

Sodium hydroxide (NaOH)

B 1

Information and recommendations for paramedics and doctors at the site

- Patients whose clothing or skin is contaminated with solid sodium hydroxide or its solutions can cause secondary contamination of rescue and medical personnel by direct contact.
- Sodium hydroxide and its solutions, mists, and aerosols are rapidly corrosive when they come in contact with the eyes, skin, and upper respiratory tract causing irritation, burns, coughing, chest pain and dyspnea. Laryngospasm and pulmonary edema (shortness of breath, cyanosis, expectoration) may occur.
- Ingestion of sodium hydroxide can cause severe corrosive injury to the lips, mouth, throat, esophagus, and stomach.
- Immediate decontamination (first removal of solid sodium hydroxide, thereafter extensive flushing of contaminated eyes, skin, and hair) is crucial.
- There is no antidote to be administered to counteract the effects of sodium hydroxide. Treatment consists of supportive measures.

1. Substance information

Sodium hydroxide (NaOH), CAS 1310-73-2
Synonyms: caustic soda, sodium hydrate, lye.
At room temperature sodium hydroxide is a white crystalline, odorless, deliquescent solid, which absorbs moisture from the air. When sodium hydroxide is dissolved in water, often a mist is formed. Sodium hydroxide itself is nonflammable, but in contact with moisture it may ignite combustibles. Toxic fumes may be formed upon heating. The solid, solutions, mists, and aerosols are all corrosive. It is water-soluble. Sodium hydroxide is widely used in the manufacture of soaps, paper, rayon, cotton, dyestuffs, and petroleum products. Other uses include etching and cleaning of metals, electroplating, ion-exchange resin regeneration, and oxide coating.

2. Routes of exposure

Inhalation

Inhalation of mists and aerosols is a relevant route of exposure. Sodium hydroxide's irritant properties generally provide adequate warning of hazardous concentrations for acute exposures. However, prolonged or repeatedly exposed persons may develop some tolerance of the irritant effects.

Skin/eye contact

Most exposures to sodium hydroxide occur by skin contact. Direct contact with liquid sodium hydroxide or concentrated vapor or fumes on eyes or wet or moist skin causes severe chemical burns.

Ingestion

Ingestion of sodium hydroxide can cause severe corrosive injury to the lips, mouth, throat, esophagus, and stomach.

3. Acute health effects

Respiratory

Sodium hydroxide exposure usually causes dryness of the nose and throat, and coughing. Inhalation of very high concentrations may result in laryngeal edema and eventually in obstruction of the airways and death. Development of respiratory distress with chest pain, dyspnea and pulmonary edema (shortness of breath, cyanosis, expectoration) may occur after a delay of up to 24 hours.

Dermal

Deep painful burns of the skin and mucous membranes may be caused by contact with concentrated sodium hydroxide. Contact with less concentrated sodium hydroxide can cause burning pain, redness, and inflammation, the onset of which might be delayed for up to several hours after exposure.

B 2

<i>Ocular</i>	Severe eye burns with clouding of the surface and ensuing blindness may occur from exposure to liquid sodium hydroxide. Low concentration levels of mists or aerosols cause burning discomfort, spasmodic blinking or involuntary closing of the eyelids, redness, and tearing.
<i>Gastrointestinal</i>	Abdominal pain, nausea, and vomiting may occur. In cases of ingestion, diffuse corrosive mucosal injury resulting in hemorrhage, perforation, and strictures can involve the entire intestinal tract.
<i>Renal</i>	Acid-base imbalance and acute renal failure may occur.
<i>Dose-effect relationships</i>	Dose-effect relationships are as follows:

<u>Sodium hydroxide concentration</u>	<u>Effect</u>
0.2-2 mg/m ³	- Mild transient mucous membrane irritation
10-20 mg/m ³	- Burning and tearing of the eyes; marked irritation of the respiratory tract
>50 mg/m ³	- Toxic pneumonitis, laryngeal and pulmonary edema possible
250 mg/m ³	- Immediately dangerous to life or health
Oral uptake of about 2 g	- Potentially lethal

4. Actions

<i>Rescuer self-protection</i>	<p>If the zone which has to be entered by the rescuer is suspected of containing sodium hydroxide mists or aerosols, pressure-demand, self-contained breathing apparatus and chemical-protective clothing shall be worn; do not use equipment that is contaminated itself.</p> <p>Patients whose clothing or skin is contaminated with solid sodium hydroxide or its solutions can cause secondary contamination of rescue and medical personnel by direct contact.</p>
<i>Patient recovery</i>	<p>Patients should be removed from the contaminated zone immediately. Patients who are unable to walk may be removed on backboards or stretchers; if these are not available, carefully remove/transport patients with appropriate action to a safe zone, taking into account your self-protection.</p> <p>Immediate priorities must follow the "A, B, C's" of resuscitation.</p>
<i>Decontamination</i>	<p>Patients exposed only to sodium hydroxide mists or aerosols who have no evidence of skin or eye irritation do not need decontamination. All others require decontamination.</p> <p>Patients who are able and cooperative may assist with their own decontamination. If the exposure involved solid or liquid sodium hydroxide and if clothing is contaminated, remove and double-bag the clothing.</p> <p>Assure that exposed or irritated eyes have been irrigated with plain water or saline for at least 20 minutes, and that the pH of the conjunctival fluid has returned to normal (7.0). If not, continue eye irrigation during other basic care and transport. If eye irrigation is impaired by blepharospasm, one to two drops of oxybuprocaine 0.4% may be instilled into affected eyes to allow adequate irrigation. Remove contact lenses if present and easily removable without additional trauma to the eye.</p> <p>If any solid sodium hydroxide is present on the patient's skin, hair or clothes, brush it away before flushing. Protect yourself and the patient's eyes.</p> <p>Then, assure that exposed skin and hair have been flushed with plain water for at least 15 minutes. If not, continue flushing during other basic care and transport. Protect eyes during flushing of skin and hair.</p> <p>Immediate decontamination is crucial.</p>
<i>Initial treatment</i>	<p>Therapy will be empiric; there is no antidote to be administered to counteract the effects of sodium hydroxide.</p>

