

ORIGINAL ARTICLE

FACTORS INFLUENCING PROLONGED STAY IN THE INTENSIVE CARE UNIT AFTER CARDIAC SURGERY

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ABSTRACT

Background: There are different risk factors that affect the intensive care unit (ICU) stay after cardiac surgery. The aim of this study was to evaluate possible risk factors influencing prolonged ICU stay.

Methodology: We conducted 443 adult patients undergoing different cardiac surgery to determinate causes of prolonged ICU stay. These patients were divided into two groups according to ICU stay ≤ 4 days and >4 days. We evaluated preoperative, intraoperative and postoperative risk factors for prolong ICU stay.

Results: Among the 443 patients studied, 277 (62.52%) had stayed ≤ 4 days and 166 (37.42%) had stayed >4 days in ICU. Frequency of prolonged ICU stay was 42.7% in patients undergoing coronary artery bypass graft (CABG), 37.3% in patients with valve surgery, 9% in patients with CABG plus valve surgery and 10.8% others surgery. Patients with > 4 days of ICU stay received more blood transfusion and higher inotropes duration. They also had longer time duration of surgery, cardiopulmonary bypass, and long ventilation hours and other preoperative and postoperative risk factors. ($P < 0.05$ for all comparisons).

Conclusions: The relationships between the pre-, intra- and postoperative risk factors and prolonged ICU stay after coronary artery bypass grafting with cardiopulmonary bypass, suggest that serum creatinine, urea and liver dysfunction were risk factors for prolong ICU stay, Whereas among surgical variables cardio pulmonary bypass time, cross clamp time and time duration of surgery are the main associates of higher ICU duration.

Keywords: Cardio Pulmonary Bypass, LVEF, Serum Creatinine

INTRODUCTION

After a cardiac operation, Intensive care admission is a standard of treatment for most of the patients but, long stay in intensive care unit (ICU) is usually associated with increased hospital mortality, poor long-term prognosis, and increased morbidity.¹ Many patients with prolonged hospital stay expired shortly after discharge and that the functional status of those who survived for a longer period was worse when compared with those who recovered faster. The prediction of their ICU stay is a fact of great importance, based on the need for having the expanding costs involved in cardiac operations and bed availability, saving resources and ICU costs concerning the population of cardiac surgery patients.² Intensive care requires only the use of exclusive equipment, highly expert and

devoted healthcare staff. Intrinsically the ICU takes a major amount of the total healthcare cost and consequently patients with prolonged ICU stay can have solemn cost implications. Furthermore, patients with prolonged ICU stay can also lead to a shortage of ICU beds and result in operations being cancelled.

We aimed to investigate the postoperative, preoperative and intraoperative predictors and prognostic significance of prolonged ICU stay amongst cardiac surgery patients. This identification could lead to the primary recognition of the high-risk patients for longer ICU hospitalization; also provide an important aid to nursing supervisors and leaders for the suitable reserve planning and actual choice of the operation list.

METHODOLOGY

This is a prospective observational study conducted in U.N. Mehta Institute of Cardiology and Research Centre from January 2014 to March 2014. The study was approved by institute ethics committee and informed and written consent was obtained from all the patients. Four hundred forty three consecutive patients who underwent various cardiac surgical procedures and admitted in to the cardiac surgery ICU were enrolled. The age group of the patients defined in the study were ≥ 18 years to which includes both sexes and a minimum ICU stay of 24 hours. The patients transferring to another ward or hospital within the first two days of postoperative stay in ICU and death during operation were excluded from the study. The length of ICU stay after surgery was considered to be the number of days spent in cardiac ICU unit immediately after surgery and 24 hours in the ICU was measured as one day. For the patient who was at the end of the day readmitted to the ICU, the total number of days (first admission and readmission) was considered. The prolonged stay in the ICU was defined as stay of >4 days.

The median of ICU stay was 4 days. On the bases of this we had two groups, Group A patients ICU stay ≤ 4 days and Group B patients ICU stay >4 days. All the relevant pre-operative details such as age, sex, pre-operative diagnosis, types of surgery and history of patient for example diabetes, smoking were recorded. Blood investigations were done on the day before surgery. Echocardiography was performed the day before the surgery and all relevant details were recorded.

