Original Article

Outcome of Patients after Coronary Artery Bypass Grafting in Cardiogenic Shock

Mudassir Iqbal Dar, FRCS (C/Th), Atta Ul Manan, MBBS, Binish Rasheed, MBBS, Ghulam Murtaza, MBBS, and Mansoor Ahmad, DSc

Purpose: Coronary artery bypass graft (CABG) surgery in patients with cardiogenic shock (CS) is a rare and very high-risk procedure carrying high mortality. In this study we reviewed hospital outcomes and 1-year survivals in these high-risk patients.
Materials and Methods: During a 4-year period (May 2001 to April 2005), 412 patients were operated on for CABG by a single surgeon, and 13 (3.1%) of them were in CS at the time of procedure.
Results: The 30-day mortality of patients who underwent CABG during CS was 16%, and mean age was 57±10 years. A total of 77% were male, 77% were hypertensive, 38% were diabetic, and 31% had renal impairment. Myocardial infarction (MI) affected 62% within 48 h of surgery. Moderate to poor left ventricular function was found in 92%. Twenty-three percent had a preoperative intra-aortic balloon pump. Postinfract ventricular septal defect was present in 16%, and catheter-related problems were present in 23% of patients. After 1 year, all patients (11) were alive, and 85% of them were in New York Heart Association (NYHA) classes I to II.
Conclusion: CABG in CS produces significant 1-year survival benefits and improvements in functional class. Therefore, early surgical intervention is suggested where percutaneous coronary intervention is not possible or contraindicated for anatomical reasons. (Ann Thorac Cardiovasc Surg 2007; 13: 247–250)

Key words: coronary artery bypass graft, cardiogenic shock, survival

Introduction

Cardiogenic shock (CS) complicates 7–10% of cases of acute myocardial infarction (MI) and is associated with a 70–80% mortality rate.[1,2] According to the SHOCK (SHould we emergently revascularize Occluded Coronary arteries for cardiogenic shocK) trial clinical criteria for CS, a systolic blood pressure of less than 90 mmHg for 30 min before inotropes/vasopressors, a vasopressor, or an intra-aortic balloon pump (IABP) is required to maintain systolic blood pressure at 90 mmHg or more, evidence of decreased organ perfusion, pulmonary capillary wedge pressure of 15 mmHg or more, and a cardiac index of 2.2 $L \cdot min^{-1} \cdot m^{-2}$ or less.[3] Although the overall incidence of CS remains unchanged, mortality rate is decreasing significantly with time. This partly reflects the greater use of revascularization, which is associated with a better outcome.[4,5] Therefore we collected our data from one surgical department and analyzed the in-hospital mortality and 1-year survival of these high-risk patients who developed CS and were operated on for coronary artery bypass surgery.

From Department of Cardiothoracic Surgery, Liaquat National Hospital, Karachi, Pakistan

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Address reprint requests to Mudassir Iqbal Dar: Asst. Professor Cardiac Surgery, Dow University of Health Sciences, Baba-e-Urdu Road, Karachi, Post code 74200, Pakistan.

Materials and Methods

Over a 4-year period from April 2001 to March 2005, a total of 412 patients underwent coronary artery bypass

Table 1. Preoperative variables

Age (years)	57±10
Males	10 (77%)
Diabetes mellitus	5 (38%)
Hypertension	10 (77%)
Renal impairment	4 (31%)
Ejection fraction	
>30%	1 (8%)
30–50%	7 (54%)
<30%	5 (38%)
MI	
<6 h	4 (31%)
<2 days	4 (31%)
Preoperative inotrops	9 (69%)
Preoperative IABP	3 (23%)
Cause of shock	
Recent MI	8 (61%)
Post MI VSD	2 (16%)
Catheter-related problems	3 (23%)

Data are shown as a number followed by percentage in parentheses or mean with standard deviations. MI, myocardial infarction; IABP, intra-aortic balloon pump; VSD, ventricular septal defect.

