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Research Article

Preoperative and Postoperative Risk Factors in Septuagenarian and Elderly Patients Undergoing Open Heart Surgery: A Single-Center Experience

Açık Kalp Cerrahisi Yapılmış Yetmiş Yaş ve Üzeri Hastalarda Preoperatif ve Postoperatif Risk Faktörleri: Tek Merkez Deneyimi

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Abstract

Life expectancy is improving worldwide. The number of septuagenarian and older patients requiring open heart surgery is increasing. The aim of this study was to determine the risk factors associated with in-hospital mortality and poor outcomes in septuagenarian and elderly patients undergoing various open heart surgery procedures in regards of gender. We retrospectively collected the medical records of 104 patients aged >70 years who underwent open heart surgery between 2018 and 2024. Preoperative comorbidities, cross-clamp time, cardiopulmonary bypass time, postoperative bleeding, acute kidney insufficiency, arrhythmia, stroke, low cardiac output, sepsis, duration of mechanical ventilation, length of intensive care unit and hospital stays, mortality were evaluated. The mean age was 74.27 ± 4.80 years; that of women was 74.9 ± 4.9 years, and men was 73.7 ± 4.6 years. Preoperative myocardial infarction was more frequent in men. Coronary artery bypass grafting and thoracic aorta surgery were more frequent in men and women, respectively. Women were more affected by postoperative atrial fibrillation, more frequently required extended mechanical ventilatory support, and had longer ICU stays. Hosmer–Lemeshow and Omnibus tests revealed that age of >76 years, cardiopulmonary bypass time longer than 200 minutes, revision for bleeding, low cardiac output were significant predictors of in-hospital mortality. Despite increased costs and longer hospital stays, cardiac operations can be successfully performed in septuagenarian and elderly patients.
Keywords: Cardiac Surgery, Mortality, Septuagenerian.

Özet

Günümüzde uzun yaşam beklentisi artmaktadır ve açık kalp cerrahisi gereksinimi olan yetmiş yaş ve üzerindeki hastalar dünya çapında artış göstermektedir. Çalışmamızda, farklı açık kalp cerrahisi prosedürleri geçiren 70 yaş ve üzerindeki hastaların cinsiyete göre, kötü prognoz ve yatış sırasındaki ölümlerine neden olan risk faktörlerinin belirlenmesi amaçlanmıştır. 2018-2024 yılları arasında açık kalp cerrahisi yapılan 70 yaş ve üzeri 104 hastanın medikal bilgileri derlenmiştir. Preoperatif ek hastalıkları, aort kros klemp süresi, kardiyo-pulmoner bypass süresi, postoperatif kanama, akut böbrek yetmezliği, aritmi, inme, düşük kalp debisi, sepsis, ventilatör destek süresi, yoğun bakım ve hastane yatış süresi, ölüm oranları değerlendirildi. Hastaların yaş ortalaması 74.27 +/- 4.80 (min 70-maks. 89) (kadın 74,9 +/- 4,9 ve erkek 73,7 +/- 4,6) idi. Preoperatif miyokard infarktüsü erkeklerde daha sıktı, koroner bypass erkeklerde ve torasik aort cerrahisiyse kadınlarda daha sıktı. Postoperatif atrial fibrilasyon kadınlarda daha sıktı. Ayrıca kadınlar uzamış ventilatör desteğine daha çok gereksinim duyuyordu ve daha uzun yoğun bakım yatış sürelerine sahipti. Hosmer-Lemeshow ve Omnibus tesleri, 76 yaşın üzerinde olma, 200 dakikanın üzerinde kardiyopulmoner bypass süresi, kanama revizyonu ve düşük kalp debisi faktörlerinin mortaliteyi öngörme açısından önemli olduğunu gösterdi. Artmış maliyet ve uzamış yatış sürelerine rağmen 70 yaş ve üzerindeki hastalarda açık kalp cerrahisi uygulanabilir.
Anahtar Kelimeler: Kalp Cerrahisi, Mortalite, Yetmişli Yaşlarda Olanlar.

