Clinical Monitoring of Stage B Heart Failure: Echocardiography

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KEYWORDS

• Stage B heart failure • Heart failure • Echocardiography
• Left ventricular systolic dysfunction

The widespread availability of echocardiography makes it an attractive tool for detecting the structural changes that accompany stage B heart failure (HF). The best studied manifestation of stage B HF is reduced left ventricular ejection fraction (LVEF), or asymptomatic left ventricular systolic dysfunction (LVSD), which is typically assessed echocardiographically. Estimates of the prevalence of asymptomatic LVSD in the community vary widely depending on the study sample and definition of LVSD (**Table 1**).[1] More subtle reductions in left ventricular (LV) systolic or diastolic function are now detectable with newer echocardiographic measures, which can influence estimates of the burden of stage B HF. For instance, if the definition is broadened to include diastolic filling abnormalities, the estimated prevalence of stage B HF increases dramatically.[2]

This article reviews the rationale for echocardiographic screening for screening for stage B HF, describes currently available measures of cardiac structure and function, and assesses the potential role of echocardiography in selected subgroups.

WHY SCREEN FOR LEFT VENTRICULAR SYSTOLIC DYSFUNCTION WITH ECHOCARDIOGRAPHY?

Several investigators have proposed screening programs for LV dysfunction, particularly systolic dysfunction, as a strategy for preventing the onset of overt HF. A critical criterion for screening is the presence of a latent phase of disease whereby an abnormality is present but is not clinically manifest. Asymptomatic LVSD detected by echocardiography represents such a latent phase in the progression to overt symptomatic HF. Wang and colleagues[3] found a dramatically increased risk of overt HF in individuals with asymptomatic LVSD detected by echocardiography in the Framingham Heart Study. Participants with LVSD in the mild range, defined as an LVEF of 40% to 50%, had a more than threefold risk of developing overt HF compared with those with normal LV function. Individuals with moderate to severe LVSD, defined as LVEF less than 40%, had a nearly eightfold risk. Of importance is that the time to onset of HF in many instances was a decade or more, suggesting a window of opportunity for preventive measures. Further, roughly half of the individuals with LVSD had no prior history of myocardial infarction.[3] As reviewed previously, evidence that early intervention can forestall the development of overt HF is provided by large-scale trials of angiotensin-converting enzyme inhibition, such as the SOLVD Prevention trial.[4] Early intervention in those with diastolic dysfunction, with risk-factor modification and blood-pressure control, may also yield benefits, although data from randomized trials are currently lacking.

ECHOCARDIOGRAPHIC ABNORMALITIES INCLUDED IN THE DEFINITION OF STAGE B HEART FAILURE

The American Heart Association and American College of Cardiology have defined stage B HF as "detectable structural disease without symptoms

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Heart Failure Clin 8 (2012) 169–178
doi:10.1016/j.hfc.2011.11.007
1551-7136/12/$ – see front matter

Table 1
Use of echocardiography to determine prevalence of systolic dysfunction in the population

Study	Participants (n)	Mean Age (y)	Men (%)	Prevalence of Asymptomatic LVSD
LVSD Defined as EF <0.50, or Equivalent				
Strong Heart Study[60]	3184	58	37	12.5
HyperGEN Study[61]	2086	55	38	12.9
Echocardiographic Heart of England Study[62]	3960	61	50	3.3
MONICA project[63]	1566	50	48	1.1
Hedberg et al[64]	412	75	50	3.2
Rotterdam Study[65]	2267	66	45	2.9[a]
Helsinki Aging Study[66]	501	75–86	27	8.6
Redfield et al, EF by 2D visual method[2]	2036	63	—	6.0
Framingham Heart Study[3]	4257	—	44	3.0
LVSD Defined as EF <0.40				
Strong Heart Study[60]	3184	58	37	2.1
HyperGEN Study[61]	2086	55	38	3.4
Echocardiographic Heart of England Study[62]	1467	50	48	0.9
MONICA project; EF $\leq$0.35[67]	1467	50	48	5.9
MONICA project; EF $\leq$0.30[67]	1467	50	48	1.4
Redfield et al, EF by 2D visual method[2]	2036	63	—	2.0

Abbreviations: HyperGEN study, Hypertension Genetic Epidemiology Network; MONICA project, Monitoring trends and determinants of cardiovascular disease.

[a] Based on 1698 participants.

From Wang TJ, Levy D, Benjamin EJ, et al. The epidemiology of "asymptomatic" left ventricular systolic dysfunction: implications for screening. Ann Intern Med 2003;138:907–16; with permission.

of HF."[5] According to the guidelines, this may include previous myocardial infarction, LVSD, left ventricular hypertrophy (LVH), and valve disease. Each of these conditions may be detected by echocardiography, with generally much better sensitivity than nonimaging tools such as clinical history or electrocardiography (ECG). There is, importantly, substantial overlap as well. For instance, LVSD frequently coexists with prior myocardial infarction, valve disease, or LVH.[1,3]

Diastolic dysfunction also frequently accompanies the structural abnormalities of stage B HF. Diastolic dysfunction appears to be an important predictor of mortality in individuals after they develop symptomatic HF, regardless of etiology. For instance, Xie and colleagues[6] reported that patients with HF and restrictive filling patterns (defined as early/atrial [E/A] ratio $\geq$2 or E/A = 1–2, and deceleration time $\leq$140 milliseconds) had 1-year mortality of 19% and 2-year mortality of 51%, compared with only 5% mortality at 2 years for those with nonrestrictive diastolic filling.

Diastolic dysfunction is also common, and predicts adverse outcomes in asymptomatic individuals.[2,7] In their review of data from Olmstead County, Ammar and colleagues[8] reported that inclusion of diastolic dysfunction in the definition of stage B HF raised the percentage of individuals with this condition from 23% to 34%. Individuals with stage B HF (including diastolic dysfunction) had a 5-year survival of 96%, compared with 99% for those with no HF risk factors.

WHAT ARE THE IMPORTANT VARIABLES TO ASSESS IN THE ECHOCARDIOGRAPHIC EVALUATION?

Echocardiography is a powerful tool that provides accurate structural and functional information about the heart, without the need for ionizing radiation or intravenous contrast. A selection of the measurements that can be gathered from echocardiography to help identify those at risk of developing HF is presented in **Fig. 1**.