

Permanent work disability in patients ≤ 50 years old after percutaneous coronary intervention and coronary artery bypass grafting (the CRAGS study)

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Abstract

Background: The aim of this study was to investigate the incidence of permanent working disability (PWD) in young patients after percutaneous or surgical coronary revascularization.

Methods and Results: The study included 1035 consecutive patients ≤ 50 years old who underwent coronary revascularization (910 and 125 patients in PCI and CABG groups, respectively) between 2002 and 2012 at 4 Finnish hospitals. The median follow-up time was 41 months. The overall incidence of PWD was higher after CABG compared to PCI (at 5 years, 34.8% vs. 14.7%, $p < 0.001$). Freedom from PWD in the general population aged 45 was 97.2% at 4 years follow-up. Median time to grant disability pension was 11.6 months after CABG and 24.4 months after PCI ($p = 0.018$). Reasons for PWD were classified as cardiac (35.3% vs. 36.9%), psychiatric (14.7% vs. 14.6%) and musculoskeletal (14.7% vs. 15.5%) in patients undergoing CABG vs. PCI. Overall freedom from PWD was higher in patients without MACCE (at 5 years, 85.6% vs. 71.9%, $p < 0.001$). Nevertheless, rate of PWD was high also in patients without MACCE and patients with preserved ejection fraction during follow-up.

Conclusions: Although coronary revascularization confers good overall survival in young patients, PWD is common especially after CABG and mostly for cardiac reasons even without occurrence of MACCE. Supportive measures to preserve occupational health are warranted concomitantly with coronary revascularization at all levels of health care.

Introduction

Myocardial revascularization is associated with low procedural risk in young patients and the rates of adverse events such as stroke, repeat revascularization and myocardial infarction after percutaneous coronary intervention (PCI) and coronary artery bypass grafting (CABG) are low.¹⁻⁴ Nevertheless, temporary work disability after revascularization is relatively common.⁵⁻⁶ Long-term data on permanent work disability (PWD) in young patients after coronary revascularization are scarce. Moreover, little is known about the impact of these revascularization methods on patients' PWD and the underlying reasons thereof – despite its potentially important economical consequences.

The aim of this study was to evaluate the need and reasons for disability pensions in patients younger than 50 years old undergoing PCI and CABG.

Methods

This study is part of a larger multicenter study (Coronary aRtery diseAse in younG adultS – study, CRAGS study) designed to describe the outcomes of patients aged less than 50 years old who underwent coronary revascularization.^{1,4} This study is registered in ClinicalTrials.gov (identifier NCT01838746). This pre-specified substudy comprised of 1003 patients who underwent PCI and 146 patients who underwent CABG at 3 university hospitals and one central hospital in Finland between 2002 and 2012. Invasive treatment of coronary disease is mainly centralized and the participating hospitals are the treating hospitals within their geographical catchment's area.

The study complies with the Declaration of Helsinki as revised in 2002, and the ethics committees of participating hospital approved the research protocol.

Data on PWD (starting date, primary and secondary diagnosis) were acquired from the Finnish Centre for Pensions, which governs the statutory pension security in Finland, which in turn consists of a defined benefit earnings-related pension that accrues from work, as well as residence-based national pension and guarantee pension that ensure minimum security. None of the patients were eligible for old age pension during follow up. Excluded from further analysis were 93 PCI patients and 21 CABG patients who were on PWD already prior to index procedure. In addition, patients over 50 years old were excluded from the study due to approaching age of general pension. The periprocedural data and baseline comorbidities along with data on post procedural morbidity were acquired from local hospital registries, which enabled complete follow up as treatment of the events of interest (cardiac- and cerebrovascular) are centralized. Data on date and mode of death was acquired from the Finnish national registry, Statistics Finland. The main outcome was permanent disability defined as grant of disability pension during follow up. Secondary measures were predictors of cardiac disability defined as PWD with a cardiac diagnosis.

