〈Case Report〉

A Case of Non-Operative Management for Sulfuric Acid Burns

Sachiko YAMADA, Yasukazu SHIINO, Keiko MIYAJI, Jun SUGIURA,
Nobuharu TAKEHARA, Jiro TAKAHASHI, Toshihiro HOTTA,
Takahiro INOUE, Ryukoh OGINO

Department of Acute Medicine, Kawasaki Medical School, 577 Matsushima, Kurashiki, 701-0192, Japan

ABSTRACT It is thought that severe chemical burns usually require a treatment of extended deep skin and subcutaneous tissue debridement and subsequent skin grafting. However, in this report we discuss the successful treatment of a severe dorsal chemical burn caused by sulfuric acid without skin grafting.

A 45-year-old man was showered with highly concentrated (80%) sulfuric acid from a pipe burst at a factory. He sustained severe chemical burn injuries to the limbs and back. On arrival at the hospital, total body surface area burned, the burn index, and the prognostic burn index were 61.5%, 57.7, and 102.7, respectively. Considering the patient's functional prognosis, surgical treatment of the limbs involving skin grafting was performed early in the treatment process. Additionally, daily bedside debridement of necrotic tissue of the back resulted in complete epithelialization without skin grafting.

It is difficult to accurately assess the depth of dorsal burns due to the thickness of dorsal skin. In cases of chemical burns, skin color changes associated with chemical reaction make the assessment of burn depth even more difficult. The dorsal burn was estimated to be third degree on arrival in the present case. However, complete epithelialization without skin grafting suggests that it was a second degree burn.

The patient was discharged 218 days after injury. The patient's functional prognosis was satisfactory with soft skin texture and no contractures.

doi:10.11482/KMJ-E42(1)9 *(Accepted on March 4, 2016)*

Key words: Third degree burn, Chemical burns, Conservative management

INTRODUCTION

Unlike thermal burns, chemical burns resulting from sulfuric and other strong acids cause deep skin injury due to tissue dehydration and degeneration. The inciting agent makes direct contact with and erodes the tissue so that the condition worsens over time[1]. Thus, chemical burns are usually deep, often third-degree burns involving full-thickness or

Corresponding author
Sachiko Yamada
Department of Acute Medicine, Kawasaki Medical School, 577 Matsushima, Kurashiki, 701-0192, Japan
Phone : 81 86 462 1111
Fax : 81 86 464 1044
E-mail: sachi.yama.31.42@gmail.com

hypodermal necrosis. Treatment by surgical wound closure is common in severe chemical burns[2].

However, in this case report, we discuss severe chemical burns due to sulfuric acid that were successfully treated without skin grafting.

CASE REPORT

Patient: A 45-year-old man

Medical history: Nothing of note

Present illness:

While working at a factory site on scaffolding approximately 4 meters from the ground, a pipe located about 5 meters away burst, and highly concentrated sulfuric acid (80%) spewed from the broken pipe and showered down on the patient from behind. The patient was wearing a helmet, long sleeves, long pants and a safety harness; therefore, it took about 15 minutes to leave the scene of the accident and begin wound irrigation.

Hospital course:

After arrival at the hospital, whole-body irrigation with tap water continued for several hours while systemic evaluation was simultaneously performed. Before wound irrigation, there were no clear skin color changes in the burned area upon comparison with healthy skin areas. Therefore, it was difficult to identify the extent of the burn. As irrigation progressed, color changes became apparent, and the injured area was clearly identified. The evaluation of the burn showed that total body surface area affected was 61.5%, with a burn index (BI) of 57.7 and a prognostic BI of 102.7.

A painless, white leathery burn wound, evaluated as third-degree burn, included the left side of his face, all four limbs and the dorsal region (Fig. 1). There was no inhalation injury. Considering the patient's functional, cosmetic prognoses, and his age, the proposed treatment strategy consisted of artificial skin culture and skin grafting, which was initiated from his limbs. Skin grafting was initiated on the 5th day after injury and was repeatedly performed in the following 3 months.

Fig. 1: Chemical burn wound of the back with sulfuric acid on arrival at our emergency room.

Fig. 2: Chemical burn wound of the back which was debrided on the 2nd hospital day.

Due to the limited availability of his own skin for harvesting and the thickness of the dorsal dermis and hypodermis suggesting the possibility that epithelialization might occur with ongoing debridement, the dorsal region was placed last in order of priority for grafting. Bedside debridement was initiated on day 1 after injury (Fig. 2). After showering the whole body, dissecting scissors were used to excise the necrotic tissue from the dorsal region while carefully monitoring for hypothermia and changes in vital signs. Duration of debridement, including all related procedures, was limited to a maximum of 1 hour per day. Wound dressings were

Fig. 3: Chemical burn wound of the back on the 40th hospital day.

Fig. 4: Chemical burn wound of the back on the 123rd hospital day

comprised of non-adherent dressing with silver sulfadiazine (Geben Cream®) or white petrolatum (Ex-Dry®). Ointment selection was based on wound status.

