Mortality Predictors for Intra Aortic Balloon Pump Support after Cardiac Surgery

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Abstract:

Objectives: Mechanical circulatory assistance is frequently needed to support the failing heart. The aim of this study was to determine perioperative prognostic factors for hospital mortality in patients undergoing open heart surgery who required intra-aortic balloon pump support

Methods: 202 patients requiring IABP support were analyzed over an 11 year period from which 117 survived the 30 days follow-up. The male to female ration was 115/87. Perioperative risk factors such as age, weight, underlying diseases, ejection fraction, ventricular aneurysm, and cardiopulmonary bypass and cross clamp time were recorded and analyzed.

Results: The overall operative mortality was 42.1%. The early mortality was related to older age and prolonged CPB time. The patients' age, gender, weight, preoperative ejection fraction, ventricular aneurysm and left main coronary stenosis didn't affect the mortality rate.

Conclusions: IABP represents a safe option of supporting the failing heart in the older patients undergoing shorter cardiac surgeries.

Keywords: Intra aortic balloon pumping; coronary artery bypass grafting; mortality

Introduction:

Intra-aortic balloon pump (IABP) is the most usable tool for temporary mechanical circulatory support in cardiac surgical patients suffering from low cardiac output in the early postoperative phase. Only in United States, more than 70.000 patients are supported annually by intra aortic balloon pump (IABP) [1, 2]. Its beneficial action is attributed to a concomitant reduction in afterload of left ventricle, and a substantial increase on coronary perfusion pressure due to an increase in aortic diastolic pressure in addition with subendocardial perfusion enhancement [3-6].

The main indication of IABP in cardiac surgical patients is peri-operatively in the treatment of a low cardiac output state refractory to the usual inotropic support. Furthermore, it has been used prior to surgery in patients having sustained mechanical complications following myocardial infarction, as well as patients with refractory angina [7-9]. The hospital and also the 30-day mortality of the patients necessitating IABP is high because of the underlying cardiac problems that led to the need for this pump, ranged from 26% to 50% [2, 8, 10]. Several studies have focused on prognostic factors of death in patients treated with IABP, and a great variety of results were found because of the diversity of indications for IABP and patient populations [6].

The aim of this retrospective study was to analyze the hospital outcome of pa-

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tients underwent open heart surgery with IABP support. It includes a risk analysis by means of looking into variables predicting mortality.

Patients and methods:

A total of 202 patients who required support with IABP Between January 1999 and December 2010 entered this Cross sectional study. The mean age was 56.4 +/- 11.8 years (range from 34 to 87 years).

There were 115 (59.9%) male and 87 (43.1%) female patients. First operation was carried out in178 patients (88.1%) and re-operations in 24 patients (11.9%). Data pertaining to the patients past medical history and variables including age, gender, prevalence of diabetes mellitus (DM), hypertension (HTN) and hyperlipidemia (HLP), left main coronary artery disease (LMCA) , Body Surface area (BSA), Body mass index (BMI), Pre-operative ejection fraction (EF), presence of left ventricular aneurysm, operative priority, cardiopulmonary bypass (CPB) time, aortic cross clamp (ACC) time, Reoperation during hospitalization, and status following the procedure were recorded. The myocardial protection of choice was Blood cardioplegia solution delivered every 20 minutes in an antegrade fashion.

Indications for IABP support were: a) patients unable to be discontinued from CPB even under full dose inotropes, b) patients in low-cardiac output status just after a "difficult" discontinuation of CPB, supported by high dose inotropes, c) patients with "difficult" discontinuation from CPB and spontaneous appearance of arrhythmia (premature ventricular beats or VT) not responsive to continuous infusion of anti-arrhythmics and e) post cardiotomy low cardiac output syndrome. Prophylactic IABP support was not advocated in any of the cases. A datascope system (Datascope Corp, Paramus, NJ) was utilized and The IABP was introduced percutaneously through the common femoral artery.

Correct placement of the device was routinely confirmed with Chest X Ray in ICU. Once mediastinal drainage was minimum (< 50 ml/h), patients were anticoagulated with Heparin infusion to keep the ACT >180-200 sec. Routine administration of a Cephalosporin 1fr generation was maintained throughout the IABP support. Operative mortality is reported as 30 day mortality. Patients who survived the first 30 days were considered and Group A, and those who died were considered as group B.

