

MOUNTAIN-RESCUE MEDICINE

MOUNTAIN RESCUE MEDICINE IN THE MONT BLANC MASSIF: 3932 ACCIDENTS IN 8 YEARS.

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RESUMEN: Medicina de Rescate en el Maciso del Mont Blanc: 3 932 Accidentes en 8 años

Se efectúan más de 500 salvatajes cada año en el maciso del Mont Blanc y en más del 60% de casos hay un médico presente. La transmisión rápida de alerta gracias a una red radiofónica sofisticada, la extensión relativamente pequeña del maciso y la ubicación ideal del hospital Chamonix hacen que casi todos los rescates se realicen en menos de una hora. El montacargas del helicóptero permite llevar a cabo rescates en las zonas más inaccesibles y en las épocas más peligrosas. Durante la temporada alta (7 meses al año) un médico de guardia se encuentra permanentemente disponible, listo para unirse al equipo de rescate. Para ser un miembro efectivo del equipo los médicos deben estar entrenados en traumatología y medicina de emergencia, así como ser montañistas resistentes y experimentados. El material médico es robusto pero lo suficientemente ligero y compacto como para ser transportado a cuestas en una bolsa. Las víctimas son sobre todo jóvenes extranjeros de sexo masculino. 15% de los pacientes presentan traumatismo grave y 7% están moribundos en el lugar del accidente. El seguimiento a largo plazo de los pacientes con traumatismo grave muestra que 83% se recuperan bien y que su pronóstico es mejor si el tiempo entre el accidente y la atención médica es breve. La patología más común es el traumatismo moderado de los miembros inferiores. Inmovilización, sedación y analgesia son la base del tratamiento en los accidentes de montaña. Más preocupantes son los traumatismos encefalo-cerebrales y de la columna vertebral, así como las cardiopatías isquémicas. La hipotermia es a menudo una consecuencia de otras lesiones o enfermedades. El tratamiento médico en condiciones adversas debe reducirse al mínimo. La experiencia del médico es esencial, pues debe encontrar el mejor equilibrio entre el tratamiento médico en el lugar y la evacuación inmediata para alejar a la víctima del frío, de la hipoxia y del peligro eventual de una avalancha, deslizamiento de terreno, etc. Si el tiempo es favorable o la evacuación inmediata es difícil, pueden aplicarse todas las técnicas habituales de reanimación. Finalmente, el rol de la prevención es siempre esencial.

Palabras claves: Salvataje en montaña, Medicina de urgencia, Traumatología, Hipotermia, Mal de montaña agudo.

RÉSUMÉ: Médecine de sauvetage dans le Massif du Mont-Blanc: 3 932 accidents en 8 ans.

Plus de 500 sauvetages sont effectués chaque année dans le Massif du Mont-Blanc et dans plus de 60 % des cas un médecin est présent. La transmission rapide de l'alerte grâce à un réseau radiophonique sophistiqué, l'extension relativement réduite du Massif et la position idéale de l'hôpital de Chamonix font que presque tous les sauvetages sont menés à terme en moins d'une heure. L'hélicoptère permet d'effectuer des sauvetages dans les zones les plus inaccessibles et aux périodes les plus dangereuses. En haute-saison (7 mois par an) un médecin de garde se trouve en permanence à l'hélistation, prêt à se joindre à l'équipe de secours quand l'alerte est donnée. Pour faire partie de l'équipe le médecin doit non seulement être compétent en traumatologie et médecine d'urgence, il doit aussi être un alpiniste résistant et expérimenté. Le matériel médical transporté est robuste, mais suffisamment léger et compact pour être transporté dans un sac à dos.

