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ORIGINAL RESEARCH

Mt Everest Base Camp Medical Clinic "Everest ER": Epidemiology of Medical Events During the First 10 Years of Operation

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Objectives.—As the highest peak on the planet, Mt Everest provides a truly austere environment in which to practice medicine. We examined records of all visits to the Everest Base Camp Medical Clinic (Everest ER) to characterize the medical problems that occur in these patients.

Methods.—A retrospective analysis of medical records from the first 10 years of operation (2003 to 2012) was performed.

Results.—Medical reasons accounted for 85.3% (3045) of diagnoses, whereas 14.0% (500) were for trauma. The most common medical diagnoses were pulmonary causes such as high altitude cough and upper respiratory infection, comprising more than 38% of medical diagnoses. For traumatic diagnoses, 56% were for dermatologic causes, most commonly for frostbite and lacerations. Pulmonary and dermatologic diagnoses were also the most frequent causes for evacuation from Everest Base Camp, most commonly for high altitude pulmonary edema and frostbite, respectively.

Conclusions.—Medical professionals treating patients at extreme altitude should have a broad scope of practice and be well prepared to deal with serious trauma from falls, cold exposure injuries, and altitude illness.

Key words: Everest, injury, illness, trauma, clinic, mountaineering

Introduction

More than 800 climbers or hired climbing staff attempt to summit Mt Everest every year. With an elevation of 8848 m (29,029 feet), Everest's peak has a barometric pressure of 253 mm Hg and an ambient P_{O_2} of 53 mm Hg. These values are roughly one-third those at sea level, where barometric pressure is 760 mm Hg and P_{O_2} is 159 mm Hg.[1] Compared with the 13 other 8000-m peaks, Mt Everest's summit is attempted more often and has more total ascents. By the end of the 2012 spring climbing season, 5208 total ascents of Mt Everest had been made. Comparatively, the next most popular 8000-m peak, Cho Oyu, had 3171 ascents during the same time period.[2]

The Everest Base Camp (EBC) Medical Clinic (Everest ER) was established in 2003 in cooperation with the Himalayan Rescue Association (HRA) to provide medical care to the climbers, support staff, and visitors to this uniquely austere environment. Since 2003, the Everest ER has been staffed yearly during the busiest climbing months of April and May. Located at the base camp within Nepal, the Everest ER is located at an elevation of 5364 m (17,598 feet) and has an ambient barometric pressure of 400 mm Hg and P_{O_2} of 84 mm Hg.[3] The clinic's mission is to treat climbers attempting the summit and foreign trekkers to EBC, using proceeds from this care to subsidize free or low-cost health care to local Nepalese.

The Everest ER is staffed by a minimum of 2 physicians who have worked at least 1 prior season in one of the other HRA clinics, located in Pheriche and Manang. In 2009, a Nepali physician position was added to the staff. In addition, physicians participate in rescue and medical radio calls to assist climbers at higher elevations on the mountain. However, with advances in helicopter technology, direct evacuations of more acute patients from higher elevations have recently been

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accomplished, in some cases without the patient ever being treated at the Everest ER.

The Everest ER consists of a 3.7-m by 6.1-m double-walled tent erected every April and removed at the end of the spring climbing season in May. The clinic uses a separate 8-person dome tent as a waiting room or treatment area for minor complaints. The Everest ER can run entirely on solar energy, and relies on a backup generator as needed. In addition to a robust medication formulary that includes resuscitation medications, the Everest ER offers oxygen cylinders, an oxygen concentrator, 12-lead electrocardiograph, transport monitors, basic suturing equipment, portable hyperbaric chambers, and needle thoracostomy equipment. Figure 1 shows the exterior and interior of the main tent.

Currently, the only available information on patterns of disease from Mt Everest is from data released after the first season of the Everest ER[4]; no longitudinal data have been previously reported. We examined records of visits to the Everest ER to characterize the medical problems that occur in these patients to prepare future medical professionals who care for patients in this type of environment.

