Evaluation of Guidelines for the Use of Telemetry in the Non-Intensive-Care Setting

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To determine if the American College of Cardiology (ACC) cardiac monitoring guidelines accurately stratify patients according to their risks for developing clinically significant arrhythmias in non-intensive-care settings, we conducted a prospective cohort study of 2,240 consecutive patients admitted to a non-intensive-care telemetry unit over 7 months. Sixty-one percent of patients were assigned to ACC class I (telemetry indicated in most patients), 38% to class II (telemetry indicated in some), and 1% to class III (telemetry not indicated). Arrhythmias were detected in 13.5% of the class I patients, 40.7% of the class II patients, and 12% of the class III patients ($p < .001$). Telemetry detected an arrhythmia resulting in transfer to an intensive care unit in 0.4% of the class I patients, 1.6% of the class II patients, and none of the class III patients ($p = .006$). Telemetry led to a change in management for 3.4% of the class I patients, 12.7% of the class II patients, and 4% of the class III patients ($p < .001$). When patients with chest pain as the reason for admission were moved from class I to class II and patients with arrhythmias as the reason for admission were moved from class II to class I, more arrhythmias and more clinically significant arrhythmias occurred in class I patients and the trends from class I to class III were more consistent with the purpose of the guidelines. These findings indicate that when the ACC guidelines are reexamined, consideration should be given to changing them so they are more useful in non-intensive-care settings.

KEY WORDS: hospital units; ambulatory monitoring; telemetry; arrhythmia; practice guidelines.
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The American College of Cardiology (ACC) has published guidelines for in-hospital cardiac monitoring to detect arrhythmias.¹ The guidelines assign cardiac conditions and diagnoses to three classes with different prior-

ities for monitoring (Table 1). For cardiac conditions and diagnoses in class I, cardiac monitoring is indicated for most patients, including all patients with significant risks of life-threatening arrhythmias. For example, monitoring is recommended for a patient with a proven or suspected myocardial infarction for the first 3 hospital days or until the infarction can be excluded. For cardiac conditions and diagnoses in class II, cardiac monitoring is indicated in some patients, for example, a patient with an uncomplicated myocardial infarction after the third hospital day, a patient with a clinically significant but non-life-threatening arrhythmia, and a patient with unexplained syncope or other transient neurologic signs or symptoms. For cardiac conditions and diagnoses in class III, cardiac monitoring is not indicated because the risk of a serious arrhythmia or the likelihood of therapeutic benefit is low.

We have reported the results of a small study that suggested few differences in the outcomes of patients in the three ACC classes while they were being monitored in a non-intensive-care telemetry unit.² We subsequently reported the results of a larger study that found telemetry in this setting rarely detected arrhythmias that resulted in the transfer of patients to an intensive care unit (0.8%) and uncommonly detected arrhythmias that led to urgent interventions or a change in medication (7%), but our analyses did not look for differences among the three ACC classes.³ In this study, we use the data from our larger study to determine whether there are differences in the frequency or the clinical significance of the arrhythmias that occur in patients in the three ACC classes when they are being monitored in a non-intensive-care setting. As a result of this study, we are proposing that the ACC modify its guidelines for telemetry in the non-intensive-care setting so that patients with chest pain are assigned to class II rather than class I and patients with an initial diagnosis of arrhythmia are assigned to class I rather than class II.

METHODS

The study was performed between June 30, 1993, and January 31, 1994, in a 900-bed primary care and tertiary care urban hospital. Telemetry beds were located in intensive care units, intermediate care units, a recovery room, an emergency room, and a 72-bed non-intensive-care telemetry unit. We included in the study all patients hospitalized in the non-intensive-care telemetry unit who were not transferred from intensive care. This unit was staffed by residents, cardiology fellows, and cardiology faculty who prospectively recorded baseline clinical data

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Table 1. American College of Cardiology Guidelines for In-hospital Cardiac Monitoring*

Class I: cardiac monitoring is indicated in most if not all patients in this group. This category includes all patients who are at significant risk of an immediate life-threatening arrhythmia.

