Canadian Journal of Cardiology 32 (2016) 459–466

Review

Risks and Benefits of Exercise Training in Adults With Congenital Heart Disease

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ABSTRACT

Exercise capacity in adults with various forms of congenital heart disease is substantially lower than that of the general population. Although the underlying congenital heart defect, and its sequelae, certainly contribute to observed exercise limitations, there is evidence suggesting that deconditioning and a sedentary lifestyle are important implicated factors. The prevalence of acquired cardiovascular comorbidities is on the increase in the aging population with congenital heart disease, such that obesity and a sedentary lifestyle confer increased risk. Health fears and misconceptions are common barriers to regular physical activity in adults with congenital heart disease, despite evidence linking lower functional capacity to poor outcomes, and data supporting the safety and efficacy of exercise in bestowing numerous physical and psychosocial rewards. With few exceptions, adults with congenital heart disease should be counselled to exercise regularly. In this contemporary review, we provide a practical approach to

RÉSUMÉ

La capacité à l'effort des adultes souffrant de différentes formes de cardiopathies congénitales est considérablement plus faible que celle de la population générale. Bien que les anomalies cardiaques congénitales sous-jacentes et leurs séquelles contribuent sans aucun doute à l'observation de limites en matière d'exercice, des données scientifiques suggèrent que le déconditionnement physique et le mode de vie sédentaire sont d'importants facteurs associés. La prévalence des comorbidités cardiovasculaires acquises est en hausse dans la population vieillissante souffrant de cardiopathies congénitales, de sorte que l'obésité et les modes de vie sédentaires confèrent un risque accru. Les craintes et les idées fausses en matière de santé sont des obstacles communs à la pratique régulière de l'activité physique chez les adultes souffrant de cardiopathies congénitales, en dépit des données scientifiques reliant la capacité fonctionnelle plus faible à des résultats médiocres, et des données appuyant l'innocuité et l'efficacité

Congenital heart disease (CHD) is the most common birth defect, afflicting approximately 1% of live births. Remarkable progress in pediatric cardiac care over the past decades has given rise to a growing and aging population of survivors with CHD.[1] As a result, adults with CHD might be exposed to traditional risk factors for coronary artery disease and to the adverse consequences of a sedentary lifestyle.[2] In some instances, the inactive lifestyle is enabled by patient fears, misconceptions, and/or well-intentioned physician reticence to endorse exercise training in the context of difficult to quantify risks.[3] Paradoxically, there is evidence to suggest that an overly conservative approach to exercise prescription in CHD can do more harm than good,[3] and that most adults with CHD can safely benefit from the physical and psychological effects of exercise.

Across the varied forms of CHD, including simple repaired defects,[4] adults with CHD suffer from a lower functional capacity and peak oxygen consumption than the general population.[5,6] Moreover, a low exercise capacity identifies those at risk for hospitalization and death.[7] In patients with CHD, the observed precipitous decline in age-related functional capacity might be attributed to several contributing factors including deconditioning and varied pathophysiological mechanisms, such as residual lesions of hemodynamic consequence, electrophysiological disorders, pharmacological therapy, cyanosis, relative anemia, and extracardiac organ involvement.

Exercise training refers to a program of physical activity intended to improve or maintain physical fitness, performance, or health. The complex and heterogeneous forms of CHD combined with limited evidence-based guidance preclude a single algorithmic approach to prescribing exercise training. The purpose of this contemporary article is to

Received for publication August 28, 2015. Accepted December 10, 2015.

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See page 464 for disclosure information.

http://dx.doi.org/10.1016/j.cjca.2015.12.007

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assessing adults with congenital heart disease before exercise training. We examine available evidence supporting the safety and benefits of exercise training. Risks associated with exercise training in adults with congenital heart disease are discussed, particularly with regard to sudden cardiac death. Finally, recommendations for exercise training are provided, with consideration for the type of congenital heart disease, the nature (ie, static vs dynamic) and intensity (ie, low, medium, high) of the physical activity, and associated factors such as systemic ventricular dysfunction and residual defects. Further research is required to determine optimal exercise regimens and to identify effective strategies to implement exercise training as a key determinant of healthy living.

