Effects of Surgical Technique on Postoperative Renal Function After Orthotopic Liver Transplant

Saman Nikeghbalian, Masood Dehghani, Heshmatollah Salahi, Ali Bahador, Kourosh Kazemi, Farzad Kakaei, Elnaz Rajaei, Siavosh Gholami, Seyed Ali Malek-Hosseini

Abstract

Objectives: **The classic technique for orthotopic liver transplant consists of the total excision of the retrohepatic inferior vena cava during native hepatectomy. Controversy about the effects of the classic technique on postoperative renal function continues. The aim of this study was to evaluate the effects of the chosen hepatectomy technique on postoperative renal function.**

Materials and Methods: **Of 253 patients who received an orthotopic liver transplant between June 2006 and July 2008 in the Shiraz transplant unit, only 15 underwent operation with the classic technique. Patient demographics and factors including cold ischemic time, warm ischemic time, operative time, transfusions, blood loss, and early postoperative renal function were assessed retrospectively. The criteria for acute renal failure were a serum creatinine level of > 133 μmol/L (1.5 mg/dL), an increase in the baseline serum creatinine level by 50%, or oliguria requiring renal replacement therapy.**

Results: **All patients received a liver from a deceased donor, and none required venovenous bypass during the operation. The minimum mean arterial blood pressure value of the patients during clamping was 65 ± 19 mm Hg. The mean preoperative plasma creatinine level was 87.51 ± 39.78 μmol/L (0.99 ± 0.45 mg/dL). During the first week after transplant, 7 patients (46.6%) experienced acute renal failure, and 3 of those 7 required renal replacement therapy. By the sixth postsurgical month, 4 of those 7 patients had died (1 from adult respiratory distress syndrome, 2 from sepsis, and 1 from recurrent cholangiocarcinoma). In all other patients, the plasma creatinine level had returned to the normal range by the third postsurgical week 3 or during short-term follow-up.**

Conclusions: **Use of the classic technique for orthotopic liver transplant may increase the rate of postoperative renal failure, but that complication usually resolves during short-term follow-up.**

Key words: *Liver transplant, Piggyback technique, Classic technique, Renal failure, Morbidity*

The first orthotopic liver transplants (OLTs) in animals and humans were attempted by Welch (1) and Starzl colleagues (2, 3). Thereafter, additional liver transplant techniques were devised. Extensive experimental work was done by other investigators (4-9), who developed the piggyback technique, which is now the most popular technique for orthotopic liver transplant. The classic technique consists of clamping the inferior vena cava above the renal veins and the excision of the retrohepatic vena cava. Many patients tolerate that procedure, but some require a venovenous bypass to maintain a blood pressure level that perfuses essential organs, especially the kidneys, during clamping. Complications caused by clamping and other intraoperative factors that obligate surgeons to use the standard technique could result in postoperative renal failure in the recipient. The aim of this study was to review the effects of the standard technique on renal function during the early postoperative period after orthotopic liver transplant.

Materials and Methods

Between January 2006 and July 2008, 253 OLTs were performed in adult patients treated in the Shiraz

From the Shiraz Transplant Center, Namazi Hospital, Shiraz University of Medical Sciences, Shiraz, Iran

Address reprint requests to: *Farzad Kakaei, MD, Shiraz Transplant Center, Namazi Hospital Liver Transplantation Ward, Namazi Hospital, Namazi Square, Shiraz, Iran, post code: 71937-11351*

***Phone**: +989153118095 **Fax:** +987116474307 **E-mail:** fkakaei@yahoo.com*

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transplant unit at Namazi Hospital in Shiraz, Iran. All transplants were performed with the piggyback technique except for those in 15 patients (5.9%; 10 men and 5 women; age range, 38.07 ± 11.69 years) after a trial of inferior vena cava and portal vein clamping via the standard technique and without venovenous bypass. Patient demographics and other factors (cold ischemic time, warm ischemic time, operative time, transfusions, blood loss, early postoperative renal function) were assessed retrospectively. Criteria for acute renal failure were a serum creatinine level of > 133 μmol/L (1.5 mg/dL) during the first week after operation, an increase in the baseline serum creatinine level by 50%, or oliguria requiring renal replacement. Immunosuppressive therapy included intravenous methylprednisolone 1 g/d for 3 days (a medication replaced with oral prednisolone 20 mg/d beginning on postsurgical day 4), oral tacrolimus 4 mg/d, and oral mycophenolate mofetil 2 g/d beginning on the first postsurgical day. In patients with a preoperative total serum bilirubin level of > 68.4 μmol/L (4 mg/dL), tacrolimus was replaced with cyclosporine. The dosage of tacrolimus was adjusted to maintain a serum level of 12 to 18 ng /mL. The mycophenolate mofetil dosage was adjusted according to the patient's leukocyte count or the development of complications such as diarrhea or abdominal pain.

