Aerobic Recovery after Radical Prostatectomy: A Case Study

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ABSTRACT

SWAIN, D. P., J. L. WYNNE, and P. B. WILSON. Aerobic Recovery after Radical Prostatectomy: A Case Study. Med. Sci. Sports Exerc., Vol. 52, No. 2, pp. 296–302, 2020. Purpose: This case study examined the recovery after radical prostatectomy (RP) of an endurance-trained 65-yr-old man. Methods: A maximal incremental exercise test and a 1-h steady-state test were performed just before and 3 months after robotic RP to determine maximal oxygen consumption (VO_{2max}) and other cardiorespiratory variables. The patient recorded his training as he prepared for an endurance event that was to occur 3 months after RP, the Norwegian Foot March, a 30-km road march carrying 11.4 kg. Results: In the month before RP, the patient performed 2 to 3 h of vigorous-intensity aerobic exercise per week, fast walking carrying an 11.4-kg pack, with the longest individual session being a 16-km road march. Just before surgery, VO_{2max} was 36.7 mL·min^{-1}·kg^{-1}, HR during 30 min at 7.2 km·h^{-1} and 0% grade was 77% of HR reserve (HRR), and during 30 min at 5.3 km·h^{-1} and 10% grade was 92% HRR. On postsurgery day 44, he did a 19-km road march carrying 11.4 kg, exceeding the training level of the month presurgery. Three months postsurgery, VO_{2max} was 42.7 mL·min^{-1}·kg^{-1}, and HR during the flat and uphill 30-min sessions at the same absolute intensity as presurgery were 70% and 83% HRR, respectively. He completed the Norwegian Foot March 93 d postsurgery in 4:24:37, with an average HR of 72% HRR. Conclusions: This case study demonstrates that an aerobically trained prostate cancer patient can return to high-level aerobic training in as little as 7 wk post-RP, and even exceed presurgery fitness. This finding has implications for prognosis given the beneficial effect of vigorous-intensity exercise on prostate cancer progression. Key Words: PROSTATE CANCER, ENDURANCE EXERCISE, AGING, VO_{2max}. How soon after radical prostatectomy (RP) a patient may safely engage in high-volume, vigorous-intensity exercise is not known. Guidelines for resumption of physical activity are designed for typical patients, that is, middle-age or older men of average physical fitness. A review of the websites of several medical centers (Johns Hopkins, Mayo Clinic, etc.) found recommendations that patients should begin easy walking as soon as they are able, but they should avoid strenuous activity and the lifting of heavy objects for 4 to 6 wk. Early ambulation is intended to offset the risk of deep vein thrombosis in the immediate postoperative period, whereas avoiding lifting heavy objects is based on the speculation that such actions might cause dehiscence of the closed abdominal incisions (5). For patients who were highly active before surgery, the rapidity with which they reach their presurgery volume and intensity of exercise after that 4- to 6-wk period is not known. One anecdotal report stated that a 65-yr-old man ran a marathon 15 months post-RP (6).

The Norwegian Foot March is an endurance event used as a test by the Norwegian Army. Soldiers are expected to walk 30 km carrying an 11.4-kg pack in under 4.5 h. A 64-yr-old man living in the United States who was training for the Norwegian Foot March (NFM) was diagnosed with prostate cancer in June 2018. He was scheduled for robotic RP on December 20 (at 65 yr), and he intended to resume full training as soon as possible and compete in an NFM event on March 23, 2019, 3 months postsurgery. This case study is a prospective examination of his training and aerobic fitness before and
after his surgery to document and evaluate the return to high-level physical activity.

