Case Report
Accidental intoxication by dichloromethane at work place:
Clinical case and literature review

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Abstract

Introduction: Dichloromethane, also known as methylene chloride, is an organic solvent used in various industrial applications. Exposure to DCM can result in toxicity caused by either the direct effects of DCM or by its metabolite, carbon monoxide.
Clinical case: A 27-year-old man, a worker in a paint-stripping factory, fell down in a well having suffered immediate loss of consciousness. He was sedated, intubated, and transported to the hospital.
Hospital blood gas showed severe metabolic acidosis and increased levels of carbon monoxide — FCOHb 23.9%. A chest radiograph showed bilateral heterogeneous pulmonary infiltrates.
The analysis of the chemicals present in the wells revealed dichloromethane with concentration > 50%. Hyperbaric oxygen therapy was performed, and the patient was discharged after a total of 10 days of hospitalization, without sequelae.
Conclusion: Initial clinical suspicion and rapid confirmation of poisoning by dichloromethane is crucial, given that the speed of action and the institution of appropriate therapy can determine the patient prognosis.

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Keywords: intoxication; carbon monoxide; dichloromethane; hyperbaric medicine

1. Background

Dichloromethane (DCM), also known as methylene chloride, is an organic solvent used in various industrial applications, such as a degreaser, extraction medium, lacquer remover, or paint stripper, and is a very volatile substance (Figure 1). At room temperature, it is a highly volatile and a colourless liquid with a chloroform-like smell. The limit value for industrial purposes in air has been set at 50 ppm (174 mg/m³).1,2

Exposure to DCM can result in toxicity caused by either the direct effects of DCM or by its metabolite, carbon monoxide. Inhalation is the most important route of exposure but poisoning through the skin and after ingestion is possible too.3 Most of the effects of DCM have been observed after acute exposures and have resulted from its direct central nervous system depressant effects, its in vivo conversion to carbon monoxide, or its oxidation to phosgene in an open flame.2

DCM can cause cough, pulmonary irritation, pulmonary edema, mucous membrane irritation, skin irritation, and corrosive burns. Once absorbed, 25—35% of the DCM is metabolized by CYP2E1 in the liver to carbon monoxide, or its oxidation to phosgene.4,5 Carboxyhemoglobin levels of 10—12% may result with rare cases of levels as high as 30—50% having been reported.6

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Although there are reported cases of poisoning by dichloromethane in the literature, clinical suspicion and confirmation of the substance is critical, given that the speed of action and the institution of appropriate therapy can determine the patient prognosis.7,8

2. Case presentation

A 27-year-old man, a worker in a paint-stripping factory where organic solvents were stocked in wells, fell down in a well and suffered immediate loss of consciousness. The emergency team found the patient with a Glasgow Coma Scale of 4, hypotensive (blood pressure: 89/45 mmHg), with bradycardia (48 beats/minute), and multiple areas of burned skin on the face and hands. The patient was intubated and transported to the hospital.

An arterial blood sample (FiO₂ 1.0), two hours after the accident, showed severe metabolic acidosis with pH 7.15 (N 7.35 to 7.45), pO₂ 142 (N 70–100 mmHg), pCO₂ 39 (N 35–45 mmHg), HCO₃ 13.5 mmol/L (N 21–26 mmol/L), BE -14.6 mmol/L, Lactates 7 mmol/L (N 0.5–2 mmol/L), and increased levels of carbon monoxide – FCOHb 10.7% (N <2%).

A chest radiograph showed bilateral heterogeneous pulmonary infiltrates (Figure 2), probably due to acute pulmonary edema and pulmonary microthrombosis. The CBC and blood chemistry showed no changes.

After skin wash for decontamination and replacement with fluid and bicarbonate, the hospital team contacted the patient’s relatives and the company where the patient worked to identify the constitution of the solvents present in the well where the patient had been found.

While we waited for this information, a rise in the levels of carbon monoxide in the blood, with a maximum value of 23.9%, was observed, two hours after admission.

The analysis of the chemicals present in the wells revealed dichloromethane with concentrations > 50% as well as butyl glycol, methanol, ethanolamide, and sodium hydroxide.

Hyperbaric oxygen therapy was performed (during 2 days, for one hour a day at 3 ATM), twelve hours after admission, with clinical, radiological, and gasometric improvement in 24 hours. The patient was extubated after 36 hours without complications. Hospital blood gas and chest radiograph on that time were normal (Figure 3).

He was discharged after a total of 10 days of hospitalization without respiratory complaints and with marked improvement in the burns on the face and hands.

3. Discussion

Lethal accidental intoxication by DCM at the work place is rare. The toxic effect of DCM starts immediately after
inhalation, and the symptoms frequently begin with shortness of breath, infirmity, stupor, and hypotonia of the skeletal muscle before unconsciousness. DCM has cardiotoxic and narcotic effects, and it has been used recently as a short time inhalative anestheticum. Differences between narcotic and toxic doses are rather small. DCM poisoning, although rare, is fatal in most cases. The mechanism of toxicity of this substance is known, but the ability to recognize its clinical presentation and the ability to act quickly and effectively can be decisive in the success of treating the patient.

Hyperbaric medicine is one of the few effective measures, which are known to reduce the levels of carbon dioxide in the blood. In the clinical case above, carboxyhemoglobin reached a value of 23.9%, which besides being rare, is an indicative factor of poor prognosis in the short term. However, we think that the speed of action and the timely start of the hyperbaric therapy determined its positive development and full recovery without sequelae, either physical or neurological. The main effects of butyl glycol, methanol, ethanamide and sodium hydroxide on this patient were probably the multiple areas of burned skin on the face and hands, since these compounds are corrosive substances that typically have their toxic effects by direct contact with the body surface.

Although there are other cases described in the literature of poisoning by DCM, we found that most of them had a fatal outcome, given the high toxicity of this substance. Those who work as furniture strippers and bathtub refinishers are especially at risk of developing severe toxicity. The DCM containing strippers are usually applied with a brush or by using aerosol cans. If the worker is not using respiratory protective equipment and is exposed to high concentrations of methylene chloride, this situation can be fatal.

Consent

Written informed consent was obtained from the patient for publication of this Case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Competing interests

The authors declare that they have no competing interests.

References