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Orthotopic Liver Transplantation Without Venovenous Bypass: 125 Cases From a Single Center

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ABSTRACT

Aim. This study analyzed a 10-year single-center experience in orthotopic liver transplantation (OLT) without venovenous bypass (VVB).

Methods. We retrospectively analysed a nonrandomized series (1999-2008) of 125 adult OLT patients without VVB.

Results. The main causes of liver failure were viral hepatitis ($n = 39$), alcoholic liver disease ($n = 22$), and liver cancer ($n = 17$). One-year survival was 76.4%. The most common postoperative complications were bile duct stenosis ($n = 12$), postoperative bleeding ($n = 8$), hepatic artery thrombosis ($n = 7$), and primary liver failure ($n = 6$). Twelve patients required hemodialysis and four underwent retransplantations of the liver. Fourteen patients died before postoperative day 30th. Univariate analysis showed significant differences between patients who did and did not survive 30 days among donor death diagnoses ($P = .05$), red blood cell units transfused ($P = .03$), aspartate aminotranferase on the first postoperative day ($P = .002$), ABO type ($P = .04$), time of orotracheal intubation ($P = .001$), hemodialysis ($P = .001$), and period of postoperative vasoactive drug use ($P = .006$). The total length of orotracheal tube intubation showed a significant independent association with mortality before 30 days ($P < .001$).

Conclusion. OLT without VVB can be safely performed even in severe cases of chronic liver failure.

Transplantation of the liver is an established therapy for patients with end-stage disease because it provides long-term survival with resumption of a nearly normal lifestyle.[1,2] The recipient surgery includes a conventional hepatectomy with removal of both the vena cava and the liver, as well as replacement of the inferior vena cava as part of the recipient hepatectomy. Pump-driven venovenous bypass (VVB), which is used to divert blood during the vena caval interruption to the heart through the axillary vein, maintains hemodynamic stability and decompresses the portal venous system, reducing injury to the bowel capillary bed.[3–5] In addition, it may decrease blood loss from venous collaterals, helping to maintain normothermia to regulate the blood volume and potassium. It may reduce the incidence of postoperative acute renal failure in these patients. Despite these beneficial effects, however, VVB has been avoided by many centers because it increases surgical and anosthesia times and increases the surgical complication rate by reasons inherent to its placement. However, workers others have questioned the favorable effects of VVB.[6] The piggyback technique has the advantage to preserve caval flow to the heart by conserving the full length of the recipient vena cava with a subsequent anastomoses of the suprahepatic donor vena cava to the orifices of the recipient hepatic vein.[7] A disadvantage of the piggyback technique is the need to dissect the vena cava fully from the liver, involving a longer excision time.[8] Conventional liver transplantation (OLT) without VVB has been performed by some transplantation centers because it represents a simpler faster approach to perform the recipient hepatectomy preserving the inferior vena cava. Apparently, the conse-

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quences of performing OLT without VVB are not as damaging as first thought.[1,2]

We have accumulated single-center experience spanning a 10-year period of performing transplantation of the liver by replacing the inferior vena cava without VVB. The aim of this partial was to describe our 10-year experience seeking to clucidate the factors associated with early mortality.

METHODS

The study was approved by our Committee for Research in Humans. The medical records of all adult patients (age >16 years) who underwent OLT between August 1999 and December 2008 were reviewed retrospectively. We excluded cases of acute liver failure, peroperative fatality as well as piggyback, pediatric recipients portocaval hemitransposition, split-liver, domino, liver/kidney double and transplantations patients with deficient data. A minimum follow-up of 12 months was required for this study.

Surgical Technique

All operations were performed by the same surgical team. The procedure for liver graft harvest from deceased donors followed a standard surgical protocol. Grafts perfused with Belzer or Celsior solutions were packed until liver implantation.

