MOUNTAIN RESCUE INJURIES AND EXPOSURE

by

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A proportion (approx. 10%) of mountain accidents are immediately fatal and provide search and recovery problems which do not concern us here. It is the special difficulties which accompany the successful salvage of those who do not fall into that category that we are going to consider today. Accidental injury occurring on a mountain requires the application of first aid under the same principles and will eventually receive the same final treatment as it would if it occurs at home or on the public highway. The site and environment of the accident will, however, profoundly modify the application of these principles which consist of:- first, ensure the safety of the injured person and the prevention of further injuries; second, recognise the nature and severity of the injuries; third, prevent further shock by insulation by all means possible against heat loss and by gentle handling; fourth, arrange proper treatment quickly and lastly evacuate to a safe place for further treatment. The essence of successful treatment is speed in the performance of these tasks.

This outline of the needs of first aid will make it apparent that only the first two and perhaps in part the third can be followed out immediately after a mountain accident unless it has occurred at an unusually accessible site, in good weather and to a strong and well equipped party. It is difficult for those who have no experience of Scottish mountains to appreciate that a scene of tranquil beauty can even in summer by a change of weather become within a few hours full of menace to the untrained or ill-equipped. In winter or early spring the conditions may vary even more widely from sunbathing conditions to Arctic severity, depending entirely on the air temperature, the cloud cover and the wind force at the time.

It will be understood, therefore, that apart from the effects of the injury itself there are the additional hazards related directly to the remoteness of the site, the difficulties of the terrain and the state of the weather and fitness of the party at the time.

Of the various injuries which may occur fractured limbs are most frequent with head injuries a close second.

The other important lesson is that only a proportion of cases can safely be evacuated under their own power and more than half of them require to be carried off the hill. It is not proposed to detail the treatment which each injury should

receive at the scene of the accident, that information can be found in the various publications special to mountaineering which are listed in the references. There are, however, one or two points which should be discussed further. The first is that to ensure the safety of the injured it is essential to belay or tie him to a rock spike or other fixture to prevent him sustaining a further fall or wandering off while irrational. This is specially necessary in head injuries. The second is to provide protection from the weather by a wind break of stone or fir boughs, by making a snow hole or by pitching a tent if available. The aim is to reduce to a minimum, the heat loss from the injured by this protection from wind and rain. Finally the site must be clearly marked by cross-bearings and/or a marker and a back bearing taken of the route away from the place so that a rapid and accurate return can be made to the spot since in circumstances like this time is vital and there is none to spare.

There are one or two details of first aid treatment which relate to the care of the individual unconscious through a head injury, exhaustion or exposure that are of sufficient importance to mention. These people are in great danger of asphyxia due to an obstructed airway or inhaled secretions or from anoxia caused by severe restriction of the respiratory excursion due to injury of the thoracic cage or exhaustion.

The severe ill effects of these conditions can be somewhat reduced by placing the individual well over on one or other side with head partly extended and if possible slightly lower than the body. This is a difficult position in which to secure a person on to a stretcher for portage without constricting their respiratory movements. If an airway is available it may be inserted in an unconscious patient; if not the jaw should be so placed that the air passages are clear. The carry should be undertaken with the head of the stretcher lower than the feet by a few inches if the ground will permit this and periodic clearances of secretions from the mouth undertaken. It is debatable whether a respirator of the "minuteman" type is of practical value in mountain accidents.

If, however, the rescue team was large enough and sufficiently trained in its use; if the ground was suitable and the hose provided was of sufficient length to permit the apparatus to be carried by one bearer walking alongside the stretcher it may have a place in the treatment of severe exhaustion or exposure during a long evacuation to base.

At present there is no experience of this kind within my knowledge but there are theoretical considerations in its favour.

Three parties of four people have died from exposure in Scottish hills since 1946. These occurrences have taken place in 1951, Ben Alder, 1956, Ben Nevis, 1959 Glen Clova, in December or January in each case and one party was very

well equipped and experienced. A fourth party of similar size escaped the same fate on the Cairngorm plateau in 1961 through the good luck which led some of them to a skiiers tent in the blizzard. These incidents all took place in very severe weather with blizzard conditions. It was not until the Four Inns tragedy of this spring when three competitors died of exposure that it was realised that this danger existed in less severe conditions. Since 1951 exposure, its prevention and treatment have been very much in the minds of those interested in mountain rescue in Scotland and several articles on different aspects of the subject have appeared in the Journal of the Scottish Mountaineering Club but an enquiry sponsored by the Outward Bound Trust and conducted by a strong team made a scientific study of the practical problems in 1963 and have put its treatment on a proper basis.

