

Relevance of Routine Admission Electrocardiograms for Psychiatric Patients

Darell E. Heiselman, D.O.
Donald L. Bredle, Ph.D.
Edward Kessler, M.D.
Gregory W. Rutecki, M.D.
Robert M. Hines, M.D., Ph.D.
Frederick C. Whittier, M.D.
Paul D. Bunn, M.D.
Andre J. Ognibene, M.D.

Objective: To make clinically relevant recommendations for electrocardiogram (ECG) testing among psychiatric patients, the study examined the practice of ordering ECGs for this population. **Methods:** The records of 4,045 patients consecutively admitted for psychiatric care to seven community teaching hospitals over one year were examined. The frequency of ECG orders was documented, and abnormal ECG results were grouped into two categories: relevant to psychiatric treatment (ischemia or conduction defects) and incidental to treatment (minor abnormalities and screening abnormalities). For those with abnormalities, additional cardiac follow-up data were recorded. Associations between ECG results and patients' characteristics were analyzed. **Results:** ECGs were performed for 2,857 (71 percent) of first admissions, of which 2,225 (78 percent) showed neither relevant nor screening abnormalities. Eighteen percent of those tested had relevant abnormalities, most commonly a first-degree atrioventricular block or some evidence of a myocardial infarction. ECG screening abnormalities were found for another 4 percent, primarily left ventricular hypertrophy (3 percent), but no follow-up occurred for 46 percent of these patients. Among patients under 40 years of age, 8 percent had relevant abnormalities, and 3 percent had screening abnormalities. Among patients without apparent cardiac risk, 10 percent had relevant and 3 percent had screening abnormalities. More than half the patients who had a second or third admission during the year had a repeat ECG, even when previous ECGs were normal. **Conclusions:** Routine ECG is not an effective treatment or screening tool in this population, and substantial cost savings could result from more selective testing, particularly among young patients, those at low risk, and those with repeat admissions. (*Psychiatric Services* 48:1323-1327, 1997)

The authors are affiliated with the Internal Medicine Collaborative Research Group of the Northeastern Ohio Universities College of Medicine in Rootstown. Send correspondence to Dr. Heiselman at the Akron General Medical Center, 400 Wabash Avenue, Akron, Ohio 44307.

Routine electrocardiograms (ECGs) on hospital admission are frequently conducted for psychiatric patients whether or not patients meet the guidelines issued by the American College of Cardiology and the American Heart Association (1). The clinical benefit of routine ECG testing has not been addressed specifically for psychiatric patients. Although an ECG appears to pose little risk, there is potential harm in unnecessary testing, including expense and unneeded further testing and treatment following false-positive results (2).

The usefulness of routine ECGs for preoperative patients (2-4), patients in the emergency department (5), and those admitted to general hospitals (6,7) is controversial. Likewise, no consensus exists on which tests constitute a routine screening battery for psychiatric admissions (8). Two reasons for ordering ECGs for psychiatric patients are to assess potential cardiac side effects of some psychotropic drugs such as tricyclic antidepressants, phenothiazine, and lithium and to screen for cardiac disease. Current understanding is that the risk of tricyclics is predominantly limited to patients with underlying cardiac conduction abnormalities or ischemic abnormalities (9).

Table 1

Characteristics of 4,045 patients admitted for psychiatric treatment at seven community-based teaching hospitals over one year

Characteristic	N	%
Sex		
Male	1,539	38
Female	2,506	62
Race		
White	3,393	84
Black	620	15
Other	32	1
Cardiac history	647	16
Pulmonary history	485	12
Diabetes	364	9
Hypertension	849	21
Stroke	121	3
Alcohol use	850	21
Tobacco use	1,739	43
Illicit drug use	526	13
Number of admissions during the year		
One	3,325	82
Two	537	13
Three	126	3
Four	38	1
Five	13	0.3
Six	6	0.1

Because of the importance of containing costs of medical care, we wanted to determine whether routine ECGs are appropriate for all psychiatric patients admitted to community hospitals, and, if not, which patients would most likely benefit. The specific aims of the study were to describe the frequency with which ECGs were ordered, the proportion of ECG findings that were relevant to psychiatric treatment—that is, related to conduction or ischemic abnormalities—and the proportion of ECG findings indicative of other major abnormalities. The associations between ECG abnormalities and characteristics of patients were explored, and follow-up care for those with cardiac abnormalities was examined.

