**Evaluation and Outcomes of Patients With Palpitations**


**Purpose:** To determine: (1) the etiologies of palpitations, (2) the usefulness of diagnostic tests in determining the etiologies of palpitations, and (3) the outcomes of patients with palpitations.

**Patients and Methods:** One hundred and ninety consecutive patients presenting with a complaint of palpitations at a university medical center were enrolled in this prospective cohort study. Patients underwent a structured clinical interview and psychiatric screening. The charts were abstracted for results of the physical exam and tests ordered by the primary physician. Assignment of an etiology of palpitations was based on strict adherence to predetermined criteria and achieved by consensus of the two physician investigators. One-year follow-up was obtained in 96% of the patients.

**Results:** An etiology of palpitations was determined in 84% of the patients. The etiology of palpitations was cardiac in 43%, psychiatric in 31%, miscellaneous in 10%, and unknown in 16%. Forty percent of the etiologies could be determined with the history and physical examination, an electrocardiogram, and/or laboratory data. The 1-year mortality rate was 1.6% (95% confidence interval [CI] 0% to 3.4%) and the 1-year stroke rate was 1.1% (95% CI 0% to 2.6%). Within the first year, 75% of the patients experienced recurrent palpitations. At 1-year follow-up, 89% reported that their health was the same or improved compared to that at enrollment, 19% reported that their work performance was impaired, 12% reported that workdays were missed, and 33% reported accomplishing less than usual work at home.

**Conclusions:** The etiology of palpitations can often be diagnosed with a simple initial evaluation. Psychiatric illness accounts for the etiology in nearly one third of all patients. The short-term prognosis of patients with palpitations is excellent with low rates of death and stroke at 1 year, but there is a high rate of recurrence of symptoms and a moderate impact on productivity.

**Palpitations are one of the most common symptoms in general medical settings, reported by as many as 16% of the patients.** This symptom may be caused by a variety of disorders, ranging from life-threatening conditions such as ventricular tachycardia to various psychiatric illnesses. As a result, patients with palpitations often undergo a wide variety of diagnostic tests and referrals leading to substantial resource utilization. Currently, clinical experience guides the physician caring for patients with palpitations, since there are no prior studies that describe the spectrum of etiologies or the usefulness of diagnostic tests in the evaluation of palpitations. Furthermore, the outcome of patients with palpitations has not been well described. In the only retrospective study of outcomes in patients with palpitations, cases with palpitations and controls without palpitations experienced similar rates of cardiac endpoints. The purpose of this prospective study was to determine (1) the etiologies of palpitations, (2) the usefulness of diagnostic tests in determining the etiologies of palpitations, and (3) the outcomes of patients with palpitations.

**Patients and Methods**

This was a prospective cohort study of patients presenting with palpitations. Palpitations were defined as one or more of the following patient complaints: fast heart beats, skipped heart beats, irregular heart rate, and heart fluttering, racing, or pounding.

**Study Entry Criteria**

Between January 2 and August 30, 1991, all patients presenting to the emergency department, admitted to the medical and surgical inpatient service, or attending the medical clinics of the University of Pittsburgh Medical Center were screened for study eligibility. Patients presenting to the psychiatric emergency department or admitted directly to the psychiatric service were not screened for study eligibility. Inclusion criteria were palpitations as a chief complaint for seeking medical care or palpitations as one of the chief complaints during a routine visit to the physician. The symptom must have occurred at least once in the 3 months preceding this index visit. Patients were excluded if their age was less than 18 years, they were known to be aphasic or demented.
or were unable to speak English. Patients transferred from the inpatient service of another hospital, those admitted only for same-day surgery, and patients with palpitations only elicited on review of systems were also excluded.

**Patient Identification**

Because palpitations are often not the sole diagnosis for admission or discharge, and patients with palpitations are often labeled with a more specific diagnosis, a comprehensive search strategy was used to capture all patients with palpitations. To identify patients eligible for the study, we performed daily review of the following lists: emergency department discharge diagnoses, hospital admission diagnoses, and outpatient visit discharge diagnoses. If any of the diagnoses noted in **Table I** was found, the medical chart was reviewed and the patient's physician was contacted to ascertain if the chief complaint was palpitations. In cases in which this could not be ascertained, the patient was contacted for clarification. Patients who met the entry criteria were asked to participate in the study. Conduct of the study was approved by the institutional review board of the University of Pittsburgh.

