INTRA AORTIC BALLOON COUNTER PULSATION AN IMPROVED OUTCOME IN HIGH-RISK PATIENT FOR CORONARY ARTERY BYPASS SURGERY.

"Intra-aortic Baloon Pump"

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SUMMARY

Intra aortic balloon pump (IABP) is the commonest used assisted device in cardiac surgery. Our aim is to investigate the effectiveness of therapy in our setup of patients, where poor ejection fraction, diffuse coronary artery disease and left main stem lesions are common.

Retrospective study where 1296 patients underwent isolated CABG surgery for the period from Jan 1997 to Dec. 2003. 48 (3.7%) patients needed insertion of IABP perioperatively or early postoperatively.
The early mortality rate in those who required IABP was 35% (17) of patients mean age of the patients was 56 ± 4 years, 36 (75%) patients have preoperative myocardial infarction (MI) within week before surgery, 39 (81%) patients were diabetic. Chronic renal failure was present in 4 (8%) patients, COPD was present in 2 (4%), poor left ventricular function (less than 30%) was present in 36 (75%) patients, 41 (85%) patients were male. 65% (31) of patients who developed sever myocardial depression at the conclusion of surgery survive and discharge home.

Significant improve in hospital survival in those patients who otherwise died warn us liberal use of IABP. High risk patients with low cardiac out put after operation, patients with low ejection fraction, recent MI and peri or postoperative MI benefit most with IABP. Insertion of IABP is simple and easily available assisted devise.

Key words: Coronary artery bypass surgery, Intra aortic balloon pump, survival.

INTRODUCTION

The intra aortic balloon counter pulsation provides an important circulatory support for variety of patient who experience haemodynamic instability. It has been shown effective in reducing mortality and morbidity when used after acute myocardial infarction[1], in those with cardiogenic shock[2] and in those with sever left ventricular dysfunction[3] it is also effective in stabilizing patient who are undergoing angioplasty[4]. The IABP usually is the first mechanical devise used for perioperative cardiac failure[5]. Its main effects are reduction of ventricular afterload, improvement of diastolic coronary perfusion and enhancement of subendocardial perfusion[6]. Suggested indications include preoperative myocardial ischemia or cardiac failure, failure to wean from cardiopulmonary bypass and postoperative low cardiac output syndrome[7]. The IABP is likely to be superior to pharmacological support alone for myocardial failure following cardiac surgery[8].

The rapid development of invasive cardiology techniques and approaches has led to a changing pattern in the characteristics of coronary patients undergoing CABG. A larger proportion of patients coming for surgical intervention are repeat or re repeat operation, more often present with unstable angina, poor left ventricular function (ejection fraction £ 0.30%), sever left main coronary artery stenosis, diffuse coronary artery disease, or a combination of these disorders. These patients have

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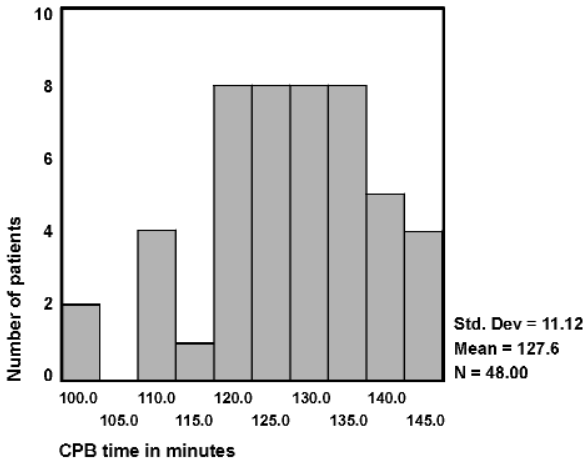
high chances of developing haemodynamic instability preoperative or post operative period. The present study, which includes clinical material from one surgical department was undertaken to analyze the short term outcome of those high risk patient who developed peri or post operative haemodynamic instability and received an IABP support.

Material and methods

Over the six years period from Jan 1997 to Dec. 2003, 1269 patients underwent isolated coronary artery bypass graft surgery at our institute. All the patients who needed intra aortic balloon pump during the perioperative or postoperative period were identified in our cardiothoracic database, whenever necessary additional data were obtained from patient records. A total of 48 patients (3.7% of all patients), 41 (85%) male and 7 (15%) female with mean age of 56 ± 4 years were treated with an IABP during (n=45) or after (n=3) operation (Table 1). The outcome analysis considered hospital stay, low cardiac output syndrome and deaths.

Figure - 1
Bars of cardiopulmonary bypass time in minutes.



