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BRIEF REPORT

Telerehabilitation: Future of Phase II Cardiac Rehabilitation: Review of Preliminary Outcomes

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Abstract

In this brief communication, we reported Telehealth Home-Based Cardiac Rehabilitation (CR) program structure and preliminary outcomes from patients that completed a 12-week program after coronary artery bypass graft surgery (CABG). We aim to advocate the use of Telerehabilitation as a Phase II CR in patients immediately after the CABG. This approach was innovative and encouraging because the patients were still in subacute phase. The program can serve as a continuation of care for the patients after being discharged from a hospital while regaining their functional ability at home. Our preliminary outcomes demonstrated improvements in resting heart rate, activity level, nutrition status, self-efficacy for managing cardiac diseases, muscle strength, endurance and depression. There were no adverse events during the virtual sessions. Patient satisfaction score was high.

Keywords Telehealth Rehabilitation · Cardiac Rehabilitation · Telemedicine · Coronary artery bypass graft surgery

Introduction

Cardiac rehabilitation (CR) is a structured program of exercise, education and risk factor modifications that aims to accelerate recovery following an acute cardiac event (i.e., heart attack or heart surgery) and to reduce the risk of recurrent cardiac events [1]. CR is designed to help patients with cardiac diseases return to optimal fitness, functional ability and independence following the cardiac events.

CR is divided into three phases. Phase I (Acute Phase) occurs in the hospital right after the event. This phase usually lasts between 2 and 5 days, depending on the patient recovery and surgical complications. Phase II CR (Subacute Phase) is a medically supervised program at an out-patient facility that usually starts approximately 1 month following cardiac event and is considered the most important phase of CR [2]. Patients exercise in the facility while the staff (e.g., physical therapist (PT), exercise physiologist) monitors the patient's responses to exercise (i.e., heart rate, SpO2, blood pressure, exertion levels, respiratory rate). Phase III (Self-Maintenance) refers to the long-term physical activities and lifestyle modifications that a patient performs ongoing conditioning independently out-of-hospital with medical guidance [3]. The three phases are designed for the patients to

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have knowledge about their cardiac conditions, medications, and risk factors (i.e., sleeping, smoking, stress, dietary) to minimize or prevent future heart problems.

Coronary artery bypass graft surgery (CABG) is an invasive revascularization procedure used to treat coronary artery disease. After the CABG, the patients are usually referred to CR and undergo Phase I-III of the CR for functional recovery. Telerehabilitation has been applied to home based cardiac rehabilitation. At our VA hospital, we recently implemented Telehealth CR, which was originally designed as telephone-based Phase 2 CR [4] for veterans that have limited access to the facility. The pandemic COVID-19 has accelerated the uses of telemedicine, including the telerehabilitation. Our telehealth CR received increased numbers of referrals from cardiothoracic surgery due to limited numbers of outpatient CR programs and patients' concerns of COVID transmission [5].

This type of home-based exercise program can be applicable to patients with coronary artery disease (CAD) (e.g., congestive heart failure, stable angina, percutaneous coronary intervention (PCI), valve replacement/repair, Acute coronary syndrome (ACS), CABG). The program can be used for stable CAD patients. Our justification to study in the CABG patient was that the patients were still in sub-acute stage and recently discharged home from the hospital after the major surgery. Unlike other CAD patients, they were not yet able to travel conveniently to participate in the center-based program.

Based on our literature review, clinical outcomes of telerehabilitation in post-CABG as Phase II CR are not currently available. In this brief communication, we summarized preliminary outcomes from the patients that completed our telerehabilitation as the Phase II. The clinical outcomes can potentially support the use of telerehabilitation as Phase II CR immediately after the CABG. The incidence of adverse cardiac events during home-based CR was low. The program could provide a safe and usable alternative form of CR [6].

Methods

The retrospective study was approved by the Institutional Review Board for Baylor College of Medicine and the Michael E. DeBakey Veterans Affairs Medical Center (MEDVAMC) (# H-47365). Patients were eligible for the 12-week Telehealth program if they: (1) willing to participate in the program; (2) medically stable and receiving optimal medical management; (3) had no severe cognitive impairments; and (4) had ability to use a computer, tablet or had a family member to assist them. The patients were mailed the program education materials (i.e., heart disease, medications, exercise, stress management, sleep hygiene, smoking cessation, nutrition), an exercise pictorial booklet, a diary (i.e., vitals, blood glucose, weight, exercise log, food log), a pedometer and exercise resistance bands. The patients connected to physical therapists (PTs) through a secure Veterans Health Administration internet connection (VA Video Connect, VVC) from their homes using computers, tablet/iPAD, or smart phones. Blood pressure monitor, pulse oximeter and weight scale were provided if needed.

