

Editorial



Assessment of Right Ventricular Systolic Function: Conventional Methods and Modified Tricuspid Annular Plane Systolic Excursion

Ji-won Hwang , MD, PhD

Division of Cardiology, Department of Medicine, Ilsan Paik Hospital, Inje University School of Medicine, Goyang, Korea

OPEN ACCESS

► See the article “Modified Tricuspid Annular Plane Systolic Excursion for Assessment of Right Ventricular Systolic Function” in volume 27 on page 24.

Received: Jan 10, 2019

Revised: Jan 22, 2019

Accepted: Jan 23, 2019

Address for Correspondence:

Ji-won Hwang, MD, PhD

Division of Cardiology, Department of Medicine, Ilsan Paik Hospital, Inje University School of Medicine, 170 Juhwa-ro, Ilsanseo-gu, Goyang 10380, Korea.
E-mail: enigma1012@hanmail.net

Copyright © 2019 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

Ji-won Hwang 
<https://orcid.org/0000-0002-7098-3546>

Conflict of Interest

The authors have no financial conflicts of interest.

Right ventricular (RV) function is one of the crucial prognostic factors in predicting the outcomes of cardiac surgery.^{1,2)} The anatomy of the RV is unique and complex, and various parameters measure RV function. Multiple imaging modalities, including echocardiography, computed tomography, and magnetic resonance imaging, are needed to precisely evaluate RV volume and function.

Among others, RV fractional area change (RV-FAC), tricuspid annular plane systolic excursion (TAPSE), and systolic tissue Doppler velocity of the tricuspid annulus (S') are clinically useful methods that are performed with transthoracic echocardiography (TTE).³⁾ TTE-derived RV-FAC can be systematically incorporated into the basic echocardiography exam, as it correlates well with ejection fraction measured by 3D TTE and magnetic resonance imaging.^{4,5)} However, tracing the RV endocardial surface can be challenging in the presence of trabeculations or suboptimal image quality. Alternatively, TAPSE is movement of the lateral annulus of the tricuspid valve toward the apex, and it represents RV contractility in the long axis.⁶⁾ TAPSE is usually assessed by TTE with M-mode from the apical window, and it is less dependent on optimal image quality and is simple to perform.⁶⁾ Finally, S' uses both spectral pulsed wave tissue Doppler and color tissue Doppler as an index of RV function.

Clinically, TAPSE has become one of the popular methods for assessing RV function because of its ease of application, high reproducibility, and good correlation with RV stroke volume.⁷⁾ Occasionally, intraoperative assessment of RV systolic function during cardiac surgery is necessary. Although it has clinical benefits, TAPSE is one of the several parameters not available intraoperatively because its measurement utilizes TTE M-mode at the lateral wall of the RV.⁸⁾ Furthermore, modified TAPSE (m-TAPSE) can be used for evaluating intraoperative RV systolic function, and apical systolic and diastolic shortening was seen in transesophageal echocardiography (TEE) mid-esophageal 4-chamber view.⁹⁾ Perioperative RV function, especially during cardiac surgery such as heart transplantation and left ventricular assist device implantation, has been valued as an important prognostic factor,^{10,11)} and attempts have been made to predict the postoperative course based on intraoperative RV function assessment.¹²⁾

In this issue of the journal, Dhawan et al.¹³⁾ investigated the usefulness of m-TAPSE in assessing RV systolic function and compared m-TAPSE with both TAPSE (the most commonly used parameter) and RV-FAC (the near-gold standard 2D echocardiography parameter). A prospective observational study was performed on 125 patients undergoing coronary artery bypass graft surgery.

To the best of my knowledge, Morita et al.⁹⁾ previously reported that m-TAPSE was validated as having a good correlation to RV-FAC and could be considered an eligible parameter to evaluate RV systolic function. Beyond the previous study, Dhawan et al.¹³⁾ suggested that m-TAPSE for evaluating RV function is possibly useful in a busy intraoperative setting and is not dependent on image quality by “prospectively” comparing m-TAPSE with three parameters: m-TAPSE on TEE, TAPSE measured by TTE, and RV-FAC on TEE. One of the strengths of this study is presentation of the data from TTE and TEE simultaneously measured and recorded post-induction. The authors made an effort to reduce the data error for the time difference between TTE and TEE, simultaneously reflecting RV systolic function. Based on intraobserver analysis, the authors' data showed that all parameters were reproducible for the validated data. In conclusion, Dhawan et al.¹³⁾ showed that m-TAPSE was correlated with both conventional TAPSE and RV-FAC. RV-FAC was validated to be a strong estimate parameter of RV function.⁸⁾

