High-intensity, sport-specific cardiac rehabilitation training of a 22-year-old competitive cyclist after spontaneous coronary artery dissection

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ABSTRACT

A 22-year-old man with spontaneous coronary artery dissection wanted to assess the feasibility of returning to competitive cycling. He was referred to the cardiac rehabilitation (CR) program at Baylor Hamilton Heart and Vascular Hospital where staff designed a high-intensity, sport-specific training program that simulated the movements and forces associated with his goal activity. The program was symptom limited and enabled the patient to train earlier and at a higher intensity than is typically allowed in conventional CR programs. Daily exercise training was customized to match the physical demands of competitive cycling by using a road bike, an indoor bike power trainer, and an interactive indoor-cycling software program. This case illustrates how specialized CR training, tailored to a patient's specific goals, can aid in the return to vigorous physical activity. He completed the high-intensity exercise training program without adverse signs or symptoms.

KEYWORDS Cardiac rehabilitation; cycling; spontaneous coronary artery dissection; sport-specific exercise training

Spontaneous coronary artery dissection (SCAD) is an increasingly recognized cause of acute myocardial infarction that tends to affect young, presumably healthy individuals.¹ The underlying pathophysiology of SCAD involves tearing or splitting of the coronary artery wall and/or intramural hematoma formation. SCAD resulting in acute coronary events has a high mortality rate and has been described in association with varied pathophysiological stimuli,² including intense exercise.³ Because of the association between SCAD and vigorous physical exertion, certain types of post-event exercise,⁴ such as competitive racing,⁵ are generally not prescribed. We present a case of SCAD in a young man for whom a unique high-intensity training program was developed toward his goal of returning to a pre-event level of competitive cycling.

CASE REPORT

A 22-year-old male cyclist with attention deficit hyperactivity disorder presented to the Baylor University Medical Center, Dallas, Texas, emergency department with severe

(8 out of 10) substernal chest pain. He complained of dyspnea, nausea, and vomiting, as well as pain radiating to his left arm and neck. The pain started while he was cycling at a popular outdoor trail and had resolved by the time he arrived at the hospital. He had been taking lisdexamfetamine for about 5 months. A computed tomography coronary angiogram revealed a dissection within the proximal left anterior descending artery.⁶ His cardiologist referred him to a cardiac rehabilitation (CR) program at Baylor Heart and Vascular Hospital, Dallas, Texas, that specializes in high-intensity, sport-specific exercise training.^{7–11}

Upon entry to CR, his medications included aspirin, atorvastatin, and carvedilol. When asked about his CR goals, the patient indicated that he wanted to resume competitive cycling but was exceedingly anxious to do so on his own. For this reason, CR staff developed a progressive high-intensity training program consisting of 55 exercise sessions over a 3-year time period. Each of the exercise sessions began with a warm-up and ended with a cooldown. In keeping with the standard protocol of the CR facility, electrocardiographic telemetry

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Table 1. Heart rate, systolic blood pressure, diastolic blood pressure, rate pressure product, and rating of perceived exertion data from exercise training sessions in a cardiac rehabilitation program

Type of exercise training	Number of sessions	Peak HR (bpm)	Mean peak HR (bpm)	Peak SBP (mm Hg)	Mean peak SBP (mm Hg)	Peak DBP (mm Hg)	Mean peak DBP (mm Hg)	Peak RPP	Mean peak RPP	Peak RPE	Mean peak RPE
TM, bike, RT	23	171	137	172	142	90	74	27,224	19,205	8	5
Interval bike	19	189	179	210	168	104	73	38,850	30,448	6	9
Interval bike ^a	13	214	184	212	159	127	80	43,223	27,815	10	8

DBP indicates diastolic blood pressure; HR, heart rate; RPE, rating of perceived exertion (scale of 1 to 10); RPP, rate pressure product; RT, resistance training; SBP, systolic blood pressure; TM, treadmill.

^aMeasured with a continuous blood pressure monitor instead of a cuff.

(TeleRehab VersaCare, ScottCare Corp, Cleveland, OH) was used to monitor the patient's heart rate and rhythm during each session. Blood pressure, heart rate, and rate pressure product values were recorded at the beginning and end of each session and at peak exertion (*Table 1*). The patient was asked to rate his perceived exertion at the peak of each exercise session (*Table 1*). Training was symptom limited; no blood pressure, heart rate, rate pressure product, or rating of perceived exertion limits were used to restrict the patient's exercise intensity. He was monitored for angina pectoris, dizziness, pain, arrhythmias, and shortness of breath. The patient performed a post-CR program maximal cycling stress test protocol while wearing a calibrated desktop metabolic system (Fitmate MED, Cosmed USA Inc., Chicago, IL) from which his oxygen consumption was measured (*Figure 1a*). The initial load of the test protocol (watts) was 120 and was increased incrementally by 20 at the beginning of each 3-min stage. During this stress test, the patient achieved 14.1 metabolic equivalents (METs, defined as the energy cost of exercise, where 1 MET = 3.5 mL O₂ per kilogram of body weight per minute).

