

# Coronary Artery Bypass and Myocardial Revascularization Surgery in Patients Aged 80 and Over

Tsung-Po Tsai<sup>1\*</sup>, Ding-Bang Lin<sup>2</sup>,  
Carlos Blanche<sup>3</sup>

Life expectancy in Taiwan has been increasing steadily. The average Taiwanese who reaches age 65 (8.44% of the total 1999 population) is now expected to live into his or her eighth decade. At the end of 1998 the 80-and-over population was 265,847 and is projected to steadily increase. These demographic changes are affecting present-day cardiac surgical practice as an increasing number of highly symptomatic elderly patients are requiring coronary artery bypass surgery. The medical and ethical issues involved are complex. A concern has been raised that this population aged-80-and-over has the potential to become a burden to society and exhaust collective resources. A review of the long-term results of coronary artery bypass surgery in octogenarians indicates, however, considerable benefits of surgery. Patients attain both improved functional benefit and quality of life after the rigor of heart surgery. In addition, actuarial survival rates for coronary artery bypass at 1-year, 3-years and 5-years are around 87%, 78% and 62%, respectively. These favorable results of coronary artery bypass surgery in octogenarians could add significant information to the healthcare costs benefit debate. Less favorable results occur in cases where physiologic age is advanced by disease of other organ systems. However, taken independently, advanced age is not a contraindication to coronary artery bypass surgery.

Keywords: coronary artery bypass surgery, octogenarians

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<sup>1</sup> Department of Cardiothoracic Surgery, Chung Shan Medical University Hospital, Taichung, Taiwan (R.O.C.)

<sup>2</sup> School of Medical Technology and Graduate Institute Medicine, Chung Shan Medical University Hospital, Taichung, Taiwan (R.O.C.)

<sup>3</sup> Department of Cardiothoracic Surgery, Cedars-Sinai Medical Center, California, U.S.A.

\* Reprints and Corresponding Author: Tsung-Po Tsai, M.D.

Address: No. 110, Sec 1, Chien-Kuo N. Road, Taichung, 402, Taiwan, R.O.C. Tel: 886-4-24739595 ext 4110

E-mail: tsai@csh.org.tw



## Introduction

Life expectancy in Taiwan has been increasing steadily. Mean estimated life expectancy in 1999 was 75.6 years (male 72.46, female 78.12) and is projected to increase further (Fig. 1)<sup>[1]</sup>. The average Taiwanese who reaches age 65 years (8.44% of population in 1999) is now expected to live into his or her eighth decade of life (average life expectancy at age 65, 16.03; male 15.05, female 17.29)<sup>[2]</sup>. These demographic changes are reflected in present-day cardiac surgical practice, in that an increasing number of highly symptomatic elderly patients are requiring coronary artery bypass surgery. Recent reports<sup>[3,4,5]</sup> have revealed that coronary artery bypass surgery in elderly patients in otherwise good physical and mental health have substantially improved their quality of life, with an acceptable morbidity and mortality.

Advanced age need not be a contraindication to coronary artery bypass surgery, provided physiological age is not advanced by disease of other organ systems, which could limit survival. Octo-

genarians are frequently offered this therapy when they meet the key selection criterion of having medically refractory cardiac symptoms not amenable to conventional cardiac intervention. Notwithstanding the potential for controversy, this highly selected group is often offered coronary artery bypass surgery in the belief that they could continue to contribute to society. Furthermore, to deny them the benefit of coronary artery bypass surgery based solely on the issue of age presents even more controversies.

The medical and ethical issues involved in such cases are complex. Therefore, the decision regarding coronary artery bypass surgery in these octogenarians should be made in an open discussion with the patients' referring physicians, as well as the entire cardiac surgical team, including cardiac surgeons, cardiologists, cardiac anesthesiologists, respiratory therapists, psychiatrists, nurse coordinators, dietitians, social workers, rehabilitation technicians and pharmacists.

