20th BETHESDA CONFERENCE

Insurability and Employability of the Patient With Ischemic Heart Disease
October 3–4, 1988
BETHESDA CONFERENCE REPORT

20th Bethesda Conference: Insurability and Employability of the Patient With Ischemic Heart Disease*

ROBERT F. DEBUSK, MD, FACC, CHAIRMAN

This Conference, sponsored by the American College of Cardiology and co-sponsored by the Association of Life Insurance Medical Directors of America, was held at Heart House, Bethesda, Maryland, October 3 to 4, 1988.

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*The recommendations set forth in this report are those of the Conference participants and do not necessarily reflect the official position of the American College of Cardiology.

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20th BETHESDA CONFERENCE: INSURABILITY AND EMPLOYABILITY OF THE PATIENT WITH ISCHEMIC HEART DISEASE

Robert F. DeBusk, MD, FACC, Chairman

Introduction

ROBERT F. DEBUSK, MD, FACC

Background

Insurability and employability are major issues for patients with ischemic heart disease and for the physicians caring for them. Physicians often perceive that these issues hinge less on determinations of cardiac impairment, with which they are familiar, than on administrative considerations, with which they are not. Similarly, insurers and administrators within business and government often perceive that determinations of cardiac impairment by physicians, on which determinations of insurability and employability rest, are not adequate. Bethesda Conference 20 was the first nationwide conference involving cardiologists to consider these issues in patients with ischemic heart disease. The Conference arose from the desire of the Bethesda Conferences Committee of the American College of Cardiology to bring physicians and nonphysicians together to address these important issues.

A variety of important medical developments have influenced the insurability and employability of patients with ischemic heart disease in recent years. These include refinements in methods to evaluate prognosis and functional capacity, improvements in the efficacy of medical and surgical intervention techniques in reducing cardiac symptoms and improving prognosis and a strong secular trend toward a lower mortality from ischemic heart disease.

Other developments influencing insurability and employability include a reduction in the physical effort involved in occupational work due to automation and mechanization, an increase in the mandatory retirement age, the erosion of retirement benefits and a long-term trend toward earlier retirement. By the mid-1990s, the number of men aged 55 to 64 years will increase rapidly, replacing a smaller cohort born in the 1930s. The number of individuals afflicted with ischemic heart disease, especially in the 45 to 64 year age group, will increase rapidly over the next 20 years. Never before has it been so important to define the capacity of patients with ischemic heart disease to remain gainfully employed.

The objective of the Conference was to define policies for insurability that are as equitable as possible and policies regarding employment that maximize the occupational work potential of the patient with ischemic heart disease while protecting the public safety.

The method of the Conference was 1) to achieve a consensus on existing methods to evaluate and enhance prognosis, functional capacity and psychological status, and 2) to consider these methods from an administrative, legal and economic perspective to create new initiatives to enhance the insurability and employability of patients with ischemic heart disease.

Definition of Terms

The important linkage between cardiac aspects of insurability and employability on the one hand and administrative aspects on the other is suggested by the definition of terms adopted by the conference.

Insurability is the ability to obtain insurance for death or disability. Because the basis of all insurance is a sharing of financial risk, the cost and availability of life and disability insurance are related to the severity of heart disease. The medical basis of life insurance is death, whereas the medical basis of disability insurance is largely impairment by cardiac symptoms.

Employability is the ability, viewed from a functional and administrative perspective, to perform gainful work. It is the opposite of disability, which is the lack of ability to perform such work.

Disability is an administrative judgment that an individual's ability to perform gainful work is to some extent limited.
Cardiac disability is an administrative judgment made by nonmedical personnel based on the physician's assessment of the extent of impairment and other factors including age, gender, education, personal motivation, type of employment and the economic and social environment.

Impairment by cardiac disease, as assessed by the physician, is of two kinds: 1) limitation by cardiac symptoms, as assessed by history and various tests of cardiac capacity, and 2) risk for sudden incapacitation even in the absence of limiting cardiac symptoms. This is especially pertinent to such individuals as firefighters, members of police forces and commercial aviators whose sudden incapacitation poses a risk to the public.

Conference Goals and Tasks

The mission and composition of Bethesda Conference 20 were quite different from those of most previous Bethesda Conferences. Most of those were narrow in scope, dealing with issues of particular interest to cardiologists. Most participants were medical scientists. In contrast, the present Conference participants were from many disciplines and perspectives within and outside medicine. This Conference was designed to bring together those involved with medical aspects of insurability and employability and those involved in the administrative, legal and economic aspects of the problem.

The work of the Conference was divided among four major groups:

1. The Committee on Economic, Administrative and Legal Factors Influencing the Insurability and Employability of Patients with Ischemic Heart Disease. This committee was charged with elucidating current methods and procedures utilized by insurers and administrative agencies in determining the insurability and employability of patients with ischemic heart disease.

2. Task Force 1 was charged with evaluating currently available techniques for assessing prognosis and changes in prognosis resulting from therapy and changes in the natural history of this condition.

3. Task Force II was charged with evaluating methods for assessing the capability of individuals in a variety of occupations to perform occupational work, with an emphasis on physical capability.

4. Task Force III was charged with evaluating methods for assessing psychological dysfunction in patients with ischemic heart disease, attempting to distinguish between valid and invalid causes for disability compensation for such patients.
COMMITTEE REPORT

Committee Report on Economic, Administrative and Legal Factors Influencing the Insurability and Employability of Patients With Ischemic Heart Disease

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This report reviews how government agencies and private industry use medical information related to ischemic heart disease. The key premises of this conference include the following:

- Ischemic heart disease exerts a significant economic impact on government and industry.
- Advances in medicine are only slowly translated into changes in administrative and legal guidelines.
- Failure of physicians to communicate pertinent information adversely affects the assessment of employability and insurability.
- Many practicing physicians need a better understanding of the administrative and legal guidelines affecting insurability and employability of patients with ischemic heart disease.

As many as 5.4 million Americans exhibit coronary artery disease, manifestations of chronic angina or healed myocardial infarction (1). Treatment of myocardial infarction accounts for the largest component of all hospitalization costs and foregone earnings due to cardiac disease (2).

Factors Influencing Employability of Patients With Ischemic Heart Disease

Mandatory pre-employment physical examinations are rarely performed in the United States today. Employers, cautious about discrimination against individuals based on medical problems, prefer to carry out post-employment placement examinations. Exceptions to this practice are for those occupations in which sudden cardiac incapacitation of the individual could jeopardize the safety of the general public or co-workers. This group includes law enforcement officers, firefighters, airline pilots, air traffic controllers and commercial drivers. This report focuses on the return to work of employed patients with ischemic heart disease.

The major factors influencing the work status of patients with ischemic heart disease are the presence or absence of angina or congestive heart failure, or both (3–7). Other determinants include:

- Severity of heart disease: The number of myocardial infarctions, cardiac damage, severity of angina, complications and physical capacity influence return to work.
- Age: After age 50 years, fewer patients return to work.
- Gender: Women are more likely to withdraw from the work market.
- Social class/education: Those with lower levels of education are less likely to return to work.
- Occupation: Physical activity at work is a factor; manual laborers are less likely than office workers to return to work, although this may reflect psychological rather than physical factors.
- Perceived job stress: Many feel that their jobs contributed to their illness. Fewer return to an unpleasant job.
- Family income: The higher the nonwork income, and the better the disability or retirement benefits, the lower the likelihood of return to work.
- Emotional disturbances: Patients with feelings of anxiety, depression, pessimism, self-perception as being disabled are less likely to return to work.
- Residence (urban versus rural): There is a lower rate of return to work in rural areas, which may reflect the type of work performed.
- Labor market/unemployment/social benefits: Economic and social factors differ among regions of the country. The rate of return to work 12 months after acute myocardial infarction varies from 64% to 90%.
- Lack of cooperation by the employer, usually because of ignorance regarding the capacity for recovery. Economic factors motivate some employers to seek an employee's early retirement through an insured disability program rather than through the standard employer-funded retirement program.
- Attending physician's attitude: A negative attitude on the part of the personal physician may diminish the likelihood of return to work.
- Overprotection by the family: The family’s lack of understanding of the patient’s degree of recovery affects return to work.
Delay in evaluating patients.
- Lack of a cardiac rehabilitation program.
- Other medical problems.

A formal occupational work evaluation incorporating exercise testing performed 3 weeks after acute myocardial infarction hastened the return to work of clinically low risk patients (8). Patients undergoing the occupational work evaluation returned to work at a median of 51 days compared with 75 days in controls.

Programs for Establishing Disability from Ischemic Heart Disease

The American Medical Association Guide to the Evaluation of Permanent Impairment stresses the difference between “impairment” and “disability.” Whereas permanent impairment is a purely medical condition as evaluated by a physician, indicating “any anatomic or functional abnormality or loss,” disability is an administrative judgment, indicating a patient’s “actual or presumed ability to engage in gainful activity.” Although permanent impairment is always considered in determining disability, other factors such as the patient’s age, gender, education, personal motivation, type of employment and the economic and social environment must also be taken into account by the administrator when determining disability. More objective measures of functional capability and impairment need to be used in this process.

1. Workers’ Compensation

This program evolved from the public’s dissatisfaction with the manner in which job-related disabilities were handled (9). The system was designed to provide appropriate treatment of work-related injuries and prompt and effective disposition of disability cases. The programs are regulated by the states, which, in general, administer their laws through their court systems, a special commission or board or a combination of both. In Canada, administrative activities are carried out by a Provincial board.

Employers are required to provide specified benefits to employees incurring work-related injuries/disabilities. Most employers meet this obligation by obtaining Workers’ Compensation insurance from a private insurance carrier or a state-administered insurance fund.

The escalating costs of Workers’ Compensation insurance have become a source of concern to employers, insurers, regulators, and legislators. Between 1982 and 1986, medical and indemnity losses increased 48% and 27%, respectively.

In a 16 state study, the National Council on Compensation Insurance found that angina pectoris and heart attacks accounted for approximately 0.5% of Workers’ Compensation cases involving “lost time” (1987). Although few in number, these cases were almost five times as expensive as the average claim (10).

2. Second-Injury Funds

These funds were developed to allocate more equitably the costs of providing disability benefits to workers with preexisting conditions. They were originally developed in response to rulings that an employer would have to bear the full costs of total disability for the loss of the crippled worker’s remaining arm or leg. Such rulings discouraged employers from hiring or retaining handicapped individuals.

Employers pay compensation related primarily to the disability caused by the second injury alone. Almost half of the states limit second-injury funds to the loss, or loss of use, of a member or an eye. However, other states allow other preexisting injuries, including myocardial infarctions. Myocardial infarction is increasingly recognized as work related.

3. Pertinent Federal Legislation

A. Age Discrimination in Employment Act of 1967 with amendments of 1978 and 1986. This Act and its amendments prohibit discrimination in employment on the basis of age in such matters as hiring, job retention and compensation. In general, the Act protects workers who are 40 years of age or older. The Equal Employment Opportunity Commission has been charged with interpreting and implementing the Age Discrimination in Employment Act.

An exception to the general rule allows age to be used as a factor in employment decisions where the employer can show that age is a bona fide occupational qualification (BFOQ). Fire and law departments often seek to justify hiring or retirement age limitations as a BFOQ. The BFOQ exception requires an employer to demonstrate a link between the aging process and the demands of a particular job. To prove in court that age is a BFOQ for a particular job, the employer must show that 1) the continued health and safety of public safety officers, said to justify the imposition of an age limit, are essential to the essence of its business, and 2) the employer must rely on age as a proxy for the safety-related job qualifications established in the first prong. To do this, the employer must establish that it has a factual basis for believing that all or substantially all persons within the class would be unable to perform safely and efficiently the duties of the jobs involved, or that it is impossible or impractical to deal with persons over the age limit on an individual basis.

In approximately 20 suits brought by individuals and the Equal Employment Opportunity Commission (EEOC) against state and municipal departments, the courts have, generally, interpreted the BFOQ “escape clause” narrowly (11). Rulings have favored the EEOC in cases in which public safety agencies have not carried out physical screening (particularly with respect to the cardiovascular system) of newly hired workers, required proof of continued good health during employment, allowed exceptions for many physical problems or failed to show that age alone was an important factor in the performance of the job.

Legislation and legal decisions regarding fair employment
Table 1. Legislative Requirements

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Country</th>
<th>Regulatory Agency</th>
<th>Regulations</th>
<th>Employability</th>
<th>Exam</th>
<th>Exercise Tolerance Test</th>
<th>Reference Source</th>
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</thead>
<tbody>
<tr>
<td>Railroad engineers</td>
<td>U.S.</td>
<td>AARR</td>
<td>“Guidelines”</td>
<td>Some full-time; some restricted</td>
<td>R</td>
<td>R</td>
<td>AARR</td>
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<tr>
<td></td>
<td>Canada</td>
<td>National</td>
<td>Yes</td>
<td>Some</td>
<td>R</td>
<td>R</td>
<td>CPCNRR</td>
</tr>
<tr>
<td></td>
<td>(freight only)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commercial drivers, including bus and truck</td>
<td>U.S.</td>
<td>Bureau of Carrier Safety Sect. 393.41 (b) (4)</td>
<td>Yes</td>
<td>Some</td>
<td>R</td>
<td>S</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Canada</td>
<td>Provincial</td>
<td>Yes</td>
<td>Many</td>
<td>R</td>
<td>R</td>
<td>19-21</td>
</tr>
<tr>
<td>Private auto drivers</td>
<td>U.S.</td>
<td>States</td>
<td>Varying</td>
<td>Most</td>
<td>NR</td>
<td>NR</td>
<td>19-21</td>
</tr>
<tr>
<td></td>
<td>Canada</td>
<td>Provincial</td>
<td>Yes</td>
<td>Most</td>
<td>R</td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>Civilian airmen</td>
<td>U.S.</td>
<td>FAA</td>
<td>Yes</td>
<td>Rare</td>
<td>R</td>
<td>R</td>
<td>12</td>
</tr>
<tr>
<td>Flight air traffic controllers</td>
<td>U.S.</td>
<td>FAA</td>
<td>Yes</td>
<td>Few</td>
<td>R</td>
<td>R</td>
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AARR = Association of American Railroads; CPCNRR = Canadian Pacific and Canadian National Railroads; Exam = examination; FAA = Federal Aviation Authority; NR = not required; R = required; S = suggested.

practices have affected the hiring and retirement practices of most employers. Except in cases affecting public safety, employers cannot inquire as to a person's past or present medical status, but must accept the employee as is. Pre-employment physical examinations have been largely replaced by post-employment examinations directed at the identification of preexisting health problems and appropriate job placement.

B. Standards for public safety officers. The thoroughness with which public safety officers are evaluated for the possibility of heart disease varies greatly.

Police officers. There are no national standards. The standards utilized by the Connecticut State Police are representative of many state and local department standards. New hires must be healthy; have a normal rest ECG; if over age 35, have a normal exercise test; have no more than 25% body fat (height and weight criteria are no longer used); complete an agility course; have uncorrected vision, no worse than 20/50 corrected to at least 20/30; have blood pressure of 140/90 or less; and have a serum cholesterol level of 240 mg/dL or less. After hire, there are neither mandatory nor ongoing standards for physical performance or periodic examinations to determine current health status.

Firefighters. The National Fire Protection Association’s publication “Firefighter Professional Qualifications” (1987 Edition) includes the following causes for rejection due to heart disease: valvular heart disease; myocardial infarction or angina pectoris; electrocardiographic (ECG) evidence of major arrhythmias, conduction defects, coronary insufficiency, myocardial infarction or heart muscle disease; cardiac hypertrophy or dilation; pericarditis, endocarditis or myocarditis (except for a single episode of idiopathic or Coxackie pericarditis); persistent tachycardia of 100 or more. However, as with law enforcement agencies, it appears that most fire departments do not require continued good health after hire.

