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Midterm Results of Coronary Artery Bypass Grafting in Patients With Endstage Renal Disease and on Maintenance Hemodialysis

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ABSTRACT

Background: Cardiovascular disease is the most common cause of death in patients with end-stage renal disease (ESRD). This underlying ischemic heart disease must be addressed to allow uncomplicated symptom free dialysis or before Renal transplant to assure successful results without myocardial infarction. **Objective:** To study the outcome of coronary artery bypass grafting in terms of morbidity and mortality in patients with end-stage renal disease. **Methods:** This prospective study has been conducted at the Department of Cardiothoracic Surgery, Federal Postgraduate Medical Institute, Shaikh Zayed Hospital, Lahore between March 2005 to April, 2009. Sixty four patients undergoing coronary artery bypass surgery with end stage renal disease were included. We admitted our patients five days before surgery and carefully managed preoperatively with the renal replacement therapy to optimize the patients for surgery. Peroperatively we used hemofiltration to reduce the preload. Postoperatively we restricted fluid management only to urine out put, blood loss and insensible losses. Intravenous fluids are carefully given according to metabolic needs of the patient (500-700 ml/24 hours + volume to urine output if any). Haemodialysis on 2nd postoperative day in intensive care unit and on 4th post-operative day in main dialysis department to keep serum creatinine ≤4 mg/dl and serum potassium around 4 mmol/dl and central venous pressure ≤10 cm. **Results:** There were 55 males and 9 females with mean age of 54.7±10.8 years. Fifty five patients were diabetics and hypertension was present in 62 patients. Mean preoperative ejection fraction was 39.4±6.4%. Triple vessel disease was present in 40 patients and 8 patients had severe left main stem coronary artery disease. The average number of grafts were 3.8 and bypass time was 142.3±17.8 minutes, Extubation time was 15-18 hours and length of stay in intensive care unit (ICU) was 4.03±0.7 days. Similarly length of hospital stay was 10.47±0.87 days. Overall mortality was 12.7% in these patients. **Conclusion:** Midterm outcome of coronary artery bypass grafting in dialysis patients is although associated with a higher incidence of complications but can be performed with an acceptable operative mortality and gives good symptomatic relief of angina. It is excellent bridge for renal transplant surgery.

Key words: Ischemic heart disease, Coronary artery bypassing grafting, End-stage renal disease, Haemodialysis, Relief of angina, Renal transplant.

INTRODUCTION

Over the last three decades.[1,2] acute myocardial infarction continues to be a major public health problem in the industrialized world even with a significant improvement in diagnosis and management have been made. The rate of acute myocardial infarction is nearly 1.5 million patients annually in the United States. Although the death rate from acute myocardial infarction has declined by about 30 percent over the last decade, it is still a fatal event in approximately one third of patients.[3] Ischemic heart disease is a main cause of death worldwide, and inspite of taking measures for its

primary and secondary prevention the number of patients with ischemic heart disease are increasing. Patients with end stage renal disease on maintenance renal replacement therapy are another leading cause of mortality and morbidity worldwide, and these patients' have significant correlation with ischemic heart disease. It is widely accepted that cardiovascular disease is common cause of death in patients suffering form end stage renal disease.[4]

Advancements in dialysis treatments have resulted in a progressive increase in the prevalence of people living with ESRD. Japanese Society for Dialysis Therapy[5] recently reported that the number of patients with ESRD increases by approximately 10,000 cases every year. The 5-year survival rate for patients with ESRD has increased to 59.3% while the mean age of ESRD patients has increased to 62 years. Patients with ESRD represent more frequently with debilitating coronary artery disease but these are regarded challenging patients for coronary artery bypass grafting.[6] Some studies show that CABG is the most successful strategy of revascularization for dialysis patients.[7,8] On the other hand, several other studies show that there CABG is associated with greater complications and a higher mortality of CABG in dialysis patients, though the latter studies agree of CABG in these patients.[9,10]

In chronic renal failure uremia is very complex syndrome that affects all structures of heart, the pericardium, the myocardium, the endocardium and the coronary arteries. The important manifestations of these pathological effects of uremia on heart occur in the form of complex symptoms which is called "uremic heart disease". In these patients coronary artery disease is very severe, diffuse, some time even circular calcification of the arteries, increased media thickness and more marked calcification.[11]

In dialysis dependent patients coronary artery bypass grafting is becoming standard of care where medical treatment is not suitable. This is becoming increasingly important as more patients undergo dialysis and dialysis population become older. In patients aged more than 65 years, cardiac disease accounts for a death rate of 131.1 per 1000 per year.[12]

After the first done in patient with end-stage renal disease in 1974 by Menzoin and associates13, since than many case reports and retrospective study in small group of patients have been published regarding the benefit and feasibility of coronary artery bypass grafting in this population. Some groups have shown improved survival and quality of life[14,15].