Methods

This retrospective study described a consecutive sample of all adult patients admitted for psychiatric treatment during calendar year 1992 at seven community-based teaching

hospitals in the Northeastern Ohio Universities College of Medicine consortium. The consortium includes Akron City Hospital, Akron General Medical Center, and St. Thomas Hospital in Akron; Aultman Hospital and Columbia-Mercy Medical Center in Canton; and St. Elizabeth's Hospital and Western Reserve Care Systems in Youngstown.

Diagnosis-related group (DRG) codes 425–432 identified potential subjects. Only direct psychiatric admissions (including those for substance abuse treatment) were included; patients who were transferred from other hospital services or who had been hospitalized within the previous week were excluded. The study was approved by the institutional review board at each hospital.

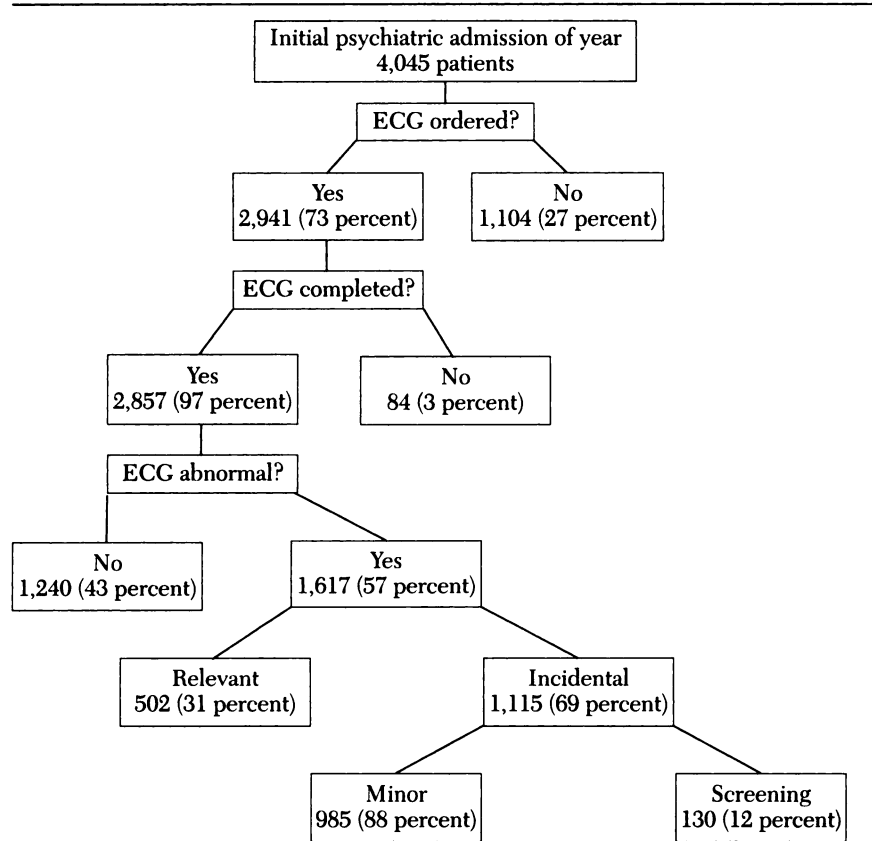
Data on eight demographic variables were abstracted from patients' records. The variables included age, sex, race, date of admission, the names of psychotropic and cardiac medications being taken on admission, and use of alcohol, tobacco, or illicit drugs. The patient's medical history in five areas of cardiac risk was determined, including hypertension, diabetes, stroke, cardiac disease, and pulmonary disease, as well as complaints of chest pain on admission. Psychiatric diagnoses were coded according to *DSM-III-R* (10). Data collectors were trained and monitored by the second author.

