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CASE REPORT: CLINICAL CASE

Cardiac Rehabilitation Outcomes in a Transgender Woman With Coronary Artery Disease

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ABSTRACT

The presented case report examines the effects of cardiac rehabilitation (CR) on a 69-year-old transgender woman with coronary artery disease (CAD). The patient engaged in 19 CR sessions without experiencing any adverse effects. Pre- to post-CR assessments revealed a worsening of body composition, characterized by an approximate 3% increase in fat mass and a 4% reduction in lean mass. In contrast, peak oxygen uptake and exercise time increased by 6% and 9%, respectively. This case report highlights the need for additional targeted strategies to improve both body composition and cardiorespiratory fitness in transgender woman undergoing CR for coronary artery disease management. (JACC Case Rep. 2024;29:102830) © 2024 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

Transgender is a term used to define people whose gender identity differs from their recorded sex at birth, eg, a transgender woman (TW) is a female person assigned male sex at birth.[1] The transgender population has a higher rate of cardiovascular disease risk factors compared with the general population.[1] The incidence of cardiovascular disease is high among the transgender population, with TW experiencing a higher rate of coronary artery disease (CAD).[1] As part of their care, TW may undergo gender-affirming hormone therapy (GAHT) including estrogens and antiandrogens.[2] A clinical study demonstrated that TW undergoing GAHT have higher fat mass, lower lean muscle mass, and reduced muscle strength compared with age/height-matched cisgender men.[3] In addition, the mean cardiorespiratory fitness of TW was reported as "fair" (~78% predicted) when calculated using male normative values and "average" (~99% predicted) when calculated using female normative values.[4] Both high body fat percentage and low cardiorespiratory fitness are predictors of long-term cardiovascular events and mortality in patients with CAD.[5] Enhancing body composition and cardiorespiratory fitness is of utmost importance to decrease the risk of cardiovascular events and improve the quality of life for TW patients.

Cardiac rehabilitation (CR) is a comprehensive program for secondary prevention of cardiovascular disease, which includes exercise training, physical activity promotion, health education, cardiovascular

TAKE-HOME MESSAGES

- This case report highlights the critical role of CR in transgender patients with CAD.
- Enhancing CR strategies is essential for improving body composition in TW with CAD.

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ABBREVIATIONS AND ACRONYMS

CAD = coronary artery disease

CR = cardiac rehabilitation

GAHT = gender-affirming hormone therapy

HIIT = high-intensity interval training

RPE = rating of perceived exertion

TW = transgender woman

VO_2peak = peak oxygen uptake

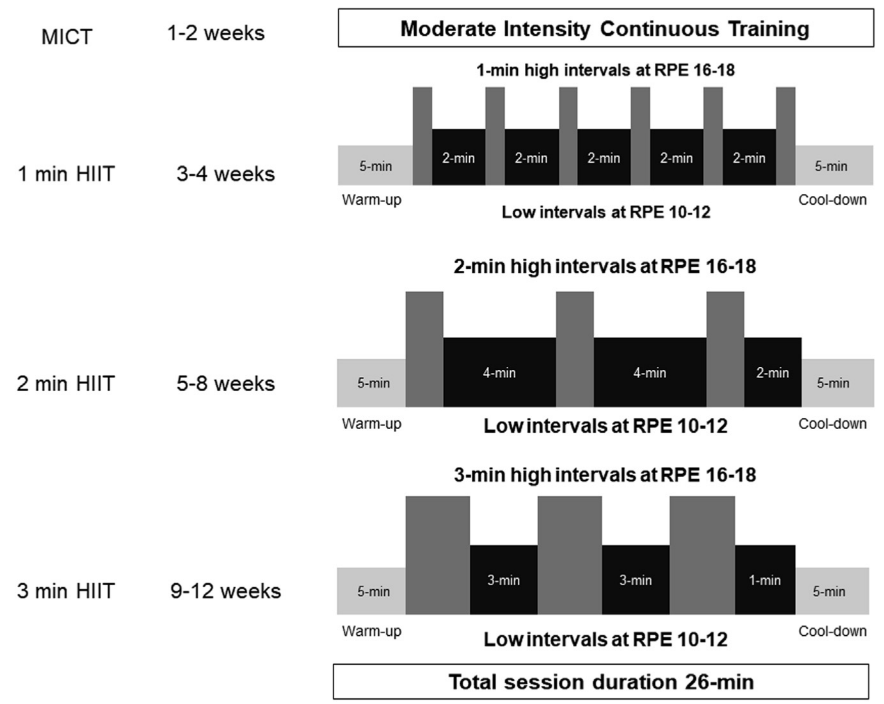
risk factor management, stress management, and psychological support.[6] Exercise training is a fundamental core component of CR programs, exerting multisystem effects that improve cardiovascular health, with a critical benefit being the improvements in peak oxygen uptake (VO_2peak) and body composition.[7] To our knowledge, no data exist on the impact of CR on body composition and VO_2peak in TW patients with CAD. In this case report, we explore the effects of CR on body composition and VO_2peak in a TW patient with CAD.

