



# Open Heart Surgery in Dialysis-Dependent Chronic Kidney Failure Patients: Clinical Experience

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ORIGINAL  
INVESTIGATION

## ABSTRACT

**Objective:** We aimed to present patients with dialysis-dependent chronic kidney failure who underwent open heart surgery.

**Materials and Methods:** Sixteen patients with dialysis-dependent end-stage chronic kidney failure (7 males, 9 females; mean age  $62\pm 11$ ; range 30-75) were involved in the study. Coronary artery bypass surgery was performed for 12 patients, 2 patients underwent both coronary artery bypass surgery and aortic valve replacement, 1 underwent both ascending aorta and aortic valve replacement, and right atrial myxoma resection was performed for 1 patient. The preoperative, intraoperative, and postoperative data were analyzed retrospectively.

**Results:** Fourteen patients underwent coronary artery bypass surgery, and the mean distal bypass was found to be  $3.07\pm 0.9$ . The mean cross-clamp time was  $50\pm 27$  minutes, and the total cardiovascular bypass duration was  $87\pm 40$  minutes. None of the patients needed revision. The mean drainage volume was  $500\pm 150$  milliliters. Atrial fibrillation occurred in 4 patients (25%), and all of them converted to sinus rhythm through medical treatment. One patient died on the second postoperative day because of fatal arrhythmia that occurred after dialysis, and 1 patient died because of low cardiac output during the intensive care follow-up. The mortality rate was 12.5%. The mean intensive care unit hospitalization time was  $52\pm 4$  hours, and the total hospitalization time was  $7\pm 2$  days.

**Conclusion:** Open heart surgery can be performed with acceptable mortality and morbidity rates for patients having dialysis-dependent chronic kidney failure.

Key words: Chronic kidney failure, coronary artery bypass, hemodialysis

## INTRODUCTION

Today, with the increasing number of open heart surgeries, these surgeries have been begun to be performed for patients in the high-risk group, such as chronic kidney failure. Coronary artery disease (CAD) is the most common cause of mortality in patients with chronic kidney failure (CKF) (1, 2). Cardiovascular diseases are more frequent in hemodialysis patients compared to the normal population, because general risk factors for atherosclerosis, such as hypertension and diabetes, are more common in this patient group. Chronic kidney failure can also lead to valvular calcification, asymmetric septal hypertrophy, and conduction disorder, and dialysis procedures increase the frequency of infective endocarditis (3). In our country, the life expectancy of CKF patients has extended due to the increased number of hemodialysis centers and improvements in technology, and as a result of this, more advanced-aged patients and diabetic patients are included in hemodialysis programs. Surgery in patients with chronic kidney failure, especially cardiopulmonary bypass (CPB), poses some problems, requiring special care. Patients with CKF constitute a high-risk group for heart surgery because of either renal failure or substantial changes in the balance of fluid and electrolytes caused by CPB (4). The mortality rate of open heart surgery in patients with CKF is higher than for those with normal kidney function. Restricted tolerance to CPB in uremic patients, bleeding associated with coagulation defects, insufficient excretion of toxic substances, and sensitivity to infections play an important role in this outcome (5). In this study, we aimed to present the clinical experiences of open heart surgery in patients with dialysis-dependent chronic kidney failure.

## MATERIALS and METHODS

Sixteen patients with dialysis-dependent end-stage chronic kidney failure who underwent heart surgery under cardiopulmonary bypass in two different cardiovascular surgery clinics between July 2006 and January 2012 were involved in the study. Approval of the Ethics Committee of Clinical Investigations of Kahramanmaraş Sütçü İmam University (No: 2011/11-10) and written informed consent forms from all patients were obtained. Of the patients, 7 were male and 9 were female. The mean age was  $62\pm 11$  (range 30-75). Isolated coronary artery bypass surgery was performed for 12 patients, 2 patients underwent coronary artery bypass surgery together with aor-