Introduction

The increase in life expectancy in Türkiye has become more pronounced in recent decades, mirroring global trends. In the Aegean region, the Mediterranean diet further supports healthy aging alongside improvements in healthcare.

As expected, the prevalence of cardiovascular diseases among septuagenarians and elderly patients—as well as the need for cardiovascular surgery—is gradually increasing. Even at younger ages, major cardiovascular procedures are associated with higher morbidity and mortality compared with other types of surgery. Advanced age may represent an additional risk factor for mortality and morbidity due to age-related organ dysfunction.

The purpose of the present study was to evaluate the characteristics and outcomes of septuagenarian and elderly Turkish patients undergoing cardiovascular surgery. We analyzed the risk factors for postoperative mortality and poor outcomes in those who underwent elective or emergency open-heart procedures.

Material and Method

Study Design

A single-center, retrospective observational study was conducted at Mugla Sıtkı Kocman University Medical Faculty, Department of Cardiovascular Surgery. Following approval from the local review board (12.12.2024 – 240220-166), patients aged >70 years who were diagnosed with any cardiac pathology and underwent elective, emergency, or redo open heart surgery between October 2018 and October 2024 were included in the study. We conducted this study to evaluate in-hospital mortality and 30-day mortality rates, as well as the occurrence of predefined poor outcomes in patients aged more than 70 years. The study was also planned to determine the risk factors associated with in-hospital mortality and poor outcomes within 30 days in relation to gender as the secondary end-point.

Patients aged <70 years or those who did not undergo cardiac surgery were excluded. The study was conducted in accordance with the principles of the Declaration of Helsinki. Data were collected retrospectively from patients' medical records via the institutional database.

Data Collection

Clinical data were obtained retrospectively and included patient demographics (sex, age, weight). Preoperative variables included comorbid conditions such as myocardial infarction (MI), hypertension (HT), preoperative cardiac rhythm, carotid artery stenosis, stroke, peripheral arterial disease (PAD), chronic obstructive pulmonary disease (COPD), diabetes mellitus (DM), chronic renal insufficiency (CRI), and previous cardiac operations. Additional preoperative data included the ejection fraction (EF); the need for emergent surgery, mechanical ventilatory support, or intra-aortic balloon pump (IABP); and the lipid profile.

Intraoperative variables included the cardiopulmonary bypass (CPB) and cross-clamp times.

Postoperative variables included the need for surgical re-exploration because of bleeding, peritoneal dialysis, continuous renal replacement therapy (CRRT), IABP use, extracorporeal membrane oxygenation (ECMO), and permanent or temporary pacemaker implantation. Other variables included arrhythmia, stroke, low cardiac output (CO), pneumonia, sepsis, duration of mechanical ventilation, length of stay (LOS) in the intensive care unit (ICU), total length of hospitalization, and mortality. These postoperative variables also served as the study's endpoints.

Postoperative poor outcomes were defined as hospitalization exceeding 15 days, an ICU stay longer than 11 days, mechanical ventilation required for more than 72 hours, the need for peritoneal dialysis or CRRT, temporary or permanent pacemaker implantation, pulmonary infection, postoperative reintubation, reoperation for any cardiac complication within 30 days, the requirement for ECMO, cardiopulmonary resuscitation (CPR), mortality within 30 days postoperatively, and an open sternum postoperatively. These thresholds were determined based on prior literature defining prolonged postoperative recovery—specifically, ICU stay longer than 10 days as a marker of poor outcome in neurosurgical patients (1) and mechanical ventilation lasting 24 hours or longer as a standard threshold in adult cardiac surgery — alongside our institutional practice (2).

Laboratory Findings

Peripheral venous blood samples were collected and sent to the laboratory for routine preoperative analysis within 48 hours prior to surgery. These tests measured levels of high-density lipoprotein (HDL), low-density lipoprotein (LDL), triglycerides, and fasting glucose. Low-density lipoprotein, HDL, and triglyceride concentrations were determined using

enzymatic methods on a COBAS 8000 biochemical analyzer (Roche Diagnostics GmbH, Mannheim, Germany).

