ALTITUDE AND HAEMOGLOBIN

A letter from Dr. J. Fielding, Consultant Pathologist, Paddington General Hospital, appeared in the Lancet, i, 1966, p. 977, drawing attention to the value of the haematocrit as an index of the oxygen carrying power of blood, and factors that might bring about an increase in the proportion of haemoglobin in a blood sample. In investigations into anoxia resulting from chronic emphysema, carried out by Fielding and Zorab, 1964, the increase in haematocrit was not proportional to the amount of iron administered by mouth, but there was a dramatic increase when iron was given by intramuscular or intravenous injection. It would appear that "Olympic Possibles", selected for the Mexico Games, might show a similar slow response to oral iron if it is given to them for the slight sub-clinical degrees of anaemia that several of the doctors concerned with the "Olympic Medical Archives" scheme found in 1964. Fielding recommended in his letter that an iron store of at least 500 mgms. was necessary for anyone hoping to undertake severe physical work at altitude. Confirmation of this view was given by Dr. G.D. Ballantyne, Medical Advisor to Fison's Pharmaceutical Ltd., Loughborough, in a letter to the Medical Advisory Committee to the British Olympic Association. He suggested that haemoglobin estimations, or preferably haematocrits should be carried out on all Olympic "possibles" well in advance of the date for emplaning for Mexico, probably four months before, or three months at a minimum. It was suggested that iron therapy would be needed for nearly all female competitors to restore the haemoglobin to a level suitable for altitude competition, and as a supra-normal level cannot be obtained by iron administration, orally or parenterally, there is no question of iron tablets being used "to give an unfair advantage over other competitors by the use of drugs", and so cannot be construed as "doping".

As the result of these letters, Dr. Fielding and Dr. Ballantyne discussed the problem with the members of the Medical Advisory Committee, after which certain recommendations were made to the British Olympic Committee, and have since been sent to the medical advisors of the various Governing Bodies of sport. Fielding gave an account of the secondary polycythaemia found in many chest diseases, which was not accompanied by a corresponding increase in oxygen transport by the blood. It was thought that a similar phenomenon would be of significance to athletes at all times, and in all environments, but that it has special relevance to questions of acclimatisation to altitude. Slight iron deficiency has many subtle effects, even in the absence of the better known signs and symptoms of clinical anaemia.

In the body, iron is found in several sites.
1. Haemiron, present in haemoglobin of the circulating blood, and in the marrow during blood formation.
2. Liver iron, stored in the cells of the sinusoids having been absorbed from the gut, and recovered from broken down red blood cells.
3. Enzyme - combined iron, present only in very small quantities, but readily available for an immediate supply of iron needed for haemopoiesis, whereas dietary sources of iron would delay the increased haemoglobin for many weeks. This store of enzyme iron can be depleted in slight anaemia, as well as the more obvious depletions of haemiron and liver iron. Most people have only small iron stores, therefore cannot be expected to expand the circulating blood iron rapidly during the earlier phases of acclimatisation to altitude. Iron stores should therefore be built up well in advance of exposure to a high or oxygen deficient environment to allow for the increased haemoglobin to be made as a result of altitude stress.

In the general population of young people without obvious disease, 30% of females and 15% males were found to have low iron stores. Dietary iron cannot give a rapid boost to these stores, and has to be administered over a period of months if it is to be effective. The response of the severely anaemic to oral iron is more rapid than the response of the slightly anaemic.

In a ladies team competing in winter games, of six skiers tested, 2 were anaemic by modern definition, 1 had no iron stores, although her haemoglobin was just within acceptable limits for an athlete, and 1 had recently sustained a shoulder injury, although her iron reserve was satisfactory. Not surprisingly this team did not score very well in the games. To one of these athletes, oral iron brought about an increase in haemoglobin from 12.2 gms% to 13.4 gms% in three weeks, but another athlete with an initial haemoglobin level of 14.1 gms% showed no increase at all with similar dosage. To a physician dealing with the severely anaemic, elderly, or malignant sufferer, even a haemoglobin level of 12 gms% may not seem frighteningly low, but those concerned with the medical care of the athlete agree that the "average male norm for the 1960's" of 14.8 gms%, should be the minimum level for a female athlete, and the male should have a minimum of 15.0 gms%. Any athlete with a haemoglobin of less than 13 gms% has deficient iron stores, and these must be built up over a long period of time with oral iron, or more rapidly with injected iron dextran.

