Original Article / Özgün Araştırma

Readmission To Intensive Care Unit After Coronary Bypass Operations in the Short Term

Koroner Baypas Ameliyatları Sonrası Erken Dönemde Yoğun Bakıma Yeniden Yatış

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Abstract / Özet

Objective: Intensive care unit (ICU) readmissions after coronary bypass (CABG) operations occur in a significant number of patients, and the prognosis is poor. We analyzed the risk factors for ICU readmissions after CABG operations in a single institution.

Methods: We retrospectively analyzed the prospectively collected data of 679 coronary bypass patients operated in a single institution in order to evaluate the risk factors for readmittance to the ICU with logistic regression analysis. The outcome results of patients readmitted to the ICU (Group R) and others (Group N) were compared.

Results: Thirty-six (5.3%) patients were readmitted to the ICU. Postoperative in-hospital mortality and pulmonary and neurologic morbidity occurred in 43 (6.3%), 135 (19.9%), and 46 (6.8%) patients, respectively. The comparison of groups showed that mortality and morbidity were significantly higher in Group R compared to Group N (mortality 16.7% vs. 5.9, p=0.029; pulmonary morbidity 66.7% vs. 17.3%, p=0.0001; neurologic morbidity 38.9% vs. 5.0%, p=0.0001). Features associated with readmission included presence of left ventricular dysfunction preoperatively[odds ratio (OR)=4.1; 95% confidence interval (CI)=1.4-12.5; p=0.013], advanced NYHA Class (OR=5.3; 95% CI=1.3-21.7; p=0.022), pulmonary complications (OR=7.3; 95% CI=2.1-25.5; p=0.002), and neurologic complications (OR=4.6; 95% CI=1.3-16.7; p=0.021).

Conclusion: Patients readmitted to the ICU postoperatively have higher rates of mortality and pulmonary and neurologic morbidity after coronary bypass operations. Left ventricular dysfunction, advanced NYHA class, and postoperative pulmonary and neurologic complications are significant risk factors for readmission to the ICU.

Key Words: Coronary artery bypass, readmission, intensive care, risk factors

Amaç: Koroner baypas (KABG) ameliyatları sonrasında yeniden yoğun bakım ünitesine (YBÜ) yatış belli bir oranda görülür ve seyri kötüdür. Bu çalışmada tek merkezde KABG uygulanmış hastalarda yeniden YBÜ'ne yatış risk faktörleri analiz edilmiştir.

Yöntemler: Tek bir merkezde koroner baypas ameliyatına alınan 679 hastanın prospektif olarak toplanan verileri, yeniden YBÜ'ne yatış risk faktörlerinin değerlendirilmesi için retrospektif olarak lojistik regresyon analizi ile incelendi. Yeniden YBÜ'ne yatış ihtiyacı olan hastalar (Grup R) ile diğerleri (Grup N) karşılaştırıldı.

Bulgular: Otuz altı hasta (%5,3) yeniden YBÜ'ne yatırıldı. Postoperatif hastane mortalitesi, pulmoner ve nörolojik morbidite sırasıyla 43 (%6,3), 135 (%19,9 ve 46 (%6,8) hastada görüldü. Grupların karşılaştırmasında mortalite ve morbiditenin Grup R'de Grup N'ye göre anlamlı olarak daha yüksek olduğu görüldü (mortalite %16,7'ye karşı %5,9, p=0,029; pulmoner morbidite %66,7'ye karşı %17,3, p=0,0001; nörolojik morbidite %38,9'a karşı %5,0, p=0,0001). Yeniden YBÜ'ne yatış ile anlamlı ilişkisi olan faktörler ameliyat öncesi sol ventrikül işlev bozukluğu olması (Odds oranı (OR)=4,1; %95 güvenlik aralığı (CI)=1,4-12,5; p=0,013), ileri NYHA sınıfı (OR=5,3; %95 CI=1,3-21,7; p=0,022), pulmoner komplikasyonlar (OR=7,3; %95 CI=2,1-25,5; p=0,002) ve nörolojik komplikasyonlar (OR=4,6; %95 CI=1,3-16,7; p=0,021) idi.

