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Effect of liver cirrhosis on patient outcomes from open heart surgery

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Abstract

Background

We designed this prospective controlled study to evaluate the early postoperative outcomes in patients with liver cirrhosis (LC) after open heart surgery (OHS).

Patients and methods

Between May 2011 and February 2017, 120 patients with elective OHS were included and categorized into a control group (50%) and patients with LC (50%), who were further subdivided according to Child–Turcotte–Pugh (CTP) score into group CTP A (49 patients) and CTP B (11 patients). All preoperative demographic and clinical data in addition to operative and postoperative data were evaluated. Patients with CTP (class C) were excluded.

Results

Overall, 48 (40%) patients experienced a postoperative complication: 47% of group A cirrhosis, and 91% of group B cirrhosis ($P < 0.001$). Of these, 21% were cardiac complications, with the majority occurring in patients with CTP A ($n = 19$) and CTP B ($n = 9$). There were 12 (10%) postoperative deaths: four (7%) patients in the control group, four (8%) patients in CTP A group, and four (36%) patients in CTP B ($P = 0.009$). Factors associated with postoperative death included preoperative CTP classification ($P = 0.01$), European System for Cardiac Operative Risk Evaluation (0.01), New York Heart Association classification ($P = 0.01$), presence of ascites (0.02), a measurements of the right ventricular diameter ($P = 0.03$), ventilation time ($P < 0.001$), and postoperative chest tube drain output (0.04).

Conclusion

Patients with LC have a high incidence of morbidity and mortality after OHS compared with the control. The more the severity of LC, the more the complications and deaths. Patients with mild LC had acceptable outcome compared with others with advanced LC. The Child–Pugh score is more predictive of postoperative course than European System for Cardiac Operative Risk Evaluation.

Keywords: Liver cirrhosis, open heart, postoperative outcome

Introduction

Individuals with liver cirrhosis (LC) are more prone to have a poorer life expectancy in comparison with their equivalent with the same age by 40% [1]. LC is paving the road toward a higher morbidity and mortality rates when combined with open heart surgery (OHS) owing to many physiological derangements like hematological abnormalities and immunological incompetence. The scarcity of data concerning the outcomes of cardiac surgery in patients with LC puts such type of intervention for a great debate concerning its benefit [2,3]. The calculation of the risk of death following OHS was solved a long time ago by the invention of the risk scoring models [e.g. European System for Cardiac Operative Risk Evaluation (EuroSCORE)], and unfortunately, none of them addressed LC as a risk factor even with their most recent modifications [4]. Seeking improvement in the outcomes of surgery for treatment of portal hypertension and liver transplantation, researchers developed both Child–Turcotte–Pugh (CTP) and the model for end-stage liver disease (MELD) scores [5,6]. One of the pioneers who first

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implemented these risk scores in the field of cardiac surgery was Suman and co-workers [7]. In this study, we evaluated the early outcome in cirrhotic patients after OHS, and we tried to answer the question about the feasibility of CTP score to be used for the evaluation of these patients.

Patients and methods

This is a prospective review of patients undergoing elective OHS at the National Heart Institute, Cairo, Egypt, between May 2011 and February 2017. Patients with the following elective procedures were included: coronary artery bypass graft surgery, valve surgery, coronary artery bypass graft surgery, and valve surgery or surgery for congenital heart disease All patients were assessed preoperatively through history taking, physical examination, complete blood count, biochemical profile, liver function tests, coagulation testing, rest-ECG, plain chest radiograph, and transthoracic echocardiogram.

Patients with abnormal liver function test results were evaluated for liver disease by abdominal ultrasound. The presence of LC and/or ascites is determined from the ultrasonographic examination. The severity of LC was graded using the CTP classification system. Patients with CTP class A or B were included in the study. The CTP score was calculated for every patient with LC. The New York Heart Association functional classification was employed to determine patients' baseline functional status. EuroSCORE score was calculated for each patient.

