

CHAPTER 1

DEVELOPMENT OF THE BEST PRACTICE GUIDELINES

Introduction

Best practice concerns outcomes, processes and structures. The achievement of better health outcomes requires effective and efficient processes for delivering health care services, as well as appropriate organisational structures. Whereas minimal standards provide recommendations for the basic requirements of a service, best practice guidelines provide recommendations for optimal standards. They aim to achieve better health outcomes by contributing to the education of health professionals and improving their practices. Best practice guidelines also identify benchmarks for providing optimal health services, thus contributing to quality assurance. Implicit in the concept of best practice is the requirement that the recommended practices should be cost effective.

Traditionally, guidelines have been based upon a consensus of expert opinion. However, expert opinion does not always reflect the current state of medical knowledge. According to the Australian National Health and Medical Research Council (NH&MRC), guideline recommendations should be evidence based, that is, they should be derived from a systematic identification and synthesis of the best available scientific evidence. While these Best Practice Guidelines for Cardiac Rehabilitation and Secondary Prevention are largely based upon scientific evidence, they also reflect expert opinion and consumer input, especially in areas where little or no scientific evidence exists.

The Best Practice Guidelines have been produced for ambulatory cardiac rehabilitation and secondary prevention programs conducted during early convalescence after hospital discharge (hereafter referred to as ambulatory cardiac rehabilitation programs). They apply to any hospital catering for cardiac patients, as well as to community health centres or similar venues where programs may be conducted.

These Guidelines provide the basis for recommending low cost, low technology, multifactorial programs of exercise, education and support, conducted by trained health care providers, whether working with or without close medical support, as recommended in the Report of the World Health Organisation (WHO) Expert Committee on Rehabilitation after Cardiovascular Diseases¹.

The reviewed scientific evidence and authoritative opinions contained within these Best Practice Guidelines are consistent with the recommendations of the above WHO Report¹, which support the types of programs most widely available in Australia and in several other countries. While commissioned by the Victorian Department of Human Services, the recommendations of the Best Practice Guidelines should apply throughout Australia. Further, they should generally apply to any country or community throughout the world.

The recommendations concerning the benefits of cardiac rehabilitation contained in the Clinical Practice Guideline No 17: Cardiac Rehabilitation, published by the United States Department of Health and Human Services through the Agency for Health Care Policy and Research (AHCPR)² are endorsed. However, many of the recommendations contained in these Best Practice Guidelines regarding the implementation of programs are very different from current practices in the United States of America. The Best Practice Guidelines present scientific evidence to support simpler, less costly programs involving less supervision, testing and technology than those still advocated and offered in the United States of America. Such low cost programs can be readily implemented anywhere.

Widespread availability of such programs is becoming increasingly important. In eastern European countries, there is already an epidemic of cardiovascular disease. It is now appearing in developing and transitional countries. The increasing burden of disability from this non-communicable disease in an ageing population can be ameliorated by providing suitable, low cost rehabilitation programs directed towards secondary prevention. These health issues facing all countries have been highlighted in the 1997 WHO World Health Report³ and the publication entitled Global Burden of Disease, produced in 1996 by WHO, the World Bank and Harvard School of Public Health⁴. They are further discussed in Chapter 4.

Terms of reference

The Cancer and Heart Offensive was initiated by the Victorian Government in 1993 to strengthen and co-ordinate efforts to reduce the incidence and impact of cancer and heart disease. An important goal of the Offensive was to identify key issues for action and to enhance current service delivery through the fostering of best practice and improved linkages between services. These Best Practice Guidelines for Cardiac Rehabilitation and Secondary Prevention were produced as part of the Victorian Cancer and Heart Offensive. The terms of reference for this project were as follows:

To develop effective models and best practice guidelines for quality and cost effective cardiac rehabilitation and secondary prevention programs for Australia, particularly Victoria, across a range of sectors, which will be of practical value to service planners and staff working in programs and provide an important basis for informed purchasing of health services.

Production of the Guidelines involved a review of the scientific literature, previous guidelines, policy statements and other publications. A Consultative Committee of experts in the field was established to assist in the development of the Guidelines. In addition, input from health care providers was obtained from a statewide survey of current services⁵ and from focus groups⁶. Finally, a pilot study was carried out to compare outcomes of patients attending four different model programs and to explore their attitudes towards cardiac rehabilitation⁷.

Clinical Practice Guideline of the United States Agency for Health Care Policy and Research

In Chapter 5, recent guidelines and policy statements are summarised. The only comprehensive scientific review to date remains the AHCPR Clinical Practice Guideline^{2*}. This scientific review merits considerable credit. The Panel which produced the AHCPR Clinical Practice Guideline researched and reviewed the available literature regarding each of the major aspects of cardiac rehabilitation. It mainly concentrated on the benefits of exercise, strongly endorsing those benefits. It further endorsed the benefits of patient education, counselling and behavioural interventions. The Clinical Practice Guideline also addressed some organisational issues. The Panel concluded that the substantial benefits of formal comprehensive ambulatory cardiac rehabilitation programs included:

- improvement in exercise tolerance
- improvement in symptoms
- improvement in blood lipid levels
- reduction in cigarette smoking
- improvement in psychosocial well being and reduction of stress
- reduction in mortality.

Development of the Best Practice Guidelines

In producing these present Best Practice Guidelines, each of the recommendations of the AHCPR Clinical Practice Guideline has been reviewed in the light of the 334 references cited by the Panel. The Best Practice Guidelines do not attempt to repeat a review of the contents of each of those references. However, many references cited in the Best Practice Guidelines are the same as those included in the AHCPR Guideline.

The Heart Research Centre decided that it was unnecessary to repeat a scientific literature review as extensive as that undertaken for the AHCPR Clinical Practice Guideline. Further, to do so would be contrary to the recommended procedures for producing guidelines laid down by the NH&MRC, which stated that if the same work had been undertaken by others, it should not be repeated⁸. Nevertheless, it was necessary to undertake a careful review of the literature in several areas which were

**Single copies of the Clinical Practice Guideline may be purchased from the Government Printing Office, Superintendent of Documents, Washington DC. 20402 USA*

addressed only briefly in, or omitted from, the AHCPR Clinical Practice Guideline. These areas include the following:

- the nature and amount of exercise
- the nature and amount of prior testing
- the nature and amount of monitoring
- the content and structure of education and counselling group programs
- the impact of education and counselling upon knowledge
- programs for special groups
- team roles and program co-ordination
- organisational issues, such as referral procedures
- program evaluation
- relative costs and cost benefits related to outcomes

The data sources used for the review for these Best Practice Guidelines were Medline, Psychlit, Cinahl, Eric and other publications not indexed in these databases.

All the recommendations of the AHCPR Clinical Practice Guideline are referred to in the following chapters. However, these Best Practice Guidelines include recommendations which differ slightly from those of the Clinical Practice Guideline of the AHCPR because additional evidence, much of it unavailable in 1995, has been considered which has changed some strength of evidence ratings.

Comment

The AHCPR Clinical Practice Guideline concentrated upon the benefits of exercise training in patients with cardiovascular disease, largely because it is in this area that there has been much research. Thus, clearly defined physical outcome differences are apparent in clinical trials. The degree of exercise conducted in a class can be finitely measured, because it has been carefully prescribed. The interpretations of outcomes from educational, psychological and behavioural interventions in cardiac rehabilitation are more difficult because their ingredients are hard to define. Further, outcomes in these areas are difficult to quantify. Human variability in many parameters makes the formation of clear conclusions difficult. Hence, clear recommendations concerning best practice in these areas are difficult to make. It is in such areas that evidence for benefit is insecure, as reported in the scientific literature. However, the balance of evidence and expert opinion from many sources is quite definite about the benefits of educational, psychological and behavioural interventions. Further, such interventions are generally within the framework of explanation, reassurance and support which is considered to be the right of all patients, facilitating recovery, promoting understanding of illness, allaying anxiety and minimising possible disability. Information, explanation and support are provided to help patients accommodate to the illness or, more importantly, to lead to changes in behaviours to prevent the occurrence of further events. Thus, although the

body of evidence concerning the benefits of exercise training by any rating is greater than the amount of evidence for the benefit from education, counselling and behavioural interventions, the strength of opinion regarding the need for supportive interventions is as great as the endorsement of exercise programs. Most past research concerning exercise has been undertaken into relatively high intensity exercise. The intensity of exercise is now being questioned, even in those places where it has been most strongly supported. Such questioning applies to physical activity levels both for the population at large and prescribed exercise training for cardiac patients.

Evidence from meta-analyses

The Panel for the AHCPR Clinical Practice Guideline² recognised difficulties in using data from meta-analyses to support recommended practice because of the significant variability in methods used in the different randomised controlled clinical trials incorporated into the meta analyses. The Panel also recognised that evidence from more than a decade previously may or may not necessarily apply to current medical practice in the light of changes in technology and interventions. We support these views and consider that some interpretations and conclusions from the meta-analyses are open to question. Nevertheless, we agree that reported meta-analyses should be addressed.

Strength of evidence rating systems

In the review of the scientific literature, the AHCPR Clinical Practice Guideline² followed a strength of evidence rating system based upon three grades of evidence. However, these 1998 Best Practice Guidelines have applied four levels of evidence, following the recommendations contained in the Guidelines for the Development and Implementation of Clinical Practice Guideline⁸ of Australia's NH&MRC. The NH&MRC strength of evidence ratings are based upon a number rating designating the strength of the scientific evidence. These number ratings are somewhat different from the letter grading used by the AHCPR. Both ratings systems reflect the quality of the studies, including methodology and study design, and the consistency of the results reported in the scientific literature. Each strength of evidence rating cannot be regarded as absolute and may change over time. It is necessary to update such recommendations every few years in the light of accumulated evidence. Each rating system is set out below:

United States Agency for Health Care Policy and Research²

- A Scientific evidence provided by well designed, well conducted, controlled trials (randomised and nonrandomised) with statistically significant results that consistently support the guideline recommendations.
- B Scientific evidence provided by observational studies or by controlled trials with less consistent results to support the guideline recommendation.
- C Expert opinion that supports the guideline recommendation because the available scientific evidence did not present consistent results, or controlled trials were lacking.

National Health and Medical Research Council of Australia⁸

- 1 Scientific evidence based upon systematic review of well designed, well conducted, randomised controlled trials.
- 2 Evidence obtained from at least one properly designed randomised trial
 - 3.1 Scientific evidence obtained from nonrandomised controlled experiments with statistically significant results supporting the guideline recommendations
 - 3.2 Scientific evidence from well designed cohort or case control studies from more than one centre or research group.
 - 3.3 Scientific evidence based upon observational studies with time series with or without the intervention or supported by observational studies which have sufficiently consistent results to support the recommended guideline.
- 4 In the absence of scientific evidence sufficient to support a recommendation under Category 1, 2 or 3, consensus expert opinion has been used to form the basis of the guideline recommendation.

The NH&MRC rating presents a significant difficulty where there are several properly designed randomised clinical trials with inconsistent outcomes, but favouring the intervention. Systematic review may lead to acceptance on balance as indicating level of evidence = 1. To submit these trials to meta-analysis, however, would be inappropriate because of the disparate methodologies employed in the studies. Where the majority of trials or larger trials support the effectiveness of the intervention, we have elected to allocate level of evidence = 2, because there is “evidence from at least one properly designed randomised trial”. Where the evidence for benefit is equalled by failure to demonstrate benefit, a strength of evidence rating = 4 has been given. Where the evidence from randomised controlled trials is balanced, but there is

significant evidence from controlled studies, we have given a strength of evidence rating = 3. Such inconsistency in outcomes from several trials presents no difficulty in the AHCPR rating system where, when positive on balance, the strength of evidence rating = B.

In some instances, there is evidence to support strength of evidence ratings from two or three of sub-categories 3.1, 3.2 and 3.3. These three sub-categories were therefore reduced in the Best Practice Guidelines into a single Strength of Evidence Rating 3.

These guidelines were developed with a view to presenting sound recommendations for the care of patients with cardiovascular disease, based upon a comprehensive literature review. Recommendations are based, where available, on published scientific literature. In those areas where the scientific literature was inconsistent or incomplete, the recommendations reflect consensus statements assessed by Consultative Committee members and consultants. In some areas it was necessary to step outside the cardiological and rehabilitation literature and to accept expert opinion or evidence from other fields such as education or behavioural psychology.

Consultative Committee

All professions involved in cardiac rehabilitation programs were represented on the multidisciplinary Consultative Committee, including the following: cardiology, rehabilitation medicine, general practice, nursing, physiotherapy, exercise physiology, occupational therapy, social work, dietetics, psychology and pharmacy. Also represented were rural health professionals and agencies such as the National Heart Foundation of Australia, the Victorian Association of Cardiac Rehabilitation and the Australian Cardiac Rehabilitation Association. In addition, consumer representatives (who had themselves had coronary artery bypass surgery or myocardial infarction) from Heartbeat Victoria and Heart Support Australia were invited to join the Committee. Members of this committee are listed in the Acknowledgements. The roles of the Committee were to provide expert advice regarding the content of the Guidelines, to facilitate the conduct of additional surveys and focus groups and to give feedback on the recommendations contained in the Guidelines. Sections of this report were submitted for review by small groups before finalising the guidelines. The complete document was then reviewed by all Consultative Committee members. During the development of the Guidelines, the Committee met on five occasions.

