WILDERNESS & ENVIRONMENTAL MEDICINE, **27,** 409–414 (2016)

BRIEF REPORT

HEMS in Alpine Rescue for Pediatric Emergencies

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Objective.—The objective of this study was to describe the pediatric emergencies encountered by the Christophorus-1 helicopter emergency medical service (HEMS) during a period of 2 years.

Methods.—Emergency treatment of pediatric casualties by HEMS was evaluated at a helicopter base. Children up to 14 years who were treated by HEMS emergency physicians from Christophorus-1 during primary missions in the alpine region were retrospectively enrolled.

Results.—Of the 1314 HEMS operations conducted during a 2-year investigation period, pediatric emergencies accounted for 114 (8.7%). Trauma was the most common emergency indication (91.3%) in alpine areas, and 77.5% of the indications were related to skiing and snowboarding; 11.3% of the prehospital pediatric emergencies were classified as life-threatening. Interventions on site were rendered in 46.3% of cases. Mean and SD intervals for approach were 11.0 ± 3.0 minutes; for treatment, 14.0 ± 6.0 minutes; and for transport, 8.0 ± 4.0 minutes. Intervals on site were significantly longer whenever it was necessary to search for an interim landing place ($P < .001$) or perform rope extrication ($P < .001$). Aggravating environmental conditions such as low temperature (78.8%), rocky terrain (18.8%), or precipitation (12.5%) were common.

Conclusions.—Rapid procedures are preferred to sustained on-scene treatment, particularly when surrounding conditions are hostile. HEMS emergency physicians attempt to keep on-site intervals short and treatment and monitoring to the essential to minimize delay in rescue.

Key words: HEMS, alpine rescue, pediatric emergencies, wilderness

Introduction

With more and more locations for leisure time events, the number of pediatric emergencies occurring during leisure activities is increasing.[1] In remote alpine regions helicopter-based emergency medical services (HEMS) hold a special position in providing access to rapid high-quality health care. Expert emergency care and direct referral to the trauma center are associated with reduced 2-week mortality in severe trauma[2,3] and may eliminate the need for secondary transfer of patients.[4] Furthermore, nondelayed extrication of patients from wilderness regions gains special importance as even mild-to-moderate trauma can become life-threatening under extreme atmospheric conditions.[5]

Pediatric emergencies frequently represent a challenge for emergency physicians, with high expectations and pressure to succeed in an atmosphere of strong emotions.[6] At the same time, sufficient experience with pediatric emergencies is difficult to obtain as the average rate of emergency treatment in routine duties is low.[7] In remote areas and at high altitude, further difficulties may arise from topographic and weather conditions, calling for individual and pragmatic solutions. This does not substitute for regular training of pediatric algorithms. Emergency techniques adjusted to the specific requirements of HEMS in the mountainous regions are important.[8]

The objective of this study was to describe the pediatric emergencies encountered by the Christophorus-1 HEMS during a period of 2 years.

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Submitted for publication October 2015.

Accepted for publication March 2016.

Patients and Methods

RESCUE SYSTEM

Christophorus-1 in Innsbruck, Austria, has provided HEMS since July 1983. The operation area is around 10,000 km^2 within a maximum diameter of 150 km. Of the 450-km^2 core catchment area, 16% is less than 800 m altitude and is where most of the population lives.

Within 15 minutes, the double-engine Eurocopter EC 135 can reach 9 different hospitals: 5 in Austria, 1 in Italy, and 3 in Germany. The crew consists of a pilot, a rescue technician, and an emergency physician.[9] Rope extrications are performed with a specially developed double-hook system located centrally on the helicopter to avoid additional weight for a winch and a winch operator. The emergency physician and rescue technician are transported as near as possible to the patient. In steep and rocky terrain, they either get off the hovering helicopter or are transported to the scene by rope. In this case, the pilot searches for a small area suitable as an interim landing place for the helicopter so the rope can be attached to the double-hook system. Duty hours differ day by day between dawn and nightfall.[8] With 15 emergency helicopter bases during the winter season, Tyrol offers the highest density of HEMS in Europe.[9]

