Impact of Preoperative Uncontrollable Hepatic Hydrothorax and Massive Ascites in Adult Liver Transplantation

Kosuke Endo, Taku Iida, Shintaro Yagi, Atsushi Yoshizawa, Yasuhiro Fujimoto, Kohei Ogawa, Yasuhiro Ogura, Akira Mori, Toshimi Kaido, and Shinji Uemoto

Division of Hepato-Biliary-Pancreatic and Transplant Surgery, Department of Surgery, Graduate School of Medicine, Kyoto University

Corresponding author: T. Iida, MD, PhD.
Division of Hepato-Biliary-Pancreatic and Transplant Surgery, Department of Surgery, Graduate School of Medicine, Kyoto University, 54 Kawahara-cho, Shogoin, Sakyo-ku, Kyoto 606-8507, Japan
E-mail address: itaku@kuhp.kyoto-u.ac.jp
Telephone: +81-75-751-4323
Fax number: +81-75-751-4348

Article type: Original article (Clinical original)

Key words: hepatic hydrothorax, liver transplantation, massive ascites, bacteremia, mortality.

Abstract:

Purpose: Uncontrollable hepatic hydrothorax and massive ascites (H&MA) requiring preoperative drainage are sometimes encountered in liver transplantation (LT). We retrospectively analyzed the characteristics of such patients and the impact of H&MA on the postoperative course.

Methods: We evaluated 237 adult patients who underwent LT in our institute between April 2006 and October 2010.

Results: Recipients with uncontrollable H&MA (group HA: *n*=36) had more intraoperative bleeding, higher Child–Pugh scores, lower serum albumin concentrations, and higher blood urea nitrogen concentrations than those without uncontrollable H&MA (group C: *n*=201). They were also more likely to have preoperative hepatorenal syndrome and infections. The incidence of postoperative bacteremia was higher (55.6% versus 46.7%, *P*=0.008) and the 1- and 3-year survival rates were lower (1 year: 58.9% versus 82.9%; 3 years: 58.9% versus 77.7%; *P*=0.003) in group HA than in group C. Multivariate proportional regression analyses revealed that uncontrollable H&MA and Child–Pugh score were independent risk factors for the postoperative prognosis.

Conclusions: Postoperative infection control may be one of the important means of improving outcome for patients with uncontrollable H&MA undergoing LT, and clinicians should strive to undertake surgery before H&MA becomes uncontrollable.

INTRODUCTION

Liver transplantation (LT) is now performed in many countries as a treatment for end-stage liver disease. In the current era, as a result of expansion of the indication of LT for HCC candidates, it also gives us a choice of curative treatment for unresectable hepatocellular carcinoma, and satisfactory long-term outcomes have been achieved [1]. However, it still has a relatively high mortality rate compared with other hepatobiliary-pancreatic procedures owing to the potentially poor preoperative condition of the patients, use of immunosuppressive agents, rejection and infection. The preoperative condition of transplant recipients is a particularly important factor that influences the outcome of LT.

We sometimes encounter patients requiring LT with uncontrollable hepatic hydrothorax or massive ascites (H&MA) that must be drained before surgery; it has also been reported that H&MA is an independent risk factor for postoperative bacteremia [2].

In this study, we focused on preoperative uncontrollable H&MA in LT candidates, and evaluated the perioperative course of patients who went on to become LT recipients.

METHODS

Patients

Between April 2006 to October 2010, 237 adult patients underwent LT at Kyoto University Hospital, Japan (227 were living-donor cases, and 10 deceased-donor cases). There were 117 males and 120 females; their median age was 54.9 years (range: 18–69 years). The indications for LT in these patients included: hepatocellular carcinoma in 78 cases; hepatocellular diseases, such as hepatitis B virus-associated liver cirrhosis, hepatitis C virus-associated liver cirrhosis, and alcoholic liver cirrhosis, in 133 cases; progressive intrahepatic cholestatic diseases, such as primary biliary cirrhosis and primary sclerosing cholangitis, in 29 cases; re-transplantation owing to graft loss in 17 cases; fulminant hepatic failure in 17 cases; cryptogenic cirrhosis in 14 cases; biliary atresia after the Kasai operation in eight cases; autoimmune hepatitis in six cases; metabolic liver diseases in six cases; and other causes in seven cases.

