

Outcomes of a percutaneous coronary intervention versus coronary artery bypass grafting in octogenarians

Rokas Šerpytis¹,

Lina Puodžiukaitė^{2*},

Saulius Petrauskas³,

Nerijus Misonis⁴,

Mantas Kurminas⁴,

Aleksandras Laucevičius⁴,

Pranas Šerpytis⁴

¹Centre for Cardiology and Angiology,
Vilnius University Hospital
Santaros Klinikos,
Vilnius, Lithuania

²Clinic of Anaesthesiology
and Intensive Care,
Faculty of Medicine,
Vilnius University,
Vilnius, Lithuania

³Faculty of Medicine,
Vilnius University,
Vilnius, Lithuania

⁴Clinic of Cardiac
and Vascular Diseases,
Faculty of Medicine,
Vilnius University,
Vilnius, Lithuania

Background. The data on long-term outcomes for elderly patients with coronary artery disease who undergo invasive treatment is limited. This study aimed to assess long-term outcomes and risk factors for patients over 80 years of age who underwent revascularisation.

Methods. This single-centre retrospective study included ≥80-year-old patients who underwent coronary angiography between 2012 and 2014. Among 590 study patients, 411 patients had significant angiographic changes and had either a percutaneous coronary intervention (PCI) or coronary artery bypass grafting (CABG) performed. Baseline patient characteristics, including demographics, comorbidities, survival to hospital discharge, and long term mortality were analysed. Three-year mortality was assessed.

Results. Three hundred sixty-nine (89.8%) patients underwent PCI and in 42 (10.2%) CABG was performed. Significant differences between groups were detected in heart failure (PCI – 51.2% vs. CABG – 78.6%; $p = 0.001$), previous CABG (11.4% vs. 0%; $p = 0.014$), cardiogenic shock (12.2% vs. 0%; $p = 0.008$). Hospital mortality rate in the PCI group – 10.6%, CABG – 7.1%; $p = 0.787$. A median 3-year survival rate in the PCI group – 66.1%, CABG – 66.7%; $p = 1.000$. Chronic heart failure (OR 2.442; 95% CI: 1.530–3.898, $p < 0.001$), atrial fibrillation (OR 0.425; 95% CI: 0.261–0.692, $p < 0.001$), cardiogenic shock (OR 0.120; 95% CI: 0.054–0.270, $p = 0.001$), and LMCA stenosis (OR 2.104; 95% CI: 1.281–3.456, $p = 0.003$) were identified as independent 3-year all-cause mortality predictors in multivariate regression analysis.

Conclusions. There was no significant difference in hospital mortality and survival rates between elderly patients who underwent PCI or CABG. The majority of elderly patients underwent a PCI and these patients appeared to experience cardiogenic shock more frequently.

Keywords: percutaneous coronary intervention, coronary artery bypass grafting, coronary artery disease, octogenarians

INTRODUCTION

As the population ages, more people with significant coronary artery disease are hospitalized and require revascularisation. During the last nine years, the relative population share of elderly people has increased by 66.6% (1). Coronary artery disease (CAD) is among the most prevalent health diseases worldwide. It is a result of an accumulation of atherosclerotic plaques within the walls of coronary arteries leading to the narrowing of blood vessels, heart failure, angina pectoris, and myocardial infarction (MI). CAD is the leading and the most common cause of morbidity and mortality worldwide (2). The CAD increase is partly due to population growth and high prevalence of risk factors such as smoking, obesity, and increased cholesterol levels (3). In 2015, the main cause of death for people over 80 years of age in Lithuania was coronary artery disease (total 52%) (4). Coronary artery bypass grafting (CABG) and the percutaneous coronary intervention (PCI) are both used for myocardial revascularization in patients with CAD with an indication for revascularization. A large number of studies have compared and reported the outcomes of CABG and PCI (5). However, they mainly focused on populations under 75 years of age, leaving a lack of information related to octogenarians. Such research is crucial, because this age group may have unique clinical characteristics that are associated with a greater risk of postoperative complications. Moreover, the number of older patients who undergo these procedures will increase as the population ages. We performed a single-centre retrospective study with the aim to compare the outcomes of PCI and CABG in octogenarians with CAD.

