CORONARY ARTERY BYPASS SURGERY FOR ACUTE CORONARY SYNDROME:OFF-PUMP VERSUS ON-PUMP APPROACH

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Abstract

Background: Aim of this study was to compare the outcome of off-pump versus on-pump coronary artery bypass strategies in acute coronary syndromes setting.

Methods and Results: Consecutive patients for coronary artery bypass surgery (CABG) were reviewed. Cases with acute coronary syndrome (ACS) receiving emergency CABG surgery via midline sternotomy from June 2006 to September 2007 were evaluated. Altogether 27 patients were operated for ACS either off-pump (OPCAB) n=16, or conventional on-pump (CPB) n-11. Seventy four grafts were performed in all with a mean of 2.74. Twenty patients between both groups had 3 or more grafts; with an aim of complete revascularization. Time from skin incision to culprit lesion revascularization was significantly reduced in OPCAB patients. OPCAB surgery led to a significant benefit in terms of less drainage loss, less transfusion requirement, less inotropic support, shorter ventilation time, and shorter intensive care unit stay.

Conclusions: Off-Pump strategies are associated with an improved hospital outcome for high-risk patients presenting acute coronary syndrome with or without cardiogenic shock.

Key Words: acute coronary syndrome • beating heart surgery • Off-Pump CABG • cardioplegia • cardiopulmonary bypass • myocardial infarction

INTRODUCTION

The use of off pump (OPCAB) versus conventional on pump (CPB) strategies for myocardial revascularization is being intensively debated at present. There are varying results from different studies comparing off with on pump coronary artery bypass graft (CABG) procedures. Overall, routine patients may achieve an excellent outcome with either type of procedure(1-8), whereas there is consistent evidence of less myocardial enzyme and troponin release in off-pump surgery(4,5,9). In recent years further efforts were made to identify high-risk subgroups that may benefit more from OPCAB strategies. These included elective patients with poor left ventricular function, older age, renal or neurological dysfunction, and recent myocardial infarction (MI), but clinical results were inconsistent (10-13).

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Patients with evolving acute coronary syndrome (ACS), defined as continuum from unstable angina (UA) to non-ST-segment elevation MI (NSTEMI) to ST-segment elevation MI (STEMI) display a high-risk entity in CABG surgery. Perioperative mortality is increased several fold compared with patients with stable angina and it may be advisable to delay surgical intervention whenever possible. However, in presence of refractory symptoms, hemodynamic alterations, or in STEMI patients, emergency surgical therapy within the first hours is indicated. Operative mortality for these patients using conventional arrested heart CABG techniques ranges from 1.6% to 32% and strongly depends on the preoperative hemodynamic condition (14-20).

It can be speculated that preserving native coronary blood flow reduce reperfusion injury or "no reflow" phenomenon and advantages of OPCAB surgery might be clinical significant in emergency ACS patients. However, until now not much evidence exist on that issue and only a few have analyzed the impact

on morbidity and mortality by using OPCAB approaches in these patients (21-24). The aim of this study was to analyze our short experience on patients with ACS and having an indication for emergency CABG surgery within the first 24 hours after onset of symptoms comparing OPCAB and CPB CABG.

PATIENTS AND METHODS

Between June 2006 & September 2007, one hundred and sixty two patients were operated for coronary artery bypass grafting. Eighty one patients of them bypass grafting performed on beating heart without the use of cardiopulmonary bypass (OPCAB group). Further eighty one cases were performed with conventional cardiopulmonary bypass (CPB group). Twenty seven (16.7%) of the patients presented with ACS, and had an emergency indication for CABG. Unstable angina (UA) as ongoing ischemia despite optimal medical therapy was present in 21 patients, ST elevation MI (STEMI) in 4 patients, and failed percutaneous coronary intervention (PCI) in 2.