Antimicrobial prophylaxis

Perioperative antimicrobial prophylaxis consisted of cefotaxime (2 g/day intravenously) and ampicillin (4 g/day intravenously) twice daily for 72 hours starting 30 min before surgery. Laxatives were administered as bowel preparation.

Therapeutic antibiotics were usually determined based on the results of culturing infection sites or blood. When the focus of the infection was unknown,

broad-spectrum antibiotics were administered empirically. Pre-transplant, antibiotics were given to treat on-going infections such as spontaneous bacterial peritonitis, and pneumonia, for example.

Immunosuppression

The standard immunosuppression protocol comprised tacrolimus and a low-dose steroid. We endeavored to maintain the whole blood trough level of tacrolimus between 10 and 15 ng/mL during the first 2 weeks, around 10 ng/mL during the next 2 weeks, and between 5 and 8 ng/mL thereafter. For the recipients who suffered from side effects of tacrolimus, we changed the immunosuppressant from tacrolimus to cyclosporine micro emulsion.

Steroid therapy with methylprednisolone sodium succinate was initiated at a dose of 10 mg/kg before graft reperfusion and then tapered from 1 mg/kg/day on day 1 to 0.3 mg/kg/day by the end of the first month; this was followed by 0.1 mg/kg/day until the end of the third month. Steroid administration was terminated thereafter. In the event of postoperative infection, steroids were discontinued and the target trough level of

tacrolimus was revised downwards.

Study Design

The medical records of patients undergoing LT were examined retrospectively to identify those recipients who had required preoperative drainage of uncontrollable H&MA (allocated to group HA; *n*=36) and those recipients who had not (allocated to a control group [group C]; *n*=201). Recipients' demographic details, surgical data, occurrence of preoperative hepatorenal syndrome (HRS) and postoperative bacteremia, and patient survival recorded and compared between the groups. Finally, independent prognostic factors for patient survival were evaluated by multivariate analyses.

Indications for thoracic or intraperitoneal drainage

We considered refractory uncontrollable massive ascites to meet the grade 3 with diuretic resistance criterion defined by the International Ascites Club [3]. The diagnosis of hepatic hydrothorax was based on evidence of a large volume effusion (estimated to be >500 ml) on chest radiography and/or computed tomography (CT) scans in the absence of underlying pulmonary or cardiac diseases [4].

We used the following indications to guide decisions about when to drain H&MA before surgery: 1) patients with hydrothorax who remained hypoxic with a peripheral oxygen saturation (SpO_2) of ≤95% despite supplemental oxygen administration underwent thoracic drainage to improve respiratory function; 2) patients

with hepatorenal syndrome (HRS) underwent peritoneal or thoracic drainage with intravenous albumin supplementation to normalize hemodynamic parameters and prevent the progression of renal dysfunction; and 3) patients experiencing dyspnea, difficulty eating and drinking or abdominal pain underwent thoracic or peritoneal drainage for symptomatic relief.

Hepatorenal syndrome was diagnosed according to the criteria of the International Ascites Club [5] as follows: 1) low glomerular filtration rate, indicated by serum creatinine >1.5 mg/dl or 24-h creatinine clearance <40 ml/min; 2) absence of shock, ongoing bacterial infections, and recent or current treatment with nephrotoxic drugs; 3) no sustained improvement of renal function by diuretic withdrawal and intravenous administration of fluids; and 4) absence of significant proteinuria (<500 mg/day) and ultrasonographic abnormalities in the kidneys.

Infections and bacteremia were defined using the criteria proposed by the Centers for Disease Control and Prevention and based on our previous report regarding LT patients [2]. Diagnosis of infection in ascitic fluid or pleural effusion, including spontaneous bacterial peritonitis (SBP) and spontaneous bacterial empyema (SBEM), was based on the level of polymorphonuclear white cells (>250/mm^3 with positive culture or >500/mm^3, if culture was negative) [6,7].

Thoracic and intraperitoneal drainage were not indicated as the treatment of SBEM and SBP in general, instead antimicrobial therapy was started immediately. In cases where SBEM and SBP had been diagnosed after the initiation of drainage, drainage was maintained in combination with antimicrobial therapy.