MATERIALS AND METHODS

As a routine practice all patients with chronic renal failure (CRF), go through preplanned workup regarding end stage renal disease to optimize patient's conditions for surgery. This planning is devised with the involvement of department of Nephrology, Anesthesiology, and Cardiology. All patients go through the protocol of Hospital admission 5 days before surgery and Haemodialysis on 4^{th}, 2^{nd}, 1^{st} day preoperatively (as per need of the patent). Our aim of these set protocols is to improve the Hb $\geq$10 g/dl, serum creatinine $\leq$4 mg/dl, serum potassium around 3.5 mmol/dl and CXR with no pulmonary odema and signs of volume overload. Peroperatively rapid sequence induction is the preferred mode of intubation for anesthesia in these patients. Succsamethonium and other fluoride producing drugs are avoided because of their dependence of renal excretion.

We planned to restrict fluid management only to urine out put, blood loss and insensible loss. Coronary bypass surgery is carried out by using cardiopulmonary bypass or off pump techniques. Where-ever cardiopulmonary bypass is opted we use moderate hypothermia (28°C) using cold blood cardioplegia for myocardial protection. In cardiopulmonary bypass we used ultrafiltration to eliminate extra fluids used for priming solutions aiming to keep central venous pressure around 7 cm of water. Heparin injection was used for anticoagulation purposes adjusting activated clotting time around 350-500s. Where ever we use off pump coronary artery bypass grafting, we give half dose of calculated anticoagulation (inject able Heparin) to keep Activated clotting time around 200 to 350.

In early postoperative period we also devised specific protocols for this group of patients. We gave Intravenous fluids carefully according to metabolic needs of the patient (500-700 ml/24 hours

+ volume to urine output if any). Blood loss in surgical drains is replaced by whole blood and FFPs. Hemodialysis was planned on 2nd postoperative day in intensive care unit and on 4th post-operative day in main dialysis department to keep serum creatinine ≤4 mg/dl and serum potassium around 4 mmol/dl and central venous pressure ≤10 cmm. Single dose of inject able vancomycin 1 gm once a week and injectable Amikaecin 500 mg is given after each haemodialysis postoperatively, and all other antibiotics are given according to patient's renal clearance with consultation of the Nephrologists. Regular follow-up is done on OPD basis and this group of patients is advised for regular visits of Nephrology with complete laboratory investigations and to carry out their routine haemodialysis.

RESULTS

Sixty four patients of end stage renal disease under went coronary artery bypass grafting. There were 55 (85.9%) males and 9 (14.1%) females with mean age of 54.7±10.8 years. Fifty five patients (85.9%) were diabetic and hypertension was present in 62 patients (96.8%). Mean preoperative Ejection fraction was 39.4±6.4%. Forty eight patients (75%) were smokers. Tripe vessels disease was present in 40 patients (62.5%) and 8 patients (12.5%) were diagnosed having severe left main stem coronary artery disease (Table 1).

Table 1: Preoperative patient characteristics

Variable	Value
Age (Years)	54.7±10.8
Male	55 (85.9%)
Female	9 (14.1%)
Diabetes mellitus	55 (85.9%)
Hypertension	62 (96.8%)
Smoking	48 (75%)
Ejection fraction (%)	39.4±6.4
Triple vessel disease	40 (62.5%)
Left main stem	8 (12.5%)

Peroperatively the average number of grafts were 3.8 with bypass time of 142.3±17.8min in patients done on pump. Inotrops were used in 27 patients (42.2%) and intra-aortic balloon was used only in 2 patients (3.1%). Ultrafiltration was carried out in almost all patients [100%] (Table 2).

Table 2: Preoperative patient characteristics

Variable	Value
Number of grafts	3.8
Inotropic use	27 (42.2%)
Intra-aortic balloon pump	2 (3.1%)
Ultrafiltration	64 (100%)

Extubation time was noted 15-18 hours and length of stay in ICU was 4.03±0.7 days, similarly length of hospital stay was 10.47±0.87 days. After one year follow up only 11.0% patients were found milld to moderate symptomatic during dialysis**.** Six patients (9.4%) went for renal transplant surgery after CABG. Overall mortality was 12.5% (8 patients) with ESRD undergoing CABG (Table 3).

Table 3: Postoperative and follow-up data

Variable	Value
Extubation time (hours)	15-18
Length of ICU stays (days)	4.03±0.7
Length of hospital stays (days)	10.47±0.87
Symptomatic during dialysis (after 1 year)	11.0%
Renal transplant after CABG	6 (9.4%)
Mortality	8 (12.5%)

DISCUSSION

Risk factor modification remains the fundamental approach of management of both end chronic kidney disease (CKD) and coronary artery disease (CAD). Many of the traditional risk factors for CAD - hypertension, diabetes mellitus, smoking, and so on - are common to CKD. However, decreased renal functions limits the clinician's flexibility to manage both diseases simultaneously. Cardiovascular diseases are the main causes of death in end-stage renal disease patients.[16] Uremia-associated factors such as hypertension, lipid abnormalities, anemia, fluid overload, platelet dysfunction or parathyroid dysfunction with