Ampicillin/sulbactam (3 g) was administered intravenously before anesthetic induction. Propofol combined with a muscle relaxant was routinely used for induction of anesthesia if not contraindicated. Inhalational anesthetics were supplemented by fentanyl and a muscle relaxant for maintenance. Recipient monitoring during OLT was performed by electrocardiography, pulse oximetry, capnography, central venous pressure, mean blood pressure, and transesophageal thermometer measurements. Neither Swan-Ganz catheter nor transesophageal echocardiography were used routinely. A thermal pad and a thermal blanket were employed to control core body temperature. Vasopressor and volume therapies were used during anesthesia to maintain cardiovascular stability. Liver transplant recipients underwent hepatectomy with inferior vena cava preservation without VVB. The conventional hepatectomy technique required clamping of both portal flow from the viscera and vena cava flow from the lower body, whereas the piggyback technique only occludes portal flow, reducing the ischemia time because it requires one less anastomosis before reperfusion compared with the conventional technique. The use of the conventional or the piggyback technique was according to the surgeon's preference. Before reperfusion of the liver graft, hydrocortisone (1 g) was administered to the patient. The pedicles were anastomosed using standard techniques. Immunosuppression was based on tacrolimus, mycophenolate mofetil, and corticosteroids. We weaned patients off corticosteroids as soon as possible based on clinical and laboratory evaluations, except in cases of autoimmune hepatitis, primary biliary cirrhosis, and primary sclerosing cholangitis.

Study Variables

Total morbidity was assessed by analyzing the incidence of biliary, vascular, septic, and renal complications within 6 months after OLT. Clinically significant acute renal failure was considered when the recipient required haemodialysis. Bile duct complications were defined as stenosis if the bile duct diameter decrease could be confirmed by cholangiography or magnetic resonance imaging in the presence of clinical or laboratory evidence of cholestasis, or by bile leakage if a peritoneal bile collection was diagnosed at reoperation or by abdominal computerized tomography or ultrasound. Extensive areas of biliary stenosis or diffuse biliary stenosis diagnosed by cholangiography or magnetic resonance imaging of the biliary tree were considered to be stenosis caused by ischemia. Portal and hepatic artery thrombosis was diagnosed by abdominal ultrasound and hepatic arteriography, respectively, during routine tests or because of clinical suspicion. Sepsis was identified if a life-threatening clinical state was caused by an established infectious disease. Primary liver failure was diagnosed when there was a liver retransplant indication; primary dysfunction, if the aminotransferase level excluded 2000 IU, within 7 days after a first OLT.

The patients were separated into two groups depending on the occurrence of mortality within 30 days after OLT. The following information was collected for each patient: Donor: age (years), death diagnosis (head injury, intracerebral bleeding, or others), serum sodium (mEq/L), vasoactive drugs at least 1 hour prior to organ retrieval, cardiac arrest prior to organ retrieval (yes/no), liver macrosteatosis (subjectively evaluated at the moment of organ retrieval, considering liver color and border characteristics of aspartate aminotranferase (AST), and alanine aminotransferase (ALT). The operative parameters included cold ischemia time (CIT), considered as the time from in situ flush of the organ until the graft was removed from the ice for implantation; warm ischmia time, the time from removal of the liver from ice until reperfusion via the portal vein; units of packed red blood cells (RBC) transfused; units of fresh-frozen plasma transfused; and graft weight (kg). Recipient and postoperative data included age, gender, Model for End-stage Liver Disease (MELD) score, Child-Turcott-Pugh criteria, diagnosis for liver failure, length of intensive care unit stay, total length of orotracheal tube (days), ABO types, use of vasoactive drugs (days), demand for hemodialysis as well as prothrombin time international namalized ratio [INR] blood urea nitrogen (mg/dL), AST and ALT on the first postoperative day. MELD score was calculated in accordance with the United Network for Organ Sharing guidelines: $3.8 \times \log_n$ bilirubin (mg/dL) + $9.6 \times \log_n$creatinine (mg/dL) + $11.2 \times (\log_n$ INR). Serum bilirubin, creatinine, and INR values <1 were set to 1 to preclude negative values, and serum creatinine upper-limit values were set at 4.0. No adjustments were made for malignancy or other conditions. All patients were followed routinely at 1, 3, 6, and 12 months, or when necessary clinically.

