Effect of Major Autohaemotherapy with Oxygen-Ozone on the Anaerobic Threshold in Athletes

A. GJONOVICH*, G. SALLUSTI*, A. BRUSOMINI**

* *Pain Therapy and Palliative Care Units, Local Health Trust 17; Este-Monselice Veneto Region, Italy*
** *Specialist in Sports Medicine*

Key words: oxygen-ozone, anaerobic threshold, autohaemotherapy

SUMMARY – We investigated the clinical capacity to increase the delivery of oxygen to tissues by major autohaemotherapy (MAHT) with oxygen-ozone. Eight top level amateur athletes were enrolled in the study. Their anaerobic threshold was periodically tested by the Conconi test during a cycle of MAHT. A clear-cut shift of the curve to the right was observed in six athletes indicating enhanced peripheral oxygenation. Although the number of subjects is limited, this study offers further confirmation that peripheral oxygen delivery can be enhanced by MAHT. The clinical use of MAHT is a valid treatment for diseases characterized by a reduced tissue uptake of oxygen.

Introduction

We undertook a clinical investigation of some of the most important actions of oxygen-ozone therapy, namely its effects on:

1. Peripheral oxygen delivery
2. Intra-erythrocyte 2,3-diphosphoglycerate concentration
3. Glucide metabolism.

The anaerobic threshold (AT) was measured by the Conconi test in amateur athlete volunteers undergoing oxygen-ozone therapy.

According to the literature, oxygen-ozone therapy can trigger major biochemical reactions. In particular, it can induce the peroxidation of membrane phospholipids in red blood cells[5] with shortening of lipid chains and subsequent membrane relaxation associated with an increase in negative charges on the erythrocyte surface. This has a major anti-sludge effect resulting in reduced viscosity. The increased permeability of the erythrocyte membrane allows greater diffusion of oxygen through its membrane. In addition, ozone affects different metabolisms, especially the glucidic metabolism where mediated by coenzymes it speeds up anaeroblic glycolysis resulting in increased ATP. Thanks also to the pentosophosphates cycle, there is an increased erythrocyte concentration of 2,3-diphosphoglycerate with a clear-cut effect on the haemoglobin dissociation curve. The enhanced peripheral delivery of oxygen is confirmed by a peripheral reduction in the partial pressure of venous oxygen (< 20 mm/Hg) rather than an increase in PaO_2. These biochemical and metabolic findings account for the fact that one of the main clinical applications of oxygen-ozone therapy is in peripheral arteriopathy. We aimed to confirm the known improvement in cell homeostasis and oxygenation assessing if and to what extent oxygen-ozone therapy influences the anaerobic threshold in athletes. Anaerobic threshold is a basic concept in sports medicine. To define a person's "aerobic strength" the maximum oxygen consumption (VO_2 MAX) is usually measured by cumbersome expensive equipment. However, there is no close correlation between VO_2 MAX and the athlete's performance even in endurance competitions. The anaerobic threshold (AT) offers more valid indications on an athlete's performance[2]. This value expresses exercise intensity corresponding to the highest percentage of VO_2 MAX used without affecting lactic acid type energy recharge mechanisms. It is well documented that during physical exercise the body uses mixtures of glucose and fatty acids which become increasingly rich in glucose as exercise intensity increases. When the aerobic potential is almost completely used up, further increases in exercise intensity will be maintained by the anaerobic-lactic acid metabolism. Hence AT is defined as the exercise intensity triggering the anaerobic mechanism. Its value varies from one individual to another, and also depends on the individual's genetic characteristics. AT also varies in the same individual depending on his/her degree of training[3]. From a practical standpoint, AT is the

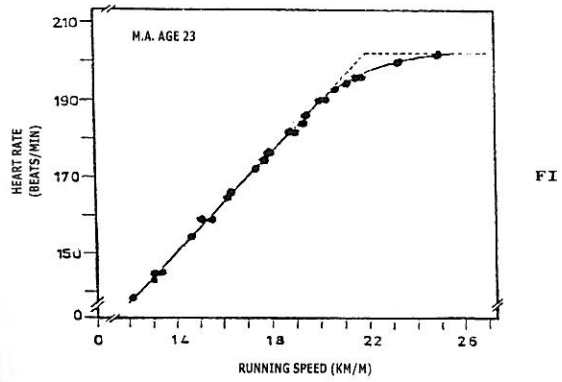


Figure 1 Conconi Test.

