Pitfalls in chemical burns

3de Lage Landen Symposium Intoxicaties

Dr. Geert Verstegen
Belgian Poison Centre

26 June 2015, Ghent

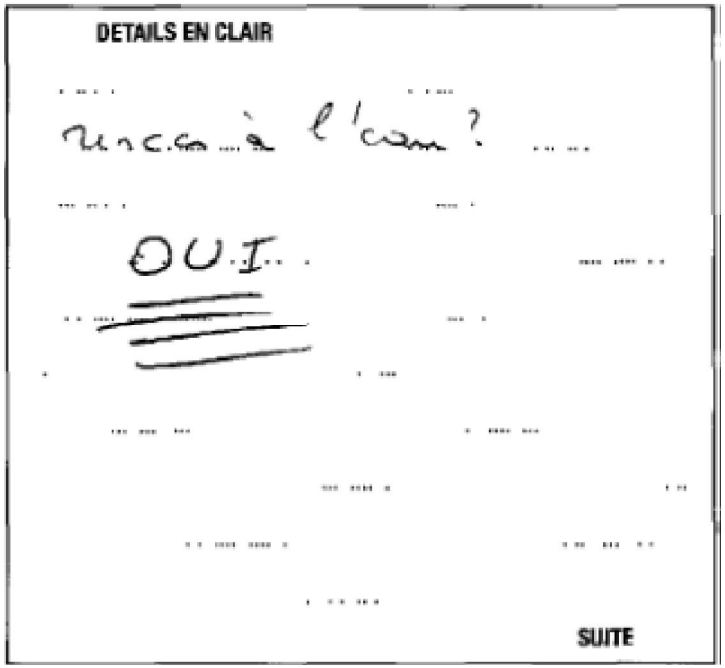
Disclosure belangen spreker

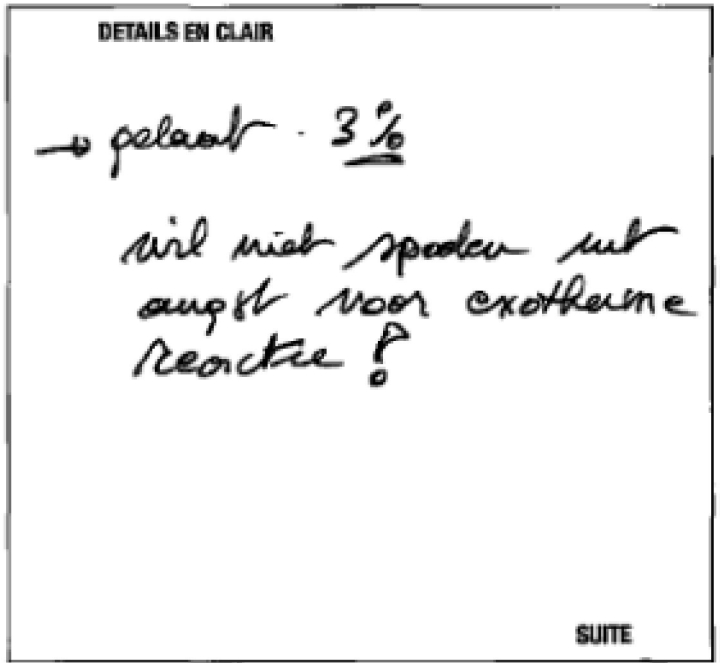
(potentiële) belangenverstrengeling	<u>Geen</u> / Zie hieronder
Voor bijeenkomst mogelijk relevante relaties met bedrijven	Bedrijfsnamen
• Sponsoring of onderzoeksgeld • Honorarium of andere (financiële) vergoeding • Aandeelhouder • Andere relatie, namelijk …	• Geen • Geen • Geen • Geen

