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# Prediction of the Length of Intensive Care After Cardiac Surgery Under Cardiopulmonary Bypass: Logistic Regression Analysis Based on Troponin I And EuroSCORE II

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#### **ABSTRACT**

**Aim**: This study is to establish a model for patients undergoing cardiac surgery under cardiopulmonary bypass (CPB) to predict the length of intensive care.

Methods: This is a single center retrospective study. A total of 265 patients admitted to the ICU after CPB from 2016 to 2017 were enrolled in the study. Preoperative indicators, intraoperative parameters, and postoperative data were collected. Each patient was scored for EuroSCORE II before surgery. According to the length of intensive care, all patients were divided into two groups: short stay (< 72 h) and long stay (≥ 72 h). A binary logistic regression analysis was performed to establish a regression model to evaluate the predictive performance of the indicators and the EuroSCORE II scoring system on the length of the intensive care.

**Results**: Both troponin I and EuroSCORE II could predict the length of intensive care of patients undergoing cardiac surgery under CPB. After combing the two factors, the prediction efficiency was higher. Comparing the prediction results with the actual data, it showed that the method had high overall accuracy.

Conclusions: The predictive model based on cTnI and EuroSCORE II can accurately predict the length of intensive care of patients undergoing cardiac surgery under CPB. This predictive model may help to improve ICU resource management.

#### INTRODUCTION

The bed utilization rate in the intensive care unit (ICU) is the determined by the turnover of patients in the cardiac surgery department. Therefore, an accurate statistical tool can make the patient's operation schedule more reasonable and provide a reference for the hospital to improve the bed

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utilization rate [Meadows 2018]. Patients in ICU requiring prolonged hospital stays account for a large proportion [Wagener 2011]. The cost of intensive care, coupled with the financial requirements of cardiac surgery itself, makes the preoperative evaluation method particularly important [Andersen 2015]. Most scoring systems have been validated in the general intensive care patients, but not in specific patients like those undergoing cardiac surgery [Exarchopoulos 2015]. Therefore, the pathophysiological changes caused by extracorporeal circulation and related invasive procedures (IABP, hemodialysis, ECMO, and mechanical ventilation, etc.) may not be covered [Hekmat 2005; Doerr 2011; Weiss 2000].

EuroSCORE II is a commonly used risk assessment system for cardiac surgery to predict short-term mortality after cardiac surgery [Nashef 1999]. Previous study has used EuroS-CORE II to predict the length of postoperative intensive care and the probability of postoperative complications [Meadows 2018]. In addition, cardiac biomarkers also have been used to assess the risk of cardiac surgery [Mukaida 2020]. Cardiac Troponin I (cTnI) is recognized as an important indicator for evaluating myocardial injury and generally is used to predict the development and mortality of patients with cardiovascular diseases [van Geene 2010; Gahl 2018]. Whether cTnI could provide additional predictive information to EuroSCORE II still is unclear. Additionally, the predictive effect of cTnI on the length of intensive care of patients undergoing cardiac surgery under cardiopulmonary bypass (CPB) has not been reported. Therefore, this study is to establish a model for patients undergoing cardiac surgery under cardiopulmonary bypass (CPB) to predict the length of intensive care.

## METHODS

**Patients**: A total of 265 patients admitted to the ICU after CBP from 2016 to 2017 were enrolled. The clinical data of patients before and during operation, and during intensive care were collected and retrospectively analyzed.

The inclusion criteria were as follows: Patients received cardiac surgery under CBP, then the patients were transferred to ICU for intensive care after surgery and to the general ward for consolidation after the condition was stable until discharge. The exclusion criteria were patients undergoing off-pump surgery and those with missing data or who died

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in hospital. Written informed consent could be avoided, as this was a retrospective study. The study was approved by the ethics review board of Xinjiang Medical University.

Preoperative data collection: Demographic data, including sex, age, height, weight, body mass index, comorbidities, risk level indicators, and preoperative ultrasound examination results were collected. New logistic EuroSCORE II is calculated, according to the official EuroSCORE II scoring system (http://www.euroscore.org/calc.html). The blood biochemical results and biomarker test results before the surgery also were collected, including white blood cells, hemoglobin, platelets, creatinine, glucose, cTnI, potassium ions, sodium ions, prothrombin time, and prothrombin time international standardized ratio, etc.