During the study year, 4,045 patients had 5,030 separate admissions. Selected patient characteristics are shown in Table 1. Patients had 171 different *DSM-III-R* diagnoses. Depression was a primary or comorbid diagnosis of 67 percent of the patients. The mean $\pm$ SD age of the patients was 47 ± 18 years.

The decision to order an ECG was made by either the emergency physicians or the admitting psychiatrists. All ECGs were read by a computer and then read again by the hospitals' attending cardiologists. The cardiologists' decisions about the ECG results were regarded as final. The ECG results were listed as either normal or abnormal, and each individual diagnosis was coded numerically. We divided the abnormal ECG diagnoses into those that were rele-

Figure 1

ECG decision and outcome tree¹



¹ The numbers represent the total number of patients per discrete category at each step.

vant to psychiatric treatment (conduction defects and ischemia) and those that were incidental, or not directly germane to the psychiatric treatment but suggesting a cardiac problem. (Complete data for these categories are available from the authors).

The incidental abnormalities were then subdivided into screening abnormalities, or those that were considered serious enough to warrant cardiac follow-up, and minor abnormalities, which included all others. For patients with screening abnormalities, additional data were recorded about cardiac follow-up, including repeat ECGs, cardiac consultations, echocardiograms, or other further cardiac testing.

Frequency distributions were used to describe patient characteristics, the rate of abnormal ECGs, and follow-up. Associations between predictor variables and the risk of abnormal ECG findings were measured by odds ratios and tested by chi square analysis.

Results

The ECG decision tree for each patient's first admission of the year is diagrammed in Figure 1. Of the 2,857 patients tested, 502 (18 percent) had a relevant result, and another 130 (4 percent) had a screening abnormality. Thus 78 percent of those tested had neither a relevant result nor a screening abnormality. For the 720 patients who had a second admission during the year, an ECG was ordered for 386 (54 percent); an ECG was ordered for more than half of those who had a normal ECG on the previous visit. For the 183 patients who had a third admission, an ECG was ordered in half of all cases; 45 percent of those who had normal ECGs on the first two admissions were given an ECG on the third.

The frequencies of diagnoses of cardiac abnormalities are shown in Table 2. Table 3 presents data on the associations between the predictor variables and ECG orders and results. No significant association was found between sex, race, psychotropic medications taken on admission, and the use of tobacco, alcohol, or illicit drugs and ECG orders or results.

Table 2

Frequency distribution of the most common ECG diagnoses (more than 1 percent of total) among 2,857 psychiatric patients

Type of abnormality and diagnosis ¹	N	%
Relevant abnormalities (N=502 patients)		
Conduction defects (N=293 diagnoses)		
First-degree atrioventricular block	61	2
Left anterior fascicular block	45	2
Nonspecific intraventricular delay	42	1
Right bundle branch block	36	1
Prolonged QT interval	31	1
Left bundle branch block	26	1
Ischemia, infarct, or injury ² (N=275 diagnoses)		
Inferior infarct	101	3
T wave abnormality	70	2
Anterior infarct	44	2
Septal infarct	24	1
Incidental abnormalities (N=1,115 patients)		
Screening abnormality (N=220 diagnoses)		
Left ventricular hypertrophy	78	3
Low-voltage QRS	50	2
Atrial fibrillation	27	1
Minor abnormality (N=1,519 diagnoses)		
Nonspecific ST or T wave abnormalities	643	22
Sinus tachycardia	289	10
Sinus bradycardia	190	7
Sinus arrhythmia	142	5
Left atrial enlargement	95	3
Left axis deviation	86	3
Poor R wave progression	69	2
Voltage criteria for left ventricular hypertrophy	57	2
Right atrial enlargement	57	2
Premature ventricular contractions	55	2

¹ Because a patient could have more than one type of abnormality, the total number of diagnoses differs from the total number of patients shown in Figure 1.