Coronary artery bypass surgery in octogenarians raises ethical question. It can be argued that this population has the potential to become a burden to society and exhaust limited resources

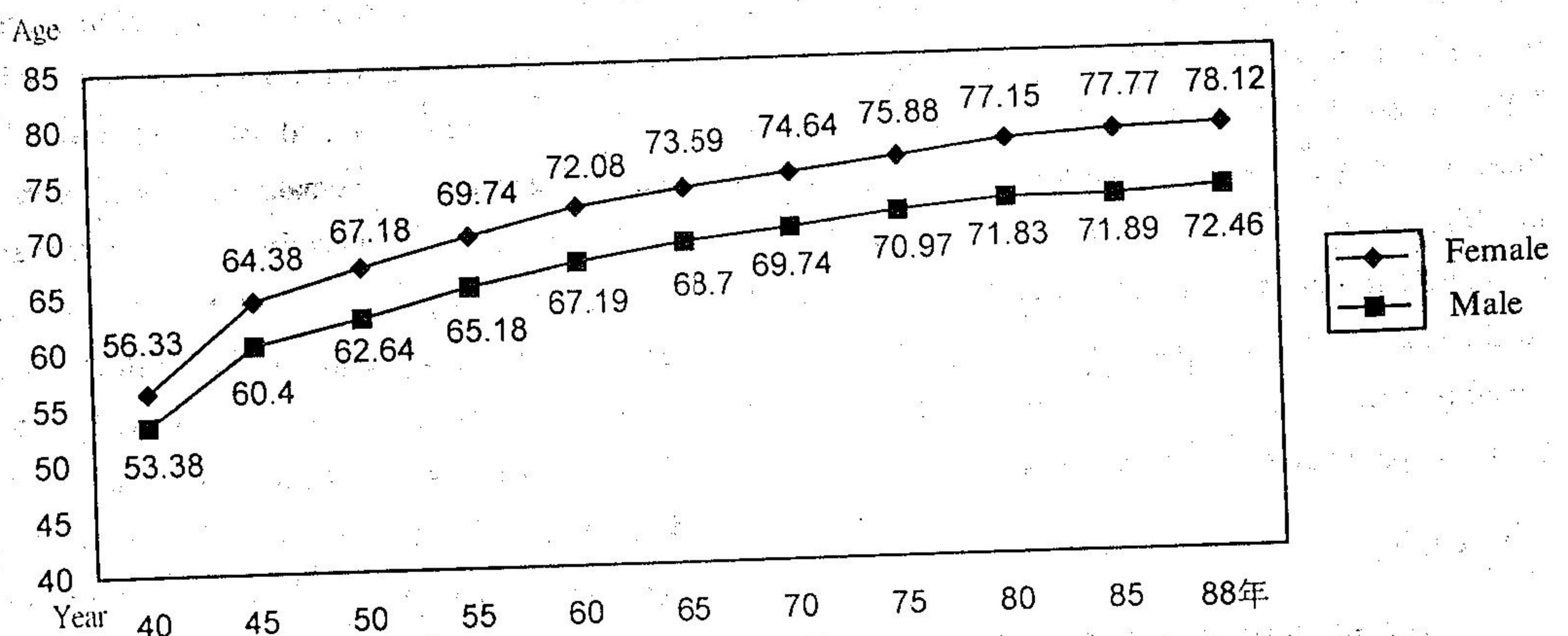


Fig. 1 Life expectancy in Taiwan



without sufficient benefit to society because of the advanced age of the patients. Therefore, it is very important to carefully evaluate the societal costs and benefits. A review of the literature was conducted which shows that long term results of coronary artery bypass surgery in this highly selected group of octogenarians indicate they can withstand the rigor of heart surgery with improved functional benefit and quality of life [3-73].

