Measurement of Terminal QRS complex delay to estimate the severity of acute myocardial ischemia

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INTRODUCTION Rapid reperfusion is essential for patients with acute coronary occlusion (ACO) to salvage the ischemic myocardium at risk of infarction. Primary Percutaneous Coronary Intervention (PPCI) requires the delay for transport to an emergency angiography center while fibrinolytic therapy could be administered immediately following symptom and ECG based diagnosis. The time period when myocardium remains reversibly ischemic is dependent on its "severity", as determined by the availability of protection via collateral blood supply and metabolic preconditioning. For patients with the most severe ischemia, time to reperfusion is especially critical. While the diagnosis of ACO is primarily dependent on ST segment deviation, the severity of ischemia can be evaluated by determination of delay in the terminal QRS complex, caused by the slowing of conduction within the severely ischemic area. In the ECG leads with ST elevation, the terminal QRS delay causes the junction between QRS and ST to become indistinctive, and precise QRS duration cannot be measured. A previous study of dogs receiving occlusion of the left circumflex artery (LCX), and patients that underwent prolonged balloon occlusion during elective PCI for stable angina pectoris, has developed a novel method to estimate QRS duration when the terminal delay has distorted the J-point[1]. The aim of this study is to investigate if QRS prolongation correlates with more severe ischemia in patients with ACO. Ischemic QRS distortion is present in leads parallel to the ischemic region, but absent in leads perpendicular to this region: therefore, the difference between the estimated QRS duration in the most parallel lead and the measured QRS duration in the most perpendicular lead can potentially serve as a "biomarker" for the severity of the ischemia. The clinical outcome indicating severe ischemia will be more infarct development over time and thus less salvage by PPCI as determined by SPECT imaging.

METHODS

STUDY POPULATION Retrospective study of 244 patients from the MONAMI database consisting of patients meeting STEMI criteria referred for PPCI in Aarhus, Denmark between 2004 and 2008. Multiple clinical parameters are registered as well as ECGs in the pre-hospital phase and at the PCI lab.

ECG AND SPECT MEASUREMENTS QRS duration from the earliest start of the QRS complex to the J-point, will be manually measured in the pre-hospital ECG in each patient. In the event of terminal QRS distortion and no distinct J-point, the method described by Almer et al[1] will be used to estimate QRS duration (Figure 1). The difference (delta) between the estimated QRS duration in the most parallel lead to the ischemia (most pronounced ST deviation) and the measured QRS duration in the most perpendicular lead (no ST deviation) will be calculated. The area at risk (AAR) and final infarct size (FIS) are determined by acute SPECT prior to the PPCI and after 30 days, respectively. Salvage will be calculated as the difference between AAR and FIS. Time of symptom onset to pre-hospital ECG and to reperfusion is registered for each patient. The resulting delta of QRS duration between the leads will be evaluated against SPECT estimated salvage with the hypothesis that a larger delta value will predict more severe ischemia and faster development of infarction, i.e less salvage over time.

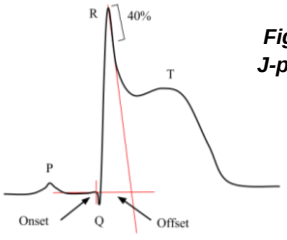

Figure 1. Evaluation of QRS duration in a lead with no distinct J-point

1. Almer J, Jenning RB et al. QRS prolongation as a biomarker of severe myocardial ischemia. Submitted.