

Prognosis of Liver Transplantation: Does Postoperative Ileus Matter ?

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Research article

Keywords: liver transplantation, postoperative ileus, MELD score, Child-Pugh score

Posted Date: December 4th, 2020

DOI: <https://doi.org/10.21203/rs.3.rs-118170/v1>

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Version of Record: A version of this preprint was published at BMC Gastroenterology on November 25th, 2021. See the published version at <https://doi.org/10.1186/s12876-021-02026-7>.

Abstract

Background: Nowadays, liver transplantation has become a main therapy for end-stage liver disease. However, studies show that there are high mortality and severe complications after liver transplantation. Although gastrointestinal dysfunction is a common and major complication among complications, there was rarely relative research. The study aims to elucidate the factors about ileus after liver transplantation and patients' survival rate.

Methods: We collected data (n=318, 2016–2019) from the First Affiliated Hospital of Xi'an Jiaotong University. After excluding cases, a total of 293 patients were included for this study. The subjects were divided into a non-ileus group and an ileus group. We reviewed 38 variables (including preoperative, operative and postoperative relative factors). In addition, other complications after liver transplantation and survival data were compared among groups.

Results: Of the 293 patients, 23.2% (n=68) experienced postoperative ileus. Ileus patients were not different with non-ileus patients in preoperative, operative and postoperative factors. HBV-positive patients with ileus had a lower MELD score (P=0.025), and lower postoperative total bilirubin was correlated with ileus (P=0.049). Besides, Child-Pugh score of HCC patients with ileus was low (P=0.029). The complications after liver transplantation and survival rate were all not different among groups.

Conclusions: According to our research, compared with non-ileus patients, we didn't obtain the risk factors for patients with ileus. Ileus-patients didn't increase complications after liver transplantation and didn't decrease post-LT survival rates. But the preoperative MELD score and postoperative total bilirubin of HBV-positive patients with ileus were lower, and Child-Pugh score of HCC patients with ileus was also lower.

Background

Liver disease accounts for approximately 2 million deaths every year worldwide[1]. Apart from cirrhosis and hepatocellular carcinoma due to viral hepatitis as well as alcohol, non-alcoholic fatty liver disease and drug induced hepatitis continue to increase as a main cause of acute liver injury. Liver diseases were estimated to become the 12th leading cause of mortality by 2020[2]. Liver transplantation (LT) becomes a major therapy for liver diseases, especially end-stage liver disease[1, 3, 4]. However, the needs of liver transplantation far exceed the supply. Current liver transplantation rates were less than 10% needs of organ transplantation[1]. Although the survival rate of liver transplantation has improved greatly in recent years, there are still many complications that affect prognosis and life span[5].

The clinical research about cardiovascular disease, acute kidney injury and thrombosis after LT are most common, and gastrointestinal dysfunction is a ordinary complication after surgery, but postoperative ileus (POI) after LT is rare[6-8]. Postoperative ileus is a common complication following especially open abdominal surgery. Preoperative malnutrition, operative procedure, anesthesia and postoperative managements may increase the gastrointestinal dysfunction rate[9]. According to clinical experience,

once the gastrointestinal function is abnormal, the recovery of LT patients is delayed, even may effect survival rate of patients. Our study is designed to identify risk factors, obtain possible predictive factors and the effects of ileus to survival rate after LT patients.

Methods

Data collection

We collected the data from the First Affiliated Hospital of Xi'an Jiaotong University between 2016 to 2019 all recipients that underwent orthotopic liver transplantation (OLT). Data elements include preoperative, operative and postoperative relative factors. In addition, patients are classified as postoperative ileus when the time of the first passage of flatus and the the first defaecation is over 72 hours, or normal. We excluded candidates who were in gastrointestinal dysfunction, homeostasis disturbance, secondary liver transplantation, MODS (multiple organ dysfunction syndrome) before surgery, critically ill after surgery and incomplete data.

Follow up

In view of regular check-up of post-LT patients, we used the in-hospital or out-hospital numbers, which are unique to each patient, to obtain patients' outcome in this study. The single endpoint of the study was all-cause mortality. Observations were stopped at the date of last available follow-up (December 1, 2019). Finally, 218 patients finished follow up.

Statistic analyse

The patients were categorized into 2 groups according to postoperative ileus. Continuous variables were summarized as means \pm standard deviation or median and interquartile ranges, whereas frequencies and percentages were used for categorical variables. Student's t-test or Mann-Whitney U-test for continuous independent variables, the Pearson test or Fisher's exact test was used to compare qualitative variables. The log-rank test (Mantel-Cox) was used to compare group survival curves. Statistical significance for all analyses was determined at $P < 0.05$. All analyses were undertaken by using Statistical Package for Social Sciences (SPSS) software, version 25.0 (IBM SPSS, Armonk, NY, USA).