Sonuç: KABG sonrası yeniden YBÜ'ne yatırılan hastalarda daha yüksek oranda mortalite, pulmoner ve nörolojik komplikasyonlar görülmektedir. Sol ventrikül işlev bozukluğu, ileri NYHA sınıfı ve postoperatif pulmoner ve nörolojik komplikasyon görülmesi yeniden YBÜ'ne yatış için anlamlı risk faktörleridir.

Anahtar Kelimeler: Koroner arter baypas, yoğun bakım ünitesi, yeniden yatış, risk faktörü

Introduction

In the postoperative recovery period, intensive care unit (ICU) stay is necessary after coronary bypass (CABG) operations in the majority of centers. Particularly, the first few hours are critical for the risk of myocardial ischemia (1). Numerous postoperative problems have to be addressed correctly in this early postoperative period, such as hypertension, arrhythmias, bleeding, and so forth. Patients are transferred to the ICU on mechanical ventilation, and the sedated and

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Table 1. Preoperative Parameters

	Whole Group (n=679)	Group R (n=36)	Group N (n=643)	p1	p2
Gender				0.270*	-
Male, n (%)	507 (74.7)	24 (66.7)	483 (75.1)		
Female, n (%)	172 (25.3)	12 (33.3)	160 (24.9)		
Age (y) mean±SD (minimum and maximum range)	60.6±10.0 (34-86)	64.2±8.9	60.4±10.1	0.026†	0.897
>75 years	56 (8.2)	4 (11.1)	52 (8.1)	0.528*	-
BMI (kg m^{-2}) (interquartile range)	28.0±4.1 (18.0-40.0)	28.2±5.5	28.0±4.1	0.778Ψ	-
Previous cardiac surgery, n (%)	4 (0.6)	0	4 (0.6)	1.000*	-
Previous PTCA/Stent, n (%)	86 (12.7)	7 (19.4)	79 (12.3)	0.237*	-
Hypertension, n (%)	365 (53.8)	26 (72.2)	339 (52.8)	0.020*	0.879
Previous CVE, n (%)	29 (4.3)	3 (8.3)	26 (4.0)	0.195*	-
CVD, n (%)	70 (10.3)	4 (11.1)	66 (10.3)	0.780*	-
COPD, n (%)	155 (22.8)	14 (38.9)	141 (22.0)	0.027*	0.086
Diabetes, n (%)	262 (38.6)	17 (47.2)	245 (38.1)	0.279*	-
Hyperlipidemia, n (%)	386 (56.8)	20 (55.6)	366 (57.0)	0.864*	-
Tobacco use, n (%)	331 (48.7)	16 (44.4)	315 (48.5)	0.595*	-
Family history of atherosclerotic disease, n (%)	229 (33.7)	9 (25.0)	220 (34.2)	0.244*	-
Peripheral arterial disease, n (%)	61 (9.0)	3 (8.3)	58 (9.0)	1.000*	-
CRD, n (%)	34 (5.0)	5 (13.9)	29 (4.5)	0.035*	0.545
Previous MI, n (%)	203 (29.9)	11 (30.6)	192 (30.0)	1.000*	-
Ejection Fraction (%) mean±SD (minimum and maximum range)	51.2±8.7 (30-60)	48.2±10.0	51.3±8.6	0.036	-
LVD, n (%)	119 (17.5)	13 (36.1)	106 (16.5)	0.006*	0.013

BMI: body mass index; COPD: chronic obstructive pulmonary disease; CRD: chronic renal disease; CVD: cerebrovascular disease; CVE: cerebrovascular event; LVD: left ventricle dysfunction (EF≤%40); MI: myocardial infarction; PTCA: percutaneous transcoronary angioplasty
p1: univariate tests; p2: logistic regression
*Chi-square or Fisher's Exact, †Independent samples t-test, ΨMann-Whitney U-test

intubated patient requires extreme caution during ICU care and extubation.