C. "Heart laws". As applied to police and firefighters, these laws state that the development of hypertension or heart disease is the result of their employment, without regard to medical evidence. Twenty-eight states have mandated such benefits for firefighters and nineteen states for police officers. Most states allow municipal employers to contest the job relatedness of the disability, in an effort to exclude patently ineligible claimants (12).

In states not allowing this "rebuttable presumption" provision, the costs of disability under the Heart Law have more than doubled in 5 years. In many states, myocardial infarction occurring during duty, is considered work-related, even if there is evidence of prior ischemic heart disease. These laws are increasingly burdensome to municipalities, an increasing number of which are unable to obtain Workers Compensation insurance. In the private sector, employees usually must prove that an unusual stress was the precipitating factor in the appearance or aggravation of underlying heart disease. Legislative requirements for other groups of individuals are summarized in Table 1.

D. Disability criteria of the Social Security Administration for workers with ischemic heart disease (13). Disability allowances for ischemic heart disease depend on the presence of typical anginal chest pain or status anginosus or variant angina of the Prinzmetal type along with objective evidence in the form of rest ECG changes, changes on treadmill exercise testing, obstructive lesions demonstrated by coro-
primary angiography, or impairment of left ventricular contractility demonstrated by left ventriculography. The specific characteristics of the typical anginal chest pain are:

Precipitation by effort and relief by sublingual nitroglycerin, rapid acting nitrates, or rest. This pain is classically described as crushing, squeezing, burning, or oppressive chest pain that may also be felt in the throat, arms or hands.

If the medical evidence includes the results of a treadmill test, this evidence is the primary basis for adjudicating claims. The criteria for a positive treadmill test are as follows:

1. Horizontal or downsloping depression (from the standing control) of the ST segment to ≥1.0 mm in at least two consecutive complexes lasting for at least 0.08 s after the J junction; or
2. Junctional depression occurring during exercise, remaining depressed (from the standing control) to ≥2.0 mm for at least 0.08 s after the J junction (the so-called slowly upsloping ST segment) in two consecutive complexes; or
3. Premature ventricular systoles that are multiform or sequential (3 or more); or
4. ST segment elevation (from the standing control) to ≥1.0 mm; or
5. Development of second or third degree heart block.

In the absence of an acceptable treadmill test, the following may be used as objective evidence:

I. Rest ECG
   A. Evidence of transmural myocardial infarction; or
   B. Ischemic ST segment depression (≥0.5 mm); or
   C. Ischemic configuration or current of injury with ST segment elevation of ≥2.0 mm; or
   D. Symmetric T wave inversion of ≥5.0 mm in any two leads except III, aVR, V1, V2; or
   E. Inversion of T waves to ≥1.0 mm in any of leads II, aVL, V2 to V5, in the presence of an R wave of at least 5.0 mm in lead aVL and an R wave greater than the S wave in lead aVF; or
   F. Complete left bundle branch block unless there is a coronary angiogram of record that is negative.

II. "Double " Master Two-Step Test
   A. Ischemic ST segment depression of ≥0.5 mm lasting for at least 0.08 s beyond the J junction in at least two consecutive complexes in any lead; or
   B. Development of second or third degree heart block.

III. Cardiac Catheterization
   A. Angiographic evidence
      1. ≥50% narrowing of the left main coronary artery; or
      2. ≥70% narrowing of a proximal coronary artery

(leave anterior descending, left circumflex, right); or
3. ≥50% narrowing of a long (≥1 cm) segment of a proximal coronary artery (leave anterior descending, left circumflex, right).

B. Left ventriculography—abnormal wall motion and/or left ventricular ejection fraction of ≤30% measured by contrast or radioisotopic methods.

The degree of residual impairment is the primary factor used by the Social Security Administration in determining disability. However, determination of residual impairment is not a uniform process. For example, an individual complaining of chest pains, presumed to be angina, after a myocardial infarction is generally considered disabled even in the absence of an exercise treadmill test. Another individual with similar symptoms who completes stage 3 of the Bruce exercise test protocol after an acute myocardial infarction, may be denied disability. Uniform standards for objective determination of the degree of residual impairment are needed.

The economic impact of Social Security Administration disability allowances. Approximately 2.65 million disabled workers and 1.25 million dependents receive Social Security Administration disability payments at an annual cost of $17 billion. Approximately 30% of the total cost and 13% of total claims is due to cardiovascular disease.

Disability allowances granted by the Social Security Administration in fiscal years 1983, 1984 and 1985 are shown in Table 2.

### Table 2. Social Security Administration Statistical Data (15): Disability Allowances for All Causes

<table>
<thead>
<tr>
<th>Year</th>
<th>Disability Allowances</th>
<th>Men</th>
<th>Women</th>
<th>&lt;35 yr</th>
<th>35 to 49 yr</th>
<th>50 yr</th>
<th>&gt;50 yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>1983</td>
<td>311,490</td>
<td>215,460</td>
<td>96,030</td>
<td>16.6</td>
<td>22.1</td>
<td>61.3</td>
<td></td>
</tr>
<tr>
<td>1984</td>
<td>357,140</td>
<td>243,549</td>
<td>113,191</td>
<td>15.9</td>
<td>23.5</td>
<td>60.6</td>
<td></td>
</tr>
<tr>
<td>1985</td>
<td>377,317</td>
<td>254,085</td>
<td>123,286</td>
<td>16.9</td>
<td>25.1</td>
<td>58.1</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Disability Allowances</th>
<th>Men</th>
<th>Women</th>
<th>&lt;35 yr</th>
<th>35 to 49 yr</th>
<th>50 yr</th>
<th>&gt;50 yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>1983</td>
<td>33,634</td>
<td>28,237</td>
<td>5,397</td>
<td>1.0</td>
<td>16.6</td>
<td>82.5</td>
<td></td>
</tr>
<tr>
<td>1984</td>
<td>34,223</td>
<td>28,227</td>
<td>5,996</td>
<td>0.8</td>
<td>15.9</td>
<td>83.2</td>
<td></td>
</tr>
<tr>
<td>1985</td>
<td>34,690</td>
<td>28,352</td>
<td>6,338</td>
<td>0.7</td>
<td>14.9</td>
<td>84.4</td>
<td></td>
</tr>
</tbody>
</table>

Factors Influencing Insurability of Patients With Ischemic Heart Disease

Insurance companies have the responsibility to treat all of their policyholders fairly by establishing premiums at a level consistent with the risk associated with the health status of the policyholder (14).
Underwriting. Underwriting is generally defined as the
process by which an insurer determines whether or not and
on what basis it will accept an application for insurance. The
primary goal of underwriting is the prediction of future
mortality and morbidity costs. Underwriting is necessary to
prevent adverse selection, which is the tendency of persons
with poorer than average health expectations to apply for
insurance to a greater extent than persons with average or
better health expectations. Antiselection results in inequitable
treatment of the healthiest group because it results in the
subsidization of high risk individuals by those at low risk.

The insurability (for life, health or disability coverage) of
individuals with ischemic heart disease is based on an
evaluation of the severity of the disease, both clinically and
as indicated by laboratory studies. Significant risk factors for
accelerated ischemic heart disease also influence prognosis
and, therefore, influence insurability decisions.

The following factors are considered in evaluating appli-
cations for insurance coverage:

I. Age and gender

II. Clinical history

Myocardial infarction, number and severity; angina,
stable/unstable, functional class; significant arrhythm-i-as;
congestive heart failure or other cardiac symp-
toms such as undue dyspnea on exertion, fatigue; card-
iale enlargement i.e., heart size; need for medications
i.e., vasodilators, beta-blockers, etc.; associated medi-
cal conditions such as hypertension, diabetes, angi-
oplasty, aortocoronary bypass surgery with internal
mammary artery or saphenous vein grafts, or both

III. Special studies

- ECG findings; i.e., residual changes of myocardial
infarction, stability of ST-T configurations in successive
tracings; exercise tests

- Exercise tests, including exercise-induced ischemia,
arrhythmia; exercise tolerance; and blood pressure
responses

- Echocardiography

- Thallium scans and other radioisotope studies

- Ambulatory ECG arrhythmias and/or silent angina

- Left heart catheterization with left ventriculography
and coronary angiography; left ventricular end-diastolic
pressure; left ventriculography, including contractile
abnormality, number of abnormal segments, degree of
abnormal contraction and left ventricular ejection fra-
tion

- Coronary angiography—number, severity and location
of coronary artery obstructions

IV. Major risk factors for ischemic heart disease

- Cigarette smoking or other use of tobacco

- Family history

- Hypertension

- Blood lipids—total serum cholesterol, low density lip-
oproteins, high density lipoproteins, triglycerides

- Diabetes mellitus

- Obesity

Most life insurance policies are issued on an individual
basis and individually underwritten with the premiums based
on that individual’s age and current physical status. As of
January 1, 1987, $3.7 trillion of individual life insurance and
$3.0 trillion of group life insurance were in force in the
United States. Of those insured, 60% are male and 85% are
between age 20 and 59 years (15,16). The cost of life
insurance has diminished steadily over the last 20 years,
reflecting lower mortality due to advances in medicine,
changes in life style and other factors.

In contrast to life insurance, most health and disability
policies are issued on a group basis. In 1987, some 158
million Americans under the age of 65 were covered by some
form of group health insurance, and 9 million were covered
solely by individual health insurance policies. Causes for the
increase in costs of health and disability policies over the
past 15 years include advances in medicine, the malpractice
crisis and inflation in general.

Insurers underwriting group life and health insurance
consider only the relevant characteristics of the group, not
of the individuals who constitute the group. The premise of
group underwriting is that within any large group of individ-
uals (especially in the workplace), only a few harbor medical
conditions that would, by individual underwriting standards,
warrant either a substandard rating, (an extra premium) or a
decimation of the risk. The entire group (including the
poorer risks) is insured without regard to preexisting condi-
tions when an employer changes carriers. The poorer risks
are passed back and forth when employers change carriers
on a “no profit—no loss basis.” The only exception to this
rule concerns late entrants into a group plan. Late entrants
are usually required to show proof of insurability, inasmuch
as they and their families exhibit an increased incidence of
significant health problems.

Individual insurance policies for health or disability are
underwritten on a per case basis usually with full disclosure
of the prior medical history. There may be an exclusion for
preexisting conditions and a 2 year period of contestability
(the period of time during which an insurance carrier can
challenge the validity of the contract). The care with which
writers of individual insurance screen applicants for ische-
mic heart disease reflects the dramatic rise in medical costs
associated with heart disease. The expensive high technol-
ogy used in the diagnosis and treatment of ischemic heart
disease today has been made possible by the sharing effect
created by widespread health insurance.

Availability of insurance and ratings. Patients with his-
tory of ischemic heart disease applying for individual life,
disability and medical care coverages are required to pay
higher premiums for these coverages because of the higher probability of a claim payment (death claim, disability claim, or claim for reimbursement of medical expenses) by the insurer. Some applicants will be denied coverage altogether.

**Life insurance.** Most applicants for life insurance who have survived a myocardial infarction will be able to buy life insurance 6 months after the episode. A typical rating for a patient who has recovered from an acute myocardial infarction is 175% plus $15 x 8 years. The applicant pays a premium that is 175% of standard select insured rates over the life of the policy. In addition, he or she pays $15 extra per 1,000 dollars of coverage for the first 8 years of the policy. Many companies have several different classes of myocardial infarction ratings, differentiated by clinical history, ECG residuals, left ventricular function, and so forth.

Applicants for life insurance who have a history of angina are generally insurable. A typical rating for an applicant with stable angina pectoris is 175% plus $7.50 for 8 years. This rating is less than that for myocardial infarction because of the shorter anticipated mortality of this condition. Coverage of applicants with unstable angina, imminent cardiac catheterization, angioplasty or bypass surgery may be postponed for a period of several months.

**Disability insurance.** Disability income policies are considered short-term (up to 6 months) and long-term (more than 6 months). Many employers will provide short-term disability benefits (i.e., sick leave) for up to 6 months as part of their benefit program. Most long-term disability policies provided through an insurance carrier require a 3 to 6 month waiting period before benefits commence. Most long-term disability policies specify that during the first 2 years of disability, the insured need only be disabled from their own occupation. After 2 years, the insured must be considered disabled from "any reasonable occupation for which they would qualify based on their physical status and training." This requirement can be removed by the payment of an increased premium.

Disability insurance is more difficult to obtain than life insurance for applicants with a documented history of coronary artery disease. Companies frequently limit their liability by offering policies with shortened benefit periods (2- or 5-year benefits) and charging an extra premium ranging from 30% to 200% depending on the clinical history. Many applications will be declined outright especially if the patient has documented severe disease or a very recent clinical event.

**Medical expense reimbursement (health insurance).** As a group, patients with ischemic heart disease incur substantially higher medical expenses than those of the general population. Many insurance companies do not write individual medical expense reimbursement coverage at all. Any offer of insurance extended to such patients would be made after several years free of clinical events, and then only at a substantially increased premium or with a substantial deductible, or both.

**State pools for uninsurables.** The majority of Americans have some type of health insurance (i.e., private, Medicare, Medicaid, and so forth). However, some individuals are unable to obtain any type of personal health insurance because of developmental disabilities, physical or mental impairment or chronic health conditions. The number of uninsured persons in the United States is estimated at 1 million.

Fifteen states currently have risk-sharing pools that provide access to insurance coverage for these high risk individuals. Funding for these programs varies by state but, in general, the programs are designed to be self-supporting through subscriber premiums. Health insurers doing business in the state usually share in the risk.

**References**

4. deVelasco JA. Return to work issues as a component of cardiac rehabilitation. Bibl Cardiol 1986;40:94-100.
TASK FORCES

Task Force I: Determination of Prognosis in Patients With Ischemic Heart Disease

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I. Introduction

This report summarizes information regarding morbidity and mortality in ischemic heart disease as it relates to insurability and employability. Insurability requires the assessment and evaluation of risks that may relate to life, disability and health. Employability should consider three aspects: 1) the capability of the individual to perform the job, 2) the risk to the individual of performing the job, and 3) the risk to society if the individual is performing the job.

This report focuses primarily on the assessment of risk of patients with chronic ischemic heart disease, including definite or probable angina pectoris, previous myocardial infarction, cardiac arrest or documented significant coronary artery obstruction. It focuses primarily on chronic disease outcomes and does not address the early prognosis of patients presenting with acute myocardial infarction. In addition, the risk to society posed by ischemic heart disease events occurring on the job is considered for individuals without manifestations of coronary artery disease. Prognostic risk focuses primarily on survival, but also encompasses subsequent myocardial infarction. The effects of specific therapies on prognosis and changes in the natural history of the disease are also considered.

II. Sources of Information

Three types of studies that have recently been extensively reviewed concern prognosis in patients with ischemic heart disease: 1) U.S. population statistics, 2) cohort or observational studies, and 3) randomized clinical trials.

U.S. population statistics. These data, obtained from national surveys, census figures and publications from the American Heart Association (2-5), provide limited information for the evaluation of specific individuals, and there are hazards in extrapolating results from specific studies to national statistics (6-8).

Cohort or observation studies. These studies define the population through community or regional surveillance. Findings from these studies can be extrapolated to the U.S. population because the study population is generally representative of the U.S. population as a whole. The findings from several large studies (the Framingham Study, Tecumseh Study, Chicago Peoples Gas Company Study, Minneapolis Professional and Business Men, U.S. Railroad Workers studies and the Chicago Western Electric Company study) largely agree with each other. The risk of developing coronary heart disease among asymptomatic individuals as it relates to the initial assessment has been defined by these studies. Estimates from the Framingham Study form the basis of the Coronary Risk Handbook (9).

Most of the detailed information regarding the assessment of risk of individual patients with manifest ischemic heart disease is derived from specific cohort studies of individuals with the disease. In general, these studies provide the most detailed assessment of the importance of characteristics influencing prognosis but suffer from the selection bias introduced from the enrollment process and criterion selection. The Coronary Artery Surgery Study (CASS) trial included a large collaborative patient registry of all individuals catheterized at participating centers (10). Collaborative registries of patients with acute myocardial infarction include the Myocardial Infarction Limitation of Size (MILLIS) Study (11), the Multicenter Postinfarction Trial (MPT) (12) and those coordinated at San Diego (13) and Stanford (14); however, this report focuses primarily on nonacute disease.

