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Exercise-based cardiac rehabilitation adaptation protocol during Covid-19 pandemic achieved similar results as compared to non-pandemic usual practice: a single center experience

Anggoro Budi Hartopo[1*], Irsad Andi Arso[1], Ade Meidian Ambari[2], Bambang Dwiputra[2], Basuni Radi[2]

[1]Department of Cardiology and Vascular Medicine, Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada/Dr. Sardjito General Hospital, Yogyakarta, [2]Department of Cardiology and Vascular Medicine, Faculty of Medicine, Universitas Indonesia/National Cardiovascular Center Harapan Kita, Jakarta, Indonesia

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ABSTRACT

During the Covid-19 pandemic, exercise-based cardiac rehabilitation (EBCR) faced challenges. Adaptation protocols were implemented to circumvent these challenges. The study aimed to investigate whether the adaptation protocols of EBCR during Covid-19 period influenced the result of cardiac rehabilitation. This was a retrospective cohort study. The subjects were patients who underwent an EBCR program in Dr. Sardjito General Hospital. Yogyakarta, Indonesia. The registry of cardiac rehabilitation was obtained and divided into two periods: non-Covid-19 period and Covid-19 period. During the non-Covid-19 period, 3 EBCR sessions per wk (10-12 total sessions) were performed. During the Covid-19 period, EBCR was reduced to 2 sessions per wk (10-12 total sessions). The functional capacities were evaluated as metabolic equivalents (METs) and exercise test time (min) by treadmill test. A total of 122 subjects completed the EBCR. There were no significant differences in METs and exercise minute-achieved between two time periods. Among subjects with different sessions per wk, namely 2, 3, and 4-5 sessions per wk, there were no significant differences in METs (7.01±1.89; 7.23±1.74; and 7.33±2.13, p=0.813) and minutes achieved (6.72±1.94; 6.96±1.96; and 6.81±1.84, p=0.848) in the end sessions. In conclusion, the adaptation of EBCR protocols during the Covid-19 period by reducing the number of sessions per wk has similar results as compared to the usual regular EBCR practice.

ABSTRAK

Selama pandemi Covid-19, rehabilitasi jantung berbasis latihan (*exercise-based cardiac rehabilitation*/EBCR) menghadapi tantangan. Protokol adaptasi diterapkan untuk menghindari tantangan ini. Penelitian ini bertujuan untuk mengetahui apakah protokol adaptasi EBCR selama periode Covid-19 mempengaruhi hasil rehabilitasi jantung. Ini adalah penelitian kohort retrospektif. Subjek adalah pasien yang menjalani program EBCR di RSUP Dr. Sardjito, Yogyakarta, Indonesia. Registrasi rehabilitasi jantung diperoleh dan dibagi menjadi dua periode yaitu periode non-Covid-19 dan periode Covid-19. Selama periode non-Covid-19, 3 sesi EBCR per minggu (total 10-12 sesi) dilakukan. Selama periode Covid-19, EBCR dikurangi menjadi 2 sesi per minggu (total 10-12 sesi). Kapasitas fungsional dievaluasi sebagai ekuivalen metabolik (MET) dan waktu uji latihan (menit) dengan uji *treadmill*. Sebanyak 122 subjek menyelesaikan EBCR. Tidak ada perbedaan signifikan dalam MET dan menit latihan yang dicapai antara dua periode waktu. Di antara subjek dengan sesi yang berbeda per minggu, yaitu 2, 3, dan 4-5 sesi per minggu, tidak ada perbedaan yang signifikan dalam MET (7,01±1,89; 7,23±1,74; dan 7,33±2,13; p=0,813) dan menit yang dicapai (6,72 ±1,94; 6,96±1,96; dan 6,81±1,84; p=0,848) di sesi akhir. Dapat disimpulkan bahwa adaptasi protokol EBCR selama periode Covid-19 dengan mengurangi jumlah sesi per minggu memiliki hasil yang sama dibandingkan dengan praktik EBCR reguler biasa.