Because of the small number of subjects in our study, the median and the range were used to analyze data by means of nonparametric methods. Continuous variables were compared with the Mann-Whitney *U* test. Categorical variables were compared with the chi-square test or the Fisher exact test where appropriate. Statistical significance was defined as a *P* value of < .05. All statistical analyses were performed with SPSS software (Statistical Product and Service Solutions, version 15.0, SSPS Inc, Chicago, IL, USA).

Results

The cause of end-stage liver disease was cryptogenic cirrhosis in 4 patients, hepatitis B in 3, autoimmune hepatitis in 3, primary sclerosing cholangitis in 2, hepatitis C in 2, and Budd-Chiari syndrome in 1. All patients received a whole-liver graft from a deceased donor. The results of frozen section studies of all grafts were within the normal range, and no fibrosis or steatosis over 5% was noted. No patient required venovenous bypass during the operation. The minimum mean arterial blood pressure value of the patients during clamping was 65 ± 19 mm Hg. The mean preoperative plasma creatinine level was 87.51 ± 39.78 μmol/L (0.99 ± 0.45 mg/dL). During the first week after transplant, 7 patients (46.6%) exhibited acute renal failure, and 3 of those 7 required renal replacement therapy. The Table shows the preoperative, intraoperative, and postoperative factors that may have contributed to postoperative renal failure in the study subjects. While hospitalized after surgery, 1 patient died from adult respiratory distress syndrome, and 2 died from sepsis. A fourth patient died from recurrent cholangiocarcinoma 6 months after surgery. In all other patients, the plasma creatinine level had returned to a value within normal limits by 3 weeks after surgery or during follow-up (6.55 ± 3.10 months)

Table. Characteristics of the study subjects

Parameters	Group I (n=7)	Group 2 (n=8)	*P* Value
Age (y)	43.00 ± 10.42	33.75 ± 11.61	.161
Sex (male/female)	5/2	5/3	1.000
Child classification (B/C)	2/5	3/5	1.000
MELD Score	23.00 ± 2.77	24.12 ± 5.05	.668
Donor age (y)	30.42 ± 16.12	27.37 ± 9.65	.866
Cold ischemic time (h)	6.00 ± 3.42	8.00 ± 5.42	.373
Warm ischemic time (min)	64.29 ± 6.07	66.25 ± 15.29	.811
Duration of surgery (h)	7.27 ± 0.61	7.57 ± 1.02	.593
Intraoperative crystalloid (mL)	9028 ± 1929	7593 ± 3093	.276
Intraoperative albumin (g)	68.57 ± 29.68	65.00 ± 30.24	.854
Intraoperative packed cell (mL)	486 ± 273	650 ± 320	.395
Preoperative creatinine (mg/dL)	1.03 ± 0.53	0.96 ± 0.39	.950
Preoperative total bilirubin (mg/dL)	9.62 ± 8.97	6.51 ± 4.40	.463
Hospital stay (d)	16.57 ± 8.64	12.87 ± 4.82	.587
In-hospital mortality (%)	14.3	25	.569

Abbreviations: B/C, Child classification B/Child classification C; MELD, Model for End Stage Liver Disease

Discussion

Complete occlusion of the inferior vena cava produces hemodynamic instability and decreases renal perfusion pressure, renal blood flow, and the glomerular filtration rate (8). According to some authors (2), the use of venovenous bypass decreases the incidence of postoperative acute renal failure, although other authors (10,11) disagree. During the piggyback technique, the pressure in the inferior vena cava and the renal perfusion pressure do not change, and those pressures have little effect on the serum creatinine level (12). Some authors have suggested that venovenous bypass does not reduce the incidence of postoperative acute renal failure (13).

In this study, we described 15 liver transplant patients who underwent hepatic resection with the classic technique. Of those patients, 46.6% exhibited acute renal failure after surgery. In comparison, the overall acute renal failure rate in our patients treated with the piggyback technique during the same period (n=238) was only 13%.

Because of the variety of factors that contribute to postoperative renal failure (13-15), we could not find a matched group with which to compare those factors in patients treated with the standard technique as opposed to the piggyback technique. The results of univariate analysis shown in the Table reveal a significant difference ($P < .05$) between the 2 groups with regard to some factors (age, cold ischemic time, the duration of surgery, the administration of intraoperative crystalloids, intraoperative paced cell transfusion, preoperative bilirubin levels), but there was no difference in other variables (sex, the model for end-stage liver disease score, child classification, donor age, warm ischemic time, intraoperative albumin use, preoperative serum creatinine level) between the study groups.

Although the number of our study subjects was small, our results suggest that the use of the standard technique may increase the rate of postoperative acute renal failure but is not a unique risk factor for that complication and that other important parameters should be considered when the incidence of postoperative acute renal failure after OLT is estimated. Our findings also suggest that although postoperative acute renal failure can be reversed by supportive care, it complicates the patients' postoperative course and increases the length of the hospital stay.

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