STUDY DESIGN

Between January 2012 and December 2013, children up to 14 years who were treated by HEMS emergency physicians from Christophorus-1 during primary missions in the alpine region were retrospectively enrolled. Secondary missions, eg, interhospital transport of neonates from a peripheral hospital to the center, were not included. Data were collected from record charts filed at the HEMS base in Innsbruck, Austria. The retrospective study was approved by the ethics committee of Innsbruck Medical University (AN 2014-0069 334/4.25). Alpine region was defined as being at an altitude exceeding 800 m above sea level.[8] Rescue intervals comprise approach interval (time from alarm to arrival on scene), treatment interval (time on site), and transport interval (time from departure to arrival in the hospital). For the sake of comparability of pediatric emergencies in the catchment area, the definitions of age groups follow the categories used by Nagele and Kroesen.[10] Five age groups include neonate (<1 month), baby (1–12 months), toddler (1–4 years), preschool (4–6 years), and school age (6–14 years).[10] Neurologic status was assessed using the Glasgow Coma Scale (GCS). In infants and young children the pediatric version of the GCS was applied.[11] Scores were evaluated in 3 groups (15, 9–14, and ≤ 8).

Pain status was estimated and documented in 3 categories as slight, moderate, or severe in consideration of overall condition and signs and symptoms observed (Figure 1). Whenever practicable, HEMS physicians asked for character and intensity of pain according to a numerical rating scale (none to slight, 0–2; moderate, 3–6; and severe, 7–10).[11]

Christophorus-1 Helicopter Emergency Medical Service
Prehospital protocol for pain management in children

Pain assesment

Overall condition: level of consciousness, associated symptoms, co-morbidities, injuries, allergies, cardiorespiratory function, monitoring
Pain characteristics: type, duration, location and radiation, severity categories: slight, moderate, severe
Observational: frown, legs drawn up, relieving posture, restlessness, crying, moaning, screaming, distractibility
Self-reported: numerical rating scale (NRS)

Pain treatment

Non-pharmacologic
Distraction
Positioning/repositioning
Immobilization
Antiinflammation, e.g. ice packs

Pharmacologic (for moderate to severe pain)
IV access, if practicable
Trauma: first choice ketamine
Non-trauma: first choice opioids

Analgesics/Narcotics
(S)-ketamine
IV 0.25 – 0.5 mg/kg; IN 1 – 1.5 mg/kg; IM 1 – 3 mg/kg in selected cases

Paracetamol (10 – 20 mg/kg); max. 100 mg/kg/24 hrs
125 mg supp. for babies, 250 mg supp. for toddlers

Opioids
IV piritramide (0.1 mg/kg)
IV morphine (0.1 mg/kg)
IV fentanyl (0.001 mg/kg)

Analgosedation
Add midazolam
IV 0.1 mg/kg; IN 0.3 mg/kg

Consider:
Difficult vascular access – IN administration of analgesic first
Dosing: via intranasal route (IN) = 2x -3x IV dose
via intramuscular route (IM) = 2x -3x IV dose
via intraossal route (IO) = IV dose
For small children and babies IV medication must be diluted to a weaker concentration of 1:10
Reassessment after 5 -10 minutes
Redosing at half the initial dose, if indicated

Figure 1. Prehospital protocol for pain management in children. IM, intramuscular; IN, intranasal; IO, intraossal.

Severity of impairment by disease or injury was rated using the scale of the National Advisory Committee for Aeronautics (NACA: 1, minor, no transport; 2, moderate, outpatient management; 3, serious, hospital admission; 4, severe, potentially life-threatening; 5, severe, immediately life-threatening; 6, critical, survival uncertain; 7, death).

Supplementary information and mission details on location (temperature, altitude), obstacles (eg, rocky terrain requiring rope extrication and a search for a landing place), and weather conditions (precipitation, strong wind, fog) were evaluated.

STATISTICAL ANALYSIS

For descriptive analysis of frequencies we used SPSS version 22.0 (IBM SPSS Statistics, IBM Corp, Armonk, NY). Data are presented as frequencies (number and percentage) and mean $\pm$ SD as appropriate. Student's t test was used for comparison of means in independent