Exposure is hypothermia caused by excessive surface cooling of the body. The effect of this is to lower deep body heat from the normal figure 36° C by several degrees. At 30°-33°C muscles go rigid and the heart is affected at 26°C, death supervening soon after when the temperature has fallen to figures given as between 20°-24°C. The causes may lie in the environment or be related to the individual. Those in the environment are air temperature, wind force and rainfall. In the Four Inns race the air temperature was between 1-4°C, there was strong wind and heavy rain fell much of the time. In most of the Scottish cases the weather has been Arctic in severity with winds of gale force, temperatures well below freezing point and snow. The causes related to the individual are insufficient or incorrect clothing, inadequate intake of food and lack of physical training and conditioning to cold. These add up to failure of insulation against heat loss at the body surface, insufficient thermal output to make up this heat loss and provide the energy for locomotion, early onset of fatigue and the tendency to fall asleep called "cold exhaustion". If there is in addition emotional stress these factors will operate more rapidly.

The symptoms and signs are first a complaint of coldness and tiredness, this is an indication that more fuel is required either with or without a rest: physical and mental lethargy, irrational behaviour, failure of vision and slurring of speech are signs of cerebral anoxia and are indications of a lowering of internal temperature, shivering fits and violent bursts of energy are attempts to raise the core heat by extra muscular work and the occurrence of falling is an indication that a serious drop in internal temperature has occurred and the end is not far.

The treatment is rest, shelter, and refuel. This is done by seeking shelter from the wind in a bivonac sac, small tent, behind walls or rocks or in a snow hole and taking in food of easily digestible kind, such as bread, butter and much jam or honey, with hot soup. The individual sufferer if showing evidence of severe

exposure must be prevented from further heat loss by insulating with extra dry clothing, by placing in a sleeping sack or casualty bag if available with a fit companion lying alongside or if possible in the sack with him. If respiration ceases mouth to mouth artificial respiration should be employed until breathing is restored. The sufferer must be carried back to base and on no account allowed to walk; when he arrives there usually some hours later he should be put in a hot bath 113°F (45°C) and kept in a hot room at 70°F until he is warmed up. At no time should local heat be applied to limbs or body by rubbing or hot water bottles and alcohol should never be given. There is experimental evidence that large doses of ascorbic acid 1 - 2 gm. given either orally as the effervescent tablet in water or by injection could be helpful.

It will be realised from this description of the treatment that it requires highly civilised conditions at the base for its administration. It must also be remembered that when collapse occurs unless effective measures can be quickly applied death will take place rapidly possibly in less than an hour in an exhausted man. The nature of the terrain and the type of weather in which these incidents occur preclude the use of mechanised transport or helicopters in all but a tiny proportion of incidents and this coupled with the fact that it affects younger people first and most severely make it essential to develop and publicise the means by which it can be prevented or mitigated in severity.

The prevention of exposure lies in the relationship between the individual and his equipment and the environment; if he is well trained, tough, is equipped with suitable clothing and adequate food and has the knowledge required to cope with the environment as it presents to him the result is safety. On the other hand if he is untrained and young, inadequately clad and has insufficient or improper food he will certainly succumb if the environment turns harsh.

The clothing must be designed to prevent heat loss from the body surface. This occurs most rapidly from the abdomen, loins and the great muscle masses in the thighs as well as from the scalp. The lightest and most efficient insulating material is air of low moisture content trapped in layers among the clothing. This is effected by string vests and trunks covered by a number of layers of loose and light woollen garments; the outer layer must be windproof with an anorak hood and secured at wrist and knee. Two or three pairs of socks are worn inside the boots and woollen fingerless mittens, gloves and windproof overmittens protect the hands with a balaclava helmet and goggles to shelter head and eyes.

Thus the ears, fingers and toes are protected from frost bite. The face should be at least partly exposed as it is the body's thermostat.