Results

Patient's characteristics of eligible transplanted cohort

There were 293 patients who were eligible and 218 patients finished the follow up. The mean age of the transplanted population was 48(40.00-55.00) and 76.5% were males. The most common aetiology of liver diseases were chronic hepatitis B (46.4%), primary hepatic carcinoma (31.4%), chronic hepatitis C (4.1%). Less common aetiology included alcohol liver disease (7 patients), autoimmune hepatitis (7 patients), cholestatic hepatitis (7 patient), NASH (31 patients) (Table 1).

Preoperative risk factors of postoperative ileus

The study demonstrated that age, male, BMI (body mass index), history of abdominal surgery, hepatic encephalopathy, portal hypertension, MELD score (Model for End-Stage Liver Disease), platelet counts, albumin, total bilirubin, serum creatinine, lactic acid and aetiology of liver disease were not significantly different between groups (Table 1) .

Table 3 shows the results of risk factors for HBV-positive patients with and without ileus. Except for MELD score ($p=0.025$), no significant differences were observed between patients with and without ileus for other factors analyzed.

There were not different between with and without ileus of HCC (hepatocellular carcinoma) patients for intraoperative risk factors, except for Child-Pugh score ($p=0.029$; Table 5).

Intraoperative and postoperative risk factors of postoperative ileus

Intraoperative factors included duration of surgery, anhepatic phase, blood loss, total infusion fluid, red cell transfusion, cryoprecipitate transfusion and anesthesia (drug doses of propofol, sufentanil, renifentanil, sevoflurane, dexmedetomidine and etomidate) were not different among groups (Table 1). Retention time of tracheal tube, length of SICU (Intensive Care Unit of surgery), length of hospital stay, total bilirubin, lactic acid, platelet counts were postoperative possible risk factors. All were not different (Table 2).

There were not different between with and without ileus of HBV-positive patients for intraoperative risk factors (Table 3), but postoperative total bilirubin was significant difference between groups ($P=0.049$; Table 4).

Table 5 and Table 6 shows that no significant differences were observed in HCC patients with and without ileus for intraoperative and postoperative risk factors.

Complications of transplanted cohort

During the follow-up period, the most common complications were Biliary infection or stricture (16.1%), vascular complication (7.8%), pulmonary infection (5.5%), kidney injury (4.1%), hepatic injury (3.2%). Other complications included acute rejection (7 patients), abdominal infection (4 patients), recurrence of hepatocellular carcinoma (8 patients), sepsis (6 patients), coagulation disorders (5 patients), acute pancreas (1 patient). Between ileus group and normal group were not different (all $P \geq 0.05$; Table 2). There were no difference in complications between patients with and without ileus of HBV-positive patients (Table 4). Furthermore, no significant differences were observed in HCC (hepatocellular carcinoma) patients with and without ileus (Table 6).

Overall survival rates of ileus and normal patients

Univariate analysis of 52 patients showed that 1-, 2- and 3-year overall survival rates post-LT were 89%, 89% and 89% in ileus patients, respectively, and 91%, 88% and 88% in normal patients, respectively. Overall survival rates post-LT were not different among groups ($p = 0.8$; Figure 1A).

1-, 2- and 3-year overall survival rates post-LT of HBV-positive patients were 87%, 87% and 87% in ileus patients, respectively, and 91%, 91% and 91% in normal patients, respectively. Overall survival rates post-LT were not different among groups ($p = 0.5$; Figure 1B).

1-, 2- and 3-year overall survival rates post-LT of HCC patients were 88%, 88% and 88% in ileus patients, respectively, and 93%, 88% and 88% in normal patients, respectively. Overall survival rates post-LT were not different among groups ($p = 0.6$; Figure 1C).

Donor's characteristics of ileus and normal patients

Table 7 shows the results of donor's characteristics for patients with and without ileus. There were no significant differences between patients with and without ileus for the factors analyzed.

Discussion

Liver transplantation is not only a definitive treatment for liver disease, but also the second most common solid organ transplantation. Although doctors and researchers take complications of liver transplantation seriously and carry out treatments, POI is ignored by researchers. Postoperative ileus is a common complication after most abdominal surgeries, which is associated with longer hospitalization and increased medical costs[10]. Fluid overload, exogenous opioids, surgical procedure are key mechanisms of POI[11, 12]. Among the 293 patients enrolled in this study with liver diseases who underwent LT, univariate analysis indicated that there was no significant difference in preoperative, intraoperative and postoperative factors between patients with and without POI. Study has reported that goal-directed fluid therapy does not reduce postoperative ileus in gastrointestinal surgery. It is possible that fluid overload is not necessary risk factor[13], which also proved our results about fluid transfusion. Besides, patients with POI had not worse overall survival rates than patients without POI.

