

Unfolding the secrets of the right ventricle in three dimensions: the tale of a custom echocardiographic method

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We thank Drs Lancellotti and Go for their observations and comments¹ on our recently published study,² in which we characterized the longitudinal and non-longitudinal components of right ventricular (RV) contraction in a large group of healthy subjects from the World Alliance of Societies of Echocardiography (WASE) study.

Three-dimensional (3D) imaging has revolutionized echocardiography, but its impact is rarely as apparent as its implementation for the assessment of the right heart. 3D-derived echocardiographic parameters of RV dysfunction provide greater diagnostic and prognostic value while overcoming conventional metrics' weaknesses.³ Using the WASE cohort, we uncovered age-, sex-, and race-related differences in healthy hearts' RV contraction patterns.² However, as perfectly pointed out by the authors, the wider adoption of 3D echocardiography faces two important barriers worth further discussion.

The first barrier is at the image acquisition level. The EACVI online survey published in 2022 indeed reported that only 17% of the participating centres measure RV volumes and ejection fraction by 3D echocardiography while also highlighting that about 50% of the ultrasound machines are equipped with 3D transthoracic transducers. Projections suggest that about 95% of the machines will be 3D in 2030. Yet, in current studies, RV morphological and functional assessment is still highly qualitative, pointing towards a knowledge gap regarding the importance of comprehensive RV quantification while emphasizing conventional measures' shortcomings. If 3D is available and we want to use it, some hurdles still hinder 3D analysis. In the WASE study, about 50% of acquired 3D images were unsuitable for further analysis due to inadequate anterior RV wall visualization, low temporal resolution, and/or artefacts due to multi-beat acquisition. Advancements in transducer technology will solve many of these issues, while modern software solutions aid in accurate RV evaluation, even in cases with suboptimal echo windows. Experienced centres report the feasibility of 3D RV ejection fraction measurement that varies between 81 and 98%, along with a good interobserver agreement.³ Notably, everyday clinical use of 3D and deformation analyses can result in even shorter analysis times compared to conventional two-dimensional readings, contrary to the common belief about their time-consuming nature. Thus, a systematic education on state-of-the-art RV imaging can mainly overcome the first barrier.

The second barrier is the availability of advanced software solutions, like the ReVISION used in our current study. ReVISION started as a custom method developed by clinicians to address some scientific questions. Over the years, several publications justified its added value in specific clinical scenarios; however, the lessons learned from these studies are influential to everyday clinical practice as well: they contribute towards a better understanding of (patho)physiological concepts that may or may not be reflected using conventional parameters.⁴ For example, while the assessment of RV radial (transverse) free-wall shortening has been targeted previously, no focused, comprehensive solution was available for the evaluation. Anteroposterior RV shortening as a reflection of ventricular interdependence, however, is a rather new idea. We are enthusiastic about seeing the adoption of these concepts in everyday practice, scientific meetings, society scientific statements,⁵ and hopefully, in the future, in guideline recommendations.

Currently, ReVISION is a validated, FDA-cleared, commercially available software medical device for a comprehensive assessment of global and segmental RV function. The technical details may be reproduced or even improved, but ReVISION is now known and used worldwide thanks to those investigators who recognized its potential and made huge efforts to validate it clinically. Beyond its scientific value, however, we were able to show its commercial value. Maybe that entire development lifecycle was a prerequisite for opening the doors to the ultrasound machine and analysis platform vendors about integration and/or distribution to truly democratize access and share the related knowledge about the amazing and momentous RV function.

Conflict of interest: A.K. serves as Chief Medical Officer of Argus Cognitive, Inc., and receives financial compensation for his work. A.F. reports personal fees from Argus Cognitive, Inc. All other authors report no competing interests that are directly or indirectly related to the work submitted for publication.

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Data availability

No new data were generated or analysed in support of this research.

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References

1. Lancellotti P, Go YY. The WASE normative data on right ventricular motion components: where uniformity meets diversity! *Eur Heart J Cardiovasc Imaging* 2024;**25**:161–2.
2. Cotella JI, Kovacs A, Addetia K, Fabian A, Asch FM, Lang RM, et al. Three-dimensional echocardiographic evaluation of longitudinal and non-longitudinal components of right ventricular contraction: results from the World Alliance of Societies of Echocardiography study. *Eur Heart J Cardiovasc Imaging* 2024;**25**:152–60.
3. Sayour AA, Tokodi M, Celeng C, Takx RAP, Fabian A, Lakatos BK, et al. Association of right ventricular functional parameters with adverse cardiopulmonary outcomes: a meta-analysis. *J Am Soc Echocardiogr* 2023;**36**:624–33.e8.
4. Surkova E, Kovacs A, Tokodi M, Lakatos BK, Merkely B, Muraru D, et al. Contraction patterns of the right ventricle associated with different degrees of left ventricular systolic dysfunction. *Circ Cardiovasc Imaging* 2021;**14**:e012774.
5. Hahn RT, Lerakis S, Delgado V, Addetia K, Burkhoff D, Muraru D, et al. Multimodality imaging of right heart function: JACC scientific statement. *J Am Coll Cardiol* 2023;**81**:1954–73.