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ORIGINAL RESEARCH

Case Report: Severe Frostbite in Extreme Altitude Climbers—The Kathmandu Iloprost Experience

Prativa Pandey, MD; Ravi Vadlamudi, MD, MPH; Rashila Pradhan, MDGP; Kishore R. Pandey, MRCP; Alex Kumar, MBBS; Peter Hackett, MD

From CIWEC Hospital and Travel Medicine Center, Kathmandu, Nepal (Drs P Pandey, Pradhan, and K Pandey); Packard Health, Ann Arbor, MI (Dr Vadlamudi); Department of Medicine and Physiology, University of Fribourg, Fribourg, Switzerland (Dr Kumar); Department of Primary Care & Public Health Sciences, King's College London, London, UK (Dr Kumar); Altitude Research Center, University of Colorado School of Medicine, Aurora, CO; and the Institute for Altitude Medicine, Telluride, CO (Dr Hackett).

Severe frostbite occurs frequently at extreme altitude in the Himalayas, often resulting in amputations. Recent advances in treatment of frostbite injuries with either intravenous or intra-arterial tissue plasminogen activator, or with iloprost, have improved outcomes in frostbite injuries, but only if the patient has access to these within 24 to 48 h postinjury, and ideally even sooner. Frostbitten Himalayan climbers are seldom able to reach medical care in this time frame. We wished to see if delayed iloprost use (up to 72 h) would help reduce tissue loss in grade 3 to 4 frostbite. In a series of 5 consecutive climbers with severe frostbite in whom we used iloprost, 4 of whom received treatment between 48 and 72 h from injury, 2 had excellent results with minimal tissue loss, and 2 had good results with tissue loss less than expected. The 1 patient with a poor outcome likely experienced a freeze-thaw-refreeze injury. This small series suggests that iloprost can be beneficial for severe frostbite, even after the standard 48-h window and perhaps for up to 72 h.

Keywords: climbing, Everest, cold injury, mountaineer, amputation

Introduction

CIWEC Hospital and Travel Medicine Center located in Kathmandu, Nepal, treats many climbers and trekkers each year. Among the more than 200 cases of frostbite recorded in the CIWEC database in the past 5 y (2012–2016), most of the injuries were in mountaineers who were trying to summit or had summited Mount Everest and other 8000 m peaks in Nepal and in Tibet. Time to presentation was usually 72 h or greater until 2012/2013, when helicopter rescue from camp 2 on Mount Everest in Nepal became routine. Since then, climbers have started to present within 48 to 72 h of their frostbite injury. Before our starting to use iloprost in 2014, care was merely supportive. In October 2014 a typhoon in India caused unusually high snowfall in the Annapurna massif during the peak trekking season. Numerous trekkers died near Thorung Pass (5416 m) and some survivors sustained severe frostbite.[1] The Nepal military evacuated 3 Israeli travelers by helicopter with severe grade 4 frostbite and we initiated iloprost treatment 72 h after injury with the first dose at CIWEC and subsequent 4 doses in Israel. Two of the trekkers had amputations but 1 of them recovered completely (Figure 1).

Based on this experience and recent literature suggesting that iloprost could be effective beyond 24 h, we developed a protocol using intravenous iloprost in persons with grade 3 to 4 frostbite who presented within 72 h of injury. We report here our experience with the first 5 climbers to encourage others to consider using iloprost for these devastating injuries in the proper setting.

Background and methods

Thrombolysis is gaining recognition as an effective treatment for severe frostbite injuries. Tissue plasminogen activator (tPA) given intravenously or intra-arterially is effective when given within 24 h of frostbite injury, and with limited warm ischemia duration.[2–4] In addition, the prostacyclin analogue iloprost given intravenously was effective in a controlled trial and in case reports, and

Corresponding author: Prativa Pandey, MD, CIWEC Hospital and Travel Medicine Center, Kathmandu, Nepal; e-mail: prativapandey@ciwec-clinic.com.

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Figure 1. Frostbite of both feet, with purplish discoloration involving all toes and extending to mid-metatarsals, with hemorrhagic blisters on toes. Photos: top row at 74 h; bottom row, left and middle photos at 3 mo, right at 1 y. (See text.).

can perhaps be given more than 24 h after frostbite injury, although data are limited.[5–8] Most patients being evacuated from Himalayan peaks with frostbite do not arrive at the hospital within 24 h, and therefore iloprost may offer a treatment option for these climbers. In order to assess this possibility, we used iloprost in a consecutive series of frostbite patients in the spring Everest climbing season of 2016.

We performed initial evaluations, documented the frostbite injuries with photographs, and obtained informed consent for treatment. Grading of frostbite injury was based on the system proposed by Cauchy et al,[9] with distal phalanx involvement being grade 2, middle and proximal phalanx grade 3, and metatarsal/metacarpal involvement grade 4. In grade 1, the initial lesion (defined by a grayness or cyanotic anesthetic area of the distal phalanx) vanishes after rapid rewarming.[9] Each injured digit was graded. All frostbite injuries had spontaneously thawed and rewarming was not necessary. Local care of frostbitten extremities included bulky protective dressings after soaking in warm povidone-iodine-water solution. Blisters were drained if large, and desquamated areas were dressed with sterile nonadherent dressings. Iloprost was mixed with normal saline to a concentration of 0.2 $mcg \cdot mL^{-1}$. Infusion was started at 2 $mcg \cdot h^{-1}$ for 30 min, then increased by 2 $mcg \cdot h^{-1}$ every 30 min to a maximum of 6 $mcg \cdot h^{-1}$ for persons 50 kg or less, 8 $mcg \cdot h^{-1}$ for persons 75 kg or less, and 10 $mcg \cdot h^{-1}$ for persons weighing more than 75 kg, making an infusion rate of approximately 2 $ng \cdot kg \cdot min^{-1}$. Monitoring of patients included heart rate and blood pressure, and we watched for vasomotor reactions such as headache, tachycardia, palpitations, and nausea; if these developed we reduced the dosage until the patient was able to tolerate the drug. The infusion was continued for 6 h each day for 5 d. We administered aspirin 325 mg daily for 5 d, and cephalexin 500 mg 4 times a day, with 1 person receiving intravenous ceftriaxone 2 g/d on account of foot cellulitis. We performed local frostbite care daily as described above. This protocol was approved by the Kathmandu CIWEC Hospital ethics committee.

Case reports

Patient demographics and treatment details of the following cases are presented in Table 1.

PATIENT 1

A 49-year-old man presented to our hospital after helicopter evacuation from camp 2 (6400 m) on Everest in May 2016. He had summited and descended to the South Col (8000 m, camp 4), where he spent the night. The next morning he felt cold and was numb in both feet. He removed his shoes to find the socks soggy with sweat and his toes frostbitten. He changed his socks, applied pads to warm his feet, and descended by foot to camp 2. He was evacuated from camp 2 the next morning to Kathmandu. He did not receive any medication before arriving in Kathmandu, where his feet showed purplish discoloration affecting all the toes of the left foot, with a large bleb on the first toe, and purplish discoloration and blebs on toes 1 to 3 of the right foot