During the recovery period, however, some problems may be encountered, so that patients may have to be readmitted to the ICU. Readmission to the ICU is associated with worse outcome (2). There are studies analyzing ICU readmissions in cardiac surgery patients (1-3); however, they are mostly focused on the fast track protocols. In our clinic, fast track protocols are not employed. Again, ICU readmissions occur in a significant number of patients, and the prognosis is also poor. We analyzed the risk factors for ICU readmissions after a heterogeneous group of CABG operations in a single institution.

Methods

After approval by the institutional ethics board (Bağcılar Training and Research Hospital, Noninvasive Clinical Research Ethics Board, May 13th, 2013; No: 2013/145) and completion of patient consent, we analyzed the hospital records of patients from a prospectively collected coronary bypass database. The outcome data of coronary bypass operations performed from December 1, 2010 (starting of our database collection) to March 28, 2013 were included in the analysis. By the time of analysis, all patients were discharged from the hospital. We obtained the preoperative demographic characteristics, operation details, and postoperative outcomes from the hospital records and the prospectively collected database. Patient characteristics and intraoperative measurements were recorded in the coronary bypass database by the anaesthesiologist. Preoperative characteristics of the patients are summarized in Table 1 and Table 2. As a routine preoperative work-up, left ventricle functions were evaluated with transthoracic echocardiography. The ejection fractions (EF) were recorded, and patients with 40% or lower EF were considered to have left ventricle dysfunction (LVD). All patients were evaluated with duplex ultrasonography for the presence of any extracranial cerebrovascular disease (CVD). In case a haemodynamically significant CVD was detected, computerized tomographic or magnetic resonance angiography was performed. Presence of

Table 2. Preoperative parameters-ECG and Classifications

	Whole Group (n=679)	Group R (n=36)	Group N (n=643)	p1	p2
Preoperative ECG				0.944	-
NSR, n (%)	668 (98.4)	36 (100)	632 (98.3)		
Non-sinus rhythms, n (%)	11 (1.6)	0	11 (0.7)		
ASA Classification, n (%)				0.046	0.134
Class I	22 (3.2)	0	22 (3.4)		
Class II	365 (53.8)	12 (33.3)	353 (54.9)		
Class III	282 (41.5)	24 (66.7)	258 (40.1)		
Class IV	10 (1.5)	0	10 (1.5)		
NYHA Classification, n (%)				0.001	0.022
Class I	155 (22.9)	4 (11.1)	151 (23.5)		
Class II	358 (52.7)	15 (41.7)	343 (53.3)		
Class III	144 (21.2)	15 (41.7)	129 (20.1)		
Class IV	22 (3.2)	2 (5.6)	20 (3.1)		
Canada Classification, n (%)				0.011	0.566
Class I	93 (13.8)	4 (11.1)	89 (13.8)		
Class II	315 (46.4)	12 (33.3)	303 (47.1)		
Class III	227 (33.4)	17 (47.3)	210 (32.7)		
Class IV	44 (6.4)	3 (8.3)	41 (6.4)		

ASA: American Society of Anesthesiologists Classification; ECG: electrocardiography; NSR: normal sinus rhythm; NYHA: New York Heart Association Classification; p1: univariate tests; p2: logistic regression

any CVD was used as a binary variable in the analysis regardless of the haemodynamic significance. Chronic obstructive pulmonary disease (COPD) was considered present for patients with dyspnea or chronic cough and prolonged use of bronchodilators or corticosteroids and/or compatible radiological changes (hypertransparency by hyperinflation and/or retraction of ribs and/or retraction diaphragm) (4). Diabetes was present when the patient was diagnosed before and/or on hypoglycemic medication. Peripheral arterial disease was present when the patient had symptoms or physical examination signs or radiographic evidence of occlusive arterial disease of the limbs. Chronic renal disease (CRD) was present when the patient had previous diagnosis or measured serum creatinine values >1.5 mg dL^{-1}. Indications for emergency procedures were determined according to the guidelines for coronary artery bypass operations (5).

