Cardiac rehabilitation: are the potential benefits being realized?

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Cardiac rehabilitation or exercise training programmes are provided by many hospitals. This article discusses the evidence supporting the implementation of such facilities and reviews the reality of services in the UK.

Shanfield (1990) defined cardiac rehabilitation as:

'a process by which patients with cardiac disease are restored to their optimal physical, medical, psychological, social, emotional, vocational and economic status.'

Medical research has concentrated on evaluating the first six objectives. The practice of evidence-based medicine requires that patient treatment is guided by the results of the best-conducted and most appropriate research. The efficacy of cardiac rehabilitation is hereby assessed in the context of current services. However, the role of rehabilitation should also be considered in terms of its potential economic impact.

In the mid-1980s, coronary artery disease in the UK accounted for 11.6% of all sick leave, and was estimated to cost £500 million in treatment, and £1800 million in lost production (Tunstall-Pedoe, 1991). Considering the cost of a rehabilitation session is only £4–5 per person (Horgan et al, 1992), the possible savings on a national scale could be vast if patients were helped back to productivity at an earlier opportunity.

It was surprising therefore that in 1991, amid the implementation of a cost-effective NHS, fewer than half of all health districts in the UK had established cardiac rehabilitation programmes (Horgan et al, 1992). However, a recent survey by the British Association of Cardiac Rehabilitation (BACR) has found that the number of individual centres providing cardiac rehabilitation has trebled since 1992.

ASSESSMENT

The results from studies assessing the efficacy of rehabilitation have been disappointing and contradictory. There are many reasons for this, mostly relating to methodological issues. Those subjects recruited for rehabilitation are a heterogeneous population and pre-selection has not been consistent. Few studies have been conducted in a randomized manner with placebo or control groups for comparison. Most of the data available are limited to postmyocardial infarction patients and must therefore be interpreted with this in mind.

It is also difficult to objectively evaluate many of the parameters involved in rehabilitation, such as exercise capacity, psychological wellbeing and vocational impact. These factors may explain why rehabilitation is inconsistent across the UK, yet the fact that some centres attempt to provide a service to those patients recovering from a myocardial infarction or coronary bypass surgery must indicate a recognition of the potential benefits from such programmes.

PHYSIOLOGICAL IMPROVEMENT

There is good evidence that physical training improves exercise tolerance and cardiac function in patients with coronary artery disease (Varnauskas et al, 1966; Frick and Kahila, 1968; Redwood et al, 1972). Groups of patients undergoing sustained training have shown increases in stroke volume, ejection fraction, myocardial contractility, left ventricular end diastolic dimensions and left ventricular mass (Williams et al, 1984; Eshani et al, 1986). As a consequence of such changes, a trained individual will be able to achieve an overall increase in peak oxygen consumption (VO_2 in ml/kg/min) (Eshani et al, 1986), which

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is accepted as the best objective indicator of functional capacity (Taylor et al, 1955; Mitchell et al, 1958).

However, at comparable workloads, catecholamine concentrations are reduced, resulting in a relative decrease in heart rate. Thus the same cardiac work can be performed more economically since heart rate and contractility are key determinants of myocardial oxygen consumption. This may explain the increased threshold for ischaemia demonstrated by patients after training (Williams et al, 1980; Hammond et al, 1985; Todd and Ballantyne, 1992).

Exercise training in patients with cardiac failure increases functional capacity in terms of both peak oxygen consumption (Sullivan et al, 1988; Adamopolous et al, 1993; Belardinelli et al, 1995), and workload (Cohn et al, 1982). This is achieved through complex central and peripheral adaptations. Submaximal cardiac output remains constant despite a reduction in heart rate due to increased stroke volume (Sullivan et al, 1988). As peak heart rate is unaltered, there is an overall increase in maximal cardiac output (Sullivan et al, 1988; Adamopolous et al, 1993). This, combined with increased limb blood flow and increased arteriovenous oxygen difference (Sullivan et al, 1988), accounts for the improved peak VO_2.

