

## ORIGINAL CONTRIBUTIONS

## OUTCOME OF CORONARY ARTERY BYPASS GRAFTING IN PATIENTS WITHOUT MAJOR RISK FACTORS AND PATIENTS WITH AT LEAST ONE MAJOR RISK FACTOR FOR CORONARY ARTERY DISEASE

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## ABSTRACT

**BACKGROUND:** Coronary artery bypass grafting (CABG) has become a safer procedure in recent years. **AIMS:** We aimed to compare complications and early outcome of CABG in patients without history of general risk factors with those in patients with at least one general risk factor for coronary artery disease (CAD). **SETTINGS AND DESIGN:** Cross-sectional study. **MATERIALS AND METHODS:** Postoperative in-hospital complications, 30-day mortality rate and length of stay in hospital of 708 patients without preoperative general risk factors undergoing CABG in three university hospitals were assessed and compared with 10,844 patients undergoing CABG with at least one general risk factor as controls. In addition, the association of the studied variables with patients' early outcome was evaluated. **STATISTICAL ANALYSIS:** SPSS software with Pearson's  $\chi^2$  test; independent sample t test, Mann-Whitney test and univariate analysis were used. **RESULTS:** All studied in-hospital complications were similar between the two groups. Thirty days mortality rate (0.7% in study group and 1.4% in control group) was similar between groups, whereas prolonged length of stay (>12 days) was more frequent in control group (61.33% vs. 71.36%,  $P < 0.0001$ ). Atrial fibrillation ( $P < 0.0001$ ) was a strong predictor for prolonged length of stay in hospital. **CONCLUSION:** Most aspects of early complications after CABG, as well as 30-day mortality rate, were similar between patients with and without general risk factors for coronary artery disease undergoing CABG.

**Key words:** Coronary artery bypass grafting, coronary artery disease, outcome, risk factors

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A favorable outcome is evaluated not only in terms of survival but also by the absence of severe complications and the degree of functional status, which is closely related to quality of life as defined. Quality of life is defined as a sense of well-being, meaning

and value or self-worth. In the empirical study of quality of life among elderly people, well-being was high in terms of satisfaction with living area, economic situation and health.<sup>[1]</sup> The presence of one or more comorbidities has been shown to be a sensitive predictor of mortality and complications following coronary artery bypass grafting (CABG), as well as of poor postoperative functional status.<sup>[2]</sup> The presence of comorbidities is a sensitive predictor of CABG outcome in the elderly patients. It was also concluded that functional status and comorbidity are independent variables that screen for different populations at risk for unfavorable CABG outcome.<sup>[3]</sup> Outcome following CABG has improved over the last decade. CABG has become a safer procedure in recent years, while the population undergoing surgery has become older and sicker. In an analysis of 1,154,486 patients from the Society of Thoracic Surgeons (STS) database who underwent CABG between 1990 and 1999, overall operative mortality decreased from 3.9% to 3.0% ( $P < 0.0001$ ).<sup>[4]</sup> This was despite the fact that in 1999, patients were older and more likely to have a history of smoking, diabetes, New York Heart Association functional class IV (inability to carry on any physical activity without discomfort) and three-vessel disease than patients were in 1990. Between 1990 and 1999, predicted risk based on patient risk profiles increased by 30.1% (from 2.6% to 3.4%), while observed mortality decreased by 23.1%.<sup>[5]</sup>

Despite the growing number of patients undergoing CABG, a few studies addressing postoperative outcome in patients without general risk factors have been reported to date to the best of our knowledge. In this study, we assessed complications and outcome of CABG

in patients without history of determined general risk factors and compared them with those in patients with at least one general risk factor for coronary artery disease (CAD).

## MATERIALS AND METHODS

Preoperative, operative and postoperative functional assessment was performed on 11,552 patients undergoing CABG, selected consecutively from three university hospitals in Tehran, Iran, from 1<sup>st</sup> July 2005 through 1<sup>st</sup> December 2005. The study protocol was approved by the Research Ethics Committee of Tehran University of Medical Sciences. Coronary artery stenosis was considered significant if there was a 70% or greater stenosis in the luminal diameter in any view. A stenosis of 50% or more in the left main coronary artery was considered significant. Among these patients, 708 patients had no preoperative general risk factors, and 10,844 patients had at least one general risk factor of CAD. In-hospital information was obtained by clinical and case note review, as well as detailed questionnaires to physicians and patients. General risk factors were defined as current smoking history (regularly smoking a tobacco product/ products one or more times per day or having smoked in this manner in the 30 days prior to admission),<sup>[6]</sup> hypercholesterolemia (total cholesterol  $\geq 5.0$  mmol/L, HDL cholesterol  $\leq 1.0$  mmol/L in men or  $\leq 1.1$  mmol/L in women, triglycerides  $\geq 2.0$  mmol/L),<sup>[7]</sup> family history of CAD (first-degree relatives before the age of 55 in men and 65 years in women),<sup>[8]</sup> hypertension (systolic blood pressure  $\geq 140$  mmHg and/ or diastolic  $\geq 90$  mmHg and/ or on antihypertensive treatment),<sup>[7]</sup> diabetes mellitus [symptoms of

