EDITORIAL

Left Atrial Strain: Is it a Paragon, Which We Cardiac Anesthesiologists Misconstrue?

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The last one and a half-decade was the era of myocardial strain imaging by speckle tracking strain echocardiography (STE) and various authors confirmed its accuracy. However, the measurements are mostly confined to the left ventricular (LV) global longitudinal strain (GLS).[1,2] Though LA function has been a subject study in the past decades and interesting pathophysiological findings have been described in the literature, not many of them have been translated into clinical practice. Commonly used approaches to study LA function are Doppler and volumetric approaches which do not bring forth the entire information about LA function. However, a deformation study by STE provides a window on all phases of LA function (LA as a reservoir, conduit, and booster pump).[3]

LA strain (LAS) imaging by STE is a noninvasive, simple, and reproducible tool for the assessment of LA function in patients with cardiovascular disease. It ensures the identification of early LA dysfunction even before LA morphological changes. It also provides further prognostic information to conventional echocardiographic parameters in patients with cardiovascular problems. For this reason, LAS measurement by STE appears to be a hopeful technique for identification and therapeutic decision-making in patients with cardiovascular dysfunction.

Deformation imaging of LA is more challenging than left ventricle (LV) because of the continuous movement of the interatrial septum, thin LA wall as well as the orifices of LA appendages (LAA) and pulmonary veins (PV) require an arbitrary extrapolation of the LA contour. Dedicated image acquisition is crucial. A narrow image sector is a key to warp the LA with an increased frame rate. A good quality electrocardiogram (ECG) trace with a clearly visible *P* wave is mandatory. Dedicated software is of paramount importance to determine the region of interest (ROI). This allows an automatic LA detection algorithm and contributes to better reproducibility of the results. The ROI starts with delineating the endocardial contour, which should be drawn from the mitral annulus on one side, extrapolates across LAA and/or PV. If tracking quality cannot be improved by adjusting ROI, the image should not be used for strain analysis. LA strain is measured as a GLS of the entire wall rather than a segmental strain.[4]

Recently, Bekki et al. had emphasized left atrial dysfunction in heart failure patients with preserved ejection fraction (EF). They conveyed that LAS measurements would be useful to predict heart failure in this subset of patients.[3]

The clinical relevance of adding LAS to left atrial volume index (LAVI) for detection of LV diastolic dysfunction (LVDD) in patients with preserved LVEF was analyzed by Morries and colleagues in a group of patients who are at risk of LVDD, e.g., those with arterial hypertension, diabetes mellitus, or family history of coronary artery disease. *Post hoc* analysis in their retrospective cohort showed that an abnormal LAS has a significant association with an increased risk of hospitalization and heart failure at 2 years (odds ratio 6.6 [95% confidence interval 2.6–16.6]) in patients with normal LAVI and normal LV EF.[5]

The association of LAS and strain rate by STE in patients with paroxysmal atrial fibrillation (PAF) (decreased LASR was independently associated with PAF) was demonstrated by Tasi et al. a decade earlier and later studied by a few other researchers.[6,7] Cheung and colleagues in a recent review described 536 patients with repaired tetralogy of Fallot who underwent right atrial strain (RAS) and LAS imaging by STE. The major findings were: association of RA and LA deformation indices (suggestive of RA and LA interaction) and a decreased RA and LAS well as stain rate consistent with reduced conduit, reservoir, and contractile function. However, this review could not obtain any dates on the prognostic value of LAS.[8]

The most valuable indications for measuring LAS are subclinical LV dysfunction (especially in aortic stenosis (AS), mitral regurgitation, AF, and sequential follow-up in the evaluation of cardiotoxicity of different drugs. Strain measurements have clinical utility in a number of settings and should be considered as a part of a standard echocardiogram.

The starting point for LAS measurement is again a matter of concern. However, the general agreement is that LAS at any phase (reservoir, booster pump, conduit) should be analyzed using the onset of P wave as the starting point).[9] The value of global LA longitudinal strain cannot be ignored global as a risk prediction model in population with AF as demonstrated by Liao et al. is one of the largest cohorts consist of 1,457 AF patients.[10] LA peak positive global strain and LAS rate parameters were significantly reduced in patients with LAA thrombosis in non-valvular AF patients. This implies that STE analyses of LA mechanics improve thrombotic risk assessment.[11] Left atrial mechanics, especially the LA booster pump function assessed early during hospitalization for cryptogenic stroke can identify patients at greater like the hood of a future diagnosis of AF as shown in a small group of patients.[12]

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In a recent study, Meimoun et al. demonstrated that in patients with moderate to severe AS, LA distensibility and LAS are associated with LV dysfunction, AS severity and independently linked to hospitalization, heart failure, or death.[13] In 71 patients with primary severe MR, the authors tried to find out the echocardiographic indices that can optimize surgical timing before irreversible left heart myocardial dysfunction. They found that LA GLS to be a reliable predictor of outcome and functional capacity for severe primary MR, and as a marker of LA fibrosis.[14] LA strain can be the only parameter to guide and therapeutic management of heart failure as expressed by a few recent authors.[15]

