Altitude Associated Conditions In Sports

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Introduction

Sir Edmund Hillary summited Mount Everest (8848m), the highest mountain in the world on 24th May 1953. He climbed via the south route in Nepal. However 29 years earlier, in 1924 George Mallory, a British climber was seen via binoculars from Tibet Base Camp almost reaching the summit when suddenly a mist of cloud enshrouded him. He was not seen nor found until 75 years later when a group of Chinese Everest climbers found his body in pristine condition near the mountain top. Nobody knew whether he fell before or after summiting Death and injuries due to trauma, hypothermia and hypoxia-related illnesses on high altitude form the risks that climbers face. In 1922, Dr Arthur Wakeland at the age of 46 became an expedition doctor functioning at North Col of Mount Everest for George Mallory's team and was described as a wise and caring physician. To date, many doctors have participated in mountain climbs as expedition doctors. [1]

Medical Challenges at High Altitude

At high altitude, medical emergency services is non-existent beyond levels where life is incompatible to human function. At a height of 5300 metres, the Himalayan Rescue Association clinic is probably the highest altitude where a running medical clinic functions during the months of Everest summit attempts- manned by volunteer doctors. Equipments are limited. Doctors cannot expect to have full range of medical supplies nor ambulances apart rom rescue helicopters which could only fly at a level with enough air to lift the rotor blades. Having own expedition doctor in each team is ideal but then again the doctor must be conversant in high altitude emergencies as well as have basic drugs and medical equipments to function effectively. Unfortunately even doctors suffer from Acute Mountain Sicknesses as they too are human.

High Altitude Medical Risks

Among the medical risks in mountain medicine are trauma from fall, acute Mountain Sickness (AMS), high altitude cerebral oedema (HACE), high altitude pulmonary edema (HAPE), snowblind, high altitude retinal hemorrhage (HARH), hypothermia, frostbites, avalanche bury and cold storms. [2,3]

Hypoxia as the root cause of medical emergencies (pathophysiology)

The root cause of most high altitude illnesses is hypoxia. It is postulated that a response towards hypoxia detected following low oxygen pressure at high altitude, the respiratory rate increases causing respiratory alkalosis initially which in turn later slows down respiratory rate and worsens hypoxic state. In hypoxic state, vasodilation occurs throughout the body. In the brain, vasodilation due to hypoxia causes headache and in severe state, vomiting as the intracranial pressure increases. Contrary to the rest of the body, the lung vessels vasoconstricts during hypoxia and this causes pulmonary hypertension and in severe state causes a state of non-cardiogenic pulmonary edema or better known as high altitude pulmonary edema (HAPE). This is facilitated by increased vessles permeability in hypoxia with the production of bradykinin. Dehyration during the climb also causes activation of renin-

angiotensin-aldosterone system which increases production of aldosterone, increasing sodium resorption and water into blood vessels. Both vasodilation and increased water resorption also contribute towards increased capillary pressure and in severe cases is thought to be the cause of high altitude retinal hemorrhage whereby patients may suffer painless vision defects and in severe cause, blindness which can only be reversed naturally in a few months. Severely painful snowblind may occur following the burn of keratoconjunctiva by poorly filtrated bright ultraviolet lights reflected from snow owing to thin air at high altitude. Patients suffering this will be 'blind' between 48-72 hours. Hypothermia, depending on its severity could cause a range of symptoms from frostnip to frostbite.

Increased Risks (hypoxia/circulation problems)

On high altitude, apart from hypoxia, physiological response would include increased erythropoietin production and hence heightened plasma viscocity. These will increase the risk of developing acute coronary syndrome and cerebrovascular accidents. [4]

Beware of the Mimickers

At high altitude, a person with HACE may suffer from altered mental status, hallucination, headache and vomiting apart from ataxia and sleeplessness. However there are cases of either ischemic or hemorrhagic cerebrovascular accident appearing with similar HACE symptoms. As for HACE, in one case report, a climber was thought to have asthma following shortness of breath but turn out to have HAPE and died the next day.