All patients were operated under general anaesthesia with median sternotomy. Anaesthesia induction and maintenance utilized intravenous midazolam, fentanyl (7-10 µg kg^{-1}), and vecuronium. Supplemental sevoflurane (0.5%-1.0%) was used when necessary to maintain mean arterial pressure and heart rate within 25% of pre-induction values, and at the start of rewarming, we started remifentanil infusion at 1-1.5 µg $kg^{-1}min^{-1}$ during cardiopulmonary bypass (CPB). In patients who were operated on for concurrent carotid procedures, carotid procedure was performed prior to sternotomy. The operative details are summarized in Table 3. Cardiopulmonary bypass was established using a non-pulsatile or pulsatile hypothermic flow of 2.0-2.4 L $min^{-1}m^{-2}$, with mean arterial pressure maintained from 50-70 mm Hg and α-stat blood gas management. Total circulatory arrest was utilized in cases of concurrent aortic procedures. Axillary arterial cannulation was utilized in these cases, and cerebral protection was maintained with selective anterograde cerebroplegia. Arterial cannulation was made on the ascending aorta in the remaining cases. According to the procedural needs, myocardial protection was modified as anterograde, retrograde, or both using cold/isothermic blood cardioplegia. Antifibrinolytic therapy was administered with aminocaproic acid, per institutional routines. The amount of intraoperative bleeding was assessed by subtracting the intraoperatively used fluids from total fluid aspirated intraoperatively.

All patients were transferred to the cardiovascular ICU after operation with mechanical ventilation. Patients were extubated in the ICU according to the following criteria: maintenance of haemodynamic stability (without inotropic support or decreased need for support), absence of clinically significant bleeding (<100 mL h^{-1}), absence of significant arrhythmias, adequate urine output (>1 mL kg^{-1} h^{-1}), adequate oxygen saturation (>95%) with <50% fractional inspired oxygen, adequate awakening (able to obey commands), and absence of cardiac or respiratory distress. Bolus doses of non-

Table 3. Intraoperative parameters

	Whole Group (n=679)	Group R (n=36)	Group N (n=643)	p1	p2
Emergency procedure, n (%)	75 (11.0)	4 (11.1)	71 (11.0)	1.000*	-
Concomitant procedure, n (%)	59 (8.7)	3 (8.3)	56 (8.7)	0.549*	-
Valvular, n (%)	28 (4.1)	2 (5.6)	26 (4.0)	0.655*	-
Carotid, n (%)	15 (2.2)	1 (2.8)	14 (2.2)	0.552*	-
OPCAB, n (%)	55 (8.1)	3 (8.3)	52 (8.1)	1.000*	-
Pulsatile CPB, n (%)	38 (5.6)	2 (5.6)	36 (5.6)	1.000*	-
TCA, n (%)	5 (0.7)	0	5 (0.8)	1.000*	-
Cross-clamp duration (min) mean±SD (minimum and maximum range)	61.1±29.8 (11-235)	63.5±22.2	61.0±30.2	0.618†	-
Perfusion duration (min) mean±SD (minimum and maximum range)	100.0±40.1 (28-392)	105.4±27.2	99.7±40.7	0.412†	-
Operation duration (min) mean±SD (minimum and maximum range)	240.7±53.9 (82-500)	246.4±40.5	240.3±54.7	0.587†	-
Number of distal anastomosis mean±SD (minimum and maximum range)	2.9±1.0 (1-7)	3.2±1.2	2.9±1.0	0.092†	-
Hypothermia (°C) mean±SD (minimum and maximum range)	30.2±1.5 (18-36)	30.4±1.1	30.2±1.5	0.587†	-
Need for intraoperative inotropic support, n (%)	254 (37.4)	22 (61.1)	232 (36.1)	0.001*	0.194
Intraoperative bleeding (mL) mean±SD (minimum and maximum range)	541.0±175.2 (100-1500)	531.3±94.8	541.6±178.7	0.747†	-
Use of LITA graft, n (%)	615 (90.6)	32 (88.9)	583 (90.7)	0.767*	-

