

Clinical Applications of Contrast Echocardiography

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One of the most recent revolutions of echocardiography has been the introduction of intravenous contrast agents for the optimization of echocardiographic imaging. This has proven to be of tremendous value, over and above the parallel improvement of equipment manufactured and new transducers capable of transmitting and receiving ultrasound at different frequencies. There are now clear recommendations by the American Society of Echocardiography jointly with the Europeans that regular use of intravenous contrast agents in echocardiography benefits image interpretation at rest and perhaps even more, during stress [1,2].

The symposium held during the Euroecho 8 congress in Athens, December 2004 on "Clinical value and perspectives of Contrast Echocardiography" gives us the opportunity to highlight the most important clinical implementations but also research opportunities ready to be implemented in clinical echocardiography today.

There are now a number of second generation echo-contrast agents that have been in the market for several years all over the world and there are more to come very soon in the market, demonstrating the benefit of those agents. In the United States, Optison and Definity are routinely used to improve image quality. In Europe, Optison and Sonovue are used for the same indications. Several hundreds of thousands of patients have received echo-contrast to date and compared to other contrast agents used in imaging, echo contrast agents are the safest [3]. During that symposium, experts from all-over Europe presented their experience in considering current but also some future applications of contrast echocardiography. These new possibilities are clearly illustrated in the articles of this supplement from which some important remarks can be drawn.

Image quality is crucial to formulate a diagnosis. Even experts can produce poor images and need to use contrast to improve quality. This is particularly important when other non-experts in echocardiography are looking at the pictures in order to make a clinical decision and if image quality is not convincing, then they will turn into alternative imaging modalities that may produce a better picture. One good picture is worth a thousand words!

Using contrast echocardiography and thus improving endocardial delineation of the left ventricle, allows for a better and more reproducible assessment of left ventricular ejection fraction in such a way that is comparable to cardiac magnetic resonance imaging (CMR) with only a fraction of its cost. This has been elegantly demonstrated by Hoffmann et al who used Sonovue in 120 patients from several centers in order to determine the agreement of unenhanced and contrast-enhanced echocardiography against biplane cine-ventriculography and CMR [4]. They convincingly showed that contrast-enhanced echocardiography significantly improves inter-observer variability for the assessment of ejection fraction to a level obtained by CMR, while cine-ventriculography exhibits a large inter-observer variability [4]. Furthermore, assessing re-

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gional ventricular function is crucial when assessing coronary artery disease patients. In this symposium, Dr Roxy Senior outlined the benefits of using contrast in such patients, both at rest and during stress, as derived from several single- and multi-center trials [2,5].

Perhaps the Holy Grail of contrast echocardiography is the detection of myocardial perfusion. Although this does not constitute a clinical indication for use of contrast at present, several laboratories use intravenous contrast agents in echocardiography for the assessment of myocardial opacification, over and above the better endocardial definition. In this way, one can obtain improved image quality but also indication on myocardial perfusion simultaneously. There is now a wealth of data derived from several studies demonstrating similar information being obtained from myocardial contrast echocardiography (MCE) and single photon emission computed tomography (SPECT) imaging [6-10] in terms of myocardial perfusion in a qualitative way. It is important however for any imaging modality to be able to quantify the information, which gives more objective and less operator-dependent information. Intravenous injection of microbubbles for MCE allows measurements of myocardial blood volumes and myocardial blood velocities. Interestingly, the product of myocardial blood volume and velocity provides a measure for myocardial blood flow [11-13], which can now be quantified and ultimately provide an alternative to positron emission tomography (PET) at a fraction of its cost. Unfortunately, what many centers currently use for assessing myocardial perfusion of the heart is SPECT, which of course only provides relative assessment of myocardial blood volumes between segments, thus lacking the measurement of myocardial perfusion. New methods of quantitation of myocardial perfusion have been detailed by Dr Luciano Agati during this symposium on contrast echocardiography. The qualitative and quantitative assessment of myocardial perfusion could thus provide additional and important information on patient outcomes.

Contrast echocardiography is a safe procedure [14]. Echo contrast agents have an excellent safety profile compared to all the other contrast agents used for X-ray, radioactive materials used in nuclear medicine, computed tomography or magnetic resonance imaging as they have the least side effects [3]. However, all contrast agents may induce allergic reactions, which physicians have to be prepared for and patients should therefore be under medical supervision after contrast injection.

TAKE HOME MESSAGES:

- Contrast echocardiography is commercially available and it is here to stay. Primary indication is to optimize assessment of left ventricular function at rest and during stress. It is alleged that some 20% of patients undergoing stress echocardiography have sub-optimal endocardial defini-

tion. All those patients ought to have contrast!

- Numerous research studies have demonstrated that intravenous contrast injection may opacify the myocardium, thus providing unique information on myocardial perfusion. Although no specific clinical indication for perfusion currently exists, this concomitant information may be of great additional value during stress.
- Finally, on the safety issue; transvenous administration of contrast agents for echocardiography is safe, certainly safer than many of the contrast agents used in radiology. All contrast agents may produce allergic reactions and echo contrast agents may do the same.

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