All surgeries were conducted according to the institute protocols for surgery and anaesthesia. The relevant details such as surgery performed, duration of surgery, cardio pulmonary bypass (CPB) time, aortic cross clamp time and blood transfusion details were recorded. Blood transfusion was done according to the institute protocol. The basic monitoring parameters such as arterial pressure, central venous pressure, oxygen saturation, urine output etc. were collected for all patients. Echocardiography was performed the day after the surgery and all complication such as renal, neurological and sepsis were recorded. Duration of inotrope in hours, mechanical ventilation in days was recorded. Blood investigations were done on first post-operative day and subsequently as required.

Statistical Analysis

Statistical analysis was carried out using SPSS version 20.0 software (SPSS Inc, USA). The chi-squared test and independent sample t-test were used to compare categorical and continuous variables respectively. Data were presented as mean \pm SD or proportion as appropriate. The "p" value less than 0.05 was considered to be significant.

RESULTS

Demographic and preoperative characteristics of the sample are shown in Table 1 and 2 respectively. The majority of patients were males (Male 68.4% and female 31.6%) and the median age was 50 years. The study population had undergone either coronary artery bypass grafting (46.04%) or valve surgery repair or replacement (35.66%) or combination of them. The preoperative factors involved in longer and shorter ICU stay are presented in Table 2.

Table 1: Demographic characteristic of the study population

Variables	Group-A (N= 277)	Group-B (N=166)	p value
Age(year)	48.511 \pm 13.05	50.52 \pm 13.53	0.122
Sex	M= 194 (70.0%) F= 83 (29.96%)	M=109 (65.6%) F= 57 (34.3%)	0.041
Weight(kg)	57.97 \pm 13.46	57.46 \pm 16.47	0.723
Height (cm)	161.33 \pm 13.01	159.49 \pm 13.74	0.159
BMI	25.98 \pm 61.40	25.91 \pm 37.42	0.989
DM	43 (15.52%)	35 (21.08%)	0.174
HTN	20 (7.2%)	14 (8.4%)	0.779

Group-A -ICU Stay ≤ 4 Days; Group-B -ICU Stay >4 Days; All figure are in mean \pm SD; NS: Non-significant, BMI: Body mass index, DM: Diabetes Mellitus, HTN: Hypertension

The preoperative level of serum creatinine, SGOT, urea, RBS, albumin and LVEF were found to be significantly ($p < 0.05$) higher in Group B as compare to Group A patients. Intraoperative characteristic of study population are shown in Table 2, same as postoperative data are shown in Table 3. The time duration of surgery is higher in group B and statistically significant (Group A 3.88 ± 1.24 Group B 4.60 ± 1.59 , $p < 0.001$). The cardio pulmonary bypass time and cross clamp time were high in group B and statically significant (Group A 49.38 ± 57.03 Group B 73.19 ± 70.03 , $p = 0.003$ and Group A 37.142 ± 45.57 Group B 50.33 ± 50.97 , $p = 0.006$).

Table 2: Preoperative finding

Variables	Group-A (mean±SD)	Group-B (mean±SD)	p Value
SGPT (mg/dl)	28.11 ± 29.70	31.01 ± 32.49	0.337
SGOT(mg/dl)	25.49 ± 17.90	31.93 ± 33.59	0.009
Total bilirubin (mg/dl)	0.88 ± 0.60	1.0 ± 0.85	0.083
Total protein (g/dl)	6.83 ± 0.62	6.826 ± 0.82	0.953
RBS(mg/dl)	137.63 ± 64.19	158.47 ± 78.27	0.003
Urea (mg/dl)	26.34 ± 11.95	34.26 ± 24.31	<0.001
Creatinine (mg/dl)	0.903 ± 0.46	1.079 ± 1.17	0.027
Sodium (mmol/litre)	136.67 ± 3.41	136.21 ± 14.63	0.616
Potassium (mmol/litre)	4.00 ± 0.50	4.104 ± 0.490	0.033
Albumin (g/dl)	3.81 ± 0.51	3.68 ± 0.44	0.006
Globulin (g/dl)	3.032 ± 0.51	3.109 ± 0.581	0.145
LVEF (%)	49.42 ± 11.80	46.09 ± 13.14	0.010

