Review Article

Echocardiography in Acute Heart Failure: Current Perspectives

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ABSTRACT

In contrast to chronic heart failure (HF), the use of echocardiography in acute HF (AHF) is less well defined, both in clinical practice and in clinical trials. Current guidelines recommend the utility of echocardiography as an adjunct diagnostic tool in the clinical setting of new-onset or decompensated HF. However, despite its unique advantages as the only practical imaging modality in AHF, echocardiography poses unique challenges in this setting. Data from early-phase clinical studies and trials provide evidence that echocardiographic end points can be clinically meaningful surrogate end points as a means to track response to treatment in AHF; however, the optimal timing and selection of echocardiographic measures is under active investigation. In addition, despite a number of studies indicating that certain echocardiographic measures of cardiac function are predictive of post-discharge prognosis, the role of echocardiography as a tool for patient classification and risk determination in AHF is less well defined. Importantly, it is unclear whether echocardiography can be used to phenotype and select AHF patients for interventions. In this article, we (1) appraise the current evidence for use of echocardiographic measures in AHF, (2) identify knowledge gaps regarding optimal use of echocardiography in AHF, and (3) assess the evidence for echocardiography as a prognosis determination and risk stratification tool in AHF. (*J Cardiac Fail 2016;22:82−94*)

Key Words: Echocardiography, heart failure, acute heart failure, clinical trials.

The role of echocardiography in patients with chronic heart failure (HF) is well established both in clinical practice and in clinical trials. In clinical practice, it is used mainly to track response to treatment and identify hemodynamic and structural abnormalities that could explain new or changing symptoms. However, we have previously highlighted that the extent and depth of use of echocardiography in chronic HF trials, in both phase II and phase III, does not parallel the use in clinical practice.[1] For example, several trials have relied on visual assessment of left ventricular ejection fraction (LVEF) as the sole structural inclusion criterion.[1] Also, new or changing symptoms rarely trigger per-protocol echocardiography in clinical trial settings. In all, echocardiography is currently used in clinical trials mostly as a tool to identify eligible patients but rarely as a surrogate or mechanistic end point,[2,3] despite echocardiographic parameters having been the most reliable surrogate end points in phase II trials of chronic HF to date.[4,5]

In contrast to chronic HF, the use of echocardiography in acute HF (AHF) is less well defined, both in clinical practice and in clinical trials. Current guidelines recommend the use of echocardiography as an adjunct diagnostic tool in the clinical setting of new-onset or acutely decompensated HF.[6−8] However, it is unclear whether echocardiography is also a useful tool for classification and risk determination in AHF and, most importantly, whether information from echocardiography can be used to phenotype and select patients for interventions. The problem of patient phenotyping in AHF is underscored by the invariably negative results of AHF trials in the past decade, despite the promising biologic properties of new agents.[9−14] A key issue in these trials appears to be the inadequate patient phenotyping and classification of the various AHF presentations.[15] Echocardiography, as the only practical imaging modality in the

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AHF setting, has the potential to provide unique insights into the structural and functional status of the heart and, potentially, guide treatment. However, echocardiography poses unique challenges in patients admitted for AHF. Besides technical challenges, AHF is a dynamic condition and thus standardization of acquisition timing—to ensure methodologic consistency of echocardiographic end point assessment—is challenging from a protocol design as well as a logistical perspective.

In the present review article, we (1) appraise the current evidence for echocardiographic measures in AHF, (2) identify knowledge gaps regarding optimal use of echocardiography in AHF, and (3) assess the evidence for echocardiography as a prognosis determination and risk stratification tool in AHF.