Data on the number of insured as well as the incidence and category (cardiovascular, musculoskeletal and psychiatric) of PWD in each age group in the general population between 2007 and 2011 were obtained from the Finnish Center for Pensions. Statistics for the 45-year-old insured were used for comparison with the study population (mean age 45 years).

Major adverse cardiac and cerebrovascular event (MACCE) was defined as a composite of myocardial infarction, repeat revascularization and stroke. For the purpose of this analysis, death was not considered as a MACCE as it does not influence PWD.

Statistical analysis was performed with SPSS Statistics version 22.0 and R version 2.15.3. Categorical variables are reported as counts and percentages, continuous variables as the mean and standard deviation (SD) or the median and interquartile range (IQR). Fisher's exact test, Chi square, independent samples T-test and Kaplan-Meier were used as

appropriate. Because of significant baseline differences between the groups, a propensity score for assignment to PCI was calculated with logistic regression with a non-parsimonious model by including all preprocedural variables (Hosmer-Lemeshow test $p=0.617$). The obtained propensity score was used for adjustment on multivariable analysis. A $p<0.05$ was considered statistically significant.

Results

Altogether 9.3% and 14.4% of patients undergoing PCI and CABG, respectively, were excluded from the analyses because they were on PWD already preoperatively. The indication for preoperative PWD was cardiovascular diagnosis in 8.6% of PCI patients and 23.8% of CABG patients.

The median follow-up time was 41 [31] months. A total of 11.3% of patients undergoing PCI and 27.2% of patients undergoing CABG were granted permanent disability pension postoperatively. The primary diagnoses after PCI and CABG are shown in Table 1. Baseline comorbidities, periprocedural variables, discharge medication and postprocedural outcomes are detailed in Table 2. In the overall series, CABG patients were slightly older and had a higher prevalence of comorbidities and a more diffuse coronary disease. Patients undergoing CABG had more often diabetes, congestive heart failure, extracardiac arteriopathy, history of prior PCI, history of myocardial infarction, family history of coronary artery disease, hypertension and $eGFR<60$ ml/min/1.73 m² compared with patients undergoing PCI. On the other hand the indication for revascularization was more often urgent or emergency in PCI patients and most of these procedures were for acute coronary syndrome as compared with CABG patients (79.5% vs. 43.2%, respectively).

Time to grant of disability pension was 24.4 [45] months after PCI and 11.6 [27.6] months after CABG ($p=0.018$). Independent predictors of PWD are shown in Table 3.

Freedom from PWD was lower in CABG patients (Kaplan-Meier –analysis at 5 years: CABG, 65.2% vs. PCI, 85.3%) and CABG was a predictor of PWD on Cox regression analysis (HR 3.12, 95% CI 1.92-5.08, $p < 0.001$) (Fig. 1). Freedom from PWD in the general population aged 45 was 97.2% at 4 years follow-up (data from the Finnish Center for Pension). In patients undergoing PCI the MACCE preceding later disability pension was more often repeated revascularization (24.2 %) and myocardial infarction (12.1%) than in patients undergoing CABG (5.5% and 3.6%). Freedom from PWD in patients undergoing PCI and CABG at 5 years was 85.6% for patients without MACCE and 71.9% for patients with a MACCE (Log rank $p < 0.001$) (Fig. 2). Freedom from PWD for patients with postprocedural stroke was 54.0% at 5 years in both study groups.

Discussion

The main finding of this study was that despite the excellent overall survival after coronary revascularization in patients under 50 years old, the rate of PWD was fairly high. At five years follow-up, every third patient after CABG and every seventh patient after PCI were on PWD. The rates of cardiac PWD were markedly higher than in the general population (a third of both CABG and PCI patients with PWD). Strikingly, there was discrepancy in the high rate of PWD compared to low post-CABG rates of repeat revascularization, stroke or congestive heart failure, which would have been the imminent reasons for cardiac PWD. This may reflect a general attitude that patients who have undergone CABG are considered sick enough for PWD even if the operation is successful and leads to complete revascularization. This is supported by the finding that the median time to PWD after CABG was equal to the maximum time of sickness benefit in the country (330 days) suggesting that these patients fail to return to work at all after CABG.