Survey of current programs in Victoria

During 1996, a survey was undertaken to document currently available cardiac rehabilitation services in hospitals and community health centres throughout Victoria⁵. All hospitals with monitoring facilities admitting acute cardiac patients were eligible for inclusion in the survey. Investigation of community health centres was confined to those centres which had already established ambulatory cardiac rehabilitation programs. The survey was conducted by telephone interview. Most respondents were program co-ordinators. In smaller hospitals where there were no formal programs, interviews were carried out with directors of nursing or other personnel. Services for both inpatients and outpatients were investigated and views were sought regarding perceived deficiencies in current services. Material from this survey is incorporated into discussions of current practice in later chapters.

Focus groups with health care providers

In order to identify pertinent issues for service providers, 10 focus groups were held⁶. Discussions lasting about one hour took place, guided by an experienced facilitator, with each of the following groups: nurses, physiotherapists, occupational therapists, dietitians, social workers, cardiologists, general practitioners, rural health workers, health insurance bodies and health fund users. These focus groups aimed to explore perceptions of cardiac rehabilitation and its aims and to uncover major areas of concern for those delivering cardiac rehabilitation services. Expectations regarding the Best Practice Guidelines were also explored and views elicited about what should be included in the Guidelines. Findings from these focus groups are referred to throughout the Guidelines.

Comparative study of four model programs

A small pilot study was conducted of 168 patients, who were consecutively enrolled into four model cardiac rehabilitation programs in Melbourne⁷. Three public hospitals and one private hospital were included in the study. The frequency of sessions at these hospitals varied from once per week in one hospital, twice per week in two hospitals and three or more times per week in the fourth hospital. Health attitudes and behaviours were investigated before program entry and after discharge from the programs which lasted between six and eight weeks. Patients' perceptions of the rehabilitation programs were explored. Data were collected via self-report questionnaires. Reference to the findings of this study is made in several chapters.

CHAPTER 2

CARDIAC REHABILITATION AND SECONDARY PREVENTION: DEFINITIONS

The traditional ingredients of formal cardiac rehabilitation programs in Australia include exercise, education, and psychological and social support. Inpatient rehabilitation is mostly undertaken on an individual basis, whereas ambulatory rehabilitation programs after discharge from hospital are usually conducted with groups of patients. Such group programs have generally been conducted in a suitable outpatient area of the treating hospital. More recently, some programs have been established in community health centres and other sites. Best practice ambulatory programs are conducted by a multidisciplinary team. However, it is recognised that a cardiac rehabilitation program can be conducted by one appropriately trained health professional, provided there is adequate external medical and other support.

Many aspects of cardiac rehabilitation and secondary prevention are addressed through medical practice on a one to one basis between patients and medical practitioners. Cardiac rehabilitation and secondary prevention programs refer to structured programs of exercise, education and support additional to usual medical care. As described in later chapters, the benefits of such programs have been demonstrated through comparing the outcomes of patients enrolled in programs after an acute cardiac event with those exposed to usual medical care alone. Cardiac rehabilitation and secondary prevention programs are thus important adjuncts to the treatment of individual patients by medical practitioners.

Cardiac rehabilitation

Cardiac rehabilitation has been defined as

The sum of activities required to ensure cardiac patients the best possible physical, mental and social conditions so that they may, by their own efforts, resume and maintain as normal a place as possible in the community⁹.

Cardiac rehabilitation has also been described as

The combined and coordinated use of medical, psychosocial, educational, vocational and physical measures to facilitate return to an active and satisfying lifestyle¹⁰.

A somewhat different definition of cardiac rehabilitation was produced by the United States Public Health Service in 1988¹¹.

Cardiac rehabilitation services are comprehensive, long term programs involving medical evaluation, prescribed exercise, cardiac risk factor modification, education and counselling. These programs are designed to limit the physiological and psychological effect of cardiac illness, reduce the risk of sudden death or reinfarction, control cardiac symptoms, stabilise or reverse the atherosclerotic process, and enhance the psychosocial and vocational status of selected patients. Cardiac rehabilitation services are prescribed for patients who have had a myocardial infarction, have had coronary bypass surgery, or have chronic stable angina pectoris.

It is now recognised that cardiac rehabilitation programs, in certain circumstances, may also be delivered to those at high risk of coronary heart disease, including those with other evidence of vascular disease or who are at high risk of vascular disease, or indeed any other form of cardiac disease. To encompass this broader definition, the Cardiac Rehabilitation Working Group of the European Society of Cardiology (ESC)¹² has modified the definition of cardiac rehabilitation to be more inclusive, as follows:

The sum of interventions required to ensure the best physical, psychological and social conditions so that patients with chronic or post acute cardiac disease may, by their own efforts, preserve or assume their proper place in society.

The words “chronic” and “preserve” were added to the previous definition of the World Health Organisation (WHO) in order to stress the concept of the importance of rehabilitation in the long term care of patients with chronic disease, including those who had not had recent acute events.

Secondary prevention

For many years, cardiac rehabilitation programs have included an educational and supportive element to facilitate lifestyle change, adherence to advice and long term maintenance of change in order to promote secondary prevention of cardiovascular disease. Many studies have now demonstrated that ambulatory cardiac rehabilitation programs can be effective launching pads for secondary prevention.

While the definitions of the US Public Health Service¹¹ embraced the concept of secondary prevention, those of WHO⁹ and ESC¹² failed to do so adequately. The US Public Health Service definition is somewhat restrictive regarding patient entry characteristics, while the other definitions favour enrolment of all patients with cardiovascular disease. A broader definition should embrace those of the WHO and ESC and include the intentions of the US Public Health Service, as follows:

Cardiac rehabilitation is the co-ordinated sum of interventions required to ensure the best physical, psychological and social conditions so that patients

with chronic or post-acute cardiovascular disease may, by their own efforts, preserve or resume optimal functioning in society and, through improved health behaviours, slow or reverse progression of disease.

A similar definition containing the same ingredients has been generated by a European WHO working group¹³.

Phases of cardiac rehabilitation

There are three recognised phases of cardiac rehabilitation.

Inpatient rehabilitation (Phase 1)

Rehabilitation begins in hospital and consists of early mobilisation and education. It is delivered on an individual basis and, additionally, in some hospitals, to groups of patients. The degree of structure of inpatient programs varies from one hospital to another. The shorter hospital stay (now commonly four to six days after acute myocardial infarction, five to seven days after coronary bypass surgery, and one day after coronary angioplasty) makes it extremely difficult to conduct formal inpatient education programs. Further, inpatients commonly undergo time consuming comprehensive investigations. Thus, inpatient cardiac rehabilitation programs are now much more limited in scope than in the past. Moreover, it is recognised that inpatient education may be ineffective because of the psychological state and concerns of patients soon after their acute event.

Inpatient rehabilitation is now mostly limited to early mobilisation, so that self care is possible by discharge, and brief counselling to explain the nature of the illness or intervention, to increase the patient's awareness of his or her risk factors and to reassure the patient about future progress and follow-up. A discharge plan usually incorporates a discharge letter to the general practitioner and/or cardiologist or cardiac surgeon and assurance that the patient is aware of the need for continued medication. Appointments are usually made for follow-up review and, ideally, referral to a formal outpatient cardiac rehabilitation program. The effects of such restricted inpatient programs upon patient outcomes have been little studied.

Ambulatory outpatient rehabilitation (Phase 2)

Most cardiac rehabilitation is based upon supervised ambulatory outpatient programs conducted during convalescence. Attendance begins soon after discharge from hospital, ideally within the first few days. In Australia and elsewhere, ambulatory cardiac rehabilitation programs usually end within two to three months of the acute event.

Formal outpatient cardiac rehabilitation programs vary widely in content. Almost all contain an element of group exercise which is conducted by allied health professionals. Therefore, an educational and supportive element is inevitably delivered together with the exercise.

The duration of ambulatory exercise programs during convalescence also varies. In the United States of America, funding is available for exercise classes conducted three times per week for 12 weeks for those who are covered by health insurance, Medicare or Medicaid. In Australia and Canada, the usual duration of programs is six to eight weeks, although in some places it may be as short as four weeks. A brief intensive program is common in Europe, particularly in Germany, where three or four week residential programs are offered.

Sessions may be offered once, twice or occasionally three times per week in Australia. Programs in the United States and Continental Europe usually offer exercise of a moderate or high intensity level, whereas most exercise programs in Australia and New Zealand are of low or moderate intensity. The pattern of exercise programs in the United Kingdom is now changing from a few programs of high or moderate intensity exercise (following the practice in the United States) to widespread programs with lower levels of intensity (as practised in Australia).

Most programs in Australia include group education, but the content and method of the delivery of such education programs varies greatly. Different facilitators in the one program also vary considerably in their approach to running group discussions.

Psychological and social support may be given on an individual basis, as required, or may be provided to groups of patients and family members.

Maintenance (Phase 3)

A lifetime, maintenance stage follows the ambulatory program in which physical fitness and risk factor control are supported in a minimally supervised or unsupervised setting.

Maintenance programs are even more varied in content and structure than ambulatory programs. The exact content of maintenance programs is often not clearly defined. They may consist of regular recall and review by physician¹⁴ or nurse¹⁵. Patients may receive additional medication, further education, social support, exercise classes and behavioural intervention, as required¹⁴⁻¹⁷. Some patients may be enrolled in special groups for specific reasons (for example, diabetes, obesity, smoking, lipid disorder, hypertension, heart failure) if clinics are established for the management of these particular risk factors or conditions. In other programs, patients may be enrolled in an ongoing exercise class^{18,19}.

Relatively few maintenance programs have been established or adequately evaluated. Most of the evidence for improved prognosis is derived from combined ambulatory and maintenance programs which have been hospital-based. Individual studies and meta-analyses have reported benefits in terms of reduced mortality, recurrent events and readmissions.

CHAPTER 3

CARDIAC REHABILITATION AND SECONDARY PREVENTION: HISTORICAL BACKGROUND

The welfare of patients with heart disease, particularly those who became unemployed as a consequence of their illness, has been a concern of medical and other health professionals throughout the twentieth century. However, during the past 50 years, it was gradually recognised that disability could be controlled or avoided, that retirement was often unnecessary and that patients could live for many years after their acute events. A distinct change in attitude developed with the introduction of formal programs of cardiac rehabilitation to facilitate and support recovery of patients and to prevent further episodes.

United States of America

Cardiac rehabilitation as a systematic discipline was initially developed in the early 1940s in the United States of America. At that time, there was an acute manpower shortage and the possibility of returning unemployed or retired men to the work force was considered. It was recognised that there were many men capable of work who had been prematurely retired because of coronary heart disease. In 1941, the first Work Evaluation Unit was established in New York under the auspices of the American Heart Association²⁰. Many people with coronary heart disease were medically reviewed and their capacity for work evaluated. The majority returned to work and were found to make satisfactory employees in occupations similar to those which they had previously enjoyed²¹.

The success of this pilot unit led to many such units being established throughout the United States. These produced a gradual change in the attitude toward medically recommended early retirement following heart attack²². Simultaneously, there occurred a slow change in medical opinion regarding mobilisation and resumption of normal activities. Whereas in the 1940s an episode of acute myocardial infarction was likely to result in some weeks of absolute bed rest and possibly three months of hospitalisation²³ or rest at home, it was later recognised that early mobilisation produced beneficial effects²⁴.

In the 1960s, progressively early mobilisation occurred amongst patients admitted with myocardial infarction. A more optimistic approach toward the future welfare of

the patients entered into medical thinking and practice. Return to work became a significant aim of cardiac rehabilitation programs. Psychosocial recovery was recognised to accompany physical recovery²⁵.

The accepted physical and psychological benefits of early mobilisation and supervised exercise training led to the introduction of exercise training programs during convalescence²⁶⁻³¹. Confirmation that early exercise testing and training could start within two to three weeks of a myocardial infarction³²⁻³³ led to exercise training starting immediately after discharge from hospital. However, because the exercise was of relatively high intensity, careful monitoring was necessary. These programs usually lasted up to twelve weeks and patients attended three times per week during that period²⁹⁻³³. Some education was delivered during these programs, partly through the natural exposure to interested health professionals who could supply requested information to patients during supervised exercise sessions. Gradually it was recognised that more formal patient education was desirable. Therefore, group education was later grafted on to many of the group exercise programs.

Australia

In 1961 the National Heart Foundation of Australia established Cardiac Rehabilitation Units in major capital cities. Patients were referred to these centres with occupational, social or psychological problems which were causing unnecessary disability or unemployment. Patients attending the cardiac rehabilitation units received guidance and support, exercise and education, both individually and in groups. The majority returned to jobs (usually new employment) suitable to their physical capacity and their training³⁴⁻³⁷.

