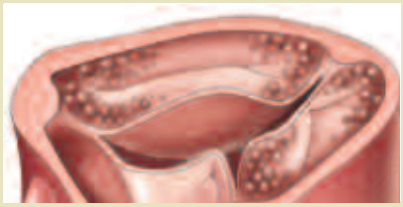
abstract



Coronary heart disease is a major cause of morbidity and mortality in older patients. For this population cardiac rehabilitation offers an improvement in functional capacity, alleviation of symptoms, enhanced mood state and quality of life, and a modification of coronary risk factors. The components of a comprehensive programme specific to older adults are the same as for younger patients, with exercise training the mainstay. However, the changes that accompany the aging process require some modification in both the aerobic and resistance exercise programmes. Unfortunately, the referral rate of older patients, particularly women, is poor. Hopefully, this could be rectified if physicians come to realize that this segment of the population is the most likely to benefit from cardiac rehabilitation.

Key words: *cardiac rehabilitation, aging, exercise training, coronary heart disease, referral patterns*

Cardiac Rehabilitation in the Older Population

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Introduction

Persons over the age of 65 account for 60% of all myocardial infarctions and revascularization procedures in Canada. Furthermore, a high proportion of this age group suffer from symptoms of coronary heart disease, are more highly disabled than their younger counterparts, are more prone to recurrent events, and have a higher prevalence of heart failure.[1] They also have more comorbid conditions, including osteoarthritis, hypertension, diabetes, chronic lung disease and osteoporosis. As a consequence over one-third are markedly limited in carrying out activities of daily living in the home or elsewhere.[2] This, then, is a population that is in need of cardiac rehabilitation and would stand to gain the most from its multifaceted services. Traditionally, however, attention has been directed to younger patients, and only recently has there been increasing interest in the value of cardiac rehabilitation in those aged 65 years and older. This shift in emphasis is well timed, since the oldest-old (those over aged 80 years) is the fastest growing portion of the older population, accounting for 20% of those aged over 65 years in 2001, and is projected to increase to 35% by the year 2016.[3]

Referral Patterns

Overall, the reported referral rate of patients considered suitable for cardiac rehabilitation varies from 15–30%. Those most likely to be referred include younger patients who are physically active with a good functional capacity, speak English, and live in a city.[4] In contrast, patients over 70 years of age, and those with a history of chronic lung disease and neurological or cognitive impairment, are less likely to be considered for cardiac rehabilitation.[5] Despite similar clinical profiles, older women are less likely to be referred than older men, possibly due to the referring physician's perception that cardiac rehabilitation is less efficacious in women, or that women are more adverse to exercise.[6] A number of studies have examined the factors that influence the referred patient's decision to enrol in and attend a cardiac rehabilitation programme. The enthusiasm of the referring physician has been shown to be the most powerful motivator,[6,7] whereas low functional status, poor spousal or family support, and a lower socio-economic status or education predict nonattendance.[8]

Benefits of Cardiac Rehabilitation

Although evidence favours the beneficial effects of cardiac rehabilitation in the younger patient, data on older adults are less robust. There are fewer randomized controlled trials and sample sizes are smaller. Nevertheless, the current literature provides sufficient information to permit conclusions to be drawn regarding outcomes.

Risk Factor Modification

An essential component of a comprehensive cardiac rehabilitation program is the identification and management of the patient's risk factors.[9] This approach is the same for old and young. The Coronary Artery Surgical Study established that smoking cessation lessens

Table 1: Benefits of Aerobic Training[18–31]

Increase in maximal work capacity as well as a greater tolerance for prolonged submaximal physical tasks*
Decrease in rate pressure product and thus myocardial oxygen demand at rest and at the same submaximal levels of effort (net effect is to increase the threshold for angina and/or ST-segment depression)*
Reduction in abdominal (visceral) adiposity, with enhanced sensitivity to insulin, improved glucose tolerance, and a consequent reduction in the risk of type 2 diabetes*
Reduction in triglycerides and an increase in HDL-cholesterol levels*
Lowering of systolic and diastolic blood pressure in hypertensive subjects*
Enhanced mood state and quality of life*
Increase in fibrinolytic activity, a reduction in fibrinogen levels, and platelet activity
Decrease in resting and exercise plasma catecholamine levels and sympathetic tone with a consequent reduction in the threshold for lethal ventricular arrhythmias
Improvement in endothelial function