METHODS

Study population

This was an observational retrospective study. The patient data was collected from a clinical database at Vilnius University Hospital Santaros Klinikos (Lithuania, Vilnius). Study-eligible patients (≥ 80 years old) with percutaneous coronary artery intervention (PCI) or coronary artery bypass grafting (CABG) performed between January 2012 and December 2014 were enrolled. Patients without significant stenosis of the left main cor-

onary artery and/or without ≥ 2 coronary vessel disease were excluded. Significant stenosis of the left main coronary artery disease was defined as stenosis $\geq 50\%$, whereas coronary vessel disease was defined as stenosis $\geq 70\%$. The details of coronary artery lesions were collected by analysing angiography results. A total of 411 patients were analysed (PCI, $n = 369$; CABG, $n = 42$).

Design overview

The decision to perform PCI or CABG depended on the physician's opinion, patient comorbidities, and preference of the heart team. All patients provided consent for the procedure. The patients who underwent revascularization procedure were divided into two groups: PCI and CABG. Baseline patient characteristics, including demographics, comorbidities, hospital mortality rates and survival rates after follow-up were analysed and compared between the groups.

Outcomes and follow-up

The patients were followed up to evaluate long-term mortality. All-cause mortality and secondary emergency revascularizations (PCI or CABG) after a medium three-year period of the procedure in study population were analyzed. All-cause mortality data was collected from the National Insurance Sick Fund database. Coronary re-interventions, the data on which were obtained from the clinical database of Vilnius University Hospital Santaros Klinikos, were evaluated.

Statistical analysis

Baseline characteristics were described using descriptive statistics. Continuous non-parametric data is presented as medians and interquartile range. Continuous data is compared between the PCI and CABG groups by two-sample t-test. Data normality was tested using the Kolmogorov-Smirnov test before further analysis was done. Categorical variables were summarized by frequencies and percentages, and differences between the two groups were assessed by χ^2 test or Fisher exact test, as appropriate. Univariate and multivariate logistic regression analyses were used to identify long-term mortality risk factors. Statistical analysis of the data was performed using the SPSS statistical software package version 24.0 (IBM/SPSS, Inc., Chicago, IL, USA). A $P < 0.05$ was considered statistically significant.

RESULTS**Patient population and baseline characteristics**

Baseline clinical characteristics are summarized in Table 1. During the study period, 369 (89.8%) out of

411 patients were treated with PCI and 42 (10.2%) with CABG. Among PCI patients, the most frequent clinical diagnosis was ST-segment elevation myocardial infarction (STEMI) – 170 (46.1%), followed by non-ST segment elevation myocardial

Table 1. Baseline characteristics of the patients

Variable	PCI (n = 369)	CABG (n = 42)	p value
	N (%) / Median (IQR)		
Sex (male)	184 (49.9)	28 (66.7)	0.050
Age (years)	83 (81–85)	82 (81–83)	0.006
Diabetes mellitus	62 (16.8)	3 (7.1)	0.121
Hypertension	345 (93.5)	42 (100)	0.155
Pulmonary disease	17 (4.6)	2 (4.8)	1.000
COPD	14 (3.8)	2 (4.8)	0.673
Hyperlipidemia	218 (59.1)	28 (66.7)	0.407
Previous MI	126 (34.1)	12 (28.6)	0.497
Stroke	49 (13.3)	2 (4.8)	0.140
Previous PCI	85 (23)	10 (23.8)	1.000
Previous CABG	42 (11.4)	0 (0)	0.014
Oncologic disease	49 (13.3)	3 (7.1)	0.333
Cardiogenic shock	45 (12.2)	0 (0)	0.008
Atrial fibrillation	114 (30.9)	11 (26.2)	0.599
CHF	189 (51.2)	33 (78.6)	0.001
NYHA class II–III	179 (48.5)	32 (76.2)	0.001
Clinical diagnosis			
Stable angina	70 (19)	11 (26.2)	<0.001
Unstable angina	46 (12.5)	16 (38.1)	<0.001
NSTEMI	83 (22.5)	6 (14.3)	<0.001
STEMI	170 (46.1)	9 (21.4)	<0.001
Coronary artery disease			
1-vessel disease	17 (4.6)	3 (7.1)	0.445
2-vessel disease	186 (50.4)	8 (19)	<0.001
3-vessel disease	164 (44.4)	30 (71.4)	<0.001
Left main	90 (24.4)	24 (57.1)	<0.001
Outcomes			
In-hospital mortality	39 (10.6)	3 (7.1)	0.787
3-year mortality	125 (33.9)	14 (33.3)	1.000

Data are presented as medians (IQR) and numbers (percentages) of patients. A *p* value of <0.05 is considered statistically significant.