Further cardiac evaluation of 130 patients after a screening abnormality included a repeat ECG for 70 patients (54 percent), a cardiac consultation for 68 (52 percent), an echocardiogram for 31 (24 percent), and a

stress test for seven (5 percent). For 60 patients (46 percent), no cardiac follow-up occurred.

A total of 489 patients (12 percent) were considered to be without cardiac risk; that is, they had no history

Table 3

Associations between predictor variables and ECG orders and results among 2,857 psychiatric patients¹

Variable	ECG ordered	Relevant results		Screening results	
		Odds ratio	95% CI	Odds ratio	95% CI
Age	+	+		+	
Cardiac history	+	4.9	3.9-6.2	4.4	3.3-6.0
Cardiovascular medications	ns	3.3	2.7-4.1	3.6	2.7-4.8
Diabetes	+	2.5	1.9-3.4	+	
Hypertension	+	2.4	1.9-2.9	2.2	1.6-2.9
Stroke	+	+		4.1	2.4-6.9
Pulmonary history	ns	+		+	
Chest complaints	+	+		+	
Total number of medications	ns	+		+	

¹ Numerical values are presented when the association was significant at the .05 level and the odds ratio was greater than 2. The plus sign (+) indicates a significant association at the .05 level but an odds ratio of less than 2.

of hypertension, cardiovascular disease, or current symptoms and they were not taking cardiovascular or psychotropic medications. An ECG was done for 272 of these patients (56 percent); a relevant result was found for 28 (10 percent) and a screening abnormality for nine (3 percent). Further cardiac evaluation of patients with relevant or screening abnormalities included a repeat ECG for six (17 percent), a cardiac consultation for four (11 percent), and an echocardiogram for three (8 percent). For 29 patients (78 percent), no cardiac follow-up occurred.

A total of 1,164 of the 1,772 patients under age 40 (66 percent) had an ECG. A relevant result was found for 94 (8 percent), most commonly nonspecific intraventricular conduction delay (nine patients, or .7 percent). Forty patients (3 percent) had a screening abnormality, most commonly short QT interval (ten patients, or 1 percent).

For 236 patients (8 percent), ECG testing was done in the emergency department. A relevant or screening abnormality was found for 69 (29 percent).

Discussion

A primary reason to order ECGs for psychiatric patients is the potential for cardiac side effects from psychotropic drugs. The tricyclic antidepressants have been considered particularly problematic since the publication of case reports of overdose and life-threatening arrhythmias (9). Orthostatic hypotension can be a concern with this class of drugs but is usually limited to elderly persons and those with cardiovascular disease. At normal therapeutic levels and in usual physiological conditions, the tricyclics are powerful class I antiarrhythmics in most patients, but paradoxically they are proarrhythmic in about 10 percent of people with pre-existing arrhythmias or ischemia (11). Thus psychiatric patients with ischemic heart disease might be most at risk for rhythm abnormalities from tricyclics (9).

Because two-thirds of the patients in the study reported here had depression, the likelihood of antidepressants' being prescribed was high.

Thus we defined ischemic and conduction ECG abnormalities as relevant to psychiatric treatment; however, only 18 percent of the patients had such findings. A substantial number of those patients (12 percent) had first-degree atrioventricular block, which does not by itself constitute a primary contraindication for prescription of tricyclics, nor is it a marker for proarrhythmic effect or cardiac side effects.

Of course, not all psychiatric patients take tricyclics, especially as newer antidepressants with fewer cardiovascular side effects evolve (11). Furthermore, there are conditions other than depression for which an ECG might be considered relevant to psychiatric treatment, including an alcohol or drug overdose or a severe eating disorder. However, among these patients in community hospitals, such occurrences were few compared with the occurrence of depression, and they had no apparent influence on the pattern of ECG ordering or follow-up.