Table 1. Postoperative Complications of Conventional OLT Without VVB

Postoperative Complications	n = 125	%
Reintervention	23	12.6
Abdominal bleeding	8	6.5
Others	15	12.1
Graft dysfunction	9	7.2
Primary dysfunction	6	4.8
Primary liver failure	3	2.4
Biliary complications	20	16.1
Leakage	3	2.4
Stenosis	12	9.7
Ischemic-type biliary stenosis	5	4
Vascular complications	9	7.2
Hepatic artery thrombosis	7	5.6
Portal vein thrombosis	2	1.6
Retransplantation	4	3.2
Hemodialysis	12	9.6
Sepsis	11	8.9

OLT, orthotopic liver transplantation; VVB, venovenous bypass.

Statistical Analysis

Continuous data were expressed as mean values ± standard deviations or as median values with ranges of distribution (min–max) as appropriate, with proportions for categorical or binary data. We fit univariate models for 30-day operative mortality, using the risk factors in Table 2. For continuous risk factors assumptions of linearity in the logit were ascertained by fractional polynomials.[9,10] To preserve tabulations, we presented the results in five categories (20th percentile cutpoints). The model estimates were obtained at the categories' middle points. Upon completion of the

Table 2. Donor and Recipient Demographic Data, Intraoperative Characteristics, and Postoperative Parameters

Parameter	Mean ± SD or Median (min–max) or % (Total *n* = 125)	Survival < 30 d (*n* = 14)	Survival > 30 d (*n* = 111)	*P*
Donor parameters				
Age (y)	37.04 ± 14.44	42.42 ± 14.13	36.44 ± 14.41	.171
Male gender	90 (72%)	9 (64%)	81 (73%)	.56
Diagnostic	44 (35.2%)			
Head trauma	57 (45.6%)	1 (7.1%)	43 (38.7%)	.05
Cerebral bleeding		8 (57.1%)	49 (44.1%)	
Others	24 (19.2%)	3 (21.4%)	14 (12.6%)	
Serum sodium (mEq/L)	148.0 (132.0–766.0)	149.2 (136.0–170.0)	148.0 (132.0–766.0)	.833
Vasoactive drugs: yes	93 (74.4%)	11 (78.5%)	82 (74%)	.265
Cardiac arrest prior to organ retrieval: yes	19 (15.2%)	3 (21.4%)	16 (14.4)	.715
Liver macrosteatosis: yes	27 (21.6%)	4 (28.5%)	23 (20.7%)	.518
AST (U/L)	50.00 (8.0–522.0)	48.00 (8.0–158.0)	50.00 (14.0–522.0)	.487
ALT (U/L)	44.55 (9.7–342.0)	41.00 (17.00–206.0)	45.00 (9.7–342.0)	.349
Intraoperative parameters				
WIT (min)	54.50 (30.0–143.0)	59.00 (35.0–82.0)	52.50 (30.0–143.0)	.397
CIT (min)	410.0 (205–930)	435.0 (245–6450)	405.0 (205–930)	.704
RBC (units)	3.50 (0.0–27.0)	5.000 (1.00–23.0)	3.000 (0.0–27.0)	.03
Fresh frozen plasma (units)	5.00 (0.0–32.0)	5.000 (0.0–15.00)	5.000 (0.0–32.0)	.945
Graft weight (kg)	1480 (675–3325)	1520 (1045–2000)	1480 (675–3325)	.64
Recipient parameters				
Age (y)	48.67 ± 13.79	54.92 ± 13.24	47.93 ± 13.72	.061
Male gender	90 (72%)	9 (64.3%)	81 (73%)	.504
MELD	16.02 ± 4.946	15.85 ± 4.580	16.04 ± 5.008	.894
Child-Turcott-Pugh				
A	22 (17.6%)	1 (7.1%)	21 (19%)	.480
B	62 (49.6%)	8 (57.1%)	54 (48.6%)	
C	40 (32%)	5 (35.7%)	35 (31.5%)	
Diagnostic				.159
Chronic hepatitis	39 (31.2%)	8 (57.1%)	31 (28%)	
Alcoholic liver disease	22 (17.6%)	1 (7.1%)	21 (19%)	
Cholestatic	12 (9.6%)	—	12 (10.8%)	
Cryptogenic cirrhosis	12 (9.6%)	2 (14.3%)	10 (9.0%)	
Hepatic malignancy	23 (18.4%)	2 (14.3%)	21 (19%)	
Others	17 (13.6%)	1 (7.1%)	16 (14%)	
ABO blood class				
O	59 (47.2%)	3 (21.4%)	56 (50.4%)	
A	49 (39.2%)	8 (57.1%)	41 (37.%)	.044
B	10 (8%)	3 (21.4%)	7 (6.3%)	
AB	7 (5.6%)	—	7 (6.3%)	
Prothrombin time (INR)	2.10 (1.0–6.7)	2.85 (1.34–5.34)	2.07 (1.0–6.7)	.058
Vasoactive drugs: yes	14 (11.2%)	5 (35.7%)	9 (8.1%)	.006
Hemodialysis: yes	12 (9.6)	7 (50%)	5 (4.5%)	<.001
BUN (mg/dL)	43.35 (13.0–131.6)	50.50 (28.0–96.0)	42.0 (13.0–131.6)	.4
Creatinine	1.0 (0.3–3.19)	1.6 (0.8–2.5)	1.0 (0.3–3.2)	.012
AST (U/L)	675.0 (49.0–13,870)	1959 (256.0–13,870)	634.0 (49.0–12,750)	.002
ALT (U/L)	504.0 (42.0–6935)	830.0 (201–4584)	494.0 (42.0–6935)	.232
Orotracheal tube (d)	2.0 (1–5)	5.00 (1.0–5.0)	2.0 (1–5)	<.001
ICU stay (d)	3.00 (1–126)	5.500 (1.00–22.00)	2.50 (1–126)	.406

