Background

Abnormal myocardial microvascular resistance (MVR) in STEMI has potent impact on prognosis and late complications. Absolute MVR determination is difficult because it requires coronary flow measurement (Q, ml/min) in its calculation. The limitations of intracoronary Doppler and thermodilution flow measurement are well documented.

This study evaluated a novel method for real-time, absolute dynamic MVR (dMVR) measurement in a preclinical STEMI model. Coronary flow is determined by the CoFi™ system (CorFlow Therapeutics, Baar, Switzerland, Fig.3) eliminating the need for complex flow calculations using a controlled, defined coronary flow infusion system the CoFi™ system, which:

1. Briefly occludes a coronary artery, blocking antegrade flow
2. Precisely infuses crystalloid into the vessel distal to occlusion balloon, Flow (Q(t)), and simultaneously
3. Measures the distal coronary artery pressure response to the flow infusion P(t).

dMVR = P(t)/Q(t)

This produced consistent myocardial infarction in all animals, and resulted in reproducible microvascular obstruction (MVO) as quantified by CMRI. These results are consistent with the incidence and extent of MVO observed clinically in humans during STEMI.

Real-time dMVR was obtained using a novel catheter-based coronary flow infusion system the CoFi™ system, which:

Seven domestic pigs (German Landrace, 50-60 kg) underwent LAD coronary balloon occlusion for 90 minutes to induce STEMI. The observed clinical and inhumans during STEMI.

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Baseline dMVR is measured before vessel occlusion (baseline) followed by repeated measurements at 10 min and 4 hours post balloon removal and reperfusion. dMVR was determined at controlled infused flows of 5, 10, 20, 30 and 40 ml/min respectively.

At six to eight hours post reperfusion all pigs underwent contrast enhanced MRI for infarct and MVO size assessment to be correlated with dMVR.

Methods

All pigs survived the procedural steps until planned study exit. dMVR was successfully measured in all animals.

Infarct size % and MVO % (in % of total LV mass) were 20.6% ± 5.6% and 2.3% ± 1.1% respectively.

dMVR increased from pre-to-post STEMI by 24% (p<0.05).

dMVR varied inversely with infused flow ranges from 3.17 (at 5 ml/min) to 0.85 (at 40 ml/min), p<0.05.

Results

Baseline to 10 min reperfusion

<table>
<thead>
<tr>
<th>Flowrate in ml/min</th>
<th>Baseline</th>
<th>10 min reperfusion</th>
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<tbody>
<tr>
<td>5</td>
<td></td>
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<tr>
<td>10</td>
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<tr>
<td>40</td>
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</tbody>
</table>

Table 1

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Conclusions

- Real time absolute microvascular resistance increases significantly and exponentially with decreased flow in experimental STEMI.
- Determination of coronary flow by this simple method provides safe and highly accurate dMVR measurement.
- The observed inverse dMVR-flow infusion relationship likely represents exponential collapse of the coronary microcirculation at low coronary flow.
- Controlled flow infusion with the CoFi™ system determines absolute microvascular resistance in real time, is catheter based, safe, and may have important clinical implications in disease states with abnormal microvascular resistance.

Implications

Controlled flow infusion measures myocardial microvascular resistance in real time using a safe, simple, and efficient method. It may have clinical use in acute coronary syndromes and other diseases involving the microvasculature.