

# Coronary artery bypass grafting in patients over 80 years of age: a single-centre experience

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## Abstract

**Background:** Extended length of human life leads to an increased number of the elderly with coronary artery disease. Advanced age does not constitute a contraindication for surgical revascularisation. However, as reflected by the available risk scores, mortality risk associated with operating patients in the 9<sup>th</sup> decade of life is increased.

**Aim:** To characterise patients over 80 years of age undergoing coronary artery bypass grafting (CABG) and to evaluate in-hospital mortality in the study group.

**Methods:** We retrospectively analysed medical records of 51 patients over 80 years of age who underwent CABG in a cardiac surgical department of a regional cardiology centre in 2008–2011. The following factors were taken into consideration: coexisting diseases, laboratory test results, echocardiographic findings, surgical data, and in-hospital mortality. EuroSCORE (European System for Cardiac Operative Risk Evaluation) I and EuroSCORE II risk scores were used for preoperative risk assessment.

**Results:** The mean age in the study group was 81.7 years. Coexisting diseases included hypertension in 76.5% of patients, impaired renal function in 62.7% of patients, heart failure in 31.4% of patients, atrial fibrillation (AF) in 21.6% of patients, and diabetes mellitus in 15.7% of patients. Most patients had a history of myocardial infarction (MI). CABG was performed using cardiopulmonary bypass in 51.6% of patients. The most frequent complications were new onset AF which occurred in 41.2% of operated patients and low cardiac output syndrome which was observed in 37.3% of patients. In-hospital mortality rate among patients over 80 years of age undergoing CABG was 3.9%, lower than predicted by the logistic EuroSCORE I (9.1%) and EuroSCORE II (7.3%). Two patients died during the postoperative period, including one operated with the use of cardiopulmonary bypass.

**Conclusions:** The most common concomitant conditions in the elderly patients undergoing cardiac surgery are hypertension and impaired renal function. The majority of operated patients already suffered a MI. AF and low cardiac output syndrome are the most common postoperative complications. Among patients above 80 years of age, operative mortality risk predicted using the EuroSCORE I and EuroSCORE II may be overestimated. Patient selection for cardiac surgery must be based on individual factors, taking into account the feasibility of postoperative rehabilitation and the potential for improved survival and quality of life.

**Key words:** old age, coronary artery bypass grafting, in-hospital mortality

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## INTRODUCTION

Civilisation advancement is associated with prolonged lifespan due to improved conditions of life and medical advances in regard to both prevention and therapy [1, 2]. This leads to an increased number of people with cardiovascular disease, and particularly the elderly with ischaemic heart disease. It

has been estimated that in 20 years, one fourth of the Polish population will be over 65 years of age [3]. According to the 2013 Statistical Yearbook of Poland, 3.6% of the population was over 80 years of age in 2011, compared to 3.1% in 2008 [4, 5]. In the elderly, vessel stiffness increases due to an increased number of collagen fibres, nitric oxide release

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is decreased, and vasomotor responsiveness is impaired. At the same time, concomitant diseases lead to progression of atherosclerotic lesions which are often diffuse [6, 7].

The most common cause of mortality among the elderly is coronary artery disease (CAD). Symptomatic CAD is present in 30% of the elderly subjects, and its incidence progressively increases with age, leading to the prevalence of about 80–90% among those aged 80–90 years [1].

CAD in the elderly is characterised by more complex clinical presentation compared to younger patients. Multiple concomitant conditions may mask symptoms of even advanced CAD, and less specific symptoms develop instead of a typical angina. Due to cardiovascular alterations related to aging, including those affecting the cardiac conduction system, patients over 80 years of age are a challenging patient population.