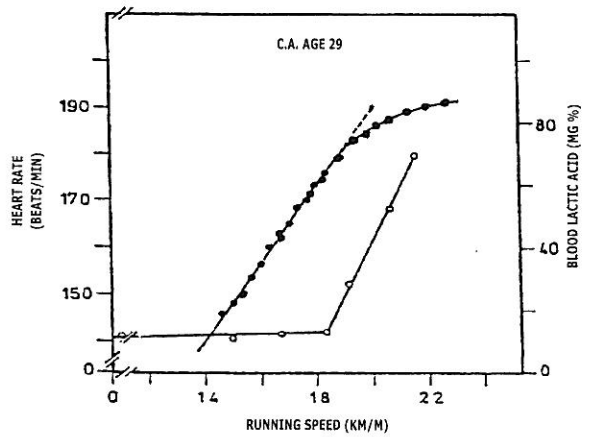


Figure 2 Anaerobic Threshold: Heart Rate And Blood Lactic Acid Ratio.

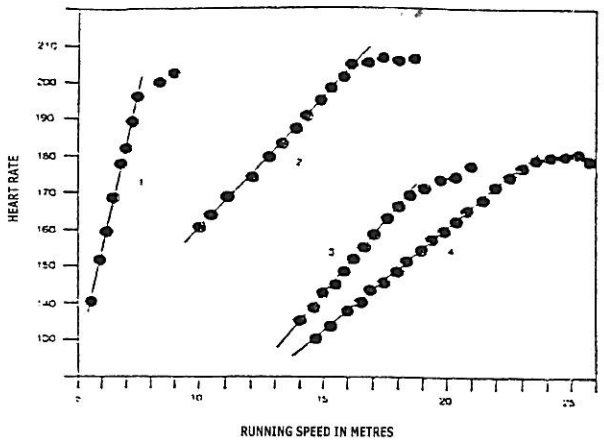


Figure 3 At: Interindividual Changes 1 Sedentary, 2 Athlete, 3-4 High Level Athlete.

level at which anaerobic glycolysis is triggered with a consequent accumulation of lactates in order to increase muscle exercise and hence athletic performance. This may be one of the factors limiting complete use of VO_2 MAX or reducing its percentage use. Different methods have been advocated to measure AT such as the relation between increasing exercise intensity and corresponding blood lactate concentrations. In the early Eighties an invasive method was developed for AT determination based on a simple principle: as there is a linear relation between oxygen consumption and heart rate, and an identical relation between oxygen consumption and running speed, there may be a linear relation between heart rate and running speed. This is the principle underlying the Conconi test which consists in a graphic study of the relation between heart rate and running speed. The line had a linear trend (figure 1) up to the point at which exercise intensity becomes high enough to trigger anaerobic glycolysis which is irrespective of both oxygen transport and heart rate [4]. Anaerobic glycolysis is thought to cause the loss of straight line linearity, i.e. there is an increase in speed without an increase in heart rate. The coincidence between linearity deflection speed and anaerobic threshold has been proved with a correlation index of 0.99 [3]. It has also been demonstrated [6] that linear deflection coincides with a major increase in plasma lactate concentration (figure 2). Figure 3 shows an example of four different anaerobic thresholds ranging from a sedentary subject to an Olympic athlete. The Conconi test is routinely used to measure an athlete's initial AT. Subsequent control tests are very useful to direct and monitor training and to yield useful indications on competition speed.

