Use of Simulated Work Testing in Cardiac Rehabilitation: A Case Report

(activity guidelines, exercise stress testing, occupational therapy, physical capacity evaluation)

Nancy A. Wilke
Lois M. Sheldahl

The case report that follows launches a new format in AJOT. Hopefully it will be followed by a flurry of others submitted by readers. The idea for the format was initiated by AOTA’s Commission on Practice as a means to document the practice of occupational therapy. Jeanne Melvin, chair of the Physical Disabilities Special Interest Section, who took on the responsibility of implementing this format and establishing guidelines for writing a single case report, described three goals of these reports: 1) to provide a model of effective occupational therapy for a specific clinical situation, 2) to share treatment methods, and 3) to create a written statement testifying to the value and effectiveness of occupational therapy that can be used to help educate physicians, administrators, and other professionals. Guidelines for writing a case report are available from the editor’s office and from the Practice Division of AOTA.

—The Editor

A significant percentage of patients do not return to work after myocardial infarction or coronary artery bypass surgery for nonmedical reasons. These reasons include unwarranted medical restrictions, patient anxiety concerning ability to meet job demands, apprehensive family members, and fearful employers. A case study is presented to illustrate how occupational therapists can enhance a patient’s work potential by using skills in activity analysis to develop simulated work evaluations. Satisfactory performance on a test that closely simulates work demands can help the physician, patient, family, and employer gain confidence in the patient’s ability to return to work.

The goal of cardiac rehabilitation is to restore the patient to an optimal life-style, which includes resuming gainful employment. Currently about 15% to 20% of myocardial infarction patients do not return to work (1). Studies have also shown that coronary artery bypass surgery does not have the positive effect on employment as had been anticipated (2, 3). Although medical complications associated with myocardial infarction or surgery can account for some patients not returning to work, a significant number of patients do not return for nonmedical reasons. Some of these reasons include a) overly restrictive physician’s advice, b) patient anxiety regarding ability to perform job demands, c) family apprehension, and d) employer concerns of financial risk associated with rehiring a cardiac patient. These nonmedical reasons can result, in part, from inadequate information concerning the cardiac patient’s tolerance to meet job requirements.

To optimize the cardiac patient’s return to work, a systematic ap-

Nancy A. Wilke, OTR, is a senior therapist, and Lois M. Sheldahl, PhD, is an exercise physiologist; both at Cardiopulmonary Rehabilitation Center, Veterans Administration Medical Center, Milwaukee, WI 53193. Sheldahl is also an assistant professor of physiology, Medical College of Wisconsin, Milwaukee, WI 53226.
approach to work evaluation has been established by the exercise physiologist and occupational therapist of the Cardiopulmonary Rehabilitation Center, Veterans Administration (VA) Medical Center, Milwaukee, WI. This approach incorporates a job analysis, graded dynamic exercise testing, and simulated work testing (4, 5). The following case report illustrates how this approach is used to make an objective medical decision on a cardiac patient’s ability to return to work.

Case Report

The patient is a 58-year-old white male who underwent two-vessel coronary artery bypass surgery at the VA Medical Center. His medical history included having an inferior wall myocardial infarction one month before surgery. The patient’s risk factors for coronary artery disease were hypertension, diabetes mellitus, and a prior history of smoking.

The patient was referred to the Cardiopulmonary Rehabilitation Center (6). Directed by a cardiologist, the rehabilitation team included an exercise physiologist, a physical therapist, an occupational therapist, a dietician, a nurse, a psychologist, and a social worker. Occupational therapy intervention began when the patient was transferred out of the surgical intensive care unit.

Evaluation

The occupational therapist interviewed the patient and completed an assessment of his prehospital life-style, which included current living situation, household and work responsibilities, and leisure interests.

The patient lived with his wife in a rural community where he was employed full-time at a lumber company. At work, he assisted customers, unloaded orders of building materials from delivery trucks, and placed the materials in the appropriate storage bins. The patient reported that the latter task required lifting and carrying of materials weighing up to 22.7 kg (50 lb). The time required to unload a truck typically ranged from 15 minutes to one hour, depending on the number of interruptions by customers. The patient reported that he generally worked quite briskly while unloading stock; however, he said that the job did afford a slower work rate, if necessary. Assistance with the heavier work tasks by another employee was not a feasible job modification because the patient was the only full-time employee and often worked alone. The patient estimated that 40% of his job was performed outdoors in varied weather conditions.