Statistical Analysis

Statistical analyses were performed using SPSS version 27.0 (IBM Corp., Armonk, NY, USA), MedCalc version 14.8.1 (MedCalc Software, Ostend, Belgium), and RStudio version 2024.09.0 (R Foundation for Statistical Computing, Vienna, Austria). Descriptive statistics are presented as mean ± standard deviation or median (minimum–maximum) for continuous variables and as frequency (percentage) for categorical variables. The distribution of continuous variables was assessed using the Kolmogorov–Smirnov test. Comparisons between categorical variables were performed using the chi-square test, while continuous variables between two groups were compared using the Mann–Whitney U test.

Univariate logistic regression analysis was conducted to identify variables associated with both in-hospital mortality and 30-day mortality. Regarding the univariate regression analysis, the diagnostic performance of age and CPB duration in predicting 30-day mortality was evaluated using receiver operating characteristic (ROC) curve analysis, with optimal cutoff values determined based on the Youden index.

The diagnostic performance of age and CPB duration in predicting 30-day mortality was evaluated using ROC curve analysis, with optimal cutoff values determined by the Youden index. Area under the curve (AUC) values were compared using DeLong's test.

To identify independent predictors of in-hospital mortality, three separate multivariate logistic regression models were developed based on the temporal stages of the surgical process: preoperative, intraoperative, and postoperative periods. For each model, all clinically relevant variables were directly entered into the analysis, and variable selection was performed using the Forward Wald method. This approach enabled the identification of independent predictors within each perioperative phase. The goodness-of-fit of each model was assessed using the Hosmer–Lemeshow test. Odds ratios (ORs) with 95% confidence intervals (CIs) and associated p-values were reported. Other predefined poor outcomes were analyzed descriptively. Due to the limited sample size and heterogeneity of surgical procedures, no inferential statistical testing was applied to these outcomes to avoid type II errors. A two-sided p-value of <0.05 was considered statistically significant.

Results

Baseline Characteristics

The study group included 104 patients. The mean age of women was 74.9 ± 4.9 years, and that of men was 73.7 ± 4.6 years; the age range was 70 to 89 years. Descriptive preoperative variables are shown in Table 1. Preoperative MI was more frequent in men (48.3% versus 13%, p<0.001).

Table 1. Baseline characteristics of the study population

	Total (n=104)	**Female (n=46, 44.2%)**	**Male (n=58, 55.8%)**	**p**
Age (year), mean±SD	74.27 ±4.80	74 (70-89)	71.5 (70-89)	0.072
HT, n (%)	51 (49%)	22 (47.8%)	29 (50%)	0.982
DM, n (%)	35 (33.7%)	15 (32.6%)	20 (34.5%)	>0.999
Hyperlipidemia, n (%)	67 (64.4%)	28 (60.9%)	39 (67.2%)	0.640
COPD, n (%)	15 (14.4%)	3 (6.5%)	12 (20.7%)	0.078
CRI, n (%)	7 (6.7%)	3 (6.5%)	4 (6.9%)	>0.999
Previous stroke, n (%)	8 (7.7%)	4 (8.7%)	4 (6.9%)	0.730
Percentage of carotid artery stenosis >50%	33 (82.5%)	11 (73.3%)	22 (88%)	0.392
Previous MI, n (%)	34 (32.7%)	6 (13%)	28 (48.3%)	<0.001
Previous cardiac surgery, n (%)	5 (4.8%)	2 (4.3%)	3 (5.2%)	>0.999
Preoperative rhythm, n (%)				
Sinus rhythm	81 (77.9%)	33 (71.7%)	48 (82.8%)	0.153
Atrial fibrillation/flutter	19 (18.3%)	12 (26.1%)	7 (12.1%)	0.153
Other	4 (3.8%)	1 (2.2%)	3 (5.2%)	0.153
Previous PAD, n(%)	23 (22.1%)	7 (15.2%)	16 (27.6)	0.204
EF ≤ 35%	9 (8.7%)	2 (4.3%)	7 (12.1%)	0.293
Emergency operation, n(%)	14 (13.5%)	8 (17.4%)	6 (10.3%)	0.449
Preoperative ventilatory support, n (%)	7 (6.7%)	3 (6.5%)	4 (6.9%)	>0.999
Preoperative IABP, n(%)	0 (0%)	0 (0%)	0 (0%)	-

n (frequency), SD (standard deviation), min (minimum), max (maximum), HT (hypertension), DM (diabetes mellitus), COPD (chronic obstructive pulmonary disease), CRI (chronic renal insufficiency), MI (myocardial infarction), PAD (peripheral arterial disease), EF (ejection fraction), IABP (intra-aortic balloon pump).

