SOME MEDICAL ASPECTS OF AIR TRAVEL

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Amongst the problems of taking a team away for overseas competition, two problems are of importance; first, circadian rhythms, and second, rapid acclimatisation. Much can be done to adapt to these by the application of common sense, and will enable athletes to adapt more easily to changed circumstances. Similar problems face non-athletic members of the public as well, and recently B.O.A.C. has been concerned to investigate these problems, and to offer advice.

This is, of course, a very recent problem for the general public due to the rapid increase of speed in air travel, and it is interesting to note that it was only in 1955 that Adam in a report to the War Office on physiological problems arising in the Army really brought it forward. When one thinks how long people have been working or changing shifts, one is horrified that the problems have been considered so recently - and further, it is sad to think that there are so few hospital matrons who have ever heard of circadian rhythms.

A preliminary study on paratroops by Adam, Lathan and Wyatt in 1962 led Shepherd and Barlow to recognise that the greatest loss of efficiency might occur during the first three or four days in troops who are moved rapidly by air from a temperate to a tropical climate. They therefore designed a study to investigate the combined effects of flight fatigue and an operational situation on arrival in a jungle climate. 60 paratroops completed a three-day programme of military tasks in the United Kingdom - marching, digging and camouflage, negotiating obstacles on an assault course, weapon handling and shooting - and then they were flown to Singapore 7½ hours time change - where the programme was repeated commencing within five hours of arrival. A clear loss of efficiency was reported in the performance of marching, digging and camouflage, and in shooting skill at Singapore. The obstacle course was performed at the same level of efficiency in Singapore as in England, but the men were more fatigued at the end. Weapon handling tests were completed equally efficiently in both climates, but it was noted that some men performed in Singapore in a vague or dazed manner - surely the efficiency was paratroop training. In general there was an impairment of both the quality and quantity of work in Singapore. Further experiments on paratroops showed that the incidence of heat casualties was higher in field experiments which combined long flights and marches, etc. shortly after arrival.

Adam also found that on arrival in Singapore troops were passing water nocturnally initially, and not during the morning, due to the +7½ hours. Their normal micturition cycle of 6 a.m. to 11 p.m. was now 1.30 p.m. to 6.30 a.m.

Hauty and Adams in 1966 for the Federal Aviation Agency of America carried out tests on volunteers who were admitted to hospital for one week prior to long flights, 8 - 12 days after these flights and for one week after the return flights. East-West flights were from Oklahoma to Manila and return, and Oklahoma to Tokyo and return, West-East from Oklahoma to Rome and return, and North-South from Washington D.C. to Santiago, Chile and return. Healthy volunteers were selected to eliminate possible discrepancies which have arisen from the loss of a night's sleep.

Psychological parameters chosen were a) reaction time including decision time, b) subjective fatigue by a standard check list and c) critical flicker fusion which is believed by some to be an indirect measure of fatigue. The physiological studies were rectal temperature, pulse and respiration rates with palmar evaporative water loss measurements.

The conclusions that could be drawn from this work were as follows:-

- 1) East-West and West-East flights involving rapid transit through several time zones produce a shift in the balance between extrinsic time and physiological time, the effects of which are very marked following outward bound journeys taking up to about four days for complete adaptation, but which return fairly rapidly to normal on arrival back in the familiar time zone.
- 2) Rapid transit across 7 time zones produces a deterioration of behavioural integrity as judged by reaction and decision times for relatively simple tests. This is for about two days in an East-West flight, but slightly longer when West-East. There is only a slight loss in performance on return to the home base.
- 3) Subjective fatigue is very marked on arrival after crossing similar time zones. Again slightly greater West-East. In older people the fatigue effect is greatly increased. The return journey appears to produce little or no fatigue.
- 4) With rectal temperature recordings the peak phase is normally between 1400 and 2000 hours. On West-East flights these recordings were out of phase for 6 days and on East-West for 4 days, but no change in North-South journeys. Circadian periodicity was also revealed by the preflight values plotted for heart rate. After West-East flights it took 8 days to rephase, and after East-West flights 4 days. Again, with North-South there was no change. Respiratory rate did not show a well defined periodicity.
- 5) Flights from North to South or vice versa involving no change in time zone produce subjective fatigue, but no alteration in circadian rhythm or psychological performance.

