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### *Myocardial revascularization for acute myocardial infarction*

The widespread use of intravenous thrombolytic therapy and primary balloon angioplasty in patients with acute myocardial infarction (AMI) diminished enthusiasm for emergency coronary artery bypass grafting (CABG) in this setting (8, 11). However, several situations like failure of thrombolytic agents and coronary artery acute dissection or occlusion after percutaneous balloon angioplasty (PTCA) remain the required emergency or urgent surgical revascularization. Coronary artery bypass for AMI is associated with increased morbidity and mortality compared with CABG in non-AMI patients (5). We describe the surgical results of these high-risk patients.

#### MATERIAL

From January 2000 to September 2003, 16 patients (nine male and seven female) underwent CABG after the recent onset of acute myocardial infarction in the Department of Cardiac Surgery, Medical University in Lublin. The mean age of these patients was 64.7 years (range: 51 to 78) for the whole group (male 64.2, female 65.3). Acute myocardial infarction was diagnosed by conventional electrocardiographic and enzyme criteria, and confirmed by coronary angiography that revealed occluded vessel(s) with a regional wall-motion abnormality on the left ventriculogram. Seven patients (43.8%) had at least one myocardial infarct in the past, three (18.8%) diabetes mellitus, two (12.5%) chronic renal failure after nephrectomy (creatinine 2.0 and 2.8 mg%, urea 120 and 138 mg% respectively), one because of nephrolithiasis, the other one because of carcinoma. Five patients (31.3%) were in cardiogenic shock, and six patients (37.5%) required preoperative intraaortic balloon pump for stabilization. Mean ejection fraction (EF) was 46% with range from 25 to 68%. There were two patients (12.5%) with postinfarction ventricular septum perforation (VSD) and three patients (18.8%) with left main artery trunk stenosis (LMA). The mean number of stenotic coronary arteries was 2.9 with range from two to four. Preoperative thrombolytic therapy was used in three patients (18.8%), and PTCA in one (6.2%).

#### RESULTS

Six patients (37.5%) were operated on within first 24 hours of the AMI, two patients (12.5%) on the 2<sup>nd</sup> day, five more (31.2%) up to the 7<sup>th</sup> day, and three (18.8%) between the 8<sup>th</sup> and 21<sup>st</sup> day after AMI. The infarct-related artery was the right coronary artery in four patients (25%), and the left coronary artery in 12 patients (75%): three – LMA, seven – left anterior descendens (LAD) and two – circumplex artery. All operations were performed with cardiopulmonary bypass (CPB) in middle hypothermia (34 C°) and with cardioplegic solution. The mean number of grafts per patient was 2.9 (range 1–4), and the left internal thoracic artery (LITA) was used in 11 patients (68.8%). In two patients VSD was closed with Dacron patch. All patients needed longer reperfusion time (25–85 min) and inotropic support and eight

patients needed mechanical support during weaning from cardiopulmonary bypass because of electrocardiographic and hemodynamic instability. Operative mortality was 18.8% (3/16), four patients (25%) had arrhythmias (atrial fibrillation, supra- and ventricular extrasystole), two patients (12.5%) had hemofiltration because of acute renal failure, three (18.8%) neurological and psychic disturbances.

All three patients (one male and three female) who died were over 70 years old (78, 73, 72 respectively) and had anterior myocardial infarction. Two of them had LMA stenosis, and two ventricular septum perforation. All of them died from multiorgan failure related to postoperative low output syndrome and high doses of inotropic agents.

The survivor patients were extubated for 24–50 hours, the mean stay in the intensive care unite was 3.5 days (range 2–7 days).

## DISCUSSION

Timing of coronary artery bypass grafting after acute myocardial infarction is controversial, especially if myocardial function is depressed. Early coronary artery bypass grafting may result in reperfusion injury causing cardiac failure. Delay, however, may risk a second ischemic event (3).

