Editorial

Clinical Application of Measurement of Left Atrial Function by Speckle-tracking Echocardiography

Eun Jeong Cho , MD, PhD

Division of Cardiology, Department of Internal Medicine, Chuncheon Sacred Heart Hospital, Hallym University College of Medicine, Chuncheon, Korea

OPEN ACCESS

► See the article “Normal Reference Values for Left Atrial Strain and Its Determinants from a Large Korean Multicenter Registry” in volume 28 on page 186.

Received: May 28, 2020

Accepted: May 31, 2020

Address for Correspondence:

Eun Jeong Cho, MD, PhD

Division of Cardiology, Department of Internal Medicine, Chuncheon Sacred Heart Hospital, Hallym University College of Medicine, 77 Sakju-ro, Chuncheon 24253, Korea.
E-mail: ounjungcho@daum.net

Copyright © 2020 Korean Society of Echocardiography

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<https://creativecommons.org/licenses/by-nc/4.0/>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ORCID iDs

Eun Jeong Cho
<https://orcid.org/0000-0003-3345-2516>

Conflict of Interest

The authors have no financial conflicts of interest.

The left atrium (LA) has an important role in modulating left ventricular (LV) filling, contributing up to a third of cardiac output.¹⁾ The LA has additionally been identified as an important biomarker of cardiovascular disease and adverse cardiovascular outcomes.²⁾³⁾

The LA contributes to cardiac hemodynamics by modulating LV filling through the interplay of atrial reservoir, conduit, and booster contractile function. LA function has been assessed from pressure-volume curves via invasive assessment.⁴⁾ The noninvasive assessment of LA anatomy and function has been performed predominantly by echocardiographic volumetric and Doppler analyses⁵⁾⁶⁾ as well as other modalities.⁷⁾ Compared with assessment of atrial strain, volumetric measures of LA function may be limited by lower sensitivity in early disease states.⁸⁾ LA speckle tracking echocardiography (STE) is a newer echocardiographic technique for strain and strain rate analyses that tracks ‘speckles’ or natural acoustic markers in the two-dimensional (2D) ultrasound image. The geometric shift of each speckle position is traced throughout the cardiac cycle.⁶⁾⁹⁾ Recently, STE has been described for assessment of regional and global LA function.¹⁰⁾

By the STE, early detection of subclinical LA dysfunction plays a crucial role in the evaluation of many cardiac diseases. Atrial strain has now been evaluated in multiple conditions, including hypertension, diabetes, heart failure, ischemic and valvular heart disease, and atrial fibrillation,¹¹⁾⁶⁾ including the facilitation of stroke risk calculation and assessment of prognostic implications.¹⁷⁾

Factors affecting LA strain have been reported in several studies.

First, some studies have shown a small yet significant relationship between age and LA strain and strain rate.¹⁸⁾ Among the published studies, Morris et al.⁸⁾ showed the difference in reservoir function persisted, but there was no difference in contractile function.

Second, previous study results demonstrated that with increasing body surface area, there were significant decreases in reservoir strain and contractile strain.¹⁹⁾

Third, LA strain has been shown to correlate with the degree of diastolic dysfunction. Morris et al.⁸⁾ demonstrated that LA function derived both volumetrically and by 2D STE strain, was

inversely related to LV filling pressure (mitral E/E' ratio) and to the degree of LV diastolic dysfunction.

Forth, LA strain values have been shown to vary between vendors. Therefore, measuring LA strain across the different vendors is not recommended.²⁰⁾

Fifth, although LA wall has a three-dimensional (3D) architecture and a complex motion during the cardiac cycle, echocardiographic speckles move out from the 2D plane during their tracking leading to difficulties in the detection of the real myocardial motion during 2D STE. Therefore, the angle-independent 3D STE solves these limitations due to its capability for quantitative assessment of LA volumes and strains in 3D space at the same time from the same 3D acquired datasets respecting LA phasic function.²¹⁾

As above, factors affecting LA strain are various.

Despite the limitations above, more recently, using 2D and 3D strain imaging, early detection of subclinical LA dysfunction plays a crucial role in the evaluation of many cardiac diseases. The widespread clinical adoption of this approach will require the definition of normal reference ranges.

Therefore, recently normal reference ranges for LA reservoir strain, contractile strain, and conduit strain have been demonstrated by meta-analysis¹⁹⁾ and have been continuously studied.

Among the published studies, the upper reference values for LA volume were higher for Europeans than East Asians, although the difference was less pronounced among women.²²⁾ So, these results pertain only to specific demographics and thus their generalizability to other populations is limited.

Therefore, studies of normal reference ranges for LA strain by 2D STE²³⁾ and 3D STE are necessary and important in South Korea.

REFERENCES

1. Matsuda Y, Toma Y, Ogawa H, et al. Importance of left atrial function in patients with myocardial infarction. *Circulation* 1983;67:566-71.
[PUBMED](#) | [CROSSREF](#)
2. Abhayaratna WP, Seward JB, Appleton CP, et al. Left atrial size: physiologic determinants and clinical applications. *J Am Coll Cardiol* 2006;47:2357-63.
[PUBMED](#) | [CROSSREF](#)
3. Tsang TS, Barnes ME, Gersh BJ, et al. Prediction of risk for first age-related cardiovascular events in an elderly population: the incremental value of echocardiography. *J Am Coll Cardiol* 2003;42:1199-205.
[PUBMED](#) | [CROSSREF](#)
4. Hoit BD, Shao Y, Gabel M, Walsh RA. In vivo assessment of left atrial contractile performance in normal and pathological conditions using a time-varying elastance model. *Circulation* 1994;89:1829-38.
[PUBMED](#) | [CROSSREF](#)
5. Rosca M, Lancellotti P, Popescu BA, Piérard LA. Left atrial function: pathophysiology, echocardiographic assessment, and clinical applications. *Heart* 2011;97:1982-9.
[PUBMED](#) | [CROSSREF](#)
6. Vieira MJ, Teixeira R, Gonçalves L, Gersh BJ. Left atrial mechanics: echocardiographic assessment and clinical implications. *J Am Soc Echocardiogr* 2014;27:463-78.
[PUBMED](#) | [CROSSREF](#)