**Patient Evaluation**

Patients who agreed to participate were interviewed. The structured interview was directed at the following issues: palpitiation characteristics, associated symptoms and situations, drug and medication use, and comorbid illness. Medical charts were reviewed and data were abstracted regarding physical examination findings and results of the diagnostic evaluation. This process was completed by the principal investigator (BEW) as soon as possible after the patient presented for medical care. Interviews were performed in person with 42% and on the phone with 58% of patients. The mean time in days between event and evaluation was 1.1, evaluation and interview was 3.4, and event and interview was 4.2. The median time in days between event and evaluation was 0, evaluation and interview was 2, and event and interview was 2. The physical exam and diagnostic evaluation (ie, electrocardiogram [ECG], laboratory tests, arrhythmia detection) was determined by the individual physician seeing the patient at the index visit. In cases in which tests for arrhythmia detection were not ordered by the clinician, the investigators made loop monitors available.

To screen for generalized anxiety disorder, panic attack, panic disorder, major depression, and somatization disorder, patients were asked to complete two validated self-administered instruments: the General Health Questionnaire (GHQ),7-12 and the somatization screening test of Othmer and DeSouza13 (SOM). The 30-question GHQ was answered using a 4 point Likert scale and scored with 1 point for each response of 3 or 4, allowing for a maximum score of 30. The 7-question SOM was scored with 1 point for each positive response. Patients with a GHQ score of 25 or a SOM score of 23 or in whom these psychiatric illnesses were clinically suspected were further assessed with the Diagnostic Interview Schedule (DIS)17,19 sections for generalized anxiety disorder, panic attack and disorder, major depression, and/or somatization disorder. The DIS was administered over the telephone by a trained certified registered nurse practitioner. The Diagnostic and Statistical Manual of Mental Disorders, third edition revised, (DSM-III-R)20 criteria were used to score the DIS. Generalized anxiety disorder, panic attack and disorder, major depression, and/or somatization disorder were considered present if symptoms were present within the last 6 months. Depression was evaluated as a lifetime disorder. Depression was considered to be comorbid and not etiologic, since palpitations are not listed as a criterion symptom in DSM-III-R.

**Assignment of Etiology of Palpitations**

Diagnostic criteria for the etiology of palpitations were developed prior to the start of the study after extensive review of the literature (see **Appendix**). We appraised pertinent articles, case reports, review papers, and cardiology and general medicine text-

<table>
<thead>
<tr>
<th>TABLE I</th>
<th>Diagnoses Used to Identify Patients</th>
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<tbody>
<tr>
<td>Anemia</td>
<td>Transfusion</td>
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<td>Anxiety</td>
<td>Aortic aneurysm</td>
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<tr>
<td>Arrhythmia</td>
<td>Specific arrhythmias (ie, atrial fibrillation, atrial flutter, bradycardia, multifocal atrial tachycardia, pre-excitation syndrome, sick sinus syndrome, supraventricular tachycardia, ventricular tachycardia, ventricular fibrillation)</td>
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<tr>
<td>Atrial myxoma</td>
<td>Cardiomyopathy</td>
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<td>Chest pain</td>
<td>Cocaine abuse</td>
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<td>Congestive heart failure</td>
<td>Dizziness</td>
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<td>Drug toxicity (ie, amphetamines, theophylline)</td>
<td>High output failure</td>
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<td>Hypoglycemia</td>
<td>Pacemaker failure</td>
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<td>Palpitations</td>
<td>Panic attack</td>
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<tr>
<td>Pheochromocytoma</td>
<td>Shunt or fistula (peripheral or cardiac)</td>
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<td>Syncope</td>
<td>Thyrotoxicosis</td>
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<td>Unstable angina</td>
<td>Valvular heart disease</td>
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TABLE II

<table>
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<th>Patient Characteristics (N = 190)</th>
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<tr>
<td>Mean age (y)</td>
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<tr>
<td>Range</td>
</tr>
<tr>
<td>Female</td>
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<tr>
<td>White</td>
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<tr>
<td>≥1 year of college education</td>
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<tr>
<td>Site of presentation</td>
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<tr>
<td>Emergency department</td>
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<tr>
<td>Medical clinic</td>
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<td>Symptom presentation</td>
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<td>Chief complaint</td>
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<tr>
<td>Complaint during a routine visit</td>
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<tr>
<td>Admitted to hospital</td>
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<tr>
<td>History of prior palpitations</td>
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<tr>
<td>Heart disease</td>
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<tr>
<td>Hypertension</td>
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<tr>
<td>Congestive heart failure</td>
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<td>Diabetes mellitus</td>
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*Other than mean age, data shown represent the percentage of patients included.