Daniel et al. (1) showed a retrospective multicenter analysis of 44,365 patients who underwent CABG after myocardial infarction between 1993 and 1996 by 179 surgeons at 32 hospitals in New York. Overall hospital mortality for patients with or without AMI was 2.5% versus 3.1% for patients who underwent CABG with history of myocardial infarction. Hospital mortality decreased with increasing time interval between CABG and AMI; 11.8%, 9.5%, and 2.5% ( $p < 0.001$  for all values) for less than 6 hours, 6 hours to one day, and greater than one day, respectively. Patients with transmural and nontransmural AMI had identical mortality of 3.1%. However, different patterns emerged when comparing these two groups of patients with respect to time of operation. Mortality was higher in transmural group if CABG was performed within 7 days after AMI. Multivariate analysis confirmed that CABG within 1 day and 6 hours of AMI is an independent risk factor for mortality in the transmural and nontransmural groups, respectively. Wasvary et al. (12) examined retrospectively 423 patients who underwent CABG within 21 days of an AMI between 1992 and 1995. The operative mortality rates also decreased with increasing time intervals between AMI and CABG and were 17.4, 9.1, 4.0 and 5.8%, for less than 6 hours, 6–24 four hours, 1–7 days and 7–21 days, respectively. Tobe et al. (10) performed emergency CABG within 24 hours after the onset of AMI with cardiogenic shock in 22 patients. The incidence of AMI involving the left main coronary artery was 50%. The incidence of interventional therapy was 40.9%. The condition in 95.5% of the patients could be stabilized hemodynamically by preoperative intraaortic balloon pumping, four of five patients suffered from cardiopulmonary arrest required percutaneous cardiopulmonary support and three of them survived. There were four (18.2%) deaths overall. Operative mortality was related to the intervals between AMI and operation (less than 6 hours – 25%, 6 to 24 hours – 10%) (Table 1).

Table 1. Mortality in patients operated in the first 24 hours of acute myocardial infarction and later

Operation time	Daniel <sup>(1)</sup> (2001)	Wasvary <sup>(12)</sup> (1997)	Tobe <sup>(10)</sup> (1999)
0–6 hours	11.8%	17.4%	25%
6–24 hours	9.5%	9.1%	10%
24 <hours	2.8%	4.0%	

The use of off-pump coronary artery bypass grafting (OCAB) has become widespread, since it has proven less invasive and has promoted early recovery. It is reasonable that avoiding cardiopulmonary bypass and its deleterious effects may be advantageous in group of patients operated in AMI. Mohr et al. (7) described the surgical results of 57 patients operated in AMI period without cardiopulmonary bypass. Thirty-two patients (56%) underwent emergency OPCAB within 48 hours and 25 patients 2–7 days after AMI. Seven patients were in cardiogenic shock and 10 patients required preoperative intra-aortic balloon pump. Operative mortality was 1.7% (one patient). One- and five-year survivals were 94.7% and 82.3%, respectively. Angina returned in seven patients, one of whom underwent reoperation. Locker et al. (4) compared two groups of patients who underwent coronary artery revascularization in AMI period. One hundred nineteen patients had CABG and 106 OPCAB. The two groups were similar with regard to most preoperative risk factors, more patients in CABG group were older than 70, and more patients required preoperative insertion of IABP. More patients in the OPCAB group had single-vessel disease, and more patients in CABG group had triple-vessel disease. Operative mortality in CABG group was 12% compared with 3.8% in OPCAB group. Mortality of patients operated on with CPB within 48 hours of AMI was significantly higher (16.5% vs. 4.3%, respectively), patients operated on after 48 hours to seven days had similar mortality (5.8% vs. 3.4%, respectively).

All the authors show higher mortality (up to 38%) in patients performed surgery revascularization in the first 48 hours. The results are much better if the patients have off-pump operation (Table 2).

Table 2. Dependence between mortality and time and type of operation in patients in acute myocardial infarction

Author and year of publication	Type of surgery and number of patients	Time of surgery ≤ 48 hours of AMI	Time of surgery between day 2 and 7
Locker <sup>(5)</sup> (2003)	CABG 119	16.5%	5.8%
	OPCAB 106	5.5%	3.4%
Fumoto <sup>(2)</sup> (2002)	CABG 66		12.0%
Michihata <sup>(6)</sup> (1999)	CABG 39		25.6%
Mohr <sup>(7)</sup> (1999)	OPCAB 32	3.1%	
	25		0%
Yamagishi <sup>(13)</sup> (1999)	CABG 18	38.0%	
Wasvary <sup>(12)</sup> (1997)	CABG 423	26.7%	4.0%

Multivariate analysis made by all the above authors shows that advanced age, preoperative hemodynamic instability, left main artery stenosis, left ventricular hypertrophy and the early time of surgical revascularization are independent risk factors for death. These risk factors were confirmed in our material. All patients who died were over 70 years old, all of them were in cardiogenic shock and needed mechanical supporting before and after operation and two of them had postinfarction ventricular septum rupture.

## CONCLUSIONS

Emergency coronary artery bypass grafting for acute myocardial infarction is associated with increased operative mortality and morbidity especially in the first 48 hours. The only risk factors for postoperative mortality in this group of patient are age over 70 years, cardiogenic shock, left main artery stenosis, and the shortness of the interval between acute myocardial infarction onset and surgery. The results seem much better in patients operated without cardiopulmonary bypass.