Intraoperative management

All patients were operated on via a median sternotomy incision. During cardiopulmonary bypass, hematocrit levels were maintained between 18 and 25%; perfusion flows were kept between 2.4 and 2.8 $l/min/m^2$, and mean arterial pressures between 50 and 70 mmHg. The systemic temperature was maintained between 28°C and 36°C.

Postoperative management

Chest drain output was monitored until removal. Comprehensive laboratory workup was performed throughout the ICU stay. The need for blood and blood product transfusions was determined based on the clinical status of the patients as well as laboratory values.

Postoperative outcomes

Patients were monitored for postoperative cardiac and noncardiac complications. Postoperative low cardiac output syndrome was defined as the need for more than one inotropic agent for more than 48 h to keep the systolic blood pressure more than 90 mmHg despite adequate pre-load and correction of electrolyte and acid–base disturbances, or the need for intra-aortic balloon pump. Postoperative cardiac complications were screened for, including postoperative low cardiac output, new-onset arrhythmias, postoperative myocardial infarction, and pericardial effusion. Other postoperative outcomes included the need for blood transfusion, neurological deficit (transient ischemic attack/stroke, and encephalopathy), pleural effusion, respiratory failure, intubation time, hepatic dysfunction and gastrointestinal complications, renal dysfunction, infection, sepsis, reoperation, and death.

Statistical analysis

We categorized the study cohort into three groups based on the presence and CTP LC: (a) patients without LC (control); (b) patients with CTP class A LC; and (c) patients with CTP class B LC. Patients were excluded if they had an emergent or redo-OHS or had CTP class C LC.

Descriptive statistics such as means, SD, and frequencies were used to describe patient demographics, clinical, treatment, and outcomes characteristics. χ^2 or Fisher's exact test was employed to compare categorical variables. Continuous variables were examined using the Kruskal–Wallis test owing to the data skewness. Correlations between CTP and EuroSCORE scores were performed in a univariate fashion. All P values reported are two sided, with the significance level set *a priori* at 0.05. Statistical analyses were performed using SPSS software (IBM, Armonk, New York, USA).

Results

A total of 120 patients underwent OHS between 2011 and 2017. There were 60 (50%) patients in the control group, 49 (41%) patients in the CTP A group, and 11 (9%) patients in the CTP B group. Table 1 details the preoperative characteristics of the three groups.

Indices of compromised liver function were more prominent in patients with CTP A or B cirrhosis, such as elevated five serum levels of international normalized ratio, bilirubin, and hepatic enzymes (Table 2).

Table 3 details the extent and type of surgery by status and degree of LC.

Postoperative outcomes

Compared with control, postoperative bleeding was significantly higher in patients with CTP A cirrhosis (634 vs. 947 ml) and CTP B cirrhosis (634 vs. 1617 ml) ($P < 0.001$). Remaining postoperative outcomes are highlighted in Table. There were 12 (10%) postoperative death events: four (7%) patients in the control group, four (8%) patients in CTP A group, and four (36%) patients in CTP group ($P = 0.009$; Table 4). Causes of postoperative death are illustrated in Table 5. Factors associated with postoperative death are illustrated in Tables 6 and 7.

Predictors of morbidity and mortality in cirrhotic patients

Table 7 details the correlation of CTP and EuroScores of patients with liver cirrhosis and their postoperative outcomes from OHS.

Discussion

Morbidity

The incidence of morbidity ranged between 25 and 100% and tended to occur in patients with more advanced liver

Table 1: Patients' clinical characteristics by status and degree of liver cirrhosis