Current Recommendations

Both the updated 2013 recommendations from the American College of Cardiology Foundation (ACCF) and American Heart Association (AHA) and the 2012 European Society of Cardiology (ESC) guidelines agree that echocardiography is the most useful imaging tool in the evaluation and initial diagnosis of systolic and diastolic cardiac dysfunction and, at times, can reveal the etiology of new-onset HF.[6,7] The ACCF/AHA guidelines further emphasize the importance of measurement of LVEF, wall thickness, wall motion, valve function, and structural remodeling in patients who either present with a change in clinical status, are recovering from a clinical event, or have received treatment that might have affected cardiac function. ESC recommendations go beyond HF diagnosis and emphasize the role of Doppler echocardiography for noninvasive monitoring during hospitalization for AHF to avoid invasive hemodynamic monitoring.

Finally, the 2011 Appropriate Use Criteria for Echocardiography are consistent with the guidelines and deem the use of echocardiography to be appropriate for initial diagnosis of HF, for evaluation of a patient who exhibits a change in clinical status without a clear precipitating factor, and, more broadly, when echocardiography results might change patient management.[16]

Current Use of Echocardiography in AHF

Despite guideline recommendations, the proportion of patients undergoing echocardiography in the clinical setting of either new-onset or decompensated HF remains low. In a recent United States study, 2 of 5 Medicare beneficiaries did not undergo assessment of LVEF after a new diagnosis of HF.[17] Although the proportion of patients who undergo LVEF assessment has increased over time, women, blacks, older patients, and outpatients are less likely to undergo recommended testing.[17] In a European HF study of 9,400 patients admitted with AHF from October 2005 to March 2006 (56% with previously diagnosed HF), only 32% had an echocardiogram performed at some point during the index admission, ie, 68% of this AHF cohort did not have an echocardiogram performed by the time of discharge.[18] The timing of echocardiogram during the admission was also highly variable: among those who underwent echocardiography, 44% were imaged within the 1st 24 hours and 90% within 5 days.[18] Finally, the decision to perform echocardiography on patients who had an earlier study also was variable, with about one-half of patients with a previous echocardiogram having a new one during the index admission. This variability underscores the lack of consensus recommendations for the optimal timing of and reevaluation with echocardiography in AHF patients. Also, despite ESC recommendations, the penetration of echocardiography for noninvasive hemodynamic monitoring of AHF patients in clinical practice is rather limited.

In contrast to the above studies, the proportion of patients with LVEF assessment in United States registries was considerably higher when LVEF assessment was considered as a quality-of-care metric. In the ADHERE registry, which included 160,000 patients with AHF admitted to 285 hospitals from January 2002 to December 2004, the proportion of patients who had an LVEF assessment increased from 82.5% to 88.9% over the 3-year period.[19] In OPTIMIZE-HF, a registry designed to improve care of HF patients by better implementation of guidelines, data from 48,612 patients were collected from 259 United States hospitals in 2003−2004. Similarly to ADHERE, evidence-based practices showed improvement over time, with LVEF assessment increasing from 89% to 92% over a 21-month period.[20] The American Heart Association's Get With the Guidelines is a program aiming to improve patient care and outcomes in coronary artery disease, stroke, and HF. Hospitals receiving performance achievement awards from the program had a 93.4% LVEF documentation compared with 88.8% in the remaining facilities.[21]

In summary, incorporation of LVEF documentation as a quality-of-care metric in AHF is effective in improving rates of LVEF assessment in these patients.

Main Echocardiographic Findings From AHF Studies

Echocardiographic findings of patients with AHF have not been adequately described, in part because a universal definition of AHF has not been established, but also because of the wide range of pathophysiologic abnormalities underlying AHF.[22] In the Euroheart Failure Survey II, a multicenter European study of 3,600 patients, characteristics of AHF patients were identified during admission.[23] Overall, mean LVEF was 38%, but de novo AHF patients had slightly higher mean LVEF compared with those with acute exacerbation of chronic HF (42% vs 36%). Severely depressed left ventricular (LV) function (LVEF $<30\%$) was more common in chronic HF patients. The left atrium was enlarged, with a median diameter of 47 mm. Valvular disorders were common, with mitral regurgitation (MR) being the most frequent. There was evidence of