Korean Circ J. 2023 Dec;53(12):826-828
https://doi.org/10.4070/kcj.2023.0237
pISSN 1738-5520·eISSN 1738-5555

kcj
Korean Circulation Journal

Editorial

Check for updates

The Clinical Application of Three-Dimensional Speckle Tracking Echocardiography and Two-Dimensional Echocardiography for Left Ventricular and Right Ventricular Assessment in Patients With Septic Cardiomyopathy

Eun Jeong Cho, MD, PhD

Division of Cardiology, Department of Internal Medicine, Heart Brain Hospital, Chung-Ang University Gwangmyeong Hospital, Chung-Ang University College of Medicine, Gwangmyeong, Korea

▸ See the article "Seven-day and In-hospital Mortality According to Left and Right Ventricular Dysfunction in Patients With Septic Shock" in volume 53 on page 813.

Echocardiography is one of the standard tests for diagnosing septic cardiomyopathy (SCM). All hemodynamically unstable patients are being evaluated through critical care echocardiography.[1] In the initial diagnosis of SCM, a reduced left ventricular ejection fraction (LVEF) was observed, which was associated with left ventricular (LV) dilation.[2] Systolic function can be assessed using LVEF measured by Simpson's method or by evaluating LV fractional area change (FAC) at the mid-ventricular level.[3] The peak systolic velocity determined by S' wave measurement at the mitral annulus using tissue Doppler imaging (TDI) may be less dependent on loading conditions than LVEF measurement.[4]

Additionally, recently, speckle-tracking echocardiography (STE) is a cardiac ultrasound examination method used to assess LV deformation over time by following speckles, which are referred to as ultrasound echoes.[5] STE is divided into two-dimensional (2D) and three-dimensional (3D) STE. 2D STE is limited to the 2D plane movement of speckles and ignores the characteristics of 3D cardiac wall motion. So, more recently, 3D STE is rapidly advancing as an important technique for accurately and comprehensively evaluating myocardial function by overcoming the limitations of 2D STE and analyzing the wall motion of the 3D left ventricle.

Recently, the global longitudinal strain (GLS) measured by STE represents a change in length between systole and diastole, serving as a surrogate measure of LV contractility. Furthermore, GLS is not influenced by angles and is less dependent on loading conditions (changes in preload or afterload). Furthermore, GLS has been demonstrated to be more sensitive in detecting subclinical cardiac dysfunction compared to LVEF.[6] Generally, it has been reported that GLS impairment is more commonly observed in intensive care unit patients who have experienced septic shock compared to those without septic shock. Therefore, 3D and 2D strain images can be valuable additional imaging parameters as useful clinical tools for monitoring the progression of myocardial deformation.[7][8]

OPEN ACCESS

Received: Sep 25, 2023
Accepted: Oct 20, 2023
Published online: Nov 3, 2023

Correspondence to
Eun Jeong Cho, MD, PhD
Division of Cardiology, Department of Internal Medicine, Heart Brain Hospital, Chung-Ang University Gwangmyeong Hospital, Chung-Ang University College of Medicine, 110, Deokan-ro, Gwangmyeong 14353, Korea.
Email: ounjungcho@hanmail.net

ORCID iDs
Eun Jeong Cho
https://orcid.org/0000-0003-3345-2516

Funding
The author received no financial support for the research, authorship, and/or publication of this article.

Conflict of Interest
The author has no financial conflicts of interest.

Data Sharing Statement
The data generated in this study is available from the corresponding author upon reasonable request.

However, assessing GLS may be limited in critically ill patients at bedside due to the need for good image resolution, endocardial visualization, and a high frame rate.

Despite these limitations, it is known that abnormal LV strain occurring during sepsis (whether too high or too low) is associated with significant cardiovascular events in patients with pre-existing cardiac conditions.[9]

Furthermore, in septic shock patients, diastolic function may be impaired. However, the assessment of this parameter should be performed in conjunction with the evaluation of LV filling pressures, as diastolic function can vary depending on the loading conditions. In addition, atrial fibrillation or tachycardia caused by sepsis can worsen diastolic dysfunction, and this can impose limitations on the use of diastolic function as a diagnostic measure.