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## SUMMARY

Coronary artery bypass grafting (CABG) for acute myocardial infarction (AMI) is associated with increased morbidity and mortality compared with CABG in non-AMI patients. We describe the surgical results of these high-risk patients. Sixteen patients (nine male and seven female) underwent CABG after recent onset of acute myocardial infarction. The mean age was 64.7 (range: 51 to 78). Seven patients (43.8%) had at least one myocardial infarction in the past, three (18.8%) – diabetes mellitus, two (12.5%) – chronic renal failure after nephrectomy. Five patients (31.3%) were

preoperatively in cardiogenic shock, and six patients (37.5%) required preoperative intraaortic balloon pump (IABP) for stabilization. Two patients (12.5%) had postinfarction ventricular septum perforation (VSD) and three patients (18.8%) had left main artery trunk stenosis. Mean ejection fraction was 46%. During the first 24 hours six patients were operated, during the second day two, up to the seventh day five more and last three between 8<sup>th</sup> and 21<sup>st</sup> day after AMI. The operations were performed with extracorporeal circulation in middle hypothermia (34°C). The mean number of grafts per patient was 2.9, and the left internal thoracic artery was used in 11 patients (68.8%). In two patients VSD was closed with Dacron patch. All the patients needed longer time of reperfusion and inotropic drugs and eight (50%) of them mechanical support (IABP) during weaning from cardiopulmonary bypass. Three patients (18.8%) died (both with VSD) because of low output syndrome and multiorgan failure, all were over 70 years old (72, 73, 78). Conclusion: emergency coronary artery bypass grafting for acute myocardial infarction is associated with increased operative mortality and morbidity especially in the first 48 hours. The only risk factors for postoperative mortality in this group of patients are age over 70 years, cardiogenic shock, left main artery stenosis and the shortness of the interval between acute myocardial infarction onset and surgery.

#### Chirurgiczna rewaskularyzacja mięśnia serca w ostrym zawale serca

Pomostowanie tętnic wieńcowych w ostrej fazie zawału mięśnia serca związane jest ze zwiększonym ryzykiem powikłań i zgonów w porównaniu z operacjami wykonywanymi bez procesu zawałowego. Opisałiśmy wyniki leczenia chirurgicznego tej grupy chorych. Zabiegowi pomostowania tętnic wieńcowych w ostrej fazie zawału mięśnia serca poddano 16 pacjentów (9 mężczyzn i 7 kobiet). Średnia wieku wynosiła 64,7 (w granicach 51 do 78). Siedmiu pacjentów (43,8%) przeżyło przynajmniej jeden zawał mięśnia serca, troje (18,8%) miało cukrzycę, dwoje (12,5%) przewlekłą niewydolność nerek po nefrektomii. Pięcioro pacjentów (31,3%) w chwili operacji znajdowało się w stanie wstrząsu sercowego, sześcioro (37,5%) wymagało założenia balonu wewnątrzaoortalnego celem stabilizacji hemodynamicznej. Dwie pacjentki miały pękniętą przegrodę międzykomorową, troje pacjentów zwężenie pnia lewej tętnicy wieńcowej. Wartość średniej frakcji wyrzutowej wynosiła 46%. Sześcioro pacjentów operowano w pierwszych 24 godzinach zawału, dwoje w drugiej dobie, pięcioro do siódmej doby, troje między ósmą a 21 dobą. Operację przeprowadzono przy użyciu krążenia pozaustrojowego w umiarkowanej hipotermii (34°C). Średnia liczba zespołów wyniosła 2,9, a lewą tętnicę piersiową wewnętrzną zastosowano u 11 pacjentów. Ubytki w przegrodzie międzykomorowej zaopatrzone lata dakronową. Wszyscy pacjenci wymagali przedłużonej reperfuzji oraz leków izotropowych, a ośmiu wspomaganie mechaniczne (IABP) przy wychodzeniu z krążenia pozaustrojowego. Zmarło troje pacjentów (18,8%) z objawami niewydolności wielonarządowej spowodowanej zespołem małego rzutu (zmarły obie pacjentki z VSD). Wszyscy troje zmarli byli w wieku powyżej 70 lat (72, 73 i 78). Operowanie pacjentów w ostrej fazie zawału mięśnia serca, szczególnie w pierwszych 48 godzinach, wiąże się z większą śmiertelnością. Jedynymi potwierdzonymi czynnikami ryzyka są: wiek powyżej 70 roku życia, wstrząs sercowopochodny, zwężenia pnia lewej tętnicy wieńcowej oraz krótki okres między zawałem a zabiegiem chirurgicznym.