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The Impact of Non–Dialysis-Dependent Renal Dysfunction on Outcome Following Cardiac Surgery

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ABSTRACT

Background: We evaluated the results of different types of cardiovascular surgery in patients with chronic renal failure (CRF) (serum creatinine ≥ 2 mg/dL) who were not dialysis-dependent.

Methods: Eighty-two patients who presented with non–dialysis-dependent CRF were retrospectively evaluated. Patients in Group 1 (n = 12) underwent valvular surgery, those in Group 2 (n = 58) underwent coronary artery bypass grafting (CABG), and those in Group 3 (n = 12) underwent combined CABG and valvular surgery.

Results: The demographics were similar among the groups. Cardiopulmonary bypass and aortic cross-clamping times were shorter ($P < .01$), the use of blood and blood products was less, and the mechanical ventilation time and hospital stay were shorter in Group 2 in comparison to the other groups ($P < .01$). There were 4 (6.9%) early mortalities in Group 2. Late mortalities occurred in 4 (33.3%), 16 (27.6%), and 6 (50%) patients from Groups 1, 2, and 3, respectively. Cox regression analysis revealed that age, the presence of a preoperative cerebrovascular accident, the presence of a left main coronary lesion, preoperative blood urea nitrogen level, and the use of blood and blood products were independent risk factors for early mortality. High Euroscore, cerebrovascular accident, the use of platelet suspension, longer ventilation support times, and combined CABG and valvular surgery were independent risk factors for late mortality.

Conclusions: Morbidity and survival seemed to be more dependent on preoperative patient characteristics than the type of surgery in this group of patients. Combined CABG and valvular surgery was a risk factor for late mortality.

INTRODUCTION

Chronic renal disease is one of the most important public health problems due to an aging population and an increasing incidence of diabetes and hypertension. A majority of patients with renal failure remain asymptomatic, and only less than 1% manifest end-stage renal disease [Anavekar 2004]. Cardiac operations may adversely affect renal function and cause a varying degree of postoperative renal function impairment [Bove 2004]. A series of studies have reported that in the presence of advanced preoperative chronic renal failure, the deleterious influence of cardiopulmonary bypass is further increased [Herzog 2002]; however, there have only been a few reports on patients with renal dysfunction independent of hemodialysis [Hirose 2001; Weerasinghe 2001; Devbhandari 2006], and most of these reports have studied patients who are undergoing coronary artery bypass grafting (CABG). Advanced renal failure is an important predictor of mortality in patients who are undergoing valve replacement [Edwards 2001]. A worse prognosis has also been reported in patients with milder renal dysfunction who are undergoing valve surgery [Anderson 2000; Gibson 2008].

The purpose of this study was to evaluate the results from different types of cardiovascular surgery (CABG, valve, or combined) in patients who have chronic renal failure (CRF) (serum creatinine ≥ 2 mg/dL) and who are not dialysis dependent in order to investigate short- and long-term survival and identify independent risk factors for mortality and morbidity.

PATIENTS AND METHODS

The current study was approved by the Istanbul Bilim University Ethics Committee. Data were retrospectively collected from 13,983 consecutive patients who were undergoing cardiovascular surgery between June 2000 and December 2006 at Istanbul Bilim University, Florence Nightingale Hospital, Istanbul. Of these patients, 126 were diagnosed with CRF (serum creatinine ≥ 2 mg/dL). Forty-four patients were excluded from the study protocol (23 patients were preoperatively dialysis dependent, and 21 were lost to the follow-up). Eighty-two patients who were not receiving hemodialysis or peritoneal dialysis were included in a multivariate analysis of morbidity and survival. These patients were divided into 3 groups: patients in Group 1 (n = 12) underwent valvular surgery, those in Group 2 (n = 58) underwent CABG surgery, and those and Group 3 (n = 12) underwent combined CABG and valvular surgery.