METHODS

Case Study

The patient is a 65-yr-old white male. In addition to prostate cancer, he has single-vessel, asymptomatic coronary heart disease (CHD), essential hypertension, glaucoma, exercise-induced asthma, and arthritis, especially of the left knee. During a research-related exercise test in 2005, ST-segment depression in the inferior leads was noted at an intensity of 18 MET and a subsequent angiogram revealed 40% blockage in the distal anterior descending coronary artery. He is a nonsmoker with a strong family history of CHD—both parents and a brother had significant coronary disease in their early 50s. He is on medical therapy for his CHD consisting of rosuvastatin, aspirin, and fish oil. His hypertension is well-controlled with lisinopril; his glaucoma is well controlled with brimonidine, brinzolamide, and travoprost; for exercise-induced asthma, he uses an albuterol inhaler before aerobic exercise, which was done throughout this study. He tore the lateral meniscus of his left knee circa 1980, which was repaired arthroscopically. He tore both menisci of his right knee circa 2004, which were trimmed arthroscopically.

His exercise history includes 3 yr in the US Army as an infantryman, after which, he went to college and did both recreational weightlifting and distance running, the latter until his knee injury. He competed in powerlifting in his early to mid-40s. He did extensive amounts of ultra-endurance bicycling in his late 40s and early 50s, crossing the United States in 26 d when he was 50 yr old, averaging 212 km·d−1. Since his mid-50s, he has done hiking and road marching in place of bicycling. In April 2018, at 64 yr, he did the US Army’s Expert Infantryman’s Badge road march, carrying a 15.9-kg pack 19.3 km in 2 h 56 min, meeting the US Army’s criterion finishing time of 4.5 h or less. He then began training for a similar event used by the Norwegian Army, the NFM described above, which has a criterion time of 4.5 h or less.

In May 2018, his prostate-specific antigen was measured at 10.3 ng·mL−1. A prostate biopsy in July found Gleason stage 6 (3 + 3) cancer, with 8 of 12 samples positive. A magnetic resonance imaging scan in August measured a prostate volume of 57.5 mL. During discussing treatment options, the patient decided on nerve-sparing robotic laparoscopic RP, which was performed on December 20, 2018, with no major problems such as hemorrhage requiring transfusion or significant dysrhythmias. The patient was released from the hospital on postoperative day (POD) 2. The pathology report found a Gleason stage 7 (3 + 4) tumor that made up 30% of the prostate. Prostate-specific antigen has been undetectable since surgery. The Foley catheter, which had slipped and was reinserted on POD 1, was removed on POD 7, and he experienced significant incontinence for the following month (utilizing about six adult diapers per day), which gradually improved thereafter (decreasing to two to three adult diapers per day by the third month, when he switched to two to three pads per day, and finally reaching one pad per day 6 months postsurgery). Before surgery, he did Kegel exercises several times a day for 1 month, which he resumed 2 wk after surgery, but stopped doing about 2 months postsurgery due to his subjective impression that they were no longer effective.

Procedures

The prospective research study was planned in November 2018; the procedures were approved by the Old Dominion University Institutional Review Board; and the subject provided written informed consent. The subject kept a log of his training for the month before surgery and for the 3 months after surgery until the NFM event.

Independent of the research protocol, the patient was administered a technetium-99 stress test 9 d before surgery for presurgery clearance. The patient completed 12 min on the Bruce protocol (7), reaching a HR of 186 bpm. There were no dysrhythmias during exercise, though a few couplets of premature ventricular contractions were observed during recovery. The imaging found no compromise of coronary blood flow.

As part of the case study protocol, the patient performed a maximal incremental exercise test, a steady-state exercise test, and body composition testing before surgery and 3 months postsurgery (before the NFM). Each test is described separately.