The following variables were included in the analysis. COPD was present in 2 (4%), diabetes mellitus in 39 (81%) patients, hypertension (SBP > 140 mm Hg) was present in 22 (46%) patients, preoperative NYHA class II was present in 5 (10%) patients, class III in 36 (75%) patients and class IV was in 7 (15%), preoperative myocardial infarction less than six weeks was present in 36 (76%) patients, chronic renal failure creatinine more than 2 mg/dL was present in 4 (8%). Cardiac catheterization data

Table 1
Preoperative Variables.

Age (years)		56 ± 4
Male		41 (58%)
Diabetes mellitus		39 (81%)
NYHA class	II	5 (10%)
	III	36 (75%)
	IV	7 (15%)
Hypertension		22 (8%)
Renal impairment		4 (8%)
Ejection fraction (%)		
> 30%		8 (17%)
< 30%		40 (83%)
Recent MI		36 (75%)

Data is shown as number followed by percentage in parentheses or mean with standard deviations.

NYHA, New York Heart Association; MI, myocardial infarction.

included the number of disease vessels (obstruction >70%) were 3 ± 0.2. the left ventricular ejection fraction (LVEF) less than 30% were present in 40 (83%) patients, 8 (17%) patients had LVEF more than 30%.

All surgical procedures were performed using moderate haemodilution (Haematocrite 20), systemic moderate hypothermia (32°C). For distal anastomosis, cross clamp fibrillation was used in 26 (54%) patients and cold (4°C) crystalloid cardioplegia used in 22 (46%) patients. Mean cardiopulmonary bypass time was128 ± 12 min (figure 1) and mean aortic cross clamp time was 60 ± 8min (figure 2) and mean number of grafts were 3 ±

Table 2
Intra-operative variables

No. of grafts	3 ± 0.8
X - clamp (min)	60 ± 8
CPB (min)	128 ± 12

Data is shown as number in mean with standard deviations.

CPB, cardiopulmonary bypass, X-clamp, Aortic cross clamp.

0.8 recorded (Table 2). The IABP used was a 9.5-F, 40-mL balloon (Datascope, Fairfield, NJ, USA) connected to a Datascope pump, system 95 (Datascope, Fairfield, NJ, USA). Percutaneous route (common femoral artery) was used in 43 (89%) patients, sheath less IABP was used in 26 (54%) patients and the major IABP related complications

Table 3
Post-operative variables

Mortality	35%
Vascular complications	8%
Duration of IABP (Hours)	
Survivors	29 ± 13
Expired	39 ± 30 (p value 0001)
ICU Stay (days)	6 ± 2.5

Data is shown as number followed by percentage in parentheses or mean with standard deviations.

IABP, Intra aortic ballon pump. ICU, intensive care unit.

were vascular. Early death was defined as any death that occurred within 30 days of operation.

Data are presented as mean with standard deviation where as discrete variables were presented as frequencies and statistical comparison is by one-sample T test with probability of less then 0.05 considered significant.

RESULTS

The overall mortality of the patients who needed IABP was 35% [17] of patients (Table 3). The patients who died, they needed IABP support for longer duration mean timing were 39 ± 30 hours (figure 3) while those who survived mean timing on IABP was 29 ± 13 hours (p value <0001) (figure 4). The patients who died have more vascular complication 3 (6%) then non survivors 1(2%). One patient needed femoro-femoral bypass, another one needed fasciotomy and one of them needed below knee amputation of respective limb. One survivor needed

Figure - 2
Bars of Aortic Cross Clamp time in minutes.

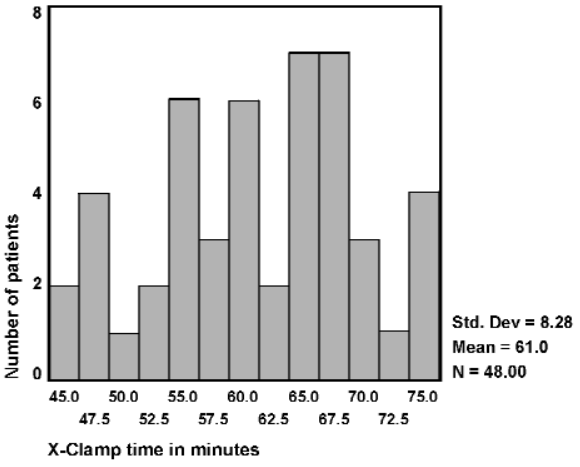


Figure - 3
Bars of Intra-aortic balloon pump time in patients who survive in hours.

