EARLY CLINICAL OUTCOME IN PATIENTS WITH ISCHEMIC CARDIOMYOPATHY (LVEDD > 70 MM) UNDERGOING CORONARY ARTERY BYPASS GRAFT SURGERY CAN BE IMPROVED WITH 12 HOURS PRE-OPERATIVE IABP SUPPORT

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ABSTRACT

BACKGROUND: Patients with left ventricular dysfunction undergoing coronary artery surgery are at an increased risk of peri-operative morbidity and mortality (1). Left ventricular dysfunction is a well-established and powerful predictor of adverse outcomes (2). The aim of this study was to assess the early clinical outcome in a group of patients with severe left ventricular dysfunction and an echocardiographic Left Ventricular Dimension greater than 70mm undergoing coronary bypass surgery in which IABP was inserted twelve hours before surgery to support the heart.

METHODS: We retrospectively reviewed 20 patients between June 2004 – May 2006. In Group I, IABP was inserted 12-16 hours before the operation in all patients (100%) to offload the heart. There were 8 patients 6(75%) male, 2(25%) female, with age ranging between 49-71 years with a mean age 55.8 years. 7(87.5%) patients had a history of multiple Myocardial Infarctions (6M,1F), 7(87.5%) had Diabetes Mellitus(4M,3F) , 6(75%) Hypertension (5M, 1F), 5(62.5%) had a positive family history, 4(50%) patients were currently smoking (all male). These were compared to Group II patients, in whom the IABP was inserted, at time of induction of anesthesia. In Group II, among 12 patients 9(75%) were male, 3(25%) female with age ranging between 45-72 years with a mean of 57.4 years. 8(66.7%) patients had a history of multiple Myocardial Infarctions (7M, 1F), 11(91%) had Diabetes Mellitus (8M, 3F), 10(83.33%) Hypertension(7M,3F), 9(75%) a positive family history, 5(42%) were currently smoking (all male). All patients were operated using conventional coronary artery bypass grafting techniques under cardiopulmonary bypass.

RESULTS: Mortality in Group I was 25%, (2 patients) while in Group II, it was 33.33% (4 patients).

CONCLUSION: Early survival in patients undergoing coronary artery bypass surgery with an LVEDD greater than 70mm can be improved if an Intra Aortic Balloon Pump is electively inserted 12-16 hours before surgery to offload the heart.

INTRODUCTION

The presence of left ventricular (LV) dysfunction is defined as an ejection fraction (EF) less than 0.30(30%). This is a major risk factor for morbidity and mortality after coronary artery bypass grafting (CABG).[3,4] In patients with dilated hearts (LVEDD >70mm), morbidity and mortality are further increased. Severe left ventricular (LV) dysfunction is an independent predictor of operative mortality in patients undergoing coronary artery bypass grafting.[5-8] It also often leads to low cardiac output and a high postoperative mortality, with many of these patients requiring inotropic or mechanical support for hours to days after surgery (9). Nowadays, surgical option is being increasingly offered to these patients as compared to the medical treatment alone, which may improve long-term survival in these patients[6] However, differences in patients and operative factors, inadequate myocardial protection, residual ischemia, incomplete revascularization, and suboptimal anastomosis are potential confounding factors when assessing outcomes. But, Coronary artery bypass grafting (CABG) for patients with ischemic left ventricular (LV) dysfunction is still

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superior to medical therapy in terms of long-term survival[10-12] as CABG causes a significant reduction in long-term mortality (13) and protects against future infarction and death even without postoperative improvement in ventricular function.[14]

In this retrospective study, we determine whether early preoperative IABP insertion in patients with left ventricular end diastolic dimension (LVEDD) more than 70 mm can improve the early outcome and survival.

PATIENTS AND METHODS CLINICAL DATA COLLECTION:

Data of all patients of both groups(I&II) with severe left ventricular (LV) dysfunction with left ventricular end diastolic dimension (LVEDD) more than 70mm who underwent coronary artery bypass grafting (CABG) for multi vessel disease at the National Institute of Cardiovascular Diseases - Karachi, between June 2004 to May 2006, were collected and analyzed.

Patients with ejection fraction (EF) less than 30% on preoperative echocardiography and/or coronary angiography were considered to have left ventricular (LV) dysfunction. The following patients were excluded from the study:

1. Patients with myocardial infarction (MI) in the last 24 hours.
2. Patients referred for emergency surgery.
3. Patients who needed additional procedures besides coronary artery grafting.

