Original Article

Coronary Artery Bypass Grafting for Octogenarians: Experience in a Private Hospital and Review of the Literature

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Background and Methods: Indications for coronary artery bypass grafting (CABG) are expanding. We retrospectively analyzed the results of isolated CABG performed at Shin-Tokyo Hospital between January 1, 1992, and August 31, 2000. Preoperative, perioperative, and follow-up data of patients 80 years of age or older (group E, n=55) were collected and compared with those of patients between 75 and 79 years of age (group Y, n=197).
Results: Patient demographics were not significantly different except there was a greater incidence of co-existing valvular disease in group E. CABG was completed without any significant differences, except fewer distal anastomoses and more frequent off-pump CABG were performed in group E than in group Y. The in-hospital mortality rates of group E and Y were 1.8% and 2.5% (p=NS), respectively. The postoperative recovery (intubation time, ICU stay, and postoperative hospital stay) of group E was similar to group Y. During the mean follow-up of 2.6 years (maximum 8.4 years), the actuarial 3-year survival of groups E and Y was 84.5% and 94.9% (p=NS), respectively, excluding in-hospital mortality. The actuarial 3-year cardiac event-free rates were 100% in group E and 88.4% in group Y (p=NS).
Conclusion: CABG for octogenarians can be performed safely. Once adequate revascularization was established, the long-term cardiac events were similar to those of the younger patients. (Ann Thorac Cardiovasc Surg 2001; 7: 282–91)

Key words: coronary artery disease, aging, distant results, octogenarian

Introduction

The elderly population is growing throughout most of the Western world. With the increase in the older population, the number of patients referred for coronary artery bypass grafting (CABG) has also increased. Many single or multicenter studies of CABG for octogenarians have been published.[1-46] We recently published data of CABG in patients 75 years of age and older;[47] the analysis of that data indicated that CABG for the elderly can be performed with increased risks; however, once surgical revascularization has been completed, the cardiac events after surgery were as effectively controlled as in younger patients. However, the outcomes of patients older than 80 years of age were not examined in our previous report. The present study is a retrospectively analysis of in-hospital and long-term data from patients who underwent CABG at Shin-Tokyo Hospital, focusing on patients 80 years of age and older, and the results were compared with those from patients aged 75 to 79 years of age.

Methods

Between January 1, 1992 and August 31, 2000, 1831 patients underwent isolated CABG at Shin-Tokyo Hospital. Among them, 55 cases (3.0%) were 80 years of age or older (group E) and 197 cases (10.8%) were

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Table 1. Preoperative patient demographics

Age	≥ 80		75-79		
n	55		197		p value
Clinical characteristics					
Age	82.1 ± 2.1	(80-87)	76.6 ± 1.3	(75-79)	<0.0001
Female sex	23	41.8%	75	38.1%	NS
Angiographic profile					
Number of diseased vessels	2.6 ± 0.6	(1-3)	2.6 ± 0.6	(1-3)	NS
Three vessel disease	38	69.1%	136	69.0%	NS
Left main disease	24	43.6%	64	32.5%	NS
Previous coronary intervention	11	20.0%	59	29.9%	NS
Cardiac profile					
Acute myocardial infarction	6	10.9%	16	8.1%	NS
Unstable angina	11	20.0%	34	17.3%	NS
Previous myocardial infarction	31	56.4%	136	69.0%	NS
Poor ejection function (<40%)	3	5.5%	15	7.6%	NS
History of congestive heart failure	13	23.6%	32	16.2%	NS
Atrial fibrillation	5	9.1%	12	6.1%	NS
Valvular disease	23	41.8%	41	20.8%	<0.005
Redo surgery	0	0.0%	2	1.0%	NS
Emergency surgery	8	14.5%	24	12.2%	NS
Preoperative IABP	2	3.6%	16	8.1%	NS
Cardiogenic shock	0	0.0%	9	4.6%	NS
Coronary risk factors					
Hypertension	30	54.5%	115	58.4%	NS
Diabetes	27	49.1%	69	35.0%	NS
Insulin user	2	3.6%	14	7.1%	NS
Hyperlipidemia	17	30.9%	51	25.9%	NS
Smoking history	12	21.8%	79	40.1%	<0.05
Obesity	1	1.8%	13	6.6%	NS
Family history	2	3.6%	21	10.7%	NS
Comorbidity					
Peripheral vascular disease	2	3.6%	13	6.6%	NS
Cerebral vascular accident	8	14.5%	40	20.3%	NS
Chronic pulmonary obstructive disease	4	7.3%	13	6.6%	NS
Active malignant neoplasm	7	12.7%	4	2.0%	<0.005
Calcified ascending aorta	11	20.0%	31	15.7%	NS
Renal dysfunction	9	16.4%	33	16.8%	NS
Dialysis	0	0.0%	0	0.0%	NS

