Cerebral Oedema at High Altitude

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SUMMARY: The case of a climber who developed cerebral oedema at high altitude in Peru is described. The diagnosis and evacuation are discussed.

Introduction
In the summer of 1986 thirteen men of an Army Mountaincaming Association expedition were gaining high altitude climbing experience in the Huascarán region of Peru. The aim for all members of the expedition was to climb Mount Alpamayo (19,700ft) which has the reputation of being the most beautiful mountain in the world (Fig 1); all available peaks were, however, to be attempted and at the time of the incident the team was also climbing Mount Artesonraju and using a common base camp (Fig 2).

All the members of the expedition had acclimatised well. The patient's condition and the means of evacuation will be outlined separately.

The Patient's Condition
The patient was 32 years old, very fit, in good health and had no significant past medical history. He had never climbed higher than Mont Blanc (16,000ft) before the expedition, although one week prior to the incident he had climbed to 18,000ft with no evident problems; indeed, 2 days before the incident he was seen by the author at 13,000ft and was in the best of health.

From there he moved to 16,000ft (snowline) and the following day to 18,500ft (col). The summit bid started early the next morning. At 19,000ft the patient had a sudden onset of severe occipital headache and became weak. He proceeded to the summit (19,700ft) but during the descent experienced increasing difficulties, especially with his co-ordination, and finally collapsed near the camp at the col.

He was examined shortly afterwards and it was noted that he was complaining of a severe headache and neck stiffness, and that he displayed severe ataxia, fluctuating consciousness and dysarthria; he also appeared to be developing a hemiplegia. A provisional diagnosis of cerebral oedema compounded by a subarachnoid haemorrhage was made and a policy of analgesia, rehydration and rapid descent was instituted.

Thirty minutes later, after descending about 1,000ft, the patient was pulseless and unresponsive but descent was continued and after descending 2,500ft to the night's resting place his condition had improved although he was still critically ill. After resting at 16,000ft overnight the patient was a good deal improved; in particular his hemiplegia was resolving and he passed urine. During the day, however, after a further 3,000ft drop in altitude to 13,000ft, he was still severely dysarthric and ataxic and his meningism had improved only slightly. Further descent to 11,000ft the following morning saw more improvement in his general condition. During temporary elevation to 14,000ft later that day, however, the patient again became transiently pulseless and unresponsive but recovered on subsequent descent to sea-level.

One week after the onset of his condition the patient was able to travel back to UK, his meningism having resolved. Subsequently he made an uneventful recovery, and 3 months later he was fully fit.

The Evacuation
The differential diagnosis included subarachnoid haemorrhage and cerebral oedema. If the correct diagnosis was the former, then moving the patient might

Figure 1. Mount Alpamayo as seen from its col.
have made his condition worse. It was considered, however, that his main problem was cerebral oedema from acute mountain sickness and therefore the overall aim was to reach sea-level as soon as possible. The immediate problem concerned descent to 11,000ft to Cashapampa where the possibility of transport existed (Fig 3). Two members of the expedition were dispatched immediately to arrange this.

From the summit to his final collapse the patient had been considerably assisted by his climbing partner. The descent from the col down to the snowline consisted of snow-slopes ranging from 70 degrees to easier snow plods. As descent was imperative and there was no stretcher at that location the patient was carried down; this was achieved by one person carrying him, the pair being belayed from above. The magnitude of this achievement – to carry an 80kg man down 2,500ft by torch-light at that altitude – cannot be over-emphasised.

The party was forced to stop at the snow-line that night as descent from there to our advanced base camp at 13,500ft involved a treacherous scree slope. To continue in darkness down the hazardous slope in freezing conditions would have been extremely dangerous both to the patient and to the rescue party. It was felt by the author that the patient might not survive overnight, and the team was briefed accordingly.

By the next morning, however, he had improved and, in particular, the hemiplegia had almost completely resolved. He passed urine which was felt to indicate that his transient hypotension had not precipitated acute renal failure, and therefore his main problem was meningism which was so severe that he had to be completely blindfolded. The use of a stretcher at this stage was again raised. There were about 10 hours of daylight available in which to cover 12km in order to achieve a 3,000ft drop in altitude, and, on account of the number of people needed to manage a stretcher, it was felt that this would be very difficult. As the patient was able to stand and move his legs it was decided to move him by supporting him in a harness, blindfolding him, and telling him where to put his feet. In this way a drop of 2,500ft was achieved in 2 hours.