Material and Methods

To date we have studied eight volunteer high level amateur athletes, six men and two women, selected by a sports medicine specialist. All athletes practice endurance sports (cycling, skating,

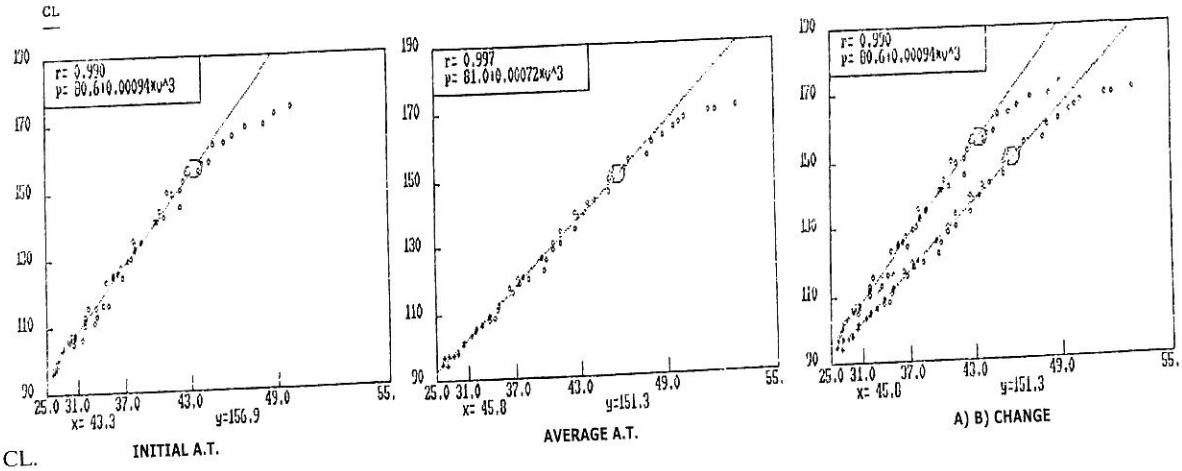


Figure 4 CL.

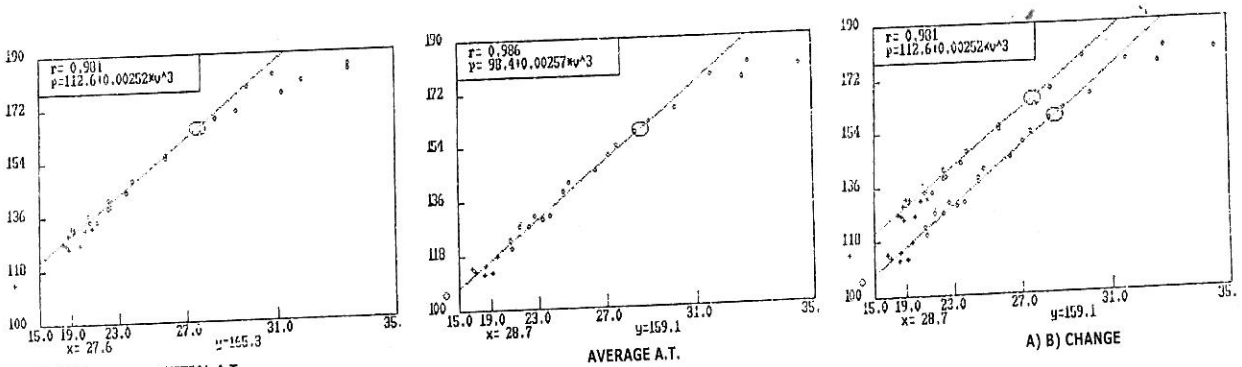


Figure 5 PT.