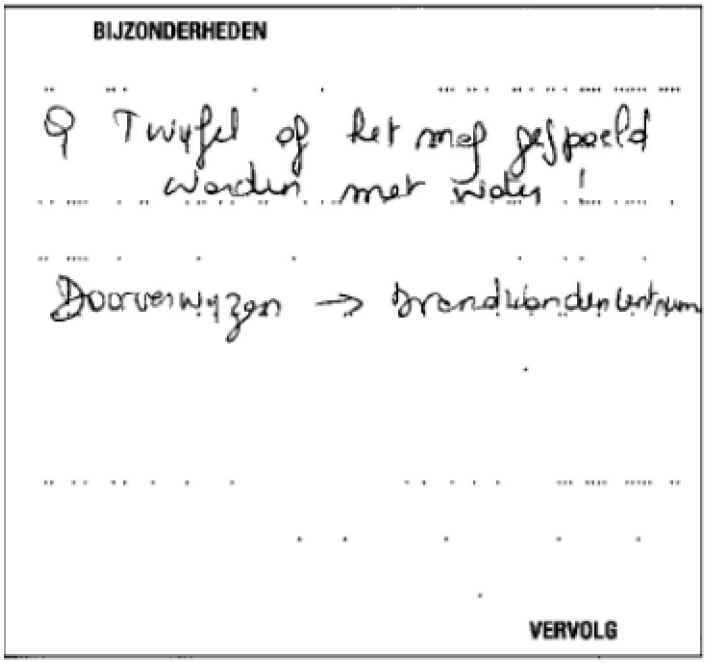
Pitfalls in chemical burns

- Typical cases: pitfalls encountered
    - Highly exothermic reactions: should we rinse?
    - Role of pH
    - Clinical picture of bases
    - Hydrogen fluoride
- Unusual suspects
    - Examples
- Hidden suspects
    - Toxicovigilance

Highly exothermic reactions: H_2SO_4 & CaO







Highly exothermic reactions: H_2SO_4 & CaO

- S30: Never add water to this product
- EUH014: Reacts violently with water

S26 - Bij aanraking met de ogen onmiddellijk met overvloedig water afspoelen en deskundig medisch advies inwinnen.
S30 - Nooit water op deze stof gieten.

Should we rinse with water???

Highly exothermic reactions: H_2SO_4 & CaO

- Always rinse with plenty of water!
  - High heat capacity of water: water will absorb the heat and will take it away while running off
  - Human tissue does contain water: heat will be produced anyway
- Only nuance:
  - Dry substance: brush or shake it off before rinsing