Les victimes sont surtout des jeunes de sexe masculin et souvent d'un pays étranger. 15 % des rescapés présentent un traumatisme grave et 7% sont moribonds sur les lieux mêmes de l'accident. Le suivi sur longue période des victimes de traumatismes graves montre que pour 83 % d'entre elles la récupération est satisfaisante et que le pronostic est meilleur si l'intervalle de temps entre l'accident et les soins est court. La pathologie la plus courante est le traumatisme modéré des membres inférieurs. Immobilisation, sédation et analgésie sont la base du traitement des accidents de montagne. Plus préoccupants sont les traumatismes crâniens et de la colonne vertébrale, ainsi que la cardiopathie ischémique. L'hypothermie est souvent une conséquence d'autres lésions ou maladies. Le traitement médical dans des conditions adverses doit être réduit au minimum. L'expérience du médecin est ici essentielle, car c'est lui qui doit trouver le meilleur équilibre entre le traitement médical sur place et l'évacuation immédiate qui éloigne ainsi la victime du froid, de l'hypoxie et d'un éventuel

danger tel qu'avalanche, glissement de terrain, etc. Si le temps est doux ou que l'évacuation immédiate s'avère difficile, toutes les techniques courantes de réanimation peuvent être appliquées. Finalement, le rôle de la prévention est toujours primordial.

Mots clés : Sauvetage en montagne, Médecine d'urgence, Traumatologie, Hypothermie, Mal des montagnes aigu.

SUMMARY: More than 500 rescues are made each year from the mountains of the Mont-Blanc Massif and in more than 60% of these rescues a doctor is present at the scene. The rapid transmission of the alert thanks to a sophisticated radio network, the relatively compact size of the Mont-Blanc Massif and the ideal position of the Hopital de Chamonix mean that almost all rescues are completed in less than an hour. The helicopters' winch allows rescues to be carried out in the most inaccessible and perilous places. During high season (seven months of the year) a doctor is permanently on-call at the heli-pad, ready to join the rescue team at a moment's notice. To be an effective member of the team the doctors must not only be competent in traumatology and emergency medicine but also be strong and experienced mountaineers. The medical equipment carried is robust, light and compact

enough to be carried in a rucksack. The rescue victims are predominantly young, male and are often foreign. 15% of patients are severely injured and 7% are pronounced dead at the scene. Long-term follow up of the severely injured patients shows that 83% go on to make a good recovery and that their prognosis is better if the time between accident and medical attention is short. The most common pathology seen is a moderately severe, traumatic injury of the lower limb. Immobilisation, sedation and analgesia prove the basis of treatment in the mountains. More worrying are injuries to the head or spine and ischaemic heart disease. Hypothermia is often a consequence of other injuries or illness. Medical treatment in hostile mountain conditions must be kept to a minimum. The experience of the doctor is essential as it is he who must find the best compromise between medical treatment at the scene and immediate evacuation so removing the victim from the effects of cold, hypoxia and objective danger (avalanche, stone-fall etc.) If the weather is mild or if immediate evacuation is difficult, all the usual resuscitation techniques are possible. Finally, the role of prevention remains essential.

KEY WORDS: Mountain rescue, Emergency medicine, Traumatology, Hypothermia, Acute mountain sickness.

INTRODUCTION

Situated at the foot of Mont Blanc, Chamonix is rightly considered one of the world capitals of mountaineering. In summer, climbers come from all over the world to climb such famous faces as the north face of the Grandes Jorasses or the west face of Les Drus but above all they

come to climb MontBlanc. Whilst in winter, the descent of the Vallée Blanche remains the reference in high-mountain off-piste skiing. The activity of the rescue service corresponds with the popularity of the massif with currently more than 500 rescues a year (Figure 1). This paper is based on the 3932 rescues that have taken place over the last eight years.