Intraoperative characteristics of the patients are described in Table 2. Coronary artery bypass grafting (CABG) was statistically more frequent in men (60.3% versus 26.1%), while thoracic aorta surgery was more common in women (26.1% versus 6.9%) (p=0.002). Other parameters were evenly distributed.

Descriptive analyses of other poor outcomes (including prolonged ICU stay, prolonged mechanical ventilation, reoperation, CRRT/peritoneal dialysis, infection, and reintubation) are presented in Table 3. No additional regression models were constructed for these outcomes due to limited statistical power. The ICU stay, postoperative ventilatory support exceeding 10 days, and postoperative atrial fibrillation (AF) were significantly more frequent in women (p=0.031, p=0.021 and p=0.003, respectively). Among all patients, extended ventilatory support (10 days <) was required in females in ratio of 15.2% versus males in ratio of 1.7% (p=0.021) and postoperative AF was found to be 58.7% in females versus in males in ratio of 27.6% (p=0.003). Postoperative AF was further analyzed across cardiac pathology subgroups: the incidence of postoperative AF was 35.4% in CABG, 71.4% in CABG + valve pathology, 33.3% in CABG + thoracic aorta surgery, 50% in valve surgery, 50% in isolated redo-valve surgery, and 37.5% in thoracic aorta surgery in total.

Table 2. Intraoperative characteristics of patients

Characteristics	Total	Female	Male	p
ACT (min)	140.17 ±54.20	138 (62-288)	124 (95-171.75)	0.377
CPB duration (min)	188.58 ±71.88	184.5(102-395)	161 (82-458)	0.096
CABG n (%)	47 (45.2 %)	12 (26.1%) [a]	35 (60.3%) [b]	0.002
CABG-valve n (%)	7 (6.7%)	3 (6.5%)	4 (6.9%)	
CABG-thoracic aorta surgery, n (%)	3 (2.9%)	1 (2.2%)	2 (3.4%)	
CABG-carotid artery surgery, n (%)	1 (1%)	0 (0%)	1 (1.7%)	
Valve n (%)	26 (25%)	15 (32.6%)	11 (19%)	
Thoracic aorta surgery n (%)	16 (15.4%)	12 (26.1%) [a]	4 (6.9%) [b]	
Thoracic aorta surgery- valve, n (%)	2 (1.9%)	2 (4.3%)	0 (0%)	
Redo-surgery n (%)	2 (1.9%)	1 (2.2%)	1 (1.7%)	

ACT (aortic clamp time), min (minute), CPB (cardiopulmonary bypass), CABG (coronary artery bypass grafting), n (frequency).

Table 3. Postoperative events

	Total	**Female**	**Male**	**p**
ICU stay (day)	6 (1-60)	8 (1-60)	6 (1-60)	0.031
Hospital stay (day)	14 (1-69)	14.50 (1-60)	12.50 (1-69)	0.068
Extended ventilatory support (10 days <)	8 (7.7%)	7 (15.2%)	1 (1.7%)	0.021
CRRT-Peritoneal dialysis	12 (11.5%)	7 (15.2%)	5 (8.6%)	0.461
IABP	7 (6.7%)	3 (6.5%)	4 (6.9%)	>0.999
ECMO	4 (3.8%)	2 (4.3%)	2 (3.45)	>0.999
Temporary/Permanent pacemaker	24 (23.1%)	15 (32.6%)	9 (15.5%)	0.069
AF	43 (41.3%)	27 (58.7%)	16 (27.6%)	0.003
Revision for bleeding	6 (5.8%)	3 (6.5%)	3 (5.2%)	>0.999
Stroke	7 (6.7%)	3 (6.5%)	4 (6.9%)	>0.999
Previously stroke+	2 (1.9%)	2 (66.7%)	0 (0%)	0.143
Low CO	27 (26%)	16 (34.8%)	11 (19%)	0.109
Pneumonia	12 (11.5%)	7 (15.2%)	5 (8.6%)	0.461
Sepsis	3 (2.9%)	3 (6.55%)	0 (0%)	0.083
In hospital mortality	23 (22.1%)	12 (26.1%)	11 (19%)	0.528