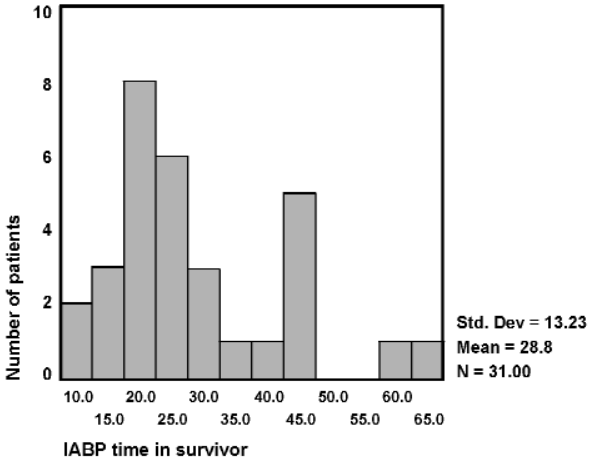


Figure - 4
Bars of Intra-aortic balloon pump in patients who expired in hours.

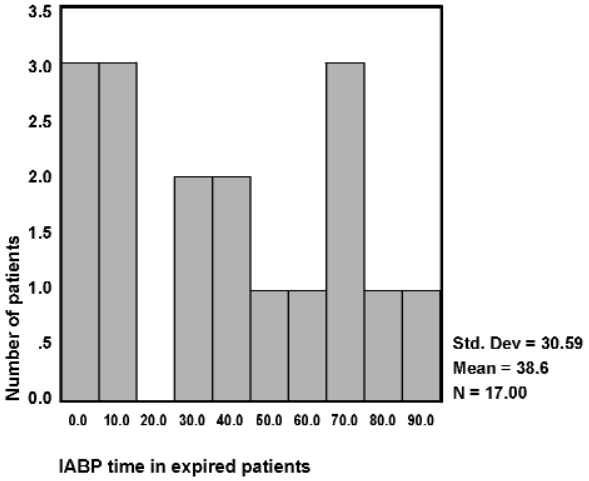
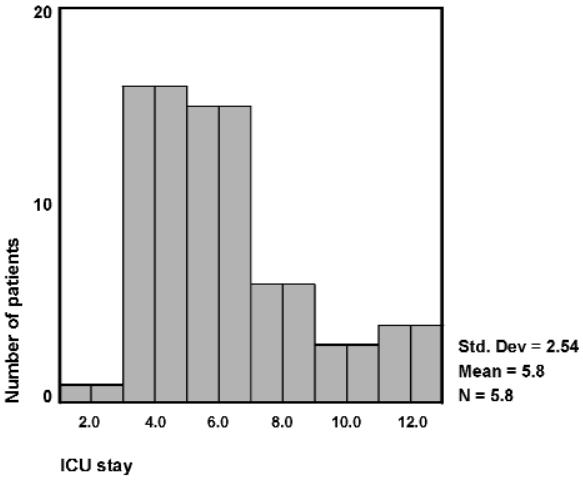


Figure - 4
Bars of intensive care unit stay in days in patients with IABP.



fasciotomy. There were 3 (6%) intra-operative (table) deaths and 14 (29%) patients died in ICU postoperatively from 2 hours to 7 days after their operation. Cause of death in those patients who shifted in ICU were low cardiac output syndrome in 7 (15%) patients, multi-organ failure in 5 (10%) patients, septicemia in 1 (2%) patient and DIC in 1 (2%) patient. 6 (12%) patients were re-explore after surgery to exclude cardiac tamponade or for excessive bleeding. The mean ICU stay was 6 ± 2.5 days (figure 5) and the mean hospital stay was 15.2 ± 11 days. Mean intubation time was 26 ± 21hours.

DISCUSSION

The intra aortic balloon pump has been established as a valuable mechanical support for temporary ventricular assistance in the treatment of the failing heart[5,9] using IABP provides significant after load reduction and enhanced myocardial blood supply through augmentation of diastolic pressures. This may also lead to redistribution of coronary blood flow toward ischemic areas of the myocardium[10]. Faulty myocardial prevention, intra-operative myocardial infarction, preoperative left ventricular dysfunction, prolonged cardiopulmonary bypass and ischemia times and technical problems contribute to postoperative low output syndrome[11]. The efficacy of IABP to sever low output syndrome has been established, with survival of approximately 30-60% (5,11). 2-6% of all patients undergoing myocardial revascularization and/or valvular heart surgery need IABP[12]. In our series IABP was inserted in 3.7% of patients during or after operation for low output syndrome refractory to maximum pharmacological treatment and volume loading. We did not have any patient in our series who received IABP before surgery as our institution has rigid hemodynamic criteria for its application. Many studies showed improve early outcome with preoperative insertion of IABP in high risk patients with poor LVEF < 30%, diffuse coronary artery disease, left main stem stenosis >70%, unstable angina or redo CABG[13]. Preoperative insertion of IABP also improved 1 year survival [14].

Early mortality rate for patients who are treated with an IABP remains high the early mortality rate in our study was 35% which is consistent with the range 36-70% (15-16).

The morbidity rate related to IABP insertion in our study was 8% which is within range (6-8%) reported by other groups[17,18] we have high re-exploration rate (12%) this is mainly due to unavailability of ECHO in ICU and not availability of swan-ganz catheter.