diabetes plus plasma glucose concentration  $\geq 200$  mg/dl (11.1 mmol/L) or fasting plasma glucose  $\geq 126$  mg/dl (7.0 mmol/L) or 2-hp  $\geq 200$  mg/dl (11.1 mmol/L),<sup>[9]</sup> central obesity [(males: WHR  $< 0.9$ ; females: WHR  $< 0.85$ ) and/or BMI  $< 30$  kg/m<sup>2</sup>];<sup>[8]</sup> and history of myocardial infarction (an acute event with abnormal creatine phosphokinase and troponin levels), congestive heart failure, cerebrovascular disease (history of stroke or transient ischemic attack) and renal insufficiency (creatinine clearance  $< 50$  ml/min). The preoperative variables included age, gender, body mass index (BMI), peripheral vascular disease (history of claudication or peripheral vascular surgery) and chronic lung disease. Cardiac status characteristics were ejection fraction (good if  $> 50\%$ , fair if 30-50% and poor if  $< 30\%$ ), left main disease (50% or more stenosis), the number of defected vessels, aorta stenosis, aorta regurgitation, mitral stenosis and mitral regurgitation. Operative variables were the number of distal anastomoses with arterial conduits and vein grafts and the use of IMA and radial as grafts.

The postoperative data included postoperative in-hospital complications: re-intubation, cerebrovascular accident, prolonged ventilation ( $> 10$  h), continuous coma ( $> 24$  h), pulmonary emboli, heart block, cardiac arrest, tamponade and atrial fibrillation. We considered four criteria to early follow-up of patients: 1) operative complications: existence of at least one of the above complications; 2) total length of stay (LOS) in hospital and 4) 30-day mortality rate. Thirty-day mortality (sometimes termed operative mortality) is death within 30 days of operation.<sup>[10]</sup> Criteria for discharge from the hospital included stable cardiac rhythm, an oral

temperature of  $< 99$  °F, hematocrit of  $\geq 25\%$ , oral intake of at least 1,000 calories per day, successful completion of an exercise test that included independent ambulation and the ability to climb one flight of stairs, no significant wound complications and adequate home support systems.

Results were expressed as mean  $\pm$  standard deviation (SD) for quantitative variables and percentages for categorical variables. Categorical variables between the groups were compared using Pearson's  $\chi^2$  test; continuous variables were compared by independent samples t test for variables with normal distributions and Mann-Whitney test for variables with non-normal distributions. Predictors exhibiting a statistically significant relation with complications in univariate analyses were taken for stepwise multivariate logistic regression analysis to investigate their independence as predictors in the group without general risk factors. 'P' values of 0.05 or less were considered statistically significant. All statistical analyses were performed using SPSS version 13 and SAS version 9.1 for Windows.

## RESULTS

### Characteristic and baseline data

There were 708 and 10,844 CABG operations performed on patients without risk factors and those with at least one risk factor of CAD respectively, with mean age of  $60.76 \pm 10.97$  and  $58.63 \pm 9.90$  respectively ( $P < 0.0001$ ). In both groups, CABG procedure was more frequent in men than in women (84.5% vs. 74.1%,  $P < 0.0001$ ). In CABG patients without risk factors, the male-to-female ratio was 5.45; and among those with at least one risk factor,

the ratio was 2.86 ( $P < 0.0001$ ). Mean of body mass index (BMI) was higher in patients with at least one risk factor than in those without any risk factor ( $25.28 \pm 2.75$  kg/m<sup>2</sup> vs.  $27.00 \pm 4.00$  kg/m<sup>2</sup>,  $P < 0.0001$ ).

### Preoperative cardiovascular status

Other preoperative factors are summarized in Table 1. Peripheral vascular disease and history of arrhythmia were similar in the two groups. The mean ejection fraction was significantly higher in the group without risk factors ( $50.56\% \pm 9.80$  vs.  $48.96\% \pm 10.50$  respectively).