The study protocol was approved by the Medical Ethics Committee of Kyoto University, and the study was performed in accordance with the ethical standards established in the 1975 Declaration of Helsinki.

Drainage protocol

We used fine catheters (Argyle™ aspiration Seldinger kit, 5Fr; COVIDIEN Japan, Shizuoka, Japan) for thoracic and intraperitoneal drainage to avoid injuring collateral vessels. Before performing drainage, Doppler ultrasonography and CT were used to establish the location of any abnormal intercostal or abdominal wall collateral vessels so as to avoid hemorrhage. To prevent hypotension, depletion of protein and electrolytes, and re-expansion pulmonary edema rapid drainage of ascites and pleural effusion was avoided. Initially, 1000 ml was drained, then the drainage volume was gradually increased from the second day. At the same time, the intravenous fluid and albumin replacement was undertaken during the drainage.

Statistical analysis

Values are presented as means and standard deviations (SD) unless otherwise indicated. Continuous data were analyzed by Student's *t*-test or the Mann–Whitney test, while categorical data were analyzed with the chi-square test. For survival analyses, Kaplan–Meier survival curves were constructed and analyzed by the log rank test, and multivariate analyses of survival were performed by proportional regression hazard analyses. Variables identified as significant ($P<0.05$) in univariate analyses were considered to be candidates for the multivariate analyses. Values of $P<0.05$ were considered significant. Statistical analyses were performed using Prism version 5 (GraphPad Software Inc., San Diego, USA) for the univariate analyses and JMP version 9 (SAS institute Inc., Cary, NC, USA) for the multivariate analyses.

RESULTS

Details of Preoperative Drainage Management

Preoperative thoracic or intraperitoneal drainage was performed in 36 cases (15.2%), all later underwent scheduled living-donor LT. In 16 cases thoracic drainage was required (including five cases with SBEM), intraperitoneal drainage was performed in 15 cases (including eight cases of SBP); and both thoracic and intraperitoneal drainage was needed in five cases (including two cases of SBP). The median drainage period was 13 days (range: 1–33 days) for thoracic drainage and 9 days (1–44 days) for intraperitoneal drainage.

Infectious complications related to the placement of an intraperitoneal drainage tube occurred in three patients (8.3%), while there were no complications related to the placement of a thoracic drainage tube. Infection was diagnosed 2, 6, and 7 days after placement of the drainage catheter; patients were treated with antibiotics and a new catheter was resited. There were no other complications, such as hemothorax or pneumothorax.

Patient characteristics

Table 1 shows the characteristics of the groups: there were no significant differences in the sex, recipient age, blood type compatibility, graft-recipient weight ratio (GRWR), operation time, cold and warm ischemic times, model for end-stage liver disease (MELD) score, evidence of preoperative hepatic encephalopathy, and preoperative serum creatinine of the patients in each group. Group HA was characterized by higher intraoperative blood loss (P=0.02), higher Child–Pugh score (P=0.001), lower

preoperative serum albumin concentration (*P*=0.01), and higher serum blood urea nitrogen concentration (*P*=0.003) compared with group C.

Preoperative HRS and perioperative infections

Group HA had a significantly higher incidence of HRS than group C (nine out of 36 cases [25%] versus 20 out of 201 cases [9.9%], *P*=0.017), and a significantly higher incidence of preoperative infection (19 out of 36 cases [52.8%] versus 35 out of 201 cases [17.4%], *P*=0.0001). The incidence of bacteremia within 90 days of LT was significantly higher in group HA than group C (20 out of 36 cases [55.6%] versus 94 out of 201 cases [46.7%], *P*=0.008).

Postoperative mortality

Figure 1 shows the Kaplan–Meier survival curves of each group. The cumulative survival rates at 1 and 3 years after LT were both significantly lower in group HA than group C (1 year survival: 58.9% versus 82.9%; 3 year survival: 58.9% versus 77.7%, respectively; *P*=0.003). Survival was worse in the HA group whether the patient had undergone intrathoracic or intraperitoneal drainage (Fig. 2a,b). Even when cases of infectious H&MA were excluded, those with sterile preoperative H&MA (*n*=23) had a significantly worse prognosis than those in group C (1 year survival: 64.6% versus 88.1%; 3 year survival: 64.1% versus 82.6%, respectively; *P*=0.015; Fig. 3).