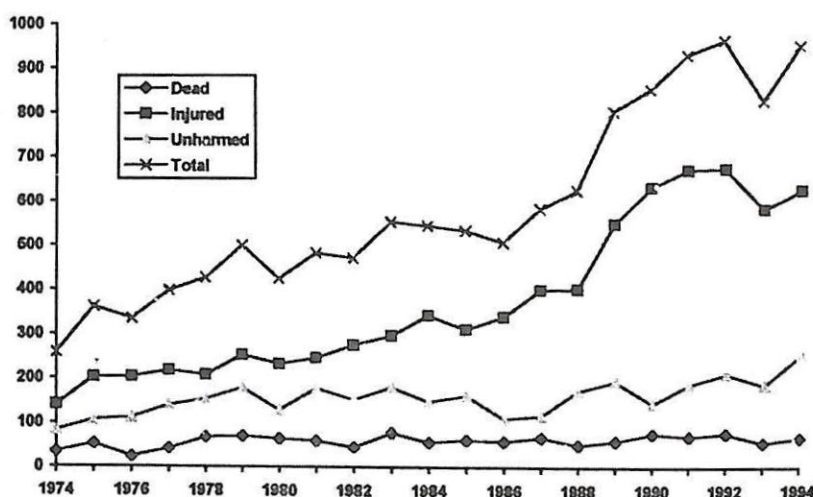


Figure 1 : Activity the last 20 years

THE STRUCTURE OF THE MOUNTAIN RESCUE SERVICE

Initially run voluntarily by mountain guides the rescue service has become more and more complex over the years. Significant developments in the service have often come in response to a major accident, most notable is the story of Vincendon and Henry who in 1956 died of exposure following a badly

managed rescue mission, an event which led to the creation of the Peloton de Gendarmerie de Haute-Montagne (PGHM) in 1958 [1].

The present rescue service can be considered in five parts:

1. The helicopter teams of the Gendarmerie and of the Sécurité Civile, who can rescue victims from the most inaccessible of

places, are involved in 95% of all rescues [photos 1&2].

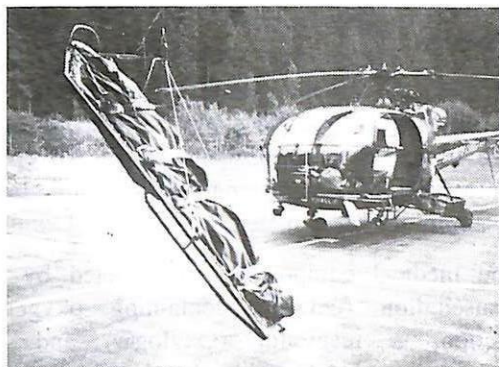


Photo 1



Photo 2

2. The PGHM rescue team members, of whom the majority are guides, deal with the logistics of the rescue including access, rope-work, and evacuation of the patient.
3. The doctors have been regular members of the team since the mid-1980's and are mainly assistants in the Emergency department of Chamonix hospital. In addition to their knowledge of emergency medicine, they are all experienced mountaineers, an essential quality that allows their integration into the team without putting either the team or victim at further risk.

The hospital is ideally situated in the heart of the massif where, at an altitude of 1000m, it is often above the valley fog that prevents the helicopter landing at other lower hospitals. This proximity allows early assessment and treatment to take place. The emergency department with its two resuscitation rooms and heli-pad may seem excessive for a small alpine town but

was designed this way to cope with the seasonal influx of patients [photo 3].



Photo 3

5. The 'Société Chamoniarde de Secours en Montagne' (SCSM), is the administrative body behind the mountain rescue service. They supply some medical and technical equipment but above all they finance the radio network, which during the last 10 years has significantly improved both the transmission of the alert and the coordination of the rescue.

Each rescue is coordinated from the PGHM in Chamonix by a member of the rescue team who has an indepth knowledge of massif. The details available to the rescue team as to the state of the victims are often vague and it is often difficult to determine if a doctor is required. This is compensated for by the high percentage (60%) of rescues that have a doctor present, a service that is above the needs of many of the patients.

THE EQUIPMENT

Aside from the mountain rescue equipment used, the medical equipment differs little from that found in a paramedic ambulance.

The stretcher the most frequently used is the 'Perche Piguillem' which is well adapted to winch rescue [photo 1]. The victim is strapped into the stretcher and if necessary can be completely immobilised with neck collar, splints and vacuum stretcher.

A first aid pouch containing syringes, cannulars and IV analgesics is carried around the doctors waist. The doctor's rucksack, developed in conjunction with Lafuma®, is divided into 2 parts, one part for the climbing equipment and one part medical, which further divides into 4 pockets (respiration, circulation, medication and dressing) [photo 4&5].

