Effectiveness of Intra- Aortic Ballon Pump (IABP) Insertion as Rescue Mechanical Support for on Pump Coronary Artery Bypass Surgery Patients with Persistent Intraoperative Hemodynamic Instability.

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Abstract

Background: Aim: Aim of this study was to evaluate the efficacy of IABP as a rescue mechanical support intra-operatively in persistent hemodynamic instability in a group of patients who have undergone elective CABG surgery. Subjects and Methods: It is a retrospective study conducted on patients who have undergone on pump CABG and received rescue IABP support intraoperatively. The IABP was inserted in the presence of hemodynamic instability as a rescue, inserted percutaneously via right or left femoral artery approach. Results: There is a marginal increase in the duration of mechanical ventilation 68.99±30.93 hours and duration of ICU stay 5.97±1.93 days. All patients had significant ST-T changes in more than 2 leads. No major complications related to IABP were recorded. An echocardiogram shown significant improvement in EF (p value=<0.0001). No in-hospital and 30 days mortality was recorded. Conclusion: This study shows significant improvement in hemodynamics post IABP insertion; improvement in EF at discharge from hospital and no mortality at discharge from hospital and 30 days postoperatively. IABP also decreased the postoperative length of stay. Preoperative IABP suggesting that it is effective in patients with severe LV dysfunction undergoing OPCAB.

Keywords: Intra-aortic ballon pump, Coronary artery bypass, Mechanical ventilation, Echocardiogram.

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Received: August 2019
Accepted: August 2019

Introduction

The use of IABP counter-pulsation in various clinical scenarios recently has become controversial.[1-3] In light of the debate initiated by high-quality randomized controlled trials (RCT) and subsequent comprehensive meta-analyses, both North American and European guidelines have downgraded the use of the IABP from a class I to a class II recommendation.[4-9] Some RCT showed a survival benefit with IABP insertion for coronary artery bypass grafting(CABG) patients with low Ejection Fraction(EF).[10,11] Also, it has been clear that IABP is an effective means of supporting failing circulation in patients at high risk of cardiovascular events postoperatively.[12] The prophylactic use of IABP has been shown to reduce in hospital mortality in patients with left ventricular (LV) systolic dysfunction undergoing CABG by meta-analysis of RCT.[13] Several authors have demonstrated the safety and efficacy of perioperative IABP support in patients undergoing either elective or urgent CABG with severe LV dysfunction.[14-16] The aim of this retrospective analysis was to evaluate the efficacy of IABP as a rescue mechanical support intraoperatively in persistent hemodynamic instability in a group of patients who have undergone elective CABG surgery.

Subjects and Methods

It is a retrospective study conducted on patients who have undergone on pump CABG and received rescue IABP support intraoperatively at our center between March 2017 to November 2018.Since this is a retrospective study, the consent was already taken for surgery and IABP support. The study was approved by local ethics committee. Selection and description of participants: Of the total 496 CABGs performed between the period March 2016 to November 2017, 40 patients who had rescue IABP support intraoperatively were included in the study. The preoperative risk assessment was analysed with EuroSCORE II scoring system and patients were categorised accordingly [Table 1]. Intraoperatively, hemodynamics just before IABP insertion and following IABP insertion at specified time intervals (15 minutes,1 hour,6 hours and 24 hours), Transesophageal Echocardiography(TEE) findings in terms of EF,new onset regional wall motion abnormalities (RWMA),ST-T changes on Electrocadiogram (ECG), no.of vasoactive drugs with dosages were analysed [Table 2]. Postoperatively, duration of IABP support, duration of mechanical ventilation, length
Operative technique:
All patients were operated by single surgeon who has 10 years of experience in cardiac surgery. All surgeries were performed by using Cardiopulmonary Bypass (CPB) after full heparinization. Technique used was moderate hypothermia (30°C-32°C) on arrested heart with antegrade cold blood cardioplegia which was repeated every 20 minutes. The average CBP time was 148.48±24.3 minutes and average cross clamp time was 91.23±31.81 minutes. Terminal warm blood cardioplegia at 37°C was infused just before removal of aortic cross clamp. Left internal mammary artery (LIMA) was used as graft to left anterior descending artery, whereas saphenous venous grafts were used for remaining vessels.

IABP USE: The IABP was inserted in the presence of hemodynamic instability as a rescue support (systolic blood pressure (SBP) <90 mmHg, Mean arterial pressure (MAP) < 40 mmHg, new onset RWMA on TEE and ST-T changes on ECG) after weaning from CPB despite maximum vasoactive drug support and optimization of preload as guided by TEE. All IABPs were inserted percutaneously via right or left femoral artery approach.

Statistical Analysis:
All statistics were performed using SPSS statistical software 20.0 version. Mean ± standard deviations are presented. T test was used to compare hemodynamic data and a P value equal to or smaller than 0.05 was considered statistically significant.