hypocalcaemia are known to adversely affect coronary artery circulation.[17] Consequently, more than 30% of the cardiac deaths are directly attributed to myocardial infarction.[15] This high incidence of coronary artery disease in this population combined with the increased number of older patients under renal replacement therapy causes the need for an increase use of myocardial revascularization.[16,18] Since the introduction of PTCA, early and late results suggest a high rate of acute complications and poor long term results in this group of patietns[15,19], especially in terms of restensois. So, from a recent review[20] and previously published studies,[14,21] coronary bypass grafting appears to be the preferred mode of treatment in this population. The overall mortality rate of ESRD patients undergoing CABG is 4-20%. The rate is increased 5-fold if surgery is emergent. Major causes of peri-operative death include sepsis, cardiac dysfunction and dysarrhythmias. Morbidity of ESRD patients is very high (upto 50%) presumably due to the volume shifts, acid base control hyper- and hypokalemia, and drug toxicity. ESRD patients tend to have longer time on pressors and mechanical ventilation, more ICU days, and longer hospital length of stay. Our study showed relatively prolonged ventilation time 15-18 hours in these patients and longer ICU stay of 4.0±0.7 days. Similarly in our study, the length of hospital stay was longer in these patients 10.47±0.87 days. Common causes of morbidity include hyperkalemia, bleeding (platelet dysfunction), infection (decreased neutrophil chemotaxis and nutrition), dysrrhythmia, anemia, hemodynamic instability, hypertension, drug toxicity, and dialysis access thrombosis. Uremia affects platelet function, fibroblast response to injury and the immune system but the uremic toxins are controversial.

About half of our dialysis patients received long sephanous vein grafts and IMA was not used because of risk IMA spasm due to expected high inotropic support in early post-operative period causing early graft closure. Performing both the coronary artery revascularization and heterogeneous renal transplant in one sitting has been described as a viable option in patients with ESRD.[22] We did not opt for the combined procedure because of the possibility of dysfunction of the transplanted kidney during phases of hypotension occurring during CABG. Delay in wound healing is known to occur in presence of immunosuppressant medications, which have to be instituted soon after carrying out the renal transplantation.

Some authors recommend dialysis more than 24 hours before the cardiopulmonary bypass (CPB) procedure,[23] but we believe it is best to use dialysis as close to the procedure as possible. We admitted our patients 5 days before surgery and hemodialysis was carried out on fourth, second and in first day preoperatively (as per need of the patient). Whereas some surgeons advocate the use of intraoperative haemodialysis[24], we chose intraoperative hemofiltration for the simplicity in achieving control of water and electrolyte (mainly K^+) balance until maintenance hemodialysis could be resumed on the first postoperative day, which was possible in all patients without untoward hemodynamic sequelae. But for logistic and safety reasons patients were usually kept in the intensive care unit slightly longer than the ordinary patients and likewise were transferred back to the referring dialysis service at a later period. In our experience, except for patients with severely depressed cardiac function, with careful observation haemodialysis could be done safety in most patients[25,26].

In our study the average extracorporeal circulation time and cross-clamping time was high in ESRD patients. The average extracorporeal circulation time 142.3±17.8 minutes and cross clamp time was 63.4±13.2 minutes. This had to be referred to technical difficulties in these patients. According to some studies[27,28], coronary arteries were much more calcified than in normal patients. However, we were always able to graft mainly diseased vessels with no use of coronary endarterectomy, and achieved complete revascularization in almost all patients with significant longer arteriatomies.

Complications after coronary artery bypass surgery are seen more often in end-stage renal failure patients than in other patients. Postoperatively, the more frequent need of inotropic medications also indicates a higher risk of major cardiac events in these patients. In various studies, advanced age has been the most important predictive factor in survival of these patients, but

cerebrovascular disease, an ejection fraction of less than 0.35, and the need for hemodialysis are other strong predictive factors[29]. Due to the presence of calcified coronary artery lesions, sometimes surgeons have had to perform incomplete revascularization in dialysis-dependent patients[19]. Many of the complications associated with CABG in dialysis patients may be related to the use of CPB. Disorders such as platelet dysfunction and susceptibility to infection increase the operative morbidity and mortality. The cerebrovascular accident rate was 3.1% in these patients. The cerebrovascular accident is a frequent cause of death in dialysis patients falling behind the cardiovascular disease and sepsis as a cause of death in dialysis patients[30].

Overall mortality among dialysis patients was 12.5%, and our this experience fits within the widely variable range of previous reports stated by Rostand et al[31] and Blum and coworkers.[14] As expected, we found a lower 1 year survival rate in ESRD patients during the whole follow-up period. Coronary artery bypass grafting and entire preoperative management in ESRD patients is demanding. Mid term results however can be achieved when specific requirements of these patients are accounted and managed successfully. These patients can get symptom free hemodialysis and go for renal transplant successfully in their later life.

CONCLUSION

Coronary artery bypass grafting can be performed on dialysis dependent patients with acceptable morbidity and mortality who have angina not relieved with medical therapy. Relief of angina is excellent, and CABG could offer easiest and most suitable solution for patients in whom angina precludes dialysis, but surgeons should informed the patient that the risk of complications and perioperative mortality is higher than that for the non-dialysis dependent patients. The patients who later want kidney transplant benefit greatly from CABG, but the conditions and performance status must be met to qualify for kidney transplantation.

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