The clinical data and cardiac risk factors for group I & II patients are shown in Tab-1(preop-

Table-1
Preoperative Variables of group I and group II Characteristics

Variable	No. of Patients Affected in Group I (n=8)	No. of Patients Affected in group II (n=12)
Age>60 years	3	8(3M,5F)
Male sex	6	9
Symptoms status(stable)	0	0
Diabetes mellitus(type 1 and 2)	6	9
Hypertension	8	10
Hypercholeterolemia(hyperlipidemia)	8	7
Family history	5	8
Smoker		
Current	5	9(M)
Ex-smoker	1	0
Renal problems(chronic renal failure)	1	1
Peripheral vascular disease	0	0
Previous myocardial infarction		
≤"1 month	5	8(6M,2F)
>1 month	3	4(3M,1F)
Thrombolysis within last 24 hours	2	1
Angina (CCS-IV)	7	9
Dyspnea(NYHA III/IV)	8	10
Intravenous nitrates	3	5
ACE inhibitors	2	6
History of CHF		
Never		
In the past		
Current	5	4
Preoperative IABP	8	5(at time of induction)
Preoperative LVEDD>70mm	8	12
Previous CVA or TIA	1	4
VT/VF	3	2
Left main stem stenosis	2	3
Triple vessel disease	8	12
Previous operation	0	0
Previous cardiological intervention		
Angiography	8	12
Previous failed PTCA/Stent	1	3
Asthma/COAD/emphysema	5	4
Preoperative arrhythmia	3	2
Operative priority		
Elective		
Urgent		
Urgent elective	8	12
Era of surgery		
6/2004-5/2006	8	12
Number of Deaths (n)	2	4

erative characteristics). In group I, among 8 patients 6(75%) were male, 2(25%) female with age range between 49-71 years (50-71 years for male, 49-60 years for female) with mean age 55.8 years. 3(37.5%) patients were >60 years(2M,1F). 7(87.5%) patients had a history of: multiple myocardial infarctions (5M,2F), 7(75%)diabetes mellitus(4M,3F), 6(75%) hypertension(5M,1F), 5(62.5%) positive family history, 4(50%) were currently smoking(all male). IABP was inserted in 8(100%) patients about 12-16 hours before operation to offload the heart preoperatively.

In group II, which comprised of 12 patients 9(75%) were male, 3(25%)female with age range between 45-72 years(45-70 years for male, 50 -72 years for female) with mean age 57.4 years. 8(66.67%) patients were >60 years(6M, 2F). 8(66.7%) patients have history of multiple myocardial infarction(7M,1F), 11(91%) diabetes mellitus(8M,3F), 10(83.33%) hypertension(7M,3F), 9(75%) had positive family history, 5(42%) were currently smoking(all male). IABP was inserted at time of induction in all patients.

TECHNIQUE OF IABP INSERTION:
Skin prepared, femoral artery punctured at 45°, then guide wire passed through the needle and advanced until tip is in thoracic aorta. Femoral artery dilated and sheath- less balloon passed over guide wire and inserted to at least the level of the manufacturer's mark (usually double line) to ensure that entire balloon has emerged from sheath, then balloon was positioned at the level of angle of Louis. Wire then removed. Central lumen flushed with heparin saline and connected to transducer to monitor intra-aortic pressure. Collector then connected to IABP console and balloon filled with helium. Timing adjusted with ECG as trigger and started as 1:1 augmentation.

SURGICAL TECHNIQUE:
Standard midline sternotomy incision. Pericardium opened using an inverted T-shaped incision. Heparin (50 U/kg) given to achieve anticoagulation. The activated clotting time was maintained more than 480 seconds. With an ascending aorta and a single right atrial cannula(two stage) cardiopulmonary bypass achieved. With membrane oxygenator, arterial line filters, non-pulsatile flow of 2.4 L/min/m^2, and a mean arterial blood pressure more than 50 mmHg was maintained. Myocardial protection achieved with moderate systemic hypothermia (28 C°), topical surface cooling with cold saline solution (4 C°), by intermittent ante-grade cold blood cardioplegia (4:1 blood to crystalloid ratio) to induce ventricular fibrillation, and intermittent aortic cross clamping. Coronary artery bypass grafting done using great saphenous vein. Internal mammory artery (IMA) was not used in any of these patients. IABP inserted in all patients Group II.

POSTOPERATIVE MANAGEMENT:
At the end of the operation patients were shifted to intensive care unit (ICU) and managed according to standard protocol. Follow-up was done during patients visit to an outpatient department at our hospital at one week and one month duration. Operative death was defined as death that occurred (within 30 days of operation or during the hospital stay). Chronic heart failure, ventricular arrhythmias and recurrent angina that required re-hospitalization after coronary artery bypass grafting (CABG) were defined as postoperative cardiac events.