Table 2. Intraoperative variables

No. of grafts	2.5±1
CPB (min)	108±28
X-clamp (min)	64±29
VSD closure with CABG	2 (16%)

Data are shown as a number followed by percentage in parentheses or mean with standard deviations. CPB, cardiopulmonary bypass; X-clamp, aortic cross-clamp; VSD, ventricular septal defect; CABG, coronary artery bypass grafting.

surgery by one surgeon and one anesthesiologist in a single institution (Liaquat National Hospital, Karachi, Pakistan). All patients who were referred for surgery after postinfract CS or mechanical complication were analyzed.

All patients with CS had clinical criteria of hypotension (systolic blood pressure of <90 mmHg) and end organ hypoperfusion (cool extremities or a urinary output of <30 ml per hour). An operation was performed as soon as possible after the diagnosis was made. Patients with acute infarction in a stable hemodynamic condition were excluded from the study, as were patients requiring valvular or another CABG surgery with CS.

A total of 13 patients (3.1% of all patients) were evaluated, 10 (77%) were males, and 3 (23%) were females. The mean age of all was 57±10 years. The outcome analyses considered were hospital stay, mortality, and functional status (assessed by telephone enquiry at 1 year).

The following variables were included in the analysis (Table 1): diabetes mellitus was present in 5 patients (38%), a history of hypertension (systolic blood pressure >140 mmHg) was present in 10 (77%), a history of smoking was present in 6 (46%), and renal impairment (creatinine >2 mg/dL) was present in 4 (31%). MI <2 days was present in 8 patients (62%) (evident by ST segment elevation in 12 lead electrocardiogram and positive troponin T tests). Ventricular septal (VS) rupture was the cause of shock in 2 (16%) patients. Catheter-related problems was present in 3 patients (23%), and 2 of these patients had percutaneous coronary intervention (PCI) after MI and developed left anterior descending (LAD) artery rupture and cardiac temponade. The third had her PCI to LAD and right coronary artery (RCA) after MI and developed acute occlusion of LAD and RCA with CS, as revealed by repeat angiography; emergency CABG surgery was done. The extent of coronary artery disease was two-vessel disease in 31% of the patients and three-vessel disease in 69%. Two patients had left main stem lesions. Poor left ventricular ejection fraction (less than 30%) was present in 5 patients (38%) and moderate (30–50%) in 7 (56%). Nine (69%) patients were on single or double inotropic support preoperatively; out of these, 3 patients were also on IABP before surgery.

A single-clamp technique was used for proximal and distal anastomoses. Warm intermittent blood, (1:4) antegrade and retrograde cardioplegia, was used in all cases. A terminal hot shot of blood cardioplegia was given after the completion of all anastomoses before a removal of the cross-clamp. Mean cardiopulmonary bypass time was 108±28 min (Table 2), and mean aortic cross-clamp time was 64±29 min. The operation was performed by one surgeon (MID). Anesthetic and cardiopulmonary bypass techniques were standardized. The bypass circuit used a hollow fiber membrane oxygenator, and nonpulsatile flow was generated by a roller pump and a 40 µm arterial line filter. Flow was 2.4 $L \cdot min^{-1} \cdot m^{-2}$ at 37°C, falling to 1.8 $L \cdot min^{-1} \cdot m^{-2}$ at 32°C; arterial pressure was maintained from 50 to 70 mmHg and hematocrit from 0.20 to 0.25; and alpha stat blood gas management was used.

Data were defined as mean with standard deviation, whereas discrete variables were presented as frequencies.