*Benefit demonstrated in older patients with CAD

the risk of a myocardial infarction in older as well as younger men and women with coronary artery disease compared to those who quit, the relative risk of an event in the age groups 35–54, 55–64, and over 65 years was 1.6 (95% CI, 1.4–1.9), 1.7 (1.4–2.1), and 1.6 (1.1–2.3), respectively.[10]

Although the relative risk of an elevated LDL-cholesterol level is lower in older adults compared with younger individuals, the absolute risk is high. This may explain why the National Cholesterol Education Program (NCEP) advised that older persons should not be denied the benefits of lipid-lowering therapy on the basis of age alone.[11] As proof of this approach, two large clinical trials demonstrated that older subjects (65–80 years) who were at high risk for cardiovascular disease, as well as with established disease, responded favourably to statin therapy, with a significant reduction in fatal and nonfatal coronary heart disease as well as fatal and nonfatal strokes.[12,13]

Lipid lowering is more readily achieved with medication than diet in older subjects with coronary heart disease. However, one study involving 74,000 healthy men and women aged 60 or more and recruited from 10 European centres reported an 8% reduction in all-cause mortality in those following a modified Mediterranean diet.[14]

Systolic hypertension occurs in over 50% of individuals 65 years or older. Nonpharmacological therapeutic measures include moderate physical exercise, sodium restriction (100 mmol/day), weight reduction, moderate alcohol consumption, smoking cessation, and an adequate daily intake of dietary potassium and calcium.

The efficacy of antihypertensive drug treatment in the older patient has been established in the Systolic Hypertension in the Elderly Program (SHEP), which reported a 30% reduction in fatal and nonfatal cardiovascular events and a 50% reduction in heart failure in patients on a beta-blocker and diuretic regimen.[15] Similar benefits were seen in a European trial,[16] and a meta-analysis of randomized control trials.[17]

Observational studies of comprehensive rehabilitation programs in the older population that include education, dietary counselling and behavioural modification as well as exercise have reported significant reductions in body mass, percent body fat, and body mass index, as well as improvements in total cholesterol, triglycerides, HDL-cholesterol and HDL/LDL ratio.[18,19]

Table 2: Benefits of Resistance Training in Older Patients with or without CAD[38–42]

Increases in maximal muscle strength and lifting endurance
Improvements, or retarded losses, of bone mineral content and bone mineral density
Increase in peak exercise capacity, submaximal endurance, and reduced ratings of perceived exertion during submaximal exercise
Reduced arterial pressure during lifting with the trained muscles
Improvement in tasks demanding significant arm or leg strength or balance
Improvement in quality of life parameters such as total mood disturbance
Depression/dejection, fatigue/inertia, and emotional health domain scores

Table 3: Physiological Changes that Occur with Aging

Gradual decline in maximal heart rate and maximal oxygen intake due to reduced beta-adrenergic sensitivity
Slower increase and decrease in heart rate at the onset of exercise and in recovery
Elevated systolic blood pressure, the result of an increase in aortic and large vessel wall stiffness
Postural hypotension, the consequence of a decrease in baroreceptor responsiveness and postexertional venous pooling (common in 30–50% of those over 75 years)
Impaired heat tolerance due to reduced sensation of thirst, an increase in subcutaneous fat (limiting heat loss by radiation) as well as atrophy and loss of sweat glands (reducing evaporation)
Increase in various conduction defects—e.g., sick sinus syndrome, bundle branch block, atrial ventricular block—because of a decrease in pacemaker cells and bundle branch fibres
Atypical adverse drug reactions
Increasing tendency to diastolic dysfunction and exertional dyspnea, the result of slow left ventricular relaxation, reduced diastolic distensibility, and increased chamber stiffness

Improvement in Mood and Quality Of Life

Older coronary patients, in addition to exhibiting high levels of physical disability, may also suffer from somatization, are subject to moderate to severe depression/anxiety states, and score poorly on quality of life measures.[20] A number of studies have reported significant improvement in mood state and total quality of life following a 12-week comprehensive cardiac rehabilitation programme.[21–24] Patients over 75 years appear to have an especially large benefit, with substantial improvements in mood.[19]

The one randomized controlled trial in older adults that evaluated quality of life after exercise training reported that a three-month intervention group experienced a marked improvement in chest pain and shortness of breath at submaximal leisure-time activities, as well as an improved alertness, physical ability, daily activity, and fitness. However, apart from chest pain and shortness of breath, some of these gains were lost at the 12-month follow-up. The authors concluded that continued reinforcement sessions are necessary to maintain the benefits gained.[25]