*Coronary (ie, history of myocardial infarction, angina, coronary artery by-pass grafting, percutaneous transluminal coronary angioplasty), congenital, or valvular heart disease, or cardiomyopathy.

books to find disorders associated with the symptom of palpitations. Assignment of an etiology was based on strict adherence to these criteria and achieved by consensus of the two physician investigators.

The diagnostic criteria permitted a simple categorization of the etiologies of palpitations. Cardiac etiology included arrhythmias, cardiac and extra-cardiac shunts, regurgitant valvular heart disease, pacemaker, prosthetic heart valve, cardiomegaly, mitral valve prolapse, hyperkinetic heart syndrome, and atrial myxoma. Psychiatric etiology included panic attack, panic disorder, generalized anxiety disorder, and somatization disorder. The category of miscellaneous etiology included medications, habits, metabolic disorders, high output states, dehydration and orthostatic hypotension, and exertion.

Given the available information (ie, history, physical, diagnostic evaluation, psychiatric testing), the investigators considered each etiology (see Appendix). Because correlation of symptoms with documented arrhythmias was the most concrete example of causality, whenever this occurred the diagnosis of arrhythmia was assigned. The remaining etiologies were carefully considered for their presence or absence. This hierarchy always designated cardiac arrhythmias as the etiology, although psychiatric or metabolic comorbid conditions may have been present. Similarly, metabolic disorders were considered to be the etiology, although psychiatric conditions may have been present.

These diagnoses were considered definite, with only three exceptions. Diagnoses involving medications or habits were considered to be definite, probable, or possible, adapted from the literature on adverse drug effects. Arrhythmias (only supraventricular tachycardia and ventricular tachycardia) and anxiety were considered definite or probable. Only 5.8% of the patients had etiologies that were considered probable or possible. As this is the first study to explore the etiologies for the symptom of palpitations, our focus was on the spectrum of etiologies; therefore, for the analyses presented here, the categories of definite, probable, and possible were combined. These diagnostic criteria allowed patients to be assigned to only one etiology category, but could have more than one diagnosis within that category (ie, premature ventricular contraction and premature atrial contraction, cocaine and caffeine, but not supraventricular tachycardia and anxiety).

Follow-Up

All patients were contacted by phone at 3 and 6 months, and for final follow-up at 9 and/or 12 months. Responses to standard questions regarding recurrences, new cardiovascular events, and mortality were obtained from the patient, the family, or caregiver; interviewers were trained to avoid leading questions and to be specific with respect to morbidity related only to palpitations. All interviews were completed by October 28, 1992; over 90% of inter-
views were performed by the same physician's assistant. Whenever follow-up events occurred, attempts were made to obtain further details from the primary physician and medical chart. The cause of death was assigned on the basis of information obtained from the patient's family and the medical chart.

**Statistical Analyses**

Standardized forms for entry of clinical, laboratory, and outcome data were utilized. Data management and analyses were conducted with the use of RBase (Microrim Inc, Seattle, Washington), BMDP (UC Press, Berkeley, California), StatXact (Cytel Corp, Cambridge, Massachusetts), and ROCFIT (University of Chicago, Chicago, Illinois) software packages. Statistical tests included the chi-square, Fisher's exact, and analysis of variance tests to evaluate differences between groups. Logistic regression analysis (BMDP LR(2)) was used to test for independence among predictors of a cardiac etiology of palpitations. Our intent was to create a clinical prediction model that incorporated variables readily available in the initial history. All variables tested were dichotomous, including the composite variable 'history of heart disease', which was considered present if any of the following was present: history of angina, myocardial infarction, cardiac surgery, percutaneous transluminal coronary angioplasty, pulmonary hypertension, congestive heart failure, and valvular or congenital disease. To evaluate this prediction model, a receiver-operating-characteristic (ROC) curve was constructed based on the number of multivariate predictors of cardiac etiology present. One-year mortality and stroke rates were calculated using the Kaplan-Meier method.

**RESULTS**

Entry criteria were met by 229 patients. Thirty-nine patients were not enrolled due to patient or physician refusal. Therefore, 83% agreed to participate. Those agreeing to participate did not differ in age, race, or gender from those who refused. Selected features of the 190 enrolled patients are shown in Table II.

**Etiologies**

An etiology for palpitations was assigned in 159 (84%) patients. The specific etiologies are listed in Table III. Overall, 43% of the patients had a cardiac etiology, 31% had a psychiatric etiology, 10% had miscellaneous etiologies, and 16% were unknown. For the subgroup of patients presenting to the medical clinic, the etiology was cardiac in 21%, psychiatric in 45%, miscellaneous in 6%, and 28% unknown. For the subgroup of patients presenting to the emergency department, the etiology was cardiac in 47%, psychiatric in 27%, miscellaneous in 13%, and 10% unknown. There was a significant difference in etiology by site of presentation (P <0.002). The distribution of etiologies was not statistically different when those with prior palpitations were compared to those without prior palpitations (P = 0.24).