Additionally, previous studies have reported that right ventricular dysfunction may coexist in 50% of patients with severe sepsis and septic shock.[10] According to the American Society of Echocardiography criteria, right ventricular dysfunction can be defined based on the following criteria: tricuspid annular systolic excursion (TAPSE) <16 mm, tricuspid annular lateral systolic velocity (TDI Str' wave) <15 cm/s, and right ventricular FAC <35%. Due to the shape of the right ventricle, there are challenges in geometric assessment, and the evaluation of the right ventricle using TAPSE or S wave is limited to longitudinal assessment. Currently, STE may be a promising tool for detecting right ventricular dysfunction, but the associations between right ventricular strain and TAPSE or other parameters used to assess right ventricular function are moderate. Additional research is necessary to determine whether right ventricular dysfunction is a result of abnormal loading conditions or an inherent issue with myocardial function in the future.[10]

Despite these limitations, some previous studies have shown that isolated right ventricular dysfunction may be associated with worse survival rates.[10]

In summary, the 3D STE and 2D echocardiography for LV and right ventricular assessment are standard tests for patients with SCM, and these tests can assist in predicting the patient's prognosis.

REFERENCES

1. Cecconi M, De Backer D, Antonelli M, et al. Consensus on circulatory shock and hemodynamic monitoring. Task force of the European Society of Intensive Care Medicine. *Intensive Care Med* 2014;40:1795-815.
PUBMED | CROSSREF
2. Parker MM, Shelhamer JH, Bacharach SL, et al. Profound but reversible myocardial depression in patients with septic shock. *Ann Intern Med* 1984;100:483-90.
PUBMED | CROSSREF
3. Vieillard-Baron A, Charron C, Chergui K, Peyrouset O, Jardin F. Bedside echocardiographic evaluation of hemodynamics in sepsis: is a qualitative evaluation sufficient? *Intensive Care Med* 2006;32:1547-52.
PUBMED | CROSSREF
4. Aissaoui N, Guerot E, Combes A, et al. Two-dimensional strain rate and Doppler tissue myocardial velocities: analysis by echocardiography of hemodynamic and functional changes of the failed left ventricle during different degrees of extracorporeal life support. *J Am Soc Echocardiogr* 2012;25:632-40.
PUBMED | CROSSREF

5. Orde SR, Pulido JN, Masaki M, et al. Outcome prediction in sepsis: speckle tracking echocardiography based assessment of myocardial function. *Crit Care* 2014;18:R149.
PUBMED | CROSSREF
6. Nafati C, Gardette M, Leone M, et al. Use of speckle-tracking strain in preload-dependent patients, need for cautious interpretation! *Ann Intensive Care* 2018;8:29.
PUBMED | CROSSREF
7. Yan X, Li Y, Liu J, et al. Serial changes in left ventricular myocardial deformation in sepsis or septic shock using three-dimensional and two-dimensional speckle tracking echocardiography. *Front Cardiovasc Med* 2022;9:925367.
PUBMED | CROSSREF
8. Kim S, Seok H, Kim BK, et al. Seven-day and in-hospital mortality according to left and right ventricular dysfunction in patients with septic shock. *Korean Circ J* 2023;53:813-25.
CROSSREF
9. Beesley SJ, Sorensen J, Walkey AJ, et al. Long- term implications of abnormal left ventricular strain during sepsis. *Crit Care Med* 2021;49:e444-53.
PUBMED | CROSSREF
10. Lanspa MJ, Cirulis MM, Wiley BM, et al. Right ventricular dysfunction in early sepsis and septic shock. *Chest* 2021;159:1055-63.
PUBMED | CROSSREF