

## NONINVASIVE DETERMINATION OF THE ANAEROBIC THRESHOLD USING HEART RATE DEFLECTION DURING THE LEGER SHUTTLE RUN IN SOCCER AND RUGBY PLAYERS

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### Introduction

Conconi et al. (1982) has shown that a deflection in heart rate (HR) from linearity occurs during graded exercise that coincides with the *anaerobic threshold (AT)*. Further research has shown that this HR deflection can be reliably measured using a variety of different field tests using a gradual increase in velocity while assessing HR with a relatively inexpensive personal monitor (Cellini et al., 1986; Conconi et al., 1982; Droghetti et al., 1985).

Leger and Lambert (1982) have created a shuttle run field test that gradually increases in velocity and is used to predict *maximal aerobic power* or  $VO_2\text{max}$ . The Leger 20 m Shuttle Run test has been validated and proven to be reliable for this prediction (Leger and Gadoury, 1987) and is now used extensively by a number of sporting groups as an inexpensive field test for aerobic fitness.

The intention of the present study was to determine whether a "Conconi" HR deflection can be measured during a Leger 20 m shuttle run test.

### Objective

The purpose of this study was to determine whether a HR deflection can be identified during the Leger 20 m Shuttle Run test in female athletes. It was hypothesized that the HR deflection can be measured during the Leger 20 m Shuttle Run test and that it will indicate the individual ventilatory threshold

(VT) measured using an established lab protocol.

### Design

Single group, 2 condition experimental design.

### Setting

University of Alberta, Edmonton.

### Subjects

Female Alberta rugby players between the ages of 18 and 24 were recruited from a varsity athlete population. A healthy, active individual was defined as a person who participated in regular aerobic physical activity a minimum of 3 times a week and was free of conditions that may have impeded their metabolic function or their effort and performance during the graded exercise test. This study was approved by a University Research Ethics Board.

### Intervention/Main Outcome Measures

The exercise testing involved two visits to the exercise physiology lab: a laboratory session for a graded treadmill test to exhaustion using both increases in speed and later grade to assess VT and maximal oxygen consumption ( $VO_2\text{max}$ ) and on a separate day, a 20-m shuttle run test with HR monitoring in an indoor facility was performed. Speed and HR at VT during the treadmill test was performed using the V-Slope method of Wasserman. HR deflection (HRd) was determined as the point at which HR departed from linearity during the 20-m shuttle run test determined visually from a plot of HR versus speed and the corresponding speed at

which the HRd occurred was also recorded. HR was determined using Suunto HR monitors that we set to record to memory and downloaded to a laptop for analysis. Metabolic measurements were made with a Parvo-Medics metabolic system.

### **Main Results**

The mean height, weight and  $VO_{2max}$  for the women rugby players was  $169.5 \pm 6.6$ ;  $71.7 \pm 12.2$  kg,  $44.2 \pm 4.4$  ml/kg/min (mean  $\pm$  sd). There was a significant difference between running speed at VT determined on the treadmill ( $11.6 \pm 0.61$  km/hr) and running speed equivalent to the HRd during the 20-m shuttle run test ( $11.1 \pm 0.52$  km/hr). There was also a significant difference between the HR at VT determined on the treadmill ( $183 \pm 8$  b/min) and the HRd that was determined during the 20-m shuttle run test ( $187 \pm 9$  b/min).

### **Conclusions**

These observations suggest that a HR deflection can be observed during a 20-m shuttle run test to exhaustion with the use of HR monitoring in women rugby players. However, the speed at which the HR deflection occurs was lower than the speed at which VT occurred during a treadmill test in the same athletes. As well, the HR at the deflection point during the 20-m shuttle was higher than HR at VT during the treadmill test. These findings suggest that the stop start nature of shuttle running elicits a higher HR response at threshold in comparison to graded treadmill running and may also be partially why the prediction of running speed at threshold was lower during the 20-m shuttle run test using the HRd method.

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### **Commentary**

Anaerobic threshold is widely used to assess aerobic fitness and as a basis to prescribe aerobic training intensities in various athletes. However, anaerobic testing requires sophisticated equipment that can also be expensive. Field tests of anaerobic threshold are few, but measuring HR during running that gradually increases in speed has been shown to elicit a deflection from linearity in HR response that may indicate anaerobic threshold. The popular and commonly performed 20-m shuttle run test is used to assess aerobic fitness and can be adapted to include measurements of HR that can be used to determine a HR deflection as a field indicator of the anaerobic threshold. Our findings indicate that this can be done, but it is cautioned that the HR deflection point measured during shuttle running may under predict running speed at VT by an average of 0.5 km/hr and overestimate HR responses by an average of 4 b/min. However, these differences may be considered small and thus the HR deflection measured during the 20-m shuttle run test still may be useful for exercise prescriptions that include a range of speed and heart rate responses for athletes to train within.