

Safety First: A Recent Case of a Dichloromethane Injection Injury

Cite This: *ACS Cent. Sci.* 2020, 6, 83–86

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Safety is of paramount importance in chemistry laboratories. Chemists deal with a wide range of potentially dangerous substances, equipment, and processes including flammable solvents, toxic chemicals/waste, glassware, heating conditions, gas cylinders, and syringes. Although it is perhaps not one of the safety issues that receives much attention or makes headlines, needles are common in chemistry laboratories, and they have the potential to be incredibly dangerous. They are typically used to transfer solvents and/or reagents from one container to another—but when not used correctly they are also very effective at delivering the same substances into the human body! Whereas gloves and lab coats can protect against casual spills, there is little protection against a syringe needle.

So, what would happen if you accidentally stabbed yourself with a syringe containing a residual amount of a common laboratory solvent after transferring the bulk of it to your reaction flask? What kind of damage would you expect, particularly if the solvent was highly toxic? Unfortunately, a real case occurred in my research group in June 2018 when a student injected himself with just a few drops of dichloromethane. The consequences were serious. To raise awareness of the consequences of what may seem like an innocuous accident, my student and I have decided to share this story more widely.

Some of the pictures shown below are graphic and may be disturbing. We show these wounds, to fully inform the reader about the consequences of a misstep in performing a routine lab procedure. Additional images at different stages in the healing process are in Supporting Information. Few would believe the consequences without seeing the pictures, and we felt that a description would not suffice.

Nicolas is a young student who joined my lab for a 2 month fellowship in June 2018. After 2 weeks in the lab performing reactions under the supervision of a PhD



student, they both rushed into my office on a Monday morning at 9:15 am. The PhD student asked me, “Seb, Nicolas just poked himself with a needle and the finger looks weird, what do you think?” This was the first stage of the injury—the picture shown above was taken roughly 10–15 min after the incident. When I saw a pink/purple looking finger with the discoloration spread over a relatively large area I immediately knew something was wrong and that we needed to head straight to the hospital.

I asked Nicolas what was in the syringe when he had pricked his finger with it, and his first reply was “nothing”. But that wasn’t quite the case; he had just finished injecting dichloromethane into his empty flask to set up a reaction. Although the syringe plunger had been fully depressed a small amount of residual solvent would have remained in the needle (a rough estimate suggests the amount would be about two drops or less than 100 μ L) when it pierced his finger.

Dichloromethane is one of the most common organic solvents used in a synthetic chemistry laboratory. More

Published: February 26, 2020

specifically for carbohydrate chemistry, dichloromethane is the typical solvent to perform glycosylation reactions. It is broadly used on a daily basis just as often as acetone, cyclohexane, ethyl acetate, ethanol, or methanol. Dichloromethane has the peculiarity to create heat when in direct contact with the skin, especially when confined between your skin and a watch or glove, as it also permeates quite readily through most protection gloves. If you have already experienced that immediate burnt feeling, you will remember how quickly you have removed your watch or glove.

We left the chemistry building and headed to the hospital, which fortunately happens to be within walking distance of our campus and even has a specialized department for hand trauma. After we arrived there—and nearly 2 h after the accident—his finger looked purple, and there was a suspicion of necrosis at the periphery of the area (see picture below). While in the waiting room at the hospital, Nicolas began to feel extreme heat in his finger, and it got to the point where he could not even move it anymore.



After a surgeon evaluated the wound at 10:30 am, the decision was made that an emergency operation was required immediately. Nicolas was taken to the operating room, and this is when, from my perspective, a very long and anxious wait began. The surgery started at 1:15 pm and lasted almost 2 h. The surgeon had to remove all of the dead flesh from around the puncture wound and the area underwent intense cleaning to reduce the possibility of subsequent infection and gangrene. To reconstruct his finger, a piece of skin was taken from Nicolas's arm and grafted over the wound. The [Supporting Information](#) provides an image showing the condition of the finger 18 h after the operation.

A few weeks after the operation, the surgeon shared that on first seeing the injury he thought he may have had to amputate the finger because of the extent of the damage. However, considering that Nicolas was only 22 years old (and loved to play the guitar), the surgeon decided that he would do everything he could to save his finger. He recounted how he had never seen such an injury during 25 years of working in an emergency hospital department that is located

within walking distance of the chemistry, biochemistry, and physics departments; he had seen many injuries, but nothing like this one. Nicolas had to take painkillers, but these were not effective on a long-term basis, and after 10 days the pain started to kick back in. Eventually, the wound began to heal and, in the end, Nicolas's finger recovered—almost back to normal. The nerve was affected by the necrosis but was not completely cut, and so through re-education and natural nerve reconstruction the normal function of the finger was restored, although with much less power or the special dexterity required for Guitar Hero.