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Table 1. Patient Characteristics*

	Group 1: Valve Surgery	Group 2: CABG Surgery	Group 3: Valve + CABG Surgery	Statistics	*P*
Number of patients	12 (14.6)	58 (70.8)	12 (14.6)		
Age, y	61.3 ± 5.8	65.7 ± 10.2	61.5 ± 9.5	F = 3.671	NS
Male sex	8 (66.7)	42 (72.4)	8 (66.7)	χ^2 = 0.271†	NS
Comorbidities					
Hypertension	12 (100.0)	54 (93.1)	10 (83.3)	χ^2 = 2.135†	NS
Diabetes	4 (33.3)	30 (51.7)	2 (16.7)	χ^2 = 5.599†	NS
Insulin use	4 (33.3)	20 (34.5)	0 (0.0)	χ^2 = 0.006†	NS
COPD	4 (33.3)	12 (20.7)	8 (66.7)	χ^2 = 10.152†	.003i
Hyperlipidemia	2 (16.7)	24 (41.4)	2 (16.7)	χ^2 = 4.274†	NS
Peripheral artery disease	0 (0.0)	8 (13.8)	2 (16.7)	χ^2 = 0.065†	NS
Cerebrovascular accident	0 (0.0)	8 (13.8)	2 (1.67)	χ^2 = 0.065†	NS
Smoking	6 (50.0)	20 (34.5)	4 (33.3)	χ^2 = 1.162†	NS
Angina class III and IV	12 (100.0)	40 (69.0)	10 (83.3)	χ^2 = 7.959†	.018§¶
NYHA class III and IV	12 (100.0)	50 (86.2)	12 (100.0)	χ^2 = 2.406†	NS
Ejection fraction, %					
<30	0 (0.0)	8 (13.8)	0 (0.0)		
30–50	10 (83.3)	34 (58.6)	8 (66.7)	χ^2 = 0.907†	NS
>50	2 (16.7)	16 (27.6)	4 (33.3)		
LMCA stenosis >50%	0 (0.0)	8 (13.8)	0 (0.0)		
Previous coronary angioplasty	0 (0.0)	2 (3.4)	2 (16.7)	χ^2 = 2.452†	NS
Previous myocardial infarction	4 (33.3)	22 (37.9)	6 (50.0)	χ^2 = 0.852†	NS
Hemoglobin, g/dL	11.6 ± 1.6	12.4 ± 1.6	13.0 ± 1.2	F = 2.584	NS
Creatinine, mg/dL	2.5 ± 0.2	2.4 ± 0.6	2.1 ± 0.2	χ^2 = 8.019‡	.018#
Blood urea nitrogen, mg/dL	47.0 ± 6.7	46.3 ± 15.6	48.5 ± 14.0	χ^2 = 0.755‡	NS
Renal pathogenesis					
Diabetic	2 (16.7)	22 (37.9)	2 (16.7)		
Nondiabetic	10 (83.3)	32 (55.2)	10 (83.3)	χ^2 = 4.741†	NS
Others	0 (0.0)	4 (6.9)	0 (0.0)		
Euroscore	5.6 ± 1.8	5.7 ± 2.4	5.9 ± 2.3	χ^2 = 4.486‡	NS

*Data are presented as number of patient (percentage) or mean values ± standard deviation. $P < .05$ was considered significant. CABG indicates coronary artery bypass graft surgery; COPD, chronic obstructive pulmonary disease; NYHA, New York Heart Association; LMCA = left main coronary artery.

†Chi square test of association (3 × 2 or 3 × 3 contingency tables).

‡Kruskal Wallis test.

§Tamhane post hoc test.

iStatistically significant difference between Groups 2 and 3.

¶Statistically significant difference between Groups 1 and 2.

#Statistically significant difference between Groups 1 and 3.

Patient demographics, operative data, postoperative early complications, and remote results were collected. Preoperative risk factors and postoperative complications were defined according to the criteria of the Society of Thoracic Surgeons. The preoperative creatinine level was defined as the highest preoperative serum creatinine level within 7 days preceding the operation. The postoperative creatinine level was taken as the highest value in the first 28 days after the operation.