Voluntary collaborative registries include the National Heart, Lung, and Blood Institute-Percutaneous Transluminal Coronary Angioplasty (PTCA) registry of patients undergoing percutaneous transluminal coronary angioplasty (15). There are large regionally-based databases describing complete assessment and outcome of patients undergoing cardiac catheterization or other specific procedures at one or more institutions. These include the Duke Database for Cardiovascular Disease (16), the Seattle Heart Watch Study (17), the Cleveland Clinic Registry (18), the University of Alabama Registry (19) and the Emory University Registry (20). Prognostic studies of specific groups of patients undergoing tests or procedures include those from Cedars-Sinai Hospital (21).

Randomized controlled trials. These trials have evaluated not only the outcome of coronary bypass surgery and medical
therapy but also changes in the natural history of ischemic heart disease. Assessments of prognosis provided by these studies are limited by selection bias introduced by who is enrolled in the trial and difficulties in generalizing beyond these subjects of patients. This report summarizes the three largest trials in patients with stable angina: the Veterans Administration Cooperative Trial, the European Coronary Surgery Study and the Coronary Artery Surgery Study.

III. Characterization of Prognosis

A. Prognostic Characteristics From the Initial Assessment

Table 1 shows significant prognostic variables from the initial assessment that have been found to be important in at least two of the seven major studies. Where the relation has been examined for the characteristic alone and found to be significant, an appropriate notation has been made in the univariate column. Where multivariate analyses have been performed including at least several of the characteristics (uncommon for the randomized clinical trials) and the characteristics have remained important, an appropriate notation has been made in the multivariate column. The prognostic evaluation of a patient with coronary artery disease begins with the physician’s initial assessment. Decisions to perform noninvasive testing or cardiac catheterization should be considered in light of what these tests add to the physician’s initial assessment.

Clinical perspective versus life insurance perspective on prognosis. Many different characteristics from the physician’s initial assessment can be used to predict survival. Their importance as they relate to prognosis depends in part on how an individual’s prognosis is considered. The prognostic risk from a life insurance perspective compares the risk of an individual with coronary artery disease with that which would be expected for an individual of similar age and gender. Clinicians generally consider the prognosis from the perspective of the importance of individual characteristics among patients with established disease. This difference in perspective regarding prognosis influences the importance assigned to characteristics from the initial assessment.

Factors affecting prognosis. Among patients with established coronary artery disease, clinical prognosis worsens with age. However, when considered from a life insurance perspective, the relation reverses (relative mortality in ischemic heart disease patients is considerably higher in younger than in older age groups) because the assigned risk of the individual with coronary artery disease is related to the expected risk in a comparable healthy population. Consequently, age is an important prognostic characteristic and of fundamental importance when considered from the life insurance perspective.

Other important prognostic characteristics from the initial assessment include the patient’s gender, risk factors, symptoms, evidence of myocardial damage and evidence of associated vascular disease. The importance of gender is marginal in patients with established disease, although this characteristic is very important in operative mortality with coronary artery bypass grafting, most likely related to the smaller size of coronary vessels in women. Risk factors are particularly important in relation to the risk of development of coronary artery disease, but their contribution to prognosis is less important among patients with established disease (16,22). When examined by themselves, they clearly identify subgroups at higher risk, but when considered in conjunction with other characteristics, their contribution is less important. Similarly, psychological constructs such as the type A personality appear to be important in the development of the disease, but evidence of their importance as independent prognostic variables is not convincing.

The presence of significant myocardial damage has been found in all studies to be an important predictor of outcome.
Table 2. Prognostic Characteristics: Treadmill Exercise Testing

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Univariate Analysis</th>
<th>Multivariate Analysis</th>
<th>Add to Cardiac Catheterization</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST segment change</td>
<td>23, 24, 27, 105-111</td>
<td>23, 94, 105</td>
<td>105</td>
</tr>
<tr>
<td>Treadmill angina</td>
<td>23, 24, 105-107</td>
<td>105</td>
<td></td>
</tr>
<tr>
<td>Treadmill time or stage</td>
<td>23, 94, 105, 107, 109-112</td>
<td>94, 105, 107, 113</td>
<td>94, 105, 113</td>
</tr>
<tr>
<td>Maximal heart rate</td>
<td>23, 94, 105, 111, 114</td>
<td>23, 94</td>
<td>94</td>
</tr>
<tr>
<td>Ventricular arrhythmias</td>
<td>23, 105, 115, 116</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>Anginal heart rate</td>
<td>117</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exertional hypotension</td>
<td>24, 118</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In essence, this characteristic reflects the presence and extent of previous myocardial infarction and is often associated with symptoms of congestive heart failure.

Anginal symptoms identify individuals with myocardium at risk, and their tempo reflects the severity of the risk. Longstanding angina reflects longstanding coronary artery disease and, because the disease is progressive in nature, suggests a worsening anatomic severity.

B. Prognostic Characteristics Elicited by Noninvasive Testing

Noninvasive testing has been able to identify high and low risk subgroups of patients with chronic coronary artery disease. In general, studies are relatively small in size and, to provide sufficient events, have often combined end points to include not only death but also myocardial infarction and coronary artery bypass grafting.

The treadmill exercise test. This test has been the most carefully studied and excellent reviews are available (23-26). The studies cited in Table 2 indicate that among the many exercise variables evaluated, the most important prognostic indicators are maximal exercise capacity, increases in systolic blood pressure, and ST segment displacement (depression and elevation) (27). Although uncommon, exertional hypotension and ventricular tachycardia also identify a high risk subgroup of patients. The magnitude of the additional prognostic information provided by exercise testing is considerable in relation to the initial assessment and comparatively modest where catheterization has been performed (28,29).

Nuclear studies. Important prognostic characteristics obtained with radionuclide angiography and with thallium scintigraphy are shown in Tables 3 and 4, respectively. The radionuclide exercise ejection fraction appears to be the most important prognostic variable. In patients with a normal rest ejection fraction, the change in ejection fraction with exercise and the peak exercise ejection fraction provide virtually identical prognostic information. Perfusion defects in the distribution of two or more coronary arteries, and perhaps the quantitative estimate of the magnitude of hypoperfusion or the uptake of thallium in the lung appear to be the most important thallium prognostic variables. The contributions of radionuclide angiography and thallium scintigraphy to prognostic assessment are similar.

Ambulatory electrocardiography. This has also been performed in large series of patients with acute myocardial infarction and chronic angina. In patients with acute myocardial infarction, two large observational studies (11,12) have shown that frequent premature ventricular complexes on a predischarge 24 h ambulatory ECG are predictive of impaired prognosis independently of left ventricular function. Similar observations have been made in patients with

Table 3. Prognostic Characteristics: Radionuclide Angiography

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Univariate Analysis</th>
<th>Multivariate Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exercise ejection fraction</td>
<td>119, 120</td>
<td>120</td>
</tr>
<tr>
<td>Change in ejection fraction</td>
<td>121</td>
<td></td>
</tr>
<tr>
<td>Rest ejection fraction</td>
<td>119-121</td>
<td>119</td>
</tr>
<tr>
<td>Angina</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ECG changes</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>Wall motion abnormalities</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>Exercise time</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>Rest end diastolic volume</td>
<td>119</td>
<td></td>
</tr>
</tbody>
</table>

Table 4. Prognostic Characteristics: Thallium Scintigraphy

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Univariate Analysis</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Transient defects</td>
<td>21, 122-124</td>
<td>21, 122, 124</td>
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<tr>
<td>Total or fixed defects</td>
<td>21, 122, 125</td>
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<tr>
<td>Degree of hypoperfusion</td>
<td>21</td>
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<tr>
<td>Lung thallium uptake</td>
<td>126</td>
<td>126</td>
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<tr>
<td>Exercise ST changes</td>
<td>124, 126</td>
<td>124, 126</td>
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<tr>
<td>Heart rate changes</td>
<td>124</td>
<td>124</td>
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<tr>
<td>Exercise ventricular arrhythmia</td>
<td>124</td>
<td></td>
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</table>
Table 5. Prognostic Characteristics: Cardiac Catheterization

<table>
<thead>
<tr>
<th>Feature</th>
<th>Univariate Analysis</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Ventricular function</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ejection fraction</td>
<td>CA, D, I, S</td>
<td>CA, D, S</td>
</tr>
<tr>
<td>LV score or wall motion abnormalities</td>
<td>CA, CL, D, S</td>
<td>CA, CL, D</td>
</tr>
<tr>
<td>Anatomy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left main disease</td>
<td>CA, D, I, V</td>
<td>CA, D, V</td>
</tr>
<tr>
<td>Number of diseased vessels</td>
<td>CA, CL, D, E, I, S, V</td>
<td>CA, CL, D, S</td>
</tr>
<tr>
<td>Proximal LAD</td>
<td>CA, D, S</td>
<td>CA, D</td>
</tr>
<tr>
<td>Other proximal disease or jeopardy score</td>
<td>CA, D</td>
<td>CA, D</td>
</tr>
<tr>
<td>Mitral regurgitation</td>
<td>CA, D, S</td>
<td>CA, D, S</td>
</tr>
<tr>
<td>LVEDP</td>
<td>CL, D, S</td>
<td>CL, D, S</td>
</tr>
</tbody>
</table>

CA = CASS Trial and Registry (10.94-98); CL = Cleveland Clinic Registry (18.103); D = Duke University Database (16.99-101); E = European Coronary Surgery Study (90-93); I = Life Insurance studies (1, 104); LAD = Left anterior descending coronary artery; LV = Left ventricular coronary artery; LVEDP = Left ventricular end-diastolic pressure; S = Seattle Heart Center Watch Registry (17, 22, 102); V = VA Trial (87-89).

Congestive heart failure (30), but this relation has not been found in patients with angina requiring cardiac catheterization (31). Premature ventricular complexes occur more frequently in patients with reduced left ventricular function, and their prognostic information overlaps with measurements of left ventricular function (31). Evidence of silent ischemia has also been shown to be related to prognosis, although the data are not fully developed.

Exercise echocardiography. This study may also identify patients with a poor prognosis through assessment of wall motion changes, however, the data are not fully developed.

C. Prognostic Characteristics From the Cardiac Catheterization

Prognostically important characteristics from cardiac catheterization are shown in Table 5. Information from the physician’s initial assessment and cardiac catheterization is shown in Table 6.

The prognostically most important characteristics from the catheterization reflect left ventricular function and coronary anatomy. Left ventricular function is usually expressed as the ejection fraction. Anatomic characteristics reflecting myocardial jeopardy include the degree of left main stenosis, the number of significantly diseased major coronary vessels and the presence of proximal disease in the major coronary arteries, particularly of the left anterior descending coronary artery. The severity of mitral regurgitation and elevated left ventricular end-diastolic pressure are also prognostically important.

Important characteristics from the initial assessment combined with the cardiac catheterization are shown in Table 6. The most important predictors of survival are left ventricular function and coronary anatomy. Patients with unstable angina or poor left ventricular function and severe congestive heart failure have an especially unfavorable prognosis. The presence of other vascular disease, mitral regurgitation and age have also been found to be significant predictors of outcome when considered with information from cardiac catheterization. When examined by themselves, risk factors clearly identify subgroups at higher risk but when considered in conjunction with the characteristics shown in Table 6, their contribution is less important. The importance of gender is marginal in patients with established disease.

Prognostic estimates are most discriminating when all characteristics are considered. For example, consider the prognosis of two patients with three vessel disease and a normal ejection fraction. One is 64, has frequent angina, resting ST depression, peripheral vascular disease, previous myocardial infarction, an ejection fraction of 51% and a 93%
proximal left anterior descending coronary artery lesion. The other is 51, has infrequent angina, no peripheral vascular disease or previous myocardial infarction, an ejection fraction of 64% and a distal 75% left anterior descending coronary artery lesion. Expected survival on medical therapy is quite different. Five year estimates from the Duke Database (32) are 42% for the first patient and 92% for the second.

IV. Effects of Therapy on Prognosis

Studies of prognosis in ischemic heart disease must consider the ameliorating effects of therapy, including medical therapy, coronary artery bypass grafting, coronary angioplasty and changes over time in the natural history of the disease.

A. Medical Therapy

The influence of risk factor modification and drug therapy on the prognosis of patients with established disease has been reviewed (1,33). In general, serum cholesterol, hypertension and particularly smoking behavior worsen the prognosis of patients with manifest ischemic heart disease. However, the influence of these characteristics on recurrent cardiac events is modest compared with their influence on the incidence of initial coronary events (34-41). Although therapy directed at modifying these risk factors remains a prudent recommendation, definitive demonstration of substantially improved survival with risk factor modification in patients with chronic stable angina is limited (40).

Trials of drug therapy in modifying medical prognosis have been largely limited to patients with acute myocardial infarction or unstable angina. Evidence for an improved outcome, due to beta-blocker therapy, is more convincing after acute myocardial infarction (42-44) than in chronic angina (26,45,46). Two studies (47,48) have shown dramatic benefit of aspirin therapy in patients hospitalized with unstable angina. Some benefit for calcium channel blocker therapy may also be present (49). Vasodilator therapy may also improve survival in patients with congestive heart failure including some patients with coronary artery disease (50,51). The evidence for the use of antiarrhythmic therapy is controversial.

B. Coronary Artery Bypass Graft Surgery

The value of surgery in modifying prognosis has been excellently reviewed (1,52-54). In general, the magnitude of the improvement in prognosis is greatest in patients with anatomically extensive disease (left main disease and three vessel disease) or high risk based on clinical evaluation. Improvement is sustained in the first 7 to 8 years after surgery, diminishing thereafter as grafts become occluded (55,56,57). The influence of repeat bypass grafting on prognosis is unknown at present. The improved patency of internal mammary artery grafting compared with saphenous vein bypass procedures may improve or extend survival benefits with surgery (58,59).

Primary characteristics influencing operative mortality include age, body size (identified by gender in many studies), hypertension, prior coronary artery bypass grafting, history of smoking, left ventricular function, extent of anatomical disease, the presence of unstable angina or recent myocardial infarction, cerebral or peripheral vascular disease, and renal or pulmonary dysfunction (60-62) (Hammermeister KE. Seattle Heart Watch 1988 [personal communication]). Pryor DB. Duke Database 1988 [personal communication]). Long-term outcome after coronary artery bypass grafting is influenced by the same characteristics that define the risk in medically-treated patients except that coronary anatomy is much less important.

C. Coronary Angioplasty

The value of angioplasty in modifying prognosis in patients with coronary artery disease is unknown (63,64). The major limitation with respect to long-term prognosis appears to be restenosis occurring within 6 months in approximately one-third of treated patients (65,66).

D. Changes in the Natural History of Ischemic Heart Disease

There is overwhelming evidence that the natural history of coronary artery disease in the United States is improving over time. A recent comprehensive review describes a 42% decline in the age-adjusted mortality rates in the U.S. population between 1963 and 1985 (67). Outcomes have improved for patients with acute myocardial infarction (34,68) and those undergoing coronary artery bypass surgery (69). Improvements for patients with chronic stable angina treated medically are more modest (34,69,70).

V. Consideration of Occupations Posing a Risk to Society

Clinicians are frequently asked to "certify" that it is appropriate for an individual with ischemic heart disease to return to work. Such decisions are especially important in public safety officers, firefighters, pilots, critical process operators (e.g., nuclear power plant operators) and professional drivers. A significant cardiac event such as cardiac arrest or myocardial infarction occurring at a "critical" time in such occupations may adversely affect not only the individual but also the public or coworkers. In "certifying" whether it is appropriate for such individuals to work, the physician should consider not only the risk to the individual but also the risk to society.
Prognostic concerns about coronary heart disease have led to the mandatory retirement of individuals with demonstrated disease, as well as individuals without manifest disease. These two groups will be considered separately with respect to both the risk to the individual and the risk to society.