Advanced age is not a contraindication to cardiac surgery but operative mortality among those over 80 years of age is increased, as reflected in the available risk scores [8–10]. In this group, patient selection for coronary artery bypass grafting (CABG) is based on the assessment of the severity of atherosclerotic lesions both in coronary arteries (by coronary angiography) and in peripheral vessels, combined with the presence of organic lesions in the central nervous system, evaluation of renal function, and most importantly evaluation of respiratory function, as respiratory problems are among the most common postoperative complications. The overall health status should also be taken into account when making plans regarding postoperative rehabilitation. On the other hand, surgical revascularisation not only benefits quality of life but may also improve long-term survival in this patient population [11].

The aim of the study was to characterise patients over 80 years of age undergoing CABG and to evaluate in-hospital mortality in the study group.

## METHODS

We performed a retrospective evaluation of medical records of 51 patients aged over 80 years who underwent isolated CABG in a cardiac surgical department of a regional cardiology centre in 2008–2011. We evaluated concomitant conditions, laboratory test results, echocardiographic findings, and periprocedural data and mortality during the in-hospital period. The operative risk was evaluated using the European System for Cardiac Operative Risk Evaluation (EuroSCORE I) which included the following data: age, gender, left ventricular ejection fraction, presence of chronic obstructive pulmonary disease (COPD), peripheral vessel disease or and neurological disease, previous open heart surgery, preoperative serum creatinine level (creatinine clearance in the EuroSCORE II), active endocarditis, critical preoperative status, unstable angina, previous myocardial infarction, pulmonary hypertension, emergent surgery, surgery other than isolated CABG, surgery involving the aorta, post-infarction ventricular septal rupture, and diabetes treated with insulin (only in the EuroSCORE II).

## RESULTS

The majority of the 51 operated patients aged 80–88 (mean age 81.7) years were men (62.7%). In the subsequent years, we observed an increasing number of patients over 80 years of age who underwent CABG: 8 (2.5%) patients in 2008, 10 (3.3%) patients in 2009, 12 (3.2%) patients in 2010, and 22 (4.9%) patients in 2011. Previous percutaneous coronary intervention (PCI) was performed in 8 (15.7%) patients, and another 2 patients underwent PCI during the same hospitalisation but without satisfactory haemodynamic effects. In 1 case, PCI was complicated by perforation of the left anterior descending artery and cardiac tamponade requiring immediate cardiac surgery. Detailed characteristics of the study subjects are shown in Table 1.

Total venous revascularisation was performed in half of patients over 80 years of age undergoing CABG. Half of operations were performed without the use of extracorporeal circulation (Table 2).

Patients were extubated mean 13 h after the surgery (range 2 h 40 min to 11 days), remained in the intensive care unit for mean 6 days and 8 h (range 2–61 days), and were discharged from the cardiac surgery unit at mean 7 days after the surgery (range 2–20 days).

The most common postoperative complication was new onset atrial fibrillation that developed in 41.2% of patients. Immediately after the surgery, catecholamines were required due to low cardiac output syndrome in 37.3% of patients. Both reoperation due to increased postoperative bleeding and re-intubation due to worsening of respiratory failure were needed in 7.8% of patients (Table 3).

Two (3.9%) patients died in the postoperative period. Both these patients underwent urgent life-saving surgery in the acute phase of myocardial infarction. One patient underwent off-pump CABG (OPCAB).

## DISCUSSION

In this study, we attempted to characterise octogenarians undergoing CABG. Benefits from surgical myocardial revascularisation in the elderly are mainly related to improvement of long-term outcomes, as CABG allows more complete revascularisation compared to PCI. The surgical approach is to revascularise all occluded vessels and bypass all significant coronary stenoses. However, multiple concomitant conditions in patients over 80 years of age with CAD increase the risk of early postoperative complications, and thus short-term outcomes in octogenarians after CABG are worse than after PCI. In our centre, in-hospital mortality among the studied patients was 3.9%, lower than predicted by the EuroSCORE I (9.1%) and EuroSCORE II (7.3%) risk scores. These results are comparable to those reported by other centres in Europe and worldwide.