## Comment myocardial revascularization

### Myocardial Revascularization in Octogenarians

Angina pectoris affects between 15-17% of people aged 65 years with no increase in prevalence with older individuals. The prevalence of myocardial infarction, however, increases from 11% at age 65-69 years to 18% at 80-84 years [6]. In the earlier days of cardiac surgery, advanced age was considered a relative contraindication for revascularization procedures. However, as surgical techniques and perioperative management have improved, more 80 and over patients are now accepted for surgical intervention. This is reflected in the figures from Cedars-Sinai Medical Center, USA where the annual activity of cardiac operations in octogenarians increased from less than 20 in 1982 to more than 90 in 1992 [4]. Despite the demand for surgery in octogenarians, reduction in cardiovascular reserve seen in this group [7,8] invariably means that the excellent outcome seen in younger patients can not be matched [9].

### Mortality

A recent cardiac surgery review reported over all mortality rates of 1.8% for the younger patients, compared with 8.3% in the over 80 years old [4,5]. Other similar series in different heart institutes quote operative mortality rates

ranging from 0% to 20% for the latter group, depending on the proportion of emergency cases and the case-mix [10,11,12]. In the series reported by Freeman and associates [10], the overall perioperative mortality rate was 2.5 times greater in patients having urgent versus elective procedures. Emergency coronary artery bypass surgery in octogenarians also has been shown to be independently predictive of an increased perioperative mortality rate. Khan and colleagues [11] stated that elderly patients operated on within 24 hours after admission had a mortality rate equivalent to that of younger patients and suggested that delays in treatment of elderly patients may adversely affect the outcome of operation in the elderly.

### Risk Factors

Several risk factors have been associated with increased mortality in these patients: left main stem disease; left ventricular ejection fraction less than 40%; New York Heart Association [NYHA] Class IV cases; low preoperative cardiac index; female gender; diabetes mellitus; internal thoracic artery (ITA) graft [4,11,12,13,14,15]. Statistically significant predictors for prolonged hospital stay were postoperative stroke ( $p < 0.001$ ) and NYHA class IV ( $p < 0.001$ ) cases. While the only predictors for late death was renal insufficiency (odds ratio 2.6,  $p < 0.001$ ) [43]. Peterson and his associates [5] found that increased age, female sex, and measures of disease acuity (preoperative acute myocardial infarction or congestive heart failure) identified octogenarians with significantly higher 30-day and 3-year post-bypass-surgery mortality rates (see Table 1). Comorbid illnesses such as chronic renal disease, peripheral vascular disease, and cerebral vascular disease also independently predicted patients with higher 30-day and 3-year mortality rates. Interestingly, diabetes mellitus and pulmonary disease were not predictive of 30-day mortality but did predict higher long-term mortality. Late referral for bypass operation has been



suggested to be another significant component in higher mortality. Tsai and associates<sup>[4]</sup> found that in their series the patient sex (66% male) did not influence early postoperative survival (male, 7.8% versus female, 7.0%).

Left main coronary artery disease was relatively common (32%); however, it was less frequently associated with operative mortality than in larger series of young patients undergoing coronary artery bypass grafting (CABG)<sup>[6]</sup>. Nearly all patients in their series had significant preoperative symptomatic limitation. However, there was significant improvement in general condition at follow-up evaluation. In refutation of the often-stated dictum that mortality at this age (80 years and over) is related to multisystem failure, a full 46% were pure cardiac in nature<sup>[4]</sup>. Therefore, highly selective criteria (identifying risks and benefits individually) should be applied to octogenarians undergoing coronary artery bypass surgery to achieve satisfactory results.

### Use of ITA

Many surgeons have avoided the use of the internal thoracic artery (ITA) graft in elderly patients, assuming that it would provide no substantial benefit for patients with a limited long-term outlook. Additionally, there has been the perception that ITA grafting in elderly patients may be associated with greater risks of non cardiac complications and thus may be inappropriate. However, studies have shown that elderly patients who undergo successful coronary bypass grafting appear to have a relative probability of survival that is greater than their age-, race-, and sex-matched counterparts in the general population. Therefore, it may be incorrect to fail to use an ITA graft in an elderly patient based on a presumed lack of importance of late patency characteristics of the ITA versus the vein graft. Clinical and angiographic follow-up data demonstrated that both early and late patency of ITA