The maximal incremental exercise test was performed on a treadmill (Cardiac Science-Quinton TM55, Bothell, WA) with the patient carrying the same 11.4-kg pack he used in training and during the NFM. The entire test was performed at 5.6 km·h−1, with 3-min stages at 0%, 5%, and 10% grade, followed by 1-min stages increasing by 1% grade. HR and rhythm were continuously monitored during the test (Quinton Q-Stress, Bothell, WA) and an automated external defibrillator (Philips HeartStart AED, Bothell, WA) was present in case of emergency. The test was not monitored by a physician, given that the patient routinely exercised vigorously on his own and had just completed a medically-supervised stress test with no problems. Ventilation ($V_{E}$), oxygen consumption ($V_{O_2}$), carbon dioxide production ($V_{CO_2}$), and RER were measured continuously during the test using a metabolic cart (Parvo Medics TrueOne 2400, Sandy, UT). Ten minutes before the start of testing, the gas analyzers and flow meter on the metabolic cart were calibrated using compressed air with known concentrations of O2 and CO2 (15.98% O2, 3.986% CO2) and a 3-L syringe, respectively. An oronasal facemask attached to a two-way nonrebreathing valve (Hans Rudolph, Shawnee, KS) was placed on the patient, checked for leaks, and connected to the metabolic cart via a hose. $V_{O_2max}$ was defined as the highest $V_{O_2}$ over 60 s. Ventilatory threshold (VT) was determined from a plot of $V_{E}$ versus $V_{O_2}$. The maximal test was performed 3 d before surgery and again 4 d before the NFM event 3 months later. The patient wore a wrist monitor that recorded HR (Garmin Forerunner 35, Olathe, KS) during the maximal testing and during training. During the first maximal test, the Garmin HR failed to match the
Quinton HR at high intensities. However, wearing the wrist strap more tightly, the Garmin and Quinton HR were virtually identical throughout the maximal test in March ($r^2 = 0.9989$).

On the day after each maximal test, the patient performed a steady-state exercise test carrying the 11.4-kg pack on the same treadmill. There was a 5-min warm-up at 0% grade with the first 2.5 min at 5.6 km·h$^{-1}$ and the second 2.5 min at 6.4 km·h$^{-1}$. Then the patient did 30 min at 7.2 km·h$^{-1}$ and 0% grade, which was immediately followed by 30 min at 5.3 km·h$^{-1}$ and 10% grade. $\dot{V}_E$, $\dot{V}_O_2$, $\dot{V}_CO_2$, and RER were measured during minutes 25 to 30 and minutes 55 to 60 of the 1-h steady-state protocol (not including the warm-up) using the same calibrated equipment as for the maximal test.

The last 3 min of those 5-min periods were averaged for data analysis. HR and rhythm were once again continuously monitored, and the AED was present.

On both maximal test days, and performed before the maximal test, the patient’s height and weight were measured, and his body composition was assessed using an air displacement plethysmography chamber (Bod Pod, Life Measurement, Inc., Concord, CA). Predicted thoracic gas volume and the Siri equation (8) were applied in the software to estimate percentage body fat. The Bod Pod was calibrated immediately before testing using a cylinder of a known volume (50.122 L) and per the manufacturer’s guidelines, the Bod Pod’s scale was calibrated using weights of a known mass (20 kg) within the 2-wk period before each test. For all metabolic and body composition variables, raw values are reported in the Results along with absolute and percent changes from premeasurements.

Exercise training volume was calculated using MET intensity times duration. In most instances, the $\dot{V}_O_2$ measured during the submaximal tests was used to estimate the MET value of training, with a slight adjustment for actual speed during training; for 1 wk when the patient used a 6.8-kg pack instead of the 11.4-kg pack, the intensity was estimated as 1 MET less. When training was done without a pack, the American College of Sports Medicine’s (ACSM) equation for the $\dot{V}_O_2$ of walking was used (9). The MET value assigned to each aerobic training session was multiplied by the duration of the session to yield MET-minutes.

**RESULTS**

The patient’s data on the maximal test days presurgery and 3 months postsurgery are given in Table 1. Resting HR (Garmin) on the presurgery test day was 62 bpm, and it was 64 bpm on the postsurgery test day. The relationship between $\dot{V}_E$ and $\dot{V}_O_2$ is illustrated in Figure 1, which shows that training postsurgery resulted in a reduced $\dot{V}_E$ at submaximal workloads (improved economy of breathing), and resulted in increases in VT, $\dot{V}_E$-max, and $\dot{V}_O_2$-max when comparing the postsurgery test to the presurgery test.