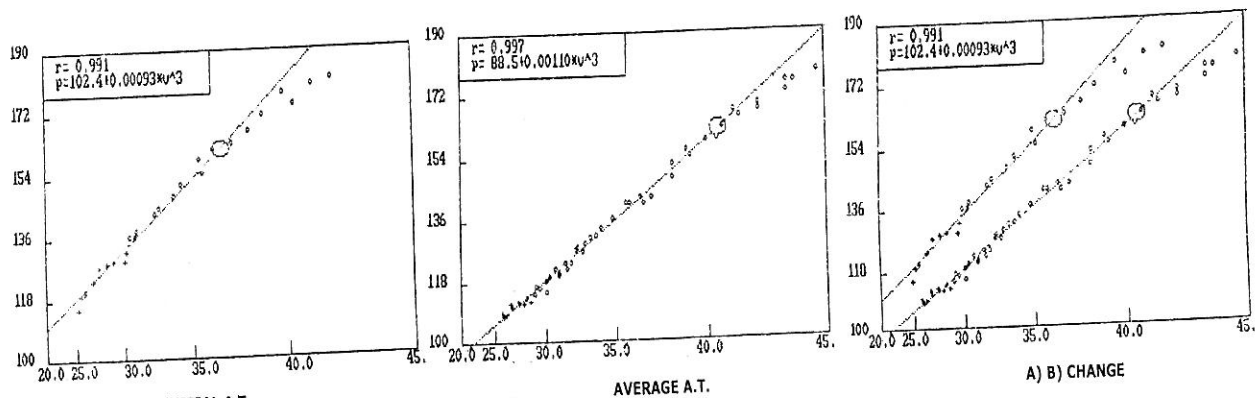


Figure 6 CL.

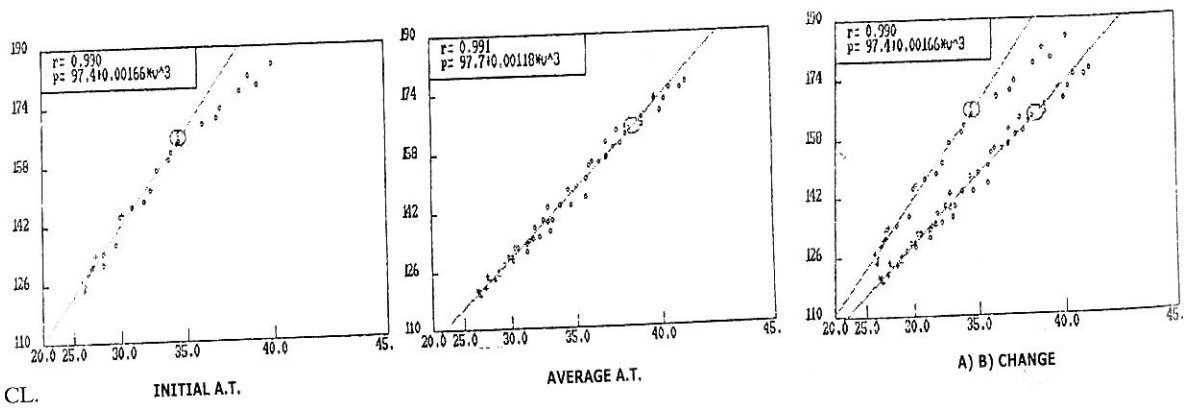


Figure 7 CL.

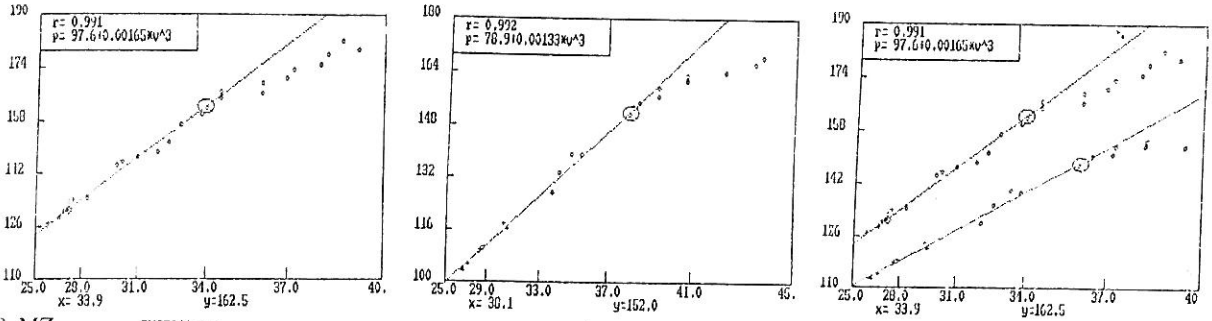


Figure 8 MZ.

