

A Comparison of Cardiologist and Noncardiologist Use of Echocardiograms:

Implications for Containing Health Care Costs

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Abstract

Echocardiography enables physicians to examine the heart noninvasively and provides a comprehensive evaluation of the cardiovascular system. However, because it is a relatively expensive procedure compared to an ECG or X-ray, it is crucial that "echo" be utilized appropriately and judiciously.

Using a retrospective chart review, we sought to determine whether there are differences in concordance between the diagnoses and echo findings of cardiologists and those of other physicians. Due to cardiologists' greater knowledge of cardiophysiology and echocardiography, cardiologists were expected to have a higher concordance between patient diagnosis and echocardiogram findings when compared to noncardiology physicians. Randomly, 500 echo reports were assessed for diagnosis, reason for the echo, and whether the echo findings agreed with the diagnosis. Other criteria that were studied included whether there were additional, unanticipated findings and whether these findings were of major or minor importance.

Concordance between cardiologist pre-test diagnosis and echo findings was found in 95 out of 175 tests (54%). Noncardiologist pre-test diagnosis concordance with echo findings was found in 117 out of 325 tests (36%) ($p < 0.0001$). Thus, the cardiologists were found to have a significantly higher concordance between diagnosis and findings on echocardiogram when compared to noncardiologist physicians.

Key Words: Echocardiography, cardiology, health care costs.

Introduction

ECHOCARDIOGRAPHY is noninvasive and provides an efficient and accurate assessment of cardiac function, often able to provide unexpected findings that can alter both the diagnosis and course of treatment (1). According to one study, echocardiography provided 63.4% of all cardiovascular imaging for Medicare enrollees in 1998 (2). However, it is a relatively expensive procedure, contributing to rising health care costs.

The use of echocardiography continues to increase, and this technical procedure is ordered not only by cardiologists, but by internists and radiologists as well. But cost-effective test utilization requires an appreciation of the potential value of the exam as well as its accurate interpretation and appropriate integration into clinical care. Inappropriate or unnecessary use leads to increases in the cost of patient care and reduces the cost-effectiveness

of this technology. In this study, we compared the degree of concordance between the clinical diagnosis and the echocardiographic findings for tests ordered by cardiologists and those ordered by noncardiologists. We hypothesized that cardiologists would have a greater concordance between their reason for ordering an echo and actual echo findings than noncardiologists.

Methods

We retrospectively reviewed random, non-sequential charts of patients who had had an M-mode, two-dimensional, and Doppler transthoracic echocardiogram (echo) during routine clinical care at a tertiary referral center in 2003. Both inpatients and outpatients were included. All studies were performed by registered technologists on state-of-the-art harmonic systems and read by level-3-trained cardiologists. Echoes of poor diagnostic yield due to inadequate imaging windows or incomplete echos were not included in this study. Echocardiograms of postoperative patients were included in this study to provide an accurate representation of physician-ordering patterns of transthoracic echocardiograms. Data were collected by a medical student uninvolved in patient

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care, employing a standardized form. Patient age and gender were recorded. Information regarding the pre-test diagnosis, the reason for performing the ultrasound, and the test findings were obtained from post-test echocardiographic reports written by a reviewing cardiologist. An independent cardiologist examined the concordance between pre-test diagnoses or reasons for performing an echocardiogram with test findings.

Physician pre-test diagnoses were considered accurate if test findings corresponded to the pre-test diagnosis and/or the reason for ordering the ultrasound. Significant echo findings were defined as any pathology severe enough to impact clinical management by a physician and patient. Insignificant findings included minimal valvular insufficiency or calcification, minimal pericardial effusions not affecting normal hemodynamics, ventricular ejection fractions above 55%, and minimal chamber dilatations. Additional test findings not predicted by pre-test diagnosis and/or reason for ordering echocardiogram were recorded and evaluated for significance, using the aforementioned criteria.

The results were blinded as to whether the ordering physician was a cardiologist or noncardiologist, a category which included a variety of physicians not specifically trained in cardiology, such as internists, emergency medicine physicians, surgeons and specialists in other areas of internal medicine. Concordance or substantial agreement between test findings and reasons for testing were tabulated and then separated into two groups, according to who ordered the test: cardiologists or noncardiologists. Category variables were evaluated using chi-square tests, and $p \leq 0.05$ was regarded as significant.

Results

We reviewed 500 random echocardiograms performed in 2003. The mean patient age was 63 years, with a median age of 64. There was no statistically significant age difference (N.S.) between the population referred by cardiologists (63.5) and that referred by noncardiologists (62.7). The average age when there was concordance of pre-test diagnosis and actual echo findings was 65.2; the average age when there was nonconcordance was 61.4 (N.S.).

The gender distribution of the patients referred by cardiologists and noncardiologists was similar. The gender distributions were also similar when tabulated according to pre-test diagnosis and reason for ultrasound. There was no significant relationship between gender and concordance of pre-test diagnosis and post-test findings.