Results

The overall in-hospital (30 days) mortality of patients who

Table 3. Postoperative variables

Duration of inotropic support (days)	3.2±1.6
Duration of IABP (days)	2.1±0.8
Extubation time (h)	13.5±3.6
ICU stay (days)	4.8±2.7
Ward stay (days)	7.8±5.2
Reexploration for bleeding	1 (8%)
Pleural effusion	1 (8%)
Rewiring for sternal wound infection	1 (8%)
Multiorgan failure and death	2 (16%)
Postoperative NYHA class of 11 survivors (after 1 year)	
Class I	5 (45.4%)
Class II	4 (36.4%)
Class III	2 (18.2%)

Data are shown as a number followed by percentage in parentheses or mean with standard deviations. IABP, intra-aortic balloon pump; ICU, intensive care unit; NYHA, New York Heart Association.

developed CS and were operated on for revascularization was 16% (Table 3). One patient initially recovered, but developed low output syndrome and died on the 28th day after the operation. Another patient, who was on IABP and was taken to the operating room with cardiopulmonary resuscitation, died 6 h after surgery. One patient needed a re-exploration for bleeding and another one for deep sternal wound infection. All patients needed inotropic support postoperatively. The duration of the support was 3.2±1.6 days, and the mean duration of postoperative IABP support was 2.1±0.8 days. Mean ventilation time was 13.5±3.6 h, Mean intensive care unit (ICU) stay 4.8±2.7 days, and mean ward stay 7.8±5.2 days. Telephone interviews with all surviving patients revealed that 5 had NYHA class I, 4 class II, and 2 class III symptoms 1 year after surgery. None of the patients died in the 1-year period. Two with class III symptoms were orally administered 80 mg/day frusemide and ACE inhibitors. They also had their echocardiogram done, which showed an ejection fraction of less 20%. One patient who was operated on immediately after MI developed class II symptoms of angina 6 months after surgery. His repeat angiography showed a reocclusion of RCA graft, and he was treated conservatively.

Discussion

The rapid establishment of blood flow in the infarct-related arteries is essential in the management of CS.[6] Autopsy studies demonstrated that the pathological basis of CS was extensive and that MI consistently involved at least 40% of the left ventricular myocardium.[7] Based on data from the SHOCK trial and registry and other databases, current guideline recommendations for the treatment of CS include intra-arterial blood pressure monitoring, pulmonary artery catheterization, echocardiography for the detection of mechanical MI complications such as papillary muscle rupture or free wall ventricular rupture, intra-aortic balloon counter pulsation, emergency revascularization, and percutaneous coronary intervention for all patients less than 75 years of age. Revascularization is recommended in selected patients older then 75.[8] A large nonrandomized cooperative study showed that IABP counter-pulsation alone without adjunctive percutaneous coronary angioplasty or CABG surgery did not reduce mortality rate, which was 83%.[9] An early revascularization in CS has a lower rate of deterioration than the initial medically stabilized patients.[10] Many studies did show better long-term survival in patients with CS treated with early revascularization than with only medical management.[11,12] Patients in CS with triple vessel disease or left main are unsuitable for PTCA; thus CABG is preferred as an alternative. Pooled data from 25 nonrandomized studies involving 391 patients in CS who underwent CABG revealed a 35% hospital mortality rate.[13] Our study showed a lower mortality rate of 16% of patients with CS, which is lower then the previous studies. The reason for low mortality may be related to using antegrade and retrograde warm blood cardioplegia and the single-clamp technique for proximal and distal anastomoses.[14–16] Although in the GUSTO (Global Utilization of Streptokinase and Tissue-plasminogen activator for Occluded coronary arteries) trial VS rupture was detected as an independent predictor of a worse prognosis or death,[17] and the SHOCK trial revealed 87% mortality with VS rupture,[18] 2 of our patients operated on for postinfarct VS defect repair survived and remained stable after 24 months of surgery. Eighty-two percent of our patients were in NYHA class I or II a year after their operation. Functional class improvement was also evident in other studies.[19]

We concluded that CABG in patients with CS contributed to lowering mortality in the hospital to a significant 1-year survival rate and to improvement in the functional class. Therefore CABG should be offered to those selected patients with post-MI CS where primary PCI is not possible or is contraindicative for anatomical reasons.

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