Mortality and Morbidity

Although epidemiological studies have demonstrated improved mortality in older patients who took part in a walking programme or were physically active;[26–28] no trials have been designed to determine the effect of cardiac rehabilitation on mortality. However, Bondestam and coworkers, in a controlled study, demonstrated a significantly lower incidence of rehospitalization and visits to the emergency department at three and 12 months in older patients who attended a four-month rehabilitation programme.[29]

Exercise Training

Aerobic-type exercise training was introduced in the 1950s to counter the deconditioning effect of prolonged immobilization in patients recovering from a myocardial infarction. It has remained a major component of cardiac rehabilitation because of its many benefits (Table 1).[30,31] Although most training-induced changes have been demonstrated in younger subjects, it is reasonable to infer that they would also be observed in an older population. Peak oxygen intake (VO_{2peak}) is the best measure of exercise capacity, and this has been shown to decline progressively from age 30 at the rate of approximately 3–8% per decade, and more rapidly after age 70 regardless of fitness level or habitual physical activity.[32] A VO_{2peak} of 15 mL/kg/min has been identified as the threshold below which independent living becomes difficult.[33] Older patients frequently enter a rehabilitation programme with VO_{2peak} values that range from 15–19 mL/kg/min, suggesting that they already have difficulties living independently. Thus, even a modest improvement in fitness will delay the onset of dependency. In fact, studies show that older patients can increase their peak oxygen intake by as much as 16–29% following exercise training, an improvement similar to or, in some cases, greater than their younger counterparts.[34,35] Older patients have also exhibited a training-induced reduction in rate pressure product, allowing them to achieve submaximal workloads at reduced ventilation, blood lactate levels, and perception of fatigue.[36,37] Activities such as climbing stairs, completing heavy household chores, or carrying out physical leisure-time activities are completed without angina or shortness of breath. None of the studies in this population reported any exercise mishap.

Resistance Training

Older patients should be encouraged to supplement cardiorespiratory endurance activities and an active lifestyle with strength developing exercises. Preferred inclusion criteria are moderate-to-good left ventricular function and an exercise capacity greater than five METs. Contraindications

Table 4: Prescribing an Aerobic Training Program for the Older Patient: Key Elements

Mode. By definition, aerobic exercise must be continuous and rhythmic; avoid high impact exercise such as jogging. Preferred activities include walking, stationary cycling, low impact or water aerobics, and swimming or arm ergometry. The activity should be accessible, convenient, enjoyable, and sociable (group sessions).

Intensity. Commonly, this is based on a percentage of VO_{2peak}, a percentage of maximal heart rate (HRmax), or on the patient's perceived exertion.

- VO_{2peak} Training intensities range from 40–85%, depending on fitness. Older patients, at least initially, will obtain a training effect at the lower intensities, i.e., 40–60%.
- **HRmax.** The preferred training range is HRmax 55–70%. Note that HRmax varies considerably in older individuals and where possible it should be measured rather than age predicted. A common age predicted equation is HRmax = 220 – age (yrs). On occasion, meaningful gains in cardiovascular fitness are obtained at training rates less than 100 bts/min, or where indicated, 10 beats below the heart rate safely achieved at exercise testing.

Perceived Exertion. In practice, the Borg numerical scale is the most commonly used (range 6 – 20). A rating of 12 is "light" and is equivalent to 40% VO_{2peak}, whereas a rating of 13 is "somewhat hard" and is equivalent to 60% VO_{2peak}.

Duration. Length of workout should start at 20 minutes and progress to 45 minutes. Where the physical limitations are such that the duration is limited to less than 15 minutes, one should aim for two to three sessions daily. Additional time should be allowed for a longer warm-up and cool-down, (e.g., 10–15 minutes), which can be spent at light activities and stretching exercises.

Frequency. Workouts should occur three to five times weekly.

include unstable angina, uncontrolled hypertension (systolic pressure >160 mm Hg and/or diastolic pressure >100 mm Hg), uncontrolled dysrrhythmias, uncompensated chronic heart failure, severe stenotic or regurgitant valvular disease, and hypertrophic cardiomyopathy. For patients who meet these criteria, the principles of prescription for resistance training are similar to those in younger individuals, with some modifications.[31] A number of studies have demonstrated the value of resistance training in young subjects as well as older individuals with and without coronary heart disease.[38–42] Benefits are observed even among the nonagenarians and frail older adults residing in long-term care facilities.[43] The specific benefits are shown in Table 2.