The decision to perform CABG off-pump, or conventional on-pump was individually based on the preoperative assessment of the surgeon, including patients' preoperative hemodynamics, concomitant diseases, and extent of ACS. Routine sternotomy and internal mammary artery harvest were applied. OPCAB surgery was performed using standard pericardial traction sutures. Octopus-4 stabilizing device (Medtronic Inc. Minnesota) was used to stabilize the cardiac segment where distal anastomosis was constructed. Norepinephrine infusion was routinely made available in OPCAB cases for heamodynamic regulation, while the heart was being manipulated during anastomosis. No preconditioning or intracoronary shunt insertions were performed. Proximal coronary snares were used when required. All anastomoses were performed using 6-0 or 7-0 monofilament sutures. The internal mammary artery (IMA) to the left anterior descending artery (LAD) was the first anastomosis in all patients, except that another culprit lesion was clearly identified. For LAD revascularization, IMA was used in all patients. In case conventional CABG, CPB was established by standard ascending aortic and right atrial cannulation. Moderate hypothermia of 28°C was applied. At the end of the operation heparin was antagonized with protamine sulfate. Full surgical revascularization was the aim in all patients and hybrid procedures were not considered. In the ICU patients were kept ventilated till the body temperature was at least 34.5°C, patient was haemodynamicaly stable, drainage was settled and the patient was conscious and oriented with good arterial blood gases on 40% fractional inspired oxygen. Fluid replacement and serum K+ levels were monitored for first 48 hours following surgery. The statistical analyses were performed using 13.0 SPSS software package.

RESULTS

Altogether 162 cases were analysed. There were 81(50.0%) patients in OPCAB group and remaining 81(50.0%) in CPB group. Mean age was 54.01 (SD= 8.67). Average weight of the patients was 69.66 kg {(SD=10.02)Table I}. Twenty seven patients presented as acute coronary syndrome (Fig.I). Two of them were referred due to acute stent occlusion of LAD with evolving infarct, associated with ECG changes and enzyme elevation. Four had ST elevation MI; two of these were given thrombolytic therapy but to no avail. Majority (n=21) of the patients had unstable angina; unrelieved by medical therapy.

Table-I

Demographic Description

	Minimum	Maximum	Mean	Std. Deviation
Weight	45	94	[illegible]	[illegible]
Age	28	75	54.01	8.679

Nineteen patients had an attempt to OPCAB; 16 had successful completion of surgery. Three patients needed conversion to conventional on-pump procedure. Remaining 8 patients had elective on-pump surgery. Four patients in OPCAB group and 10 in CPB had critical left main stenosis (Fig II).

Figure-I
Case Distribution

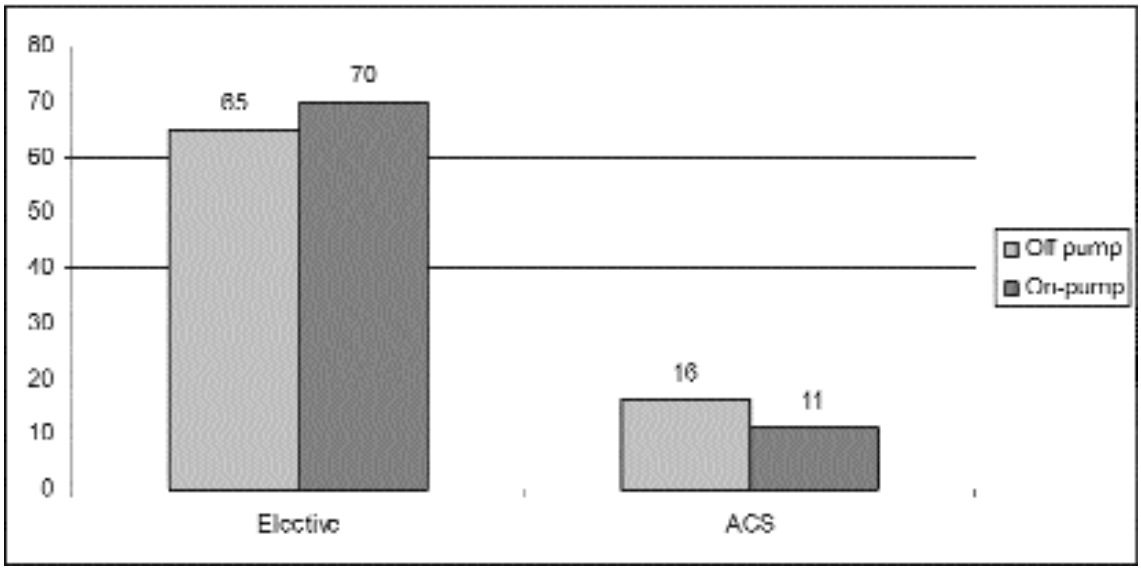
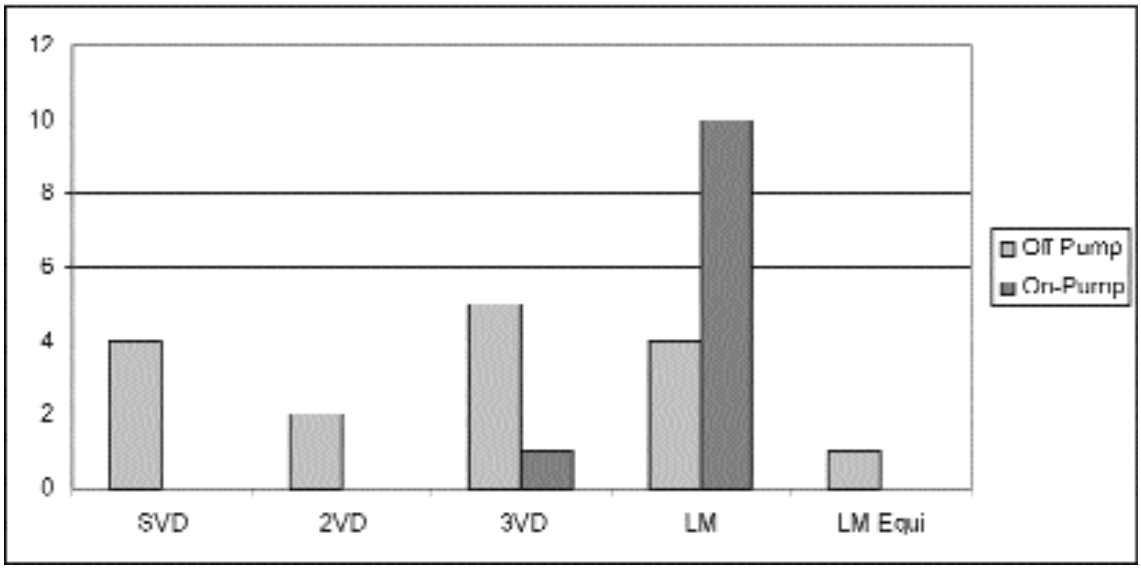