Any athletic team needs its managers, assistants, the physiotherapists and its medical advisers. For an Olympic exercise this is quite a collection. They are all in the slightly older age group. Whatever the athletes may think at times their presence is most essential and the success of the team depends on them.

Age is of considerable relevance to adaptation both to circadian rhythm upset and to climate and altitude. The Army have said that soldiers deteriorate physically after 26 years of age. Let us be generous and say 30. How many team officials under 30? Star athletes are unlikely to pay much attention to them - they know better, or think they do. They certainly will not pay attention if their advisers do not.

Before going on to the practical side one should mention the basic primary changes which occur with heat acclimatisation.

1. Changes occur in the sweating mechanism in order to increase evaporative loss.
 - a) Sweating onset occurs at a lower body temperature.
 - b) Sweat rate is higher at any given body temperature.
 - c) Greater ability to maintain high sweat rates for longer periods or a reduction in the so called sweat gland fatigue.
2. Changes occur in peripheral circulation in order to improve convective heat transfer from body core to surface.
 - a) An onset of vaso-dilatation at lower body temperature.
 - b) A dilution of the blood.
 - c) The skin blood flow is higher at any body temperature above normal limits.
 - d) The venous tone increases,
3. Changes occur in the body temperature in that a fall occurs in the resting body temperature. Dehydration retards the rate of acclimatisation,

With this acclimatisation the second to fifth days are critical and by the end of the first week there is well over 80% acclimatisation and it is nearly complete in 12 - 14 days.

Fatigue is a predisposing factor to heat illness and so particular care must be taken during the first few days not to become over fatigued.

There are some practical, sensible and easily carried out procedures that can be put into practice to make adaptation easier.

- 1) Where possible a flight should be selected so that arrival time coincides with the usual bedtime. On arrival athletes should go straight to the hotel, eat a light meal if indicated, and go to bed. A light sedative is very useful on the first and second nights after crossing 5 or more time zones, but should not be necessary after two nights.
- 2) Proceeding straight to a meeting or a long reception after arrival is unwise. Further, staying in hotels allows for greater individual freedom for sleeping and eating adaptation rather than in private homes. With small teams going overseas this may be a financial factor (as there will not be a campus) but it is most important.
- 3) Clothing suitable for the climate to which the team are going should be readily available because to be too hot or too cold whilst undergoing physiological adaptation will slow down the process.

Regarding clothing, nylon is entirely non-absorbent and must not be worn in the tropics. It is a guaranteed way to develop prickly heat which, if it occurs, is nearly always in the first few weeks so is an important factor for short-term visitors.

- 4) Regarding suggestions for in-flight problems
- (a) Smoking should be cut out or reduced for at least two days prior to departure. This will help to reduce the heavy smokers' carboxy-haemoglobin levels and so reduce the effect of relative in-flight hypoxia.
 - (b) Alcohol should be kept down to a minimum. It affects adversely both fatigue, recovery and physiological adaptation on arrival.
 - (c) In-flight feeding should be confined to a minimum and then to easily digestible foods. Due to the cabin pressure being equivalent to an altitude 6-7000 feet there is expansion of the intestinal gases and distension occurs, so the alimentary tract must not be overloaded with food, or gaseous drinks like beer or carbonated lemonade. This again applies particularly to those whose abdominal musculature is not as good as it used to be. Remember further that bowel emptying, with the crossing of time zones, can be upset completely and constipation ensue. The carrying of a mild aperient on these occasions can be of great value.
 - (d) The wearing of loose fitting clothing in an aircraft is essential. With the possible distension mentioned above and the venous stasis which occurs on a long flight, this will make the flight far more comfortable. Have slippers in the cabin bags.
 - (e) With the comparatively dry atmosphere of the pressurised cabin (BOAC insert humidifiers) and the tendency not to drink a large amount of fluid, some dehydration occurs during flight so it is advisable to try and maintain one's fluids but not with carbonated drinks.