A. Asymptomatic Individuals Without Manifest Coronary Disease

In general, there is no convincing evidence that employment in a specific occupation worsens an individual’s risk for the occurrence of a cardiac event. A possible exception is firefighting, which entails bursts of heavy physical activity and exposure to heat and psychological stress. The risk of cardiac events in individuals without manifest coronary disease can be estimated with use of standard risk factor equations such as the Coronary Risk Handbook (9) based on the Framingham Study.

Epidemiologic studies suggest that habitual physical exercise may offer some protection against primary or secondary events of coronary heart disease and associated mortality but “falls short of proving” (71) this. The evidence also suggests that the effect of exercise training is outweighed by the other risk factors. There has also been some demonstration that emotional stress and sudden bursts of activity may increase the risk of sudden death, particularly in sedentary individuals (72,73).

Risk factor profiling using techniques such as the Coronary Risk Handbook are accurate and well substantiated. Screening programs to detect individuals without manifest coronary disease should consider such strategies rather than relying solely on individual characteristics such as age, gender, smoking, and others. Exercise testing can further improve the identification of individuals with one or more risk factors (74-77) and can be applied economically to specific occupations (78). In some cases, such as for airline pilots, it may be appropriate to consider further evaluation with radionuclide procedures or coronary angiography, or both, for individuals at increased risk (79-84).

B. Symptomatic Individuals

Whether it is appropriate for symptomatic individuals to return to occupations posing a risk to the public is often difficult to determine. From a prognostic standpoint, the goal is to determine whether the job is likely to place the individual under a stress that would otherwise be unlikely to occur. However, it is difficult to duplicate or simulate on-the-job conditions, such as those encountered in firefighting (85,86), in a standard ECG stress laboratory.

The decision should also consider the status of the patient’s disease. The risk of death or infarction is substantially higher in individuals with manifest or symptomatic coronary disease than in those without manifest disease. The

<table>
<thead>
<tr>
<th>Pathophysiologic Construct</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Myocardial function</td>
<td>+++++</td>
</tr>
<tr>
<td>Congestive heart failure</td>
<td>+++</td>
</tr>
<tr>
<td>Functional class</td>
<td>+++</td>
</tr>
<tr>
<td>Diuretic use</td>
<td>++</td>
</tr>
<tr>
<td>Diabetics use</td>
<td>+</td>
</tr>
<tr>
<td>Cardiomegaly</td>
<td>+++</td>
</tr>
<tr>
<td>S1 gallop</td>
<td>+++</td>
</tr>
<tr>
<td>Prior myocardial infarction</td>
<td>+</td>
</tr>
<tr>
<td>Exercise systolic pressure</td>
<td>+++</td>
</tr>
<tr>
<td>Exercise capacity</td>
<td>+++</td>
</tr>
<tr>
<td>Ventricular arrhythmias</td>
<td>+</td>
</tr>
<tr>
<td>Ejection fraction</td>
<td>+++</td>
</tr>
<tr>
<td>Wall motion score or assessment</td>
<td>+++</td>
</tr>
<tr>
<td>Left ventricular end-diastolic pressure</td>
<td>+</td>
</tr>
<tr>
<td>Myocardial jeopardy</td>
<td>+</td>
</tr>
<tr>
<td>Angina frequency</td>
<td>+</td>
</tr>
<tr>
<td>Duration of angina</td>
<td>+</td>
</tr>
<tr>
<td>Level of exercise inducing ischemia</td>
<td>+++</td>
</tr>
<tr>
<td>Degree of exercise induced ST segment depression</td>
<td>+++</td>
</tr>
<tr>
<td>Exercise systolic pressure</td>
<td>+++</td>
</tr>
<tr>
<td>Presence and extent of reversible thallium uptake</td>
<td>+++</td>
</tr>
<tr>
<td>Number and distribution of coronary vessels with obstruction</td>
<td>+++</td>
</tr>
<tr>
<td>Myocardial ischemia</td>
<td>+</td>
</tr>
<tr>
<td>Rest or nocturnal angina</td>
<td>++</td>
</tr>
<tr>
<td>Progressive angina</td>
<td>+</td>
</tr>
<tr>
<td>Unstable angina</td>
<td>++</td>
</tr>
<tr>
<td>Failure of angina to respond to nitroglycerin</td>
<td>+</td>
</tr>
<tr>
<td>ST segment depression on rest ECG</td>
<td>+++</td>
</tr>
</tbody>
</table>

prognostic value of silent ischemia, defined as ST segment depression without chest pain, in patients without manifest coronary artery disease is unknown. For certain groups of patients, such as those with unstable angina, return to work is clearly inappropriate in a setting where the occurrence of a significant cardiac event would place the public at risk. In contrast, individuals without clinical or angiographic evidence of myocardial ischemia after coronary artery bypass grafting have an excellent prognosis (82).

VI. Conclusions

1. Variables from the clinical assessment, noninvasive tests and cardiac catheterization that are important for estimating prognosis include descriptors of myocardial function, myocardial jeopardy and myocardial ischemia (Table 7).

2. Prognosis can be estimated from the clinical examination (history, physical examination, ECG, chest roentgenogram) combined when indicated with one or more noninvasive studies (e.g., exercise test, radionuclide angiography, myocardial imaging or echocardiography) and does not usually require cardiac catheterization except when dictated by regulations or recommendations.
3. Most occupations do not increase the risk of coronary events. In patients with manifest coronary disease, continued employment should be permitted when patients are functionally able to perform the job.

4. Prognosis should be estimated for occupations in which sudden disability might endanger others. For patients with manifest disease, this evaluation should occur at yearly intervals, or more frequently if required by regulation or recommendation. The cost effectiveness of these approaches needs to be evaluated.

5. Prognosis should also be estimated for patients in occupations requiring sudden or sustained high level physical effort or exposure to extremes of hot or cold or to hypoxia, hypercarbia, carbon monoxide or stimuli producing sudden bursts of autonomic activity.

6. Prognosis need not be estimated for individuals without manifest coronary disease, except perhaps for those with occupations in which sudden disability might endanger others. In the latter group, noninvasive assessment may be of value. In some instances, cardiac catheterization may be required to satisfy regulations or recommendations.

7. Although the advisability of return to full-time work of individuals with manifest coronary disease can usually be established a priori, a trial work period may sometimes be necessary.

References


118. Bruce RA, DeRouen TA, Peterson DR, et al. Noninvasive predictors of
Task Force II: Determination of Occupational Working Capacity in Patients With Ischemic Heart Disease

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Introduction

The physical, metabolic and cardiovascular demands of occupations in industrialized countries have substantially declined during the past century. Many jobs that once required substantial physical effort are now performed by machines, robots or computers. This decrease in job-related energy demand is especially apparent in occupations performed by people over age 40, who, given some seniority, rarely perform physical tasks exceeding a peak energy expenditure of 5 kcal/min or 3.5 METS, where 1 MET = energy expenditure sitting at rest (1). Nonetheless, the physical stress of employment is still the greatest challenge to the cardiovascular system of many patients with ischemic heart disease.

For many sedentary jobs posing limited psychological or environmental demands, the adequacy of the patient’s physical working capacity can be assessed by a medical history, physical examination and symptom-limited exercise testing. However, as the physical demands of the job tasks increase to include exercise of widely varying intensities and types, or substantial psychological or environmental stress, assessment of physical working capacity becomes more complex.

In patients with ischemic heart disease, the focus of occupational work evaluation is to determine whether or not the increase in cardiac demands produced by physical, psychological and environmental stressors will exceed the threshold for a “safe working capacity.” The challenge to the physician is to obtain an accurate, valid and reliable determination of this capacity.

Factors Influencing Metabolic and Cardiovascular Demands During Work

Physical exertion increases metabolic and cardiac demands roughly in proportion to the absolute intensity of the exertion. The magnitude of effort required for a particular task by an individual is related to the individual’s physical working capacity. Therefore, the metabolic and cardiac demands on an individual are related to characteristics of the task, such as the work intensity, type of work, size of muscle mass involved, work-rest cycle and environmental conditions as well as characteristics of the patient including cardiovascular function, skeletal muscle training and psychological factors (2).

1. Types of Exercise Encountered in Occupational Tasks

Occupational tasks require different types of exertion, performed singly and in combination, and vary in the number and mass of muscle groups involved. The major types of exercise usually performed are dynamic (isotonic) and static (isometric), or a combination of both dynamic and static exertion.
A. Dynamic exercise. This type of exercise is characterized by the shortening of the muscle during contraction and the movement of limbs or the entire body such as occurs with walking, cycling or climbing stairs. The cardiovascular response to dynamic exercise is characterized by a linear increase in oxygen uptake, heart rate and cardiac output proportional to the increase in exercise intensity (3). Although the increase in heart rate with increasing oxygen uptake is linear, the slope of this relation varies with the aerobic capacity of the individual (4). Systolic blood pressure and the product of heart rate and systolic blood pressure (rate-pressure product) also increase in proportion to the exercise intensity. Diastolic blood pressure usually is maintained or decreases slightly, especially in younger or well-conditioned persons. Because percent maximal heart rate bears a constant relation to percent maximal VO₂, the heart rate response to exercise is a good clinical measure of the relative metabolic demands of most forms of dynamic exercise.

Patients with ischemic heart disease generally show a similar relation between relative exercise intensity and heart rate. However, in patients whose physical capacity is limited by ischemia or prior myocardial infarction, the estimation of maximal oxygen uptake during exercise is less reliable (5).

B. Static exercise. This type of exercise results in greater tension but no major shortening of the muscle nor movement of the limb. It is characterized by a rapid and continuous rise in both systolic and, to a lesser extent, in diastolic blood pressure and only a moderate rise in oxygen uptake and heart rate. Examples of static exercise encountered in occupational tasks include supporting an object against gravity (e.g., holding a suitcase), lifting and holding heavy objects or maintaining a sustained handgrip with various tools. The magnitude of the increase in blood pressure is proportional to the percent of the maximal tension or voluntary contraction maintained and the size of the muscle mass involved in the contraction (6). Total oxygen uptake during short-term static exercise is relatively small (2 to 4 METs) compared with dynamic exercise producing a similar degree of fatigue.

Patients with stable ischemic heart disease without left ventricular dysfunction usually show increases in blood pressure and heart rate in response to static exercise, which are similar to those of healthy persons (7). Submaximal static exercise is generally well tolerated by patients with reasonably good left ventricular function (dynamic exercise capacity >7 METs). Recent studies have shown no impairment of left ventricular ejection fraction during submaximal (30%) handgrip or a standing deadlift maintained for 3 min (8). However, patients with poor left ventricular function respond poorly to sustained static exercise, demonstrating a rapid decline in ejection fraction and increased myocardial ischemia (9).

C. Combined dynamic and static exercise. Combined dynamic and static exercise can produce an additional increase in heart rate, systolic and diastolic blood pressure and rate-pressure product, especially during submaximal exercise, in both healthy men and patients with ischemic heart disease. Oxygen uptake increases in proportion to the added carriage weight (10). In patients whose exercise capacity is ≥5 METs, carrying weights while walking on the treadmill is well tolerated. Moreover, the prevalence of ischemic ST depression and anginal symptoms is somewhat less during this combined exercise compared with that of treadmill exercise alone (11).

D. Arm-shoulder exercise. Upper limb exercise involves a smaller muscle mass than lower limb exercise. The peak maximal oxygen uptake (VO₂ max) for dynamic upper limb work (arm cranking) usually is 60% to 80% of that attained during treadmill or cycle exercise (12,13). Heart rate increases linearly in proportion to percent VO₂ max and the peak value is usually somewhat less than that achieved during treadmill or cycle exercise (14). Systolic and diastolic blood pressure are usually higher during arm than during leg exercise, probably because of an increased contribution of static exercise or vasoconstriction, or both, occurring in the larger non-exercising muscle mass of the leg (15). The heart rate or rate-pressure product at which ischemia occurs tends to be similar or slightly higher during dynamic arm exercise than during dynamic leg exercise (16).

2. Work Duration and Rest Cycle

Higher intensity job tasks can be performed more effectively when work is interrupted by rest periods (17). Cardiovascular demands decrease significantly as work and rest cycles shorten. This approach may be used to increase the working capacity of patients with ischemic heart disease. For example, heart rate during combined dynamic and static exercise at 80% of VO₂ max was 126, 161 and 172 beats/min, respectively, during work cycles of 30 s, 3 min and 6 min followed by rest cycles of similar duration (18).

3. Environmental Conditions

The energy requirements and myocardial oxygen demands of various work tasks are significantly influenced by hot and cold air temperatures. Conditions of heat or humidity or both, which require active thermal regulation, increase the metabolic requirements for and cardiovascular responses to physical work (19). In addition, increased body fluid losses through sweating must be replaced to prevent dehydration. Exercise in cold temperatures results in a higher metabolic rate due to the weight of additional clothing and the decreased efficiency of body movement. The vasoconstriction produced by cold air may increase the myocardial work and decrease the exercise tolerance of patients whose capacity is limited by angina pectoris (20). High levels of air pollution reduce the exercise tolerance of healthy people as well as those limited by ischemia (21). Exercise capacity is...
decreased at altitudes exceeding 2,000 m (6,500 feet) and decreases further at higher altitudes.

4. Psychological Factors

In highly industrialized countries, psychological stress has often replaced physical stress at the most commonly perceived cardiovascular demand of occupational work. Standard psychological testing procedures have been used to induce psychological stress in the laboratory in patients with ischemic heart disease. Metabolic and cardiovascular demands of psychological stress testing are substantially lower than those produced by dynamic or static exercise (22). Some patients manifest myocardial ischemia with psychological stress at significantly lower heart rates and blood pressures than those precipitating ischemia on exercise testing. In this minority of patients, changes in coronary tone, catecholamine concentrations or platelet aggregation, or both are believed to underlie ischemia (23).

Quantitation of the Metabolic and Cardiovascular Demands of Occupational Tasks

The energy required for the performance of occupational tasks has been assessed primarily by measurement of the oxygen requirement during work performance and immediate recovery (24). Continuous delivery of oxygen by the circulation is required for the generation of adenosine triphosphate (ATP), which supplies energy for prolonged muscular contraction. One liter of oxygen corresponds to about 5 kcal of useful energy. When oxygen transport is adequate, muscular contractions are maintained by aerobic metabolism of carbohydrates, fatty acids, pyruvate, lactate and other substrates to form ATP, carbon dioxide and water, with little or no formation of lactic acid. At the initiation of an activity and when the oxygen delivery becomes insufficient to meet the total demands of muscular contraction (usually at about 65% of peak aerobic capacity), anaerobic processes are activated and some of the ATP is produced by metabolism of muscle glycogen and blood glucose. This results in the formation of lactic acid in the skeletal muscle, at a concentration that is dependent on the intensity and duration of the activity. The intensity of exercise at which anaerobic metabolism begins to increase sharply is called the anaerobic threshold. Allowed to exercise at their own preferred rate, individuals performing occupational tasks work at an intensity of about 40% of their VO2 max (25), which is below their anaerobic threshold.

The energy requirements of a large variety of occupational tasks were reported in a series of industrial studies performed in the 1940-1960 era (26,27). These studies continue to serve as the basis for the estimation of the energy expenditure for most job tasks. Very few studies of this type have been conducted in the past several decades. The most frequently used classification of job tasks according to estimated energy requirements expressed as METs is provided in Table 1.

Energy requirements for a wide range of occupational categories are summarized in Table 2. This table does not contain all categories of modern jobs, and automation and mechanization have diminished the physical effort involved in many of the jobs listed. Moreover, these values were determined for healthy individuals. Unfortunately, there are no comprehensive studies that verify the accuracy of published occupational energy requirements for patients with ischemic heart disease. The capacity of an individual to perform a given task is determined by the relative intensity (% VO2 max) and the duration of the activity. Healthy men and women are able to perform 6 to 8 h of continuous work at intensities <40% of VO2 max. Work tolerance declines substantially at higher relative work intensities. At 40% to 60% of VO2 max, tolerance for continuous work duration is decreased to 4 h. Work intensities exceeding 60% VO2 max are difficult to sustain for >2 h (28).