CPB: cardiopulmonary bypass; LITA: left internal thoracic artery; TCA: total circulatory arrest
p1: univariate tests; p2: logistic regression; *Chi-square or Fisher's Exact, †Independent samples t-test

steroidal anti-inflammatory drugs (diclofenac) were used for analgesia in the ICU. The decision to discharge patients from the ICU was made by the cardiovascular ICU staff surgeons on a patient-by-patient basis. The discharge from the ICU was delayed in the presence of significant oxygenation problems (evidenced by arterial blood gas analysis and pulse oximetry measurements) and disturbed tissue oxygen delivery [evidenced by increased lactate (>4 mmol L^{-1}), decreased urine output (<0.5 mL kg^{-1} h^{-1}), decreased cardiac index (<2 L min^{-1} m^{-2}), haemodynamic instability, need for inotropic support or intraaortic balloon counterpulsation, and multiorgan dysfunction] (3). Discharged patients were transferred to the cardiovascular surgery ward. The decision to readmit the patient to the ICU was made by the ward staff surgeons during working hours or the attending physician after hours, notifying the ward surgeons. The criteria for ICU readmission were as follows: respiratory distress or persistent significant dyspnea or tachypnea despite medical treatment or presence of hemo/pneumothorax necessitating chest tube insertion, haemodynamic instability, renal failure with metabolic derangement, cerebrovascular events necessitating close monitoring, and patient follow-up after revision surgery (sternal dehiscence or infection or thromboembolic complication). The decisions for readmissions were determined from the daily follow-up records.

The primary clinical endpoint of this study was readmission to the ICU after coronary bypass. We used Acute Kidney Injury Network criteria (≥50% postoperative increase from baseline creatinine to peak postoperative creatinine level in the first 10 postoperative days) (6). Pulmonary complication was defined as the presence of postoperative respiratory distress, re-intubation, or prolonged mechanical ventilation and presence of pneumothorax/pulmonary effusion. Infectious complications were defined as positive blood, urine, sputum, or wound cultures postoperatively, requiring dressings and intravenous antibiotics, requiring revision surgery (i.e., mediastinal infection), or presence of radiographic infiltrate. Gastrointestinal complication was defined as the presence of any postoperative complication requiring medical or surgical intervention. Neurological complication was defined as the presence of any cerebrovascular event (stroke, transient ischemic attack, or reversible ischemic neurologic deficit) documented by tomography and clinical examination, encephalopathy (onset after the 4^{th} postoperative day or lasting more than 4 days postoperatively in order to rule out the effect of anaesthesia (7)), and neurologic complications of other causes.

Statistical analysis

Continuous variables were described as mean±standard deviation, and categorical variables were described as frequencies and percentages. The ranges of data were expressed as minimum and maximum range (for normally distributed data) or interquartile range (for non-normally distributed data). The discrete data were analyzed with chi-square or Fisher's exact test where appropriate. The normally distributed continuous data were analyzed with independent t-test and the non-normally distributed data were analyzed with Mann-Whitney U-test. Patients were divided into two groups according to their readmission to the ICU: Group R: patients who were readmitted to the ICU and Group N: patients who were not readmitted to the ICU. A logistic regression model for the outcome readmission to the ICU was constructed after univariate analyses with the following dependent predictors: age, hypertension, COPD, LVD, preoperative CRD, advanced American Society of Anesthesiologists (ASA) Class (class III or IV), advanced New York Heart Association Class (NYHA) (Class III or IV), use of inotropic support during weaning from CPB, postoperative pulmonary complication, neurologic complication, need for inotropic support in ICU, infection, sternal dehiscence, and sternal revision surgery. The complications that occurred after readmission were not included as variables in the analysis. The fitness of the model was tested with R_L^2 as described by Menard (8) (values close to 1 imply perfect association). The data management and analysis were performed with Statistical Package for the Social Sciences, version 11.0 (SPSS Inc, statistical software package). A p value of 0.05 was considered statistically significant.