between 75 and 79 years of age (group Y). Their records were retrospectively reviewed, and the following data were collected; patient age, gender, results of preoperative angiography, cardiac profiles, preoperative risk factors, graft materials, surgical data, postoperative complications, and mortalities. Preoperative risk factors and postoperative complications were defined according to the Society of Thoracic Surgeons (STS) criteria. Patients who had undergone valvular surgery, left ventricular surgery, or surgery related to other vascular or major general surgery procedures were excluded from the study. All patients and their family members were contacted by telephone and their remote status was determined by medical professionals. Remote cardiac events included angina recurrence, percutaneous transluminal coronary angioplasty (PTCA), congestive heart failure requiring admission, arrhythmia requiring admission, and sudden death.

Statistical analyses were performed using Student's t-tests for continuous variables or Chi-square tests (Fisher's exact tests if n<5) for categorical variables. Results were expressed as the mean ± standard deviation (SD). Postoperative patient survival and event-free rates were constructed by the Kaplan-Meier method, and compared using Mantel-Cox's log rank tests. A p-value of less than 0.05 was considered statistically significant. All statisti-

Table 2. Surgical data

Age	≥ 80		75-79		
n	55		197		p value
Number of distal anastomoses	2.7 ± 1.1	(1-5)	3.1 ± 1.2	(1-6)	<0.05
Complete revascularization	40	72.7%	169	85.8%	<0.05
Grafts					
Bilateral internal mammary arteries	9	16.4%	27	13.7%	NS
Total arterial bypass	27	49.1%	81	41.1%	NS
Off-pump CABG	31	56.4%	58	29.4%	<0.0005
MIDCAB	6	10.9%	16	8.1%	NS
Off-pump CABG via mid-sternotomy	25	45.5%	42	21.3%	<0.001
Aorta clamp time (minutes)	60.0 ± 22.5	(14-105)	65.6 ± 21.8	(18-161)	NS
Pump time (minutes)	95.3 ± 26.4	(38-143)	103.3 ± 32.8	(32-219)	NS
Coronary clamp time (minutes)	12.1 ± 4.0	(0-20)	13.0 ± 4.8	(0-26)	
Operation time (minutes)	263.7 ± 60.4	(120-430)	294.2 ± 78.3	(135-705)	NS
Left internal mammary artery (LIMA)	50	90.9%	194	98.5%	NS
distal anastomosis of LIMA	51		202		
Right internal mammary artery (RIMA)	10	18.2%	28	14.2%	NS
distal anastomosis of RIMA	11		32		
Radial artery (RA)	19	34.5%	60	30.5%	NS
distal anastomosis of RA	25		83		
Gastroepiploic artery (GEA)	18	32.7%	88	44.7%	NS
distal anastomosis of GEA	18		93		
Inferior epigastric artery (IEA)	2	3.6%	4	2.0%	NS
distal anastomosis of IEA	2		4		
Saphenous vein (SV)	28	50.9%	117	59.4%	NS
distal anastomosis of SV	44		206		
Blood transfusion	21	38.2%	72	36.5%	NS
Packed red blood cells (unit)	3.9 ± 1.0	(2-6)	4.3 ± 1.4	(2-8)	NS
Fresh frozen plasma (unit)	12.0 ± 4.5	(10-20)	14.3 ± 6.0	(5-29)	NS
Platelet (unit)	10.0 ± 0.0	(10-10)	18.3 ± 5.2	(10-25)	

cal analyses were performed using Statview version 5.0 (SAS Institute, Cary, NC).