The increase in arteriovenous oxygen difference occurs as a consequence of enhanced aerobic metabolism and an elevation in the lactate threshold (Belardinelli et al, 1995). Support for this is provided by the histological observation of increased mitochondrial density and capilliarization in skeletal muscle. Hence there is a decrease in the metabolism of phosphocreatinine and diminished production of adenosine diphosphate. It has also been observed that at similar workloads before and after training, ventilatory equivalents for oxygen (VE/VO_2) and carbon dioxide (VE/VO_2) are reduced (Killavori et al, 1996), relieving the sensation of dyspnoea.

Regular exercise training induces complex metabolic changes, and significant benefit can be gained on an individual basis. In patients with well-controlled diabetes mellitus, glucose tolerance can be improved and insulin requirements diminished (Pedersen et al, 1980). This is mediated by enhanced insulin receptor binding during exertion. Plasma high-density lipoprotein (HDL) concentration can be increased (Hartung et al, 1981), which is translated into an elevation of the HDL/total cholesterol ratio, and incurs some cardioprotection. Finally, physical conditioning enhances the augmentation of fibrinolytic activity that occurs in response to venous occlusion (Williams et al, 1980). Thus frequent physical activity can reduce the risk of cardiovascular disease in the general population.

MORTALITY AND RISK FACTOR MODIFICATION

Difficulties in design have again prevented definitive conclusions on mortality. Only one of the major trials of exercise training has reported a significant reduction in cardiac mortality (Kallio and Hamalaainen, 1979). However, meta-analyses, with their inherent problems of non-uniformity, were conducted on all the rehabilitation studies in the 1970s and 1980s, showing reduced pooled odds ratios for mortality of 0.75 (Oldridge et al, 1988) and 0.78 (O'Connor et al, 1989). Unfortunately there were differences in patient populations, mortality and exercise programmes between studies. Given the gradually progressive pathological mechanisms involved in the atherosclerotic process, it is unlikely that the effects of relatively short-term exercise regimes, for example, less than 4 or 5 years, would substantially alter mortality and morbidity in patients with coronary artery disease.

Following myocardial infarction, exercise training alone has been shown to be ineffective in reducing cardiac risk factors. However, incorporation into a multifactorial approach, with antismoking and dietary advice, has contributed to a reduction in blood pressure and an improvement in lipid profile (Kallio et al, 1979). As such, rehabilitation may be indicated along with other therapies to reduce the likelihood of further cardiac events in specific groups, preidentified as being at risk.

PSYCHOLOGICAL ASPECTS

The diversity of issues demanding attention during rehabilitation is highlighted by the fact that despite the observed physical recovery following a cardiac event, some patients may suffer significant psychological sequelae (Goble et al, 1963). Depression, anxiety and sexual dysfunction are well recognized in cardiac patients. The inability to quantitatively evaluate these conditions has again hampered meaningful research into this area. Data from the few randomized, controlled studies conducted, suggest a marginal impact of exercise on psychological wellbeing, and question whether this improvement simply relates to the reassurance from regular contact with medical personnel (Mayou et al, 1981; Stern and Cleary, 1982). Thus it is recommended that rehabilitation programmes provide adequate literature, discussing areas of potential psychological stress, and are able to identify those susceptible individuals who may require more specialized treatment.

VOCATIONAL ASPECTS

The return of a patient to work is a primary aim of cardiac rehabilitation, and those factors indicating likely success include a satisfactory pre-infarction work status, high educational level, social ranking, good exercise tolerance, absence of symptoms and the patient's own assessment of physical status (Horgan et al, 1992). It is thus difficult to evaluate the impact of rehabilitation on vocation because of the large number of variables that require simultaneous consideration. Nevertheless, the financial burden from cardiac illness is sufficient to warrant evaluation of any therapy that might improve the situation.

IMPLEMENTATION

Gottheiner first introduced exercise training programmes for patients with cardiac disorders in 1955 (Gottheiner, 1968). Despite major advances in other areas of cardiology, little has changed in the application of, and approaches to, rehabilitation since then.

