Clinical Value of the Electrocardiogram in Ambulatory Care

Robert Nissan, MD, and Maria Encarnacion, MD
Bay Shore, New York

The direct impact of the electrocardiogram (ECG) on clinical outcome in an ambulatory health care population during a six-month period was reviewed. Three hundred seventy-six ECG tracings were recorded, of which 262 (69.7 percent) were interpreted as normal. The ECG was clinically useful and had direct impact on treatment in only two instances (0.5 percent of all tracings recorded). Three patients were inappropriately referred or treated because of an incorrect ECG interpretation. No electrocardiograms done on asymptomatic persons led to useful medical interventions.

The clinical usefulness of the routine electrocardiogram (ECG) has been a subject of debate for the past several years. A majority of ECGs done on ambulatory patients are interpreted as normal, and investigators have begun to reconsider the value of the ECG in this setting. Froom and Froom[1] found that 62.4 percent of all ECGs performed in an ambulatory care center were interpreted as normal. He noted that only 15 different ECG diagnoses were needed to interpret 96.5 percent of ECG tracings performed.

The high prevalence of normal ECGs performed in an ambulatory care health center raises a significant concern about the clinical usefulness of this examination. Rubenstein and Greenfield[2] recently addressed this question in an emergency room setting and concluded that screening ECGs performed to serve as a base line had no practical or clinical value. Sackett[3] reported on the potential usefulness of the ECG in hypertension and concluded that it may, in fact, do more harm than good. Froelicher[4] concluded that the routine ECG could potentially create iatrogenic cardiac cripples.

There is a growing clinical impression that ECGs are overordered for screening purposes and, whether normal or abnormal, have little impact on the choice of treatment. Likewise, there is concern that ECGs ordered in symptomatic patients are overutilized and rarely useful.

The purpose of this investigation was to evaluate the clinical usefulness of the ECG performed in an ambulatory care health center and to determine how often a medical intervention was made as a direct result of the ECG interpretation.

METHODS

Three hundred seventy-six consecutive ECGs performed between December 1983 and May 1984 in an ambulatory care health center were reviewed. ECGs were ordered by the facility's health care providers composed of staff and faculty physicians, first-, second-, and third-year family practice residents, and physician assistants. The facility is operated by Suffolk County in affiliation with the family practice residency program at Southside Hospital. The total number of ECGs performed during this period represented 0.02 percent of all patient visits. The ECGs examined were performed for patients with scheduled appointments and for those seen in the walk-in service provided by the facility.

All ECGs were interpreted by one of the authors. Criteria for interpretation of the ECG included (1) normal ECG (including sinus bradycardia, sinus tachycardia, and sinus arrhythmia), (2) abnormal ST-T waves (did not include J junction elevation and did not include isolated T wave inversion in lead III in an otherwise normal ECG), (3) left ventricular hypertrophy according to Romhilt and Estes[5] criteria, (4) left axis deviation $> -45°$, (5) left anterior hemiblock after meeting axis criteria of $> -45°$, (6) first-degree atrioventricular block defined as a PR interval of 0.20 or greater, (7) low voltage of 5 mm or less in all limb leads (low voltage was occasionally caused by myocardial infarction), (8) left atrial enlargement defined as a significant negative terminal P wave in V_1 (>0.04mm) and a broad-notched P wave in lead II, (9) right atrial hypertrophy defined by a P wave of at least 3 mm am-

TABLE 1. FREQUENCY OF ABNORMAL ELECTROCARDIAGRAM DIAGNOSES

Diagnosis	Number	Total ECGs Ordered (%)	Abnormal ECGs (%)
Abnormal ST-T waves	56	14.89	49.12
Premature ventricular complexes	25	6.64	21.92
Left ventricular hypertrophy	22	5.85	19.29
Left axis deviation	18	4.78	15.78
Left anterior hemiblock	15	3.98	13.15
Atrial fibrillation	15	3.98	13.15
Myocardial infarction	14	3.72	12.28
First-degree atrioventricular block	13	3.45	11.40
Low voltage	11	2.92	9.64
Left atrial enlargement	10	2.65	8.77
Premature atrial complexes	7	1.86	6.14
Right bundle-branch block	7	1.86	6.14
Right atrial enlargement	4	1.06	3.50
Pacemakers	3	0.79	2.63
Right ventricular hypertrophy	2	0.53	1.75
Left bundle-branch block	2	0.53	1.75
Bifasicular block	2	0.53	1.75
Arrhythmia (other than atrial fibrillation)	1	0.26	.87
Other (Wolff-Parkinson-White syndrome)	1	0.26	.87

plitude in lead II, and (10) pacemaker—including any pacemaker whether functioning normally or not. Following the interpretation of the ECG, the patient's chart was reviewed to determine the reason the ECG was ordered and the intervention, if any, that was made as a result of the ECG findings.

RESULTS

Three hundred seventy-six ECGs were reviewed. Two hundred sixty-two (69.7 percent) were normal, and 114 (30.3 percent) were abnormal. The 114 abnormal ECGs contained 228 abnormalities or approximately two abnormalities per ECG (Table 1). The most common abnormality observed was abnormal ST-T waves, which occurred in 56 tracings. The second most common abnormality was premature ventricular contractions. Left ventricular hypertrophy was the third most common.