Anesthesia: Anesthesia was induced with midazolam, fentanyl, and rocuronium. Before CPB, sevoflurane was inhaled for anesthesia, while propofol and fentanyl were given to maintain anesthesia. At the end of the operation, fentanyl was discontinued, and propofol was continuously given until extubation in the ICU.

**CPB management**: Modified del Nido blood (4:1) cardioplegia 20 mL/kg was used, another 10 mL/kg was added one hour later, and this dose was used for infusion every half hour. The aortic pump flow rate was controlled at 60-100 mL/kg/min, the average arterial pressure was controlled at 50-80mmHg, and the arterial blood oxygen saturation was controlled at more than 90%. The suspension of red blood cells was given when the hematocrit was less than 20%.

**Surgical procedures**: All operations using CPB, including coronary artery bypass grafting, valve replacement, aortic surgery, and surgical treatment of adult congenital heart disease were included in this study. Intraoperative variables, including the CPB time, lowest intraoperative hemoglobin, and lowest hematocrit, etc. were evaluated.

Clinical outcomes: The primary outcome measurement was whether the length of the intensive care was prolonged. Seventy-two hours (three days) was set as the cut-off point for determining whether the intensive care time was prolonged. In addition to medical factors, non-medical factors, such as the size of the hospital ICU, doctor's opinion, feasibility of returning to the general ward, the busy surgical schedule, and particularity of the specific time schedule for the day (generally after early rounds), etc. [Messaoudi 2009], also affects intensive care time. On the other hand, Mazer et al. reported that the average ICU hospital stay after cardiac surgery was 2.3 to 5.2 days [Mazer 1993]. Pascal et al. reported that the optimal cut-off value of intensive care time of elderly people over 80 years old after cardiac surgery was four days, and 84% of the patients without postoperative complications had an intensive care time less than four days [Augustin 2016].

The percentage of prolonged intensive care time was determined based on the hospital's electronic medical record system. The secondary outcome measurements were the intubation time, postoperative suction drainage, and total hospital stay.

**Statistical analysis**: The data was analyzed using SPSS 25.0 (IBM Inc. US). The sample size was estimated by the multivariate binary logistic regression analysis, based on the

positive rate of outcome variables and number of independent variables included in the multivariate regression analysis. Continuous variables of normal distribution were presented as mean ± standard deviation; those of non-normal distribution were expressed as median and interquartile range. Categorical variables were expressed as n (percentage). As cTnI belonged to a positive skewed distribution, Log10 transformation was performed on cTnI before regression analysis.

Univariate binary logistic regression analysis was used to comprehensively evaluate the relationship between each variable and the length of intensive care. Due to the limited sample size, only a limited multi-factor regression model was allowed, therefore, the significance requirement was taken as P < 0.005 [Cuthbertson 2009]. Subsequently, multivariate logistic regression analysis was performed, and regression models with cTnI were established, according to the categories of the candidate factors (demographic data, preoperative tests, operative variable, risk stratification, etc.). Whether each candidate factor and cTnI were independent predictors and whether the prediction efficiency was improved after modeling were observed.

The receiver operating characteristic curve (ROC) was used to assess the correlation between the predictor and the length of intensive care, and to determine the cutoff value of the predictor. Univariate binary logistic regression analysis method was used to evaluate the correlation between the prolonged intensive care time and the cutoff value of the predictor, and  $\rm r^2$  and corresponding P value were calculated, respectively. Chi-square test was used to analyze the correlation of predictors, intubation time, hospital stay, and intensive care time between the two groups. The odds ratio and 95% confidence interval (95% CI) were calculated. A P value of less than 0.05 was considered as statistically significant.

## RESULTS

Proportion of prolonged intensive care time: This study analyzed the data of 265 patients undergoing cardiac surgery with CPB. There were 159 males and 106 females. The average age was 46.15±11.69 years old. The average BMI was 24.8±4.1. The average length of ICU care was 52.5±61.4 hours. The average of the length of total hospital stay was 13.8±7.3 days. Among them, 50 patients had prolonged intensive care time, accounting for about 18.9%.

