ORIGINAL ARTICLE

Impact of early biliary complications in liver transplantation in the presence or absence of a T-tube: a Chinese transplant centre experience

Tang Li, Zhi-Shui Chen, Fan-Jun Zeng, Chang-Sheng Ming, Wei-Jie Zhang, Dun-Gui Liu, Ji-Ping Jiang, Dun-Feng Du, Zhong-Hua Klaus Chen

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See end of article for authors' affiliations

Correspondence to:
Professor Chen Zhishui,
Institute of Organ
Transplantation, Tongji
Hospital, NO1095 Jiefang
Road, Wuhan, China,
430030; zschen@
tjh.tjmu.edu.cn

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Background: Biliary complications continue to be an important determinant of the recipient's survival rate after orthotopic liver transplantation (OLT). The objective of this study was to evaluate the incidence of early biliary complications in OLT in the presence or absence of a T-tube.

Methods: This retrospective study, based on inpatient data, focused on the relationship between T-tube placement and early biliary complications of 84 patients after OLT, from November 2002 to June 2005. Patients were divided into two groups based on whether or not a T-tube was used following bile duct reconstruction: T-tube group (group I, n = 33); non-T-tube group (group II, n = 51).

Results: 45.2% of OLT recipients had a malignant neoplasm. There were no significant differences in the demographic characteristics or operation data between the two groups. Overall, early biliary tract complications developed in 19.0% (16/84) of patients. The rate of early biliary complications was 30.3% (10/33) and 11.8% (6/51) in groups I and II, respectively ($p=0.035$). Biliary complications which were directly caused by T-tube placement occurred in 12.1% (4/33) of patients in group I. Overall, the percentage of malignant neoplasms, chronic viral cirrhosis, fulminant liver failure and other primary disease recipients with early biliary complications were 6.2%, 37.5%, 43.8% and 12.5%, respectively.

Conclusion: This study suggests that the use of a T-tube in Chinese patients undergoing OLT causes a higher incidence of early biliary complications. Most of the early biliary complications occurred in chronic viral cirrhosis and fulminant liver failure recipients.

Biliary reconstruction is a major cause of morbidity associated with orthotopic liver transplantation (OLT).^{1,2} Currently, there are two or three popular reconstruction methods available for surgeons based on their experience. Most centres' reports showed that non-T-tube reconstruction may be associated with fewer complications and could be more cost effective.^{3–9} According to their reports, cholangitis, fistula, dislodgement, obstruction and peritonitis are complications directly related to the T-tube, accounting for 60% of all postoperative biliary problems.⁹ However, to date, there have been no formal reports on this problem published in China. Furthermore, Chinese recipients are unique as the main cause of end stage liver disease is different from that in other countries. The aim of this study was to compare early biliary tract complications in the presence or absence of a T-tube and assess our centre's experience.

PATIENTS AND METHODS

Patients and graft

A total of 84 patients, including 33 patients with a T-tube and 51 without a T-tube, underwent liver transplantation in our centre, from November 2002 to June 2005. The decision to insert a T-tube was taken by the surgeon accordingly to the clinical needs of individual patients. The indication for OLT was primary liver carcinoma in 45.2% of cases, end stage liver viral cirrhosis in 17.9%, fulminant liver failure in 16.7% and other diseases in 20.2%. Based on Child score assessment, 19.1% were grade A, 46.4% grade B and 34.5% grade C. Seventy six patients had normal renal function among whom eight cases showed increased serum creatinine levels. In addition, five patients experienced massive haemorrhage of the gastrointestinal before the operation.

All liver grafts were retrieved from cadaver donors. Vena cava preservation was performed in all donors. Whole livers and the biliary tract were flushed and stored with 3000 ml of cool University of Wisconsin solution. The cold ischaemic period of the graft was approximately six to nine hours. Blood type between donors and recipients was compatible.

Factors such as liver disease, Child-Pugh score, graft cold ischaemic time, anhepatic phase, operation time and operative blood transfusion that could contribute to biliary complications were noted, and these parameters were well matched in both groups (tables 1, 2).

Methods

Eighty four OLT procedures were performed using either the standard technique or the piggyback technique. All patients were underwent OLT without venovenous bypass.

