

Hand and brain coordination: new challenges for interventional cardiology and echocardiography

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The past: limited interaction and cooperation

There was a time when interventional cardiologists almost believed they were self-sufficient in their work, not requiring much input from other cardiology specialists, especially “non-invasive” cardiologists, the ones without access to their elected world of catheters, balloons and stents. Echocardiography replaced invasive haemodynamics in the assessment of patients with valve disease^{1,2}, but nobody questioned the divine right of the interventionalist to dilate and stent whatever artery with a visually determined “significant” stenosis came to their attention. Certainly an echo scanner was available in the cathlab, but its use was limited to rule out pericardial effusions when a patient suddenly dropped his pressure and to monitor relatively rare procedures such as septal alcoholisation of hypertrophic obstructive cardiomyopathy³.

New procedures demand integration of work

Everything has changed in a very few years. We examined, in a previous President's page, the growing importance of multislice computed tomography (MSCT) for interventionalists⁴. Echocardiography poses no challenge in terms of direct visualisation of the coronary tree, but there are a growing number of clinical conditions where echocardiography has become a necessary and complementary tool. The only positive result for angioplasty in the COURAGE trial came from the evidence that patients with large reversible perfusion deficits with nuclear scans had a mortality benefit from angioplasty⁵. Stress echocardiography, shown to have similar predictive value to nuclear perfusion, has become a popular alternative, avoiding double radiation exposure, to establish whether patients with stable angina or suspected silent ischaemia need coronary angiography and angioplasty⁶. The big change in attitude towards echocardiography, however, came from the sudden interest in aortic stenosis and mitral insufficiency

created by the introduction of effective catheter mounted aortic valves and the MitralClip.

The need for (re-)training in echocardiography

Grey-haired interventional cardiologists such as myself had to regret not having followed the development of new indices to quantify an elusive entity such as mitral regurgitation, and we are now confronted daily with the traps posed by establishing the severity of aortic valve stenosis in octogenarians, with poor echographic windows, massive calcification of the degenerated aortic leaflets and depressed left ventricular function. Interventional cardiologists have started to realise that the haemodynamics in valve disease patients is critically dependent on changes in cardiac output and pre/afterload and to appreciate the advantage echocardiography offers with the unique ability to perform serial studies and assess patients during exercise⁷. If the basics of transthoracic echocardiography has remained familiar to most interventionalists as part of their clinical routine outside the catheterisation laboratory, the more limited indications of transoesophageal echocardiography (TOE) have reduced the interest of interventionalists to maintain or develop skills to acquire and interpret it. TOE is much more than the gold standard for the assessment of left atrial thrombosis and aortic dissection, images familiar to all cardiologists. The reluctance to use general anaesthesia during percutaneous procedures has limited the use of TOE for intraprocedural guidance, used almost only for visualisation of the interatrial septum in centres practising ASD/PFO closure or left atrial appendage exclusion. The masters in the utilisation of TOE for procedural guidance, especially for mitral valve repair, have become the cardiac surgeons, who can correlate direct surgical observation with intra-operative TOE, performed by skilled, dedicated echocardiographers with cardiology or anaesthesiology backgrounds.

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Specific needs during transcatheter valve implantation (TAVI)

Everything has changed now that TAVI has come of age. Currently TOE is the gold standard for assessment of the aortic annulus diameter⁸, an essential information for the selection of the size of valve to implant, but both magnetic resonance and MSCT have a role and probably offer greater precision in assessing non-circular geometries⁹. The absolute need of having TOE available during the TAVI procedure is debatable, and we may envision that, with smaller sheaths available and fewer patients requiring surgical access, general anaesthesia may become unnecessary in many patients, eliminating the opportunity to use TOE for periprocedural guidance. Certainly, when this happens, many of us will regret the ability offered by TOE to immediately detect the development and location of acute aortic insufficiency without repeat contrast injections and the continuous monitoring of left ventricular function, pericardial effusion or aortic damage¹⁰. Conversely, I do not see in the foreseeable future techniques which can replace TOE for the guidance of MitralClip implantation, and for the other devices for transcatheter mitral valve repair which are under clinical evaluation or development. During MitralClip implantation, continuous TOE monitoring addresses the need of a high posterior puncture, with a small tolerance in the distance between puncture site and mitral annulus, guides safe steering of the delivery catheter towards the valve without engaging the left atrial appendage, displays the fine details of the morphology of the leaflets and position of the jet, controls the alignment with the leaflets before deployment and confirms that both leaflets have been grabbed after clip closure and that insufficiency has been adequately reduced and no significant stenosis has developed.

In the last decade echocardiography went through a rapid pace of technological developments, unthinkable at the time most of us train in this technique. TOE three-dimensional echocardiography now presents real time three-dimensional images, which are easier to be interpreted by the non-echocardiography specialist. I remember when I was watching with scepticism the first images of three-dimensional prototypes developed at the Thoraxcentre of Rotterdam through the cooperation of Jos Roelandt and Nicolaas Bom. The vision of these pioneers has now come to fruition. In a recent course I attended for MitralClip implantation, I was surprised to see that the vast majority of the centres active in the field were already routinely using three-dimensional TOE for procedural guidance. A close coordination between TOE operator and interventionalist is essential to improve results and avoid complications. This obviously requires that the interventionalist has a sufficient knowledge in echocardiography, including TOE, and that the echocardiographer is able to react quickly to the requests of the operator, providing the best possible information to guide the procedure. Therefore both interventionalists and echocardiographers must train (or re-train) and learn to work together.