Wound care was an essential part of CR in patients after the CABG. The participants were instructed to check for signs of infection at incision and graft sites, and to report to the therapist, and/or to call cardiothoracic surgery (CTS) clinic. Picture of incisions could be taken using screen shot and report to CTS providers for further management.

Outcome measures

Demographics included age, gender, Charlson Comorbidity Index (CCI) [7] were summarized (Table 1). Outcomes included, body mass index (BMI), blood pressure, resting heart rate, weight, Cardiac Self Efficacy scale [8], Patient Health Questionnaire-9 [9], Duke Activity Status Index [10], Rate My Plate [11], Medication Adherence [12], 5 Times Sit to Stand Test (5X-STS) [13], 1-Minute Sit to Stand Test (1-MIN STS) [14] and daily step activity (Table 1).

Procedures

For the VVC session, the patients gave verbal consent to the session, verified themself, their secure location with privacy and emergency contact. The physical therapist (PT) had the patient checked his blood pressure, heart rate, blood oxygen saturation (SpO2), weight, respiratory rate, and blood glucose (if applicable) and reviewed changes in the patient health status (i.e., dyspnea, edema, exertional chest pain, shortness of breath). Each patient performed exercises and other related activities (i.e., incentive spirometer, Acapella, splinted Huff cough) during the session as instructed by the PT. Real-time exercise program consisted of stretching, aerobic, strengthening, posture, balance and breathing exercises. The exercises were symptom limited exercise (e.g., shortness of breath, lightheadedness) with low to moderate intensity. Each patient was trained to check blood pressure, heart rate, SpO2, respiratory rate and level of exertion during the exercise session. The program was one hour, once a week, continuously for 12 weeks. PT also discussed about sternal precautions, fluid restriction (if any), exercise precautions, posture correction, pursed-lip breathing, pacing and symptoms to discontinue exercise. If patients reported urgent medical issue, PT contacted the physician for proper medical management. The patients were prescribed exercises to do on their own as self-management.

Table 1 Demographics and Outcomes

Outcomes	Pre-Tele CR	Post-Tele CR	*p*-Value
Age (year)	68.59 (8.35)	na	
Ejection Fraction (%)	52.69 (8.92)	na	
Charlson Comorbidity Index (CCI)	6.06 (2.02)	na	
Body Mass Index (BMI, kg/m)	27.45 (3.82)	27.19 (3.41)	.345
Systolic Blood Pressure (mm Hg)	125.76 (14.84)	122.82 (13.66)	.355
Diastolic Blood Pressure (mm Hg)	74.65 (10.08)	73.71 (8.07)	.729
Resting Heart Rate (bpm)	79.82 (14.33)	70.18 (9.91)	.006*
Cardiac Self Efficacy Scale (CSE)	32.00 (11.76)	42.29 (6.70)	< .001*
Duke Activity Status Index	15.36 (12.05)	36.50 (13.43)	< .001*
Patient Health Questionnaire (PHQ-9)	6.59 (5.04)	4.06 (5.04)	.031*
Medication Adherence	3.82 (2.68)	3.53 (1.28)	.701
Rate Your Plate	54.47 (7.73)	59.41 (5.58)	.006*
Daily Step Activity (steps/day)	3,034.72 (3037.91)	7,125.58 (2825.99)	< .001*
5 Times Sit to Stand (5X-STS) (sec)	16.54 (5.99)	11.96 (3.94)	< .001*
1-Min Sit to Stand (1-MIN STS; # repetitions)	15.41 (7.91)	24.65 (8.25)	< .001*
Total cholesterol (mg/dL) [a]	131.85 (40.32)	123.77 (36.07)	.558
High-density lipoprotein (mg/dL) [a]	35.59 (8.85)	37.15 (7.95)	.420
Low-density lipoprotein (mg/dL) [a]	75.89 (35.94)	67.35 (38.11)	.457
Triglycerides (mg/dL) [a]	101.62 (56.04)	96.62 (40.64)	.767
Hemoglobin A1C (%) [b]	6.37 (1.58)	6.12 (0.79)	.447
Average days after CABG to enrollment	37.87 (12.08)		
Patient Satisfaction		29.82 (0.53)	

[a] data from N = 13

[b] data from N = 12

There self-exercise included daily walking, breathing exercise and strengthening exercise for 3 days a week.

