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Helicopter rescue operations involving winching of an emergency physician

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ABSTRACT

Objective: We sought to study the epidemiologic and medical aspects of alpine helicopter rescue operations involving the winching of an emergency physician to the victim.
Methods: We retrospectively reviewed the medical and operational reports of a single helicopter-based emergency medical service. Data from 1 January 2003 to 31 December 2008 were analysed.
Results: A total of 921 patients were identified, with a male:female ratio of 2:1. There were 56 (6%) patients aged 15 or under. The median time from emergency call to helicopter take-off was 7 min (IQR = 5–10 min). 840 (91%) patients suffered from trauma-related injuries, with falls from heights during sports activities the most frequent event. The most common injuries involved the legs (246 or 27%), head (175 or 19%), upper limbs (117 or 13%), spine (108 or 12%), and femur (66 or 7%). Only 81 (9%) victims suffered from a medical emergency, but these cases were, when compared to the trauma victims, significantly more severe according to the NACA index ($p < 0.001$). Overall, 246 (27%) patients had a severe injury or illness, namely, a potential or overt vital threat (NACA score between 4 and 6). A total of 478 (52%) patients required administration of major analgesics: fentanyl (443 patients or 48%), ketamine (42 patients or 5%) or morphine (7 patients or 1%). The mean dose of fentanyl was 188 micrograms (range 25–750, SD 127). Major medical interventions such as administration of vasoactive drugs, intravenous perfusions of more than 1000 ml of fluids, ventilation or intubation were performed on 39 (4%) patients.
Conclusions: The severity of the patients' injuries or illnesses along with the high proportion of medical procedures performed directly on-site validates emergency physician winching for advanced life support procedures and analgesia.

Introduction

The number of helicopter-based emergency medical services (HEMS) rescue operations for people involved in outdoor leisure activities has increased over the last few years.[1] Helicopter rescues offer several advantages over ground transport, including the ability to perform air searches for lost victims, rapidly shuttle rescue personnel and equipment to the scene, deliver timely on-site advanced medical care decreasing both the number of rescuers required for ground evacuation and exposure to hazards associated with hostile environments, and reduce patient transport time to the hospital.[2] On the other hand, HEMS operations have higher accident and fatality rates when compared to helicopter operations in other fields.[3] The risk factors include night flight and poor weather, the latter being frequently the case during mountain rescues.[4] Winching procedures account for a non-negligible number of incidents during rescue missions,[5] and therefore are not used by all HEMS and in all countries.[6] Whereas the use of helicopters as a rapid means to reach victims and to bring them to a secure place is well-recognised, there are very few data available about the value of winching physicians to provide medical care for the victims directly on-site. We analysed the medical aspects of helicopter rescue operations involving winching of an emergency physician in a Swiss setting.

Air-Glaciers' helicopter-based emergency medical service

Air-Glaciers (AG) is a commercial rescue company founded in 1965 based in the heart of the Alps in Sion, Switzerland. This helicopter-based emergency medical service covers a resident population of about 220,000, and grows significantly during the peak tourist seasons in winter and summer.

AG intervenes at altitudes from 500 to over 4000 metres, with a time of flight from the base to the scene of generally less of 20 min. The base covers an operational area of 250 km^2. About 1700 rescue flights are made each year, of which more than 90% are primary missions ranging from road traffic accidents to high altitude

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mountain rescues, whilst 10% are interhospital transfers. Most of the patients are admitted either to the local trauma and medical centre of Sion which has neurosurgery, cardiovascular surgery, intensive care and coronary angioplasty services, or to the nearby University Hospital of Lausanne.

Operational aspects

The AG's base station can simultaneously deploy up to 5 helicopters equipped with medical staff during the peak tourist season. It is the only service operating in this geographical area, although helicopters from other companies can be engaged in a one-off basis for extraordinary circumstances. All rescue missions requiring a winch strategy also include a mountain guide with a paramedical training. Depending on the presumed severity of the medical situation, an emergency physician is winched either as a first course of action, or as recommended after the mountain guide's initial evaluation of the situation. A spine board, a monitor/defibrillator, an electric suction device and a medical bag with advanced life support material (intubation and resuscitation drugs) are taken on-site by the rescuers as needed. After immobilisation and stabilisation of the patient, extrication with the winch is followed by a short flight until landing is possible, at which point the victim and the rescuers are moved inside the helicopter cabin. During the winching procedure, the lying victim is immobilised on a spine board which is attached to a winching bag. Alternatively, the victim can also be winched in a sitting position using a harness or the KED® system (Kendrick Extraction Device). The winching strategies are the same whether the method used is a traditional winching (where a steel cable with a hook is unrolled) or a human cargo sling (where a fixed length cable is attached directly to the helicopter).