grafts were better than vein grafts. On a more practical level, it was apparent that in many elderly patients, the greater saphenous vein is a poor-quality bypass conduit. On the other hand, the ITA graft generally proved to be an excellent conduit, especially in elderly female patients, who often have relatively poorer quality of greater saphenous veins. The growing satisfaction with the internal thoracic artery graft as a superior bypass conduit in many elderly patients resulted in the current worldwide policy of routine ITA grafting regardless of age<sup>[7,16]</sup>. Gardner and associates (92% of their 723 patients aged over 70 receiving ITA graft) demonstrated that late follow-up data indicates a significant improved 4-year survival rate in patients with ITA grafts compared with those without:  $86 \pm 0.02\%$  versus  $77 \pm 0.03\%$  ( $p < 0.01$ ). Therefore, they concluded that LITA grafting appears to be an independent predictor both of improved early and late survival [16]. Moreover, Galbut and colleagues<sup>[17]</sup> demonstrated that bilateral internal thoracic artery grafting can be accomplished in elderly patients with low operative risk and hospital morbidity. The Morris group<sup>[18]</sup> further concluded that the internal thoracic artery was the bypass graft of choice, especially in regard to long-term mortality, and should not be denied to this high-risk group of octogenarians. However, Sergeant and associates<sup>[19]</sup> concluded that use of more than a single arterial graft appears to confer no additional benefit in their series of 99.95% complete follow-up of 9,600 patients (1971 to 1992). Patients chosen for ITA bypass conduit tended to be better surgical candidates by a variety of criteria, but only the incidence of preoperative intra-aortic balloon counterpulsation and emergency operation reached statistical significance<sup>[20]</sup>.

The advent of minimally invasive procedures, such as percutaneous transluminal coronary angioplasty (PTCA) and coronary stenting, has not reduced the risks inherent in this group. It is



technically more difficult in the elderly, with several centers only offering PTCA and stenting to those who are fit for surgery. There is an increased complication rate, necessitating conversion to open surgery, and long-term results are inferior to coronary artery bypass surgery with a high risk of restenosis and, therefore, a frequent need for re-intervention [21,22,23]. Furthermore, several studies have also reported higher mortality rate following PTCA than CABG surgery in octogenarians [24].

### MIDCAB and OPCAB

Minimally Invasive Direct Coronary Artery Bypass (MIDCAB) reduces the length of incision from 30 cm to 8 cm and avoids the need for both sternotomy and cardio pulmonary bypass. There is increasing interest in this procedure [25]. Theoretically, it offers a less traumatic option for the patient and has been demonstrated to be safe and effective with good early and mid-term results [26]. Furthermore, a recent retrospective study reported comparable long-term results between MIDCAB and conventional CABG, but at the cost of a threefold increase in reinterventions in the former group [27]. Stamou and colleagues [26] concluded that off-pump coronary artery bypass grafting (OPCAB) can be appropriately applied in patients older than 80 years (71 patients) with acceptable post-operative in hospital mortality (6%), morbidity (6% pneumonia & 47% atrial

fibrillation) and hospital stay ( $9 \pm 6$  days). Cheng and associates [46] reported similar results with acceptable mortality (7.7%), post-operative complication (1 patients had a stroke and 20.6% atrial fibrillation) and post-operative length of stay ( $8.6 \pm 4.5$  days) in their series of 92 OPCAB patients aged over-80. Lin and associates [28] used a small series of 11 patients at Taiwan and demonstrated OPCAB appears to be a safe and effective way to treat this high risk group of age 80-and-over.

