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Case Report

The role of exercised-based cardiac rehabilitation in unrevascularized complex coronary artery disease patients: A case series

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ABSTRACT

Background: Coronary artery disease (CAD) is a common type of heart disease that elevates the risk of morbidity and mortality significantly. Although revascularization techniques like coronary artery bypass grafting (CABG) and percutaneous coronary intervention (PCI) are advised for CAD patients, some people may not be eligible for or choose not to undergo revascularization. Even though cardiac rehabilitation (CR) enhances cardiovascular outcomes, quality of life, and general well-being, the utilization of CR is still very low.
Case illustration: The first patient was a 72-year-old man, and the second patient was a 60-year-old man. They were referred for CR after refusing revascularization, and both are left-main and three-vessel disease patients. The first patient underwent CR for six months and the second patient for 18 months, then the Six Minutes Walking Test (6MWT) and 36-Item Short Form Health Survey (SF-36) were performed before and following CR. The evaluation is an increase in walking distance and patient quality of life.
Conclusion: By enhancing quality of life, exercised-based CR programs offer an approach to managing CAD, especially in those who may not be suitable candidates for or choose to avoid revascularization procedures.

1. Introduction

Coronary artery disease (CAD) remains the main cause of death worldwide[1], with various treatment options available, including revascularization such as coronary artery bypass grafting (CABG) and percutaneous coronary intervention (PCI)[2]. However, alternative treatment techniques are necessary since a significant number of CAD patients may not be candidates for revascularization for personal or medical reasons. Exercise-based cardiac rehabilitation (CR) is a program designed to address the needs of CAD patients[3], including those who have not undergone revascularization. We presented, in this serial case, two patients with unrevascularized left main and three-vessel disease lesions.

Case 1

The first patient was a 72-year-old man who came to the hospital because of stable chest pain while doing mild-moderate activity. He had this symptom five years ago and had risk factors of hypertension, diabetes mellitus (HbA1c 7.6%), stroke, and smoking history. The echocardiogram showed a preserved left ventricular systolic function (LVEF 56%) and regional wall motion abnormality (hypokinetic basal mid inferoseptal, basal mid inferolateral, and basal inferior). Chest x-ray (CXR), electrocardiogram (ECG), exercise stress test (MODBRUCE Protocol), and diagnostic coronary angiography (DCA) results are presented in Figure 1. The syntax score was 55.5 and he was advised to receive CABG but refused. Six-minute walk test (6MWT) was performed with results of 306 m and 2.6 METs. He followed a diabetic diet and managed his stress by gardening in his house. He routinely consumed medicines such as Aspirin 80 mg once daily, Clopidogrel 75 mg once daily, Atorvastatin 40 mg once daily, Bisoprolol 5 mg three times daily, Candesartan 8mg once daily, ISDN 5 mg three times daily, Glibenclamide 2 mg once daily, Acarbose 50 mg three times daily, Metformin 500mg once daily and underwent phase II CR for 6 months, 2 times/week. The initial six minutes walk test (6MWT) was 306 m and 2.6 METs. He walked at a treadmill speed of 1.8 km/h at first and then increased gradually to 0.1 km/h per visit with a target of 3.0 km/h. He often felt a burning sensation in his chest while doing the treadmill for 10-15 minutes. He attended 34 times with the last speed was 3.4 km/h and decreased chest discomfort (Table 1). At home, he also did physical activity such as walking for 30 minutes, 4-5x/week every morning. The 6MWT evaluation results were 354 m and 4.17 METs. The patient continues CR in our hospital. The initial and evaluation of biochemical analyses for total cholesterol, triglycerides, HDL cholesterol, low-density cholesterol, and fasting blood glucose were 184 and 138 mg/dL, 262 and 178 mg/dL, 31 and 39 mg/dL, 122 and 115 mg/dL, and 133 and 99 mg/dL, respectively. Quality of life (QOL) was evaluated with SF-36 scoring. The initial and evaluation of QOL for physical functioning, role limitation due to physical health, emotional problems, energy/fatigue, emotional well-being, social functioning, pain, general health, and health change were 40 and 80%, 0 and 75%, 0 and 66.7 %, 50 and 80%, 48 and 92%, 37.5 and 62.5 %, 45 and 77.5 %, 25 and 35%, and 50 and 75%, respectively.