Ideally, rehabilitation programmes should be available to all patients with cardiac disorders in whom exercise is not contraindicated (*Table 1*). At present they are almost exclusively for those recovering from a myocardial infarction or coronary artery bypass surgery. Despite the fact that patients with cardiac failure showed significant improvement in symptomatic status and functional capacity following exercise training (Conn et al, 1982; Sullivan et al, 1988), the numbers referred by clinicians remain relatively small. The traditional remedy of 'bed rest' would still appear to be a preferred short-term solution for symptomatic relief, even though patients undergo deconditioning and are at risk from thromboembolic phenomena.

Programmes should be supervised by enthusiastic personnel trained in basic resuscitation; medical or nursing cover, although preferable, is not essential. The form of exercise undertaken is less important than the need for sustained commitment from patients and staff (Goble et al, 1991), and services should therefore provide a continuous facility. Studies by Hammond et al (1985) and Van Dixhoorn et al (1990) have indicated that those patients with the poorest initial physical capabilities improve the most. Thus it is essential to identify those patients in the worst prognostic and functional categories and direct more intensive therapy towards them.

The reality of cardiac rehabilitation services in the UK was described by the report of a working party in 1992 (Horgan et al, 1992). From the 268 established cardiac units (intensive/coronary care), only 91 provided any form of rehabilitation service. Eighty per cent of programmes were physiotherapist led, with variable participation from dieticians (66%), nurses (38%), occupational therapists (20%) and psychologists (21%). Only 30% reported cardiologist involvement at any level, although 35% had a doctor present during sessions. Courses varied in length (4–12 weeks), intensity (1–2 hours) and frequency (1–6 times per week). Formal exercise testing was carried out as a routine in 31% of centres before, and only 19% after rehabilitation, although most carried out exercise testing in selected patients. The drop-out rate was estimated to be less than 10% in most centres.

TABLE 1.
Contraindications to exercise training/testing

Absolute contraindications	Unstable angina
	Recent myocardial infarction (<6 weeks)
	Uncontrolled ventricular dysrhythmia
	Uncontrolled atrial dysrhythmia compromising cardiac function
	Acute congestive cardiac failure
	Third degree heart block
	Severe aortic stenosis (gradient >50 mmHg)
	Aortic aneurysm
	Active myocarditis or pericarditis
	Intracardiac thrombus
	Systemic or pulmonary embolus
	Active thrombophlebitis
Relative contraindications	Resting systolic blood pressure >200 mmHg, diastolic blood pressure >120 mmHg
	Frequent or multifocal ventricular ectopy
	Fixed rate pacemaker
	Cardiomyopathy (hypertrophic)
	Ventricular aneurysm
	Moderate valvular heart disease
	Electrolyte abnormalities, e.g. hypokalaemia
	Uncontrolled metabolic disease, e.g. diabetes or thyrotoxicosis
	Neuromuscular and rheumatoid disorders exacerbated by exercise
	Advanced or complicated pregnancy

As a result of the differing services available depending upon geographical situation, a series of recommendations were made in order to improve uniformity and quality. Subsequently in 1996, a multidisciplinary workshop addressed not just exercise training, but the broader issues of cardiac rehabilitation, including patient expectation and understanding, secondary prevention, psychological support and long-term readaptation (Thompson et al, 1996). A further series of guidelines and audit standards were proposed in order to ensure consistent high-quality services in the UK. The findings of a forthcoming report from the BACR UK database will reveal the effectiveness of current services.

CONCLUSIONS

Cardiac rehabilitation is at present inconsistent across the UK. The scarcity of objective assessment in randomized, controlled studies prevents firm conclusions being drawn and makes the practice of evidence-based medicine virtually impossible. The fact that physiological improvement is seen in patients with cardiac and non-cardiac pathology would suggest that physical training is beneficial and might be introduced in other specialties. There is a need for further, well-conducted research into this subject. HM

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KEY POINTS

Cardiac rehabilitation/exercise training:

- Provides methodological challenges for objective assessment.
- Facilities across the UK are inconsistent.
- Improves the functional capacity of patients with ischaemic heart disease and cardiac failure.
- Combined with lifestyle modification can reduce the risk factors in patients with ischaemic heart disease.
- Can benefit non-cardiac patients with metabolic disorders, such as diabetes and hyperlipidaemia.
- May help to reduce the economic impact of cardiac disease.