ACC/AHA TASK FORCE REPORT

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)

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Preamble

It is becoming more apparent each day that despite a strong national commitment to excellence in health care, the resources and personnel are finite. It is, therefore, appropriate that the medical profession examine the impact of developing technology on the practice and cost of medical care. Such analyses, carefully conducted, could potentially have an impact on the cost of medical care without diminishing the effectiveness of that care.

To this end, the American College of Cardiology and the American Heart Association in 1980 established a Task Force on Assessment of Diagnostic and Therapeutic Cardiovascular Procedures with the following charge:

> The Task Force of the American College of Cardiology and the American Heart Association shall define the role of specific noninvasive and invasive procedures in the diagnosis and management of cardiovascular disease.
>
> The Task Force shall address, when appropriate, the contribution, uniqueness, sensitivity, specificity, indications, contraindications and cost-effectiveness of such specific procedures.
>
> The Task Force shall include a Chairman and six members, three representatives from the American Heart Association and three representatives from the American College of Cardiology. The Task Force may select ad hoc members as needed upon the approval of the Presidents of both organizations. Recommendations of the Task Force are forwarded to the President of each organization.

The members of the Task Force are: George A. Beller, MD, Roman W. DeSanctis, MD, Harold T. Dodge, MD, J. Ward Kennedy, MD, T. Joseph Reeves, MD, Sylvan Lee Weinberg, MD and Charles Fisch, MD, Chairman.

This document was reviewed by the officers and other responsible individuals of the two organizations and received final approval in October 1991. It is being published simultaneously in *Circulation* and the *Journal of the American College of Cardiology*. The potential impact of this document on the practice of cardiology and some of its unavoidable shortcomings are clearly set out in the introduction.

Charles Fisch, MD, FACC

I. Introduction

A. Defining the Role of Electrocardiography in Clinical Practice

Einthoven (1,2) published the first description of his string galvanometer in 1901 and the first results of its application in 1903. The first commercial string galvanometer was manufactured by the Cambridge Instrument Company of London in 1908 (3). In the years since these major milestones, electrocardiography has undergone significant technical advances and has become the most widely employed technical procedure for evaluating cardiovascular function. It remains an important keystone for the care of patients with both cardiac and noncardiac diseases. It is painless, without direct risk to the patient and is reproducible. Compared with many other procedures, it is relatively inexpensive to perform.

The basic electrophysiologic principles underlying clini-

cal electrocardiography are usually taught in physiology courses in medical schools and some medical students learn rudimentary electrocardiography during their clinical years in medical school. However, most physicians who interpret electrocardiograms (ECGs) become experienced and develop skills in interpretation during residency or cardiovascular fellowship training and subsequently in clinical practice. In recent years, computers have become an integral part of some ECG systems. Although computer programs can usually provide accurate information regarding the heart rate, intervals and electrical axes, all computer ECG interpretations, particularly interpretations of rhythm disturbances, ischemia or infarction, require careful overreading by a physician qualified to interpret ECGs. Before an ECG can have proper diagnostic accuracy and clinical usefulness, a skilled physician is required to compare it with previous tracings and, particularly, to integrate clinical data and provide a differential diagnosis. No computer program for ECG interpretation can replace the interpretation provided by a skilled physician (4,5). An incorrect ECG diagnosis can have significant undesirable medical and legal consequences.

In considering the appropriate use of electrocardiography, the physician should examine the clinical question being asked, the additional information to be derived and the usefulness of the new information in establishing a diagnosis or making a management decision. The unique role of the responsible physician should always be kept in mind. Thus, there are circumstances when the physician's judgment transcends the specific recommendations of these (or other) guidelines. For example, there may be instances when it is very appropriate to obtain an ECG in a patient with an acute illness even when no cardiac symptom, physical finding or risk factor is present or when none of the commonly recognized indications for an ECG are present (Class I or II categories of this report). In other instances, an ECG may be obtained as a baseline study before another procedure such as an exercise test or a signal-averaged ECG is performed or before the patient undergoes a high risk procedure or is treated with some pharmacologic agents.