Results

Six hundred seventy-nine patients underwent CABG during the study period. Thirty-six patients (5.3%) were readmitted to the ICU during their postoperative follow-up in the surgical ward. The preoperative characteristics are outlined in Table 1 and Table 2, and the procedural characteristics are outlined in Table 3. Among the preoperative parameters, the following were found to be statistically significantly different between the groups in the univariate analysis: age; presence of hypertension; COPD; CRD; the average EF and the frequency of patients with LVD; and the ASA, NYHA, and Canada classes of the patients. In the operative parameters, the only factor with a statistically significant difference was the need for inotropic support during weaning from CPB (Table 3). These factors were included in the regression analysis.

The postoperative follow-up parameters are outlined in Table 4. Among these factors, the following parameters showed statistically significant difference between the groups: hospital mortality, intensive care and total hospital length of stay, presence of postoperative morbidity, pulmonary complications, neurological complications and cerebrovascular events, need for inotropic support in ICU, infection, mediastinitis, sternal dehiscence, and sternal revision. The reasons for readmission to the ICU are summarized in Table 5. Among the 19 patients with pulmonary complications, four of them were readmitted to the ICU on two occasions: two of them were transferred for pulmonary complications, one with cardiopulmonary arrest and the other for postoperative follow-up after sternal revision surgery.

Postoperative mortality in 30 days was seen in 36 (5.3%) of patients, and in-hospital mortality was seen in 43 (6.3%) patients. Although 30-day mortality rates were higher in Group R, the difference was not statistically significant (Table 4). However, in-hospital mortality rate was significantly higher in Group R (Table 4).

After logistic regression analysis, the following factors were found to be independently associated with readmission to the ICU: presence of LVD preoperatively [odds ratio (OR)=4.1; 95% confidence interval (CI)=1.4-12.5; p=0.013], advanced NYHA Class (OR=5.3; 95% CI=1.3-21.7; p=0.022), pulmonary complications (OR=7.3; 95% CI=2.1-25.5; p=0.002), and neurologic complications (OR=4.6; 95% CI=1.3-16.7; p=0.021). The R_L^2 value for the model was 0.629, which implies fair fitness.

Discussion

In this series of 679 CABG patients, the rate of readmission to the ICU was 5.3%, which is similar to other reports (3, 9). The poor prognosis of ICU readmission (2, 3) is confirmed by our analysis. Although 30-day mortality rates were not significantly different, total hospital mortality showed a statistically significant difference in Group R (Table 4). Group R patients had significantly higher rates of pulmonary and neurologic complications, which caused readmissions and eventually caused increased risk for hospital mortality.

Several factors have been reported to be significantly associated with ICU readmissions by various authors (3, 10-12). Some of these are age, female sex, operations other than first time isolated CABG, high Bernstein-Parsonnet score, long cross-clamp times, high EuroSCORE, sternal dehiscence, ventricular arrhythmias, postoperative renal failure, and prolonged ventilation. Some of these factors were also found to be significantly associated with ICU readmissions in the univariate analysis; however, the association was not significant in the regression analysis. Considering preoperative factors, LVD and advanced NYHA class were significant predictors of ICU readmissions. Kiessling and colleagues reported that low EF was a risk factor for ICU readmissions, which is compatible with our results (1). Advanced NYHA class is an associated finding with the preoperative LVD in our point of view. These patients are prone to complications; an ICU readmission may be an expected outcome. The discharge decisions from the ICU should be taken with extreme caution in these patients. Postoperative care in the surgical ward is also important. It can be seen that even with a longer average duration of ICU stay, significant numbers of patients experience important complications during their hospital stays. Another factor that Joskowiak et al. (13) reported was complex cardiac surgery. We analyzed concurrent procedures as

