

Coronary Artery Bypass in Patients 80 Years and Older: Comparison with a Younger Age Group

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Octogenarians are at increased risk for perioperative morbidity and mortality following coronary artery bypass grafting (CABG). We compared the perioperative outcome after CABG from March 1997 to June 2003, between patients 80 years and older (n=15), and those aged 70 to 79 years (n=64). In comparison with younger patients, more octogenarians had congestive heart failure (40% vs. 9% in patients aged 70 to 79 years, p=0.003) and underwent off-pump CABG more frequently (80% vs. 42%, p=0.008). There were no significant differences in the incidence of emergent surgery (27% vs. 28%) and number of bypass grafts (2.3±0.7 vs. 2.5±0.9) between the two groups. Octogenarians had less complete revascularization compared to the younger group (67% vs. 81%, not significant). There was no mediastinitis, and no stroke in either groups. Octogenarians had more minor wound complications (20% vs. 3%, p=0.01). There were no operative deaths in octogenarians, while the mortality rate of the younger group was high (6%). Surgical myocardial revascularization in octogenarians can be performed with acceptable mortality and morbidity using off-pump CABG. (Ann Thorac Cardiovasc Surg 2004; 10: 85–9)

Key words: octogenarians, coronary artery bypass grafting (CABG), off-pump CABG

Introduction

With the progressive aging of the Japanese population, older patients are increasingly being considered for coronary artery bypass grafting (CABG). Numerous investigators have examined the feasibility and the efficacy of CABG in octogenarians.¹⁻³ Patients of advanced age are known to be at an increased risk for morbidity and mortality following bypass surgery.^{4,5} In the present study, we compared the perioperative morbidity and mortality after CABG between patients 80 years and older and those aged 70 to 79 years.

Patients and Methods (Table 1)

Between March 1997 and June 2003, 79 consecutive pa-

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tients aged 70 and older underwent CABG in our department. They were 15 patients aged 80 years or older (mean, 81.7±1.7 years; range, 80-85 years) and 64 patients aged 70-79 years (mean, 73.1±2.5 years). We studied the preoperative data, operative procedure and operative results in each group.

Patient selection criteria

The selection of conventional CABG with cardiopulmonary bypass or off-pump CABG was changed over time. At first, off-pump CABG was performed for the high risk patients who had a poor general condition, calcified ascending aorta and combined cancer. From September 2001, in accordance with the progress in technical surgical skills and devices, most of the cases underwent off-pump CABG. In total, conventional CABG was performed in 40 patients and off-pump CABG in 39 patients. At present, conventional CABG is performed only for the patients who have very low cardiac function and need circulation assistance. Patient selection was not changed even when it was an emergency operation.

In patients with abdominal aortic aneurysm (AAA), peripheral vascular disease (PVD) or cancer, the severity

Table 1. Patient characteristics

	≥80 years (n=15)	70-79 years (n=64)	p value
Age	81.7±1.7	73.1±2.5	<0.0001
Female gender	6 (40%)	20 (31%)	0.51
Acute myocardial infarction	4 (27%)	12 (19%)	0.49
Old myocardial infarction	5 (33%)	23 (36%)	0.84
Unstable angina pectoris	4 (27%)	15 (23%)	0.79
Congestive heart failure	6 (40%)	6 (9%)	0.003
Diabetes	4 (27%)	21 (33%)	0.64
History of stroke	1 (7%)	6 (9%)	0.74
History of COPD	3 (20%)	8 (13%)	0.45
Chronic renal dysfunction	4 (27%)	7 (11%)	0.13
Preoperative IABP, PCPS	2 (13%)	6 (9%)	0.64
Prior CABG	0 (0%)	2 (3%)	0.49
Left main trunk disease	8 (53%)	35 (55%)	0.92
Triple vessel disease	7 (47%)	38 (59%)	0.37
Peripheral vascular disease	2 (13%)	6 (9%)	0.64
AAA	1 (7%)	2 (3%)	0.51
Cancer	1 (7%)	7 (11%)	0.62

COPD, chronic obstructive pulmonary disease; IABP, intraaortic balloon pumping; PCPS, percutaneous cardiopulmonary support; CABG, coronary artery bypass grafting; AAA, abdominal aortic aneurysm.

of the disease determines the procedure (simultaneous operation or two-staged operation) as previously reported.⁶⁾ For example, the patient with a giant aneurysm or impending ruptured aneurysm needs simultaneous operation. Except for operations that enable simultaneous procedure through the same skin incision such as lung cancer surgery through the median sternotomy or off-pump CABG through the diaphragm with AAA surgery, two-staged operations were usually performed.

Operative technique

The internal thoracic artery was harvested in a skeletonized fashion. The dilatation of an in situ artery was achieved by injection of papaverine, and in the case of a free graft, nitroglycerin was used. When the operation was performed with the cardiopulmonary bypass, body temperature was maintained at 33°C with natural cooling and tepid blood cardioplegia. Regarding the order of anastomosis, distal anastomosis of the vein graft was performed first and the sequential grafting technique with a 7-0 monofilament suture was used as much as possible. Next, arterial grafts were anastomosed, and finally, proximal anastomosis of the vein grafts was performed using the single clamp method.