When the team arrives in a new climate, it will be out of circadian rhythm and perhaps at an altitude. The most important thing of all is to take things quietly during the first four days whilst adjusting physiologically and psychologically.

Athletes should do no active training for at least three days. The best exercise at this time is walking.

To bed early, and sensible feeding during this time are essential. No exotic local dishes should be taken.

Traveller's diarrhoea is a problem, dealt with in another paper (Sperryn) but Professor Kean of Cornell did his original work in Mexico and he felt that the sixth day was critical, and the incidence in Mexico is high.

Maintain fluids in a tropical climate. A practical tip is one pint for every 10°F per 24 hours. See that the urine remains practically colourless - a darkening means not enough. Of course, with violent physical exercise the intake should be greater.

Extra salt is necessary with extra sweating, but the most important thing is not to take extra salt without taking extra fluid. Daily salt intake should be 15 - 25 gms. In Europe, the intake is usually 10 gms so an extra 5 - 15 gms a day must be taken.

Joseph Banks, the distinguished naturalist of the eighteenth century, and who was subsequently President of the Royal Society, accompanied Captain Cook on his first visit to Tahiti. In his writings he described a dinner given by the Tahitians. Everyone was given one half cocoanut shell of ordinary water and one of salted water. The Tahitians obviously had the answer. On taking extra salt they doubled their fluid intake.

Although not necessary in Mexico City one must mention antimalarials. If you take a team to or through a malarious area, antimalarials are essential from the day the team arrive until 28 days after it leaves the area. The daily variety, such as Paludrine, is the best.

As far as altitude is concerned, this was very well covered by L.G.C.E. Pugh at the previous symposium, but here again the most important point is taking it very easily for the first four or five days.

The sun must be treated with great care on arrival, especially by the fair and the redheads. No stripping off in the first four days, and after that only by very carefully graded time dosage.

To recapitulate the most important things:-

- 1) Dress sensibly and eat lightly in the aircraft.
- 2) Go to bed early for the first few days after arrival taking perhaps a mild sedative.
- 3) Watch bowel habits on arrival.
- 4) Do not start intensive training for four days.
- 5) Maintain sufficient fluids and salt.
- 6) Take antimalarials regularly if in or passing through a malarious area.
- 7) Be sensible over local food and especially local drink.
- 8) Be extremely careful with the sun initially.
- 9) Remember officials are older than the athletes and will suffer more. They must set an example.
- 10) Everyone should have their necessary vaccination and TABT inoculations done six months before travelling. They must not be left to the last few weeks. Vaccination is necessary by law, and TABT is absolutely essential for medical reasons.

The Mexico Olympics are timed at the end of a long season. This long season, plus the upset circadian rhythms, plus the sudden change of climate, plus the change in altitude will put a very marked physiological and psychological strain on everyone. Please do abide by medical suggestions which have been put forward by trained observers over the last few years.

References.

- 1) ADAM J.M. (1955) A general review of the physiological problems arising in the Army Report to War Office AMD5.
- 2) ADAM J.M., LATHAM F., & WYATT H.T. (1963) Preliminary observations of the immediate effect of heat on acclimatised paratroops. Army Personnel Research Committee Report No. 61/31 M.R.C. London.
- 3) SHEPHERD R.D. & BARLOW J. (1962) The effects of travel fatigue and tropical conditions on the military efficiency of unacclimatised parachute troops during the first three days. Army Personnel Research Committee Report No. 61/26 M.R.C. London.
- 4) HAUTY G.T. AND ADAMS T. Human Circadian System and Performance in East-West Flight. Aerospace Medicine July 1966 Vol. 37 No. 7 p.668.
- 5) HAUGHTY G.T. AND ADAMS T. Circadian Phase Periodicity in West-East Flight. Aerospace Medicine Oct. 1966 Vol. 37 No. 10 p. 1027.
- 6) HAUTY G.T. AND ADAMS T. Circadian Phase Periodicity in North-South Flight Aerospace Medicine Dec.1966 Vol. 37 No. 12 p. 1259.
- 7) THE "ENDEAVOUR" JOURNAL OF JOSEPH BANKS, F.R.S. 1768-71 Edited by J.C.Beaglehole 1962.