Results

Group E consisted of 55 patients (32 males and 23 females with a mean age of 82.1±2.1 years), and group Y consisted of 197 patients (122 males and 75 females with a mean age of 76.6±1.3 years). The preoperative data are described in Table 1. Coexisting valvular disease and malignant tumor were significantly more frequent in group E than in group Y.

Operative data are shown in Table 2. Fewer distal anastomoses were performed in group E than in group Y. Incomplete revascularization was significantly more frequent in group E. Off-pump CABG, introduced in our institution in late 1996, was more often utilized in group E. Selection of the graft materials and the incidence of total arterial reconstruction were not significantly different between groups. Clamp time, pump time, and operative time were not significantly different.

The postoperative course is shown in Table 3. Intubation period, intensive care unit (ICU) stay, and postoperative hospital stay were not significantly different between the two groups. The in-hospital mortality rates of groups E and Y were 1.8% and 2.5%, respectively (p=NS). Major complications were more frequently observed in group Y (23.9%) than group E (7.3%; p<0.01). There was one hospital death in group E: an 84-year-old male with acute myocardial infarction requiring an urgent CABG. Off-pump four-vessel revascularization was performed; however, the patient had been dependent on high dose inotropics. Subsequently renal failure developed and he died 7 days after surgery.

Excluding hospital mortalities, collection of long-term data was completed with a mean follow-up period of 1.8±1.6 years for group E and 2.7±2.0 years

Table 3. Postoperative results

Age	≥ 80		75-79		
n	55		197		p value
Intubation (hours)	10.9 ± 10.0	(2-62)	15.3 ± 24.6	(0-269)	NS
ICU stay (days)	2.6 ± 1.4	(1-10)	3.4 ± 3.4	(0-53)	NS
Postop stay (days)	16.2 ± 9.6	(7-66)	19.2 ± 11.1	(4-175)	NS
Major complication (patients)	4	7.3%	47	23.9%	<0.01
Low output syndrome	2	3.6%	7	3.6%	NS
Postoperative myocardial infarction	0	0.0%	2	1.0%	NS
IABP support	1	1.8%	16	8.1%	NS
Re-exploration for bleeding	0	0.0%	3	1.5%	NS
Postop dialysis	1	1.8%	5	2.5%	NS
Mediastinitis	0	0.0%	3	1.5%	NS
Cerebral vascular accident	0	0.0%	9	4.6%	NS
Prolonged ventilator support	2	3.6%	13	6.6%	NS
Pneumonia	2	3.6%	8	4.1%	NS
Reintubation	1	1.8%	2	1.0%	NS
In-hospital Death	1	1.8%	5	2.5%	NS
Cause of in-hospital death					
Cardiac death	1	1.8%	0	0.0%	NS
Cerebral vascular accident	0	0.0%	1	0.5%	NS
Respiratory failure	0	0.0%	2	1.0%	NS
Renal failure	0	0.0%	1	0.5%	NS
Infections	0	0.0%	1	0.5%	NS

for group Y. Late death was observed in 3 patients (5.7%) in group E, which was not significantly different from that in group Y (13 patients, 7.1%). The causes of long-term death are shown in Table 4. The actuarial 1-, 2-, 3- and 4-year survival rates were 98.0%, 84.5%, 84.5%, and 84.5% in group E, and 98.3%, 94.5%, 94.9%, and 88.0% in group Y, which was not significantly different.

The remote cardiac events are also listed in Table 4. The actuarial 1-, 2-, 3-, and 4-year event-free rates were 100%, 100%, 100%, and 85.7% in group E and 97.2%, 93.8%, 91.9%, and 88.4% in group Y, with no significant difference. Besides the cardiac events, 66.0% of the octogenarian patients (35) were independent with a reasonable quality of life, and 15.1% (8) were home bound, and 18.9% (10) were confined to bed rest, at a nursing home, or hospital bound.