The ECG is the product of a unique technology that provides a record of electrical activity of the heart and information not readily obtained by other methods. It has many uses, including the following: it may serve as an independent marker of myocardial disease; it may reflect electrophysiologic, anatomic, metabolic and hemodynamic alterations; it may provide information that is essential for the proper diagnosis and therapy of a variety of cardiac disorders and it is without equal as a noninvasive method for the diagnosis and treatment of arrhythmias. It is the procedure of first choice in patients presenting with chest pain, dizziness or syncope—symptoms that may be predictive of sudden death or myocardial infarction. Electrocardiographic abnormalities also may be the first indicators of life-threatening side effects of drugs or of severe metabolic or electrolyte disturbance and occasionally may be the only

sign of myocardial disease such as, for example, "asymptomatic" myocardial infarction in the aged (6).

Consideration of sensitivity and specificity. Appropriate, accurate use of the ECG requires an understanding and appreciation of its sensitivity and specificity. The task of achieving this understanding is somewhat more complex for the ECG than for many other laboratory tests because the ECG is composed of several waveforms, each of which has its own sensitivity and specificity and each of which may be influenced differently by a variety of pathologic and pathophysiologic factors (6).

When one considers the sensitivity and specificity of the ECG, it is important to recognize that the ECG is a record of electrical activity. Consequently, diagnoses of structural changes (myocardial infarction, hypertrophy) or pathophysiologic changes (electrolyte disturbance, effect of drugs) are made by inference and are therefore subject to error. The data that allow for a diagnosis by inference have been derived from extensive studies correlating the ECG with a variety of clinical, pathologic and experimental states (6).

It is also important to recognize that the same ECG pattern may be recorded in patients with different structural and pathophysiologic states. This explains the frequent low specificity of the ECG for determining the etiology and anatomy of cardiovascular disease (6). For example, the ST segment and the T wave changes are generally the most common and the most sensitive ECG abnormalities, but these changes are at the same time the least specific (7,8). Similarly, different etiologic factors and structural abnormalities may result in an identical ECG pattern of bundle branch block.

It is apparent from these considerations that the sensitivity and specificity of the ECG depend to a large extent on the specific clinical question being asked. Thus, the sensitivity and specificity of the ECG for myocardial disorders vary considerably depending on the cause of the disorder and on the size and location of the pathologic process, whereas they are consistently high for arrhythmias. The ECG is the only practical, noninvasive method of recording and analyzing abnormalities of cardiac rhythm.

This report is intended to provide guidelines rather than standards. Furthermore, because it is impossible to consider all clinical situations, the general principles underlying the examples in these guidelines can be extended to other specific cases by the responsible physician, utilizing his or her best clinical judgment.

In this report the guidelines for indications for ECG study are classified by patient group: 1) patients with known cardiovascular disease or dysfunction; 2) patients who are suspected of having, or who are at increased risk of developing, cardiovascular disease or dysfunction; and 3) patients with no apparent or suspected heart disease or dysfunction. Within each group of patients, guidelines for electrocardiography are classified as follows:

Class I: Conditions for which or patients for whom there is general agreement that electrocardiography is useful.

Class II: Conditions for which or patients for whom electrocardiography is frequently used but there is divergence of opinion with respect to its usefulness.

Class III: Conditions for which or patients for whom there is general agreement that electrocardiography is of little or no usefulness.

B. Assumptions Underlying the Committee Report

This report is based on the assumption that the ECG is performed and interpreted in accordance with the guidelines for optimal electrocardiography described in the American College of Cardiology 10th Bethesda Conference report (9), the guidelines for training described in the American College of Cardiology 17th Bethesda Conference report on cardiology training (10), the recommendations for standardization of leads and specifications for instruments in electrocardiography and vectorcardiography of the American Heart Association (11) and the recommendations for standardization and specifications for automated electrocardiography of the American Heart Association (12).

II. Definition of Terms

To ensure compatibility of data transfer among varying sources of information pertaining to the ECG and to assure the correct exchange of information among multiple sources of information, the definitions of terms employed need to be as precise as possible. The following definitions are used in this document:

Electrocardiogram (ECG): A standard 12-lead ECG, with or without a rhythm strip or other special leads, that has been interpreted by a physician qualified to interpret ECGs and that has been made part of the patient's medical record. An ECG that has been interpreted by a computer alone is not recognized as a properly interpreted ECG. The term ECG does not refer to continuous ambulatory electrocardiography, monitor leads, rhythm strips, exercise testing, transtelephonic recordings, signal-averaging techniques with late potentials or intracardiac electrograms. In most cases a 12-lead ECG is required for accurate interpretation of these latter studies or is necessary to provide complementary information. In children and selected adults, it may be necessary to record additional leads.

