ORIGINAL ARTICLE

Determinants of 30-day mortality in elderly patients admitted to a cardiovascular surgery intensive care unit

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ABSTRACT

BACKGROUND: This study aims to identify the factors influencing 30-day morbidity and mortality in patients aged 65 and older undergoing cardiovascular surgery.

METHODS: Data from 360 patients who underwent cardiac surgery between January 2012 and August 2021 in the Cardiovascular Surgery Intensive Care Unit (CVS ICU) were analyzed. Patients were categorized into two groups: "mortality+" (33 patients) and "mortality-" (327 patients). Factors influencing mortality, including preoperative, intraoperative, and postoperative risk factors, complications, and outcomes, were assessed.

RESULTS: Significant differences were observed between the two groups in factors affecting mortality, including extubation time, ICU stay duration, blood transfusion, surgical reexploration, aortic clamp duration, glomerular filtration rate (GFR), blood urea nitrogen (BUN), creatinine, hemoglobin A1c (HbA1c) levels, and the lowest systolic blood pressure during the first 24 hours in the ICU ($p<0.05$). The "mortality+" group had longer extubation times and ICU stays, required more blood transfusions, and had higher BUN-creatinine ratios, but lower systolic blood pressures, GFR, and HbA1c levels. Mortality was also higher in patients needing noradrenaline infusions and those who underwent reoperation for bleeding ($p<0.05$).

CONCLUSION: By optimizing preoperative renal function, minimizing extubation time, shortening ICU stays, and carefully managing blood transfusions, surgical reexplorations, aortic clamp duration, and HbA1c levels, we believe that the mortality rate can be reduced in elderly patients. Key strategies include shortening aortic clamp times, reducing perioperative blood transfusions, and ensuring effective bleeding control.

Keywords: Aging; cardiac surgery; intensive care; mortality.

INTRODUCTION

Cardiovascular diseases have become an increasing health concern in recent years, capturing global attention as a leading cause of both mortality and morbidity. Despite advancements in diagnostic and treatment technologies, which have improved average life expectancy, these conditions have also led

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to a rise in the incidence of recurrent cardiovascular events.[1] Preoperatively assessing potential postoperative complications is essential for efficiently allocating medical personnel, intensive care unit (ICU) beds, hospital ward beds, medical equipment, and financial resources.[2]

Over the past two decades, there has been a substantial increase in the global elderly population. The United Nations predicts that by 2050, the ratio of individuals aged 65 and above to the total population will reach 1/6, compared to 1/11 in 2019.[3]

Cardiovascular diseases are responsible for approximately one-third of all global deaths, posing a significant threat to sustainable development in the 21st century.[4] The surge in cardiovascular disease incidence is anticipated to persist, attributed not only to the rising prevalence of obesity, diabetes, and metabolic syndrome but also to the increasing proportion of elderly individuals in the population. Additionally, there is a gradual increase in the number of patients undergoing cardiac surgery, leading to a growing interest in cost analyses within the realm of cardiac surgery.[5] Notably, a 2016 study found that perioperative mortality rates in cardiac surgeries vary from 1.1% to 9.5%, depending on the utilization of specialized procedures.[6]

In this retrospective study, our objective is to investigate the risk factors associated with mortality in patients who underwent cardiac surgery at our hospital.

MATERIALS AND METHODS

This retrospective review analyzed patient records from surgeries conducted between January 2012 and August 2021, following approval by our hospital's Clinical Research Ethics Committee (Approval Date: 27/04/2021, Ethics Committee Number: 2021/25). The study excluded patients aged 64 or younger, those who underwent cardiac transplantation, left ventricular assist device implantation, or robot-assisted surgery, individuals who suffered cardiac arrest and died within 24 hours, and cases related to congenital heart diseases. The inclusion criteria comprised patients aged 65 or older, divided into two groups: 65-74 as the "elderly" group and 75 or older as the "very old" group). Included were patients who underwent isolated coronary artery bypass grafting (CABG), isolated valve surgery, combined CABG and valve surgery, aortic surgery, reoperation, and emergency cases.