In a retrospective study by Dacey et al. [12] which included 1,693 patients above 80 years of age who underwent elective CABG or PCI, in-hospital mortality was 3% in the PCI

Table 1. Characteristic of patients over 80 years of age

		Number of patients (n = 51)	Proportion of patients [%]
Age		81.7 (80–88)	
Gender	Men	32	62.7
	Women	19	37.3
Cardiac profile	Acute ST elevation myocardial infarction	8	15.7
	Acute non-ST elevation myocardial infarction	22	43.1
	Unstable angina	10	19.6
	Stable angina	11	21.6
	Previous myocardial infarction	30	58.8
	Reduced left ventricular ejection fraction (< 40%)	9	17.6
	Heart failure	16	31.4
	Atrial fibrillation	11	21.6
	Preoperative intraaortic balloon pump	2	2.9
	Urgent surgery	33	64.7
	Cardiovascular risk factors	Arterial hypertension	39
Type 2 diabetes		8	15.7
Insulin therapy		5	9.8
Dyslipidaemia		16	31.4
Underweight (BMI < 19.9 kg/m <sup>2</sup> )		0	0
Overweight (BMI 25–29.9 kg/m <sup>2</sup> )		27	52.9
Obesity (BMI ≥ 30 kg/m <sup>2</sup> )		5	9.8
Concomitant conditions	Previous stroke	3	5.9
	Previous transient ischaemic attack	1	2.0
	Chronic obstructive pulmonary disease	4	7.8
	Impaired renal function (GFR < 60 mL/min)	32	62.7
	Hyperthyroidism	3	5.9
EuroSCORE I (logistic)		16.97% (3.71–51.45%)	
EuroSCORE II		7.3% (1.73–31.1%)	

BMI — body mass index; GFR — glomerular filtration rate; EuroSCORE — European System for Cardiac Operative Risk Evaluation

Table 2. Details of surgical treatment

		Number of patients (n = 51)	Proportion of patients [%]
Revascularization	Coronary artery bypass grafting	51	100
	Use of cardiopulmonary bypass	26	51.6
	Number of anastomoses	2.3 (1–4)	
	LIMA + saphenous vein	23	45.1
	LIMA	5	9.8
	Distal anastomosis using saphenous vein only	22	43.1
	LAD (saphenous vein)	1	2.0
Duration	Surgery [min]	180.1 (110–365)	
	Aortic clamping [min]	42.1 (23–97)	
	Cardiopulmonary bypass [min]	87.5 (54–149)	

LIMA — left internal mammary artery; LAD — left anterior descending artery

**Table 3.** Postoperative outcomes

Postoperative complications	Number of patients (n = 51)	Proportion of patients [%]
In-hospital mortality	2	3.9
Atrial fibrillation	21	41.2
Low cardiac output syndrome	19	37.3
Postoperative renal failure	7	13.7
Rethoracotomy due to bleeding	4	7.8
Reintubation	4	7.8
Prolonged ventilation	3	5.9
Mediastinitis	2	3.9
Intraaortic balloon pump	2	3.9
Cerebral ischaemic event	1	2.0

group and 5.9% in the CABG group ( $p = 0.005$ ). Survival at 6 months was worse in the CABG group compared to the PCI group (hazard ratio [HR] 1.32,  $p = 0.135$ ), but at 8 years, it was significantly better among patients treated with CABG compared to PCI (HR 0.72,  $p = 0.005$ ).

In a retrospective analysis of patients undergoing CABG, Hirose et al. [13] compared 55 octogenarians and 197 patients aged 75–79 years. In this study, in-hospital mortality among those above 80 years of age was 1.8% and did not differ significantly from mortality in the younger age group (2.5%). Similar mortality in both groups was likely related to similar rates of concomitant conditions regardless of patient age. A higher mortality in our study compared to that reported by Hirose et al. [13] was a result of higher rates of concomitant diseases among patients over 80 years of age, including hypertension (76.5% vs. 55%), obesity (9.8% vs. 2%), atrial fibrillation (21.6% vs. 9%), impaired renal function (62.7% vs. 16%), and COPD (7.8% vs. 7%). In addition, urgent surgery in our patients was much more frequent (64.7% vs. 14%), mostly for life-saving indications in acute myocardial infarction (58.8% vs. 11%). Also, preoperative left ventricular ejection fraction was below 40% in a higher proportion of patients (17.6% vs. 5%). In our study group, postoperative complications were seen more frequently, including low cardiac output syndrome (41.2% vs. 4%), the need for intraaortic balloon counterpulsation (3.9% vs. 2%), and rethoracotomy due to increased postoperative bleeding (7.8% vs. 0%).

