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Efficacy of Early Mobilization Supervised Resistance Training (EMoSReT) on Adolescent Patients With congenital heart Disease Following Cardiac Surgery in IJN

^[1] Raja Ahmad Nizar, ^[2] Dr. Mohd Izham Mohd Zain, ^[3] Siti Nur Baait Mohd Sokran, ^[4] Dr. Mohd Daud Sulaiman, ^[5] Dr. Joyce Darshinee Sirisani

^[1] KPJ University, ^[2] KPJ University, ^[3] KPJ University, ^[4] KPJ University, ^[5] IJN

^[1] rajanizar86@gmail.com, ^[2] izham@kpju.edu.my, ^[3] bait.sokran@gmail.com, ^[4] dr.daud@kpidsh2.com.my, ^[5] drjoyce@ijn.com.my

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Abstract:- Introduction: Physiotherapy intervention is beneficial in terms of prevention of postoperative complications, improves functional capacity, psychological aspect and enhance a better prognosis. Exercise programmes protocol of early mobility with resistance training which help patients to regain functional capacity, self-efficacy and general well-being as soon as possible are therefore a vital component of recovery after cardiac surgery. However, there was limited evidences on optimal exercise prescription for adolescent with CHD post cardiac surgery patients. The objective of this present study was to assess the efficacy of early mobilization supervised resistance training in aerobic functional capacity (VO₂ max) among adolescents with congenital heart disease following cardiac surgery. Methods: This was a pre and post experimental study which also known as quasi experimental study. Prior to the surgery, 54 patients were provided with standard care, closely following the existing protocol, involving early mobilization and supervised resistance exercises for the upper and lower limbs, commencing on the first day after the surgery. 6MWT were assessed according to 3 timeframes which is pre-test during pre-operative that is baseline, mid test and post-test which during post-operative and prior to discharge sessions. Results: 54 patients, 27 (50%) males and 27 (50%) were included, with a mean age of 14.6 ±2.4 years. For the within-group differences, the VO₂ max value shows a better value during post-test when compared to pre-test within the group. For the between-group differences, VO₂ max [pre-mid 33.00 (7.07, 3.30), p= <0.038, pre-post 38.82 (7.27, 3.23), p= <0.003 and mid-post 47.04 (7.98, 3.92), p= <0.092]. Conclusion: Early mobilization supervised resistance training in physiotherapy intervention showed high significant difference on functional aerobic capacity between pre and post value among adolescent with CHD post cardiac surgery patients.

Keywords: aerobic functional capacity; VO₂ max; 6MWT, CHD; early mobilization.

1. Introduction

The objective of evaluating the effectiveness of early mobilization supervised resistance training (EMoSReT) in enhancing aerobic functional capacity among adolescents with congenital heart disease (CHD) following cardiac surgery is crucial due to the significant physical and functional challenges these patients face during recovery. Adolescents with CHD often experience prolonged physical inactivity and diminished aerobic capacity post-surgery, which can impede their overall recovery and quality of life. By introducing a structured intervention like EMoSReT, this study aims to address these challenges and provide evidence-based support for integrating such programs into routine postoperative care. The anticipated outcomes, including improved performance in the 6-minute walk test (6MWT) and enhanced functional endurance, underscore the potential of EMoSReT to significantly improve the rehabilitation process for adolescent CHD patients, ultimately promoting better health outcomes and a quicker return to daily activities.

2. Method

Study subject: Congenital Heart Disease (CHD) patients, particularly those who have undergone congenital open-heart surgery, represent a critical population for studying the efficacy of rehabilitation interventions due to their unique and complex health needs. These individuals often face significant postoperative challenges, including reduced functional capacity, psychological stress, and an increased risk of further complications. By focusing on this group, the study aims to optimize recovery outcomes, provide evidence-based guidelines for improving postoperative care in adolescents with CHD, thereby addressing a crucial gap in pediatric cardiac rehabilitation.

The 6-minute walk test (6MWT) is a standardized assessment used to measure aerobic and functional walking capacity, providing valuable insights into patients' ability to perform daily activities. Participants walk a 30-meter indoor track for 6 minutes, with the test conducted twice before starting cardiac rehabilitation to establish a baseline from the better result. Elapsed time is recorded at each minute without additional encouragement, following American Thoracic Society guidelines. The test has high validity (0.88-0.94) and reliability (0.71-0.82). The 6MWT is an important outcome measure for aerobic capacity, with a standard score of 250 meters. It offers objective indicators of functional capacity and predicted oxygen consumption, applicable to daily activities and various clinical populations. Pre-operative 6MWT distance has been shown to predict significant adverse outcomes and quality of life post-heart surgery.

Table 1. Mean comparison of VO2 max within treatment group

Domain	Objective	Outcomemeasure	Time point fordata collection
Functionalcapacity	Aerobiccapacity	6 Minute Walk Test (6MWT)	Baseline, intermediate, upon hospitaldischarge

3. Result

A. Effectiveness of early mobilization supervised resistance training in aerobic functional capacity among adolescent with CHD following cardiac surgery

The analysis conducted using Repeated Measures ANOVA investigated the effects of early mobility supervised resistance training on aerobic functional capacity, as measured by VO2 max, at different time points (Pre, Mid, and Post) within groups. The results revealed significant differences in VO2 max measurements across these time points. Post-hoc Tukey Honestly Significant Difference (HSD) tests identified substantial mean differences: 33.00 for Pre-Mid VO2 max (95% CI: 7.07, 3.30), 38.82 for Pre-Post VO2 max (95% CI: 7.27, 3.23), and 47.04 for Mid-Post VO2 max (95% CI: 7.98, 3.92). The F-statistic value of 2.143 indicates significant variance between group means relative to within-group variability. These findings suggest that early mobility supervised resistance training leads to significant improvements in VO2 max over time, highlighting its effectiveness in enhancing aerobic functional capacity.

