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Chemical Emergency Medical Guideline

Information and recommendations for healthcare professionals

Toluene

CAS No.: 108-88-3

GHS symbols:

GHS07
Acute toxicity

GHS08
Health hazard

Signal word: Danger

Hazard statements:

H304	May be fatal if swallowed and enters airways.
H315	Causes skin irritation.
H336	May cause drowsiness or dizziness.
H373	May cause damage to organs (central nervous system) through prolonged or repeated exposure.
H361d	May cause harm to the unborn child.

Overview

- There is no danger from contact with patients who have only been exposed to toluene vapors. A patient who is wet with liquid toluene (boiling point 110.6°C) or whose clothing is wet with liquid toluene may endanger other people through direct contact or through evaporating toluene.
- Toluene irritates the skin, eyes and respiratory tract and can cause headaches, nausea, dizziness, weakness, confusion and unconsciousness. Disorders of the central and peripheral nervous system have been observed.
- There is no known specific antidote. Treatment depends on the extent of exposure and the symptoms.

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1. Information on the substance

Toluene (C_6H_5-CH_3), CAS 108-88-3
Synonyms: methylbenzene, phenylmethane
At room temperature (boiling point 110.6°C), toluene is a clear, colorless liquid. The vapor and liquid are flammable. Toluene has an aromatic odor. The odor threshold is 2.5ppm. It is slightly soluble in water but highly soluble in organic solvents. Combustion produces carbon monoxide.
Toluene is an organic solvent with high vapor pressure and is mainly obtained from the refining of crude oil. It is used in the manufacture of benzene, trinitrotoluene, nylon, plastics and polyurethane.

2. Exposition

2.1. Inhalation

Exposure to toluene occurs mainly through inhalation. Toluene is rapidly absorbed through the lungs.

2.2. Skin/eye contact

Toluene is absorbed through the skin and can lead to general symptoms of poisoning.

2.3. Ingestion

Toluene is absorbed through the gastrointestinal tract. Ingestion is rare in the workplace. However, if swallowed, it can also enter the respiratory tract.

3. Acute health effects

Toluene can cause general symptoms of poisoning such as headache, nausea, dizziness, weakness, confusion and unconsciousness. Exposure to high concentrations can cause signs of upper respiratory tract irritation, followed by asphyxia, muscle weakness, cardiac arrhythmia, coma and respiratory arrest. Disorders of the central and peripheral nervous system and liver enzyme changes have been observed with chronic exposure. High concentrations can lead to temporary kidney dysfunction with acidosis and electrolyte disturbances.

3.1. Dose-response relationship

Toluene concentration		Effect/effects
2.5 ppm	-	Odor threshold
50 ppm	-	Occupational exposure limit (Germany, AGS)
50 – 100 ppm	-	Mild subjective complaints, such as headaches, weakness, concentration problems
100 ppm	–	REL (NIOSH, USA)
150 ppm	-	STEL (NIOSH, USA)
300 ppm	-	ERPG-2 (AHIA, USA)
500 ppm	-	IDLH (NIOSH, USA)
800 ppm	-	Weakness, difficulty concentrating, dizziness and drowsiness
4000 ppm	-	Life-threatening if exposed for more than 1 hour
10000 - 30000 ppm	-	Life-threatening if exposed for a few minutes minutes

Occupational exposure limit: According to the Hazardous Substances Ordinance, the occupational exposure limit (OEL) is the limit value for the time-weighted average concentration of a substance in the air at the workplace in relation to a given reference period. It specifies the concentration of a substance at which acute or chronic harmful effects on health are generally not to be expected.
TWA: Time weighted average
REL: Recommended Exposure Level → Limit value for the amount or concentration of a substance in the air. This is usually based on a time-weighted average (TWA) over eight hours.
ERPG-2 is the maximum concentration in the air below which it is assumed that individuals can be exposed for up to one hour without developing irreversible, serious health effects or symptoms that could impair a person's ability to take protective measures.
ERPG: Emergency Response Planning Guidelines
AIHA: American Industrial Hygiene Association
STEL: Short-Term Exposure Limit → Average concentration over 15 minutes to which workers may be exposed up to four times per day with at least 60 minutes between successive exposures without adverse health effects
IDLH: Immediately Dangerous to Life and Health
NIOSH: National Institute for Occupational Safety and Health

The maximum workplace concentration for toluene is 50ppm (Germany, Committee for Hazardous Substances AGS).

3.2. Respiratory tract

Toluene irritates the upper respiratory tract.

3.3. Skin

Local exposure to liquid toluene can cause skin irritation.

3.4. Eye contact

Local exposure to liquid toluene or high vapor concentrations can cause severe eye irritation with redness, burning, tearing or spasmodic eyelid closure.

3.5. Possible consequences

If the patient survives the first 48 hours after exposure, further improvement in symptoms can be expected. After acute exposure, lung function usually returns to normal within 7 to 14 days. Complete recovery is usually achieved. Increased sensitivity to irritants may persist and cause bronchospasm or chronic bronchitis. Such "reactive airways dysfunction syndrome" (RADS) may persist for several years. Destruction of lung tissue or scarring can lead to chronic dilation of the bronchi and increased susceptibility to infection.

Central and peripheral neuropathy (impaired psychomotor function, dementia, distal hypesthesia and delayed nerve conduction velocity) and ototoxicity have been observed in chronically exposed workers.

4. Measures

4.1. Self-protection of first aiders

If there is a suspicion that the area the helper must enter contains toluene, a self-contained breathing apparatus and a chemical protection suit must be worn.
There is no danger from contact with patients who have only been exposed to toluene vapors. A patient who is wet with liquid toluene or whose clothing is wet with liquid toluene may endanger other people through direct contact or through evaporating toluene.