Model of end-stage liver disease (MELD) and Child-Pugh scores have been widely used to assess the prognosis and predict the outcomes of cirrhotic patients[14]. MELD score is incorporated only 3 objective variables, including total bilirubin, creatinine and INR. Studies has proved that the MELD score system could reduce the death rate in patients waiting for a liver transplantation, and downgrading MELD score can improve the outcomes after liver transplantation in patients with acute-on-chronic hepatitis B liver failure[15, 16]. The Child-Pugh score, based on clinical symptoms of insufficient liver function (ascites/encephalopathy), and laboratory analysis of parameters of liver function (albumin, bilirubin, and PT) can be used to identify low or high-risk patients[17]. And the Child-Pugh score has been proved that it is not only as a predictor of postoperative mortality after portocaval shunt surgery but also predicts mortality risk associated with other major operations[18]. The preoperative MELD score and postoperative total bilirubin of HBV-positive patients with ileus were lower than without ileus. And Child-Pugh score of

HCC patients with ileus was lower than without ileus. There were no difference in other observed factors and overall survival rates among groups. According to the results, we can get that MELD and Child-Pugh scores are not suitable for predicting the POI after liver transplantation. Then, complications after liver transplantation including biliary infection or stricture, vascular compliacation, pulmonary infection, kidney injury were not different in LT patients with ileus and without ileus according to our study.

Several limitations of this study must be considered. First, this study was retrospective. Second, postoperative ileus was determined based on medical history, and the diagnosis of postoperative ileus lacks objective standards, which needs further research and disccusion of professionals, especially ileus after liver transplantation. However, this study indicate that ileus of liver transplantation is a worthy research direction and demands sufficient clinical attetion.

Conclusion

In conclusion, compared with non-ileus patients, we didn't obtain the risk factors of patients with ileus. Ileus-patients didn't increase complications after liver transplantation and didn't decrease post-LT survival rates. But the preoperative MELD score and postoperative total bilirubin of HBV-positive patients with ileus were lower, and Child-Pugh score of HCC patients with ileus was also lower. A future prospective cohort study with larger a sample size should be conducted to confirm these observations, or POI may not be vital in the liver transplantation patients.

Abbreviations

| | |
|------------|-------------------------------------|
| LT | Liver transplantation |
| POI | postoperative ileus |
| OLT | orthotopic liver transplantation |
| MODS | multiple organ dysfunction syndrome |
| BMI | body mass index |
| MELD score | Model for End-Stage Liver Disease |
| HCC | hepatocellular carcinoma |
| SICU | Intensive Care Unit of surgery |

Declarations

Ethics approval and consent to participate

The institutional review board of the First Affiliated Hospital of Xi'an Jiaotong University approved this retrospective study.

Consent for publication Not applicable.

Competing interest The authors declare that they have no conflict of interest.

Availability of data and material The data that support the findings of this study are available from the corresponding authors.

Funding This research did not receive any specific grant from funding agencies in the public, commercial, or not-for profit sectors.

Author Contributions RP B contributed to the methodology, data collection, data analysis and writing-original draft; R A and KY H contributed to the data collection, software, data analysis; X S contributed to the research design, project administration, writing-review & editing; SH Z contributed to the research design, project administration, writing-review & editing. All authors have read and approved the manuscript.

Acknowledgement Not applicable.