### Outcomes

Octogenarians face significantly higher procedural risk and can be expected to have significantly poorer long-term outcomes than patients of age 65 to 70 years (see Table 1). Due to limited information, it is still unclear whether or not octogenarians incur sufficient benefit from surgery in terms of symptom relief and improved survival expectations to justify the surgical risk. In terms of symptom relief, Weintraube and colleagues [9] found that at 3-year follow-up 82% of surviving severe baseline angina patients remained asymptomatic, who were alive. Other clinical series have confirmed these findings, demonstrating long-term improvements in functional status and symptom relief with surgical therapy in the very elderly. Whether bypass surgery improves survival expectations in octogenarians, however, remains unknown. Published randomized trials of bypass surgery versus medical therapy have excluded the

Table 1 Mortality after bypass surgery by age group

Age (years)	65-70 (n=147,822)	$\geq 80$ (n=24,461)
Outcome (%)		
In-hospital mortality	4.4	11.5
30-d mortality	4.3	10.5
1-y mortality	7.9	19.2
2-y mortality	10.3	23.7
3-y mortality	13.1	28.8

All  $p < .01$

From US Medicare [5]



very elderly [29, 30]

Craver and associates [20] concluded that an acceptable early mortality and long-term survival equal to those seen for age-matched elderly population are sound outcome measures that support the justification of CABG in older patients irrespective of age (see Table 2).

## Coronary artery reoperations in octogenarians

The number of reoperations for coronary revascularization is increasing. This is also true in the octogenarian patient cohort. The national data base of the Society of Thoracic Surgeons indicates that the incidence of reoperations for CABG has increased progressively from 1.9% in 1980 to 7.0% of operations in 1990 [32]. Significantly, it is well documented that reoperative coronary revascularization carries a higher mortality rate than primary intervention, with a reported range from 3.4% to 12.5% [32,33]. Although previous reviews document trends of decreasing perioperative risk, despite improvements in myocardial protection and increased surgical experience, the risk of reoperative coronary artery bypass grafting procedures still exceed those for primary coronary artery bypass surgery.

Overall, the characteristics of patients undergoing repeat operation for coronary artery bypass grafting (CABG) are similar to those for patients undergoing primary revascularization [34]. A few exceptions were noted: the proportion of women increased, there was a significantly greater mean age, more patients had either triple-vessel disease or left main obstruction. In addition, most patients were reoperated on because of one of three conditions: progression of atherosclerosis in the native coronary circulation; incomplete revascularization; or graft failure. Graft failure more than 5 years postoperative is most often caused by vein graft atherosclerosis. Use of platelet in-

hibiting agents and of the ITA graft or any arterial conduit are necessary to prevent graft failure.

For patients undergoing primary operation for coronary artery disease, the most striking characteristics over the past two decades have been a decrease in the level of perioperative myocardial damage. This trend is attributable to multiple factors, including increasing surgical anesthetic experience and the use of cardioplegia (blood or crystalloid; antegrade and/or retrograde) for better myocardial protection. However, for those reoperative patients, the overall rate of perioperative myocardial infarction has not been significantly lowered. In fact, the difference between primary operation and reoperation in regard to perioperative myocardial infarction is even more striking than the difference in overall mortality. Most deaths of cardiac reoperation were related to myocardial dysfunction and more than 50% of those were of the left main stenosis. Reoperation provides more subtle technical challenges than just reopening the sternum with difficulty. Vessel identification can be difficult, and lack of bypass conduits can contribute to suboptimal revascularization and the risk of perioperative myocardial damage. Incomplete revascularization after the primary operation was previously identified as a significant factor, but is not now considered a determinant of risk. Left main coronary artery stenosis and advanced age have previously been identified as significant factors and remain so. Advanced age and decreased left ventricular function adversely affected long-term survival after coronary artery bypass grafting reoperation [33].

In the series reported by Blanche and his colleagues (113 consecutive patients), the 30-day mortality rate for cardiac reoperation in octogenarians was 8%, and 17% for the combined CABG and valve group. And 5-year survival rates were 58% for the CABG group and 63%