Twenty-four patients were assigned more than one etiology: 21 were coexisting psychiatric illnesses (eg, generalized anxiety disorder and panic disorder), 2 had both symptomatic premature atrial and ventricular beats, and 1 had coexisting cocaine and caffeine use.

Of the 159 patients for whom an etiology could be determined, 148 were definite, 10 were probable, and 1 was possible. In the miscellaneous category, there were 4 probable medication and habit etiologies and 1 possible medication/thyrotoxicosis etiology. In the psychiatric category, there were 3 probable anxiety etiologies. In the cardiac category, there were 3 probable arrhythmias. (See Methods section for specific definitions).

Table IV lists selected variables (ie, demographic, historical, and symptom characteristic) and their relationship with the four categories of etiology. The cardiac group had the highest mean age and the greatest percentage of males, and its patients were more likely to describe an irregular heart beat and report
The duration of their palpitation event as greater than 5 minutes. The highest mean number of associated symptoms was reported by patients in the psychiatric group. One variable that did not distinguish the etiologies was a history of prior palpitations.

After the noncardiac etiologies were combined and compared to the cardiac etiology group, we found six clinically meaningful variables that were significant univariate predictors of a cardiac etiology of palpitations ($P <0.05$). These variables were older age (continuous), male sex, description of an irregular heart beat, history of heart disease, duration of palpitation event $>5$ minutes, and fewer number of associated symptoms (continuous variable). When these variables were entered into a multivariate logistic regression model, male sex, description of an irregular heart beat, history of heart disease, and event duration of $>5$ minutes were found to be independent predictors of a cardiac etiology (Table V). Although univariate analysis revealed that presentation to the emergency department compared with the medical clinic was associated with a cardiac etiology of palpitations ($P <0.002$), this was not a significant multivariate predictor of cardiac etiology (odds ratio 2.03, 95% confidence interval 0.76 to 5.4). None of the 17 patients with 0 predictors had a cardiac etiology, 13 (26%) of the 50 patients with 1 predictor had a cardiac etiology, 28 (48%) of the 58 patients with 2 predictors had a cardiac etiology, 22 (71%) of the 31 patients with 3 predictors had a cardiac etiology, and 9 (90%) of the 10 patients with all 4 predictors had a cardiac etiology. Twenty four patients with missing data were excluded from this analysis. The area under the ROC curve for this model was 0.79 (standard deviation of the area $= 0.04$).

### Diagnostic Testing

Table VI describes the evaluation of patients in terms of the types of tests ordered, as well as the number of patients for whom a diagnostic test led to the etiology of palpitations. The basic patient evaluation consisted of a history and physical (completed in 100%), psychiatric screening with the GHQ (completed in 76%), and arrhythmia detection (ECG completed in 87%, prolonged electrocardiographic monitoring completed in 64%). The performance of history and physical examination, ECG, and prolonged electrocardiographic monitoring was not significantly different ($P >0.2$) between patients who had a known etiology of palpitations and those who had unknown etiology.

Of the 159 patients for whom a diagnosis could be made, 64 (40%) were accomplished with either the history and physical examination, an ECG, and/or laboratory data. The laboratory data that was diagnostic in 8 patients included thyroid function studies and serum theophylline level and hematocrit determinations.

Cardiac arrhythmia etiologies were detected by ECG in 43 patients and by prolonged electrocardiographic monitors in 25 patients; of the remaining 122 patients, 110 (90%) underwent electrocardiography or prolonged electrocardiographic monitoring, however, none of these tests revealed the etiology of palpitations. There was no evidence for gender, age, or racial bias in the performance of ECG or monitoring.

There was no evidence for bias in the performance of monitoring based on site of presentation. An ECG was more likely to be performed if the patient presented to the emergency department (94%), rather than any other site (78%); conversely, an ECG was less likely to have been performed if the patient presented to the medical clinic (70%), rather than any other site (95%) ($P <0.01$).

