

RESEARCH LETTERS

HEALTH CARE REFORM

Prognostic Impact of Hospital Readmissions After Primary Percutaneous Coronary Intervention

The implementation of primary percutaneous coronary intervention (PCI) has significantly improved the clinical outcome of patients admitted for ST-segment elevation myocardial infarction (STEMI).¹ However, some patients still develop recurrent adverse events, with a negative impact on survival. Accordingly, we analyzed the data from the REAL (Registro Angioplastiche dell'Emilia-Romagna) registry in order to evaluate the 3-year readmission rate for cardiovascular causes and their influence on death.

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Methods. For all patients with STEMI (from January 2003 to June 2009) undergoing primary PCI enrolled in the REAL registry,²⁻⁴ we evaluated the incidence of death and hospital readmission due to cardiovascular causes up to 3 years. Particularly, myocardial infarction (MI), coronary revascularization (CR), acute or congestive heart failure (HF), and serious bleeding events (SBEs) were assessed. An SBE was defined as hemorrhagic stroke or any bleeding leading to hospitalization and/or transfu-

sion of red blood cells.⁵ The end points were assessed on December 31, 2009. The cumulative probability of adverse events was determined by the Kaplan-Meier method. Statistically significant differences between curves were evaluated with the log-rank test. To investigate the association of hospital readmission with the incidence and timing of mortality, Cox models were fitted with each adverse event as a time-updated binary covariate. These models were fitted with an adjustment for the baseline variables. $P < .05$ was considered statistically significant. All analyses were performed with the SAS 9.1 system (SAS Institute Inc, Cary, North Carolina).

Results. The study population included 11 118 patients. Overall, we observed 1779 deaths. The cumulative incidence of death was 12.1% at 1 year and 17.5% at 3 years. After the index hospitalization, we observed 7867 readmissions. The most frequent diseases or conditions associated with hospital readmissions were CR (28%), acute or congestive HF (26%), supraventricular arrhythmias (SA) (13%), MI (11%), and SBE (10%) (**Table**). Interestingly, the patients with 1 hospital admission for HF, SA, or SBE frequently showed a second (or more) readmission for the same cause (36% [95% CI, 33%-39%], 34% [95% CI, 30%-38%], and 22% [95% CI, 19%-26%], respectively). All these events tended to be more frequent during the first year (Table). This was particularly evident for CR. Approximately 60% of these procedures was target vessel revascularization, whereas approximately 17% was staged intervention. The influence of these readmissions on mortality varies consistently. Considering SA, no influence on mor-

