INFECTIVE ENDOCARDITIS (IE) continues to cause substantial morbidity and carries a mortality rate up to 21% for patients with native valve endocarditis and higher than 50% for patients with prosthetic valve endocarditis.1-6 Used for more than 50 years, antibiotics to prevent IE have become a medical7 and legal1 standard for appropriate care, despite the lack of randomized controlled human trials demonstrating efficacy and retrospective studies questioning their effectiveness.8-10

First published in 1955, the American Heart Association’s (AHA’s) recommendations for IE prevention were updated in June 1997.7 Recognizing that 75% of patients with IE have preexisting cardiac structural abnormalities,1 the AHA recommended IE prophylaxis for patients at moderate and high risk for IE prior to procedures known to produce bacteremia. With evidence of poor compliance despite prior recommendations,11-16 a goal of the AHA’s 1997 recommendations was to improve patient and physician compliance by simplifying the antibiotic dosing regimen and clarifying which patients are at risk for IE.7 Although prior recommendations based the assessment of risk on clinical or auscultatory findings, the 1997 AHA recommendations7 recognized the widespread availability of echocardiography and recommended it be performed for patients with suspected valvular lesions to demonstrate the need for prophylaxis. However, compliance with these
updated recommendations in patients with echocardiographic verification of their IE risk profile is unknown.

We sought to determine the use of IE prophylaxis by surveying patients who recently underwent elective, outpatient transthoracic echocardiography (TTE) and correlating echocardiographic data with clinical and prophylaxis data.

METHODS

Study Population

Eligible subjects included all 308 patients who underwent elective, outpatient TTE at the Beth Israel Deaconess Medical Center’s east campus in Boston, Mass, during December 1997 (6 months after widespread dissemination of the AHA guidelines). Patients were excluded if they did not speak English (n = 10), did not have a forwarding address (n = 17), were unable to complete the survey due to stroke or dementia (n = 4), or had died (n = 3). The study was approved by the hospital’s committee on clinical investigation, which waived the requirement for written informed consent.

Survey Data

To allow for guideline dissemination and physician follow-up, patients were contacted 6 to 9 months following their index TTE. Over a 3-month period (June-August 1998), subjects were contacted to complete a brief survey. Eligible patients received 2 US Postal mailings and 3 telephone calls before being considered nonrespondents.

TTE Data

Transthoracic echocardiography reports were obtained from medical records. Based on AHA recommendations, patients were classified into 3 categories: (1) high risk, which included history of prosthetic heart valve, prior IE, cyanotic congenital heart disease, and surgically constructed systemic pulmonary shunt or conduit; (2) moderate risk, which included other congenital malformation, acquired valvular dysfunction, hypertrophic cardiomyopathy, and mitral valve prolapse with mitral regurgitation and/or thickened leaflets; (3) negligible risk, which included isolated secundum atrial septal defects, mitral valve prolapse without valvular regurgitation, pacemaker or defibrillator implantation, physiologic or functional murmurs with normal valve, or absence of high- or moderate-risk characteristics. For this study, we used a definition of acquired valvular dysfunction based on the US Food and Drug Administration recommendations for significant valvular abnormalities and included patients with valvular stenosis, at least mild aortic regurgitation, at least moderate mitral or tricuspid regurgitation, and thickened mitral valves with at least mild mitral regurgitation. None of the TTE reports specifically addressed the need for IE prophylaxis.

Statistical Analyses

We compared subjects who reported with those who did not report being instructed to take IE prophylaxis, using the t test and Fisher exact test as appropriate for continuous and categorical variables. P < .05 was considered significant and all tests were 2-tailed. Analyses were performed using STATA version 5.0 statistical software (STATA Corp, College Station, Tex).

RESULTS

Of the 274 eligible subjects, 218 (80%) completed the survey and comprised our analytic cohort. There were no significant differences between respondents and nonrespondents in age, sex, or echocardiographic results, including the presence of structural valvular disease or prosthetic heart valves. A total of 18 patients (8.2%) were categorized as being at high risk for IE based on echocardiography, 90 (41.3%) as moderate risk, and 110 (50.5%) as negligible risk. All patients who reported prior rheumatic fever (n = 9) or IE (n = 13) had findings on TTE that classified them as being at either moderate or high risk for IE. Thus, according to AHA recommendations, 108 (49.5%) of the study patients should have received IE prophylaxis.

Recommendations for Prophylaxis

Of the 218 patients, 100 (45.9%) reported that they were instructed by their physician to use IE prophylaxis prior to dental work or other nonsterile procedures (TABLE). Of these 100 patients, 32.0% were first given these instructions after their index TTE and 66.0% reported that they were told to use prophylaxis 1 hour prior to the procedure (in accordance with 1997 AHA recommendations). For the group, primary care physicians wrote the prescriptions for antibiotics for IE most frequently (49%), followed by dentists (38%), and cardiologists (13%).

Of the 218 patients, 162 (74%) reported that their TTE results were reviewed by a health care professional, most commonly by the ordering physician (209 patients [95.9%]). Of the 108 moderate- or high-risk patients, 80 (74.1%) reviewed their TTE results with a health care professional, most frequently by the ordering physician (77 of 80 patients). One hundred thirteen (51.8%) of the 218 respondents reported having undergone a prior TTE. Of the 108 patients who met AHA recommendations for IE prophylaxis, 71 (65.7%) reported that they were told by their physicians to take prophylaxis prior to dental work or other nonsterile procedures, including 88.9% of high-risk patients. Among the 110 patients at negligible risk, 29 (26.4%) reported that they had been instructed to take IE prophylaxis. Of the 32 patients first instructed to take prophylaxis after their index TTE, 11 patients (34.4%) were at negligible risk for IE.