Methods

We retrospectively reviewed all rescue missions conducted by Air-Glaciers from 1 January 2003 to 31 December 2008. The medical reports of the cases for which an emergency physician had been winched to the victim were collected. Cases where the emergency call clearly indicated that the victim was deceased were excluded. Data included the time from the emergency call to take-off, the age and gender of the victim, the activity at the time of injury, the mechanism of injury, and the main body part injured as reported by the emergency physician. The severity of the illnesses or injuries was graded using the 7-level scale of the National Advisory Committee for Aeronautics (NACA) index[7,8] by the emergency physician immediately after the rescue mission (1 = no need for acute physician care, 2 = therapy required without hospital admission, 3 = hospital admission, no vital threat, 4 = potentially life-threatening, 5 = acute threat to life, 6 = transport after successful resuscitation of vital signs, 7 = death, with or without reanimation efforts). Patients' injuries were further pooled into minor (NACA 1), moderate (NACA 2–3), severe (NACA 4–6) or lethal (NACA 7) categories. The following medical procedures provided on-site were recorded: intravenous line access, fluid or drug administration, airway management, cardiopulmonary resuscitation, reduction of shoulder dislocation and femoral nerve blockade. Vasoactive drug administration (i.e., epinephrine, ephedrine or atropine), bag-mask ventilation, intubation, intravenous fluid administration of more than 1000 ml and cardiopulmonary resuscitation were defined as major life-saving procedures.

Descriptive statistics were expressed as a mean and 95% CI or median with interquartile range, as appropriate. We explored differences in characteristics between patients using chi-square tests for categorical variables. We used two-sided p-values of <0.05 to assess statistical significance.

Table 1
Activity at the time of injury or medical emergency ($n = 921$).

	n (%)
Mountaineering	257 (28)
Downhill skiing	239 (26)
Off-piste skiing	100 (11)
Working	55 (6)
Ski touring	51 (6)
Snowboarding	38 (4)
Driving a car	35 (4)
Mountain biking	23 (3)
Paragliding	25 (3)
Hiking	30 (3)
Other[a]	68 (7)

[a] Includes hunting ($n = 6$), housework (5), ice-skating (4), canyoning (2), hang gliding (2), water sports (2), parachuting (1), horseback riding (1), and unknown ($n = 45$).

Results

9879 rescue missions were conducted between 1 January 2003 and 31 December 2008. In 921 (9.3%) missions the emergency physician had to be winched.

Characteristics of the victims and take-off time

621 (67%) of the 921 victims were male with a male:female ratio of 2:1, and a mean age of 41 years (SD 18), with a range of 2–90 years. There were 56 (6%) paediatric patients ($\leq$15 years). Most of the victims were injured whilst practising winter sports or mountain-related activities during the summer. A more detailed description of the respective activities of the victims at the time of injury is presented in Table 1. Falls accounted for the great majority of the trauma events (700 patients or 76%), followed by illnesses (81 patients or 9%). Of the 921 missions in which the physician was winched in the field, 28 (3%) were avalanche rescues and 13 (1%) were glacier crevasse rescues. The median time from emergency call to helicopter take-off was 7 min (IQR = 5–10 min, range 0–280 min).

Type and severity of injuries or illnesses

Trauma to the upper and lower extremities accounted for 429 (47%) of all injuries, followed by 175 (19%) head injuries and 108 (12%) spinal lesions. Hypothermia, frostbite and altitude illnesses were diagnosed in 11 (1%) cases. In 128 (14%) cases two different diagnoses were made, and in 69 (7%) three or more diagnoses.

The severity of the lesions as assessed by the NACA score is presented in Table 2. Potential or actual life-threatening injuries (NACA grades 4–6) were found in 246 (27%) victims. Medical patients had significantly more severe pathologies according to the NACA score when compared to trauma victims ($p < 0.001$) whereas the total number of medical victims was much smaller. Overall, 52 (6%) victims were dead at the scene (NACA 7). Forty-

Table 2
Injuries and medical emergencies by NACA score.

	Trauma victims (%)	Medical patients[b] (%)	Total
Minor-moderate (NACA 1–3)[a]	584 (63)	39 (4)	623 (68)
Severe (NACA 4–6)	210 (23)	36 (4)	246 (27)
Dead (NACA 7)	46 (5)	6 (1)	52 (6)
Total number (%)	840 (91)	81 (9)	921 (100)

[a] 14 (2%) with NACA = 1; 216 (23%) with NACA = 2; 393 (43%) with NACA = 3.
[b] When compared to trauma victims, medical patients had significantly more severe pathologies according to the NACA index (Pearson's chi-square test; $p < 0.001$).