Ventricular fibrillation in acute ischemia: ECG predictors and prognostic impact

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INTRODUCTION: Malignant ventricular arrhythmias, particularly ventricular fibrillation (VF), remain an important contributor to mortality in ST-segment elevation myocardial infarction (STEMI). Although several studies proposed predictors of ventricular arrhythmias in STEMI settings, most of those predictors can be attributed to clinical characteristics, while data on dynamic electrocardiographic (ECG) changes that can predict VF are scarce. Despite several studies assessed the prognostic value of VF in STEMI, most of them were performed before percutaneous coronary interventions (PCI) era, and prognostic value of VF in STEMI treated by primary PCI still remains controversial.

METHODS: ECG-markers associated with impending VF were studied in the porcine model of myocardial infarction (MI). In 32 pigs MI was induced by 40-min inflation of an angioplasty balloon in the left descending artery (LAD) and ECG was continuously recorded. QRS-duration and morphology, dynamics of ST-segment and T-wave alternans (TWA) were calculated during the occlusion period. QRS-duration was measured in 3-min sliding window and the association between QRS-widening and subsequent VF was studied using ROC-curve analysis. The prognostic impact of early VF in STEMI was assessed in a register-based study on 1718 consecutive patients admitted for primary PCI during 2007-2009 who were followed up for one year.

RESULTS: In the experimental study, 10 animals had VF 21±4 min after occlusion start. Marked and fast transient QRS widening (≥28 ms during 3 min) predicted impending VF with Se=80%, Sp=73%, PPV=57% and NPV=89% (p=0.008). In 10 of the 14 pigs with QRS widening, J-wave pattern was observed at maximal QRS duration. Neither the maximal TWA–amplitude, nor TWA-duration were associated with VF occurrence.

In the clinical study, VF occurred in 121 (7%) during the first 48 hours of STEMI while in 96% of them it was observed during the first 24 hours. Patients successfully resuscitated after VF and alive at 48 hours had higher in-hospital mortality (12% vs. 2%, $p<0.001$). However, in VF patients who were discharged alive, 1-year mortality did not differ compared with patients without VF.

DISCUSSION: Transient QRS widening, commonly associated with J-wave pattern, appears to predict impending VF in the settings of acute ischemia. VF during the acute phase of STEMI increased in-hospital mortality, but does not influence the long-term prognosis for those discharged alive.