blockage of the venous reflux of internal organs increases the incidence of complications as well as mortality. Maintenance of the normal blood flow by extracor-

poreal veno-venous bypass is suggested, but the bypass may bring about many serious complications, such as injury to blood vessels, gas embolism, and disturbance of internal environment and coagulation. Piggyback liver transplantation, however, requires no blockage of the reflux of the inferior vena cava in the ahepatic phase.[4-6] Its merits are as follows:

1. There is no severe congestion in the legs and kidneys, which avoids early renal failure after the operation.

2. During the operation, the inferior vena cava is unobstructed for a stable hemodynamics.

3. Minimal bleeding reduces blood and fluid transfusion for a stable internal environment.

4. Extracorporeal veno-venous bypass and anastomosis of the infrahepatic inferior vena cava are not performed to shorten the operative time and the ahepatic phase.

5. Blood coagulation is not affected while minimizing the wound area without dissecting the inferior vena cava, which lowers the incidence of postoperative bleeding.

6. ICU and hospital stay is shortened.

7. The one-year survival is increased significantly.

Improvement of hepatic outflow tract reconstruction

The reconstructed hepatic outflow tract after traditional piggyback liver transplantation might become twisted or induce thrombosis. The operation is fairly difficult and time-consuming.[7] Possibly it is attributed to the long stump left for anastomosis, the recipient's three hepatic veins being not in the same level, and the right hepatic vein on the right of the vena cava, below the conjunction of the left and middle hepatic veins. To make them in a right order, the sidewall of the vena cava must be incised. We advocate that the three hepatic veins of the recipient are trimmed with a shared open end within a limit of 5 mm, and the suprahepatic inferior vena cava was trimmed just close to the upper edge of the donor liver, followed by endothelium-to-endothelium anastomosis, without folding or eversion for precisely suturing. This procedure can limit the anastomosed suprahepatic inferior vena cava within 1.5 cm, avoiding the occlusion of blood reflux due to the twist of the vena cava. Because the stump is short, a vascular forceps is used to partially clamp the inferior vena cava of the recipient liver. After the anastomosis is completed, another forceps is utilized to clamp the stump and the first forceps is released to free the partially occluded inferior vena cava. In our group, the modified operation was performed successfully in 18 patients without occlusion of the outflow tract.

The demerits of conventional vena cava reconstruction vary. First, the reconstruction is difficult and time-consuming. Since the three hepatic veins are not in the same level, the shared open end is easily twisted or constricted after the reconstruction. Second, the improper trimming of the suprahepatic inferior vena cava may lead to its redundancy and twist. Third, anastomosis in the narrow space between the donor liver and the diaphragm makes the operative field poorly exposed and the suturing difficult, particularly when the inferior vena cava in an ideal short length. The modified side-by-side anastomosis of the retrohepatic inferior vena cava in piggyback liver transplantation has avoided such shortcomings of the traditional one as long anastomotic stoma between the hepatic veins of the donor liver and the vena cava of the recipient as well as twist and occlusion of the hepatic outflow tract. It is characterized by an adequate operative space, simplified procedures, and unblockage of the inferior vena cava. Making inferior vena cava reconstruction simple, easy and reliable, the modified operation is helpful to enhance the success rate of piggyback liver transplantation.

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Competing interest

No benefits in any form have been received or will be re-

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