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Right ventricular involvement in acute myocardial infarction: can echo-derived indices aid in diagnosis?

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Right ventricular (RV) dysfunction in acute myocardial infarction (MI) has been shown to adversely impact prognosis [1, 2]. Measurement of global RV function by echocardiography is challenging due to the complex structure of the RV. While quantitation of RV volumes and ejection fraction has been performed using geometric modeling of the RV [3, 4], these methods are cumbersome and have been difficult to apply in practice. In addition, RV involvement in acute MI can sometimes be subtle and difficult to detect echocardiographically.

Several methods for quantitation of cardiac function independent of geometric assumptions have been studied for the assessment of both LV and RV dysfunction. Tei and colleagues first described the use of the myocardial performance index (MPI) to assess LV function [5, 6], and later applied this to the right ventricle [7]. This Doppler-derived index is a ratio of the sum of the isovolumetric contraction and relaxation times divided by the ejection time. Tei and colleagues found this index to be independent of tricuspid regurgitation severity, heart rate, and loading conditions [7], while others have found a modest relationship between the MPI and loading conditions [8]. The RV MPI has been studied in a variety of disease states which impact RV function such as primary pulmonary hypertension [7, 9], right ventricular infarct [10, 11] and congenital heart disease [12] and found to be a sensitive marker of RV dysfunction.

Additionally, annular motion of the tricuspid valve (TAM) has been used as a surrogate for assessment of global RV function. This method involves measurement of the maximal systolic excursion of the free wall annulus and was first described by Kaul and colleagues in a population consisting of normal patients and those with CAD [13]. A good correlation of the maximal systolic excursion of the tricuspid annulus was noted with RV function assessed by the gold standard of radionuclide angiography. This method was later expanded to include M-mode [14] and tissue Doppler indices [11, 15] of annular motion. When applied to individuals with known depressed RVEF from a variety of causes [16], an excellent correlation was again found with RV function by radionuclide angiography. The utility of tricuspid annular motion has also been noted to have excellent specificity and negative predictive value for RV dysfunction in a serial population of patients referred for echocardiography, using the RVEF by the Simpson's method as the gold standard for RV dysfunction [11]. Interestingly, Yoshifuku and colleagues described a "pseudonormal" pattern of the MPI in acute RV infarction [10]. RV infarction was defined hemodynamically as elevated RA pressure (> 10 mm Hg) or elevated RA pressure/pulmonary capillary wedge pressure (> 0.8). While the investigators noted that RV MPI was decreased in the setting of an RV infarct, when subjects were separated according to the severity of their RV infarct (again hemodynamically), the RV MPI decreased and was not statistically different from the MPI of subjects with inferior MI without RV involvement.

In this issue, Piestrzeniewicz et al. report on the utility of the RV MPI and the RV TAM in

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individuals presenting with first inferior MI (IMI) and compared individuals with and without concomitant right ventricular infarction [17]. All patients were treated with primary percutaneous coronary intervention, and echocardiography was performed 2–3 days after presentation. The investigators appropriately excluded individuals with coexisting diseases that can impact RV function, as well as those with arrhythmias such as atrial fibrillation, and those in whom echo imaging was suboptimal. An important feature of this study is that the investigators defined RV infarction independent of the echocardiographic findings. Using electrocardiographic criteria for the diagnosis of RV infarct in patients presenting with acute MI, they were thus able to determine the sensitivity and specificity of echocardiographic values for MPI and TAM for the detection of RV infarct. Cutoff values of > 0.36 for MPI and < 19.5 mm for TAM, were found to be the most accurate for the diagnosis of RV infarct. Use of both the RV MPI [18] and the TAM [19, 20] have been previously described in patients with MI, and the current study confirms that these markers are useful to detect RV dysfunction.

The decision of the investigators to use the ECG as the gold standard for the diagnosis of RV infarct can be seen as both an advantage, as outlined above and a disadvantage. While the sensitivity and specificity of ECG criteria for MI has been found by other investigators to be high [1], right precordial lead information was not available in all patients, potentially decreasing the accuracy of the diagnosis and raising the question of whether the groups were classified correctly. The authors appropriately make reference to this problem in the limitations section, and added a different grouping classification (proximal versus distal involvement of the infarct related artery) to help better understand the limits of the ECG gold standard. The authors found that a finding of TAM < 19.5 mm and/or MPI > 0.36 diagnosed RV involvement in 100% of subjects with IMI and proximal involvement of the infarct related artery. Another important point to be considered is that the echocardiograms were performed on day 2–3 after MI, thus all patients with RV involvement may not have been detected, since RV function may recover rapidly after revascularization.

