Original Article

Bypass Grafting in Renal Failure

Outcome of Off Pump and On Pump Coronary Artery Bypass Grafting in Patients with End Stage Renal Disease

Aqeel Ahmad, Zahid Parvez and Oneeb Sanaullah

ABSTRACT

Objective: To study the outcome of, off pump and on pump coronary artery bypass grafting in terms of morbidity and mortality in patients with end stage renal disease (ESRD).

Study Design: Randomized controlled trial study.

Place and Duration of Study: This study was conducted at the Department of Cardiothoracic Surgery, Shaikh Zayed Hospital, Lahore from 2014 to 2017.

Materials and Methods: The study comprised 52 patients. We divided these patients into two groups; Group:1 (on pump coronary artery bypass grafting) and Group:2 (off pump coronary artery by pass grafting [OPCAB]). We enrolled all patients with chronic kidney disease on maintenance hemodialysis, those needed coronary artery bypass grafting.

Results: There was no significant demographic difference in both groups preoperatively. Triple vessel coronary artery disease (CAD) was present in 28 (53.8%)patients; double vessel CAD was present in 18 (34.6%) patients and sever left main CAD was present in 6 (11.5) patients. Peroperatively 3.5 and 3 number of grafts were used in-group:1 and group :2 respectively. Number of blood and blood products were used more in group:1 as compare to group:2.The use of inotropic support and Intra aortic balloon pump (IABP) was significantly higher in group:1.We found increased extubation time, ICU stay and hospital stay in group:1 as compare to group:2.Early postoperative mortality in group:1 and group:2 was 7.7% and 3.8% respectively. Six months survival rate was equal in both groups.

Conclusion: Off pump coronary artery bypass grafting is encouraging operative strategy in patients with End stage renal disease. In this technique less number of blood and blood products are used and it has lower morbidity, mortality and hospital stay.

Key Words: Chronic kidney disease, Ischemic heart disease, Hemodialysis, Off pump coronary artery bypasses grafting

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INTRODUCTION

Acute myocardial infarction continues to be a major public health problem despite revolutionary advancements in diagnosis and management over the last three decades.[1,2]. Patients with End stage renal disease on maintenance hemodialysis are another leading cause of mortality and morbidity worldwide, and these patients have significant correlation with ischemic heart disease. It is widely reported that cardiovascular disease and ischemic heart disease is a common cause of death in patients suffering form End stage renal disease.[1]

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Advancements in dialysis treatment have resulted in a progressive increase in the prevalence of people living with ESRD. The Japanese Society for Dialysis Therapy recently reported that the number of patients with ESRD increased by approximately 10,000 cases every year.[2]

End stage renal disease patients represent more frequently with debilitating coronary artery disease and these are very challenging patients for coronary artery bypass grafting.[3]Studies are available that shows CABG is the most successful strategy of revascularization for dialysis patients.[4] While other authors document that there are greater complications and a higher mortality rate of CABG for dialysis patients, though the later studies agree for performing CABG in these patients.[5, 6]

In 1974, Menzoinand associates[7] went for first successful CABG in patients with end stage renal disease and 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. Literature is available that shows improved survival and

quality of life after CABG in patient with ESRD.[8-10] Some other studies suggest that although there is an improved quality of life but no improvement in survival in these patients.[11-13] Coronary artery bypass grafting is the best available approach for the management of severe coronary artery disease in patients with ESRD. Surgeons have been trying to get better outcome of off pump technique in coronary artery bypass surgery in these patients but the results are still obscure.

MATERIALS AND METHODS

During this study 52 patients with ESRD were selected for coronary artery bypass grafting (CABG) at Shaikh Zayed Hospital, Lahore from 2014 to 2017. These patients were randomly divided in to two groups,Group:1(on pump coronary artery bypass grafting) and Group:2 (off pump coronary artery by pass grafting [(OPCAB]). Each group comprised equal number of patients. Written consent was taken from each patient. All patients with ESRD on maintenance hemodialysis go through pre-planned workup regarding End stage renal disease to optimize patient's conditions for surgery. We planned this protocol with the involvement of department of nephrology, anesthesiology and Cardiology. We admit our patients 5 days before surgery and Haemodialysis carried out on 4^{th}, 2^{nd}, 1^{st} day preoperatively (as per need of the patient). We improved the Hb ≥10 g/dl, serum creatinine ≤4 mg/dl, serum potassium around 3.5 mmol/dl and no pulmonary edema and signs of volume overload with this judicious use of hemodialysis.