METHODS

A 69-year-old TW began the transition process with GAHT in 2018 and was diagnosed with 3-vessel CAD and underwent coronary artery bypass grafting in November 2019. The patient had a history of hypertension, hyperlipidemia, obesity, anxiety, and gender dysphoria. Since 2018, the GAHT included estradiol valerate (20 mg, 1 injection/wk) and leuprolide (22.5 mg, 1 injection per 3 months). In addition, the patient was receiving escitalopram (10 mg, 1 tablet/d) and antacid medicine for anxiety. The patient was also treated with lisinopril (5 mg, 1 tablet/d), metoprolol succinate (25 mg, 1 tablet/d), isosorbide mononitrate (60 mg, 1 tablet/d), atorvastatin (40 mg, 1 tablet/d), and aspirin (81 mg, 1 tablet/d) for cardiovascular disease risk factor management. Hemoglobin and hematocrit were within normal range. In June 2022, this patient was referred to CR because of a history of stable angina and subsequently enrolled in a randomized clinical trial in our CR center at Mayo Clinic in Rochester, Minnesota, USA, after providing written informed consent. This case report received approval from the Mayo Clinic Institutional Review Board and adheres to the principles outlined in the Declaration of Helsinki.

Body composition was measured using dual-energy x-ray absorptiometry (Lunar iDXA Series X).[7] Scans were used to measure body mass, body lean mass, and body fat mass. Body mass index, lean mass index, and fat mass index were calculated as mass divided by height squared. Body lean percentage and

FIGURE 1 Exercise Training Prescription for the Transgender Woman Patient



HIIT = high-intensity interval training; MICT = moderate-intensity continuous training; RPE = rate of perceived exertion.

body fat percentage were calculated as body lean mass or body fat mass divided by body mass multiplied by 100.

A standard symptom-limit cardiopulmonary exercise test was performed by a trained exercise physiologist under the supervision of a cardiologist, using institutionally derived incremental exercise protocol on the treadmill.[7] Throughout the test, the patient remained on their standard pharmacologic therapy. Breath-by-breath open-circuit spirometry (MGC Diagnostic) was used for breath-by-breath measurement of VO_2peak, carbon dioxide, respiratory exchange ratio, respiratory rate, tidal volume, and minute ventilation. The anaerobic threshold was calculated using the V-slope method. Heart rate was measured by 12-lead electrocardiogram and heart rate recovery in 1 minute was calculated. Systolic blood pressure was measured at each stage of exercise by manual sphygmomanometry. A Borg rate of perceived exertion (RPE) scale of 6 to 20 was used to measure exercise intensity during the exercise test. Peak values were obtained during the final minute of the exercise test. To assess the effect of gender identity on the predicated VO_2peak, the following equation from the Fitness Registry and the Importance of Exercise National Database (FRIEND) was used:

$$VO_2\text{peak (mL/kg/min)} = 79.9 - (0.39 \times \text{age}) - (13.7 \times \text{sex}) - 0.127 \times \text{weight})$$

