Financial Disclosure

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Changes in Oxygen Uptake in Male Cardiac Rehabilitation Patients as Measured by a Self-paced Cycle Ergometer Test: The King 6-minute Cycle Test

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Introduction:

The need to measure functional capacity and write an individualized exercise prescription in cardiac rehabilitation for patients prior to beginning a Cardiac Rehabilitation Program has been grossly underutilized over the last decade. A simple, but valid and reliable test of functional capacity might make this evaluation and prescription possible. The King 6 Minute Cycle Test (K6MC) has been shown to be valid and reliable when compared to the American Thoracic Society (ATS) 6 Minute Walk Test. As an alternative a self-paced six-minute cycle ergometer test (King 6MC) using a Schwinn Air-Dyne ergometer was developed and evaluated. The Schwinn Air-Dyne ergometer is widely used in cardiac rehabilitation programs and can be easily adapted to accurately measure the distance covered in six minutes of self-paced cycling.
Purpose:

This study measured oxygen uptake using standard gas exchange principles while performing the King 6 MC Test to determine if a relationship exists between $V_{02}$ peak and distance covered on a Schwinn Airdyne® (AD4) cycle ergometer in a 6 minute self-paced functional exercise test.
Objective:

This investigation was designed to measure oxygen consumption in a convenience sample of 96 male patients referred to cardiac rehabilitation using standard gas exchange. A self-paced cycle ergometer test, the King 6 MC Test, was administered and comparing the distance covered in six minutes with peak $V_{02}$ obtained.
Demographics

• Ninety-six (96) male cardiac rehabilitation patients agreed and were consented to perform a King 6MC test while measuring expired gas exchange, heart rate, blood pressure and rating of perceived exertion.
• Mean age was 64.8 years ± 8.5; range 43-83 years.
• Primary patient diagnoses were:
  - CABG-42
  - MI-39
  - CAD-15
Methods:

96 male patients (64.8 years ± 8.5; range 43-83 years) were referred to cardiac rehabilitation and consented to this test. They were administered the King 6 minute cycle test while measuring gas exchange, heart rate, blood pressure, rate of perceived exertion and distance covered. The cycle test was performed on a Schwinn Air-Dyne cycle (AD4) ergometer and gas exchange was measured using a Medgraphics metabolic cart both pre and post rehabilitation. Oxygen uptake data was analyzed to measure improvement using a dependent t-test and linear regression was performed to determine the relationship between distance covered and oxygen consumption.
Methodology

- All patients were given one practice session ($T_1$) before the actual data collection test ($T_2$).
- Patients were asked to pedal as far as they could in a six minute period of time.
- The time and standard encouragement was given to the patient every two minutes.
Methodology (cont.)

• Patients were allowed to rest or stop during either test if they became fatigued or symptomatic
• Heart rates were obtained via a single lead ECG during each minute and immediately post exercise
• Blood pressures were measured at rest and immediately post exercise
• HR x SBP were calculated using the immediate post-exercise values to obtain rate-pressure products (RPP 10⁻²)
• The distances covered in feet were recorded immediately post exercise
Results:

The men attended a mean of 32 sessions (range 28 to 36) of cardiac rehabilitation. Mean 6 MC distance increased from entry to discharge was 1159.44 ± 1264.5 feet (p<0.05). The % improvement was 19.8%. Mean oxygen uptake increased from 15.52 ml/kg·1/min·1± 4.8 to 19.70 ml/kg·1/min·1 ± 6.25 (p<0.05). The mean improvement in oxygen consumption was 26.9%, an increase of 4.18 ml/kg·1/min·1 (p<0.05). The RER mean was 1.16 ± 0.05. Linear regression showed a positive correlation(r=.83) between V0₂ peak and distance covered and a regression equation was derived to predict oxygen consumption from distance covered on the King 6 MC test. That equation is: V0₂ in ml/kg·1/min·1= 0.004 (distance covered in feet) -8.3668.
King 6 Minute Cycle Test - Men (N=96)

\[ y = 0.004x - 8.3668 \]
Summary

- Strong positive correlations ($r=0.83$) exist between the distance covered in feet and peak oxygen consumption using the King 6MC test for this sample.

- Mean 6 MC distance increased from entry (1st week) to discharge (last week) was $1159.44 \pm 1264.5$ feet ($p<0.05$) which was a 19.8% improvement.

- Mean oxygen uptake increased from $15.52 \text{ ml/kg/min} \pm 4.8 \text{ ml/kg/min}$ to $19.70 \text{ ml/kg}^{-1}/\text{min}^{-1} \pm 6.25\text{ml/kg/min}$ ($p<0.05$) which was a 26.9% increase.

- The mean RER was $1.16 \pm 0.05$.

- Linear regression showed a positive correlation of $r = .83$.

- A regression equation was derived to predict oxygen consumption from distance covered on the King 6MC test. That equation is: $V0_2 \text{ in ml/kg}^{-1}/\text{min}^{-1} = 0.004 \text{ (distance in feet)} - 8.3668$. 
Conclusions:

The King 6 MC Test accurately measured improvement in distance covered and oxygen consumption and the distance covered accurately predicted peak VO$_2$ in this population of 96 male cardiac rehabilitation patients. The data collected also provided cardiac rehabilitation professionals the data necessary to write an individualized exercise prescription.
Advantages of the King 6MC Test

• Inexpensive and relatively simple.
• Well accepted by patients.
• Uses equipment that is commonly available in most cardiac rehabilitation programs.
• Patient remains in a stationary position where vital signs and gas exchange are easily obtained.
• Requires minimal staff and staff training to perform; can be performed as a part of a regular exercise session.
• Easily repeated as medical status or fitness level changes.