Table 1. Occupational Work Classification by Energy Requirement

<table>
<thead>
<tr>
<th>Classification</th>
<th>kcal/min</th>
<th>METs</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very heavy and heavy</td>
<td>&gt;7.5</td>
<td>&gt;6</td>
<td>Carrying heavy objects, climbing many stairs rapidly</td>
</tr>
<tr>
<td>Medium</td>
<td>5.0 to 7.5</td>
<td>4 to 6</td>
<td>Carrying moderate weight objects, i.e., 50 lb (110 kg)</td>
</tr>
<tr>
<td>Light</td>
<td>2.6 to 4.9</td>
<td>2 to 4</td>
<td>Carrying light weight objects, i.e., 20 lb (44 kg)</td>
</tr>
<tr>
<td>Sedentary</td>
<td>&lt;2.5</td>
<td>&lt;2</td>
<td>Sitting, slow walking, lifting light objects, i.e., 10 lb (22 kg)</td>
</tr>
</tbody>
</table>

A. Objectives of the Occupational Work Evaluation

There are three major objectives of the occupational work evaluation. These are:

1. To determine symptom-limited exercise capacity in a standard environment. After a cardiovascular clinical examination, including a rest 12 lead electrocardiogram (ECG), a progressive, multistage, symptom-limited exercise test should be used to ascertain the threshold of work load, heart rate and systolic pressure at which significant abnormalities appear. These abnormalities include cardiac symptoms, ECG responses, blood pressure abnormalities and physical signs. The Borg scale provides a reproducible measure of the intensity of exercise perceived by the patient (29). These
Table 2. Energy Requirements of Occupations

<table>
<thead>
<tr>
<th>Activity</th>
<th>METs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bakery, general</td>
<td>2.25</td>
</tr>
<tr>
<td>Bookbinding</td>
<td>2.25</td>
</tr>
<tr>
<td>Building road (including hauling debris)</td>
<td>6.0</td>
</tr>
<tr>
<td>Carpentry, general</td>
<td>3.5</td>
</tr>
<tr>
<td>Carrying heavy loads, such as bricks</td>
<td>8.0</td>
</tr>
<tr>
<td>Carrying moderate loads upstairs (16 to 40 lbs, 35 to 88 kg)</td>
<td>8.0</td>
</tr>
<tr>
<td>Chambermaid</td>
<td>2.5</td>
</tr>
<tr>
<td>Coal mining, drilling coal, rock</td>
<td>6.5</td>
</tr>
<tr>
<td>Coal mining, erecting supports</td>
<td>6.5</td>
</tr>
<tr>
<td>Coal mining, general</td>
<td>6.0</td>
</tr>
<tr>
<td>Coal mining, shoveling coal</td>
<td>7.0</td>
</tr>
<tr>
<td>Construction, outside, remodeling</td>
<td>5.5</td>
</tr>
<tr>
<td>Electrical work, plumbing</td>
<td>3.5</td>
</tr>
<tr>
<td>Farming, baling hay, cleaning barn, poultry work</td>
<td>8.0</td>
</tr>
<tr>
<td>Farming, driving harvester</td>
<td>2.5</td>
</tr>
<tr>
<td>Farming, driving tractor</td>
<td>2.5</td>
</tr>
<tr>
<td>Farming, feeding animals</td>
<td>4.0</td>
</tr>
<tr>
<td>Farming, feeding cattle</td>
<td>4.5</td>
</tr>
<tr>
<td>Farming, forking straw bales</td>
<td>8.0</td>
</tr>
<tr>
<td>Farming, milking by hand</td>
<td>3.0</td>
</tr>
<tr>
<td>Farming, milking by machine</td>
<td>1.5</td>
</tr>
<tr>
<td>Farming, shoveling grain</td>
<td>5.5</td>
</tr>
<tr>
<td>Fire fighter</td>
<td>4.5</td>
</tr>
<tr>
<td>Forestry, ax chopping, fast</td>
<td>17.0</td>
</tr>
<tr>
<td>Forestry, ax chopping, slow</td>
<td>5.0</td>
</tr>
<tr>
<td>Forestry, bucking trees</td>
<td>7.0</td>
</tr>
<tr>
<td>Forestry, carrying logs</td>
<td>11.0</td>
</tr>
<tr>
<td>Forestry, felling trees</td>
<td>8.0</td>
</tr>
<tr>
<td>Forestry, general</td>
<td>8.0</td>
</tr>
<tr>
<td>Forestry, hoeing</td>
<td>5.0</td>
</tr>
<tr>
<td>Forestry, planting by hand</td>
<td>6.0</td>
</tr>
<tr>
<td>Forestry, sawing by hand</td>
<td>7.0</td>
</tr>
<tr>
<td>Forestry, sawing, power</td>
<td>4.5</td>
</tr>
<tr>
<td>Forestry, trimming trees</td>
<td>9.0</td>
</tr>
<tr>
<td>Forestry, weeding</td>
<td>4.0</td>
</tr>
<tr>
<td>Furrier</td>
<td>4.5</td>
</tr>
<tr>
<td>Horse grooming</td>
<td>6.0</td>
</tr>
<tr>
<td>Horse racing, galloping</td>
<td>8.0</td>
</tr>
<tr>
<td>Horse racing, trotting</td>
<td>6.5</td>
</tr>
<tr>
<td>Horse racing, walking</td>
<td>2.6</td>
</tr>
<tr>
<td>Locksmith</td>
<td>3.5</td>
</tr>
<tr>
<td>Machine tooling, machining, working sheet metal</td>
<td>2.5</td>
</tr>
<tr>
<td>Machine tooling, operating lathe</td>
<td>3.0</td>
</tr>
<tr>
<td>Machine tooling, operating punch press</td>
<td>5.0</td>
</tr>
<tr>
<td>Machine tooling, tapping and drilling</td>
<td>4.0</td>
</tr>
<tr>
<td>Machine tooling, welding</td>
<td>3.0</td>
</tr>
<tr>
<td>Masonry, concrete</td>
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<tr>
<td>Moving, pushing heavy objects, ≤75 lbs. (165 kg) (desks, moving van work)</td>
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<table>
<thead>
<tr>
<th>Activity</th>
<th>METs</th>
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<tbody>
<tr>
<td>Operating heavy duty equipment</td>
<td>2.5</td>
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<tr>
<td>Orange grove work</td>
<td>4.5</td>
</tr>
<tr>
<td>Printing (standing)</td>
<td>2.25</td>
</tr>
<tr>
<td>Shoe repair, general</td>
<td>2.5</td>
</tr>
<tr>
<td>Shoveling, digging ditches</td>
<td>8.5</td>
</tr>
<tr>
<td>Shoveling, heavy (&gt;16 lbs./min)</td>
<td>9.0</td>
</tr>
<tr>
<td>Shoveling, light (&lt;10 lbs./min [22 kg/min])</td>
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</tr>
<tr>
<td>Shoveling, moderate (10 to 15 lbs./min [22 to 33 kg/min])</td>
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</tr>
<tr>
<td>Sitting: light (desk work, phone, hand tools, R. assembly/repair, driving car/truck)</td>
<td>2.5</td>
</tr>
<tr>
<td>Standing: light (bartending, store clerk, standing/talking, assembling, filing)</td>
<td>2.5</td>
</tr>
<tr>
<td>Standing: light/moderate (assemble/repair heavy parts, welding, stocking, etc.)</td>
<td>3.0</td>
</tr>
<tr>
<td>Standing: moderate (assembling at fast rate, lifting 50 lbs., 110 kg, hitch/twisting ropes)</td>
<td>3.5</td>
</tr>
<tr>
<td>Standing: moderate/heavy (lifting &gt;50 lb [110 kg], masonry, painting, paper hanging)</td>
<td>4.0</td>
</tr>
<tr>
<td>Steel mill, forging</td>
<td>5.5</td>
</tr>
<tr>
<td>Steel mill, hand rolling</td>
<td>8.0</td>
</tr>
<tr>
<td>Steel mill, merchant mill rolling</td>
<td>8.0</td>
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<tr>
<td>Steel mill, removing slag</td>
<td>11.0</td>
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<tr>
<td>Steel mill, tending furnace</td>
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<td>Steel mill, tipping molds</td>
<td>5.5</td>
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<tr>
<td>Steel mill, working in general</td>
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</tr>
<tr>
<td>Tailoring, cutting</td>
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<tr>
<td>Tailoring, general</td>
<td>2.5</td>
</tr>
<tr>
<td>Tailoring, hand sewing</td>
<td>2.0</td>
</tr>
<tr>
<td>Tailoring, machine sewing</td>
<td>2.5</td>
</tr>
<tr>
<td>Tailoring, pressing</td>
<td>4.0</td>
</tr>
<tr>
<td>Typing, electric, manual or computer</td>
<td>1.5</td>
</tr>
<tr>
<td>Using heavy power tools such as pneumatic tools (jackhammers, drills, etc.)</td>
<td>6.0</td>
</tr>
<tr>
<td>Using heavy tools (not power) such as shovel, pick, tunnel bar, spade</td>
<td>8.0</td>
</tr>
<tr>
<td>Walking, 3.0 mph, moderate, not carrying light objects</td>
<td>3.5</td>
</tr>
<tr>
<td>Walking, 3.5 mph, brisk, or standing, carrying objects &lt; 25 lbs. (35 kg)</td>
<td>4.5</td>
</tr>
<tr>
<td>Walking or standing, carrying objects about 25 to 49 lbs. (55 to 86 kg)</td>
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<tr>
<td>Walking or standing, carrying objects about 50 to 74 lbs. (110 to 163 kg)</td>
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</tr>
<tr>
<td>Walking or standing, carrying objects about 75 to 99 lbs. (165 to 218 kg)</td>
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</tr>
<tr>
<td>Walking or standing, carrying objects about ≥100 lbs. (220 kg)</td>
<td>8.5</td>
</tr>
<tr>
<td>Watch repairing</td>
<td>1.5</td>
</tr>
<tr>
<td>Working in scene shop</td>
<td>3.0</td>
</tr>
</tbody>
</table>

Adapted from reference 26 and 27. Data are from many sources and are best estimates of the average energy requirement expressed as METs (multiples of energy expenditure while sitting at rest). Peak energy expenditure for some of these occupations will be substantially higher.

Observations should be obtained in a standard environment with a normal ambient temperature and relative humidity and freedom from air pollution, unusual noise or other stressful stimuli.

2. To determine reasons for limited work tolerance, significant left ventricular dysfunction, myocardial ischemia, arrhythmia, or conduction defects can usually be assessed by heart rate, blood pressure, ECG responses and
peak work load. Other symptoms or signs indicative of impairment of respiratory, neuromuscular-skeletal, peripheral vascular or metabolic disorders should be noted as well, including the changes in physical findings during and after exercise (murmurs, gallops, peripheral pulse, etc.). Echocardiography or radionuclide studies can be used to assess pathophysiologic responses when standard exercise test results are equivocal or suboptimal.

3. To determine cardiovascular responses to specific work tasks. A more extensive job-specific evaluation may be necessary for occupations posing unusually taxing physical, psychological or environmental stress especially those posing a risk to the public. Such an evaluation may involve laboratory work simulation with ECG and blood pressure monitoring or direct measurement of cardiovascular response on the job, including ambulatory ECG or blood pressure monitoring, or both.

B. Occupations Requiring Special Considerations

Some occupations require special consideration because sudden cardiac incapacitation of the patient could jeopardize the safety of the general public or co-workers. Public safety officers, firefighters, commercial airline pilots, air traffic controllers and drivers of commercial vehicles are of special concern.

1. Police officers and firefighters. Police work and firefighting pose special problems in assessing physical requirements for the job. Activities are sedentary or light during more than 95% of duty time on these jobs. However, both occupations may at any time entail extreme physical, emotional and environmental challenges (30). For a police officer, heavy physical exertion requirements may include subduing and handcuffing a suspect who is resisting arrest or removing an accident victim from a burning vehicle. In addition, there is the emotional stress accompanying the danger and uncertainty of high speed automobile chases and the physiological stress of shift work.

Firefighters must wear up to 50 lbs (110 kg) of firefighting gear and carry additional weights that may approach 70 lbs. (154 kg). They may have to ascend stairs or ladders quickly in entering a burning building and carry or drag out a victim. These tasks sometimes are performed in a hot environment filled with noxious fumes.

Because strenuous physical activity in both occupations is infrequent, job-related activity is incapable of keeping these workers in good physical condition. Few police and fire departments require exercise conditioning programs, periodic medical evaluations or physical fitness testing; nor do they enforce body weight standards after hiring and the initial training period. Individuals in these occupations commonly exhibit a low physical working capacity and many are overweight and smoke cigarettes. These considerations must be kept in mind in judging if or when a patient with ischemic heart disease should return to work in one of these occupations.

2. Commercial airline pilots. Whereas the physical demands of piloting commercial aircraft are low, at times the psychological stress can be very high, imposing significant cardiac demands (31). Taking off and landing when the airways are crowded or during inclement weather, can substantially increase heart rate and systolic pressure. There is no established procedure for simulating this type of stress in the laboratory. It is not known what level of sign- and symptom-free performance during exercise testing is a good indication that psychological stress is unlikely to precipitate sudden cardiac arrest or myocardial infarction.

3. Air traffic controllers. Air traffic controllers are exposed to potentially stressful situations for much of their working day (32). Physical demands are low and peak cardiac demands reflect largely the response to psychological stressors.

4. Drivers of commercial vehicles. The cardiac demands of driving various types of commercial vehicles reflect physical, psychological and environmental factors (33). Physical factors include the work of driving (especially isometric exercise) and the fatigue of extended work hours; psychological factors include the pressure of driving in bad weather, heavy traffic or other demanding situations (meeting schedules); and environmental factors of air pollution, heat and altitude.

C. Guidelines for Assessing Occupational Working Capacity

Return to work decisions should be based on a cardiovascular evaluation conducted by a physician experienced in clinical cardiology and functional assessment of the cardiovascular system. The exact timing of this evaluation will depend on the clinical status of the patient, time since infarction, surgery or coronary angioplasty, the interest and motivation of the patient and the expectation or requirements of the employer, insurance company or government agency.

Return to work evaluation can be performed within 5 weeks after medically uncomplicated myocardial infarction, 7 weeks after coronary artery bypass surgery and 1 week after successful coronary angioplasty (34,35). At the time of the evaluation, the patient should be free of signs or symptoms of significant cardiac dysfunction at rest or at very low level exertion (e.g., standing or walking at <2 mph).

1. Historical and clinical data. Three major cardiac pathophysiologic processes due to ischemic heart disease may impair physical working capacity: left ventricular dysfunction, myocardial ischemia and electrophysiologic disturbances. Clinically severe manifestations of these processes are sufficient to exclude patients from occupational work or to defer recommendations regarding work until further diag-
nostic evaluations or therapeutic interventions have been carried out. In such patients, exercise testing provides little or no incremental information beyond historical and clinical data and may be contraindicated due to its risk (36).

2. Specialized laboratory testing. In individuals with few or no cardiac symptoms, specialized testing can provide objective measures of prognosis and functional capacity. These measures can be used to direct further diagnostic evaluation, provide recommendations regarding the performance of occupational work and direct physical conditioning programs.

A. Treadmill Exercise Testing

The most useful information for determining occupational working capacity is provided by multistage, symptom-limited exercise testing in which a multi-lead ECG is continuously monitored, systemic arterial blood pressure is recorded noninvasively at least at the end of each stage of exercise, ratings using the Borg perceived exertion scale are obtained during each stage and patients are closely monitored for signs or symptoms of cardiopulmonary distress.