Preventive Mountain Medicine

A climber should ideally wear a a good sunglass with ultraviolet protection to avoid snowblind. Good 'goose feather' downjacket and sleeping bag will prevent hypothermia. The best approach is to apply preventive high altitude illnesses by climbing up slowly and allow acclimatization to take place. Usually AMS develops beyond the level of 3000 metres. Beyond this level, a climber should not go beyond 300m per day and to spend 2 nights in the same place every 1000m ascent. The word of wisdom is "climb high, sleep low". This allows acclimatization, which physiologically means the ability of kidney to adapt to hypoxia by excreting more alkalic sodium bicarbonate rendering the plasma to be in a state of metabolic acidosis. In this state, the respiratory system responds by increasing the respiratory rate and depth which in turn draws more oxygen into the lung and compensates hypoxic state. Without acclimatization, drug such as acetazolamide can be used to achieve the same effect as the side effect of taking this diuretic antihypertensive drug is that it causes the body to be in a state of metabolic acidosis and yields the similar effect of acclimatization.[5] However,once started the drug should be continued for at least 72 hours so that the body could acclimatize in time. In 2007, one expedition doctor having suffered from AMS at a level of 3000 metres at Namchee Bazaar in Nepal took acetazolamide and felt relieved. However upon ascent to a level of 4200 metres, he suffered severe AMS and required steroids and strong analgesia to relieve the symptoms. Swimming or snorkeling activities before climbing helps to increase total lung capacity and oxygen reserve could also prevent AMS.

Medical Emergencies on the Mountain

It is very important to establish a ‘safety network ‘ on the mountains. The Himalayan Rescue Association provides evacuation assistance. It is good to establish goodwill and working relationship with expedition doctors from other climbing parties. Expertise, drugs and equipments could be shared in many cases. Insurance is crucial as evacuation cost is very high. Telemedicine practice whereby doctors at base camp instruct medications to be taken for climbers via satellite phones or walkie talkie serves as a ‘safety net’ for climbers in need but basic drugs should be carried with climbers. Climbers too need to have basic knowledge on high altitude illnesses symptoms. Basic drugs with labels on drug use will be of great help as at high altitude, without doctors or communication with base camp, the climbers themselves need to be able to take the right medicine. ‘ During a Tibet Everest attempt by Malaysian climbers in 2011, a Mongolian climber was left to dead. Malaysian climbers gave medicine to her based on what was written on the drug sticker prepared by the expedition doctor. The Mongolian recovered and later managed to climb down and hailed as a heroine by her countrymen upon her return.

Case Illustrations on the Mountain

In this paper, I shall describe the symptoms and management of the following cases which I encountered while working as an expedition doctor with take homes messages as below :

Case 1 : a young and fit man climbing fast is prone to get AMS
Case 2 : a doctor developed severe AMS despite taking acetazolamide prophylaxis
Case 3 : eye emergencies comparing between painful and painless eye defects
Case 4 : altered mental status is not necessarily a HACE
Case 5 : frostnip and frostbite
Case 6 : stroke on Mountain
Case 7 : acute coronary syndrome on the Mountain

The Future

Well equipped Base Camp clinics need to be established with access to helicopter landing area. Expedition doctors need to be trained in recognizing high altitude emergencies and providing accurate treatments. Smartphone applications such as one that could diagnose AMS using Lake Louis scoring may be developed along with other medical emergencies and treatment as these will be useful for climbers without expedition doctors. There is a great potential for use of portable pocket ultrasound as diagnosis of HAPE, HACE and acute coronary syndrome can be made using these.

Conclusion

High Altitude Emergency Medicine common illnesses should be understood by expedition doctors. Vital decisions depend on doctor’s assessment to save money and lives. Well equipped static base camp is essential. Preventive medicine should be applied. Climbers themselves should be trained to recognize relevant common emergency symptoms be guided by expedition doctors to self-medicate in absence of communication with clear written instructions.

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