Because the majority of patients eligible for IE prophylaxis are at moderate risk and because this category contains the least specific criteria (eg, acquired valvular dysfunction), we further examined the echocardiographic data of this subgroup. Thirty-four percent of patients with thickened mitral leaflets and mild or higher mitral regurgitation and 44.0% of patients with mild or higher aortic regurgitation reported that they were not told to take prophylaxis. Addi-

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tionally, because the decision to recommend IE prophylaxis for the 113 patients who had undergone prior TTE may have been based on data obtained from that prior TTE, we reviewed the results of the 61 patients (54.0%) who had undergone the prior TTE at our institution. There was very high (60/61) concordance between the 2 studies, with only 1 patient (1.6%) changing risk categories based on echocardiographic data (from being considered at negligible risk following prior TTE results to moderate risk following the index TTE results).

Compared with patients who were not told to take IE prophylaxis, patients instructed to take prophylaxis were significantly more likely to have had a prior TTE, rheumatic fever, prior valvular surgery, endocarditis, heart murmur, or TTE evidence of valvular disease, including regurgitation or stenosis (Table).

**Use of Prophylaxis**

Sixty-eight of the 100 patients who reported being instructed to take IE prophylaxis visited their dentist subsequent to the index TTE in December 1997. Of these patients, 9 (13.2%), 7 at moderate and 2 at negligible risk failed to take IE prophylaxis, despite their being aware of their physicians’ suggestion that they take it.

**COMMENT**

The updated 1997 AHA recommendations were intended to improve physician and patient compliance by clarifying which patients are at risk for IE and simplifying the antibiotic dosing regimen. Comparison of our study results with historical data suggests that this goal has been accomplished, especially with respect to patient compliance. However, our results indicate that there remains room for improvement, with substantial underuse of prophylaxis for moderate-risk patients and overuse of prophylaxis for negligible-risk patients.

Studies that predated the 1997 AHA recommendations reported poor compliance with guidelines for IE prophylaxis. In patients with TTE evidence of mitral valve prolapse and mitral regurgitation, only 29% to 66% of patients received prophylaxis in accordance with contemporary guidelines. In a study of patients with cardiac lesions predisposing to endocarditis, 70% of patients received advice on prophylaxis from their physician, but only 22% actually took prophylaxis as suggested. Similarly, in patients who underwent a nonsterile procedure, only 25% of patients with known structural heart disease took prophylaxis prior to that procedure.

The reasons for noncompliance with established guidelines are numerous and likely related to both patient- and physician-specific factors. Studies questioning the effectiveness of IE prophylaxis, unfamiliarity with guidelines, patient preferences, and noncompliance may result in the underuse of prophylaxis. Our findings that nearly 40% of moderate-risk patients were not instructed to take prophylaxis may reflect uncertainty about the criteria that define this category. Although we used criteria published by the US Food and Drug Administration to define acquired valvular disease, it is possible that physicians are unfamiliar or may disagree with these criteria or with the recommendations. Nevertheless, physicians must decide whether to recommend prophylaxis for their patients, and our data highlight the need for further clarification of the criteria used to define the moderate-risk category.

Conversely, physicians may unnecessarily recommend IE prophylaxis based solely on physical examination findings (eg, click and murmur), being unaware that the AHA recommen-
dations were updated to include echocardiographic criteria for IE risk. Additionally, although our data suggest a high concordance between prior echocardiographic studies and the index TTE, physicians may have been influenced by findings from prior TTE studies. Moreover, even if physicians interpret and apply the AHA recommendations appropriately, difficulties implementing the recommendations may affect our measure of compliance. For example, although clinical data were available via our institution’s computerized medical record, physicians may have had difficulty accessing the TTE report or communicating their recommendations to their patients or other health care professionals.

There are several limitations to our study. First, there may be reasons to recommend IE prophylaxis based on a medical history beyond that of prior endocarditis or rheumatic heart disease, the data that were obtained from the patient survey. With no clear consensus from the literature, physicians may recommend IE prophylaxis for patients with a history of rheumatic fever or a murmur on auscultation but without echocardiographic abnormalities. Second, our study consists of patients referred to an urban, university-affiliated medical center; therefore, our results may not be generalizable to other populations. Third, because we asked patients rather than physicians about what physicians had recommended, it is possible that some patients did not recall their physicians’ recommendations. Finally, we chose patient-reported use of IE prophylaxis as our outcome, rather than pill counts or prescriptions filled, recognizing that both patient- and physician-related factors ultimately affect our estimate of compliance. However, because much of the initiative to take IE prophylaxis depends on the patient, we believe that patient-reported prophylaxis use is an appropriate and clinically relevant measure.

In conclusion, the majority of patients receive IE prophylaxis in accordance with current AHA recommendations, although there may be substantial underuse among patients with moderate risk and overuse among patients with negligible risk. Further clarification of specific at-risk categories, particularly those with acquired valvular dysfunction, as well as continued physician and patient education,11,12,18–20 may lead to improved compliance with the current AHA recommendations.

REFERENCES