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## Diastolic function and its non-invasive assessment. The quest for the Holy Grail continues

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The assessment of left ventricular diastolic function is key for the diagnosis of heart failure with preserved ejection fraction (HFpEF) yet it is still limited by practical difficulties and inaccuracies. Therefore, the search of new methods to improve this assessment is ongoing.

Kertsens et al (1) sought to explore a very promising tool. They have compared left ventricular strain-volume loop (SVL) characteristics and diastolic dysfunction (DD) in patients with suspected HFpEF. Patients with good quality images and strain and volume analysis, were classified according to the current diastolic function recommendations (2) in two groups: DD (n=91) and control (n=65). SVL analysis showed a different longitudinal strain contribution to volume change in DD compared to controls, i.e. 'uncoupling of the SVL', which was independently associated with DD.

This approach has already been looked at and discussed(3-5). There are other new innovative approaches with other limitations that are under investigation. In a pig model, it has been demonstrated that shear wave speed after mitral valve closure was influenced by both acute changes in loading but also myocardial mechanical properties. It might be a window for reflecting changes in operating myocardial stiffness(6).

Firstly, the authors have to be congratulated. They are pursuing on testing the practical use of strain-volume loops(7). Hubert et al have opened the field for an automatization of this analysis(3). It has been nicely challenged in an editorial,(4) but of course, it is important in such an endeavour to hold the helm even if the results are not perfect.

383 patients were screened but only 156 were finally included in the statistical analysis. The feasibility has been an issue. Patients who were not in sinus rhythm were excluded, and so were patients whose diastolic function was classified as indeterminate by the current recommendations. These two categories include a significant number of patients for whom we still need a better solution. Left atrial reservoir strain seems a promising tool to solve part of the issues we still have in “estimating” diastolic function and filling pressures(8, 9).

Some may argue that instead of looking for newer parameters, cardiologists should look more carefully at conventional ones, such as pulmonary vein flow signals, or response of mitral flow to a standardized Valsalva maneuver. This may be true in selected cases with feasible signals but will not work in others. The method used in the current study (1) has improved since the publication of the first reports, is more automated and could become more robust, averaged over several cardiac cycles and perhaps also including 3D-echocardiography for volume measurements(5). Already now, only the strain traces have to be checked by physicians (the human factor) and then all data are extracted from the industrial software and treated by an automated algorithm.

We previously found a difference between patients with DD and controls but this could be attributed to a difference in stroke volume between the two groups(3). Interestingly, Kertsens et al (1) demonstrated, on top of our previous work, that a real difference between SVL of patients with DD and controls exists even after normalizing for stroke volume. The underlying potential of the method exists and it has to be further tuned to further improve.

Conversely to the “classical” parameters advocated by the ASE/EACVI recommendations(2), SVL is an automated tool which could be easily integrated in machine learning algorithms to improve the capability of echocardiography to diagnose DD computing automated quantification of multiple parameters. The SVL will not solve every issue on their own but could be part of the solution. Our team has already proposed methods that have demonstrated value in predicting the result of a cardiac resynchronization system implantation just by looking automatically at the amount of information that strain curves provide about cardiac mechanics(10, 11).

The present work is a step forward but unresolved issues remain(1). Explaining the difference in uncoupling between DD patients and controls will require further studies. Validation in animal experiments and/or clinical studies with invasive measurements of diastolic function properties will be needed. Also, the incremental value of this method over the existing ones will have to be tested prospectively in large cohorts looking at the impact of treatments and at the outcome.

It is an interesting study but it is still “work in progress” and it is too early to consider this approach for a change in the paradigm of the recommendations on left ventricular diastolic function assessment(8, 12).

Conflict of interest

There are no commercial products involved in this editorial.