Due to the small number of in-hospital and remote mortality, further risk analyses predicting mortality and morbidity were not performed.

Postoperative coronary angiography was performed in 12 cases (21.8%) in group E and 43 cases (21.8%) in various occasions after surgery. All grafts were patent, except one occlusion of the gastroepiploic artery bypassed to the right coronary artery. The patient was a 79-year-old man after a triple bypass and his angina was controlled with medication.

Review of Literature for Octogenarians

Forty-six of CABGs in octogenarians in the English literature have been analyzed (Table 5). All, but three multicenter studies,[26,33,46] were from a single institute. Study subjects were patients who underwent isolated CABG or included cases with concomitant valvular or other cardiac surgery. A variety of associated medical problems was described. In particular, the incidences of chronic renal failure and cerebral vascular accident were more than twice the baseline frequency of the preoperative comorbidity, provided by the STS registry.[48] The median number of the distal anastomoses was 3.0, consistent with CABG in general. The left internal mammary artery (LIMA), however, was used in only 30% in the octogenarian cases, which is less frequent than that in the data from STS (77.7%). The saphenous vein graft was used instead of the LIMA. A few current studies indicated better short- and long-term mortality and morbidity of the LIMA graft than from saphenous vein grafts.[35,38,43]

The median mortality rate of isolated CABG for oc-

Table 4. Long-term cardiac events and mortalities

Age	≥ 80		75-79		p value
Number of patients followed	53	98.1%	184	95.8%	NS
Follow-up period	1.8 ± 1.6	(0.1-6.6)	2.7 ± 2.0	(0.1-8.4)	<0.005
Total outpatient cardiac events	1	1.9%	18	9.8%	
Angina	1	1.9%	5	2.7%	
Congestive heart failure	0	0.0%	9	4.9%	
PTCA	0	0.0%	3	1.6%	
Arrhythmia	0	0.0%	0	0.0%	
Sudden death	0	0.0%	1	0.5%	
1-year event-free rate	100.0%		97.2%		
2-year event-free rate	100.0%		93.8%		NS
3-year event-free rate	100.0%		91.9%		
4-year event-free rate	85.7%		88.4%		

Age	≥ 80		75-79		p value
Distant death	3	5.7%	13	7.1%	NS
Cardiac death	0	0.0%	5	2.7%	NS
Non-cardiac death	3	5.7%	8	4.3%	NS
1-year survival rate	98.0%		98.3%		
2-year survival rate	84.5%		94.5%		NS
3-year survival rate	84.5%		94.9%		
4-year survival rate	84.5%		88.0%		

togenarians was 8.3%, which was 2.7 times greater than the mortality of isolated CABG in the general population extracted from STS database (3.1%). Some studies compared the hospital mortality based on the urgency of the surgery. The median hospital mortality of urgent or emergent isolated CABG for octogenarians was 12.5% and 1.7% for elective surgery (data are not shown). STS registry data indicate that the mortality rates were 6.0% in emergent cases and 1.7% in elective cases. Because the criteria of the postoperative mortality varied, the figures of morbidity could not be directly compared. Major complications were more frequent than expected for CABG in general. All studies concluded that CABG for octogenarians had remarkable preoperative risks, but was feasible, and that coexisting medical problems would influence the outcomes.

Independent preoperative risk factors predicting hospital mortality, identified in more than two series of studies included: emergent or urgent surgery,[4,11-13,19,21,23,24,38,40,46] poor left ventricular function,[10,12,13,16,19,24,38,40,42] advanced functional class,[4,6,7,12,16,25] pulmonary disease,[7,34,38,42] renal dysfunction,[30,33,34,37] pump time or cross clamp time,[6,23,25,30] congestive heart failure,[11,19,33] mitral valve repair or replacement,[7,11,44] female gender,[19,23,33] and stroke.[33,43]

During a median follow-up of 2.9 years, the median 1-, 2-, 3-, and 4-year survival rates after CABG were 87%, 81%, 77%, and 73%, respectively. The survival curve in the first 5 years after CABG was similar to the general population;[34,38,43] however, the survival curve declined rapidly after 5 years.[43] Late cardiac events were available in three studies,[14,24,38] and the median 3-year event-free was 81.0%.

