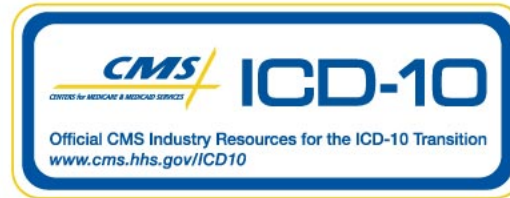


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Editorial Comment

Outcomes Research: Evaluating the Impact of Echocardiography in Congestive Heart Failure*

GOTTLIEB C. FRIESINGER II, MD, FACC

Nashville, Tennessee

The last two decades have seen extraordinary changes in physicians' attitudes toward and approach to the syndrome of congestive heart failure (CHF). Research into etiology and pathophysiology, development of powerful diagnostic tools that provide insights into pathophysiology and new therapeutic approaches effective in ameliorating symptoms and prolonging life all contribute to this change. Echocardiography is uniquely suited to evaluate the anatomical and functional cardiac abnormalities in CHF. In this editorial, the term "echocardiography" is used to indicate the Doppler echocardiographic study as Doppler interrogation is essential to study valvular function and estimate diastolic function. It provides valuable information in reference to the diagnosis, prognosis and therapeutic approaches to this very common syndrome. The clinical utility of echocardiography in patients known or suspected of having congestive heart failure, the ease with which it can be obtained, and the widespread availability and safety of the procedure have made it (except for the electrocardiogram) the most frequently used cardiovascular diagnostic technique, resulting in the largest expenditure for any cardiovascular diagnostic test.

Evaluating the utility of a diagnostic, in contrast to a therapeutic intervention, is a daunting task (1).

Two widely cited guidelines, one a consensus-based document (2) and the other an "evidence-based" document (3), recommend that echocardiography be an integral part of the evaluation of the patient with CHF. In this era of so-called evidence-based, cost-effective medicine, it is desirable to learn whether guidelines are effective in enhancing the quality of care.

In this issue of the Journal, Senni and colleagues (4) report the use and impact of echocardiography in the 216 patients

with newly diagnosed congestive heart failure, using the Framingham criteria, in Olmstead County, Minnesota, in 1991.

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Data from the unique Rochester Epidemiologic Program were used. They compared a variety of patient characteristics and the outcome of the 137 patients who underwent echocardiography within 3 weeks of the episode of congestive heart failure (Echocardiography group) with 79 patients (37% of the sample) who did not have such an echocardiogram (No-Echocardiography group). The principal end point was mortality. Although crude survival was not significantly different between the two groups adjusting for baseline differences in age, New York Heart Association (NYHA) functional class, and sex by multivariate analysis, there was a lower risk of death in the Echocardiography group (RR = 0.607, $p = 0.017$). This is an unexpected result.

Although patients in the No Echocardiography group were slightly older (mean age 80 vs. 76 years), the Echocardiography group patients had markers of more severe congestive heart failure. Statistically, more in the Echocardiography group were in-patients who had higher NYHA class, had far more frequent gallop sounds and had greater changes on chest X-ray film (pulmonary venous hypertension, interstitial pulmonary edema and bilateral pleural effusions). In addition, a single but important measure of co-morbidity, creatinine of greater than 2 mg/dl, was statistically more frequent in the Echocardiography group. Of particular importance in assessing mortality as an outcome, the Echocardiography group patients were statistically more likely to get digoxin, angiotensin-converting enzyme (ACE) inhibitor, warfarin and (although nonstatistically significant) a diuretic. The investigators' conclusion that survival after the adjustments was lower in the No-Echocardiography group than in the Echocardiography group is warranted by the data, but why the difference exists needs explanation.

The current report has the important advantage of being population based; the entire population of Olmstead County (more than 100,000 inhabitants) were surveyed, and in-patient as well as out-patient cases of congestive heart failure are included. This has the potential to avoid selection bias although the generalizability of the information must be undertaken cautiously as the ethnicity and diversity of the United States is not reflected because Olmstead County is overwhelmingly white (96%). In addition, retrospective studies are always subject to diagnostic error despite the most thoughtful and fastidious chart review. Although using the Framingham diagnostic criteria is a reasonable approach there is considerable subjectivity in assessing a number of the major criteria whether they be symptoms, presence of a third heart sound or an estimate of central venous pressure of more than 16 cm of water, and these major diagnostic criteria have considerable temporal variation. Much has changed since these criteria were formulated in 1971. In the studies of Marantz (4), 407 patients

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From Vanderbilt University School of Medicine, Nashville, Tennessee 37232. Dr. Friesinger is Betty and Jack Bailey Professor of Cardiology.