These Cardiac Rehabilitation Centres (or Work Assessment Centres) contributed significantly to a change in the pattern of medical management of patients with cardiovascular disease. Progressively earlier mobilisation occurred with progressively shorter hospital stay. It became recognised that it should be possible to prevent patients from requiring such late rehabilitation services if one could intervene at an early stage. Thus, in the 1970s "preventive" rehabilitation programs for patients following acute myocardial infarction were started in a number of hospitals. Initially patients were referred to these outpatient programs four weeks or more after discharge from hospital. Later, it was accepted that exercise programs could start earlier after discharge from hospital³⁸. Thus, the pattern of outpatient ambulatory cardiac rehabilitation programs in Australia evolved. Increasingly, patients were referred to a rehabilitation program, usually based on group education and relatively light or moderate group exercise with minimal equipment and testing and limited monitoring³⁹. These programs lasted for six to eight weeks with once or twice weekly attendance. Family members were encouraged to participate.

This pattern is typical of most current cardiac rehabilitation programs in Australia, although several are now shorter (4–8 weeks). A few programs, particularly in New South Wales and Queensland, use higher levels of exercise and consequently require more technology in assessment and monitoring.

Results of recent surveys show a rapid growth in the number of cardiac rehabilitation programs in Australia, and especially in Victoria^{5,40–41}. A survey conducted in Victoria in 1996 showed that 67 outpatient group exercise and education programs and 23 inpatient group programs were available⁵. All major hospitals in metropolitan Melbourne and country Victoria now provide ambulatory group programs.

Europe

Support for multiple benefits arising from exercise training of patients after myocardial infarction has also been reported from studies in Europe^{42–46}. Most of these studies were based on hospital outpatient programs. In Central Europe some residential rehabilitation centres became cardiac rehabilitation hospitals and eventually developed into regional cardiological centres for the inpatient assessment, management, education and training of patients. Patients were referred to these centres directly from the hospital to which they had been admitted for the acute event or were called to the cardiac rehabilitation hospital some weeks after discharge from the acute hospital^{47–48}.

United Kingdom

Rehabilitation programs in the United Kingdom have developed rapidly in recent years. The structure of the rehabilitation program is described as “fairly consistent and follows the low level program advocated by Goble et al from Melbourne, rather than the high intensity programs seen in North America”⁴⁹.

Asia

Cardiac rehabilitation programs have recently been established in several Asian countries, supported in some places by the World Heart Federation (formerly International Society and Federation of Cardiology)⁵⁰. The programs follow WHO recommendations¹ and are based upon programs of low intensity exercise and group education which is the model for the great majority of programs currently available in Australia⁴¹. However, there are a few programs in private hospitals based upon the US model of high intensity exercise training, delivered to those who can afford to pay. The introduction of cardiac rehabilitation programs in Asian countries has been facilitated by the Heart Research Centre, which has developed and conducted training programs in Melbourne and elsewhere in Australia^{50–51}. Health professionals from Hong Kong, Malaysia, India, Pakistan, Philippines, Indonesia and Thailand have attended these training programs and observed cardiac rehabilitation programs in

Australia. They have then established similar programs in their own countries. Over the past five years, training programs modified to suit local needs have been conducted in these Asian countries, in conjunction with the Heart Research Centre and sponsored by the World Heart Federation.

Participation in programs

The gradual acceptance of cardiac rehabilitation as an important adjunct to medical care and an important need for patients has received support from the World Health Organisation, health departments and professional societies throughout the world. However, participation in cardiac rehabilitation programs has been relatively low in all countries⁵²⁻⁵⁶. The challenge now is to increase participation rates, as discussed in Chapter 17.

CHAPTER 4

THE BURDEN OF CARDIOVASCULAR DISEASE

According to the 1997 World Health Report, circulatory diseases such as heart attacks and stroke kill more people than any other disease, accounting for at least 15 million deaths, or 30% of the annual total, every year³. In developing countries these diseases also account for about 25% of all deaths. In 1996, coronary heart disease accounted for more than 7 million deaths worldwide and was responsible for about one-third of all deaths in industrialised countries. In 1994 cardiovascular disease (CVD) was certified to be the primary cause of death in 43.33% of all deaths in Australia and 41.97% in Victoria (39.2% in males, 44.9% in females)⁵⁷. The majority of these deaths were from coronary heart disease (CHD), also referred to as ischaemic heart disease (IHD) (Table 1). The proportion of deaths from CHD/IHD in the State of Victoria (23.0%) is similar to that of Australia generally (24.1%). It is also similar to that reported in the 'The Global Burden of Disease 1996'⁴, with CHD/IHD constituting 24.7% of all certified deaths in developed regions in 1990.

Table 1: Deaths from CVD (1994)

	Australia		Victoria	
	n	%	n	%
Estimated population	17,844,449		4,477,419	
Total deaths	126,683		32,353	
CVD deaths	54,886	43.33	13,577	41.97
CHD/IHD	30,573	24.13	7,448	23.02
Stroke	12,838	10.13	3,127	9.67
Other	11,475	9.06	3,002	9.28

Source: Australian Bureau of Statistics 1996⁵⁷

The majority of patients who die from CHD already have a past diagnosis of CHD and many have had one or more admissions to hospital. The Victorian Inpatient Minimum Database for the 12 month periods to June 1995 and to June 1996 highlights the rapid increase in the number of patients admitted to hospital with CHD and also discharged alive with a primary diagnosis of CHD (Table 2)⁵⁸. In addition, there has been a rapid increase in the number of major interventions in the treatment of CHD, both coronary artery bypass graft surgery (CABGS) and percutaneous transluminal coronary angioplasty (PTCA) (Table 2).

Table 2: Hospital separations: number of patients with a diagnosis of CHD (Victoria)

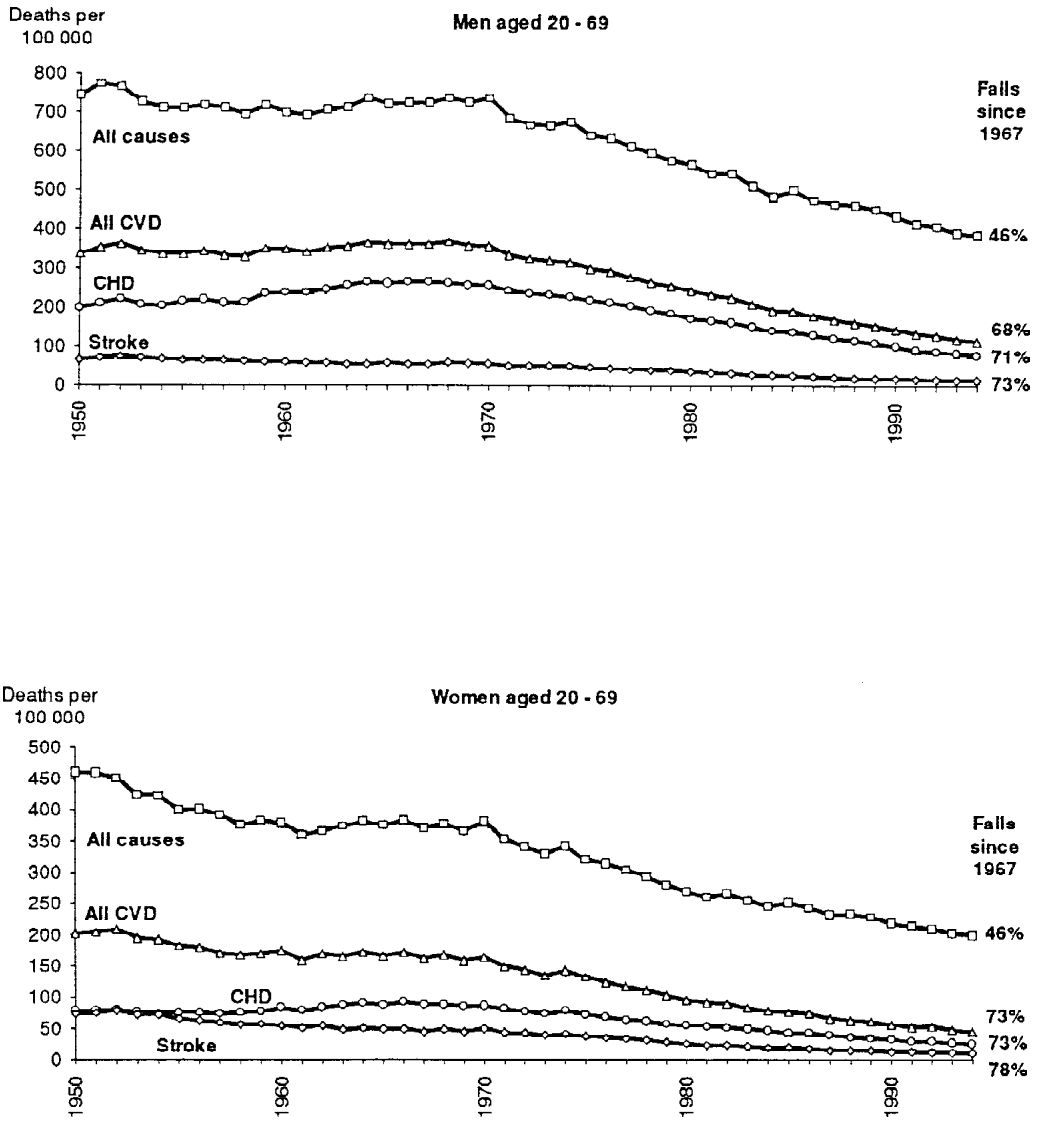
Year to June	1995	1996
Myocardial infarction (ICD9 410)	7,956	8,456
Angina pectoris (ICD9 413)	5,633	8,918
Coronary bypass surgery (ICD9 36.10 - 36.19)	3,972	4,439
Coronary angioplasty (ICD9 36.01, 36.02, 36.05)	2,622	3,463
(Coronary stent) (ICD9 36.06)	(198)	(817)

Source: Victorian Inpatient Minimum Database⁵⁸

The increased number of hospital admissions and separations for angina pectoris may be partly accounted for by increased admissions for coronary angiography to determine suitability for CABGS or PTCA. The number of stents inserted concurrently with PTCA has also rapidly increased, which may explain the increasing number of PTCA procedures performed. This rise in the number of admissions and successful (living) hospital separations is occurring in the face of a falling death rate from CVD, both in Australia generally (Figure 1)⁵⁹ as well as in Victoria (Figure 2)⁶⁰, for both men and women. Similar patterns prevail in many industrialised countries.

In Eastern Europe there is a rapidly rising prevalence of CVD with a rising death rate in all socioeconomic groups. Death rates from CVD in most Eastern European countries now far exceed those of Western Europe, USA, Australia and New Zealand⁶¹. In Asia there is a rapidly rising prevalence of CVD, particularly among the growing professional, managerial, business and factory supervising groups⁶²⁻⁶⁴.

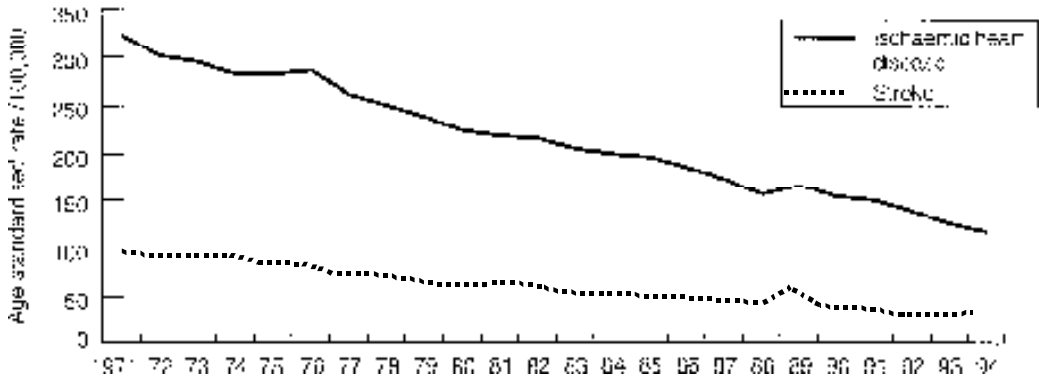
Figure 1: Age-adjusted death rates 1950–1994, and falls since 1967