Prediction of prolonged intensive care time based on preoperative variables: Univariate logistic regression analysis of preoperative indexes and prolonged intensive care time are shown in Table 1 and Table 2. (Table 1) (Table 2) The results of the *chi*-square test and logistic regression analysis of the variables related to the operation are shown in Table 3. (Table 3) EuroSCORE II, sex, weight, height, LVEF (left ventricular ejection fraction), cTnI, and creatinine were highly correlated with prolonged intensive care time (*P* < 0.05).

cTnI in the prediction of intensive care time: cTnI was significantly correlated with the length of intensive care time (P < 0.005). The cTnI and EuroSCORE II were independent risk factors for each other (P < 0.005). (Table 4)

Table 1. Preoperative variables related to demography and echocardiography and results of univariate logistic regression analyses for prolonged intensive care

Preoperative variables	Total cohort (N = 265)	Not prolonged (N = 215) (81.1%)	Prolonged (N = 50) (18.9%)	Odds ratio (95% CI)	r²	P-value
Female	106 (40%)	100 (94.3%)	6 (5.7%)	6.377 (2.608-15.592)	0.134	<0.001*
Age	47 (38.5-55)	46 (37-54)	44.5 (52-57)	1.041 (1.011-1.072)	0.048	0.007
Body weight (kg)	70 (60-80)	68 (58-79)	76.5 (66.75-86.25)	1.038 (1.015-1.061)	0.068	0.001*
Body height (cm)	169 (162-173)	168 (160-172)	170.5 (168-176.5)	1.086 (1.038-1.136)	0.087	<0.001*
Body mass index (kg/m²)	24.81±4.06	24.55±3.96	25.96±4.30	1.089 (1.009-1.176)	0.029	0.028
Comorbidities						
Hypertension	61 (23.0%)	42 (68.9%)	19 (31.1%)	0.396 (0.204-0.769)	0.430	0.006
Diabetes	11 (4.2%)	6 (54.5%)	5 (45.5%)	3.870 (1.132-13.238)	0.026	0.031
Chronic obstructive lung disease	2 (0.8%)	2 (100%)	0	0	0	0.999
Atrial fibrillation	20 (7.5%)	18 (90%)	2 (10%)	0.456 (0.102-2.033)	0.008	0.303
Risk stratification						
NYHA III or IV	68 (25.7%)	54 (79.4%)	14 (20.6%)	1.159 (0.583-2.312)	0.001	0.674
Previous cardiac surgery	4 (1.5%)	3 (75%)	1 (25%)	1.442 (0.147-14.162)	0.001	0.753
EuroSCORE II (%)	1.06 (0.69-1.435)	0.98 (0.69-1.33)	1.24 (0.74-2.24)	1.660 (1.245-2.213)	0.100	0.001*
Echocardiography data						
LVEF	63 (58-66)	59 (63-67)	59 (54-63.25)	0.918 (0.879-0.959)	0.095	0.001*

Data are presented as median and interquartile range or numbers (%). Results of the logistic regression are given as odds ratio with 95% confidence interval (CI) and Nagelkerke's generalized  $r^2$  ( $r^2$ ). LVEF, left ventricular ejection fraction; NYHA, New York Heart Association functional class

Table 2. Preoperative biomarkers and results of univariate logistic regression analyses for prolonged intensive care - Associations with prolonged intensive care

Preoperative blood laboratory tests	Total cohort (N = 265)	Not prolonged (N = 215) (81.1%)	Prolonged (N = 50) (18.9%)	Odds ratio (95% CI)	r²	P-value
White blood cell count (103/µL)	6.70 (5.80-7.90)	6.70 (5.80-7.80)	6.17 (6.90-8.30)	0.997 (0.941-1.056)	0.000	
Hemoglobin (g/dL)	13.8 (12.7-14.95)	13.7 (12.7-14.7)	14.3 (12.95-15.33)	1.011 (0.957-1.067)	0.001	0.701
Platelet count (104/µL)	225 (181-258.5)	229 (183-261)	203.5 (170.5-247.3)	0.994 (0.989-1.000)	0.028	0.039
APTT (s)	32 (30-34)	32 (30-34)	31.1 (29-34)	0.988 (0.931-1.048)	0.001	0.681
PT-INR	1.0 (1.0-1.1)	1.0 (1.0-1.1)	1.0 (1.0-1.1)	0.890 (0.183-4.323)	0.000	0.885
Creatinine (µmol/L)	68.0 (57.0-80.5)	55.0 (66.0-78.0)	74 (63.30-88.4)	1.029 (1.013-1.045)	0.083	<0.001*
Sodium (mmol/L)	140 (138-142)	140 (138-143)	140 (137.9-142)	1.006 (0.962-1.052)	0.000	0.796
Potassium (mmol/L)	4.0 (3.7-4.3)	4.0 (3.7-4.3)	3.9 (3.7-4.1)	0.513 (0.219-1.200)	0.018	0.124
Glucose	4.8 (4.4-5.3)	4.8 (4.4-5.2)	4.9 (4.5-5.7)	1.248 (0.983-1.586)	0.019	0.069
log cTnl	0.79 (0.41-1.17)	0.70 (0.38-1.06)	0.98 (0.70-1.46)	2.822 (1.630-4.886)	0.089	<0.001*