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tic valve replacement, 1 patient underwent both ascending aorta and aortic valve replacement, and right atrial myxoma resection was performed for 1 patient. The preoperative, intraoperative and postoperative findings of these cases were analyzed retrospectively. One patient had right atrial myxoma, 1 had an ascending aortic aneurysm and aortic insufficiency, and 14 patients had coronary artery disease. Myocardial infarction developed preoperatively in 4 patients (25%). Ten patients had diabetes mellitus (62.5%), 15 patients had hypertension (93.8%), and 2 had chronic obstructive lung pulmonary disease (12.5%). Both hypertension and diabetes mellitus were present in 9 patients (56%). The mean left ventricular ejection fraction was  $52\pm 11$ . Preoperative features of the patients are shown in Table 1. One patient underwent right atrial myxoma resection, and 1 patient underwent ascending aorta replacement together with aortic valve replacement. Hemodialysis was performed for all patients 1 day before the operation. A hemoconcentration filter was added to the cardiopulmonary bypass system, and hemofiltration was applied during CPB in all patients. Hemodialysis was repeated on the second, fourth, and sixth postoperative days. A mixture of fresh blood and plasma with isotonic NaCl and hematocrit rate over 25% was used as the prime solution. Mild hypothermia was applied. Fluid or vasopressor agent was used by keeping the flow rate at 2.5 lt/min/m<sup>2</sup> and arterial pressure above 50 mm Hg. Myocardial protection was provided with intermittent antegrade and retrograde isothermic blood cardioplegia that included potassium in all patients.

#### Statistical analysis

All of the data obtained from the study were analyzed using SPSS statistical software for Windows (version 15.00, SPSS Inc., Chicago, IL, USA). Quantitative variables were presented as mean±standard deviation (SS), and qualitative variables were presented as frequency distribution and percentage.

## RESULTS

The left internal mammary artery (LIMA) was used for the left anterior descending coronary artery (LAD). The saphenous vein was preferred as the graft for other coronary arteries. Coronary artery bypass surgery was done for 14 patients, and the mean distal bypass number was  $3.07\pm 0.9$ . Ascending aorta replacement was performed with a 30-mm Dacron graft, and valve replacement was performed with a mechanical valve. During the operations,

**Table 1.** Preoperative features of the cases

	n=16	%
Age	62±11	(30-75)
Gender M/F	7/9	43.7/56.3
Diabetes	10	62.5
Hypertension	15	93.8
COPD	12	12.5
Myocardial Infarction	4	25
EF	50±8	(40-60)

COPD: Chronic obstructive pulmonary disease; EF: left ventricular ejection fraction

the mean cross-clamp time was  $50\pm 27$  minutes, and the total perfusion time was  $87\pm 40$  minutes. Cardiac inotropic support was needed after CPB in 6 patients. No revision was required due to bleeding or any other reason, and the mean drainage volume was  $550\pm 150$  mL. Before the operation, the mean BUN value of the patients was 76.2 mg, creatinine value was 4.6 mg/dL, and potassium value was 4.8 mEq/lt. After the operation, these values were 93.8 mg, 6.1 mg/dL, and 5.2 mEq/lt, respectively. Atrial fibrillation was observed in 4 patients (25%). All of these patients had a positive response to the treatment and converted to sinus rhythm. One patient died on the second postoperative day because of arrhythmia that occurred after dialysis, and 2 patients died because of low cardiac output and development of associated multi-organ failure on the fourth postoperative day. The mortality rate was found to be 12.5%. The mean intensive care unit hospitalization stay was  $52\pm 4$  hours, and total hospitalization time was  $7\pm 2$  days. The operative and postoperative findings related to the patients are shown in Table 2. In 1 patient, a wound site infection developed during the late postoperative period and healed completely with appropriate wound care. All of the patients who were discharged from the hospital continued to undergo dialysis, as they were cardiacally asymptomatic.

## DISCUSSION

Recently, among dialysis-dependent chronic kidney failure patients, the number of patients exposed to open heart surgery has been increasing (6). According to many research results, cardiovascular events are the most crucial cause of mortality for hemodialysis patients (7). The need for revascularization is increasing for

**Table 2.** Operative and postoperative findings of the cases

	n=16	%
Operation		
cabg	12	75.0
cabg+avr	2	12.5
avr+aar	1	6.25
myxoma	1	6.25
Distal bypass number	3.07±0.9	
CPB time (min)	87±40	
Cross-clamp time (min)	50±27	
Postoperative AF	4	25
Preoperative/ Postoperative	76.2/93.8 mg/dL	
BUN	75.0	
Creatinine	4.6/6.1 mEq/lt	
Potassium	4.2/5.2 mg/dL	
Drainage Volume	550±150 mL	
Hospitalization time (day)	7±2	
Mortality	2	12.5

cabg: Coronary artery bypass graft; avr: Aortic valve replacement; aar: ascending aorta replacement; CPB: cardiopulmonary bypass; AF: atrial fibrillation