Values are expressed as medians (min–max) except for age, expressed as ± mean SD, or expressed as a number (percentage) when given. The figures are based on the patients who presented the characteristic in the study. BUN, creatinine, ALT, AST, INR on the first postoperative day. AST, aspartate aminotransferase; ALT, alanine aminotransferase; BUN, blood urea nitrogen; WIT, warm ischemia time; CIT, cold ischemia time; RBC, red blood cell; MELD, Model for End-stage Liver Disease; SD, standard deviation; INR, international normalized ratio; ICU, intensive care unit.

univariate analyses, variables with P values $< .05$ were included in a multivariable model. Backward elimination was used to select the final model. The results were expressed by odds ratio and 95% confidence interval with P values $< .05$ considered to be statistically significant. The cumulative patient survival rate was calculated according to the Kaplan-Meier method. All analyses were performed with STATA 9.2 software (StataCorp, College Station, Tex, USA).

RESULTS

We evaluated 302 consecutive patients admitted for OLT from March 1999 to December 2008. We excluded piggyback OLT ($n = 70$), patients under 16 years old ($n = 59$), cases of acute liver failure ($n = 8$), peroperative fatality ($n = 3$), portocaval hemitransposition ($n = 2$), split liver ($n = 2$) and domino liver transplantation ($n = 2$), liver/kidney double transplantation ($n = 1$), retransplantation of liver ($n = 10$), and cases of deficient data ($n = 15$). Hence, we included 125 adult patients with terminal hepatic failure in the study.

Transplantation of the liver by the conventional technique without VVB was possible in all cases. The 1-year overall patient survival (Kaplan-Meier) was 76.4%. The most common etiologies of cirrhosis were viral (31%) or alcohol-related disease (17.6%) as well as hepatic malignancy. ($n = 23$; 18.4%) CIT was 410 minutes (range = 205–930) and the anhepatic phase, 54.5 minutes (30–143).