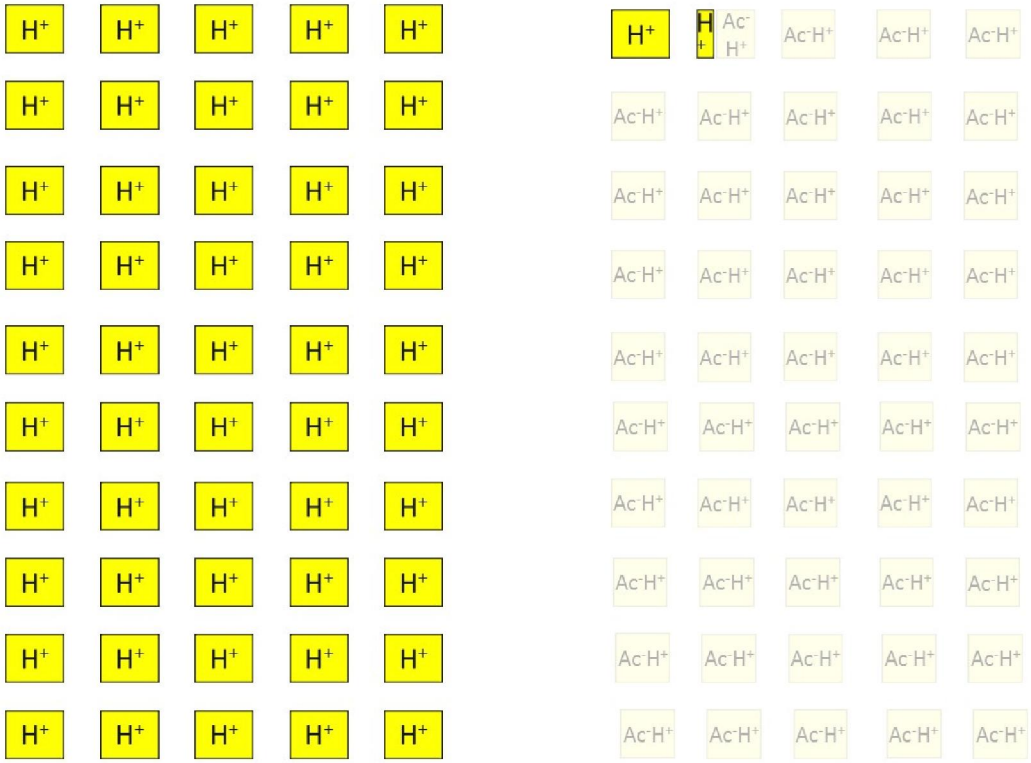
Non-extreme pH

- Women, 62 yrs
- Pulling tiles out of bucket with hypochlorite solution 7,5° (15°/2), pH 12,05 (± 0,5)
- ± 50 minutes, 2 consecutive days
- Cleaned the floor afterwards with 2/3 dilution of same hypochlorite solution.
- 12 hours after last contact: redness & pain
- 24 hours after last contact: crusts & pain, fragile and bleeding skin

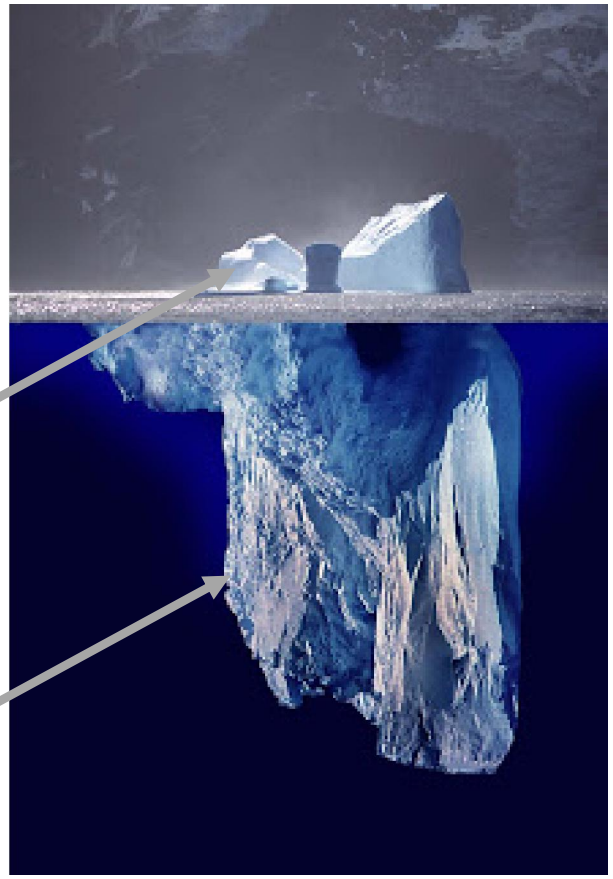
Non-extreme pH

Non-extreme pH: what happened?

- Not very agressive, but <u>prolonged exposition</u>
- pH does not tell it all, also consider the <u>concentration</u>
  - Glacial acetic = 99% = 16,5 M → pH 2,4
  - Hydrochloric acid 0,1 M = 0,36% → pH 2,0



Acid/alkaline reserve



p(O)H

p(O)H-reserve

« Pizza knee » from a cement burn

Non-extreme pH: vinegar

CHEMICAL SKIN BURNS CAUSED BY A BIPHASIC NAIL POLISH REMOVER CONTAINING ETHYL ACETATE

Verstegen G, Mostin M
Belgian Poison Centre, Brussels, Belgium

070 245 245

Introduction

Ethyl acetate and butyl acetate are widely used in nail polish removers. In contact with water they may decompose with formation of acetic acid(1,2). Our aim is to describe a case of skin injury caused by a decomposed biphasic nail polish remover.

Case report

Three hours after using a nail polish remover, a 74-year-old woman felt a burning sensation in her fingers. The following hours, she complained of increasing burning pain. She was examined by a general practitioner one day later. There was erythema with blisters at the top of the fingers, suggestive of a second degree burn. The lesions were treated with a silver sulfadiazine ointment. She recovered without sequellae. The original product presented in two phases: a solvent phase containing 59.4 % of ethyl acetate, 20.0 % of butyl acetate and 20.0 % of dimethoxymethane and an aqueous phase consisting of 99.2% of water with trace amounts of other ingredients. At the time of the accident, one month after opening of the bottle, there was only an aqueous phase left with a pH of 2.47. Analysis by HPLC-UV revealed 40% of acetic acid.