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Address for correspondence: Dr. Gottlieb C. Friesinger, 315 MRB II, 2220 Pierce Avenue, Vanderbilt University School of Medicine, Nashville, Tennessee 37232-6300. E-mail: gottlieb.friesinger@mcmail.vanderbilt.edu.

were prospectively evaluated using three clinical classifications of CHF (Framingham, Boston, and Duke criteria) compared to left ventricular ejection fraction determined by radionuclide triculography. They concluded that the definitions had varying utility depending on the population being examined. In another study (5), they reviewed the early heart failure trials in reference to CHF classification and found wide disparity. Their overall conclusion that a combination of clinical features and an objective measure of cardiac performance are needed to diagnose congestive heart failure is a sound one and raises the question: Should echocardiographic abnormalities be a part of *the definition* of congestive heart failure?

The increased mortality in the No-Echocardiography group patients who had clinical markers of less severe cardiovascular disease is surprising and emphasizes (as the authors discuss) shortcomings of this retrospective study. Most important are potential differences in baseline co-morbidity in this very old population. A variety of fatal conditions may have been present in the No-Echocardiography group and accounted for the increased mortality. The cause of death was not studied, and a cardiac cause for death cannot be assumed in patients with CHF whose mean age at time of entry is 80 years. The mean difference of 4 years in this older age group is important biologically and emphasizes the need to consider competing risks, the situation when the establishment of a new diagnosis (in this case CHF) has much less effect on long-term mortality (5). Not only is co-morbidity much greater with increasing age, but the effect of old age per se and the lack of physiologic reserve both come into play.

Of major importance, the data suggest that knowledge obtained from the echocardiogram was the reason why the Echocardiography group had better survival. Patients in the Echocardiography group were treated more frequently with the three major classes of drugs known to improve symptoms—digoxin, ACE inhibitor, and diuretic—and much more frequently with the ACE inhibitor (53% vs. 28%), the drug known to prolong life in congestive heart failure. Nine Echocardiography group patients underwent cardiac surgery perhaps as a direct result of information uncovered by echocardiography. Although this represents only 6% of the sample, with such a small sample size these nine patients could be responsible for the improved outcome for the Echocardiography group if there was a mortality benefit from surgery. Data in the report do not allow a judgment as to which of these possibilities—or a combination of possibilities—might explain the differences.

Additional features could help explain the outcome and also the question: Who provided care for the patients? Cardiologists, particularly those with special knowledge and interest in CHF, have been shown to provide different care and derive better outcomes than noncardiologists (6–10). What was the pathophysiology? On the basis of echocardiographic can assess diastolic and systolic dysfunction. Patients with diastolic dysfunction generally have better outcomes than do patients with systolic dysfunction (11). Certainly, the greater the degree of systolic dysfunction, the poorer the outcome, so that estima-

tion of ejection fraction is, of course, a critical variable in prognosis.

When differences that are possibly related to a lack of balance in important baseline variables and/or treatment differences are judged to be the explanation of an outcome, it is usual to call for a randomized controlled trial. In the evaluation of a diagnostic test or a management strategy, in contrast to the short-term evaluation of a therapeutic intervention, randomized controlled trials are ordinarily not feasible and probably not the most appropriate mechanism to evaluate a diagnostic test. Observational databases, appropriately constructed, utilizing quantitative epidemiological methods and sophisticated statistical approaches to assess outcomes are not only justified but preferred (12). In reference to the current report, the inadequate information on important baseline variables in this elderly population and inability to assess the cause of death are major drawbacks, as was cited, and the sample was relatively small. However, these issues can be overcome by more fastidious collection of data prospectively and specific efforts to assess the cause of death, always a difficult issue, but differentiating cardiac death from other causes is usually possible.

What has the study taught us? The work of Senni and her colleagues reminds us that retrospective analyses which appropriately link existing databases can provide useful insights regarding the manner in which guidelines are being utilized and provide persuasive suggestions concerning how they influence patient care. Even with thoughtful, detailed analyses, the limitations of such an approach, however, are abundantly apparent. Despite these limitations, the strong suggestion that echocardiography as a part of the workup of new-onset congestive heart failure is underutilized and improves care and outcome seems reasonable.

What must we do to learn more? To study outcomes initially, whether therapies or the more difficult area of use of “tests,” disease-specific, detailed, prospective data collection is a key to appropriate interpretation. The Rochester Epidemiology Project is unique (13,14), but other databases could be similarly studied. However, to clarify the problem, details about the spectrum of etiology of congestive heart failure, much more detail about echocardiographic findings in the form of pathophysiology and anatomical change disease as well as details concerning mode of death are all critical. Beyond that, the evaluation of echocardiography as a test to improve outcome almost certainly will require broader and “softer” end points, not just mortality, to be evaluated. Hospitalization for episodes of congestive heart failure was a particularly valuable end point in the SOLVD Prevention Trial (15) and the DIG trial (16). Not only do fewer hospitalizations improve the patient’s lifestyle but they greatly reduce the expense of caring for this very costly syndrome. In addition, because the vast majority of patients who have CHF are elderly, information about functional status and ability to continue to live independently would be important. Such an approach would provide an important first step in a very complicated process—that is,

evaluating the use of a test, echocardiography, in the treatment of a complicated syndrome, namely congestive heart failure.