PTCA is an alternative treatment to CABG. There were several studies comparing the outcomes of octogenarians after PTCA and after CABG.[8,14,15,24] Among these four studies, three studies concluded that CABG provided better short- and long-term survival and freedom from cardiac events in octogenarians than PTCA.[8,15,24] They concluded that elderly patients might have heavily calcified coronary arteries or totally occluded vessels, which were not suitable conditions for PTCA and would be indications for CABG.

Discussion

Comparison between groups E and Y

Preoperative risk factors were similar in the two groups except for the presence of co-existing valvular disease,

most of which were mitral lesions. All these valvular lesions were re-evaluated by intraoperative transesophageal echocardiography. If the lesions were grade 3 or greater, the lesions were corrected in the appropriate manner; however if the lesions were grade 2 or 1, they were left alone. Evaluation of the valvular lesion is essential in the era of off-pump CABG, as off-pump CABG does not require cardiopulmonary bypass, but all valvular surgery does.

In general, the primary goal of CABG was complete revascularization. The CABG for octogenarians was more focused on minimal invasiveness, rather than complicated revascularization. Thus, in octogenarians, the culprit lesion for angina or the left anterior descending artery (LAD) was always revascularized by one of the internal mammary arteries (IMA), preferably the LIMA. An adequate bypass of the culprit lesions or the LAD will protect patient from the recurrence of angina or other cardiac events.

Off-pump CABG is known to be less invasive and its early results are acceptable.[49,50] The indications of off-pump CABG have been expanded. Recent advancement of the coronary stabilizing platform allows us to perform CABG to any aspect of the heart, including the posterior wall of the heart, which used to be difficult to perform without hemodynamic change.[50] Except for a few contraindications of off-pump CABG, calcified coronary artery and intramyocardial coronary artery, most of the elderly will benefit from off-pump CABG. For example, postoperative strokes, which influence both the length of stay and postoperative quality of life, could be avoided by off-pump CABG. We believe that frequent use of off-pump CABG in octogenarians successfully reduces the postoperative complications and shortens the postoperative recovery period.

Follow-up was limited to a relatively shorter period in group E than in group Y, because of the recent increase of referrals of octogenarians to our institute. During the follow-up, the cardiac events in group E were minimal, and the remote mortality was acceptable. The 3-year survival rates after CABG in our series (84.5%) were higher than expected in Japanese octogenarians (66.1%).[51] Because cardiac events were adequately controlled by surgical revascularization, cardiac death, the leading cause of the death in Japanese octogenarians, can be effectively avoided. Thus, during the relatively short period of study, survival appeared to be better in patients after CABG than in octogenarians in the general population. A longer follow-up might be necessary to determine these remote outcomes.

Comparison between the present study and previous reports

Compared to previous reports, our octogenarians shared similar preoperative risks, but the surgical technique was much different from others. First, we used the LIMA in the majority of the patients. Harvesting the single IMA in the octogenarians is safe, and the LIMA graft provides better patient outcomes, even in octogenarians.[35,38,43] In our practice, however, bilateral IMAs were used in a limited number of patients, since double mammary artery harvesting can increase the risk of sternal dehiscence in the elderly, due to advanced osteoporosis.[7]

Second, off-pump CABG was performed in more than half of the octogenarians in the present study, which was never mentioned in previous reports and its early results were favorable.[49,50] The current off-pump method, using a suction type of coronary stabilizer and retropericardial suspensions, allows us to perform bypass grafting on any aspect of the heart.[50] While on-pump CABG was the only standard method for CABG, surgical revascularization has not usually been considered for elderly patients, who have multiple medical problems. These patients were referred for PTCA instead. Considering the current higher failure rate of PTCA in octogenarians,[24] and considering small invasiveness of off-pump CABG, these highly compromised patients now more often undergo off-pump CABG.