Using a published metabolic equivalents (METs) table (7), we estimated the energy cost of the patient’s job to be approximately 2 to 3 METs while assisting customers and 5 to 6 METs while unloading a truckload of building materials. (1 MET equals the oxygen consumption of a person at rest, which is usually assumed to be 3.5 ml/kg body wt/min).

The patient wanted to return to work for financial reasons. However, because of the physical demands of the job and his cardiovascular disease, his ability to return to his previous occupation was identified as a potential problem. Also, his age made it difficult to find alternative employment. To better determine the patient’s ability to resume his prior job, the occupational therapist recommended that a simulated work test be conducted in addition to a graded dynamic stress test at the end of the surgical convalescent phase (usually 6 wk following surgery). Such testing would help evaluate the patient’s ability to resume his job demands within a reasonable degree of cardiovascular stress.

The patient followed a normal recovery course and was discharged to his home on the eighth postoperative day. During the remainder of the convalescent phase, the patient returned to the hospital twice weekly to participate in the outpatient cardiac rehabilitation exercise and education program.

Seven weeks following surgery, the patient underwent a treadmill graded dynamic exercise test. The test was stopped by fatigue at a peak energy expenditure of 8 METs (peak oxygen consumption measured by the Beckman metabolic Measurement Cart was 28 ml/kg/min). The patient achieved a peak heart rate of 138 beats/min (72 beats/min at rest) and a peak blood pressure of 158/74 mmHg (124/70 mmHg at rest). The exercise electrocardiogram showed normal sinus rhythm with occasional premature ventricular contractions. There was no electrocardiograph evidence of myocardial ischemia (i.e., ST segment depression), and the patient did not report any symptoms other than fatigue. The blood pressure response to exercise was within normal limits.

Medications at the time of testing were digoxin, procainamide, propranolol, dipyridamole, and Aspirin.

For many cardiac patients, the graded dynamic exercise test provides sufficient information to determine employability. However, for this individual, there was a limitation to developing activity recommendations based solely on this test result. The graded dynamic
exercise test evaluated the patient’s cardiovascular response to dynamic leg effort; however, his occupation required considerable weight lifting and weight carrying. These two types of effort produce a greater pressor response compared with dynamic leg effort (7). To determine if the patient was capable of performing work tasks within a reasonable degree of cardiovascular stress, he was referred to occupational therapy for simulated work testing.

**Simulated Work Testing**

Rather than simulate all aspects of the patient’s occupation, the therapist evaluated only the most physically demanding component of his job: the unloading of building materials from delivery trucks. To simulate this work task, a repetitive weight-lifting test was administered. The test protocol required the patient to lift boxes weighing 13.6, 18.1, and 22.7 kg (30 and 50 lb) for a 30-minute period of time. Practicality prevented simulating the size of the objects actually lifted on the job, although the weight of the objects was simulated. The test was divided into four 6-minute work stages with a 2-minute seated rest period between adjacent work stages. In the first work stage, the patient consecutively lifted three boxes (each weighing 13.6 kg) from the floor up to a table (height of 83.8 cm) and then back to the floor. This sequence was continued for six minutes. During the second, third, and fourth work stages, boxes (weighing 18.1, 22.7, and 18.1 kg [40, 50, and 40 lb], respectively) were lifted following the same procedure previously described. The exercise end points for this test were fatigue, angina pectoris, ventricular tachycardia, electrocardiographic evidence of myocardial ischemia ≥3 mm ST segment depression, a decrease in systolic blood pressure ≥15 mmHg, and a hypertensive response (systolic blood pressure ≥250 mmHg, diastolic ≥120 mmHg).

Before the test was started, the application of proper body mechanics while lifting was reviewed and the patient was cautioned to avoid the Valsalva maneuver. (The Valsalva maneuver occurs when a person strains against a closed glottis. It is associated with a sudden significant rise in blood pressure.) The patient was instructed to set his own pace of lifting, but he was encouraged to work at a higher intensity than he would normally encounter at his job. We rationalized that if the patient had an appropriate response to repetitive lifting at a higher intensity than on the job, then he should be able to perform less-intense repetitive lifting for longer durations or in combination with some other job stress.