Chemical identity

IUPAC name:
Ethyl ethanoate

CAS number:
141-78-6

Discussion

Ethyl acetate and butyl acetate are widely used in nail polish removers, usually in one phase formulations. Some products are sold in a biphasic presentation, with an apolar solvent phase and a polar aqueous phase, to be shaken before use. Ethyl acetate (1) and butyl acetate (2) in biphasic solvent systems may slowly decompose into acetic acid and ethanol. In the literature we found no cases of skin burns caused by nail polish removers containing ethyl acetate or butyl acetate. We believe that the polar phase promoted decomposition of ethyl acetate by trapping acetic acid. This resulted in a solution with 40% of acetic acid and a pH of 2.47. Acetic acid is known to cause skin burns in concentrations as low as 5% (3).

Conclusions

Decomposition of ethyl acetate or butyl acetate in biphasic nail polish removers can lead to the formation of a highly concentrated acetic acid solution, causing second degree skin burns.

Fig. 1. Deep ulcer on the dorsum of the left foot.

Tafelazijn:
6% ~ 1 M
pH 2,88

Contact Dermatitis. 1997 Mar;36(3):169-70.
Chemical burn from acetic acid with deep ulceration.
Kuniyuki S, Oonishi H.

Bases: late presentation

- ± 50 minutes, 2 consecutive days
- 12 hours after last contact: redness & pain
- 24 hours after last contact: crusts & pain, fragile and bleeding skin

Bases

- Proper tendency to penetrate deeper
- Late presentation
- Prolonged rinsing!
  - 30 minutes, up to 2 hrs if late presentation and (potentially serious)
- Late evaluation necessary
  - 24 hrs (48 hrs ?)

Hydrofluoric acid (HF)

- A workman cleans wheel rims (= velgen), with bare hands. He uses a product containing hydrofluoric acid (7%).
- The following hours he develops a stinging sensation in the fingers, later a very intense pain in the fingertips.
- Next day: excruciating pain (« as if truck ran over his fingers ») and presents at the hospital
- Clinical examination: normal except pain intensifying when pushing the nail bed
- Poison Centre recommends intra-arterial calcium gluconate + calcium gel -> pain disappears but returns after stopping. Several infusions needed.
- Complete healing

Hydrofluoric acid (HF)

- Applications:
  - Facade cleaner
  - Wheel rim cleaners
  - Cleaning while welding stainless steel
  - Industrial applications
- Bizarre course: missing or underestimation possible. This can lead to loss of fingers
- No symptoms → paresthesia → severe pain without visible lesions → necrosis
- Systemical effects if > 1 hand surface: life-threatening hypocalcemia!
- Calciumtherapy:
  - Gel
  - Infiltration
  - Intra-arterially

Protocol: www.antigifcentrum.be go to “medische professionals”

Unusual suspects

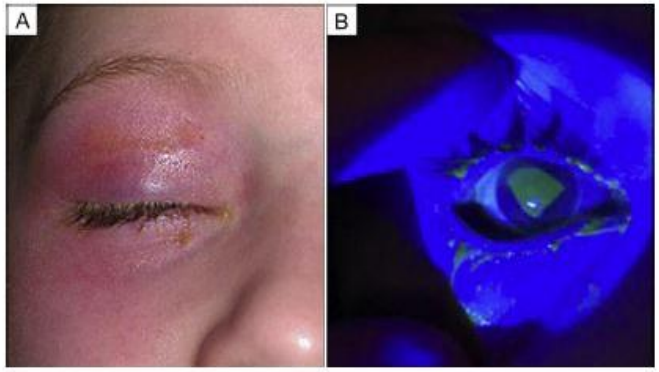
- Always remain cautious
  - Unusual quantity of a rather innocuous substance (suicide, mental limitations, including Alzheimer!)
  - Examples: detergents, tablets to clean false teeth,…
- Not very frequent / dangers aren't common knowledge
  - Heracleum mantegazzianum