Contraindications to symptom-limited exercise
- Uncompensated left ventricular failure
- Angina at rest or with minimal exertion (unstable angina)
- High grade ventricular arrhythmias
- High grade conduction abnormalities
- Chronotropic incompetence on previous testing
- Severe aortic stenosis

Conditions limiting peak exercise capacity
- Chronic obstructive pulmonary disease
- Peripheral vascular disease
- Orthopedic, Neurologic and neuromuscular disorders
- Atrial fibrillation or flutter with poorly controlled ventricular rate
- Psychiatric and psychological disorders
- Myocardial infarction within 7 to 14 days
- Coronary or other surgery within 14 to 30 days

Conditions limiting the interpretation of the exercise ECG
- Extensive Q wave infarction pattern
- Left bundle branch block
- Atrial fibrillation or flutter
- Pre-excitation syndromes (Wolff-Parkinson-White; Lown-Ganong-Levine)
- Left ventricular hypertrophy
- Rest ST-T wave abnormalities
- Cardiac medications (e.g., digitalis)

1. The peak treadmill work load. This variable which reflects the capacity for sustained occupational work, may be limited not only by pathophysiologic mechanisms of ischemic heart disease but by the degree of physical conditioning. In general, the peak exercise work load should be at least twice the average physical requirement of occupational tasks over a working day. A low peak treadmill work load may represent physical deconditioning, fixed left ventricular dysfunction, ischemia-induced left ventricular dysfunction, or significant valvular disease. Differentiating these pro-

| Table 3A. Energy Requirements for Various Standardized Exercise Testing Protocols |
|------------------------|---------|---------|---------|--------|--------|
|                        | O₂       | 2.0 mph | 3.0 mph | 3.4 mph | Speed  |
| Requirements           | 2.0 mph  | 3.0 mph | 3.4 mph | 3.0 mph | Gradient |
| (METs)                 | (METs)   | (METs)  | (METs)  | (METs)  | (METs)  |
| 1                      | 0        | 0       | 0       | 8.0     | 1.7     |
| 2                      | 0        | 1.0     | 1.3     | 8.0     | 1.7     |
| 3                      | 3.5      | 3.0     | 3.0     | 6.0     | 1.7     |
| 4                      | 7.0      | 7.0     | 7.0     | 6.0     | 1.7     |
| 5                      | 10.5     | 10.5    | 10.5    | 8.0     | 1.7     |
| 6                      | 14.0     | 14.0    | 14.0    | 12.0    | 1.7     |
| 7                      | 17.5     | 17.5    | 17.5    | 14.0    | 2.5     |
| 8                      | 21.0     | 21.0    | 21.0    | 18.0    | 2.5     |
| 9                      | 25.0     | 25.0    | 25.0    | 20.0    | 3.0     |
| 10                     | 29.0     | 29.0    | 29.0    | 22.0    | 3.5     |
| 11                     | 33.5     | 33.5    | 33.5    | 24.0    | 4.5     |
| 12                     | 37.5     | 37.5    | 37.5    | 26.0    | 5.0     |
| 13                     | 41.0     | 41.0    | 41.0    | 28.0    | 5.5     |
| 14                     | 44.5     | 44.5    | 44.5    | 30.0    | 6.5     |
| 15                     | 49.0     | 49.0    | 49.0    | 32.0    | 7.5     |
| 16                     | 52.5     | 52.5    | 52.5    | 34.0    | 8.5     |

*Example of a treadmill protocol for return to work assessment in patients with ischemic heart disease using 3 min stages, starting at 3 mph, 0% grade (3 METS) and increasing the gradient by 5% each stage (2 MET increments every 3 min). 1MET values for a 70 kg (154 lb.) person are indicated in parentheses; see Table 3B for MET requirements for work loads at other body weights.
cesses may require echocardiography, radionuclide ventriculography or thallium scintigraphy performed at rest or with exercise. Exercise test protocols outlined in Tables 3A and B are well suited to occupational work evaluation. Detailed methods for exercise testing have been published (37-39).

2. ST segment response. The ECG ST segment response, in combination with the work load, reflects the extent and severity of myocardial ischemia in patients with ischemic heart disease. Marked ischemia at a low work load (e.g., ≥1 mm ST depression at a work load of ≤5 METs) portends a poor prognosis. Ischemia occurring at work loads between 5 and 7 METs places patients into a prognostic 'gray zone,' whereas attainment of a peak work load of ≥8 METs, even with ischemia, portends an excellent prognosis. The effect of ST segment response on occupational capacity should be judged on the basis of the work load at which abnormalities occur, duration of evolutionary changes after exercise and the physical work requirements of the specific occupational task.

ST segment depression is a nonspecific sign of functional imbalance in the subendocardium of the left ventricle. It may be physiologic when it occurs only at or beyond average normal maximal heart rate and systolic pressure, is not accompanied by chest pain, and resolves within a minute after such exertion. In the absence of conventional risk factors and other abnormal response to exercise, "ischemic" ST segment depression in asymptomatic men is frequently a falsely positive response.

ST segment depression is pathologic when it occurs at a low work load, heart rate and systolic pressure, is accompanied by chest pain and persists several minutes after exertion. Failure to elicit ischemic ST segment depression in patients with ischemic heart disease ("false negative" response) occurs when regional dyskinesia causes ST elevation and cancels ST segment depression or when exercise is terminated because of dyspnea and fatigue before attainment of the "ischemic threshold."

3. Arrhythmias. Ventricular arrhythmias cause occupational impairment through two mechanisms: 1) restriction from certain job tasks because of concern about public safety, and 2) symptoms that impair performance. Physical working capacity is usually more influenced by left ventricular dysfunction than by arrhythmias (40), which often coexist with left ventricular dysfunction.

Atrial and ventricular arrhythmias can also decrease working capacity due to their hemodynamic effects. High grade ventricular ectopic activity causing recurrent episodes of presyncope and syncope requires further evaluation and therapy. Uncontrolled atrial fibrillation and flutter diminish cardiac output by shortening diastolic filling and eliminating atrial contractile support of ventricular filling.

B. Thallium Perfusion Scintigraphy

Scintigraphic abnormalities may contribute insights into occupational or physiological impairment apart from their association with other exercise test variables.

1. Reversible perfusion. The number and severity of reversible perfusion defects, and the time to resolution of perfusion defects often reflect the extent and severity of myocardial ischemia (41). The influence of these findings on occupational working capacity must be judged on the basis of the work load at which the abnormalities occur and the physical work requirements of the specific occupational task.

The severity of reversible perfusion defects in combination with the work load correlates well with the extent and severity of coronary artery disease (42). The effect of these findings on prognosis and their response to medical and surgical therapy has not been well defined.

2. Fixed perfusion defects. Fixed defects associated with electrocardiographic Q waves usually reflect infarcted myocardium. Fixed defects without Q waves may reflect severely ischemic myocardium which is slow to reperfuse. In either case, fixed defects are usually associated with left
ventricular dysfunction. The influence of left ventricular dysfunction on physical working capacity may be reflected indirectly by reduction in peak treadmill workload or directly through a fall in left ventricular ejection fraction measured by radionuclide ventriculography.

C. Radionuclide Ventriculography

Radionuclide ventriculography performed at rest and during exercise may disclose abnormalities of left ventricular function which contribute insights into occupational or physiological impairment apart from their association with other exercise test variables.

1. Rest left ventricular ejection fraction. A moderately or severely diminished rest left ventricular ejection fraction of ≤40% may be associated with symptoms of exertion or at rest. However, rest left ventricular ejection fraction over a range of 20% to 50% correlates poorly with exercise capacity (43). Compensatory mechanisms include an augmented heart rate response to exercise, ventricular dilation and an increased tolerance to elevated pulmonary artery wedge pressure. Rest left ventricular ejection fraction alone is therefore a poor indication of occupational working capacity. However, left ventricular dysfunction portends a poor prognosis.

2. Exercise left ventricular ejection fraction. In general, an ejection fraction that fails to rise or falls with exercise usually represents myocardial ischemia (44). The influence of this response on occupational capacity is most closely related to the severity of the abnormality and the work load at which it occurs.

A low peak work load accompanied by a normal increase in ejection fraction usually indicates physical deconditioning. Exercise capacity in such individuals can usually be improved by exercise training.

3. Simulated work testing. Work simulation may be useful for evaluation of patients with moderate impairment of exercise capacity (<8 METs) or left ventricular dysfunction (<40%) who must perform work involving a large component of upper limb, isometric or resistive exercise. Work simulation tasks include repetitive lifting, carrying, stacking, shoveling, and so forth, using weights or equivalent loads within the range anticipated on the job. The ECG should be monitored continuously and blood pressure and rating of perceived exertion measured at frequent intervals. Several studies have reported heart rate, blood pressure and oxygen uptake during repetitive lifting and graded weight carrying in patients with cardiac disease (10). These measurements have also been obtained during shoveling and overhead work (simulating painting, plastering). Simulated work testing can provide precise physiological quantitation and direct observation of responses to anticipated job demands. Unfortunately, this form of evaluation has not been standardized, is more costly and is not widely available outside specialized exercise testing and cardiac rehabilitation centers.

4. On-the-job-monitoring. Monitoring of the cardiovascular responses to work tasks with use of ambulatory ECG or blood pressure devices may be helpful in patients with unusual job demands when uncertainty about individual patient response has not been resolved by conventional testing. Individuals whose jobs entail unusual physical, psychological or environmental stress, and who have exhibited signs or symptoms of cardiac dysfunction during symptom-limited exercise testing may be candidates for on-site testing. This approach may be impractical except for specially equipped evaluation or rehabilitation centers.

Recommendations

1. Patients with ischemic heart disease who are being considered for gainful employment should be evaluated to determine their functional capacity and degree of cardiac impairment.

2. Such evaluations should be directly supervised by a physician knowledgeable and experienced in cardiovascular evaluations at rest and during exercise in a facility appropriately equipped to conduct symptom-limited exercise testing with a motor driven treadmill or a stationary cycle ergometer.

3. Initial evaluation of occupational working capacity should be performed as soon as the patient becomes clinically stable: in general, within 5 weeks after uncomplicated myocardial infarction, 7 weeks after coronary artery bypass surgery or 1 week after coronary angioplasty. However, an inadequate work capacity at these times should not be equated with permanent cardiac impairment; exercise testing at 3 to 6 months is more definitive.

4. Evaluation should include a medical history and physical examination emphasizing the cardiopulmonary and vascular systems. In patients exhibiting signs or symptoms of significant cardiac dysfunction at rest, evaluation of functional capacity should be deferred until clinical status improves.

5. In patients free of clinically significant cardiac dysfunction at rest, impairment should be evaluated by symptom-limited exercise testing on a motor driven treadmill or cycle ergometer. A standard multistage protocol should be selected using 2 or 3 min stages to assure a steady state cardiovascular and metabolic response to each workload. Use of handrails for support during treadmill exercise must be minimized because this will result in a serious overestimation of exercise capacity. ECG and blood pressure should be recorded at least during each stage of exercise, at peak exercise and during at least 6 min of recovery. For testing of functional capacity, exercise tests should be conducted with patients on their usual medication regimen.
6. The primary objectives of the exercise test are to determine the functional capacity and identify abnormal responses to exercise. The physician should carefully document the onset of angina or angina-like symptoms, inappropriate shortness of breath, ECG abnormalities and abnormal blood pressure responses and their duration after exercise. A written report of the test results should also include the peak heart rate, systolic blood pressure and work load (METs) achieved, reason for stopping the test, and any ECG changes suggestive of ischemia, arrhythmias or conduction abnormalities and the heart rate and work load (METs) at their onset.

7. Patients with uninterpretable or equivocal exercise test responses should undergo further noninvasive testing to establish their safe working capacity. This may include exercise, thallium scintigraphy or radionuclide ventriculography or echocardiography performed at rest and during exercise. These tests may reveal the location and severity of reversible myocardial perfusion defects, regional wall motion abnormalities and impaired left ventricular function. Coronary arteriography may be required to better define the anatomic status and prognostic risk in occupations where sudden incapacitation due to cardiac arrest or myocardial infarction would place co-workers or the general public at risk.

8. In general, patients should demonstrate an exercise performance free of significant cardiac dysfunction that is at least twice the average energy requirement and 20% more than the expected peak energy requirement encountered on the job. Consideration also needs to be given to the higher cardiac demands of heavy resistance or isometric exercise, environmental factors (heat, cold, humidity, pollution and altitude) and psychological stress.

9. Job simulation may be useful for evaluation of patients with moderate impairment of exercise capacity (<8 METs) or left ventricular function (ejection fraction <40%) who must perform work involving a large component of upper extremity, isometric or resistive exercise. Work simulation tasks include repetitive lifting, carrying, stacking, shoveling, and the like, using weights or equivalent loads within the range anticipated on the job. The ECG should be monitored continuously and blood pressure and rating of perceived exertion measured at frequent intervals.

10. On-site evaluation of cardiovascular responses to occupational work may clarify the patient’s tolerance for work when symptoms supervene on-the-job despite a previously acceptable functional evaluation using standard laboratory techniques. Methods for on-site evaluation include ambulatory monitoring of the ECG for arrhythmias and ST segment response and ambulatory blood pressure monitoring. However, the current state of technology of these ambulatory monitoring techniques and the clinical utility of measurements made with them during occupational work are inadequate to recommend them for general clinical use.

11. Functional capacity can be significantly increased by exercise training. Patients with impaired functional capacity should be encouraged to undergo physical rehabilitation (and education) for a period of 12 weeks, followed by retesting.

References
Task Force III: Assessment of Psychological Status in Patients With Ischemic Heart Disease

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I. A Conceptual Framework for Assessment of Psychological Status in Patients With Ischemic Heart Disease

A multidimensional assessment considers the ability of patients with ischemic heart disease to function in a variety of key life areas and guides efforts to restore these patients to an optimal level of functioning (I).

This report is written from the perspective of the "biopsychosocial" model (2), which emphasizes the need to understand the patient in a psychosocial context. From this perspective all disease is considered to have psychological and social, as well as physical, aspects. The patient, the social and cultural environment, and the complementary system devised by society to meet the patient's needs—that is, the health care system—all influence the functional course of the disease.

II. The Physician-Patient Relation

The physician-patient relation has typically been one in which the patient adopts a sick role and the physician adopts...
a professional one. These roles are transmitted by the culture. For the patient, sick behavior extends beyond the primary symptoms to include a set of behaviors that develop secondary to the disease. For example, the attention and sympathy a patient receives may reinforce a pattern of illness behavior that may eventually be maintained independently of the disease itself.

Each role imposes certain responsibilities and obligations. The patient must be motivated to get well, seek help and accept the physician as acting in his or her best interest. In adopting these principles, the patient is often exempted from certain obligations and personal responsibilities. For example, the patient may not be required to return to work or to perform routine household duties. Moreover, the patient is frequently not held responsible for symptoms or behaviors that may result from the disease.

The physician is obligated to act in the patient’s best interests and to be ethically and morally responsible. As a result, physicians claim the privilege of having full access to patients’ private lives and may assume control of the relation with the patient, as well as authority over other health care providers (3). However, at times the physician may be placed in a conflict of interest situation, such as when patients demand disability when their medical status does not justify such action.

Chronic illness behavior represents a long-standing pattern of response characterized by complaints of pain or dysfunction that are disproportionate to objective medical evidence. Typical chronic illness behaviors include multiple somatic complaints, a constant search for diagnosis or more successful treatment, and behaviors designed to elicit attention from health care providers and family members. Although there may be an organic basis for some symptoms, the perception of the symptoms and the resultant behaviors are considered to be subject to the laws of learning. Behavior that is followed by a desirable experience and/or the discontinuation of a negative or aversive experience tends to be reinforced; that is, the consequences of behavior affect the likelihood of its recurrence. Typical social reinforcers include sympathy, attention and avoidance of embarrassment or pain. For example, a patient who develops chest pain during occupational work and relief of pain on stopping, associates the behavior (resting) with the diminution of pain. This increases the likelihood that such activities will not be performed. Social reinforcement, such as attention to and sympathy for pain behaviors (i.e., verbal complaints, grimacing or posturing), may also reinforce the pain behaviors. Furthermore, patients may avoid responsibilities that may be assumed by others, such as family members. This situation is often referred to as secondary gain—that is, the social advantages of being ill. Money is also a potent reinforcer; disability payments may reinforce the sick role, and, in some cases, discourage return to work. The sick role thus can become an ingrained style of behaving that is highly resistant to change.