The patient was prescribed 24 exercise sessions 2 times per week over 12 to 14 weeks. Each exercise session consisted of ~30 minutes of aerobic exercise and 10 to 15 minutes of resistance training exercise. The exercise training prescription is illustrated in Figure 1. During the first 2 weeks of CR, the patient performed moderate-intensity continuous training at a rating of perceived exertion of 12 to 14. In the third and fourth weeks, the patient started high-intensity interval training (HIIT) with 5 minutes of warm-up and cool-down separated by 6 high-intensity intervals of 1 minute interspersed with 5 low-intensity intervals of 2 minutes. Between the fifth and eighth weeks, the HIIT transitioned to 3 high-intensity intervals of 2 minutes interspersed with 2 low-intensity intervals of 4 minutes, and a further 2-min of low intensity following the last interval before cool-down. For the remainder of the CR program, the patient performed HIIT with 3 high-intensity intervals of 3 minutes interspersed with 2 low-intensity intervals of 3 minutes, and a further 1 minute of low intensity following the last interval before cool-down. Training intensity was determined by the patient using RPE. The patient was instructed to warm up and cool down at an RPE of <10, low-intensity intervals were prescribed at an RPE of 10 to 12, and high-intensity intervals were prescribed at an RPE of 15 to 18. On days of the week with no supervised CR sessions, the patient was encouraged to engage in physical activity independently for at least 30 minutes consistent with the prescribed exercise program.

TABLE 1 Body Composition and Cardiopulmonary Exercise Test Pre- and Post-CR

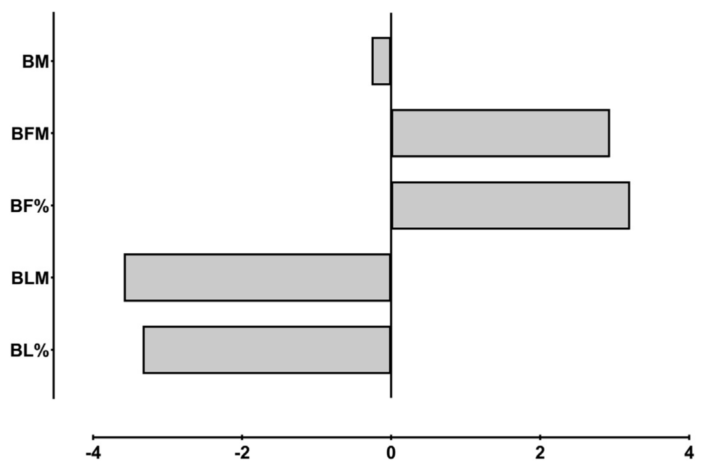
	Pre-CR	Post-CR
Body composition		
BM, kg	114.9	114.6
BMI, kg/m^2	39.3	39.2
BFM, kg	55.3	56.9
FMI, kg/m^2	18.9	19.5
BF%	48.1	49.6
BLM, kg	56.3	54.3
LMI, kg/m^2	19.3	18.6
BL%	49.0	47.4
CPET		
HR_{rest}, beats/min	63	54
HR_{peak}, beats/min	120	134
HRR	10	14
SBP_{peak}, mm Hg	172	172
VO_2peak, L/min	1.99	2.1
VO_2peak, mL/kg/min	17.3	18.1
Male predicated VO_2, %	45	47
Female predicated VO_2, %	70	73
AT, mL/min	1120	1380
VCO_2, L/min	2.3	2.6
RR, breaths/min	35.2	36.5
V_T, L	2.2	2.4
V_E, L/min	80	86
RER	1.18	1.22
RPE	19	18
Exercise time, min	5.6	6.1

AT = anaerobic threshold; BFM = body fat mass; BF% = body fat percentage; BLM = body lean mass; BL% = body lean percentage; BM = body mass; BMI = body mass index; CPET = cardiopulmonary exercise test; CR = cardiac rehabilitation; FMI = fat mass index; HR = heart rate; HRR = heart rate recovery; LMI = lean mass index; RER = respiratory exchange ratio; RPE = rating of perceived exertion; RR = respiratory rate; SBP = systolic blood pressure; VCO_2 = carbon dioxide; V_E = minute ventilation; VO_2 = peak oxygen uptake; V_T = tidal volume.