Examples:

- Proven or suspected myocardial infarction
- Post cardiac surgery, cardiac arrest, or catheter ablation
- Unstable angina
- Drug poisoning known to have arrhythmic toxicity
- Post percutaneous transluminal angioplasty with complications
- High-risk coronary artery lesions, critically ill patients
- Mobitz type II block or greater
- Sustained ventricular tachycardia
- Myocarditis
- Loading type I/III antiarrhythmic agents (high risk)

Class II: cardiac monitoring may be of benefit in some patients but is not essential for all.

Examples:

- Syncope
- More than 3 d post myocardial infarction
- Potentially lethal arrhythmia several days after control
- Significant non-life-threatening arrhythmia such as atrial fibrillation
- Significant risk of cardiac or respiratory arrest
- Hypotension
- Post angioplasty, pacemaker, cardiac surgery (stable)
- Loading type I/III antiarrhythmic agents (low risk)
- Tachyarrhythmia/bradyarrhythmia
- Pericarditis

Class III: cardiac monitoring is not indicated because the patient's risk of a serious arrhythmia or the likelihood of therapeutic benefit is low.

Examples:

- Postoperative patients at low risk
- Terminal illness
- Post routine uncomplicated coronary angiography
- Chronic stable atrial fibrillation or nonsustained ventricular tachycardia
- Stable cardiac disease or obstetrics

*Diagnoses are based on clinical assessment by the patient's attending physician.

and the presence and type of arrhythmias. Two authors independently classified each patient's need for telemetry according to ACC guidelines, on the basis of the admission diagnosis¹; disagreement was resolved by consensus. Interrater agreement was good in a pilot study ($\kappa = 0.8$).² The study was approved by the Human Rights Committee at Henry Ford Hospital.

Heart rate and rhythm were recorded continuously by a Hewlett Packard 78720 ASDN system (Rockville, Md) with 24-hour memory and recall. Technicians trained in arrhythmia recognition watched the monitors 24 hours a day and printed tracings of abnormal findings for review. The patients' cardiologists reviewed these tracings and recorded the following arrhythmias: ventricular fibrillation, sustained ventricular tachycardia, nonsustained ventricular tachycardia (≥ 3 consecutive ventricular beats at a rate ≥ 100 beats per minute with spontaneous resolution), sinus tachycardia (heart rate [HR] ≥ 100 beats per minute), supraventricular tachycardias, atrial fibrillation, atrial flutter, sinus bradycardia (HR ≥ 50 beats per minute), sick sinus syndrome, junctional rhythms, third-degree and

second-degree type II atrioventricular block, second-degree type I atrioventricular block, bifascicular block, bigeminy, and some other arrhythmias. Premature ventricular contractions and atrial contractions were not recorded.

To identify clinically significant arrhythmias, we asked cardiologists open-ended questions when their patients were discharged from the unit. The questions asked whether telemetry led to a change in management, for example, a change in drug type or dosage schedules; whether telemetry was reassuring to the cardiologist, for example, after a cardiac intervention or the initiation of antiarrhythmics; and whether telemetry detected an arrhythmia that resulted in transfer to an intensive care unit.

The χ^2 test was used to test for differences across ACC classes. The χ^2 test for trend was used to test for trends in the differences across ACC classes.⁴ Because of the small number of class III patients, we performed post hoc comparisons between class I and class II patients using the χ^2 test or Fisher's exact test. The results of the post hoc analyses were similar to the initial analyses and are not reported here.

RESULTS

A detailed description of overall patient characteristics has been reported elsewhere.³ Information was collected prospectively for 91% of the 2,240 patients in the study, and information was collected retrospectively on the remaining patients when residents or cardiologists failed to follow study procedures, patients were discharged within 12 hours, or forms were lost. Patients with prospectively collected information had a lower mortality rate in the unit (0.5% vs 5%, $p < .001$) but a similar rate of transfer to intensive care (11% vs 9%, $p = .55$).

Using ACC guidelines, 61% of patients were assigned to class I, 38% to class II, and 1% to class III (Table 2). Most of the patients in class I had an admitting diagnosis of chest pain (90%), but the admitting diagnoses in class II were more diverse (32% heart failure, 26% syncope, 34% arrhythmia, and 7% other).

