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# Absolute coronary flow measurement by continuous infusion thermodilution: in-vitro evaluation

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## Introduction

Direct volumetric coronary blood flow measurement during catheterization has not been possible so far. Derived parameters could be assessed using Doppler probes or thermodilution by bolus injection. In this study, the application of continuous infusion of saline for volumetric flow measurement is assessed.

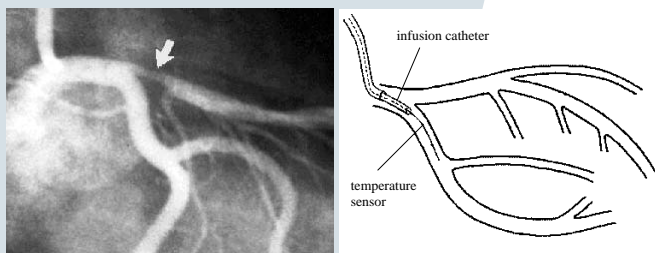


Figure 1: Left: Angiogram of the coronary arterial tree. Right: schematic representation of the coronary arteries, with infusion catheter and guidewire-mounted temperature sensor.

The method is based on the measurement of the temperatures of the blood and the infused saline, and the mixing temperature distal of the infusion site [1]. The main prerequisite for appropriate calculation of the blood flow is for full mixing of the infusate and the blood to occur.

## Materials and methods

The mixing is investigated in a physiologically representative in-vitro model of the coronary circulation (figure 2, [2]), using different over-the-wire infusion catheters (specially designed by Occam, commercially available Boston Scientific Tracker 18), at two infusion rates (15 and 25 ml/min), with coronary flow rates varying between 50 and 250 ml/min.

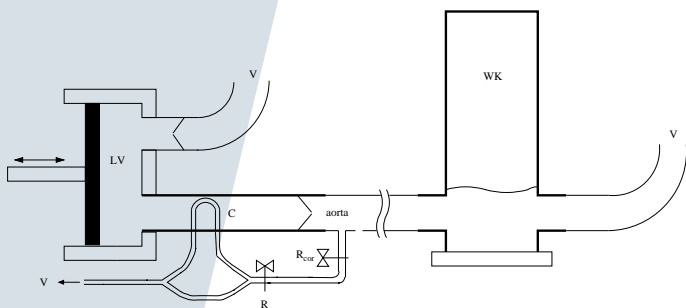


Figure 2: *In vitro* model of the circulation used in this study; LV, left ventricle; V, venous outlet; C, collapsible tube;  $R_{ar}$ , arteriolar resistance clamp;  $R_{cor}$ , epicardial coronary stenosis clamp; WK, windkessel.

Infusate temperature (inside the catheter) and distal mixing temperature are measured by a sensor-tipped guidewire. The reference flow is registered by an ultrasound flow meter.

## Results and discussion

The accuracy of the flow derivation increased with increasing infusion rate and decreasing coronary flow. With increasing coronary flow rate, the flow was progressively underestimated, indicating incomplete mixing and concentration of infusate around the wire in the middle of the vessel. The specially designed infusion catheter (Occam) had the best mixing properties: the coronary flow was reliably estimated over the entire range at an infusion rate of 25 ml/min.

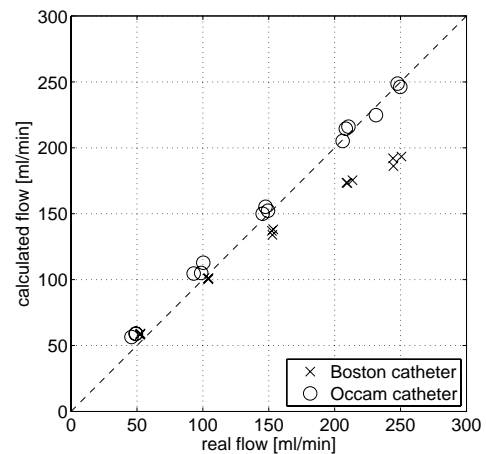


Figure 3: Coronary flow calculated from mixing temperature and infusion temperature vs. real flow. Data obtained with two different infusion catheters at an infusion rate of 25 ml/min.

Mixing was found to be better when the infusion location was near the entrance of the coronary artery, probably due to the secondary flow patterns. These patterns are expected to be present in the coronary artery as well.

## Conclusion

This model study indicates appropriate application of the continuous infusion method for coronary flow measurement, using the specially designed infusion catheter.

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