International Journal of Cardiology 187 (2015) 175–182

Contents lists available at ScienceDirect

International Journal of Cardiology

journal homepage: www.elsevier.com/locate/ijcard

Sports participation in adults with congenital heart disease☆,☆☆

Petra Opić [a,b], Elisabeth M.W.J. Utens [b], Judith A.A.E. Cuypers [a], Maarten Witsenburg [a], Annemien van den Bosch [a], Ron van Domburg [a], Ad J.J.C. Bogers [c], Eric Boersma [a], Antonio Pelliccia [d], Jolien W. Roos-Hesselink [a,*]

[a] Department of Cardiology, Erasmus Medical Center, Rotterdam, The Netherlands
[b] Department of Child and Adolescent Psychiatry/Psychology, Erasmus Medical Center-Sophia Children's Hospital, Rotterdam, The Netherlands
[c] Department of Cardiothoracic Surgery, Erasmus Medical Center, Rotterdam, The Netherlands
[d] Institute of Sports Medicine and Science, Rome, Italy

ARTICLE INFO

Article history:
Received 9 November 2014
Received in revised form 4 February 2015
Accepted 7 March 2015
Available online 11 March 2015

Keywords:
Sport
Congenital heart disease
Arrhythmia
Safety
Quality of life

ABSTRACT

Background: It is unclear whether sports participation in adults with repaired congenital heart disease is safe and has benefits.
Methods: Congenital heart disease (ConHD) patients who underwent corrective surgery for Atrial Septal Defect, Ventricular Septal Defect, Pulmonary Stenosis, Tetralogy of Fallot or Transposition of the Great Arteries in our center between 1968 and 1980 were included, and participated in our longitudinal follow-up study with serial evaluations in 2001 and 2011. At both time points patients filled in questionnaires on sports participation, subjective physical functioning and quality of life. Exercise testing, echocardiogram and 24-hour continuous ambulatory ECG-monitoring were performed in both 2001 and 2011. All clinical events (re-intervention, arrhythmia, heart failure) were prospectively recorded.
Results: No relationship was found between practicing sports and the occurrence of sudden death, PVCs or SVTs. Patients with moderate/complex forms of ConHD practiced fewer hours of sports compared with the general Dutch normative population. Patients with both simple and moderate/complex ConHD who practiced sports showed a higher exercise capacity. More favorable subjective physical functioning was found for moderate/complex patients who practiced sports.
Conclusions: Adults with repaired ConHD are less often involved in sports than the Dutch general population. The patients that were engaged in sports show a higher exercise capacity than those who did not. Sports participation in patients with ConHD was not associated with an increased incidence of adverse cardiac events.

1. Introduction

Since the first surgical techniques for patients with congenital heart disease (ConHD) became available some 55 years ago, virtually every area of medical care has evolved substantially. These improvements led to an increased survival for patients with ConHD, with over 90% of infants reaching adulthood nowadays [1].

Sports participation in adults with ConHD is a relatively new territory and many physicians are having difficulty in advising their patients. The first concern is the safety of the patients, and the fear exists that exercise training and competitive sports participation may increase the risk of adverse events, including sudden death. In this field, however, there is a paucity of prospective data and controversial opinions still exist concerning the safety for these patients to be regularly engaged in sports [2,3].

Participation in sports can have beneficial effects on quality of life, as was recently shown in a multicenter randomized controlled trial for adolescents with ConHD, and also for ischemic heart disease and heart failure [4–6]. Moreover, adolescents overall do not achieve the 60 min of recommended daily moderate to vigorous physical activity [7]. The recent RCT showed that practicing sports reduced passive leisure time spending [4].

We therefore planned the present study to investigate the clinical consequences of sports participation in adults with repaired ConHD, with particular emphasis on the occurrence of adverse cardiac events, but also assessing the cardiovascular functional capacity, the patients' physical fitness and quality of life. To this scope, we took advantage of the long-standing follow-up program, which includes consecutive

Abbreviations: ASD, Atrial Septal Defect; CBS, Central Bureau of Statistics; CI, confidence interval; ConHD, congenital heart disease; LAS, Linear Analogue Scale; OR, odds ratio; PS, Pulmonary Stenosis; SVT, supraventricular tachycardia; TGA, Transposition of the Great Arteries; ToF, Tetralogy of Fallot; VSD, Ventricular Septal Defect; VT, ventricular tachycardia

☆ All authors take responsibility for all aspects of the reliability and freedom from bias of the data presented and their discussed interpretation.

☆☆ **Grant support**: van de Hoop foundation, Dordrecht, The Netherlands.

* Corresponding author at: Erasmus Medical Center, Department of Cardiology, Room Ba-583a, P.O. Box 2040, 3000 CA Rotterdam, The Netherlands.
E-mail address: j.roos@erasmusmc.nl (J.W. Roos-Hesselink).

http://dx.doi.org/10.1016/j.ijcard.2015.03.107
0167-5273/

ConHD patients operated at the Erasmus Medical Center between 1968 and 1980, and extensively followed-up every 10 years.

2. Methods

2.1. Inclusion criteria

The original cohort consisted of all consecutive patients who underwent surgical correction for Atrial Septal Defect (ASD), Ventricular Septal Defect (VSD), Pulmonary Stenosis (PS), Tetralogy of Fallot (ToF) or Transposition of the Great Arteries (TGA) between 1968 and 1980 in the Erasmus MC, and were younger than 15 years at the time of surgery. This patient cohort has been investigated in 1991, in 2001, and again in 2011. The baseline characteristics and medical and psychosocial results of these investigations have been reported previously [8–13].