Results from the patient’s steady-state tests presurgery and 3 months postsurgery are given in Table 2. There was no apparent effect of training on $\dot{V}_O_2$ during steady-state exercise, meaning no increase in work efficiency. During the easier, flat stage of the test, $\dot{V}_E$ was below the VT and nearly identical pre and post, whereas during the uphill stage $\dot{V}_E$ was above the VT and substantially reduced by training. The reduction in RER and HR with training implies an increase of fat utilization and an adaptation in autonomic tone from training, respectively. The % HR reserve (HRR) values were derived using the resting and maximal HR of each day.

The patient was instructed by his surgeon to do daily walking as tolerated, but to lift no more than 4.5 kg until 3 wk postsurgery, and to not do “strenuous” exercise (weightlifting, running, etc.) until 4 wk postsurgery. The surgeon stated that there were no restrictions on physical activity after 4 wk, and the patient should use his own judgment for how rapidly to progress at that point. The patient did two slow, short walks in the hospital after surgery on the surgery day, and multiple indoor walks on POD 1 and 2 in the hospital and on POD 3 to 5 at home. His first outdoor walk was on POD 6 for a distance of 0.8 km in 13 min. The Foley catheter was removed on POD 7, and he rapidly increased his walking distance and speed. His first walk with a pack was on POD 21, carrying 6.8 kg for 6.4 km in 56 min. Beginning with POD 28, all of his training was with an 11.4-kg pack, the full amount to be used in the NFM. On POD 44, he walked 19.3 km with that load.

<table>
<thead>
<tr>
<th>Date</th>
<th>HT (cm)</th>
<th>BM (kg)</th>
<th>BF (%)</th>
<th>$\dot{V}_O_2$ max (L·min$^{-1}$)</th>
<th>$\dot{V}_O_2$ max (mL·min$^{-1}$·kg$^{-1}$)</th>
<th>HR max (bpm)</th>
<th>$\dot{V}_E$ max</th>
<th>RER max</th>
<th>VT (L·min$^{-1}$)</th>
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<tr>
<td>December 2018</td>
<td>173</td>
<td>61.3</td>
<td>24.4</td>
<td>2.26</td>
<td>36.7</td>
<td>182</td>
<td>88.9</td>
<td>1.14</td>
<td>1.80</td>
</tr>
<tr>
<td>March 2019</td>
<td>173</td>
<td>60.9</td>
<td>22.0</td>
<td>2.61</td>
<td>42.7</td>
<td>186</td>
<td>110.8</td>
<td>1.10</td>
<td>2.00</td>
</tr>
<tr>
<td>Change</td>
<td>-0.4</td>
<td>-2.4</td>
<td>0.35</td>
<td></td>
<td>6.0</td>
<td>4</td>
<td>21.7</td>
<td>-0.04</td>
<td>0.20</td>
</tr>
<tr>
<td>% Change</td>
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<td>-9.8</td>
<td>15.5</td>
<td></td>
<td>16.3</td>
<td>2.2</td>
<td>24.4</td>
<td>-3.5</td>
<td>11.1</td>
</tr>
</tbody>
</table>

HT, height; BM, body mass; BF, body fat.
AEROBIC RECOVERY FROM PROSTATECTOMY

TABLE 2. Steady-state exercise test data.

<table>
<thead>
<tr>
<th>Time</th>
<th>VO(_2) (L·min(^{-1})) Flat</th>
<th>VO(_2) (L·min(^{-1})) Uphill</th>
<th>(\dot{V}E) (L·min(^{-1})) Flat</th>
<th>(\dot{V}E) (L·min(^{-1})) Uphill</th>
<th>RER</th>
<th>HR (bpm) Flat</th>
<th>HR (bpm) Uphill</th>
<th>HRR (%) Flat</th>
<th>HRR (%) Uphill</th>
</tr>
</thead>
<tbody>
<tr>
<td>December 2018</td>
<td>1.74</td>
<td>2.15</td>
<td>53.3</td>
<td>86.1</td>
<td>0.89</td>
<td>154</td>
<td>172</td>
<td>76.7</td>
<td>91.7</td>
</tr>
<tr>
<td>March 2019</td>
<td>1.79</td>
<td>2.14</td>
<td>55.0</td>
<td>74.4</td>
<td>0.83</td>
<td>149</td>
<td>165</td>
<td>69.7</td>
<td>82.8</td>
</tr>
<tr>
<td>Change</td>
<td>0.05</td>
<td>-0.01</td>
<td>1.7</td>
<td>-11.7</td>
<td>-0.06</td>
<td>-0.08</td>
<td>-5</td>
<td>-7</td>
<td>-7.0</td>
</tr>
<tr>
<td>% Change</td>
<td>2.8</td>
<td>-0.5</td>
<td>3.2</td>
<td>-13.6</td>
<td>-6.7</td>
<td>-6.5</td>
<td>-3.2</td>
<td>-4.0</td>
<td>-9.1</td>
</tr>
</tbody>
</table>