Figure-II
Vessels Involvement



Altogether five patients in both groups had triple vessel disease, 4 (including one as left main equivalent) and 1 respectively (Fig II). There were more sick patients with moderate to severe LV dysfunction in OPCAB group compared to CBP group (Fig III). In all 74 coronary anastomoses were performed with a mean number of graft performed per patient was 2.74 {(SD=0.944) Fig IV}. There were three deaths, two of them had left main disease and presented with unstable angina. These were attempted OPCAB but had to be converted to CBP. One patient had CPB CABG and could not survive.

Twenty patients among ACS group were on some form of antiplatelet and/or anticoagulant therapy (Fig V). Yet post operative bleeding did not remain a concern; only 5 patients bled in excess of 1000ml (Fig VI). Interestingly 4 of these 5 patients who bled in excess of 1000 ml over first 24 hours were operated on-pump(CPB), and the remaining one did not take any anti-platelet therapy. Correspondingly transfusion requirement were reduced in OPCAB group and this difference was also statically significant {(p=0.03) Fig VII}.

Figure-III
Ejection Fraction

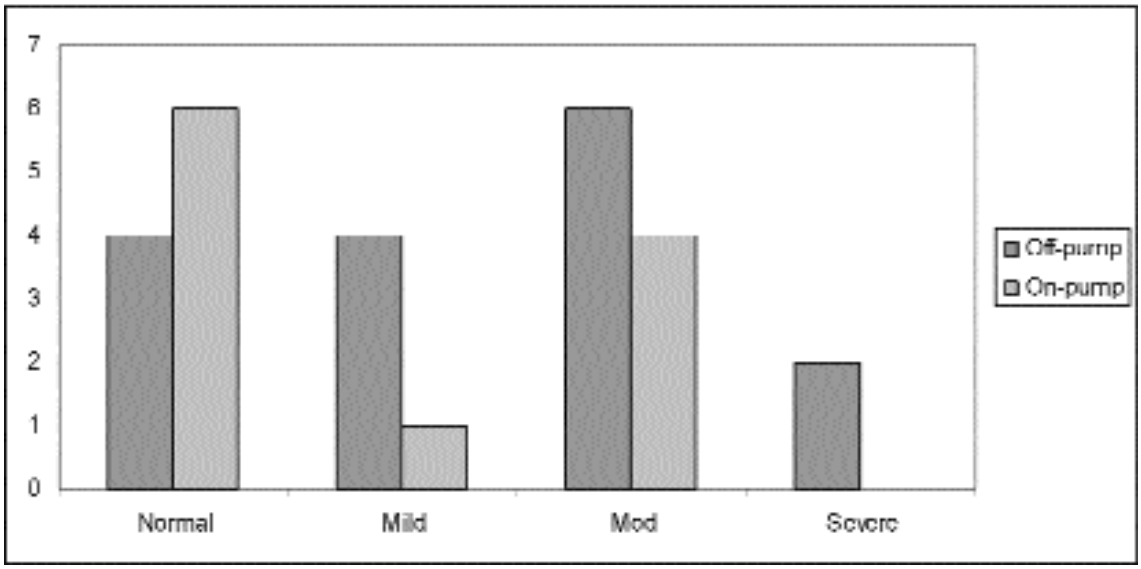
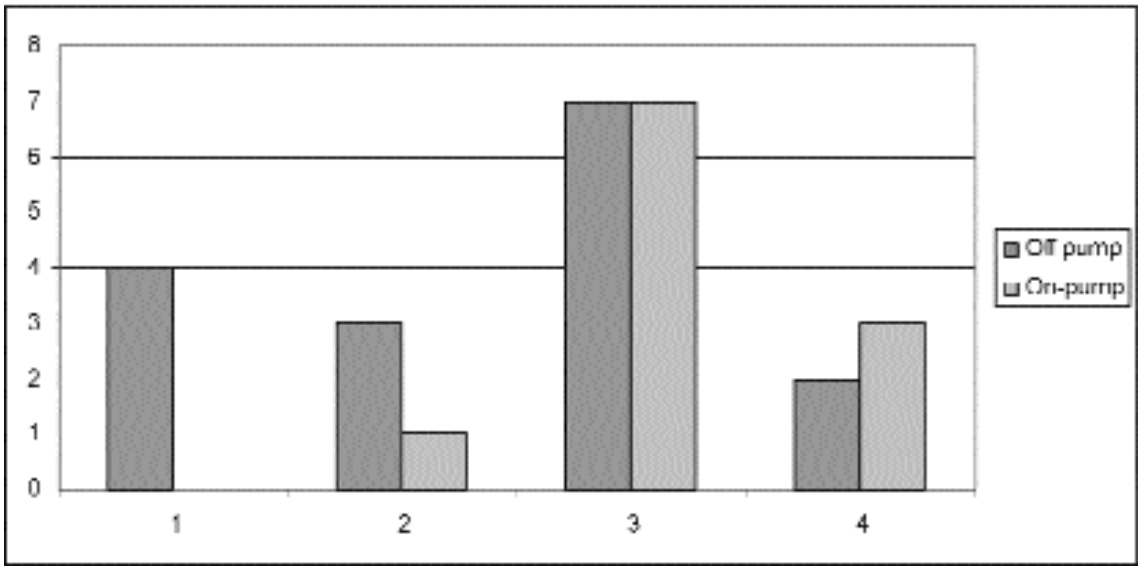


Figure-IV
No. of Coronary Anastomosis



Post operative recovery in the ICU was faster in OPCAB group (Fig VIII). Operative and post operative blood loss was still recorded low and statically significant in OPCAB group. Similarly post-op hospital stay was significantly shorter in OPCAB group (Fig IX). Clinical data concerning myocardial injury were comparable in both groups.

DISCUSSION

Current indications for emergency CABG surgery in ACS patients are limited to those presenting with evolving myocardial ischemia refractory to optimal medical therapy, presence of left main stenosis and/or 3-vessel disease, ongoing ischemia despite successful or failed PCI, complicated PCI, or cardiogenic shock accompanied by complex coronary anatomy.