Cardiopulmonary bypass (CPB) was performed using standard techniques. A membrane oxygenator and roller pump was used in all of the patients. A bovine heparin dose of 400 IU/kg was given before cannulation and followed by additional doses as needed in order to maintain an

Table 2. Operative and Postoperative Data*

	Group 1 (n = 12)	Group 2 (n = 58)	Group 3 (n = 12)	Statistics	*P*
Cardiopulmonary bypass time, min	109.6 ± 24.2	64.4 ± 44.8	105.8 ± 35.5	χ^2 = 16.842†	<.001‡/.004§
Aortic clamping time, min	66.3 ± 19.3	34.6 ± 25.2	64.3 ± 20.6	χ^2 = 20.304†	<.001‡/.004§
Number of distal anastomosesi	—	2.7 ± 1.0	2.0 ± 1.7		.05¶
Use of internal thoracic arteryi	0 (0.0)	46 (79.3)	6 (50.0)	χ^2 = 4.472#	.034
Blood and blood products, units	5.6 ± 4.2	2.2 ± 2.7	8.3 ± 5.5	χ^2 = 20.734†	<.001/.009§
Packed red blood cells	2.8 ± 1.8	1.5 ± 1.4	4.0 ± 2.4	χ^2 = 16.390†	<.001/.014§
Fresh frozen plasma	2.8 ± 2.4	0.6 ± 1.5	3.0 ± 2.5	χ^2 = 18.499†	<.001/.036‡/.03§
Platelet suspension	—	0.07 ± 0.37	1.33 ± 3.11		.063¶
Mechanical ventilation, min	18.6 ± 12.2	10.3 ± 5.3	19.1 ± 13.3	χ^2 = 10.861†	.004/.005‡/.003§
Intensive care unit stay, h	220.3 ± 198.3	61.5 ± 22.0	94.6 ± 63.7	χ^2 = 10.441†	.005/<.001‡/.001**
Hospital stay, d	26.5 ± 11.0	12.9 ± 4.5	22.8 ± 18.1	χ^2 = 20.544†	<.001/<.001‡/.002§
Postoperative creatinine, mg/dL	4.1 ± 1.8	2.7 ± 1.1	2.9 ± 1.3	χ^2 = 10.717†	.005/.002

*Data are presented as number of patients (percentage) or mean values ± standard deviation. *P* < .05 was considered significant.
†Kruskal Wallis test.
‡Statistically significant difference between Groups 1 and 2.
§Statistically significant difference between Groups 2 and 3.
iValues were given for patients undergoing coronary bypass surgery.
¶Mann-Whitney *U* test.
#Chi-square test of association (3 × 2 or 3 × 3 contingency tables).
**Statistically significant difference between Groups 1 and 3.

activated-clotting time in excess of 500 seconds. Patients were cooled to a rectal temperature of 28°C, and topical myocardial cooling was accomplished using a pericardial lavage with a cold saline solution. During CPB, the hematocrit level was maintained between 0.20 and 0.25, pump flow rates between 2.0 and 2.5 L/m^2 per minute, and the mean arterial pressure at approximately 65 mm Hg. Blood cardioplegia was used for myocardial protection. The cardioplegic solution was delivered in either an antegrade fashion via the aortic root or coronary ostium or a retrograde fashion via the coronary sinus. Protamine sulfate was administered as 1 mg/100 IU of the heparin dose after complete separation from CPB.

Operative mortality included deaths that occurred during hospitalization. Complications that developed within 30 days after surgery were defined as "early complications." A pulmonary complication was defined as an episode of primary lung failure that required mechanical ventilation for more than 48 hours, reintubation, or the intermittent application of positive end-expiratory pressure via a mask. A neurologic complication was defined as an episode of stroke due to a focal or general neurological lesion. Patients were followed for 6 to 96 (51.8 ± 21.6) months, and the follow-up was 100% complete.