ICU (intensive care unit), CRRT (continuous renal replacement therapy), IABP (intra-aortic balloon pump), ECMO (extracorporeal membrane oxygenation), AF (atrial fibrillation), CO (cardiac output)

In Table 4, cut-off values were obtained using ROC analysis to evaluate the predictive performance of age and CPB duration for 30-day mortality. Age demonstrated moderate discriminative ability, with an AUC of 0.689 (95% CI: 0.590–0.776, $p < 0.001$). A cut-off value of >76 years yielded a sensitivity of 52.17% and specificity of 81.48%. In comparison, the CPB duration showed a higher predictive performance, with an AUC of 0.819 (95% CI: 0.732–0.888, $p < 0.001$); the optimal cut-off point of >200 minutes provided a sensitivity of 82.61% and specificity of 77.78%. Although these findings suggest that prolonged CPB duration is a stronger predictor of 30-day mortality, the difference in discriminative power between age and CPB duration was not statistically significant ($Z = 1.589$, $p = 0.112$).

Table 4. Receiver operating characteristic analysis results in prediction of 30 day mortality

Variables	Cut-off	SE	Sensitivity	Specificity	AUC	95% CI		p
Age (year)	>76	0.072	52.17	81.48	0.689	0.590	0.776	<0.001
CPB (min)	>200	0.056	82.61	77.78	0.819	0.732	0.888	<0.001

SE (standard error), AUC (area under the curve), CI (confidence interval), CPB (cardiopulmonary bypass

Table 5 presents the results of a multiple logistic regression analysis identifying predictors of in-hospital mortality in elderly patients. Among preoperative variables, age of >76 years was significantly associated with increased mortality risk (OR = 5.186, 95% CI: 1.887–14.879, p=0.002), and the overall model was statistically significant (Omnibus p = 0.002). Intraoperatively, a CPB time longer than 200 minutes emerged as a strong predictor (OR = 16.625, 95% CI: 5.464–63.178, p = 0.001), with the overall model also reaching statistical significance (Omnibus p < 0.001). Postoperative predictors included surgical revision due to bleeding (OR = 9.623, 95% CI: 1.078–85.855, p = 0.043) and low CO syndrome, which showed the highest predictive value (OR = 20.896, 95% CI: 6.309–69.208, p < 0.001); the overall postoperative model was statistically significant as well (Omnibus p < 0.001).

The Hosmer–Lemeshow goodness-of-fit test was applied to each of the three univariate logistic regression models and yielded the following results: age (χ^2 = 0.918, p = 0.821), CPB duration (χ^2 = 0.855, p = 0.991), and revision for bleeding (χ^2 = 0.065, p = 0.799). These results indicate no significant discrepancy between the observed and expected probabilities in any of the models, suggesting that each model demonstrated an adequate fit. Thus, the univariate logistic regression models were not only statistically significant but also showed satisfactory goodness of fit.

Table 5. Predictors of in-hospital mortality in patients

	OR (95% CI)	p
Preoperative predictor: Age (reference: >76 years)	5.186 (1.887-14.879)	0.002
Intraoperative predictor: CPB (reference: >200 min)	16.625 (5.464-63.178)	0.001
Postoperative predictor: Revision for bleeding (reference: none)	9.623 (1.078-85.855)	0.043
Low CO (reference: none)	20.896 (6.309-69.208)	<0.001

OR (Odds ratio), CI (confidence interval), CPB (cardiopulmonary bypass), Low CO (Low cardiac output)

Discussion

This study involving septuagenarian and elderly patients revealed that preoperative MI was more frequent in men, while CABG and thoracic aorta surgery were more frequent in men and women, respectively. Women were more affected by postoperative AF. They also required extended mechanical ventilatory support and had a longer ICU stay overall. In-hospital mortality was associated with age of >76 years, CPB time longer than 200 minutes, revision for bleeding, and low CO.