Data were collected from a comprehensive review of preoperative patient records housed in the Cardiovascular Surgery Intensive Care Unit (CVS ICU), along with intensive care follow-up forms and hospital discharge summaries. Patients were classified into two groups based on their survival: "mortality (+)" for deceased patients and "mortality (-)" for survivors. We assessed preoperative, intraoperative, and postoperative risk factors, complications, and outcomes.

The preoperative evaluation encompassed the analysis of patients' demographic characteristics, American Society of Anesthesiologists (ASA) scores, left ventricular ejection fraction (LVEF), body mass index (BMI), and comorbidities including obesity (BMI>30 kg/m2), hypertension (HT), hyperlipidemia (HL), diabetes mellitus (DM), chronic obstructive pulmonary disease (COPD), peripheral arterial disease (PAD), and renal dysfunction. Intraoperative data included the type of surgery (CABG or valve replacement, emergency or elective), anesthetic method, use of cardiopulmonary bypass (on-pump or off-pump), and the duration of aortic cross-clamping, cardiopulmonary bypass (CPB), and the total surgical procedure. Postoperatively, we assessed various parameters including the volume of drainage, need for inotropic support, usage of intra-aortic balloon pump (IABP), re-exploration for bleeding, quantity of blood products used, and duration of mechanical ventilation (MV, defined as prolonged if >24 hours). We also evaluated complications such as respiratory system issues (e.g., pneumonia), neurological events (stroke, transient ischemic attack), renal failure requiring dialysis, atrial fibrillation, permanent pacemaker requirements, presence of delirium, and length of stay in the intensive care unit. Lactate levels were measured at the first and 24th hours of ICU postoperative follow-up, alongside preoperative values. Mortality during the postoperative hospital stay and within the first 30 days after discharge was categorized as "early mortality," and causative factors were investigated.

Pre- and postoperative laboratory parameters documented included hemoglobin, hematocrit, white blood cell (WBC) count, neutrophil count, levels of sodium, calcium, potassium, hemoglobin A1c (HbA1c), blood urea nitrogen (BUN), creatinine (Cr), and glomerular filtration rates (GFR). The lowest and highest GFR values during the ICU stay were also analyzed. A comparative analysis was conducted between the Young old (65-74) and Middle-aged (75-84) patient groups regarding these parameters.

To determine the sample size, a power analysis was performed using G*Power software (v3.1.9). Based on mortality rates reported by Demir et al. (7) of 4.3% and 14% for different age groups, it was determined that a minimum of 128 cases per group (totaling 256 cases) was necessary to achieve 80% power at a significance level of α=0.05.

Statistical analysis included descriptive statistics, utilizing means, medians, standard deviations, ranges (lowest and highest values), frequencies, and ratios. Data distribution was assessed using the Kolmogorov-Smirnov Test. The Mann-Whitney U Test was applied to analyze quantitative independent data. Qualitative independent data were analyzed using the Chi-Square Test, with Fisher's Test employed when conditions for the Chi-Square Test were not met. Both univariate and multivariate logistic regression were used to investigate the effects, and analyses were performed using the Statistical Package for the Social Sciences (SPSS) 28.0 program.

RESULTS

In Table 1, a meticulous examination reveals no statistically significant differences between the "mortality (+)" and "mortality (-)" groups regarding various patient characteristics, including age, height, weight, BMI, gender, ASA score distribution, preoperative leukocyte count, neutrophil count, hemoglobin (Hb) levels, hematocrit (HCT) values, GFR, blood urea nitrogen, Cr, sodium (Na), potassium (K), lactate values, and left ventricular ejection fraction (EF) percentages. Moreover, there were no significant differences in rates of HT, DM, thyroid dysfunction, chronic obstructive pulmonary disease, use of cardiopulmonary bypass (on-pump), and type of sur-

Table 1. Preoperative characteristics and laboratory results of patients by 30-day mortality outcome