Statistical Analysis

Data were expressed as mean ± standard deviation. The mean values of continuous variables that exhibited normal distributions and frequencies among the 3 groups were compared using ANOVA and chi-square (χ^2) analyses, respectively. The Kruskal Wallis test and Mann Whitney *U* test were used to detect differences between groups' characteristics when the normality assumption of the data was violated. Cox proportional hazard analysis was used to identify independent factors for death during the follow-up period. Kaplan-Meier survival curves were generated for the 3 operating groups using MedCalc version 11.2 (MedCalc Software, Mariakerke, Belgium). All other calculations were performed using SPSS statistical software, version 13.0 (IBM, Chicago, IL, USA). A *P* value of less than .05 was considered to be significant.

RESULTS

Patient Demographics

Patient demographics and preoperative variables are listed in Table 1. Group 1 consisted of 12 patients who underwent valvular surgery. Operations included aortic valve replacement (AVR) in 2 patients, AVR + mitral plasty (MP) in 2 patients, AVR + supracoronary graft replacement in 2 patients, mitral valve replacement (MVR) + tricuspid plasty in 2 patients, and MVR + tricuspid valve replacement in 4 patients (2 were reoperations). Group 2 consisted of 58 patients who underwent coronary bypass grafting. The mean number of distal anastomoses was 2.76 ± 1.01. Group 3 consisted of 12 patients who underwent combined coronary artery and valvular surgery. Operations included CABG + MP in 8 patients, CABG + MVR in 2 patients, and CABG + AVR in 2 patients. The mean number of distal anastomoses was 2.00 ± 1.71 in this group.

Table 3. Early Postoperative Complications*

	Group 1	Group 2	Group 3	Statistical Significance	*P*
Early mortality	0 (0.0)	4 (6.9)	0 (0.0)	—	
Early complication	10 (83.3)	32 (55.2)	8 (66.7)	χ^2 = 3.388†	NS
Pulmonary complications	6 (50.0)	12 (20.7)	6 (50.0)	χ^2 = 6.969†	.036‡§
Neurological complications	2 (16.7)	0 (0.0)	2 (16.7)		NS
Atrial fibrillation	8 (66.7)	30 (51.7)	6(50.0)	χ^2 = 0.968†	NS
Pneumonia	6 (50.0)	4 (6.9)	2 (16.7)	χ^2 = 14.871†	.001‡
Mediastinitis	2 (16.7)	0 (0.0)	2 (16.7)		NS
Myocardial infarction	2 (16.7)	0 (0.0)	0 (0.0)		
Cardiac tamponade	4 (33.3)	0 (0.0)	0 (0.0)		
Late mortality	4 (33.3)	16 (27.6)	6 (50.0)	χ^2 = 2.205	NS

*Data are presented as number of patients (percentage). $P < .05$ was considered significant.
†Chi square test of association.
‡Statistically significant difference between Groups 1 and 2.
§Statistically significant difference between Groups 2 and 3.

Table 4. Analysis of Independent Predictors for Early Mortality by Cox Regression Analyses*

	β	s.e.	*P*	Hazard Ratio	95% Confidence Interval
Age	0.109	0.053	.038	1.116	1.006–1.237
Cerebrovascular accident	−1.974	1.000	.048	0.139	0.020–0.986
LCMA stenosis (>50%)	−2.225	1.000	.026	0.108	0.015–0.767
Preoperative BUN level	0.104	0.035	.003	1.110	1.035–1.189
Blood and blood products	0.162	0.083	.049	1.176	1.000–1.383

*LCMA indicates left main coronary artery; BUN, blood urea nitrogen.