Table 4. Postoperative parameters

	Whole Group (n=679)	Group R (n=36)	Group N (n=643)	p1	p2
Mortality					
30-day mortality, n (%)	36 (5.3)	3 (8.3)	33 (5.1)	0.430*	-
Hospital mortality, n (%)	43 (6.3)	6 (16.7)	38 (5.9)	0.029*	-
Extubation duration (h) mean±SD (minimum and maximum range)	10.0±10.5 (2-180)	10.0±4.7	10.0±10.7	0.905†	-
Drainage from chest tubes (mL) mean±SD (minimum and maximum range)	638.4±365.1 (50-3350)	538.2±268.9	643.8±369.0	0.101†	-
ICU stay (d) (interquartile range)	4.4±5.9 (1-79)	9.0±8.7	4.2±5.7	0.0001Ψ	-
Hospital stay (d) (interquartile range)	9.4±7.9 (1-79)	19.7±14.5	8.8±7.0	0.0001Ψ	-
Postoperative morbidity, n (%)	343 (50.5)	36 (100.0)	307 (47.7)	0.0001*	-
Arrhythmia, n (%)	138 (20.3)	10 (27.8)	128 (19.9)	0.271*	-
AF, n (%)	116 (17.1)	9 (25.0)	107 (16.6)	0.217*	-
Persistent AF, n (%)	22 (3.2)	2 (5.6)	20 (3.1)	0.327*	-
Pulmonary, n (%)	135 (19.9)	24 (66.7)	111 (17.3)	0.0001*	0.002
Renal, n (%)	92 (13.5)	8 (22.2)	84 (13.1)	0.145*	-
Need for dialysis, n (%)	32 (4.7)	2 (5.6)	30 (4.7)	0.684*	-
Neurologic, n (%)	46 (6.8)	14 (38.9)	32 (5.0)	0.0001*	0.021
CVE, n (%)	15 (2.2)	4 (11.1)	11 (1.7)	0.006*	-
Ischemic ECG changes, n (%)	30 (4.4)	1 (2.8)	29 (4.5)	1.000*	-
CHF, n (%)	8 (1.2)	4 (11.1)	4 (0.6)	0.0001*	-
LCO, n (%)	41 (6.0)	1 (2.8)	40 (6.2)	0.717*	-
Need for inotropic support, n (%)	106 (15.6)	11 (30.6)	95 (14.8)	0.020*	0.124
IABP, n (%)	24 (3.5)	0	24 (3.7)	0.632*	-
Revision surgery for bleeding, n (%)	28 (4.1)	0	28 (4.4)	0.391*	-
Tamponade	14 (2.1)	1 (2.8)	13 (2.0)	0.537*	-
Infection, n (%)	63 (9.3)	12 (33.3)	51 (7.9)	0.0001*	0.243
Mediastinitis, n (%)	13 (1.9)	6 (16.7)	7 (1.1)	0.0001*	-
Sternal dehiscence, n (%)	16 (2.4)	7 (19.4)	9 (1.4)	0.0001*	0.863
Sternal revision surgery, n (%)	16 (2.4)	8 (22.2)	8 (1.2)	0.0001*	0.053
Gastrointestinal, n (%)	38 (5.6)	2 (5.6)	36 (5.6)	1.000*	-

AF: atrial fibrillation; CHF: congestive heart failure; CVE: cerebrovascular event; IABP: intra-aortic balloon counterpulsation; ICU: intensive care unit; LCOS: low cardiac output; p1: univariate tests; p2: logistic regression; *Chi-square or Fisher's Exact; †Independent samples t-test; ΨMann-Whitney U-test

a separate variable and found no significant association with readmission.