Table 2 Myocardial revascularization in the octogenarian

Source [Reference]		Number of Patients	Average Age	Operative Mortality (%)
Edmunds, 1988 [36]		41	80	24.0
Naunheim, 1990 [31]		71	80	13.0
Mullany, 1990 [29]		159	82	6.3
Ultly, 1991 [37]		25	80	0.0
Freeman, 1991 [10]		36	82	5.6
Ko, 1991 [12]		100	83	12.0
Weintraub, 1991 [9]		146	80	8.3
Tsai, 1991 [38]		157	82	7.0
Tsai, 1994 [4]		303	83	8.3
Peterson, 1995 [5]		24,461	80 <sup>+</sup>	11.5
Williams, 1995 [39]	CABG	300	80.9	11.0
	CABG (elective)	240		9.0
	CABG (urgent)	45		11.0
	CABG (emergent)	15		33.3
Cane, 1995 [40]	CABG	121	82.1	9.1
Talwalker, 1996 [41]	CABG	100	80 <sup>+</sup>	8.0
Ranger, 1996 [42]	CABG	255	82.0	8.6
Morris, 1996 [18]	CABG (SVG)	286	82.6	7.0
	CABG (ITA)	188		9.0
Akins, 1997 [43]	CABG	292	80 <sup>+</sup>	5.8
Kirsch, 1998 [44]	CABG	47	80 <sup>+</sup>	16.2
Craver, 1999 [20]	CABG (SVG)	329	82.2	11.3
	CABG (ITA)	101		2.0
Blanche 1999 [35]	CABG (Redo)	49	83.2	8.0
Stamou, 2000 [26]	OPCAB	71	80 <sup>+</sup>	6.0
Alexander, 2000 [45]	CABG	4,743	80 <sup>+</sup>	8.1
Cheng, 2001 [46]	OPCAB	92	80 <sup>+</sup>	9.7
	CABG	280	80 <sup>+</sup>	5.0

\* CABG = coronary artery bypass grafting

\* SVG = saphenous vein graft

\* ITA = internal thoracic artery

\* OPCAB = off-pump coronary artery bypass



or the combined CABG and valve group. They concluded that coronary artery bypass grafting reoperation can be performed successfully in most octogenarians, although with an increased risk, particularly in the combined CABG and valve group. Long-term survival rates are acceptable and there is improved quality of life and functional status. However, to earlier referral and surgical intervention could further improve these results, thereby increasing the effectiveness of health care resources [35].

## Summary

**Mortality:** Elective coronary artery bypass surgery can be performed in selected patients aged 80 and up with acceptable perioperative mortality (5.8 to 10.6%) or morbidity with the reasonable expectation of significantly improved symptomatic status (70 to 87%) and possible increased longevity [4,43] (Table 1,2).

**Surgical Complications:** Variables leading to postoperative complications influencing long-term survival after CABG in octogenarians, include arrhythmia (41% atrial fibrillation and 19% atrial flutter) and cerebrovascular accident (14% disorientation, 5 to 6.3% of stroke). A substantial percentage (24%) of patients develop major complications during the early postoperative period [4].

**Survival:** One-year, 3-year and 5-year postoperative actuarial survival rates are 82 to 87%, 65 to 78% and 62 to 66% for the CABG. [4,20,43].

**Quality of Life:** Seventy to 87% of octogenarians who underwent coronary artery bypass surgery were shown to improve in their general health as compared to pre-surgery, 18% remained unchanged and 12% deteriorated. Thirty-eight percent of octogenarians led active lives, 26% of the patients were sedentary, and 35% of the patients were restricted in their daily activities for a mean total of 2 years' follow-up [4]. Additionally, a cardiac event-free survival of 61.6% at 5

years has been reported for the total patient population (coronary artery bypass surgery patients aged 80-and-over) [43]. Kumar and colleagues [73] (68 patients aged 80 and over) reported that significant improvements were seen in objective indicators of quality of life: the mean NYHA functional class ( $3.1 \pm 0.9$  to  $1.5 \pm 0.7$ ,  $p < 0.01$ ); mean Karnofsky dependency category ( $2.0 \pm 0.4$  to  $1.5 \pm 0.5$ ,  $p < 0.01$ ); social support index ( $3.0 \pm 1.1$  to  $1.4 \pm 0.9$ ,  $p < 0.05$ ); and mean number of cardiovascular symptoms ( $4.2 \pm 1.4$  to  $1.6 \pm 1.3$ ,  $p < 0.05$ ). Sixty-three percent of octogenarians were completely pain free at follow-up compared with 3% preoperatively ( $p < 0.01$ ). Significant improvements were seen in the indices for satisfaction with overall life, general affect, and positive feelings. At follow-up, 76% of octogenarians indicated that they had made the right decision to undergo coronary artery bypass surgery.

