D iastolic dysfunction (DD) of the left ventricle is often found during comprehensive echocardiography, including tissue Doppler imaging, regardless of the presence or absence of heart failure (HF). The prevalence of DD increases with aging and is associated with coronary artery disease (CAD), hypertension, diabetes mellitus and left ventricular (LV) systolic dysfunction. The DD grade can be used for risk assessment in patients with heart disease. An advanced grade of DD (i.e., moderate (pseudonormal filling) or severe (restrictive filling)) is known to be associated with increased risk of death not only in patients with impaired systolic function but also in patients with normal systolic function.

Several recent studies have demonstrated that the DD grade temporally changes in patients with preserved LV ejection fraction (LVEF). It has been shown that DD grade worsened in approximately one-fifth of a study population during the follow-up period and that worsening of diastolic function (DF) was associated with the development of HF and increased risk of death (Table). Furthermore, Cavalcante et al recently demonstrated that temporal changes in DF can predict clinical outcomes independently of LVEF recovery in patients with acute onset of left ventricular systolic dysfunction.

### Table. Comparison of Reports Regarding the Association Between Changes in DF and Cardiac Events

| Study | n | Age (years) | Study population | Mean EF | Mean interval from 1st to 2nd test | Worsened DF | Unchanged DF | Improved DF | Mean follow-up period from 2nd test | Results |
|-------|---|-------------|-----------------|---------|----------------------------------|------------|-------------|------------|-----------------------------------|---------|
| Achong et al (2009) | 184 | 62 | Preserved EF (≥45%) | NA | 3.6 years | 27% | 52% | 21% | 4.8 years | Patients with improved DF have favorable outcomes |
| Kane et al (2011) | 1,402 | 61 | Population-based cohort | 64% | 4.0 years | 23% | 68% | 9% | 6.3 years | Persistent or progression of DD associated with development of heart failure |
| Aljaroudi et al (2012) | 1,065 | 68 | Preserved EF (≥55%) | 59% | 1.1 years | 16% | 73% | 11% | 1.6 years | Worsening of DF independently associated with increased risk of death |
| Cavalcante et al (2016) | 147 | 46 | Acute NICM with reduced EF (≤40%) | 23% | 6 months | 14% | 28% | 58% | 1.8 years | Patients with improved DF have favorable outcomes |
| Kim et al (2019) | 1,235 | 64 | CAD patients undergoing PCI | 60% | 7 months | 18% | 50% | 32% | 44 months | Worsening of DF independently associated with increased risk of MACE |

CAD, coronary artery disease; DD, diastolic dysfunction; DF, diastolic function; EF, ejection fraction; MACE, major adverse cardiac event; NA, not available; NICM, nonischemic cardiomyopathy; PCI, percutaneous coronary intervention.

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non-ischemic cardiomyopathy (mean LVEF 23%) (Table). Collectively, these findings indicate that temporal changes in DF are also an important predictor of cardiac events in patients with heart disease, regardless of the presence or absence of systolic LV dysfunction. However, it has not been determined whether temporal changes in DF are associated with clinical outcomes in patients who have undergone percutaneous coronary intervention (PCI).

In this issue of the Journal, Kim et al13 report the prognostic importance of temporal changes in DF in patients undergoing PCI. They showed that DF worsened in 219 (17.8%) patients at the time of follow-up echocardiography, which was comparable with the results of other recent studies (Table). They also show the clinical characteristics of the patients with worsened DF. Patients with worsened DF had a higher SYNTAX score, larger number of treated coronary artery lesions, and higher frequencies of hypertension, chronic kidney disease, and multivessel disease than did patients with improved DF. Kim et al demonstrate that worsening of DF is independently associated with an increased risk of major adverse cardiac events (i.e., cardiac death, myocardial infarction, and repeat revascularization) in patients undergoing PCI. Furthermore, they confirmed that the close relationship between aggravation of DF after PCI and long-term adverse outcomes was consistent among various conditions in their subgroup analysis.

This study clearly demonstrated that changes in DF independently predict long-term outcomes after PCI. The results suggest that monitoring of DD before and after revascularization is important for predicting cardiac events. It might be interesting to conduct a future study to determine whether there is also a close relationship between temporal changes in DF and clinical outcomes in patients who have undergone surgical interventions such as coronary artery bypass grafting and transcatheter aortic valve replacement. However, several unresolved points remain. First, the mechanisms responsible for the association between changes in DF and adverse outcomes are still unknown. As stated by Kim et al., several factors, including residual ischemia, procedural complications (e.g., distal embolization and no-reflow during PCI) and poor control status of risk factors for CAD might explain this association. Further study is needed to clarify the unresolved mechanisms. Second, the interval from preprocedural echocardiography to follow-up echocardiography was not uniform. However, the authors showed that the association between changes in DF and clinical outcomes was more potent in patients with a relatively short interval until follow-up echocardiography (i.e., within 7 months), as shown in their Supplementary Table 5. The optimal interval until follow-up echocardiography should be clarified in order to determine the need for more intensive management in the early phase of post-revascularization. Third, only selected patients undergoing PCI who underwent serial echocardiography at both baseline and follow-up were enrolled in the study, as shown in Figure 1. There might be selection bias that may have influenced the results of this study.

In conclusion, regardless of LV systolic function and other clinical factors, DF change has prognostic value in patients who have undergone PCI. Assessment of not only systolic function but also DF in CAD patients before and after revascularization should be considered in order to better predict long-term clinical outcomes. We hope that a multicenter study will be performed in the future to validate the results of this study.

Disclosure

None.

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