Flat, walking at 7.2 km·h\(^{-1}\) and 0% grade; uphill, walking at 5.3 km·h\(^{-1}\) and 10% grade.

pack in 2:43, exceeding his longest road march in the 4 wk presurgery, which had been 16.0 km with the same pack in 2:19:28. A summary of the patient’s exercise training is given in Table 3.

In the month before surgery and during weeks 5 to 13 postsurgery, the intensity of training was 7.6 to 8.6 METs during flat walking carrying an 11.4-kg pack, and averaged approximately 10 METs during uphill treadmill training, with intervals as high as 12 METs. In the first 4 wk postsurgery, intensity ranged from 2.5 METs during slow walking without a pack to as high as 9 METs while carrying a 6.8-kg pack uphill. All exercise in the month before surgery and in weeks 5 to 13 postsurgery was performed at HR above 60% HRR. The volume of aerobic training is provided in Figure 2. Volume averaged 1079 MET·min·wk\(^{-1}\) in the 4 wk before surgery, and the patient exceeded that volume in the fourth week postsurgery. The greatest volume was in the 11th week postsurgery, 3078 MET·min.

In addition to the aerobic training, the patient performed light resistance training twice a week from POD 13 to 46, primarily for general fitness though it was an adjunct to the NFM training. The routine included six rotator cuff exercises, knee extensions, knee curls, stiff-legged deadlifts, abdominal curls, biceps curls, and triceps extensions. He strained his lower back on POD 46 and decided to forego resistance training until the second 6-month aerobic training program (10). Thus, we believe this case study provides the first example of an RP patient returning to significant aerobic training within 4 wk of surgery and completing a strenuous endurance event just 3 months postsurgery. A similar case study on a stage III breast cancer patient demonstrated that she was able to resume training after chemotherapy and bilateral mastectomies and return to her prediagnosis fitness level, though her multiple therapies, recovery, and retraining occurred over a longer timespan (11).

Although not a competitive athlete, the patient in the current case study had a long history of performing high-volume aerobic exercise. At the age of 52 yr, 2 yr after he bicycled across the United States, he completed 350 W during an incremental exercise test on a bicycle, equivalent to approximately 63 mL·min\(^{-1}\)·kg\(^{-1}\). In the same year, he was a participant in the NFM distance of 30 km on his own flat, paved road course on POD 73 in a time of 4:14:48. The official NFM event was held on a more difficult course (hills, varying road surface) on POD 93, and he completed it in 4:24:37 with an average HR of 152 bpm, or 72.1% HRR. He won the 60-yr-and-older age group, and he met the qualifying time for young men in the Norwegian Army.