While waiting at the hospital during the surgery, I started looking for information about dichloromethane injuries and its Material Safety Data Sheet (MSDS) (see [Table 1](#)). To my surprise, I could not find anything about the injection of this solvent, just information related to eye contact, skin contact, ingestion, and inhalation. After tweeting about this accident to alert the chemistry community to the danger, in August 2018 I came across the publication of a similar case in Thailand (Dichloromethane injection: case report, DOI: 10.22038/apjmt.2018.11981). The pictures included in this article are also quite graphic and involve a man who voluntarily self-injected 2 mL of dichloromethane subcutaneously. The scientific evaluation of the injury and its consequences were carefully studied by the hospital in Bangkok.

Unfortunately, any new entry to the dichloromethane MSDS document would require a detailed study with animals to be performed by a specific agency or laboratory. The study must reproduce the accident (or injection) and exposure to dichloromethane with an analysis of the damage to the tissues and a medical evaluation of the consequences. University Lyon 1 has spread the information to every chemistry-related laboratory to inform researchers about the accident in an effort to prevent further instances among students and staff.

Table 1. Portions of the MSDS Data of Dichloromethane from Thermo Fisher Scientific^a Are Reproduced (Revised Nov. 28, 2019)

SAFETY DATA SHEET	
Dichloromethane	
Hazard(s) Identification	
Classification: This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200) Hazard Statements: Causes skin irritation Causes serious eye irritation May cause drowsiness or dizziness May cause cancer May cause damage to organs through prolonged or repeated exposure	
First-aid Measures	
General Advice: If symptoms persist, call a physician. Eye Contact: Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Get medical attention. Skin Contact: Wash off immediately with plenty of water for at least 15 minutes. If skin irritation persists, call a physician. Inhalation: Remove to fresh air. If not breathing, give artificial respiration. Get medical attention if symptoms occur. Ingestion: Clean mouth with water and drink afterwards plenty of water. Most important symptoms and effects: Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting; Causes central nervous system depression: Continued or high exposures by inhalation will cause anaesthetic effects. This may result in a loss of consciousness and could prove fatal: Causes formation of carbon monoxide in the blood. Carbon monoxide may cause adverse effects on the cardiovascular system and the central nervous system Notes to Physician: Treat symptomatically	

^a<https://www.fishersci.com/store/msds?partNumber=AC167770025&productDescription=DICHLOROMETHANE%2C+99.8%25%2C+2.5LT&vendorId=VN00032119&countryCode=US&language=en>.

Of course, it would have been better if the accident had never happened, but it did, and so the most important outcome at this point is to consider what we can learn from this accident and what steps can we take to minimize the chances of something similar happening again.

- (1) The accidental injection of any solvent, especially a toxic one such as dichloromethane, should be taken very seriously, and action should be taken *immediately*. If the color of the puncture wound and the surrounding area turns pink or purple in a short period of time, this is most likely a sign of necrosis, and it is imperative that medical assessment and treatment is sought rapidly—emergency surgery may very well be required.
- (2) Try not to panic. Inform your colleagues as soon as possible and do not assume that you can take care of the injury yourself; the support of your co-workers could be vital at this point.

Lastly, to minimize the likelihood of accidents with needles, *can we develop new methods and systems for transferring solvents that do not involve cannulas and needles?* Needles present a real hazard, amplified by their

routine use in the lab. The consequences of a misstep can be catastrophic, resonating with the 2008 case at UCLA that resulted in the tragic death of a research assistant. In this case, the syringe used to transfer *tert*-butyl lithium between sealed containers became disassociated, causing the pyrophoric reagent to spill and ignite. The student passed away due to the severe burns she sustained from the fire.

I would like to thank Nicolas for consenting to his story being shared in this article; he wanted the details of his accident to be communicated as widely as possible to alert others to the potential risk. He finished his internship in the lab and focused mainly on a literature survey for the project he was working on. Despite his examiners complaining about the lack of data in his project (maybe they forgot he could only spend 2 weeks at the bench rather than 8), he gave a great defense. Nicolas has not let his accident deter him, and he has continued doing organic chemistry; the following year he joined a chemistry laboratory in Sweden for a 6 month internship focusing on ionic liquids. He can also still play the guitar a little, but hasn't yet quite got back to where he was prior to the accident.

Given the lack of information on injection of dichloromethane, I would also like every student, lab manager, technician, engineer, principal investigator, professor, and safety officer, in academia or industry, to share this accident with their colleagues. Please help spread the word that dichloromethane injection is terribly serious and must be considered as an immediate threat. Additionally, this is an open challenge to the scientific community, engineers, and chemical suppliers to develop safer protocols and alternative equipment for routine procedures with high risk.

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Associated Content

Supporting Information

The Supporting Information is available free of charge at <https://pubs.acs.org/doi/10.1021/acscentsci.0c00100>.

Additional images of the site of injury at various points after the incident ([PDF](#))

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Complete contact information is available at:

<https://pubs.acs.org/10.1021/acscentsci.0c00100>

Notes

Views expressed in this editorial are those of the author and not necessarily the views of the ACS.