Not surprisingly, perioperative or later MACCE was associated with more common

PWD. Reasons for MACCE in PCI patients were mainly myocardial infarction and repeat revascularization. This may partly be related to the use of bare metal stent in the earlier phase of data collection. The most common adverse event leading to disability pension was repeat revascularization in both study groups. The risk for PWD was doubled at 5 years follow-up for patients who experienced a MACCE compared to those without MACCE. Especially patients with stroke had high rates of PWD as half of them were on PWD at 5 years follow-up. The most disappointing finding in this study was that the incidence of PWD is higher than in the general population even in the patients who did not suffer from MACCE during follow up. Moreover, almost one in four of the patients with PWD but no follow-up MACCE had a primary diagnosis of ischemic heart disease stated as grounds for pension and 47.2% had ischemic heart disease as a first or second diagnosis. Therefore, it can be speculated that the high prevalence of PWD might be partly explained by patients' and health care professionals' attitudes towards recovery of working ability after coronary revascularization.

Patients under 50 years old are in the prime of their input in the workplace and have a potential for longevity. Studies comparing young patients undergoing coronary revascularization procedures, nonetheless, are scarce. In a recently published comparison of occupational health in young patients undergoing PCI or CABG, it appeared that the most common reason for the disability pension was a diagnosis of musculoskeletal disease and around a quarter of patients undergoing coronary revascularization had disability pension already prior to the index procedure.⁷⁻⁸ Patients who underwent CABG had a significantly higher risk for disability pension and surgical revascularization in itself was associated with disability pension. The nature and extent of the disease and comorbidities could partly explain the unfavorable outcomes. For example patients with diabetes or severe renal impairment have high risk for complications after CABG.⁹⁻¹³ Previous studies have suggested that indicators of lower sociodemographics such as smoking and patients' sedentary lifestyle

are associated with an increased risk for cardiovascular disease and may potentially entail a more aggressive disease.¹⁴⁻¹⁷ Young patients with these risk factors have frequently more advanced coronary artery disease and had more commonly previous coronary interventions than patients without risk factors.¹

The results in the current study support the conception that the overall psychosocial and somatic health in patients undergoing revascularization and especially CABG is often poor when they require invasive treatment. The most common indication for revascularization was stable angina pectoris in patients undergoing CABG, whereas it was acute coronary syndrome in PCI group. Patients undergoing CABG had more often history of PCI and this underlines the fact that patients undergoing CABG have more often advanced disease. The high amount of comorbidities in itself predicts poor outcomes after coronary interventions. Moreover, a higher incidence of disability pension in the CABG group is also explained by common extracardiac, e.g. psychiatric, diagnoses. However, for both CABG and PCI patients the vast majority of factors leading to disability are unaddressed by revascularization and is easily overlooked when the focus is on the heart.

These findings emphasize the need for early identifying patient at high-risk for PWD. Especially those with repeat revascularization frequently have disease progression in addition to restenosis and stent thrombosis.¹ Occurrence of MACCE and repeated revascularization were the most important risk factor for PWD in study groups. Therefore, effort should be put to prevent these outcomes and focus on complete initial revascularization of ischemic lesions, efficient secondary prevention and careful follow-up. Pre-existing attitudes towards PWD must be taken into account. The decision on PWD should be done in close co-operation with cardiac care center and occupational health care to avoid “playing it safe” by ascribing the revascularized patient to PWD. The current notions of working capacity seem to lead to PWD more often than actually might be needed. Consequently, effective secondary