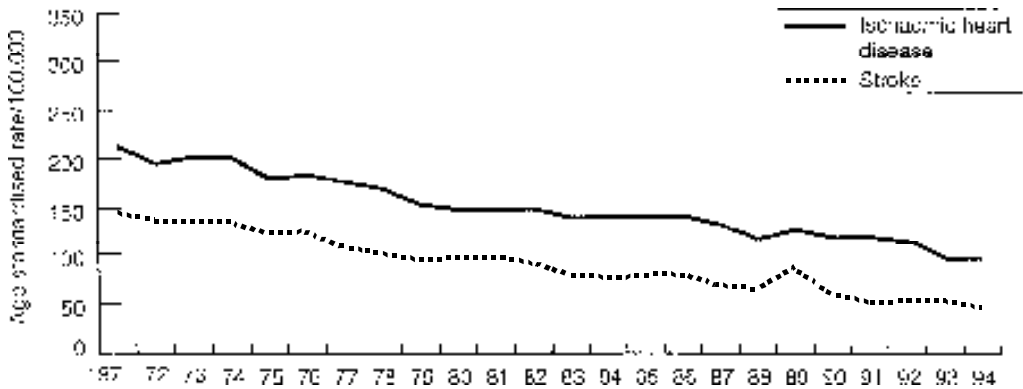
Source: Heart and Stroke Facts, National Heart Foundation of Australia 1996⁵⁹

Figure 2: Trends in cardiovascular death rates in males and females, Victoria

Males



Females



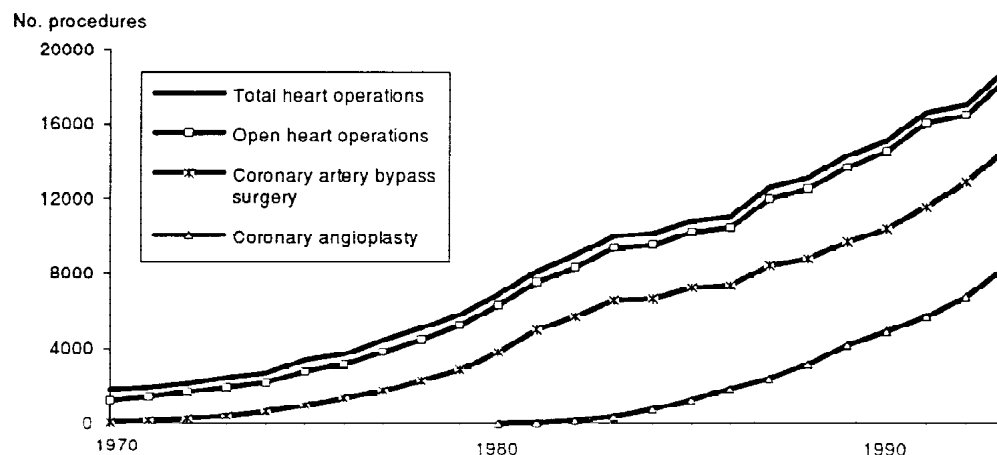
Source: Health Indicators: Victorian Department of Human Services, 1996⁶⁰

In Australia, the falling death rate from CVD, particularly CHD, is leading to overall falling death rates at all ages, and consequently a progressive increase in overall life expectancy. The increase of five years' life expectancy to 75 years in men and to 81 years in women during the past 20 years is very largely due to reduced premature deaths from CVD⁶⁵. While certified death rates from CHD, both total and age adjusted, in men and in women are falling, there is an increasing survival of persons with CHD. Modern medical and surgical treatments for acute myocardial infarction, angina pectoris, stroke and other manifestations of CVD have contributed greatly to this falling annual death rate. In addition, changes in population and patient behaviours have led to a delay in the appearance of CVD and CHD, less severity of CVD and CHD and increasing chance of survival after the disease becomes symptomatic.

Thus, we have an increasing survival rate in an increasingly ageing population. It is possible that while death rates are falling, the actual prevalence of the disease is not. The ageing population means that those presenting with CHD are more likely to suffer comorbidity (for example, osteoporosis, arthritis) and to have increased chance of death from other illness (for example, cancer, respiratory disease).

The development of effective but costly interventions continues to increase rapidly in Australia (Figure 3), including Victoria⁵⁹. Thus, there are increasing numbers of patients discharged alive from hospital after acute episodes of CHD and also after acute interventions. These patients constitute the major pool of those eligible to attend ambulatory cardiac rehabilitation programs. Apart from the benefits to individual patients and their families, these programs should also aim to reduce recurrent events, including avoidance of subsequent interventions, and to reduce health costs by delaying or preventing dependency, disability and hospital readmissions. These are the aims of secondary prevention of cardiovascular disease.

Figure 3: Cardiovascular procedures in Australia, 1970–93



Source: Heart and Stroke Facts, National Heart Foundation of Australia 1996⁵⁹

Another group of persons who may benefit from cardiac rehabilitation programs includes those who are at high risk of CVD who commonly have multiple risk factors. This group may need support additional to that obtained from usual medical care. In this regard, cardiac rehabilitation programs may well be a suitable means of encouraging healthier behaviours and compliance. This may apply particularly to those of high risk declared by a positive family history⁶⁶. Motivation to change lifestyle may be heightened if a family member suffers an acute cardiovascular illness. The potential pool of patients with diagnoses of CHD in Victoria could be up to 20,000 new patients per year and in Australia up to 80,000 new patients per year. The possible numbers of high risk patients could be much greater.

The magnitude of the burden of CHD in Australia is one reason for delivering cardiac rehabilitation and secondary prevention to patients in groups. Such group programs can be delivered at low cost, reducing the cost burden of CVD. In Australia in the year 1989–1990, the total direct costs for CVD were calculated by the Australian Institute of Health and Welfare to have been \$2.2 billion and indirect costs \$1.3 billion⁶⁵.

CHAPTER 5

RECENT PRACTICE GUIDELINES AND POLICY STATEMENTS

Several bodies have produced guidelines and policy statements regarding cardiac rehabilitation. Only one of these is a scientific review of the available evidence in the literature. The remainder are guidelines for practitioners, policy statements, position statements or non-systematic reviews.

Scientific review

United States Agency for Health Care Policy and Research

An extensive scientific review of the available literature was undertaken in 1995 by NK Wenger, ES Froelicher, CK Smith et al entitled “Clinical Practice Guideline No 17: Cardiac Rehabilitation”. It was published by the US Department of Health and Human Services, Public Health Service, Agency for Health Care Policy and Research (AHCPR) and The National Heart, Lung, and Blood Institute². “A Quick Reference Guide for Clinicians” entitled “Cardiac Rehabilitation as Secondary Prevention”⁶⁷ was also produced, which summarised the review of the literature and the conclusions and recommendations arising from the review. However, the US guidelines did not address several important issues relating to program content and other aspects of cardiac rehabilitation. Moreover, publications since 1995 have modified some of their recommendations. A review of the US recommendations is provided in Chapter 6.

Other guidelines and statements

American Association of Cardiovascular and Pulmonary Rehabilitation

The American Association of Cardiovascular and Pulmonary Rehabilitation produced “Guidelines for Cardiac Rehabilitation Programs” (first edition in 1991⁶⁸; second edition in 1995⁶⁹). These are well referenced text books for health professionals working in the field.

British Association of Cardiac Rehabilitation

The British Association of Cardiac Rehabilitation published “Guidelines for Cardiac Rehabilitation” in 1995⁷⁰. The British guidelines are somewhat more clinically oriented than the AHCPR Clinical Practice Guidelines.

American College of Sports Medicine

The American College of Sports Medicine produced “Guidelines for Exercise Testing and Prescription” (5th edition) in 1995⁷¹. This also is not a scientific review guideline: it is a referenced instruction manual for those exercise physiologists and others who co-ordinate or participate in exercise training programs. It follows the preferred high intensity exercise programs in the USA.

British Cardiac Society

A working party of the British Cardiac Society produced a “Working Party report on Cardiac Rehabilitation” in 1992⁷².

Another working party in the United Kingdom produced “Cardiac rehabilitation in the United Kingdom: guidelines and audit standards” in 1996⁷³.

American Heart Association

The American Heart Association (AHA) produced a Position Statement “Cardiac Rehabilitation Programs: A Statement for Healthcare Professionals from the American Heart Association” in 1994⁷⁴. The AHA also produced a “Consensus Panel Statement: Preventing Heart Attack and Death in Patients with Coronary Disease” in 1995⁷⁵. The statement has been endorsed by the Board of Trustees of the American College of Cardiology.

American College of Physicians

The Health and Public Policy Committee of the American College of Physicians produced a report “Efficacy of Cardiac Rehabilitation Services” in 1988⁷⁶.

Rehabilitation Systems in Europe

An independent review from Europe entitled “Cardiac rehabilitation today: programs, their effects and practical guidelines” was published in 1992⁷⁷.

The residential option for rehabilitation, common in Central Europe, is presented in a paper entitled “Cardiac rehabilitation in the Federal Republic of Germany: Klinik Roderbirken” by Jette et al in 1988⁴⁷. Such costly residential rehabilitation programs appear to confer questionable benefit to patients^{48,78}.

European Society of Cardiology

The Working Group on Cardiac Rehabilitation of the European Society of Cardiology produced “Cardiac Rehabilitation: Definitions and Goals” in 1992¹².

Comment

While none of the above guidelines and policy statements represents a scientific literature review comparable to that contained in the AHCPR Clinical Practice Guideline², their recommendations are generally consistent with the AHCPR

Guideline. They are also consistent with the following recommendations of the National Heart Foundation of Australia published in 1994 and of the World Health Organisation Expert Committee in 1993.

National Heart Foundation of Australia

In 1994, the National Heart Foundation of Australia published a Policy Statement on Cardiac Rehabilitation, which states:

Secondary prevention programs, including outpatient cardiac rehabilitation, should be available to all patients in Australia who have had acute myocardial infarction, coronary artery bypass grafts, coronary angioplasty or other cardiovascular disease. Unless contraindicated, these patients should be routinely referred to hospital or community based outpatient programs⁷⁹.

World Health Organisation

The World Health Organisation Expert Committee report "Rehabilitation after Cardiovascular Diseases, with Special Emphasis on Developing Countries" of 1993¹ made the following recommendations:

- 1 Cardiac rehabilitation should be an integral component of the long-term, comprehensive care of cardiac patients.
- 2 Cardiac rehabilitation programs or services should be available to all patients with cardiovascular disease, both children and adults.
- 3 Rehabilitation services should be provided by any trained health professional caring for cardiac patients, since no sophisticated equipment or facilities are required. Both patients and their families should participate.
- 4 Rehabilitation programs should be integrated into the existing health care system; this can be done at modest cost. The major requirement is for health professionals to be trained in prescribing appropriate exercise and providing health education and vocational guidance.
- 5 Responsibility for the implementation of cardiac rehabilitation should be given to a designated health professional at the local level, trained as a coordinator. This individual should, in turn, be responsible to an appropriate physician or to a department, hospital, or other health care facility, which may operate under the auspices of the government or a nongovernmental organisation or other agency.
- 6 All plans for the implementation of rehabilitative programs should include provision for evaluating the efficacy of the programs.

Comment

The conclusion from all of the above guidelines and policy statements is that cardiac rehabilitation services should be available to all patients with cardiac and vascular disease. There is uniformity of opinion to support the view that cardiac rehabilitation should include exercise, education, social support, behavioural change, follow-up of patients and program evaluation. However, there are significant differences between regions regarding specific aspects of the content of these programs; that is “how much of what and for whom?” and in methods of delivering programs.

CHAPTER 6

REVIEW OF CLINICAL PRACTICE GUIDELINE NO 17 "CARDIAC REHABILITATION" (1995)

US Agency for Health Care Policy and Research

The extensive scientific review undertaken in 1995 to produce the Clinical Practice Guideline on Cardiac Rehabilitation for the US Agency for Health Care Policy and Research (AHCPR)² generated a series of recommendations based upon consideration of evidence of over 900 reports, a review of over 400 scientific papers and analysis of 334 of these papers. The Clinical Practice Guideline consists of the following:

- 1 Overview
- 2 Effects of cardiac rehabilitation exercise training
- 3 Effects of cardiac rehabilitation education, counselling and behavioural interventions
- 4 Organisational issues.

The overall conclusion of the scientific review is that

Cardiac rehabilitation based upon exercise, education, counselling and behavioural interventions should be incorporated into programs of management for all patients with cardiovascular disease.

This is consistent with the recommendations of the WHO Expert Committee of 1993)¹.

This chapter summarises the strength of evidence ratings and the number of references reviewed for each recommendation of the AHCPR Clinical Practice Guideline. Table 3 presents the strength of evidence ratings derived from the scientific review applicable to a series of outcome measures. The evidence for the benefits of exercise training is sufficient to be absolute for some outcome measures (such as the vast amount of evidence that exercise tolerance is increased by exercise training). The evidence is sufficient to make fairly strong statements in other areas (for example, psychological functioning is likely to be improved by exercise training alone and it is definitely improved by exercise training together with educational support and other measures). Although the evidence is not absolute in some areas, it is reasonable to conclude that some outcomes are neither affected by exercise training nor by comprehensive cardiac rehabilitation (for example, collateral coronary circulation and myocardial function are not improved by exercise training, while

peripheral muscle efficiency is clearly improved). It is also highly likely that in many areas, a comprehensive cardiac rehabilitation program produces beneficial effects additional to exercise training alone.