DISCUSSION

A search of the scientific literature revealed no previous studies that examined the rapidity with which a patient might return to high-level aerobic training after RP. An anecdotal report described a 65-yr-old man who completed the 2014 Boston Marathon 15 months after RP (6), whereas one training study had RP patients perform VO\(_{2}\)max tests 4 months postsurgery and then begin a 6-month aerobic training program (10). Thus, we believe this case study provides the first example of an RP patient returning to significant aerobic training within 4 wk of surgery and completing a strenuous endurance event just 3 months postsurgery. A similar case study on a stage III breast cancer patient demonstrated that she was able to resume training after chemotherapy and bilateral mastectomies and return to her prediagnosis fitness level, though her multiple therapies, recovery, and retraining occurred over a longer timespan (11).
a study on backpacking that used a VO\textsubscript{2max} test similar to that in the current study and was measured at 62 mL·min\textsuperscript{−1}·kg\textsuperscript{−1}, at a body mass of 63.8 kg and 13% fat (12). He was not as physically active in the next decade, performing heavy training only intermittently, but did complete a 19.2-km road march carrying 16.4 kg in under 3 h a few months before start of the current study. His training in the month before RP, described in the Results, was typical of his aerobic exercise during more active periods in his early 60s. His presurgery VO\textsubscript{2max} of 37 mL·min\textsuperscript{−1}·kg\textsuperscript{−1} at age 65 yr in this study was in the 80th percentile for age and sex according to ACSM classification (9), and represents a 40% decline over the preceding 13 yr (when it was well above the 95th percentile), or about three times faster than the widely cited 1% decline per year found in cross-sectional studies (13). After surgery and 3 months of intensive training, the patient was able to increase his VO\textsubscript{2max} by 16%, bringing it to approximately the 95th percentile. In the only training study of prostate cancer patients in which VO\textsubscript{2max} was measured, patients with low fitness were placed in a training program 4 months after RP (10). The patients were prescribed moderate-to-vigorous walking five times a week for 6 months, though attendance at training sessions averaged less than 80%. VO\textsubscript{2max} increased 9%, from 27.7 to 30.1 mL·min\textsuperscript{−1}·kg\textsuperscript{−1}. The patient in the current study was able to attain a greater increase due to his more intensive training.

Rates of decline in VO\textsubscript{2max} with age vary widely in longitudinal studies and are impacted by the activity level of the individuals. Two studies of endurance athletes from young adulthood to middle age found that those maintaining high-level training had a much smaller decline in VO\textsubscript{2max} than those who had become sedentary (14,15). In the Marti et al. (14) study, VO\textsubscript{2max} declined by 0.5% per year in subjects who continued training, whereas subjects who had essentially stopped training declined by 1.5% per year. Trappe et al. (15) reported declines of 0.6% and 1.5% per year in active versus sedentary subjects, respectively. A study that examined the VO\textsubscript{2max} of former champion runners into their 50s and, in some cases, 60s provides a comparable age range to the current study (16). One subject (the lead author, Sid Robinson) from the ages of 42 to 61 yr declined by 1.7% per year, and another subject (a former world record holder in the two-mile run) declined by 2.5% per year from ages 51 to 60 yr. Large declines in formerly aerobically trained individuals are likely due more to the effects of inactivity (detraining) and increased body fat than to the primary effect of aging itself.

In comparing exercise test data presurgery and 3 months postsurgery, it is evident that the patient adapted to aerobic training due to his increased volume as he approached the NFM. His training intensity was always (other than the first 3 wk postsurgery) in the vigorous range both in terms of MET level and %HRR. Most population-based recommendations define vigorous as 6 MET or more (1), whereas the ACSM defines vigorous on an individual level as 60% to 89% HRR (17). Despite time needed to recover from the surgery itself, his VO\textsubscript{2max}, \( V\text{E}_{\text{max}} \), and VT were greater 3 months postsurgery than presurgery. Although his maximal HR was slightly higher postsurgery, he attained an RER of 1.14 in the presurgery test, strongly suggesting that maximal effort was attained presurgery and the increase in VO\textsubscript{2max} was a true adaptation. During submaximal exercise, his \( V\text{E}_{\text{max}} \) and RER decreased, demonstrating improved ventilatory economy and greater fat utilization during exercise, respectively. Notably, his maximal HR has remained in the low 180s bpm on every maximal test he has performed (clinically and in research) over the past 13 yr. Although maximal HR is classically stated to decline 1 bpm per year, recent research has confirmed that the decline is much less in fitter than less fit subjects (18).

