Doppler echocardiographic assessment of coronary artery disease: a challenge becomes reality

Please see page 51 for the article by Krzanowski et al. (doi: 10.1016/j.euje.2003.10.004) to which this editorial pertains.

The effect of a coronary stenosis on coronary flow and myocardial function is one of the essential questions the invasive cardiologist has to answer. However, in many patients this problem cannot be solved solely by morphologic examination of the coronary lumen using coronary angiography or intravascular ultrasound imaging. In most commonly encountered stenoses, those in the intermediate ranges, coronary lumenology does not provide sufficient information to support clinical decisions. It is widely accepted that the decision for coronary interventions should be based on objective evidence of ischemia provided by ergometry, myocardial scintigraphy or stress echocardiography. An alternative approach to evaluate the hemodynamic relevance of a coronary stenosis in the catheterization laboratory is the assessment of post-stenotic coronary flow velocity reserve (CFR) using Doppler flow wire. In addition to morphologic findings, this method performed after diagnostic angiography or before angioplasty provides valuable quantitative information about coronary function. Excellent correlations have been reported when myocardial perfusion imaging studies and invasive post-stenotic CFR measurements were compared for detection of coronary narrowing of hemodynamic significance. The results indicate that an impaired distal hyperemic flow velocity reserve <2.0 corresponds to reversible myocardial perfusion imaging defects with high sensitivity (82–95%), specificity (71–100%), accuracy (86–96%) and positive and negative predictive values (94–100% and 77–95%, respectively). Cardiac ultrasound technology has developed rapidly over the last decade. Modern high end echocardiographic equipment with high frequency transducers and second harmonic imaging technology, with or without the aid of ultrasound contrast agents, allows image acquisition with excellent temporal and spatial resolution. This technology allows the first time to visualize systematically coronary arteries and assess reliably coronary artery flow velocity using precordial echocardiography. As a result CFR, defined as the maximal increase in coronary blood flow above its basal level for a given perfusion pressure when coronary circulation is maximally dilated (i.e. by infusing Adenosine intravenously), can be determined in the left anterior descending coronary artery (LAD) non-invasively in >90% of patients. Additionally, the technique to image the posterior descending branch of the right coronary artery (RCA) has been described recently. The combination of coronary morphologic findings from heart catheterization and functional information provided by coronary flow velocity reserve assessment may be helpful in planning further interventional procedures of coronary artery disease or in estimating the prognosis after such treatment. Serial echocardiographic measurements of CFR can be performed to evaluate functional status of the LAD or RCA before and after coronary intervention, or of the internal mammary artery after coronary bypass grafting. Furthermore, assessment of CFR in combination with results of quantitative coronary angiography allows the detection of microvascular coronary disorders and is a useful tool for follow-up examinations of the coronary microvasculature under adequate treatment. The correlation of transthoracic Doppler echocardiographic assessment of CFR with invasive Doppler flow wire measurements is high, the feasibility for the LAD is more than 90% and for the RCA above 80%; the method accurately predicts...
the presence of significant coronary artery stenosis or restenosis. The main advantage of transthoracic echocardiographic assessment of CFR compared to invasive measurements of CFR lies in its non-invasiveness and the lack of radiation exposure. So far, clinical application of this method is limited, as this approach requires training and experience, as well as detailed knowledge of coronary anatomy and physiology.

Krzanowski et al. describe a new echocardiographic approach for the detection of restenosis after percutaneous coronary intervention (PCI). The method is based on the measurement of coronary flow velocity within the coronary stenosis and immediately proximal to the stenosis. A ratio of peak diastolic velocities of 2 or more defines a significant restenosis; if no segment of the coronary artery above the stenosed area is detected, maximal intrastenotic flow velocity is assessed and a velocity above 2 m/s is taken as a sign of stenosis. Thus, the search for colour flow aliasing along the vessel course indicating coronary flow acceleration as a sign of restenosis represents the challenge, the echocardiographer has to deal with. The results indicate that it is possible to visualize echocardiographically the site of interventional treatment in all 3 principal coronary arteries. The success rate was highest for the LAD (100%), 75% for the circumflex artery (LCX) and lowest for the RCA (43%). Moreover, a substantial number of patients (20%) had to be excluded from the study because it was not possible to visualize the vessel in which the interventional treatment was performed. Even knowing the exact PCI site by reviewing initial angiographic recordings the feasibility of this new Doppler echocardiographic assessment seems to be limited; this characterizes the main problem of this new approach for non-invasive detection of coronary artery stenosis. It is necessary to visualize long segments of the coronary artery in order to find the site of PCI, which may be very difficult in many patients. This is in contrast to CFR assessment for stenosis detection, which is performed somewhere distal to the stenosed area in a peripheral part of the vessel. Additionally, it is very likely that a “de novo” stenosis of the vessel remains undetected; to prevent this, the complete vessel course and not only the known PCI location has to be analyzed. Some more questions have to be solved before this method can be recommended for clinical use. The stenosis criteria used by the authors have to be validated with CFR values based on Doppler guide wire data, which until now represent the clinical gold standard for the functional evaluation of the hemodynamic relevance of coronary stenosis. Furthermore, one may expect that this way of Doppler echocardiographic assessment of a coronary artery will be quite time consuming; therefore, information regarding the duration of the examination in the 3 principal arteries would be of interest. So far, if a non-invasive Doppler echocardiographic approach for functional assessment of coronary artery disease is applied, the validated CFR measurement seems to be the favorable method at the moment. Nevertheless the work of Krzanowski et al. represents a valuable contribution in the field of non-invasive assessment of coronary artery disease by Doppler echocardiography.

References


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Accepted 20 November 2003