When we subdivided the patients in group HA into two groups depending on the diagnosis of postoperative bacteremia, we found that 1- and 3-year survival rates were significantly reduced in those with bacteremia compared with those who were not (1-year survival: 41.2% versus 86.2%; 3-year survival: 41.2% versus 86.2%,

respectively; *P*=0.008).

Prognostic indicators after LT

Blood loss, Child-Pugh score, preoperative albumin and blood urea nitrogen concentrations, HRS, preoperative infection, and GRWR, were included in the multivariate analysis along with preoperative uncontrollable H&MA. We found that preoperative uncontrollable H&MA (hazard ratio: 2.304; *P* = 0.034) and Child–Pugh score (hazard ratio: 1.258; *P* = 0.003) were independent risk factors for mortality after LT (Table 2).

DISCUSSION

We analyzed the incidence and characteristics of patients with uncontrollable H&MA before LT and evaluated its effect on the postoperative course after LT.

Hepatic hydrothorax is said to be secondary to passage of ascites through a diaphragmatic defect. Therefore, we included patients with hepatic hydrothorax and those with massive ascites in the same group. When we subdivided these patients into two groups based on the type of drainage, the survival rates were almost the same. Ascites is attributed to impaired albumin production in the liver, portal hypertension, and salt retention owing to renal dysfunction. These symptoms are usually treated with a high-protein diet and diuretics, but in some cases ascites proves to be refractory to manipulating the dose and type of diuretics and dietary intake. A vicious cycle may develop in which increasing abdominal distension further impairs hepatic function. Ascites and hydrothorax can cause SBP and SBEM, respectively, and can also cause a decrease in the circulating blood volume, which can lead to HRS. A transhepatic intra-jugular porto-systemic shunt (TIPS) is one of the options for treating refractory hepatic hydrothorax and massive ascites, and there are reports that TIPS is superior to large-volume paracentesis in the control of ascites or hydrothorax [8,9]; however, it only provides supportive care and cannot prolong survival.

It is well recognized that the health of an LT recipient pre-transplant is closely associated with postoperative mortality. Our study showed that patients with preoperative uncontrollable H&MA had a higher mortality rate after LT. The causes of death were mainly related to postoperative infections, including bacteremia. Notably, when cases of infectious H&MA were excluded, the remaining recipients with

uncontrollable H&MA still had a poorer survival than those in group C. This finding suggests that LT recipients with uncontrollable H&MA are at risk of post-transplant mortality regardless of the presence of preoperative infection. It is likely that the recipients in group HA were more severely compromised by more severe end-stage liver disease. The higher rate of postoperative infections in group HA might also be a consequence of poorer general condition and comorbidities of the patients with high Child–Pugh scores. The substantially reduced survival rates in patients in group HA diagnosed with postoperative infections suggests that effective postoperative infection control could be a crucial means of improving outcome after LT.

MELD scores were not substantially different between the groups in our study. MELD score is a useful means of prioritizing the waiting list, but it is controversial as to whether it can effectively predict survival after LT [10-12]. The severity of preoperative ascites and hepatic hydrothorax, which are not sufficiently reflected in the MELD score, might have a greater impact on survival. Clinicians should carefully consider the timing of LT, undertaking transplantation – where possible – before H&MA becomes uncontrollable.

The multivariate proportional hazard analyses revealed that uncontrollable H&MA was an independent risk factor for postoperative mortality in our study. Somsouk et al. [13] reported that patients with moderate ascites and a MELD score <21 were at higher risk of death while on the waiting list for LT. It is possible that the presence of preoperative uncontrollable H&MA may be a more important prognostic indicator than the MELD scores.