Cardiovascular disease: Disease in which the heart, pericardium or blood vessels are directly or indirectly involved. Examples of *direct* involvement include coronary artery disease, cardiomyopathy, valvular disease, congenital heart disease, arrhythmias and conduction disturbances. Examples of *indirect* involvement or conditions with comorbidity that could affect the heart include systemic hyper-

tension, pulmonary hypertension and serum electrolyte abnormalities. The conditions may be permanent or transient, slowly or rapidly progressive or nonprogressive, life-threatening or usually associated with a good prognosis. These descriptors and the presence or absence of new or changing symptoms, physical signs or laboratory findings are important in determining the frequency of repeat 12-lead ECGs.

Cardiovascular dysfunction: Dysfunction with or without documented underlying organic heart disease. The dysfunction may indicate either inappropriate mechanical performance or electrical dysfunction evidenced by arrhythmias or conduction abnormalities.

Response to therapy: Improvement or worsening of the cardiovascular disease or dysfunction in response to treatment directed either to the underlying condition (for example, valve replacement, antiarrhythmic drug) or to the indirectly responsible cause (for example, antihypertensive therapy). The therapy may be invasive (for example, coronary angioplasty or cardiac surgery) or pharmacologic.

Follow-up: The use of serial ECGs to aid in the assessment of the severity and progression of the underlying cardiovascular disease or dysfunction. The interval between ECGs should be a medical judgment made by the responsible physician after evaluation of many factors. These include what is known about the natural history of the underlying condition; the severity of the condition at the time of the initial or the most recent evaluation; the presence of any change in symptoms, physical signs or laboratory findings or changes in the interval growth or maturation that suggest a change in the cardiovascular condition or growth of a child. Some examples of specific symptoms include syncope or near-syncope, palpitation, an unexplained change in the usual pattern of anginal pain, new or worsening dyspnea, a recent cerebrovascular or other embolic event, extreme unexplained fatigue, weakness or prostration.

Before surgery: refers to an ECG performed before surgery for the purpose of evaluating cardiac risk.

III. Introduction to Indications for Electrocardiography in Different Patient Groups

The indications that follow for the use of electrocardiography have been classified by the following three patient groups:

Group IV: Patients with known cardiovascular disease or dysfunction.

Group V: Patients who are suspected of having, or who are at increased risk of developing, cardiovascular disease or dysfunction.

Group VI: Patients with no apparent or suspected heart disease or dysfunction.

Within each group, indications are separated according to the following categories:

A. Baseline or initial evaluation.
B. Response to therapy.
C. Follow-up.
D. Before surgery.

It must be kept in mind that for any individual patient both the group and the category of indication may change with time.

IV. Indications for Electrocardiography in Patients With Known Cardiovascular Disease or Dysfunction

A. Baseline or Initial Evaluation

1. General considerations

The ECG is accepted as a useful and important baseline test in all patients with known cardiovascular disease, dysfunction or arrhythmia during the initial evaluation. In some instances more than one ECG is required during the initial evaluation if the underlying condition is evolving rapidly (as in acute myocardial infarction) or is intermittent or transient (as with anginal attacks or certain arrhythmias and conduction defects). A baseline ECG may disclose useful information regarding diagnosis and prognosis and may permit rational decisions regarding management, including risk of medical and surgical intervention. A baseline ECG in patients with known heart disease or dysfunction gives useful information regarding the presence or absence of arrhythmias, conduction defects, chamber enlargement, myocardial hypertrophy, myocardial ischemia, myocardial necrosis, pericardial inflammation and electrolyte disturbance. It is especially noteworthy that in such patients, for certain conditions (for example, arrhythmias, conduction defects, myocardial infarction) the baseline ECG may give instantaneous information that is not available with other tests.

2. Classification of indications for electrocardiography for baseline or initial evaluation of patients with known cardiovascular disease or dysfunction

Class I
a. In patients with known cardiovascular disease or dysfunction.

Class II
None.

Class III
None.