patients with dialysis-dependent ischemic heart disease. For these patients, percutaneous transluminal coronary angioplasty (PTCA) procedures are used less often because of the high complication rate and poor long-term outcomes (8). Of all patients who undergo cardiac surgery in various health centers, 0.3%-0.9% consists of dialysis-dependent CKF patients (9, 10). In our clinic, 3 of the last 300 patients who underwent open heart surgery were dialysis-dependent CKF patients. In a comprehensive literature review, including 863 dialysis-dependent CKF patients requiring open heart surgery, the mortality rate was reported as 8.9% in isolated coronary artery bypass surgery, 19.3% in isolated valve replacement, and 39.5% in combined valve replacement and coronary bypass surgeries (11). The mortality rate in our clinic was found to be 18.8%. For our patients, the most important factor affecting mortality was advanced age. The patients who died were at the age of 70 years and above. Kamohara et al. (12) suggested that patients with chronic kidney failure constituted a risk group of patients for heart surgery associated with either kidney failure or fluid-electrolyte imbalance and reported a mortality rate of between 3% and 25%-9% on average. For these patients, low tolerance to CPB, bleeding due to coagulation defects, and susceptibility to infections associated with a suppressed immune system play an important role in this outcome. In the literature, cardiac events, sepsis, and multi-organ failure have been mentioned as the most common causes of mortality (13, 14). The rates of mortality and morbidity are decreasing in these patients, in accordance with the improvements in operation and postoperative care and with the experience acquired. On the other hand, the elevated mean age and the length of dialysis dependence in patients who are operated on are factors that increase the mortality rate. Labrousse et al. (13) stated in their study that hospital mortality rate decreased gradually over the years. Ariyoshi et al. (14) reported an early perioperative mortality rate of 5.7% and also suggested that performing coronary bypass surgeries on a beating heart was the most rational method for chronic dialysis patients. In a study conducted by Horst et al. (15), the mortality rate within the first 30 days was found to be 14%, and the causes of mortality were stated as perioperative myocardial infarction, hypotension during hemodialysis, low output-induced cardiac arrest, cardiac tamponade, and multi-organ failure. During cardiopulmonary bypass surgery in patients with CKF, it is recommended that mild hypothermia be applied, hematocrit value be kept above a rate of 25%, and mean perfusion pressure be kept at 50 mm Hg and above. In our clinic, we tried to perform mild hypothermia and keep the hematocrit value around a rate of 25%. Today, antegrade and retrograde blood cardioplegia are used as cardioplegia techniques in many centers during CPB. In our clinic, intermittent antegrade and retrograde isothermic blood cardioplegia are used routinely with standard CPB techniques. In dialysis-dependent CKF patients, early graft thrombosis can develop due to impaired baroreceptor mechanisms and early postoperative hypotension. Therefore, the postoperative filling pressures and hemodynamics of the patient should be followed up closely. In CKF patients with valvular heart disease, considering the increased possibility of calcification of bioprostheses secondary to a disturbance of calcium metabolism, mechanical valves are preferred most of the time (9). There is no consensus on the preoperative preparation of dialysis-dependent CKF patients who will undergo open heart

surgery. In many studies conducted recently, postoperative hemodialysis is suggested to be performed within the first 24-48 hours for dialysis-dependent patients (10). In the postoperative period, if the patient does not have severe fluid-electrolyte imbalance, hemodialysis should be performed on the second day. Delayed hemodialysis in these patients will cause the patient to be exposed to fluid overload, complications that are associated with high potassium levels, and negative effects of toxic metabolites. It is important to perform dialysis 1 day before the operation for CKF patients for whom open heart surgery has been planned and to provide the most optimal levels of fluid and electrolytes in the early perioperative period. Moreover, the most hemodynamically unstable period after open heart surgery is the first 24 hours in the intensive care unit. Administration of hemofiltration with a pump and avoiding unnecessary fluid load during postoperative follow-up will provide the advantage of extending the time for the need of postoperative dialysis (16). In the study by Turgut et al. (17), it was revealed that hemofiltration used during the operation influenced postoperative morbidity and mortality rates in a positive way. It has been recently accepted that open heart surgery can be performed with acceptable morbidity and mortality rates in patients with hemodialysis-dependent chronic kidney failure. In most of the centers, cardiac surgery is performed for patients with CKF, and successful outcomes are reached.

#### Study limitations

The study design and data, based on a retrospective archive review, and the low number of patients are important limitations of the study.

## CONCLUSION

In CKF patients who undergo cardiac surgery under cardiopulmonary bypass, hemodynamic stability can be ensured by especially examining the balance of fluid and electrolytes and filling pressures closely. For these patients, better results can be obtained when cardiology, nephrology, and cardiovascular surgery teams work in cooperation and in coordination, and recovery of symptoms and extension of life expectancy can be provided through successful cardiac surgery.

**Ethics Committee Approval:** Ethics committee approval was received for this study from the ethics committee of Kahramanmaraş Sütçü İmam University School of Medicine.

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

**Peer-review:** Externally peer-reviewed.

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