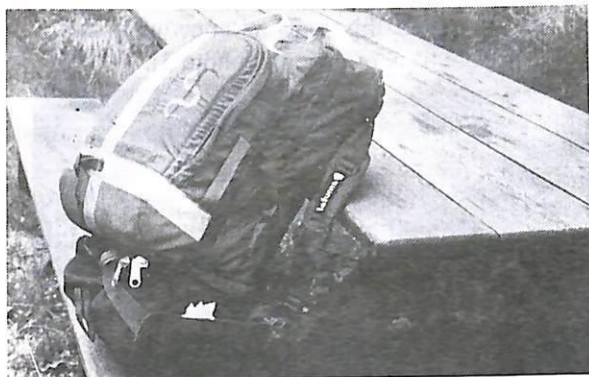


Photo 4



Photo 5

FICHE MEDICALE SECOURS EN MONTAGNE CHAMONIX									
Date	Heure Appel		Heure Secours						
Météo	1. Beau	2. Mauvais	Hélico	Carav	Pr. en charge	1. Lieu	2. DZ	0. Sens	
Alerte	10. accident	11. accident grave	12. médical	13. médical grave	14. mort	15. épuisé	16. recherche	17. évacuation	18. sans précision
19. découverte fortuite									
IDENTITE									
Nom	Prénom				Sexe				
Date de naissance	National								
ACTIVITE									
Lieu					Altitude				
Rando/Prom	Ski	Alpinisme	Parap. Delta	Vélo	Rafting				
Cotation	Montagne	F	PD	AD	D	TD	ED	Ski: F	D ED
Circonstances (cochez autant de numéros que nécessaire)									
30. Rocher	34. Sbd piste	38. Collation	42. Dévalage	46. Rappel					
31. Glace	35. Hors piste	39. Chute Têlé	43. Chute pierre	47. Feutre					
32. Neige	36. Sbd Montag	40. Abris	44. Chute séréc	48. Pb. Techn					
33. Météo	37. Sbd Fond	41. Décollage	45. Avalanche	49. Cravasse					
50. Autres (détaillez)			51. Surf	52. Météo					
Difficulté du secours: 1. facile 2. facile et danger 3. difficile 4. difficile et danger									
BILAN MEDICAL									
	1-4	CONTUS	ENTORS	LUXAT	FRACT	PLAIE	OSLURS	MEDIC	
CRANE	10	—	—	—	13	14	—	18	
O.R.L.	20	21	22	23	24	25	26		
RACHIS	30	31	32	33	34	35	36		
THORAX	40	—	—	—	43	44	—	46	
ABDOMEN	50	—	—	—	54	—	56		
BASSIN	60	—	—	—	63	64	—	66	
MBRE SUP	70	71	72	73	74	75	76		
MBRE INF	80	81	82	83	84	85	86		

A standard range of medication is carried with an emphasis towards intra-venous analgesia, sedation, rehydration and coronary artery dilatation.

Vital signs can be monitored at the scene including a cardiac trace by a miniscope the size of a calculator, temperature by an epi-tympanic thermometer and oxygen saturation by a mini pulse oxymeter.

The medical equipment is completed by a resuscitation rucksack containing oxygen, suction, a respirator (Oxylog®) and a defibrillator (Leardal®) all of which are compact and robust

THE GATHERING OF DATA

Each rescue victim has a medical record card on which is recorded their personal details along with the time, place, and circumstances of the accident, the injuries sustained (WHO classification), the state of the patient and the treatment given at the scene (Figure 2).

Gravité Initiale : 1. Indemne 2. modéré 3. grave 4. risque vital 5. mort
Polytraumatisé Glasgow Oeil(4-1) + verbal(5-1) + moteur(6-1) =

RESUME CLINIQUE

MISE EN CONDITION

Injection : IM IV SC Abord périphérique Abord central
Intubation Défibrillation Drainage thoracique Immobilisation
Thérapeutiques

EVACUATION

Evacuation 1. coquille 2. barquette 3. Pigullem 4. assis
Treuilage Heure arrivée DZ Hôpital receveur
Evolution 1. stable 2. amélioré 3. aggravé 4. décédé
MEDECIN : Dr

Dr B. Marquay Avril 90

Figure 2 : Medical records card

EPIDEMIOLOGY

The population rescued are young with an average age of 32 years (Sd 13), predominantly male (71%) and often foreign (37%). February, March, July and August are the busiest months, together accounting for 65% of all rescues (Figure 3). The activity of the rescue team is spread evenly throughout the working day with a slightly earlier start in summer.