Data are presented as median and interquartile range. Results of the logistic regression are given as odds ratio with 95% confidence interval (CI) and Nagelker-ke's generalized  $r^2$  ( $r^2$ ). APTT, activated partial thromboplastin time; PT-INR, international normalized ratio of prothrombin time; cTnI, cardiac troponin I

Table 3. Operative variables and results of the Chi square test and univariate logistic regression analyses for prolonged intensive care – Associations with prolonged intensive care

Type of surgery	Total cohort (N = 265)	Not prolonged (N = 215) (81.1%)	Prolonged (N = 50) (18.9%)	Odds ratio (95% CI)	r²	P-value
AVR	47 (17.7%)	35 (74.5%)	12 (25.5%)	-	-	0.218
MVR	76 (29.7%)	69 (90.8%)	7 (9.2%)	-	-	0.010
AVR+MVR	19 (7.2%)	17 (89.5%)	2 (10.5%)	-	-	0.542
ARR	22 (8.3%)	14 (63.6%)	8 (36.4%)	-	-	0.043
AVR+CABG	5 (1.89%)	4 (80%)	1 (20%)	-	-	1
MVR+CABG	2 (0.8%)	1 (50%)	1 (50%)	-	-	0.342
CABG	28 (10.6%)	18 (64.3%)	10 (35.7%)		-	0.022
ARR+CABG	1 (0.4%)	0	1 (100%)	-	-	0.189
TVR	5 (1.9%)	4 (80%)	1 (20%)	-	-	1
ARR+MVR	2 (0.8%)	2 (100%)	0	-	-	1
MVR+TVP	1 (0.4%)	1 (100%)	0 -		-	1
RASD/RVSD	46 (17.4%)	42 (91.3%)	4 (8.7%)	-	-	0.062
Resection of left atrial myxoma	9 (3.4%)	8 (88.9%)	1 (11.1%)	-	-	1
Replacement of ascending aorta and the entire bow	2 (0.8%)	0	2 (100%)	-	-	0.035
Operative variables						
CPB time	67 (54-85.5)	65 (50-81)	74.5 (60-96.25)	1.014 (1.005-1.024)	0.051	0.003*
Lowest hemoglobin during the operation	8.4 (7.1-9.5)	8.2 (7.1-9.3)	8.45 (7.5-10.2)	5 (7.5-10.2) 1.122 (0.950-1.325)		0.176
Lowest hematocrit during the operation	25 (21-28)	25 (21-28)	25.5 (22-30)	1.002 (0.947-1.059)	0.001	0.953

Data are presented as median and interquartile range or numbers (%). Results of the logistic regression are given as odds ratio with 95% confidence interval (CI), and Nagelkerke's generalized r² (r²). AAR, ascending aortic replacement; ARR, aortic root replacement; AVR/P, aortic valve replacement or plasty; CABG, coronary artery bypass graft; CPB, cardiopulmonary bypass; MVR/P, mitral valve replacement or plasty; TVP, tricuspid valve plasty; RASD/RVSD, repair of atrial/ventricular septal defect

Table 4. Results of multivariate logistic regression analysis for prolonged intensive care

Log(cTnI) 2.591 (1.463-5.590) 0.001*  EuroSCORE II 1.566 (1.188-2.064) 0.001*	Variables	Odds ratio (95%)	P-value
Overall model iit 1 -0.104 \ \tag{0.001}	G( )	,	

Results of the logistic regression are given as odds ratio with 95% confidence interval (CI), and Nagelkerke's generalized  $r^2$  ( $r^2$ ).

Relationship between cTnI and established risk assessment system for cardiac surgery: Model 5 in Table 4 showed that cTnI and the existing cardiac risk assessment system were independent in predicting whether the intensive care time is prolonged. The Nagelkerke's generalized  $r^2$  ( $r^2 = 0.164$ ) and the correct prediction percentage (83.6%) of the two established models were greater than those of cTnI ( $r^2 = 0.164$ ) and the correct prediction percentage (83.6%) of the

0.089, 81.9%) alone and EuroSCORE II ( $r^2$  = 0.1, 83%) alone. This suggests that the addition use of cTnI can improve the predictive ability of EuroSCORE II.

