Making CPX Testing a Positive Experience for the Pediatric Patient

by Carl Mottram, BA, RRT, RPFT

Cardiopulmonary exercise (CPX) testing in the pediatric population can be both challenging and rewarding. It is challenging to be able to adapt equipment and protocols to meet the age-specific needs of the subject, and it is rewarding to make the testing session a positive experience for the child. In the 14 years I have been administering or participating in pediatric testing, I continue to face new and diverse challenges.

The reason children and adolescents are referred to the lab is often different from their adult counterparts. The American Heart Association’s “Guidelines for Exercise Testing in the Pediatric Age Group” cites the following reasons for exercise testing in this population:

1. Evaluate specific symptoms or signs that may be induced by exercise
2. Identify abnormal adaptive responses
3. Assess the effectiveness of specific medical and surgical treatments
4. Establish levels of functional capacity
5. Estimate prognosis
6. Evaluate fitness levels
7. Establish baseline and follow up effectiveness of rehabilitation.

Laboratory environment

The exercise laboratory can be very intimidating and anxiety-provoking, especially to the younger subject. Therefore, clinicians should make special efforts to help reduce the hostile environment that is present in sophisticated laboratories. This can be accomplished through pictures, music, or simply by a friendly voice and smile from the technologist upon the child’s arrival. The very first thing I say to a young subject in a noninvasive test is, “None of this will hurt. It’s just like being a scuba diver on a bike.” Giving constant reassurance throughout the study is essential, but don’t be surprised if you still have to wipe away a few tears.

Laboratory environmental factors should also be controlled. It should be well ventilated, with the temperature and humidity maintained at or below 22 degrees Celsius and 50 percent relative humidity, respectively. The room should be large enough for the equipment and also have enough room for handling emergency situations.
Laboratory personnel

It is generally accepted that a physician should be present during diagnostic testing. Preferably, this physician should be trained in exercise testing in young subjects with disorders of various severity.1 In certain situations, the physician may delegate the actual testing to personnel who are trained in exercise physiology and in emergency procedures.

Although not required, Advanced Cardiac Life Support certification is recommended, and further certification in Pediatric Advanced Life Support is advantageous. At least two individuals should be in the room in order to adequately perform the test.1

Laboratory equipment

Whether testing is conducted using a cycle or treadmill ergometer, adjustments may be needed to accommodate the smaller physical structure of a child. Our laboratory had our engineering department make a special stem for our cycle ergometer so the seat can be lowered to accept subjects as small as 104 cm.

When measuring expired gas, as is the case in CPX testing, many of the mouth/patient interfaces may be too large. Since smaller mouthpieces are often required, it can affect the attachment to the breathing apparatus. We made adapters to fit these smaller mouthpieces onto our disposable pneumotachs. It is also not uncommon that the smallest mouthpiece is too large and needs to be trimmed down to the appropriate size.

A large variety of blood pressure cuffs should be available to allow for selection of the appropriate size for the child. Placing a cuff that is too small for the subject can cause an overestimation of systemic blood pressure.3

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Resuscitation equipment should be immediately available and age-specific for the population tested in the laboratory.1

Exercise protocols

Identifying a protocol that meets the needs of the patient, physician, and laboratory can be a challenge. This is the most frequently asked question I get from outside practitioners when inquiring about pediatric testing.

The Bruce treadmill protocol is the most widely used protocol in adult testing in North America, but the population Bruce studied ranged from 29 to 73 years in age. Cumming and colleagues have published normative data using this protocol for children 4 to 14 years of age.4 One potential problem with the Bruce protocol is it may be too aggressive for many young subjects, thus not allowing for adequate data collection or achieving maximum physiologic parameters.

Many of the published protocols in the pediatric literature use the cycle ergometer as the method of exercise. The James protocol utilizes three-minute stages with the increments based on the body surface area of the subject.5 Many laboratories, because of the amount of normative data that they provide, have accepted this protocol.
This includes data for the total exercise time, total work, heart rate, and blood pressure.

The James protocol has been further enhanced through data collected by Washington, et al, that includes the additional parameters of maximum oxygen consumption (VO$_2$max) and other ventilatory indices.

Another highly cited protocol in the pediatric literature was developed by Godfrey. In this protocol, three height groups were studied to determine the workload increments, which then increment in one-minute intervals.

Cooper and his colleagues at UCLA Medical Center developed normal data in children using a ramp protocol. The only drawback is that Cooper only reports predicted values for VO$_2$max. Measurement of other parameters during the test or as adjuncts to the test, such as pre/post spirometry for the detection of exercise-induced bronchospasm, may also be included in the testing regime. For more information on the actual test performance, the American Thoracic Society’s (ATS) “Pulmonary Function Laboratory Management and Procedure Manual” (an overall guide to cardiopulmonary diagnostic testing), has a chapter on CPX testing. This manual is available at the ATS website at www.thoracic.org in the book store section.

The performance of the CPX test and the ability to measure expired gases during exercise have been made much easier with the advent of new technologies. The indices derived from these measurements and the kinetic response to exercise can be very helpful in the diagnosis of reduced exercise capacity and dyspnea on exertion in the young.

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References


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