B. Response to Therapy

1. General considerations

After the initial evaluation, subsequent ECGs may be indicated to evaluate short-term and long-term responses to therapy. Conditions in which serial ECGs may be useful in

this regard include, but are not limited to, the following: regression or progression of chamber enlargement or myocardial hypertrophy, resolution or alterations of arrhythmias or conduction disturbances, pacemaker function, acute myocardial infarction or ischemia, electrolyte disturbances, pericarditis, endocarditis, myocarditis, acquired immune deficiency syndrome (AIDS), transplant rejection, infiltrative cardiomyopathies, therapy with antineoplastic agents and other conditions known to produce ECG changes. When patients with these conditions receive therapy that is not expected to influence the ECG findings, they do not usually require a repeat ECG unless it is indicated by the appearance of new symptoms or findings. In general, the frequency of repeat ECGs is best determined by the specific condition and left to the judgment of the patient's physician. Repeat or serial ECGs are often indicated until the patient's disease process and ECG response to therapy have stabilized. In different situations this may require multiple ECG recordings over a period of minutes, hours, days, weeks or years. Although continuous ECG rhythm monitoring may be available in some clinical settings, the diagnostic information obtained in this manner is often less informative than that obtained from a full 12-lead ECG and may be inadequate in a given situation.

2. Selected examples of frequently encountered problems

In patients with acute ischemia, the ECG may be used to assess reversal or progression of this condition. Serial ECGs are therefore appropriately used to monitor responses to thrombolytic or anti-ischemic therapy or to verify spontaneous recovery. They may be used for similar reasons in patients with myocarditis, pericarditis or endocarditis.

In patients who have undergone coronary angioplasty or other intracardiac invasive procedures or electrophysiologic ablative procedures, serial ECGs are warranted until the condition is stable and again shortly before hospital discharge in all patients, including those with uncomplicated procedures.

In patients in whom antiarrhythmic drug therapy is initiated, serial ECGs may be useful to assess conversion to normal sinus rhythm, changing rhythm, QRS duration, prolongation of the QT interval or proarrhythmia. Patients who are being monitored may require a 12-lead ECG if one or more of these changes is suspected, particularly alterations in the PR, QRS and QT intervals and relevant morphologic changes.

Patients receiving drug therapy with potential cardiac effects: Many drugs that are used for either cardiovascular conditions or noncardiovascular conditions may produce cardiac effects that may be detected by the ECG even if their primary pharmacologic action is not best monitored by electrocardiography. Electrocardiograms may therefore be indicated before and during therapy with such drugs to protect against adverse reactions. Some commonly used drugs known to produce significant ECG changes are psychotropic agents, such as phenothiazines, tricyclic and tet-

racyclic antidepressants and lithium; anti-infective agents, such as erythromycin or pentamidine; antihypertensive agents, such as diuretic drugs, angiotensin-converting enzyme inhibitors, calcium channel and beta-adrenergic receptor blocking agents; antineoplastic agents and anti-heart failure agents, such as digitalis, dopamine and dobutamine; similarly, many other drugs may produce changes detectable by the ECG. Electrocardiographic recordings are appropriate after initiation of drug therapy, after changes in therapy and after addition to the regimen of other drugs that may interact and have cardiac effects.

Patients undergoing electrical or pharmacologic cardioversion of ventricular tachycardia, supraventricular tachycardia, atrial fibrillation or atrial flutter should have an ECG just before and immediately after the procedure and before hospital discharge.

Pacemaker malfunction or suboptimal programming may be detected by serial ECGs even in the absence of symptoms. A 12-lead ECG is indicated soon after pacemaker insertion or revision, whenever a pacemaker malfunction is suspected, after lead threshold maturation and at periodic intervals throughout the lifetime of the patient and the pacing system. More frequent ECGs are usually indicated with atrial or dual-chamber pacing systems since atrial lead malfunction may not be easily detectable otherwise. These indications also apply to antitachycardia and antifibrillatory devices that have pacemaker capability.

In patients after cardiac surgery or extensive pulmonary surgery including transplantation, serial ECGs are recommended until the condition is stable and shortly before the patient's discharge.

3. Classification of indications for electrocardiography to assess the response to therapy of patients with known cardiovascular disease or dysfunction

Class I
a. In patients in whom prescribed therapy is known to produce ECG changes that correlate with therapeutic responses or progression of disease.
b. In patients in whom prescribed therapy may produce adverse effects that may be predicted from or detected by ECG changes.

Class II
None.

Class III
a. In patients receiving pharmacologic or nonpharmacologic therapy not known to produce ECG changes or to affect conditions that may be associated with such changes.