RESULTS

During CR, the patient completed 19 sessions over 14 weeks without any disease flare-ups, training-related injuries, adverse events, or medication changes. The body composition and variables of cardiopulmonary exercise test characteristics of the TW patient are provided in Table 1. Post-CR, there was a decrease in body mass because of reduced body lean mass by 0.3% and 4% respectively, whereas body fat mass increased by 3% (Figure 2). Additionally, the

FIGURE 2 Percentage Change of Body Composition



BFM = body fat mass; BF% = body fat percentage; BLM = body lean mass; BL% = body lean percentage; BM = body mass.

body fat percentage increased by 3%, while the body lean percentage decreased by 3%. The patient's body mass index and lean mass index decreased by 0.3 and 2 kg/m^2 respectively, and fat mass index increased by 0.6 kg/m^2. Post-CR, resting heart rate decreased by 14%, while peak heart rate and heart rate recovery increased by 12% and 40%, respectively. Additionally, there was an increase in absolute VO_2peak, relative VO_2peak, and anaerobic threshold by 6%, 5%, and 23%, respectively. Regarding respiratory variables, there were increases in carbon dioxide (13%), respiratory rate (4%), tidal volume (5%), minute ventilation (8%), and respiratory exchange ratio (3%). With this, exercise time increased by 9% and RPE decreased by 5%, suggesting improved exercise tolerance.

DISCUSSION

This is the first case report exploring the impact of cardiac rehabilitation on body composition and cardiorespiratory fitness in a TW with CAD. The findings indicate that CR improves cardiorespiratory fitness such as VO_2peak, anaerobic threshold, peak heart rate, respiratory capacity, and exercise time. Additionally, CR enhances autonomic nervous system function, evidenced by decreased resting heart rate and improved heart rate recovery. Despite these cardiovascular benefits, CR was ineffective in mitigating the deterioration of body composition in this patient.

The body composition of the TW patient deteriorated with an increase in fat mass and a decrease in lean mass. Despite a slight reduction in body mass index, it remained classified as class II obesity.[8] Additionally, fat mass index increased by 3% in TW, resulting in post-CR classifications of class III obesity for men and class II obesity for women.[8] This is concerning because a higher fat mass and lower lean mass are associated with poor prognosis in CAD.[5] Several studies have suggested that GAHT may contribute to adverse changes to body composition, with an increase in fat mass and a decrease in lean mass among TWs.[9] In this context, our patient was receiving GAHT, which included estradiol valerate (estrogen) to promote fat redistribution and deposition, in conjunction with leuprorelin (a testosterone suppressor) to facilitate the reduction of muscle mass. This case report highlights the importance of increased attention to CR programming to mitigate the deterioration of body composition in TW patients with CAD who are receiving GAHT. Implementing resistance training interventions may offer a promising approach to prevent adverse changes in body composition.[10]

The post-CR percent predicted VO_2 peak increased by 2% to 47%, remaining classified as "limited" according to male normative values, and increased by 3% to 73%, remaining classified as "below average" according to female normative values.[11] Furthermore, the increment in VO_2peak of 0.8 mL/kg/min observed in the TW patient is modest compared with the average improvement of 2.5 mL/kg/min seen in a cohort of CR patients at our institution.[7] There are well-documented sex disparities in CR outcomes, with female patients typically demonstrating smaller improvements in VO_2 peak and a greater prevalence of musculoskeletal conditions.[6] These disparities suggest the need for more tailored exercise prescriptions depending on patient sex and possibly for TW patients undergoing GAHT, who may experience similar challenges. Individualized strategies, such as modifying the number of CR sessions, increasing focus on strength training, and progressively enhancing exercise intensity, are all viable approaches to optimize CR outcomes in TW patients, addressing both cardiovascular and musculoskeletal needs.[6]

CONCLUSIONS

This case report highlights the necessity to develop a broader understanding of the physiologic changes and adaptations associated with gender transition, particularly later in life, and the importance of developing additional strategies and/or interventions to augment improvements in body composition and cardiorespiratory fitness outcomes in TW patients undergoing CR.

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