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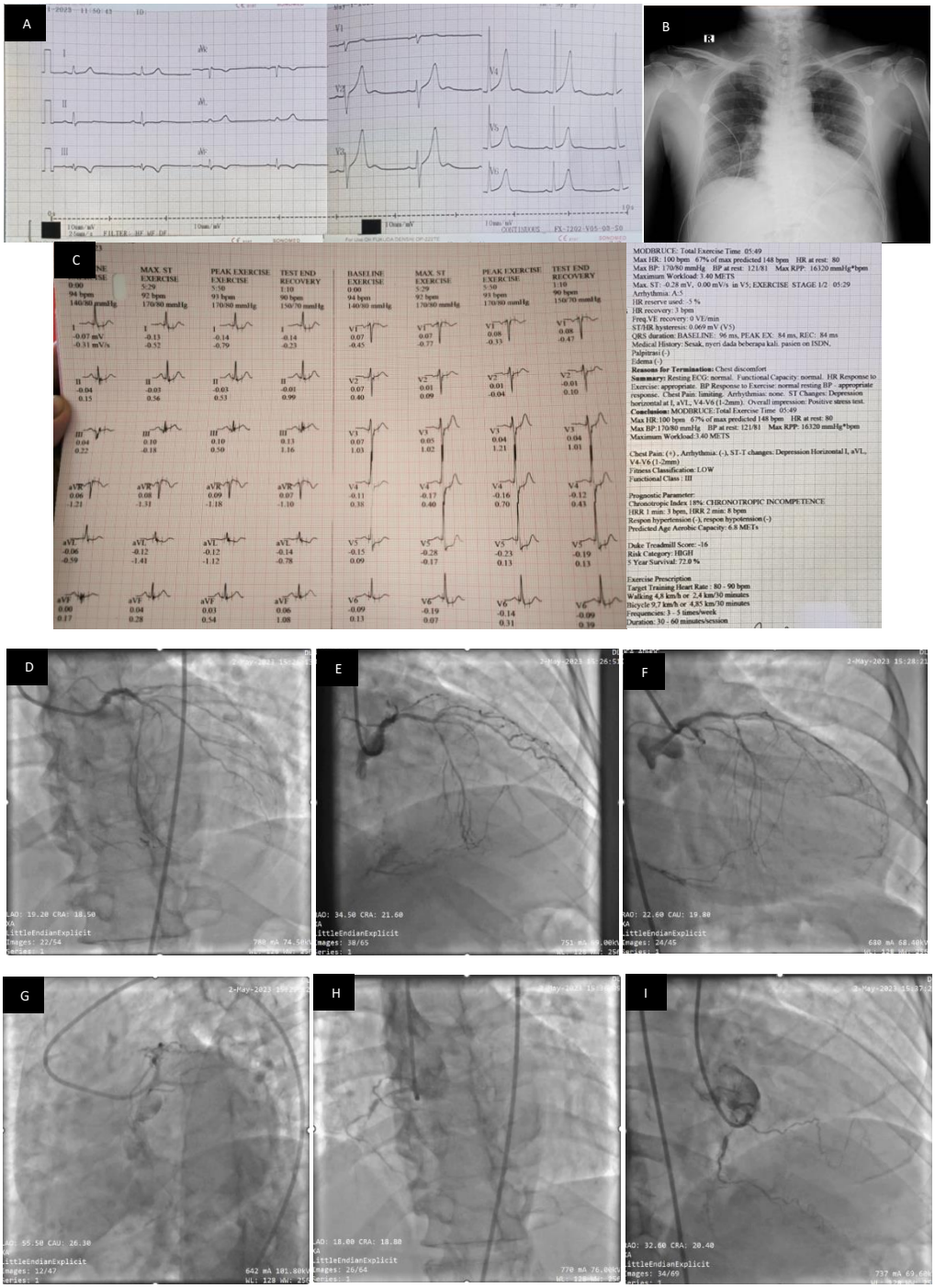