The other primary reason for a routine ECG is to screen for cardiac disease. However, screening abnormalities alone were found in only an additional 4 percent of patients. Therefore for 78 percent of the 2,857 patients given an ECG, the ECG suggested no further testing or evaluation. Even ECGs done in the emergency department were of little clinical consequence in 71 percent of cases.

A study of 1,410 admissions to the general medicine service of a university hospital found that ECGs rarely (in about 1 percent of cases) added information beyond that available from the history and physical exam, even when the rate of abnormal findings was as high as 74 percent (7). The rates of ECG abnormalities found in that and other studies (6,12) are similar to or higher than the rate found in our study. Thus one potential reason for ordering an ECG for psychiatric patients—a higher-than-expected frequency of abnormal findings—was not supported in this sample of patients from community hospitals. Other populations with less depression and more drug abuse or other serious comorbidities could

have a higher rate of abnormalities, although that is unlikely based on the studies of diverse populations cited.

Three potential predictors of ECG abnormalities—taking psychotropic medications, smoking, or being African American—have been identified in the literature. We cannot explain why these variables were not associated with increased ECG abnormalities in our study. Likewise, self-reported use of illicit drugs, another previously identified predictor, was not associated with an abnormal ECG; however, actual use may have been underreported (13).

We presumed that abnormal ECG results would initiate further cardiac evaluation. However, no clear pattern of cardiac follow-up was evident among the patients with screening abnormalities. For more than half of these patients, no evidence of any further cardiac evaluation was found, and less than a third had a repeat ECG or cardiology consultation. In addition, among the patients for whom screening would be most beneficial, those with no cardiac history or current symptoms, the rate of cardiac follow-up was even lower—78 percent had no further cardiac evaluation despite an abnormality.

Not surprisingly, in this study an ECG order was associated with patients' increasing age and a history or current symptoms of cardiovascular disease. More important, the high overall frequency of ECG orders (71 percent) was only slightly lower among patients under age 40 and among those with a low cardiac risk, implying that these factors were not considered in the decision to order the test. Also, the high rate of ECG testing on second and third admissions during the year, especially when previous ECGs were normal, implies that little attention was paid to cardiac history or results of previous ECG testing. Rather than a consistent pattern of ordering, we found that some physicians routinely ordered an ECG for all psychiatric admissions, and some for those over age 35 or 40; other physicians were more selective.

Significant cost savings as well as improved outcomes could result from ECG testing focused on pa-

tients who meet specific risk criteria. Assuming that an ECG costs \$80, a savings of \$114,000 would have resulted if ECG testing had been reduced 50 percent in this study. Expanded to the national level, where more than a million patients are discharged with psychosis as a first-listed diagnosis and 6.3 million are discharged with diagnoses of mental disorders (14), a comparable reduction in ECG testing could realize cost savings of \$28 million to \$168 million per year.

Roizen (2) has concluded that the number of preoperative ECGs could safely be reduced 50 percent by limiting testing to patients identified as having a high risk based on criteria of age, diabetes, hypertension, chest pain, congestive heart failure, smoking, exercise intolerance, or the need for vascular surgery. We propose that these conditions could be applied to most psychiatric patients admitted to community hospitals, with the following modifications. Any patient presenting with drug abuse or overdose, particularly drugs with cardiotoxic potential such as tricyclic antidepressants (15), should be given an ECG. Any patient to be started on a tricyclic antidepressant should receive an ECG as a baseline, as should any patient taking a tricyclic antidepressant who has a history of a cardiac conduction problem or evidence of ischemic disease (an alternative medication could also be considered in these cases).