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Tables

| Table 1 Preoperative and operative relative factors | | | | |
|--|---------------------|--------------------|---------------------|---------|
| | Over all (n=293) | Ileus (n=68) | Non-ileus (n=225) | P value |
| Preoperative characteristics | | | | |
| Age (years) | 48.0 (40.00-55.00) | 48.0 (37.00-54.75) | 47.9 ± 10.08 | 0.676 |
| Male | 224.0 (76.50%) | 53.0 (77.90%) | 171.0 (76.00%) | 0.741 |
| BMI (kg/m ²) | 22.5 (20.76-24.47) | 22.6 ± 3.19 | 22.3 (20.76-24.39) | 0.952 |
| History of abdominal surgery | 75.0 (25.60%) | 20.0 (29.40%) | 55.0 (24.40%) | 0.411 |
| Hepatic encephalopathy | 33.0 (11.30%) | 7.0 (10.30%) | 26.0 (11.60%) | 0.773 |
| Portal hypertension | 197.0 (67.20%) | 47.0 (69.10%) | 150.0 (66.70%) | 0.706 |
| Pleural fluid or ascites | 143.0 (48.80%) | 31.0 (45.60%) | 112.0 (49.80%) | 0.545 |
| Child-Pugh | 10.0 (9.00-11.00) | 10.0 (8.00-11.00) | 10.0 (9.00-11.00) | 0.289 |
| MELD score | 15.0 (11.00-23.00) | 14.5 (10.00-19.75) | 16.0 (11.50-23.00) | 0.058 |
| Albumin (g/L) | 36.8 (32.90-42.20) | 36.7 ± 6.57 | 37.0 (32.95-42.25) | 0.432 |
| Total bilirubin (umol/L) | 44.8 (25.05-135.40) | 44.8 (22.30-98.40) | 44.8 (26.10-168.35) | 0.363 |
| Serum creatinine (umol/L) | 56.0 (46.00-67.00) | 57.0 (45.50-75.00) | 55.0 (46.00-66.00) | 0.370 |
| Preoperative lactic acid | 1.5 (1.10-1.90) | 1.5 (1.00-2.00) | 1.4 (1.10-1.90) | 0.725 |
| Atiology of liver disease | | | | |
| Chronic hepatitis B | 136.0 (46.40%) | 34.0 (50.00%) | 102.0 (45.30%) | 0.499 |
| Primary hepatic carcinoma | 92.0 (31.40%) | 18.0 (26.50%) | 74.0 (32.90%) | 0.318 |
| Chronic hepatitis C | 12.0 (4.10%) | 1.0 (1.50%) | 11.0 (4.90%) | 0.370 |
| Alcoholic hepatitis | 7.0 (2.40%) | 1.0 (1.50%) | 6.0 (2.70%) | 0.910 |
| Autoimmune hepatitis | 7.0 (2.40%) | 4.0 (5.90%) | 3.0 (1.30%) | 0.089 |
| Cholestatic Cirrhosis | 7.0 (2.40%) | 1.0 (1.50%) | 6.0 (2.70%) | 0.910 |
| Other | 31.0 (10.60%) | 9.0 (13.20%) | 22.0 (9.80%) | 0.417 |
| Intraoperative factors | | | | |

| | | | | |
|---|--------------------------|--------------------------|--------------------------|-------|
| Operation time (min) | 365.0 (330.00-420.00) | 377.0 ± 81.52 | 367.0 (330.00-420.00) | 0.668 |
| Anhepatic phase (min) | 50.0 (45.00-57.00) | 51.4 ± 11.59 | 51.0 (45.00-57.00) | 0.578 |
| Blood loss during operation (ml) | 1000.0 (650-2000) | 1000.0 (625-1600) | 1000.0 (650-2000) | 0.661 |
| Total infusion fluid (ml) | 5660.0 (4735-6690) | 5750.7 ± 1653.65 | 5700.0 (4780-6710) | 0.385 |
| Intraoperative RBC transfusion (units) | 8.0 (4.00-12.00) | 8.0 (4.00-11.75) | 8.0 (6.00-12.00) | 0.167 |
| Intraoperative cryoprecipitate transfusion(units) | 1200.0 (800-1600) | 1000.0 (800.00-1550.00) | 1200.0 (800.00-1600.00) | 0.177 |
| Retention time of tracheal tube (hours) | 7.2 (5.25-9.63) | 7.3 (5.50-9.44) | 7.2 (5.00-9.88) | 0.917 |
| Length of SICU (days) | 6.0 (5.00-10.00) | 6.0 (5.00-9.50) | 7.0 (5.00-10.00) | 0.394 |
| Length of hospital stay (days) | 19.0 (15.00-24.50) | 19.5 (15.00-23.75) | 19.0 (15.00-26.00) | 0.947 |
| Anesthesia factors | | | | |
| Propofol (mg) | 1500.0 (1300.00-1820.00) | 1500.0 (1200.00-1930.00) | 1500.0 (1300.00-1800.00) | 0.826 |
| Sufentanil (ug) | 30.0 (30.00-40.00) | 30.0 (30.00-40.00) | 30.0 (30.00-40.00) | 0.101 |
| Renifentanil (ug) | 3000.0 (2517-3800) | 3000.0 (2400-3956) | 3000.0 (2600-3600) | 0.773 |
| Sevoflurane (ml) | 60.0 (50.00-80.00) | 60.0 (50.00-70.00) | 60.0 (50.00-80.00) | 0.796 |
| Dexmedetomidine (ug) | 120.0 (100.00-180.00) | 111.0 (100.00-150.00) | 120.0 (85.00-180.00) | 0.881 |
| Etomidate (mg) | 14.0 (10.00-16.00) | 14.0 (11.25-16.00) | 14.00 (10.00-16.00) | 0.572 |