Table 5. Analysis of Independent Predictors for Late Mortality by Cox Regression Analyses

	β	s.e.	*P*	Hazard Ratio	95% Confidence Interval
Cerebrovascular accident	−1.238	0.472	.009	0.290	0.115–0.732
Euroscore	0.180	0.082	.029	1.197	1.019–1.407
Platelet suspension	0.273	0.099	.006	1.314	1.082–1.595
Ventilation support	0.035	0.017	.038	1.035	1.002–1.070
Group (3 versus others)	−1.505	0.524	.004	0.222	0.080–0.620

There were more male than female patients in all of the groups. Mean patient ages at the time of operation in Groups 1, 2, and 3 were 61.3 ± 5.8 years, 65.7 ± 10.2 years, and 61.5 ± 9.6 years, respectively. Preoperative creatinine levels were observed to be 2.5 ± 0.2, 2.4 ± 0.6, and 2.1 ± 0.2 mg/dL in Groups 1, 2, and 3, respectively. The difference in creatinine level was only significant in Groups 1 and 3 ($P = .018$). Chronic obstructive pulmonary disease was more common in Group 3 ($P = .003$), whereas higher anginal classes (III and IV) were observed in Group 1 ($P = .019$).

Operative Results

Operative and postoperative data are shown in Table 2. Postoperative creatinine levels in Groups 1, 2, and 3 were observed to be 4.1 ± 1.8, 2.7 ± 1.1, and 2.9 ± 1.3 mg/dL, respectively. Group 1 exhibited a higher creatinine level after surgery in comparison to the other groups ($P = .005$). The difference in the use of blood and blood products was significant between Groups 2 and 3 ($P = .009$). Cardiopulmonary bypass and aortic clamping times were significantly longer in Groups 1 and 3 in comparison to Group 2 ($P = .001$, and $P = .004$, respectively). The internal thoracic artery was used in 46 patients (79.3%) in Group 2. The duration of mechanical ventilation, intensive care unit stays, and hospital stays were significantly shorter in Group 2 in comparison to the other groups.

Postoperative Results

Early postoperative complications are summarized in Table 3. Early mortality occurred in 4 patients (6.9%) in Group 2, and there was no early mortality in Groups 1 and 3. The reasons for early mortality included sepsis and multiple organ failure. More pulmonary complications were detected in Groups 1 and 3 ($P = .036$) in comparison to Group 2. Pneumonia was the most common in Group 1 ($P = .001$). Late mortality occurred in 4 patients (33.3%), 16 patients (27.6%), 6 patients (50%) in Groups 1, 2, and 3, respectively ($P = .332$). The causes of late mortality included renal insufficiency in 8 patients, heart failure in 10 patients, cerebrovascular accident in 2 patients, and sepsis in 6 patients.

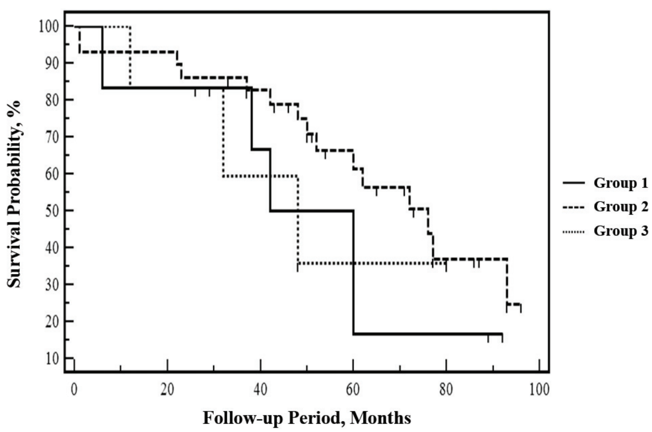

Figure 1. The actuarial cardiac event–free survival rates by Kaplan-Meier analysis.