Third, mortality (1.8%) and morbidity (7.8%) rates in the present study were much lower than in other reports. Furthermore, these figures were smaller than for the expected mortality and morbidity of isolated CABG in the general US population provided by the STS.[48] The reduced number of complications after CABG was mostly attributed to off-pump CABG, as mentioned above.[52]

Study limitations

The present study took place in a single institution with a single surgical group. Although none of the patients referred for surgery were turned down by the staff surgeons, a biased patient selection process might have been in effect at the time of referral from the cardiologists, which is unknown to us because more than 80% of the patients were referred from outside our institute. Outpatient management was mainly performed by these private physicians and postoperative clinic visits are individualized.

Table 5. Reported results of coronary artery bypass graft

					Preoperative risk factors												
Year	Author (ref)	Number of patients ≥80	Percent of isolated CABG	Mean age	Female	3VD	LMT	EM	HTN	DM	Poor EF	CHF	CRF	CVA	Number of bypass	Use of LIMA	Postop stay (day)
1983	Hall (1)	29	100%		38%												
1985	Rich (2)	25	28%	83.1	36%				44%	4%	24%	56%			3.0		19.5
1986	Tsai (3)	76	50%	82.0	54%				20%	44%							23.0
1988	Edmunds (4)	100	41%	83.1	56%	58%	24%		37%	12%		59%		10%			11.5
1988	Houser (5)	69	67%	82.1	61%										3.0	22%	21.2
1989	Tsai (6)	64	100%	82.0	36%				49%	19%							
1990	Bashour (7)	80	55%	83.0	51%	74%	22%				19%						
1990	Kowalchuk (8)	19	95%	82.0	52%	57%	13%	0%	53%	25%	38%		5%	14%	2.8		
1990	Merrill (9)	40	70%	82.4	48%	83%	29%								2.7	0%	14.0
1990	Mullany (10)	159	100%	82.0	33%	81%	41%	20%		13%	10%	10%	36%	33%	3.2	33%	10.0
1990	Naunheim (11)	103	69%	81.7	43%			33%	48%	11%		47%					14.0
1991	Freeman (12)	195	33%	82.3	46%	59%		23%									
1991	Ko (13)	100	100%	83.0	39%		28%	68%	42%	17%	14%		15%	9%	2.8	10%	
1991	Mick (14)	142	100%	82.0	39%	77%			53%	18%	11%				3.0	31%	18.0
1991	Myler (15)	49	100%	82.0	33%	51%	33%		47%	16%	17%						18.0
1991	Tsai (16)	157	100%	82.4	34%				62%	27%					3.4	20%	19.7
1991	Utley (17)	25	100%		44%	100%			56%	28%	12%				4.0		