I would like to make some suggestions for additional points about this subject. In this study, the number of subjects is relatively small compared with the previous study. Attempts were made to measure and simply verify an echocardiographic RV function parameter at baseline hemodynamics as a predictor for prognosis, and the authors could have further evaluated follow-up data and relationships with clinical outcomes. Furthermore, RV systolic function should be evaluated in a multimodal fashion by combining parameters by multimodality because the gold standard method, RV-FAC measured by magnetic resonance imaging, is highly regarded. Therefore, to actively use m-TAPSE as a parameter for assessment of RV systolic function in a perioperative setting, further validation and correction of shortcomings are needed in clinical practice.

REFERENCES

1. Kaul TK, Fields BL. Postoperative acute refractory right ventricular failure: incidence, pathogenesis, management and prognosis. *Cardiovasc Surg* 2000;8:1-9.
[PUBMED](#) | [CROSSREF](#)
2. Denault AY, Haddad F, Jacobsohn E, Deschamps A. Perioperative right ventricular dysfunction. *Curr Opin Anaesthesiol* 2013;26:71-81.
[PUBMED](#) | [CROSSREF](#)
3. Haddad F, Couture P, Tousignant C, Denault AY. The right ventricle in cardiac surgery, a perioperative perspective: I. Anatomy, physiology, and assessment. *Anesth Analg* 2009;108:407-21.
[PUBMED](#) | [CROSSREF](#)
4. Imada T, Kamibayashi T, Ota C, et al. Intraoperative right ventricular fractional area change is a good indicator of right ventricular contractility: a retrospective comparison using two- and three-dimensional echocardiography. *J Cardiothorac Vasc Anesth* 2015;29:831-5.
[PUBMED](#) | [CROSSREF](#)
5. Focardi M, Cameli M, Carbone SF, et al. Traditional and innovative echocardiographic parameters for the analysis of right ventricular performance in comparison with cardiac magnetic resonance. *Eur Heart J Cardiovasc Imaging* 2015;16:47-52.
[PUBMED](#) | [CROSSREF](#)

6. Miller D, Farah MG, Liner A, Fox K, Schluchter M, Hoit BD. The relation between quantitative right ventricular ejection fraction and indices of tricuspid annular motion and myocardial performance. *J Am Soc Echocardiogr* 2004;17:443-7.
[PUBMED](#) | [CROSSREF](#)
7. Hu R, Mazer CD, Tousignant C. Relationship between tricuspid annular excursion and velocity in cardiac surgical patients. *J Cardiothorac Vasc Anesth* 2014;28:1198-202.
[PUBMED](#) | [CROSSREF](#)
8. 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; quiz 786-8.
[PUBMED](#) | [CROSSREF](#)
9. Morita Y, Nomoto K, Fischer GW. Modified tricuspid annular plane systolic excursion using transesophageal echocardiography for assessment of right ventricular function. *J Cardiothorac Vasc Anesth* 2016;30:122-6.
[PUBMED](#) | [CROSSREF](#)
10. Puwanant S, Hamilton KK, Klodell CT, et al. Tricuspid annular motion as a predictor of severe right ventricular failure after left ventricular assist device implantation. *J Heart Lung Transplant* 2008;27:1102-7.
[PUBMED](#) | [CROSSREF](#)
11. Lampert BC, Teuteberg JJ. Right ventricular failure after left ventricular assist devices. *J Heart Lung Transplant* 2015;34:1123-30.
[PUBMED](#) | [CROSSREF](#)
12. Morita Y, Lencho T, Gunasekaran S, Modak R. Modified tricuspid annular plane systolic excursion using transesophageal echocardiography and its utility to predict postoperative course in heart transplantation and left ventricular assist device implantation. *J Cardiothorac Vasc Anesth* 2018;32:1316-24.
[PUBMED](#) | [CROSSREF](#)
13. Dhawan I, Makhija N, Choudhury M, Choudhury A. Modified tricuspid annular plane systolic excursion for assessment of right ventricular systolic function. *J Cardiovasc Imaging* 2019;27:24-33.
[CROSSREF](#)