Intracoronary ECG ST-segment shift remission time during reactive coronary hyperemia (τ-icECG): a new approach to assess hemodynamic coronary stenosis severity

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Background: Coronary pressure-derived fractional flow reserve (FFR) measurements are recommended for hemodynamic coronary stenosis assessment. Given temporary paralysis of the coronary microcirculation during hyperemia, pressure is, in theory, directly related to coronary flow. Pressure drop during hyperemia across a coronary stenosis, thus, provides an estimate of its restrictive effect on flow. FFR during reactive hyperemia induced by a proximal, 1-minute coronary artery balloon occlusion has been shown non-inferior to FFR as obtained by adenosine-induced hyperemia. Intracoronary ECG (icECG) is more sensitive in detecting myocardial ischemia than the surface ECG, and can be easily obtained.

Purpose: The present study evaluated a novel diagnostic approach based on icECG ST-segment shift remission time for hemodynamic stenosis severity assessment.

Methods: This was a retrospective observational trial in patients with chronic coronary syndrome, who underwent hemodynamic measurements during a brief coronary occlusion with simultaneous icECG recording during coronary angiography. The icECG recording was used for a beat-to-beat analysis of the ST-segment elevation performed by a previously developed fully autonomous algorithm. The time after release of the 1-minute ostial coronary balloon occlusion when the ST elevation reached 50% of the pre-occlusion (baseline) isoelectric line, i.e., icECG remission half time (τ-icECG; τ=tau), was obtained by the algorithm (Figure1). τ-icECG was evaluated using the simultaneously obtained FFR at a threshold of 0.80 as reference parameter.

Results: 139 icECGs from 119 patients were analysed, 23 had to be excluded in advance, due to incomplete icECG recording or algorithm failure. A ROC-analysis of τ at a threshold of >8s found it significantly accurate for detecting a hemodynamically relevant coronary stenosis at FFR≤0.80 (area under the ROC-curve 0.618, 95% CI 0.507-0.735, sensitivity 60%, specificity 67%, p=0.037) (Figure2).

Conclusion: τ-icECG, a measure of icECG ST-elevation remission time to isoelectricity as obtained during reactive hyperemia FFR accurately detects hemodynamically relevant coronary artery stenoses at a threshold of ≥ 8 seconds.
Figure 2. ROC analysis of τau values in the prediction of stenosis severity/significance determined by a FFR value ≤ 0.8. The dots represent the empirical value of true/false fractions for τau of 0–100s. (positive 35, negative 104, positive ≤ 0.8, AUC 0.818, std error 0.059 , p=0.037, 95% CI 0.502-0.734, cut-off 0.08)