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The 'Sport-tester': a device for monitoring the free running test

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SUMMARY A cheap telemetric device, the 'Sport-tester', has been shown to be useful in monitoring the free running test for bronchoconstriction.

The free running test is one of the most potent bronchoconstrictive stimulants in subjects with bronchial hyperreactivity.[1] The test consists of running for six to eight minutes under standardised conditions, at a workload equivalent to 60–80% of the subject's maximal aerobic power.[2] Even though it is difficult to measure workload directly, an indirect estimate may be obtained by measuring heart rate during the exercise.[3] Hitherto, monitoring of heart rate during a free running test has involved the use of telemetry, which is generally expensive and therefore not widely employed. In the present study we examined a simple inexpensive form of heart rate telemetry during free running tests in children.

Subjects and methods

The device tested was the self monitoring 'Sport-tester PE 2000' (available in the United Kingdom from Duffield Medical Equipment Ltd, Belper, Derbyshire, at £97·90 +VAT), which consists of two parts (Fig. 1): (1) the 'transmitter', which is a battery operated electronic electrocardiogram (ECG) monitor strapped to the anterior chest wall with a rubber belt, and (2) the 'receiver', which is an electronic watch with an antenna housing, capable of receiving signals from the transmitter. The mean heart rate over five second epochs is displayed as a digital read out. Moreover, the receiver can store readings of heart rate every 30 seconds for up to 64 minutes for later recall. The subject must wear the receiver as a wrist watch while running, so that the receiver-transmitter distance is not more than one metre.

The reliability of the 'Sport-tester' was checked by comparing it with the readings of a standard ECG monitor (Kontron 105–000C) in 14 healthy children (eight boys and six girls) aged 8–12 years, who performed a submaximal treadmill exercise test while being monitored simultaneously by the 'Sport-tester' and ECG.

The 'Sport-tester' was then used to monitor the heart rate during two types of running: 'fast' running when the subjects were instructed to run as fast as they could and 'moderate' running in which they were asked to run at a comfortable pace. Twenty four normal healthy children (11 boys and 13 girls) aged 6–11 years participated. Each period of exercise lasted for six minutes, with an interval of 90 minutes between the two tests.

Finally, the 'Sport-tester' was used to monitor a group of 240 unselected children 6–12 years old, taking part in a fast free running test.

Results

The correlation between the results obtained from

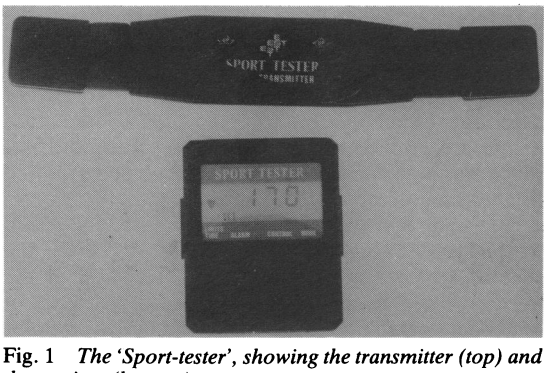

Fig. 1 *The 'Sport-tester', showing the transmitter (top) and the receiver (bottom).*

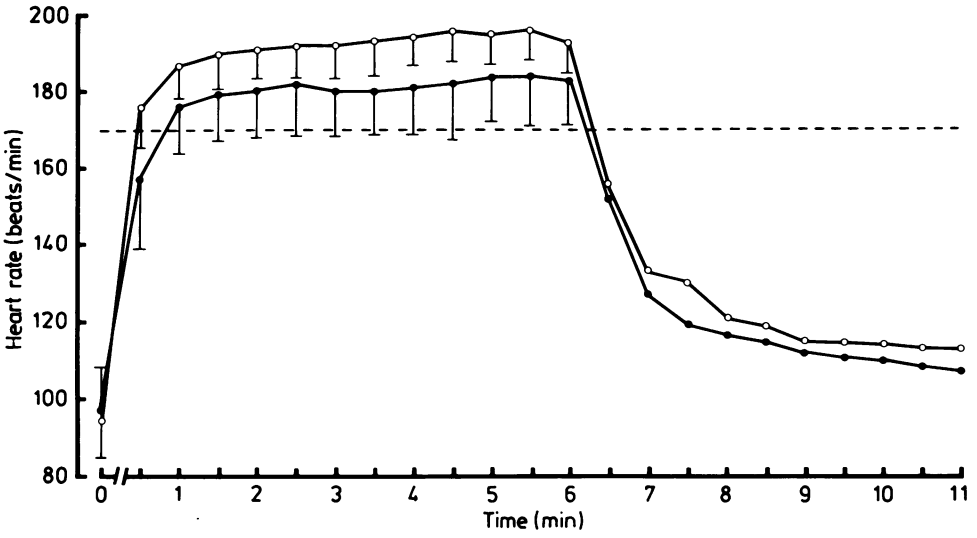

Fig. 2 *The heart rate recorded in 24 normal healthy children with the 'Sport-tester' during fast and moderate free running.* ○——○ *= Fast running,* ●——● *= moderate running. The dotted line represents a heart rate of 170 beats/minute.*

the 'Sport-tester' and the ECG was best described by a weak quadratic expression: $y=13{\cdot}3+0{\cdot}8x+0{\cdot}0008x^2$ ($n=167$, $r=0{\cdot}99$), where y is the 'Sport-tester' reading and x is the ECG monitor readings. Thus the 'Sport-tester' was a reliable indicator of heart rate even though it tended to overestimate at the extremes of the range and underestimate in the mid-range, but the deviation from linearity was not clinically important.