In summary, the RV MPI and TAM are echocardiography-derived indices of RV function that are independent of geometric assumptions, and have been shown to be reliable tools for assessment of RV function in a variety of disease states. The MPI is a simple index obtainable from standard echocardiographic imaging, and the TAM can be readily measured, but requires M-mode tracings of the RV free wall annulus. While severe global RV function in the setting of RV infarct may be obvious by 2-D imaging alone, detection of subtle RV dysfunction can be more challenging. Given that RV involvement in acute MI impacts prognosis, indices such as these that may detect subtle RV dysfunction provide an important diagnostic tool for clinicians to help guide therapy and impact prognosis after MI. The studies by Piestrzeniewicz et al. (from this issue) and others have shown these indices to be useful markers to detect RV involvement in acute myocardial infarction when other disease states which can impact RV function (obstructive lung disease, pulmonary embolism, valve disease or congenital heart disease) have been excluded. Serial measurement of these indices after MI may help shed light on the impact of different therapeutic strategies on long term prognosis after RV infarction.

References

1. Zehender M, Kasper W, Kauder E et al. Right ventricular infarction as an independent predictor of prognosis after acute inferior myocardial infarction. N Engl J Med, 1993; 328: 981–988.
2. Kinch JW, Ryan TJ. Right ventricular infarction. N Engl J Med, 1994; 330: 1211–7.
3. Ninomiya K, Duncan WJ, Cook DH, Olley PM, Rowe RD. Right ventricular ejection fraction and volumes after mustard repair: correlation of two dimensional echocardiograms and cineangiograms. Am J Cardiol, 1981; 48: 317–324.
4. Levine RA, Gibson TC, Aretz T et al. Echocardiographic measurement of right ventricular volume. Circulation, 1984; 69: 497–505.
5. Tei C, Ling LH, Hodge DO et al. New index of combined systolic and diastolic myocardial performance: a simple and reproducible measure of cardiac function — a study in normals and dilated cardiomyopathy. J Cardiol, 1995; 26: 357–366.
6. Tei C. New non-invasive index for combined systolic and diastolic ventricular function. J Cardiol, 1995; 26: 135–136.
7. Tei C, Dujardin KS, Hodge DO et al. Doppler echocardiographic index for assessment of global right ventricular function. J Am Soc Echocardiogr, 1996; 9: 838–847.
8. Moller JE, Poulsen SH, Egstrup K. Effect of preload alternations on a new Doppler echocardiographic index of combined systolic and diastolic performance. J Am Soc Echocardiogr, 1999; 12: 1065–1072.

9. Sebbag I, Rudski LG, Therrien J, Hirsch A, Langleben D. Effect of chronic infusion of epoprostenol on echocardiographic right ventricular myocardial performance index and its relation to clinical outcome in patients with primary pulmonary hypertension. Am J Cardiol, 2001; 88: 1060–1063.
10. Yoshifuku S, Otsuji Y, Takasaki K et al. Pseudonormalized Doppler total ejection isovolume (Tei) index in patients with right ventricular acute myocardial infarction. Am J Cardiol, 2003; 91: 527–531.
11. 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: 443–447.
12. Eidem BW, Tei C, O'Leary PW, Cetta F, Seward JB. Nongeometric quantitative assessment of right and left ventricular function: myocardial performance index in normal children and patients with Ebstein anomaly. J Am Soc Echocardiogr, 1998; 11: 849–856.
13. Kaul S, Tei C, Hopkins JM, Shah PM. Assessment of right ventricular function using two-dimensional echocardiography. Am Heart J, 1984; 107: 526–531.
14. Hammarstrom E, Wranne B, Pinto FJ, Puryear J, Popp RL. Tricuspid annular motion. J Am Soc Echocardiogr, 1991; 4: 131–139.
15. Isaaz K, Munoz del Romeral L, Lee E, Schiller NB. Quantitation of the motion of the cardiac base in normal subjects by Doppler echocardiography. J Am Soc Echocardiogr, 1993; 6: 166–176.
16. Ueti OM, Camargo EE, Ueti Ade A, de Lima-Filho EC, Nogueira EA. Assessment of right ventricular function with Doppler echocardiographic indices derived from tricuspid annular motion: comparison with radionuclide angiography. Heart, 2002; 88: 244–248.
17. Piestrzeniewicz K, Łuczak K, Piechowiak M, Maciejewski M, Goch JH. The value Doppler-derived myocardial performance index and tricuspid annular motion in the evaluation of the right ventricular function in patients with acute inferior myocardial infarction. Folia Cardiol, 2006; 13: 369–378.
18. Moller JE, Sondergaard E, Poulsen SH, Appleton CP, Egstrup K. Serial Doppler echocardiographic assessment of left and right ventricular performance after a first myocardial infarction. J Am Soc Echocardiogr, 2001; 14: 249–255.
19. Alam M, Wardell J, Andersson E, Samad BA, Nordlander R. Right ventricular function in patients with first inferior myocardial infarction: assessment by tricuspid annular motion and tricuspid annular velocity. Am Heart J, 2000; 139: 710–715.
20. Samad BA, Alam M, Jensen-Urstad K. Prognostic impact of right ventricular involvement as assessed by tricuspid annular motion in patients with acute myocardial infarction. Am J Cardiol, 2002; 90: 778–781.