	Control (*n*=60)	Child-Pugh A (*n*=49)	Child-Pugh B (*n*=11)	All patients (*n*=120)	*P*
Patient age (mean±SD) (years)	39.6±12.7		43.7±12		0.07
Sex (male) [*n* (%)]	24 (42.8)		32 (57.14)		0.14
History of MI [*n* (%)]					0.86
No	57 (95)	46 (94)	10 (91)	113 (94)	
Yes	3 (5)	3 (6)	1 (9)	7 (6)	
Hypertension [*n* (%)]					0.42
No	55 (92)	41 (84)	10 (91)	106 (88)	
Yes	5 (8)	8 (16)	1 (9)	14 (12)	
COPD [*n* (%)]					0.22
No	57 (95)	43 (88)	11 (100)	111 (92)	
Yes	3 (5)	6 (12)	0	9 (8)	
Diabetes mellitus [*n* (%)]					0.69
No	48 (80)	40 (82)	10 (915)	98 (82)	
Yes	12 (20)	9 (18)	1 (9)	22 (18)	
Ascites [*n* (%)]					<0.001
Mild	1 (2)	5 (10)	10 (91)	16 (13)	
Moderate	0	0	1 (9)	1 (1)	
Preoperative renal impairment [*n* (%)]					0.79
No	58 (97)	47 (96)	11 (100)	116 (97)	
Yes	2 (3)	2 (4)	0	4 (3)	
Preoperative neurologic deficit [*n* (%)]					0.89
No	59 (98)	48 (98)	11 (100)	118 (98)	
Yes	1 (2)	1 (2)	0	2 (2)	
NYHA [*n* (%)]class					0.04
2	52 (87)	38 (78)	6 (54)	96 (80)	
3	8 (13)	11 (22)	5 (45)	24 (20)	
EuroSCORE score (mean±SD)	1.42±0.77	1.80±1.25	2.07±0.97		0.03
Hepatic diagnosis [*n* (%)]					0.02
Hepatic	-	22 (45)	0	22 (18)	
Cardiac	-	25 (51)	10 (91)	35 (29)	
Unknown	-	2 (4)	1 (9)	3 (2)	
Viral infection [*n* (%)]					0.13
Non	37 (62)	25 (51)	10 (91)	72 (60)	
HCV	23 (38)	23 (47)	1 (9)	47 (39)	
HCV/HBV	0	1 (2)	0	1 (1)	
Bilharzia [*n* (%)]					0.45
No	53 (88)	39 (80)	9 (82)	101 (84)	
Yes	7 (12)	10 (20)	2 (18)	19 (16)	
Cardiac diagnosis [*n* (%)]					0.20
IHD	20 (33)	18 (37)	1 (9)	39 (32)	
RHD	36 (60)	28 (57)	10 (91)	74 (62)	
CHD	4 (7)	1 (2)	0	5 (4)	
Mixed	0	2 (4)	0	2 (2)	
EDD (mean±SD) (mm)	54±11	53±11	53±9		0.76
ESD (mean±SD) (mm)	35±10	36±10	35±8		0.99
RVD (mean±SD) (mm)	21±4	21±4	25±8		0.06
FS%	34±8	31±8	34±7		0.32
EF%	64±10	61±12	65±9		0.16

CHD, congenital heart disease; COPD, chronic obstructive pulmonary disease; EDD, left ventricular end-diastolic dimension; EF, ejection fraction; ESD, left ventricular end-systolic dimension; EuroSCORE, European System for Cardiac Operative Risk Evaluation score; FS, fractional shortening; HBV, hepatitis B virus; HCV, hepatitis C virus; IHD, ischemic heart disease; MI, myocardial infarction; NYHA, New York Heart Association; RHD, right heart disease; RVD, right ventricular diameter.

impairment [8–11]. According to our results, the morbidity outcomes in patients with LC was 47% in group A and 91% in group B. Patients with LC bled significantly, and bleeding was significantly obvious in the patients with advanced hepatic affection [2,8,12–15], and hence the transfusion requirements [15,16]. Moreover, these patients had a higher

Table 2: Preoperative laboratory values by status and degree of liver cirrhosis

	Control (*n*=60)	Child-Pugh A (*n*=49)	Child-Pugh B (*n*=11)	*P*
Hemoglobin (g/dl)	12.7±1.2	12.5±1.7	11.6±1.5	0.122
Platelet count (µl)	275±64×10^3	262±92×10^3	256±123×10^3	0.15
INR	1.1±0.1	1.1±0.1	1.3±0.2	<0.001
PT (s)	13.7±1.1	14.6±1.5	16.0±1.9	<0.001
PTT (s)	32±3	34±8	34±4	0.46
Serum creatinine (mg/dl)	0.8±0.2	0.9±0.4	0.9±0.3	0.99
Serum bilirubin (mg/dl)	0.7±0.3	0.7±0.3	1.6±0.7	<0.001
Serum albumin (g/dl)	4.1±0.3	4.0±0.4	3.3±0.5	<0.001
ALT (U/l)	30±12	22±11	28±16	0.003
AST (U/l)	31±15	36±27	52±34	0.05