de l'exercice en lui attribuant de nombreux avantages physiques et psychosociaux. À quelques exceptions près, les adultes souffrant de cardiopathies congénitales devraient être invités à faire régulièrement de l'exercice. Dans la présente revue contemporaine, nous proposons une approche pratique pour évaluer les adultes souffrant de cardiopathies congénitales avant l'entraînement à l'effort. Nous examinons les données scientifiques disponibles appuyant l'innocuité et les avantages de l'entraînement à l'effort. Nous discutons des risques associés à l'entraînement à l'effort chez les adultes souffrant de cardiopathies congénitales, particulièrement de la mort cardiaque subite. Finalement, nous donnons des recommandations en matière d'entraînement à l'effort en tenant compte du type de cardiopathie congénitale, de la nature (c.-à-d. statique *vs* dynamique) et de l'intensité (c.-à-d. faible, moyenne, élevée) de l'activité physique, et des facteurs associés comme la dysfonction du ventricule systémique et les anomalies résiduelles. Des recherches plus approfondies sont nécessaires pour déterminer les programmes d'exercices optimaux et établir des stratégies efficaces de mise en œuvre de l'entraînement à l'effort comme facteur déterminant d'un mode de vie sain.

highlight key considerations in assessing adults with CHD before exercise training, discuss associated risks and benefits, and provide practical guidance regarding exercise prescription.

Assessment Before Exercise Training in CHD

As outlined in Table 1, a thorough assessment is required before recommending exercise training in patients with CHD, with the purpose of informing the counselling process, identifying those at high risk for exercise-induced adverse events, and providing evidence to reassure patients concerning safety.[8] One study reported that education of adults with CHD regarding exercise is suboptimal, even in a specialist clinic, leading to frequent misconceptions about potential benefits and dangers.[9] A substantial proportion of patients with CHD over-rate their functional capacity and underestimate their physical limitations.[10] At the other end of the spectrum, others with CHD refrain from exercise training because of fear, lack of interest, or symptoms.[9] More often than not, when exercise training is discussed by health care professionals, prohibitive rather than encouraging advice is provided, despite evidence to the contrary.[9]

In addition to a comprehensive clinical appraisal, cardiopulmonary exercise testing (CPET) provides a precise and reproducible means of objectively assessing functional capacity. It is useful in prescribing exercise and measuring response to training. The maximum oxygen consumption (VO_2 max), is the point at which oxygen uptake reaches a maximum and cannot be further increased by an additional workload. It is not synonymous with maximum exercise. It determines an

Table 1. Assessment before exercise training

Step	Description
Step 1: Assess current status	(A) Assessment of daily activities, including current exercise (type, intensity, duration, frequency)
	(B) Evaluation of the motivation for exercise training
	(C) Assessment of expectations regarding intended physical activities (description, duration, environment)
Step 2: Medical history	(A) Type of congenital heart disease, severity, physiological ramifications
	(B) Clinical history (functional status, exercise intolerance, presyncope/syncope, chest pain, palpitations, hypoxia)
	(C) Pharmacological history (including anticoagulants and β-blockers)
	(D) Cardiac arrhythmia device (pacemaker, defibrillator, cardiac resynchronization therapy)
	(E) Associated comorbidities and cardiovascular risk factors
Step 3: Clinical examination	(A) Physical examination (including a detailed cardiopulmonary examination, skeletal assessment [scoliosis, malformations], and neurologic examination [motor/sensory deficits])
	(B) Electrocardiogram (rhythm, repolarization abnormalities, QRS duration, QTc)
	(C) Oxygen saturation at rest
Step 4: Paraclinical investigations	(A) Recent assessment of systemic and subpulmonary ventricular function (standard or stress echocardiography, magnetic resonance imaging [right ventricle], nuclear ventriculography)
	(B) Ambulatory electrocardiogram monitoring (detection of asymptomatic arrhythmias)
	(C) Assessment for pulmonary hypertension
	(D) Rule out aortic dilation
	(E) Blood tests (anemia/relative anemia, iron deficiency)
Step 5: CPET	VO_2 max, peak oxygen pulse
	VE/VCO_2 slope and VE/VO_2 slope
	Anaerobic or lactate threshold
	Oxygen saturation during exercise, exercise duration
	Heart rate and blood pressure response

CPET, cardiopulmonary exercise test; VE/VCO_2, ratio of minute ventilation to carbon dioxide production; VE/VO_2, ratio of minute ventilation to oxygen uptake; VO_2, oxygen consumption; VO_2 max, maximal oxygen consumption.

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