Keywords:
cardiac rehabilitation;
exercise therapy;
Covid-19;
metabolic equivalent;
retrospective study

*corresponding author: a_bhartopo@ugm.ac.id

INTRODUCTION

The movement restriction and physical distancing recommendations by government regulations during the Covid-19 pandemic are the exercise-based cardiac rehabilitation (EBCR) program in many countries. Cardiac rehabilitation facilities were not allowed to open or schedule many patients during exercise sessions. Patients could not freely attend these exercise sessions in the hospital. As a result, most countries suspended hospital- or center-based EBCR services and replaced them with virtual cardiac rehabilitation (VCR) or telerehabilitation.[1,2] However, the VCR and telerehabilitation are not feasible in several countries, especially in developing countries including Indonesia.

The hospital-based EBCR program in Indonesia is supported by national insurance, whereas the VCR and telerehabilitation are not, even during the Covid-19 pandemic. Therefore, the hospital or cardiac rehabilitation centers which rely on national insurance payment prefer performing hospital-based EBCR programs.[3] In most hospitals in Indonesia, the ECBR participation was reduced during the Covid-19 pandemic due to movement restriction, reduced cardiac surgery, hospital regulations to close or downsize EBCR programs, and the reluctance of patients and caregivers to come to the hospital during the pandemic.[4,5]

The cardiac rehabilitation service did not stop operating in Dr. Sarjito General Hospital, Yogyakarta which is a tertiary center for cardiovascular disease referral in the region but adapted with the pandemic condition. Dr. Sardjito General Hospital implemented an adaptive strategy to perform and sustain the participation of EBCR by reducing the number of EBCR sessions performed per wk and maintaining more than 70% of the total number of sessions completed. While VCR and telerehabilitation had not yet been implemented, these adaptation protocols in our hospital were well-received by patients who underwent EBCR and the nursing staffs who supervised the EBCR. However, the results of these EBCR adaptation protocols have not yet been compared with the results of the usual protocols given previously.

This study aimed to investigate whether the adaptation protocols of EBCR during Covid-19 period influenced the result of cardiac rehabilitation by comparing the functional capacity achieved at the end of the EBCR program among patients who underwent different EBCR sessions per wk. This study intends to provide some recommendations to perform the EBCR during the Covid-19 pandemic by adapting the EBCR protocols.

MATERIALS AND METHODS

Subjects

This study was a retrospective cohort study. The subjects were recruited from the patient's register who underwent EBCR in Integrated hearth center Dr. Sardjito General Hospital, Yogyakarta, Indonesia. The time of subjects' recruitment was divided into two periods i.e., the non-Covid-19 period (January 2019 – February 2020) and during the Covid-19 period (March 2020 – March 2021).

Procedure

Subjects admitted, performed, and evaluated in our cardiac rehabilitation center were included in this study. Demography data, pre-rehabilitation diagnosis, total number of sessions, and the evaluation results were collected. The subjects who did not completely perform the EBCR until evaluation, i.e., less than 8 out of a total number of sessions (70%

from 12 sessions), were excluded. The study protocol was approved by the Medical and Health Research Ethics Committee of Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada, Indonesia/Dr. Sardjito General Hospital, Yogyakarta.

The EBCR consisted of a hospital-based and supervised exercise program. Each exercise session consisted of a warming-up period (cycle ergometer for 5 min), main exercise (walking on the treadmill for 30 min with an optimal heart rate target), and cooling-down period (stretching for 10 min). Supervised by cardiac rehabilitation registered nurses, a total of 45-min of exercise each session was performed. During the non-Covid-19 pandemic period, 10-12 total sessions were performed, generally with 3 sessions per wk (every-other-day). Several patients performed 4-5 sessions per wk. During the Covid-19 pandemic, the sessions per wk were reduced to 2 sessions with 10-12 total sessions. The evaluation after the end of session was performed with graded treadmill test according to the Bruce or modified Bruce protocol. The functional capacities were calculated as predicted metabolic equivalents (METs) based on the treadmill test results, by standardized nomogram and as exercise test time, by minutes achieved during treadmill. The same registered nurses supervised the EBCR in both periods.

Statistical analysis

The comparison between two groups was conducted by Chi-square test for categorical data, or Fisher exact test where applicable, and by student t-test for continuous data, or Mann-Whitney test where applicable. The comparison among three groups were analyzed using a Chi-square test for categorical data and one-way Anova for continuous data.

