Emergency Off-Pump Coronary Artery Bypass Graft Surgery for Patients on Preoperative Intraaortic Balloon Pump

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Background. **The aim of this study was to investigate early and long-term outcomes of patients with acute coronary syndrome preoperatively requiring intraaortic balloon pump support who underwent emergency off-pump coronary artery bypass graft surgery.**

Methods. **One hundred and fifteen patients on preoperative intraaortic balloon pump receiving emergency off-pump coronary artery bypass graft surgery over an 11-year period were evaluated. The median age was 71 years (range, 33 to 87). Acute myocardial infarction and unstable angina were present in 54 patients (47.0%) and 61 patients (53.0%), respectively. Left main disease and triple-vessel disease without left main involvement were present in 74 patients (64.3%) and 33 patients (28.7%), respectively.**

Results. **There were 3 perioperative deaths. Complete surgical revascularization was accomplished in 82 patients (71.3%), and in situ internal thoracic artery graft was used in 96 (83.5%). Late survival, freedom from major adverse cardiac and cerebrovascular events, and freedom from repeat revascularization rates at 5 years were 83.3%, 73.5%, and 84.2%, respectively. The Cox multivariate prognostic predictors of total mortality were preoperative renal impairment (hazard ratio [HR] 7.90; 95% confidence interval [CI]: 3.06 to 20.4) and low ejection fraction (HR 0.94, 95% CI: 0.88 to 0.99). The multivariate risk predictors of major adverse cardiac and cerebrovascular events were preoperative renal impairment (HR 2.68, 95% CI: 1.00 to 7.19) and peripheral vascular disease (HR 2.81, 95% CI: 1.05 to 7.51), and complete revascularization was protective (HR 0.39, 95% CI: 0.19 to 0.81). The multivariate risk factor of repeat revascularization was previous percutaneous coronary intervention (HR 3.26, 95% CI: 1.14 to 9.33), and complete surgical revascularization was also protective (HR 0.30, 95% CI: 0.11 to 0.85).**

Conclusions. **Off-pump coronary artery bypass graft surgery is a feasible option for patients requiring preoperative intraaortic balloon pump support.**

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Surgical revascularization plays an essential role in the treatment of the patients with acute coronary syndrome (ACS) exhibiting complex coronary anatomies and hemodynamic instability even in the era of widely prevalent percutaneous coronary intervention (PCI). According to the Acute Catheterization and Urgent Intervention Triage Strategy (ACUITY) trial, coronary artery bypass graft surgery (CABG) demonstrated a good survival benefit for patients with ACS excluding ST-segment elevation myocardial infarction, with approximate operative mortality of 3.3% [1]. Biancari and colleagues [2] reported 10.1% inhospital mortality for emergency CABG in ACS patients including ST-segment elevation myocardial infarction [2].

It has been discussed whether off-pump coronary artery bypass graft surgery (OPCABG) has a better survival benefit than on-pump coronary artery bypass graft surgery (ONCABG), or vice versa for this subset of patients, and the optimal surgical approach still remains a matter for debate [2–7]. Immediate postoperative mortality benefit for OPCABG has been advocated since it could avoid inflammatory burden caused by cardiopulmonary bypass on those who is already in proinflammatory state with acute myocardial damage. Concerns exist, however, over the possibility of fewer grafts and incomplete revascularization due to technical difficulties, especially during anastomosis of the circumflex branches, with hemodynamic instability on upward positioning of the acutely ischemic heart. Conflicting results have been reported about whether fewer grafts or incomplete revascularization have a negative impact on long-term outcomes, including repeat revascularization. According to the literature, long-term survival after emergency OPCABG varied from 24.6 to 85.4% [4, 5].

A limited number of analyses have been reported in the literature on the feasibility of OPCABG and its long-term effect on ACS patients, and few studies have been

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Abbreviations and Acronyms

ACS = acute coronary syndrome
AMI = acute myocardial infarction
CABG = coronary artery bypass grafting
CI = confidence interval
HR = hazard ratio
IABP = intraaortic balloon pump
ITA = internal thoracic artery
LAD = left anterior descending coronary artery
MACCE = major adverse cardiac and cerebrovascular events
ONCABG = on-pump coronary artery bypass graft surgery
OPCABG = off-pump coronary artery bypass graft surgery
PCI = percutaneous coronary intervention

published on the long-term results of OPCABG for the ACS patients requiring preoperative intraaortic balloon pump (IABP) support. The aim of this study was to analyze the early and long-term outcomes of OPCABG for high-risk ACS patients preoperatively on IABP and to identify the prognostic factors for late outcomes, including the need for repeat revascularization.