Table 3: Strength of evidence ratings for benefit (AHCPR 1995)

	Strength of evidence (A, B, C)		
	Exercise alone	Comprehensive rehabilitation	Maintenance programs
Outcomes—Physical			
Functional effect			
Improved exercise tolerance	A		
Increased muscular strength	B	-	-
Disease progression			
Symptoms reduced	B	B	-
Morbidity reduced	A	A	A
Mortality reduced	B	B	B
Atherosclerosis slowed	-	B	B
Cardiac status			
Myocardial perfusion (reduced ischaemia)	B	-	-
Collateral circulation (no effect)	B	-	-
Myocardial function (no effect)	B	-	-
Arrhythmias (no effect)	B	-	-
Risk factors			
Smoking reduced	-	B	B
Lipids improved	-	B	B
Weight controlled	-	B	B
Blood pressure improved	-	B	B
Exercise habits improved	B	B	B
Safety of exercise training	A		
Outcomes—Psychosocial			
Psychological wellbeing improved	B	A	-
Social functioning improved	B	A	-
Return to work increased	-	C	-
Outcomes—Special Cases			
Heart failure			
Improved symptoms & exercise tolerance	A	-	-
Transplantation			
Improved symptoms & exercise tolerance	B	-	-
Elderly			
As for younger patients	B	B	B

Footnote: In Table 3, no evidence or insufficient evidence is indicated by a dash (-). The alphabetical letters (A, B, C) are those used in the AHCPR Clinical Practice Guideline, as set out in Chapter 1. Morbidity includes both recurrent events and hospital readmissions.

Exercise training

Table 4 sets out the number of studies related to exercise training in cardiac patients from which the strength of evidence is derived. In some areas, the evidence is considerable and consistent. In others, it is slight or equivocal (for example, the effect of exercise training upon arrhythmias).

Table 4: Number of exercise studies reviewed (AHCPR 1995)
Scientific basis for recommendations: exercise training

Outcome	Randomised trials	Non-randomised trials	Observational studies
Exercise tolerance	46	25	43
Muscle strength	4	3	0
Symptoms	12	7	7
Morbidity	15	14	13
Mortality	17	8	6
Atherosclerosis	5	1	3
Myocardial perfusion/ischaemia	6	2	3
Collateral circulation	0	0	5
Myocardial function	9	5	8
Arrhythmias	4	0	1
Smoking	12	8	4
Lipids	18	6	13
Weight	11	7	16
Blood pressure	9	6	3
Exercise habits	10	2	3
Psychological status	9	8	3
Social functioning	2	2	2
Return to work	10	9	9
Heart failure	5	3	4
Transplantation	0	1	4
Elderly	0	1	6

Education, counselling and behavioural interventions

Table 5 sets out the number of studies from which the recommendations and strength of evidence ratings were derived for education, counselling and behavioural interventions in cardiac rehabilitation. The evidence is small compared with that concerning exercise, but is sufficient to demonstrate that interventions additional to, or independent of, exercise training contribute to favourable outcomes in several areas, particularly those concerning risk factors and psychological wellbeing. Hence, such interventions should either directly or indirectly affect morbidity and mortality. Rather than attempting to dissect out the benefits of interventions additional to exercise, they are included in Table 3 in the framework of “comprehensive cardiac rehabilitation”. Some incremental benefits to outcomes, apparent from exercise training alone, become more apparent when exercise training is combined with education, counselling and behavioural interventions. Some reports suggest, further, that benefits may arise from education, counselling and behavioural interventions independently of exercise training.

Table 5: Number of studies reviewed reporting education, counselling and behavioural interventions (AHCPR 1995)

Outcome	Randomised trials	Non-randomised trials	Observational studies
Smoking	5	1	1
Lipids	12	3	3
Weight	3	1	1
Blood pressure	0	2	0
Exercise tolerance (without exercise training)	1	1	1
Symptoms	2	1	1
Return to work	2	0	1
Psychological wellbeing	7	5	2
Morbidity	3	0	0
Mortality	8	0	0

Organisational issues

In the final section, the Clinical Practice Guideline addresses organisational issues, which include intake assessment, risk stratification, alternate approaches such as home-based cardiac rehabilitation, strategies for encouraging adherence to programs, and a brief discussion about the cost and benefit of cardiac rehabilitation. They also make recommendations for additional research.

CHAPTER 7

EXERCISE TRAINING IN CARDIAC REHABILITATION

This chapter reviews the scientific evidence for benefits from exercise training, both as the sole intervention and as a part of comprehensive cardiac rehabilitation. The term “exercise training” applies to a program of repeated exercise undertaken at a guided or prescribed intensity and frequency over a period of time, usually several weeks. The exercise training is based upon so-called aerobic or dynamic exercise, designed to improve physical performance at both maximal and submaximal levels. Such exercise may be of low, moderate or high intensity, as discussed in Chapter 8. Exercise training may also include resistance training involving the use of muscular effort against resistance, with the aim of increasing muscular strength

Meta-analyses

Reported randomised clinical trials involving exercise training in cardiac patients have been collected and submitted to meta-analyses with death as the major outcome measure^{80,81}. These aggregations include trials which have been limited to convalescence (eight to 12 weeks) and continuing programs with follow-up support extending for three, five or even 10 years. In these meta-analyses, positive outcomes have been essentially attributed to exercise rather than to the comprehensive process of cardiac rehabilitation. Several of the trials in the meta-analyses have clearly been multifactorial interventions. These meta-analyses have shown benefit from exercise programs in terms of longterm mortality. The benefit is a mortality reduction of between 20% and 25%.

Dissection of the major studies included in the meta-analysis by O'Connor et al⁸¹ reveals such disparate research designs that submitting them to meta-analysis is questionable. The meta-analysis has concentrated on longterm mortality reduction. Mortality reduction of statistical significance has been demonstrated in a few of the longer term trials standing alone^{14,17}. The study from Finland¹⁴, which achieved a statistically significant effect on mortality, was included in the WHO Europe Study¹⁷.

Aggregation of disparate studies and other problems have led some to regard meta-analysis as potentially misleading⁸²⁻⁸⁴, particularly in the light of insecurity regarding methodology and outcome measures in some non-blinded randomised clinical trials⁸⁵⁻⁸⁷.

The trials included in the meta-analyses by O'Connor et al⁸¹ fall into four groups:

1 Ambulatory (convalescent) cardiac rehabilitation trials

Most programs were of short duration (12 weeks) or less with insufficient long-term intervention or attention to follow-up to contribute to long-term mortality studies.

2 Long-term exercise studies where exercise training alone is compared with standard medical care

In those studies in which exercise training was apparently the sole intervention, there may have been a statistically significant difference demonstrable by meta-analysis^{18,43-45,88-90}. However, these exercise trials are included with, and much influenced by, the definite mortality differences reported in some long-term multifactorial interventions.

3 Long-term multifactorial interventions compared with standard medical care

Reduction in mortality, recurrent events, hospital readmissions and risk factors has been demonstrated in randomised trials from the 1970s and 1980s^{14,17}. The results of these trials are supported by a well designed, controlled experiment from Sweden^{16,91} which produced similar results but which, not being a randomised trial, is not included in the meta-analyses. The Stanford Coronary Risk Intervention Program (SCRIP), also not included in the meta-analyses because of its recent publication date¹⁵, was more a clinical trial of continued "shared care" than strictly of cardiac rehabilitation.

4 Comparisons of high and low intensity exercise training

In one randomised controlled trial extending over four years^{19,92}, outcomes of recurrent myocardial infarction and death were followed in patients randomly allocated to low or high intensity exercise programs. Each group was exposed to health professionals, but without specific additional intervention other than advice to individual patients. Here no difference in events was observed over three years. In the other study included in the meta-analysis, patients were followed for one year after programs of eight weeks of high or low intensity exercise⁹⁴. Here again, no difference in events was apparent at follow-up.

There are two randomised controlled trials comparing other effects of high versus low intensity exercise with up to 12 month follow-up. These showed a minor difference only⁹⁴ or no difference in physical performance⁹³. Both failed to show statistically significant differences between groups in psychological, social, occupational or other outcomes^{95,96}. Another study⁹⁷ showed only trivial physical differences between groups. Psychosocial outcomes are not yet reported from this study.

Comment

It appears likely that exercise intensity, frequency and duration may not necessarily be the keys to better survival, fewer events, fewer hospital admissions and improved risk factors. Such benefits may well arise from the multifactorial nature of interventions (either intended or accidental) offered in cardiac rehabilitation programs, including exercise. This possibility was raised by Stern in 1981 and 1983^{98,99}. A similar conclusion concerning the limitations of meta-analyses was presented in a review by Kellermann¹⁰⁰.

The benefits of exercise training

There are several clearly defined benefits from exercise training of cardiac patients. Other claimed benefits are less securely based. Some may be due to aspects of cardiac rehabilitation other than the exercise component itself.

Physical performance

Recommendation

Exercise training is recommended to improve physical performance (exercise tolerance, muscular strength and symptoms)

Strength of evidence = 1

Exercise tolerance

The physical benefits of exercise training in patients after acute myocardial infarction (AMI) have been extensively studied. Randomised clinical trials have repeatedly shown that functional capacity improves through exercise training, whether directly measured by maximal oxygen uptake or indirectly measured from nomograms based upon maximal treadmill exercise tests or in Watts by cycle ergometry^{15,17,26,42-46,101-123}.

Similar benefits from exercise training have been demonstrated in randomised clinical trials involving patients who have had coronary artery bypass graft surgery (CABGS)^{118,123-129}. Improvement in exercise tolerance continues for up to 8 or 12 weeks and possibly beyond. Most randomised trials of exercise in cardiac patients have been based upon exercise training at a heart rate of between 70 and 85% of the maximal heart rate determined by symptom limited maximal exercise testing. Most trials have been limited to "low risk or moderate risk" patients. The process of "risk stratification"¹³⁰ has led to exclusion of so-called "high risk" patients, such as those with heart failure, significant impairment of left ventricular function or arrhythmias. Patients with "residual ischaemia", being those with angina or abnormal ST segment depression in the electrocardiogram at an exercise test or on 24 hour ECG monitoring, have also been commonly excluded from these trials. Patients in this last group have

been classified as being at “moderate or high risk”. It now appears from the literature that most of the risk in patients with residual ischaemia is a subsequent need for revascularisation rather than a significantly greater chance of death or reinfarction. Risk stratification methods and significance are discussed in Chapter 9.

Widely accepted recommendations regarding exercise training have come from many authoritative sources based upon literature review and consensus^{1,2,12,31,68-77,79}. It is also well recognised that physical performance spontaneously recovers through resumption of normal activities after a period of physical inactivity following AMI or other illnesses¹³¹. However, trials have demonstrated that exercise training produces a significantly more rapid recovery of physical function.

Muscular strength

There have now been several reports, including randomised trials¹³²⁻¹³⁷ and observational studies¹³⁸⁻¹⁴² in which patients with impaired left ventricular function or heart failure have been trained in exercise of multiple muscle groups successively, with flexion and extension against resistance. All have demonstrated increased muscular strength. These findings are important because most activities of daily living involve movement against resistance or movement of objects requiring some strength. Although previously thought to have been hazardous, progressive resistive exercise training is now recommended, particularly for those who have become inactive and weakened by muscle wasting.

Symptoms

Some patients may be limited by dyspnoea or by angina. It has been demonstrated that patients with left ventricular failure enrolled in exercise training experienced less dyspnoea at the same level of exercise than did patients receiving usual care^{102,106,107,111,112}.

In randomised trials in patients with angina, exercise training has also been demonstrated to raise the threshold of activity at which symptoms appear^{17,88,114,143-145}. The improvement is attributed to less cardiac work being required to deliver blood and oxygen to the exercising muscles at any given level of activity. However, no significant reduction of angina was reported in four other randomised clinical trials^{14,43,108,146}.

In one report of a comprehensive cardiac rehabilitation program, including exercise, half of the patients with angina awaiting elective coronary artery bypass graft surgery were removed from the waiting list following abatement of their angina¹⁴⁷.

Comment

There is no doubt that dynamic (aerobic) exercise training improves functional capacity. Although less studied, it is also definite that strength training, through resistive exercise, increases muscular strength. Both types of exercise training appear to lead to reduction in symptoms of dyspnoea and of angina.

Psychological functioning

Recommendation

Exercise training is recommended to improve psychological functioning (anxiety, depression, well-being)

Strength of evidence = 2

There are two randomised clinical trials demonstrating improvement in psychological functioning (anxiety, depression and other measures) from exercise training alone, compared with standard medical care^{110,148}. The benefit is more apparent with multifactorial rehabilitation^{92,121,148-150}. One randomised trial failed to demonstrate benefit¹⁴⁶. The evidence for benefit from exercise training in randomised trials is supported by non-randomised studies^{98,151-156}.

Comment

While spontaneous recovery of psychological functioning occurs over many months following major illness or surgery, it is apparent that enrolment in a group exercise training program accelerates psychological recovery. Reviews and consensus statements support this benefit from exercise training. Benefits in psychological functioning are apparently greater in multifactorial rehabilitation.

