

Is Hemorrhage in Acute Reperfused Myocardial Infarction a New Marker for the Severity of Tissue Injury?

A. Kumar¹, J. D. Green^{1,2}, J. M. Sykes³, A. J. Mitchell³, G. Wisenberg³, and M. G. Friedrich¹

¹Stephenson CMR Centre, University of Calgary, Calgary, AB, Canada, ²Siemens Canada Ltd, Calgary, AB, Canada, ³Lawson Health Research Institute, University of Western Ontario, London, ON, Canada

Introduction

Acute reperfused myocardial infarction is frequently complicated by microvascular obstruction, which can occur with or without gross reperfusion hemorrhage. The pathophysiology of reperfusion hemorrhage is not well investigated. A recently described *in vivo* imaging approach using T2*-weighted cardiovascular magnetic resonance can help investigate the pathophysiology of reperfusion hemorrhage *in vivo*.

Hypothesis

We hypothesized that hemorrhage reflects a severer form of reperfusion injury and therefore occurs with larger infarct size and worse LV function as compared to reperfusion injury without hemorrhage.

Methods

In 14 female mongrel dogs, myocardial infarction was induced by ligation of the left anterior descending coronary artery for 2-4 hours, followed by reperfusion. On day 3±1, a cardiovascular magnetic resonance study was performed *in vivo* using the following protocol: (1) To quantify left ventricular end-diastolic volume, ejection fraction and cardiac output, steady-state-free-precession cine imaging was performed; (2) to assess presence of reperfusion hemorrhage, a T2*-weighted gradient-echo-EPI sequence (TE=35ms) was applied, with hemorrhage being defined as areas of myocardial signal drop beyond 2 standard deviations off mean of remote myocardium. (3) To assess presence of microvascular obstruction, a contrast enhanced inversion-recovery sequence ("late enhancement") at minute 2-5 post injection of 0.1mmol/l Gd-DTPA was applied. (4) To quantify infarct size the late enhancement imaging approach was repeated 10 min after injection of contrast, with the inversion time optimized individually to null remote myocardium. All imaging was performed in short axis orientation covering the entire left ventricle in slices of 10mm thickness. An independent-samples t-test was performed to compare infarct size and LV function parameters in dogs with and without hemorrhage in reperfusion injury.

Results

From 14 dogs, 9 had microvascular obstruction, and 4/9 had reperfusion hemorrhage in addition to microvascular obstruction.

Dogs with hemorrhagic infarcts had significantly larger infarct size (26.1±6.6 g vs. 5.5±3.9g, p<0.05), lower LV ejection fraction (28±7% vs. 53±12%, p<0.05), and lower cardiac output (1.9±0.2 l/min vs. 2.8±0.5 l/min, p<0.05). There were no differences in LV end-diastolic volume and LV mass.

Discussion and Conclusion

In this dog model of ischemia/ reperfusion injury, gross hemorrhage was associated with significantly larger infarct size and worse LV functional parameters. This supports the hypothesis that hemorrhage may occur with advanced, severe tissue injury only.