Other factors of significance were pulmonary and neurologic complications (Table 4). Pulmonary complications were reported to be the most common cause of ICU readmissions by various authors (3, 13). They found that prolonged ventilation is a significant factor in predicting ICU readmissions. In our analysis, however, times to extubation were not statistically different between the groups (Table 4). Postoperative respiratory morbidity and mortality is a multifactorial concept. Patients need to be evaluated thoroughly for multi-system problems (14). We believe that these pulmonary complications may be related to the performance of the heart, and both the operation and the low-performing heart may cause congestion and pulmonary problems. Table 4 outlines the significant difference in postoperative CHF in Group R. This parameter could not be analyzed in the multivariate analysis, since the patient number was less than 2% of the population. Some of these cases also had sternal problems, and sternal dehiscence was a significant factor in the univariate analysis. But, overall, the significant association of pulmonary problems may be evaluated together with the patients' ventricular performance. The presence of preoperative COPD was not significantly associated with readmissions in the multivariate analysis, which in turn supports our point of view.

Table 5. Reasons for Readmission to Intensive Care Unit	
Reason	**n (%)**
Pulmonary complications, n (%)	19 (52.8)
Atrial fibrillation, n (%)	5 (13.8)
Neurologic complications, n (%)	5 (13.8)
Cardiopulmonary arrest, n (%)	2 (5.6)
Renal complications, n (%)	2 (5.6)
Sternum revision, n (%)	2 (5.6)
Emergency operation for Left Femoropopliteal Bypass, n (%)	1 (2.8)
Total	36

The lack of significant difference in 30-day mortality is an important point. This result may be interpreted, as the length of stay and occurrence of additional complications may be responsible for the reasons of mortality. Considering the 3 patients with mortality in 30 days in Group R, only one of them had a cardiac cause for death, and the day of demise was postoperative day 8. The remaining two patients died from infection and late occurrence of tamponade on the 20^{th} and 19^{th} postoperative day. The reason for readmission to the ICU was emergency cardiac arrest in the surgical ward, emergency femoro-popliteal bypass, and sternal revision, respectively. It is evident that the longer the length of stay, the more problems the patient may have. The rates of readmissions were shown to be associated with worse outcomes by Kramer and colleagues (15). They reported that intensive care units with readmission rates >7% had significantly higher mortality rates, and they discussed using this measure as a quality measure, because the readmission rates are associated with preadmission severity of illness other than medical care.

The lengths of ICU and hospital stays were longer in Group R, as expected. The differences were highly significant, which mark the increased utilization of sources in these patients. That is why extreme caution in the group of high-risk patients is necessary, not only to obtain better results but also in order to decrease the costs.

The main drawback of this study is the retrospective nature of the study. We tried to overcome the observational bias by multivariate analysis. Also, the author was completely blinded to the discharge decisions, and the determinations were made from the hospital records. Another factor of objection may be the length of ICU stays in the overall group and Group N. There was about 4 days of ICU stay for the overall group, which can be determined to be too long. Fast track surgery is used increasingly, and successful outcome results have been reported (1, 16). Our analysis marks the point that even with a long ICU stay, there is a considerable rate of ICU readmission, especially in the high-risk groups. Therefore, we try to decrease the duration of ICU stays in our clinic. A preventive measure may be the introduction of intermediate care facilities (17, 18).

Conclusion

In conclusion, readmission to the ICU after CABG operations is a bad prognostic sign, with increased mortality and morbidity. The presence of preoperative LVD, having advanced NYHA Class, and postoperative pulmonary and neurologic complications are predictors of ICU readmissions. We believe that our findings are important, since this group is not subject to the fast track protocol and may give further information in risk stratification analyses. Increased ICU stays do not seem to be decreasing the need for ICU readmissions. The evaluation of these risk factors may aid the physicians in the preoperative planning, and risk adjustments may be made accordingly.

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Informed Consent: Written informed consent was obtained from patients who participated in this study.

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