One hundred forty-six ECGs (38.8 percent) were performed on persons aged over 60 years. Two hundred thirty-five ECGs were done on women and 141 ECGs were done on men. Of the 114 ECGs with abnormal results, 70 came from female patients and 44 from male patients, which is consistent with the proportion of ECGs ordered in each sex. As might be expected, 77 of the 114 abnormal ECG test results came from patients older than 60 years.

Two hundred nineteen ECGs (58.2 percent) were performed on asymptomatic persons. Of these, 76 (34.7 percent) were interpreted as abnormal tracings. Only 157 ECGs were ordered on symptomatic persons. Of these 38

(24.2 percent) had abnormal findings, and 119 were normal.

In only two instances did the ECG interpretation directly affect the patient's treatment. Both of these patients were symptomatic. One patient was admitted to the hospital coronary care unit for treatment of an acute myocardial infarction, and the other patient presented with an acute onset of atrial fibrillation and was started on digoxin as an outpatient. The patient converted to a sinus rhythm. Two patients were inappropriately referred to the hospital emergency room because of an incorrect interpretation of the ECG, and both were discharged from the emergency room with no change in therapy. Another patient was begun on propranolol because of an incorrect ECG interpretation. Two patients were referred for cardiac consultation because of their symptoms, not as a result of ECG findings.

DISCUSSION

The findings of this investigation are consistent with Froom and Froom's report,[1] in which they found 62.4 percent of ECGs in a primary care setting were interpreted as normal and commented that "15 different diagnoses were needed to interpret 96.5 percent of the ECGs done."

This investigation is one of only a few to specifically examine medical interventions made as a result of the ECG in the ambulatory care patient. Hedworth-Whitty[6] reported that in only 70 of 4,000 (1.8 percent) ECGs ordered in routine health screening was clinical action indicated based on abnormal ECG findings. The two most

common causes of abnormal findings were ischemic heart disease and ventricular extrasystoles (based on ECG and not clinical symptoms). The authors, however, did not determine whether follow-up action was taken and whether that action proved beneficial to the patient.

Resnekov et al[7] have suggested that all asymptomatic adults should have an ECG for screening purposes. They also reported, however, that the data were not adequate to establish an age at which ECGs are justified for asymptomatic persons and suggested that physicians consider the cost, unwarranted anxiety, unnecessary workup, and potential for misinterpretation in their decision to order an ECG. The findings of this investigation support the lack of positive impact of the ECG in the ambulatory care setting and underscore the concern that physicians overutilize the ECG. Physicians must seriously consider the lack of useful information that the ECG provides and the negative impact it may have before ordering routine ECGs for asymptomatic persons.

Ungerleider[8] commented that there is potential value in the screening ECG for evaluation of the patient with hypertension. Sackett[9] evaluated the usefulness of the ECG in hypertension and found that its performance showed no clear benefit with regard to decreasing the risk of a patient's disability or premature cardiovascular death. In addition, the literature in recent years has redefined hypertension, supporting an aggressive treatment approach to it that makes the ECG of less value regarding initiation of antihypertensive treatment.

It has been common practice to order base line ECGs because of their potential value for future comparison. In an editorial, Rubenstein and Greenfield[10] stated that overordering of base line ECGs was a fairly common practice, and felt that routine annual ECGs for normal patients was not cost effective. They also commented that the ECG done to screen for unsuspected disease was unreasonable, noting that there is no evidence that it changes the quality or the longevity of life, and suggested that it may even decrease the quality of life because of labeling and unnecessary workups. In addition, they commented on the variability of interpretations among readers and the inherent subjectivity of readings, which also raises concerns about the significant abnormalities found. Rubenstein and Greenfield[2] found that the base line ECG did not prove useful and often was not available for comparison in symptomatic patients evaluated in an emergency room. Furthermore, if a patient's history and examination prompted the physician to admit a patient, a base line ECG for comparison would probably not alter the decision, which in the acute phase is essentially a clinical judgment.

The data from this study also raise a question about the value of routine ECGs in the elderly, the age group physicians are most inclined to screen. There were a total of 77 (67.54 percent) abnormal ECG tracings in those aged over 60 years, even though this patient group represented only 36.17 percent of the total number of ECGs ordered. The prevalence of abnormal results in this group is well out of proportion to expected statistical evaluation, but these results still did not have an impact on the medical management. Of the 77 abnormal ECG interpretations in this group, 48 (62.33 percent) of the 77 abnormal ECG tracings occurred in asymptomatic persons, thereby also showing that symptoms were not necessarily helpful in predicting abnormalities on the ECG. In those who were symptomatic, it was also noted that the symptom had no relevance to the abnormality on the ECG. Mihalich and Fisch[11] noted that "the incidence of abnormalities increases with advancing age." They found that 46 percent of electrocardiograms on persons aged 65 years and older had abnormal interpretations, and 56 percent had abnormal findings if a patient had clinical heart disease, whereas 37 percent had abnormal findings in persons without evidence of clinical heart disease.

Two other reasons proposed by clinicians for the performance of ECGs are related first to patient expectations and satisfaction and second to medicolegal concerns. Patients often perceive that better, more comprehensive care is provided when an ECG is included as part of the complete physical examination. The physician is then faced with the public's personal bias about this test, which has implications about the thoroughness and quality of medical care provided. Patient education may offset some aspect of the misconception, but it requires time, effort, and patience.

References

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Suggested Reading

Frame P, Carlson S: A critical review of periodic health screening using specific screening criteria. Part 1: Selected diseases of respiratory, cardiovascular, and central nervous systems. J Fam Pract 1975; 2:29–36