C. Follow-Up

1. General considerations

Many cardiovascular diseases undergo progressive worsening with time despite therapy, with or without acute exacerbations, and this progression may be evaluated by periodic (for example, yearly) ECGs. In an individual patient the appropriate interval depends on the known natural history of the disease, the age of the patient, the effectiveness of therapy and the severity of the disease when the patient was last evaluated. In general, the indications for follow-up ECGs and their frequency should be determined by the responsible physician largely on the basis of changes in symptoms, physical signs, growth or maturation of infants or children, or laboratory findings.

2. Specific examples of frequently encountered symptoms or findings

Examples of symptoms that warrant a repeat ECG include the following:

Syncope and near-syncope
Unexplained change in the usual pattern of angina pectoris
Chest pain
New or worsening dyspnea
Extreme and unexplained fatigue, weakness and prostration
Palpitation

Examples of findings that warrant a repeat ECG include the following:

New signs of congestive heart failure
A new organic murmur or pericardial friction rub
New findings suggesting pulmonary hypertension
Accelerating or poorly controlled systemic arterial hypertension
Evidence of a recent cerebrovascular accident
Unexplained fever in patients with known valvular disease
New onset of cardiac arrhythmia or inappropriate heart rate

Examples of diseases or conditions in which ECG changes may often reflect progression or improvement of underlying cardiovascular disease without the appearance of new symptoms or signs include the following:

Valvular or congenital heart disease
Convalescence after acute myocardial infarction, cardiac surgery or coronary angioplasty
Chronic ischemic heart disease, Kawasaki disease or anomalous origin or course of proximal coronary artery
Moderate or severe systemic arterial hypertension
Pericarditis, myocarditis or endocarditis
Conduction abnormalities
Long QT syndrome, pre-excitation syndromes
Implanted pacemakers or antitachycardia devices
Co-morbidity such as renal failure, diabetic acidosis, hypothermia or electrolyte abnormalities

3. Classification of indications for electrocardiography in the follow-up evaluation of patients with known cardiovascular disease or dysfunction

Class I

a. Patients with a change in symptoms, signs or relevant laboratory findings.
b. Patients with an implanted pacemaker or antitachycardia device.
c. Patients with the preceding conditions, even in the absence of new symptoms or signs, after an interval of time appropriate for the condition or disease, except as described in Class III.

Class II

None.

Class III

a. In adult patients whose cardiovascular condition is usually benign and unlikely to progress, ECGs are not indicated at follow-up visits unless changes in clinical status occur. Such patients include those with asymptomatic mild mitral valve prolapse, minimal to mild systemic arterial hypertension or premature contractions in the absence of organic heart disease.
b. In adult patients with chronic stable heart disease seen at frequent intervals (i.e., ≤4 months) and who have no new or unexplained symptoms, physical or laboratory findings, follow-up ECGs at *each* visit are not indicated. Such patients include those with systemic arterial hypertension, chronic coronary artery disease, valvular heart disease, cardiomyopathy or lone atrial fibrillation.

D. Before Surgery

1. General considerations

A recent preoperative ECG is recommended in patients with known cardiovascular disease undergoing cardiac or noncardiac surgery. These patients may have an increased risk for perioperative cardiovascular complications.

2. Classification of indications for electrocardiography for preoperative evaluations of patients with known cardiovascular disease or dysfunction

Class I

a. All patients with known cardiovascular disease or dysfunction except as noted under Classes II and III.

Class II

a. Patients with hemodynamically insignificant congenital or acquired heart disease, minimal to mild systemic arterial hypertension or infrequent premature complexes in the absence of organic heart disease.

Class III

None.

V. Indications for Electrocardiography in Patients Who Are Suspected of Having or Who Are at Increased High Risk of Developing Cardiovascular Disease or Dysfunction