The most common cause of surgical reintervention was abdominal bleeding (6.5%). Graft primary dysfunction occurred in 4.8% of cases. Biliary stenosis was more common than bile leakage (12% versus 3%). Hemodialysis was required in 9.6% of cases (Table 1).

Table 2 summarizes the donor, intraoperative, and recipient variables in both groups. Univariate analysis revealed significant differences between patients who did versus did not survive 30 days according to donor death diagnosis ($P = .05$), RBC transfused units ($P = .03$), first postoperative day AST ($P = .002$), ABO ($P = .04$), orotracheal intubation time ($P = .001$), hemodialysis ($P = .001$), or postoperative use of vasoactive drugs ($P = .006$).

Tables 3 and 4 show the results of the subsequent analysis of five categories (20th percentile cutpoints) for each quantitative (Table 3) and categorical (Table 4) variable identified in Table 1 ($P < .01$), ascertained by fractional polynomials.

Factors Independently Associated With Mortality Before 30 Days

A multivariate analysis performed using a logistic regression model revealed a significant independent association of mortality before 30 days with total length of orotracheal tube intubation (days, $P < .001$; Table 5).

DISCUSSION

While VVB quickly became routine in conventional OLT, it is no longer necessary with the piggyback technique.[11] We initiated an OLT program excluding when it was contraindicated due to technical constraints. As a consequence, we have significant experience in OLT using the conventional technique without VVB; most of our patients underwent OLT using this method. With increasing experience, this technique became the most frequent safe option even for the most severe cases.

We have focused on a cohort of OLT recipients with demographic characteristics that are similar to those in the surgical experience in the medical literature.[12] We excluded children, cases of acute liver failure and patients who underwent OLT by surgical technique other than conventional technique without VVB. Thus, we analyzed the results of conventional OLT without VVB among a typical samples of patients. They were composed of a large number of patients with virus C cirrhosis, alcohol, and hepatocarcinoma. We chose to consider mortality up to the postoperative day 30 because it is rational to assume that the choice of the surgical technique has more impact during the initial postoperative weeks. We did not observe a greater incidence of severe complications resulting from OLT without VVB compared with the medical literature with VVB or using the piggyback technique.

OLT without VVB can result in acute renal failure (ARF) because of the decreased renal perfusion during caval clamping.[13] VVB seeks to preserve adequate kidney perfusion as evidenced by lower postoperative dialysis rates. Our experience with postoperative urine output and serum creatinine values were comparable to those of other workers.[12,14] Among our patients, 9.6% required hemodialysis after OLT. The role of VVB to prevent ARF after OLT is still a controversial issue. According to Cabezuelo, OLT with VVB produced an independent risk factor for postoperative ARF on the one hand, whereas, the piggyback technique significantly reduced the probability of ARF after liver transplantation.[15] However, this observation has not been confirmed by other investigators,[16,17] suggesting little clinical relevance of the theoretical benefits of VVB on renal perfusion during the anhenpatic phase of OLT. In a prospectively randomized study of OLT with versus without VVB, avoidance of VVB did not result in ARF.[17] To analyze the present results, it is relevant to consider that the most seriously ill patients were selected to undergo OLT without VVB because the surgical team felt it was safe to perform OLT this way in sicker patients. More severely ill patients are more susceptible to demand hemodialysis in the postoperative period.

