JACC: CARDIOVASCULAR IMAGING VOL. ■, NO. ■, 2018

PUBLISHED BY ELSEVIER

Cardiac Magnetic Resonance Myocardial Feature Tracking for Optimized Prediction of Cardiovascular Events Following Myocardial Infarction

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ABSTRACT

OBJECTIVES The aims of the study were to assess the prognostic significance of cardiac magnetic resonance myocardial feature tracking (CMR-FT) in a large multicenter study and to evaluate the most potent CMR-FT predictor of hard clinical events following myocardial infarction (MI).

BACKGROUND CMR-FT is a new method that allows accurate assessment of global and regional circumferential, radial, and longitudinal myocardial strain. The prognostic value of CMR-FT in patients with reperfused MI is unknown.

METHODS The study included 1,235 MI patients (n = 795 with ST-segment elevation MI and 440 with non–ST-elevation MI) at 15 centers. All patients were reperfused by primary percutaneous coronary intervention. Central core laboratory–masked analyses were performed to determine left ventricular (LV) circumferential, radial, and longitudinal strain. The primary clinical endpoint of the study was the occurrence of major adverse cardiac events within 12 months after infarction.

RESULTS Patients with cardiovascular events had significantly impaired CMR-FT strain values ($p < 0.001$ for all). Global longitudinal strain was identified as the strongest CMR-FT parameter of future cardiovascular events and emerged as an independent predictor of poor prognosis following MI even after adjustment for established prognostic markers. Global longitudinal strain provided an incremental prognostic value for all-cause mortality above LV ejection fraction (c-index increase from 0.65 to 0.73; $p = 0.04$) and infarct size (c-index increase from 0.60 to 0.78; $p = 0.002$).

CONCLUSIONS CMR-FT is a superior measure of LV function and performance early after reperfused MI with incremental prognostic value for mortality over and above LV ejection fraction and infarct size. (Abciximab i.v. Versus i.c. in ST-segment elevation Myocardial Infarction [AIDA STEMI]; NCT00712101; Thrombus Aspiration in ThrOmbus Containing culpRIT Lesions in Non-ST-Elevation Myocardial Infarction [TATORT-NSTEMI]; NCT01612312). (J Am Coll Cardiol Img 2018;■:■–■) © 2018 by the American College of Cardiology Foundation.

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Manuscript received May 31, 2017; revised manuscript received November 15, 2017, accepted November 27, 2017.

ISSN 1936-878X/$36.00 https://doi.org/10.1016/j.jcmg.2017.11.034

ABBREVIATIONS AND ACRONYMS

CI = confidence interval

CMR-FT = cardiac magnetic resonance myocardial feature tracking

GCS = global circumferential strain

GLS = global longitudinal strain

GRS = global radial strain

IQR = interquartile range

LVEF = left ventricular ejection fraction

MI = myocardial infarction

MO = microvascular obstruction

NSTEMI = non-ST-segment elevation myocardial infarction

PCI = percutaneous coronary intervention

STEMI = ST-segment elevation myocardial infarction

Despite marked advances in the diagnosis and management of patients with myocardial infarction (MI), the burden of recurrent cardiovascular events including mortality remains high (1,2). Efforts to improve risk stratification and identify targets for therapeutic interventions are therefore of paramount importance to reduce morbidity and mortality following MI. Multiple studies have demonstrated that the measurement of left ventricular ejection fraction (LVEF) as a marker of global systolic myocardial function is a powerful predictor of adverse clinical events in patients with MI (3–5). Consequently, LVEF has become an important prognostic and functional marker for routine risk stratification and therapeutic decision making in MI survivors (2,6). However, routine LVEF assessment is not able to detect subtle changes in cardiac function and previous trials have clearly demonstrated that LVEF as a standalone determinant of outcome has major limitations in post-infarction patients (7).

Myocardial strain measurements that track intramyocardial features detected between the epicardial and endocardial myocardial tissue boundaries (e.g., speckle tracking echocardiography) have emerged as superior parameters of LV function and performance by reflecting both systolic and diastolic LV function (8–10). Recently, cardiac magnetic resonance myocardial feature tracking (CMR-FT) has been introduced as a new method for high-resolution assessment of global and regional myocardial deformation by tracking the actual myocardial borders and following them over time (9,11). This technique allows accurate evaluation of circumferential, radial, and longitudinal myocardial strain and has been already applied in a wide range of cardiovascular conditions (11). However, in patients with MI the prognostic implications of CMR-FT are unknown and especially data from an adequately sized multicenter trial are lacking. Moreover, there is no consensus as for which strain marker is the most potent predictor of future cardiovascular events in MI.

The aims of our study were, therefore, to assess the prognostic significance of CMR-FT in a large multicenter study and to evaluate the most potent CMR-FT predictor of hard clinical events in a well characterized high-risk MI population consisting of patients with ST-segment elevation myocardial infarction (STEMI) and non-ST-segment elevation myocardial infarction (NSTEMI) treated by primary percutaneous coronary intervention (PCI).

METHODS

The study population of this predefined study consists of 2 previously published infarction cohorts, the AIDA STEMI (Abciximab Intracoronary versus intravenously Drug Application in STEMI) trial and the TATORT-NSTEMI (Thrombus Aspiration in Thrombus Containing Culprit Lesions in NSTEMI) trial (12,13). The AIDA STEMI trial compared the strategy of intravenous versus intracoronary abciximab application in STEMI patients and did not show a difference in infarct size, reperfusion injury and clinical outcome between the treatment groups. The detailed design and main results of the trial have previously been published (12,14–16). Briefly, the AIDA STEMI trial was a randomized, open-label, multicenter trial. Patients presenting with STEMI in the first 12 h after symptom onset were randomly assigned in a 1:1 ratio by a central web-based randomization system to intracoronary versus intravenous abciximab bolus (0.25 mg/kg body weight) during primary PCI with a subsequent 12-h intravenous infusion at 0.125 g/kg/min (maximum 10 μg/min).

Patients were enrolled at 22 sites in Germany, with a final enrolled trial population of 2,065 patients (intracoronary abciximab: n = 1,032; intravenous abciximab: n = 1,033).

Consecutive patients enrolled in the AIDA STEMI trial at 8 sites were included in the CMR substudy (n = 795) (14). The sites were chosen based on proven expertise in performing CMR examinations in patients with MI. The study was approved by national regulatory authorities and Ethical committee of the University of Leipzig. All patients provided written informed consent. This trial is registered with ClinicalTrials.gov (NCT00712101).

The TATORT-NSTEMI trial compared the effect of aspiration thrombectomy versus standard PCI on microvascular injury in patients with NSTEMI and did not show a difference in infarct size, reperfusion injury, and clinical outcome between the treatment groups. The detailed design and main results of the trial have previously been published (13,17). Briefly, TATORT-NSTEMI was a prospective, controlled, multicenter, randomized, open-label trial in NSTEMI patients with relevant thrombus burden undergoing early invasive PCI. Patients were enrolled at 7 sites in Germany, with a final enrolled trial sample of 440 patients (thrombectomy group: n = 221; standard PCI group: n = 219). All patients gave written informed consent before randomization. The lead ethical committee at the University of Leipzig and at all local ethical committees of the participating sites approved the study. The TATORT-NSTEMI trial is registered with ClinicalTrials.gov (NCT01612312).