Unusual suspects: denture cleansers

- Women, aged 95 yrs
- Swallows two denture tablets
  - Sodium bicarbonate, citric acid, persulfate (generator of H_2O_2)
- Admission four hours later, critical state:
  - Important dyspnea
  - Cyanosis
  - Oedema of mouth and tongue with almost complete obstruction of the oropharynx
  - Part of tablet found in pharynx
  - Intubated / ventilation
  - Bilateral lung infiltrates
  - Died 1 day later on intensive care

Unusual suspects: laundry pods

- Girl, 2 yrs old is playing with a laundry pod
- Pod ruptures and splashes in the face.
- Product on the cheek, around the mouth and in the eye
- Mother rinses face and eye for several minutes and afterwards, the child is quiet
- A few hours later: swollen and painful eye → parents go to emergency ward
- On admission: erythema on right cheek, swollen eyelid (upper right) and red conjunctiva
- Ophthalmological advice: cornea erosion
- Treatment with antibiotics and analgesics
- No follow-up



Picture ≠ our case.

Source:
Corneal injuries from liquid detergent pods. Gray ME1 et al. J AAPOS. 2014 Oct;18(5):494-5.

Unusual suspects: laundry pods

- Very concentrated
- Sticky
- Attractive to children

Significant chemical burns associated with dermal exposure to laundry pod detergent.

Russell JL et al. J Med Toxicol. 2014, Sep;10(3):292-4.

Fig. 1 Chemical burns associated with laundry pod detergent exposure

Calcium chloride

- Neutral pH
- Calcium toxicity – necrosis
- If ingestion: rapidly progressing, deadly hypercalcemia occurs

Cutaneous Necrosis After Contact With Calcium Chloride: A Mistaken Diagnosis of Child Abuse

Necrosis of the skin after contact with calcium chloride has been described in a variety of situations, including that of oil field workers and prolonged electroencephalographic testing (contact paste).[1,2,3] Circumscribed dystrophic dermal calcification was reported for the first time in 1935 and may follow the application of dry calcium or calcium-containing solutions.[4] The authors report a case of percutaneous penetration of a defrosting, industrial calcium salt, which was followed by deep-dermal thigh necrosis in a child. This uncommon injury raised concern about child abuse.

CASE REPORT

An 8-year-old boy was referred to our hospital in October 1993, after progressive dermal necrosis developed on a part of his left thigh. Three days earlier, he had walked in the Swiss Alps; at the beginning of his hike, he had collected three whitish stones from the edge of a mountain path, each approximately 2 cm in diameter, and had stored them in his left trouser pocket. In the shower, a few hours later, he had noticed that a mildly itchy but painless erythema had appeared on the anterolateral aspect of his left thigh, at the site of his trouser pocket.

During the next 2 days, the lesion increased in size to approximately 30 cm^2 and became progressively black, dry, slightly raised, and necrotic (Fig 1). The patient was admitted, and a debridement was performed under general anesthesia. The necrosis was found to extend to the fascia cruris, which remained intact; a simple dressing was applied. On day 6, a superficial skin graft, taken from the scalp, was performed. The patient's postoperative course and healing were uneventful.

Initially, because the child had offered no clear history that could explain the lesion, even when he was interviewed alone, child abuse was considered. This diagnosis was furthermore sustained by the fact that the patient's living conditions were poor and that his mother was known for drug addiction. It was only with repeated questioning that the patient was able to recollect the details of his mountain hike and provided the stones, which he had kept at home. In addition, on the 20th postoperative day, a yellowish fragmented material appeared, scattered on the edges of the grafted and healed wound (Fig 2). This was easily removed, revealing a mild inflammatory reaction underneath.

Von Kossa's staining and mass spectrometry of these concretions, as well as the analysis of the stones kept by the child, confirmed the presence of calcium chloride, which had accumulated in the upper dermis and was progressively extruding from the wound. In the meantime, local investigation revealed that an open bag of calcium chloride, used as a deicing salt, had been forgotten by a road worker on the side of the path where the child had walked.