Social adaptation and functioning

Recommendation

Exercise training is recommended to improve social adaptation and functioning

Strength of evidence = 2

The effects of exercise training on social functioning are less well defined than those assessing other aspects of recovery. Outcome studies include social adjustment, marital adjustment, sexual recovery and occupational adjustment. Positive outcomes have been reported from two randomised clinical trials^{149,157}. Three observational studies produced statistically significant improvement in social functioning^{98,128,158}, while one controlled study showed no significant difference between groups¹⁵⁹.

Comment

While the attribution of better social recovery to the exercise training is generally accepted, uncertainty remains as to whether it is the exercise itself or interaction with health professionals and other patients which produces the benefit. Benefits in social functioning are more apparent with multifactorial rehabilitation.

Return to work

Recommendation

Return to work should be a specific goal of cardiac rehabilitation programs. Comprehensive rehabilitation, including education, counselling and vocational rehabilitation, is recommended. Exercise training as the sole intervention has not been shown to increase the rate of return to work.

Strength of evidence = 3

There is no convincing evidence from controlled trials that exercise training alone favourably affects the rate of return to work. There is evidence that comprehensive cardiac rehabilitation is effective but that benefit appears only to be achieved when return to work is considered an important outcome measure of cardiac rehabilitation.

Of three randomised controlled trials of exercise training alone, compared with usual care, none demonstrated an increased rate of return to work^{43,44,90}. Where education and counselling were included in the rehabilitation program, additional to the exercise, three studies reported positive results^{17,155,160}, while eight showed no significant increase in return to work^{32,45,46,108,146,157,161,162}. None of the reported interventions in these studies specifically included vocational rehabilitation. Several controlled nonrandomised and observational studies, where return to work was a major aim of the rehabilitation program, showed significant benefit in return to work (see Chapters 12 and 15).

Comment

While exercise programs may improve levels of fitness for work and enhance self efficacy and psychological functioning, they may not be enough to prove effective in increasing return to work. Education and psychosocial support may have some additional effect, but can be ineffective unless return to work is a formal aim of cardiac rehabilitation. These issues are discussed in Chapters 12 and 15.

Major risk factors

Recommendation

Exercise training alone may possibly lead to improvement of risk factors (lipid profile, smoking, weight control, blood pressure control). However, the improvement is not apparent in the absence of a comprehensive rehabilitation program. Education, counselling and support are additionally recommended to improve risk factors.

The strength of evidence is different for each risk factor. However, as indicated below, it is difficult to attribute reported improvement in risk factors to exercise alone, as many studies were of multifactorial interventions, with exercise as a major component.

Lipids

Strength of evidence = 3

A beneficial effect upon lipid levels has not been clearly demonstrated from exercise training alone in randomised trials. One showed statistically significant total cholesterol lowering in the exercise group⁸⁸, while three did not^{17,43,163}. This may be partly due to the relatively short period of the exercise training.

Beneficial differences in lipid profiles have been demonstrated in randomised multifactorial trials of cardiac rehabilitation during convalescence, where exercise is one ingredient of the program and attention is also paid to nutritional and behavioural advice and support^{14,15,104,105,116,143,144,164–166}. However, in others, no statistically significant benefit has been demonstrated using the same outcome measure^{109,167}.

Favourable increases in HDL cholesterol levels have not been reported in randomised clinical trials of exercise training in cardiac patients. Two observational studies^{168,169} showed a rise in HDL cholesterol during exercise training lasting six months and five years respectively. In a randomised trial of exercise training in sedentary men and women aged 50–65 years, HDL cholesterol rose in those enrolled in exercise training of moderate intensity over a two year period¹⁷⁰. These time frames make it unlikely that improvement (increase) in HDL cholesterol can be achieved through exercise training in ambulatory rehabilitation programs of up to three months duration.

Smoking habit

Strength of evidence = 3

Three randomised controlled trials have shown no benefit in terms of reduction in the rate of return to smoking through exercise training alone^{88,90,146}. Those randomised trials in which improved smoking habit has been demonstrated have included patient

education, support and attention to behavioural change and maintenance of change, in addition to exercise training^{104,118}. However, four multifactorial trials showed no difference^{14,143,164,171}. Non-randomised trials have shown improved smoking habits in the multifactorial intervention group^{16,152,172-174} and others have produced no significant difference between groups^{138,175,176}. Observational studies have shown reduced smoking habits at the end of cardiac rehabilitation programs¹⁷⁷⁻¹⁸⁰.

Body weight

Strength of Evidence = 4

One randomised controlled trial of exercise training alone compared with standard medical care documented lower body weight in the intervention group⁴³. Another failed to demonstrate significant intergroup differences⁹⁰. In randomised multifactorial cardiac rehabilitation programs, five studies reported statistically significant lower weight in the intervention group^{14,15,105,144,164}. Four found no difference^{44,118,143,171}. Non-randomised controlled studies and observational studies are similarly divided between demonstration of benefit and no benefit².

While it may be reasonable to assume that aerobic exercise training, without increased caloric intake, should result in lower body weight, the above studies failed to show that exercise training alone is effective in reducing body weight. Further, even combined with other measures, body weight may be resistant to change. It is possible that overweight non-smokers may lose weight through exercise training and cardiac rehabilitation, but that those who cease smoking following a cardiac event may increase in weight. Thus, the group mean weight and body mass index may not change. Further, those who adhere to an increased level of activity may increase their caloric intake.

Expert opinion that weight loss should be achieved by exercise training is not well supported by scientific evidence.

Blood pressure

Strength of evidence = 4

Two randomised trials of exercise training alone resulted in no significant difference in blood pressure between groups^{106,143}. Three randomised controlled trials have demonstrated better blood pressure control through comprehensive cardiac rehabilitation including exercise training^{14,15,43}, while three showed no difference between groups^{118,144,165}. Some non-randomised cardiac rehabilitation programs including exercise training have produced evidence of greater reduction of blood pressure than amongst controls^{16,152,181-183} while one reported no intergroup difference¹⁷⁵.

It is not possible to attribute better blood pressure control to exercise training alone in these studies, because blood pressure control may well be affected by greater

prescribing of medication for those noted to have raised blood pressure in rehabilitation classes. Further, the level of adherence to medication may be affected by other factors.

Nevertheless, based upon expert opinion, comprehensive cardiac rehabilitation is recommended as a means of favourably influencing blood pressure.

Comment

The effects of exercise training alone on major risk factors (lipid profile, smoking habit, weight control, blood pressure) appear to be statistically slight, insignificant or absent. Those studies producing favourable results have usually been multifactorial management programs, extending over months or years and including specific attention to risk factors. They have usually consisted of combined medical and other health professional care in special management clinics. This degree of intervention is beyond the scope of usual ambulatory cardiac rehabilitation programs conducted during convalescence. However, modification of risk factors is of critical importance in reduction of recurrent events, morbidity and mortality. A convalescent ambulatory cardiac rehabilitation program, including group exercise, education and support, may be regarded as a “launching pad” for secondary prevention. To achieve this aim, however, closer linkage with medical care is required.

Subsequent exercise habits

Recommendation

Exercise training is recommended to improve subsequent exercise habits. However, programs should be followed by longterm availability of support and facilities for maintenance of activity.

Strength of evidence = 3

The positive effect of exercise training on exercise habits has usually been limited to the period during which patients are enrolled in the exercise training program. Return to prior levels of activity or inactivity commonly occurs after discharge from the program. In randomised controlled trials of exercise training, significant improvement in subsequent exercise habits has been reported in six trials^{88,105,144-146,184} but no difference in four trials^{28,44,160,185}. Some observational studies have demonstrated better exercise habits following a period of exercise training^{174,186,187}. Maintenance (phase 3) programs with continued availability of group exercise classes, support groups and clinical review providing advice and encouragement are likely to be required for maintenance of activity levels.

Comment

The majority of studies concerning exercise habits involved men under 65 years of age following myocardial infarction. It is important to recognise that exercise in most of these studies was high intensity aerobic exercise training which is not embraced by the great majority of people over the age of 50 years¹⁸⁸⁻¹⁹¹. Hence, abandonment of high intensity exercise is almost inevitable. It may well be that, with lower levels of exercise, an established pattern of regular walking or other increased levels of activity could be achieved. This possibility requires further study.

Morbidity, recurrent events, hospital readmissions and mortality

Recommendation

Exercise training extending beyond convalescence, with a maintenance or follow-up (phase 3) program is recommended to reduce morbidity, recurrent events, hospital readmissions and mortality.

Strength of evidence = 2

The evidence for these claims for secondary prevention comes from a few studies with longterm follow-up support^{14,17,185} and from meta-analyses^{80,81}. As suggested earlier in this chapter, it may be that some benefits arise not from the exercise training itself, but from the comprehensive nature of the interventions. The reduction of mortality is largely demonstrated in randomised trials conducted in Finland, Britain and Continental Europe in the 1970s and 80s. Longterm follow-up programs in these trials was made possible by the nature of the health care systems in the countries in which the studies were undertaken. Similar positive outcomes have been reported in the controlled study from Sweden with reports of five and 10 year follow-up^{16,91}.

Both the Finnish^{14,185} and the Swedish^{16,91} studies showed improved risk factor profiles in the multifactorial intervention groups, compared with the controls, during the first three and five years respectively. The SCRIP trial from the USA showed benefits through intensive application of nurse-managed shared care¹⁵. While not as yet showing a significant mortality difference, significant differences in risk factor profiles have already been demonstrated between the treatment and control groups in this study. Reduced progression of coronary artery disease has also been shown in this study by quantitative angiography.

Comment

Exercise training alone may account, in part, for better outcomes if it leads to improved habits and risk factors in the longterm. However, it is clear that major benefits are more apparent from long term multifactorial interventions. These outcomes include morbidity, recurrent events, hospital readmissions and mortality.

Conclusions

A comprehensive review of the scientific literature shows that physical outcomes in cardiac patients are definitely improved by exercise training. The evidence for improved psychological and social functioning is favourable, while the evidence for improvement in risk factors, behaviours and resumption of work is equivocal. The addition of education, counselling and behavioural interventions to an exercise training program produces demonstrable benefit in all outcome measures.

The greater increment in maximal oxygen uptake, strength and physical functioning is directly attributable to the exercise itself. The other benefits of exercise training may possibly be attributable in part to the exercise. However, they are more likely to be due to the effects of group interaction, the availability of health professional advice and peer support.

The difficulty of separating the effects of exercise from the psychosocial benefits of group activity, patient interaction and access to health professionals is a further argument for approaching cardiac rehabilitation as a comprehensive program. The major portion of a benefit may be attributable to any part of the program or to the program in its entirety. The addition of a new or modified component may produce changes in few patients, not reflected in the psychological, social or even physical outcome measures in the group as a whole. Further, any group program may have favourable effects which cannot be demonstrated by intergroup outcome measures. This could be the case, even if all patients consider the new added intervention or support to be beneficial.

Many patients are fearful of possible adverse effects of various physical activities or of any form of exercise. Demonstration of the capacity to be active with safety, initially with supervision and subsequently without supervision, facilitates recovery of morale. This in turn may lead to other beneficial effects. Nearly all patients claim that they are greatly assisted, physically and psychologically, by participating in an exercise program. However, this common claim has proved difficult to demonstrate in randomised controlled trials where the primary emphasis has been upon physical measurement. Psychological and social outcomes are more difficult to measure, as discussed in Chapters 13 and 18.

CHAPTER 8

THE AMOUNT OF EXERCISE TRAINING

In Chapter 7 the demonstrated benefits of exercise training were reviewed. In this chapter major issues are explored relating to:

- the intensity of exercise training
- the determination of “training heart rate” and “rate of perceived exertion”
- the frequency, number and duration of exercise classes
- home exercise programs
- continuing exercise and levels of physical activity
- eligibility for and exclusions from exercise training.

Intensity of exercise training

Recommendation

Low to moderate intensity exercise training is recommended for all cardiac rehabilitation programs. Exercise training at low to moderate intensity has effects similar to those of moderate to high intensity exercise training.

Strength of evidence = 2

While most exercise training programs in the USA (and many in Europe) are based upon high intensity exercise, most in Australia (and the United Kingdom) are based upon low intensity exercise. As previously stated, nearly all past studies investigating the effectiveness of exercise have compared high intensity exercise training plus standard medical care with medical care alone. Further, most of these studies did not include high risk groups. However, there are now four randomised clinical trials which have compared the effects of high and low intensity exercise training upon multiple outcomes.

Rechnitzer et al¹⁹ compared two groups of low risk men randomly allocated to high intensity exercise (n=390) twice weekly or to low intensity exercise (n=371) once weekly for eight weeks, with continued similar exercise thereafter. There was no difference between groups in deaths or reinfarction during the four years of follow-up.

Blumenthal et al^{93,95} recruited 70 male patients up to six months after acute myocardial infarction. No differences were found in any physical, psychological or social outcomes between the two groups of low risk patients at follow-up three months after enrolment in programs of high or low intensity exercise.