According to a major review by the US Department of Health and Human Services, there is only weak evidence for a role of physical activity in preventing prostate cancer (2). However, research suggests that physical activity improves the prognosis of individuals who already have prostate cancer, and the greatest benefit appears to be from higher intensities of exercise. One prospective epidemiological study followed over 1400 patients with localized prostate cancer for an average of 1.9 yr (4). The patients’ mean age was 65 yr, and the primary treatment for 63% of them was RP. Those who walked >4.8 km·h\textsuperscript{−1} for at least 3 h·wk\textsuperscript{−1} had 57% less incidence of disease progression (recurrence, secondary treatment) than those who walked <4.8 km·h\textsuperscript{−1} for less than 3 h·wk\textsuperscript{−1}. Moreover, speed of walking was inversely related with progression independently of walking volume. Another study followed over 2700 patients with localized prostate cancer for an average of 9.7 yr (3). Their mean age was 69 yr, and RP was the primary treatment for 46% of them. The volume of nonvigorous physical activity was associated with reduced all-cause mortality, but not prostate-cancer mortality. However, those patients performing at least 3 h·wk\textsuperscript{−1} of vigorous activity (>6 MET) had 61% lower prostate cancer mortality than those performing less than 1 h·wk\textsuperscript{−1} of vigorous activity. Although these prospective studies provide good evidence of a relationship between vigorous activity and improved prognosis for prostate cancer patients, the role of self-selection in this finding cannot be discounted. Currently, there are two randomized controlled trials taking place to determine conclusively if exercise improves the health of prostate cancer patients. One study will utilize moderate-to-vigorous aerobic exercise plus resistance exercise in patients who are in active surveillance (19), whereas the other will study stage IV patients using aerobic exercise done with high-intensity intervals plus resistance exercise (20). Hopefully, a study of the largest group of prostate cancer patients, those with localized cancer who have been (or are about to be) treated with RP or radiation, will also be conducted.

How exercise may delay cancer progression is not known, but a variety of mechanisms have been postulated (21). These mechanisms may be categorized as a direct role of exercise or as a synergistic effect in combination with other treatments. As direct effects, physical activity modulates immune system function, insulin and glucose control, testosterone production, platelet activity, and telomere length, which have been
postulated to affect tumor growth. Synergistically, exercise is postulated to enhance tumor blood flow and thus improve delivery of chemotherapy agents and improve delivery of oxygen to enhance the effectiveness of radiation. Although there may be an exercise intensity threshold that triggers certain mechanistic responses, this hypothesis remains speculative; thus, it remains uncertain why vigorous exercise has been shown in observational studies to be more predictive of positive outcomes than lower-intensity exercise. The speed at which a surgical patient may return to high-level exercise may be influenced by presurgical fitness. Fitter, more physically active patients have been shown to have lower short-term mortality and shorter hospital stays after abdominal surgery—though, RP was not specifically studied (22,23). Given the benefit of better presurgical fitness, some studies have evaluated the use of prehabilitation programs, but with mixed results. One systematic review of studies involving abdominal surgery patients concluded that prehabilitation—including inspiration, aerobic, and resistance training—resulted in fewer postoperative complications (24), whereas a review limited to cancer patients undergoing abdominal surgery did not (25). Neither of these reviews included RP patients. A recent report of a small feasibility study of prehabilitation with RP patients found greater functional capacity (6-min walk test) at 4 wk postsurgery in the prehabilitation group, though the n was too small to evaluate complications (26).

CONCLUSIONS

This case study has demonstrated that an aerobically trained individual undergoing RP for localized prostate cancer was able to rapidly return to a program of vigorous-intensity, high-volume training, and was able to successfully complete a significant endurance event just 3 months postsurgery. Further research on larger numbers of patients is needed to determine how soon after major treatment patients may engage in vigorous-intensity exercise and what benefits with regard to disease prognosis may accrue.

The results of this case study are presented clearly, honestly, and without fabrication, falsification, or inappropriate data manipulation. Results of the present study do not constitute endorsement by ACSM. There was no funding for this study. There are no conflicts of interest.


