UNIVERSITY OF CALGARY KINESIOLOGY

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# Development of a Diagnostic Test of Performance, Cardiac Power and Training Status.

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**Statement of the Problem:** The aim of this research is to compare the simultaneous measurement of cardiac output by two techniques across a range of exercise intensities. The implementation of a rapid non-invasive technique (Johnson et al., 2000) is required which incorporates a computerized breathing valve system to ensure rapid delivery of sample gases.

**Implications and Relevance of this Research for Sport in Alberta/Canada:** The characterisation of cardiac power (CPo) across fitness levels and exercise protocols is required to develop the reference range needed for future training interventions. This novel approach to the non-invasive determination of CPo will provide a stepping stone needed to accurately assess cardiovascular function and the underlying limitations to functional physical capacity. Furthermore, this will facilitate optimal training prescription for both athletic and diseased populations.

**Methods:** The proposed research required for the integration of numerous pieces of technical hardware and the development of software to analyze the physiological signals desired in the study is ongoing. The key components purchased were a data acquisition system (PowerLab 16/30, ADInstruments), pneumotachographs (series 3813 & 4813, Hans Rudolph), pneumotach amplifier (series 1110A, Hans Rudolph), pneumatic sliding-type valve (Custom 3-Way, Hans Rudolph) and controller (series 4285A), and a mass spectrometer (1100, Perkin Elmer).
Each of these components provides the electrical signal to the data acquisition system and thus software was developed to accurately calibrate these signals and convert them into meaningful physiological data. This included developing software which was comprised of the sophisticated algorithms developed by Tang et al. (2002) to calibrate the flow of the pneumotachographs from known volume syringe strokes (3L) in order to measure inspired and expired ventilation. Furthermore, the data acquisition software was electronically integrated with the pneumatic valve controller for rapid administration of known concentrations of acetylene into the inspired air for the determination of cardiac output. This is the principle purpose of the proposed study. Finally, development of computer software was undertaken that combined many scholarly contributions for the calculation of breath-by-breath oxygen consumption (Beaver et al. 1983) and cardiac output (Johnson et al, 2000; Barker et al, 1999) from the basic physiological signals of inspired and expired flow and fractional gas concentrations.

Combined with blood pressure, the measurement of cardiac output can be used to determine cardiac power which represents a measure global cardiovascular work, integrating the mechanical capacity of the heart and vasculature to generate both flow and pressure (Tan, 1991). With the above technology, cardiac output can now be measured non-invasively in approximately 15s, which is a significant improvement in the ability to conduct repeated measures of this variable during exercise.

**Summary:** This significant undertaking which required six months of full time development following the purchase of the equipment, is now near completion allowing for data collection and analysis as proposed as part of the aforementioned grant application and will occur within the next six weeks.

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