Cutoff values of cTnI and EuroSCORE II: ROC analysis assessing the association between each of Log(cTnI), CPB time, EuroSCORE II, creatinine, and prolonged intensive care time are shown in Figure 1. (Figure 1) The cutoff values were 1.27 for Log cTnI (corresponding to cTnI, 18.9) and 1.065% for EuroSCORE II.

Relationship of cTnI and EuroSCORE II with intensive care time and other outcome variables: The two predictors of cTnI and EuroSCORE II were converted into binary variables based on the cut-off value, and binary logistic regression analysis was performed to determine whether the intensive care time was prolonged. The results showed that cTnI  $\geq$  18.9 and EuroSCORE II  $\geq$  1.065% were significantly correlated with the intensive care time, and the combination of the two was related to the further increase of the intensive care time. (Table 5) In addition, cTnI  $\geq$  18.9 and EuroSCORE II  $\geq$  1.065% were both related to the increased drainage volume and increased ventilation time of endotracheal intubation at 24 h after operation. (Table 6)

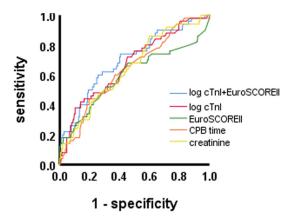


Figure 1. Results of the receiver operating characteristic (ROC) analysis assessing the association between each of Log(cTnI), CPB time, EuroSCORE II, creatinine, Log(cTnI)+EuroSCORE II and the prolonged intensive care time.

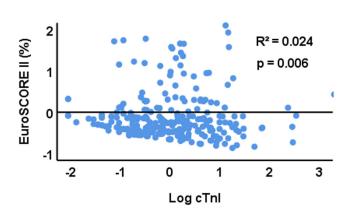


Figure 2. The linear regression analysis of the relationship between log cTnl and EuroSCORE II.

Table 5. Effects of high log cTnl and/or high EuroSCORE II on actual prolonged intensive care rates and predicted increases prolonged intensive care

Variables	Actual proportion of p	prolonged intensive care	Results of the logist	Results of the logistic regression analyses		
	Odd	ls ratio	r²	<i>P</i> -value		
CTnl ≥18.9	41.2% (21/51)	4.466 (2.259-8.826)	0.105	<0.001*		
EureSCORE II ≥1.065%	25.8% (34/132)	2.537 (1.322-4.869)	0.050	0.005*		
CTnI ≥18.9 & EuroSCORE II ≥1.065%	53.1 (17/32)	6.869 (3.130-15.073)	0.130	<0.001*		

Results of the univariate binary logistic regression analysis to evaluate effects of high cTnI and/or high EuroSCORE II according to cutoff values of log cTnI (1.27ng/L) corresponding to a cTnI value(18.9ng/L) and EuroSCORE II (1.065%) on prolonged intensive care are given as odds ratio with 95% confidence interval (CI) and Nagelkerke's generalized  $r^2$  ( $r^2$ ). Actual prolonged intensive care in patients with high cTnI and/or high EuroSCORE II also are shown. See Figure 1 for cutoff values of cTnI and EuroSCORE II.

Table 6. Effects of cTnl and/or EuroSCORE II dichotomized according to cutoff values on Postoperative suction drainage more than 1000ml and Prolonged ventilation longer than 24h

Variables	cTnl ≥18.9 (N = 51)	cTnl <18.9 (N = 214)	Odds ratio (95% CI)	<i>P</i> -value	EuroS- CORE II ≥1.065% (N = 132)	EuroS- CORE II <1.065% (N = 133)	Odds ratio (95% CI)	P-value	cTnI ≥18.9 & EuroS- CORE II ≥1.065% (N = 32)	cTnI <18.9 or EuroS- CORE II <1.065% (N = 233)	Odds ratio (95% CI)	<i>P</i> -value
Postoperative suction drainage more than 1000ml	5 (9.8)	5 (2.3)	4.54 (1.26-16.34)	0.012*	9 (6.8)	1 (0.8)	9.66 (1.21-77.35)	0.010*	5 (15.6)	5 (2.1)	8.44 (2.3-31.1)	0.000*
Prolonged ventilation longer than 24h	15 (29.4)	32 (15)	2.37 (1.17-4.82)	0.015*	30 (22.7)	17 (12.8)	2.0 (1.04-3.85)	0.034*	11 (34.3)	36 (15.5)	2.87 (1.27-6.45)	0.009*

Categorical data are presented as n (%). Variables were analyzed with Chi square test. See also Figure 1 for cutoff values of log cTnl and EuroSCORE II. Newly required dialysis is divided into two types.