	Mortality (-)		Mortality (+)		P
	Mean±SD/n (%)	**Median**	**Mean±SD/n (%)**	**Median**	
Age	75.2±6.5	75.0	76.8±6.4	78.0	0.116[m]
<75	154 (47.1%)		13 (39.0%)		0.398^{X^2}
>75	173 (52.9%)		20 (60.0%)		
Gender					
Female	128 (39.1%)		17 (51.0%)		0.167^{X^2}
Male	199 (60.9%)		16 (48.0%)		
Height	1.6±0.1	1.7	1.6±0.1	1.6	0.401[m]
Weight	72.5±11.9	71.0	73.7±15.0	70.0	0.989[m]
BMI (Body Mass Index)	27.2±4.1	26.6	28.2±4.5	28.1	0.258[m]
ASA (American Society of Anesthesiologists) Score					
II	49 (15.0%)		2 (6.1%)		0.347^{X^2}
III	206 (63.0%)		22 (66.0%)		
IV	72 (22.0%)		9 (27.0%)		
HT (Hypertension)	248 (75.8%)		25 (75.0%)		0.991^{X^2}
DM	172 (52.6%)		17 (51.0%)		0.905^{X^2}
Thyroid Dysfunction	38 (11.6%)		1 (3.0%)		0.130^{X^2}
COPD	62 (19.0%)		8 (24.0%)		0.465^{X^2}
Elective Surgery	318 (97.2%)		31 (93.0%)		0.071^{X^2}
Emergency Surgery	9 (2.8%)		2 (6.1%)		
On-Pump	315 (96.3%)		32 (97.0%)		1.000^{X^2}
Preoperative Laboratory Values					
Leukocyte	8.0±2.6	7.7	8.1±2.1	7.8	0.607[m]
Neutrophil	5.5±3.6	4.6	6.0±2.8	5.3	0.109[m]
HB (Hemoglobin)	12.2±2.0	12.2	12.4±2.1	12.1	0.771[m]
Hematocrit	37.6±5.7	37.6	37.1±5.2	36.7	0.739[m]
GFR	72.5±21.1	73.8	68.3±23.7	74.9	0.659[m]
BUN	22.3±9.9	20.0	28.6±23.9	22.5	0.288[m]
Cr (Creatinine)	1.0±0.5	1.0	1.2±0.6	1.0	0.349[m]
Na (Sodium)	138.0±6.0	138.0	1385±7.9	137.5	0.912[m]
K (Potassium)	4.3±0.5	4.3	4.4±0.6	4.3	0.319[m]
Lactate (Preoperative)	1.0±0.4	0.9	1.0±0.4	0.9	0.832[m]
Lactate (1st ABG in ICU)	1.6±0.6	1.5	1.4±0.4	1.4	0.398[m]
Lactate (24-hour ABG in ICU)	2.0±1.1	1.7	4.6±5.5	2.3	0.089[m]
EF (Ejection Fraction)	52.8±9.9	55.0	50.4±10.1	50.0	0.167[m]

[M]Mann Whitney-U Test/$^{X^2}$Chi-Square Test. ABG: Arterial Blood Gas; BUN: Blood Urea Nitrogen; COPD: Chronic Obstructive Pulmonary Disease; DM: Diabetes Mellitus; GFR: Glomerular Filtration Rate; ICU: Intensive Care Unit.

Table 2. Laboratory and rhythm assessments in the first 24 hours postoperatively for patients who survived or died within the first 30 days

	Mortality (-)		Mortality (+)		P
	Mean±SD/n (%)	**Median**	**Mean±SD/n (%)**	**Median**	
24th hour lab values in ICU					
Leukocyte	12.2±4.1	11.6	12.3±4.4	11.0	0.856[m]
Neutrophil	10.9±4.2	10.2	10.9±4.1	10.0	0.884[m]
Hb	9.3±1.1	9.2	9.6±1.0	9.6	0.141[m]
Hematocrit	27.5±3.3	27.5	28.7±2.8	29.0	0.080[m]
GFR	67.3±19.8	67.9	55.2±21.8	53.1	0.032[m]
BUN	23.6±10.9	21.0	34.6±22.9	27.0	0.005[m]
Creatinine	1.3±0.9	1.1	1.6±0.7	1.5	0.004[m]
Na	142.1±10.4	142.0	144.5±7.9	143.0	0.245[m]
K	4.4±0.6	4.3	4.4±0.8	4.4	0.982[m]
Postoperative lowest GFR	58.5±22.9	60.0	34.4±20.9	29.3	0.001[m]
Postoperative highest GFR	79.7±22.3	86.0	61.3±26.9	61.5	0.016[m]
Duration of aortic clamp	187.4±263.9	75.0	324.6±364.0	154.0	0.014[m]
HbA1c	6.9±1.6	6.3	6.2±1.0	5.9	0.047[m]
Dysrhythmias in ICU					
Yes	118 (36.1%)		16 (48.5%)		0.160 $^{X^2}$
No	209 (63.9%)		17 (51.5%)		
AF	6 (2.9%)		2 (11.8%)		0.114 $^{X^2}$
PACE	19 (9.1%)		6 (35.3%)		0.005 $^{X^2}$
SR	141 (67.5%)		7 (41.2%)		0.028 $^{X^2}$
PR	8 (3.8%)		1 (5.9%)		0.512 $^{X^2}$
SB	11 (5.3%)		0 (0.0%)		1.000 $^{X^2}$
ST	22 (10.5%)		1 (5.9%)		1.000 $^{X^2}$
SVT	1 (0.5%)		0 (0.0%)		1.000 $^{X^2}$
SE	1 (0.5%)		0 (0.0%)		1.000 $^{X^2}$
SNT	1 (0.5%)		0 (0.0%)		1.000 $^{X^2}$

