# Hepaticojejunostomy in Orthotopic Liver Transplant: A Retrospective Case Control Study

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## ABSTRACT

The reported biliary morbidity rate for deceased donor full-size orthotopic liver transplantation is up to 30%. The technique used may be influenced by multiple factors, and in some situations, biliary reconstruction must be carried out through Roux-en-Y hepaticojejunostomy. The aim of our study was to determine the results of the orthotopic liver transplantation according to the technique used in the biliary reconstruction. A retrospective study was performed with the first 1000 orthotopic liver transplants (951 patients) carried out consecutively (1996-2013) with follow-up until 2017. A matched case-control study was designed in 1:3 ratio (47/136) to compare the reconstruction by hepaticojejunostomy vs the end-to-end coledoco-coledocostomy. Hepaticojejunostomy was associated with patients with cholestatic (44.7% vs 3.7%) and ischemic disease (14.9% vs 0%; $P < .001$) and previous transplant (29.8% vs 1.5%; $P = .003$). The mean biliary duct reconstruction, surgery, and cold ischemia times were also higher. Vascular complications were significantly more frequent in the hepaticojejunostomy group (36.1% vs 10.4%; $P < .001$), mainly because of differences in early arterial complications. Nevertheless, there were no differences in the total biliary complication (21.2% vs 16.9%; $P = .5$). The biliary leakage rate and the biliary stricture rate were also similar. Hepaticojejunostomy in orthotopic liver transplantation presented longer biliary reconstruction, surgery, and cold ischemia times when compared with end-to-end coledoco-coledocostomy. In addition, it was followed by a higher incidence of arterial complications but had similar biliary complication rate and graft survival. Differences could be explained by the fact that hepaticojejunostomy was used more often in cholestatic or ischemic diseases and in retransplant procedures.

THE BILIARY morbidity rate for deceased donor full-size orthotopic liver transplant (OLT) is reported to be 5% to 30% and the mortality rate is up to 10% [1–3]. Major concerns are early biliary leakage (BL) and biliary stricture (BS), which are associated with technical, anatomic, or microvascularization aspects. It has been reported that risk factors for biliary complication (BC) in OLT related to preoperative period were recipient condition, ischemic time, hepatic artery complications [1], and cytomegalovirus infection [4–8]. Biliary reconstruction using end-to-end coledoco-coledocostomy (CC) is the technique of choice in OLT. Nevertheless, use of this technique may be influenced by multiple factors, such as underlying liver disease, mismatch between donor and recipient bile ducts, retransplant, or other biliary surgery [9]. In such situations, biliary reconstruction must be carried out using Roux-en-Y hepaticojejunostomy (HJ) [10]. The aim of our study was to

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determine the results of the OLT according to the technique used for biliary reconstruction.

## MATERIAL AND METHODS

A retrospective study was performed involving the first 1000 OLTs (951 patients) carried out consecutively from February 1996 to December 2013, with follow-up until January 2017. All transplants were performed using whole grafts from donors after brain death. University of Wisconsin solution was used for graft preservation in all patients. Biliary anastomosis was performed after completion of vascular anastomosis and sequential revascularization of the graft (portal first). The CC method was performed as previously described by our group [3]. Roux-en-Y HJ was performed using polydioxanone absorbable monofilament sutures (Maxon suture size, 5-0; Medtronic, Minneapolis, Minn, United States). No internal stent was used. Identical immunosuppressive treatment was used in both groups and has been described in a previous study [11]. Acute cellular rejection in this study was biopsy-proven in all cases, evaluated by the local pathologist, and graded according to the Banff international consensus document [12]. Late outcomes were defined as those appearing after hospital discharge. In 47 OLT cases, the HJ technique was used for biliary tract reconstruction (40 patients). A matched case-control study was designed based on a 1:3 ratio (47/136) reconstruction using HJ vs CC. The matching process was based on the following variables: age and cause of death of the donor, age of recipient, and Child-Pugh and Model for End-Stage Liver Disease scores of the recipient. Both groups were compared in terms of multiple variables relating to the donor, the recipient, and the OLT procedure. Binary logistic regression models were adjusted, taking into account the matched design by estimating robust standard errors, including matching factors in the estimation. The qualitative variables were expressed as percentages, while quantitative values were expressed as the median and range or the interquartile range. Comparisons between groups were performed using Fisher exact and $\chi^2$ tests. Statistically significant difference was indicated by $P < .05$. Graft survival data were analyzed using the Kaplan-Meier method.

