

## POSTER SESSION

## 1045 Echocardiographic Assessment of Coronary Flow Reserve

Sunday, March 17, 2002, Noon-2:00 p.m.  
Georgia World Congress Center, Hall G  
Presentation Hour: 1:00 p.m.-2:00 p.m.

1045-59

### The Optimum Hypoglycemic Therapy Can Improve Coronary Flow Velocity Reserve in Diabetic Patients: Demonstration by Transthoracic Doppler Echocardiography

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**Background:** Although hyperglycemia is known to be one of the pivotal factors for the reduction of coronary flow reserve in diabetic patients, it has not been determined whether the reduction or elimination of hyperglycemia would improve coronary microvascular dysfunction. Transthoracic Doppler echocardiography (TTDE) is a suitable method for serial assessment of coronary flow velocity reserve (CFVR). **Methods:** To explore the effect of hypoglycemic therapy on CFVR, we performed TTDE in 27 consecutive diabetic patients without a history of coronary artery disease who required admission for the treatment of their high blood glucose level. On admission, we measured coronary flow velocity (CFV) in the distal part of the left anterior descending coronary artery by TTDE at rest and during continuous infusion of adenosine triphosphate (140 mcg/kg/min). CFVR was defined as hyperemic CFV divided by CFV at rest. The same procedure was repeated after the reduction of glucose level by intensive treatment. **Results:** Adequate quality of CFV at baseline and during hyperemia was obtained in all but one patient (feasibility: 98%). Fasting blood glucose level reduced from  $229 \pm 80$  mg/dl on admission to  $119 \pm 28$  mg/dl at 17  $\pm$  10 days after the treatment. CFV at rest did not change between two measurements ( $19.9 \pm 7.3$  cm/s vs.  $18.5 \pm 4.1$  cm/s, p=ns). CFV during hyperemia increased significantly after the treatment ( $43.2 \pm 12.4$  cm/s vs.  $49.5 \pm 10.0$  cm/s, p<0.05). Thus, CFVR after the treatment ( $2.75 \pm 0.62$ ) was significantly increased compared to that on admission ( $2.25 \pm 0.44$ , p<0.01). There was significant positive correlation between the reduction of fasting blood glucose level and the change in CFVR ( $r=0.64$ , p<0.01). Even if we confined patients with retinopathy, the significant correlation was also noted ( $r=0.77$ , p<0.01). **Conclusion:** We demonstrated that the reduction of blood glucose level is accompanied by the improvement of CFVR in diabetic patients. These results suggest that optimal hypoglycemic therapy is important to improve coronary microvascular dysfunction even in patients with diabetic retinopathy.

1045-60

### Assessment of the Reduction of Coronary Flow Velocity Reserve in Patients With Diabetic Retinopathy by Transthoracic Doppler Echocardiography

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**Background:** The development of diabetic retinopathy has been associated with the reduction of coronary flow velocity reserve (CFVR), but this assessment is only applicable by the invasive approach (Doppler guidewire) or expensive method (PET). CFVR in the distal part of the left anterior descending coronary artery (LAD) can be measured by transthoracic Doppler echocardiography (TTDE). **Methods:** To clarify the relationship between CFVR and the severity of diabetic retinopathy, we measured CFVR in the distal LAD by TTDE in 37 consecutive diabetic patients without a history of coronary artery disease. Coronary flow velocity (CFV) was obtained at baseline and during hyperemia induced by continuous infusion of adenosine triphosphate (140 mcg/kg/min). CFVR was calculated as hyperemic CFV divided by baseline CFV. Patients were divided into three groups according to the degree of retinopathy assessed by ophthalmologist (NDR: no retinopathy, SDR: simple or preproliferative retinopathy, PDR: proliferative retinopathy). **Results:** Adequate quality of CFV at baseline and during hyperemia was obtained in all but one patient (feasibility: 97%). The mean value of fasting blood glucose was  $126 \pm 32$  mg/dl and glycohemoglobin A1c was  $10.0 \pm 2.2$  %. The number of patients with NDR, SDR and PDR was 19, 8 and 9, respectively. Although there was no significant difference of CFV at baseline among three groups (NDR:  $20.7 \pm 11.4$  cm/s, SDR:  $18.0 \pm 2.5$  cm/s, PDR:  $22.7 \pm 8.5$  cm/s), hyperemic CFV was significantly lower in patients with PDR ( $44.9 \pm 13.3$  cm/s) than in those with NDR ( $63.1 \pm 31.5$  cm/s, p<0.05). CFVR was significantly lower in patients with PDR ( $2.03 \pm 0.34$ ) than in patients with NDR ( $3.11 \pm 0.53$ , p<0.01) or those with SDR ( $2.67 \pm 0.55$ , p<0.05). **Conclusion:** The reduction of CFVR in diabetic patients was inversely correlated with the severity of retinopathy. These results suggest that diabetic retinopathy may be a marker of microvascular dysfunction in the coronary circulation.