A. Baseline or Initial Evaluation

1. General considerations

The recording of an ECG is an integral and useful part of the initial evaluation and the follow-up of patients with suspected cardiac disease. A cardiac abnormality may be suspected on the basis of a patient's symptoms, abnormal physical findings, previous abnormal ECGs, abnormal radiographic or echocardiographic findings or other abnormal laboratory studies or conditions commonly associated with or increasing the risk of development of cardiac disease or dysfunction. Common symptoms include chest pain, dyspnea, palpitation, syncope, edema, cough, hemoptysis or intermittent claudication. Examples of abnormal physical findings are hypertension, hypotension, cardiomegaly, heart murmur, pericardial friction rub, inappropriate heart rate, irregular heart rhythm, gallop rhythm, elevated venous pressure, dependent edema, hepatomegaly, evidence of pulmonary congestion, new cerebrovascular event, cyanosis, nonfebrile seizures, congenital deafness, chest trauma, carotid, cranial or abdominal bruit or evidence of increased intracranial pressure. Abnormal laboratory findings include anemia, electrolyte abnormalities, lipid abnormalities and azotemia. Examples of conditions that are associated with, or that increase the risk of, cardiac disease include advanced age, diabetes mellitus, tobacco use, hyperlipidemia, pulmonary disease, peripheral vascular disease, thyroid disease, muscular dystrophies, collagen vascular disease, sarcoidosis, amyloidosis, drug abuse, chest trauma, anorexia nervosa, dysmorphic syndromes or a family history of coronary artery disease, sudden cardiac death, pre-excitation, long QT syndrome, hypertrophic cardiomyopathy or other heredofamilial diseases with a significant incidence of cardiac disease.

The ECG is an important component of the initial assessment of many patients entering the emergency room. This is especially true for middle-aged or elderly persons, for those possibly exposed to inhaled or ingested toxins and for patients with altered mental status who cannot contribute a reliable history.

2. Classification of indications for electrocardiography for the baseline or initial evaluation or diagnosis of patients with suspected, or at increased risk of developing, cardiac abnormalities or dysfunction

Class I

a. Patients with suspected cardiac disease or dysfunction, as described under General considerations.
b. Patients at increased risk for the development of

cardiac disease, as described under General considerations.

c. Patients who may have used cocaine, amphetamines or other illicit drugs known to have cardiac effects.

d. Patients who may have received an overdose of a drug known to have cardiac effects.

Class II
None.

Class III
None.

B. Response to Therapy

Classification of indications for electrocardiography to assess the response to therapy of patients with suspected, or at increased risk of developing, cardiovascular disease or dysfunction

Class I
a. To assess therapy with cardioactive drugs in patients with suspected cardiac disease. (For example, the use of beta-blocker drugs in patients with palpitation, tremor or migraine headache.)

b. To assess the response to the administration of any agent known to result in cardiac abnormalities or ECG abnormalities. (For example, antineoplastic drugs, lithium, tranquilizers and anticonvulsant and antidepressant agents.)

Class II
a. To assess the response to administration of any agent known to alter serum electrolyte concentrations. (Diuretic drugs in hypertensive patients are one example. An ECG may be indicated when the potassium or magnesium concentration is suspected or known to be altered into or near the abnormal range.)

Class III
a. To assess the response to administration of agents known not to influence cardiac structure or function.

C. Follow-Up

Classification of indications for electrocardiography in the follow-up evaluation of patients with suspected, or at increased risk of developing, cardiac disease or dysfunction

Class I
a. The presence of any change in clinical status or laboratory findings suggesting the interval development of cardiac disease or dysfunction.

b. The periodic follow-up (for example, every 1 to 5 years) of patients known to be at increased risk for the development of cardiac disease. More frequent follow-up may be appropriate in children <2 years of age.

c. The follow-up of patients after the resolution of chest pain.

Class II
None.

Class III
a. Follow-up ECGs more often than once yearly are not indicated in patients who remain clinically stable, who are not at increased risk for the development of cardiac disease and who have not been demonstrated to have cardiac disease with previous studies.

D. Before Surgery

Classification of indications for electrocardiography in the preoperative evaluation of patients with suspected, or at increased risk of developing, cardiac disease or dysfunction

Class I
a. As part of the preoperative evaluation of any patient with suspected, or at increased risk of developing, cardiac disease or dysfunction, as discussed under General considerations.

Class II
None.

Class III
None.

VI. Indications for Electrocardiography in Patients With No Apparent or Suspected Heart Disease or Dysfunction

General Considerations

The ECG has been a traditional and fundamental part of screening programs for the detection of heart disease. Many studies have established that apparently normal persons may have a significant prevalence of normal variations and abnormalities in their ECG (13–23). Other studies have found a significant percentage of angiographic abnormalities in asymptomatic aircrewmen with ECG abnormalities (24); and in another study (19) approximately 8% of asymptomatic aircrewmen with minor ST-T wave changes at rest had significant coronary artery disease. In general, the frequency of ECG abnormalities increases exponentially with age. Thus, there is a prevalence of approximately 10% of such abnormalities by about age 35 years and a 25% prevalence by about age 60 years, using pooled data combining a variety of ECG findings in both men and women (22,25). It is also known that a significant proportion of myocardial infarctions in men over age 30 years and in women over age 40 years are asymptomatic but can be diagnosed by ECG and are associated with a prognosis similar to that of patients with symptomatic myocardial infarction (26–30). Unfortunately, there are no adequate studies of patients discovered to have an unrecognized myocardial infarction of indeterminate age on a routine preoperative ECG (25).