ALT, alanine aminotransferase; AST, aspartate aminotransferase; INR, international normalized ratio; PT, prothrombin time; PTT, partial thromboplastin time.

Table 3: Extent and type of surgery by status and degree of liver cirrhosis

	Control (*n*=60)	Child-Pugh A (*n*=49)	Child-Pugh B (*n*=11)	All patients (*n*=120)	*P*
Extent of surgery [*n* (%)]					
CABG	20 (33)	18 (37)	1 (9)	39 (32)	
Valve surgery	36 (60)	28 (57)	10 (91)	74 (62)	
CABG/valve	0	2 (4)	0	2 (2)	
Congenital	4 (7)	1 (2)	0	5 (4)	
Cardiopulmonary bypass [*n* (%)]					
No	4 (8)	7 (14)	0	11 (9)	0.21
Yes	56 (93)	42 (86)	11 (100)	109 (91)	
CABG [*n* (%)]					
On-bypass	15 (25)	11 (22)	1 (9)	27 (22)	
Off-bypass	5 (8)	7 (14)	0	12 (10)	
Aortic cross-clamp time (min)	60±21	65±25	74±25		0.36
Cardiopulmonary bypass time (min)	86±29	92±35	104±28		0.21
Temperature [*n* (%)]					
Normothermia	13 (22)	12 (24)	0	25 (21)	0.19
Hypothermia	47 (78)	37 (76)	11 (100)	95 (79)	

CABG, coronary artery bypass graft surgery.

rate for wound exploration for bleeding [14,16,17]. However, according to our results, there was no difference between the groups regarding wound exploration. Drastic use of coagulants and transfusion of deficient coagulation factors may dramatically affect our rate of wound re-exploration. Other reported postoperative complications were increased incidence of infections [4,12,16], gut bleeding [9–11,18], increased mechanical ventilatory support duration [3,9,10,12,16] together with the more extended intensive care unit and hospital stay [12,16,19]. In addition, cerebral insults are known to occur in patients with LC after cardiac surgery [8,11]. Cardiac morbidity is not known to be a problem following surgery in patients with LC, and the patients rarely die owing to a cardiac problem [4]. We strikingly reported an increased incidence of cardiac events. Arrhythmias, pericardial effusion, and low cardiac output tended to complicate patients with LC and were obvious with the elevated class of LC. Moreover, patients with high-grade LC tend to have multiple cardiac complications.

Moreover, a considerable number of patients died owing to a cardiac issue. The attributing factors of this observation may be the increased number of patients who had cardiac cirrhosis. Rationally, patients who develop LC owing to cardiac disease are more prone to have more impaired heart performance. Moreover, cardiomyopathic changes that complicate patients with LC, in addition to the higher number of the patients included in the study compared with other reports, may play a role [20,21].

Hepatic failure (HF) is a devastating outcome after cardiac surgery. HF is reported to complicate postoperative course. Lin *et al.* [8] reported an incidence of 0.8% in non-LC patients, whereas others reported 25–28% in patients with LC. Increased severity of LC tends to elevate the incidence of liver failure [7,19]. In our study, none of the control group had hepatic impairment. In the patients with LC, the incidence of HF is high; we have an incidence of 4% in groups A and 36% in group B.