None of the authors have any conflict of interest related to this work

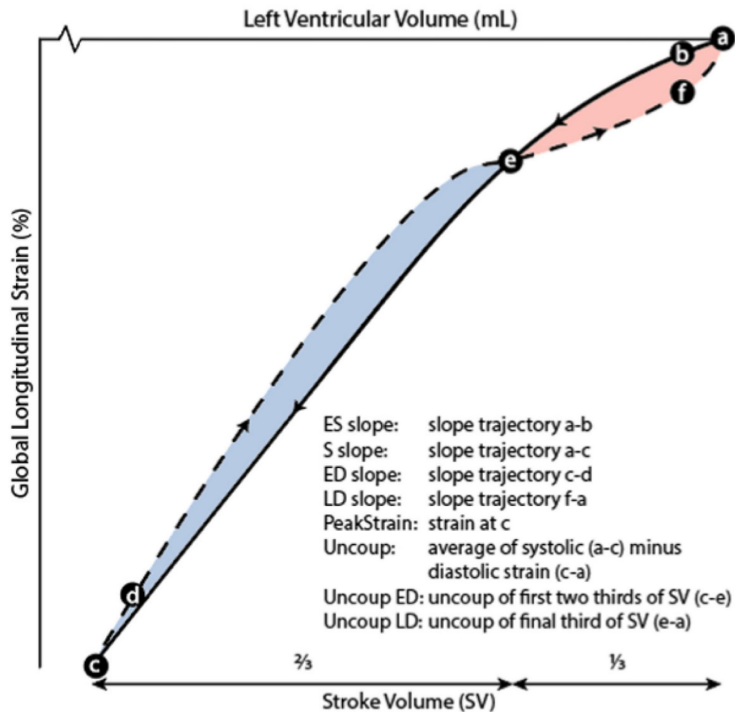
Reference

1. Kerstens TP WJ, Arie PJ van Dijk APJ, Gert Weijers, Knackstedt C, Eijsvogels TMH, Oxborough D, van Empel VPM, Thijssen DHJ. Left Ventricular Strain-Volume Loops and Diastolic Dysfunction in Suspected Heart Failure with Preserved Ejection Fraction. *Int J Cardiol.* 2023;in press.
2. Nagueh SF, Smiseth OA, Appleton CP, Byrd BF, 3rd, Dokainish H, Edvardsen T, et al. Recommendations for the Evaluation of Left Ventricular Diastolic Function by

Echocardiography: An Update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. *Eur Heart J Cardiovasc Imaging*. 2016;17(12):1321-60.

3. Hubert A, Le Rolle V, Galli E, Bidaut A, Hernandez A, Donal E. New expectations for diastolic function assessment in transthoracic echocardiography based on a semi-automated computing of strain-volume loops. *Eur Heart J Cardiovasc Imaging*. 2020;21(12):1366-71.
4. Pagourelis ED, Mirea O, Duchenne J. Diastolic function assessment based on a semi-automated computing of strain-volume loops. *Eur Heart J Cardiovasc Imaging*. 2021;22(5):597-8.
5. Donal E, Taconne M, Hubert A, Le Rolle V. The future of the diastolic function assessment will take advantage of the past and of the automatization. *Eur Heart J Cardiovasc Imaging*. 2021;22(5):599-600.
6. Bezy S, Duchenne J, Orłowska M, Caenen A, Amoni M, Ingelaere S, et al. Impact of Loading and Myocardial Mechanical Properties on Natural Shear Waves: Comparison to Pressure-Volume Loops. *JACC Cardiovasc Imaging*. 2022;15(12):2023-34.
7. Hulshof HG, van Dijk AP, George KP, Hopman MTE, Thijssen DHJ, Oxborough DL. Exploratory assessment of left ventricular strain-volume loops in severe aortic valve diseases. *J Physiol*. 2017;595(12):3961-71.
8. Popescu BA, Beladan CC, Nagueh SF, Smiseth OA. How to assess left ventricular filling pressures by echocardiography in clinical practice. *Eur Heart J Cardiovasc Imaging*. 2022;23(9):1127-9.
9. Smiseth OA, Morris DA, Cardim N, Cikes M, Delgado V, Donal E, et al. Multimodality imaging in patients with heart failure and preserved ejection fraction: an expert consensus document of the European Association of Cardiovascular Imaging. *Eur Heart J Cardiovasc Imaging*. 2022;23(2):e34-e61.
10. Gallard A, Bidaut A, Hubert A, Sade E, Marechaux S, Sitges M, et al. Characterization of Responder Profiles for Cardiac Resynchronization Therapy through Unsupervised Clustering of Clinical and Strain Data. *J Am Soc Echocardiogr*. 2021;34(5):483-93.
11. Gallard A, Galli E, Hubert A, Bidaut A, Le Rolle V, Smiseth O, et al. Echocardiographic view and feature selection for the estimation of the response to CRT. *PLoS One*. 2021;16(6):e0252857.
12. Smiseth OA, Morris DA, Cardim N, Cikes M, Delgado V, Donal E, et al. Multimodality imaging in patients with heart failure and preserved ejection fraction: an expert consensus document of the European Association of Cardiovascular Imaging. *Eur Heart J Cardiovasc Imaging*. 2021.

Figure 1 : summary figure of the strain volume loop that could be automatically calculated after the speckle tracking recording exportation from the commercially available software.



Automatic extraction of left ventricular volumes and longitudinal deformation data



Combination of parameters (automatically extracted and robust) for BEST assessment of diastolic function in each individual

Figure 1