**Medical Cost Issues:** Peterson and associates [5] compared patients of age 80 years and over with patients of age 65 to 70 years. Octogenarians had significantly longer mean postprocedural lengths of stay and higher hospital costs. The mean overall hospital cost was 20% to 40% higher for octogenarians than for younger patients (patient number, 24,461 vs 147,882) [5]. Avery and colleagues [72] concluded that octogenarians (104 patients) experienced a longer intensive care (69.2 vs 43.2 hours,  $p = 0.002$ ) and postoperative stay (10.09 vs 7.45 days,  $p = 0.001$ ), and were discharged to a skilled nursing facility more often than younger patients (351 patients aged 65 to 75 years) (47% vs 21%,  $p = 0.0001$ ). Total direct costs were only modestly higher (\$4,818) in the octogenarian group ( $p = 0.0007$ ). Despite the higher stakes for coronary artery bypass surgery in the octogenarian, the favorable outcome experienced by the majority of these patients justifies the incremental risk to the patients and the added expenditure on the behalf of these oldest members of our society.



## Conclusion

Physicians are likely to be approached to evaluate an increasing number of very elderly patients for coronary artery bypass surgery given the excellent results obtained in younger patients. At the same time, the National Health Insurance Bureau has recently set strategies to reduce health care costs by limiting the availability of medical benefits to the elderly. The decision to ration health care resources will have to take into consideration the fact that the elderly are becoming the fastest-growing and largest segment of the Taiwan population. The allocation of sophisticated technology may have to be adjusted as biodemographic changes continue to accelerate. Despite the difficulties already involved in analyzing the issue of elder care in the present day health care reform, good results of coronary artery bypass surgery in the octogenarians could add significant information to the cost-benefit health care debate.

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# 八十歲以上老年人的冠狀動脈繞道 手術經驗

蔡宗博<sup>1\*</sup> 林定邦<sup>2</sup> Carlos Blanche<sup>3</sup>

台灣人的平均壽命（民國八十八年為75.6歲；男性72.46歲，女性78歲），每年以穩定的成長率增加。民國八十八年高齡人口（65歲以上）佔台灣全人口比率的8.44%，已進入聯合國規定的高齡化社會（門檻7.0%）。台灣在民國八十七年人口登記中，八十歲以上的人口有265,847人，而且有逐年增加的趨勢，從更多的老年人接受冠狀動脈繞道手術更可看出此一事實所牽涉的醫療倫理問題，相當複雜；因為八十歲以上老年人接受冠狀動脈繞道手術後，很可能成為我們社會的一大負擔，而且也會消耗不少珍貴的醫療資源。然而從多篇文獻的探討，發現經嚴格挑選過患有冠狀動脈心臟病的八十歲以上老年人，接受冠狀動脈繞道手術後的長期成效，顯示八十歲以上患有冠狀動脈心臟病的老年人，不但能耐受心臟大手術的考驗，而且70%到80%的病人症狀能改善並能增進生活品質。八十歲以上老年人接受冠狀動脈繞道手術後一年、三年及五年的存活率，分別為87%、78%和62%。這種顯著的效果，對健保給付成本效益政策提供了不少爭論的資訊。只要身體的其他器官沒有老化或生病而影響存活，年齡並非八十歲以上老年人接受冠狀動脈繞道手術的絕對禁忌。

關鍵詞：八十歲老年人、冠狀動脈繞道手術

<sup>1</sup> 中山醫學大學附設醫院心胸外科

<sup>2</sup> 中山醫學大學醫事技術系

<sup>3</sup> 美國洛杉磯西達賽奈醫學中心心胸外科

\* 通訊作者：蔡宗博

通訊地址：402台中市南區建國北路一段110號 電話：(04)24739595轉4110

電子信箱：tsai@csh.org.tw