Preoperative MI and CABG

All over the world, there is an increase in the elderly population, contributing to a higher prevalence of coronary atherosclerotic disease (3). In a study of 69,000 patients with acute coronary syndrome, 35% of the patients were older than 75 years (4). At all ages, females tend to have a lower atherosclerotic burden than males and show increased microvascular resistance when they experience an MI (5). The higher risk of previous MI in males may be related to the lack of estrogen, which has protective effects throughout life.

It has been shown that there is increased acetylation of mitochondrial DNA indicating reduced mitochondrial function in males. In young females, this process offers protection against atherosclerosis. Unfortunately, this difference gradually diminishes with aging (5). In our study, men had a previous MI three times more frequently than women. Accordingly, CABG was more common in men. However, several studies have reported that female gender is a well-established risk factor for increased postoperative morbidity and mortality following isolated CABG (6,7).

Thoracic aorta pathologies

Thoracic aortic surgery is not uncommon in septuagenarians and octogenarians. The underlying cause of aortic aneurysm or dissection, which increases with age, may be related to structural defects in collagen and elastin within arterial tissues over the years (8,9). Shigemitsu et al. reported that 22.5% of their patients underwent thoracic aorta surgery in their cohort (10), although they did not provide gender-specific data. In addition, Castano et al. investigated various types of aortic dissections and postoperative

outcomes in octogenarians, identifying a high mortality rate associated with a cut-off age of 70 years (9). In our series, women were more affected by thoracic aorta pathologies, with a rate of 26.1%.

Postoperative AF

Atrial fibrillation is the most common cardiac arrhythmia detected postoperatively following both cardiac and non-cardiac surgeries (11). Despite advancements in treatment and therapy, AF remains a significant adverse factor, contributing to prolonged ICU and hospital stays (11). Atrial fibrillation may occur after non-cardiac surgery at a rate of 0.4% (11). Başar et al. reported a postoperative AF rate of 14.9% following cardiac surgery (12), while Dobrev et al. found a rate of 30% in their cohort (13). Gaudino et al. observed AF incidence rates of 20% after CABG and 50% after valve surgery (11). By contrast, Rajan et al. reported a rate of 6.06% following CABG in septuagenarians in their cohort (14). In our series, we found the overall postoperative AF rate to be 41.3%, with 58.7% in women and 35.4% following CABG.

Extended mechanical ventilation and extended ICU stay in women

Cardiac surgery is strongly associated with pulmonary complications across all age groups, which negatively affects postoperative outcomes; increases mortality rates; and leads to prolonged mechanical ventilatory support, extended hospital stays, and longer ICU stays. In a study by Fisher et al., post-cardiac surgery-related pulmonary complications included atelectasis, pleural effusion, respiratory failure, pneumonia, pneumothorax, bronchospasm, and chemical pneumonitis due to aspiration (15).

In our study, COPD was less frequent in women (6.5%), yet the need for extended ventilatory support after open heart surgery was higher among women, at a rate of 15.2%. Eight women were diagnosed predominantly with type 1 aortic dissection. We attributed the extended mechanical ventilatory support and ICU stay in these patients to thoracic aorta surgery which involves significantly longer CPB times and is associated with pulmonary edema.

Duration of CBP

In cardiac surgery, many procedures require meticulous tissue handling and extended CPB times. Additionally, elderly patients—particularly septuagenarians and octogenarians—naturally have deficiencies in collagen and elastin. In some instances, because of the reduced durability of the patient's cardiac or vascular tissues or in cases of redo-surgery, complications such as rupture or tearing may become imminent. The need for extended CPB time is often associated with complex or multiple cardiac procedures. Prolonged CPB duration is also linked to thrombocyte dysfunction and hemorrhagic diathesis (16). In our study, we found that a CPB time longer than 200 minutes was associated with a higher risk of mortality.