Figure 1 – Case 1 A. Electrocardiogram revealed sinus rhythm at 50 bpm with persistent ST elevation at lead V2-V5 and a tall T wave. B. Chest x-ray (CXR) showed aorta sclerosis C. Treadmill stress test (MODBRUCE Protocol) showed a positive stress test presenting chest discomfort and ST depression horizontal at I, aVL, V4-V6 (1-2 mm), total exercise time 05:49.D-I Coronary angiography showed calcified stenosis at 50% at the proximal left main coronary artery. Diffuse calcified stenosis from the proximal until mid-left anterior ascending (LAD) coronary artery, with maximal stenosis 50% at the proximal and CTO 100% at mid-LAD, collateral from the septal and diagonal branches. Diffuse calcified stenosis from proximal-distal Left Circumflex (LCx) coronary artery with maximal stenosis 80% at proximal and CTO 100% at distal LCx, collateral from septal branch. Diffuse calcified stenosis from the proximal-mid RCA with critical stenosis 99% at the proximal right coronary artery (RCA) with critical stenosis 99% at the proximal and CTO 100% at the mid, collateral from the septal branch (I-J).

Case 2

A man, 60 years old, come with the symptom of gastric pain that radiates to the back and left hand while walking 100 meters. He had this symptom 23 years ago and had the risk factors of strong family history, history of smoking, and hypertension. The echocardiogram showed a preserved left ventricular systolic function (LVEF 62%) and regional wall abnormality (mild hypokinetic basal mid-anteroseptal). CXR, ECG, exercise stress test (MODBRUCE Protocol), and DCA results are presented in Figure 2. The syntax score was 36, and he was advised to do CABG but refused. A six-minute walk test (6MWT) was performed with 216 m and 2.47 METs results. He reduced the portion of his meal but sometimes still ate fatty food. He managed his stress by doing recreational activities such as road trips. He routinely consumed medicines such as Aspirin 80 mg once daily, Clopidogrel 75 mg once daily, Atorvastatin 40 mg once daily, Candesartan 16 mg once daily, Nitroglycerin 5 mg twice daily, Bisoprolol 5 mg once daily, Lansoprazole 30 mg once daily and underwent phase II CR for 2 months, 2 times/week, continued with phase III in our facility for 14 months. Initial 6MWT was 216 m and 2.47 METs. At the first visit, he could only walk for 2x15 minutes followed by a treadmill on the third visit with a speed of 1.2 km/h and increased gradually to 0.1 km/h per visit with a target