| Table 2 Postoperative characteristics and complications | | | | |
|--|---------------------|--------------------|---------------------|---------|
| | Over all (n=218) | Ileus (n=52) | Non-ileus (n=166) | P value |
| Postoperative characteristics | | | | |
| Total bilirubin (umol/L) | 62.1 (40.53-106.05) | 58.0 (40.30-94.28) | 65.0 (41.13-112.90) | 0.315 |
| Lactic acid | 2.1 (1.40-3.53) | 2.3 (1.40-4.58) | 2.0 (1.40-3.23) | 0.123 |
| Platelet ($\times 10^9/L$) | 48.5 (35.00-73.00) | 50.5 (39.00-82.75) | 48.0 (32.75-70.25) | 0.217 |
| Complications | | | | |
| Hepatic injury | 7 (3.20%) | 1 (1.90%) | 6 (3.60%) | 0.878 |
| Pulmonary infection | 12 (5.50%) | 5 (9.60%) | 7 (4.20%) | 0.254 |
| Kidney injury | 9 (4.10%) | 3 (5.80%) | 6 (3.60%) | 0.778 |
| Biliary infection or stricture | 35 (16.10%) | 6 (11.50%) | 29 (17.50%) | 0.309 |
| Vascular complication | 17 (7.80%) | 5 (9.60%) | 12 (7.20%) | 0.792 |
| Others | 31 (14.40%) | 7 (14.90%) | 24 (14.30%) | 0.916 |

| Table 3 Preoperative and operative relative factors of patients with HBV | | | | |
|---|---------------------------|-----------------------------|---------------------------|--------------|
| | Over all (n=192) | Ileus (n=47) | Non-ileus (n=145) | P value |
| Preoperative characteristics | | | | |
| Age (years) | 45.4 ± 9.17 | 45.7 ± 9.25 | 46.5 ± 9.41 | 0.633 |
| Male | 158.0 (82.30%) | 40.0 (85.10%) | 118.0 (81.40%) | 0.561 |
| BMI (kg/m ²) | 22.2 (20.76- 24.22) | 22.8 ± 2.94 | 22.328 (20.76- 24.39) | 0.772 |
| History of abdominal surgery | 49.0 (25.50%) | 14.0 (29.80%) | 35.0 (24.10%) | 0.440 |
| Hepatic encephalopathy | 21.0 (10.90%) | 4.0 (8.50%) | 17.0 (11.70%) | 0.540 |
| Portal hypertension | 135.0 (70.30%) | 34.0 (72.30%) | 101.0 (69.70%) | 0.726 |
| Pleural fluid or ascites | 89.0 (46.40%) | 20.0 (42.60%) | 69.0 (47.60%) | 0.548 |
| Child-Pugh | 10.0 (9.00- 12.00) | 9.4 ± 2.06 | 10.0 (9.00- 11.50) | 0.055 |
| MELD score | 16.0 (12.00- 24.00) | 13.0 (9.00-19.00) | 16.0 (11.00- 23.00) | 0.025 |
| Albumin (g/L) | 35.7 (31.80- 41.48) | 37.0 ± 6.90 | 37.1 (32.90- 43.30) | 0.536 |
| Total bilirubin (umol/L) | 45.9 (25.93- 127.05) | 32.7 (21.30- 98.50) | 46.8 (26.05- 126.70) | 0.140 |
| Serum creatinine (umol/L) | 57.0 (46.00- 71.75) | 57.0 (44.00- 76.00) | 55.0 (46.00- 66.00) | 0.499 |
| Preoperative lactic acid | 1.5 (1.10-1.88) | 1.5 (1.00-1.80) | 1.4 (1.10-1.80) | 0.722 |
| Intraoperative factors | | | | |
| Operation time (min) | 390.0 (330.00- 420.00) | 371.4 ± 93.24 | 365.0 (330.00- 420.00) | 0.401 |
| Anhepatic phase (min) | 50.0 (45.00- 57.00) | 50.0 (45.00- 59.00) | 51.0 (45.00- 57.50) | 0.862 |
| Blood loss during operation (ml) | 1200.0 (800- 2000) | 1000.0 (600- 1600) | 1200.0 (800- 2000) | 0.446 |
| Total infusion fluid (ml) | 5830.0 (5032- 6820) | 5410.0 (4490- 6524) | 5710.0 (4690- 6725) | 0.210 |
| Intraoperative RBC transfusion (units) | 8.0 (6.00- 12.00) | 6.0 (4.00-12.00) | 8.0 (4.50- 12.00) | 0.167 |
| Intraoperative cryoprecipitate transfusion (units) | 1400.0 (1000- 1600) | 1000.0 (800.00- 1600.00) | 1200.0 (1000- 1600) | 0.245 |

