

# Outcome of Emergency Coronary Artery Bypass Grafting

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**Objectives:** The aim of this study was to evaluate the immediate and late outcome of emergency coronary artery bypass grafting (CABG) in a multicenter setting.

**Design:** Multicenter, retrospective study.

**Setting:** Four university hospitals.

**Participants:** 596 patients were included in this study.

**Interventions:** Included patients underwent isolated, emergency CABG.

**Measurements and Main Results:** Sixty patients (absolute rate: 10.1%, pooled rate: 8.7%) died during the in-hospital stay period. Increasing emergency CABG classes ( $p < 0.0001$ ), recent myocardial infarction ( $p = 0.019$ ), left ventricular ejection fraction  $\leq 30\%$  ( $p = 0.034$ ), on-pump surgery ( $p = 0.012$ ), and participating centers ( $p < 0.0001$ ) were independent predictors of in-hospital mortality. Survival rates at 1, 3, and 5 years were 86.4%, 81.6%, and 76.1%, respectively. Extracorporeal membrane oxygenation was used in 6 patients and 3 of them (50.0%) survived the immediate postoperative period. Patient

populations of participating centers differed significantly in most of baseline characteristics. The preoperative use of intra-aortic balloon pump (8% to 51%) and off-pump surgery (2.8% to 56.3%) varied significantly between institutions. In-hospital mortality (2.8%, 5.9%, 7.7% and 19.8%,  $p < 0.0001$ ), as well as midterm survival, significantly differed between institutions (at 3 years, 90.6%, 89.8%, 81.2%, and 67.2%,  $p < 0.0001$ ).

**Conclusions:** The outcome after emergency CABG is satisfactory despite a significant operative risk. However, the results of emergency CABG significantly differed between the participating institutions, likely due to differences in the referral pathways and perioperative treatment strategies. Evaluation of these factors is crucial for implementation of treatment in centers with suboptimal results.

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**KEY WORDS:** coronary artery bypass, CABG, emergency, intra-aortic balloon pump, counterpulsation

PATIENTS UNDERGOING emergency coronary artery bypass grafting (CABG) are considered at very high risk for early mortality and morbidity.<sup>1-4</sup> Series from the last decade reported mortality rates widely ranging from 4% to 18%<sup>1-3,5-10</sup> and rising to 43% to 63% in the presence of cardiogenic shock, pulmonary hypertension, and severely depressed left ventricular function.<sup>1,4</sup> Immediate mortality after emergency CABG for percutaneous coronary intervention (PCI)-related complications also has been reported, ranging from 8% to 17%.<sup>11-14</sup> Because mortality rates markedly varied in published reports, the authors suspected that significant heterogeneities existed in baseline characteristics and perioperative treatment strategies, and these may have an impact on the outcome of patients undergoing emergency CABG. These issues have been investigated in the present multicenter study.

## METHODS

The present is a retrospective study performed by collecting data on 596 consecutive patients who underwent emergency CABG from 2004 to 2014, during different study periods, at 4 European centers of cardiac surgery (Catania University Hospital, Italy; Oulu University Hospital, Finland; Varese University Hospital, Italy; and Verona University Hospital, Italy). Baseline and operative characteristics of these patients are summarized in Table 1. The study was approved by the institutional review board at each participating center.

Eligible study participants were patients of any age who received a diagnosis of unstable angina, non-ST-elevation myocardial infarction or ST-elevation myocardial infarction and underwent emergency CABG. Data on preoperative and procedural variables, as well as on the immediate outcome, were retrieved from patients' records. Baseline and operative characteristics are listed in Table 1. Late death was recorded by contacting patients, their relatives, and/or their general practitioner and by checking patients' records and, when available, national registries.

## Definition Criteria

Emergency surgery was defined according to the EuroSCORE II definition criterion,<sup>15</sup> ie, an operation performed before the beginning of the

next working day after decision to operate. The severity of the emergency condition was further graded according to the following criteria:

class 1: persistent angina, persistent changes in the electrocardiogram, and/or increasing levels of cardiac enzymes despite best medical treatment (nitrates infusion, etc), but with no need of inotropes; class 2: hemodynamic instability responsive to inotropes; class 3: hemodynamic instability unresponsive to inotropes and/or requiring intra-aortic balloon pump; class 4: salvage CABG: patients requiring cardiopulmonary resuscitation (external cardiac massage) en route to the operating theater or before induction of anesthesia. This does not include cardiopulmonary resuscitation after induction of anesthesia.

Neurological status immediately before surgery was defined as (1) no acute neurological problem; (2) acute stroke, responsive; (3) coma/unresponsive (stroke not assessed preoperatively); and (4) coma/unresponsive after diagnosed acute stroke.

Failure of primary PCI was defined as a failed attempt, but not a direct complication, of PCI to successfully restore coronary flow; PCI-related complication was defined as an emergency state secondary to complication after elective/urgent PCI. Patients who underwent emergency PCI were excluded from this category. Ischemia despite successful PCI was defined as persistent ischemia despite successful PCI.

Heart failure was defined as any acute heart failure episode within 2 weeks of the operation.

