CLINICAL ARTERIAL INFUSION OF CALCIUM GLUCONATE: THE PREFERRED METHOD FOR TREATING HYDROFLUORIC ACID BURNS OF DISTAL HUMAN LIMBS

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Abstract
Objective: This study was designed to evaluate the efficiency and safety of arterial infusions of calcium gluconate to treat hydrofluoric (HF) acid burns of the distal human limbs. Materials and Methods: Eligible patients with HF burn limbs, collected from January 2008 to October 2011, were given the arterial infusion of calcium gluconate into the injured limbs. The measures of pain were conducted before the infusion, immediately after the infusion, 4 h after the infusion, and 2 days after the infusion by the visual analogy score (VAS). If the VAS score was higher than 4.0 at the time point 4 h after the first infusion, the infusion was repeated. The time of wound healing, and the number and ratio of the cases receiving the surgical operation were also evaluated. Results: A total of 118 patients, male (107 cases) and female (11 cases), were collected, including 64 cases of outpatients and 54 cases of inpatients. The age of the subjects ranged from 16 to 60 years, with the mean age of 37.6. The burn sites were located in the lateral limbs (28 cases) and in the unilateral limbs (90 cases). For 107 cases, the pain scores decreased quickly after the first infusion. The other 11 cases, with the VAS score higher than 4.0 at the time point 4 h after the first infusion, received the second infusion. The average time of wound healing and the ratio of the cases receiving the surgical operation were closely related to the interval from the injury to the reception of infusion. Conclusions: Arterial infusion of calcium gluconate, effectively relieving the pain, blocking wound progressive deepening, and causing no adverse effects, could be the preferential method to treat hydrofluoric acid burns of the distal human limbs.

Keywords:
Hydrofluoric acid, Burn, Calcium gluconate, Arterial infusion

INTRODUCTION
Hydrofluoric acid (HF), a colorless poisonous corrosive liquid, has been widely used in the synthesis of organic fluorine compounds, semi-conductor production, glass etching, metal casting and in other industrial fields. During the production, transportation and usage of HF, this powerful inorganic acid easily causes burns individually or in batches, which usually occur on the distal limbs.

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The accidents of HF burns have occurred not only in the enterprises dealing with chemical production and transportation, but also in the daily life [1–3]. Among all the chemicals resulting in chemical burns, HF could become the first most common substance to cause chemical injuries [3]. Moreover, the fluoride ion can be absorbed quickly through the skin and further result in secondary lesions, such as serious skin necrosis, hypocalcemia, and severe pain [4]. To effectively treat the patients with HF exposure, immediate specific and specialized medical measures seem to be essential. In addition to the traditional measures for chemical injuries, arterial infusion of calcium gluconate has been reported as an effective method to treat chemical burns occurring due to HF [5,6]. Herein, we report 118 cases of HF burns, who received intraarterial calcium gluconate treatment. We also emphasize the importance of the early management of the treatment and the efficacy and safety of this method used to treat HF burns of the distal human limbs systematically evaluated by observing the level of pain, the time and way of wound healing, and the occurrence of adverse reactions.

MATERIALS AND METHODS

Clinical materials

From January 2008 to October 2011, eligible patients with HF burns of distal lateral or unilateral limbs out of the inpatients and outpatients of the Department of Burns of Zhejiang Quhua Hospital or of the Department of Burns of 2nd Affiliated Hospital of Zhejiang University were enrolled in this retrospective study. The patients with inhalation injuries, disturbances of consciousness, severe diseases of important organs and other HF burns beyond the limbs were excluded. The teenage patients under the age of 14 were also excluded. The burn patients did not receive the same or similar treatment related to calcium gluconate after HF burns. A total of 118 patients, male (107 cases) and female (11 cases), were collected, including 64 cases of outpatients and 54 cases of inpatients. The demographic and clinical characteristics of the 118 enrolled patients are listed in Table 1. The age of the patients ranged from 16 to 60 years, with the mean age of 37.6. The burn sites were located in the lateral limbs (28 cases) and in the unilateral limbs (90 cases). The analysis of the data of the patients and the cause of the HF burns showed that except one case resulting from the accidental injury involving a glass detergent used in the kitchen, all the other cases were associated with the particular occupations of the subjects. 32 injuries occurred in the production plants, 39 during transportation, 11 during facility maintenance and repairs, 4 in the laboratory and the remaining 31 cases occurred in the glass sculpture, metal casting, electronics industries and so on. Among 107 patients with the burn wounds on the hands, there were 90 cases with finger burns and 17 cases with accompanying palm of the hand or back injuries. Table 2 shows the distribution of 281 burned fingers of 107 patients. In the other 11 patients, their burn wounds mainly occurred on the sole of the foot, distal back and toes. Out of all 118 patients, only 34 cases (28.8%) used protective equipment at the workplace and they were exposed to HF due to broken rubber gloves, shoes or clothes.

Methods for arterial infusion of calcium gluconate

In the patients injured immediately after the HF burn, their radial artery, dorsal pedal artery or posterior tibial artery of the injured site was selected as the puncture blood vessel. After successfully puncture along or against the blood flow, the mixed solution of 10 ml of 10% calcium gluconate and 20 ml of 10% glucose was injected slowly by the syringe pumps. The injection procedure finished in 15 min, usually aroused the obvious burning sensation in the patients.