Programme Delivery

Shorter hospital stays following a coronary event have all but eliminated inpatient rehabilitation programmes. In the traditional outpatient model the patient is referred to a rehabilitation facility, is assessed by a multidisciplinary team, prescribed an individualized exercise and risk reduction programme, and attends an onsite exercise education class two or three times weekly for as short as eight weeks, or as long as one year.[9] An alternative is the home-based model where the patient reports at regular intervals by mail, telephone, or email to a nurse case manager. The latter functions as a link between the patient, the family physician, and the rehabilitation team, which may include a lipidologist, a cardiologist, a psychologist, or exercise specialist, depending on the patient's needs. This approach has the

Table 5: Prescribing a Resistance Training Program for the Older Patient[38–43]

Pretraining. Patients should take part in two to four weeks of aerobic training prior to doing resistance training. Pretraining instructions should emphasize correct lifting and breathing techniques. Training should be carried out twice weekly and include one set of 10 to 15 repetitions of eight to 10 exercises designed to train all major muscle groups.

Increasing Weight. Begin using light weights, which should result in moderate levels of fatigue by the end of a set of lifting. Once patients can complete their final lift with ease, the weights can be increased by two to five pounds per week for the arms and five to ten pounds per week for the legs.

Equipment. Equipment can include springs, elastic bands, free weights, and an assortment of machines. The likelihood of dropping a weight is greater in older patients; therefore, machine weights may be preferable.

Monitoring. Blood pressure can be monitored in a nonengaged limb. Note that pressures measured immediately after lifting do not reflect the increase during lifting, and may even be below the resting values. Artifact from muscle contraction limits the value of electrocardiographic telemetry.

advantage of promoting self-reliance as well as being effective and low cost. However, there is less opportunity for in-depth education and counselling. Also, the lack of surveillance and emergency care during exercise sessions makes it unsuitable for high-risk patients. Finally, it probably does not lend itself to the Canadian Health Service system of funding.

For the physically independent patient, the attraction of the home-based programme is clear. Even where a cardiac rehabilitation facility is available, a combined programme is often the preferred choice. The initial stages of the programme begin with attendance at an outpatient centre followed by transition to a home regimen. Facilities for exercise may exist in local community centres or covered shopping malls and are becoming increasingly available to early-morning seniors walking clubs. With a local case manager, follow-up can be carried out in combination with the family physician or cardiovascular specialist.

The Exercise Programme

Although many older patients have a low fitness level, others have enjoyed an active physical life and aspire to regain their prior functional capacity through exercise rehabilitation. Thus, although it is prudent to start exercise training at a low intensity and to progress cautiously in those who are poorly conditioned, one should allow for individual differences and prescribe accordingly.

The general principles of exercise prescription are similar for both young and old patients. However, some modifications may be required to allow for age-related changes that may affect the responses to exercise (Table 3). It is also important to individualize the exercise prescription based on clinical status, symptoms, and comorbidity.

As with younger patients, the exercise prescription is customarily based on the results of an exercise test. The preferred protocol is one in which the initial work rate is low and the subsequent increments small; for example, a modified Bruce or Naughton test.[44] When patient balance is poor, exercise on a cycle ergometer is an alternative to the treadmill. For the very frail patients, other testing options are electrocardiographic telemetry during submaximal tests such as the six-minute walk,[45] the 10-metre shuttle walk test,[46] or simulated activities of daily living.[47,48] Contraindications to testing and training are similar to those in younger patients. The essential components of the exercise prescription are also similar to those of the younger patient, with appropriate allowances for the aging changes (Tables 4 & 5).

Conclusion

Older cardiac patients are more disabled than their younger counterparts, have a lower exercise capacity, are more prone to recurrent events, and have a greater prevalence of comorbid conditions. Nevertheless, there is convincing evidence that this population can benefit from a cardiac rehabilitation programme in terms of improved effort tolerance, enhanced ability to live independently, alleviation of depression and anxiety, modification of risk factors, and an increase in quality of life measures. Despite this, there is a perceptible gap between the number of older patients, particularly women, who are potential candidates for cardiac rehabilitation and the number of patients actually referred. Health professionals should keep this in mind and strongly encourage older patients to participate in rehabilitation programmes.

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