[m]Mann-Whitney U Test/ $^{X^2}$ Chi-Square Test. AF: Atrial Fibrillation; PR: Paced Rhythm; SB: Sinus Bradycardia; SE: Sinusal Extrasystole; SNT: Sinus Node Tachycardia; SR: Sinus Rhythm; ST: Sinus Tachycardia; SVT: Supraventricular Tachycardia.

gery (elective or emergency) (p>0.05).

In Table 2, which presents values measured at the 24th hour in the ICU, there were no statistically significant differences between the groups, except for certain key factors. Specifically, HbA1c levels and the postoperative lowest and highest GFR values were significantly lower in the "mortality (+)" group (p<0.05), while BUN, Cr levels, and aortic clamp times were found to be significantly higher in this group (p<0.05).

Regarding dysrhythmias observed in the ICU (Table 3), there was no statistically significant difference between the two groups (p>0.05), except for two notable exceptions. The "mortality (+)" group exhibited a significantly higher incidence of permanent pacemaker requirement (PACE) and a lower incidence of sinus rhythm (SR) compared to the "mortality (-)" group (p<0.05). Additionally, the "mortality (+)" group required significantly more erythrocyte suspensions (ES), fresh frozen plasma (FFP), apheresis platelet suspensions, and whole blood transfusions than the "mortality (-)" group (p<0.05). Furthermore, the lowest systolic pressure was notably higher in the "mortality (+)" group (p<0.05).

Analysis of noradrenaline (NE) usage (Table 3) revealed a significantly higher requirement and use in the "mortality (+)" group (p<0.05). Conversely, the need for inotropic support following the cross-clamp showed no significant difference between the two groups in terms of four inotropic agents (adrenaline, noradrenaline, dopamine, dobutamine) (p>0.05). The "mortality (+)" group also exhibited a significantly higher rate of surgical revision (re-exploration) compared to the

Table 3. Postoperative blood transfusion needs, blood pressure monitoring, and inotrope use in the first 24 hours for patients who survived or died within the first 30 days