4.2. Rescue

Patients should be removed from the danger zone immediately. If they are unable to walk unaided, they should be removed from the danger zone quickly using appropriate means, taking care to protect themselves. The "A, B, C procedure" has absolute priority in this case.

A) Clear the airways (check for blockages caused by the tongue or foreign objects)
B) Ventilation (check the patient's breathing; if necessary, begin ventilation with adequate self-protection, e.g. breathing mask)
C) Circulation (begin resuscitation for any person who does not respond to verbal commands and is not breathing normally)

4.3. Cleaning

Patients who have only been exposed to toluene vapors and show no signs of skin or eye irritation do not require any special cleaning measures, unlike all others. If possible, patients should assist in cleaning themselves. If liquid toluene has been exposed and clothing is contaminated, it must be removed and securely wrapped.
It must be ensured that the eyes are rinsed with water or neutral saline solution for at least 15 minutes in the event of toluene exposure. If eye rinsing is impeded by spasmodic eyelid closure, the use of a local anesthetic solution (e.g. lidocaine, oxybuprocaine) may be considered. Remove any contact lenses, if possible, without causing additional danger to the eye. Continue other important first aid measures in the meantime.

Affected skin and hair areas should be rinsed with water for at least 15 minutes. Other important first aid measures must be continued during this time. Protect the eyes during rinsing.

Rinse mouth and then administer 200ml-300ml of water for dilution if the patient is awake and responsive. Do not induce vomiting under any circumstances; this may cause irritation of the esophagus and aspiration.

4.4. Estimation of inhaled dose

Patients with an exposure concentration of 100ppm or more (depending on the duration of exposure) and patients for whom no exposure dose can be estimated but exposure is very likely should be transported immediately to a hospital with intensive care facilities.

4.5. Initial treatment (preclinical or clinical)

Empirical therapy; no specific antidote available.
The following measures are recommended if the toluene concentration is 100ppm or more (depending on the duration of exposure), symptoms are present (e.g. irritation of the eyes or upper respiratory tract) or if no concentration can be estimated but exposure is likely to have occurred:

- Oxygen administration
- Administration of 8 sprays of beclomethasone (800µg beclomethasone dipropionate) from a metered dose inhaler.

If there are signs of airway constriction (e.g. bronchospasm or stridor)

- Nebulization of adrenalin (epinephrine): mix 2mg adrenalin (2ml) with 3ml NaCl 0.9% and administer via a nebulizer mask
- Administration of a ß2-selective adrenoceptor agonist, e.g. four puffs of terbutaline or salbutamol or fenoterol (one puff usually contains 0.25mg terbutaline sulphate; or 0.1mg salbutamol; or 0.2mg fenoterol); this can be repeated once after 10 minutes.

Alternatively, 2.5mg salbutamol and 0.5mg ipratropium bromide can be administered via a nebulizer mask. If inhalation is not possible, administer terbutaline sulphate (0.25mg to 0.5mg) subcutaneously or salbutamol (0.2mg to 0.4mg over 15 minutes) intravenously.
Intravenous administration of 250mg methylprednisolone (or an equivalent steroid dose).

If there are signs of toxic pulmonary oedema (e.g. frothy sputum, moist rales)

- CPAP therapy
- Intravenous administration of 1000mg methylprednisolone (or an equivalent steroid dose)
  In case of (increasing) respiratory insufficiency, advanced airway management, e.g. endotracheal intubation or coniotomy if necessary.

Note: The effectiveness of administering corticosteroids has not yet been proven in controlled clinical trials.

Skin contact with liquid toluene can cause skin irritation; this should be treated as a burn.
Exposure to the eyes can also cause irritation; this should also be treated as a burn. Consult an ophthalmologist.

Patients who are conscious and able to swallow should, if possible, be given 50 g of activated charcoal (or 1 g/kg body weight for children weighing up to 50 kg). Activated charcoal may be administered repeatedly at any time to complete decontamination if there are signs or suspicion of ongoing absorption. For multiple doses, start with the single-dose amount mentioned above, followed by the same dose every four hours or half the dose every two hours. Avoid inhaling the product.

Avoid vomiting; it can cause irritation of the esophagus and aspiration.

Note: Any contact with liquid toluene in the facial area can have serious consequences.

Laboratory tests: The diagnosis of toluene poisoning is based primarily on the clinical signs of irritation and central nervous system disorders, together with the very probable exposure to toluene.

4.6. Biomonitoring

Biomonitoring with determination of the 2-cresol concentration in urine can be carried out to estimate the systemic dose absorbed after exposure. In addition, toluene determination (biological agent tolerance value 1,000µg/l) can be carried out in the blood.

4.7. Further procedure and treatment

In addition to taking medical history, performing a physical examination and checking vital signs, spirometry should be performed. However, various laboratory tests can be performed to monitor and assess complications. Blood count, glucose and electrolytes should be determined routinely.

4.8. Discharge of the patient / instructions for further action

Asymptomatic patients who have been exposed to a toluene concentration of less than 100ppm (and for less than 15 minutes) and who show no abnormal clinical findings and no signs of toxic effects after an appropriate follow-up period may be discharged under the following circumstances:

- Information and recommendations for patients with instructions for further rules of conduct were provided. The patient was advised to seek immediate medical attention if any health problems arise.
- The patient is aware of and understands the toxic effects of toluene.
- The attending physician has been informed that regular contact between the patient and the physician is possible in the following 24 hours.
- Drinking alcohol should be prohibited for at least 72 hours.
- Heavy physical work should not be carried out in the following 24 hours.
- Do not smoke for at least 72 hours and avoid cigarette smoke; smoke can impair lung function.

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