canoeing) and on enrolment they were in excellent training condition. The athletes were monitored for a period of four months and underwent an initial Conconi test and at least three subsequent controls during the observation period. In previous years all athletes had undergone the Conconi test to establish their AT. Each athlete was administered MAHT by the standard method using an E 30 Ozon-Line device: 150-200 ml are taken and mixed with 150 ml of oxygen-ozone mixture at an O_3 concentration of 30 gamma/ml; the gas mixture was then reinfused over a period of 15 minutes. MAHT was performed at three day intervals up to a total of four consecutive applications. After a 20/30 day interval another two cycles of three MAHT were administered up to a total of ten sessions throughout the period of observation. As no specific oxygen-ozone concentration is given in the literature, we kept to our long-standing clinical experience in the field of peripheral arteriopathy [1,7,8]. As we were using the method on healthy subjects, we chose a concentration of 30 gamma/ml deemed low-average for peripheral arteriopathy. In addition to the initial Conconi test, the first follow-up was carried out after the fourth MAHT. Subsequent controls were regularly spread over the following three months. All volunteers gave their informed consent on enrolment in the study. Seven tests were carried out on a bicycle mounted on rollers, one directly on the field. All athletes wore a heart rate monitor with a memory subsequently decoded. The results were processed and assessed by the sports medicine specialist. The AT and the slope of the curve were taken as parameters for assessment of the Conconi test. The effect on the threshold was deemed positive when it coincided with a rightward shift of the line.

Results

Only two of the eight athletes studied had a negative response to MAHT with an unchanged curve both during and after the protocol. The rise in AT in the remaining six athletes was demonstrated by a clear rightwards shift of the curve. Figures 4-9 show a detailed analysis of initial AT and final AT for each athlete. Final AT is construed as the average threshold obtained in the three follow-up Conconi tests. Figure 9 shows an example of an intermediate threshold.

None of the athletes presented any side effects or unforeseen reactions and the method was well tolerated.

At the first follow-up after the fourth MAHT session, the rightward shift was already clearly evident and subsequent changes were less radical showing a good stabilization. It is noteworthy that heart rate was reduced in four athletes with respect to initial values.

Discussion

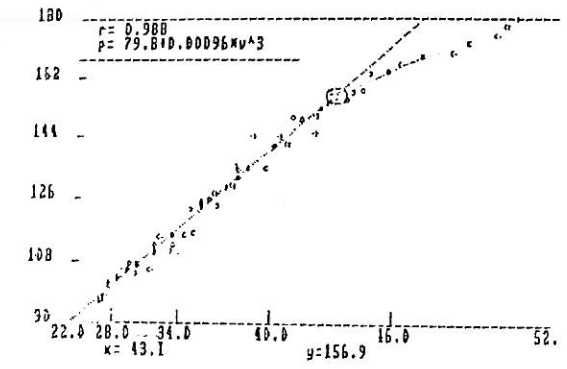
The fact that a cycle of MAHT had an effect on AT is further evidence of how oxygen-ozone therapy interacts at several levels. On the one hand the treatment allows the aerobic reserve to be fully exploited by boosting metabolism; on the other it ensures enhanced peripheral delivery of oxygen also by virtue of its effect on erythrocyte 2,3-diphosphoglycerate.

The experience of our athletes and the assessment of trainers and the sports medicine specialist disclosed a slight reduction in performance on the day after MAHT in three athletes. This effect was attenuated after the first treatment sessions and suggests that healthy subjects require an initial phase of adaptation to therapy.

