

## Index of myocardial resistance: a simple way to quantify microvascular disease invasively

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## FRACTIONAL FLOW RESERVE: CLINICAL APPLICATIONS

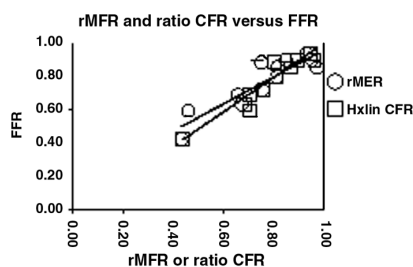
**P2224 Validation of fractional and relative coronary flow reserve measurements in patients with prior myocardial infarction**

K. Marques<sup>1</sup>, P. Knaapen<sup>1</sup>, R. Boellaard<sup>2</sup>, AA. Lammertsma<sup>2</sup>, CA. Visser<sup>1</sup>, FC. Visser<sup>1</sup>. <sup>1</sup>VU University Medical Centre, Cardiology, Amsterdam, Netherlands; <sup>2</sup>VU University Medical Centre, PET Centre, Amsterdam, Netherlands

**Background:** The accuracy of the fractional flow reserve (FFR) and coronary flow reserve (CFR) to identify significant coronary stenoses is well established in normal myocardial regions. The validity of FFR has been demonstrated with PET in non-infarcted areas. In partially infarcted regions, the mass of viable myocardium depending on the infarct related artery (IRA) is smaller and resistive vessels may be dysfunctional. The purpose of the present study was to assess whether FFR measurements are also valid in IRAs.

**Methods:** Patients with prior infarction and 1 or 2 vessel disease were studied. Relative myocardial flow reserve (rMFR), defined as the ratio of maximum perfusion in the infarcted area to the maximum perfusion in the contralateral normally perfused area during hyperemia (IV adenosine), was assessed by <sup>15</sup>O-labeled water and PET. The ratio of CFR (ratio of maximum to baseline flow) in the infarcted area to CFR of the reference region was also compared with FFR. On the same day, during catheterization FFR (ratio of mean aortic to distal coronary pressure at maximum hyperemia) was measured with a pressure wire in the IRA.

**Results:** Measurements were performed in 12 patients. Percent diameter stenosis in the IRA ranged from 27% to 83% (mean  $47 \pm 20\%$ ), FFR from 0.42 to 0.94 (mean,  $0.77 \pm 0.16$ ), rMFR from 0.43 to 0.97 (mean,  $0.76 \pm 0.18$ ) and the ratio of CFR from 0.44 to 0.97 (mean  $0.78 \pm 0.14$ ). A close correlation was found between rMFR and FFR ( $R^2 = 0.83$ ) and between the ratio of CFR and FFR ( $R^2 = 0.84$ ).



rMFR and ratio CFR versus FFR.

**Conclusion:** FFR correlates well with rMFR and the ratio of CFR derived from PET measurements in patients with a prior myocardial infarction. This validates the use of the pressure and Doppler flow wires in the assessment of coronary stenoses in IRAs.

**P2225 Real world validation of coronary thermodilution: the week 25**

E. Barbato<sup>1</sup>, W. Aarnoudse<sup>2</sup>, N H J. Pijls<sup>2</sup>, W. Aengevaeren<sup>3</sup>, G. Werner<sup>4</sup>, V. Klauss<sup>5</sup>, W. Bojara<sup>6</sup>, B. De Bruyne<sup>7</sup>. <sup>1</sup>O.L.V.-Ziekenhuis, Cardiovascular Center, Aalst, Belgium; <sup>2</sup>Catharina Ziekenhuis, Cardiology Dept., Eindhoven, Netherlands; <sup>3</sup>University Medical Center, Cardiology, Nijmegen, Netherlands; <sup>4</sup>Friedrich-Schiller-Universität, Klinik für Innere Medizin III, Jena, Germany; <sup>5</sup>University of Munich, Department of Cardiology, Munich, Germany; <sup>6</sup>Bergmannsheil Bochum University Hosp, Department of Cardiology, Bochum, Germany; <sup>7</sup>O.L.V.-Ziekenhuis, Cardiovascular Center, Aalst, Belgium

**Background:** Thermodilution-derived coronary flow reserve (CFR)thermo, the ratio between resting and hyperemic transit time (Tmn), has been recently validated in humans. However, in vivo, quite some scatter persists in the relationship between CFRthermo and Doppler-derived coronary flow reserve (CFR-Doppler). Among the factors that may account for these differences are: 1) the injection of the bolus of saline in the coronary circulation; 2) the algorithm used to calculate the Tmn; 3) high baseline flow status might affect more the CFRthermo than CFRDoppler.

