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Editorial

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How to Determine Right Ventricular Dysfunction in Pulmonary Hypertension

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▸ See the article "Speckle Tracking Imaging in Patients with Pulmonary Hypertension" in volume 29 on page 236.

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Pulmonary hypertension (PH) is a condition of increased blood pressure within the pulmonary circulation and is related to poor prognosis in various cardiovascular diseases including idiopathic PH.[1)2)] As a consequence of PH, the right ventricle (RV) increases contractility, expands, and finally adapts to uncoupling with high demand and reduced output.[3)] Prognosis of PH is related to the ability of RV to adapt to the elevated pulmonary artery pressure. RV failure is the most important prognostic determinant in PH, occurring when the RV can no longer adapt to the increased afterload.[4)5)]

Non-invasive assessment of RV function is challenging but of importance owing to complex RV geometry and load dependency of the RV functional parameters. Conventional two-dimensional (2D) transthoracic echocardiography has been the imaging modality of choice for assessment of RV function in patients with PH. Tricuspid annular peak systolic velocity < 10 cm/sec, tricuspid annular plane systolic excursion < 17 mm, or RV fractional area change < 35% indicates RV systolic dysfunction, with limited prognostic power in patients with PH.[6)7)]

Contemporary speckle tracking echocardiography (STE) provides advanced information on regional and global RV function.[8)] RV global longitudinal strain (RV GLS) with 2D STE is reduced in patients with PH compared with healthy controls and showed independent prognostic value for morbidity and mortality in patients with PH.[9-11)] However, there is a limitation that RV GLS does not provide comprehensive assessment of RV function but only a single projection. A recent analysis on the role of regional RV deformation using 3D STE revealed dominant RV regions such as inferior and lateral walls, representative of global RV deformation.[12)]

Meanwhile, assessment of RA function and volume also can provide important information on the functional status of PH. With PH, RV diastolic function is impaired with or without RV systolic dysfunction. RA contractility first increases to compensate, and then the RA cavity dilates to maintain active filling of the RV.[13)] Diminished RA function and enlarged RA cavity are associated with poor outcome in patients with PH.[14)15)]

In the current issue of *Journal of Cardiovascular Imaging*, Prieto et al.[16)] compared global RV longitudinal strain, RA strain, and strain rate between normal controls and patients with PH. They demonstrated that RV free wall longitudinal strain (RVFWSL), global right atrial reservoir

strain, peak strain rate during reservoir phase, and peak strain rate during passive conduit phase in the RA free wall were significantly reduced in patients with PH compared to normal controls. These findings imply that the RVFWSL other than RV GLS could be utilized in simple assessment of incipient RV dysfunction. According to this study, RA reservoir and conduit function are decreased, whereas RA pump function remains relatively preserved in patients with PH, in agreement with a previous study.[14] RA volume and functional indices as measured by 2D STE might be suggested as important clinical predictor of adverse clinical outcome in patients with PH. In contrary to a previous observation,[17] the present study failed to demonstrate the association between conventional 2D echocardiographic parameters of RV function and strain. This contradictory result might be due to the small study population in this study.

Despite some limitations, novel noninvasive imaging modalities that can incorporate anatomical and functional assessment of RV function should continue to be investigated, and their prognostic roles remain to be elucidated.

