

YEAR 9 SIX-MINUTE WALK

1 Background & Rationale

The ability to walk for a distance is an important component of quality of life and is reduced by several types of diseases, including obstructive lung disease, heart failure, arthritis, and neuromuscular disease. The distance walked during six minutes is a quick and safe test, and is an independent predictor of morbidity and mortality. The addition of pulse oximetry during the six minute walk may allow the cause of exercise limitation to be identified.

Pulse Oximetry is a noninvasive method of monitoring arterial blood oxygen saturation (SpO₂). The amount of arterial hemoglobin that is saturated with oxygen is determined by beams of light passing through the tissue. The sensor with the light source is placed on the finger or other site. The SpO₂ and pulse rate is stored by the portable oximeter with every heart beat and after the exercise, the data is transferred to a personal computer for analysis. Patients with moderate to severe COPD, interstitial lung disease, or heart failure will often show a decrease in their SpO₂ during the first minute of exercise which persists during the exercise and recovers to their baseline value during the first minute at the end of the exercise. Healthy persons will show an increase in pulse rate and a slight increase (or no change) in SpO₂ during exercise. Changes in SpO₂ of less than 4% are within the instrument's measurement noise. Motion artifact can cause false decreases in the measured SpO₂ when using most pulse oximeters, but we have chosen a model designed to detect and eliminate signals with motion artifact.

More than 90% of elderly patients can perform a six minute walk at their own pace, stopping whenever desired. The total time for the test is about 10 minutes, including 1-2 minutes before and after the walk. The test was introduced in 1976 as the "12 minute corridor walking test" (McGavin 1976), and has been validated by high correlations with workloads, heart rate, oxygen saturation, and dyspnea responses when compared to standard bike and treadmill exercise tests (Langenfeld 1990, Spense 1993). There is a learning effect when performed on two successive days, with a mean 15% improvement in distance walked, but thereafter the repeatability is very good, with a 95th percentile change of -15% to +18% (Leach 1992). The learning effect should not be a problem for us since we are not using it to measure change following an intervention.

In patients with COPD, the six minute walking distance is modestly correlated ($r=.4$ to $.6$) with the FEV₁ and peak flow, diffusing capacity (a measure of emphysema), maximal inspiratory pressure (MIP, measured during the CHS baseline exam), MRC dyspnea grade (Mak 1993, Wijkstra 1994), and self-reported mobility and energy level (Alonso 1992). The degree of oxygen desaturation during the six minute walk was correlated with pulmonary hypertension in one group of COPD patients (Taguchi 1994).

The six minute walk distance was an excellent independent predictor of morbidity and mortality after only one year in 898 patients with heart failure (CHF or ejection fraction $<.45$) in the SOLVD study (Bittner 1993). The six minute walk test has also been used safely and successfully in a wide variety of very sick patients to evaluate pacemaker performance (Langenfeld 1990), the outcome of total hip replacement surgery (Laupacis 1993), the need for and efficacy of oxygen therapy during exercise in patients with COPD, interstitial lung disease, and severe kyphoscoliosis (Leach 1992, Jones 1995); and to predict the success of lung transplantation (Holden 1992).

Participants are encouraged to walk from end to end of a hallway at their own pace while attempting to cover as much ground as possible in the allotted period of six minutes. Testing is conducted in a 50 or 100 foot section of hallway, with the distance marked every five feet by colored tape along the baseboard.

2 Quality Assurance And Safety

All technicians administering the test will be CPR certified, will read the pulse oximeter operator's manual and this protocol, and will be supervised for their first 8 tests. Exclusions from testing include:

- 1) resting oxygen saturation less than 90%;

- 2) use of an ambulatory aid such as wheelchair, crutches, walker or cane;
- 3) heart attack, angioplasty, or heart surgery within past three months;
- 4) resting heart rate less than 50 or greater than 110;
- 5) systolic blood pressure greater than 200 or diastolic blood pressure greater than 110;
- 6) previous echo evidence of severe aortic stenosis (> 50 mmHg gradient on most recent CHS echo exam) - CC will generate list;
- 7) new or worsening symptoms of chest pain, shortening of breath, or fainting in the past 8 weeks;
- 8) Marquette ECG hardcopy reference to ventricular fibrillation, acute injury, acute ischemia, acute myocardial infarction, or any other acute cardiac condition;
- 9) Participant refuses or at the technician's discretion.