Saxena et al. [14] in a retrospective study that included 1,664 patients above 80 years of age and 21,534 younger patients showed higher postoperative mortality among octogenarians compared to younger patients (4.2% vs. 1.5%). This difference was related to higher rates of concomitant conditions including preexisting myocardial damage and hypertension, and more frequent postoperative complications.

In a retrospective analysis of 1,746 patients, including 155 patients in the 9<sup>th</sup> decade of life, Scott et al. [15] showed a 30-day mortality of 9% in the older group compared to 1.2% in the younger patients. Older patients had more complications including postoperative renal failure and neurological complications.

Alexander et al. [16] in a retrospective analysis of 67,764 patients, including 4,743 patients above 80 years of age, showed significantly higher in-hospital mortality among octogenarians compared to younger patients (8% vs. 3%). The elderly patients were characterised by more advanced CAD and a higher rate of urgent operations, similarly to our data, with comparable rates of concomitant disease and more frequent postoperative complications including strokes and renal failure.

In our study, half of patients were operated without the use of cardiopulmonary bypass (48.4% vs. 51.6%). OPCAB procedures are related with a lower risk of stroke which significantly worsens short- and long-term outcomes but are also more technically challenging as they require performing coronary anastomoses on the beating heart, which is particularly difficult on the lateral and posterior aspect of the cardiac surface. In our study, 1 of the 2 CABG patients who died in the postoperative period, was operated using cardiopulmonary bypass. In a retrospective analysis of patients over 80 years of age who underwent CABG, Saleh et al. [17] showed that OPCAB was not associated with a significant mortality reduction compared to octogenarians operated using cardiopulmonary bypass (4.7% vs. 6.5%,  $p = 0.55$ ). However, patients in the OPCAB group were ventilated for a shorter time in the postoperative period, required shorter duration of stay in an intensive care unit, and less frequently required inotropic support.

When selecting patients for cardiac surgery, evaluation using the EuroSCORE allows estimation of perioperative mortality in patients in whom surgery is contemplated. We used the EuroSCORE I and currently used EuroSCORE II system. In our study, the mean risk was 9.1% in the EuroSCORE I and 7.3% in the EuroSCORE II, indicating high perioperative mortality risk. However, actual mortality in the study group was 3.9%, suggesting that both the additive and the logistic model overestimated the risk of death. In the EuroSCORE, octogenarians score high due to their chronological age which often does not correspond to their biologic age. Thus, preoperative patient assessment must be based on individual factors, taking into account the feasibility of postoperative rehabilitation and the potential for improved survival and quality of life. In our centre, we pay much attention to respiratory function. Patients with advanced lung diseases are considered ineligible for cardiac surgery, and thus the study group included only 4 patients with COPD, and prolonged ventilation was necessary in only 5.9% of patients. Another important element of the preoperative assessment is carotid

artery Doppler ultrasound, which indirectly assesses the risk of neurological complications. In our study group, 4 patients previously suffered a cerebral event, and postoperative stroke occurred in only 1 patient. Appropriate preoperative management including proper hydration and intra- and postoperative fluid replacement reduced the rate of postoperative acute renal failure to 13.7%, although renal function was impaired preoperatively in a high proportion of patients (62.7%).