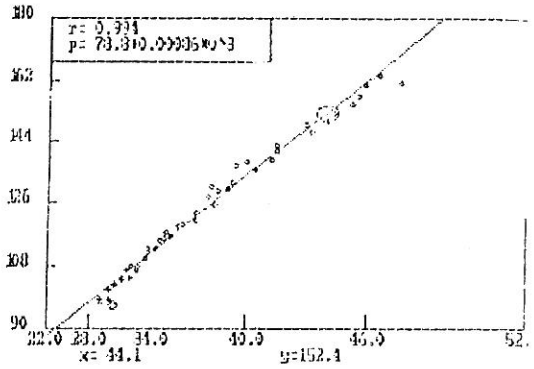
In the future it would be interesting to determine the effects of oxygen-ozone concentrations higher than 30 gamma/ml in the same athletes using the same test.

This would establish whether oxygen concentration is correlated to changes in AT.

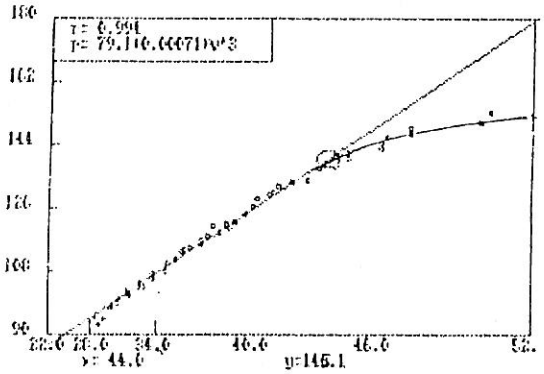
Another problem is the duration of the effect.



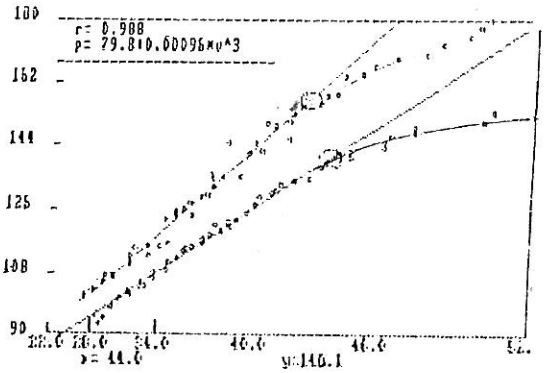
A) INITIAL A.T.



INTERMEDIATE CHECK-UP



B) AVERAGE A.T.



A) B) CHANGE

Figure 9 VG.

Currently available evidence indicates that the benefits of MAHT last for at least two months after the end of the protocol.

Apart from the objective findings of the Conconi test, the volunteers also had a subjective sensation which is very important in treating highly sensitive athletes.

In addition to a subjective feeling of well-being and "lightness in the legs", our athletes had much shorter recovery times. This could be due to both the raised AT and the frequent drop in heart rate during exercise.

Although confined to a small cohort, our findings further confirm the usefulness of oxygen-ozone therapy by MAHT in all diseases characterized by reduced peripheral oxygen delivery.

References

1 Bocci V: Ossigeno-ozono terapia. Casa editrice Ambrosiana 2000.

2 Conconi F et Al: Noninvasive determination of the anaerobic threshold in swimming. Int. J. Sports Med. 7: 347-351, 1986.

3 Conconi F et Al: Noninvasive determination of the anaerobic threshold in canoeing, cross–country skiing, cycling, roller, and iceskating, rowing and walking. Eur. J. Appl. Physiol 53: 299-303 1985.

4 Conconi F et Al: Un test da campo per la determinazione della soglia anaerobica nell'uomo. Boll. Soc. It. Biol. Sper. Vol. LVI, 1980.

5 Coppola L. et Al: Oxygen-Ozone therapy and haemorheological parameters in peripheral chronic arterial occlusive disease. Trombosi e Arteriosclerosi Vol. 3 n. 2 mar-apr 1992.

6 Green et Al: Anaerobic threshold, blood lactate and muscle metabolites in progressive exercises. J. Appl. Physiol.: Respirat. Envirom Exercise Physiol 54: 1032-1038, 1993.

7 R. Matassi: Ozonoterapia. Organizzazione Editoriale

Dr A. Gjonovich
UOC Terapia del Dolore e Cure Palliative
USL 17 Regione Veneto
C.so Vittorio Emanuele, 15
35123 Padova
Tel. 049 8754347 - 8801910