Single-vessel disease was more frequent in patients without general risk factors ( $P = 0.016$ ), whereas two- and three-vessel diseases were similar in the two groups. Mitral regurgitation was more frequent in the group with risk factors ( $P = 0.032$ ), whereas other valvular diseases were similar in the two groups.

**Table 1: Preoperative characteristics of patients undergoing coronary artery bypass grafting**

Variables	Patients without general risk factors (n=708) %	Patients with at least one general risk factor (n=10844) %	P value
Male gender	84.5	74.1	$< 0.0001$
Peripheral vascular disease	1.0	1.5	0.284
Chronic lung disease	1.1	2.4	0.026
Cardiac arrhythmia	1.4	2.5	0.065
Left main disease	14.1	9.8	0.0002
Single vessel disease	8.2	5.4	0.016
Two vessel disease	21.2	21.1	0.949
Three vessel disease	70.6	73.5	0.091
Aorta stenosis	1.6	1.4	0.662
Aorta regurgitation	6.7	5.7	0.268
Mitral stenosis	0.6	1.0	0.294
Mitral regurgitation	16.6	19.9	0.032
Tricuspid stenosis	0.0	0.0	0.999
Tricuspid regurgitation	7.0	6.7	0.752

**Table 2: Operative characteristics of patients undergoing coronary artery bypass grafting**

Variables	Patients without general risk factors (n=708) %	Patients with at least one general risk factor (n=10844) %	P value
Anastomoses with arterial conduits	93.4	96.7	$< 0.0001$
Anastomoses with vein grafts	95.7	97.7	0.002
Mitral valve surgery	1.7	2.6	0.141
Aortic valve surgery	1.5	2.6	0.071
Tricuspid valve surgery	0.4	0.5	0.713

### Operative indices

The operative cardiac indices are shown in Table 2. Patients without risk factors and patients with at least one general risk factor for CAD received a total of 95.6 and 96.4% arterial conduits and 96.6 and 97.5% vein graft distal anastomoses respectively. Both arterial and venous grafts were found to be similar in the two groups.

### Postoperative variables

The main postoperative characteristics are summarized in Table 3. Among postoperative in-hospital complications, all complications were similar between the two groups. Pulmonary emboli and tamponade were not found in both the groups.

Thirty-day mortality rate was also similar in the two groups. The mean of total LOS in hospital in the group without risk factors and the group

**Table 3: In-hospital postoperative complications in patients undergoing coronary artery bypass grafting**

Variables	Patients without general risk factors (n=708)%	Patients with at least one general risk factor (n=10844)%	P value
Re-intubation	0.7	1.5	0.084
Continues coma	0.0	0.3	0.144
Prolonged ventilation	1.3	1.5	0.670
Heart block	0.8	0.7	0.758
Cardiac arrest	0.6	1.2	0.149
Atrial fibrillation	8.9	7.1	0.072
30-day mortality rate	0.7	1.4	0.118
Prolonged LOS* (>12 days)	61.33	71.36	<0.0001

\*Length of stay in hospital

with risk factors was 15.01 and 16.39 days respectively; LOS >12 days was found in 61.33 and 71.36% respectively ( $P < 0.0001$ ).

The mean of ICU stay was  $40.01 \pm 32.10$  and  $42.09 \pm 35.20$  h respectively, which was similar between the two groups; whereas the mean of LOS in hospital was higher in the group with risk factors ( $15.01 \pm 6.93$  vs.  $16.39 \pm 7.42$  days,  $P < 0.0001$ ). Stepwise multivariate logistic regression analysis showed that among preoperative characteristics, gender (OR: 2.556, 95% CI: 1.562-3.211,  $P = 0.011$ ), arrhythmia (OR: 2.797, 95%CI: 1.204-4.023,  $P = 0.005$ ); and among postoperative complications, only prolonged ventilation (OR: 2.793, 95% CI: 1.245-4.746,  $P = 0.005$ ) were

predictors for 30-day mortality rate in patients without risk factors [Table 4]. Also, only atrial fibrillation was a strong predictor for prolonged LOS in this group (OR: 6.592, 95% CI: 3.455-8.212,  $P < 0.0001$ ) [Table 5].