Despite the great significance of LAS study by STE in many disease states, this method of quantification of LA function is not free from some issues that need to be addressed in the future:

- LA function is tightly linked to several cardiovascular diseases and confers key prognostic information. Speckle tracking strain echocardiography-based deformation as a feasible and sensitive LA mechanical assessment has proven its clinical significance beyond volume measures; however, the reference values are pertinent to different races, and clinical conditions are yet largely unknown.
- The software application for this technique still needs improvement.
- A strong association of LAS with LV filling pressure is an important point. A reduction in LV filling pressure improves LAS but rarely normalizes LA volume. Further research is much needed on this point.
- Several research articles exist emphasizing LAS as a predictor of PAF, stroke, and thromboembolic risk, especially in patients with recurrent AF and impending heart failure. Larger multicenter studies or randomized trials are much required to confirm whether LAS can be used as a risk stratification parameter.

Despite the above flaws, LAS measurement by STE is noted to be a useful parameter for evaluating LA function better than the regular use of volumetric or Doppler methods. However, extensive work is required to establish its unique value in the clinical management of cardiac surgical patients especially to predict postoperative atrial fibrillation, ventricular dysfunction, and heart failure. Looking at the booster pump function rather than reservoir function is more important to study the candidates who are at more risk of LV function.[16]

References

1. Potter E, Marwick TH. Assessment of left ventricular function by echocardiography:the case for routine adding global longitudinal strain to ejection fraction. J Am CollCardiol Img 2018;11:260–274.
2. Park JJ, Park JB, Park JH, et al. Global longitudinal strain to predict mortality in patients with acute heart failure. J Am Coll Cardiol 2018;71(18):1947–1957.
3. Bekki N, Hayama H, Miyake W, et al. Left atrial strain and outcome in heart failure with preserved ejection fraction. Eur Heart J 2021(Suppl 1):jeaa356.117.
4. Badano LP, Kolias Tj Muraru D, Abraham Tp Aurigemma G, et al. Standardization of left atrial, right ventricular, and right atrial deformation imaging using two-dimensional speckle tracking echocardiography: a consensus document of the EACVI/ASE/ Industry Task Force to standardize deformation imaging. Eur Heart J Cardiovasc Imag 2018;9:591–600.
5. Morris DA, Belyavskiy E, Kumar RA, et al. Potential usefulness and clinical relevance of adding left atrial strain to left atrial volume index in detection of left ventricular diastolic dysfunction. J Am Coll Cardiol Img 2018;11:1405–1415.
6. Tsai WC, Lee C-H, Lin C-C, et al. Association of left atrial strain and strain rate assessed by speckle tracking echocardiography with paroxysmal atrial fibrillation. Echocardiography 2000;26: 1188–1194.
7. Dufour LS, Lang S, Ederhy S, et al. Biatrial remodeling in atrial fibrillation: A three dimensional and strain echocardiography insight. Arch Cardiovase Dis 2019;112:585–593.
8. Cheung Y-F, Yu CKM, So EKF, et al. Atrial strain imaging after repair of tetralogy of fallot: A systemic Review. Ultrasound Med Biol 2019;45:1896–1908.
9. Itayashi S, Yamada H, Bando M, et al. Optimal analyses of left atrial strain by speckle tracking echocardiography: *P* wave versus *R* wave trigger. Echocardiography 2015;32:1241–1249.
10. Liao JN, Chao TF, Kuo JY, et al. Global left atrial longitudinal strain using 3-beat method improves risk prediction of stroke over conventional echocardiography in atrial fibrillation. Circ Cardiovasc Imag 2020;13:e010287.
11. Sonaglion A, Lambardo M, Nicolosi GL, et al. Incremental diagnostic role of LA strain analysis in thrombotic risk assessment of non volvular atrial fibrillation patients planned for electrical cardioversion. Int J Cardiovasc Imaging 2021;31:1539–1550.
12. Deferm S, Bertrand PB, Churchill TW, et al. Left atrial mechanics assessed early during hospitalization for cryptogenic stroke are associated with occult atrial fibrillation: a speckle tracking strain echocardiography study. J Am Soc Echocardiogr 2021;34:156–165.
13. Meimoun P, Djebali M, Botoro T, et al. Left atrial strain and distensibility in relation to left ventricular dysfunction and prognosis in aortic stenosis. Echocardiography 2019;36:469–477.
14. Mandoli GE, Pastore MC, Bonfari G, et al. Left atrial strain as a pre operative prognostic marker for patients with severe mitral regurgitation. Int J Cardiol 2021;324:139–145.
15. Mandoli GE, Sisti NS, Mondilo S, et al. Left atrial strain in left ventricular diastolic dysfunction: have we finally found the missing piece of the puzzle? Heart Fail Rev 2020;25:409–417.
16. Huynh QL, Kalam K, Iannaccone A, et al. Functional and anatomic responses of the left atrium to change in estimated left ventricular filling pressure. J Am Soc Echocardiogr 2015;28:1428–1433.