The reasons for ordering an echocardiogram consisted mainly of assessments of ventricular and

valvular function (107/500) (Fig. 1), problems with ventricular function only (237/500), and problems with valvular function only (58/500). However, the reason for ordering an echo did not compare with whether the test results subsequently agreed with the initial diagnosis.

Overall, physician pre-test diagnosis corresponded with actual test findings in 212 (42%) out of 500 total ultrasound exams. Concordance between cardiologist pre-test diagnosis and echo findings was found in 95 (54%) of 175 tests. Noncardiologist pre-test diagnosis concordance with echo findings was found in 117 (36%) of 325 tests (Fig. 2). Concordance rates between the cardiologists and noncardiologists were significantly different ($p < 0.0001$).

Additional information unrelated to pre-test diagnosis and additional reasons for ultrasound as

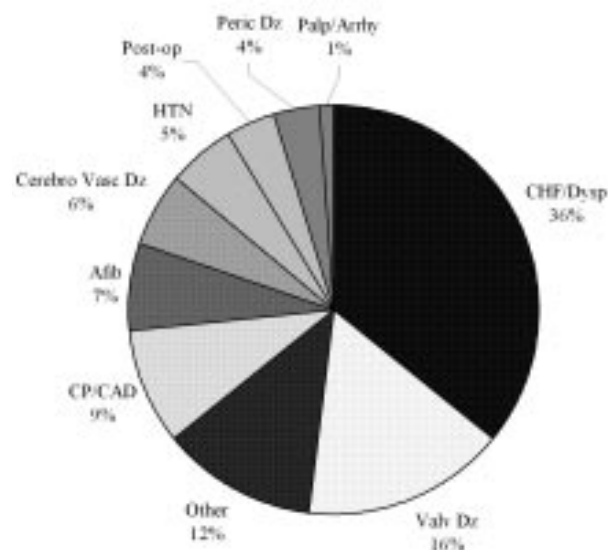


Fig. 1. Distribution of pre-test diagnoses.

HTN = hypertension; CP/CAD = chest pain / coronary artery disease; DZ = disease; CHF/Dysp = congestive heart failure / dyspnea; Afib = atrial fibrillation; Palp/Arrhy = palpitations / arrhythmia.

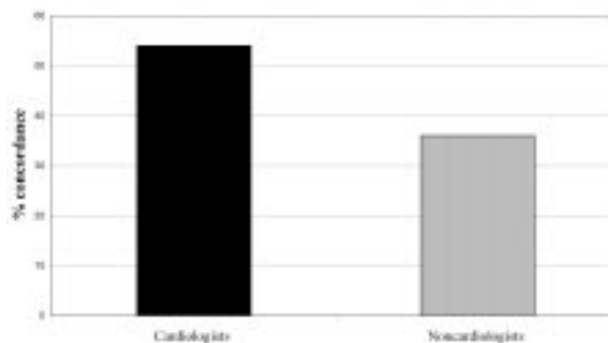


Fig. 2. Pre-test/post-test diagnosis concordance for cardiologists and noncardiologists ($p < 0.0001$).

stated in echocardiographic post-test report were found in 273 of 500 exams. Additional information was obtained in 160 out of 325 echocardiograms (49.2%) ordered by noncardiologists, while further information was found in 113 out of 175 tests (64.5%) ordered by cardiologists. One hundred thirty-seven (50%) exams contained additional information of significant clinical importance. Major new findings were more frequent in echocardiograms ordered by the cardiologist group (38%) compared to the noncardiologist group (21.5%) ($p=0.0114$) (Fig. 3). Important additional information resulted most frequently from echocardiograms that were ordered for a pre-test diagnosis of congestive heart failure/dyspnea (40%), chest pain or coronary artery disease (10.3%), and valvular dysfunction (15.4%).

Discussion

Since its introduction, echocardiography has emerged as a leading diagnostic tool for patients with cardiovascular illnesses. However, the high cost of technology in medicine, including echocardiograms, mandates certain appropriate guidelines for its utilization. The balance between the benefit to patients, usefulness to health care providers, and cost may depend on appropriate usage and interpretation. In fact, Wann and Passo (3) argue that physicians' failure to interact with patients and provide adequate feedback to echo technicians may decrease the cost-effectiveness of this procedure. Concerns over health care costs have raised debates as to whether specialists or generalists order echocardiograms more appropriately. With no specialized training or certification needed to schedule an echocardiogram, tests may be ordered unnecessarily and therefore create an excessive burden on health care finances.

Previous investigators have explored differences in the way cardiologists and noncardiolo-

gists implement echocardiography to diagnose and treat cardiovascular disease. These studies have demonstrated that differences exist between these two groups, especially in terms of the age of the patients, the type of abnormality present, and the plan of action subsequently followed.

Comparisons between specialists and generalists have also been examined in other areas of internal medicine, and these studies have likewise shown differences between the two groups. For example, one study of asthmatic children demonstrated that even after adjustment was made for symptom severity, recent care encounters, and patient demographics, specialists were more likely than generalists to provide care that was consistent with national asthma guidelines (4). Another study examining how physician specialty affected the outcome of treatments for patients with diabetic ketoacidosis yielded similar results (5). The results showed that patients under the care of an endocrinologist had shorter hospital stays and incurred lower hospital costs than did patients whose physician did not have a subspecialty in diabetes.