preventive measures are needed in this young patient group along with changes in attitudes, both among patients and physicians. For example, at the index revascularization, a significant proportion of patients were smokers, and smoking is a well-known risk factor for adverse event.^{2, 18-21} During follow-up, more effective measures to help patients quit smoking are needed in this subset of patients. Smoking is known to be a major risk factor for thrombosis-associated complications. Therefore, complete smoking cessation would be an important part of preventing the most important risk factors for PWD such as MACCE and repeated revascularization. Patients, their workplace and the professionals in occupational health care should be motivated to ensure a swift and facilitated return to work shortly after revascularization as it has been shown that a longer initial sick leave is associated with and increased risk of permanent disability. Furthermore, young patients with coronary artery disease could benefit from a more detailed psychosocial assessment and support prior to coronary revascularization.

Limitations

These findings need to be interpreted in the light of some limitations in mind. Firstly, this study assessed only permanent disability, not employment status. The rate of patients outside of the workforce can be even higher. We do not have data on sociodemographic factors such as educational and occupational background. The quite low number of patients in the CABG group as compared to PCI group is also a limitation. Moreover, PCI techniques have evolved during the data collection period with the introduction of newer generation DES, new strategies to open chronic total occlusions. Although this study is based on a single country healthcare and health insurance system, we believe that the results can be extrapolated in many Western countries. Secondly, the patients' age may also introduce a

bias. The retrospective nature of the study is also a limitation, but a prospective study on this issue would hardly be feasible because of the limited number of young patients treated yearly in each center. In addition, the present registry has all the inherent limitations of an observational study, including individual risk-based decision-making in treatment choices.

Conclusion

Although overall survival after revascularization among young patients is good, the amount of PWD in patients undergoing PCI or CABG is significant. Especially patients with follow-up MACCE are at risk for PWD. In general, the frequent need for revascularization in young patients discloses the advanced nature of coronary artery disease largely explained by a high burden of risk factors. It appears that young patients with coronary artery disease requiring revascularization are at high risk for diminished working capacity and often for cardiac reasons despite apparently successful revascularization.

This study suggests that coronary revascularization in this patient group should act as a red flag entailing supportive occupational health care measures and changes in attitudes towards working capability after coronary revascularization in addition to aggressive secondary prevention to decrease the need for repeated revascularizations and permanent work disability.

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Conflict of Interest

None declared.

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Table 1. Primary diagnoses for permanent work disability after undergoing percutaneous coronary intervention (PCI) and coronary artery bypass grafting (CABG) in patients ≤ 50 years old.

Diagnosis group	CABG (n=34)	PCI (n= 103)
Angina pectoris and ischemic heart disease (I20&I25)	10 (29.4%)	34 (33.1%)
Heart failure (I50)	0 (0%)	1 (1.1%)
Any cardiac	12 (35.3%)	38 (36.9%)
Diabetes (E10-11)	4 (11.8%)	10 (7.8%)
Cerebrovascular disease (I63&I69)	1 (4.8%)	3 (2.9%)
Depression and bipolar disorder (F31-33)	4 (11.8%)	10 (9.6%)
Other psychiatric	1 (5.9%)	5 (4.9%)
Musculoskeletal disorders (M-dg)	5 (14.7%)	16 (15.5%)

Table 2. Baseline and procedural characteristics for patients ≤50 years old undergoing percutaneous coronary intervention (PCI) and coronary artery bypass grafting (CABG).