We performed two different methods for biliary reconstruction. One procedure involved a duct-to-duct choledochocholedochostomy without a T-tube and was performed with 6/0 polydioxanone non-continuous suture. The other involved a choledochocholedochostomy with a silicone T-tube and was performed using 6/0 polydioxanone running suture in the posterior wall and a non-continuous suture in the anterior wall. When the anastomosis was completed it was checked for leaks. This was done by first flooding the area with saline solution, then injecting air through the T-tube and finally by performing a T-tube cholangiogram. The decision to insert a T-tube was taken by the surgeon accordingly to the clinical needs of

Abbreviations: EST, endoscopic sphincterotomy; ERBD, endoscopic retrograde biliary drainage; ERCP, endoscopic retrograde cholangiopancreatography; OLT, orthotopic liver transplantation

Table 1 Demographic data for group I and group II patients before OLT

Parameter	Group I (n = 33)	Group II (n = 51)	p Value
Sex (F/M)	3/30	5/46	0.913
Mean age at OLT (y)	47.2 (9.4)	42.50 (13.5)	0.116
Mean weight (kg)	64.3 (9.9)	63.6 (11.2)	0.789
Diagnosis			
Malignant neoplasm	14 (42.4)	24 (47.1)	0.829
Chronic viral cirrhosis	6 (18.2)	9 (17.6)	
Fulminant liver failure	7 (21.2)	7 (13.7)	
Other*	6 (18.2)	11 (21.6)	
Child score assessment			
A	6 (18.2)	10 (19.6)	0.453
B	13 (39.4)	26 (51.0)	
C	14 (42.4)	15 (29.4)	

OLT, orthotopic liver transplantation.

Values are number (%).

*Includes Wilson's disease, polycystic liver, alcoholic cirrhosis, and cholestatic.

individual patients. After May 2004, all surgeons performed choledochcholedochostomy without a T-tube. The T-tube was removed 3 months post-transplant. Liver function tests and clinical examination were tested regularly during the period of hospitalisation. Endoscopic retrograde cholangiopancreatography (ERCP), cholangiography and ultrasonic inspections were commonly used to diagnose biliary complications if clinically indicated in the post-transplant period.

Statistical analysis

Eighty four patients were divided into two groups: group I comprised patients whose bile duct reconstruction involved a T-tube; group II patients did not have a T-tube. We retrospectively reviewed the following variables in the two groups: primary diagnosis, cold ischaemia time, early biliary complications, non-biliary complications, treatment and other. Early biliary complications were defined as leaks, obstruction or cholangitis occurring during the first 3 months post-transplant.

Statistical analyses were conducted using the Statistical Package for the Social Science computer programs (SPSS for Windows 11.5; SPSS Inc., Chicago, Illinois, USA). The Student's *t* test and the χ^2 test were used to determine statistical significance between groups. A *p* value <0.05 was considered significant.

RESULTS

Common information about patients

Eighty four patients had bile duct reconstruction with or without a T-tube. Statistical analysis was performed on preoperative data in the two groups, such as general data, primary liver disease and Child score. The demographic characteristics of group I and group II were similar (table 1). The proportion of patients with hepatocellular carcinoma was 45.2% (42.4% in group I and 47.1% in group II). Intraoperative data for the two groups are reported in table 2. Although mean

graft ischaemia time was longer in group I, the difference was not statistically significant (479 (98) *v* 457 (89) min).

Early biliary tract complications

Overall 16 of 84 recipients (19.0%) experienced early biliary complications. The incidence of biliary complications was 30.3% in group I compared with 11.8% in group II (*p* = 0.035). The types of early biliary complications in both groups are detailed in table 3. Clinical data showed that T-tube placement directly caused biliary complications in 12.1% of patients in group I. This included two patients in whom bile leaks were caused by accidental dislodgement of the T tube, one biliary stricture due to coiling of a T-tube in the common bile duct and one cholangitis due to cholangiography using a T-tube. Group II included one case of anastomotic leak caused by suture related insufficiencies, four cases of bile duct obstruction and one case of cholangitis related to sphincter of Oddi dysfunction.

The primary diagnosis of patients with early biliary complication was also analysed (table 3). In total, early biliary complications occurred in one recipient with malignant neoplasms (6.2%), six recipients with chronic viral cirrhosis (37.5%), seven recipients with fulminant liver failure (43.8%) and two recipients with other primary diseases (12.5%). The primary diagnosis did not differ significantly between the two groups of patients with biliary complications.