During the program, PT also provided education for heart healthy lifestyle. Educations included understanding lab results, heart healthy nutrition, weight management, diabetic education, sleep hygiene, stress management, relaxation breathing, smoking cessation and medications adherence. Inhaler educations, oxygen therapy and continuous positive airway pressure (CPAP) compliance were discussed as needed.

Results

We studied clinical outcomes from 17 male Veterans (age 68.59 ± 8.35 yr.) who underwent CABG and completed telehealth CR. Displayed in Table 1 are the comparison of the outcomes at baseline and after 12-session program.

There were improvements in resting heart rate, Cardiac Self Efficacy Scale score (higher self-efficacy for managing chronic diseases), Duke Activity Status Index, PHQ-9 score, Rate Your Plate score, Daily Step Activity, muscle strength (5X-STS) and endurance (1-MIN STS). There were no significant changes in BMI, BP, Medication Adherence and other blood test results after the 12-week. There were no adverse events during the virtual sessions.

Displayed in Table 2 are medical issues occurred during the telehealth CR program. Most patients received medications to treat at home, only one was hospitalized for chest drainage at the hospital.

Discussion

Based on literature, our retrospective study was the first to report outcomes of using Telerehabilitation as Phase II CR after CABG. The preliminary results demonstrated improvements in resting heart rate, level of physical activity, CSE score, muscle strength, nutritional status,

Table 2 Medical issues during the program

Medical Issue	Number of Patients	Intervention, Location
No Medical issue	11 (65.7%)	n/a
Fluid retention	1	Medication, home
Pleural effusion, A-Fib	1	Chest drainage, hospital
Urinary tract infection	1	Medication, home
Incision infection	1	Medication, home

endurance and improved depression. The patient satisfaction was high due to convenience of the program, avoiding COVID risk, no driving, and individualized program. Therefore, our findings suggested the effectiveness and safety of program as a Phase II CR (Subacute Phase) after CABG.

Typically, patients receive CR in supervised, monitored in person program in an outpatient setting over several weeks after CABG. Prior to COVID-19, telerehabilitation can be considered as phase III CR [15], delivering CR digitally using real-time video. In those programs, patients exercise independently and receive coaching via a smartphone application and telephone calls. The COVID pandemic accelerated the use of telerehabilitation to mitigate the COVID transmission. Our telehealth CR was an interactive, supervised, self-monitored session with the PT. The patients performed prescribed exercises in the session and exercised independently at home during the week. The patients reported any changes in health status (i.e., fluid retention, infection, elevated BP) or issues with the exercise to the PT weekly. The PT contacted primary care provider, cardiothoracic team (i.e., surgeon, nurse, physician assistant) or cardiologist to address medical issues, as needed. This indicated that the continuation of care after the CABG can be done effectively through Telerehabilitation.

Only 24.4% of eligible Medicare patients participated in the CR, and only 24.3% of those patients start CR within 21 days, and only 26.9% complete CR within the year [16]. To reach the CDC's Million Hearts Cardiac Rehabilitation Collaborative's goal to increase CR utilization by 70% by 2022, many disparities and geographic variations need to be overcome. Telehealth CR can overcome several barriers that limit participation in center-based CR (i.e., rural areas, underserved area, transportation) and facilitate the participation. Our findings support the use of Telerehabilitation as Phase II CR in patients immediately after the CABG, when the patients had driving and activity restrictions.

There are a number of limitations of the study, which need to be addressed. There was no control group (i.e., outpatient CR at a facility) with randomization to compare with the Telehealth CR. The small sample limits our ability to generalize the findings to other patients. Not all the referred patients agreed to participated in the program. Not all the participants were compliance with the weekly reports. Many patients preferred to use home health rehabilitation services for their recovery. Larger studies are needed to assess the effectiveness of the program on outcomes to extend the findings of the present study. Our program was not timely (average days to enrollment after CABG was 37), comparing to the average 1 month for Phase II as reported previously [2]. Delay in getting iPAD due to backlog and understaffing during COVID cause the delay.

Future directions and conclusions

Our brief report provided preliminary data to advocate the use of interactive, supervised, self-monitored telerehabilitation as phase II CR. Improvement in several clinical outcomes were found after the program. A larger study is needed to extend our findings, and our structured program may provide methodological guidance for future programs.

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Data availability Supporting data are available upon request after publication.

Declarations

Ethical approval The study was approved by the Institutional Review Board for Baylor College of Medicine and the Michael E. DeBakey Veterans Affairs Medical Center (MEDVAMC) (# H-47365).

Consent to participate Signed consent form was not applicable to the study.

Consent for publication Not applicable.

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