### CONCLUSIONS

1. The number of elderly patients undergoing surgical myocardial revascularisation is steadily growing.
2. Most common concomitant conditions in this patient group are hypertension, impaired renal function, and a history of myocardial infarction.
3. Atrial fibrillation and low cardiac output syndrome requiring catecholamine pressor support are the most common postoperative complications.
4. Among patients above 80 years of age, operative mortality risk predicted using the EuroSCORE I and EuroSCORE II may be overestimated.
5. Patient selection for cardiac surgery must be based on individual factors, taking into account the feasibility of postoperative rehabilitation and the potential for improved survival and quality of life.

**Conflict of interest:** none declared

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# Pomostowanie aortalno-wieńcowe u chorych powyżej 80. roku życia: doświadczenia jednego ośrodka

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## Streszczenie

**Wstęp:** Wydłużenie czasu trwania życia ludzi prowadzi do zwiększenia populacji osób z chorobą niedokrwienną serca w podeszłym wieku. Zaawansowany wiek nie stanowi przeciwwskazania do rewaskularyzacji chirurgicznej, jednak ryzyko zgonu związane z przeprowadzeniem operacji u osób w 9. dekadzie życia jest zwiększone, co uwzględniając dostępne skale ryzyka.

**Cel:** Celem niniejszej pracy były: charakterystyka populacji chorych powyżej 80. rż. poddawanych pomostowaniu aortalno-wieńcowemu (CABG) i ocena śmiertelności wewnątrzszpitalnej w badanej grupie.

**Metody:** Retrospektywną analizą objęto dokumentację 51 pacjentów powyżej 80. rż. poddawanych CABG w latach 2008–2011 na Oddziale Kardiochirurgii referencyjnego ośrodka kardiologicznego. Oceniono występowanie schorzeń współistniejących, wyniki badań laboratoryjnych, echokardiograficznych oraz dane dotyczące zabiegu i śmiertelności w okresie wewnątrzszpitalnym. Do oceny ryzyka przedoperacyjnego zastosowano skale EuroSCORE I oraz EuroSCORE II.

**Wyniki:** Średnia wieku w badanej grupie wynosiła 81,7 roku. Stwierdzono występowanie licznych schorzeń towarzyszących (nadciśnienie tętnicze — 76,5% pacjentów, upośledzona funkcja nerek — 62,7%, niewydolność serca — 31,4%, migotanie przedsionków — 21,6%, cukrzyca — 15,7%). U większości operowanych w przeszłości wystąpił zawał serca. U 51,6% chorych CABG przeprowadzono w krążeniu pozaustrojowym. Najczęstszymi powikłaniami pooperacyjnymi były migotanie przedsionków *de novo*, które wystąpiło u 41,2% osób, oraz zespół małego rzutu obserwowany u 37,3%. Śmiertelność wśród pacjentów powyżej 80. rż. poddanych CABG wynosiła 3,9%. Była ona niższa niż prognozowana ze pomocą skali EuroSCORE I (model logistyczny) — 9,1% oraz skali EuroSCORE II — 7,3%. Dwóch chorych zmarło w okresie pooperacyjnym. Jeden spośród nich był operowany w krążeniu pozaustrojowym.

**Wnioski:** Systematycznie zwiększa się odsetek osób w podeszłym wieku poddawanych rewaskularyzacji chirurgicznej. Najczęstszymi schorzeniami towarzyszącymi są nadciśnienie tętnicze i upośledzona funkcja nerek. Migotanie przedsionków i zespół małego rzutu serca były najczęściej występującymi powikłaniami pooperacyjnymi. Śmiertelność okołozabiegowa w grupie 80-latków jest niższa niż wynika to ze skal EuroSCORE I i EuroSCORE II. Kwalifikacja do operacji kardiochirurgicznej pacjentów w podeszłym wieku wymaga indywidualizacji z oceną możliwości pooperacyjnej rehabilitacji, wydłużenia życia i poprawy jego jakości.

**Słowa kluczowe:** podeszły wiek, pomostowanie aortalno-wieńcowe, śmiertelność wewnątrzszpitalna

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