Leading Article

Acute mountain sickness

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Acute mountain sickness (AMS) is a clinical syndrome occurring in otherwise healthy normal individuals who ascend rapidly to high altitude. Symptoms develop over a period of a few hours or days. The usual symptoms include headache, anorexia, nausea, vomiting, lethargy, unsteadiness of gait, undue dyspnoea on moderate exertion and interrupted sleep. AMS is unrelated to physical fitness, sex or age except that young children over two years of age are unduly susceptible. One of the striking features of AMS is the wide variation in individual susceptibility which is to some extent consistent. Some subjects never experience symptoms at any altitude while others have repeated attacks on ascending to quite modest altitudes.

Rapid ascent to altitudes of 2500 to 3000 m will produce symptoms in some subjects while after ascent over 2–3 days to 5000 m most subjects will be affected, some to a marked degree. In general, the more rapid the ascent, the higher the altitude reached and the greater the physical exertion involved, the more severe AMS will be. If the subjects stay at the altitude reached there is a tendency for acclimatization to occur and symptoms to remit over 1–7 days.

High altitude pulmonary and cerebral oedema

The typical form of AMS described above can be troublesome but is not dangerous. In a few subjects however, at altitudes over 4000 m it progresses unpredictably, sometimes after relatively minor preliminary symptoms, to one of two potentially fatal forms. Probably the more common of the two is high altitude pulmonary oedema¹ with typical features of orthopnoea, paroxysmal nocturnal dyspnoea, cough, frothy sputum and lung crackles but without definite abnormal cardiac signs. These typical features may be misdiagnosed as pneumonia which, however, may sometimes be present as an aggravating factor. The

other form is high altitude cerebral oedema² causing mental disturbance, ataxia, severe headache, drowsiness, stupor and coma.

Other effects of high altitude

A stay of a few days at high altitude is likely to ameliorate the symptoms of AMS as acclimatization occurs. However, the accompanying improvement in exercise performance is accompanied by remarkably rapid adverse changes of other kinds of which the best known is loss of weight. This is due to the loss of fat and of muscle and, if the high altitude stay is prolonged, by eventual loss of exercise performance of particular significance to mountaineers. The cause of these weight changes is obscure. Small intestinal malabsorption has not been found at altitudes up to about 5000 m³ but has been shown to occur at higher altitudes.⁴

Aetiology and pathology of AMS

The features of AMS correlate with the degree of hypoxia, particularly during sleep. It is probable that the incidence and severity of AMS are related more to the altitude at which an individual sleeps than to the altitude reached during the day.⁵ Also, the worsening of symptoms at night follows significant reduction in arterial oxygen tension⁶ related perhaps to extended periods of apnoea.

The ventilatory response to hypoxia has been studied extensively.⁷ It varies considerably between individuals and this may be the basis of the variation in individual susceptibility to AMS noted above. Hypoxia causes changes in tissue function or eventually tissue damage and it is proposed that capillary dysfunction could account for the features of both the mild and severe forms of AMS. Direct evidence of this has not been obtained but glomerular capillary permeability for albumin is increased,⁸ capillary fragility increases⁹ and retinal haemorrhages occur.¹⁰

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Prevention and therapy

With an increasing number of people going to moderate and high altitudes for business and pleasure the need for preventive measures has become obvious and good advice is now available. Most of the problems can be avoided or much diminished by following the system of slow ascent, i.e. less than 300 m a day over 2500 m and less than 150 m a day over 4500 m. It is prudent also to spend days at intermediate altitudes or sleep low but climb high. Unfortunately such routines are not always practical.

AMS can nearly always be relieved by rapid descent. The mild case can be treated by staying at the same altitude until acclimatization occurs. For the severe case descent is mandatory but sometimes the progress of the illness is so rapid that even this does not prevent a fatal outcome. Oxygen therapy, if available, causes a dramatic improvement but what is required is a simpler method of improving oxygenation.

Acetazolamide

It has been shown by double-blind randomized trials that carbonic anhydrase inhibitors such as acetazolamide given prophylactically reduce the severity of AMS.¹¹ The drugs appear to improve the ventilatory response to hypoxia via their effect of producing a relative acidosis – the net effect is to

improve Pa, O_2 . An interesting effect of acute acetazolamide is to increase cerebral blood flow¹² which suggests another mechanism whereby the severity of AMS might be reduced. Whether acetazolamide impairs acclimatization at high altitude remains uncertain although Milles *et al.*¹³ have reported no deterioration in blood gases over 5 days in these circumstances. Acetazolamide appears also to reduce the muscle loss associated with sojourn at high altitude.¹⁴

Comment

There has been rapidly increasing interest in these topics of recent years as indicated by the rising number of related scientific publications. The Birmingham Medical Research Expeditionary Society convened a symposium at the University of Birmingham on 20 September, 1985 at which some of their recent studies, accompanied by papers from other workers, were presented. The following papers and abstracts are the proceedings of that symposium.

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