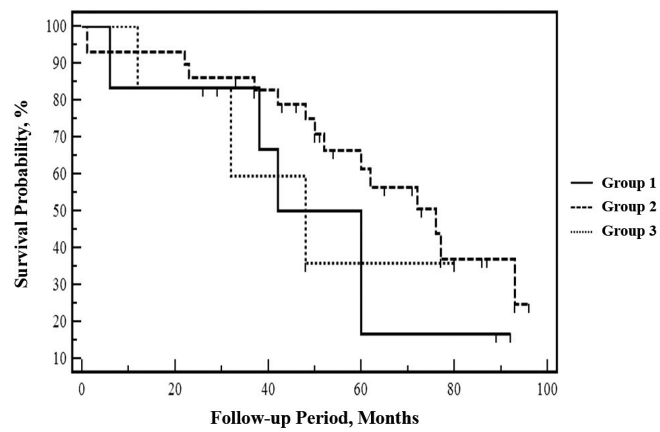

Figure 2. The actuarial survival rates by Kaplan-Meier analysis.

Risk Factor Analysis

Age, the incidence of preoperative cerebrovascular accident (CVA), the presence of left main coronary artery (LMCA) lesions, a higher preoperative blood urea nitrogen, and the use of blood and blood products were identified to be independent risk factors for early mortality (Table 4). Cox regression analysis also revealed that a preoperative CVA, a higher Euroscore, the use of platelet suspension, a longer ventilation support time, and combined CABG and valve operations (Group 3) were independent predictors of late mortality (Table 5).

Late Survivals

The long-term cardiac event-free curve is displayed in Figure 1. The actuarial 1-, 2-, 3-, 4-, and 8-year event-free rates were 83.3%, 83.3%, 83.3%, 50.0%, and 16.7%, respectively, in Group 1; 93.1%, 86.2%, 82.7%, 75.0%, and 24.7%, respectively, in Group 2; and 83.3%, 83.3%, 59.5%, 35.7%, and 35.7%, respectively, in Group 3, which demonstrates a non-significant difference among the 3 groups (P = .085). Ten patients in Group 2 and 4 patients in Group 3 underwent chronic dialysis; none of the patients in Group 1 were dialysis dependent. Four patients received renal transplantation (Group 2).

The survival curve of the groups is depicted in Figure 2. The actuarial 1-, 2-, 3-, 4-, and 8-year survival rates were 83.3%, 83.3%, 83.3%, 66.7%, and 66.7%, respectively, in Group 1; 93.1%, 86.2%, 82.8%, 75.9%, and 64.0%, respectively, in Group 2; and 83.3%, 83.3%, 64.8%, 46.3%, and 46.3%, respectively, in Group 3, which was not significantly different according to Kaplan-Meier analysis (P = .417)

COMMENTS

Renal dysfunction is a recognized marker of increased risk in patients who are undergoing myocardial revascularization [Hillis 2007]. Several studies have assessed the impact of kidney disease on postoperative morbidity and mortality and have assessed long-term outcome in patients who are undergoing CABG; however, relatively few studies have specifically investigated patients who are undergoing heart valve surgery. Edwards et al [2001] examined data from 92,536 patients who were undergoing valve surgery using the Society of Thoracic Surgeons database. The presence of dialysis-dependant renal failure and renal dysfunction (creatinine > 2 mg/dL) were both strong predictors of operative mortality. Gibson et al [2008] prospectively examined 514 consecutive patients who were undergoing heart valve surgery and demonstrated the importance of preoperative renal function in predicting perioperative and mid-term mortality in these patients. Patients undergoing CABG with mildly elevated creatinine are more likely to require postoperative renal replacement therapy [Durmaz 1999]. Postoperative renal dysfunction may be a consequence of global hypoperfusion and, therefore, be a reflection of poor cardiac performance.

In this study, we observed that mortality during isolated operations was not significantly different between the groups, although a combined operation was an independent predictor of late mortality. Horst et al [2000] overviewed the literature and summarized that the calculated relative risks for perioperative death in patients with end-stage renal disease (ESRD) who were undergoing isolated CABG, an isolated cardiac valve procedure, and combined procedures were 0.4, 1.8, and 3.5, respectively. In their study, they observed no differences in mortality between isolated CABG and isolated cardiac valve procedures; however, the authors noted that combined procedures (CABG and valve operations) were associated with a higher relative risk for perioperative death. Furthermore, other studies in the literature that have examined non–dialysis-dependent renal insufficiency [Penta de Peppo 2002; Gibson 2008] have concluded that patients who are undergoing associated procedures had a higher mortality in comparison to those who were undergoing isolated procedures. There was also no reported significant difference between isolated procedures. Similarly, our data agree with those in the literature.

