GUEST EDITORIAL

Myocardial contrast echocardiography: advantages of quantitative analysis

Please see page 41 for the article by Sieswerda et al. (doi: 10.1016/j.euje.2003.08.005) to which this editorial pertains.

Every technology yet to be consolidated needs to be compared with reference methods to evaluate its accuracy. Over the past years, contrast echocardiography has been compared against a variety of standards. In experimental studies, myocardial perfusion data from ultrasound have been compared with the measurements of coronary blood flow obtained by labeled microspheres, or with infarct size following myocardial tissue staining. In initial clinical studies, hand-made contrast agents have been injected into the coronary arteries during cardiac catheterization, and myocardial contrast enhancement has been compared with angiographic coronary patency in the acute phase of the infarction, left ventricular recovery following myocardial reperfusion, and patient's outcome. With the marketing of lung-crossing agents and the availability of technologies that make myocardial enhancement visible after intravenous contrast administration, it became natural to compare myocardial contrast echocardiography with a consolidated diagnostic tool such as SPECT.

Contrast echocardiography and SPECT differ both in physical principles and in information provided. Specifically, myocardial contrast effect depends upon ultrasound-induced resonance or destruction of microbubbles in coronary microcirculation; thus, a regional contrast enhancement implies microvascular patency. Conversely, tracer uptake by SPECT requires the functional integrity of cell’s membrane in addition to a patent microcirculation. Still, myocardial contrast echocardiography has been compared with SPECT as this method is the most widely available for the study of myocardial perfusion in patients.

In previous studies the agreement between myocardial contrast echocardiography and SPECT varied from an almost perfect concordance\(^1,2\) to a good\(^3\text{-}^9\), or limited correlation.\(^10\) Furthermore, performing a myocardial echo contrast study can present practical difficulties in setting up the optimal gain controls, holding the probe in a fixed position for several seconds, changing the triggering intervals during the examination and simultaneously administering the contrast agent. In addition, the analysis of contrast echo images is subjective and requires an adequate expertise to differentiate the true information from the artifacts. Because of the above considerations and of its variability in results, new adopters can become skeptical on myocardial contrast echocardiography. In the study by Sieswerda et al.,\(^11\) myocardial contrast enhancement was analyzed by an operator-independent quantitative method. These authors found a linear correlation between myocardial peak videointensity obtained by contrast echo and myocardial count rate obtained by SPECT. The validity of this correlation was not biased by the investigating center, the echocardiographic view, or the coronary perfusion territory.

The good results obtained by Sieswerda et al. derive from a variety of factors, mainly related to the good quality of the protocol and to the accuracy of data collection and analysis. First of all the study was performed in two centers with deep experience in echocardiography and in ultrasound contrast agents. Patient inclusion criteria were strict, reflecting the current indications to primary PTCA. The reperfusion strategy was homogeneous and all patients received a stent implantation. Furthermore, the time window for
myocardial perfusion study was narrow (12–24 h after hospital admission), well beyond post-reperfusion coronary reactive hyperemia. In addition, the gain setting controls were defined in the protocol and were similar in different patients. Finally, the echocardiographic images were analyzed quantitatively, after manual correction of translation and rotation which frequently occur during data acquisition.

Further accuracy of the ultrasound method could be obtained with the aid of more modern technologies. As a matter of fact, Sieswerda et al. stored contrast echo images on Super VHS videotapes and digitized them off-line, a method which significantly degrades image content, which does not occur with on-line digital recording. Additionally, the contrast agent was bolus injected and myocardial perfusion was analyzed at peak contrast enhancement when saturation or attenuation artifacts most frequently occur; this limit could be overcome by contrast infusion in which the contrast dose can be more easily optimized. Finally, the use of different triggering intervals would allow to separate the information on coronary blood flow and volume, which can only be speculated upon when using a fixed one-beat triggering.

One limitation of myocardial contrast echocardiography emerging from this as well as from other studies relates to its feasibility in the clinical setting. In the study by Sieswerda et al., up to 18% of the segments were excluded from the analysis. In a recent multicenter study, in which the contrast agent was intravenously infused at different triggering intervals, 15% of the patients were excluded from the analysis and an additional 15% provided non-diagnostic data. Thus, even in centers with proven expertise and with the latest technologies, myocardial contrast echocardiography is not able to provide clinically useful information for a significant proportion of patients. This is due to some yet unsolved limitations of this technique, including contrast-induced attenuation, saturation, motion artifacts, heterogeneous beam energy and significant beat-to-beat and within-beat variability.

A further comment is needed on the clinical implications of the information provided by myocardial contrast enhancement. Intracoronary contrast injections have demonstrated that post-infarct perfusion defects predict a poor recovery of left ventricular function, a worst clinical outcome, and even an increased mortality rate. However, few data are available on the clinical impact of intravenous contrast echocardiography. Thus, although the study by Sieswerda et al. further substantiates the use of myocardial contrast echocardiography as a tool for the non-invasive evaluation of myocardial perfusion, more studies are needed to elucidate how intravenous myocardial contrast enhancement impacts patient’s outcome and thus medical decision making.

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References


Daniele Rovai  
**CNR Clinical Physiology Institute**  
**San Cataldo Research Area, Via Moruzzi 1**  
56124 Pisa, Italy

E-mail address: drovai@ifc.cnr.it

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