| | | | | |
|---|----------------------|-----------------------|----------------------|-------|
| Retention time of tracheal tube (hours) | 7.0 (5.00-9.50) | 6.3 (5.25-11.00) | 7.3 (5.00-9.63) | 0.328 |
| Length of SICU (days) | 6.0 (4.00-10.00) | 6.0 (4.00-8.00) | 7.0 (5.00-10.00) | 0.213 |
| Length of hospital stay (days) | 18.0 (14.00-23.00) | 18.0 (14.00-23.00) | 18.0 (15.00-26.00) | 0.721 |
| Anesthesia factors | | | | |
| Propofol (mg) | 1500.0 (1400-1885) | 1609.6 ± 452.87 | 1500.0 (1300-1990) | 0.985 |
| Sufentanil (ug) | 30.0 (30.00-40.00) | 30.0 (25.00-40.00) | 30.0 (30.00-40.00) | 0.209 |
| Renifentanil (ug) | 3000.0 (2725-4000) | 3219.6 ± 996.15 | 3000.0 (2600-4000) | 0.868 |
| Sevoflurane (ml) | 60.0 (50.00-80.00) | 60.0 (50.00-80.00) | 60.0 (50.00-70.00) | 0.355 |
| Dexmedetomidine (ug) | 116.0 (80.25-186.75) | 100.0 (100.00-150.00) | 120.0 (80.00-189.50) | 0.627 |
| Etomidate (mg) | 14.0 (10.00-16.00) | 14.0 (12.00-16.00) | 14.0 (10.00-16.00) | 0.288 |

| Table 4 Postoperative characteristics and complications of patients with HBV | | | | |
|---|---------------------|--------------------|---------------------|--------------|
| | Over all (n=134) | Ileus (n=34) | Non-ileus (n=100) | P value |
| Postoperative characteristics | | | | |
| Total bilirubin (umol/L) | 62.7 (43.00-106.73) | 61.1 ± 30.44 | 66.4 (44.65-116.58) | 0.049 |
| Lactic acid | 2.2 (1.30-3.53) | 2.3 (1.55-4.05) | 2.1 (1.30-3.18) | 0.186 |
| Platelet (×10 ⁹ /L) | 49.5 (35.00-70.75) | 47.0 (38.75-75.50) | 50.0 (35.00-69.75) | 0.820 |
| Complications | | | | |
| Hepatic injury | 6 (4.50%) | 1 (2.90%) | 5 (5.00%) | 0.983 |
| Pulmonary infection | 6 (4.50%) | 3 (8.80%) | 3 (3.00%) | 0.348 |
| Kidney injury | 5 (3.70%) | 2 (5.90%) | 3 (3.00%) | 0.809 |
| Biliary infection or stricture | 24 (17.90%) | 3 (8.80%) | 21 (21.00%) | 0.110 |
| Vascular complication | 7 (5.20%) | 1 (2.90%) | 6 (6.00%) | 0.805 |
| Others | 22 (16.40%) | 5 (14.70%) | 17 (17.00%) | 0.755 |

| Table 5 Preoperative and operative relative factors of patients with HCC | | | | |
|---|------------------------|------------------------|------------------------|--------------|
| | Over all (n=92) | Ileus (n=18) | Non-ileus (n=74) | P value |
| Preoperative characteristics | | | | |
| Age (years) | 50.1 ± 9.33 | 50.2 ± 8.83 | 50.0 ± 9.51 | 0.959 |
| Male | 77.0 (83.70%) | 18.0 (100.00%) | 59.0 (79.70%) | 0.083 |
| BMI (kg/m ²) | 23.3 ± 3.33 | 23.4 ± 2.75 | 23.2 ± 3.47 | 0.832 |
| History of abdominal surgery | 17.0 (18.50%) | 4.0 (22.20%) | 13.0 (17.60%) | 0.906 |
| Hepatic encephalopathy | 3.0 (3.30%) | 0 (0.0%) | 3.0 (4.10%) | 1.000 |
| Portal hypertension | 47.0 (51.10%) | 10.0 (55.60%) | 37.0 (50.00%) | 0.672 |
| Pleural fluid or ascites | 30.0 (32.60%) | 6.0 (33.30%) | 24.0 (32.40%) | 0.942 |
| Child-Pugh | 9.0 (8.00-11.00) | 8.0 (6.00-10.25) | 9.0 (8.00-11.00) | 0.029 |
| MELD score | 12.0 (9.00-18.00) | 11.6 ± 4.46 | 12.0 (10.00-19.25) | 0.081 |
| Albumin (g/L) | 39.7 ± 5.97 | 36.0 ± 7.06 | 39.9 ± 6.12 | 0.488 |
| Total bilirubin (umol/L) | 34.9 (19.47-77.48) | 30.9 (15.48-68.48) | 35.5 (19.63-87.63) | 0.425 |
| Serum creatinine (umol/L) | 55.0 (46.00-64.75) | 63.1 ± 26.72 | 54.5 (46.00-63.25) | 0.394 |
| Preoperative lactic acid | 1.3 (1.03-1.70) | 1.4 (1.00-1.80) | 1.3 (1.08-1.70) | 0.657 |
| Intraoperative factors | | | | |
| Operation time (min) | 360.0 (300.00-420.00) | 369.2 ± 71.71 | 360.0 (300.00-412.50) | 0.726 |
| Anhepatic phase (min) | 50.0 (45.00-57.75) | 52.4 ± 12.67 | 50.0 (45.00-57.25) | 0.976 |
| Blood loss during operation (ml) | 800.0 (500.00-1200.00) | 800.0 (575.00-1050.00) | 800.0 (500.00-1225.00) | 0.832 |
| Total infusion fluid (ml) | 4915.0 (4285-5960) | 4656.2 ± 1190.72 | 5070.0 (4308-6145) | 0.080 |
| Intraoperative RBC transfusion (units) | 5.0 (2.00-9.50) | 4.0 (1.50-6.50) | 6.0 (2.00-10.00) | 0.181 |
| Intraoperative cryoprecipitate transfusion (units) | 800.0 (600.00-1200.00) | 800.0 (750.00-1000.00) | 800.0 (600.00-1200.00) | 0.420 |