Extensive fluid administration during OLT without VVB may contribute to postoperative pulmonary complications.[18] Although we did not study intraoperative or post-

Table 3. Bivariated Analysis of Continuous Variable

Variable	Reference Point*	*n*	Decease (%)	OR	95% CI	*P*
AST						.002
49–253.2	151.1	24	0.0	1.0	—	
253.2–477.2	365.2	25	12.0	1.3	1.10–1.52	
477.3–913.6	695.3	25	8.0	1.7	1.21–2.39	
913.7–1907.0	1910.4	25	4.0	3.3	1.52–6.99	
1907.1–13870	7888.6	24	25.0	17.8	2.79–114.10	
RBC						.092
0–1	0.5	21	4.7	1.0	—	
2	2.0	19	5.3	2.7	0.83–8.84	
3	3.0	21	4.8	3.6	0.78–16.73	
4–6	5.0	37	18.9	5.2	0.73–37.34	
7–27	17.0	24	16.7	12.6	0.62–255.71	
Age (y)						.035
16–37	26.5	24	4.2	1.0	—	
38–48	43.0	26	3.8	1.5	1.02–5.50	
49–55	52.0	26	7.7	2.4	1.04–5.50	
56–60	58.0	23	17.4	3.5	1.06–11.79	
60–71	65.5	24	20.8	6.5	1.08–39.16	
Donor age (y)						.113
6–22	14.0	26	3.8	1.0	—	
23–30	26.5	23	8.7	8.1	0.35–189.62	
31–42	36.5	25	16.0	11.9	0.28–495.38	
43–52	47.5	22	4.5	14.1	0.26–767.91	
53–65	59.0	24	16.7	15.5	0.25–959.15	
Prothrombin time (INR)						.033
1.00–1.53	1.26	25	4.0	1.0	—	
1.54–1.99	1.76	23	13.0	2.0	1.04–3.78	
2.00–2.20	2.10	25	4.0	2.7	1.06–7.01	
2.21–2.98	2.60	23	13.0	3.9	1.08–13.81	
2.99–6.70	4.84	24	21.0	8.8	1.13–68.84	
Orotracheal tube (d)						<.01
1	1	31	3.2	1.0	—	
2	2	43	2.3	1.3	1.17–1.43	
3	3	27	3.7	2.6	1.77–3.81	
4	4	10	20.0	10.1	4.00–25.54	
5	5	12	66.7	94.9	15.29–588.4	

Mathematics transformations: (1) AST: square root; (2) RBC: logarithm; (3) age: power 3; (4) donor age: power 2; (5) INR power: 0.5; (6) orotracheal tube: power 3. OR, odds ratio; CI, confidence interval; AST, aspartate aminotransferase; RBC, red blood cells; INR, international normalized ratio.
*Class variable midpoint.

operative parameters of pulmonary physiology, most of the patients who underwent OLT without VVB had the orotracheal tube removed in the immediate postoperative period. The length of orotracheal intervation was independently associated with 30-day mortality.

Hypothermia during OLT may produce deleterious effects on coagulation, increasing the demand for blood products and on myocardial performance. VVB may decrease these effects by virtue of the continuous warming in the bypass circuit.[18] Core body temperature was continuously monitored by transesophageal thermometer in our patients. Hypothermia was managed by external use of a thermal pad and thermal blanket to monitor and treat severe hypothermia. VVB can reduce the blood product requirements because of the decreased venous congestion. We observed the requirements for blood transfusions to be comparable to those previously published by others.[19] Intraoperative requirements for packed red cell units were not independently associated with 30-day mortality in the present evaluation.

We showed a comparable incidence of arterial and biliary complications.[12] Apparently, OLT without VVB did not have any effects over these targets.

The 1-year survival rate at of 76.4% is lower than that demonstrated by top OLT centers in the world.[20] Nevertheless, we presume that if survival after OLT is discussed, it is essential to consider waiting list mortality and donor selection. Patients who suffer from terminal liver disease can benefit from OLT even by using grafts from extended-criteria donors.[20,21] Although this OLT policy may have a beneficial effect over waiting-list mortality by offering an opportunity for OLT to additional patients, it may impact