3 Equipment Needed

Countdown timer (Radio Shack)
 Lap counter (mechanical tally counter)
 Borg Dyspnea Scale (0-10)
 Nellcor Pulse Oximeter N-3000
 Semi-disposable oximeter sensors, Nellcor D-25
 Battery charger, sensor cable, PC serial interface cable
 Paper tape, chair on rollers
 Fingernail polish remover
 Shoulder bag or backpack for the oximeter

4 Methods

Before beginning the procedure, use the form to check for exclusion criteria. The final criteria, oxygen saturation less than 90%, will be evaluated after the sensor has been attached. If any exclusion criteria exist, do not continue with the procedure.

When learning to do this test we suggest you use this protocol as a checklist, marking off each item as you go. Alternatively, get a companion to follow along as a "spotter."

1. Seat the participant near the equipment. Prepare a pulse sensor.
2. Check for appropriate shoes.
3. Explain that you are attaching the sensor to check the amount of oxygen in the participant's blood.
4. Select the index finger of the non-dominant hand.
5. Examine the finger for nail polish and select a sensor orientation.
6. Attach the sensor. Position one LED directly over the center of the nail and fold the other around the fingertip to the opposing side. If nail polish is present and cannot be removed, or if participant has very long fingernails, place the sensor horizontally so as to avoid the nail. The sensor should be snug but not tight enough to impede blood flow. The participant should not feel any pulsing sensation. Strain relieve the cable,

using tape.

7. Detach the oximeter from the computer and charger.
8. Plug the pulse sensor into the oximeter and turn the oximeter on. Note that the battery symbol will be displayed, indicating that the battery is being used to power the unit.
9. Verify that you gave good perfusion. The bar graph should reach the top with each pulse. If not, rearrange the sensor on the finger.
10. **Reset the oximeter** by pressing **and holding** the small button on the back until you hear the three distinctive beeps. Check the display to be sure that you didn't accidentally set the unit to NEONATAL mode. If so, press and **hold** the rear button again for 3 seconds. (This is done before the steps that follow so that a baseline of at least one minute will be recorded.)
11. Record the baseline values for SpO₂ and Pulse on the worksheet.
12. Request the baseline dyspnea index from the Borg scale (read the script from the worksheet).
13. Explain the six-minute walk:

The purpose of this test is to see how far you can walk in six minutes. We would like you to walk at your own pace while attempting to cover as much ground as possible up and down the hallway. I will show you exactly what to do. During the test we will monitor your pulse rate and your blood oxygen level, using the sensor that we have attached to your finger.

Six minutes is a long time to walk so you may get out of breath and you may even have to stop and rest. If you need to rest, just stop where you are and I will bring you a chair so that you can sit down for a while before continuing.

You will be walking from end to end of this hallway between the lines. At the ends of the walk there is a line on the floor. You should pivot at the line and continue back the other way without hesitation.

14. Reset the hand-held silver lap counter to zero.
15. Set the timer for 7 minutes.
16. **Turn down the alarm volume** by rotating the big knob on top of the oximeter.
17. Place the oximeter into the carry bag or backpack and secure it. You will not need to read it again until after the walk.
18. Ask the participant to stand up. Place the strap over his/her neck and show the participant how the hand with the sensor should rest on the bag so as to prevent the bag from swinging during the walk.
19. Instruct the participant not to hold onto the strap with a clenched hand since this will impede blood flow.
20. Get the clipboard with the Borg scale, worksheet, timer, lap counter and a pen.
21. Take the participant to the starting line of the walk.
22. Verify that a chair on rollers is ready.

23. Record the approximate test start time.
24. Demonstrate by walking one lap yourself. Walk with exaggerated rapidity to emphasize that the walk is **fast**. Step one foot across the line and dramatically illustrate a brisk pivot.

Now I am going to show you. Please watch the way I turn at the lines with no hesitation.

25. Instruct the participant:

Are you ready to do that? I will be telling you when the six minutes is half over and again when it is almost over. At the end of the six minutes I will tell you to stop. I am going to use this counter to keep track of the number of laps you complete. I will click it each time you turn around at this starting line.

Remember that the object is to walk at your own pace for six minutes. DO not run or jog, and please don't talk, whistle, or sing as you walk. AND remember you may slow down or rest should you need to.