Coronary artery bypass surgery is carried out by using cardiopulmonary bypass or by off pump technique. Moderate hypothermia (28°C) is achieved. Cold blood cardioplegia is opted for myocardial protection. Ultra filtration is carried out to eliminate extra fluids used for priming solutions to keep central venous pressure around 7 cm of water. Heparin was used to keep activated clotting time (ACT) around 350-500s.Half dose of calculated anticoagulant (inject able Heparin) is given in off pump coronary artery bypass grafting, to keep ACT around 200 to 350s.

In early postoperative period intravenous fluids are carefully planned 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 pack blood cells and fresh frozen plasma (FFP). Hemodialysis carried out on 2^{nd} postoperative day in intensive care unit and on 4^{th} post-operative day in dialysis department to keep the laboratory test around our pre-planned protocols and central venous pressure ≤10 cmm. Regular follow-up of these patients was carried out according to the study protocol after 30 days, 6 months and 1 year in our OPD. These patients are also advised to take regular follow up from the Nephrology department. The data was entered and analyzed by SPSS-20.

RESULTS

Fifty two patients of End stage renal disease (ESRD) were randomly selected for coronary artery bypass grafting (CABG). There was no significant difference of demographic characteristics in both groups. The demographic data of both groups is given in table 1. Peroperatively the average numbers of grafts were 3.5in-group: 1 (on pump patients) and 3 in Group2 (OPCAB patients). Total bypass time was 142.3±17.8 minutes in-group 1 patients operated with cardiopulmonary bypass (CPB). Blood and blood products were used more in-group 1 as compare to group 2 (Table 2).

Table No. 1: Preoperative demographic characteristics of both groups of patients with CKD undergoing CABG

Variable	On pump (n = 26)	Off Pump (n = 26)
Male	21 (80.7%)	19 (73.07%)
Female	5 (19.23%)	7 (26.9%)
Diabetes mellitus	17 (65.4%)	18 (69.2%)
Hypertension	21 (80.7%)	2 2(84.6%)
Smoking	16 (61.5%)	15 (57.7%)
Age	54.7±10.8	53.9±10.8
Ejection Fraction (EF)	39.4±6.4	40.4±7.0

Table No.2: Per operative data of on pump (n=38) and off pump (n=8) CABG in patients with chronic kidney disease

	On pump	Off pump
No. of grafts(average)	3.5	3
Pack cells used (units) average	4	2
FFPs used(average)	3	1
P value	P<0.05	

Table No.3: Postoperative data of on pump and off pump CABG in patients with chronic kidney disease

Variable	On pump	Off pump	P value
Inotropes used	12(46.2%)	6(23.1%)	0.05
IABP used	1 (3.8%)	--	0.05
Extubation time(Hours)	7-10	3-5	0.05
Length of ICU stay	4.03±0.7	2.04±0.07	0.05
Length of Hospital stay	10.47±0.87	6.56±0.7	0.05
Reopen surgery	1 (3.8%)	--	0.05
Atrial fibrillation	3 (11.5%)	1 (3.8%)	0.05
Neurological complications	1 (3.8%)		0.05

Prolong extubation time was noted 7-10 hours in group1(on pump) as compare to 3-5 hours in group2 (off pump).Similarly length of stay in ICU and hospital was significantly higher in group 1 as compare to group:2. The use of inotropic support was higher in-group 1 as compare to group 2. Intra aortic balloon pump (IABP) was used in one patients in-group 1 while no IABP was used in-group 2. In early post operative period reopen surgery, wound infection and neurological complications were noticed more frequently in group 1 as compare to group2 as shown in table 3. Table 4 shows postoperative results of on pump and off pump CABG in patients with end stage renal disease in terms of freedom from angina, freedom from acute MI, freedom from sudden death and so on. We found freedom from acute MI was 88.4% in-group:1and 84.6%in group 2,. The results of freedom from angina and failure to work were 84.6% and 73.1% in-group: 1 and 80.4% and 76.9% in group2 respectively. Early postoperative mortality in group 1was 7.7% and 3.8% in group 2 respectively (Table 4).