It is possible to estimate the iron storage, but it is a lengthy process, difficult technically, and therefore expensive. At present it must be regarded purely as an elaborate research project. The haemoglobin can be estimated easily, and this should be done well in advance, but most simple equipment available gives the most accurate results in the range of about 7 gms% (50% - Sahli's standard) to 13.6% (90% - Sahli) and any values over 14.0 gms% are not so easily or accurately calculated. Clinical equipment is designed for the detection of the sick, and not for the investigation of the supra-normal, such as the athlete in training. Provided that there are adequate iron stores, exercise at altitude acts as a stimulus for the production of extra haemoglobin, in as short a time as four weeks, assuming that oral iron is being given during this acclimatisation period.
It is unlikely that the majority of doctors realise that subclinical anaemia is widespread amongst athletes. Before the 1964 (Tokyo) Olympic Games, the international scheme of medical examination of athletes the "Olympic Medical Archives" project, was put into operation. Over 100 male athletes out of 1,000 were found to have a haematocrit of less than 37, the average male value for the general population being 44. It was felt by the members of the Medical Advisory Committee that iron therapy should be given to all female competitors who might be selected for the Mexico City Games, with a view to building up an iron store in each of from 200 to 500 mgms. This could be achieved by a dosage of oral iron of 100 mgms. daily for at least three, but preferably four or five months, but this must be taken conscientiously. There is little difference in effect between the various iron preparations available, but on economic grounds the cheapest are indicated for the majority, the expensive preparations being reserved for those who show idiosynchrony to the commoner forms, and iron dextran injections being used for those who do not respond, or who are selected at the last minute. A schedule of 10 grammes in a hundred days is remembered easily, and is the minimum needed to guarantee adequate iron storage in the majority of competitors.

Administratively, there are problems. There are some 150 "probables" for the endurance events alone in Britain, and if all the "possibles" were to be included, there would be about 600 in these events only. Giving extra iron to anyone whose reserves were already adequate would be completely harmless, and as mentioned before, would not infringe the spirit of the doping recommendations, as levels above normal could not be attained.

Because mild degrees of anaemia are common, even amongst trained athletes, and because these slight degrees of anaemia are likely to affect well-being and physical performance at an altitude of 8,000 feet, it is recommended that all Olympic "Possibles" should take an iron preparation by mouth, about 100 mgms. daily, for at least three months before the Games, not only to correct any iron deficiency in the circulating blood, but also to build up a reserve store likely to be needed when living, training and competing at altitude. It is recommended that this iron be taken for at least two weeks after arrival at altitude, during the four weeks period of acclimatisation necessary.

Amongst the preparations discussed, the following iron compounds are available.

Tabs. Ferrous Sulph., B.P. One, twice daily, or several ethical preparations of this compound.

Tabs. Ferrous Gluconate, B.P. One, twice daily or equivalent ethical compound.

Tabs. Ferrous Succinate, one, twice daily.

Where these tablets are not easily tolerated, capsules of a slow-release iron can be used, but they are costly.

In situations where a long course of oral iron is not feasible, an adequate store, which will last for up to two years, can be given by
administering three intravenous injections of 100 mgms. each time, at weekly or preferably fortnightly intervals. These must be given slowly with a careful intravenous technique. Intramuscular iron is not recommended for athletes.

It would be beneficial if members would interest or even inspire haematologists and pathologists known to them to take an active interest in these problems, by advice, or better still by helping to carry out clinical laboratory investigations upon athletes likely to be subjected to stresses associated with high energy output in an adverse environment.