

## **UIAA Mountain Medicine Centre Information Sheet 2**

Intended Distribution: High Altitude Mountaineers  
\*COPYRIGHT UIAA MOUNTAIN MEDICINE CENTRE\*

### **CLIMBING AT EXTREME ALTITUDE ABOVE 7000 METRES**

Expeditions to peaks over 7000m (23,000ft) without supplementary oxygen are now commonplace but information about medical problems and the practical difficulties of survival remains restricted to a few highly experienced mountaineers. It is the purpose of these paragraphs to familiarise climbers with some of the basic problems of existence at extreme altitudes.

#### **The physiological problem**

The amount of oxygen in air decreases linearly with ascent and very approximately there is about half of sea level oxygen present at 5500m (Everest Base Camp in Nepal). This falls to roughly one third at the summit of Everest. It is important to appreciate that the partial pressure of oxygen at the summit of Everest is very close to the limits at which human beings can survive at all. Permanent human habitation ceases - due to lack of oxygen, not terrain - above 5400m. Whilst acclimatised man can survive for several weeks or months at 6000m, deterioration is taking place steadily, by the apparent reversal of the very process of acclimatisation that has enabled ascent possible to these altitudes.

#### **Physical and mental effects on man**

Around 6000m acclimatised climbers may expect to feel well, have reasonable appetites, sleep normally and be capable of carrying loads of 20-25 kilos on easy ground. Ascent rates comparable to those on Alpine routes have been well documented over many years.

Above 7000m, the situation changes: the feeling of tiredness and lethargy increases, continuous exercise becomes impossible and climbing even easy slopes becomes a painstaking, breathless achievement. Despite this, technical climbing of a high standard has been done and heavy loads have been carried at this height, though well under 20 kilos should be aimed at. Ascent rates will vary enormously depending on terrain and the climbers' physiology, but 300-400m a day is a very reasonable achievement.

#### **Deterioration**

Deterioration becomes increasingly apparent after several nights at 7000m. The feeling of tiredness increases and more importantly, appetite falls; even foods that were popular at lower altitudes appear tasteless and unpalatable. Weight loss is profound and lethargy also sets in, adding to the difficulties of cooking, which usually takes many hours even in ideal circumstances. Sleep becomes intermittent and due to the lack of oxygen, the cold is felt more even in the warmest of sleeping bags.

The effects of deterioration become increasingly marked after 4 or 5 days and unless trapped by weather it is advisable not to stay much above 7000m for longer periods. There is little to be gained from attempting to set an altitude duration record by waiting for several days for weather to clear, because it is unlikely that you will have the energy in reserve to make use of it. Recovery from high altitude deterioration is a gradual process that can only take place at altitudes well below 6000m, so base camp should be below or as near 5000m as possible.

#### **Illnesses at extreme altitude**

Any illness at extreme altitude tends to be much more serious than at sea level. Sore throats and persistent coughing are common, a product of the dry air and cold, and notoriously difficult to treat - a silk facemask (worn as continuously as possible) helps by warming and

moistening the air. Inhalations of steam, with or without one of the many proprietary cough linctuses may also help. Any chest infection is potentially dangerous and needs urgent treatment by descent and antibiotics, as it may be impossible to distinguish between an infection and pulmonary oedema. A number of illnesses occur as a result of prolonged exposure to extreme altitude. Blood clots - causing pain in the calf (deep vein thrombosis), pain in the chest (pulmonary embolus), and stroke (a weakness of one arm and leg) are a product of dehydration, changes in blood clotting and extended periods lying still in a sleeping bag.

High Altitude Cerebral Oedema and Pulmonary Oedema, though seen typically between 4000-5500m during acclimatisation, do also occur suddenly at extreme altitudes in well-acclimatised climbers. Cerebral oedema and stroke (e.g. weakness of one side of the body) may come on suddenly and be confused with simple exhaustion, dehydration or hypothermia. Mental changes are frequent - the feeling of apathy is coupled with mood changes, despair or undue elation and sometimes unreasonableness in argument. Recent memory is impaired above 7000m.

It is most important to recognise these effects and to bear in mind that they may be made worse by many depressant drugs, such as sleeping pills - though these seem quite safe at lower altitudes.

#### **Cold, washing, defaecation, boots, frostbite, cooking**

The effects of cold are more pronounced at great heights for a variety of reasons. Firstly, it is colder with a summer night temperature of -25°C common at 7000m. High winds with speeds in excess of 160kph (100 mph) are frequent, and lack of oxygen depresses the body's own heat production. Fourthly, apathy and fatigue contribute to carelessness - you must constantly think about how to keep yourself warm!