During the initial 23 CR exercises sessions, the patient performed various low- to moderate-intensity treadmill, bike, and resistance training exercises. Following an 18-month hiatus attending a nearby university, he returned to participate in 32 additional CR exercise sessions over an 11-month period of

time. During these sessions, the three previously prescribed medications had been discontinued. CR staff provided exercise training that simulated competitive cycling through use of his road bike, an indoor bike power trainer (Wahoo KICKR), and an interactive indoor-cycling software program (TrainerRoad; *Figure 1b*). The patient brought his road bike to the CR department. The back wheel was removed and the bike chain was attached to the sprocket cassette on the power trainer. A laptop that supported the software program communicated to the power trainer by Bluetooth. The varied workouts consisted of high-intensity, interactive, diverse interval training exercises. The patient selected his daily workouts and was able to adjust the power (watts) during the exercise bouts. Continuous blood pressure, using the Finometer monitor (Finometer MIDI, Finapres Medical Systems B.V., Amsterdam, The Netherlands), was obtained (*Table 1*) during 13 of these sessions. Over the course of the CR program, the patient had no adverse signs or symptoms that would have required the exercise training to be stopped.

DISCUSSION

Traditional CR programs (36 sessions of moderate-intensity workouts) have been shown to improve patients' exercise capacity and psychosocial well-being.⁴ Attending CR may be especially important for previously active patients with SCAD

Figure 1. The patient performing (a) a maximal metabolic stress test and (b) high-intensity training on an indoor bike power trainer.

who have considerable anxiety⁵ about resuming high-intensity exercise training. Traditional CR program exercise guidelines are generally conservative: aerobic activity for 30 minutes on a treadmill and/or stationary cycle ergometer at moderate intensity.¹² Nevertheless, there is still reluctance to refer patients to CR due to the perception that exercise training may trigger a recurrent SCAD.⁴ This traditional CR approach is not customized toward individualized patient goals and, as a result, does not meet the needs of patients who were active and physically fit before their SCAD event.¹³

In the present case study, our patient underwent a high-intensity, sport-specific CR training program that enabled him to feel confident about resuming competitive cycling in an outdoor setting. At 4 years post-SCAD, this former patient is symptom free and is regularly cycling 200 to 250 miles per week.

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1. Afzal A, Sarmast S, Choi JW, McCullough PA, Schussler JM. Spontaneous coronary artery dissection: a review of pathogenesis, presentations, treatment, and outcomes. *Rev Cardiovasc Med*. 2017;18(1):29–36.
2. Vanzetto G, Berger-Coiz E, Barone-Rochette G, et al. Prevalence, therapeutic management and medium-term prognosis of spontaneous coronary artery dissection: results from a database of 11,605 patients. *Eur J Cardiothorac Surg*. 2009;35(2):250–254. doi:10.1016/j.ejcts.2008.10.023.
3. Ellis CJ, Haywood GA, Monro JL. Spontaneous coronary artery dissection in a young woman resulting from an intense gymnasium “work-out.” *Int J Cardiol*. 1994;47(2):193–194. doi:10.1016/0167-5273(94)90191-0.
4. Silber TC, Tweet MS, Bowman MJ, Hayes SN, Squires RW. Cardiac rehabilitation after spontaneous coronary artery dissection. *J Cardiopulm Rehabil Prev*. 2015;35(5):328–333. doi:10.1097/HCR.0000000000000111.
5. Hayes SN. Spontaneous coronary artery dissection (SCAD): new insights into this not-so-rare condition. *Tex Heart Inst J*. 2014;41(3):295–298. doi:10.14503/THIJ-14-4089.
6. Afzal AM, Sarmast SA, Weber NA, Schussler JM. Spontaneous coronary artery dissection in a 22-year-old man on lisdexamfetamine. *Proc (Bayl Univ Med Cent)*. 2015;28(3):367–368.
7. Bartee S, Shrestha S, Ramos B, et al. Specificity of testing in a cardiac rehabilitation setting resulting in a patient’s return to high-intensity outdoor activity following aortic dissection repair. *Proc (Bayl Univ Med Cent)*. 2016;29(2):151–153.
8. Adams J, DeJong S, Arnett JK, Kennedy K, Franklin JO, Berbarie RF. High-intensity cardiac rehabilitation training of a firefighter after placement of an implantable cardioverter-defibrillator. *Proc (Bayl Univ Med Cent)*. 2014;27(3):226–228.
9. Adams J, Cheng D, Berbarie RF. High-intensity, occupation-specific training in a series of firefighters during phase II cardiac rehabilitation. *Proc (Bayl Univ Med Cent)*. 2013;26(2):106–108.
10. Adams J, Berbarie RF. High-intensity cardiac rehabilitation training of a police officer for his return to work and sports after coronary artery bypass grafting. *Proc (Bayl Univ Med Cent)*. 2013;26(1):39–41.
11. Kennedy K, Adams J, Cheng D, Berbarie RF. High-intensity track and field training in a cardiac rehabilitation program. *Proc (Bayl Univ Med Cent)*. 2012;25(1):34–36.
12. de Carvalho Pinto M, Camargo RC, Filho JC, et al. Influence of cardiac rehabilitation in primigravida with spontaneous coronary artery dissection during postpartum. *Int Arch Med*. 2014;7(20):1–5.
13. Krittanawong C, Tweet MS, Hayes SE, et al. Usefulness of cardiac rehabilitation after spontaneous coronary artery dissection. *Am J Cardiol*. 2016;117(10):1604–1609. doi:10.1016/j.amjcard.2016.02.034.