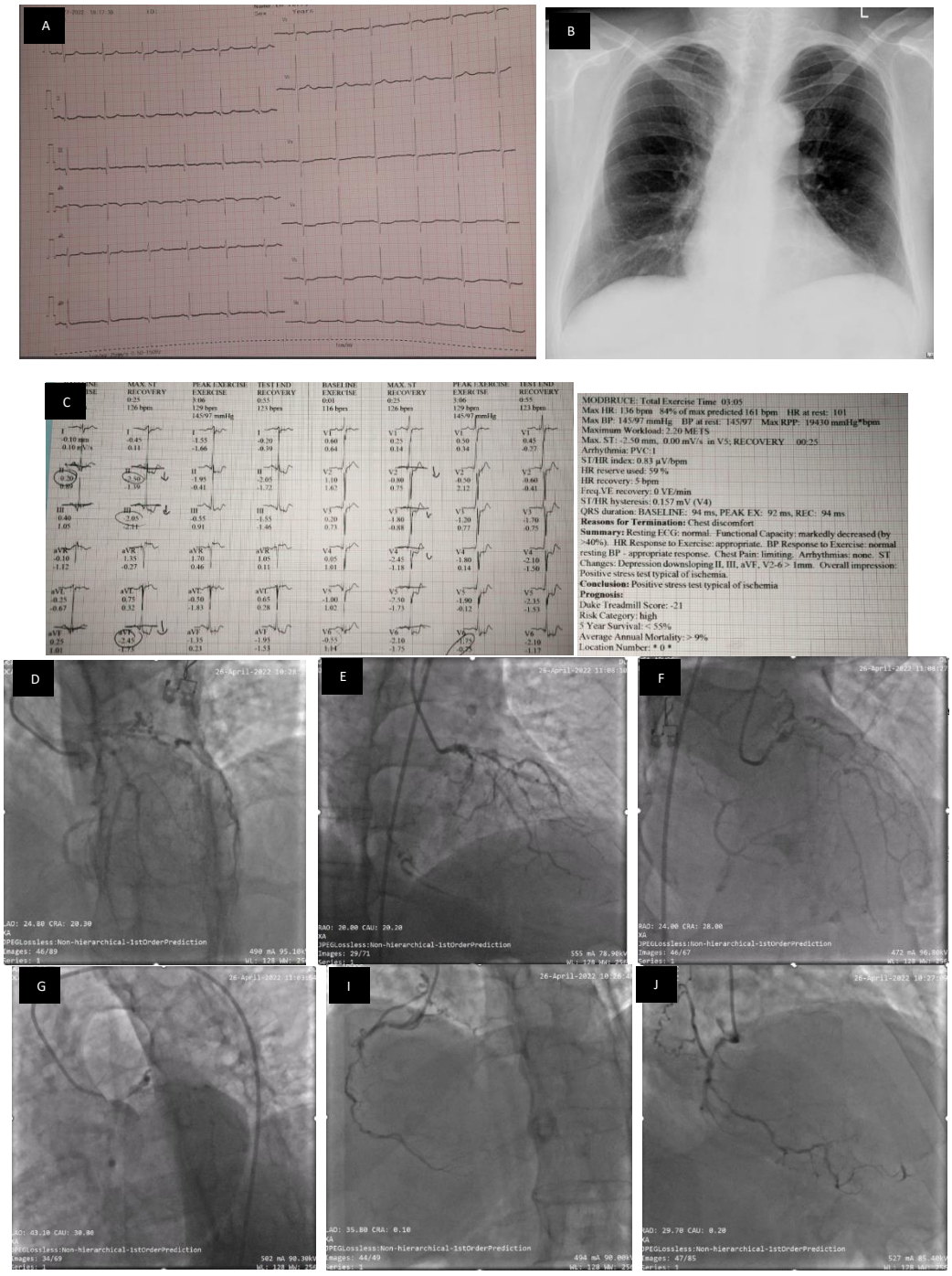

Figure 2 – Case 2 A. The electrocardiogram showed a sinus rhythm of 68 bpm with q pathologist at lead III. B. CXR showed cardiomegaly and aorta sclerosis. C. The initial treadmill stress test (MODBRUCE Protocol) showed a positive stress test presenting chest discomfort and ST depression downsloping at II, III, aVF, and V2-V6 (> 1 mm). Total exercise time: 03:05. D-J. Coronary angiography showed stenosis of 10–20% at the proximal LM. Calcified proximal-mid LAD. Multiple stenoses at the osteal, proximal, and mid-LAD with critical stenosis (95% at the osteal and mid-LAD) High Obtuse Marginal (OM) 1. Chronic Total Occlusion (CTO) at mid-OM 1. Bridging collateral at proximal-distal OM1. CTO distal LCx. Collateral from OM1 to distal RCA. Moderate calcification at the proximal-mid-distal RCA. Multiple stenosis from proximal-mid RCA with critical stenosis 90% at proximal RCA and CTO at distal RCA. Poor collateral ranges from acute marginal (AM) to distal LAD. Collateral from the Sinoatrial (SA) nodal branch to the distal RCA. (I-J).