Table 4. Bivariate Analysis of Categorical Variable

Variable	*n*	Deceased (%)	OR	95% CI	*P*
Donor diagnostic	11 8				.051
1	44	2.3	1.0	—	
2	57	14.0	7.0	0.8–58.4	
3	17	17.6	9.2	0.9–95.9	
Recipient diagnostic	11 3				.294
1	39	20.5	1.0		
2	22	4.6	0.2	0.02–1.59	
4	12	16.7	0.8	0.14–4.27	
5	23	8.7	0.4	0.07–1.91	
6	17	5.9	0.2	0.03–2.11	
Hemodialysis	11 9				<0.001
Yes	12	58.3	28.6	6.6–122.6	
No	10 7	4.7	1.0	—	
Vasoactive drug (postoperative)	12 4				.006
Yes	14	35.7	7.1	1.9–26.2	
No	11 0	7.3	1.0	—	
ABO blood class	11 8				.041
1	59	5.1	1.0		
2	49	16.3	3.6	0.91–14.58	
3	10	30.0	8.7	1.35–47.57	

OR, odds ratio; CI, confidence interval.

1-year survival because more severe patients receive grafts that are not ideal. In addition, we should consider that our surgical team works in the poorest region of a developing country in South America. Survival rates may have been influenced negatively by factors such as the low educational level and socioeconomic status of our patients as well as limited governmental social assistance for patients living in remote areas of the countryside.

Furthermore, we achieved a rather short CIT. Although scientific publications suggest that CIT can be extended to 12 hours using Belzer or Celsior solutions without harming the graft or the OLT outcome,[22] we strongly believe that shortening the CIT improves OLT outcomes. Hence, we strived to reduce CIT through well-organized synchronization between the liver donor surgery and the recipient OLT. This efficient management of OLT practice made it feasible to keep the CIT within 6 to 7 hours.

Our study had some limitations. First, it was a retrospective review of medical records. Because of the extensive experience and conviction of this surgical team to perform OLT without VVB, the most severe cases were selected for this type of surgery. The surgical team feet that hepatectomies were easier and faster if performed in this way rather than by the piggyback technique. The surgical technique was the choice of the surgeon at the moment of transplantation, so this was not a series of patients chosen by chance. This fact can explain some observations, such as the survival rate being below the usual and the longer time of respiratory assistance required by some patients that caused an expected bias in the statistical analysis. Second, until July 2006, by force of Brazilian law, recipient selection followed chronologic criteria. Because of this, several patients with MELD scores below 15 underwent OLT. It has been stressed that the outcome of OLT is related to the status of the recipient.[23] Since 2006, recipient selection has been done following the MELD score.[24] Furthermore, since July 2006, thanks to the efforts of the Brazilian government, we have had a significant increase in the number of organ donations, leading to a larger number of transplantations. Recipients selected based upon chronologic criteria may show better postoperative results because of the better health status of these patients. Although the main number of OLT were performed under MELD score criteria, we did not observe a relevant change in MELD score between these two periods. It is significant that even though we performed OLT without VVB in sicker recipients, the results did not differ considerably from those shown by other worked in similar circumstances. Finally, a small number of patients died before postoperative day 30, which had consequences for the multivariate analysis because of the practical characteristics of this statistical method limiting the mathematical conclusions. This observation could explain the large increase in the calculated odds ratio from 10.1 to 94.9 when the time of orotracheal intubation increased from 4 to 5 days.

Table 5. Results of Logistic Regression Model to Evaluate the Variables Associated With Mortality Before 30 d

	n = 123	Deceased (%)	OR	95% CI	*P*	OR (adjusted)	95% CI	*P*
Orotracheal tube (d)								
1	31	3.2	1.0	—	<.001	1.0	—	<.001
2	43	2.3	1.3	1.17–1.43		1.5	1.20–1.85	
3	27	3.7	2.6	1.77–3.81		4.4	1.96–9.84	
4	10	20.0	10.1	4.00–25.54		35.8	5.08–254.7	
5	12	66.7	94.9	15.29–588		1155.0	24.53–54,400.86	

OR, odds ratio; CI, confidence interval.

In conclusion, we demonstrated that OLT could successfully be performed without VVB as the standard surgical procedure even in more severe cases, with acceptable consequences for renal function and blood loss.

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