## RESULTS

A total of 47 OLT cases were included in the HJ group, and 136 patients were included in the CC group. Table 1 shows a comparison of donor, recipient, and technical and/or operative factors between the 2 groups. Results are presented here as HJ group vs CC group. HJ was significantly associated with patients with cholestatic (44.7% vs 3.7%) and ischemic disease (14.9% vs 0%; $P < .001$). Previous transplant was a statistically more frequent occurrence in the HJ group (29.8% vs 1.5%; $P = .003$). The mean times for biliary duct reconstruction, surgery, and cold ischemia were also significantly higher in patients with HJ bile duct reconstruction. On the other hand, the mean hepatic artery anastomosis time was similar between the 2 groups 11.9 (SD, 5.2) minutes vs 11.3 (SD, 5.7) minutes ($P = .3$). Postoperative outcome according to biliary reconstruction technique is shown in Table 2. The median intensive care unit stay, hospital stay, and biopsy-proven acute cellular rejection rate were similar in both groups. Vascular complications (VC), venous and arterial, were significantly more frequent in the HJ group (36.1% vs 10.4%; $P < .001$), mainly because of differences in early arterial complications (14.9% vs 2.2%). Nevertheless, there were no differences in the total BC (21.2% vs 16.9%; $P = .5$). The early BL rate and the BS rate were not significantly different between the groups: 10.6% vs 4.4% ($P = .13$) and 0% vs 4.4% ($P = .4$), respectively. In addition, the long-term BL and BS were also similar in both groups: 6.4% vs 2.2% ($P = .34$) and 4.2% vs 5.9 ($P = .6$), respectively. The global infection rate was significantly higher in the HJ group (65.9% vs 22.8%; $P = .001$). Postoperative mortality was similar in both groups (4.2% vs 1.5%; $P = .35$). With regard to retransplant, this occurred in 15% of the HJ group and in 6.6% of the CC group ($P = .12$). Finally, graft survival at 1, 3, and 5 years after transplant showed comparable results for the 2 groups (HJ vs CC): 87.2%, 81%, and 74.5% vs 92.6%, 85.2%, and 83.8%, respectively ($P = .55$) (Fig 1).

**Table 1. Baseline Recipient, Donor, and Surgical Characteristics According to Biliary Reconstruction Technique**

| Variable | HJ (47 OLT) | CC (136 OLT) | *P* Value |
|---|---|---|---|
| Donor age, mean (SD), y | 41.4 (19.3) | 43.1 (18.5) | .58 |
| Donor cause of death, No. (%) | | | .99 |
| Stroke | 20 (42.5) | 67 (49.5) | |
| Trauma | 23 (49) | 59 (43.7) | |
| Other | 4 (8.5) | 10 (6.8) | |
| Recipient age, mean (SD), y | 44.2 (14.6) | 47.7 (11.6) | .13 |
| Cause of transplant, No. (%) | | | <.001 |
| HCV | 2 (4.2) | 52 (38.2) | |
| Alcohol | 4 (8.5) | 35 (25.7) | |
| Cholestasis | 21 (44.7) | 5 (3.7) | |
| Ischemia | 7 (14.9) | 0 (0) | |
| Others | 13 (27.7) | 44 (32.4) | |
| Retransplant, (No. %) | 14 (29.8) | 2 (1.5) | .003 |
| MELD, mean (SD) | 14.6 (11.3) | 13.5 (9.4) | .49 |
| Child-Pugh, No. (%) | | | .81 |
| A | 24 (51) | 54 (40) | |
| B | 14 (30) | 48 (35.2) | |
| C | 9 (19) | 34 (24.8) | |
| Bile duct anastomosis time, mean (SD), min | 20.1 (9.1) | 16.4 (12.1) | .04 |
| Surgery time, mean (SD), min | 330 (110) | 264 (74.5) | <.001 |
| Cold ischemia time, mean (SD), min | 398 (147) | 324 (131) | <.001 |

CC, coledoco-coledocostomy; HCV, hepatitis C virus; HJ, hepaticojejunostomy; MELD, Model for End-Stage Liver Disease; OLT, orthotopic liver transplant.

## DISCUSSION

Biliary reconstruction is the Achilles heel of OLT and is the most common cause of postoperative morbidity [4]. The 2 main methods of bile duct reconstruction are CC and HJ. Multiple factors influence selection of the reconstruction method, with underlying liver disease being a key element involved in this selection. In our study, HJ was significantly associated with patients with prior cholestatic or ischemic disease and retransplant. Only 5 of 26 patients diagnosed as