Our survival rate was 65%, these were those patients who developed difficulty to wean off from bypass, even after high dosed of inotropic support, due to sever low cardiac out put syndrome. 6% of patients were died on table even after insertion of IABP and maximum inotropic support. Such patients are more likely to be benefited from more effective modalities of ventricular support [19].

Hospital survivors usually have a relatively good probability of later survival. The highest mortality rate after hospital discharge occurred in 1st year, especially in the first three months after operation[16].

In conclusion although the early mortality rate in patients who received an IABP was high. IABP provide excellent early survival benefit to the patients who otherwise died after conclusion of CPB or due to low cardiac output syndrome post-operatively. This retrospective data suggest that more liberal and earlier use of the IABP is advisable in high risk patients.

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REFERENCES:

1. Waksman R, Weiss AT, Gotsman MS, Hassin Y. Intra-aortic balloon counterpulsation improves survival in cardiogenic shock complicating acute myocardial infarction. Eur Heart J 1993;14:71-4.

2. Kantrowitz A, Tjonneland S, Freed PS, Phillips SJ, Butner AN, Sherman JL Jr. Initial experience with intraaortic balloon pumping in cardiogenic shock. JAMA 1968;203:135-40.

3. Christakis GT, Weisel RD, Fremes SE, et al. Coronary artery bypass grafting in patients with poor ventricular function. J Thorac Cardiovasc Surg 1992;103:1083-92.

4. Ohman EM, George BS, Shite CJ. Et al. Use of

aortic counterpulsation to sustained coronary artery patency during acute myocardial infarction. Results of a randomized trial. The randomized IABP study group. Circulation 1994;90(2):792-9.

5. Naunheim KS, Swartz MT, Pennington DG, et al. intraaortic balloon pumping in patients requiring cardiac operation. Risk analysis and long term follow-up. J Thorac Cardiovasc Surg 1992;104:1654-61.

6. Maccioli GA, Lucas WJ, Norfleet EA. Intra-aortic balloon pump: a review. J Cardiothorac Anesth 1988;2:365-73.

7. Sanfelippo PM, Baker NH, Ewy HG, et al. Therapeutic efficacy of intraaortic balloon pump counterpulsation. Ann Thorac Surg 1986;41:36-41.

8. Downing TP, Miller DC, Stinson EB, et al. Therapeutic efficacy of intraaortic balloon pump counterpulsation. Analysis with concurrent "control" subjects. Circulation 1981;64(11):108-13.

9. Christenson JT. Buswell L, Velebit V, et al. The intraaortic balloon pump for postcardiotomy heart failure. Experience with 169 intraortic balloon pumps. Thorac Cardiovasc Surg 1995;43:129-33.

10. Gill C, Wechsler A. Newman G, Oldman H. Augmentation and redistribution of myocardial blood flow during acute ischemia by intraaortic balloon pumping. Ann Thorac Surg 1975;16:44-53.

11. Bolooki H, Balloon pumping in cardiac surgery. In Bolooki H (ed) Clinical application of intra-aortic balloon pump. New York. Futura, 1984, p 373.

12. Norman JC, Colley DA, Igo SR, et al. Prognostic indices for survival during postcardiotomy intra-aortic balloon pumping. J Thorac Cardiovasc Surg 1977;74:709.

13. Christenson JT, Simonet F, Badel P, Schmuziger M. Optimal timing of preoperative inraaortic balloon pump support in high-risk coronary patients. Ann Thorac Surg 1999;68:934-9.

14. Ramnarine IR, Grayson AD, Dihmis WC, Mediratta NK, Fabri BM, Chalmers JA. Timing of intra-aortic balloon pump support and 1-year survival. Eur J Cardiothorac Surg. 2005;27:887-92.

15. Mueller HS. Role of intra-aortic counterpulsation in cardiogenic shock and acute myocardial infarction. Cardiology 1994;84:168-74.

16. Arafa OE, Pedersen TH, Svennevig JL, Fosse E, Geiran OR. Intraaortic balloon pump in open heart operations: 10-year follow-up with risk analysis. Ann Thorac Surg 1998;65:741-7.

17. Meharwal ZS, Trehan N. Vascular complications of intra-aortic balloon insertion in patients undergoing coronary revascularization: analysis of 911 cases. Eur J Cardiothorac Surg 2002;21(4):741-7.

18. Arafa OE, Pedersen TH, Svennevig JL, Fosse E, Geiran OR. Vascular complication of the intraaortic balloon pump in patients undergoing open heart operation: 15 year experience. Ann Thorac Surg 1999;67:645-51.

19. Baldwin RT, Slogoff S, Noon GP, et al. A Model to predict survival at time of post cardiotomy intraaortic balloon pump insertion. Ann Throac Surg 1993;55:908-13.