Arrhythmias of any type were detected in 13.5% of the class I patients, 40.7% of the class II patients, and 12% of the class III patients ($p < .001$). Sustained ventricular tachycardia or fibrillation was detected in 0.2% of the class I patients, 0.6% of the class II patients, and none of the class III patients ($p = .4$). The percentage of patients in class I who developed any arrhythmia and the percentage of those who developed sustained ventricular tachycardia or fibrillation in the unit were lower for patients admitted with a diagnosis of chest pain than they were for patients in class I who were admitted with other diagnoses. The percentage of patients who developed any ar-

rhythmia and the percentage of those who developed sustained ventricular tachycardia or fibrillation in the unit were similar for patients admitted with a diagnosis of arrhythmia whether they were in class I or class II, and they were higher than they were for patients in these classes who were admitted with other diagnoses. Patients were admitted with the following arrhythmia diagnoses: 55.8% with supraventricular tachycardia, atrial fibrillation, or atrial flutter; 4.8% with sinus tachycardia; 3.2% with nonsustained ventricular tachycardia; 1.9% with sustained ventricular tachycardia; 7.3% with third-degree or second-degree type II atrioventricular block; and 27% with other arrhythmias.

Telemetry led to a change in management for 3.4% of the class I patients, 12.7% of the class II patients, and 4% of the class III patients ($p < .001$) (Table 2). Telemetry was reassuring for the cardiologists of 1.8% of the class I patients, 12% of the class II patients, and none of the class III patients ($p < .001$). Telemetry detected an arrhythmia resulting in transfer to intensive care for 0.4% of the class I patients, 1.6% of the class II patients, and none of the class III patients ($p = .006$). The percentages of patients in class I who had a change in management because of telemetry findings, whose cardiologists were reassured by telemetry findings, and who were transferred to intensive care were similar for patients admitted with chest pain and patients with other diagnoses. The percentages of patients who had a change in management because of telemetry findings, whose cardiologists were reassured by telemetry findings, and who were transferred to intensive

Table 2. Patients with Each Outcome by American College of Cardiology (ACC) Class and the Reason for Admission

ACC Class and Reason for Admission	Number of Patients in Category	Percentage in Category with Any Arrhythmia	Percentage in Category with Ventricular Tachycardia or Fibrillation	Percentage in Category Whose Telemetry Led to a Change in Management	Percentage in Category Whose Telemetry Was Reassuring	Percentage in Category Whose Telemetry Led to Transfer to Intensive Care
Class I						
Chest pain	1,225	12.3	0.2	3.3	1.1	0.3
Awaiting revascularization	37	2.7	0.0	0.0	0.0	0.0
Post infarct	38	15.8	0.0	2.6	2.6	0.0
Arrhythmia	19	73.7	5.3	21.1	42.1	5.3
Other*	37	29.7	0.0	2.7	2.7	0.0
Total	1,356	13.5	0.2	3.4	1.8	0.4
Class II						
Heart failure	277	25.3	0.4	5.1	2.5	1.1
Syncope	227	26.0	0.0	8.4	7.5	0.4
Arrhythmia	295	68.8	1.4	24.7	25.4	3.1
Other*	60	30.0	0.0	5.0	6.7	1.7
Total	859	40.7	0.6	12.7	12.0	1.6
Class III						
Arrhythmia	1	0.0	0.0	0.0	0.0	0.0
Other*	24	12.5	0.0	4.2	0.0	0.0
Total	25	12.0	0.0	4.0	0.0	0.0

*Drug intoxication, chronic obstructive pulmonary disease, chest trauma, asthma, pneumonia, pneumothorax, pulmonary embolism, gastrointestinal bleed, sepsis, seizure, pericarditis, stroke, and hypertension.

care were similar for patients admitted with a diagnosis of arrhythmia whether they were in class I or class II, and they were higher than they were for patients in these classes who were admitted with other diagnoses.

Table 3 describes what the outcomes in each class would have been if patients with chest pain as the reason for admission had been assigned to class II rather than class I and patients with arrhythmia as the reason for admission in class II or III had been assigned to class I. Although there were significant differences across classes for most of the outcomes using either classification plan, there were significant differences in trends for the proposed classification plan for all of the outcomes (for any arrhythmia, $p < .001$; for ventricular tachycardia or fibrillation, $p < .007$; for a change in management, $p < .001$; for cardiologists' reassurance, $p < .001$; for telemetry led to a transfer to intensive care, $p < .001$), but not in the original ACC plan (all $p > .05$).