The patient with cardiac disease is not a psychiatric patient. The patient who has experienced a significant change in health status now suffers from a physical condition that affects, and is affected by, his or her ability to function psychologically, socially and behaviorally. Most patients do not experience prolonged emotional distress after acute cardiac events; they do not need and do not seek traditional psychiatric treatment.

### III. Domains of Assessment

Psychological assessment should be incorporated into the medical evaluation of every patient who has suffered from an acute myocardial infarction. All physicians should be able to evaluate gross psychological functioning in such patients. Problem cases may require consultation by psychologists or psychiatrists specially trained in behavioral medicine. In some instances, the involvement of trained psychologists in cardiac rehabilitation settings has been mandated by state statutes (4).

Reviewing the psychosocial issues common to all patients with coronary heart disease helps the physician to identify a subset of patients in whom issues of insurability and disability have special relevance. These subsets include: 1) patients overly concerned about their disease; 2) patients medically eligible to return to work who are reluctant or refuse to do so; 3) patients with major psychiatric problems in which disability on a psychiatric basis; and 4) patients experiencing transient distress who could benefit from psychological treatment.

Identification of these patients requires that physicians be familiar with at least five broad areas of psychosocial functioning (Table 1). A more detailed discussion of psychological assessment of the patient who has had a myocardial infarction is presented in several recent reviews (1,5,6).

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**Table 1. Domains of Assessment**

<table>
<thead>
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<th>Domain of Assessment</th>
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<tbody>
<tr>
<td>Personality functioning and psychopathology</td>
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<td>Health-related behaviors</td>
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<td>- Self efficacy</td>
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<tr>
<td>- Pain</td>
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<tr>
<td>- Diet</td>
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<tr>
<td>- Physical activity</td>
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<tr>
<td>- Medication</td>
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<tr>
<td>- Health care utilization</td>
</tr>
<tr>
<td>Stress, hostility and type A behavior</td>
</tr>
<tr>
<td>Social and work adjustment</td>
</tr>
<tr>
<td>- Social support</td>
</tr>
<tr>
<td>- Marriage</td>
</tr>
<tr>
<td>- Sexual functioning</td>
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<td>- Work</td>
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</table>
A. Personality Functioning and Psychopathology

Emotional reactions almost always accompany a myocardial infarction. Indeed, Cassen and Hackett (7) have used the term "ego infarction" to describe the psychological impact of heart disease on the individual. In one study (8), 80% of patients in the coronary care unit had some signs of anxiety, 58% were depressed, 22% were hostile, and 16% were agitated. Anxiety is usually the first emotional reaction to a myocardial infarction. The content of anxious thought frequently focuses on fear of death, apprehension of further damage, concern with the significance of various somatic symptoms such as pain or dyspnea, and fear of being abandoned and isolated. Depression often follows and may persist for up to a year or longer. Many patients express fears of loss of income, sexual function, autonomy and physical abilities. Anger is common. Patients with heart disease often feel frustrated by restrictions placed on their activities and feel threatened by being placed in a dependent role in which they experience a lack of control.

When assessing emotional reactions, it is also important to evaluate how patients cope with their feelings. Patients who claim that they were never afraid or insist that there is nothing wrong with them are engaging in denial (the most common defense mechanism). In contrast, patients using "isolation of affect" are aware of having had a myocardial infarction but do not experience the natural feelings of anxiety or depression associated with the illness. Regression is seen less frequently, but may be a precursor of cardiac neurosis, a condition in which patients are extremely fearful about their physical integrity and adopt an overly passive and dependent sick role. These patients often become extremely debilitated; "secondary gain" (e.g., attention, sympathy, disability compensation, avoidance of adult responsibilities) may serve to perpetuate their maladaptive adjustment.

Successful coping has been shown to be associated with a better prognosis after a myocardial infarction. For example, several studies (9,10) have shown that cardiac patients who fail to adequately adjust to their illness while in the coronary care unit had higher mortality rates in the first 6 months after discharge from the hospital than those who were judged to be better adjusted.

Many instruments exist for measuring anxiety and depression. Self-rating forms are popular because they are brief, easily administered and scored, and relatively easy to interpret. The most common self-rating scales for depression are the Zung Self-Rating Depression Scale (11), the Center for Epidemiological Studies—Depression Scale (12) and the Beck Depression Inventory (13). Comparable self-report measures for assessing anxiety include the Taylor Manifest Anxiety Scale (14), Spielberger State-Trait Anxiety Questionnaire (15) and the Zung Self-Rating Anxiety Scale (16). A screening questionnaire developed by Taylor (5) may be particularly useful for the physician. However, these self-rating forms have a number of limitations; they are subject to distortion and response bias (e.g., denial), and they should not be relied on exclusively for diagnostic purposes.

Several self-report measures have been constructed to incorporate test-taking attitude. The best known multiple-scale inventory is the Minnesota Multiphasic Personality Inventory (17). This test is a 566 item true/false questionnaire that yields four validity scales, ten clinical scales, and a variety of experimental scales, including measures of anxiety, hostility, and ego strength. However, the test may be less appropriate in medical than in psychiatric settings, and consequently should only be used when the presence of psychopathology is strongly suspected.

The reported incidence of psychiatric disturbance after acute myocardial infarction ranges from 15% to 88%. This wide variability reflects differences in patient selection, premorbis adjustment, timing and duration of the assessment, perceived purpose of the assessment and choice of assessment instruments. In general, it appears that psychiatric disturbance persists in only a minority of patients after a myocardial infarction. For example, <15% of patients suffer from moderate to severe depression and anxiety (18). Depressive symptoms tend to be more biologic (e.g., sleep disturbance, excessive fatigue, decreased libido, change in appetite, and so forth) than psychological, although the physician should be alert to the presence of crying spells, feelings of hopelessness and despair and, in rare occasions, suicidal ideation.

The most common cause of emotional distress is the myocardial infarction itself. However, persistent depression is frequently a result of more long-standing emotional problems; patients with a history of recurrent depressions are most likely to suffer from depression after a myocardial infarction. A second common cause, frequently overlooked, is cardiac medication. For example, recent studies have associated beta-blocker therapy with increased prevalence of depression (19), although the extent to which the use of beta-blockers is associated with depression and other behavioral deficits is still open to empirical investigation (20).

B. Neuropsychological Functioning

Screening for cognitive impairment in cardiac patients is often appropriate. Memory loss, reduced concentration and attention and, less frequently, aphasic signs (e.g., difficulty in remembering a particular word, sensory loss, decreased fine motor control or inability to perform simple arithmetic tasks) are frequently observed after cardiac surgery (10,21,22). Cognitive dysfunction may significantly influence patient's medical management. For example, patients who are unable to comprehend or remember specific instructions may be noncompliant to complex drug regimens.
A number of standardized instruments may aid the clinician in evaluating the presence and extent of cognitive impairment. The Mini-Mental State examination (23), for example, consists of only 11 questions and requires <10 min to administer. The items measure orientation, attention, verbal recall, arithmetic skills, language function and visual-motor integration.

More sophisticated instruments require a psychologist for administration, scoring and test-interpretation. For example, the Russell Revised Wechsler Memory Scale (24) is a brief, easily administered test of memory function that yields objective scores of short- and long-term verbal (paragraph recall) and visual (reproduction of geometric designs) memory. The Halstead-Reitan Aphasia Screening Test (25) used by psychologists is an inexpensive, reliable, and rapidly administered instrument that assesses receptive and expressive language, simple arithmetic skills, and psychomotor function.

Because normative data on older, medically ill patients are frequently unavailable, it is often difficult for many clinicians to determine the clinical significance of the test scores. However, standardized assessment can provide a baseline for future comparisons.

C. Health-Related Behavior

Assessment of health behaviors is of primary concern for the physician. Review of cardiovascular risk factors—smoking, hypercholesterolemia and hypertension, as well as dietary habits, alcohol consumption, and medication use—should have a high priority. There are also a broad range of health-related issues that are relevant to the postinfarction patient that should be covered in the assessment.

1. Perceived health status. The patient’s perception of his or her own health is important for several reasons. Perceived health is closely correlated with general morale or life satisfaction. Moreover, perceived health is related to the likelihood of the patient’s seeking further medical care. A simple four-point rating scale (excellent, good, fair and poor) not only agrees with physicians’ ratings but excels physicians’ ratings in predicting patients’ future ratings (26). Finally, self-ratings of health can be predictive of adjustment to illness. For example, health ratings have been found to predict morale after heart surgery (27), return to work (28), and adherence to exercise therapy (29).

2. Self-efficacy. Self-efficacy refers to patients’ perceived self-confidence in their ability to perform a specific set of activities. The self-efficacy construct has been applied to a wide range of health behaviors including return to work, morale and functional capacity (30).

3. Pain. Behavioral diaries, popular in medical settings, may be especially useful in assessing symptoms in patients with ischemic heart disease. Requesting that patients keep records of the frequency and duration of pain episodes and indicate precipitating factors (e.g., physical exertion or emotional stress) and relieving factors (e.g., rest or nitroglycerin) can provide the clinician with important information. Patients’ retrospective accounts of their pain are less reliable and less accurate than are concurrent pain ratings (31).

Standard psychometric instruments also may be useful. For example, the McGill Pain Questionnaire (32) can be used to assess verbal descriptions of pain. This is a 102-adjective checklist divided into 20 categories that describe three major dimensions of pain: sensory, affective and evaluative. It yields measures of pain quality and intensity.

4. Diet. Most patients recovering from myocardial infarction are asked to modify their diets by restricting consumption of animal fats and foods high in cholesterol. A variety of standard measures for assessing dietary habits are available. Alcohol consumption is also relevant, not only as an independent risk factor but through its association with cigarette smoking.

5. Physical activity. It is estimated that 40% of patients report that they are less active 6 months after an acute myocardial infarction. Psychological factors such as ratings of perceived self-efficacy are often more predictive of physical activity during this interval than is peak treadmill work load measured within 3 weeks of the acute infarction (30).

Several activities of daily living questionnaires may be useful for the more impaired patient. These assess the degree and type of help required by the patient in coping with the daily demands of living, including eating, dressing, grooming, shopping, cooking, doing housework, taking appropriate medicine and handling financial matters. Several standardized instruments are available including the OARS MFAQ (33) and the Instrumental Activities of Daily Living scale (34).

6. Medication. Most patients are required to take medication after an acute myocardial infarction. The potential side effects of medications and the ability of the patient to adhere to the pharmacologic regimen should be carefully monitored. An excellent discussion of the problems of noncompliance with prescribed medications is presented elsewhere (35).

7. Health care utilization. Patients’ patterns of health care utilization provide important insights into their recovery from acute myocardial infarction. All patients become sensitized to their physical health and many may become preoccupied with it, overreacting to physical sensations. Patients who are overly concerned about their condition may engage in a variety of maladaptive behaviors, including “doctor shopping,” frequent trips to the emergency room and solicitation of information and advice from various sources (family, friends, other medical staff, and so forth). These patients often present management problems, because they tend to be demanding and never seem to receive the reassurance they need. Their behavior is often self-
defeating: patients may get conflicting messages that serve to heighten their anxiety, or they may alienate the physician and thus frustrate their dependency needs. At the other extreme, “deniers” avoid medical contact and do not advise the physician of symptoms or changes in health status. Failing to communicate information may increase these patients’ risk for reinfarction and death.

D. Stress, Hostility and Type A Behavior

Although the association of stress and type A behavior to new and recurrent ischemic heart disease events is controversial, most patients believe that stress is a major factor contributing to their myocardial infarction. Although it is difficult to arrive at a consensus about how stress is defined, most patients “know it when they see it.” Stress is generally conceptualized as excessive environmental demands combined with inadequate coping resources yielding the presence of emotional distress or characteristic patterns of maladaptive behaviors, or both.

The type A behavior pattern is considered a risk factor for coronary heart disease (36). Type A individuals are hard-driving, competitive, aggressive and impatient. Type B individuals, on the other hand, are more relaxed and easy-going. In the Western Collaborative Group Study, type A individuals were twice as likely to develop coronary heart disease as were their type B counterparts (37). Type A patients were also more prone to recurrent infarction and sudden cardiac death. However, recent data have failed to show a significant relation between type A and coronary heart disease in patients at risk for myocardial infarction (38) or in patients with a prior myocardial infarction (39,40). Moreover, follow-up data from the Western Collaborative Group Study revealed that type A was associated with reduced survival but rather with increased survival in postinfarction patients (41). In contrast, data from 321 male survivors who were stratified as being at high or low risk on the basis of historical and clinical characteristics indicated that the low risk type A patients had significantly more cardiac events than did low risk type B patients (42). In addition, data from the Recurrent Prevention Project indicate that type A behavior is a significant predictor of sudden cardiac death (43) and that reductions in such behavior among patients with good cardiac function are associated with a reduced risk of fatal and nonfatal coronary events (44). A recent meta-analysis (45) suggested that type A behavior is a better predictor of initial coronary heart disease events in population-based studies. Moreover, one component of type A behavior—hostility—appears to be especially pathogenic (46-48).

Classification of individuals as having a type A or type B personality is usually determined by a clinical judgment based on a structured interview (49). The questions are designed to elicit a particular style of response that is often displayed by type A individuals, as well as to acquire information regarding the individual’s typical behavior based on self-reported attitudes and practices. Expressive speech style, particularly loud and rapid speech, frequent interruptions and the potential for hostility appear to be most strongly correlated with type A interview ratings (50).

Although the interview method is widely recognized as the most valid measure of type A behavior, it requires training for administration and classification, and it has been criticized for being too global and subjective. As a result, more objective paper-and-pencil questionnaires to assess type A characteristics have been developed.

The Jenkins Activity Survey for Health Prediction is the most widely used self-report measure of type A behavior (51). It yields an overall type A score and three-factor analytically derived subscales: “speed and impatience,” “job involvement” and “hard-driving and competitive” (52). Scores on the type A scale of the Jenkins Activity Survey have been shown to be both prospectively and retrospectively correlated with increased risk of primary and secondary coronary heart disease events, although its predictive value for myocardial infarction appears to be weaker than that of the structured interview (36). However, the Jenkins Activity Survey also has several shortcomings: it is relatively expensive to administer and score by computer, it requires up to 25 min to score by hand, and the type A scale has a relatively low correlation with the structured interview and with risk of coronary heart disease. As a result, too many patients may be misclassified by the Jenkins Activity Survey, if the structured interview is considered the reference standard. Other self-report measures have been developed (33,54), although their clinical efficacy has not been well established.

E. Social and Work Adjustment

1. Social support. Social support may be defined as the availability of people on whom the patient can rely, or of people who make the patient feel valued, loved and cared about. A number of studies indicate that good social support mitigates the effects of stress on illness (55). For example, Berkman and Syme (56) found that people who lacked social and community ties were more than twice as likely to die in the next 9 years than were those with more extensive contacts. Among coronary patients classified as type A, Blumenthal and colleagues (57) found a significantly lower mortality rate in those reporting high levels of social support than among those with low levels of social support.

The Social Support Questionnaire (58) is a promising method for quantifying social support. It is a 27-item questionnaire that requires respondents to list the people on whom they can rely in a given situation and to indicate how satisfied they are with these social supports. An abbreviated 12-item questionnaire that is easier to administer, complete and score also has been recently developed, and it may prove to be a useful screening instrument (57).
2. Marriage. Heart disease affects the spouse as well as the patient, and it has been suggested that, whereas the patient may recover, the spouse may not (59). Spouses of patients often display anxiety and depression, but are seldom included in treatment planning. Therefore, the spouse should always be included in the assessment procedure. Several self-report measures of global marital satisfaction can be used to assess marital adjustment (60,61).