of 2.16 km/h. He often felt chest discomfort while doing the treadmill for 20 minutes. He attended a total of 13 times in phase 2 rehabilitation and 32 times in phase 3 rehabilitation with the last speed was 3.0 km/h without any chest discomfort (Table 2).At home, he also did physical activity, e.g., walking for more than 30 minutes, 4-5 times per week, every morning. He also felt stronger and could walk to 3000 m without any symptoms. The 6MWT evaluation result was 367 m and 3.3 METs. Treadmill (MODBRUCE) total exercise time was improved from 03:05 to 06:39. The initial and evaluation of biochemical analyses for total cholesterol, triglycerides, HDL cholesterol, and low-density cholesterol were 180 and 150 mg/dL, 115 and 75 mg/dL, 42 and 34 mg/dL, 122 and 101 mg/dL, respectively. Quality of life (QOL) was evaluated with SF-36 scoring. The initial and evaluation of QOL for physical functioning, role limitation due to physical health, emotional problems, energy/fatigue, emotional well-being, social functioning, pain, general health, and health change were 40 and 75%, 25 and 25%, 33.3 and 100%, 65 and 75 %, 100 and 100%, 50 and 75%, 32.5 and 100%, 20 and 70 %, 25 and 75 %, 25 and 35%, and 50 and 75%, respectively.

Table 1 - Cardiac Rehabilitation Progression Case I

No.	Speed (duration)
1	1.8 km/h (7 min (burning sensation)); 1.6 km/h (11 min (chest discomfort))
2	1.7 km/h (6 min (burning sensation); 8 min (chest discomfort))
3	1.6 km/h (10 min (burning sensation); 10 min (burning sensation))
4	1.6 km/h (10 min (burning sensation); 10 min (burning sensation))
5	1.7 km/h (9 min (burning sensation); 15 min)
6	1.8 km/h (8 min (burning sensation); 15 min)
7	1.9 km/h (10 min (burning sensation); 16 min)
8	2.0-2.1 km/h (2x15 min)
9	2.1-2.2 km/h (6 min (burning sensation); 15 min)
10	2.3 km/h (7 min (burning sensation); 10 min (chest discomfort))
11	2.3 km/h (10 min (burning sensation); 12 min (chest discomfort))
12	2.3-2.4 km/h (2x15 min)
13	1.8-1.9 km/h (2 x 15 min)
14	2.0-2.1 km/h (2 x 15 min)
15	2.2 km/h (11 min (burning sensation), 15 min)
16	2.3-2.4 km/h (2 x 15 min)
17	2.5-2.6 km/h (15 min, 14.5 min (chest discomfort))
18	2.7-2.8 km/h (2x15 min)
19	2.9 km/h (2x10 min, burning sensation)
20	2.9 km/h (10 min (burning sensation), 15 min)
21	2.9 km/h (7 min (chest discomfort)); 2.7 km/h (10 min (chest discomfort))
22	2.7 km/h (7 min (burning sensation)); 2.2 km/h (10 min (burning sensation))
23	2.0-2.1 km/h (15 min)
24	2.2-2.3 km/h (15 min)
25	2.4 km/h (15 min (burning sensation)); 2.5 km/h (12 min (chest pain))
26	2.5 km/h (15 min); 2.6 km/h (12 min (burning sensation)
27	2.6 – 2.7 km/h (2x15 min, burning sensation)
28	2.7 km/h (15 min (burning sensation)); 2.8 km/h (15 min)
29	2.9-3.0 km/h (2x15 min)
30	3.0-3.1 km/h (2x15 min)
31	3.2 km/h (7 min (burning sensation)); 3.3 km/h (10 min (burning sensation))
32	3.3 km/h (10 min (chest discomfort)); (11 min (chest discomfort))
33	3.3 km/h (8 min (chest discomfort)); (10 min (chest discomfort))
34	3.3-3.4 km/h (2x15 min)