It can be speculated that maintaining native coronary blood and avoiding global myocardial ischemia is the optimal treatment strategy for ACS patients whenever CABG surgery is indicated. More and more centers

Figure-V
Anti Platelet Therapy

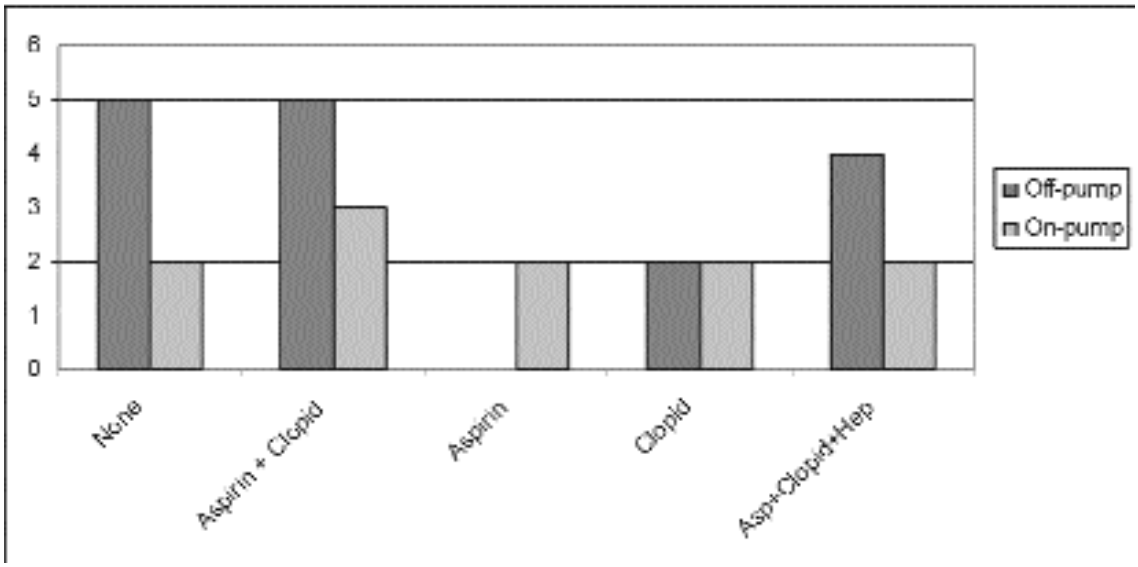
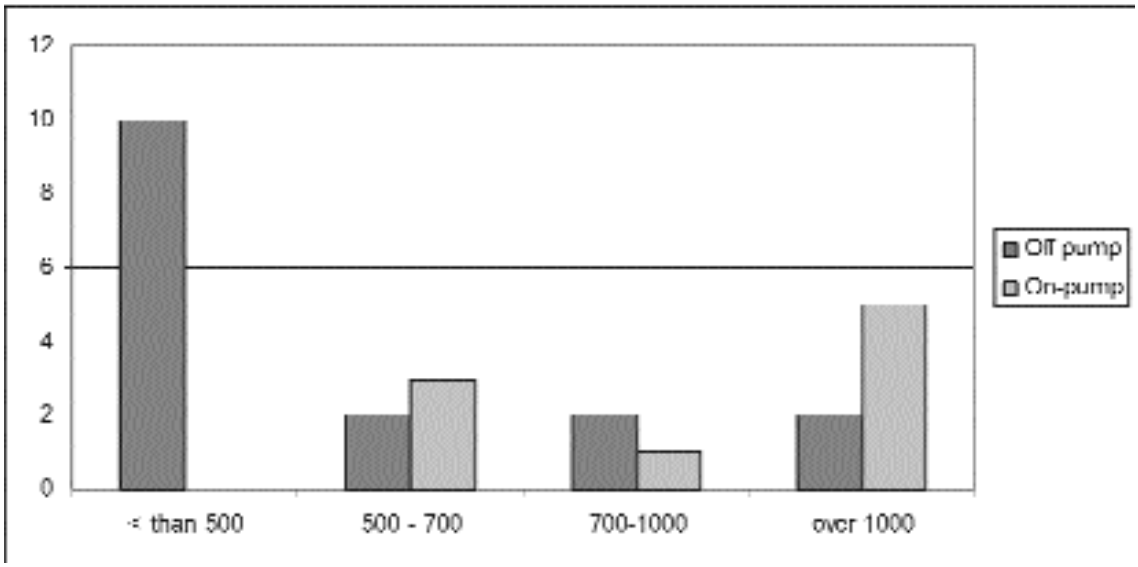


Figure VI
Post-op Blood Loss



on the basis of encouraging experience in high-risk patients (21-24), are contemplating OPCAB as first option to emergency ACS patients rather than conventional CABG. At our centre also we are more interested to perform OPCAB surgery in sicker patients and in presence of CS. However patients with left main disease may still be better off by CPB technique. In our series 8 left main cases were electively operated on-pump; two of the OPCAB left main cases had to be converted to CPB who could not survive surgery.