All the other baseline variables were defined according to the EuroSCORE II criteria.<sup>15</sup>

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**Table 1. Baseline Characteristics and Operative Data of Patients who Underwent Emergency Coronary Artery Bypass Grafting**

	Mean or n (%)	Hospital Mortality		Univariate Analysis p Value	Multivariate Analysis OR, 95% CI
		Risk Factor Absent n (%)	Risk Factor Present n (%)		
Age	68.1 ± 9.4	—	—	0.483	
Octogenarians	55 (9.2)	51 (10.4)	4 (7.4)	0.470	
Female gender	138 (23.2)	41 (9.0)	19 (13.8)	0.107	
Emergency classes				<0.0001	
1 - Stable hemodynamics	351 (58.9)	—	16 (4.6)		Reference cat.
2 - Stable hemodynamics with inotropes	74 (12.4)	—	10 (13.5)		2.25,2.99-13.96
3 - Unstable hemodynamics despite inotropes	148 (24.8)	—	28 (18.9)		6.46,2.99-13.96
4 - Salvage operation	23 (3.9)	—	6 (26.1)		12.49,3.57-43.74
Creatinine clearance (mL/min)	70 ± 30	—	—	0.351	
Dialysis	14 (2.3)	60 (10.3)	0	0.205	
Diabetes	204 (34.2)	44 (11.2)	16 (7.8)	0.193	
Extracardiac arteriopathy	112 (18.8)	49 (10.1)	11 (89.8)	0.924	
Pulmonary disease	81 (13.6)	54 (10.5)	6 (7.4)	0.392	
Poor mobility	5 (0.8)	60 (10.2)	0	0.452	
Prior stroke	37 (6.2)	57 (10.2)	3 (8.1)	0.683	
Altered neurological status	12 (2.0)	55 (9.4)	5 (41.7)	<0.0001	
Acute stroke, responsive	1 (0.2)	—	0		
Coma/unresponsive (stroke not assessed)	10 (1.7)	—	4 (40.0)		
Coma/unresponsive (stroke assessed)	1 (0.2)	—	1 (100)		
Prior cardiac surgery	13 (2.2)	57 (9.8)	3 (23.1)	0.134	
Prior PCI	124 (20.8)	45 (9.5)	15 (12.1)	0.399	
Heart failure	153 (25.7)	26 (5.9)	34 (22.2)	<0.0001	
No. diseased vessels	2.7 ± 0.5	—	—	0.237	
Left ventricular ejection fraction				<0.0001	
>50%	243 (40.8)	—	17 (7.0)		
31-50%	231 (38.8)	—	15 (6.5)		
21-30%	101 (16.9)	—	22 (21.8)		
<21%	21 (3.5)	—	6 (28.6)		
Left ventricular ejection fraction ≤ 30%	122 (20.5)	32 (6.8)	28 (23.0)	<0.0001	2.05,1.05-3.96
Systolic pulmonary pressure				0.003	
<31 mmHg	246 (41.3)	—	13 (5.3)		
31-55 mmHg	319 (53.5)	—	41 (12.9)		
>55 mmHg	31 (5.2)	—	6 (19.4)		
Recent myocardial infarction (<3 months)	372 (62.4)	6 (2.7)	54 (14.5)	<0.0001	3.17,1.20-8.32
STEMI	193 (32.4)	29 (7.2)	31 (16.1)	0.001	
Left main stenosis	270 (45.3)	36 (11.0)	24 (8.9)	0.384	
Critical preoperative state	248 (41.6)	18 (5.2)	42 (16.9)	<0.0001	
Preoperative ventricular arrhythmia	58 (9.7)	47 (8.7)	13 (22.4)	0.001	
Preoperative IABP	148 (24.8)	35 (7.8)	25 (16.9)	0.001	
Direct transferal from cath lab	90 (15.1)	44 (8.7)	16 (17.8)	0.008	
Failure of primary PCI	50 (8.4)	49 (9.0)	11 (22.0)	0.003	
PCI-related complication	41 (6.9)	54 (9.7)	6 (14.6)	0.314	
Ischemia despite successful PCI	21 (3.5)	59 (10.3)	1 (4.8)	0.411	
Revascularization technique				<0.0001	
Off-pump surgery (intention-to-treat)	152 (25.5)	—	14 (9.2)	<0.0001	0.38,0.18-0.81
Conversion to on-pump beating heart	6 (1.0)	—	3 (50.0)		
On-pump surgery	389 (65.3)	—	30 (7.7)		
On-pump beating heart surgery	55 (9.2)	—	16 (29.1)		
Non-use of mammary artery graft	102 (17.1)	31 (6.3)	29 (28.4)	<0.0001	
No. of distal anastomoses	3.1 ± 1.0	—	—	0.052	
EuroSCORE II (%)	16.3 ± 13.8	—	—	<0.0001	
Institutions				<0.0001	
Verona	106 (17.8)	—	3 (2.8)		Reference cat.
Varese	220 (36.9)	—	13 (5.9)		3.14,0.82-12.2
Catania	78 (13.1)	—	6 (7.7)		8.26,1.78-38.64
Oulu	192 (32.2)	—	38 (19.8)		24.14,6.11-95.35

NOTE. In-hospital mortality rates in patients with and without risk factors are shown. Results of univariate and multivariate analysis for in-hospital mortality are given. Variables are defined according to the EuroSCORE II criteria; continuous variables are reported as the mean and standard deviation; nominal and ordinal variables are reported as counts and percentages.

Abbreviations: OR, odds ratio; cat, category; CI, confidence interval; PCI, percutaneous coronary intervention; STEMI, ST-elevation myocardial infarction; IABP, intra-aortic balloon pump; No., number

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