Start now, whenever you are ready.

26. As soon as the participant starts to walk, start the timer.
27. During the walk do not talk to anyone yourself. Watch the participant encouragingly. Do not get distracted and lose count of the laps. Each time the participant returns to the starting line, click the lap counter once. Let the participant see you do it. Exaggerate the click like using a stopwatch at a race.
28. To encourage the participant you may only say:

Keep up the good work."
and You are doing well."

29. You may ask the participant occasionally:

Do you feel all right?

Check for signs of distress and discontinue walk if any are apparent.

30. When the timer reads **4 minutes** tell the participant:

Half way there!
You are doing well."

31. When the timer reads **2 minutes** tell the participant:

Almost done! Only one minute left.
Keep up the good work."

32. When the timer is **10 seconds short of 1 minute** say:

In a moment I'm going to tell you to stop. When I do, just stop right where you are and I will come to you."

33. When the timer reads **1 minute** say:

Stop!”

34. Walk over to the participant, consider taking a chair if he/she looks exhausted. Mark the spot where the participant stopped.
35. Proceed with the following items, but **when the timer beeps at 0 minutes stop whatever you are doing and turn OFF oximeter at once.**
(Reset the timer to stop the alarm.)
36. Read the oximeter. Record the post walk SpO₂ and Pulse. You may remove the oximeter from the case to do this since you can carry it back yourself, but **do not turn it off or disconnect** the sensor cable until the timer alarm sounds. If you do turn it off by mistake, just turn it back on at once.
37. Record the number of laps from the counter.
38. Record the additional distance covered (the number of feet in the final partial lap).
39. After the alarm, when you have turned the oximeter off, you may disconnect the sensor at the cable and remove the pack from the participant in order to carry it yourself. At this point the oximeter should be off. If it turns on inadvertently, just turn it back off again.
40. Take the participant, the oximeter and the clipboard back to the spirometry room.
41. Ask for and **record the post walk dyspnea.**
42. Ask the other questions on the worksheet, *referring back to how the participant felt at the end of the walk.* Check for anything on the worksheet that may have been missed.
43. Remove the oximeter from the pack and put away the pack, the clipboard and other clutter.
44. Remove the pulse sensor from the participant’s finger. Offer thanks for a good effort and do whatever is required for the participant’s comfort. Offer a drink of water.

When the participant is comfortable, continue with
down line loading the data into the computer:
45. The oximeter should be off.
46. Attach the cables for the charger and the computer to the oximeter.
47. Select “OXY-Receive oximetry data” from the F1 menu, or type OXY.
(The name of the last participant that performed spirometry may be displayed but that is alright.)
48. The oximeter program runs. (Don't press the spacebar yet.)
49. Turn the oximeter on. Watch the resulting screen activity. If there is no activity check the connections.
50. Watch the message at the bottom of the screen (otherwise it will keep counting up, seemingly forever). When it changes to “STOP reply received,” press the space bar.
51. Fill in the participant identification information on the blue screen. At the ending question reply with “Y” but do not press <Enter> yet, or the results will flash by too rapidly to read.
52. Note the success of the results:

Reasonable values for SpO2 and Pulse
At least 8 minutes of data
At least 90% good data

53. Press <Enter>; observe the results being saved.
54. Turn the oximeter off again, but leave it attached so that it can charge up for next time. Note the small green light next to the power switch is off and the charging symbol (|_|) is displayed.
55. YOU ARE ALL DONE!

Notes:

1. The DISTANCE WALKED IS THE PRIMARY OUTCOME MEASURE for this test. If oximetry is not possible for any reason, the walk itself should still be performed.
2. If the participant stops and needs a rest, wheel the chair over to her and let her sit for a moment. Tell her to continue walking whenever she feels able. DO NOT stop or reset the timer. The resting time is a part of the six minutes. Do not get distracted and forget about the timer and counter.
3. If the participant stops before the six minutes are up and refuses to continue, you may discontinue the walk, but do not disconnect or turn off the oximeter until the full seven minutes has elapsed and the alarm on the timer sounds. Note that the walk was partial on the worksheet.
4. We turn off the oximeter exactly 7 minutes after the start of the walk in order to synchronize the time clocks of the oximeter and the computer.

5 References

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