Senni and her colleagues deserve our thanks for providing a stimulating report. We hope others will pursue additional follow-up studies despite the considerable obstacles that exist in evaluating a diagnostic test.

The review and critique of Benjamin F. Byrd III is appreciated.

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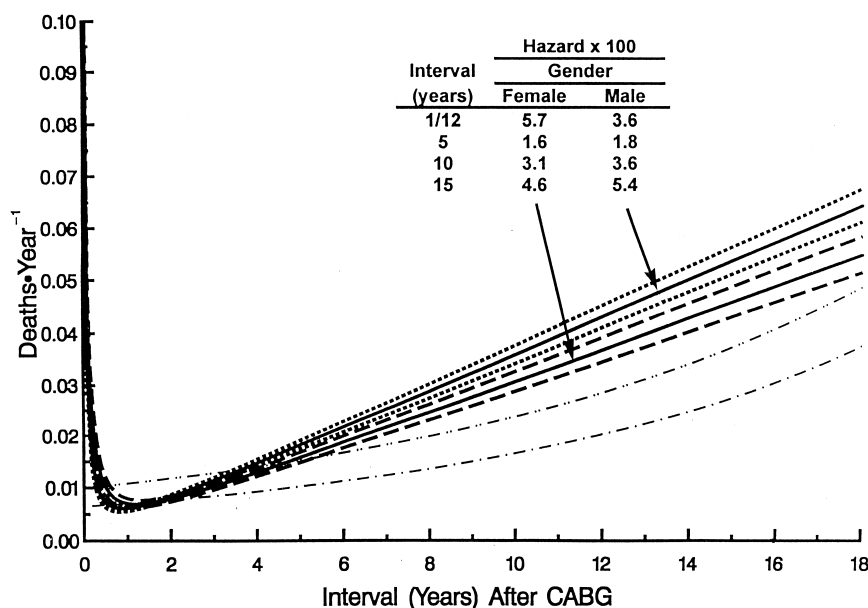
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CORRECTIONS

Myers WO, Blackstone EH, Davis K, Foster ED, Kaiser GC. CASS Registry: Long Term Surgical Survival. *J Am Coll Cardiol* 1999;33:488-98.

There is a graphical representation error in Figure 3 on page 493. The arrows pointing to the curves for female and male are reversed.

The corrected Figure 3 appears below. The authors regret the error.



Friesinger GC, II. Outcomes Research: Evaluating the Impact of Echocardiography in Congestive Heart Failure (editorial comment). *J Am Coll Cardiol* 1999;33:171-3.

The following references were omitted from the reference list:

- Marantz PR, Tobin JN, Wassertheil-Smoller S, et al. The relationship between left ventricular systolic function and congestive heart failure diagnosed by clinical criteria. *Circulation* 1988;3:607-12.
- Marantz PR, Alderman MH, Tobin JN. Diagnostic heterogeneity in clinical trials for congestive heart failure. *Ann Intern Med* 1988;109:55-61.

The addition of these citations re-orders the reference list, altering the numbers of citations in the text. We regret the error.

Zannad F, Briancon S, Julliere Y, Mertes P-M, Villemot J-P, Alla F, Virion J-M, and the EPICAL Investigators. Incidence, Clinical and Etiologic Features, and Outcomes of Advanced Chronic Heart Failure: The EPICAL Study. *J Am Coll Cardiol* 1999;33:734-42.

The legends for Figures 2 and 3 were transposed.

The correct legends for Figures 2 and 3 are as follows:

Figure 2. Hospital readmission-free survival in patients with advanced congestive heart failure (censorship is represented by vertical bars).

Figure 3. Survival of patients with advanced congestive heart failure (including index hospitalization mortality) (censorship is represented by vertical bars).

Furthermore, line 4 in the RESULTS section in the condensed abstract on p. 734 should read as follows: "Patients were admitted to hospital 2.05 times per year (50.3% of these for worsening heart failure)."

Finally, on page 737, under "Incidence and patient characteristics" heading, lines 23-24, should read as follows: "Attributable causes of CHF included CHD (n = 231; 46.3%) (history of MI in 202 patients [87.4%]) and non-CHD causes (n = 268; 53.6%) (congenital heart disease [n = 3], valvular heart disease [n = 47], dilated cardiomyopathy [n = 214], unknown causes [n = 4])."

The authors regret the errors.