

# An Unusual Laboratory Accident: Bromine Burn

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## ABSTRACT

Bromine is a water-soluble, severely toxic element. It leads to tissue injury by causing the release of radical oxygen species from mucosal membranes. Redness or brownish discoloration of the skin, pain, measles-like rash, vesicles, blisters, pustules, furuncles, burns, and ulcers may be seen in the acute phase. A 32-year-old male presented to the emergency department after an accidental spill of bromine on his left forearm. Erythematous skin, including brownish discoloration and occasional small blisters, were seen on the forearm and wrist. The affected extremity was washed with plenty of water. The lesions were covered with antibiotic cream and wrapped with sterile gauzes; they healed without any complications. Mild burn scars with slightly pale discoloration of the affected skin remained after the lesions healed. Although bromine burn is rare, it causes severe damage to the skin, and injury starts insidiously without causing a visible skin reaction at the beginning. Irrigation with plenty of water in the early period is critically important in reducing the severity of the injury.

**Key Words:** *Bromine, Burn, Skin, Radical oxygen species.*

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## INTRODUCTION

Bromine ( $\text{Br}_2$ ), a member of the halogen group, is a reactive element, which is in the liquid phase at room temperature. It is a water-soluble, severely toxic substance that has a brownish-red color and a smell resembling that of bleach.<sup>1</sup> It is used, as an alternative to chlorine, in swimming pools. Bromine-containing products are also used in flame retarders and agricultural fields.<sup>2</sup> Most of the victims are exposed to  $\text{Br}_2$  accidentally. After exposure, it reacts with tissue components like respiratory epithelium and dermal keratinocytes. It causes tissue injury by triggering the release of radical oxygen species (ROS) from mucosal membranes. Besides, hydrobromic and hypobromous acids, which appear when  $\text{Br}_2$  reacts with water in tissues, contribute to secondary damage. In the case of contact with the skin,  $\text{Br}_2$  may cause erythema or brownish discoloration of the skin, pain, measles-like rash, vesicles, pustules, furuncles, burns, and deep ulcers in the acute phase.<sup>3</sup> It does not lead to systemic effects in the acute phase; however, various systemic symptoms may appear several months after exposure to  $\text{Br}_2$  vapor. Cough, dyspnea, chest tightness, eye irritation, headache, dizziness, fatigue and disorders of memory, sleep and sexual functions may be observed 6 to 8 weeks after exposure.<sup>4</sup> A patient with skin exposure to liquid  $\text{Br}_2$ , leading to 2<sup>nd</sup> degree burns in the acute phase, is presented in this report.

## CASE REPORT

A 32-year-old male presented to the emergency department (ED) after an accidental spill of  $\text{Br}_2$  on his left forearm while working in the chemistry laboratory one hour before. He stated that he felt pain in his skin nearly 30 minutes after the exposure. Erythema, including brownish discoloration and occasional small blisters (some of which had burst), were seen on the forearm and wrist (Figure 1). The left upper extremity was washed with plenty of water for the purpose of dilution and removal of the chemical. The lesions were covered with antibiotic cream and wrapped with sterile gauzes. Tetanus toxoid was given intramuscularly. The patient was consulted with the Plastic and Reconstructive Surgery Department, and an out-patient follow-up visit was arranged for the next day. He was advised to re-admit to the ED in the case of new or worsening symptoms. His lesions healed without any complications. Mild burn scars with slightly pale discoloration of the affected skin remained after the lesions had healed (Figure 2). No additional problems have developed during the 6-month out-patient follow-up.

## DISCUSSION

$\text{Br}_2$  burns start insidiously without causing a visible skin reaction at the beginning. So, this delay in the development of signs and symptoms should be taken into consideration while dealing with the injuries caused by  $\text{Br}_2$  or its compounds. Symptoms of the present patient, who had skin exposure to liquid form of  $\text{Br}_2$ , started 30 minutes after the exposure. Kim and Seo reported 4 cases of possible  $\text{Br}_2$  exposure through skin contact with waste chemicals. The patients developed skin lesions 1 to 5 days after the exposure. Their lesions included grouped bullae and lichenified hyperpigmented patches.<sup>5</sup>

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**Figure 1: Second degree chemical burns with mild edema and erythematous skin, including brownish discoloration, occasional small blisters (arrows) and a burst blister (arrowhead), are seen in the forearm and wrist.**



**Figure 2: Healed lesions, with mild scar formation and pale discoloration of the skin, are seen in this photograph taken 6 months after the exposure.**

Eliaz *et al.* demonstrated the destruction of stratum corneum in whole-length human skin through in vitro analysis. They have suggested that affected cells and collagen release  $\text{Br}_2$  when they lose their structural integrity, which results in penetration of  $\text{Br}_2$  into nearby skin components and causes further damage. So, they postulated that even mild lesions may require early intervention and debridement.<sup>6</sup> No debridement procedure was needed in the present case. Recently, Snider *et al.* found out that superficial and deep dermal injuries occurred with 7 min and 17 min of exposure, respectively when pig skin was exposed to  $\text{Br}_2$  vapor.<sup>7</sup> Price *et al.* examined transcriptional changes in the porcine skin caused by  $\text{Br}_2$  vapor exposure.<sup>8</sup> Both studies evaluated the effects of exposure to  $\text{Br}_2$  vapor. We have not encountered any burn cases caused by direct exposure of skin to liquid  $\text{Br}_2$ .

There is no specific antidote for  $\text{Br}_2$ , so treatment of  $\text{Br}_2$  exposure is mostly supportive. Any attempt to undress the victim by pulling the clothes must be avoided; all contaminated clothes must be cut with scissors and removed cautiously. Skin exposed to  $\text{Br}_2$  must be washed with streaming water for at least 6 minutes. Close observation is critical during the first 24 hours due to the risk of the development of delayed effects. The patient must be given tetanus toxoid. The basis of ED management is the initiation of supportive and symptomatic treatment as soon as possible to prevent further damage. The patient should be hospitalized if there are any high-risk findings like considerable edema, which may lead to the development of compartment syndrome.

In conclusion, it should be kept in mind that tissue injury caused by  $\text{Br}_2$  exposure may be started already though there are no visible lesions at the time of admission to the ED. Besides, the patient should be informed and warned about possible alarming signs and symptoms, which may appear later, and an out-patient follow-up visit should be arranged for the next day before discharge from the ED.

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#### **PATIENT'S CONSENT:**

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#### **COMPETING INTEREST:**

The authors declared no conflict of interest.

#### **AUTHORS' CONTRIBUTION:**

Literature review and data collection were performed by both authors. The first draft of the manuscript was written by Hasan Basri Cetinkaya, and Harun Gunes commented on previous versions of the manuscript. Both authors read and approved the final manuscript.

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