Conclusions

We found an excessive rate of ECG testing of psychiatric patients in community hospitals. Only a small proportion of tests yielded results relevant to treatment or helpful for cardiac screening. Therefore, routinely conducting ECGs in this population is overtesting, particularly among young patients, those at low risk of cardiac disease, and those with a normal ECG on a previous admission. In addition, follow-up of patients with screening abnormalities was inconsistent, which implied that ordering such tests had no impact on practice. As others have recommended for routine preoperative ECGs (2), we recommend limiting ECG testing to

psychiatric patients who may be at risk because of planned tricyclic antidepressant use or because of findings relevant to cardiac disease on history and physical examination. ♦

Acknowledgments

For help in data collection, the authors thank Melissa Himes, Jalel Judeh, M.D., Ray Hong, David Kimball, Barb Laroque, Rahul Rastogi, Usamah Shah, and Divya Singh.

References

1. Schlant RC, Adolph RJ, DiMarco JP, et al: Guidelines for electrocardiography: a report of the American College of Cardiology/American Heart Association task force on assessment of diagnostic and therapeutic cardiovascular procedures (committee on electrocardiography). *Journal of the American College of Cardiology* 19:473-481, 1992
2. Roizen MF: The usefulness of the preoperative electrocardiogram. *Journal of Clinical Monitoring* 9:101-103, 1993
3. Velanovich V: Preoperative laboratory screening based on age, gender, and concomitant medical diseases. *Surgery* 115:5-61, 1994
4. Atkins RF: Predicting the utility of the preoperative electrocardiogram: ageism and its economic impact (ltr, reply). *Journal of Clinical Monitoring* 10:70-72, 1994
5. Garland JL, Wolfson AB: Routine admission electrocardiography in emergency department patients. *Annals of Emergency Medicine* 23:275-280, 1994
6. Goldberger AL, O'Konski M: Utility of the routine electrocardiogram before surgery

and on general hospital admission: critical review and new guidelines. *Annals of Internal Medicine* 105:552-557, 1986

7. Moorman JR, Hlatky MA, Eddy DM, et al: The yield of the routine admission electrocardiogram. *Annals of Internal Medicine* 103:590-595, 1985
8. Morihisa JM, Rosse RB, Cross CD: Laboratory and other diagnostic tests in psychiatry, in *American Psychiatric Press Textbook of Psychiatry*, 2nd ed. Edited by Hales RE, Yudofsky SC, Talbott JA. Washington DC, American Psychiatric Press, 1994
9. Glassman AH, Roose SP: Risks of antidepressants in the elderly: tricyclic antidepressants and arrhythmia: revising risks. *Gerontology* 40(suppl 1):15-20, 1994
10. *Diagnostic and Statistical Manual of Mental Disorders*, 3rd ed, rev. Washington, DC, American Psychiatric Association, 1987
11. Glassman AH, Preud'homme XA: Review of the cardiovascular effects of heterocyclic antidepressants. *Journal of Clinical Psychiatry* 54(suppl 2):16-22, 1993
12. Roizen MF: Preoperative evaluation, in *Anesthesia*, 3rd ed, vol 1. Edited by Miller RD. New York, Churchill Livingstone, 1990
13. Hammersley R: A digest of memory phenomena for addiction research. *Addiction* 89(3):283-293, 1994
14. Graves E: National Hospital Discharge Survey: Annual Summary, 1993. Hyattsville, Md, National Center for Health Statistics, 1995
15. Smilkstein MJ: Reviewing cyclic antidepressant cardiotoxicity: wheat and chaff. *Journal of Emergency Medicine* 8:645-648, 1990

Program Submissions Sought for 1998 Institute

The scientific program committee is now accepting program submissions for the 1998 Institute on Psychiatric Services, to be held October 2-6, 1998, at the Westin Bonaventure Hotel in Los Angeles. To request a program submission booklet by mail, call the American Psychiatric Association's Answer Center at 202-682-6000. To obtain a copy by fax, call 888-267-5400 and request document no. 4106. The submission booklet can also be downloaded from APA's Web site at <http://www.psych.org>.

A copy of the disclosure statement on page 6 of the booklet must be signed by each presenter and must accompany each submission. For more information about the submission process, call 202-682-6396. The deadline for submissions is November 17, 1997.