| | | | | |
|---|-----------------------|-----------------------|----------------------|-------|
| Retention time of tracheal tube (hours) | 7.0 (5.00-9.88) | 9.2 ± 4.63 | 6.8 (5.00-9.31) | 0.162 |
| Length of SICU (days) | 6.0 (5.00-9.00) | 6.0 (5.00-8.00) | 6.0 (5.00-9.00) | 0.714 |
| Length of hospital stay (days) | 18.0 (15.00-25.75) | 17.5 (14.00-22.50) | 19.0 (15.00-26.00) | 0.427 |
| Anesthesia factors | | | | |
| Propofol (mg) | 1500.0 (1200-1970) | 1522.2 ± 542.93 | 1500.0 (1300-1909) | 0.432 |
| Sufentanil (ug) | 30.0 (30.00-40.00) | 30.0 (30.00-40.00) | 30.0 (30.00-40.00) | 0.791 |
| Renifentanil (ug) | 3000.0 (2500-3750) | 3116.7 ± 1169.84 | 3000.0 (2500-3650) | 0.596 |
| Sevoflurane (ml) | 50.0 (50.00-80.00) | 50.0 (50.00-62.50) | 55.0 (47.50-80.00) | 0.920 |
| Dexmedetomidine (ug) | 100.0 (100.00-160.00) | 100.0 (100.00-162.50) | 100.0 (89.25-160.00) | 0.783 |
| Etomidate (mg) | 14.0 (12.00-16.00) | 14.0 (12.00-16.00) | 14.0 (11.50-16.00) | 0.284 |

| Table 6 Postoperative characteristics and complications of patients with HCC | | | | |
|---|---------------------|---------------------|---------------------|---------|
| | Over all (n=68) | Ileus (n=16) | Non-ileus (n=52) | P value |
| Postoperative characteristics | | | | |
| Total bilirubin (umol/L) | 61.8 (35.15-115.60) | 60.3 (36.93-115.13) | 62.9 (34.85-115.60) | 0.686 |
| Lactic acid | 2.0 (1.40-3.40) | 2.8 ± 1.62 | 1.9 (1.40-3.40) | 0.401 |
| Platelet (×10 ⁹ /L) | 50.5 (35.25-69.50) | 57.8 ± 28.36 | 50.0 (35.00-64.75) | 0.638 |
| Complications | | | | |
| Hepatic injury | 2 (2.90%) | 1 (6.30%) | 1 (1.90%) | 0.418 |
| Kidney injury | 4 (5.90%) | 2 (12.50%) | 2 (3.80%) | 0.233 |
| Biliary infection or stricture | 11 (16.20%) | 1 (6.30%) | 10 (19.20%) | 0.398 |
| Vascular complication | 8 (11.80%) | 3 (18.80%) | 5 (9.60%) | 0.584 |
| Others | 8 (11.80%) | 3 (18.80%) | 5 (9.60%) | 0.584 |

| Table 7 The donor's characteristics | | | | |
|--|--------------------|--------------------|--------------------|---------|
| | Over all (n=293) | Ileus (n=68) | Non-ileus (n=225) | P value |
| Age (years) | 50.0 (39.00-58.00) | 52.0 (39.25-59.00) | 50.0 (39.00-58.00) | 0.439 |
| Male | 257.0 (87.70%) | 60.0 (88.20%) | 197.0 (87.60%) | 0.881 |
| BMI (kg/m ²) | 22.5 (20.52-24.31) | 22.5 (20.76-24.35) | 22.2 ± 3.13 | 0.502 |
| Warm ischemia time (min) | 14.0 (11.00-15.00) | 12.5 (10.25-15.00) | 14.0 (11.00-15.50) | 0.180 |
| Cold ischemia time (hours) | 6.0 (5.00-6.00) | 6.0 (5.00-6.00) | 6.0 (5.00-6.00) | 0.527 |