In the off-pump CABG procedure, a deep pericardial suture and a suction type heart stabilizer were used. In general, the artery was used in an in-situ fashion, but when it did not reach the target coronary arteries, y-shaped composite grafting was used. Regarding the order of anasto-

mosis, when an additional vein graft was used, the proximal anastomosis was performed using a side-biting clamp with a 6-0 suture. Next, the left internal thoracic artery (LITA)-left anterior descending artery (LAD) anastomosis was performed with a 7-0 or 8-0 suture, then the heart was lifted and rotated, and distal anastomosis of the circumflex system or right coronary system was performed.

Statistical analysis

Patient characteristics (diagnosis, concomitant disease, coronary artery disease, cardiac function, circulatory support), surgical procedure (timing of operation, ratio of off-pump CABG, the number of anastomosis, amount of blood transfusion), postoperative condition (max CK-MB, catecholamine dose, period of intubation, period from continuous hemofiltration to usual dialysis, operative results, postoperative complications, patency rate), and long-term results (actuarial survival rates, survival rates estimated by cardiac death) were studied in both groups.

The χ^2 test was used for the nonparametric variables and the unpaired t test for continuous variables. A p value of <0.05 was regarded as statistically significant. Hospital deaths were included as events in this analysis. All data are presented as mean \pm SD unless stated otherwise.

Results

The preoperative clinical characteristics of patients in the

Table 2. Operative and postoperative patient characteristics

	≥80 years (n=15)	70-79 years (n=64)	p value
Emergent CABG	4 (27%)	18 (28%)	0.9
Off-pump CABG	12 (80%)	27 (42%)	0.008
Graft number	1-3 (2.3±0.7)	1-5 (2.5±0.9)	0.3
Arterial graft number	0-3 (1.7±1.0)	1-4 (1.6±0.8)	0.65
Complete revascularization	10 (66%)	52 (81%)	0.23
Non-blood transfusion	3 (20%)	19 (30%)	0.45
Reoperation due to bleeding	1 (7%)	1 (2%)	0.25
Perioperative myocardial infarction	0 (0%)	1 (2%)	0.62
Mediastinitis	0 (0%)	0 (0%)	–
Stroke	0 (0%)	0 (0%)	–
Prolonged ventilation	1 (7%)	3 (5%)	0.75
Hemodialysis	0 (0%)	2 (3%)	0.48
IABP or PCPS	0 (0%)	1 (2%)	0.62
Wound complication	3 (20%)	2 (3%)	0.01
In-hospital death	0 (0%)	4 (6%)	0.32

CABG, coronary artery bypass grafting; IABP, intraaortic balloon pumping; PCPS, percutaneous cardiopulmonary support.

two age groups are summarized in Table 1. There was no difference between the two groups in terms of ratio of female patients, acute myocardial infarction (AMI), old myocardial infarction (OMI), unstable angina pectoris (UAP), severity of coronary artery disease and history of CABG. Octogenarians had more congestive heart failure (CHF) than the young group (6/15, 40% vs. 6/64, 9%, $p=0.003$). CHF was defined as preoperative New York Heart Association class III and IV. Comorbid illness such as diabetes mellitus (DM), stroke, chronic obstructive pulmonary disease (COPD), peripheral vascular disease (PVD), AAA, and cancer was equivalent between the two groups. Octogenarians had more chronic renal dysfunction (4/15, 27% vs. 7/64, 11%) but the difference was not significant ($p=0.13$). Chronic renal dysfunction was defined as a serum creatinine level greater than 2 mg/dl. Both groups had the same frequency of preoperative intraaortic balloon pumping (IABP) or percutaneous cardiopulmonary support (PCPS), and emergent operation (27% vs. 28%). Off-pump CABG was performed more often in octogenarians than in the younger group (12/15, 80% vs. 27/64, 42%, $p=0.008$) (Table 2). The mean number of grafts and arterial conduit grafts was similar in both groups (2.3±0.7 vs. 2.5±0.9 and 1.7±1.0 vs. 1.6±0.8). Complete revascularization was achieved in 10/15 (67%) in octogenarians and in 52/64 (81%) of the younger group. The non-blood transfusion rate was also nearly the same. Simultaneous operation of off-pump CABG with lung cancer surgery was performed in one patient in their 70s. Two-staged operation was carried out with AAA and gastric cancer in patients in their 70s. In octogenarians,

radiation therapy was carried out in esophageal cancer, and AAA, PVD were surgically untouched.

Postoperative complication

There was no difference in terms of reoperation for bleeding and perioperative myocardial infarction (PMI) between the two groups. Neither group had mediastinitis nor stroke. Octogenarians had more minor wound complications than the younger group (3/15, 20% vs. 2/64, 3%). Four hospital deaths (6%) were recognized in the younger group, while there was no hospital deaths in octogenarians. The reasons of death in those who did not survive emergent operation with preoperative PCPS or IABP support were low output syndrome, disseminated intravascular coagulation (DIC), arrhythmia, and multiple organ failure.