Group-A -ICU Stay ≤4 Days; Group-B -ICU Stay >4 Days; NS: Non-significant, SGOT: Serum glutamic oxaloacetic transaminase, SGPT:Serum glutamic pyruvic transaminase, RBS: Random blood sugar, LVEF: Left ventricular ejection fraction

Table 3: Intraoperative findings

Variable	Group-A (mean±SD)	Group-B (mean±SD)	p Value
CPB time (min)	49.38 ± 57.03	73.19 ± 70.03	0.003
AOX time (min)	37.142 ± 45.57	50.33 ± 50.97	0.006
Time duration of surgery (Hours)	3.88 ± 1.24	4.60 ± 1.59	<0.001

Group-A -ICU Stay ≤4 Days; Group-B -ICU Stay >4 Days; CPB: Cardio pulmonary bypass, AOX: Aortic cross clamp

Table 4: Postoperative findings

Variables	Group-A (mean±SD)	Group-B (mean±SD)	p Value
SGOT (mg/dl)	56.42 ± 35.88	72.04 ± 60.19	0.001
SGPT (mg/dl)	34.32 ± 27.10	38.89 ± 40.76	0.1575
Urea (mg/dl)	33.98 ± 13.80	41.84 ± 24.79	<0.001
Creatinine (mg/dl)	1.055 ± 0.49	1.138 ± 0.507	0.0892
Total Protein (g/dl)	5.820 ± 0.75	5.44 ± 0.93	0.0043
Albumin (g/dl)	3.190 ± 0.418	2.93 ± 0.55	<0.001
Total Bilirubin (mg/dl)	1.442 ± 1.045	1.846 ± 1.66	0.0021
RBS (mg/dl)	203.56 ± 61.88	250.16 ± 85.70	0.0040
Total WBC(/cmm)	17268.26 ± 8935.53	15960.47 ± 5750.56	0.0922
Platelets (/cmm)	215221.42 ± 103564.944	187508.85 ± 82733.03	0.0044
LVEF (%)	49.423 ± 11.80	46.095 ± 13.14	0.0102
Inotropes Duration (Hours)	29.94 ± 20.10	86 ± 72.874	<0.001
Ventilations (Hours)	8.198 ± 6.723	31.92 ± 52.88	<0.001
Post op Hospital Stay (Days)	7.761 ± 3.049	11.15 ± 6.95	<0.001
Mortality (%)	2.8	12.04	0.0003

Group-A -ICU Stay ≤4 Days; Group-B -ICU Stay >4 Days; SGOT: Serum glutamic oxaloacetic transaminase, SGPT:Serum glutamic pyruvic transaminase, RBS: Random blood sugar, LVEF: Left ventricular ejection fraction, WBC: White blood cell

Postoperative complications of both the groups are shown in Table 4. Similar to preoperative findings the higher level of SGOT, urea, RBS, albumin and lower LVEF were associated with Group B patients. Apart from this, other morbidities such as higher protein loss, higher level of bilirubin, greater inotrope duration, ventilation and postoperative hospital stay was observed with group B patients which was statistically significant the inci-

dence of mortality were also higher in Group B (20%) patients as compare to Group A (8%).

In Table 5 summarizes the main findings of the correlation analysis. A correlation was measured prior to conducting the multivariate logistic regression analysis to check the independent variables. Because duration of cross clamp time, cardiopulmonary bypass were and preoperative and postoperative LVEF strongly correlated ($P < 0.001$) with prolong ICU stay.

Table 5: Independent correlation with prolong ICU stay

Variables	Pearson Correlation	p Value
Group-A		
Pre op SGOT (mg/dl)	-.119*	0.049
Pre op LVEF (%)	-.168**	0.009
Post op RBS (mg/dl)	.195*	0.011
Post op LVEF (%)	-.168**	0.009
CPB time (min)	-.159**	0.009
AOX time (min)	-.155*	0.011
Group-B		
Post op LVEF (%)	-.314**	<0.001
Post op RBS (mg/dl)	.376**	<0.001
CPB time (min)	-.255**	0.001
AOX time (min)	-.290**	<0.001

Group-A -ICU Stay ≤4 Days; Group-B -ICU Stay >4 Days; *Correlation is significant at the 0.05 level (2-tailed); **. Correlation is significant at the 0.01 level (2-tailed).