Figures

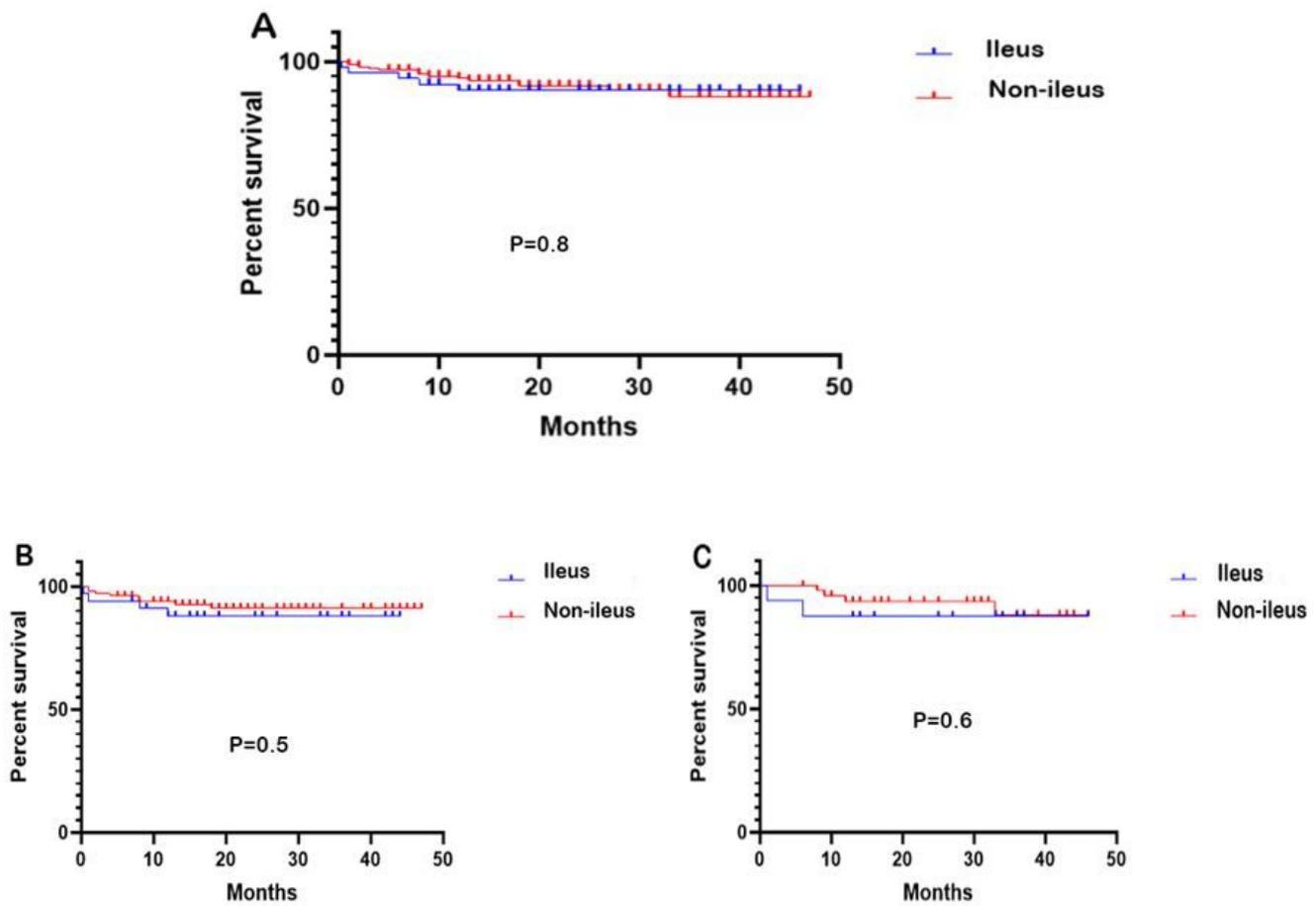


Figure 1

Overall (A), HBV-positive (B) and HCC (C) survival rates of ileus and non-ileus patients.