The extrusion phenomenon progressed and intensified for 2 months. Treatment consisted of repeated removal of the crystals and simple dressings. After 60 days, the extrusion of calcium salts decreased and definitely ceased after 5 months. A final inspection at the 12-month follow-up showed a depressed and slightly atrophic scar.

Received for publication Feb 13, 1995; accepted Mar 29, 1995.
Reprint requests to (D.S.H.) Hopital des Enfants, 1211 Geneva 14, Switzerland.

Fig 1. Skin necrosis as it appeared at day 3 after exposure to calcium chloride.

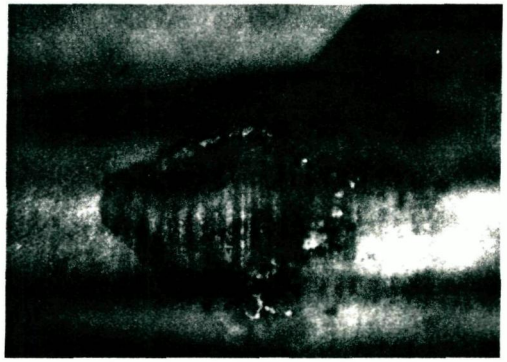


Fig 2. Extrusion of calcium crystals at the edges of the lesion on the 20th postoperative day.

DISCUSSION

Although subcutaneous necrosis has been recognized for many years as a predictable complication after extravasation of intravenously administered calcium salts,[5,6] few cases of skin necrosis caused by external contact have been reported in the literature.[1-4]

In 1935, an ice cream maker developed papules on his feet and legs, at areas of contact with a concentrated calcium chloride solution, used in the freezing procedure.[4] Calcium chloride necrosis also occurred in British coal miners and American oil field workers. The latter handled the so called "drill mud," which contains calcium chloride among other substances and is used to protect the drill; these workers had papulonodular lesions on their hands.[1]

Heracleum mantegazzianum

(reuzenberenklauw)

- People do not mention the contact (not aware of the contact)
- Important to recognize
  - Eradication of the plant
  - Secundary prevention: psoralene. Keep away from sunlight!

Other plants

- Ruta graveolens (common rue, wijnruit)
- Garlic (look)
- Euphorbiaceae (spurge, wolfsmelkfamilie)
- Etc.

Hidden suspects

- Grey (black) zone of the law
- Classification of products does not provide enough protection
    - E.g. because dangers are nut sufficiently known
- Please notify the Poison Centre: toxicovigilance!

Toxicovigilance: removed from the market

« Drops to de-acidify »

Cuatomer	: Alka Vitae
Product	: pH drops
pH pure drops	: 13,5
pH 3 drops diluted in of glass water	: > 9,5
Productnumber	: 156040004027
Appearance	: Colourless solution

Actief component	Active component	Specification
Potassium hydroxide	6,5 %	
Sodium hydroxide	3,5 %	

In Active component	In Active component	Specification
Water	90,0 %	Filtered demi water class A

« Drops to de-acidify »

Quaternary ammonium compounds

- Adult, 58 yrs
- Swallows accidentally 1 mouthfull of 4,6% benzalkonium chloride solution
- Dysphagia, loss of voice
- Burns of mouth, pharynx and hypopharynx
- Oesophagoscopy: glottis oedema, oesophagitis grade 2A and erythematous gastropathy

< > toxicological sources:

7.4 MAXIMUM TOLERATED EXPOSURE

A) GENERAL/SUMMARY

1) Esophageal burns are possible with ingestion of just a few mL of concentrated solution.
2) Corrosive effects have been seen with ingestion of 10% or more concentrated solutions

Quaternary ammonium compounds

- Girl, 9 years old
- Washes her hands with anti-bacterial soap (<3% quaternary compounds)
- Skin itches /aches
- Next morning: red skin between fingers
- Next evening: blisters (picture)
- Second next: even worse (no picture)

Take home messages

- ALWAYS rinse
- pH does not tell you everything
- Bases can give very late burns
- Hydrogen fluoride = tricky
- Remain cautious if unusual quantities are involved
- Consider some unusual causes of burns
- Call us if you think there is an emerging public health threat

070 245 245

http://www.centreantipoisons.be/

http://www.antigifcentrum.be/