Facemasks, one-piece down suits, windproof suits, waterproof/breathable coverings for sleeping bags and clothing have revolutionised the high altitude wardrobe. Advice from well established manufacturers should be sought early in planning, as much of the gear has to be specially made and fitted. Plastic double boots, being extremely light, are the norm at altitude - their one problem is moisture generated by sweating: spare inners and socks, and homemade closed cell foam insoles are worth thinking about. 'Plastic boot disease' (white, discoloured, swollen feet) is difficult to deal with - the only solution is to allow the feet to dry out.

Washing is obviously unheard of but boiling all water (though it only boils at 77°C at 7000m) helps to cut down diarrhoea from bowel infections. Pee bottles (with a funnel for women) are vital (a half litre size is usually adequate, but not always). Defecation is difficult, but various suits with appropriate zips are available: thought should be given to the design of underclothes to make sure they can be used with this system.

Frostbite is usually a product of several factors and it is frequently avoidable. Since one's appreciation of the degree of cold is very poor in temperatures below -15°C, it's worthwhile carrying a miniature plastic encased thermometer (they weigh only a few grams). The treatment of serious, established frostbite is dealt with in sheet 10, but descent is essential. The occurrence of frostbite almost always means the end of any serious climbing for the victim on the current expedition and much extra work for colleagues. Drugs are of little use.

Cooking is a boring and time-consuming chore: reliable stoves are vital and although Primus, MSR or other liquid fuel stoves work well at extreme altitude they require care in operation and are fiddly to maintain. Butane-propane mix stoves are quick, easy to use and safer, but problems with fuel availability are sometimes encountered.

Unfortunately, no one has yet designed a palatable high altitude diet: dehydrated food is usually rejected after a few days, and despite its weight I favour a wide variety of foil packed ready cooked meals which require heating only. Vegetarian foods - porridge, pasta, cooked rice, tsampa (ground roast barley) cheese, dahl or beans - are popular in contrast to high calorie fatty meats such as smoked ham, salamis and the tinned meats that are popular at

lower altitudes. There is such wide variation between individuals that no firm rules can be made. Ask everyone well in advance what they think they would like and in any case provide ample quantities of fuel for snow melts and ample sugar: an ideal fluid intake of 3 litres or more per man per day should be aimed at. The only real nutrition issues are fluids and calories.

### **Tents and snowholes**

Modern tents have revolutionised high altitude camping. Specially designed box tents have also added to the repertoire of those trying to solve the high altitude accommodation problem, but they are heavy. Snow holes, coffins and igloos provide shelter from wind, noise and snow and are often preferable.

### **Oxygen equipment**

The decision to climb an 8000+m peak without bottled oxygen is a personal one. Be aware that at 8000m you are near man's physiological limits and that simple factors such as minor illness, a change in the weather (depressing atmospheric pressure further) and intense cold will each limit further the amount of oxygen available in your lungs, muscles and your brain.

### **Drugs and "? brain damage"**

No drugs have shown to be of use in preventing the deterioration that occurs at extreme altitudes. Diamox (acetazolamide), which is useful in the prevention of AMS at 4000-5500m, has not been shown to alter performance above 7000 metres. Despite some popular opinion, vitamin E, garlic, marijuana or alcohol are not known to help or hinder, unless excess of the latter two are taken (a hindrance rather than help!). Amphetamines and other stimulants are strongly discouraged.

Certain drugs should be used with great caution at extreme altitudes - sleeping pills, short acting ones such as temazepam are quite widely used and useful but they can give a nasty hangover or episodes of confusion, so do not take them for the first time the night before you set out for a summit! Temazepam does not however cause or exacerbate AMS during acclimatisation (there was a suspicion that it might). Women should not, on theoretical grounds at least, take a contraceptive pill at extreme altitude (further details on sheet 11).

The possible long-term effects of climbing at extreme high altitude have attracted much publicity. Whilst severe lack of oxygen undoubtedly causes damage to the nerve cells in the brain, there is no clinical evidence of "brain damage" or intellectual impairment in the many climbers who have spent time over 7000 metres. The main danger in climbing the highest peaks in the world lies in death by accident, or unrecognised illness - usually a combination of the snow conditions, cold and the effects of lack of oxygen.

### **Conclusions**

There is no way to prevent completely the ill effects of extreme altitudes. The rules are:-

- To be well acclimatised to around 6500m.
- To keep well hydrated by drinking over 3 litres per day.
- To stay above 7000m for as short a time as possible.
- To think about the effects of wind/cold and make camps and caves as snug as possible.
- To descend if unwell even with apparently minor illness.
- To take rest periods as low as possible, certainly below 5500 metres.

Updated October 2002 by Dr Charles Clarke FRCP

© UIAA Mountain Medicine Centre