Herzog et al [2002] calculated late survival statistics based on almost 7000 patients in the US Renal Data System database. These registry data showed a 4-year survival of 32% for

CABG operations; however, a comparison of survival rates was difficult because of variations in patient populations, operative procedures, and statistical methodologies. Nakayama et al [2003] reported on 5- and 10-year survival rates of 65% and 32%, respectively, for CABG in patients with creatinine >1.5 mg/dL. Hirose et al [2001] reported the 3-year survival of patients who underwent CABG with creatinine > 2 mg/dL to be 75.3%.

Apart from studies that have dealt with isolated CABG, several studies have investigated patients who underwent CABG, valvular, and other cardiovascular operations. Witczac et al [2005] identified that the 1-, 3-, and 5-year survival rates of predialysis patients were 75%, 60%, and 54%, respectively. Durmaz et al [1999] followed non–dialysis-dependent patients with various degrees of renal function and reported a 3-year survival rate of 96% in patients with creatinine levels between 1.6 and 2.5 mg/dL and 57% in patients with creatinine levels > 2.5 mg/dL. In our study, we defined patients with a serum creatinine level of greater than 2 mg/dL as non–dialysis-dependent CRF. The actuarial 1-, 2-, 3-, 4-, and 8-year survival rates were 83.3%, 83.3%, 83.3%, 66.7%, and 66.7%, respectively, in isolated valvular; 93.1%, 86.2%, 82.8%, 75.9%, and 64.0%, respectively, in isolated CABG; and 83.3%, 83.3%, 64.8%, 46.3%, and 46.3%, respectively, in combined operations, and there were no significant differences between groups in terms of survival. Our results agree with those in the literature and demonstrate that the presence of renal dysfunction, rather than the etiology of cardiac pathology, was the cause of poor outcomes following surgery. Although there was no difference in postoperative mortality between the groups, our data demonstrate that a history of combined operations was an independent predictor of late mortality. In order to explain this outcome, we excluded patients with early mortality and performed Kaplan-Meier analyses for patients who died within 30 days of surgery. This analysis exhibited a significant difference in survival curves between patients who were undergoing coronary bypass versus combined surgeries. This result might be associated with a simultaneous presentation of cardiac ischemia and myopathy before surgery that worsens the surgical outcome or exacerbates one of these morbidities, resulting in a deterioration of myocardial function over time.

Patients with a valvular pathology exhibited a greater number of pulmonary and infectious complications. Pulmonary complications were more frequently detected in Groups 1 and 3, and pneumonia was most frequently diagnosed in Group 1. An impairment of fluid handling by the kidneys may contribute to hypoxia from pulmonary edema, necessitating prolonged postoperative ventilatory support [Schrier 2006]; this is associated with a longer hospital stay and an increased risk of infection. Similarly, chronic renal disease was observed to be a risk factor for left ventricular hypertrophy, dilatation, and dysfunction. Similar mechanisms may be important in patients with valvular heart disease.

Our study demonstrates that previous cerebrovascular accidents were independent predictors of both early and late mortality, which is comparable to findings in the literature [Hasoda 2001; Nakayama 2003; Devbhandari 2006]. Age and the presence of LMCA lesions were also independent predictors of early mortality, which are, again, similar to findings in the literature [Anderson 2000; Edwards 2001; Devbhandari 2006; Hillis 2007; Gibson 2008]. Several studies have shown that diabetes mellitus (DM) independently affects operative mortality and morbidity [Penta de Peppo 2002; Nakayama 2003] or late survival [Hasoda 2001]. In our study, DM was not a predictor of early and late mortality. Furthermore, we did not find any significant differences between diabetic nephropathy and non-diabetic nephropathy.