The target population of the third follow-up (conducted in 2011) consisted of the 362 patients who had previously participated in 2001. Of these patients, 10 died (i.e., 6 cardiac-related, 3 unknown, 1 accident), 1 underwent heart transplantation and 22 patients were lost to the follow-up. Of the remaining 329 eligible patients, 245 patients (already examined in 2001) agreed to participate and represent the study population of the current analysis in 2011. The flow-chart describing the plan of the study is shown in Fig. 1. No differences were found in baseline characteristics between the patients who participated again in 2011 and those who did not.

2.2. Assessment procedure

All patients were invited to the outpatient clinic for cardiac and psychological examination and were informed of the study project. During the outpatient visit, patients underwent a cardiac examination which consisted of 24-hour Holter monitoring, an electrocardiogram, an echocardiogram and exercise testing. The participation in exercise programs, sports and psychosocial characteristics were assessed by questionnaires, which are described in detail below. The questionnaires were administered verbally for patients who had difficulty reading or understanding the written questions. The research protocol was approved by the institutional ethical committee of the Erasmus MC and all patients included in the present analysis provided written informed consent.

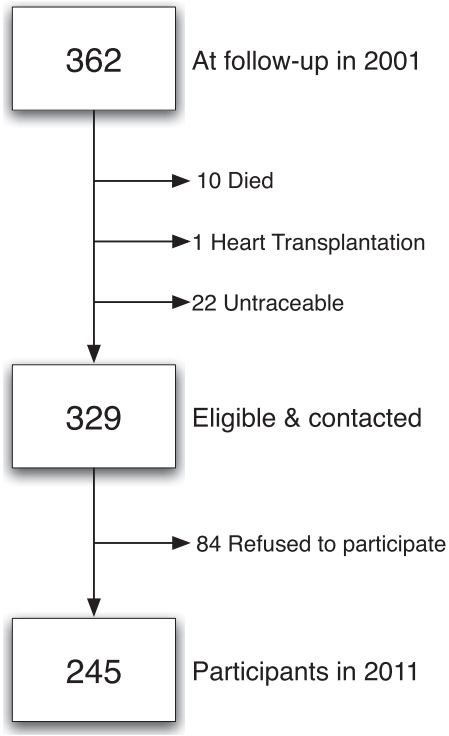

Fig. 1. Flow-chart of patient inclusion.

2.3. Questionnaires and normative groups

Sports participation was assessed using the same general questionnaire on leisure activities in 2001 and 2011 which is based on the Dutch Central Bureau of Statistics (CBS) [10,14,15]. In addition, in 2011, four items of the "Baecke questionnaire", widely used for assessing habitual physical activity in epidemiological studies [16] were used. Sports participation was defined as any form of solitary or group physical activities outside of regular walking and cycling throughout the day. In order to make comparison with the general Dutch population possible, the types of sports were classified according to the CBS, which was also used to obtain normative values for the average Dutch population (data retrieved in 2012) [17]. Specifically, the categories "Extensive" (more than 5 h of sports per week), "Little/Moderate" (in between 1 and 5 h of sports per week) and "None" (up to 1 h or less of sports per week) were used. The physiologic types of sports that patients in our study were practicing (listed in Table 3) were classified according to Mitchell et al. [18]. This classification shows the percentage of patients practicing dynamic and static sports in different intensities.

According to the classification adopted at the American Heart Association Task Force on Adults with CHD [19], patients with repaired ASD, VSD and PS were classified as simple ConHD (unless they had complications such as severe ventricular dysfunction), while patients with ToF or TGA (all operated with a Mustard repair) were classified as moderate to complex ConHD.

Clinical events were defined as surgical/transcatheter re-intervention, ICD implantation, pacemaker implantation, heart failure or symptomatic and clinically relevant arrhythmia. Arrhythmias (supraventricular tachycardia or ventricular tachycardia) were defined as clinically relevant if anti-arrhythmic medication was needed, cardioversion or catheter-based or surgical ablation had been applied, or hospitalization was necessary. Data on events were collected from patient records, and classified by the first and last authors.

Maximal *exercise capacity* was assessed by bicycle ergometry and was compared with that of normal individuals corrected for age, gender, body height and weight [20]. Gradual increments of workload of 20 Watts per minute were used. Exercise capacity $<85\%$ of the predicted value was considered to be decreased. VO2 max was also measured in the evaluation of 2011, but not in 2001.

Subjective physical functioning [21] was assessed by the physical functioning scale of the SF-36. This scale measures the amount of limitation in physical activities due to health problems. Good reliability and validity for the Dutch version of the SF-36 have been reported [22].

Self-perceived quality of life was assessed by the *Linear Analogue Scale (LAS) for Quality of Life*. The LAS has been proven valid, reliable, and sensitive for the ConHD population [23]. This instrument was not used in 2001 and therefore no historical comparison can be made.

2.4. Statistical analyses

Continuous data are presented by means ± SD. In case of a skewed distribution (significant Kolmogorov–Smirnov test or highly skewed histogram by visual inspection), medians and interquartile ranges [IQR] (Q1–Q3) are displayed. The SF36 Physical Functioning scale is analyzed with means ± SD according to its manual [22]. To assess differences between ConHD diagnostic groups (simple versus moderate/complex), t-tests or Mann–Whitney-U tests were utilized. Longitudinal comparison was assessed by paired sample t-tests or Wilcoxon signed-rank tests.