Xiol et al. [14] and Serste et al. [15] have reported that the presence of preoperative hepatic hydrothorax had no significant negative influence on postoperative

outcome after deceased donor LT. Xiol et al. [14] reported that the survival rate of patients with hydrothorax was 70% at 8 years. However, in their hydrothorax group, they included not only patients with refractory hydrothorax but also those with previous episodes of spontaneous bacterial empyema and those with uncomplicated hydrothorax with impaired hepatic function. In addition, the Child–Pugh score in their hydrothorax group was 9.9±1.4, which was lower than that in our study (mean: 11.5). Serste et al. [15] established two control groups: a group with ascites but not hydrothorax; and a group with no ascites or hydrothorax, and compared survival between the three groups. They found no significant difference in the overall risk of death, but the 1-year survival rate in the hydrothorax group was 64±15%, which is higher than expected. The apparent discrepancy in findings of the impact of hydrothorax may also be a consequence of the type of LT. Most of the cases in Xiol and Serste's studies [14,15] were deceased donor LT cases, while all our cases received grafts from living donors. As the graft volume is limited in living-donor LT, H&MA may have persisted due to higher portal venous pressures and hypoalbuminemia due to inadequate postoperative hepatic synthetic function.

It has still not been established whether thoracic and/or intraperitoneal drainage is the best means of managing uncontrollable H&MA for liver cirrhosis (LC) before scheduled LT. However, complications related to paracentesis have been reported in only about 1% of patients with coagulopathy [16], therefore intraperitoneal drainage appears to be a safe approach. According to treatment guidelines for LC [17,18], intraperitoneal drainage is an effective first line treatment for uncontrollable tense and refractory ascites. Total paracentesis reduces intra-abdominal, intrathoracic, right arterial, and pulmonary pressures, improving cardiac output by increasing stroke

volume without changing heart rate [19]. Moreover it results in a rapid fall in portal pressure, by decreasing the wedged hepatic venous pressure and hence the hepatic venous pressure gradient [20]. Although intraperitoneal drainage is an established treatment for uncontrollable massive ascites, there are no data on its role in the management of SBP [18].

Regarding the management of refractory hydrothorax, thoracic drainage using a chest tube should be avoided due to the risk of complications [21]. It has been reported that chest tube insertion for hepatic hydrothorax carries significant morbidity and mortality, with questionable benefit [22,23]. In our institution, however, the morbidity was 8.3%, all related to intraperitoneal drainage, and we experienced no serious or fatal complications such as hemothorax or pneumothorax.

Drainage of H&MA might adversely influence a patient's preoperative condition. Drainage of fluid could cause electrolyte and hemodynamic disturbance, and impair renal function. This can be prevented by adequate volume replacement with an appropriate combination of intravenous fluids. Nevertheless, antibodies and immune competent cells in the hydrothorax and ascitic fluid cannot be replaced, which might result in a state of relative immunodeficiency and increase the rate of postoperative infections.

Thoracic and intraperitoneal drainages alone without LT will not improve the prognosis of patients with end-stage liver diseases obviously, but we should aim to improve the recipient's condition as much as possible before LT, especially if in living donor procedures. Recently, we have ensured that drainage of ascites or hydrothorax is not undertaken in the 3 days before LT in an effort to avoid intraperitoneal infections.

There are several limitations to our study. It was a retrospective, single-center

study, and the numbers of patients are small. We believe that a larger series and a multicenter study design would address these issues.

In conclusion, uncontrollable H&MA was found to be an independent risk factor for poor post-transplant outcome in our study. In particular, for patients with uncontrollable H&MA, effective postoperative treatment of infection is key to improving outcome after LT. In addition, the timing of transplant is crucial; efforts should be made to undertake surgery before H&MA becomes uncontrollable.

Conflict of interest:

None of the authors has a conflict of interest to declare.

References

1. Taketomi A, Shirabe K, Toshima T, Hashimoto N, Kayashima H, Ikegami T, et al. The long-term outcomes of patients with hepatocellular carcinoma after living donor liver transplantation: a comparison of right and left lobe grafts. Surg Today. 2012;42:559-64

2. Iida T, Kaido T, Yagi S, Yoshizawa A, Hata K, Mizumoto M, et al. Post-transplant bacteremia in adult living donor liver transplant recipients. Liver Transpl. 2010;16:1379-85.

3. Arroyo V, Gines P, Gerbes AL, Dudley FJ, Gentilini P, Laffi G, et al. Definition and diagnostic criteria of refractory ascites and hepatorenal syndrome in cirrhosis. International Ascites Club. Hepatology. 1996;23:164-76.