Mortality

Nearly all patients (100%) [7,9,11,19] with CTP class C died postoperatively. We excluded these group because of

Table 4: Postoperative outcomes by status and degree of liver cirrhosis

	Control (*n*=60)	Child-Pugh A (*n*=49)	Child-Pugh B (*n*=11)	All patients (*n*=120)	*P*
Postoperative hemoglobin (g/dl)	9.5±1.5	9.4±1.6	8.1±1.6		0.03
Postoperative PT (s)	16.4±2.9	18.1±5.2	22.5±5.6		<0.001
Postoperative INR	1.4±0.4	1.6±0.5	2.0±0.6		<0.001
Chest drains output (ml)	634±559	947±756	1617±931		<0.001
Blood transfusion (ml)	865.2±647	1381±1009	2341±1097		<0.001
Plasma transfusion (ml)	589±354	919±751	2150±1459		<0.001
Platelet transfusion (ml)	60±47	83±74	167±140		0.001
Ventilation time (h)	10±13	18±24	75±83		<0.001
Arrhythmia [*n* (%)]	8 (13)	15 (31)	6 (55)	29 (24)	0.005
Myocardial infarction [*n* (%)]	4 (7)	4 (8)	1 (9)	9 (8)	0.94
Pericardial effusion [*n* (%)]	1 (2)	1 (2)	2 (18)	4 (3)	0.02
Low cardiac output [*n* (%)]	5 (8)	12 (24)	8 (73)	25 (21)	<0.001
Number of cardiac complications [*n* (%)]					0.002
0	47 (78)	30 (61)	2 (18)	79 (66)	
1	9 (15)	11 (22)	4 (36)	24 (20)	
2	3 (5)	5 (10)	2 (18)	10 (8)	
3	0	3 (6)	3 (27)	6 (5)	
>3	1 (2)	0	0	1 (1)	
Pleural effusion [*n* (%)]	0	1 (2)	2 (18)	3 (2)	0.002
Respiratory complications [*n* (%)]	3 (5)	3 (6)	6 (55)	12 (10)	<0.001
Hematemesis [*n* (%)]	0	0	2 (18)	2 (2)	<0.001
Hepatic impairment [*n* (%)]	0	2 (4)	4 (36)	6 (5)	<0.001
Renal complications [*n* (%)]	5 (8)	5 (10)	5 (45)	15 (12)	0.002
Infection [*n* (%)]	1 (2)	2 (4)	1 (9)	4 (3)	0.42
Neurological complications [*n* (%)]	0	3 (6)	2 (18)	5 (4)	0.01
Reoperation [*n* (%)]	1 (2)	1 (2)	1 (9)	3 (2)	0.34
ICU stay (h)	11±8	13±8	13±9		0.001
Overall complications [*n* (%)]	15 (25)	23 (47)	10 (91)	48 (40)	<0.001
Postoperative mortality [*n* (%)]	4 (7)	4 (8)	4 (36)	12 (10)	0.009

INR, international normalized ratio; PT, prothrombin time.

Table 5: Causes of death by Child class and type of operation

Groups	Operation	Suspected cause (s) of death
Control	CABG-On	MCC
	DVR	LCO+RF
	MVR	LCO+RF
	CABG-On	LCO
Child-Pugh A	CABG-On	MCC
	CAGB-On	MCC+RF
	CABG-On	MSOF
	DVR	MCC+RF
Child-Pugh B	MVR-TR	MCC+RF
	MVR-TR	MSOF
	MVR-TR	MSOF
	CABG-On	MSOF

CABG, coronary artery bypass graft surgery; CABG-On, on-pump CABG; DVR, double valve replacement; MVR, mitral valve replacement; MVR, mitral valve replacement + tricuspid valve repair; MCC, multicardiac complications; RF, renal failure; MSOF, multiorgans systems failure.