Table 2 - Cardiac Rehabilitation Progression Case II

No.	Speed (duration)
1	Walking (15 min, 9 min)
2	Walking (15 min, 16 min)
3	1.2 km/h (2x15 min)
4	1.5-1.6 km/h (2 x 20 min)
5	1.5-1.6 km/h (2x15 min)
6	1.7 km/h (15 min), 1.8 km/h (30 min)
7	1.9-2.0 km/h (2x15 min)
8	2.1-2.2 km/h (2x15 min)
9	2.3-2.4 km/h (2x15 min)
10	2.5-2.6 km/h (2x15 min)
11	2.7-2.8 km/h (2x15 min)
12	2.8-2.9 km/h (2x15 min)
13	3.0 km/h (2x15 min)

3. Discussion

Optimal medical treatment is essential for CAD patients to minimize symptoms, stop the disease's progression, and avoid atherothrombotic events. Also, myocardial revascularization is vital to improve the prognosis and/or relieve angina symptoms.[2] Prior guidelines stated revascularization indications primarily for CAD patients still experiencing symptoms after receiving guideline-recommended optimal medical therapy.[4] Nonetheless, angina is linked to worse clinical results, a lower quality of life (QOL), diminished physical stamina, mental distress, and frequent hospital stays and doctor visits.[5] One of the strategies to reduce angina symptoms is exercise-based CR which has been recommended as effective for CAD patients to manage risk factors and achieve a healthy lifestyle.[2] This strategy is effective in reducing cardiovascular hospitalizations and mortality.[3]

The cardiovascular rehabilitation (CR) program is intended to address risk factors and causes of cardiovascular disease control; accelerate physical and mental recovery; help psychological adaptation to the chronic disease healing process; increase knowledge about the disease, risk factors, and planning that have been carried out, precautions; encourage healthy living habits and lifestyle changes to improve long-term prognosis; improve patient's functional capacity; maintain healthy living habits; helping optimal return to life physically, mentally, socially, vocationally, and sexually. [6]

CR programs consist of some phases. The first Phase, applicable to inpatients, is the initial step to lead an active life. It primarily consists of low-intensity exercise, stress reduction strategies, and risk factor education programs. At this point, the program's goal is for the patient to be discharged in the greatest possible bodily and mental health, armed much knowledge about leading a healthy lifestyle. Phase two, after discharging and taking place for three to six months, involves an exercise program tailored to the patient's needs in frequency, intensity, duration, type of training, and progression. It also involves ongoing monitoring to allow the patient to resume professional and social activities. Phase 3 lasts for six to twenty-four months. The primary goals are enhanced QOL and physical condition improvement. [7]

Our patients, the first one underwent phase II CR for six months, and the second patient underwent phase II CR for two months and continued with phase III in our facility for 14 months. They did low-intensity physical activity, such as walking around home 3-5 times per week, for 30–60 minutes or until symptoms emerged, and did treadmilling in our facility, gradually increasing speed. (Table 1 and Table 2).

Exercise has a positive impact on CAD due to several mechanisms. Numerous theories to explain these effects including increased coronary collateralization, cardiac pre-conditioning, and regression of plaque formation. Frequent exercise promotes arteriogenesis, which in turn increases collateralization. In cases of ischemia, collateral arterioles can alleviate reduced blood flow, reduce the size of infarcts, and have cardioprotective effects. It is cardioprotective because cardiac pre-conditioning increases the body's capacity to reduce reactive oxygen species (ROS) from damaged tissue. Exercise stops the regression of pre-existing plaques as well as the advancement of atherosclerosis. [8]

Physical capacity evaluation can be measured with field tests (e.g., the six-minute walk test (6MWT), the shuttle walking test, the one-minute standing test, and the Chester step test) or laboratory tests (e.g., the cardiopulmonary exercise test). The 6MWT is an inexpensive, straightforward, and basic test. It is extensively used in clinical practice, well-standardized, and has reference equations for interpretation. It helps monitor patients with cardiovascular and respiratory disorders and offers pertinent data on submaximal (and sometimes maximal) exercise capacity. The primary result is the greatest distance a patient can walk for six minutes (6MWD). [9]

In our patients, the first patient's 6MWT evaluation after 6 months was increased from 306 to 354 m and 2.6 to 4.17 METs. The second patient's 6MWT evaluation after 18 months was improved from 216 to 367 m and 2.47 to 3.3 METs.