Easily digested food of high calorie value should be carried on a scale

of 4000 calories per man day with some means of providing hot fluid or food, preferably a light butane gas stove and matches in water proof container. In wet cold conditions some light plastic waterproof cover or cape should be provided to keep the rucksack and the individual dry since the former greatly increases in weight when wet and the latter will lose heat and morale more rapidly from the same cause. An ice axe and nailed boots or crampons are essential equipment in winter and the axe can be a useful aid on steep grass slopes in summer. In the shelterless conditions of parts of the Scottish highlands a bivonac sheet or mountain tent may prevent loss of life when the snow is unsuitable for snow holes and material to construct a windbreak is not available since they may be used to provide shelter in the lee of a boulder or in a small fold in the ground where a pocket of dead air exists under the wind. The aim of the equipment and clothing is to keep its user dry and warm in severe conditions but it is the individual himself that is the important factor.

Survival in severe conditions requires of the individual a tough mental attitude that does not despair easily, unflappable judgement able to assess coolly the relationship of his party, the environment and the weather and know when to seek shelter where he can and when to carry on. He must have the physical fitness which makes exhaustion unlikely and be free of disorders such as diabetes mellitus, heart disease or epilepsy and he must be fully acclimatised to cold and exposure to wet conditions. In this age of centrally heated dwellings and work places and motor cars this means that youths in their late teens but not before should undergo hard training by long walks in all weathers for man as a species does not acclimatise easily to a cold environment and only in this way can habituation to severe conditions be acquired.

As this talk has proceeded you may have felt that too much time has been spent on technical details but you may also have noticed some similarity between exposure and adrenal exhaustion and for the remainder of my time I propose to enlarge on this aspect and its relation with training. It is accepted that the adrenal cortex is responsible for the ability of the body to cope with conditions of stress and it is known that sudden short stresses deplete the adrenal cortex of lipids and of ascorbic acid, these changes being associated with increased secretion of corticoids. It is also known that the recovery from episodes of severe stress is associated with hypertrophy of this part of the suprarenal glands and that the following clinical conditions cause secretion of adrenal corticoids:- viz. muscular exercise, external heat or cold, haemorrhage, trauma and anoxia. These facts when correlated in this way lead reasonably to the assumption that if any one or more of these factors is experienced to a severe degree the recovery will be followed by a greater protection to further trauma of the same or related type.

There is experimental evidence that this protection may be considerable.

Ungar (1943) in a series of observations on the effects of trauma on rabbits, mice and guinea pigs showed that the mortality of a standard trauma carried a seasonal variation as wide as 44% in August to 100% in December and January; that previous trauma reduced the mortality in these months from 100% to 12.5% and that this protection was serum transmissable not only to other animals of the same species but from rabbits to guinea pigs. He also showed that the injection of ascorbic acid in large doses (100.500 mgm. per kilo) within fifteen minutes of the trauma made a similar and in one species (guinea pigs) a more marked reduction in the mortality rate. This effect was also noted after the injection of nupercaine (4mgm. per kilo). As well as demonstrating the protective value of a previous trauma this series of experiments shows that the provision of large quantities of ascorbic acid are even more efficient in providing this protection. They would seem, therefore, to suggest a possible clinical function for the large quantity of ascorbic acid which is present in the adrenal cortex.

In the Four Inns competition this year 240 started, 22 finished; there were 5 cases of severe exhaustion of whom 2 were collapsed as well as 3 deaths from exposure. These youngsters were all fit but lightly clad for the weather and with little food, could it be that such a large number failed to cover the course because the diet in general consumption today contains fruit and vegetables tinned rather than fresh and cooked as they often are by methods not designed to conserve ascorbic acid. May the diet of many youngsters today in fact contain just enough ascorbic acid to prevent scurvy but insufficient to store in the adrenal cortex an adequate supply to cover the needs of growth and provide a reserve for protection against incidents of severe stress such as this race.

Training for any sport be it mountaineering with its background danger of trauma and exposure or other activities involving severe muscular effort is a means of conditioning the body to undertake physical tasks of a graded increase in severity and to be effective it must traumatise a little. It was not by chance that Lochaber was chosen as the training area for the Commandoes during the Second World War. It would seem to me that observations made before, during and after a period of intensive training on adrenal function on subjects in their late teens and grouped by measured intake of ascorbic acid would be informative as well as interesting. They might provide a lead to better means for protecting adventurous youths from the effects of exposure on our mountains and even perhaps help to win more medals in Mexico in three years time.

Summary

In this paper a brief review of mountain accidents with special reference to asphyxia and exposure has been made. Certain aspects of treatment including

the use of oxygen for exhaustion and exposure have been considered. The prevention of exposure with special reference to the value of training and the possible role of ascorbic acid in prevention and treatment have been discussed.

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