4. Morrow CS, Kantor M, Armen RN. Hepatic hydrothorax. Ann Intern Med. 1958;49:193-203.

5. Gines P, Arroyo V. Hepatorenal syndrome. J Am Soc Nephrol. 1999;10:1833-9.

6. Rimola A, Garcia-Tsao G, Navasa M, Piddock LJ, Planas R, Bernard B, et al. Diagnosis, treatment and prophylaxis of spontaneous bacterial peritonitis: a consensus document. International Ascites Club. J Hepatol. 2000;32:142-53.

7. Xiol X, Castellvi JM, Guardiola J, Sese E, Castellote J, Perello A, et al. Spontaneous bacterial empyema in cirrhotic patients: a prospective study. Hepatology. 1996;23:719-23.

8. Salerno F, Merli M, Riggio O, Cazzaniga M, Valeriano V, Pozzi M, et al. Randomized controlled study of TIPS versus paracentesis plus albumin in cirrhosis with severe ascites. Hepatology. 2004;40:629-35.

9. Sanyal AJ, Genning C, Reddy KR, Wong F, Kowdley KV, Benner K, et al. The North

American Study for the Treatment of Refractory Ascites. Gastroenterology. 2003;124:634-41.

10. Hayashi PH, Forman L, Steinberg T, Bak T, Wachs M, Kugelmas M, et al. Model for End-Stage Liver Disease score does not predict patient or graft survival in living donor liver transplant recipients. Liver Transpl. 2003;9:737-40.

11. Ishigami M, Honda T, Okumura A, Ishikawa T, Kobayashi M, Katano Y, et al. Use of the Model for End-Stage Liver Disease (MELD) score to predict 1-year survival of Japanese patients with cirrhosis and to determine who will benefit from living donor liver transplantation. J Gastroenterl. 2008;43:363-8.

12. Selzner M, Kashfi A, Cattral MS, Selzner N, McGilvray ID, Greig PD, et al. Ann Surg. 2010;251:153-7.

13. Somsouk M, Kornfield R, Vittinghoff E, Inadomi JM, Biggins SW. Moderate ascites identifies patients with low model for end-stage liver disease scores awaiting liver transplantation who have a high mortality risk. Liver Transpl. 2011;17:129-36.

14. Xiol X, Tremosa G, Castellote J, Gornals J, Lama C, Lopez C, et al. Liver transplantation in patients with hepatic hydrothorax. Transpl Int. 2005;18:672-5.

15. Serste T, Moreno C, Francoz C, Razek WA, Paugham C, Belghitti J, et al. The impact of preoperative hepatic hydrothorax on the outcome of adult liver transplantation. Eur J Gastroenterol Hepatol. 2010;22:207-12.

16. Runyon BA. Paracentesis of ascitic fluid. A safe procedure. Arch Intern Med. 1986;146:2259-61.

17. Runyon BA, Committee APG. Management of adult patients with ascites due to cirrhosis: an update. Hepatology. 2009;49:2087-107.

18. Moore KP, Aithal GP. Guidelines on the management of ascites in cirrhosis. Gut.

2006;55 Suppl 6:vi1-12.

19. Pozzi M, Osculati G, Boari G, Serboli P, Colombo P, Lambrughi C, et al. Time course of circulatory and humoral effects of rapid total paracentesis in cirrhotic patients with tense, refractory ascites. Gastroenterology. 1994;106:709-19.

20. Luca A, Feu F, Garcia-Pagan JC, Jimenez W, Arroyo V, Bosch J, et al. Favorable effects of total paracentesis on splanchnic hemodynamics in cirrhotic patients with tense ascites. Hepatology. 1994;20:30-3.

21. Cardenas A, Arroyo V. Management of ascites and hepatic hydrothorax. Best Pract Res Clin Gastroenterol. 2007;21:55-75.

22. Orman ES, Lok AS. Outcomes of patients with chest tube insertion for hepatic hydrothorax. Hepatol Int. 2009;3:582-6.

23. Liu LU, Haddadin HA, Bodian CA, Sigal SH, Korman JD, Bodenheimer HC, Jr., et al. Outcome analysis of cirrhotic patients undergoing chest tube placement. Chest. 2004;126:142-8.