SGOT: Serum glutamic oxaloacetic transaminase, SGPT:Serum glutamic pyruvic transaminase, RBS: Random blood sugar, LVEF: Left ventricular ejection fraction,CPB: Cardio pulmonary bypass, AOX: Aortic cross clamp

The group wise surgeries are shown in Table 6. The frequencies of on pump and off pump surgeries are shown in Table 7.

Table 6: Types of surgery

Variable	Group-A (n=277)	Group-B (n=166)
CABG (%)	48	42.77
Valvular (%)	34	37.34
CABG+ Valvular (%)	3.9	9
Other (%)	13.35	10.84

Group-A -ICU Stay ≤4 Days; Group-B -ICU Stay >4 Days; CABG: Coronary artery bypass grafting

Table 7: The frequencies of on pump and off pump surgeries

Variable	Group-A (n=277)	Group-B (n=166)
On pump (%)	51.98	37.34
Off pump (%)	48.01	62.65

Group-A -ICU Stay ≤4 Days; Group-B -ICU Stay >4 Days;

DISCUSSION

Several studies have been done to determine the risk factors which may lead to the prolong stay in ICU after cardiac surgeries. Multifactorial nature and wide range of patients’ conditions make the understanding of individual factor’s contribution difficult. Any of these factors can affect other factors and strengthen or weaken their effect. The more complicated the surgery is, the higher the rate of mortality, morbidity and postoperative

complications .The main findings of our study were the significant association of four preoperative parameter such as serum creatinine, SGOT, and urea with the prolonged ICU stay of cardiac surgery patients. In particular, patients with preoperative renal dysfunction, high perioperative risk, and high mean glucose levels intraoperative have greater possibility to stay in the cardiac surgery ICU more than 4 days.

The preoperatively increased serum creatinine levels were significantly higher with prolonged ICU stay. In concordance to our findings, several other reports have concluded that the history of renal dysfunction is an independent predictor for prolonged hospitalization into the intensive care unit.^{3, 4, 5, 6} In addition, Ranucci et al. ⁷, in a retrospective study of 9120 cardiac surgery patients revealed the increased preoperative creatinine levels among the main determinants of late discharge from the ICU.

In our study we have also found out postoperative RBS, urea, SGOT, LVEF and inotrope duration and prolong ventilation hours significantly correlated with prolong ICU stay. Among the postoperative and intraoperative factors, units of transfused blood and other blood products in operation room, administer of inotropes and its duration in after surgery, duration of CPB, and time duration of cross clamp time affected the duration of ICU stay.

Most studies reported prolonged (> 72 hours) ICU stay rate of about 33% while we faced with the same rate by defining prolonged ICU stay as stay > 96 hours. For example, in study of Hein et al. ICU stay was longer (> 72 hours) in 26% of cardiac surgery patients.⁸ In another study by Mahesh et al. prolonged ICU stay (> 72 hours) rate was 18.7%.⁹ Type of operations and their proportions might play roll in ICU stay time. Only 42.7% of cases in our study underwent CABG, whereas in most centres (even in our centre) about 70% of the adult cardiac surgeries are CABG, which might affect the study result and prolonged ICU stay. Duration of ventilation and inotrope administration in ICU can be considered as independent predictors of prolonged ICU stay in our study.

CONCLUSION

The relationships between the pre-, intra- and postoperative risk factors and prolonged ICU stay after coronary artery bypass grafting with cardio-pulmonary bypass, suggest that serum creatinine, urea and liver dysfunction were risk factors for prolong ICU stay, Whereas among surgical vari-

ables cardio pulmonary bypass time, cross clamp time and time duration of surgery are the main associates of higher ICU duration. These findings point to the necessary evaluation of strategies for reduction of hospitalization time and suggests special attention to certain clinical and/or surgical conditions that may, when prevented or better controlled, reduce the length of hospital stay for patients undergoing coronary artery bypass grafting.

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