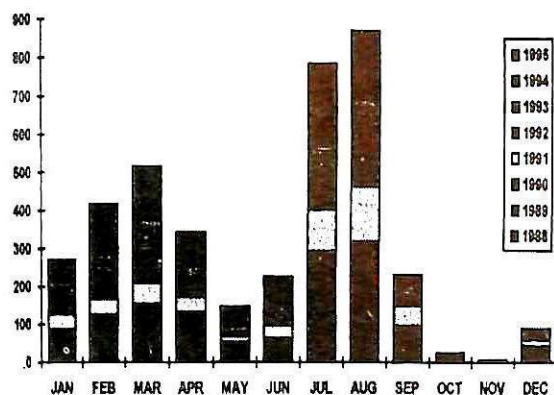


Figure 3 : Monthly distribution (1988 - 1995)

The rescues are generally rapid, with an average time between the alert and the return to the valley of 58mins (Sd 10). The speed of the rescue is aided by the relatively compact size of the massif (25km by 12km), by the central position of the hospital and by the brief and rapid approach to treatment.

The average altitude of rescue is 2406m with 24% taking place above 3500m. The high number of people that ski the Vallée Blanche in winter and climb Mont-Blanc in summer makes these two areas the most common sites for rescues in the massif.

40% of all victims are from ski accidents (half of them on piste) and 44% are due to climbing. However traumatic deaths are four times more common amongst climbers than amongst skiers and are mainly due to falls or stone fall. Hiking in the lower mountains of the massif accounts for 14% of rescues and involves a more standard population. Finally, although paragliding is an increasingly popular sport it accounts for only 2% of all accidents.

SCIO-CULTURAL FACTORS

Fashion

Mountaineering is and remains a dangerous sport, however recently a worrying trend is emerging. With the increasing popularity of bolted rock climbing, more and more climbers are heading into the mountains with the ability to climb hard rock but with few of the skills necessary to deal with glaciers or mixed ground. With the dangerous result that many climb without a helmet or move on crevassed glaciers unroped. On the other hand, a rope badly used can increase the risk of an accident for example when a climber falls and pulls off the other climber.

The mystique

Each year a number of climbers, inspired by the reputation of Mont-Blanc and encouraged by the media as to the facility of its ascent, choose to ignore the risks and climb it with a minimum of experience. Some succeed, many fail and sadly some have serious accidents (amputations following a winter ascent in light shoes) or even die (diabetic keto-acidosis when a climber was caught out in bad weather with limited supplies).

The other side of the coin

In recent years, the generous nature of a free rescue service has sadly begun to be abused. Occasionally, climbers demand a rescue where in the past they would not have thought to do so. Without doubt they are encouraged by the ease of calling for help with a radio and are used to seeing the helicopter in the massif. Because of the overall increase in the number of rescues, the number of cases of minor trauma or even simple fatigue are increasing. This problem is important as each rescue must be balanced against the risk to the rescue team and the expense of the mission.

PATHOLOGY

The majority of the pathology seen in mountain accidents is traumatic (90%) and can be graded from 1 to 5. Of the 3932 victims rescued, 10% were unharmed (grade 1), 68% had an injury of moderate severity e.g. fracture/dislocation of a long bone (grade 2), 12% were severely injured e.g. fracture of the spine (grade 3), 3% were in a serious state e.g. haemorrhagic shock or profound hypothermia (grade 4), and 7% were dead on rescue (grade 5). It is interesting to note that men account for 83% of all seriously injured patients.