Tables:

TABLE 1. Background and Characteristics of the Two Groups

	Group HA (*n*=36)	Group C (*n*=201)	*P*
Sex (male/female)	18/18	99/102	0.54
Age	55.3±7.89	51.1±12.81	0.05
ABO compatibility	identical/compatible 28 incompatible 8	identical/compatible 153 incompatible 48	0.51
Graft type	right 15, left 19 posterior 2	right 114, left 71 posterior 6, whole 10	0.08
GRWR	0.90±0.17	0.98±0.31	0.14
Operation time (min)	814.8±120.5	793.6±149.4	0.45
Blood loss (ml)	12244.2±9505.48	8814.4±7251.1	0.02
CIT (min)	98.1±53.3	119.1±113.0	0.31
WIT (min)	43.6±13.2	48.6±53.4	0.60
MELD score	20.9±8.84	20.5±9.47	0.79
Child–Pugh score	11.4±2.20	10.0±2.22	0.001
Preop hepatic encephalopathy	1.44±0.65	1.32±0.65	0.1517
Preop serum Alb (g/dl)	2.65±0.42	2.94±0.52	0.001
Preop serum BUN (mg/dl)	28.9±19.4	18.9±14.3	0.0003
Preop serum Cr (mg/dl)	1.17±0.68	1.19±3.58	098

GRWR. graft-recipient weight rate; CIT, cold ischemic time; WIT, warm ischemic time; MELD, model for end-stage liver disease; Preop, preoperative; Alb, albumin; BUN, blood urea nitrogen; Cr, creatinine.

1

TABLE 2. Independent Prognostic Risk Factors for mortality after liver transplantation

Variable	Hazard ratio	95% Confidence interval	*P*
Preop uncontrollable hydrothorax and massive ascites	2.304	1.069–4.691	0.0339
Blood loss	1.000	0.999-1.000	0.1123
Child–Pugh score	1.258	1.085–1.422	0.0033
Preop serum Alb	1.003	0.460-2.144	0.9938
Preop serum BUN	1.004	0.983-1.024	0.7006
HRS	1.345	0.434-3.633	0.5884
Preop infection	1.088	0.493-2.270	0.8281
GRWR	0.971	0.269-3.036	0.9612

Preop, preoperative; H&MA, hydrothorax and massive ascites; Alb, albumin; BUN, blood urea nitrogen; GRWR, graft-recipient weight ratio.

Figure Legends

Figure 1. Survival rates of patients with (group HA) and without (group C) uncontrollable H&MA. The cumulative survival rates after LT were significantly lower in group HA than group C (*P*=0.0007).

Figure 2. Survival rates of patients depending on the site of drainage. Patients who underwent intraperitoneal drainage (a) and those who underwent thoracic drainage (b) had higher mortality rates than those in group C.

Figure 3. Kaplan–Meier curves comparing group HA and group C having excluded infectious H&MA cases from group HA. Mortality rates are still significantly higher in group HA than group C.

Figures:

Fig.1:

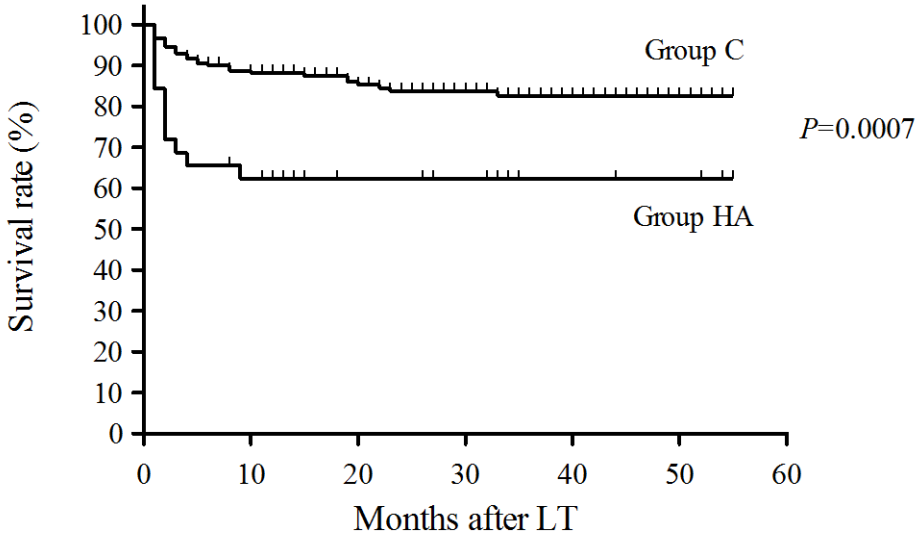
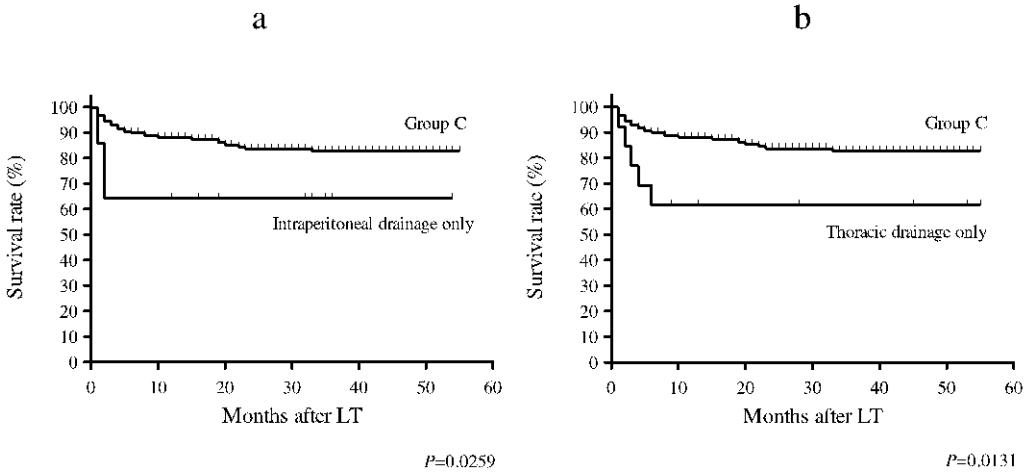
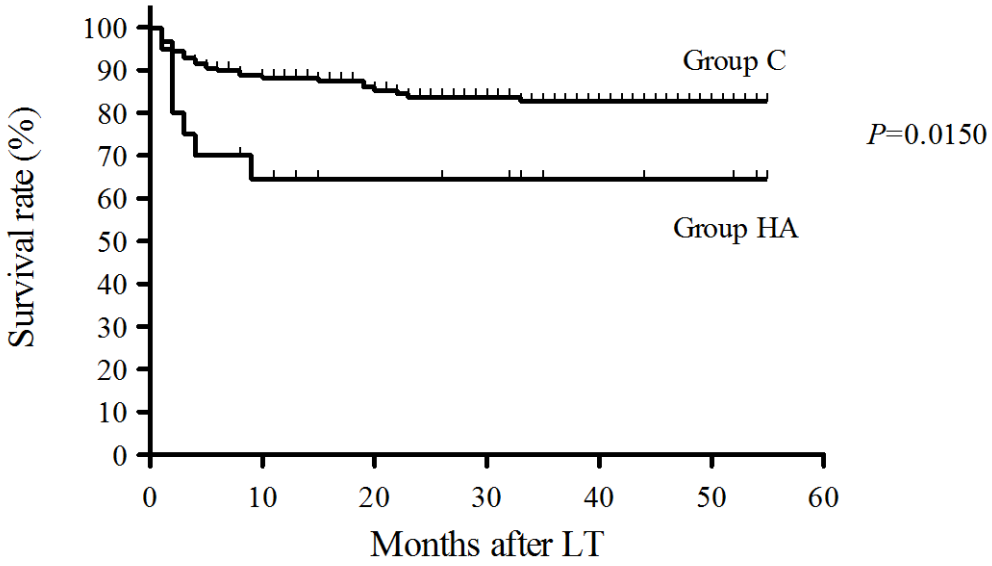


Fig.2:



1 **Fig.3:**


100
90
80
70
60
50
40
30
20
10
0
Survival rate (%)
Group C
Group HA
P=0.0150
0
10
20
30
40
50
60
Months after LT

2

3