Psychiatric screening instruments were completed by 144 (76%) patients. A GHQ score $\geq 5$ and/or SOM score $\geq 3$ was found in 73 individuals. The DIS was ad-
ministered to these 73 patients and to an additional 23 patients with clinical features suggestive of a possible psychiatric illness. Of the 96 patients assessed by the DIS, one or more psychiatric illness was diagnosed in 78 patients (for a total of 154 diagnoses). Additionally, 4 other patients were felt to have clinically significant psychiatric illness (3 with anxiety, 1 with depression and suicidal ideation). The diagnoses made by DIS were panic attack and/or disorder (n = 69), generalized anxiety disorder (n = 39), somatization disorder (n = 1), and depression (n = 45). The majority of patients (52 of 78) had 2 or more coexisting psychiatric illnesses; most frequently, depression accompanied one of the other disorders (n = 41).

There were significantly more DIS performed in nonwhite (65%) than white (45%) patients (P < 0.02).

Ultimately, 58 of these 82 patients (55 with a positive DIS, 3 with a clinical diagnosis) were assigned to the psychiatric etiology group (Table III); 53% (29/55) of these patients were also depressed, however depression was considered to be comorbid and not etiologic.

There were 19 patients with a positive DIS in whom the psychiatric illness was considered to be comorbid and not etiologic. The assigned etiologies in these patients were: arrhythmias in 14, medications in 2, thyrotoxicosis in 1, and unknown in 2. These 2 patients were categorized as unknown etiology instead of psychiatric etiology because one had coexisting alcoholism and the second had a remote history of the psychiatric disorder.

Follow-Up

By October 28, 1992, follow-up was completed in 98% of the patients. At least 1-year follow-up (365 days ± 14 days) was available for 90% of the patients. Table VII details the outcomes at final follow-up. All reports of stroke were confirmed by the medical record.

Mortality was documented in 3 patients; none of the deaths was sudden. One death was due to a subarachnoid hemorrhage in a patient taking warfarin following aortic valve replacement for aortic insufficiency. The second death was due to congestive heart failure and renal failure in a patient following a stroke. The third death was due to severe congestive heart failure in a patient with cellulitis and soft-tissue abscess. There were 2 patients with new arrhythmias documented in follow-up; it is probable that these were responsible for the original palpitations. One patient, originally in the unknown category, had symptomatic correlation of palpitations with premature ventricular beats upon repeat presentation. Another patient with increasing symptoms, originally in the psychiatric category, had documentation of symptomatic correlation of palpitations with supraventricular tachycardia.

The percent with recurrent palpitations varied by etiology, however, this difference was only significant at the first follow-up when recurrent symptoms were experienced by 61% of the psychiatric group, 53% of the cardiac group, 17% of the miscellaneous group, and 48% of the group with an unknown etiology (P < 0.02). By the last follow-up, 75% of all patients reported recurrent symptoms. This rate of recurrent symptoms varied by history of prior palpitations; 79% of the patients with and 61% of the patients without a prior history of palpitations had recurrent events within the follow-up period (P < 0.03).

At 1 year, 95% of the patients were satisfied with the care they received for their palpitations. Eighty-nine percent reported that their health was the same or improved compared to 1 year before. Of those working outside of the home (52% of the cohort), work performance was impaired in 19%, and workdays were missed by 12%. Because of palpitations, 33% reported accomplishing less than usual work at home.

DISCUSSION

Although palpitations are a common symptom, there are very limited descriptive, etiologic, or prognostic data for nonreferred patients on this subject. This is the first study that describes the etiologies of palpitations and the outcomes of patients in a cohort of patients presenting for care at a university-based medical center.

We found that (1) an etiology could be determined in 84% of the cohort, (2) 40% of those etiologies could be determined with the history and physical examination, an ECG, and/or laboratory data, (3) psychiatric illnesses were common causes of palpitations, and (4) the prognosis was excellent except that most patients continued to have recurrent symptoms.

Our finding that only 16% of patients had no clear etiology for their palpitations differs from research on other common symptoms in primary care. In a 3-year incidence study analyzing the probable etiology of 14 common symptoms in 1,000 internal medicine outpatients, Kroenke and Mangelsdorff reported that the percent of each symptom with an unknown etiology ranged from 47% for insomnia to 100% for constipation.
A wide variety of etiologies were diagnosed in this population of patients with palpitations. Previous reports of the etiology of palpitations are limited to studies of patients referred for ambulatory electrocardiographic monitoring. These studies report the arrhythmias recorded by ambulatory electrocardiographic monitoring, however not all studies indicate the relationship between symptoms reported and arrhythmias detected. The reported yield of ambulatory electrocardiographic monitoring in the detection of symptomatic arrhythmias ranges from 13% to 69%. However, referral bias and the inclusion of patients symptomatic arrhythmias raises concerns about the generalizability of these findings. The prevalence of the various etiologies of palpitations may also be misrepresented by case series of patients with specific diseases associated with the symptom of palpitations.