Diagnosis and treatments of early biliary complications

The types of radiological studies and treatments are given in (table 4). In group I, four biliary tract obstructions and one anastomosis leak were successfully treated with internal stents. Three patients underwent endoscopic sphincterotomy (EST) with or without endoscopic retrograde biliary drainage (ERBD) for treatment of non-anastomosis bile leak. One patient had endoscopic placement of nasobiliary catheters to treat biliary obstruction. In group II, three patients had internal stents to treat biliary tract obstruction, and one had nasobiliary drainage

Table 2 Operative data for group I and group II patients

Parameter	Group I (n = 33)	Group II (n = 51)	p Value
Cold ischaemia time (min)	479 (98)	457 (89)	0.417
Mean anhepatic phase (min)	57 (13)	64 (25)	0.301
Mean operation time (min)	375 (98)	397 (120)	0.502
Red blood cell transfusion (ml)	2433.3 (2373.9)	2829.2 (2693.9)	0.606
Fresh plasma transfusion (ml)	851.5 (563)	1150 (674)	0.089
Implantation of the liver graft			
Classic OLT	27	38	0.434
Piggyback technique	6	13	

OLT, orthotopic liver transplantation.

Table 3 Early biliary complications in group I and group II patients

Complication	Total (n = 84)	Group I (n = 33)	Group II (n = 51)
No with biliary complications	16	10*	6*
No without biliary complications	68	23	45
Leaks			
Anastomosis	2	1	1
Non-anastomosis	3	3	0
Bile duct obstruction			
Extrahepatic obstruction	8	5	3
Intrahepatic stricture	1	0	1
Cholangitis	2	1	1
Primary diagnosis of patients with biliary complication			
Malignant neoplasm	1	1	0
Chronic viral cirrhosis	6	3	3
Fulminant liver failure	7	5	2
Other†	2	1	1

*p<0.05.

†Other.

to treat cholangitis and the nasobiliary drain was removed after 14 days. One patient with biliary obstruction had a surgical revision and creation of a Roux-en-Y choledochojejunostomy. In addition, one recipient with cholangitis in group I and one recipient with an anastomotic leak in group II were successfully managed with conservative treatment.

Non-biliary tract complications

A number of non-biliary complications developed during the hospital stay included hepatic artery thrombosis/stenosis, portal vein thrombosis, acute rejection, pulmonary infection, primary liver graft non-function and thoracic/abdominal cavity haemorrhage. In the two groups the non-biliary complications were similar (table 5).

DISCUSSION

Orthotopic liver transplantation is the definitive treatment for end stage liver disease. With the advances in surgical techniques, immunosuppressive drugs and organ preservation, the survival ratio of recipients has gradually increased.^{10 11} However, biliary complications remain common after OLT, and it have been reported in 9–34% of liver transplant patients.^{2 12 13} Biliary complications continue to be the major hurdle to the survival of OLT patients. Based on the time of onset following OLT, biliary complications may be divided into early and late complications. Approximately two thirds of all biliary complications occur as early complications within the first 3 months after OLT, and are a significant source of morbidity and mortality.¹⁴ Several post-transplant biliary complications exist but the most common are leaks and strictures. Leaks usually occur during the early post-transplant period while stricture formation typically develops gradually over several months to years.

For the past few years, more and more reports have shown that the absence of a T-tube is better for biliary reconstruction.^{3–9 23} Furthermore, in China, to date there have been no published studies on this topic. During the early development stage of OLT, duct-to-duct choledochocholedochostomy over a T-tube has been used in most transplant centres. The T-tubes used in biliary reconstruction are of benefit to the patient in terms of biliary tract decompression, monitoring of bile output from the graft and allowing direct therapy access to the biliary tract. Thus the use of a T-tube can help doctors acquire information on graft function and assist in therapy.^{15 16} However, use of a T-tube in biliary anastomosis can cause bile leaks, nosocomial

Table 4 Biliary diagnosis/treatment in group I and group II patients

	Group I (n = 33)	Group II (n = 51)
Biliary diagnosis		
ERCP	10	6
Cholangiography	14	0
Ultrasonography	23	32
Treatment		
ERCP+BS	5	3
ERCP+EST	1	0
ERCP+EST+ERBD	2	0
ERCP+NBD	1	1
Reoperation	0	1

BS, biliary stent; ERBD, endoscopic retrograde biliary drainage; ERCP, endoscopic retrograde cholangiopancreatography; EST, endoscopic sphincterotomy; NBD, nasobiliary drainage.

infection and biliary sludge formation. Additionally, it is difficult to format the fistula of a T-tube when a large dose of immunosuppressive is administered. Also, the T-tube can cause bile leakage at the time of drain removal.^{14–16} Inflammation of tissue surrounding the T-tube may repeatedly stimulate scar formation and induce stricture. In our centre, we have avoided using T-tubes since May 2004. This study focused on early biliary complications of liver transplantation and the safety of non-T-tube use in China.