IQR – interquartile range; PCI – percutaneous coronary intervention; CABG – coronary artery bypass grafting; COPD – chronic obstructive pulmonary disease; MI – myocardial infarction; CHF – chronic heart failure; NYHA – New York Heart Association heart failure scale; STEMI – ST segment elevation myocardial infarction; NSTEMI – non-ST segment elevation myocardial infarction.

infarction (NSTEMI) – 83 (22.5%), stable angina – 70 (19%), and unstable angina – 46 (12.5%); $p < 0.001$. In the PCI group, a trend of higher ratio of diabetes mellitus (16.8% versus 7.1%; $p = 0.121$) and atrial fibrillation (30.9% versus 26.2%; $p = 0.599$) was observed. Patients treated with PCI were older: 83 years (range, 81–85) versus 82 years in the CABG group (range, 81–83); $p = 0.006$. There were more females than males (49.9% versus 66.7%; $p = 0.050$), they had congestive heart failure (51.2% versus 78.6%; $p = 0.001$), but more often presented with previous CABG (11.4% versus 0%; $p = 0.014$) and cardiogenic shock (12.2% versus 0%; $p = 0.008$). In the PCI group, 23% had previous PCI, 34.1% had a previous myocardial infarction (MI). Among the CABG patients, the diagnosis of unstable angina was present in 38.1% of patients, whereas stable angina occurred in 26.2%, STEMI in 21.4%, and NSTEMI in 14.3% of cases; $p < 0.001$. In the CABG group, 23.8% had previous PCI and 28.6% had a previous MI. Patients undergoing CABG more often had hypertension (100% versus 93.5%; $p = 0.155$), chronic obstructive pulmonary disease (COPD) (4.8% versus 3.8%; $p = 0.673$), and dyslipidaemia (66.7% versus 59.1%; $p = 0.407$).

Procedural characteristics and outcomes

Procedural characteristics and outcomes are summarized in Table 1. 24.4% of patients in the PCI group and 57.1% in the CABG group had a significant left main coronary artery stenosis ($p < 0.001$). Compared with patients who underwent PCI, those who underwent CABG were more likely to have a lower hospital mortality rate (PCI group – 10.6%, CABG – 7.1%; $p = 0.787$) and 3-year mortality rate (PCI group – 33.9%, CABG – 33.1%; $p = 1.000$), but the results were not statistically significant.

Univariate and multivariate analyses of the pre-operative comorbidities for predicting 3-year all-cause mortality are shown in Table 2. Patient factors significantly associated with 3-year mortality included age, diabetes mellitus, pulmonary disease, chronic heart failure, cardiogenic shock, atrial fibrillation, and left main coronary artery stenosis in the univariate analysis. Seven variables were included in the final multivariate analysis. Chronic heart failure, cardiogenic shock, atrial fibrillation and left main coronary artery stenosis persisted as predictive factors for 3-year all-cause mortality in the multivariate regression model.

Table 2. Regression analysis of risk factors for 3-year all-cause mortality

Factor	Odds ratio		p value	Odds ratio		p value
	Estimate	95% CI		Estimate	95% CI	
	Univariate			Multivariate		
Comorbidities						
Procedure PCI vs. CABG	n.s.		0.944	n.i.		
Age	0.905	0.846–0.970	0.004	n.s.		0.072
Diabetes mellitus	1.864	1.088–3.191	0.023	n.s.		0.051
Hypertension	n.s.		0.200	n.i.		
Pulmonary disease	2.836	1.114–7.223	0.029	n.s.		0.063
CHF	0.342	0.224–0.523	<0.001	2.442	1.530–3.898	<0.001
Stroke	n.s.		0.235	n.i.		
Previous MI	n.s.		0.607	n.i.		
Cardiogenic shock	10.214	4.752–21.952	<0.001	0.120	0.054–0.270	<0.001
Atrial fibrillation	2.302	1.489–3.559	<0.001	0.425	0.261–0.692	0.001
Left main coronary artery stenosis	1.646	1.054–2.572	0.029	2.104	1.281–3.456	0.003

n.i., not included; n.s., not significant with p value >0.05

PCI – percutaneous coronary intervention; CABG – coronary artery bypass grafting; CHF – chronic heart failure; MI – myocardial infarction.