Table. Recurrence of Adverse Events and Impact on Mortality^a

Adverse Event	Hospital Admissions, No.	No. (%)		% (95% CI)		Adjusted Proportional HR (95% CI) for Mortality
		Patients With AE	Patients With ≥2 HA for AE	1-y Cumulative Incidence of AE	3-y Cumulative Incidence of AE	
Death	NA	1779 (16)	NA	12.1 (11.5-12.7)	17.5 (16.7-18.2)	NA
Myocardial infarction	831	724 (6.5)	89 (0.8)	5 (4.6-5.4)	8.2 (7.6-8.8)	3.1 (2.6-3.7)
Cerebrovascular accident	338	301 (2.7)	33 (0.3)	1.6 (1.4-1.9)	3.7 (3.3-4.1)	3.1 (2.4-4)
Coronary revascularization	2201	1881 (17)	235 (2.1)	15.2 (14.5-15.9)	20.1 (19.3-21)	1.4 (1.2-1.7)
PCI	1946	1661 (15)	235 (2.1)	13.3 (12.6-13.9)	17.9 (17.1-18.7)	1.2 (1.1-1.5)
CABG	279	279 (2.5)	NA	2.3 (2.1-2.6)	2.9 (2.6-3.3)	1.6 (1.2-1.9)
Admission for A-CHF	2066	1166 (11)	424 (3.8)	8.8 (8.3-9.4)	13 (12.3-13.7)	3.5 (3-4)
Cardiac transplant	8	8 (0.1)	NA	NA	0.1 (0.05-0.2)	NA
PM implant	84	84 (0.7)	NA	0.4 (0.3-0.6)	1.1 (0.8-1.4)	2 (0.8-5)
Ventricular tachycardia/fibrillation	38	38 (0.4)	NA	0.3 (0.2-0.4)	0.4 (0.3-0.7)	2.1 (0.8-3.2)
ICD implant	155	155 (1.4)	NA	1 (0.8-1.2)	1.8 (1.5-2.1)	0.8 (0.4-1.5)
Cardiac resynchronization therapy	51	51 (0.5)	NA	0.3 (0.2-0.4)	0.5 (0.2-0.8)	0.85 (0.42-1.8)
Supraventricular arrhythmias	1018	622 (5.6)	213 (1.9)	4.8 (4.4-5.3)	9.8 (8.9-10.6)	1.1 (0.3-1.8)
RF ablation procedure	101	95 (0.8)	3 (<0.1)	0.2 (0.1-0.3)	1 (0.7-1.3)	0.9 (0.5-1.7)
Serious bleeding events	735	546 (4.9)	123 (0.1)	4.1 (3.7-4.5)	7.1 (6.6-7.7)	4.1 (3.6-4.8)
Red blood cells transfusion	447	360 (3.2)	66 (0.5)	3.2 (2.9-3.6)	5.3 (4.8-5.8)	3.8 (3.2-4.5)
Hemorrhagic stroke	39	39 (0.3)	NA	0.2 (0.1-0.25)	0.5 (0.4-0.7)	18.4 (11.8-28)
Anemia	241	201 (3.2)	27 (0.2)	1.3 (1.1-1.5)	3.5 (3-3.8)	3.7 (2.8-4.9)

Abbreviations: AE, adverse event; A-CHF, acute or congestive heart failure; CABG, coronary artery bypass graft; HA, hospital admission; HR, hazard ratio; ICD, implantable cardioverter/defibrillator; NA, not applicable; PCI, percutaneous coronary intervention; PM, pacemaker; RF, radiofrequency ablation.
^aBoldface indicates statistical significance ($P < .05$)

tality was found. Hemorrhagic stroke showed the strongest association with death. Coronary revascularization showed a low impact on mortality, although still numerically relevant and statistically significant. After a recurrence of MI, a quarter of the patients died, whereas almost half died after a hospital readmission for HF or SBE.

Comment. Our main focus was to describe cardiovascular causes of hospital readmission after primary PCI and to determine their influence on death, through an analysis of a multicenter registry that well reflects the patients seen in daily practice. The mortality rate after 3 years was 17.5%. This mortality was strongly influenced by the occurrence of adverse events requiring a new hospitalization. Approximately one-quarter of hospital readmissions were associated with new CR procedures. These revascularizations were predominantly target vessel revascularization. Of note, as suggested by current guidelines, in our registry drug-eluting stent implantation during primary PCI was relatively low (approximately 15%).² Also, readmission for HF is really frequent, particularly during the first year. In addition, patients with a first readmission for HF show high probability to have a second (or more) recurrence. Several registries suggest that there is an underuse of effective cardiac therapies.⁶ Our findings reinforce the need for the application of timely and effective preventive and treatment strategies. Over the last years, several new antiplatelet agents have been introduced in the medical treatment of STEMI. All these agents reduced the incidence of MI and stent thrombosis but increased the rate of bleeding complications.^{7,8} This is especially important considering that a longer dual antiplatelet therapy is recommended in patients receiving a drug-eluting stent, which is currently the only option to reduce target vessel revascularization. Reinfarction and bleeding events were associated with an increased risk of death; their 3-year incidence was similar but the risk of death after an SBE was significantly higher than after a reinfarction. In addition, as well as HF, patients with a first SBE tended to show a high recurrence rate. Finally, several bleeding events occurred late during follow-up, after the first year. This is probably because bleeding risk is not only related to dual antiplatelet therapy, but is also strongly influenced by baseline characteristics and comorbidities.⁹

In conclusion, hospital readmission for new CR procedures, HF, MI, and SBE occurred frequently (7%-20% at 3 years) in patients with STEMI receiving primary PCI and have a negative impact on long-term mortality.

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