1991	Weintraub (18)	154	100%	82.0	36%			27%	49%	17%		12%			3.3	10%	11.0
1991	Weintraub (19)	146	100%		36%	47%	22%	23%	52%	17%	4%	11%			3.3	14%	11.0
1992	Glower (20)	86	100%	81.0	47%	70%	24%	53%	67%	14%		9%	5%	27%	3.0	52%	10.0
1992	Ko (21)	36	100%	81.3	36%	86%	28%	0%	36%	8%	14%		17%	8%	3.0	8%	
1993	Yashar (22)	43	60%	82.0	53%			79%	47%	14%	14%	23%	23%	12%	2.8		19.0
1994	Curtis (23)	68	100%		26%		16%	71%									
1994	Kaul (24)	205	100%	82.4	46%	56%	19%	56%	26%	15%	54%				3.5		14.0
1994	Kilma (25)	75	59%	81.7	51%			53%	48%			9%			3.3		10.9
1994	Peterson (26)	47293	100%														
1994	Sahar (27)	35	71%	82.3	34%										2.8	30%	11.5
1994	Shah (28)	56	59%	82.0	39%	61%	33%		45%	4%	48%		46%		3.1	93%	20.0
1994	Tsai (29)	528	57%	83.7	44%				60%	19%		18%			3.3	35%	17.2
1995	Cane (30)	121	69%	82.1	45%	62%	13%	14%					3%	7%	2.5	34%	13.2
1995	Diegeler (31)	54	43%	82.2	43%	61%		11%		7%			4%	4%	3.1	48%	
1995	Kumar (32)	53	53%	83.3	59%		11%	13%	62%	19%	42%		4%	2%	3.0	78%	
1995	Peterson (33)	24416	100%	82.2	43%					9%		17%	1%	9%			14.3
1995	Williams (34)	300	100%	82.9	41%	89%	25%		59%	29%	9%		7%		3.7	6%	14.0
1996	Morris (35)	474	100%	82.6	34%	78%	3%	3%	71%	11%			19%	20%	3.4	40%	12.9
1996	Sahar (36)	42	71%	82.1			27%		36%	21%	14%		7%		2.7	30%	11.4
1996	Talwalkar (37)	100	100%	82.3	36%		35%	61%	60%	18%	55%	12%	13%	19%	2.8	7%	12.0
1997	Akins (38)	292	100%	82.0	36%	74%	32%	65%	62%	24%		39%	28%	13%			15.0
1997	de Mol (39)	130	49%	82.2	50%			16%			13%						22.5
1997	Deiwick (40)	101	60%	81.0	55%	70%	18%	57%	17%	23%			26%	4%	2.2	30%	
1997	Ott (41)	37	100%	82.4	57%				49%	19%	24%	32%			2.5		10.3
1998	Kirsch (42)	191	25%	83.0	49%			17%	48%	7%			8%	24%	2.4		
1999	Craver (43)	601	72%	82.2	44%			16%		15%		5%			3.4	17%	12.9
1999	Dalrympe-Hay (44)	242	21%	82.8		80%											
1999	Wong (45)	37	54%	82.8	48%			100%		5%				5%	3.4	68%	14.0
2000	Alexander (46)	4743	91%	82.4	44%	70%	44%	12%	63%	23%		19%	8%	19%	3.5	59%	7.0
2000	Hirose (Current)	55	100%	82.1	42%	69%	44%	15%	55%	49%	6%	24%	16%	15%	2.7	91%	16.2
	Median	50	91%	82.2	43%	70%	27%	27%	49%	18%	14%	19%	10%	13%	3.0	30%	14.0
	STS database	(3.99%)	100%	64.8	29.2%		20.6%	38.1%	65.9%	30.5%		13.1%	4.3%	6.4%	3.1	77.7%	