Psychiatric illness was frequently diagnosed and was associated with the highest rate of recurrent symptoms at 3 months. Palpitations are one of the DSM-III-R diagnostic criteria for panic attack, generalized anxiety disorder, and somatization disorder. Although depression may be a comorbid illness, we did not consider this to be an etiology of palpitations. Previously published data from our own general medical clinic, documented a 9.2% prevalence of major depressive disorder and 1.7% prevalence of panic disorder in primary care populations. Depressed patients had more physical illness, somatic symptoms, and disability than nondepressed patients. It is likely that depression may result in palpitations, but 41 of 45 of our patients with depression had other coexisting psychiatric illness. Thus, we were unable to clarify the role of depression in leading to palpitations. As suggested by Barsky, further studies of the relationship between common symptoms such as palpitations and psychiatric illness are needed, since there is evidence for significant unrecognized psychiatric morbidity in ambulatory care patients with common medical symptoms. Based on our findings, assessment for generalized anxiety, panic, and somatization disorders and depression should become an important focus of evaluation of patients with palpitations.

We identified four variables that were independent predictors of a cardiac etiology of palpitations. This model performed better than chance, as demonstrated by the area under the ROC curve. However, the prediction of a cardiac etiology must be interpreted with caution because (1) assignment to the cardiac etiology group does not necessarily imply a higher mortality, (2) further testing beyond the initial database may not be required to make this diagnosis, and (3) diverse etiologies were included in the cardiac group.

Palpitations were associated with low mortality and cardiac morbidity. Despite the high prevalence of cardiac disease, mortality was documented in only 3 women over the age of 70. None of the deaths was sudden or directly related to the original etiology of palpitations. In the only other study of outcomes in patients with palpitations, the proportion experiencing a cardiac endpoint (i.e., myocardial infarction, ventricular tachycardia, ventricular fibrillation, cardiac arrest, or death) in 5 years was similar between cases with palpitations (6.4%) and clinic-based controls (7.2%). In only 4 patients was ventricular tachycardia responsible for the symptom of palpitations. The 1-year mortality rate of 1.6% in patients with palpitations is in striking contrast to our experience with syncope, where there is a 28% mortality and 15% incidence of sudden death at 1 year in patients with cardiac etiologies.

In contrast, the morbidity from palpitations was substantial. Although 77% had prior palpitations, it was surprising that the majority of patients with and without a history of prior palpitations had recurrent symptoms. This is in contrast to the 35% of syncope patients with recurrent symptoms at 5 years. The recurrences appeared to have substantial effect on quality of life since at least one third of the patients reported accomplishing less than usual work in the home and a smaller fraction had impaired work performance or missed work. These data suggest that this common symptom has characteristics similar to a chronic disease with exacerbation and remission of symptoms over time.

Limitations of this study should be acknowledged. First, we did not assemble an inception cohort by limiting our patient enrollment to those with new onset of palpitations because patients often could not define the first onset of this symptom. Despite this limitation, our findings are relevant to the patients seen with palpitations since the vast majority of patients present with chronic symptomatology. Second, not all patients underwent all diagnostic tests. Specifically, the DIS was performed less frequently in patients for whom an etiology could not be determined. We believe this is not a major limitation since, surprisingly, an etiology could be determined in the majority of the patients.

Based on this study, we suggest the following strategy for a practical evaluation of patients with palpitations. A careful history, physical examination, and ECG along with selective use of laboratory tests will identify the etiology of palpitations in close to half of the patients. In the remaining patients, a major focus should be screening (with the GHQ) for psychiatric disorders to detect generalized anxiety, panic, and depression. In those without a diagnosis who have heart disease, palpitations lasting longer than 5 minutes, or irregular beats, prolonged cardiac monitoring may show an etiology of palpitations. Since symptomatic correlation is critical in determining whether an ar
rhythm is the etiology of palpitations, event monitoring appears to be well suited for diagnostic evaluation of this symptom. Electrophysiologic testing should be reserved for specific high-risk groups such as patients with accessory pathways or when therapy of documented arrhythmias is needed.48

In conclusion, the etiology of palpitations can often be diagnosed with a simple initial evaluation. Psychiatric illness accounts for the etiology in nearly one third of all patients with palpitations. The short-term prognosis of patients with palpitations is excellent; however, the recurrence rate is high. Future studies are needed to develop interventions that may decrease recurrent symptoms in these patients and improve their quality of life.