Worcester et al^{94,96} studied 337 consecutive patients with acute myocardial infarction admitted to a single coronary care unit. Patients were randomly allocated to either a high intensity program (70–85% of maximal heart rate) thrice weekly or to a low intensity exercise program (less than 65% of maximal heart rate or less than 20 beats per minute over resting heart rate) twice weekly. Each group was encouraged to walk each day for at least half an hour. The study included high risk patients. Physical working capacity improved in both groups. After eight weeks the high intensity exercise training group had a greater physical working capacity (10.6METs) compared with the lower intensity exercise group (9.6METs). This 10% difference at the end of the eight week exercise program had disappeared at 12 months when both groups had the same physical working capacity (10.6METs). More importantly, there was no significant difference between groups in several measures of quality of life at entry to the study or at four and 12 months after the myocardial infarction.

Oberman et al⁹⁷ have reported only trivial differences in maximal oxygen uptake and rest to maximal exercise ejection fraction in patients randomly allocated to high intensity (n=111) or low intensity (n=89) exercise over a period of one year. Possible differences in risk factors and psychosocial adjustments between the two groups have not yet been reported.

From these trials, it appears that a higher level of supervised exercise training has a small, positive relationship to maximal physical working capacity at the completion of the exercise program, but no significant difference is achieved in the long term. Thus, while the process of reconditioning appears to be accelerated through high intensity exercise, it is not associated with any recognisable or demonstrable other benefit. It is therefore reasonable to conclude that low to moderate intensity exercise is, with the single exception of physical working capacity, as effective as high intensity exercise, provided that home activity (particularly walking) is encouraged and undertaken. Moderate to high intensity exercise training may be of additional benefit to those whose work is physically demanding.

Lower levels of exercise training (heart rate less than 70% of maximal heart rate or an awareness of slight breathlessness) are considered safe and require lesser supervision than higher levels of exercise training (greater than 70% of maximal heart rate). Although ventricular fibrillation is infrequent and death rare in high intensity exercise programs^{192,193}, the consensus view remains that high intensity exercise training requires prior risk stratification with a symptom limited exercise test, specific monitoring for high risk patients or exclusion from exercise training of such high risk patients^{68,69,71,74,130,194}. Thus, high intensity exercise programs are usually preceded by

risk stratification by technological methods. A symptom limited exercise test is performed to determine training heart rate. Electrocardiographic monitoring during the period of medically supervised exercise training is also recommended. There is a significant increase in costs because of such testing and monitoring.

Categorisation of exercise intensity

Categorisation of exercise intensity (low, moderate, high) may be by symptoms, perceived exertion by Borg's scale¹⁹⁵, or by heart rate. Categorisation should not be by correlating levels of various activities with METs (metabolic equivalents), without due allowance for age and CVD status of each patient.

1 MET is the oxygen consumption at rest, measured as 3.5ml O₂/Kg/min. 2 METs would be equivalent to strolling at about 3kms/hour for a healthy person. 3.5 METs should be equivalent to walking at about 5kms/hour (the usual walking pace for a middle-aged male). One could therefore suggest that 3.5 METs is light exercise. That would be so for a healthy male. It may well be a high level of activity for an elderly woman, for a patient with controlled or compensated heart failure or for a patient deconditioned by a long period of immobilisation in hospital.

Exercise three times per week for 20–30 minutes, which leads to breathlessness and sweating, is performed by 2% of men and 1% of women aged 60 to 69 years in Australia¹⁸⁸. Activity at this level, performed less frequently, is undertaken by 10% of men and 8% of women of the same age. The proportions are only 3% and 18% for men and 2% and 14% for women aged 50 to 59 years. Walking for exercise is undertaken by 65% of men and 57% of women in these age groups¹⁸⁸. Similar attitudes and sedentariness have been noted in the USA^{189–191} and elsewhere. As one of the aims of reconditioning through exercise training is to lead to a more active longterm lifestyle, it is preferable that the activity is enjoyable or acceptable. Prescribed high intensity exercise training involving attention to clothing, weather conditions and adherence to a regular thrice weekly time slot is likely to lead to abandonment of the physical training program. In the study by Oberman et al⁹⁷, the dropout rate from high intensity exercise was twice that from low intensity exercise. This difference, however, was less apparent in the study by Rechnitzer of low risk, somewhat younger men^{19,92}.

Low intensity exercise

Low intensity exercise (see Table 6) is acceptable to almost all patients. It can be managed by the elderly and by patients with incipient or actual heart failure. It is associated with little risk and requires little supervision. However, some monitoring is needed for the disabled and those with congestive heart failure. Examples of low intensity exercise programs are given in Annex 1 and 2 of the Report of the WHO Expert Committee¹.

Moderate intensity exercise

Moderate intensity exercise (see Table 6) is acceptable to many patients. It may prove difficult to incorporate into daily living activities on a long term basis and can lead to musculoskeletal injury in the elderly. It may not initially be within the capacity of many older patients and probably should not be attempted by those with heart failure except with careful supervision.

High intensity exercise

High intensity exercise (see Table 6) is embraced by only a small minority of patients. It is a barrier to participation in cardiac rehabilitation for the elderly, the obese and for most middle aged or older women. It is beyond the capacity of those with heart failure or significantly impaired left ventricular function and requires prior testing for safety and determination of a training heart rate. High intensity exercise requires monitoring. Further, it is unlikely to be subsequently incorporated into the life activities of most patients. For some patients, however, high intensity exercise training is a desired level of activity, particularly for younger males who are usually of higher socioeconomic status and who are in a position to continue such activity in a social or gymnasium environment. It may also be desirable for rapid reconditioning of those in physically demanding work.

The need for high intensity exercise has now been questioned in the USA^{97,196} and many programs now offer moderate intensity exercise training. While high intensity exercise represents the quickest method of achieving or regaining fitness, it is the most demanding on resources and costs. Further, it delivers a program with limited appeal and with poor equity of access.

Comment

Low to moderate levels of physical exercise training, coupled with regular physical activity at home, approaches that of high intensity exercise training as a mode of enhancing physical working capacity. High intensity and low intensity exercise training appear to be equally effective in accelerating psychosocial recovery. Thus, low to moderate intensity exercise is recommended as best practice for cardiac rehabilitation programs. As well as producing comparable physical benefits to those achieved through high intensity exercise, it is acceptable to a larger proportion of the population with greater safety. Further, because of the reduced need for technology and medical supervision, low to moderate intensity exercise training programs can be delivered at low cost.

Measuring exercise intensity

Heart rate

Moderate or high intensity exercise is commonly monitored by heart rate, aiming at a specified training (or target) heart rate. The training heart rate during exercise is usually based upon a prior symptom limited exercise test. Some have suggested that the training heart rate may be calculated from a simple formula.

Recommendation

Training heart rates for moderate to high intensity exercise should be based upon actual measurements of individual patients' maximal heart rates from a maximal stress test. They should not be based upon calculations of heart rates from formulae devised for healthy adults.

Strength of evidence = 3

Determination of training heart rate from exercise stress test

For high intensity exercise it is usual to perform a symptom-limited maximal stress test to determine what is the maximal heart rate that can be achieved by an individual at the time when it is no longer possible to continue the test. The peak heart rate achieved is that patient's maximal heart rate. From that may be determined the percentage of the maximal heart rate at which patients exercise. With high intensity exercise this is usually between 70%–85% of the achieved maximal heart rate from a maximal stress test. Low intensity exercise is usually in the range of 50%–65% of the achieved maximal heart rate. Moderate exercise lies in the band of about 60%–75% of achieved maximal heart rate. Thus, there is a correlation between low, moderate and high intensities of exercise training and the percent of maximal heart rate.

The scale devised by Borg¹⁹⁵ also correlates reasonably well (see Table 6 and later section in this chapter entitled "Perceived exertion"). A rating of perceived exertion of 10–12 ("Light") corresponds with low intensity exercise training. A rating of 12–14 ("Somewhat hard") corresponds with a moderate exercise training level and a rating of 14–16 ("Hard") corresponds with high intensity exercise training. These correlations are set out in Table 6. However, the correlations constitute a guide only and represent approximations.

Table 6: Correlation with exercise training levels (approximate)

Exercise training level	Rate of perceived exertion (Borg)	% of maximal heart rate on test	Increment over resting heart rate
LOW	Very, very light	6	10–25
		7	
		8	
	Very light	9	
		10	
MODERATE	Light	11	50–65
		12	60–75
	Somewhat hard	13	
	14		
HIGH	Hard (heavy)	15	70–85
		16	30–55
	Very hard	17	
		18	
	Very, very hard	19	
		20	

Note: Chronotropic dysfunction (refer below), present in many cardiac patients, may result in a lower maximal heart rate, thereby permitting a higher percentage of maximal heart rate at any given workload. Further, the possible blunting of heart rate response in some patients generates a wide range of increment over resting heart rate. In addition, the different levels of exercise training and of perceived exertion may be accompanied by significant overlapping of percentage of maximal heart rate and increment over resting heart rate.

Determination of training heart rate from formula

There are some who consider that the formula 220 minus years of age is a suitable method of calculating the maximal heart rate for cardiac patients. This could expose individual patients to unnecessary risks. This risk applies whether the training heart rate is based upon a calculated percentage of the maximal heart rate, or upon a calculated percentage of heart rate reserve.

Following acute myocardial infarction, coronary artery bypass graft surgery, or other acute cardiac illness, heart rate response to exercise may be affected by chronotropic dysfunction of variable degree^{197–199}, possibly further modified by medication. Thus, the normal increment in heart rate at increasing levels of exercise may not be followed. Further, the maximal heart rate achieved by a symptom limited maximal exercise test may fall far below that expected from any formula devised for normal subjects.

Formula-based percentage of maximal heart rate

Example

Consider the case of a 52 year old male three weeks after AMI. From the formula $(220 - \text{age})$, the maximal heart rate (HR max) is $220 - 52 = 168$ beats per minute.

A calculated training heart rate of 70% of HR max (70% of 168) = 118 beats per minute

A calculated heart rate of 85% (85% of 168) = 143 beats per minute.

In one series of 238 male patients at mean age of 52 years, who underwent symptom limited maximal treadmill testing three weeks after acute myocardial infarction⁹⁴, the achieved HR max was $147 (\pm 20 \text{ SD})$ beats per minute. Only 12% of these patients were taking a beta blocker and 15% were taking a calcium blocker. In this group of patients the calculated 70% of HR max (118 beats per minute by formula) would actually be 80% of the achieved HR max on treadmill test. The calculated 85% of HR max (143 bpm by formula) would actually be 97% of achieved HR max from a maximal stress test. Fortunately, most patients cannot achieve such a level of activity, being limited by breathlessness, fatigue or profound distress. This level of activity, if attempted, could prove fatal. Further, it must be noted that individual variation is great (for example, $\text{SD} \pm 20$ beats per minute).

Formula based percentage of heart rate reserve

The other manner in which the formula has been used is to determine the training heart rate based upon a percentage of "heart rate reserve" as suggested by Karvonen²⁰⁰, say 65% of the difference between resting heart rate (measured) and the HR max (calculated from the formula).

Example

Consider the case of a 52 years old man three weeks after AMI. The formula based maximal HR max of $220 - 52 = 168$ beats per minute.

Assume a resting heart rate of 83 beats per minute (the mean resting heart rate of the above group of 238 patients with mean age of 52 years). The heart rate reserve would therefore be, calculated from the formula, $168 - 83 = 85$ beats per minute.

65% of heart rate reserve (65% of 85 beats per minute) = 55 beats per minute.

This would give a training heart rate (resting heart rate $84 + 55$) = 139 beats per minute

139 beats per minute is estimated to be 95% of the HR max determined by test - a dangerous level of exercise.

The concept of using a formula to obtain maximal heart rate based upon 220 less the patient's age in years should not be considered as having a place in exercise programs in cardiac rehabilitation.

Perceived exertion

Studies conducted by Borg¹⁹⁵ have resulted in a scale of rates of perceived exertion. The scale ranges from "no exertion at all" or "very, very light" exertion at one end to "very, very hard" or "maximal" exertion at the other end of the scale (see Table 6). These rates of perceived exertion have been correlated with heart rate, presented as the percentage of the maximal heart rate determined by a symptom limited maximal exercise test. Based upon this correlation, it has become common practice for patients to exercise at a given rate of perceived exertion, which correlates with their advised or prescribed training heart rate. This correlation may also be applied to the increment in heart rate over the resting heart rate. Thus, it is possible for patients to monitor their own exercise levels, based either upon heart rate or rate of perceived exertion (see Table 6). One should refer to the note at the foot of Table 6 which highlights and explains the greater range of heart rates amongst cardiac patients than amongst normal subjects.

Frequency of exercise sessions and duration of program

Currently, most authorities and consensus statements in the United States of America still recommend supervised exercise of high or moderate intensity three times weekly (preferably not on consecutive days) for 12 weeks^{69,71,74}. This is based upon acceptance that improvement in physical working capacity tends to plateau from 10 to 21 weeks in such programs^{113,201}.