QOL is important in CAD patients and can be measured by a 36-item Short Form Health Survey (SF-36). This questionnaire is shorter and more adaptable than other QOL evaluation tools, which makes it much simpler to administer and has good reliability and validity. [10]

Both our patients felt improved in QOL from physical functioning, role limitation due to physical health and emotional problems, energy/fatigue, emotional well-being, social functioning, pain, general health, and health change.

4. Conclusion

Exercised based cardiovascular rehabilitation is an important management strategy for individuals with CAD who have not undergone revascularization. Revascularization treatments are not always an ideal option, and exercise-based CR programs offer an alternative for controlling CAD by enhancing quality of life.

5. Declaration

5.1 Ethics Approval and Consent to participate

Patient has provided written informed consent prior to involvement in the study.

5.2. Consent for publication

Not applicable.

5.3 Availibility of data and materials

Data used in our study were presented in the main text.

5.4 Competing interests

Not applicable.

5.5 Funding Source

Not applicable.

5.6 Authors contributions

Idea/concept: TA. Design: TA. Control/supervision: CT, VM, BS, SA. Data collection/processing: TA. Analysis/interpretation: TA, CT, VM. Literature review: TA, CT, VM. Writing the article: TA. Critical review: CT, VM, BS, SA. All authors have critically reviewed and approved the final draft and are possible for the content and similarity index of the manuscript.

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References

1. Lindstrom M, Decleene N, Dorsey H, et al. Summary of Global Burden of Disease Study Methods. J Am Coll Cardiol 2022;80(25):2372–425. 10.1016/j.jacc.2022.11.001

2. Neumann FJ, Sechtem U, Banning AP, et al. 2019 ESC Guidelines for the diagnosis and management of chronic coronary syndromes. Eur Heart J 2020;41(3):407–77. 10.1093/eurheartj/ehz425

3. Heran B, Chen J, Ebrahim S, et al. La w). Cochrane Database Syst Rev 2016;(1):1–211. 10.1002/14651858.CD001800.pub3.www.cochranelibrary.com

4. Neumann FJ, Sousa-Uva M, Ahlsson A, et al. 2018 ESC/EACTS Guidelines on myocardial revascularization. Eur Heart J 2019;40(2):87–165. 10.1093/eurheartj/ehy394

5. Steg PG, Greenlaw N, Tendera M, et al. Prevalence of anginal symptoms and myocardial ischemia and their effect on clinical outcomes in outpatients with stable coronary artery disease data from the international observational CLARIFY registry. JAMA Intern Med 2014;174(10):1651–9. 10.1001/jamainternmed.2014.3773

6. PERKI. Panduan Rehabilitasi Kardiovaskular. 2019.

7. Winkelmann ER, Dallazen F, Bronzatti ABS, Lorenzoni JCW, Windmöller P. Análise do protocolo adaptado de steps na reabilitação cardíaca na fase hospitalar. Brazilian J Cardiovasc Surg 2015;30(1):40–8. 10.5935/1678-9741.20140048

8. Chacon D, Fiani B. A Review of Mechanisms on the Beneficial Effect of Exercise on Atherosclerosis. Cureus 2020;12(11). 10.7759/cureus.11641

9. Torres-Castro R, Núñez-Cortés R, Larrateguy S, et al. Assessment of Exercise Capacity in Post-COVID-19 Patients: How Is the Appropriate Test Chosen? Life 2023;13(3):1–13. 10.3390/life13030621

10. Qu B, Guo HQ, Liu J, Zhang Y, Sun G. Reliability and validity testing of the SF-36 questionnaire for the evaluation of the quality of life of Chinese urban construction workers. J Int Med Res 2009;37(4):1184–90. 10.1177/147323000903700425