

EACVI-ASE-industry initiative to standardize deformation imaging: a brief update from the co-chairs

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Echocardiographic quantitation of myocardial deformation has been one of the most significant developments in our field over the last decade, with important applications in basic myocardial mechanics, ischaemic heart disease, cardiomyopathies, valvular heart disease, diastolic function, and in detecting pre-clinical myocardial dysfunction such as in cardiotoxicity in cancer chemotherapy and valvular regurgitation. Unfortunately, several investigators have documented a relatively poor reproducibility when strain is calculated using echocardiographic equipment from different vendors, an issue that threatens widespread clinical application of this important new technology.

Recognizing the critical need for standardization in strain imaging, in 2010, the leaders of the European Association of Echocardiography (now the European Association of Cardiovascular Imaging, EACVI), and the American Society of Echocardiography (ASE) invited technical representatives from all interested vendors to participate in a concerted effort to reduce intervendor variability of strain measurement. Table 1 lists the society and vendor representatives on this committee, which met for the first time at EuroEcho in Copenhagen in December, 2010. This brief report will provide an update on the activities of the committee.

Initial scope and approach

While there is a plethora of parameters that can be derived from myocardial deformation imaging, it was felt that the committee's work would have to be focused initially on global longitudinal strain (GLS) derived from 2D echocardiographic speckle tracking, with which there is the most clinical experience. While recognizing the importance of circumferential, radial, and torsional strain components as well as regional strain, systolic and diastolic strain rate, and deformation indices derived from tissue Doppler and 3D echo, addressing these issues will await success in GLS standardization.

To test intervendor agreement, the committee needed standard data sets against which GLS comparisons could be made. A range of such data sets was needed to reflect a balance between 'ground truth' in known strain values and the 'real world' nature of the images.

Table 1 EACVI-ASE-industry initiative to standardize deformation imaging

Founding societies
European Association of Cardiovascular Imaging—Luigi P. Badano, MD, co-chair
American Society of Echocardiography—James D. Thomas, MD, co-chair
Supporting societies
Japanese Society of Echocardiography
Korean Society of Echocardiography
Industrial partners (hardware)
Esaote
GE Healthcare
Hitachi Aloka Medical, Ltd.
Philips Healthcare
Samsung Medison
SIEMENS Medical Solutions
Toshiba Medical Systems
Industrial partners (software)
Epsilon Imaging
TomTec Imaging Systems
Members (clinical)
Theodore Abraham, MD
Gerard Aurigemma, MD
Bart Bijnens, PhD
Jan D'hooge, MSc, PhD
Thor Edvardsen, MD, PhD
Alan Fraser, BSc, MB ChB
Theodore Kolias, MD
Jun Kwan, MD
Thomas Marwick, MBBS, PhD
Satoshi Nakatani, MD, PhD
Gianni Pedrizzetti, PhD
David Sahn, MD
Partho Sengupta, MBBS, MD, DM
Joon-Han Shin, MD
Masaaki Takeuchi, MD, PhD
Jens-Uwe Voigt, MD, PhD

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Synthetic data sets

On the extreme of perfectly defined strain in a non-realistic setting are synthetic ultrasound images simulated from mathematically modelled ventricles. Jan D'hooge and colleagues from the University of Leuven have generated cine loops mimicking normal, hypertrophied, and dysfunctional ventricles, providing them to the vendors in the spring of 2012. The data sets were analysed by each of the vendors and the results provided to the committee in a vendor-blinded fashion in June, 2012 at the ASE Scientific Sessions in Washington, DC. It was clear that some of the intervender variability resulted from variations in exactly what was being measured and reported (e.g. subendocardial vs. transmural strain). After refining the GLS definition and the regions of interest being analysed, a new set of images were provided in the fall of 2012 with results presented at EuroEcho 2012 in Athens. It was clear that reproducibility was improved in comparison with the earlier trial. A full report of this work is under preparation.

Patient data

At the other extreme, with maximal reality in acquisition but no absolute reference standard for strain, are images acquired in the clinical setting. To address this situation, Jens-Uwe Voigt and colleagues in Leuven organized a clinical scanning trial in April, 2013. In an amazing feat of tenacity, they managed over 5 days to have 62 patients and volunteers with a wide range of LV function imaged on seven different acquisition instruments and additionally analysed on two programmes from software-only vendors. Full analysis of these data for GLS is on-going and results are expected to be presented at EuroEcho 2013 in Istanbul. This study will provide a rich data set for standardization efforts involving other strain parameters.

Relationship to DICOM

From the beginning, the strain standardization committee has maintained a liaison with (Digital Imaging and Communications in Medicine) DICOM Working Group (WG) 12, responsible for codifying exchange of ultrasound images and data. Early on there were discussions about developing a standardized exchange format based on individual ultrasound scan lines, used by some vendors in their strain analysis, rather than the more typical Cartesian grid currently used. However, such modality-unique formats are discouraged by the parent DICOM committee, and consideration of this has been shelved. There is more enthusiasm, however, for developing a dictionary of standardized terms, which could be used in structured reporting to pass parameters from the echo machine into the generated report. Our committee stands ready to assist WG-12 (and WG-8, which is responsible for setting the general principles in structured reporting) whenever it is appropriate to add advanced myocardial mechanics indices to the ultrasound structured reporting standard.

Industry collaboration

The experience of the committee thus far has demonstrated the potential for co-operation among vendors and the echo societies. Within the confines of our roughly biannual meetings, there has been a great deal of productive technical discussion converging on a consensus document drafted and agreed to by our industry partners. The strong spirit of collaboration demonstrated in this process encourages us to press forward in this and other areas where echocardiographic standardization is needed.