Relationship between cTnI and EuroSCORE II: The linear regression analysis showed that Log(cTnI) was significantly correlated with EuroSCORE II (P = 0.006), but the adjusted  $r^2$  was 0.024, indicating the evaluation of the linear regression model was not statistically significant. (Figure 2)

## DISCUSSION

The results of this study showed that cTnI could independently predict whether the intensive care time would be prolonged after cardiac surgery using CPB. The existing cardiac surgery risk assessment system EuroSCORE II also had good prediction accuracy. The additional use of cTnI can improve the prediction accuracy of EuroSCORE II. This process was independent of CPB time, LVEF, and creatinine value. In addition, the increase of cTnI and EuroSCORE II was related to the postoperative increased drainage volume and ventilation time.

Previous study showed that cTnI was correlated with the prognosis and mortality in patients who underwent cardiac surgery [Muehlschlegel 2010], and the basis for the prediction of postoperative mortality using cTnI has been provided [van Geene 2010]. However, the prediction of intensive care time by cTnI is less investigated. Our study found that cTnI could predict whether the intensive care period of patients undergoing cardiac surgery using CBP would be prolonged. In addition, the increase of cTnI was related with some direct factors, which prolong the intensive care time, such as increased drainage volume and ventilation time. This may explain why cTnI can predict the length of intensive care time.

EuroSCORE II, as an existing surgical risk assessment system for patients treated with cardiac surgery, is commonly used to predict mortality within 30 days after cardiac surgery [Nashef 2012]. The results of this study showed that EuroSCORE II could also predict whether the intensive care time is prolonged. In addition, EuroSCORE II was related to increased drainage volume and ventilation time.

A previous large-scale study, involving 18,377 patients, showed that EuroSCORE II can not only accurately predict postoperative mortality, but also predict prolonged intensive care time and the occurrence rate of major complications [Meadows 2018], which is consistent with our results. However, the effect of CPB on patient prognosis was not evaluated. The current not only used EuroSCORE II to predict the intensive care time of patients undergoing cardiac surgery using CPB, but also provided a new direction for the prediction using EuroSCORE II. The results of this study showed that both cTnI  $\geq$  18.9 and EuroSCORE II  $\geq$  1.065% were related to the prolonged ventilation time and increased postoperative drainage. This also may suggest that cTnI and EuroSCORE II may predict the occurrence of postoperative complications.

Although previous studies have shown that cTnI and EuroSCORE II can predict postoperative mortality [van Geene 2010; Nashef 2012] and the additional use of cTnI can improve the predictive performance [Fellahi 2011], there is no report on the predictive value of cTnI and EuroSCORE II on

the length of intensive care time. In this study, we found that the prediction of cTnI for the length of intensive care time was independent of EuroSCORE II, and the linear relationship between the two factors was very weak. Moreover, cTnI could improve the predictive performance of EuroSCORE II. The existing cardiac surgery risk assessment system contains only one biomarker, creatinine, or creatinine clearance. LVEF also is included in the EuroSCORE II scoring system, but it is not a reliable indicator of cardiac function in patients with heart valve disease [Galli 2014; Ishigaki 2020]. The current study also showed that the AUC area of LVEF was less than 0.5, and the diagnostic value was much less than cTnI. Therefore, cTnI may be more objective than LVEF to reflect the state of heart disease and improve the practicality of the existing cardiac surgery risk assessment system.

**Study limitation:** This study has some limitations. First, the sample size was relatively small. Second, this is a single-center study. Further multi-center studies with larger sample size are warranted. Third, we only included Chinese patients. The situation might be different with other ethnicities.

### CONCLUSION

Our findings support the use of preoperative cTnI and the established cardiac surgery risk assessment system EuroS-CORE II to identify the patients with increased intensive care time, prolonged endotracheal intubation ventilation time, and increased risk of increased drainage volume after cardiac surgery using CBP. CTnI and EuroSCORE II are independent of each other in predicting whether intensive care time is prolonged, moreover they are independent of CPB time and patient's preoperative creatinine value. The additional use of cTnI can improve the predictive performance of EuroS-CORE II and provide important information for the risk assessment tool of cardiac surgery.

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