Postoperative bleeding

In our cohort, the rate of surgical exploration for postoperative bleeding was 5.8%. Hypothermia required during CPB and postoperative thrombocyte dysfunction can lead to hemorrhagic diathesis. As a result, up to 500 mL of hemorrhagic drainage is generally expected in an adult patient by the first postoperative day. Although this drainage can often be managed with blood product replacement, beyond a certain threshold, disseminated intravascular coagulopathy (DIC) may develop, triggering a reversal of the coagulation system toward an anti-coagulative state (16). Massive transfusion of blood products can lead to infection, volume overload, acute kidney injury (AKI), and DIC. Therefore, to avoid these complications, timely surgical reexploration is essential. Preoperatively, it is also important to identify vitamin K deficiency or other hematological disorders that may predispose patients to a bleeding tendency.

Low CO

Post-cardiac surgery–related low CO is observed in approximately 10% of patients. Desoki et al. and Duncan et al. reported that low CO is associated with IABP usage, reoperation, neurological and pulmonary complications, mediastinitis, AKI, and prolonged ICU and hospital stays (17,18). Low CO has been found to be more frequent in male patients, with a reported rate of 65.7% (18). In our study, the overall incidence of low CO was 26%, with a higher occurrence in female patients (34.8%). These female patients predominantly underwent thoracic aorta surgery and, as noted earlier, had longer CPB times.

Age and Mortality

A recent study revealed that the mortality rate in elderly patients has decreased to 8.1%, despite the complications associated with open heart surgery (19). Similarly, Alves et al. concluded that

an age of >70 years is an independent and strong risk factor following cardiovascular surgical procedures (20). In studies conducted among Turkish populations, reported mortality rates range between 12.5% and 16.8% (19). In our series, the mortality rate was found to be 22.1%. Because our hospital is the only tertiary care center in the city, we are unable to refuse high-risk elderly patients. This factor alone may contribute to the elevated mortality rate observed.

Regarding sex, several studies have found worse mortality and poorer outcomes in female patients (21,22). Likewise, in our study, mortality was higher among females, at a rate of 26.1%. By contrast, Arif et al. did not find any gender-related difference in mortality (23).

Age has consistently been identified as a significant factor impacting mortality in multiple studies (17,24,25). Elderly patients often have additional systemic comorbidities at the time of cardiac surgery, which can increase the risk of mortality. In our series, patients aged >76 years had a 5.186 times greater risk of mortality compared with those aged ≤76 years.

These findings align with previous literature suggesting that chronological age alone may not fully reflect a patient's physiological reserve or surgical risk. Factors such as frailty, comorbidities, and functional capacity can significantly influence outcomes independent of chronological age (26, 27). This underscores the importance of individualized surgical planning in elderly patients.

Limitations

Our study has several limitations. First, it is a retrospective, single-center study, and the patient population may be criticized for its limited size. We did not evaluate the effect of smoking on patient outcomes. Additionally, our study included various types of cardiac diseases, so for a more meaningful comparison based on specific heart pathologies the sample size may be considered insufficient. Moreover, although classifying postoperative complications by surgical procedure type could yield more detailed insights, the unequal and small sample sizes of each surgical subgroup in our study precluded meaningful statistical comparisons. We agree that such stratification could provide additional insights, the number of patients in each surgical subgroup in our cohort was too small to allow for meaningful statistical comparisons without risking type II errors. Therefore, we presented the results collectively for the entire cohort to maintain statistical validity. We believe that further studies should be conducted to better understand the impact of the factors mentioned above.

Conclusion

In our cohort of patients aged over 70 years undergoing open heart surgery, in-hospital mortality was significantly associated with age >76 years, CPB time >200 minutes, revision for bleeding, and low cardiac output syndrome. Despite increased length of ICU and hospital stay, cardiac surgery can be successfully performed in selected elderly patients.

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Conflict of interest statement

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethics Committee Approval

Ethical approval was obtained from Muğla Sıtkı Koçman University Medical Faculty Institutional Review Board (protocol number 12.12.2024–240220-166).

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