RESULTS

The total subjects admitted for EBCR were 156 patients with 96 patients who performed EBCR in the non-Covid-19 period (January 2019-February 2020) and 60 patients in the Covid-19 period (March 2020-March 2021). Among them, 122 subjects completed more than 70% of the EBCR session (77 subjects of the non-Covid-19 period and 45 subjects of the Covid-19 period). The reduction of patients referred to the cardiac rehabilitation program during the Covid-19 period occurred due to the reduction of cardiac surgery to almost 50%.

There were no significant differences in sex, pre-rehabilitation diagnosis, the total number of sessions, evaluation protocol, and METs and minutes achieved in the evaluation between subjects performing EBCR in the non-Covid-19 and the Covid-19 periods (TABLE 1). However, there was a significant difference in the number of sessions per wk. Subjects in the Covid-19 period predominantly underwent 2 EBCR sessions per wk [n=22 (48.9%) vs. n=3 (3.9%), p<0.001], whereas in the non-Covid-19 period, EBCR was done predominantly in 3 sessions per-wk (every-other-day), [n=8 (17.8%) vs. n=59 (76.6%), p<0.001]. The most common protocol used for evaluation at the end of the sessions was the Bruce protocol in both periods. There was no significant difference in METs [median (interquartile range (IQR) : 7.37 (6.11-8.35) vs. 6.90 (5.40-8.10), p=0.075] and exercise minutes- achieved between two time periods respectively [median (IQR): 7.02 (6.10-8.14) vs. 6.36 (5.28-7.77), p=0.112].

TABLE 1. The comparison of parameters between subjects performing EBCR during the non Covid-19 period and Covid-19 period

Parameters	Non Covid-19 period (n=77)	Covid-19 period (n=45)	p
Sex [n (%)]			
• Male	30 (39.0)	11 (24.4)	0.101
• Female	47 (61.0)	34 (75.6)	
Age [mean±SD year]	40.6±12.3	37.4±12.4	0.174
Diagnosis [n (%)]			
• Post ASD/VSD closure	32 (41.6)	28 (60.9)	
• Post CABG	1 (1.3)	0	
• Post PCI	1 (1.3)	0	
• Post MVR	30 (39.0)	14 (31.1)	0.347
• Post AVR	6 (7.8)	1 (2.2)	
• Post DVR	5 (6.5)	1 (2.2)	
• Post myxoma surgery	2 (2.6)	1 (2.2)	
Total number of session [n (%)]			
• 8-9	15 (19.5)	6 (13.3)	0.385
• 10-12	62 (80.5)	39 (86.7)	
Session per wk [n (%)]			
• 2	3 (3.9)	22 (48.9)	
• 3	59 (76.6)	8 (17.8)	<0.001
• 4-5	15 (19.5)	15 (33.3)	
Treadmill protocol [n (%)]			
• Bruce	72 (93.5)	44 (97.8)	0.292
• Modified Bruce	5 (6.5)	1 (2.2)	
METs achieved [med (IQR)]	7.37 (6.11-8.35)	6.90 (5.40-8.10)	0.075*
Minute achieved [med (IQR)]	7.02 (6.10-8.14)	6.36 (5.28-7.77)	0.112*

*Mann Whitney test; SD: standard deviation; ASD: atrial septal defect; VSD: ventricle septal defect; CABG: coronary artery bypass graft; PCI: percutaneous coronary intervention; MVR: mitral valve replacement; AVR: aortic valve replacement; DVR: double valves replacement; METs: metabolic equivalents; med: median; IQR: interquartile range; wk: week.

Among subjects with different sessions per wk, namely 2 sessions per wk, 3 sessions per wk, and 4-5 sessions per wk, there were no significant differences in METs (mean±SD: 7.01±1.89, 7.23±1.74 and 7.33±2.13, p=0.813) and minutes achieved (mean±SD: 6.72±1.94, 6.96±1.96 and 6.81±1.84, p=0.848) in the evaluation after the end-session of EBCR (TABLE 2).