One cardiological study demonstrated that in the treatment of unstable angina, internists were less likely to use aspirin, heparin, and beta-adrenergic blocking agents in their initial treatment (6). The mortality rate of patients cared for by internists was higher, suggesting that these patients did not receive the most effective medical therapy.

A study by the Pennsylvania Health Care Cost Containment Council suggests that care provided by cardiologists might not only be superior to that provided by generalists, but might even be more cost-effective. The council examined the clinical and administrative data on 40,684 hospital admissions for acute myocardial infarction in Pennsylvania in 1993 and determined that patients cared for by cardiologists had a lower risk-adjusted mortality rate and shorter length of stay than did patients cared for by internists or family practitioners (7).

A study published in 1999 found that cardiologists were more aggressive than internists in ordering echocardiograms to test both aortic stenosis and mitral regurgitation (8). Cardiologists often would order echoes for patients who were asymptomatic, whereas internists would wait until the disorder was significantly more severe before they ordered imaging studies. However, the study also pointed out that the higher costs could be balanced by lower morbidity and mortality rates resulting from an earlier diagnosis.

Another study showed that cardiologists tended to order echoes for an older patient population and used this technology as a means of determining left ventricular dysfunction and detecting

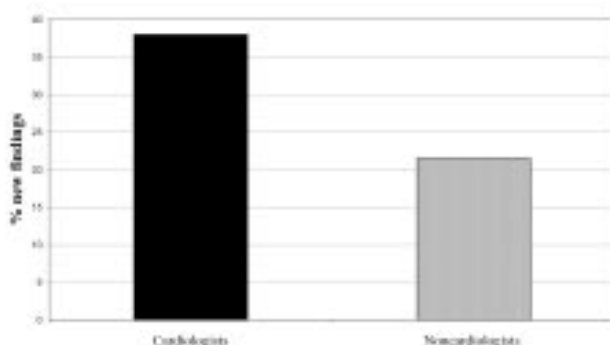


Fig. 3. Exam results with major new findings for cardiologists and noncardiologists ($p=0.0114$).

wall motion abnormalities (9). Internists, in contrast, ordered echocardiograms for younger patients and focused more on detecting valvular heart disease, a cardiac source of embolism, and vegetation in patients with suspected endocarditis. A change in management that resulted from echo findings also occurred more frequently where cardiologists ordered the test.

In this retrospective chart review study, we attempted to assess whether the ordering of echocardiography by noncardiologists might be less cost-effective by comparing the accuracy of the diagnoses predicted by cardiologists with those predicted by noncardiologists prior to the echocardiogram. In this study, no significant age difference was found between populations referred by cardiologists and by noncardiologists. There was also no significant difference in the gender of these populations. Our study further revealed that echocardiograms were ordered most often to evaluate ventricular dysfunction, valvular dysfunction, or both.

Our results showed that cardiologists' pre-test patient diagnoses and reasons for testing corresponded with echo results more often than those of noncardiologists (54% to 36%, $p < 0.0001$). Also, echocardiograms ordered by cardiologists revealed additional information more frequently than those ordered by noncardiologists. Furthermore, clinically significant additional information resulted more often from tests ordered by cardiologists. Pre-test diagnoses of congestive heart failure or dyspnea, chest pain or coronary artery disease, and valvular dysfunction most frequently resulted in echocardiograms that provided major additional information.

There are several significant limitations to the results of our study. As mentioned before, the data gathered for this study came from a retrospective chart review. Retrospectively, we cannot know the precise reason for ordering an echo other than the written diagnosis and purpose of the exam. Furthermore, the effectiveness of an echocardiogram in clinical practice is determined by its impact on subsequent patient management, which we did not determine.

Another limitation is our inability to know the true intent of the physician ordering the echo; was it to confirm suspected or known disease, or because of a clinical dilemma? Because we could not interview the physician or the patient, it may be difficult to gauge the true purpose of the request. Moreover, any small-sample size error might affect our data's applicability to a wider population and we did not determine if the generalists gained more than the cardiologists by the echo results. The echoes they ordered confirmed the cardiologists' suspicions, by elucidating the severity of an

entity, but those same tests might have proved even more valuable than to the noncardiologists, who might not have diagnosed certain abnormalities without the echocardiogram.

Conclusion

Our study showed that cardiologists are more accurate than generalists (54% to 36%, $p < 0.0001$) in their use of echocardiography, meaning that their predicted diagnoses were confirmed more often by echocardiogram than those of noncardiologists. This could have important implications in the management and treatment of cardiovascular disease. Since the number of people who suffer these illnesses is likely to increase over the years, medical costs will probably continue to rise also. Efforts to contain these costs could be affected by who is allowed to order echocardiograms. Because this procedure is expensive, it might be more cost-effective if only cardiologists were able to order echocardiograms, since they have more experience and knowledge and would know the circumstances that would truly warrant the use of echocardiography. However, our study is a preliminary one. Further investigations are needed to see whether these trends are applicable to larger populations.

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