ACKNOWLEDGMENT
We are indebted to Nancy Brant Miller, CRNP, for the administration of the DIS, Karen Brich, PAC, for completing patient follow-up, Barbara Hanuss, PhD, for statistical assistance, Terry Seftick, MSC, for data management guidance, Lisa Joseph for data entry, and Roberta Eckman for manuscript preparation.

REFERENCES
22. Reuse data management software. Micro...
tachycardia or ventricular tachycardia in the absence

APPENDIX

Diagnostic Criteria Used for the Categorization of the Etiologies of Palpitations

Arrhythmias. Any new deviation from normal sinus rhythm or a significant change in the rate of a stable arrhythmia (eg, atrial fibrillation) can cause the symptom of palpitations.

Definite: Symptomatic correlation of palpitations with the arrhythmia recorded on electrocardiographic monitoring.

Probable: Greater than 5 beats of supraventricular tachycardia or ventricular tachycardia in the absence of symptomatic correlation.

Increased Stroke Volume. Stroke volume may be increased with cardiac and extra-cardiac shunts or regurgitant valvular heart disease. Palpitations may be noted at different stages, so general guidelines were used to determine causality.

- Cardiac and extra-cardiac shunts. A cardiac shunt was considered causal if there was either echocardiographic or cardiac catheterization documentation of moderate to severe shunt flow in a patient with palpitations. Any extra-cardiac arteriovenous fistula in a patient with palpitations was considered causal if no other etiology was present.

- Regurgitant valvular heart disease. Valvular heart disease such as mitral regurgitation and aortic insufficiency was considered causal if there was either echocardiographic or cardiac catheterization documentation of moderate or severe regurgitant flow in a patient with constant palpitations and no concurrent arrhythmia.

Pacemaker. Paced beats or intercostal muscle and diaphragmatic flutter may be sensed by the patient with a pacemaker. Pacemaker syndrome may also be associated with palpitations. To be considered causal, the sensed beats must have been correlated with the paced beats.

Prosthetic Heart Valve. Each heart beat in a patient with a prosthetic heart valve may be sensed and reported as constant palpitations. To be considered causal, the sensed beats must have been correlated with the normal heart rhythm.

Cardiac Disease. Various cardiac diseases have been associated with palpitations in the absence of arrhythmias or other causes for palpitations. These reports were interpreted to define causality.

- Cardiomegaly. The enlarged cardiac silhouette can cause palpitations, probably on the basis of increased cardiac output or contractility. This was considered causal if there was chest radiographic evidence of at least moderate cardiomegaly in a patient with palpitations.

- Mitral Valve Prolapse (MVP). Although the literature reports series of patients with MVP in whom there is symptomatic correlation of arrhythmias on ambulatory monitoring, there are also patients with symptoms in the absence of arrhythmias. For the patient with clinical (ie, classic murmur or click) or echocardiographic evidence of mitral valve prolapse and palpitations, MVP was considered causal in the absence of symptomatic arrhythmias. Patients in whom symptomatic arrhythmias were documented were classified as an arrhythmia etiology.

- Hyperkinetic heart syndrome. Classification into this category was limited to young males with a systolic murmur and a hyperdynamic precordium and pulse, in the absence of any other etiology for a hyperadrenergic state.

- Atrial myxoma. Although this entity is rare, there have been reports of atrial myxoma presenting with palpitations. For the patient with echocardiographic evidence of atrial myxoma and palpitations, the myxoma was considered causal in the absence of symptomatic arrhythmias.

Psychiatric Disease. Palpitations commonly occur in patients with panic attack and disorder, generalized anxiety disorder, and somatization disorder and are included in their Diagnostic and Statistical Manual of Mental Disorders, Third edition, Revised (DSM-III-R) definitions.

Definite: A diagnosis of one or more of these disorders was made if the patient met DSM-III-R criteria as diagnosed with Diagnostic Interview Schedule (DIS). and there was no other significant medical comorbidity or etiology for palpitations.

Probable: When the DIS was not administered but there was strong clinical evidence, the investigators considered a category of probable anxiety to fit the DSM-III-R category of generalized anxiety disorder that was not otherwise specified.

Comorbid: In cases in which any other etiology for palpitations existed, the psychiatric disorder was not considered as the etiology.

Medications. Palpitations occurring with a temporal relationship to the use of medications such as sympathomimetic agents, vasodilators, anticholinergics, or during withdrawal from β-blockers are well recognized. Each potential etiologic medication must have been reported to cause palpitations as a possible adverse effect. Criteria were devised to justify causality, similar to previous reports on adverse drug reactions.

Definite: (1) Palpitations following a temporal sequence after the medication was introduced or reached an abnormal level, (2) resolving after withdrawal of the medication or normalization of the
blood concentration, and (3) having no other apparent etiologic factor.