Long-term results

In the octogenarian group, there were two late deaths (acute respiratory failure three months after the surgery, lung cancer two years after the surgery). Among the survivors, there was no recurrence of angina or MI.

Discussion

With the longer life expectancy in patients 80 years or older, the number of elderly patients undergoing CABG is also increasing year by year. However, octogenarian patients have a higher surgical risk because they have more comorbid illness and less physiologic reserve of multiple organs compared to those in their 70s. Peterson et al.

reported the largest study of conventional CABG in 24,461 octogenarians.⁷⁾ According to their report, octogenarians had longer hospital stay, incurred greater costs, and higher hospital mortality compared with younger patients. Advanced age is reported to be an independent risk factor for higher perioperative mortality and morbidity.^{4,5)} Oskvig reported cardiac age-related factors such as aortic calcification, stiff vessels, diminished cardiac response to exercise, and intolerance of anemia.⁸⁾ He also reported additional age-related factors such as low performance and less physiologic reserve of the pulmonary, renal, and nervous systems. Stamou et al. reported that the operative mortality and morbidity of octogenarians are increased because octogenarians have more CHF, advanced class of Canadian Cardiovascular Society (CCS), low ejection fraction (EF), severe coronary artery disease (CAD), COPD, higher proportion of women, and urgent operation compared with younger patients.⁴⁾ CHF and renal dysfunction which were more frequently seen in octogenarians of the present study, are reported to be predictors of operative mortality.^{2,9,10)} Therefore, poor surgical results were expected, however in this study in which the number of patients was limited, a good result for octogenarians was obtained. To determine the reasons for these positive results, patient selection, operative methods (off-pump CABG, complete revascularization or not), and postoperative management were considered. Patients were selected at the cardiology consultation prior to surgery. That is to say, the octogenarian patients are candidates for surgery even in the emergency setting if their condition is relatively good. In elective surgery, an octogenarian was not a candidate for surgery, if they were bedridden. While in the younger group, even if the patient was very seriously ill, they were referred for emergency surgery. In many cases, the physical age of the elderly patient who was referred to surgery is often younger than their calendar age. Octogenarians who had less physiologic reserve of organs would have accompanying pulmonary complication and central nervous disorder when the ICU and hospital stay were lengthened. Therefore, for the octogenarians, lessening the operative damage, quick extubation and recovery are very important.

There were many reports that describe the advantage of off-pump CABG for elderly patients who easily fall seriously ill.^{4,11,12)} Off-pump CABG is reported to have a low complication rate and is suitable for the high risk patients who have had respiratory insufficiency, renal insufficiency, and previous stroke.¹³⁻¹⁵⁾ Hoff et al. reported that improvement of prolonged ventilation and stroke were

achieved in off-pump CABG, in a comparison of 169 cases of conventional CABG and 60 cases of off-pump CABG.¹¹⁾ Reduced blood use in off-pump CABG is also reported.¹²⁻¹⁴⁾ Neurologic deterioration is caused by atheromatous microemboli in the aortic cannulation of conventional CABG because the ascending aorta in octogenarians was often severely atherosclerotic.¹⁶⁾ Therefore, off-pump CABG with the aortic no touch technique is very important to avoid brain complications.¹⁷⁾ In most of our octogenarian patients, off-pump CABG achieved a good outcome.

The significance of complete revascularization in octogenarian's CABG seems to be small in comparison with the younger patients, because the life table of the octogenarian is much shorter than the younger patients. In this study, the complete revascularization rate of octogenarians was 67% compared to 81% in the younger group. This is the result in pursuit of less invasive surgery. Moon et al. reported the importance of complete revascularization,¹⁸⁾ however we believe that quick recovery using selective revascularization of key coronary arteries is more important, rather than demanding long surgery and revascularization of even small coronary arteries in the infarcted area in pursuing complete revascularization.

Pneumonia was often seen as a serious complication in the postoperative period and long-term follow-up. Thus, prevention of respiratory complications is important in postoperative care. Preoperative respiratory training and postoperative fast track are important in elective cases.

There were many wound complications in minor postoperative complications of octogenarians. Although mediastinitis did not occur, attention seemed necessary because elderly patients often had delayed wound healing.

Study limitation

The present study suffers from the limitations common to all nonrandomized, and retrospective analyses. The lack of angiographic data which would document late graft patency was one study limitation. The small sample size was also a major study limitation; to confirm these findings, a larger study should be undertaken. The decision to perform off-pump CABG or conventional CABG was changed over time as previously described. In the early series, octogenarians underwent off-pump CABG more frequently than younger age group for high risk group. In the later, most of the patient underwent off-pump CABG regardless of age. Thus, these introduce the possibility of selection bias.

Conclusion

Surgical revascularization was good even in patients 80 years and older. Off-pump CABG offered a suitable means of coronary revascularization for octogenarians.

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