The median frequency of the observations is listed in the second to last bottom line.
The bottom line shows the data from the Society of Thoracic Surgery Database (1999) for the reference of baseline data.

(CABG) for octogenarians (number of CABG cases ≥25)

			Postoperative complications								Survival rate					
Ref	Mortality including associated surgery	Mortality of Isolated CABG	Morbidity	LOS	PMI	CVA	Bleed	Mediastinitis	Respiratory failure	Renal failure	Mean follow-up (year)	1-year	2-year	3-year	4-year	5-year
1	6.9%	6.9%														
2	4.0%		92.0%		4%	4%	36%	12%		8%						
3	13.0%	15.8%	77.0%			1%	8%			3%						
4	29.0%	24.0%	67.0%	20%	8%	3%	11%	5%	19%	19%	3.4	66%	63%	60%	55%	55%
5	14.3%	15.2%		15%		13%	5%	4%	38%		1.6					
6	3.1%	3.1%			20%	2%	6%	3%	14%	13%	3.2			89%		
7	12.5%	11.4%														
8	15.8%	16.7%	37.0%	0%	11%	0%	0%	5%	5%	0%						
9	10.0%	8.3%				5%	3%									
10	10.7%	10.7%		29%	6%	4%			12%		2.4	95%				80%
11	16.0%	13.0%		17%	16%	20%	5%		11%	10%	1.9	90%	82%			
12	15.7%	12.9%	30.4%		5%	8%	13%			6%	1.9	92%	87%	82%	78%	
13	12.0%	12.0%	14.0%		5%						1.8		77%		51%	
14	6.0%	6.0%			4%	4%				1%	3.3	95%	90%	87%		
15	10.0%	10.0%	38.0%													
16	7.0%	7.0%	19.8%		11%	4%	10%		6%	11%	2.7	85%				62%
17	0.0%		20.0%	0%	0%	8%	0%	0%	0%	0%		94%				88%
18	10.0%	10.0%		6%	3%	5%	5%				2.9	85%	80%	78%	72%	62%
19	8.3%	8.3%			3%	7%										
20	13.9%	13.9%	29.0%	15%		9%	7%	0%	8%	5%	1.4	74%		64%		50%
21	2.7%	2.7%		0%	3%	8%	0%	0%	0%	3%	2.4		88%	77%		
22	9.0%	4.0%	38.0%		13%	5%	13%		36%	13%						
23	4.2%	4.2%														
24	5.6%	5.8%	54.0%			2%						89%		77%		66%
25	8.0%	11.1%				1%	4%									
26	10.6%											91%				
27	0.0%	0.0%	25.7%			11%		6%	1%							
28	7.0%			16%	4%	2%	9%	2%			1.3	88%				
29	10.6%	8.3%		6%			9%				2.5	82%				62%
30	9.1%	5.9%	49.0%			14%	7%		12%	10%	3.0					42%
31	9.3%	8.6%									2.2	90%	90%	58%		
32	17.0%				6%	4%	8%	2%	4%	4%	1.6	75%				
33	11.5%	11.5%										81%	76%	71%		
34	11.0%	11.0%		5%	1%	2%	3%	2%	20%	13%	1.4				76%	
35	7.8%		23.8%		4%	7%	3%		10%	3%						
36	2.4%		20.0%	5%	2%	5%	2%	2%	2%	2%						
37	8.0%	8.0%	78.0%		8%	4%	2%	1%	34%	14%	3.0	87%	80%	77%	73%	
38	6.0%	6.0%		1%	3%	8%	4%	1%	15%	2%	3.2	87%		78%		66%
39	11.5%	14.1%	40.8%	6%	12%		10%		6%		2.6	84%	81%	79%	74%	
40	7.9%		73.3%	11%	3%	13%	7%	1%	7%	21%	1.6	88%	80%			73%
41	5.4%	5.4%	31.0%	0%	0%	0%	3%	0%	8%							
42	16.2%	12.8%	69.1%	12%	3%	9%	9%		33%	12%	1.9	79%		75%		56%
43	9.1%	9.0%		4%	2%	6%	6%		6%		2.8		75%			55%
44	5.7%	4.0%										86%				68%
45	10.8%	10.8%	30.0%	5%		8%	5%	3%	22%	8%						
46	8.1%	8.1%			3%	10%				7%						
Hirose	1.8%	1.8%	7.3%	4%	0%	0%	0%	0%	5%	2%	1.8	98%	85%	85%	85%	
Median	9.2%	8.3%	34.0%	6%	4%	5%	5%	2%	10%	7%	2.9	87%	81%	77%	73%	64%
STS		3.1%	36.3%		1.1%	3.4%	2.3%	0.6%		3.2%						

3VD: triple vessel disease, LMT: left main disease, EM: emergent or urgent surgery, HTN: hypertension, DM: diabetes mellitus, EF: ejection fraction (<40%), CHF: congestive heart failure, CRF: chronic renal failure, CVA: cerebral vascular accidence, LIMA: left internal mammary artery, LOS: low output syndrome, PMI: preoperative myocardial infarction, Ref: reference number, Surv: survival rate, STS: Society of Thoracic Surgeons.

Summary

In summary, CABG for octogenarians can be performed with acceptable risks. To minimize mortality and morbidity, off-pump CABG was used in selected cases. Adequate surgical revascularization provides freedom from cardiac events in octogenarians, as expected in younger patients.

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