Probable: Two of the three factors listed above.

Possible: One of the three factors listed above or two of the three factors listed above in the presence of another etiologic factor.

**Habits.** Palpitations occurring with a temporal relationship to the use of cocaine\(^{17-19}\) and amphetamines,\(^{16}\) caffeine,\(^{20-23}\) and nicotine\(^{15}\) have been reported. Criteria have been developed to define this association.

- **Cocaine or amphetamines**
  - **Definite:** (1) Palpitations temporally related to cocaine or amphetamine use, (2) with resolution after discontinuation of the drug, and (3) no other apparent etiology.
  - **Probable:** Palpitations temporally related to cocaine or amphetamine use and one of the other two factors listed above.
  - **Possible:** Palpitations temporally related to cocaine or amphetamine use, but other possible etiologies exist.

- **Caffeine**
  - **Definite:** (1) Palpitations temporally related to caffeine intake of greater than 4 cups of coffee (or equivalent) per day, (2) with resolution after discontinuation of caffeine, and (3) no other apparent etiology.
  - **Probable:** Palpitations temporally related to caffeine intake of greater than 2 cups of coffee (or equivalent) per day and one of the other two factors listed above.
  - **Possible:** Palpitations temporally related to any caffeine intake, but other possible etiologies exist.

- **Nicotine**
  - **Definite:** (1) Palpitations temporally related to nicotine product use, (2) with resolution after cessation, and (3) no other apparent etiology.
  - **Probable:** Palpitations temporally related to nicotine product use and one of the other two factors listed above.
  - **Possible:** Palpitations temporally related to nicotine product use, but other possible etiologies exist.

**Metabolic Disorders.** Several metabolic disorders have been reported to be associated with palpitations and are often accompanied by a sinus tachycardia. These abnormal metabolic states are often recognized by other characteristic associated signs and symptoms.

- **Hypoglycemia.**\(^{24}\) Hypoglycemia was documented in association with palpitations that resolved with restoration of normal glucose levels.
- **Thyrotoxicosis.**\(^{25}\) Palpitations were associated with the clinical presence of thyrotoxicosis, confirmed by laboratory tests.
- **Pheochromocytoma.**\(^{26}\) Palpitations were associated with the clinical presence of pheochromocytoma, confirmed by laboratory tests.
- **Mastocytosis.**\(^{27}\) Palpitations were associated with the clinical presence of mastocytosis, confirmed by laboratory tests.
- **Scombroid food poisoning.**\(^{28}\) Palpitations following ingestion of scombroid fish.
- **Idiopathic flushing.**\(^{29}\) The clinical scenario was consistent with idiopathic flushing and other disorders were excluded (ie, diagnosis by exclusion).

**High Output States.** Increased cardiac output can be responsible for the symptom of palpitations. The conditions listed below are known causes of a high output state. The following definitions were used to relate the palpitations to the high output state:

- **Anemia.**\(^{120}\) There is no clear level of hemoglobin at which the cardiac output rises. Symptoms vary with the rate of onset of anemia and the underlying comorbidity of the patient. For the purpose of this study, anemia was considered causal if palpitations occurred in a patient with a hemoglobin < 100 g/L and resolved after correction of the anemia.
- **Pregnancy.**\(^{31}\) Peak cardiac output occurs between the 20th and 24th week of gestation. Palpitations in a pregnant woman after the 20th week of gestation were attributed to the high output state of pregnancy when no other etiology was present.
- **Paget's disease.**\(^{32}\) Cardiac output rises when more than 15% of the skeleton is involved with active Paget's disease. For the purpose of this study, Paget's disease was considered causal in a patient with palpitations if there was active disease of at least two skeletal locations and no other etiology was present.
- **Fever.**\(^{33}\) There is a linear relationship between rise in temperature above normal and the heart rate. As baseline heart rate varies among individuals, so will the appearance of tachycardia. Fever was considered causal when palpitations were temporally related to a new temperature of ≥ 38°C, with resolution after defervescence, if no other etiology was present.

**Dehydration and Orthostatic Hypotension.** Palpitations occurring in the patient with dehydration or orthostatic hypotension are generally believed to be related to a physiologic (compensatory) sinus tachycardia. These were considered present in the appropriate clinical setting if clinical or laboratory signs of dehydration or symptomatic orthostatic hypotension existed.\(^{34}\)

**Exertion.** Exertional palpitations are related to an increased stroke volume. Exertion was considered causal if historical data confirmed physical exertion for that individual, in the absence of another etiology of palpitations.

**REFERENCES**