TABLE 2. The comparison of parameters among subjects underwent EBCR based on sessions fulfilled per wk

Parameters	2 sessions per wk (n=25)	3 sessions per wk (n=67)	4-5 sessions per wk (n=30)	p
Sex [n (%)]				
• Male	8 (32)	26 (39)	7 (23)	0.323.
• Female	17 (68)	41 (61)	23 (77)	
Age (mean±SD year)	41.56±11.85	41.31±12.24	33.40±12.24	0.008
Diagnosis [n (%)]				
• Post ASD/VSD closure	15 (60)	29 (43)	16 (53)	
• Post CABG	0 (0)	1 (1.5)	0 (0)	
• Post PCI	0 (0)	1 (1.5)	0 (0)	
• Post MVR	7 (28)	27 (40)	10 (34)	0.345
• Post AVR	2 (8)	5 (7.5)	0 (0)	
• Post DVR	1 (4)	2 (3)	3 (10)	
• Post myxoma surgery	0 (0)	2 (3)	1 (3)	
Total number of session [n (%)]				
• 8-9	2 (8)	15 (22)	4 (13)	0.216
• 10-12	23 (92)	52 (78)	26 (87)	
Evaluation treadmill protocol [n (%)]				
• Bruce	25 (100)	63 (94)	28 (93)	0.439
• Modified Bruce	0 (0)	4 (6)	2 (7)	
METs achieved (mean±SD)	7.01±1.89	7.23±1.74	7.33±2.13	0.813
Minute achieved (mean±SD)	6.72±1.94	6.96±1.96	6.81±1.84	0.848

ASD: atrial septal defect; VSD: ventricular septal defect; CABG: coronary artery bypass graft; PCI: percutaneous coronary intervention; MVR: mitral valve replacement; AVR: aortic valve replacement; DVR: double valve replacement; METs: metabolic equivalents; SD: standard deviation; wk: week

DISCUSSION

This study showed that the reduction of EBCR sessions per wk of outpatient cardiac rehabilitation program did not associate with the reduction of functional capacity achieved at the end-session of EBCR, which was comparable with previously conducted usual and regular EBCR. This result supports the current adaptive practice to reduce sessions of hospital-based EBCR practice during the Covid-19 pandemic where the VCR and telerehabilitation are not feasible.

The movement restriction during the Covid-19 pandemic affects hospital visits and load in the cardiac rehabilitation center. Therefore, a significant number of cardiac rehabilitation programs were temporarily halted during the Covid-19 pandemic.[6] An international survey indicated that most common cardiac rehabilitation program adaptations experienced a reduction in the program elements, postponement of the graduation until post-program assessments were finished, decreased program duration, while discharging patients more speedily, and adapting all program elements to maintain service

levels.[4,6] Program adaptation was made in Dr. Sardjito General Hospital, Yogyakarta as well by reducing the number of EBCR sessions per wk while maintaining at least 70% program completeness.

The patients who are scheduled to perform cardiac rehabilitation are reduced in order to circumvent overcapacity, as a solution if the VCR and telerehabilitation to perform EBCR are not feasible in several centers.[4,7] Current studies indicated that the VCR and telerehabilitation showed a significant benefit as an alternative to hospital-based cardiac rehabilitation during the Covid-19 pandemic for low-to-moderate risk patients.[2,8-11] However, in Indonesia, such technology has not been performed due to several limitations from healthcare providers, national insurance coverage, and patients' ability to access sites.[5,12] As a result, the practice of telemedicine in cardiac rehabilitation has not yet been performed during the current Covid-19 pandemic restrictions. The Covid-19 pandemic is predicted to make enduring impact on cardiac rehabilitation worldwide, therefore the sustainability of program and safe environments for exercise are important by performing adaptive protocols based on the respective policies of each center, region, or nation.[13-16]

Some limitations of this study were as follows (1) the retrospective method of the research may not be adequate to fully evaluate the results of different sessions among groups, (2) the limited sample size of subjects who participate in the study, (3) the single center analysis which needs more data from multicenter studies and (4) the potential bias by selecting subjects who motivated to perform EBCR in both periods and also performed unscheduled exercise at home. The best research method to evaluate the effectiveness of adaptation protocol is by performing randomized-control trials.

CONCLUSION

Based on our single center study experience, two EBCR sessions per wk with a complete evaluation of cardiac rehabilitation achieved a similar result to the previously usual number of sessions (3, 4 or 5 sessions per wk), but was accomplished with more safety for patients and staffs and in compliance to the government's movement restriction and physical distancing orders. Therefore, in countries which rely on hospital-based cardiac EBCR programs, this adaptation protocol is more feasible to sustain the participation of patients in the cardiac rehabilitation program.

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