As excision of necrotic tissue progressed, granulation occurred, and by day 39 after injury, sparse islands of epithelialization were observed (Fig. 3). Approximately two months were required to excise most of the necrotic tissue. Epithelialization of the residual epithelial components subsequently took place (Fig. 4). Complete epithelialization of the dorsal burn wound took 190 days and discharge from the hospital at 218 days. At the time of discharge, there was no contracture or hypertrophic scarring. Although hypohidrosis and vitiligo were

Fig. 5: Healed chemical burn wound of the back on the 1095 days after injury.

Fig. 6: Local findings of the back on the same day in Fig. 5.

present, there was no exercise limitation in the back. At three years after injury, the patient has no difficulty in daily activities (Figs. 5, 6). With regard to back sensation, he felt no pain on admission, but now has moderate pain sensation. The vitiligo remains unchanged.

DISCUSSION

The majority of chemical burns occur due to industrial accidents[3]. Since complete accident prevention is impossible, the correct handling of chemical burn patients is an important issue,

particularly at medical facilities near industrial areas. However, there is limited useful literature regarding appropriate management of chemical burns not only at the scene but also at medical facilities.

During initial irrigation with water for highly concentrated sulfuric acid burns, the sulfuric acid initiates an exothermic reaction with water. The reaction results in an extremely rapid temperature increase. However, this temperature elevation can be minimized by using copious amount of water[4, 5]. On the other hand, the usefulness of sodium bicarbonate to neutralize the acid still remains to be investigated[6].

Assessing burn depth of chemical burns and prognoses is still challenging because color changes and sclerotization associated with the chemical reaction may obscure burn depth, and blisters may not accompany superficial dermal burns. As for suspected third-degree burns, there was a report of complete epithelialization in 4 weeks[7]. However, if the burn depth is underestimated, the period of epithelialization may take longer than anticipated. Subsequently, scar contractures may result in motor dysfunction. Furthermore, prolonged immobility may result in serious infection and a poor prognosis.

In the present patient, rapid irrigation with copious amounts of tap water was performed to treat a dorsal burn caused by highly concentrated sulfuric acid. During this process, it was thought that the burn was likely to be third degree. However, epithelial structures such as hair follicles and sweat glands survived, and granulation occurred with ongoing debridement, thereby enabling successful epithelialization. This indicates that the burn was second degree.

The present patient was a healthy adult man with good nutritional status and no medical history. Therefore, active rehabilitation from an early stage after injury was possible for satisfactory wound healing without residual functional limitations.

In general, the primary goal of severe burn treatment is rapid wound closure for fluid and infection control; for this purpose, surgical intervention is required[8]. However, in the case of severe burns to the back, the patient may have difficulty in resting in the supine position when the burned subcutaneous fat-pad in the back is excised extensively to the depth of the pre-fascia layer. Therefore, early surgical intervention may not be feasible prior to the confirmation that there is no conservative wound management besides aggressive surgical intervention such as extensive debridement and skin grafting. The dorsal skin is thick enough that burns seldom reach the subcutaneous tissue to create a third degree burn, and the dorsal burn wound may be misdiagnosed as a deeper wound than anticipated. Additionally, when there are other deep thermal burn areas, these areas have priority over the back for extensive surgical procedures. Therefore, it may be reasonable to do repetitive minimal debridement to remove superficial necrotic burned skin. This procedure may result in successful epithelialization of the back without extensive debridement and skin grafting, although it may take a longer time to heal. In cases of dorsal chemical burns, overestimation of burn depth can be caused by the thickness of dorsal skin and skin color changes associated with chemical reaction. The present case suggests that careful assessment of burn depth is required.

ACKNOWLEDGEMENTS

A summary of this case report was presented at the 40th Japanese Society for Burn Injuries (Saitama, 2014). The authors report no conflicts of interest.

REFERENCES

1) Palao R, Monge I, Ruiz M, Barret JP: Chemical burns: pathophysiology and treatment. Burns 36: 295-304, 2010
2) Bond SJ, Schnier GC, Sundine MJ, Maniscalco SP, Groff DB: Cutaneous burns caused by sulfuric acid drain

cleaner. J Trauma 44: 523-526, 1998

3） Sykes RA, Mani MM, Hiebert JM: Chemical burns: retrospective review. J Burn Care Rehabil 7: 343-347, 1986

4） Davidson EC: The treatment of acid and alkali burns: an experimental study. Ann Surg 85: 481-489, 1927

5） Penner GE: Acid ingestion: toxicology and treatment. Ann Emerg Med. 9: 374-379, 1980

6） Roock SD, Deleuze JP, Rose T, Jennes S, Hantson P: Severe metabolic acidosis following assault chemical burn. J Emerg Trauma Shock 5: 178-180, 2012

7） Dominic WJ, Field TO Jr, Hansbrough JF: Sulfuric acid burns in a child: histologic examination as an indication of wound depth. J Burn Care Rehabil 8: 395-397, 1987

8） Gibran NS: Committee on Organization and Delivery of Burn Care, American Burn Association.: Practice Guidelines for burn care, 2006. J Burn Care Res 27: 437-438. 2006