Perioperative mortality for emergency revascularization in acute MI patients presenting under stable hemodynamic condition and using conventional CABG is varying. Creswell et al indicated a mortality rate of patients operated within 6 hours after onset of acute MI symptoms of 9.1% (17). In a multicenter analysis of 32 099 patients who underwent conventional CABG within 24 hours after AMI, hospital mortality was 14% (19). Tomasco et al indicated a similar mortality rate of 13.4% for

Figure VII
Transfusion Requirements

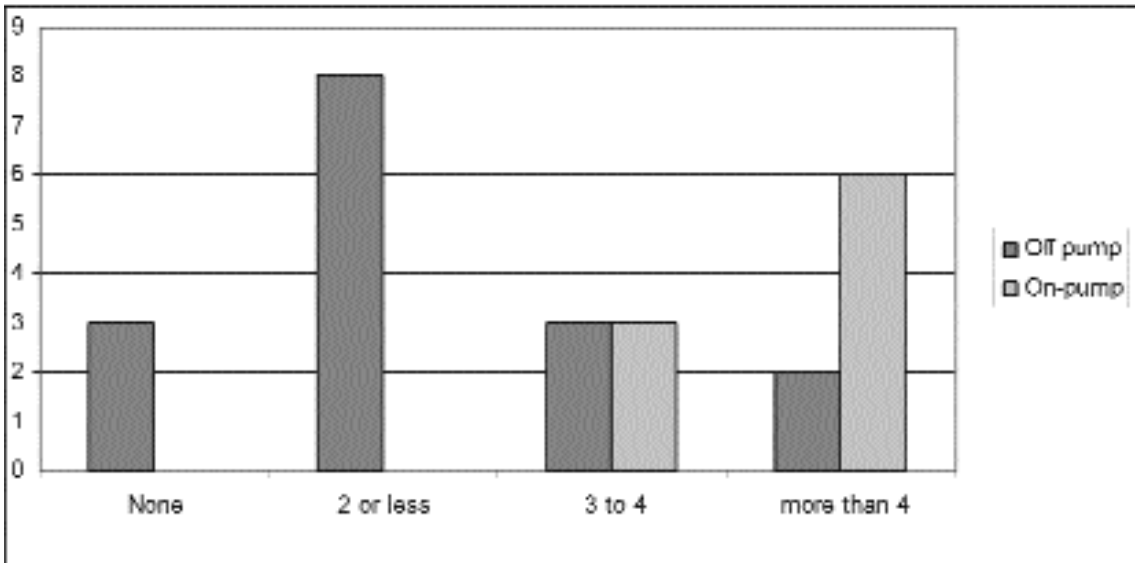
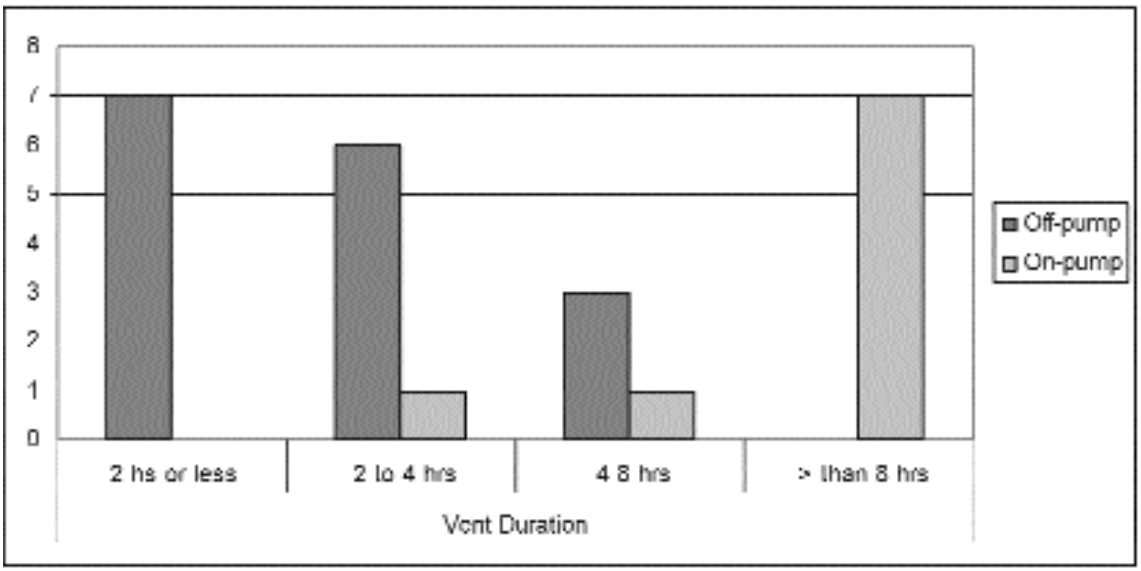