## DISCUSSION

The frequency of major morbidity and mortality after CABG can vary widely across institutions and surgeons. Comparisons of mortality rates without considering morbidity may reach incorrect conclusions regarding quality of care. Major morbidity is more common than mortality after CABG and might have greater economic importance because it results in a prolonged hospital stay and greater utilization of health

**Table 4: Factors influencing 30-day mortality in patients without risk factors undergoing coronary artery bypass grafting**

Risk factor	Univariate	Multivariate	Odds ratio	95% confidence intervals	
	P value	P value		Lower	Higher
Gender (male/female)	0.029	0.011	2.556	1.562	3.211
Age	0.076	0.126	0.560	0.056	0.996
Cardiac arrhythmia	0.069	0.005	2.797	1.204	4.023
Anastomoses with arterial conduits	0.017	<0.0001	-3.535	-5.213	-1.123
Prolonged ventilation	0.062	0.005	2.793	1.245	4.746
Prolonged intensive care unit stay	0.091	0.244	0.218	0.102	0.445

**Table 5: Factors influencing prolonged length of stay in patients without risk factors undergoing coronary artery bypass grafting**

Risk factor	Univariate	Multivariate	Odds ratio	95% confidence intervals	
	P value	P value		Lower	Higher
Peripheral vascular disease	0.045	0.191	0.333	0.019	0.779
Left main disease	0.054	0.122	0.112	0.015	0.356
Atrial fibrillation	<0.0001	<0.0001	6.592	3.455	8.212

care resources.<sup>[10]</sup> The risk factors of patients selected for CABG have increased in recent years because of the aging population.<sup>[11]</sup> Prediction of postoperative complications is essential for optimal use of the available resources.<sup>[12]</sup> In this study, we compared preoperative and postoperative variables in patients without general risk factors for CAD with those in patients with at least one of these risk factors undergoing CABG.

We found that aortic and tricuspid valves diseases were similar between the two groups, whereas mitral regurgitation was more frequent in patients with at least one general risk factor. Development of mitral regurgitation following CABG is common and may be related to incomplete myocardium revascularization, especially in the PDA area and LV remodeling.<sup>[13]</sup> In our study, 30-day mortality rate was similar between patients without general risk factors and patients with at least one general risk factor. In Gardner *et al.* study, the majority of predictors of short-term mortality were cardiac-related variables. Previous heart operation, angina class III or IV, previous myocardial infarction and preoperative use of an intra-aortic balloon pump had greater effects in the short term.<sup>[14]</sup> In another study, even socioeconomic status was an important factor influencing 30-day mortality rate.<sup>[15]</sup> We found that despite the absence of preoperative general risk factors, atrial fibrillation was common after CABG (7.9%). Similar to our study, in other studies, atrial fibrillation increased the total LOS in hospital after CABG. Atrial fibrillation is the most common arrhythmia occurring in patients after CABG. Similar to our study, in Tamis and Steinberg's study, atrial fibrillation lengthened hospital stay after CABG, and its effect was independent of other important

variables. Identification of patients who are at risk for atrial fibrillation and successful treatment to prevent atrial fibrillation is likely to contribute to major reductions in consumption of health care resources in patients with CABG.<sup>[16]</sup>

In our study, the use of artery as graft decreased mortality rate in the two groups. There is clear evidence that patients having CABG with an artery have better long-term survival. Some studies have suggested a short-term protective effect as well; but because older and sicker patients are less likely to receive an artery graft, there has been concern that the apparent protective effect of the artery, especially intra-mammary artery (IMA), on short-term mortality has been confounded by other risk factors. Artery grafting has a strong protective effect on perioperative mortality.<sup>[17-19]</sup>

In our study, several predictors were determined for prolonged LOS in hospital, although only atrial fibrillation was a predictor for prolonged LOS in patients without risk factors.

The presence of certain preoperative and postoperative risk factors can be predicted to prolong LOS after CABG surgery. Preoperative length of stay is more difficult to control. Therefore, attention has been directed to curtailing the postoperative length of stay. In the past 3 years, changes in health care reimbursement policies have prompted the introduction of various changes in the practice of cardiac surgery that have had a dramatic impact on the length of stay. All elective cases are now admitted on the same day of surgery. There has also been a change in preoperative risk factors that prolong length of stay.<sup>[20]</sup> Atrial fibrillation after CABG is associated with



significant morbidity rates, including coronary ischemia, congestive heart failure, ventricular arrhythmias, thromboembolic events and infection - all leading to prolonged hospital stay and increased cost of care.<sup>[21]</sup>

Several limitations need to be considered when interpreting our results. We concentrated on short-term clinical events, such as in-hospital complications, 30-day mortality rate and LOS, as our outcomes of interest. We were therefore unable to consider the frequency of important surgical complications (e.g., stroke or renal failure) or the effects of CABG on functional status or long-term survival.

## CONCLUSION

Postoperative in-hospital complications and 30-day mortality rate were similar between the patients with and without risk factors for CAD. Also, mean of ICU stay was similar between the two groups, although a comparatively prolonged length of stay in hospital was found in patients with at least one risk factor for CAD.

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