JACC: CARDIOVASCULAR IMAGING
VOL. ■, NO. ■, 2017

ISSN 1936-878X/$36.00
PUBLISHED BY ELSEVIER
http://dx.doi.org/10.1016/j.jcmg.2017.05.023

Long-Term Incremental Prognostic Value of Cardiovascular Magnetic Resonance After ST-Segment Elevation Myocardial Infarction

A Study of the Collaborative Registry on CMR in STEMI

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ABSTRACT

OBJECTIVES This study sought to investigate whether early post-infarction cardiac magnetic resonance (CMR) parameters provide additional long-term prognostic value beyond traditional outcome predictors in ST-segment elevation myocardial infarction (STEMI) patients.

BACKGROUND Long-term prognostic significance of CMR in STEMI patients has not been assessed yet.

METHODS This was a longitudinal study from a multicenter registry that prospectively included STEMI patients undergoing CMR after infarction. Between May 2003 and August 2015, 810 revascularized STEMI patients were included. CMR was performed at a median of 4 days after STEMI. Infarct size, microvascular obstruction (MVO), and left ventricular (LV) volumes and function were measured. Primary endpoint was a composite of all death and decompensated heart failure (HF).

RESULTS During median follow-up of 5.5 years (range 1.0 to 13.1 years), primary endpoint occurred in 99 patients (39 deaths and 60 HF hospitalization). MVO was a strong predictor of the composite endpoint after correction for important clinical, CMR, and angiographic parameters, including age, LV systolic function, and infarct size. The independent prognostic value of MVO was confirmed in all multivariate models irrespective of whether it was included as a dichotomous (presence of MVO, hazard ratio [HR]: 1.985 to 1.995), continuous (MVO extent as % LV, HR: 1.095 to 1.097), or optimal cutoff value (MVO extent ≥2.6% of LV; HR: 3.185 to 3.199; $p < 0.05$ for all). MVO extent ≥2.6% of LV was a strong independent predictor of all death (HR: 2.055; 95% confidence interval: 1.076 to 3.925; $p = 0.029$) and HF hospitalization (HR: 5.999; 95% confidence interval: 3.251 to 11.069; $p < 0.001$). Finally, MVO extent ≥2.6% of LV provided incremental prognostic value over traditional outcome predictors (net reclassification improvement index: 0.16 to 0.30; $p < 0.05$ for all models).

CONCLUSIONS Early post-infarction CMR-based MVO is a strong independent prognosticator in revascularized STEMI patients. Remarkably, MVO extent ≥2.6% of LV improved long-term risk stratification over traditional outcome predictors. (J Am Coll Cardiol Img 2017;■:■–■) © 2017 by the American College of Cardiology Foundation.

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ABBREVIATIONS AND ACRONYMS

CMR = cardiac magnetic resonance

EDV = end-diastolic volume

ESV = end-systolic volume

EF = ejection fraction

HF = heart failure

LGE = late gadolinium enhancement

LV = left ventricle

PCI = percutaneous coronary intervention

SCD = sudden cardiac death

STEMI = ST-segment elevation myocardial infarction

TIMI = Thrombolysis in Myocardial Infarction

In the last decade, in-hospital mortality of patients with acute ST-segment elevation myocardial infarction (STEMI) progressively declined as a result of effective reperfusion strategies (1,2). However, this favorable trend has been paralleled by an increasing number of patients who, having survived the acute infarction, remained exposed to the considerable long-term risk of sudden cardiac death (SCD) or heart failure (HF) (3). The identification of patients at high risk after STEMI is crucial for effective risk stratification, patient management, and efficient allocation of public health resources. The current American Heart Association/American College of Cardiology and European Society of Cardiology guidelines for STEMI recommend including left ventricular (LV) ejection fraction (EF) quantification for decision-making and risk stratification in all STEMI patients (4,5). However, this parameter is largely influenced by post-infarction stunning and compensatory hyperkinesis of noninfarcted myocardium, limiting its applicability as a prognostic marker (6,7). Conversely, the quantification of irreversible ischemic damage after STEMI may be a more attractive measure for clinical outcome prediction. Cardiac magnetic resonance (CMR) is well suited for use in STEMI patients because it provides quantitative multiparametric characterization of the infarcted myocardium along with comprehensive assessment of LV function and morphology. Unfortunately, previous CMR studies in STEMI patients have been limited by single-center design, small sample sizes, short-term follow-up, as well as the adoption of soft clinical endpoints (8–17). Recent meta-analyses raised the hypothesis that CMR-based parameters of irreversible myocardial ischemic damage, such as infarct size or microvascular obstruction (MVO), may be useful for improving risk stratification of STEMI patients in the short-term (<24 months) (18–20).

Accordingly, the aim of the current study was to investigate the incremental prognostic value of CMR-based parameters measured early after STEMI in addition to traditional outcome predictors in a large cohort of STEMI patients during long-term follow-up.

METHODS

STUDY POPULATION. This pre-specified multicenter longitudinal study was derived from CoReCMR-in-STEMI (Collaborative Registry on CMR in STEMI), which prospectively included STEMI patients undergoing CMR in the early post-infarction phase. Between May 2003 and August 2015, 967 patients with the diagnosis of STEMI were evaluated for study inclusion in 6 tertiary referral hospitals across Europe (Online Appendix). Patients were included if they were older than 18 years, met the electrocardiographic criteria for STEMI, and were successfully treated by percutaneous coronary intervention (PCI) within 12 h from symptom onset. Exclusion criteria included cardiogenic shock, prior myocardial infarction or coronary revascularization, claustrophobia, and glomerular filtration rate <30 ml/min. The study was approved by each center's institutional review board, and all patients provided written informed consent.

CMR PROTOCOL. CMR studies were conducted using a 1.5-T unit at each site (Online Appendix). All studies were performed using dedicated cardiac software, phased-array surface receiver coil, and electrocardiogram triggering. A standardized CMR protocol was followed in all centers. Cine images were acquired using a breath-hold steady-state free-precession sequence in long-axis and short-axis views. A stack of short-axis slices covering from the atrioventricular ring to the apex was used to derived LV volume, mass, and EF. Ten minutes after intravenous injection of gadolinium-based contrast agent, late gadolinium enhancement (LGE) images were acquired using a breath-hold segmented T1-weighted

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Manuscript received March 9, 2017; revised manuscript received May 8, 2017, accepted May 24, 2017.