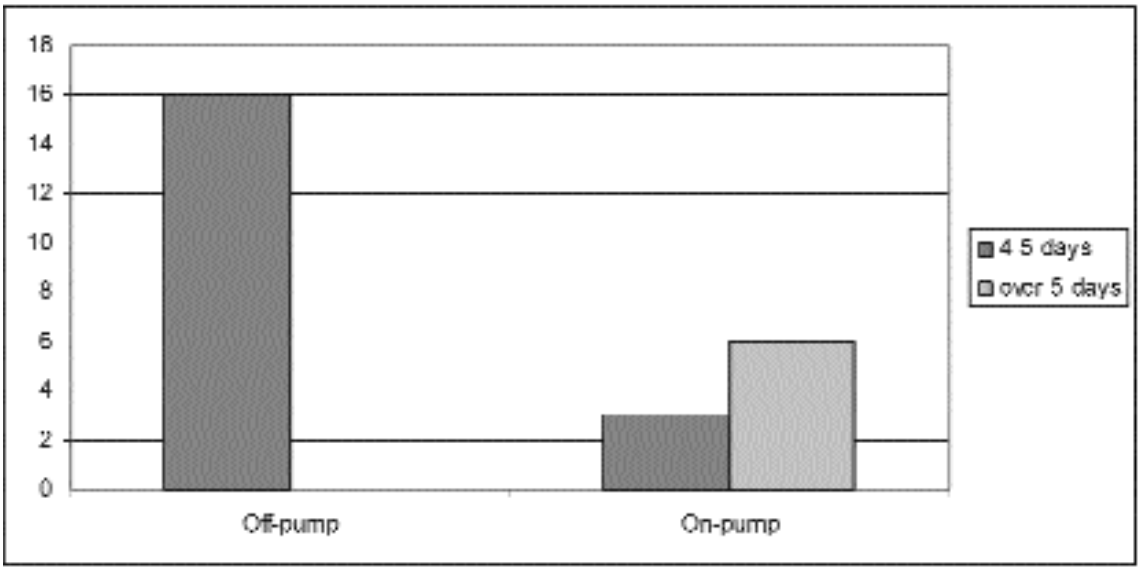
Figure VIII
Post Surgery Ventilation



patients operated within 24 hours after acute MI (15). However, Sergeant et al found a remarkably lower mortality rate of 1.6% for this subset of patients(16). In a retrospective analysis of 225 patients operated within <7 days after acute MI, Locker reported a significantly reduced perioperative mortality for the OPCAB group (22). The present analysis on a small number of patients revealed a trend toward a lower mortality in stable patients when operated by OPCAB. Also, perioperative morbidity was significantly reduced as indicated by lower requirement for postoperative inotropic support, less blood loss, shorter ventilation time. This is in line with other studies that demonstrated lower neurological injury in off-pump surgery in elective patients (25-27). Postoperative inotropic support was reduced in OPCAB patients. None of the patients however needed intra aortic balloon implantation.

Patients with cardiogenic shock have a mortality rate ranging from 21.3% to 46.7% (15,16,28). The data from the SHOCK trial particularly revealed a benefit

Figure IX
Post Surgery Hospital Stay



of early revascularization strategies and also superiority of CABG compared with PCI. Stroke rate and the incidence of acute renal failure are also significantly reduced in OPCAB patients. OPCAB is advantageous to reduce extracardiac complications in these high-risk patients. This is attributed to preserved pulsatility in circulatory flow that has a protective potential, although a renoprotective effect of OPCAB surgery in elective patients is controversially discussed (29-31).

The purpose of our study was to analyze the impact of preserved native coronary blood flow during emergency treatment for ACS. It is felt that OPCAB is a safe option in this sick group patients. In case of left main disease, CPB still remains a better choice.

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