New challenges for the echocardiographer

In view of this, training in echocardiography is requiring a new scope and viewpoint, in which the echocardiographer must get used to the cathlab environment – as well as to the specific needs of the interventionalist – when guiding procedures such as percutaneous aortic valve or MitralClip implantation. Besides the fast pace of the cathlab, it is useful to remember fluoroscopic views, in order to take advan-

tage of all imaging methods available within the cathlab during the procedure. Particularly, when performing TAVI in the presence of highly calcified aortic valves, the fluoroscopic image might be a valuable orientation for the echocardiographer. Additionally, there is the duty of appropriate patient selection, mainly based on echocardiography, when clinical criteria are achieved¹¹. The assessment of the aortic annulus diameter by TOE predicts the size of the prosthesis, irrespective of the type of valve inserted, and the appropriate valve diameter will contribute to effective treatment avoiding complications¹². Moreover, there is a need for redefining new criteria that will enable a better classification of the interventional results. The presence and severity of acute aortic regurgitation after TAVI, or mitral regurgitation after mitral clip implantation, are clear examples of this. In an attempt to rethink the echocardiography criteria in this type of new procedures, the European Association of Echocardiography (EAE) and the American Society of Echocardiography are now preparing joint guidelines on this topic. Specific definitions have also been proposed by the Valvular Academic Research Consortium or VARC (Serruys PW, “Yes we can!” Friday 28th May, 2010, EuroPCR 2010, <http://www.pconline.com/Lectures/2010/Yes-we-can>).

We have reached an era where the echocardiographer no longer works alone, and besides the traditional diagnostic work-up, now plays an essential role in guiding treatment. Echocardiography still remains largely operator-dependent and a detailed knowledge of cardiovascular anatomy and pathophysiology, together with appropriate technical skills, is required. Recent recommendations of the ESC have highlighted the fact that this knowledge and skill can only be gained through supervised education and training in an appropriate environment. An advanced level of training is required and, ideally, a well organised program should be followed¹³. Training in echocardiography already extends beyond non-invasive cardiologists. Many cardiovascular anaesthesiologists also perform intra-operative TOE studies, so that the need of this group must be considered in the training program. The EAE should probably now address the need of the interventional cardiologists, less interested in handling the probe for acquisition but in need of a comprehensive knowledge for image interpretation. Consensus on training modalities and procedural guidelines to guide these interventions play an essential role for insuring the high standards in performing echocardiography. Certification of training is also important to ensure quality and achieve high uniform standards throughout Europe. The EAE has already established a platform of training certification in TOE. This implies both passing a written exam and showing expertise in TOE procedures, for instance, in a logbook (<http://www.escardio.org/communities/EAE/accreditation/TEE/Pages/aims.aspx>). A more sophisticated web-platform is under development at the Heart House to reflect the need of more stringent direct evaluation of procedural skills, with review of echo examinations done by external supervisors, and more detailed documentation of type and number of procedures, as well as attendance of formal teaching courses or documentation of e-learning via textbooks like the recently published ESC Textbook of Cardiovascular Imaging, journals or other educational platforms available on the web. Since a similar web-platform will be used by all Associations, this should more easily meet the needs of Fellows keen to be trained in both techniques.

Rethinking the work model: from sole decision maker to coordinator of various specialists

Interventional cardiologists used to work in their cathlabs as if they were in an ivory tower, keeping at bay new developments in other fields of cardiology, from pharmacology to non-invasive imaging. The last years have seen a complete change of direction, with more and more specialists integrated in the work of the cathlab. Five years ago we laughed at crowded operating theatres where large teams would be busy for hours fixing a patient – during which time a single operator in the cathlab could already have performed 10 angioplasties. Now the situation is completely different, and busy cathlabs shared by the anaesthetic team, consultant cardiac surgeons, interventional cardiologists and specialists in cardiac imaging are commonplace in centres where transcatheter valves are implanted. It is counter-intuitive for somebody used to rely on angiography for all stages of a procedure to realise that during MitralClip implantation the role of fluoroscopy is almost nil¹⁴. Instead of pushing a control handle and rotating the angio tube as desired, we must learn patience – a virtue very rare among interventionalists – and wait for the echocardiographer to adjust the transoesophageal probe according to our needs. We must learn a common language, less familiar to some of us, and ask for a bi-caval, two-chamber or an outflow tract view instead of a right anterior oblique or left caudal view¹⁴.

New skills and knowledge are now required for the growing range of procedures falling into the realm of interventional cardiology, but the most important change must be in the mentality of interventionalists. Rather than being the absolute ruler of a small kingdom, the interventionalist is now a constitutional monarch who shares responsibility for the patient's care and discusses every step of the procedure with the Heart team. It is time to get out of the ivory tower, appreciate that other subspecialties in cardiology have progressed to the same extent or more than interventional cardiology and join forces for the patient's benefit.

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