Comparison between fast free running and moderate free running showed that there was a similar pattern of heart rate response to both types of exercise, though the maximal heart rate plateau tended to be higher during the fast free running period (Fig. 2).

Monitoring the fast free running test in 240 children with the 'Sport-tester' was successful in 229 cases (95%). In every case the heart rate rose above 170 beats/minute within 30 seconds of the onset of running. In eight cases there was poor contact between the pulse transmitter and the skin, resulting in failure to record the heart rate. A further three children refused to participate after their skin had inadvertently been pinched while tightening the securing belt around the chest.

Discussion

Childhood asthma is still underdiagnosed and there is no simple objective method available to provoke bronchoconstriction in children.[4] Free running is a potentially useful test but involves an estimate of the workload while running. We decided to evaluate the 'Sport-tester' because of the association between heart rate and aerobic workload.[5] The results show that the 'Sport-tester' is a reliable and cost effective monitor of heart rate in this test. The device is readily tolerated by most children and when technical failure occurred it was complete.

Exercise induced bronchoconstriction is directly related to work intensity, and maximal post-exercise airway constriction follows a workload of 60–80% aerobic power.[6] This corresponds to a heart rate of more than 170 beats/minute, which was achieved in all the 229 children who successfully completed the free running test. Partial failure of the 'Sport-tester' would lead to an underestimate of maximum heart rate. There is little chance, therefore, of a false diagnosis of exercise provoked bronchoconstriction being made using this technique.

It could be argued that it would be desirable to use a monitor that was integral within the chest belt, thereby eliminating telemetry. This is not directly pertinent to the present study, which has shown the utility of a commercially available, fairly inexpensive device that is useful in the objective assessment of the free running test.

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High aluminium content of infant milk formulas

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SUMMARY The aluminium content of several commercially available infant milk formulas was measured by electrothermal atomic absorption spectrometry. Results were compared with those for fresh breast milk, cow's milk, and local tap water. Differences in aluminium concentration of greater than 150-fold were found, with the lowest concentrations in breast milk.

Because of its ubiquitous nature, aluminium has not traditionally been regarded as an essential trace element.[1] No cases of aluminium deficiency have been reported and minimum daily requirements for different ages are unknown. Fluids yielding as little as 7·5–15 μg of aluminium per day have been used recently without detriment, however, in infants receiving long term total parenteral nutrition.[2]

Aluminium toxicity in patients with chronic renal insufficiency undergoing haemodialysis or ingesting large quantities of phosphate binding gels is well recognised.[3] Recently, the high aluminium content of a proprietary milk formula was implicated as the cause of aluminium toxicity in two infants with neonatal uraemia.[4] In this paper we report the results of the measurement of aluminium in a variety of infant feeds.

Methods

Sample collection and preparation. Preprepared liquid and powdered formulas were sampled either directly from their glass containers or, in the case of preparations in cans, by collecting aliquots into acid washed polystyrene tubes. Each feed was sampled on two occasions and, where possible, from different batches. Breast milk was collected by lactating mothers directly into acid washed polystyrene tubes, using a no touch technique.

The powders were reconstituted in the laboratory by adding distilled, double deionised (aluminium free) water, using acid washed volumetric apparatus, to portions of accurately weighed milk powder.

Aluminium analysis. Aluminium was assayed by graphite furnace atomic absorption spectrometry employing a Varian Techtron AA975 and GTA 95 with autosampler.

All samples were initially diluted in the ratio of 1 volume of sample to 14·2 volumes of 0·3% analytical grade hydrochloric acid on an automatic diluter.

The aluminium content of samples was quantitated by the method of standard additions to allow for the variation in instrument response caused by the different sample matrices. Typically, a single random representative sample was used to generate a standard additions calibration curve for each analytical run. Subsequent samples in the run were quantitated by comparison with this curve. Samples yielding a mean peak height absorbance greater than the highest calibration point were further diluted with 0·3% hydrochloric acid until they fell within the calibration range.

The analytical technique was controlled with 'in house' aqueous and serum based control materials (method coefficient of variation at 80 μg/l was roughly 10%, run to run) and by participation in a national aluminium analysis quality control survey (Department of Applied Biology, Royal Melbourne Institute of Technology).

The spectrometer was operated in peak height