Because of the preceding and other considerations, different groups have recommended either that a baseline ECG be obtained in all adults and a routine annual ECG be obtained in patients at high risk of having heart disease (9) or that a baseline ECG be obtained at age 20 years and repeated at ages 40 and 60 years (31). Unfortunately, no large, statistically valid, prospective long-term studies have been conducted to determine the cost-effectiveness of such recommendations. A recent review (32) of the available studies concluded that data were insufficient to support performing a routine baseline ECG in young healthy persons without evidence of cardiac disease or cardiovascular risk factors. In presumably normal persons who are known to have had a normal ECG in the past, the likelihood is low that a repeat ECG will be specifically helpful in the absence of a change in general health status or a new onset of cardiac symptoms. Because the value of a screening ECG has not been completely identified, its proper use is best determined by the responsible physician for an individual patient. Additional prospective studies on the use of baseline or screening ECGs are needed.

The cost-effectiveness of ECGs obtained routinely for hospital admissions or before surgery has also come under scrutiny (25,33), although this practice has been and is recommended in selected patient groups (21,22,23). The cost-effectiveness of the preoperative ECG in apparently healthy persons has also not been adequately evaluated by a large, prospective study.

It has been recognized (34) that more stringent examination standards must be applied to persons in high risk occupations and to those whose performance affects the safety of others.

The baseline or initial evaluation described below may be a routine physical examination, pre-employment examination, insurance examination, school health examination, examination preceding the start of a weight reduction or exercise program, routine hospital admission or any other cardiac screening program in which the patient has previously not been known or suspected to have heart disease or an increased risk of having heart disease.

When persons in this category (patients with no apparent or suspected heart disease or dysfunction) develop or are found to have symptoms, signs, risk factors or ECG or other laboratory findings that suggest an increased risk of cardiovascular disease or dysfunction, they then belong in the preceding group of patients.

A. Baseline or Initial Evaluation

Classification of indications for electrocardiography for baseline or initial evaluation of patients with no apparent heart disease or dysfunction

Class I
   a. To evaluate persons >40 years of age undergoing physical examination.

   b. To evaluate patients before administration of pharmacologic agents that are known to have a high incidence of cardiovascular effects (for example, chemotherapy of malignancies).
   c. To evaluate persons before exercise stress testing.
   d. To evaluate patients of any age who are in special occupations that require very high cardiovascular performance (for example, fire fighters, police officers, astronauts) or whose cardiovascular performance is linked to public safety (for example, pilots, air traffic controllers, critical process operators, bus or truck drivers and railroad engineers).

Class II
   a. To evaluate competitive athletes.

Class III
   a. Routine screening or baseline ECGs in asymptomatic persons <40 years of age with no risk factors, except as specified under Class I or II.

B. Response to Therapy

Classification of indications for electrocardiography to assess the response to therapy of patients with no apparent heart disease or dysfunction

Class I
   a. To evaluate patients in whom prescribed therapy (for example, doxorubicin) is known to produce cardiovascular effects.

Class II
   None.

Class III
   a. To assess treatment that is known not to produce any cardiovascular effects.

C. Follow-Up

Classification of indications for electrocardiography in the follow-up evaluation of patients with no apparent heart disease or dysfunction

Class I
   a. To evaluate asymptomatic persons >40 years of age.

Class II
   a. None

Class III
   a. To evaluate asymptomatic adults who have had no interval change in symptoms, signs or risk factors and who have had a normal ECG within the recent past.

D. Before Surgery

Classification of indications for electrocardiography for the preoperative evaluation of patients with no apparent heart disease or dysfunction

Class I

a Patients >40 years old.

b. Patients being evaluated as a donor for heart transplantation or as a recipient of a noncardiopulmonary transplant.

Class II

a. Patients 30 to 40 years of age.

Class III

a. Patients <30 years old with no risk factors for coronary artery disease.

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