Table 2. Mean comparison of VO2 max within treatment group

Comparison	VO2 max score MD (95% CI)	p-value	F-stat (df)
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Pre – Mid VO2 max	33.00 (7.07,3.30)	.038	2.143 (1)
Pre – Post VO2 max	38.82 (7.27,3.23)	.003	
Mid – Post VO2 max	47.04 (7.98,3.92)	.092	

In the other hand, the analysis using Repeated Measures ANOVA and post-hoc multiple comparisons with Tukey HSD investigated the changes in 6-minute walk test (6MWT) performance at different time points (Pre, Mid, and Post) among different groups. The results revealed significant differences between Pre-Mid (MD = 42.00, 95% CI: 6.93, 9.69, $p = .042$) and Pre-Post (MD = 38.00, 95% CI: 4.00, 2.19, $p = .000$) measurements, indicating substantial improvements in performance over time. However, no significant difference was found between Mid-Post (MD = 19.04, 95% CI: 6.75, 6.81, $p = .136$) measurements. The F-statistic of 2.101 further supports the presence of significant variance between group means relative to within-group variability. These findings suggest that the early intervention had a significant positive impact on 6MWT performance primarily between the initial and later stages, while changes between the mid and final stages were not statistically significant.

4. Discussion

A. Effectiveness of early mobilization supervised resistance training in aerobic functional capacity among adolescent with CHD following cardiac surgery

Early mobilization combined with resistance training significantly improves aerobic functional capacity in patients recovering from cardiac surgery, as evidenced by increased VO2max and enhanced 6-minute walk test (6MWT) performance. These findings align with those of Judas, M.C. et al. (2023) and corroborate the benefits of early mobilization in rehabilitation post-coronary artery bypass graft (CABG) surgery, improving functional capacity, respiratory muscle strength, and quality of life while reducing atelectasis, pleural effusion, and hospital stays. Although Zanini et al. (2019) reported higher training loads, the current study's focus on 6MWT and VO2max outcomes revealed substantial pre- to post-test improvements. Early mobilization proved more effective than respiratory exercises alone, supporting Santos P.M.R. et al.'s (2017) findings on physical function enhancement. Additionally, Moradian et al. (2017) highlighted early mobilization's role in reducing complications that impair gas exchange and exercise capacity, further validating the observed increases in VO2max and 6MWT performance.

5. Helpful Hints

A. Abbreviations and Acronyms

Various abbreviations for key terms, including NCD for Non-communicable diseases, CHD for Congenital Heart Disease, and CVD for Cardiovascular Disease. Other notable abbreviations include AHA for the American Heart Association, CAD for Coronary Artery Disease, WHO for the World Health Organization, PICU for Paediatric Intensive Care Unit, and ICF for the International Classification of Functioning, Disability, and Health. Postoperative Complications are abbreviated as POC, while RACHS stands for Risk Adjustment in Congenital Heart Surgery, and CR denotes Cardiac Rehabilitation. The study also references IJN (Institut Jantung Negara), ICU (Intensive Care Unit), and CABG (Coronary Artery Bypass Graft). Measures such as the 6MWT (6-minute Walk Test), and institutions like ACSM (The American College of Sports Medicine) are noted. Psychological scales are indicated by DASS-Y (Depression Anxiety Stress Scales – Youth version), with functional assessments categorized as BF-BS (Body Functions-Body Structures), A (Activity), and P (Participation). Analytical tools like SPSS (Statistical Package for Social Science) and methods such as EMoSRet (Early Mobilization with Supervised Resistance Training) and ANOVA (Analysis of Variance) are mentioned. Additional terms include BPM (Beats Per Minute) and SD (Standard Deviations).

B. Other Recommendations

After heart surgery at IJN, the current study gave baseline data on the effectiveness of early mobilization supervised resistance training (EMoSReT) for adolescents with congenital heart disease. Based on the observed benefits of early mobilization supervised resistance training (EMoSReT) in enhancing aerobic functional capacity among adolescents with congenital heart disease (CHD) following cardiac surgery, it is recommended that this intervention be integrated into standard postoperative care protocols. The significant improvements in the 6-minute walk test (6MWT) and overall physical endurance suggest that EMoSReT is a highly effective strategy for promoting faster recovery and better long-term health outcomes. Furthermore, tailoring these exercise programs to meet individual patient needs can optimize rehabilitation efforts, ensuring that adolescents regain their functional capacity more efficiently. Implementing EMoSReT as a routine component of postoperative care will likely contribute to better management of CHD and improve the quality of life for these young patients.

6. Conclusion

The study rigorously evaluated the efficacy of Early Mobilization Supervised Resistance Training (EMoSReT) in adolescent patients with congenital heart disease who underwent cardiac surgery at the National Heart Institute (IJN). The study effectively demonstrates that early mobilization supervised resistance training (EMoSReT) significantly enhances aerobic functional capacity in adolescents with congenital heart disease (CHD) following cardiac surgery. The implementation of EMoSReT led to notable improvements in aerobic capacity, as evidenced by the increased distance covered in the 6-minute walk test (6MWT). This intervention not only facilitated faster recovery and improved physical endurance but also highlighted the critical role of early and structured physical activity in the postoperative rehabilitation of CHD patients. The positive outcomes underscore the importance of integrating EMoSReT into standard postoperative care protocols to optimize functional recovery and overall health in this vulnerable population.

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