un-accepted mortality, very low referral, and high refusal rates for surgery by either the patients or the surgeons. We had an acceptable mortality rate (8%) for patients with CTP class A, and our results are comparable to the others [18,19], but mortality rate was still high in the patients with CTP class B (36%) [9–11,15,19]. Despite the absence of the relation between our deaths and use of cardiopulmonary bypass, nearly all our deaths were linked to the using of cardiopulmonary bypass. Moreover, we had no deaths with the use of the beating heart technique, validating the results of Hayashida and Aoyagi [9] and Morimoto *et al.* [22], who reported no deaths on using off-pump technique. On comparing survivors and nonsurvivors concerning preoperative, operative, and postoperative variables, we found that the nonsurvivors had higher EuroSCORE, larger right ventricular diameter, more elevated preoperative urea levels, prolonged mechanical ventilation, higher drain output, higher New York Heart Association class, higher CTP class, and had more ascites, whereas others found that nonsurvivors had more prolonged ventilation time, higher central venous pressure, lower partial pressure of oxygen in the arterial blood/fraction of inspired oxygen (PO_2/FiO_2), higher lactate levels in the arterial blood, and higher international normalized ratio. In addition, their nonsurvivors needed more vasoactive agents, renal dialysis, and more blood transfusion, meanwhile elevated preoperative bilirubin levels, lower preoperative choline esterase, and prolonged CBP time were obvious in nonsurvivors, as report

Table 6: Comparing between survivors and nonsurvivors regarding preoperative and postoperative parametric characteristics

	Survivors (mean±SD)	Nonsurvivors (mean±SD)	*t*	*P*
Age (years)	43±12	48.6±14	−1.231	0.223
Weight (kg)	77.2±17.3	75.4±19.7	0.278	0.78
EuroSCORE	1.7±1.1	2.8±1.2	−2.7	0.01
EF%	62.6±10.7	56.3±13.5	1.5	0.14
RVD (mm)	21.8±4.5	25.6±5.9	−2.17	0.03
Hb preoperative (g/dl)	12.4±1.6	12.2±2.4	0.40	0.68
WBC preoperative	7.05±2.5	7.1±2.09	−0.145	0.88
PLT preoperative	269.7±101.06	204.7±42.7	1.78	0.8
Urea preoperative	39.36±16.5	55.5±28.7	−2.31	0.024
Creatinine preoperative	0.83±0.33	0.93±0.38	−0.81	0.4
Bilirubin preoperative	0.92±0.51	0.92±0.54	−0.02	0.98
Albumin preoperative	3.59±0.51	3.62±0.55	1.688	0.09
ALT preoperative (U/l)	22.4±11.5	28.1±14.8	−1.285	0.2
AST preoperative (U/l)	37.88±29.2	43.1±24.22	−0.48	0.6
PT preoperative (s)	14.8±1.5	15.6±2.33	−1.303	0.19
INR preoperative	1.16±0.14	1.25±0.23	−1.40	0.16
PTT preoperative (s)	34.5±8.1	31.6±4.13	1.006	0.3
X-clamp (min)	66.4±25.26	69.4±26.65	−0.30	0.77
Cardiopulmonary bypass time (min)	92.4±32.9	104.4±39.6	−0.92	0.3
Ventilation time (h)	15.1±16.7	113.6±79.23	−8.17	<0.001
Chest drain (ml)	982.7±757.83	1636.3±1061.9	−2.15	0.03
Blood transfusion (ml)	1461.7±989	2225.0±1459.94	−1.876	0.06

Hb, hemoglobin; PLT, platelets; X-clamp: aortic cross-clamp; RVD, right ventricular diameter; WBC, white blood cells.

by An *et al.* [19]. Vanhuyse *et al.* [4] reported lower albumin levels to have a negative effect on the multivariate model. MOSF has been reported to complicate postoperative course in cirrhotic patients after OHS causing considerable deaths [3]. In this study, MSOF was the main cause of death in one patient in class A and three patients in class B; similar results have been declared before [3,4,19].

It is now clear that lowering the scale in CHP classification through proper preoperative nutritional and medical optimization will dramatically affect the postoperative outcomes in this group of patients [23].