	Mortality (-)		Mortality (+)		P
	Mean±SD/n (%)	Median	Mean±SD/n (%)	Median	
Transfusion in ICU					
ES	2.2±2.3	2.0	5.9±5.5	5.0	0.000m
FFP	1.3±1.8	0.0	3.3±3.5	3.0	0.000m
Apheresis PLT Suspension	0.2±0.7	0.0	1.0±1.3	0.0	0.000m
Whole Blood	0.1±0.4	0.0	0.4±0.8	0.0	0.000m
Intraoperative Transfusion					
ES	0.4±0.9	0.0	0.6±1.0	0.0	0.522m
FFP	0.3±0.7	0.0	0.4±1.3	0.0	0.623m
Apheresis PLT Suspension	0.0±0.2	0.0	0.1±0.2	0.0	0.176m
Whole Blood	0.0±0.1	0.0	0.0±0.0	0.0	0.651m
Drainage 0th Day	465.9±305.2	400.0	685.7±674.7	425.0	0.505m
Drainage 1st Day	240.8±207.1	200.0	316.7±358.9	200.0	0.375m
First 24 hours in ICU					
Systolic Pressure (Highest)	136.5±20.3	140.0	131.3±18.8	140.0	0.437m
Systolic Pressure (Lowest)	97.6±12.5	100.0	88.0±14.7	90.0	0.016m
Diastolic Pressure (Highest)	72.7±10.5	70.0	70.0±7.6	70.0	0.258m
Diastolic Pressure (Lowest)	49.4±8.6	50.0	50.7±13.3	50.0	0.634m
Inotropic Support in ICU					
Adrenaline	50	15.3%	9	27.3%	0.076X^2
NA (Noradrenaline)	41	12.5%	11	33.3%	0.001X^2
DA (Dopamine)	158	48.3%	16	48.5%	0.985X^2
Dobutamine	6	1.8%	1	3.0%	0.493X^2
Inotropic Support after cross clamp					
Adrenaline	29	8.9%	6	18.2%	0.085X^2
NA	41	12.5%	4	12.1%	0.945X^2
DA	122	37.3%	11	33.3%	0.652X^2
Dobutamine	2	0.6%	0	0.0%	1.000X^2
Revision (Reexploration)	27	8.3%	10	30.3%	0.000X^2
Agitation	13	4.0%	0	0.0%	0.618X^2
Extubation Time (Hours)	38.7±32.8	20.0	49.5±24.2	62.0	0.047m
Transfer Time to the Ward (days)	3.0±3.3	2.0	15.6±14.2	10.0	0.000m

mMann-Whitney U Test/ X^2Chi-Square Test

"mortality (-)" group (p<0.05). However, the occurrence of postoperative agitation in the ICU did not differ significantly between the two groups (p>0.05).

Furthermore, the "mortality (+)" group experienced a significantly longer duration of mechanical ventilation and an extended stay in the ICU compared to the "mortality (-)" group (p<0.05) (Table 3).

In a logistic regression model (Table 4), the length of the ICU stay and the 24th-hour BUN values were identified as significant predictors of mortality. Specifically, each additional day in the ICU was associated with a 1.217 times higher probability of mortality [OR (Odds Ratio) (95% CI - Confidence Interval) = 1.217 (1.117, 1.325), p<0.001]. Similarly, each one-unit increase in 24th-hour BUN levels in the ICU was linked to a 1.066-fold increase in the likelihood of mortality [OR (95% CI) = 1.066 (1.015, 1.120), p=0.010].

Additionally, the need for noradrenaline and the rate of surgical revisions during ICU follow-up were significantly asso-

Table 4. Regression analysis results

	OR (95% CI)	Wald Statistic	p
Constant	–	30.004	<0.001
Duration of ICU Follow-up	1.217 (1.117, 1.325)	20.264	<0.001
24th Hour BUN in the ICU	1.066 (1.015, 1.120)	6.615	0.010*

ciated with higher mortality rates. Patients requiring noradrenaline or undergoing surgical revision exhibited increased mortality.

In our study, which included 360 patients, 33 deaths occurred during the postoperative period. The surgeries performed in the "mortality (+)" group were as follows: 33 patients underwent coronary artery bypass grafting (CABG), 11 underwent combined CABG and valve replacement (CABG+valve R), 13 underwent reoperative valve replacement (Reop. Valve R), 2 underwent isolated valve replacement (Valve R), and 5 underwent surgery of the ascending aorta (Surg. of Ascending Aorta: 2).

DISCUSSION

Expectations for both life expectancy and the quality of life among the elderly have seen a notable increase. Advances in modern medicine have boosted confidence and led an increasing number of elderly patients to seek treatment at cardiac surgery centers. These improvements include advances in surgical and anesthetic techniques, extracorporeal circulation, comprehensive monitoring, and intensive care services. These developments have significantly reduced morbidity and mortality, making open cardiac surgeries a feasible treatment option for the elderly. Various factors influence the prognosis following cardiac surgery in this demographic, which experiences anatomical and functional changes due to aging. Postoperative complications in open cardiac surgeries can significantly impact quality of life and, in some cases, lead to mortality. This study aims to identify the factors contributing to mortality among 360 patients monitored in the intensive care unit following open-heart surgery.