7. To AC, Flamm SD, Marwick TH, Klein AL. Clinical utility of multimodality LA imaging: assessment of size, function, and structure. *JACC Cardiovasc Imaging* 2011;4:788-98.
[PUBMED](#) | [CROSSREF](#)
8. Morris DA, Takeuchi M, Krisper M, et al. Normal values and clinical relevance of left atrial myocardial function analysed by speckle-tracking echocardiography: multicentre study. *Eur Heart J Cardiovasc Imaging* 2015;16:364-72.
[PUBMED](#) | [CROSSREF](#)
9. Perk G, Tunick PA, Kronzon I. Non-Doppler two-dimensional strain imaging by echocardiography--from technical considerations to clinical applications. *J Am Soc Echocardiogr* 2007;20:234-43.
[PUBMED](#) | [CROSSREF](#)
10. Vianna-Pinton R, Moreno CA, Baxter CM, Lee KS, Tsang TS, Appleton CP. Two-dimensional speckle-tracking echocardiography of the left atrium: feasibility and regional contraction and relaxation differences in normal subjects. *J Am Soc Echocardiogr* 2009;22:299-305.
[PUBMED](#) | [CROSSREF](#)
11. Debonnaire P, Leong DP, Witkowski TG, et al. Left atrial function by two-dimensional speckle-tracking echocardiography in patients with severe organic mitral regurgitation: association with guidelines-based surgical indication and postoperative (long-term) survival. *J Am Soc Echocardiogr* 2013;26:1053-62.
[PUBMED](#) | [CROSSREF](#)
12. Liu Y, Wang K, Su D, et al. Noninvasive assessment of left atrial phasic function in patients with hypertension and diabetes using two-dimensional speckle tracking and volumetric parameters. *Echocardiography* 2014;31:727-35.
[PUBMED](#) | [CROSSREF](#)
13. Mondillo S, Cameli M, Caputo ML, et al. Early detection of left atrial strain abnormalities by speckle-tracking in hypertensive and diabetic patients with normal left atrial size. *J Am Soc Echocardiogr* 2011;24:898-908.
[PUBMED](#) | [CROSSREF](#)
14. Antoni ML, Ten Brinke EA, Marsan NA, et al. Comprehensive assessment of changes in left atrial volumes and function after ST-segment elevation acute myocardial infarction: role of two-dimensional speckle-tracking strain imaging. *J Am Soc Echocardiogr* 2011;24:1126-33.
[PUBMED](#) | [CROSSREF](#)
15. Mochizuki A, Yuda S, Oi Y, et al. Assessment of left atrial deformation and synchrony by three-dimensional speckle-tracking echocardiography: comparative studies in healthy subjects and patients with atrial fibrillation. *J Am Soc Echocardiogr* 2013;26:165-74.
[PUBMED](#) | [CROSSREF](#)
16. Obokata M, Negishi K, Kurosawa K, et al. Incremental diagnostic value of LA strain with leg lifts in heart failure with preserved ejection fraction. *JACC Cardiovasc Imaging* 2013;6:749-58.
[PUBMED](#) | [CROSSREF](#)
17. Obokata M, Negishi K, Kurosawa K, et al. Left atrial strain provides incremental value for embolism risk stratification over CHA₂DS₂-VASc score and indicates prognostic impact in patients with atrial fibrillation. *J Am Soc Echocardiogr* 2014;27:709-716.e4.
[PUBMED](#) | [CROSSREF](#)
18. Gan GC, Ferkh A, Boyd A, Thomas L. Left atrial function: evaluation by strain analysis. *Cardiovasc Diagn Ther* 2018;8:29-46.
[PUBMED](#) | [CROSSREF](#)
19. Pathan F, D'Elia N, Nolan MT, Marwick TH, Negishi K. Normal ranges of left atrial strain by speckle-tracking echocardiography: A systematic review and meta-analysis. *J Am Soc Echocardiogr* 2017;30:59-70.e8.
[PUBMED](#) | [CROSSREF](#)
20. Wang Y, Li Z, Fei H, et al. Left atrial strain reproducibility using vendor-dependent and vendor-independent software. *Cardiovasc Ultrasound* 2019;17:9.
[PUBMED](#) | [CROSSREF](#)
21. Nemes A, Kalapos A, Domsik P, Forster T. Three-dimensional speckle-tracking echocardiography -- a further step in non-invasive three-dimensional cardiac imaging. *Orv Hetil* 2012;153:1570-7.
[PUBMED](#) | [CROSSREF](#)
22. Echocardiographic Normal Ranges Meta-Analysis of the Left Heart Collaboration. Ethnic-specific normative reference values for echocardiographic LA and LV size, LV mass, and systolic function: the EchoNoRMAL study. *JACC Cardiovasc Imaging* 2015;8:656-65.
[PUBMED](#) | [CROSSREF](#)
23. Sun BJ, Park JH, Lee M, et al. Normal reference values for left atrial strain and its determinants from a large Korean multicenter registry. *J Cardiovasc Imaging* 2020;28:186-98.
[CROSSREF](#)