DISCUSSION

The treatment of elderly patients with ischemic heart disease is challenging (6). Elderly patients comprise the fastest growing population segment and more patients aged 80 years and above require CABG or PCI for coronary revascularization than ever before (7). More recently it was reported that the proportion of octogenarians undergoing CABG increased from 1% in 1990 to 6% in 2005 (8).

Care of elderly patients requires an adequate consideration of coronary artery disease in the context of multiple medical diseases. Moreover, age alone is a significant predictor of adverse procedural events with a higher risk of mortality (9). In addition, there is data suggesting that octogenarians can benefit from a coronary intervention (6, 7, 10). A number of randomized controlled trials have been conducted that demonstrated a survival benefit for surgical revascularization versus optimal medical management in elderly patients with advanced coronary artery disease (6, 11). Despite that, the risks to octogenarians undergoing PCI and CABG are significantly higher than to younger patients and that risk is strongly influenced by comorbidities (12, 13). Comparison of revascularization versus no revascularization shows that the difference in the outcomes of these two revascularization strategies is quite modest (6).

The results of this single-centre study demonstrate that there is no significant difference in hospital mortality and average 3-year survival between patients who underwent PCI or CABG. Patients were more likely to be selected for CABG if they were male, had heart failure, and significant left main coronary artery stenosis.

Several studies demonstrated similar results. Rodés-Cabau et al. reported a non-significant difference in outcomes between CABG and PCI in octogenarians after a mean follow-up of two years (14). Palmerini et al. reported similar results in patients of a younger age group (>75 years) (15, 16). Some systematic reviews showed that clinical outcomes were similar for patients undergoing PCI and CABG despite a higher pre-procedural risk among patients undergoing CABG (7). Results of our study confirm these observations: patients were more likely to be selected for CABG

if they had heart failure and LMCA stenosis (6, 17). Moreover, there was no difference between the groups comparing the in-hospital mortality rate (17).

Our study evaluated the hospital mortality rate and a mean 3-year survival rate, which was not statistically significantly different between PCI and CABG groups. Some other studies noted that short-term mortality was significantly higher using CABG but has decreased significantly between the periods of 1990–1996 and 2003–2010 (18, 19). Two previous meta-analyses, by McKellar et al. and Alam et al. analysed all-cause mortality at 30 days among patients who were 75 or 80 years of age or older (7, 20). Both studies concluded that the mortality rate was not significantly different among patients who underwent CABG versus PCI (Alam et al.: 6.7% vs. 5.4%; McKellar et al.: 7.2% vs. 5.4%). One meta-analysis showed that patients undergoing PCI for unprotected LMCA disease have not experienced increase in mortality and MI compared with their CABG counterparts (20).

Alam et al. showed that compared PCI with CABG, 10-year survival was similar for both procedures. Percutaneous coronary intervention in octogenarians seems to be associated with good early and intermediate results, and the long-term results after CABG can be even better (10). CABG was associated with worse survival than PCI during the first six months; survival from six months to eight years was significantly better with CABG for the group as a whole and for patients with two-vessel disease, and there was a non-significant trend for those with three-vessel disease (17). One nonrandomized study showed that there were no significant differences in cardiac death or myocardial infarction between CABG and PCI for the treatment of left main coronary artery disease in octogenarians after a mean follow-up of two years (14). Some studies show that CABG was associated with significantly higher survival and freedom from composite outcome (death, revascularization, stroke and acute myocardial infarction) at three years (8).

It is important to note that physicians should consider not only the clinical features of coronary artery disease, but also the elderly patients' functional status when choosing a revascularization strategy (19). Some studies show that patients who underwent PCI experienced significantly higher

heart-related quality of life in six months after revascularization. Nevertheless, after 24-month follow-up no difference was observed between PCI and CABG groups (21). Also, some researches shows that the short-time mortality rate and hospital stay of octogenarians who received PCI was lower, but overall survival was longer for CABG patients (19). These findings suggest that physicians who choose a revascularization procedure should consider unique aspects of elderly patients' short- and long-term health status.

Death is not the only outcome of relevance in this age group of patients. Quality of life is another important consideration and further work is required in this area (6).