Abel et al.[8] reported that mortality in elderly patients undergoing myocardial revascularization was twice as high as in younger patients. In our study, the mortality rate was 9.1%, with cardiac causes and complications identified as the most common reasons for early mortality. We attribute this slightly elevated mortality rate to the performance of highly complex and urgent procedures. Although we did not observe a statistically significant difference in mortality between elderly and very old patients, we believe that mortality rates are higher compared to younger patients, especially in cases with a high ASA score during surgery. Notably, emergency cases exhibited higher mortality rates (Table 1).

In patients who are anemic prior to surgery, hemodilution during cardiopulmonary bypass can exacerbate the condition, necessitating increased blood transfusions. This escalation in transfusions can lead to complications such as postoperative low-output heart failure, the need for intra-aortic balloon pumps, repeated CPB, and the use of more than two inotropic agents.[9] Caroline Holaubek et al.[10] highlighted the association between preoperative anemia (hemoglobin<10.0 g/dL) and increased mortality. In our study, the group that experienced mortality received significantly higher quantities of erythrocyte suspensions, fresh frozen plasma, apheresis platelet suspensions, and whole blood transfusions in the ICU (p<0.05). However, no notable differences were observed between the groups regarding the amount of intraoperative ES, FFP, apheresis, and whole blood transfusions (p>0.05) (Table 3).

While transfusions in non-cardiac surgeries often depend on the extent of bleeding and Hb levels, cardiac surgeries introduce additional complexities due to inflammatory factors that can contribute to heart failure and disturbances in microcirculation. This underscores the importance of advanced monitoring methods such as thromboelastography (TEG) and rotational thromboelastometry (ROTEM). We believe that mortality rates can be mitigated by effectively controlling bleeding during the perioperative period and optimizing Hb and HCT levels prior to cardiac surgeries, which frequently involve substantial blood loss.

Pickering et al.,[11] in their comprehensive meta-analysis of 46 studies, revealed a notable increase in early postoperative mortality rates among patients who developed acute renal failure (ARF) related to cardiopulmonary bypass. Similarly, L. Volk et al.[12] underscored the significance of renal failure as a significant risk factor for mortality. In our study, we observed significantly elevated BUN and Cr levels in the mortality group at the 24th hour of postoperative ICU follow-up compared to the non-mortality group (p<0.05). Additionally, the lowest postoperative GFR was notably lower in patients with mortality (34 vs. 58 in the non-mortality group), and the highest GFR was also lower in patients with mortality (61 vs. 80 in the non-mortality group), with these differences being statistically significant. Mortality rates were higher in patients with postoperative acute renal failure and preoperative chronic renal failure (Table 4). Regression analysis further illustrated that a 1-unit increase in the BUN value measured at the 24th hour of ICU follow-up escalated the probability of mortality by 1.066 times [OR (95% CI)=1.066 (1.015, 1.120), p=0.010].

In a study by Lagercrantz et al.,[13] which examined the survival, functional status, and quality of life of 141 patients who spent more than 10 days in the postoperative ICU out of 4,086 cardiac surgery patients over five years, the survival rate was found to be only 52%. The most common causes of death included infections, strokes, and multiple organ failure. Several studies have similarly reported a higher mortality rate with increasing ICU stays, particularly in patients exhibiting signs of infection. Correspondingly, in our study, we observed that both extubation time and the duration until transfer to the ward were significantly longer in the "mortality (+)" group compared to the "mortality (-)" group ($p<0.05$) (Table 5). Moreover, a 1-day increase in ICU length of stay was associated with a 1.217-fold increase in the probability of mortality [OR (95% CI) = 1.217 (1.117, 1.325), $p<0.001$].

In contrast to the retrospective review by Liu XY et al.,[14] which examined 311 patients who underwent unplanned re-exploration after cardiovascular surgery and identified the highest lactate value within the first 24 hours post-reexploration, duration of reoperation, and cardiac dysfunction as independent prognostic factors for hospital mortality, our study found no significant differences in mortality rates based on lactate values measured in arterial blood gasses before anesthesia induction, at the first hour, and at the 24th hour in the ICU.