Our study indicates that biliary reconstruction in OLT without a T-tube is safer than with a T-tube during the early postoperative period. The incidence of early biliary complications in group I without a T-tube was significantly less than that in group II with a T-tube during biliary reconstruction. Overall biliary complications occurred in 19.0% of patients. In group I, 30.3% of patients developed early biliary tract complications compared with only 11.8% of group II patients. Biliary leakage in group II was caused by anastomosis leaks while in group I it usually occurred at the time of T-tube removal after OLT. Our results showed that biliary complications directly caused by the T-tube occurred in 12.1% of group I, with two leaks, one biliary stricture and one cholangitis. Additionally, patients without a T-tube were not at a higher risk of bile duct obstruction formation. The similarity in strictures in our study differs from previous reports which showed that the use of T-tubes was associated with fewer biliary strictures and stenoses, suggesting that T-tubes may have a protective role against the formation of biliary strictures.²¹ This difference may due to our shorter observation time and limited study of the patients' early biliary complications. Biliary complications have been associated with surgical anastomosis, graft ischaemic reperfusion injury, cold ischaemic time, ABO incompatibility

Table 5 Non-biliary complications in group I and group II patients

Complication	Group I (n = 33)	Group II (n = 51)
Hepatic artery complications		
Thrombosis	2	1
Stenosis	1	3
Portal vein thrombosis	2	1
Acute rejection	2	1
Pulmonary infection	1	1
Primary liver graft non-function	0	1
Thoracic/abdominal cavity haemorrhage	4	2

and other factors.^{1 2 10-12} Although the mean graft ischaemia time was longer in group I, the difference was not significant. Other intraoperative data were similar between the two groups. Also, non-biliary complications during the hospital stay were similar in the two groups.

The primary liver diseases in our Chinese recipients were different from those of patients in other countries. In our centre, 45.2% of recipients suffered from malignant neoplasm (table 1). Child-Pugh classification revealed that 46.4% of patients had grade B and 34.5% grade C disease. This is in contrast with UNOS statistics of American transplant recipients in 2003 where only 6.2% of patients suffered from malignant neoplasm.²⁰ Our study also analysed the primary diagnosis of the two groups with biliary complications. The results showed that the majority of biliary complications occurred in recipients with chronic viral cirrhosis and fulminant liver failure. However, there were no significant differences between the two groups. Our experience revealed the patients with viral cirrhosis and fulminant liver failure had more severe metabolic and blood clotting disorders than carcinoma patients at pretransplantation. We believe that primary liver disease may be an important influential factor for biliary complications in China.

Recently, endoscopic examination has become more commonly used in the diagnosis and treatment of biliary complications after OLT in China. Furthermore, therapeutic ERCP, such as EST and ERBD, has become the first choice in the management of bile duct obstructions.²² In our study, there was only one biliary obstruction with required surgical revision and creation of a Roux-en-Y choledochojejunostomy. This was in a patient in group II. One cholangitis in group I and one anastomotic leak in group II were successfully managed with conservatively. In our study, leakages were localised and managed endoscopically with EST, ERBD or nasobiliary drainage. For severe leak, surgical treatment is recommended. Delayed management can lead to subphrenic abscess. Generally, the internal stent was maintained for 3 months or longer in our centre and patients received long term follow-up to prevent the recurrence of biliary obstruction. The nasobiliary stent in two patients was removed after 14 days.

The present study has several limitations. Firstly, we analysed patient data only during their hospital stay (about 3 months) and we did not obtain adequate follow-up data to assess the incidence of late biliary complications in the presence or absence of a T-tube. Secondly, all cases came from our centre and the sample size was small. If we increased the number of patients, the results may be more convincing. Lastly, although patient groups were comparable for some factors, the results and conclusions may have been biased by the selection process of the patients.

In conclusion, this is the first report of early biliary tract complications after OLT in the presence or absence of a T-tube in a Chinese population. Our results suggest that the development of early biliary complications in patients of OLT were significantly related to drainage with the T-tube. Most early biliary complications occurred in recipients with chronic viral cirrhosis and fulminant liver failure, irrespective of the presence or absence of a T-tube.

Authors' affiliations

Tang Li*, Zhi-Shui Chen*, Fan-Jun Zeng, Chang-Sheng Ming, Wei-Jie Zhang, Dun-Gui Liu, Ji-Ping Jiang, Dun-Feng Du, Zhong-Hua Klaus Chen, Institute of Organ Transplantation (Key Laboratory of Organ Transplantation, Ministry of Education/Ministry of Health), Tongji Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China

*Li Tang and Zhi-Shui Chen are joint first authors.

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