RESULTS
Age group of our patients ranged from 49 to 71 years (mean: 55.8 years) for group I. Of these,6 (75%) patients were male and 2 (25%) were female, 5(3M,2F) were more than 60 years of age, ,07(5M,2F) patients had history of more than two myocardial infarction(87.5%), 07(4M,3F)were diabetics(87.5%), 06(5M,1F) were hypertensive(75%) positive family history in 05(62.5%) patients,04(all male)were currently smoking(50%) .

In group II age range was 45 to 72 years(mean: 57.4years). Of these,9 (75%) patients were male and 3 (25%) were female, 8(6M,2F) were more than 60 years of age, ,08(7M,1F) patients had history of more than two myocardial infarction(66.7%), 11(8M,3F)were diabetics(91%),10(7M,3F) were hypertensive(83.3%) positive family history in 09(75%) patients,05(all male)were currently smoking(42%) In 8(100%) patients of group I, IABP was inserted in the ICU 12-16 hours before operation, while in 12(100%) patients of group II it was inserted at time of induction. The duration of IABP kept inserted was 36hours to 07 days.

Early extubation was done in 14 patients in

less than 12 hours. IABP kept inserted with range 36 hours to 7 days which is little longer. Inotropic support weaned off within 72 hours in 14 patients. Morbidity include: Reopening was done in 2 patients because of bleeding. 2 patients develop stroke, 2 patients develop renal failure,one patient had pneumothorax, while one patient had pleural effusion. We did not experience any balloon leaks or any insertion difficulties. The balloon was repositioned in one patient, in view of poor augmentation.

In group I, 2 patients (25%) died while in group II 4 patients (33.33%) died. Out of 20 patients 06 died. 02 patients could not wean off bypass even with IABP due to cardiac failure. 02patients died because of multi organ failure, 01due to stroke, 01 due to septicemia. ICU stay of our patients was 4.3 days (average) with range of 03-8 days.Hospital stay was 11to 30 days (range) with mean of 12 days.Follow-up of our patients was 100% as all our patients came for follow-up which was done at one week and one month duration.Out of 14 patients one patient died at one month follow-up.

PREOPERATIVE CHARACTERISTICS:
The preoperative characteristics are presented in Table 1. None of the study patients had significant valvular disease including mitral regurgitation (MR) on echocardiography or angiography but patients had trace MR.

OPERATIVE DATA:
The grafts used included great saphenous vein in all patients of both groups. Internal mammory artery (IMA) was not used in any of these patients. There were no sequential grafts constructed and no end-arterectomy was performed on the grafted coronary arteries. The distribution of distal anastomoses to the various vascular territories of the heart was not significantly different in both groups of patients (Table 2). Average number of grafts were 3.

Table-2
Distribution of Distal anastomosis among the various vascular terriotories of the Heart in group I & II

Vascular trritory	*No. of Patients in group I*	*Number of Patients in group II*
Anterior territory	3	6
Lateral territory	2	2
Posterior territory	3	4

(Anterior territory includes LAD and diagonal arteries, Lateral terriotory include circumflex and marginal arteries, Posterior terriotory include Descending and right coronary arteries)

POSTOPERATIVE OUTCOME:
Postoperative morbidity and mortality are presented in both groups of patients in Table 3.

COMMENTS (DISCUSSION)
Nowadays, there are increasing number of patients with severely impaired left ventricular function with end-stage ischemic cardiomyopathy presenting for coronary revascularization.[1] Coronary artery bypass grafting for patients with ischemic left ventricular dysfunction (ILVD) remains superior to medical therapy in terms of long term survival.[27] Early postoperative survival after CABG has improved as a result of advances in surgical techniques, myocardial protection strategies, anesthesia, and postoperative pharmacologic and mechanical support.[28] Several studies have confirmed that severe LV dysfunction is associated with a poor long-term prognosis and increase the risk of death associated with CABG. This is particularly true when the coronary artery disease is diffuse and LV dysfunction is severe (E.F<0.30)(28). Studies have shown that patients who have ischemic cardiomyopathy respond better to myocardial revascularization than to medical therapy alone.[28]

We have conducted this study to examine the outcome of IABP insertion in this tertiary care center. In 2 patients reopening was done due to bleeding,2 developed stroke, 2 patients developed renal failure, one pneumothorax, and one developed pleural effusion.

