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Editorial Comment
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How To Perform Comprehensive Transthoracic Echocardiography?

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Abbreviations	
AS	Aortic stenosis
LV	Left ventricular
MR	Mitral regurgitation
PISA	Proximal isovelocity surface
TEE	Transesophageal echocardiography
2D	Two-dimensional
3D	Three-dimensional

Echocardiography serves as an essential tool for assessing cardiac structure and function. In the past five decades, the progress in this field has been remarkable. Beginning with A-mode, the technology progressed to B-mode and two-dimensional (2D) imaging, and then advanced further to speckle tracking and three-dimensional (3D) imaging.[1-5] It has matured significantly and is now evolving into the era of artificial intelligence.[6-11] Modern techniques have expanded the scope of echocardiography, enabling its use in cardiac monitoring for cancer therapies and supporting transcatheter structural heart interventions.[12-19] Additionally, these clinical applications contribute to ongoing innovations in cardiac imaging. As echocardiography has evolved into a specialized field, the importance of nurturing skilled professionals has become increasingly critical.

The process of conducting an echocardiogram emphasizes several essential aspects: 1. obtaining high-quality images; 2. ensuring standardized and accurate measurements; and 3. making correct and reasonable interpretations. The quality of images is influenced by the patient's condition, the examiner's skill, and the quality of the equipment used. With proper patient positioning and cooperation, it is crucial to individually adjust machine settings such as sector width, gain, compression, frame rate, and frequency to achieve optimal clarity and contrast. When searching for the best imaging windows, operators should avoid applying excessive pressure on patients; instead, making positional adjustments and utilizing respiratory maneuvers can help obtain higher quality images. Ideally, all images should be recorded as dynamic clips and stored in a suitable database for future clinical and research purposes.[3]

Measurement techniques have also evolved over the past decades. Since 2015, the Journal of the American Society of Echocardiography has consistently released guidelines regarding measurement standards and reference data for chamber size, valvular heart disease, speckle tracking, and various specific conditions.[4,20-23] However, despite these reference data have been adjusted for body surface area, it remains unclear whether these data can directly apply to our population. This issue requires further researches by local scholars to yield definitive conclusions.

In this issue of Acta Cardiologica Sinica, Meiling Chen, Hsin-Yueh Liang, and colleagues present the 2024 Recommendations for the Diagnostic Requirements in Routine Practices of Transthoracic Echocardiography, highlighting the need for standardized guidelines to improve accuracy and consistency in echocardiographic practices across Taiwan. These recommendations, based on observational studies and expert consensus, aim to address report variability and facilitate the establishment of a national echocardiography database, making a significant contribution to the field and aligning more closely with daily practice compared to the 2019 Journal of the American Society of Echocardiography guidelines.[3]

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Here, we have provided comments on various topics addressed in these recommendations.

1. Left ventricular (LV) volume and systolic function

Traditionally, the M-mode in the parasternal long axis view has been used to measure LV size and function. This method allows for continuous detection of blood-tissue interface but can be affected by axis and longitudinal ventricular motion distortions. Therefore, 2-dimensional images should be employed for correction or direct measurement, ensuring that the reference line aligns with the tips of the mitral leaflets, and that the LV dimension includes non-compacted myocardium.[20] 2D volumetry provides high resolution and accurately identifies the tissue-blood interface. However, relying solely on apical four-chamber and apical two-chamber views only captures two longitudinal axes of the left ventricle, which may not adequately represent the overall ventricular shape, particularly in cases of ventricular remodeling. In cases of asymmetric contraction, this limitation can lead to over- or under-estimation of ventricular size and function. Although 3D echocardiography offers a more comprehensive assessment, it has lower spatial and temporal resolution, and requires image quality and advanced equipment. Regardless of the methods used, measuring LV volume must include trabeculae and non-compacted myocardium, and care should be taken to avoid apical foreshortening.[1,2,24-27] Currently, model-based 3D echocardiographic measurements of LV volume closely approximate those obtained through cardiac magnetic resonance imaging.[24,27] Accurate and reproducible measurements are crucial for determining the severity of valvular disease and monitoring patients with structural heart diseases.

2. Valvular heart disease

In 2D echocardiography, it is advisable to avoid excessive reliance on qualitative methods to determine the severity of valvular disease, such as using pressure half-time in cases of mitral stenosis and aortic regurgitation.[21,22] The guideline highlights the use of 3D echocardiography for mitral planimetry, which is currently regarded as the most accurate method for determining in rheumatic mitral stenosis, avoiding the effects of pressure half time by LV diastolic function and heart rate.[28] For aortic stenosis (AS), the continuity equation method for calculating aortic valve area remains the standard approach. However, it is crucial to carefully adjust duplex quality is necessary to prevent bias in measuring signals from the aortic valve and LV outflow tract.[22,29] In cases of low-flow-low-gradient and normal-flow-low-gradient AS, data correction is necessary. Advanced techniques such as stress echocardiography or calcium scoring may also be used to confirm the final diagnosis.[30]

In terms of regurgitant valvular diseases, it is known that primary and secondary mitral regurgitation (MR) have distinct etiologies and clinical presentations. Secondary MR typically arise from changes in the left ventricle or mitral annulus, resulting in regurgitant orifices that are rarely circular. The proximal isovelocity surface (PISA) tends to be more ellipsoidal than spherical, and relying on PISA-derived effective regurgitant orifice can significantly underestimate the true severity. Although 3D transesophageal echocardiography (TEE) can use vena contracta area to estimate the regurgitant orifice, assessing regurgitant volume and fraction (RF) is necessary.[21] When calculating regurgitant volume, the trabecula-inclusion method should be used to measure changes in LV volume. Additionally, contrast or model-based 3D echocardiography may provide a more accurate approach. It is important to recognize that PISA-derived regurgitant volume in primary MR can be substantially overestimated, warranting special attention.[14,31-38] In cases of tricuspid regurgitation, where the majority are secondary, it is important to utilize multiple parameters, such as PISA-derived effective orifice area, vena contracta, or 3D TTE vena contracta area, for a comprehensive assessment.[16,19,39-46] It is advised to adopt the updated classification of etiology and severity when planning interventions for structural heart disease.

3. Speckle tracking strain imaging

The advancement of speckle tracking strain imaging has been significant. Historically, its application in routine TTE faced challenges due to limitations of machine capabilities, resulting in issues with reproducibility and variability stemming from different vectors. However, with recent technological improvements, strain imaging can now effectively and reliably assess LV, left atrial, and right ventricular longitudinal strains in a semi-automatic fashion using TTE. Currently, one of the most common applications is the assessment of LV hypertrophy, especially by identifying the apical sparing pattern in longitudinal strain analysis, which aids in the diagnosis of amyloidosis.[4,12,13,47,48] Furthermore, right ventricular strain has shown superior prognostic value in a range of conditions when compared to conventional metrics such as tricuspid annular plane systolic excursion or fractional area change.[43,49,50] LV global longitudinal strain and myocardial work can also be used to predict and monitor responses to cardiac resynchronization therapy.[5,51] Overall, the potential for strain imaging in routine TTE is promising.

CONCLUSIONS

TTE is an essential diagnostic and therapeutic tool. We anticipate that practitioners will benefit from consistent and region-specific guidelines to follow. As more evidence emerges and technology advances, the incorporation of new techniques will further improve the convenience, accuracy, and reproducibility of TTE.

DECLARATION OF CONFLICT OF INTEREST

All the authors declare no conflict of interest.

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