DISCUSSION

Our study is the first to have reported the risk of arrhythmia based on the ACC classification. We found that the current version of the ACC telemetry guidelines in the non-intensive care setting does not stratify appropriately patients' risk of developing any arrhythmia. Patients in class I did not have more significant arrhythmias than patients in class II or III. We also found that the guidelines do not stratify physicians' perceived clinical significance of the arrhythmias. Telemetry was not perceived as more helpful in class I patients.

Our data suggest that two simple modifications might improve the ACC classification for use in non-intensive-care settings. Patients with an admission diagnosis of arrhythmia had frequent arrhythmias in the hospital, and telemetry frequently led to changes of management. Conversely, patients hospitalized with chest pain had infrequent ventricular arrhythmias, and telemetry infrequently led to changes of management. In the revised version, we classified patients with an initial diagnosis of arrhythmia as class I, and patients hospitalized with chest pain as class II. Trends in class-to-class differences could be seen with the proposed classification; arrhythmias, changes in man-

agement, cardiologists' reassurance, or telemetry leading to a transfer to intensive care occurred more frequently among patients in class I than among patients in class II or III.

Other data support our proposal for a modified version of the ACC telemetry guidelines. In patients with chest pain seen at the emergency department, Goldman et al. report that ventricular fibrillation, cardiac arrest, complete heart block, or Mobitz type II block occurs in 0.4% of patients within 24 hours and in 0.2% between 24 and 72 hours.⁵ These estimates combine data from hospitalized patients (intensive care units or general medical wards) and from patients who are not hospitalized. The risk of a major event within 72 hours was 0.3% among patients admitted to a general ward or discharged home. In another study on 205 patients, Lipskis et al. identified that significant arrhythmias occurred only in patients with known or suspected coronary artery disease or in those with previously documented arrhythmia.⁶

We collected data prospectively and obtained perceptions of utility of telemetry from practicing cardiologists in daily clinical work. However, our study has several limitations. First, because telemetry is designed to detect infrequent but important events, sample size is an issue. Our study is the largest to date that looks specifically at telemetry and the ACC guidelines. The observed absolute difference in detection of ventricular arrhythmias of 0.4% between class I and II patients will require a large sample, and it is probably not clinically meaningful. Second, the generalizability of our study has two facets: the role of cardiologists and the setting. Cardiologists were involved in the triage of patients to telemetry and were the individuals who judged the usefulness of the telemetry findings. The potential effect of physician bias is uncertain; because of their expertise, cardiologists may value telemetry differently than other specialists or general internists. Also, the study took place in a single institution with an integrated delivery system and with substantial managed care. The study needs to be prospectively validated in other settings. We acknowledge that our findings may not apply to other settings since the patients' likelihood of significant arrhythmia may be different. A third limitation is the potential for underreporting of arrhythmia and

Table 3. Patients in Each Class by Original American College of Cardiology (ACC) Versus Proposed Classification Plans

Class	Number of Patients in Class		Percentage in Class with Any Arrhythmia		Percentage in Class with Ventricular Tachycardia or Fibrillation		Percentage in Class Whose Telemetry Led to a Change in Management		Percentage in Class Whose Telemetry Was Reassuring		Percentage in Class Whose Telemetry Led to a Transfer to Intensive Care	
	ACC	Proposed	ACC*	Proposed†	ACC	Proposed†	ACC*	Proposed†	ACC*	Proposed†	ACC*	Proposed†
I	1,356	427	13.5	55.0	0.2	1.2	3.4	18.5	1.8	19.9	0.4	2.3
II	859	1,789	40.7	16.7	0.6	0.2	12.7	4.2	12.0	2.3	1.6	0.5
III	25	24	12.5	12.0	0.0	0.0	4.0	4.2	0.0	0.0	0.0	0.0

* $\chi^2 < .05$, χ^2 for trend $> .05$.

† χ^2 and χ^2 for trend $< .05$.

observation bias (some data were obtained retrospectively). We attempted to address observation bias by reviewing life-threatening arrhythmias in all patients.

In summary, this study supports a reconsideration of classification in future guidelines for the use of telemetry in the general medical care. We propose that patients with an initial diagnosis of arrhythmia be categorized as class I (telemetry is indicated in most, if not all, patients) and patients hospitalized with chest pain be categorized as class II (cardiac monitoring may be of benefit in some patients, but it is not essential for all).

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