INPLASY

Effects of Aerobic Exercise on Cardiopulmonary Function in Postoperative Patients with Congenital Heart Disease：a meta-analysis

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ADMINISTRATIVE INFORMATION

Support - None.

Review Stage at time of this submission - The review has not yet started.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 03 April 2024 and was last updated on 03 April 2024.

INTRODUCTION

Review question / Objective The aim of this study was to systematically evaluate whether aerobic exercise can effectively improve Peak VO2 in postoperative CHD patients. Besides, we also tried to discover whether the improvement is influenced by patients' ages, modes of supervision, types of exercise, and the types of congenital heart disease (CHD). Additionally, we investigated whether the duration, frequency, and intervention period of aerobic exercise have a dose-response effect on improving the condition of CHD patients.

Condition being studied Congenital heart disease (CHD), caused by abnormal fetal cardiovascular development, is one of the most common congenital abnormalities. According to 2020 ESC Guidelines for the Management of Adult Congenital Heart Disease issued by Association for European Paediatric and Congenital Cardiology (AEPC) and International Society for Adult Congenital Heart Disease (ISACHD), approximately 9 out of every 1000 newborns worldwide are affected by CHD. Being a condition present at birth, CHD leads to impaired blood supply to tissues and organs of the body, resulting in tissue hypoxia, which significantly hampers the growth and development of affected children. Moreover, hemodynamic abnormalities will exacerbate cardiac workload, predisposing patients to malignant arrhythmias and sudden cardiac death. With substantial advancements in cardiac surgery and perioperative management techniques, approximately 90% of CHD patients can survive to adolescence and adulthood through surgical intervention. Nevertheless, postoperative patients with CHD often encounter long-term issues such as hypoxia and reduced exercise endurance. These challenges directly impact patients' oxygen supply capacity and exercise endurance, posing an urgent need for effective strategies to enhance postoperative cardiopulmonary function of CHD patients.

METHODS

Participant or population Patients diagnosed with CHD, excluding those with conditions such as pregnancy or history of sudden death, and those with abnormal exercise test results.

Intervention The experimental group undergoes exercise training as an intervention. In addition to routine care, this includes aerobic exercise, resistance training, or unsupervised home-based exercise through electronic health education.

Comparator The control group undergoes non-exercise interventions, including routine care and health education.

Study designs to be included RCT.

Eligibility criteria Inclusion criteria(1) The subjects under study have been diagnosed as postoperative CHD patients by the hospital. (2) The experimental group took aerobic exercise as an intervention in addition to routine postoperative care, with the intervention period being ≥10 weeks. (3) The control group skipped exercise interventions and only adopted routine postoperative care. (4) The primary outcome is Peak VO2. (5) The study design is Randomized Controlled Trials (RCTs). Exclusion criteria(1) Patients with contraindications for exercise, conditions such as pregnancy or history of sudden death, and those with abnormal exercise test results. (2) Duplicated publications or literature of low academic quality. (3) Studies with unclear data descriptions, preventing the calculation or extraction of data. (4) Inappropriate interventions or mismatched outcomes.Following the PICOS principle, randomized controlled trials (RCTs), which evaluated the intervention effects of aerobic exercise on cardiopulmonary function in postoperative CHD patients, were included.

Information sources Two researchers respectively searched literature published from the establishment of the database to December 2023 in four databases: PubMed, Web of Science, EMbase, and The Cochrane Library Literature.

Main outcome(s) Peak VO2.

Quality assessment / Risk of bias analysis The methodological quality of included studies was evaluated using the PEDro scale[34], which includes 10 items: “random allocation” “concealed allocation” “similarity at baseline” “subject blinding” “therapist blinding” “assessor blinding” “> 85% follow up” “intention-to-treat analysis” “between-group statistical comparison” and “point and variability measures”. One point was awarded for meeting a criterion, and zero point for not meeting it. The total score was 10 points, with <4 points indicating low quality, 4-5 points indicating moderate quality, 6-8 points indicating good quality, and 9-10 points indicating high quality. Only studies of moderate quality or above were included in this study.

Strategy of data synthesis RevMan 5.4.1 software was used for heterogeneity assessment of all outcomes in the included studies. The sample sizes as well as the mean and standard difference of the improvement values before and after interventions were assessed. The included outcomes were all continuous variables. For outcomes with the same measurement method and unit, the mean difference (MD) was used, and for those with different measurement methods or units, the standard mean difference (SMD) was used. We used a threshold of P less than 0.05 and I^2 greater than 50% to represent heterogeneity for studies, and a random-effects model would be employed. Conversely, if there was no significant heterogeneity among studies ($P \geq 0.05$ or $I^2 \leq 50\%$), a fixed-effects model would be used. The outcomes of our meta-analysis were presented with a 95% confidence interval (95% CI) and the publication bias test was conducted using Stata 17.0.

Subgroup analysis Age,Mode of supervision,Type of exercise,Total dose of exercise,Intervention period,Type of CHD.

Sensitivity analysis To investigate whether the heterogeneity among studies was caused by certain studies, this study conducted a sensitivity analysis by excluding individual studies one by one to analyze the combined effect, as shown in Table 6. After excluding the study by Klausen et al. (2016)[32], the combined effect was MD=-3.4, 95% CI (-6.44, -0.36), and I^2 decreased from 36% to 0%, indicating a significant reduction in heterogeneity, and the difference compared to the control group was statistically significant. Since the study by Klausen et al. (2016)[23] used unsupervised intervention for 52 weeks, modes of supervision and intervention periods may be sources of heterogeneity. After excluding Klausen’s study, the combined effect size MD and I^2 all remained stable, with P<0.00001, suggesting robust results, indicating that compared to the control group, aerobic exercise effectively enhanced Peak VO2 in postoperative CHD patients.

Country(ies) involved China.

Keywords Aerobic exercise; Congenital heart disease; Peak oxygen uptake; Cardiopulmonary function; Systematic review.

Contributions of each author

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