Bardia et al.[15] also found no correlation between HbA1c levels and postoperative complications or mortality in patients undergoing isolated valve surgery. They highlighted the absence of an association between postoperative glycemic variability and complications, contrary to what has been observed in patients undergoing coronary artery surgery. Diabetes is acknowledged as a complex condition that carries a high prevalence of cardiovascular, microvascular, and macrovascular complications, and is associated with an increased risk of mortality. The management of Type 2 Diabetes Mellitus should include a comprehensive risk reduction strategy that focuses not only on achieving normal HbA1c and blood glucose levels but also on optimal blood pressure control and dyslipidemia correction. While aggressive glycemic control may benefit younger diabetic patients in preventing cardiovascular diseases (CVD), it could be detrimental to older patients with long-standing diabetes and established cardiovascular disease.[16] In our study, we observed a significant difference in HbA1c levels between the groups with and without mortality ($p<0.05$), with lower HbA1c values in the "mortality (+)" group (6.2) compared to the "mortality (-)" group (6.8). However, no definitive conclusions regarding case discrimination could be drawn.

The Swedish Evidence Development Web System conducted a comprehensive analysis of all adults under the age of 50, including 932 women and 4,514 men, who underwent coronary artery bypass grafting between 1995 and 2013. This study explored gender disparities and revealed that despite women having a higher cardiovascular risk compared to men, there was no significant difference in mortality rates between the two groups.[17] Similarly, our study found no significant gender-based distribution disparities in mortality between the groups ($p>0.05$).

Borracci et al. conducted a retrospective analysis of 1,823 adult patients who underwent cardiac surgery.[18] These patients were categorized by BMI: normal weight (18.5-24.9 kg/m2), overweight (25-29.9 kg/m2), class I obese (30-34.9 kg/m2), class II obese (35-39.9 kg/m2), and class III obese (morbidly obese) (40-49.9 kg/m2). They discovered that overweight and obese patients had similar or slightly lower in-hospital mortality rates following cardiac surgery compared to normal-weight patients. However, obese patients experienced higher rates of postoperative complications. Their systematic meta-analysis further demonstrated that overweight and obese patients had mortality rates comparable to or even lower than those of normal-weight patients. In our study, we also found no significant differences between the groups in terms of height, weight, or BMI values among the elderly ($p>0.05$).

Reoperations due to bleeding increase the risk of mortality and morbidity in open cardiac surgeries, with rates ranging between 3% and 14% across different clinics.[19-20] In our study, the revision rate for the group with mortality was significantly higher ($p<0.05$) than for the group without. Out of 360 cases, 37 (10.2%) required reoperation due to excessive drainage, resulting in 10 deaths. Given that bleeding and cardiovascular complications, both risk factors for mortality, are more prevalent in elderly patients, we believe that implementing precautionary measures to minimize bleeding, ensuring meticulous surgical hemostasis, and providing excellent postoperative care can contribute to reducing mortality.

Low cardiac output syndrome is a common complication in cardiac surgery patients, characterized by a decrease in cardiac index to <2.0 L/min/m2, systolic blood pressure <90 mmHg, and signs of tissue hypoperfusion.[21] Inotropic drugs[22-23] are frequently initiated to enhance ventricular function post-cardiopulmonary bypass in patients with low cardiac output. Our study revealed a higher mortality rate in patients receiving inotropic support. Although no significant differences were observed between the groups with and without mortality regarding adrenaline, dopamine, and dobutamine support in the ICU ($p>0.05$), the mortality group exhibited significantly higher noradrenaline support in the ICU ($p<0.05$) (Table 5). Additionally, the rates of adrenaline, dopamine, dobutamine, and noradrenaline support after aortic cross-clamp did not significantly differ between the groups ($p>0.05$) (Table 4).

In a study by Nissinen et al.,[24] involving a total of 3,280 patients who had undergone adult cardiac surgery, each 30-minute increase in the duration of aortic cross-clamp and CPB time increased the 30-day mortality rate with an OR of 1.21 (95% CI: 1.01-1.52) and 1.47 (CI: 1.27-1.71), respectively.

The increase in the cross-clamp time is strongly correlated with the increase in CPB time. Myocardial dysfunction resulting from prolonged cross-clamp time is exacerbated by the long duration of CPB. In our study, we observed that the cross-clamp time exceeded 90 minutes in 14 patients in the "mortality (+)" group and mortality increased with prolonged cross-clamp time. Therefore, shortening the duration of the myocardial ischemic period is prognostically important, and developing adequate myocardial protection strategies in patients with severe coronary artery disease is crucial.

