Acta haemat. 71: 410–411 (1984)

0001-5792/84/0716-0410 $ 2.75/0

2,3-Diphosphoglycerate and P_{50} after Exercise

'Sports anaemia' often occurs in persons making intensive training, above all in runners or joggers [1]. As compensatory mechanism oxygen delivery to the tissues was demonstrated to be increased in these persons [2], yet its causes remain unclear. In our study we investigated the red blood cell (RBC) indices and the adaptation to exercise by means of the 2,3-diphosphoglycerate (2,3-DPG) red cell contents and P_{50} levels in a group of runners.

24 non-smoking male well-trained runners (age: 21–43 years) were examined. Training consisted of 5–6 times/week running over an 11-miles cross-country course. After exercise, blood samples were obtained. A comparable number of healthy untrained volunteers (age: 16–47 years) was used as the control group. RBC indices were obtained from Hemalog 8. The red cell 2,3-DPG levels were determined with enzymatic assay (Sigma); whole blood P_{50} was measured using mixing technique [3].

The results are summarized in table I. In the runners, 2,3-DPG red cell content was significantly higher than in controls, while P_{50} values were not significantly different. RBC indices revealed both a significant decrease of RBC count and an increase of MCV in the runner group. Hb. PCV, MCH, and MCHC were not statistically different.

In our runners both the Hb and the PCV levels, utilized as criteria for anaemia [4], were in the normal range. The failure to find in these subjects the 'sports anaemia' could be related to the fact that blood samples were obtained after training, and therefore with a possible relative increase of RBC, Hb, and PCV due to exercise dehydration [5]. Nevertheless, the runners had a higher 2,3-DPG RBC content than controls, as previously observed [2]. This aspect may be caused by an increase of the erythropoietic activity compensating for a mild haemolysis. Such events could induce an increase of the number of young RBC with a mean enhancement of some glycolytic substrates, such as 2,3-DPG. This hypothesis may be suggested by the significant increase of the MCV in the runners.

Finally, the failure to find an increase of P_{50} in runners could be attributed to a greater than normal oxygen extraction by an improvement of mitochondria activity, as previously suggested [2].

Table I. Haematological data in the runners and in the controls

	RBC $\times 10^{12}$/l	Hb g/dl	PCV	MCV fl	MCH pg	MCHC g/dl	2,3-DPG μmol/g Hb	P_{50} mm Hg
Runners	5.0 ± 0.3	15.0 ± 0.8	0.43 ± 0.02	86 ± 4	29.9 ± 1.7	34.7 ± 1.5	18.9 ± 3.7	24.5 ± 1.5
Controls	5.2 ± 0.4	15.5 ± 1.1	0.44 ± 0.02	83 ± 4	29.2 ± 1.3	35.3 ± 1.3	15.4 ± 2.5	24.8 ± 1.2
Significance	$p < 0.05$	NS	NS	$p < 0.01$	NS	NS	$p < 0.001$	NS

Student's t test. NS = Not significant.

References

1 Yoshimura, H.: Anemia during physical training (sports anemia). Nutr. Rev. *28:* 251–253 (1970).
2 Shappel, S.D.; Murray, J.A.; Bellingham, A.J.; Woodson, R.D.; Detter, J.C.; Lefant, C.: Adaption to exercise: role of the hemoglobin affinity for oxygen and 2,3-diphosphoglycerate. J. appl. Physiol. *30:* 827–832 (1971).
3 Edwards, M.J.; Martin, R.J.: Mixing technique for the oxygen-hemoglobin equilibrium and Bohr effect. J. appl. Physiol. *21:* 1892–1902 (1966).
4 Committee Medical Association. J. Am. med. Ass. *203:* 407 (1968).
5 Costill, D.L.; Fink, D.J.: Plasma volume changes following exercise and thermal dehydration. J. appl. Physiol. *37:* 521–525 (1974).

Accepted: April 11, 1984

G. Ricci, G. Castaldi, M. Masotti,
G. Lupi, D. Bonetti,
Istituto di Clinica Medica,
University of Ferrara,
I-44100 Ferrara (Italy)

Announcement

Discussion Seminar on Heparin and Structurally Releated Substances:
Some Theoretical and Practical Considerations

November 8–9, 1984

The object of this Discussion Seminar is to critically review the current developments in the area of heparin and its derivatives, and to discuss the abvailable clinical trial results. Critical review of the structure:

Antithrombotic activity relationship potency considerations, preclinical and clinical evaluations will be made by one of the discussants in their field of expertise. An open format will lead to active participation from the audience. This Discussion Seminar is organized prior to the American Heart Association Meetings so that participants to this meeting may attend.

There is no registration fee to participate in this workshop, however, an early registration is recommended.

For further information, please contact:

Dr. J. Fareed, Loyola University Medical Center, 2160 S. First Avenue, Maywood, IL 60153, USA, or call (312 531-3256.