The following measures are recommended if the airborne exposure concentration is 10 mg/m³ or greater, if symptoms, e. g. eye irritation or pulmonary symptoms have developed, or if no exposure concentration can be estimated but exposure has possibly occurred:

If not already done, initially, administration of 8 puffs of beclomethasone (800 µg beclomethasone dipropionate) from a metered dose inhaler.

The following measures are recommended if the airborne exposure concentration is 50 mg/m³ or more and/or if patients have respiratory complaints or evidence of systemic toxic effects after inhalation of sodium hydroxide:

- Administration of oxygen
- Administration of 8 puffs of beclomethasone (800 µg beclomethasone dipropionate) from a metered dose inhaler.

Patients with severe clinical respiratory symptoms (e.g. bronchospasms, stridor) should be treated as follows:

a) Nebulization of adrenaline (epinephrine): 2 mg adrenaline (2 ml) with 3 ml NaCl 0.9% and inhale through a nebulizer mask.

b) Administration of a β 2-selective adrenoceptor agonist, e.g., four strokes of terbutaline or salbutamol or fenoterol (one stroke usually contains 0.25 mg of terbutaline sulfate; or 0.1 mg of salbutamol; or 0.2 mg of fenoterol); this may be repeated once after 10 minutes. Alternatively, 2.5 mg salbutamol and 0.5 mg atrovent may be administered by nebulizer mask.

If inhalation is not possible, administration of terbutaline sulfate (0.25 mg to 0.5 mg) subcutaneously or salbutamol (0.2 mg to 0.4 mg over 15 minutes) intravenously.

c) Intravenous administration of 250 mg methylprednisolone (or equivalent steroid dose).

Patients with clinical signs of a toxic lung edema (e.g. foamy sputum, wet crackles) should be treated as follows:

a) Start CPAP-therapy (Continuous Positive Airway Pressure Ventilation).

b) Intravenous administration of 1000 mg methylprednisolone (or an equivalent steroid dose) is recommended.

Establishment of intravenous access.

Intubation of the trachea or an alternative airway management should be considered in cases of respiratory compromise. When the patient's condition precludes this, consider cricothyrotomy if equipped and trained to do so.

Note: Efficacy of corticosteroid administration has not yet been proven in controlled clinical studies.

If inhalation exposure has occurred, humidified air or oxygen should be provided. If signs of hypoxemia are present, humidified supplemental oxygen should be administered.

If sodium hydroxide was in contact with the skin, chemical burns may result; treat as thermal burns: adequate fluid resuscitation and administration of analgesics, maintenance of the body temperature, covering of the burn with a sterile pad or clean sheet.

After eye exposure chemical burns may result; treat as thermal burns. Immediately consult an ophthalmologist.

Note: Any facial exposure to liquid sodium hydroxide should be considered as a serious exposure.

In case of ingestion of sodium hydroxide, **do not induce emesis, do not perform gastric lavage. Intubate the trachea in cases of stridor resulting from laryngeal edema.**

Patients with an exposure concentration of 10 mg/m³ or more or with ingestion of sodium hydroxide as well as patients without available exposure measurements but suspected of being exposed to concentrations of 10 mg/m³ or more should be transferred to a hospital/emergency department.

*Patient release/
follow-up instructions*

Asymptomatic patients exposed to an airborne concentration of **less than 10 mg/m³** as well as **patients who have a normal clinical examination and no signs or symptoms of toxicity may be discharged after an appropriate observation period in the following circumstances:**

- a) The evaluating physician is experienced in the evaluation of individuals with sodium hydroxide or irritant gas exposure.
- b) Information and recommendations for patients with follow-up instructions are provided verbally and in writing. Patients are advised to seek medical care promptly if symptoms develop or recur.
- c) The physician is comfortable that the patient understands the health effects of sodium hydroxide and the provided follow-up instructions.
- d) Site physician is notified, so that the patient may be contacted at regular intervals in the 24-hour period following release.
- e) Heavy physical work should be precluded for up to 24 hours.
- f) Exposure to cigarette smoke should be avoided for 72 hours; the smoke may worsen the condition of the lungs.

Patients who have serious skin or eye injuries should be reexamined in 24 hours.

In this document BASF has made a diligent effort to ensure the accuracy and currency of the information presented but makes no claim that the document comprehensively addresses all possible situations related to this topic. This document is intended as an additional resource for paramedics and doctors at the site in assessing the condition and managing the treatment of patients exposed to sodium hydroxide. It is not, however, a substitute for the professional judgement of a paramedic or a doctor and must be interpreted in the light of specific information regarding the patient available to such a paramedic or doctor and in conjunction with other sources of authority.

BASF SE
Corporate Health Management
Carl-Bosch-Straße 38
67056 Ludwigshafen
Germany

BASF Corporation
Medical Department
100 Campus Drive, M/S F 221
Florham Park, NJ 07932
USA