Out of 20 patients, 06 died (02 in group I, 04 in group II). Out of 6 patients 02 could not weaned off bypass even with IABP due to cardiac failure, 02 died due to multiorgan failure, 01 due to stroke(while in other patient CVA was resolved), and 01 patient died due to septicemia.In our study overall in-hospital mortality rate was 25% in group I and 33.33% in group II. We compared this study with others reported in the literature. In-hospital mortality of our study was 25% (2/8), while 20% (1098/5495) as reported by the Benchmark Counterpulsation Registry(25)and 45% (90/201) in-hospital mortality from the Cardiology

Center,Geneva(26).The apparent high overall mortality in this severe left ventricular (LV) dysfunction patient group (25%) could be explained by the fact that there is relatively highly prevalent co morbid conditions in our study group included: diabetic patients, history of multiple myocardial infarctions (MI), smoking, positive family history. Despite all these factors, the overall mortality still compared favourably to previously reported series including those of Kaul and associates(24%) and Milauo and colleagues(11%)(12,15).

Intra-aortic balloon pump was used in patients demanding high doses of inotropic support preoperatively and who have severe left ventricular (LV) dysfunction with Cardiomyopathy (LVEDD>70mm) so the use of intra-aortic balloon pump in our study is 100%. In group I, IABP was inserted 12-16 hours before operation to offload the heart preoperatively and was found to be very rewarding in terms of reducing operative mortality significantly. In group II, IABP was inserted at time of induction. Our mean duration of the IABP in-situ was 72.8 hours, while it was 64.8 hours from the Benchmark Counterpulsation Registry and 48 hours at the Cardiology Center, Geneva.

IABP works on the principle of counter-pulsation. Balloon inflates during the diastolic phase of the cardiac cycle (enhances blood flow to the coronary and systemic circulation), and deflates during systole (reduces afterload). Overall, this should increase stroke volume and decrease myocardial oxygen demand. As a consequence of augmentation, there is a fall in the systolic pressure of the subsequent beat (16). IABP is an effective therapeutic option because it decreases myocardial oxygen demand while simultaneously increases oxygen supply and maintain mean aortic pressure. The systolic unloading leads to a reduction in afterload and thus in left ventricular end-diastolic pressure, which reduces oxygen demand in ischemic segments. This is also the only method that will augment diastolic aortic pressure without increasing oxygen demand, as is the case with catecholamine-mediated vasoconstriction.

The increasing need to perform coronary revascularization in patients with severely impaired left ventricular (LV) function is the result of increasing number of patients presenting with end-stage ischemic cardiomyopathy as well as the non availability of heart transplantation in Pakistan.
Indications for IABP insertion include: unstable angina, cardiogenic shock (17) and refractory ventricular failure, as a bridge to cardiac revascularization procedures i-e CABG (18), angioplasty (19), cardiac transplant, or left ventricular assist device placement, post-operatively when unable to wean off for ongoing myocardial ischemia with ventricular arrhythmias and septic shock.[20,21] Favorable outcomes have been reported when IABP have been inserted for these indications (22). With emergence of the sheathless technique for IABP insertion, the incidence of complications especially ischemic complications has decreased (23). Higher complication rates are noted in the elderly, and in patients with peripheral vascular disease.[24]

Weaning from IABP should begin in 24-48 hours of reperfusion or medical stabilization, if surgery is not planned. This is achieved by gradually reducing the proportion of cardiac cycles during which the balloon inflates. When the patient's own circulation can be maintained at a pumping frequency of every fourth or greater cardiac cycle, the balloon can usually be removed successfully. It should not be completely stopped in situ because of the risk of thrombus formation.

Among the mechanical devices developed to assist the left ventricle until more definitive therapy can be undertaken, the Intra-aortic balloon pump(IABP)has been in use, since Kantrowitz reported the first successful clinical use in 1967.Although this device can im-

Table-3
Postoperative morbidity & mortality in group I & II

Variable	*n=8 (%) in group I*	*n=12 (%) in group II*
Perioperative MI	4 (50)	5 (41.6)
Low cardiac output	2(25)	3(25)
Reopening for bleeding	1(12.5)	3(25)
Ventilation>24 hours	3(37.5)	3(25)
Pulmonary Complications	5(62.5)	4(33.33)
CVA or TIA	1(12.5)	0(0)
Infective Complications	1(12.5)	1(8.3)
Renal Complications	2(25)	1(8.3)
Readmission to ITU	1(12.5)	3(25)
30-day mortality	2(25)	4(33.33)

prove hemodynamics in the short term, but will not improve survival by itself, reaffirming the importance of definitive therapy (survival of cardiogenic shock patients with IABP without reperfusion therapy is very low, averaging 20%; with reperfusion it is about 50%).

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