Exercise Rehabilitation Programs for Children With Congenital Heart Disease: A Note of Enthusiasm

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Cardiac rehabilitation programs are now well established as a routine part of care for adults with heart disease, especially following myocardial infarction and coronary artery surgery (6, 12, 14). There is ample scientific evidence that such programs improve cardiovascular fitness and exercise tolerance (1,7). There is less certain evidence of a reduction in the risk of recurrent myocardial infarction and sudden death after participation in such programs (4). It should be remembered that a primary goal of these programs is to change the life-style of individuals with heart disease. Exercise training is only one part of an appropriate cardiac rehabilitation program. Other factors such as dietary measures and reduction of stress are clearly identified as improving the outlook for patients in these adult programs (13).

Pediatric cardiac rehabilitation programs have a somewhat different role than the adult programs (10, 11). I believe that these structured, carefully supervised programs for children are not designed for all patients with congenital heart disease. There is no question that the individual who has had successful surgery for lesions such as an atrial septal defect, patent ductus arteriosus, pulmonary stenosis, and even ventricular septal defect without an extensive ventriculotomy can participate in all activities including competitive sports without restriction. These individuals with congenital heart disease are not candidates for a pediatric cardiac rehabilitation program, as they simply do not need it. The role of the pediatric cardiologist for these patients is to approve and even encourage all normal activities of childhood. The normal activities of childhood and adolescence include sports competition, and individuals with successfully repaired congenital heart disease and no residual problems should not be restrained from participation.

Cardiac rehabilitation programs for children are designed for individuals with significant residual heart disease. These include, but are not restricted to, individuals with atrial operations for d-transposition of the great arteries, patients with only one functioning ventricle for which they have had a division of their circulations by Fontan’s operation, or individuals with lesions such as tetralogy of Fallot whose repair included a significant reconstruction with residual impairment.
of ventricular function. Such individuals have reduced fitness indicators such as reduced oxygen uptake, reduced cardiac output, and reduced exercise tolerance. It is for these individuals with reduced function that cardiac rehabilitation is intended.

The goals of cardiac rehabilitation for children with such residual cardiac lesions should not include training them for competitive sports. A goal of the cardiac rehabilitation program for these individuals is to allow them to participate safely in the normal activities of daily living, which for children include athletic participation. Exclusion from such participation, in my opinion, leads to an abnormal life-style and this may lead to further psychosocial problems later in life. Therefore, the major goal of a cardiac rehabilitation program for children should be to improve the quality of life, not to establish fitness at a level equal to that of children with no heart disease. Indeed, the results from our pediatric cardiac rehabilitation program in Washington, DC, have shown that children who undergo this program can be safely integrated into regular physical education classes in school with only minor restrictions such as refraining from only the most strenuous isometric and endurance activities.

The physiological assessment of the success of a pediatric cardiac rehabilitation program can easily be measured in terms such as improved oxygen uptake and cardiac output. In my opinion, a more significant result is an improvement in self-esteem that results in a much better attitude toward life in general for these children and adolescents. This factor is extremely difficult to quantify on a scientific basis, but one merely has to participate in a cardiac rehabilitation program for children to understand the true meaning of this significant benefit. Family life is improved as the child's feeling of self-worth increases. The patient enjoys the athletic participation of the program because it restores to him or her those normal activities of his/her schoolmates that had arbitrarily been proscribed by overprotective parents and cardiologists.

In two studies there was little if any improvement in oxygen uptake in patients undergoing a cardiac rehabilitation program, but an examination of the methods under which they were performed reveals significant problems (3, 8). The program established by our group in Washington, DC, calls for careful measurement of the level of work performed during each training session. In neither of the other two studies—one of which was home-based (8) and therefore had no direct medical supervision, or the other (3) which was of a large group without any individual measurements of parameters during exercise—was there any measure to assure that work was being done at an adequate level to improve fitness. I believe there was no improvement in oxygen uptake because a training effect level of work was not sustained. It is clear from the exercise physiology literature that an individual must perform at a work level of at least 60% of maximum in terms of either heart rate or oxygen uptake for a sustained period of time in order to improve cardiovascular fitness. In the several studies that our group has published, there have been significant increases in oxygen uptake, exercise time, and cardiac output (2, 9).

Comments about endurance, strength, flexibility, and coordination as related to cardiac rehabilitation programs merit additional discussion. Our group has conducted a study showing significant improvement in a variety of flexibility measures in pediatric patients undergoing a cardiac rehabilitation program (5). What is even more important to understand from that study is that the patients
who entered our cardiac rehabilitation program had abnormal flexibility measures. This was an important point of our study because we learned that this lack of flexibility interfered significantly with any exercise training program. Indeed, we had to change the design of our program to allow for an improvement in flexibility measures before the children were able to exercise at levels sufficient to improve their cardiovascular endurance.

To state that a cardiac rehabilitation program reduces the incidence of sudden death is laudable but extremely difficult to prove. There is no evidence that a cardiac rehabilitation program for children reduces the risk of sudden death. However, I could propose on theoretical grounds that the myocardium prepared for sudden exercise because of an improvement in mitochondrial function secondary to training is better prepared for stress than one that is completely untrained. There is evidence from the adult cardiology literature that sudden exertion in a completely unfit individual is a risk factor compared to a similar exertion in the trained individual. It is well known that children do exert themselves suddenly and are prone to participate in activities that their parents might not approve of. If we can improve the fitness of these children, then they would be better prepared for these all too common occurrences.

The goal of a cardiac rehabilitation program for children calling for a reduction in the incidence and consequences of coronary artery disease as adults is laudable for our society in general and should not be restricted to a cardiac rehabilitation program. Again, there is ample evidence that a healthier life-style for a child leads to less risk for coronary artery disease in adult life. Millions of dollars in research money are being spent on this problem and, while in a scientific sense it is still an open question, most investigators feel that the prevention of coronary artery disease should begin in childhood. This goal for society in general should be no different for patients with congenital heart disease. I do not feel that a cardiac rehabilitation program for children detracts from this goal, and it may reinforce the healthier life-style we all endorse.

**Summary**

1. Exercise efficiency as measured by oxygen uptake and cardiac output can be improved in children who have residual congenital heart disease. The fact that these improvements occurred in a structured program rather than in an unstructured program points to the importance of assuring that children who participate in such programs work at a level sufficient to improve their fitness.

2. Most children who have congenital heart disease undergo successful repair and do not require any restrictions on their activities following repair. Cardiac rehabilitation for children is useful only for selected individuals who have impaired cardiovascular responses to exercise. In these cases a major goal of the program is to improve exercise capability to a level that allows these individuals to participate in the activities of daily living, not in competitive sports.

3. Finally, further studies are needed to fully define the efficacy of these programs. Measures of success should be in psychological as well as physiological terms.
References