Overall series			
Variable	CABG (n=125)	PCI (n=910)	p-value
Age (years)	46.3 (4.2)	44.8 (4.7)	<0.001
Females	15 (12.0%)	143(15.7%)	0.28
eGFR<60 ml/min/m ²	8 (6.4%)	17 (1.9%)	0.002
Family history of CAD	80 (64.5%)	484 (53.4%)	0.02
Hypertension	62 (49.6%)	274 (30.1%)	<0.001
Smoker	86 (68.8%)	646 (71.0%)	0.61
Diabetes	27 (21.6%)	112 (12.3%)	0.004
History of MI	44 (35.5%)	56 (6.2%)	<0.001
History of PCI	14 (11.2%)	40 (4.4%)	0.001
History of CABG	1 (0.8%)	3 (0.3%)	0.428
Extracardiac arteriopathy	10 (8.0%)	10 (1.1%)	<0.001
Congestive heart failure	9 (7.2%)	4 (0.4%)	<0.001
Cerebrovascular disease	2 (1.6%)	10 (1.1%)	0.63
Indication for revascularization			<0.001
STEMI	15 (12.0%)	367 (40.5%)	
NSTEMI	32 (25.6%)	276 (32.5%)	
UAP	7 (5.6%)	80 (8.8%)	
Stable AP	71 (56.8%)	187 (20.6%)	
Urgency			<0.001
Elective	72 (57.6%)	193 (21.4%)	

Urgent	47 (37.6%)	494 (54.7%)	
Emergent	6 (4.8%)	216 (23.9%)	
LVEF			0.005
>50%	92 (74.2%)	494 (74.8%)	
30-50%	24 (19.4%)	155 (23.5%)	
<30%	8 (6.5%)	11 (1.7%)	
Left main stenosis	31 (25.2%)	10 (1.1%)	<0.001
No. of diseased vessels	2.6±0.7	1.4±0.7	<0.001
No. of treated vessels			<0.001
1	13 (10.4%)	630 (69.2%)	
2	30 (24.0%)	207 (22.7%)	
3	82 (65.6%)	69 (7.6%)	
Incomplete revascularization	3 (2.4%)	171 (18.8%)	<0.001
At least one IMA graft	119 (95.2%)	-	
Bilateral IMA graft	23 (18.4%)	-	
At least 2 arterial grafts	57 (45.6%)	-	
Drug eluting stent	-	531 (58.5%)	
Discharge medication			
ASA	118 (95.9%)	900 (99.3%)	0.001
Clopidogrel	12 (9.9%)	859 (94.8%)	<0.001
Warfarin	3 (2.4%)	35 (3.8%)	0.58
Statin	118 (97.5%)	881 (97.1%)	0.81
ACE- or AT2-antagonist	46 (37.7%)	535 (59.6%)	<0.001
Beta blocker	119 (98.3%)	834 (92.5%)	0.016
Diuretics	21 (17.2%)	64 (7.2%)	<0.001

Ca-blocker	6 (4.9%)	63 (7.1%)	0.36
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Continuous variables are reported as mean and standard deviation and nominal variables are reported as absolute number and percentage. CAD: coronary artery disease; PCI: percutaneous coronary intervention; CABG: coronary artery bypass grafting. STEMI: ST elevation myocardial infarction, NSTEMI: non-ST elevation myocardial infarction, UAP: unstable angina pectoris, AP: angina pectoris, IMA: internal mammary artery, MI: myocardial infarction; ASA: acetyl salicylic acid. Lvef: Left ventricular ejection fraction

Table 3. Predictors of PWD for patients ≤50 years old undergoing percutaneous coronary intervention and coronary artery bypass grafting. Baseline and procedural variables included in a non-parsimonious Cox proportional hazards model adjusted for propensity score.

Variable	HR	95% confidence interval	p-value
Age (per each year)	1.09	1.03-1.15	0.001
eGFR <60 mL/min/m ²	3.46	1.50-7.98	0.004
Prior PCI	2.86	1.52-5.39	0.001
Preprocedural LVEF ≤50%	1.73	1.06-2.81	0.03
Diabetes	1.86	1.15-3.00	0.01

eGFR: estimated glomerular filtration rate (according to the MDRD –formula); PCI: percutaneous coronary intervention; LVEF: left ventricular ejection fraction.

Figure legends

Figure 1. Freedom from PWD in patients ≤ 50 years after coronary revascularization with percutaneous coronary intervention (PCI) or coronary artery bypass grafting (CABG)

Figure 2. Freedom from PWD in patients ≤ 50 years with MACCE and without MACCE after percutaneous or surgical coronary revascularization