Intermittent Hypoxic Training: A Review

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Intermittent Hypoxic Training (IHT) consists of exposure to alternating periods of hypoxia (9 - 14% O2 inhaled through a mask) and reoxygenation with atmospheric air. [1, 2]

The method originates in Russia where it has been studied extensively in the areas of aviation and clinical medicine. [1]

Recently it has been applied in the field of athletic performance as an alternative to altitude training. [3]

For the purpose of performance enhancement IHT sessions consist of six 5 minute periods of hypoxic air (9-10%) alternated with 5 minutes of exposure to atmospheric air. A full course consists of 1 or 2 sessions a day for 15 - 20 days.

Adaptations to IHT do not only include improvements in oxygen uptake, transport and utilisation but also in neuroendocrine regulation and immunity. [4,7]

Kolchinskaye and others have done studies on rowers, swimmers, cyclists, kayakers, skiers, track and field athletes and volleyball players. [3]

A course of IHT showed improvements in performance, VO_2 max, haematological values as well as decreased heart rates and pulmonary ventilation, compared to a placebo group. Athletes involved in the studies also showed a lesser increase in arterial O_2 saturation during exercise and an improved lactate response.

Of interest is that volleyball players showed a significant improvement in the Vertical Jump test following IHT. One study showed a significant increase in resistance to high physical training loads measured by products related to activation of lipid peroxidation. [5]

It is acknowledged that the adaptation process to IHT is not necessarily exactly the same as those obtained during altitude hypoxia and that additional adaptive processes might be responsible for some of the more pronounced effects of IHT. [6,7]

Meerson describes the following advantages of IHT in comparison with continuous hypoxic exposure. [7]:

1. Avoidance of chronic stress associated with continuous exposure to hypoxic air.2. Control of the dose.
3. The absence of the disadaptation syndrome which athletes experience when returning to sea level following altitude training.
4. Increased activities of antioxidant enzymes in the brain, liver, heart and other organs. (In

contrast to suppression of antioxidant processes under chronic hypoxic stress)

To have an optimal effect IHT needs to be done in conjunction with physical training. Both types of training will expose the body to hypoxic stress. The adaptive responses to hypoxic hypoxia (via IHT) and load hypoxia (via training) have a different mechanism but are complimentary. 8. Adaptive effects of training are enhanced by the adaptation to IHT. 9.

Intermittent Hypoxic Training, A Pilot Study

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Intermittent Hypoxic Training (I.H.T) is a method of altitude simulation which originates in Russia. It has been studied extensively for the purpose of aviation and clinical medicine for many years and more recently also in the area of performance enhancement in sport. Recently the method of IHT was presented to New Zealand sport by Dr Alexei Korolev, currently from Auckland. The results of IHT are claimed to be similar or superior to those obtained when doing conventional altitude training. The method of IHT consists of exposing athletes to hypoxic air (9 - 11%) intermittently for five minute intervals, alternated by normoxic air, also for five minutes for a total of one hour for one or two sessions a day for a total of 15 - 20 days.

The effect of exposure to altitude air on endurance performance is thought to be related to an increased production of red blood cells, resulting in an increased oxygen carrying capacity of the blood

IHT is done with help of an hypoxicator which is a machine which can extract oxygen from the air to any desired level, between 9 and 16%. This is comparable to an altitude of 2000 to 6,500 metres. Normoxic (athmospheric) air has an oxygen concentration of 20.9%. Recently an hypoxicator was installed in QEII Sports Stadium in Christchurch. This paper reports on the results of the first pilot project on the effects of IHT on performance and haematological factors.

Methods

Ten athletes, consisting of four elite swimmers, two elite triathletes, three age-group triathletes and one runner were invited to take part in the study. All were well trained athletes in the final preparations for major events. The group consisted of four woman and seven men ranging from 16 to 45 in age. The athletes were exposed to 10% (first 10 days) and 9% (second 10 days) intermittently for five minute intervals, alternated by normoxic air also for 5 minutes for one hour twice a day for a total of 18 days. Athletes were instructed to have a minimum of one hour between IHT and their physical training sessions. All athletes underwent performance testing in the form of specific field time trials in their sport, decided by the athletes and their coach and haematological testing (Haemoglobin, Haematocrit, Reticulocytes and Erythropoetin) before, and after the period of IHT.During the period athletes kept a record of subjective perception in regard to muscle soreness, fatigue, sleep and performance.

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Results and Discussion

Results are summarised in Table 1. Performance improved by 2.9%, haemoglobin by 4.3%, haematocrit by 5% and reticulocytes by 30.3%. Overall improvements for the group are expressed in percentages compared to the baseline. Only one athlete did worse on the performance test. The athlete who improved most (CP) also had the most marked haematological response. Of interest is that this athlete did only I hour of IHT per day due to time constraints. The general increase in haemoglobin, haematocrit and reticulocytes are known to support improvements in endurance performance, making it less likely that the performance results are solely due to a placebo effect. Haematological and performance improvements observed with IHT are similar or superior to those observed in other methods of altitude training.

The findings suggest a significant stimulation in red blood cell production as indicated by a strong reticulocyte response. The accompanying performance improvement can be linked to the haematological changes although other factors will play a role, including motivation, mood, conditions etc.

No significant side effects were experienced by the athletes. All experienced transient light headedness during the first one or two sessions, to the extent that two athletes had to remove their mask temporarily during the first hypoxic phase. All athletes reported a significant improvement in subjective well being soon after starting IHT. Two of the athletes reported excessive fatigue during the second half of the programme. However they were also in a high intensity phase of their training programme. One of the athletes reduced IHT to one session a day for a period of four days before returning to two. Not all athletes observed the rule to have a minimum of one hour break between sessions of IHT and physical training sessions. This could have resulted in an accumulative effect of both types of training, contributing to excessive fatigue. Two athletes, who were known asthmatics, noticed that they did not require to take their usual medication during the three weeks of IHT.

Summary

Ten endurance athletes were tested with the method of intermittent hypoxic training (IHT) in relation to haematological factors and performance over a period of three weeks. Results show an overall improvement in haematological factors related to oxygen transport and performance. The results indicate that IHT is an effective method to simulate altitude training. On the basis of the results it is recommended that further research and testing is done in the area of maximising outcome for individual athletes. However, in general the method of IHT can be strongly recommended for any serious athlete as part of their training and preparation.

Conclusions

1. IHT is an effective alternative to altitude training.
2. Side effects are minimal or absent.

3. IHR is often accompanied by a general improvement in health and wellbeing (confirming its use in the medical field).
4. There is likely to be an optimal dose for any individual athlete. This needs to be established.
5 Results compare favourably with other studies done on altitude training, in particular the live high-train low model.
6 Hypoxic training can be considered as additional training. There is potential for overload if the athlete does not adhere to the guidelines, especially in relation to recovery.
7 Some athletes will respond more than others, comparable with any form of training.
8 IHT is user friendly and easily accessable. It can be used by 4 athletes at any one time.
9 Current cost of a course of IHR is $385.00 per athlete, which is considerable cheaper than other forms of altitude training and simulation.
10 Of relevance are the significant health benefits obtained through IHT, which are unique for this particular method.

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