Table No.4: Midterm postoperative results of on pump and off pump CABG in patients with ESRD

Variable	On pump (n = 26)	Off Pump (n = 26)
Freedom from Angina (patients)	22 (84.6%)	21 (80.4%)
Freedom from MI(patients)	23 (88.4%)	22 (84.6%)
Freedom from failure to work(patients)	19 (73.1%)	20 (76.9%)
Freedom from unsatisfactory quality of life(patients)	18 (69.2%)	20 (76.9%)
Mortality	2(7.69%)	1 (3.8%)

DISCUSSION

Cardiovascular diseases are one of the biggest causes of death in end-stage renal disease.[14]Coronary arteries are very badly affected by uremia and uremia associated factors.[15]In these patients myocardial Infarction is directly related to more 30% of cardiac deaths.[16] Since the beginning of PTCA, early and late outcomes suggest a high rate of acute complications and poor long term results in patients with ESRD especially restenosis rate.[16, 17] So, from a recent studies and previously published literature, coronary artery bypass grafting appeared to be the preferred mode of treatment in this population.[18-20]End-stage renal disease patients tend to have longer time on pressors and mechanical ventilation, longer ICU stay and hospital stay. Our study showed prolonged ventilation time of 7-10 hours in on pump group in comparison to 3-5 hours in off pump group. There was longer ICU stay of 4.0±0.7 days in group:1 than 2.04±0.07 days in group:2 ($p<0.05$). Similarly we noticed increased hospital stay of 10.47±0.87 days in group1 as compare to 6.56±0.7days in group2 with (p value <0.05).

In patients undergoing On pump CABG it very necessary to maintain good perfusion pressures to maintain capillary bed perfusion. This very high perfusion pressures will shift fluid to interstitial spaces which will lead to intravascular fluid deficit. To keep the balance mean perfusion pressure on heart lung machine should ideally be maintained between 50 mm Hg and 65 mm Hg.[21, 22]

Many researcher prefer to get hemodialysis 24 hour before Coronary artery bypass on CPB,[23-25] but in our protocols it is best to use dialysis as close to the procedure as possible. We chose intraoperative hemofiltration to keep the central Venus pressure around 7 to 10 cm of water.

Where we opted CPB, average extracorporeal circulation time and cross-clamping time was increased in these patients because of more diffuse and extensive calcification of the coronary vessels. The average extracorporeal circulation time 142.3±17.8 minutes and cross clamp time was 63.4±13.2 minutes respectively.

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 and neurological complications increase the operative morbidity and mortality. The cerebrovascular accident rate was 3.8% in our patients we did on CPB but no such incident was noticed in OPCABG patients. The cerebral complications are leading cause of death in ESRD patients falling behind the cardiovascular complications and sepsis.[26]

In our experience we identified that although the in hospital results of OPCAB are better that conventional CPB but the midterm results are comparable. As we illustrated the midterm postoperative results in terms of freedom from angina (84.6% and 80.4%%), freedom from acute MI (88.4% and 84.6%), freedom from failure to work (73.1% and 76.7%) respectively are equally good in both groups. Coronary artery bypass grafting can be opted in end stage renal disease patients either on pump or off pump depending upon the preoperative conditions of the patient and the nature of coronary artery disease. Overall mortality among dialysis patients was 7.7% and 3.4% in both groups respectively. Our operative mortality has improved in comparison to widely variable range of previous reports stated by Rostand et al[27]and Blum and coworkers.[19]

Coronary artery bypass grafting and entire preoperative management in ESRD patients is very challenging and complicated, however satisfactory mid term results can be achieved using both techniques when specific requirements of these patients are accounted and managed successfully.

CONCLUSION

The off pump coronary artery bypass grafting technique in patients with end stage renal disease is associated with less mortality and decreased use of blood products and lower hospital stay than on pump technique. In end-stage renal disease patients OPCAB is encouraging operative strategy, and it has comparable midterm results with on pump CABG.

Author's Contribution:

Concept & Design of Study:	Aqeel Ahmad
Drafting:	Zahid Parvez
Data Analysis:	Oneeb Sanaullah
Revisiting Critically:	Zahid Parvez, Aqeel Ahmad
Final Approval of version:	Aqeel Ahmad

Conflict of Interest: The study has no conflict of interest to declare by any author.

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