There then followed the prospect of a long trek to the overnight resting place. The patient was by now exhausted and could not walk at all. Descent was still imperative and yet the team would have been able to make very slow progress by stretcher. It may seem to the reader that the next decision – to put a casualty who had cerebral oedema and meningism onto a mule – was unkind, but there was little option as it was essential that the lowest possible altitude at which to rest that night was achieved. The patient was therefore sedated, his

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Figure 2. Peruvian Andes, Huscaran Region
The rate of ascent to altitude is a major determinant of both incidence and severity of AMS. Other factors include age (the younger being slightly more susceptible), previous history of AMS, and probably the level of exertion at altitude. Cold and dehydration may play a part. The sex distribution is equal with respect to AMS. At present there is no proven way to determine susceptibility to mountain sickness prior to exposure to altitude. The patient’s physical condition was thoroughly investigated under specialist care in Peru and on return to the United Kingdom. In Peru, full blood count, erythrocyte sedimentation rate, plasma urea and electrolytes, and liver function tests were all normal, as was a cerebral CAT scan. In UK all of the above remained normal and an examination of cerebro-spinal fluid was also normal. It seems likely that the diagnosis was cerebral oedema complicated by a small mid-brain haemorrhage. The reason that he was transiently pulseless and unresponsive was presumably that he was coning. The differential diagnosis is of course long. The conditions for clinical assessment were not ideal but the basic observations that he was hemiplegic, dysarthric and ataxic with severe meningism remain.

The fact that he was pulseless and unresponsive would exclude migraine and his very rapid recovery on descent in very adverse conditions would tend to exclude meningitis, subarachnoid haemorrhage or cerebral thrombosis, although 6 months after return to UK he did suffer an attack of viral meningitis. The fact that his condition rapidly deteriorated on regaining height during the helicopter flight would support the diagnosis of cerebral oedema or a cerebral arterio-venous malformation. The latter has been excluded, although it is accepted that uncomplicated acute cerebral oedema from acute mountain sickness does not usually produce neck stiffness.

The most important point to be made in this report is that patients with altitude sickness manifesting as cerebral oedema need rapid descent and rehydration. People with cerebral oedema who are rested at altitude do not recover and usually die. The aim is to evacuate the patient to 10,000ft initially and then to sea-level. In this case unconventional means were used, but in terms of the patient’s survival, they worked. If, for example, the team had waited for a stretcher at the col, the patient might well have died.

The evacuation of casualties in such circumstances is not dissimilar to a military operation, and the requirements for success overlap to a large extent. Firstly, there must be adequate training. Several members of the expedition were experienced Alpine and Himalayan mountaineers and without their expertise it would not have been possible to evacuate the patient from the summit to the col, and from there to the advanced base camp.

Secondly, rehearsal is essential. In the context of casualty evacuation this is difficult to achieve as every...

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**Figure 3. Diagram to illustrate the evacuation in relation to altitude.**

The diagram shows the evacuation route from Alpamayo to Chimbote, with various altitudes and key locations marked. The route includes a steep mountain drop from 14,000ft to 11,000ft by midday the following morning, with possible methods of further evacuation discussed.
situation is different but in this case four members of the expedition had previously been involved in evacuations, and their help and advice were invaluable.

Thirdly, clear decisions must be made. Those directly concerning the medical state of the patient are made by the doctor who should remain separate from the organisation of the evacuation itself.

And lastly, an element of luck is necessary. In retrospect, many seemingly trivial events could have seriously jeopardised the evacuation, and, indeed, there was a considerable element of luck in the fact that the helicopter found the team when it did – it was flagged down by members of the expedition in a village square having “hedge-hopped” the mountain village looking for us!

Conclusion

Only one important question remains. Should the subject be allowed to return to high altitude? Medical opinion is divided. Persons having recovered from any degree of acute mountain sickness can usually reascend, as long as the ascent is done slowly and cautiously\(^3\).

Fortunately in this case the question is purely academic as his wife has sold his climbing kit.

REFERENCES


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