Statistical analysis

Collection of the data is served using the Patients Analysis and Tracking System (PATS) software. Variables were retrospectively collected and carefully validated before the analysis. A regression analysis was performed to evaluate the effect of each variable independently on the mortality rate.

Results:

Baseline and operative characteristic of a total of 202 patients were recorded. There were 87 (43.1%) female and 115 (59.9%) male patients in the study. The overall 30 day mortality was 42.1% and female to male mortality ratio was 43/42 (P=0.06), so the patients' sex didn't affect the mortality rate statistically but the difference in clinically considerable. The regression analysis evaluated the effect of each

Table 1) Baseline characteristics and Regression analysis results on the impact of each variable on the mortality rate independently

	Group A	Group B	Regression Analysis Results
Patients' number	116	85	
Age (years)	58.49 ± 11.29	53.99 ± 20.88	P < 0.05*
BSA(m^2)	1.71 ± 0.2	1.67 ± 0.16	P = 0.29
BMI	25.75 ± 4.09	25.45 ± 1.95	P = 0.65
DM	23	23	P = 0.21
HTN	38	33	P = 0.32
HLP	35	33	P = 0.16
LV Aneurysm	10	4	P = 0.41
Pre-op EF (%)	36.75 ± 12.49	38.53 ± 16.49	P = 0.12
LMCA involvement	39	35	P = 0.15

This table shows a significant relation between the mortality ratio and patients' age after IABP use.

Table 2) Intraoperative characteristics and Regression analysis results on the impact of each variable on the mortality rate independently

	Group A	Group B	Regression Analysis Results
CPB time (Min)	72.81 ± 30.75	159.99 ± 26.81	P < 0.05*
ACC time (Min)	71.87 ± 37.33	135.31 ± 56.21	P > 0.05
Emergent Surgery	21	9	P = 0.9
Re-operation	15	9	P = 0.62

This table shows a significant relation between the mortality ratio and CPB time after IABP use.

variable on the mortality rate independently (Table 1 and 2). Mean age of group A was 58.49 ± 11.29 vs. 53.99 ± 20.88 years in group B ($P < 0.05$). Patients of group B had a longer CPB time than those of group A (72.81 ± 30.75 vs. 159.99 ± 26.81 minutes; $P < 0.05$). The mortality rate was higher in younger patients and those who underwent CBP for longer. There were no significant relationship between the mortality rate and gender, prevalence of diabetes mellitus, hypertension and high cholesterol, left main disease, BSA, BMI, Pre-operative ejection fraction, presence of left ventricular aneurysm, operative priority, and cross clamp time. (Table 1 and 2)

Discussion:

The need for increased use of IABP during cardiac surgery in the recent years has been reported by many groups [7, 11]. This is mainly due to the fact that the patient population has changed and includes older patients with multi-vessel disease and more ventricular dysfunction now days. On the other hand, there is a lower threshold for IABP use due to improved technology and lower rate of complications [7]. The main findings of the present study are that the mortality rate is significantly related to age and cardiopulmonary bypass time. These findings are in accordance with the results of Gutfingers and colleagues that reported high-risk patients older than 70 yrs undergoing CABG with preoperative IABP had lower mortality rate compares to control group (12). The CPB time was prolonged (159.9 ± 26.8 min) for the complex cases that was mostly due to: bleeding, a prolong "resting on CPB" after aortic cross-clamp removal because of difficulties in weaning from CPB, and a rather high threshold for intraoperative IABP insertion. Throughout the literature the mortality rates range widely from 7% to 86% [13, 14]. This is probably due to the heterogeneous groups of patients considered. With the wide range of indications some series have included low risk patients, whereby the device was inserted prophylactically, with subsequent favorable outcome. The overall mortality in our series was around 42.1% which obviously reflects a population of high risk patients. Incremental risk factors for perioperative death have been reported by various investigators [15, 16, and 17]. In a large retrospective study by Torchiana et al [16], age, MVR, prolonged CPB time, emergency operation, preoperative renal dysfunction, ventricular arrhythmias, right ventricular failure and emergency reinstitution of cardiopulmonary bypass were independent predictors of death. In another elegant study by Arafa et al [17] serum creatinine levels, EF, perioperative MI, timing of IABP insertion and indication for operation were independent predictors of early death. Although our study includes smaller number of patients the incremental risk factors for early death are age and prolonged CPB time reports.

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