It has been accepted that if high intensity exercise training lasts for longer than half an hour, the chance of musculo-skeletal injury is increased. Further, it has also been confirmed that the risk of injury is greater if exercise training occurs more frequently than on alternate days^{202,203}.

The concept of exercising three times per week for 12 weeks (36 training sessions), with electrocardiographic monitoring, either with telemetry or other methods (limited leads or defibrillator paddles), has been the basis for funding of programs throughout the United States. It is recognised that this requirement needs to be changed (for example, there has been no defined insurance funding for non-ECG monitored programs, nor for education programs or psychosocial support of individual patients who may well require additional personal attention).

Frequency of sessions

Recommendation

Supervised twice weekly group exercise programs are recommended during convalescence as they achieve similar benefits to group exercise training conducted three times per week.

Supervised once weekly group exercise training may possibly be similarly effective. Supervised exercise should be coupled with a home activity/exercise program.

Strength of evidence = 2

Similar increments in physical working capacity have been reported in exercise training programs where patients attend thrice or twice weekly for supervised exercise².

The study by Worcester et al⁹⁶, comparing high and low intensity exercise, also included a comparison of thrice weekly (high intensity exercise) versus twice weekly (low intensity exercise). In view of the absence of significant differences between the two groups in all measures other than physical working capacity (attributed to the higher level of training in the high intensity exercise training group), it is reasonable to conclude that twice weekly group supervised exercise is almost as efficient in achieving desired outcomes as is three times per week during convalescence. This appears to have been accepted in some Canadian exercise rehabilitation programs where funding is not the basis for the structure of the program^{19,121}. In the Swedish controlled study, which demonstrated considerable benefits from a comprehensive rehabilitation and follow-up program after acute myocardial infarction, group exercise was also conducted twice weekly¹⁶.

One randomised clinical trial specifically investigated the relative benefits of frequency of supervised exercise sessions less than thrice weekly²⁰⁴. The increment in maximal physical working capacity, estimated by treadmill testing, was equal in those randomised to two or three training sessions per week. One training session per week resulted in increased treadmill time compared with the control group but less than was found in those who attended two or three sessions per week.

In another randomised trial, thrice weekly hospital based exercise training was compared with once weekly hospital based exercise training, coupled with two equivalent home based exercise sessions, and further compared with an unsupervised home activity program²⁰⁵. Physical performance increased in each of the supervised programs, with little difference between them. All three were superior to the totally unsupervised home program. There was little relationship between levels of depression at entry and on completion of each of the four programs. In the groups

with home walking (rather than home cycling), anxiety was less. This study suggests once weekly supervised activity, coupled with home walking, may be as effective as more demanding and costly thrice weekly hospital based supervised exercise programs.

Thus, while it is probable that one supervised group exercise session per week is beneficial, it has not been adequately demonstrated to be as effective as two supervised exercise sessions per week. However, coupled with home exercise (as it should be), it may prove equally effective. Patients commonly report considerable satisfaction with their exercise programs, irrespective of the number of sessions they attend each week⁷.

Duration of program

Recommendation

It is recommended that most patients should attend a twice weekly program for six to eight weeks (a total of 12 to 16 sessions) and a minimum of six to eight group discussions.

Strength of evidence = 4

The basis of 12 weeks of exercise training is as set out earlier in this chapter. This duration of supervised exercise training is not universally accepted. In studies in Canada^{19,121} and Australia^{94,96}, an initial eight week program was considered sufficient.

Six to eight weeks has also been considered adequate in most other Australian programs^{5-7,10,39-41}. In these programs, the exercise training component is usually perceived by patients as an important part of their convalescent care. The educational and support aspects of the program are commonly perceived by staff as of equal or greater importance. Hence, the duration of the program may be more likely determined by the educational and behavioural needs of patients. It is considered that a longer program may delay return to work and possible loss of work in consequence. These issues have not been adequately studied. It is not known for how long a regular supervised group exercise program should continue. The consensus in Australia would suggest that eight, six or even four weeks may be enough to facilitate recovery from an acute cardiac event and to initiate behavioural change. The Minimal Standards document of the National Heart Foundation is in line with this consensus⁷⁹.

Comment

It is important to recognise that there is no mean or average patient. Some patients require little support, education or advice about activity. Some may have only one or few questions about activity, health behaviours or other matters which they seek to gain from a program. Such matters may well be asked and resolved during exercise

classes. On the other hand, there are some patients whose needs appear to be impossible to meet. They are frequently seeking additional advice, often on matters upon which they have already been advised. In terms of best practice guidelines, one seeks to find a reasonable mean for the duration of programs with the recognition that some patients will require less, others will require more, but the majority will be satisfied and will have achieved the aims of the ambulatory program within a defined period of time.

Patients who are unfit, frail, elderly or who have heart failure need continued, longterm support with both dynamic and resistive exercises (including in groups) to encourage and help the maintenance of muscle strength and fitness. For these patients, longterm community-based activity programs are therefore required. Such programs are not perceived as standard ambulatory cardiac rehabilitation during convalescence, but the linkage is apparent between cardiac rehabilitation and supportive care for the aged and infirm.

Home exercise programs

Recommendation

A home exercise program is recommended for those patients who are unable to attend a group exercise program. A daily home walking program is recommended as a supplementary activity for all patients enrolled in a group program.

Strength of evidence = 2

Trials conducted in the USA have compared home versus hospital ambulatory group exercise^{206,207}. These have shown benefits in physical working capacity and psychosocial outcomes approaching those achieved by patients randomly allocated to a hospital based group program. While home-based programs reduce patient travelling time, patients who undertake exercise training at home may still require careful assessment before an exercise prescription is offered them, if they are to undertake moderate or high intensity exercise. Further, in the reported trials, patients had a cycle ergometer at home for their prescribed exercise session, telephone communication with the nurse program co-ordinator and facilities for telephone electrocardiographic transmission during exercise. While this extends the opportunities for individual patients to participate in supervised high or moderate intensity exercise, it is not of low cost. Further, it could be irrelevant. If lower levels of exercise are accepted, telephonic monitoring would become unnecessary for the great majority of patients.

It may not be possible for all patients to attend a group cardiac rehabilitation program. Such patients require guidance regarding exercise, education and behaviour

change, as well as support. Simple verbal and written instructions to such patients are required, together with discussion about activity and behaviour while in hospital (inpatient rehabilitation) and as part of discharge planning. Follow-up by telephone may be possible²⁰⁸. General practitioner follow-up should be assured.

Ideally, patients receiving a home-based program should attend at least one group exercise session for guidance regarding home exercise and to learn the level of exercise recommended for them. They should learn self monitoring based upon observation of heart rate during activities or recognition of symptoms to the level of awareness of breathing (Borg scale 10–12: Table 6)¹⁹⁵. They should be advised to continue activity at that level on a daily basis, preferably for half an hour each day.

Home exercise programs generally involve daily walking at a low or moderate intensity (ref 205), as well as other physical activities with gradual progression to achieve an increase in muscular strength for activities of daily living.

Patients who are enrolled in a group exercise program should also follow a home activity program, accumulating at least 30 minutes of activity daily at a similar level of perceived exertion or heart rate.

Continued exercise beyond convalescence

Recommendation

Following ambulatory rehabilitation, a multifactorial program of longterm follow-up should be offered to all patients as a part of their continuing management. All patients should maintain a continuing level of activity, including 30 minutes of walking or its equivalent each day, and should maintain muscular strength to manage all activities of daily living.

Strength of evidence = 1

For a low or moderate activity exercise program, half an hour per day of activity at a level of awareness of breathing is sufficient to achieve progressive improvement in physical functioning and is sufficient to achieve psychological benefits similar to those claimed to be achieved by high intensity exercise training three times per week^{93–97}.

Randomised and controlled trials have shown that multifactorial cardiac rehabilitation programs (including exercise, education, support, behavioural change and review) induce a wide range of benefits if continued over several months or extending out to a few years^{14–16,91,209}. These trials indicate the desirability of continued support, as required or on a regular basis, until the changed behaviours have become part of the patient's lifetime pattern. Such trials have demonstrated major benefits

through improvement in risk factors, fewer recurrent episodes, fewer readmissions to hospital, fewer myocardial infarctions and fewer deaths. Further, one trial has demonstrated, through multifactorial programs of this type on a continuing basis, slowing or reversal of coronary artery lesions¹⁵. While another trial of a comprehensive program successfully demonstrating lesion reversal, the intervention was extremely time consuming and costly and required considerable dedication of both patients and staff¹⁴⁴. It is therefore unlikely that such an intervention would be acceptable to many patients. More trials are required to define the ingredients and duration of effective programs to encourage maintenance of regular physical activity.

One longer term study has shown that, in a multifactorial rehabilitation program, increased physical activity up to a total caloric utilisation of 1500 kilocalories (during training and leisure time) results in slowing of lesion progression, while physical activity at a level of 2200 kilocalories per week leads to reversal of lesions¹⁰⁵. This raises the possibility that the more leisure time physical activity undertaken by patients, the better. This suggestion is similar to that which has been recommended by some, based upon epidemiological and observational studies in normal subjects^{210,211} but which is not supported by others²¹²⁻²¹⁴, who appear to have demonstrated that most of the benefits of physical activity are achievable by moderate levels of exercise and fitness.

It is possible to achieve a level of 2200 kilocalories per week through moderate intensity exercise such as walking, with awareness of increased breathing, for a period of one hour each day of the week, either singly or in broken periods. Further, it may not be necessary that the physical activity be evenly divided throughout the week. Additional research is required in this area. However, it is important to recognise that the majority of middle aged or older people are not prepared to exercise regularly at a higher level¹⁸⁸⁻¹⁹¹.

A further issue is whether exercise training will raise HDL cholesterol as an additional protective factor in lipid profiles. There is little evidence for this but one study showed that regular moderate daily activity extending over many months led to a gradual increase in HDL cholesterol¹⁷⁰.

Eligibility for exercise programs

Recommendation

Group cardiac rehabilitation, including exercise, should be offered to all patients with cardiovascular disease (with the proviso that some may be incapable of participation in group activity and should be offered individual assistance). Cardiovascular disease includes special groups of patients described in Chapter 11.

Strength of evidence = 1

Until recently, it was recommended that high risk patients should not be enrolled in exercise training programs (based upon moderate to high intensity exercise). Several trials and observational studies have now shown, however, that low levels of exercise lead to improvement in physical functioning and quality of life. This applies to patients with impaired ventricular function, with controlled cardiac failure and with symptomatic or asymptomatic residual ischaemia^{1,2,215-217}.

According to one report, patients with heart failure awaiting transplantation who followed a program of low intensity exercise were removed from the transplantation waiting list because they achieved improvement in their physical functioning²¹⁸. It has been demonstrated that improvement in physical functioning usually occurs without any demonstrable improvement in cardiac function; that is, there is no significant change in ejection fraction or wall movement abnormalities. The improvement lies in peripheral muscle efficiency with greater extraction of oxygen, increased peripheral muscle strength and improved muscular efficiency, so that patients may function at the same level of physical activity, but with lesser cardiac work (lower systolic pressure, lower heart rate, lower rate/pressure product)²¹⁹⁻²²⁵.

Thus, it has now been confirmed that patients who were previously excluded from programs can be enrolled and do improve with graded low intensity exercise, with slow progression. Therefore, there should be few exclusions on physical grounds from cardiac rehabilitation programs. Physical problems are no longer a barrier to participation. However, those who require significant attention may be better supported and encouraged on an individual basis rather than in a group.

Exclusion from exercise training

A sizeable list of exclusions from exercise training in cardiac patients has been prepared by the American College of Sports Medicine 5th Edition (1995)⁷¹. Most of these exclusions are reasonable for high intensity exercise and many apply to low intensity exercise.

One exclusion, apparently fit and healthy patients, is meant to indicate that some require no exercise training. However, such patients could well obtain other benefits from undergoing exercise training, including reassurance, psychological support, reinforcement of the need for behaviour change and adherence to regimens, additional education and better understanding of the illness.

Another exclusion from exercise training (unstable angina) is reasonable for high intensity exercise. However, such patients may achieve considerable benefits from light exercise and from education and support.

A third exclusion (no recent exercise test) would apply to those patients who are to be enrolled in a high intensity exercise program, and who, on clinical assessment, are at high risk and for whom a training heart rate prescription has not yet been prepared.

All of the other exclusions are serious conditions requiring attention before exercise is commenced. These are:

- Significant hypertension or hypotension
- Severe aortic stenosis
- Uncontrolled arrhythmias
- Uncontrolled congestive heart failure
- Uncontrolled diabetes or metabolic disturbance
- High grade atrioventricular block without a pacemaker
- Current pericarditis or myocarditis
- Recent pulmonary or other embolism
- Recent stroke or transient ischaemic attack
- Recent major surgery
- Terminal illness or severe disabling concurrent illness
- Acute febrile or systemic illness
- Physical or psychological disability preventing participation

An additional reason for exclusion is physician or patient refusal.