**Aim:** 1) To compare CFRDoppler to CFRthermo, with a simplified injection technique and an improved algorithm in the setting of a multicentric study; 2) To assess the feasibility and timing for CFRthermo as compared to CFRDoppler.

**Methods:** Patients were recruited from the 8 participating centers during a five day period. Patients had at least one vessel stenosis to be functionally evaluated or treated percutaneously. Ostial lesions, tortuous vessels and poor Doppler tracings quality were exclusion criteria. Vessels under study were instrumented with a Doppler wire (Jomed) and a Pressure Wire 4 (Radi Medical System). Three measurements of Tmn and of the average peak velocity (APV)

were obtained at baseline and after hyperemia, as induced by IV adenosine. The ratio between the 3 baseline and 3 hyperemic Tmn values represented CFRthermo. The ratio between the 3 hyperemic and 3 baseline APV values represented CFRDoppler.

**Results:** Among the patients recruited, 31% were excluded upfront because of poor Doppler tracings, 3% were excluded because of unreliable CFRthermo. The time needed to measure CFRDoppler was  $6 \pm 2$  min, while the time needed to measure CFRthermo was  $5 \pm 1$  min. A good linear correlation ( $r=0.79$ ,  $p<0.01$ ) was observed between CFRDoppler and CFRthermo.

**Conclusion:** In a multicentric setting, closer to everyday clinical practice, a good correlation was found between CFRDoppler and CFRthermo. The higher feasibility makes CFR measured by thermodilution technique a valid alternative to CFR measured by Doppler.

**P2226 Index of myocardial resistance: a simple way to quantify microvascular disease invasively**

W. Aarnoudse<sup>1</sup>, M. Geven<sup>2</sup>, P. Van den Berg<sup>2</sup>, M. Rutten<sup>2</sup>, F. Van de Vosse<sup>2</sup>, B. De Bruyne<sup>3</sup>, W. Fearon<sup>4</sup>, N. Pijls<sup>1</sup>. <sup>1</sup>Catharina Hospital, Cardiology, Eindhoven, Netherlands; <sup>2</sup>Eindhoven University of Technology, Biomedical Engineering, Eindhoven, Netherlands; <sup>3</sup>Cardiovascular Center, Cardiology, Aalst, Belgium; <sup>4</sup>Stanford University, Cardiology, Stanford, United States of America

**Purpose:** Using a pressure-temperature sensor-tipped guidewire, distal coronary pressure (Pd) and temperature can be measured simultaneously during coronary catheterization. Using thermodilution principles after injection of 3 cc of saline into the coronary artery, mean transit time (Tmn) can be obtained and its inverse is a correlate to absolute blood flow. Therefore, an index of coronary microvascular resistance (IMR) can be defined by the product of Tmn and Pd at hyperemia.

In this in-vitro study, we compared the IMR with true myocardial resistance (Rmyo) at different degrees of myocardial resistance and in the presence of different degrees of stenosis.

**Methods:** The in-vitro model consists of a pump providing pulsatile flow and a systemic and a coronary circulation. In this model, also arterioles and the microvasculature are mimicked realistically and true myocardial resistance is calculated using electromagnetic flow measurements and can be varied over the complete physiological range. Six different levels of myocardial resistance were applied. At every level of microvascular resistance, 4 different degrees of epicardial stenosis were induced, using an external occluder. For each combination of myocardial resistance and epicardial stenosis, IMR was determined and compared to Rmyo. Simultaneously, distal coronary pressure, aortic pressure and fractional flow reserve (FFR) were measured throughout the experiment.

**Results:** A total of 24 measurements were performed. Blood flow varied from 42-203 ml/min and Rmyo varied from 0.39 to 1.63 dynes.s.cm<sup>-5</sup>. An excellent correlation between IMR and Rmyo was found ( $R^2=0.94$ ,  $p<0.0001$ ). Importantly, IMR was not dependent on the severity of any stenosis in the epicardial vessel, and thus specific for true myocardial resistance.

**Conclusion:** In this in-vitro set up, IMR correlates well with true myocardial resistance and is not dependent on the severity of the epicardial stenosis. Therefore, using one single guide wire, both FFR and microvascular resistance can be measured in an easy and simple way as indexes of epicardial and microvascular disease, respectively.