Traumatic injury of the lower limb is common, accounting for 35% of all rescues, although it

rarely leads to serious complications (Figure 4). More worrying are the 22% of victims that present with a head injury, often due to stone or ice fall or to a fall by the climber. 10% of those rescued have a spinal injury, 12% of whom go on to have some residual impairment. 13% of victims have multiple trauma. In many of these neurological signs, hypothermia and haemorrhagic shock are often intricate and it can then prove difficult to distinguish the cause.

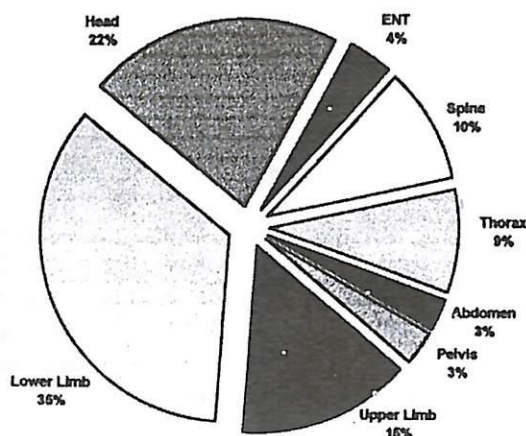


Figure 4 : Traumatic injuries (n = 3932)

At this point it should be stated that hypothermia is frequently secondary to other injuries (78% in a series of 89 cases in 6 years) and less often a pure phenomenon. Finally, although always present in the mind of climbers, lightning strikes are rare with only 2 or 3 cases a year.

Medical problems account for only 10% of rescues amongst which two pathologies are common:

- Coronary artery insufficiency is often exposed in men still in their fifties who are taken quickly to altitude by cablecar and are then very active. This leads to numerous cases of chest pain and around 5 myocardial infarcts a year.
- Acute mountain sickness (25 cases a year) usually begins after a symptom free period of 4-6 hours above 3500m. Although often limited to headaches, shortness of breath and nausea, it can however be serious. This condition is often misjudged by mountaineers who only associate it with expeditions to very high altitude.

TREATMENT

A doctor is present at the scene in 60% of all rescues and in 93% of rescues of seriously injured victims. Some serious cases are still rescued

without a doctor either because the details of the accident were vague or because of dangerous flying conditions where a minimum team is carried.

The treatment given in the mountains depends on the state of the patient and on the environment. It is unrealistic to expect to be able to perform advanced resuscitation in the hostile conditions often encountered in the mountains. Therefore after an initial assessment of the patient, the aim is to remove the victim from the effects of cold, hypoxia and objective danger (stone-fall, avalanche etc.). From our experience it is apparent that at 4000m in summer, an adult climber, well equipped but seriously injured (internal bleeding or a head injury) can drop his temperature to 30°C in less than one hour. From this it is clear that only essential treatment should be given in the mountains and that the rest be left to the hospital. The experience of the doctor in this initial assessment is essential, as it is his role to find the compromise between optimal treatment and rapid evacuation.

Treatment in the mountains

Clinical examination of a patient in the mountains is always difficult because of the amount of clothing and equipment worn by mountaineers.

If the air temperature is warm and if immediate evacuation of the patient is not possible, then more advanced resuscitation techniques are possible (central venous line, intra-thoracic drain etc.) without forgetting that the doctor must perform them alone. If the conditions are less favourable one must limit oneself to essential acts such as immobilisation, analgesia, sedation, compressive dressings, intubation and cardiac resuscitation.

The securing of venous access although preferable must not delay the rescue. We rarely put up an infusion because of the difficulty of guarding the line open in extreme conditions and use the catheter mainly for injection of intra-venous drugs. Hypovolaemia can sometimes be dealt with in the field simply by raising the patient's legs. The preferred rehydration fluid is the plasma expander hydroxyethylamidon, as it is more resistant to the cold than the gelatins. In the future we hope to be able to use the new hypertonic 7% saline solutions which have a good relationship between efficacy and weight.

Finally, in the case of an overland evacuation, it is better, if possible, to allow the victim to participate in their own rescue. Patients can often walk with a fractured arm or skull if they have sufficient pain relief.