REFERENCES

1. Benza RL, Miller DP, Gomberg-Maitland M, et al. Predicting survival in pulmonary arterial hypertension: insights from the Registry to Evaluate Early and Long-Term Pulmonary Arterial Hypertension Disease Management (REVEAL). *Circulation* 2010;122:164-72.
PUBMED | CROSSREF
2. Al-Omary MS, Sugito S, Boyle AJ, Sverdlov AL, Collins NJ. Pulmonary hypertension due to left heart disease: diagnosis, pathophysiology, and therapy. *Hypertension* 2020;75:1397-408.
PUBMED | CROSSREF
3. Vonk Noordegraaf A, Westerhof BE, Westerhof N. The relationship between the right ventricle and its load in pulmonary hypertension. *J Am Coll Cardiol* 2017;69:236-43.
PUBMED | CROSSREF
4. Raymond RJ, Hinderliter AL, Willis PW 4th, et al. Echocardiographic predictors of adverse outcomes in primary pulmonary hypertension. *J Am Coll Cardiol* 2002;39:1214-9.
PUBMED | CROSSREF
5. Forfia PR, Fisher MR, Mathai SC, et al. Tricuspid annular displacement predicts survival in pulmonary hypertension. *Am J Respir Crit Care Med* 2006;174:1034-41.
PUBMED | CROSSREF
6. Haddad F, Spruijt OA, Denault AY, et al. Right heart score for predicting outcome in idiopathic, familial, or drug- and toxin-associated pulmonary arterial hypertension. *JACC Cardiovasc Imaging* 2015;8:627-38.
PUBMED | CROSSREF
7. Rudski LG, Lai WW, Afilalo J, et al. Guidelines for the echocardiographic assessment of the right heart in adults: a report from the American Society of Echocardiography endorsed by the European Association of Echocardiography, a registered branch of the European Society of Cardiology, and the Canadian Society of Echocardiography. *J Am Soc Echocardiogr* 2010;23:685-713.
PUBMED | CROSSREF
8. Seo HS, Lee H. Assessment of right ventricular function in pulmonary hypertension with multimodality imaging. *J Cardiovasc Imaging* 2018;26:189-200.
PUBMED | CROSSREF
9. Fine NM, Chen L, Bastiansen PM, et al. Outcome prediction by quantitative right ventricular function assessment in 575 subjects evaluated for pulmonary hypertension. *Circ Cardiovasc Imaging* 2013;6:711-21.
PUBMED | CROSSREF
10. da Costa Junior AA, Ota-Arakaki JS, Ramos RP, et al. Diagnostic and prognostic value of right ventricular strain in patients with pulmonary arterial hypertension and relatively preserved functional capacity studied with echocardiography and magnetic resonance. *Int J Cardiovasc Imaging* 2017;33:39-46.
PUBMED | CROSSREF
11. Hulshof HG, Eijsvogels TM, Kleinnibbelink G, et al. Prognostic value of right ventricular longitudinal strain in patients with pulmonary hypertension: a systematic review and meta-analysis. *Eur Heart J Cardiovasc Imaging* 2019;20:475-84.
PUBMED | CROSSREF

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12. Moceri P, Duchateau N, Baudouy D, et al. Three-dimensional right-ventricular regional deformation and survival in pulmonary hypertension. *Eur Heart J Cardiovasc Imaging* 2018;19:450-8.
PUBMED | CROSSREF

13. Gaynor SL, Maniar HS, Bloch JB, Steendijk P, Moon MR. Right atrial and ventricular adaptation to chronic right ventricular pressure overload. *Circulation* 2005;112:I212-8.
PUBMED

14. Sakata K, Uesugi Y, Isaka A, et al. Evaluation of right atrial function using right atrial speckle tracking analysis in patients with pulmonary artery hypertension. *J Echocardiogr* 2016;14:30-8.
PUBMED | CROSSREF

15. Sato T, Tsujino I, Ohira H, et al. Right atrial volume and reservoir function are novel independent predictors of clinical worsening in patients with pulmonary hypertension. *J Heart Lung Transplant* 2015;34:414-23.
PUBMED | CROSSREF

16. Prieto O, Cianciulli TF, Stewart-Harris A, et al. Speckle tracking imaging in patients with pulmonary hypertension. *J Cardiovasc Imaging* 2021;29:236-51.
CROSSREF

17. Lee JH, Park JH. Strain analysis of the right ventricle using two-dimensional echocardiography. *J Cardiovasc Imaging* 2018;26:111-24.
PUBMED | CROSSREF

https://doi.org/10.4250/jcvi.2021.0035