Methods

Clinic documentation was reviewed for patients seen at the Everest ER during its first 10 consecutive seasons (2003 to 2012). Recorded information included patient demographics, diagnoses, treatments, prescriptions, medications dispensed, and evacuation type, if any. From 2003 to 2008, all original documentation was handwritten and then transferred to a computerized spreadsheet at the end of the climbing season. From 2009 to 2011, the transfer from the handwritten documentation to spreadsheet occurred in real time on a computer in the Everest ER. From 2012 onward, documentation has used an iPad application, which is then extracted into the spreadsheet. Radio consults or evacuations at higher elevations were not included in documentation and, therefore, were not included in the analysis.

If the patient had multiple diagnoses, each diagnosis was included individually. If not explicitly recorded, the category of diagnosis (medical vs trauma) was inferred from the diagnosis. Diagnoses were then grouped into the categories listed in Table 1 that are based on the 14 recognized systems by the US Center for Medicaid and Medicare Services. In addition to these 14 systems, we also included dental, toxicology, and a general category for visits that incorporated general advice, checkups, medication refills, and vital signs checks. Records that were incomplete or illegible were included in the analysis as missing data.

Because of the Everest ER's unique environment for altitude- and cold-related complaints, subgroup analysis was done specifically on altitude-associated conditions and cold exposure injury. We defined cold exposure as frostbite, frost nip, and nonfreezing cold injury. We included acute mountain sickness (AMS), high altitude pulmonary edema (HAPE), high altitude cerebral edema (HACE), and periodic breathing as altitude-associated conditions.

As there are no recorded data for the total number of EBC visits annually, all percentages included represent proportions of the total diagnoses and do not represent prevalence or incidence. Descriptive information was analyzed with SPSS (version 20; IBM Inc, Chicago, IL). Ethical approval was obtained from the University of

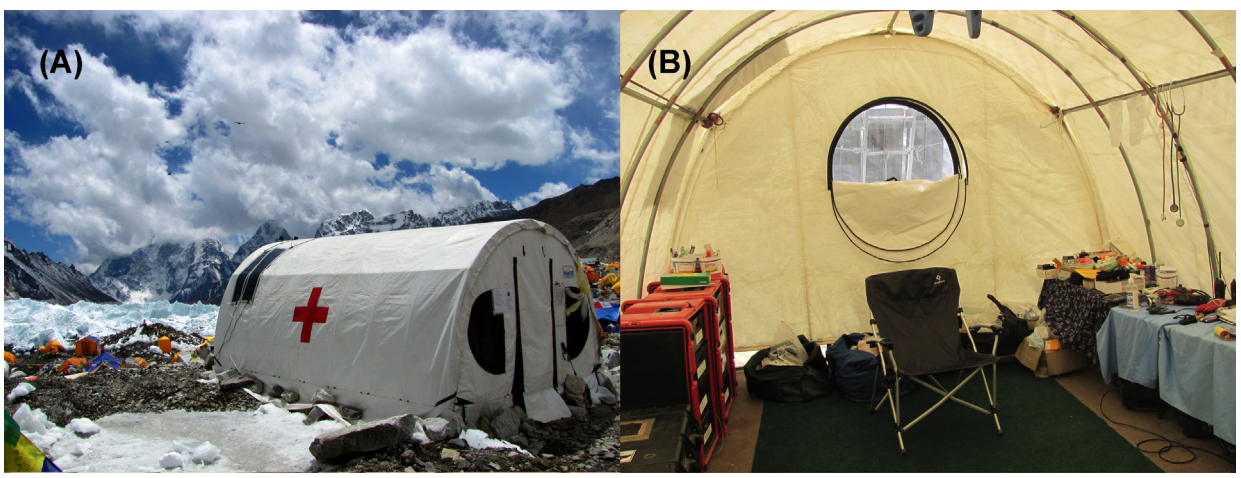

Figure 1. Photographs of the (a) exterior and (b) interior of the Everest ER. Photographs by Magnus Johansson.