During the testing procedure, the electrocardiogram was continuously monitored by the exercise physiologist and the patient’s physical appearance and blood pressures were determined by the occupational therapist. Blood pressures were taken at minute two and six of each work stage when the patient momentarily stood in place and sustained his hold on the box (see Figure 1).

The patient completed the testing protocol with an appropriate hemodynamic response (see Table 1). The electrocardiogram did not show any evidence of myocardial ischemia, and no ventricular arrhythmias occurred. The patient became mildly short of breath during the test however, but did not report any additional symptoms. Peak energy expenditure during the test was 6 METs (oxygen consumption of 21 ml/kg/min). (Although we measured oxygen consumption during this evaluation, it is not essential; heart rate, blood pressure, and electrocardiographic monitoring are sufficient for assessing the degree of cardiovascular stress imposed by the activity.)
Table 1
Hemodynamic Response To Simulated Work Evaluation

<table>
<thead>
<tr>
<th>Work Load, kg</th>
<th>Peak HR, beats/min</th>
<th>Peak BP, mmHg</th>
<th>Lifts*, no./min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>73</td>
<td>122/70</td>
<td>0</td>
</tr>
<tr>
<td>13.6</td>
<td>92</td>
<td>178/80</td>
<td>15</td>
</tr>
<tr>
<td>18.1</td>
<td>97</td>
<td>184/96</td>
<td>14</td>
</tr>
<tr>
<td>22.7</td>
<td>95</td>
<td>194/102</td>
<td>13</td>
</tr>
<tr>
<td>25.1</td>
<td>100</td>
<td>190/98</td>
<td>14</td>
</tr>
</tbody>
</table>

* Value represents average number of lifts per minute during a six-minute work stage. HR, heart rate; BP, blood pressure.

It is generally recommended that the average energy expenditure over an eight-hour working day should not exceed 40% of the individual's peak MET capacity. This is based on studies of healthy individuals which demonstrate that fatigue results if work is performed at higher relative intensity for eight hours (8, 9). However, this does not mean that all work tasks need to be restricted to this level of exertion. Work tasks can be performed at higher relative intensities if they are carried out for a short period of time (i.e., 30 min). The upper intensity should generally not exceed 70% to 80% of the patient's peak MET capacity.

Peak energy expenditure during the simulated work test represented 75% of the patient's peak MET capacity determined by the graded dynamic exercise test. It is important to note that the patient performed the lifting test at a higher intensity than that which is encountered on the job. Also, his job required only short periods of repetitive lifting throughout the work day. The remainder of his work tasks were estimated to require about 2 to 3 METs (i.e., <40% of the patient's peak MET capacity).

Outcome

The information provided by the occupational therapist regarding the patient's job demands and his hemodynamic response to simulated work testing allowed the physician to more accurately determine the patient's ability to return to work. The patient was released for work nine weeks after surgery. To allow for adjustment to the work routine, he initially returned on a part-time basis for one week. This was followed by full-time employment.

Before he returned to work, the patient and his wife attended a counseling session with the occupational therapist. During this session, the proper pacing of work tasks was reinforced and the patient was given a heart rate prescription that allowed him to guide the intensity of his effort by pulse rate monitoring. This heart rate prescription corresponded to 80% of the peak heart rate he achieved on the graded dynamic exercise test. (Eighty percent of peak heart rate is generally accepted as a safe upper-limit guideline for activity intensity.)

The effect of temperature stress on exercise tolerance was also discussed. Because a significant percentage of his work is performed outdoors, the patient was advised to decrease the intensity of his activity during periods of high environmental temperatures.

Finally, the importance of continuing with a home exercise routine was emphasized. He was told that if he improved his level of cardiovascular fitness, then he could reduce the relative stress imposed by normal daily activities, including occupational work tasks.

Follow-up one year later indicated no complications from his return to work.

Discussion

By using their skills in task analysis to develop simulated work evaluations, occupational therapists can make a valuable contribution to cardiac rehabilitation and enhance the patient's work potential. Simulated work evaluations provide objective data on which to develop realistic decisions about the patient's ability to return to work that involves nondynamic types of effort. Satisfactory performance on a test that closely simulates work demands helps the patient and the family gain confidence in the patient's ability to return to work. Such testing also provides the employer with specific information regarding the patient's ability to safely perform occupational work activities after experiencing a cardiac event.

REFERENCES