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BRIEF REPORT

Search and Rescue Response to a Large-Scale Rockfall Disaster

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Objective.—To describe the prehospital management and safety of search and rescue (SAR) teams involved in a large-scale rockfall disaster and monitor the acute and chronic health effects on personnel with severe dolomitic dust exposure.

Methods.—SAR personnel underwent on-site medical screening and lung function testing 3 months and 3 years after the event.

Results.—The emergency dispatch center was responsible for central coordination of resources. One hundred fifty SAR members from multidisciplinary air- and ground-based teams as well as geotechnical experts were dispatched to a provisionary operation center. Acute exposure to dolomite dust with detectable silicon and magnesium concentrations was not associated with (sub)acute or chronic sequelae or a clinically significant impairment in lung function in exposed personnel.

Conclusions.—The risk for personnel involved in mountain SAR operations is rarely reported and not easily investigated or quantified. This case exemplifies the importance of a multiskilled team and additional considerations for prehospital management during natural hazard events. Safety plans should include compulsory protective measures and medical monitoring of personnel.

Key words: spirometry, dust exposure, rockfall, mountain search and rescue

Introduction

Natural hazard disasters have been a part of the recorded history of the Alps for centuries. The destruction of the city of Plurs, Switzerland, in the 17th century, and the village of Arth-Goldau, Switzerland, and the death of 457 inhabitants in 1806 are well-documented examples of historic rockslides.[1] Major events of the past century include the devastating rockslide of Monte Toc into the Vajont reservoir, Italy (1963), which caused the largest landslide in recent European history with 1917 fatalities, as well as the rockslide of Valtellina, Val Pola, Italy (1987), and Randa, Switzerland (1991).

Whether a natural hazard or any other environmental disaster, emergency situations require the implementation of medical search and rescue (SAR) operations in highly adverse conditions.[2] The risk for responding personnel may be minimal or may pose potentially severe or fatal consequences.[3] When planning an intervention, the risks incurred by personnel must be weighed against the expected benefit for the victims. However, the inherent need for immediate response may override the feasibility of adequate assessment of the potentially adverse effects of exposure to the situation.[2] Interestingly, the prevalence of fatalities in SAR teams and the physical and psychological sequelae are often not reported, and literature on SAR operations in mountainous areas is lacking.

The largest rockfall disaster in recent European history occurred on October 12, 2007, in a highly popular tourist area of the Italian Dolomites. The resulting dust cloud spread rapidly throughout the area, severely limiting visibility. The aim of this report is to describe the prehospital management and safety of the SAR teams and to monitor the acute and chronic health effects on personnel with severe dolomitic dust exposure.

Methods

Information on the emergency response operation was collected from the emergency dispatch center, mountain

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rescue organizations, and firefighter divisions. Medical screening including patient history, clinical examination, and pulmonary auscultation was performed on site in exposed personnel immediately after SAR duties, and medical and lung function data were collected 3 months (December 2007, n = 21) and 3 years (December 2010, n = 14) after the event. Participants were informed that they would be part of a follow-up study, and written informed consent was obtained. A reference sample of spirometry data was obtained from firefighters not involved in this event but who had had a routine spirometry test in 2007 (n = 20). The study was reviewed by the local ethics board.

Lung function was investigated in accordance with the standardized procedures of the American Thoracic Society[4] using a Pony Spirometer 3.9 (COSMED, Rome, Italy) and Minispir S/N 001771 (MIR Medical International Research, Rome, Italy). Measured parameters included forced vital capacity (FVC), forced expiratory volume in 1 second (FEV_1), and forced expiratory flow at 75% of FVC (FEF_{75}). Reference values were calculated from the predictive equations of the European Resuscitation Society Statement.[5] All results are reported in percentage of reference value (mean ± SD) unless indicated otherwise.

Student's *t* tests were used to compare changes in spirometric parameters between the 3-month and 3-year screening and between subgroups classified according to smoking status or occupational dust exposure. All statistical analyses were performed using the SPSS Version 19.0 software (SPSS Inc, Chicago, IL) and a probability value of less than .05 was considered significant.

Results

EMERGENCY MEDICAL SERVICE RESPONSE

On October 12, 2007, approximately 60,000 m^3 of rock released from the northwestern slope of Mt Einser (2698 m), Italy, resulting in a dust cloud that spread rapidly throughout the region (Figure 1). The provincial emergency dispatch center was alerted at 9:41 AM with details that several hikers were in the rockfall area. Within 53 minutes, 2 firefighter teams (120 members), a mountain rescue team (30 members), 3 rescue helicopters, and 2 ambulances had been assembled at the provisionary operation center (3 km from the rockfall site), followed by 3 emergency physicians, 2 geologists, a meteorologist, and additional ambulances on standby. The dust cloud caused more than 30 minutes of near darkness in the valley bottom, and the rescue helicopter team confirmed that a helicopter-supported rescue was impossible because of poor visibility and potential harm to the helicopter engine. The terrestrial-based team was dispatched to perform a search directly in the rockfall area. Dust depositions amounted to several centimeters within the first hour, and visibility remained less than 10 m after 3 hours and less than 100 m after 6 hours in the surrounding areas. Wind patterns and dust cloud dispersion were monitored to determine whether inhabited areas should be evacuated. The hikers contacted the dispatch center 128 minutes after the first alarm to confirm they were not in the exposed area, and after accounting for additional potentially missing persons the operation was concluded at 14:34 PM.

MEDICAL SCREENING

The mean age of participants at the 3-month screening was 36.3 ± 13.9 years (n = 21), and all participants were male. There were 12 nonsmokers, 6 ex-smokers, and 3 smokers. Smoking status remained constant during the period of investigation. Occupational dust exposure (metal, wood, and flour dust) was reported in 8 participants.

At the on-site medical screening there were no life-threatening events in any of the exposed personnel. Self-reported complaints included feelings of pressure in the chest (n = 1), nausea (n = 1), and upper airway viral disease (n = 1). The maximal reported duration of dust exposure was less than 6 hours (<2 hours, n = 1; 2–4 hours, n = 10; 4–6 hours, n = 4; unknown but <6 hours, n = 6), and 20 of 21 rescuers wore a European standard FFP1 respiratory face mask during SAR

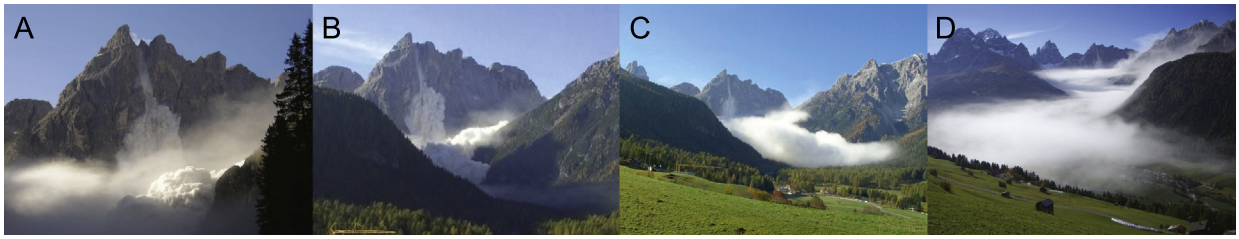

Figure 1. Initial release of material from Mt Einser on October 12, 2007 (A), and dispersion of the dust cloud 5 (B), 10 (C), and 60 (D) minutes after release. Photo credit: P. Tschurtschenthaler, firefighter division Sexten.