Patients and Methods

From January 2004 to December 2014, 747 patients underwent isolated CABG in our facility. Among them, 115 patients (15.4%) with ACS requiring preoperative IABP support underwent emergency or urgent OPCABG, and constituted the study cohort. The patients with ACS who did not require IABP support preoperatively or those for whom ONCABG was intended before surgery were excluded from the study. The IABP support was begun for all patients in the cardiac catheterization laboratory on the cardiologists' decision. The indications for IABP insertion were hemodynamic instability or ongoing ischemia with persistent chest pain and ST-segment change on electrocardiogram with left main disease or multivessel disease with involvement of critical lesions of the proximal left anterior descending artery (LAD). Thirty patients (26.1%) received IABP owing to hemodynamic instability, and 85 patients (73.9%) received IABP owing to hemodynamically stable ongoing ischemia with intractable chest pain and ST-segment change on electrocardiogram. No patient received IABP merely for the reason of critical coronary anatomy. OPCABG was the first choice for patients who were relatively stable on IABP support, whereas ONCABG was limited to patients who had cardiac arrest, including ventricular arrhythmia requiring defibrillation, patients with hemodynamic deterioration even with IABP, patients who were on percutaneous mechanical circulatory support device, or patients who required concomitant procedures such as valve repair or replacement.

The median follow-up was 40 months (range, 0 to 126). Preoperative patient characteristics are shown in Table 1. Nine patients (7.8%) were in cardiogenic shock, of whom 4 (3.5%) required intubation before surgery and 6 (5.2%) required catecholamine support. Three patients (2.6%) required temporary pacing owing to bradycardia. One patient (0.87%) had cardiac tamponade requiring pericardiocentesis before surgery. The ACS caused by PCI problems was seen in 4 patients (3.5%). All the operations were performed through median sternotomy. The arterial grafts were harvested in fully skeletonized fashion using the Harmonic scalpel (Ethicon Endo-Surgery, Cincinnati, OH). The internal thoracic artery (ITA) to LAD anastomosis was performed first, and intracoronary shunts were routinely used only for that anastomosis. Silicone coronary artery snares (Quest Medical, Allen, TX) were used to occlude the vessels of other territories. Ischemic preconditioning was not used. The Starfish heart positioner (Medtronic, Minneapolis, MN) was used for an appropriate heart positioning for distal anastomoses of the circumflex and the right coronary arteries. Proximal anastomoses of the vein grafts were usually performed with

Table 1. Preoperative Patient Characteristics

Preoperative Characteristics	Values (n = 115)
Age, years	71 (33–87)
Female	24 (20.9)
Hypertension	91 (79.1)
Dyslipidemia	82 (71.3)
Diabetes mellitus	61 (53.0)
Insulin dependent	11 (9.57)
Oral antiglycemic agents	40 (34.8)
Smoker	46 (40.0)
History of cerebrovascular accident	14 (12.2)
Previous myocardial infarction	12 (10.4)
History of PCI	34 (29.6)
Peripheral artery disease	16 (13.9)
Serum creatinine, mg/dL	0.79 (0.43–12.61)
Hemodialysis	9 (7.83)
LVEF, %	50.0 (25.0–71.9)
Acute myocardial infarction	54 (47.0)
STEMI	42 (36.5)
Non-STEMI	12 (10.4)
Unstable angina	61 (53.0)
Three-vessel disease	69 (60.0)
Left main disease	74 (64.3)
LMD plus three-vessel disease	36 (31.3)
Two-vessel disease without LMD	7 (6.09)
One-vessel disease	1 (0.87)
EuroSCORE II	10.2 (3.70–60.5)

Values are n (%) or median (range).

EuroSCORE = European System for Cardiac Operative Risk Evaluation; LMD = left main disease; LVEF = left ventricular ejection fraction; PCI = percutaneous coronary intervention; STEMI = ST-segment elevation myocardial infarction.