Stroke is also a significant concern for the elderly following on-pump cardiac surgeries. Carrascal et al. reported a postoperative stroke rate of 4.1% in 418 patients over 80 years of age who underwent cardiac surgery between 2000 and 2012. They stated that the presence of preoperative vascular disease and postoperative atrial fibrillation are the most important risk factors for stroke formation.[25] In our study, stroke occurred in 14 out of 360 patients, with a rate of neurological complications at 3.9%, consistent with the literature. Unfortunately, stroke was the cause of mortality in 7 of these 14 patients.

CONCLUSION

In conclusion, morbidity and mortality in cardiac surgeries performed on patients aged 65 and older result from multifactorial causes, with age-related physiological decline being a significant factor. Our study revealed a high prevalence of additional diseases and risk factors among the elderly population. While early mortality rates are slightly elevated, achieving acceptable mortality-morbidity rates necessitates thorough evaluation of risk factors and comorbidities before surgery. Patients should undergo surgery under optimal elective conditions, utilizing appropriate surgical and anesthetic techniques. Furthermore, we believe that quality of life and survival rates can be increased through vigilant intensive care follow-up and early mobilization in the postoperative period.

Ethics Committee Approval: This study was approved by the Mehmet Akif Ersoy Thoracic and Cardiovascular Surgery Training and Research Hospital Ethics Committee (Date: 27.05.2021, Decision No: 2021/25).

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ORİJİNAL ÇALIŞMA - *ÖZ*

Kardiyovasküler cerrahi yoğun bakım ünitesine yatırılan yaşlı hastalarda 30 günlük mortalitenin belirleyicileri

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AMAÇ: Bu çalışma, kardiyovasküler cerrahi geçiren 65 yaş ve üzeri hastaların 30 günlük morbidite ve mortalitesinde rol oynayan faktörleri değerlendirmeyi amaçlamaktadır.

GEREÇ VE YÖNTEM: Ocak 2012 ile Ağustos 2021 tarihleri arasında Kardiyovasküler Cerrahi Yoğun Bakım Ünitesi'nde (KCYBÜ) kalp cerrahisi geçiren 360 hastanın verilerini analiz ettik. Hastalar "mortalite+" (33 hasta) ve "mortalite-" (327 hasta) olmak üzere iki gruba ayrıldı. Mortaliteyi etkileyen faktörleri, preoperatif, intraoperatif ve postoperatif risk faktörleri, komplikasyonlar ve sonuçlar da dahil olmak üzere değerlendirdik.

BULGULAR: Mortaliteyi etkileyen faktörler arasında ekstübasyon süresi, yoğun bakım süresi, kan transfüzyonu, cerrahi reeksplorasyon, aort kelepçe süresi, GFR, BUN, kreatinin, HbA1c seviyeleri ve 24 saatlik yoğun bakım süresince en düşük sistolik kan basıncı gibi faktörler arasında iki grup arasında önemli farklar bulundu ($p<0.05$). "Mortalite+" grubunda ekstübasyon süresi, yoğun bakım süresi, kan transfüzyonu ve BUN-Cr seviyeleri daha yüksekken, en düşük sistolik kan basıncı, GFR ve HbA1c seviyeleri daha düşüktü. Noradrenalin infüzyonu gereken hastalarda ve kanama nedeniyle reoperasyon geçiren hastalarda mortalite oranları da daha yüksekti ($p<0.05$).

SONUÇ: Preoperatif böbrek fonksiyonu, ekstübasyon süresi, yoğun bakım takip süresi, yoğun bakımda kan transfüzyonu, cerrahi reeksplorasyon, aort kelepçe süresi ve HbA1c gibi faktörler göz önüne alındığında, yaşlı hastalarda mortalite oranının, kısa aort kelepçeleme süresi, perioperatif kan transfüzyonunu azaltmaya yönelik önlemler almak ve kanamanın iyi kontrolü ile azaltılabileceğini düşünüyoruz.

Anahtar sözcükler: Kardiyovasküler cerrahi; mortalite; yaşlanma; yoğun bakım.

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