**Table 2. Postoperative Outcome According to Biliary Reconstruction Technique**

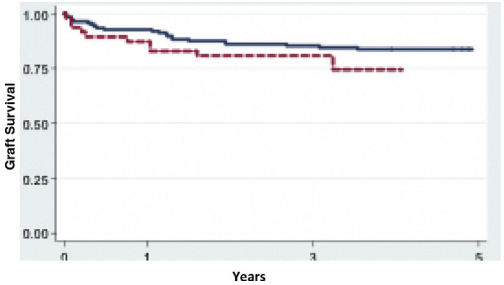
| Variable | HJ (47 OLT) | CC (136 OLT) | *P* Value |
|---|---|---|---|
| Intensive care unit stay, mean (SD), d | 7.8 (9) | 7.6 (12) | .59 |
| Hospital stay, mean (SD), d | 28 (26) | 30 (88) | .11 |
| Rejection (biopsy), No. (%) | 10 (21.2) | 19 (14.3) | .11 |
| Vascular complication, No. (%) | 17 (36.1) | 14 (10.4) | <.001 |
| Venous | | | |
| Early | 2 (4.2) | 2 (1.5) | |
| Late | 3 (6.4) | 4 (3) | |
| Arterial | | | |
| Early | 7 (14.9) | 3 (2.2) | |
| Late | 5 (10.6) | 5 (3.7) | |
| Biliary complication, No. (%) | 10 (21.2) | 23 (16.9) | .5 |
| Fistula | | | |
| Early | 5 (10.6) | 6 (4.4) | |
| Late | 3 (6.4) | 3 (2.2) | |
| Stenosis | | | |
| Early | 0 (0) | 6 (4.4) | |
| Late | 2 (4.2) | 8 (5.9) | |
| Infection | 31 (65.9) | 31 (22.8) | <.001 |
| Mortality, No. (%) | 2 (4.2) | 2 (1.5) | .35 |
| Retransplant, No. (%) | 7 (15) | 9 (6.6) | .12 |

CC, coledoco-coledocostomy; HJ, hepaticojejunostomy; OLT, orthotopic liver transplant.

having a cholestatic disease received reconstructions using the CC method. Nevertheless, a recent meta-analysis did not indicate any disadvantages when CC anastomosis was performed in selected patients with cholestatic disease undergoing OLT [13]. Ischemic disease and retransplant were more frequent in the HJ group with probable correlation of these 2 conditions. These differences could explain not only the disparity in time taken for biliary tract reconstruction, which is intrinsically related to technical aspects, but also variation in the time required for surgery and cold ischemia because these involved more challenging procedures. The VC rate in our study involved a combination of venous and arterial complications, stenosis, or thrombosis During the postoperative time period, a correlation was apparent between the HJ group and higher VC rates (36.1% vs 10.4%, respectively; $P < .001$); this was principally because of early arterial complications (14.9% vs 2.2%, respectively), but not long-term outcomes (10.6% vs 3.7%, respectively). This finding could be related to the fact that more ischemic disease and retransplant were present in the HJ group, which are associated with a more demanding surgical technique. Despite differences in arterial complications, overall incidence of BC, as well as the incidence of BL and BS, was similar for the different biliary reconstruction methods investigated in our study. This finding is consistent with results reported in recent studies. Al-Judaibi et al recently reported no statistically significant difference in BC incidence in the HJ group compared with the CC group (8.6% vs 13.3%, respectively; $P = .95$) in OLT [14]. Similarly, results of a meta-analysis, based on 10 studies and involving 910 patients with cholestatic disease, did not show any difference between the 2 biliary duct techniques with respect to BCs [13]. In a previous study [8], we reported that, based on univariate analysis, surgery that lasted longer than 5 hours was associated with a higher incidence of BCs; however, this finding was not confirmed in multivariate analysis. In our present study, the global infection rate was significantly higher in the HJ group. Because HJ involves an open connection between the intrahepatic bile ducts and the bowel lumen, this may facilitate ascending bacterial migration and recurrent cholangitis [15]. Nevertheless, other factors, such as a higher number of retransplant procedures, longer surgery time, and higher VC rates, may have influenced this finding. It is noteworthy that we observed no disparity in graft survival between the 2 types of biliary reconstruction.

There are several limitations in our study. First, the investigation is retrospective and observational, although the data were retrieved from a prospective data base. Second, although efforts were made to minimize the impact of selection and make both study groups comparable with a matching process, selection of the reconstructive technique had been clearly influenced by the cause of transplant, and this may constitute an important bias.

We conclude that reconstruction with using the HJ method in OLT resulted in longer biliary reconstruction, surgery, and cold ischemia times when compared with the CC method. In addition, use of the HJ method was followed by a higher incidence of arterial complications and infection episodes than with CC, although similar BC rates and graft survival were reported. Nevertheless, the differences could be a result of HJ being used more often in cholestatic or ischemic diseases and in retransplant procedures using CC.




| | HJ (47 OLT) | CC (136 OLT) | *P* Value 0=55 |
|---|---|---|---|
| 1 year | 87.2% | 92.6% | |
| 3 years | 81% | 85.2% | |
| 5 years | 74.5% | 83.8% | |

**Fig 1.** Graft survival according to biliary reconstruction technique. CC, coledoco-coledocostomy; HJ, hepaticojejunostomy; OLT, orthotopic liver transplant.

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