Prediction of postoperative outcome

Predicting postoperative outcome in cardiac surgery has been attempted a long time ago through universally designed and accepted scoring systems such as EuroSCORE and The Society of Thoracic Surgeon Score. As the association of the liver affection with the cardiac pathology is considered as two diverse issues with erratic outcomes, and also the designed cardiac surgical scores did not incorporate specific pathological changes associated with LC, it is illogic to use these scores to predict outcomes in this exceptional type of patients. Since the first use of the particular scoring system (MELD and CHP) designed to predict the surgical outcome in patients with LC by Suman *et al.* [7], the literature became overwhelmed with reports applying both scoring system for prediction [8–11,15,19]. Some had a conclusions taking the side of CHP score importance regarding its specificity and sensitivity [4,20,24] other gone with MELD [20,25] EuroSCORE lost nearly all reported battles to link it to the postoperative outcome [4,26] even when comparing it with other risk scores such as SAPS II (simplified acute physiology score), SPAS III, SOFA (sequential organ failure assessment), MELD, UK end-stage liver disease, and CTP scores [3]. However, Lin and Hsu [18] had a contrary view. They reported that the predictive power of the EuroSCORE exceeded that of MELD and CTP scores in prediction of postoperative outcome in cirrhotic patients. According to our results, the prediction worth of the CTP score exceeded that of the EuroSCORE. CTP predicted mortality and nearly all postoperative morbidity except arrhythmia and neurological insult, whereas EuroSCORE predicted mortality and development of morbidity namely, low cardiac output, and renal and hepatic impairment only.

Conclusion

Patients with LC have a high incidence of morbidity and mortality after OHS compared with the control. The more the severity of LC (higher CTP score), the more the occurrence of the complications and deaths. Patients with mild LC had an acceptable outcome compared with others with advanced disease. Compared with CHP score, EuroSCORE is less efficient to predict postoperative outcomes in patients with LC after OHS.

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Conflicts of interest

There are no conflicts of interest.

Table 7: Comparison between survivors and nonsurvivors regarding preoperative and postoperative nonparametric characteristics

	Survivors [*n* (%)]	Nonsurvivors [*n* (%)]	Total [*n* (%)]	χ^2	*P*
Sex					
Male	24 (40)	4 (6.67)	28 (46.67)	0.041	0.83
Female	28 (46.6)	4 (6.67)	32 (53.33)		
Child-Turcotte-Pugh class					
A	45 (91.84)	4 (8.16)	49 (81.7)	6.18	0.013
B	7 (63.64)	4 (36.36)	18.3		
Type of cirrhosis					
Hepatitis	20 (33.3)	2 (3.33)	22 (36.67)	1.40	0.49
Cardiac	30 (50)	5 (8.33)	35 (58.3)		
Uncertain	2 (3.3)	1 (1.67)	3 (5)		
Cardiac pathology					
Ischemic heart disease	15 (25)	4 (6.67)	19 (31.67)	1.7	0.63
Right heart disease	34 (56.67)	4 (6.67)	38 (63.33)		
Congenital heart disease	1 (1.67)	0	1 (1.67)		
Mixed	2 (3.33)	0	2 (3.33)		
New York Heart Association class					
II	41 (68.3)	3 (5.00)	44 (73.3)	6.06	0.01
III	11 (18.3)	5 (8.3)	16 (26.7)		
Ascites					
No	40 (66.67)	4 (6.67)	44 (73.3)	7.76	0.02
Mild	12 (20)	3 (5)	15 (25)		
Moderate	0	1 (1.67)	1 (1.67)		
Neuro preoperative					
No	51 (85)	8 (13.3)	59 (98.3)	0.16	0.7
Yes	1 (1.67)	0	1 (1.67)		
Renal preoperative					
No	51 (85)	7 (11.7)	58 (96.7)	2.4	0.1
Yes	1 (1.67)	1 (1.67)	2 (3.3)		
Cardiopulmonary bypass					
No	7 (11.7)	0	7 (11.7)	1.2	0.3
Yes	45 (75)	8 (13.3)	53 (88.3)		
Temperature					
Normothermia	12 (20)	0	12 (20)	2.3	0.1
Hypothermia	40 (66.7)	8 (13.3)	48 (80)		
Reopening					
No	51 (85)	7 (11.7)	58 (96.7)	2.4	0.1
Yes	1 (1.7)	1 (1.7)	2 (3.3)		

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