Our study had some limitations. Firstly, PCI and CABG groups were not equal. Three hundred sixty-nine patients were included in the PCI group, whereas only 42 patients were in the CABG group. Secondly, we did not exclude the patients who had cardiogenic shock and this could have led to inaccuracy since a higher proportion of patients had cardiogenic shock in the PCI group. Furthermore, we found a significant difference in age and left main coronary artery disease between PCI and CABG patients. PCI patients were younger and less frequently had a significant left main coronary artery stenosis. Secondly, our research did not identify mortality causes. We estimated all-cause mortality and did not distinguish cardiac mortality separately. Moreover, we did not analyse hospitalizations and repeated procedures, because we analysed the data only from one centre and some patients could have been treated in other hospitals.

CONCLUSIONS

In elderly patients, there was no significant difference in hospital mortality and survival rates between patients who undergo PCI or CABG. This study reported that heart failure on admission, atrial fibrillation, and cardiogenic shock, along with left main coronary artery stenosis, were significantly associated with 3-year all-cause mortality in octogenarians. While this study had limitations due to retrospective design, awareness of these risk factors could be used to identify patients at a higher risk for worse outcomes and therefore improve patient management to reduce this risk.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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Rokas Šerpytis, Lina Puodžiukaitė,
Saulius Petrauskas, Nerijus Misonis,
Mantas Kurminas, Aleksandras Laucevičius,
Pranas Šerpytis

IŠEIČIŲ PO PERKUTANINĖS KORONARINĖS INTERVENCIJOS IR AORTOKORONARINIŲ JUNGČIŲ SUFORMAVIMO OPERACIJOS PALYGINIMAS TARP VYRESNIO AMŽIAUS PACIENTŲ

Santrauka

Įvadas. Mokslinėje literatūroje trūksta duomenų apie ilgalaikius rezultatus gydant senyvo amžiaus pacientus su reikšminga koronarine širdies liga, kuriems atliekama perkutaninė koronarinė intervencija (PKI) arba aortokoronarinių jungčių suformavimo operacija (AKJO). Šios studijos tikslas buvo įvertinti vyresnių nei 80 metų pacientų, kuriems atlikta revaskuliarizacija, gydymo rezultatus ir rizikos veiksnius.

Medžiaga ir metodai. Tyrime dalyvavo vyresni nei 80 metų pacientai, kuriems atlikta koronarinė angiografija 2012–2014 metais. Iš 590 pacientų 411-ai buvo nustatyti reikšmingi angiografiniai pakitimai ir atlikta PKI arba AKJO. Vertinti demografiniai parametrai, gretutinės ligos, mirštamumas ligoninėje iki hospitalizacijos pabaigos ir ilgalaikis trejų metų išgyvenamumas.

Rezultatai. 369-iems (89,8 %) pacientams atlikta PKI, o 42-iems (10,2 %) – AKJO. Reikšmingi skirtumai tarp grupių buvo nustatyti vertinant širdies nepakankamumo (PKI – 51,2 % vs. AKJO – 78,6 %; $p = 0,001$), anksčiau atliktos AKJO (11,4 % vs. 0 %; $p = 0,014$), kardiogeninio šoko (12,2 % vs. 0 %; $p = 0,008$) dažnius. Mirštamumas ligoninėje iki išrašymo PKI grupėje siekė 10,6 %, AKJO – 7,1 %; $p = 0,787$. Trejų metų išgyvenamumo dažnių mediana PKI grupės – 66,1 %, AKJO – 66,7 %; $p = 1,000$. Lėtinis širdies nepakankamumas (ŠS 2,442; 95 % PI: 1,530–3,898; $p < 0,001$), prieširdžių virpėjimas (ŠS 0,425; 95 % PI: 0,261–0,692; $p < 0,001$), kardiogeninis šokas (ŠS 0,120; 95 % PI: 0,054–0,270; $p = 0,001$) ir kairės vainikinės arterijos kamieno stenozė (ŠS 2,104; 95 % PI: 1,281–3,456; $p = 0,003$) buvo nustatyti kaip nepriklausomi trejų metų mirštamumo rizikos veiksniai daugiaveiksniėje regresinėje analizėje.

Išvados. Vertinant mirštamumą ligoninėje ir išgyvenamumo dažnius nebuvo nustatytas reikšmingas skirtumas tarp senyvo amžiaus pacientų, kuriems atlikta PKI ir AKJO. Didžiajai daliai vyresnio amžiaus pacientų atlikta PKI ir jiems buvo dažniau diagnozuojamas kardiogeninis šokas.

Raktažodžiai: perkutaninė koronarinė intervencija, aortokoronarinių jungčių suformavimo operacija, koronarinė širdies liga, vyresnio amžiaus pacientai