Conflicts over compliance with prescribed medical treatment are common, even in "healthy" marriages. For example, it has been reported that 6 to 9 months after a myocardial infarction, emotional problems are present in three-quarters of all families studied as a result of "differences over medical instruction" (62). Therefore, it is important that patient and spouse be clear about the instructions and aware of which behaviors are and are not permitted.

3. Sexual functioning. Problems in sexual functioning are common in postinfarction patients and their spouses. The level of sexual activity reported 1 year after a myocardial infarction is about 60% of the level before illness, and fewer than half of the postinfarction patients resume the same frequency of sexual intercourse as before the infarct. Patients attribute their decreased sexual activity to a loss of interest, spousal reluctance, depression and anxiety. Unfortunately, patients and physicians tend to be uncomfortable when discussing sexual matters; as a result, this area tends to be ignored. All too often, advice on sexual activity either is not given or is presented in terms so global (e.g., "just take it easy") that it is useless to most patients. Indeed, less information is given to patients with heart disease about sexual activity than about other activities, such as work, physical exertion or diet. Curiously, data suggest that whereas physicians report that they do counsel their patients about sexuality, most patients report that they receive no such counseling. Most patients would like to know more about how their condition affects their sex life; excellent materials providing such information are available (63). Postinfarction sexual dysfunction also may be caused by medications. Among patients taking propranolol, Taylor et al. (5) reported impotence in 15%, decreased potency in 28% and decreased libido in 40%. Concurrent medical problems, the presence of high levels of anxiety or depression and marital problems can also impair sexual performance.

4. Work. Most patients who have a myocardial infarction return to work within the first 6 months after the infarction. Nevertheless, approximately 2.65 million disabled workers and 1.25 million dependents are receiving Social Security disability payments at an annual cost of $17 billion (64). One-fourth to one-third of this total is due to coronary heart disease (65). Millions of other patients with heart disease elect early retirement or receive other disability benefits (66).

Many studies (67–70) have investigated the medical and psychosocial factors associated with failure to return to work after an acute myocardial infarction. Severity of infarction, socio-demographic factors, financial considerations, job satisfaction, physical demands, perceived health and various indexes of mental health, especially depression, have been linked to return to work. One recent study (71) showed social, medical and psychological factors to be independent predictors of return to work. Educational level, depression and hypochondriasis, and disease severity were especially important. Similarly, educational level and physical activity associated with employment correctly classified 71% of patients who returned to work. However, return to work proved to be easier to predict than work disability, as this needs to be the subject of future research (72). Although acute myocardial infarction is often attributed to job stress, the relation between occupational stress and ischemic heart disease is difficult to document (73,74).

IV. Treatment Considerations

Behavioral therapies offer considerable benefit to many patients recovering from acute myocardial infarction (75–77). Most cardiac rehabilitation programs emphasize smoking cessation, dietary modification, exercise and some form of stress management or type A modification. Although smoking cessation appears to reduce the risk of recurrent myocardial infarction by 50%, there are no randomized controlled trials of smoking cessation in postinfarction patients. In addition, studies of dietary modification have generally been inconclusive (78). The role of exercise in secondary prevention also remains controversial. For example, the National Exercise and Heart Disease Project (79) randomized 651 men who had had a myocardial infarction to an exercise or nonexercise regimen and followed them up after 3 years. Results indicated that the cumulative mortality rate was 7.5% in the control group and 4.6% in the exercise group (p = NS). These data are generally comparable with data obtained in Canada and Europe (80–83). In a review by May et al. (84), five of six studies conducted in the past 10 years showed an advantage for the exercise group, and pooling data resulted in a 19% reduction for the exercise group. Similarly, in a recent meta analysis performed by Oldridge et al. (85), exercising subjects were found to have a significant 25% lower fatal event rate than that of nonexercisers, although there was no difference in the rates of nonfatal infarction. Evidence is lacking that exercise improves psychosocial functioning in postinfarction patients (86). Consequently, reliance on purely medical therapies to treat emotional disturbance is not likely to be effective.

Psychological therapies also have been shown to improve quality of life, and may also promote greater longevity and reduced rates of fatal and nonfatal recurrence of acute myocardial infarction (75–77). In one randomized controlled trial, 453 men with a prior infarction underwent stress monitoring monthly for 1 year (87). Brief, individualized stress management was provided to patients who felt
stressed. The treated group experienced a greater decline in stress scores and had significantly fewer cardiac deaths than did the control group.

In the largest clinical trial of psychological therapies to date (88), 862 postinfarction patients were randomized to a group that received either routine cardiologic counseling and type A modification or routine cardiologic counseling alone. At 3 year follow-up (89), statistically significant reductions in type A behavior were observed in 43.8% of those referred to type A modification, compared with a 25.2% reduction in the control group. Moreover, the myocardial infarction recurrence rate was 44% lower in the treatment group than in the control group (7% versus 13%, respectively). A 4.5 year report has shown that subjects in the treatment group who had a prior myocardial infarction but had good cardiac function (determined by the Peel index) also experienced a significant reduction in coronary heart disease mortality (90). Thus, clinical trials indicate that recurrent coronary heart disease events can be reduced by 40% to 50% with stress management treatment.

V. When to Refer

Although disruption of emotional and psychosocial functioning is almost universal after acute myocardial infarction, the incidence of major psychiatric disturbance requiring treatment is <15%. For example, most depressions tend to be self-limited and require little more than support and reassurance. The primary care physician is responsible for the identification and initial evaluation of psychosocial problems. More comprehensive assessment of behavioral and psychological functioning in the postinfarction patient is best achieved by a trained clinician, preferably a psychologist or psychiatrist. Formal counseling should be recommended to patients who experience persistent anxiety or depression. Pharmacologic intervention should be considered for patients who do not respond to brief psychotherapy. In addition, because successful rehabilitation of the cardiac patient almost always involves significant changes in lifestyle habits including smoking cessation, dietary modification, exercise and stress management, it is important to consider referring patients to appropriate behavioral specialists who may assist in modifying those health-damaging habits. Finally, the problem of noncompliance with prescribed medical therapies should not be underestimated in these patients, and those at risk for noncompliance should be carefully monitored by the physician and referred to a trained clinician if necessary.

Conclusions

1. Psychosocial assessment of patients with ischemic heart disease should cover at least five broad domains of psychological functioning:

- personality and psychopathology (including anxiety and depression);
- neuropsychological functioning (including memory, concentration and attention);
- health behaviors (including perceived health, self-efficacy, and motivation to change lifestyle habits, including smoking, diet, alcohol consumption and drug use, pain behavior and health care utilization);
- stress, coping and type A behavior;
- social and work adjustment (including social support, sexual functioning, marital satisfaction and work stress).

2. Physicians caring for patients with ischemic heart disease should assess each of these periodically as part of their usual medical exam and refer patients to psychologists or psychiatrists for further assessment and treatment as necessary.

3. Psychotropic drugs should be considered for patients not responding to brief psychotherapy who have no medical contraindications for the use of these agents.

4. Most patients with ischemic heart disease have cardiovascular risk factors requiring significant lifestyle changes. Physicians should provide specific and concrete guidelines for behavior change or refer patients to programs designed to facilitate and maintain such changes.

5. Adherence to medical regimens and risk factor change programs should be systematically monitored on an ongoing basis. Patients failing to maintain behavior change in these areas should be referred to psychologists or psychiatrists as appropriate.

6. To avoid needless delays in return to work after acute myocardial infarction, patients should be given explicit instructions about when they can return to work.

7. Patients with ischemic heart disease who are medically eligible to work but who are reluctant to do so should be encouraged by the physician to work, be monitored carefully during the early trial work period and undergo a thorough psychosocial evaluation by a psychologist or psychiatrist.

8. Psychological problems, including perceived stress at work, rarely justify a physician's recommendation that the patient not return to work, although other employment options should be explored.

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EXECUTIVE SUMMARY

Determination of Cardiac Impairment and Disability

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The conference recommendations fell into three categories: 1) guidelines for the determination of cardiac impairment, 2) future directions of research in the determination of cardiac impairment, and 3) proposed administrative guidelines for the determination of disability by agencies and organizations.

I. Guidelines for the Determination of Cardiac Impairment

The quality of administrative determinations of cardiac disability by administrators reflects the quality of the medical determination of cardiac impairment by physicians. The two chief determinants of cardiac impairment are prognosis, or the likelihood of future cardiac events, and functional capacity, or the capacity to withstand the physical, environmental and psychological demands of occupational work.

Evaluation of prognosis. The capacity of individuals with ischemic heart disease to perform gainful work is often equated with physical working capacity. However, it is the prognosis, the risk of subsequent cardiac events, that most strongly influences the response to ischemic heart disease of patients and physicians alike. The issues of prognosis and functional capacity have often been regarded by physicians as separate and distinct. However, the experience of the past decade has made clear that these issues reflect the same pathophysiologic mechanisms, i.e., the extent of left ventricular dysfunction and the extent of myocardial ischemia. Moreover, similar approaches and methodologies are used to evaluate left ventricular dysfunction and myocardial ischemia on which prognosis and functional capacity rest.

Evaluation of prognosis, the cornerstone of management of ischemic heart disease, encompasses clinical evaluation, noninvasive testing and coronary arteriography. Prognostic evaluation in most cases is accomplished by a combination of clinical evaluation and noninvasive testing. Both prognosis and functional capacity are elucidated by standard laboratory exercise testing performed with or without radionuclide ventriculography or thallium scintigraphy. When these evaluations reveal no evidence of adverse prognostic factors, i.e., significant left ventricular dysfunction or myocardial ischemia, patients can be advised to resume their customary vocational activities. Patients with occupations posing a risk to the public may require cardiac catheterization and coronary angiography depending on regulations or recommendations.

Evaluation of functional capacity. Determination of functional capacity elucidates the capability of an individual to perform the specific tasks of the job. In most cases, this is accomplished by clinical evaluation and standardized laboratory exercise testing. More extensive evaluation may be warranted in patients whose job tasks consist of substantial arm, combined arm and leg, static or heavy resistance exercise. Work stimulation testing in the laboratory may be helpful, especially in patients whose symptom-limited or sign-limited exercise capacity on a treadmill or cycle ergometer is <8 METs. Sudden or sustained physical effort, exposure to extremes of temperature or to hypoxia, hypercarbia, carbon monoxide or stimuli-producing sudden bursts of autonomic activity are difficult to stimulate in the laboratory. Individuals such as firefighters whose jobs entail such circumstances may require on-the-job recording of the electrocardiogram or blood pressure or both.

Assessing psychological factors. Tolerance for the psychological stressors encountered in occupational work is of concern to patients with ischemic heart disease and the physicians caring for them. However, despite the perceived stress of occupational work, the rate of cardiac events is no greater on than off the job. Moreover, the ability of the heart to withstand psychological stressors reflects the same factors underlying prognosis, namely myocardial ischemia and left ventricular dysfunction. If the standard evaluation of prognosis is favorable, patients with ischemic heart disease should be encouraged to resume their occupational activities. Therefore, “psychological problems,” including perceived stress at work, rarely justify a physician’s recommendation that patients not return to work after acute ischemic heart disease events. Treatment of severe psychological dysfunction, i.e., anxiety and depression, is similar to that provided to patients without ischemic heart disease.

II. Research Objectives

Although considerable research has been carried out in the assessment and enhancement of prognosis, functional capacity and psychological status in patients with ischemic heart disease, relatively few attempts have been made to integrate and focus this information on issues of insurability and employability. Whereas many aspects of recovery from acute cardiac events, such as early ambulation and discharge
from hospital, have been informed by the results of controlled trials, other aspects, including return to work, have received much less attention. Much of the research into issues of insurability and employability was carried out before the availability of advanced methods to characterize left ventricular function and myocardial ischemia during laboratory evaluation and on-the-job monitoring. Moreover, few studies have included large numbers of subjects and most suffer from selection bias. The research agenda that has evolved from discussions within this conference addresses the following needs:

1. To develop optimal methods for characterizing the metabolic and cardiac responses to the physical, psychological and environmental demands of various job tasks. This encompasses two major areas:
   A. Laboratory evaluation. The major objective is to characterize the peak cardiovascular response to symptom-limited exercise with treadmill or cycle ergometry, i.e., the peak work load, heart rate and blood pressure, the extent of ischemic abnormalities and the nature of limiting symptoms. This evaluation, which elucidates not only the prognosis but the functional capacity, provides useful insights into the type of work tasks that can be safely undertaken. The following issues require further clarification: 1) What jobs require more extensive evaluation with rest and exercise radionuclide ventriculography, exercise thallium scintigraphy, coronary arteriography or other methods? 2) To what extent are other forms of physical effort, i.e., static effort, combined static and dynamic effort and upper extremity dynamic effort indicated in the laboratory evaluation of the capacity to perform specific job tasks? 3) To what extent is the simulation of physical, environmental and psychological stressors helpful in evaluating the capacity for specific job tasks? 4) What are the medical, occupational, psychological and economic outcomes of patients who have undergone laboratory evaluation designed to provide clearance to return to work after acute cardiac events?
   B. On the job evaluation. A new generation of portable devices for recording ambulatory heart rate, blood pressure and the electrocardiogram and automated methods for data reduction have largely overcome the technical inadequacies of previous devices and systems. These enable elucidation of the following issues: 1) To what extent does the prevalence and severity of ischemic and arrhythmic abnormalities recorded during habitual vocational and avocational activities differ from those recorded during the laboratory evaluations described above? 2) What are the medical, occupational, psychological and economic outcomes of patients who have undergone on-the-job monitoring designed to provide clearance to return to work after acute cardiac events?

2. To evaluate the appropriateness of criteria and methods used by public and private agencies to establish medical impairment. Among patients with ischemic heart disease, how do those classified by standardized criteria, e.g., Social Security listings, as medically impaired compare with those classified as nonimpaired, with respect to medical outcomes such as the extent of limitation by symptoms, and the incidence of new cardiac events including death.

3. To evaluate how demographic/cultural, psychological, economic and other factors cardiac symptoms and medical advice result in cardiac disability. Specifically, it is important to elucidate factors resulting in disability in the absence of well-documented cardiac impairment.

4. To evaluate the incidence of actual or potential cardiac incapacitation in individuals engaged in occupations which pose a risk to the public. Among individuals with and without manifest ischemic heart disease, what is the incidence of such events during working and off-work hours?

5. To reclassify the peak and average energy requirements of physical tasks actually encountered in the contemporary job market as a guide to work assignment of patients with ischemic heart disease.

6. To disseminate information about prognosis after acute cardiac events to allay physicians' apprehensions about recommending return to work.

7. To develop and validate methods to measure the effect of psychological factors on myocardial ischemia. Standardized assessment methods are needed for both the psychophysiological laboratory setting and the natural environment.

8. To evaluate the unique concerns of female patients with ischemic heart disease in regard to psychosocial adjustment.

III. New Administrative Guidelines for the Determination of Disability by Agencies and Organizations

1. Uniform policy recommendations for the performance of cardiac catheterization as a condition of reemployment need to be developed.

2. Policies supporting a trial work period should be developed that do not jeopardize an individual's future eligibility for disability support if the job cannot be performed adequately from a prognostic or functional perspective.

3. Psychological assessment should be incorporated routinely into the medical assessment of patients with ischemic heart disease. This service should be reimbursed and physicians should receive specialized training to ensure competence in this assessment. Mental health workers need to be educated about the unique concerns of patients with ischemic heart disease—and trained in specific techniques for treatment of patients with ischemic heart disease.

4. The assessment of medical impairment by physicians lacks uniformity. Administrative guidelines for the determination of disability by agencies and organizations also lack uniformity. Further efforts are required by private and public institutions to standardize and streamline the procedures for determination of medical impairment and disability.