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### Transthoracic Echocardiographic Measurement of Coronary Flow Reserve in the Right Coronary Artery: Comparison With Invasive Data

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**Background:** Measurement of coronary flow reserve (CFR) is an important diagnostic tool providing valuable clinical and pathophysiological information about coronary artery function. Transthoracic Doppler echocardiography (TDE) has proven to reliably assess CFR non invasively, but so far the method is limited to the left anterior descending artery. **Methods:** Introduction of a modified transthoracic two-chamber view with the transducer

rotated anticlockwise and angulated anteriorly allows visualization of the posterior Interventricular descending branch (RPD) of the right coronary artery. Images were obtained in fundamental mode at 2.5 MHz color Doppler and 2.0 MHz pulsed wave Doppler using a digital ultrasound system (Acuson Sequoia C256). Coronary flow velocities were recorded in the RPD at rest and during maximal hyperemia induced by i.v. Adenosine (0.140 mg/kg/min.). CFR was calculated by the ratio of average systolic-diastolic peak velocity during maximal hyperemia compared to baseline conditions. Coronary angiography was performed in all patients (pts) after TDE has been done. A total of 45 pts (33 men, 12 women, mean age  $56 \pm 12$ ) were investigated by TDE. In a subgroup of 20 pts TDE measurement was repeated on the same day (measurement1, measurement2) to assess reproducibility. Additionally, CFR was recorded invasively in 22 pts using Doppler Flow-wire.

**Results:** Echocardiographically, adequate Doppler signals to calculate CFR in the RPD were obtained in 33/45 (73%) pts. Non invasively derived CFR was  $2.6 \pm 0.8$  compared to  $2.8 \pm 0.9$  after invasive CFR measurement and showed good correlation ( $r=0.89$ ). Repeated measurements correlated highly (measurement1:  $2.4 \pm 0.7$ , measurement2:  $2.3 \pm 0.8$ ,  $r=0.87$ ).

**Conclusion:** These results demonstrate for the first time that non invasive CFR assessment using TDE is practicable in the RPD of the right coronary artery in about 70% of pts using a modified apical two chamber view. Results of TDE show good reproducibility and high correlation with invasive CFR recordings.

1045-62

### Noninvasive Measurements of Coronary Collateral Flow Velocity Using Transthoracic Doppler Echocardiography

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**Background:** The functional importance of the coronary collateral circulation has been established. However, in clinical lab, coronary collateral flow has been assessed by angiographic techniques, which allows only a qualitative and subjective determination of collateral channels. Transthoracic Doppler echocardiography (TTDE) is a completely noninvasive technique, which allows the direct assessment of intramyocardial coronary collateral channels in humans. We aimed to evaluate the feasibility of noninvasive measurements and phasic characterization of intramyocardial coronary collateral flow velocity by TTDE.

**Methods:** Twenty-six consecutive patients with total or subtotal (99% with delay) occlusion in the left anterior descending artery (LAD) were studied. Retrograde intramyocardial collateral flow signal runs through the ventricular septum toward the LAD were searched by high-resolution color Doppler technique with the use of high frequency transducer (ATL, HDI 5000®, 7-4MHz probe [Doppler: 4MHz]). Retrograde collateral flow velocity was recorded by pulsed Doppler technique under the guidance of color Doppler echocardiography.

**Results:** Retrograde intramyocardial collateral flow was recorded in all 26 patients by color Doppler (septal branch connected to mid-to-distal LAD in 20 patients, posterior descending artery connected to the distal LAD in 6 patients). In 22 of 26 patients, biphasic retrograde flow velocity was recorded: 18; predominantly diastolic, 4; predominantly systolic flow velocity. Mean diastolic collateral flow velocity was  $23.4 \pm 10.0$  cm/s.

**Conclusions:** TTDE is feasible for the noninvasive measurements of the coronary collateral flow velocity. This technique is the only one method for direct assessment of the intramyocardial coronary collateral channels, and this result shows the important potential for new understanding of the coronary collateral circulation in humans.

1045-63

### Noninvasive Assessment of Coronary Flow Velocity Pattern by Transthoracic Color Doppler Echocardiography Can Predict Adverse Cardiac Events in Reperfused Anterior Wall Acute Myocardial Infarction

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**Background:** Previous study has demonstrated that the no-reflow phenomenon after coronary reflow predicts adverse cardiac events after acute myocardial infarction (AMI). It has been shown that the coronary flow velocity pattern of no-reflow phenomenon is characterized by a rapid deceleration time of diastolic flow velocity (DDT) using a Doppler guidewire. On the other hand, recent advances in transthoracic color Doppler echocardiography (TTCDE) provide noninvasive coronary flow velocity measurement in the left anterior descending artery (LAD). The aim of this study was to determine whether DDT measured by TTCDE can predict adverse cardiac events in patients (pts) with reperfused anterior wall AMI.

**Methods:** The study population consisted of 50 consecutive pts with a first anterior AMI successfully treated with percutaneous coronary intervention. Using TTCDE (Logic500, GE Yokogawa Medical, 3.5-8MHz), we measured coronary flow velocity in the LAD at  $1.8 \pm 0.5$  days after the infarction. Patients were divided in two groups according to the DDT, 28pts with  $DDT > 600$ ms (Group1) and 19pts with  $DDT \leq 600$ ms (Group2). The patients were followed up for the occurrence of complications until their discharge from hospital.

**Results:** DDT measurement was possible in 47 of 50 pts (94%). Pericardial effusion, cardiac tamponade and left ventricular thrombus were observed more frequently in Group2 than in Group1 (53%(10/19) vs 18%(5/28), p<0.05; 28%(5/19) vs 4%(1/28), p<0.05; 32%(6/19) vs 7%(2/28), p<0.05, respectively). Congestive heart failure was observed more frequently in Group2 than in Group1 (53%(10/19) vs 4%(1/28), p<0.01) and Group2 pts had a longer coronary care unit stay than Group1 pts ( $9.6 \pm 5.9$  days vs  $5.0 \pm 2.8$  days, p<0.01).

**Conclusion:** DDT of coronary flow velocity measured by TTCDE can provide important prognostic information in pts with reperfused anterior wall AMI.