Rescue and Evacuation

Although very well suited to alpine rescue, the single engined Alouette III faces two technical restrictions in winch rescues (44% of all rescues). Firstly, the stretcher can only be brought on board if it is inclined at an angle of 50°, a manoeuvre which is obviously incompatible with a patient who is haemodynamically unstable [photos 1&6]. In such a case the stretcher is winched in a horizontal position to a flat area where it is landed, and from there loaded onto the helicopter. Secondly, as only one person can be winched at a time the doctor is taken up first, followed by the patient.



Photo 6

The cockpit of the Alouette III is cramped and it is our practice to load the stretcher in transversely with the doctor sitting above the patient. Therefore every drug that the doctor may want to use during the flight must be prepared before take off and carried in the hand. In such circumstances the pursuit of a cardio-vascular resuscitation would prove difficult. These inconveniences would disappear with the introduction of a new generation of helicopter which each year is held back for financial reasons.

Finally, in the case of hypothermia, the transport is the period of greatest danger and must be performed gently yet quickly. Also one must be particularly careful when moving the patient on and off the stretcher to not set off a ventricular fibrillation

The first few hours

The resuscitation and management of a victim of mountain trauma is the same as for any other

victim of trauma, however two points specific to the mountains need emphasising.

- Sliding down a snow slope can lead to internal injuries which are not always obvious on initial examination. For these patients abdominal ultra-sound on admission is systematic.
- All multiple trauma cases should be suspected to be hypothermic and the taking of core temperature systematic. Reciprocally, as hypothermia is most often seen secondary to other injuries, a hypothermic patient is presumed to have other injuries until proved otherwise and rehydration remains the basis of resuscitation [2].

Transfers

Despite the amount of mountain related medicine that it sees, Chamonix Hospital is still essentially a small hospital. For patients with serious injuries, specifically of the head, spine or thorax, it allows resuscitation and stabilisation before transfer to a specialist centre. For some patients, for example those with internal haemorrhage, this service requires great resources which are proving more difficult to finance each year.

OUTCOME

Long-term follow up of trauma victims shows that of the patients comatosed following head injuries, three quarters go on to make a full recovery. Of those that die from head injuries more do so from haemorrhagic contusions with oedema than from pure haematomas which are usually drained successfully. Spinal injuries can be well immobilised once the patient is on the stretcher, however sometimes irreversible damage is already done. The prognosis for victims of multiple trauma is generally good unless they have a significant head injury.

Follow up of those presenting with medical problems shows that patients with pure hypothermia and a cardiac output, even if the hypothermia is profound, have a good prognosis; that the prognosis of patients with a myocardial infarction in the mountains, as elsewhere, depends largely on the rapidity of treatment; and that all patients suffering from acute mountain sickness recover fully, only occasionally needing a short stay in hospital.

A follow-up study of 145 serious (Grade 3&4) victims of mountain accidents [3] showed that 83% went on to make either a good or complete

recovery, 5% recovered poorly, and that 12% finally died. The total mortality, before and after rescue is 9%, or around 50 per year. They have an average age of 32 years and are predominantly male (87%). This same study showed that the less the delay between accident and rescue and the less the time of the medical intervention, the better the outcome ($p=0.006$). This result is all the more important as it applies to a population predominantly young and male for whom rapid recuperation has important economic implications.

The presence of a doctor in the rescue team is clearly beneficial and this is supported by the fact that the number of deaths each year has not increased despite the fact that the number of rescues has increased by approximately 9% per year since 1974.

CONCLUSION

Within Chamonix's prestigious and popular massif one finds much mountain related trauma, rescue team members who are guides, doctors who are experienced mountaineers and a highly equipped hospital at the foot of the mountains. Everything is there to maintain and justify an integrated rescue service of the highest standard which is capable, in the majority of cases, of managing the patient from the scene of the accident through hospital to their return home.

Once the alert is received, the rescue almost always goes ahead in a satisfactory manner. Therefore, to reduce mortality in the Mont-Blanc massif one must concentrate on the time before the alert is received and specifically on two areas. Firstly, to encourage the more widespread and more responsible use of radios; and secondly and above all, to promote a higher level of safety in the mountains. For as ever, the prevention of accidents by education and training is essential.

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