Results
Clinical characteristics of the patients are presented in the Table 1. In total of 34 patients, 19(47.5%) patients had an episode of myocardial infarction (MI) prior to surgery. All the patients were operated electively. Angiographically, 12(30%) patients were having severe left main (LM) with triple vessel disease (TVD), remaining 28(70%) were of only TVD. Most of the patients 33(82.5%) were of mild risk and 2(5%) were of high risk according to EuroSCORE II. All patients received equal number of vasoactive drugs(3) (Dobutamine 5-10mcg/kg/min, Adrenaline 0.05-0.1mcg/kg/min and Noradrenaline 0.05-0.15mcg/kg/min). Persistence of hemodynamic instability with a forementioned vasoactive drugs and optimized preload led to IABP insertion as a rescue mechanical support. The TEE examination during the instability showed persistent RWMA and new RWMA in all patients. All patients had significant ST-T changes and no preoperative MI. All patients had significant ST-T changes in more than 2 leads. SBP-systolic blood pressure in mmHg; MAP-mean arterial pressure in mm of Hg; HR-heart rate in beats per minute; CVP-central venous pressure in cm of H2O.

Discussion
Mechanical circulatory assistance is used frequently to support the failing heart. IABP is usually the first choice of mechanical device used for perioperative cardiac failure. The perioperative cardiac failure and usage of IABP are increasing as patient population referred for surgical treatment increases in age and severity of preoperative LV dysfunction. In this retrospective study we evaluated the duration of mechanical ventilation 68.99±30.93 hours and duration of ICU stay 5.97±1.93 days. No major complications related to IABP were recorded. There is increase in transfusion of packed cells at an average of 1.2 units, no components were transfused. An echocardiogram was done for all patients just before discharge from hospital which showed significant improvement in EF (p value=<0.0001) [Table 5]. No in-hospital and 30 days mortality was recorded.
effectiveness of IABP as a rescue mechanical support in severe hemodynamic instability post CABG. The beneficial hemodynamic effects of IABP include increase in the following variables: cardiac output (CO), EF, MAP, and coronary perfusion pressure (CPP).[18] Furthermore, these benefits also include decrease in following variables: aortic systolic pressure, left ventricular end diastolic pressure (LVEDP), pulmonary capillary wedge pressure (PCWP) and left atrial pressure (LAP).[19] As with percutaneous coronary intervention (PCI), the IABP-SHOCK II trial remains the largest RCT to date regarding the insertion of IABP before surgical revascularization.[20] Neither SHOCK II (2012) nor SHOCK II follow up (2013) demonstrated a mortality benefit with the preprocedural placement of an IABP in the CABG cohort.[21] Shih, M. Huang, J. Pang, L. et al. conducted a single centered RCT involving 232 patients who have undergone off pump CABG.

### Table 4: Comparison of hemodynamic variables before and after IABP insertion

| Time         | SBP     | MAP     | HR      | CVP     |
|--------------|---------|---------|---------|---------|
| Before IABP insertion | 85.88±3.41 | 44.29±1.12 | 99.71±2.07 | 8.53±0.71 |
| 15 min after IABP | 104.35±1.81 | 56.5±1.21 | 94.91±2.86 | 5.03±0.72 |
| 1 hr after IABP | 112.53±1.83 | 61.1±1.43 | 88.12±1.98 | 5.74±0.62 |
| 6 hrs after IABP | 115.68±2.92 | 67.41±1.52 | 99.8±2.5 | 6.52±0.69 |
| 24 hrs after IABP | 118.7±1.17 | 70.53±1.16 | 80.38±1.07 | 4.79±0.69 |
| P value       | 0.0001  | 0.0001  | 0.0001  | 0.0001  |

### Table 5: Comparison of Ejection Fraction (EF%) during IABP insertion and at the discharge from hospital.

| EF% | MEAN | P VALUE |
|-----|------|---------|
| EF% during IABP insertion | 36.26±3.66 | <0.0001 |
| EF% before discharge from hospital | 50.56±2.58 | |

Of the total 69 patients of their study, 59 (85.5%) could be weaned from CPB successfully with IABP support. The average in hospital mortality in their study of the patients treated with IABP was 33%. In our study, we did not have any mortality or major complications related to IABP. The three recent meta analyses regarding use of IABP in high risk CABG surgeries,[25-27] showed a mortality benefit in CABG with IABP but in most of the RCTs included in these meta analyses, IABP insertion was done before surgery. Most of the studies conducted in cardiac surgery on IABP insertion were in preoperative high risk elective groups. Our study showed a significant improvement in hemodynamics and no mortality when IABP was used as rescue measure intraoperatively during severe hemodynamic instability.

Unlike cardiogenic shock associated with acute MI where the role of IABP is controversial according to current literature, cardiogenic shock or pump failure associated with cardiac surgery has various contributing etiological factors. Even though many studies have showed a mortality benefit for usage of IABP in cardiac surgery,[16,27] there is down grading of recommendations from class I to class II for IABP usage by American Heart Association/American College of Cardiology (AHA/ACC). A large multicentric RCT is needed to see that efficacy of IABP support as a rescue measure in pump failure associated with cardiac surgery.

### Conclusion

In a retrospective analysis of 34 patients, who have undergone conventional CABG and received IABP as a rescue mechanical support for severe hemodynamic disturbances, showed: significant improvement in hemodynamics post IABP insertion; Improvement in EF at discharge from hospital; No mortality at discharge from hospital and 30 days postoperatively. Limitations: It is a retrospective analysis of small sample single centre study. The exact mortality benefit could not be studied as there is no control group.

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