Chronic anemia and platelet function disturbances may increase the need for the transfusion of blood products during the perioperative period in CRF patients. Witczak et al [2005] compared CRF patients to an age-matched control group and found that the transfusions of both red cells and plasma were twice as high as controls and that the need for platelets was almost 5 times as high. In our study, the amount of blood and blood products that were used were higher in valvular and combined procedure patients than in CABG patients, which may be due to longer aortic cross-clamping and CPB times in these patients. The excessive use of blood and blood products may also explain the higher frequency of pulmonary complications in these patients. The excessive use of blood and blood products was an independent risk factor for early mortality, which is consistent with findings in the literature [Penta de Peppo 2002; Gibson 2008]. Surprisingly, our study demonstrates that the use of a platelet suspension was an independent risk factor for late mortality. This could be explained by advanced renal failure–induced platelet dysfunction, which necessitated perioperative platelet transfusion and potentially led to an increased rate of late mortality.

The management of renal failure patients requires the careful management of fluid retention, hypertension, electrolyte imbalance, metabolic acidosis, anemia, bleeding disorders, and glucose intolerance. In the postoperative ward, regular estimations of acid–base balance, electrolytes, hemodynamic parameters, and daily weight are essential. Potassium levels should be closely monitored in order to avoid any dangers of high- or low-potassium–related arrhythmia. Preoperative and intraoperative hemodialyses have been recommended to decrease postoperative risks in CABG [Devbhandari 2006]. In our clinical routine, dialysis was instituted in patients with inadequate urine output (<400 mL for 24 hours) despite corrections to their hemodynamic statuses and the implementation of diuretic therapies, especially if fluid overload, hyperkalemia, or metabolic acidosis were also present. We preferred peritoneal dialysis as an initial intervention over hemodialysis, unless any contraindication was noted. The use of peritoneal dialysis has some advantages over hemodialysis in the early postoperative period, where it can be initiated with minimal equipment and does not require specialized personnel. Peritoneal dialysis also avoids the potential complications of abrupt hemodynamic changes or the risk of heparin-associated bleeding that may occur when using hemodialysis. Peritoneal dialysis facilitates a prolonged delay in the reinstitution of hemodialysis. We believe that a multidisciplinary approach to non–dialysis-dependent CRF between the surgeon, anesthesiologist, intensivist, and nephrologist is required to improve the postoperative outcomes of patients.

In conclusion, preoperative renal failure was observed to increase the mortality and morbidity of patients who are undergoing open heart surgery. Patients with CRF and other comorbidities, such as an increased age, a preoperative CVA, LMCA lesions, and a higher Euroscore, should be carefully evaluated. The type of surgery was observed to have no effect on morbidity and survival in non-dialysis CRF patients; however, combined operations were associated with an increased risk of late mortality.

Study Limitations

The sample sizes in Groups 1 and 3 were small. Although the mean long-term survival was reduced in Group 3 patients in comparison to the other groups, the findings were difficult to interpret due to the relatively small sample sizes of Groups 1 and 3 and the number of deaths in these groups. An analysis of the long-term cardiac event-free curve and the small sample sizes in Groups 1 and 3 make the detection of possible dependencies between censoring and survival difficult. Furthermore, they also obscure the presence of implicit factors. A subgroup analysis of patients who were undergoing an additional valve surgery was limited by the small sample sizes. Serum creatinine was selected to be a marker of renal dysfunction because of the simplicity of its measurement. Ideally, creatinine clearance or estimated glomerular filtration rate should be measured to assess renal function because serum creatinine levels are influenced by body surface area and body water mass. Finally, no data were obtained regarding pre- and postoperative medication, which may have influenced preoperative renal function, operative risk, and long-term outcome.

Despite these limitations, our study was performed in a single institution with a single surgical group, and all of the patients were followed up at our outpatient clinic.

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