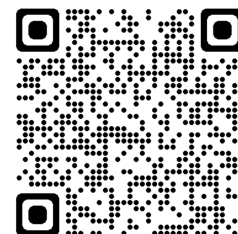

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Chemical Emergency Medical Guideline

Information and recommendations for healthcare professionals

Methanol

CAS No.: 67-56-1

GHS symbols:

GHS06
Acute toxicity

GHS08
Health hazard

Signal word: Danger

Hazard statements:

H301+H311+H331	Toxic if swallowed, in contact with skin or if inhaled
H319	Causes serious eye irritation.
H336	May cause drowsiness or dizziness.
H360	May damage fertility or the unborn child.
H370	Causes damage to organs.

Overview

- Ingesting as little as 10ml of methanol can have severe systemic toxic effects, including irreversible blindness, central nervous system depression and metabolic acidosis. A dose of approximately 0.5ml of methanol per kg of body weight can be fatal.
- Methanol can cause mild irritation after contact with the eyes, skin and upper respiratory tract, which can manifest itself in redness of the eyes and tearing, coughing, and degreasing and inflammation of the skin.
- Inhalation of methanol at concentrations above 1000 ppm and prolonged skin contact can lead to significant systemic toxic absorption.
- Methanol poisoning can be treated by inhibiting the formation of toxic metabolites. This can be achieved by administering the antidotes 4-methylpyrazole (fomepizole i.v.) or ethanol i.v.
- If the patient is conscious after ingesting methanol and fomepizole is not readily available, adults should immediately consume 0.7g ethanol/kg body weight in the form of alcoholic beverages, e.g. 150ml whisky or brandy.
- Correct metabolic acidosis. Determine blood methanol concentration (if analysis methods are immediately available). Collect urine sample for biomonitoring. If the methanol concentration is greater than 500 mg/l or if there are already signs or symptoms of metabolic acidosis or visual disturbances, consider hemodialysis. Adjust the 4-methylpyrazole or ethanol doses accordingly.

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1. Information on the substance

Methanol (CH_3OH), CAS 67-56-1
Synonyms: methyl alcohol, carbinol
At room temperature, methanol is a clear, colorless, volatile and flammable liquid (boiling point 65°C). Its mild alcoholic odor can be detected at concentrations of 5 to 100ppm. It is miscible with water.
Methanol is used as a solvent, antifreeze, fuel and as an intermediate product in the manufacture of formaldehyde, acetic acid and methyl esters.

2. Exposition

2.1. Inhalation

Inhalation plays a significant role in occupational exposure. The smell and irritant effect of methanol serve as a clear warning of dangerous concentrations. As methanol is heavier than air, there is a risk of suffocation in poorly ventilated, low-lying or enclosed spaces.

2.2. Skin/eye contact

Methanol can cause slight irritation to the skin and eyes. Methanol is very easily absorbed through intact skin.

2.3. Ingestion

Ingestion of methanol causes severe systemic poisoning. An asymptomatic latency period may precede the onset of severe signs of intoxication.

3. Acute health effects

3.1. Dose-response principle

Ingestion of 0.1g methanol/kg body weight or more should be considered severe, and ingestion of more than 0.5g methanol/kg body weight should be considered life-threatening intoxication. Inhalation of methanol at concentrations above 1000ppm or prolonged or extensive exposure of the skin can also have systemic toxic effects.

Three phases can usually be distinguished:
1) Narcotic phase
Up to 8 hours after methanol intoxication, symptoms of intoxication like those of ethanol intoxication may occur, but usually to a lesser degree: mild inhibition of the central nervous system, confusion, ataxia. Irritation of the gastrointestinal tract may lead to nausea, vomiting and epigastric pain.
2) Latency phase
Patients with methanol poisoning, even very severe cases, are often asymptomatic during a latency phase of approximately 6 to 36 hours after exposure.
3) Acidosis/neurotoxicity
The severity of the symptoms of methanol poisoning is often proportional to the metabolic acidosis with anion gap resulting from the oxidation of methanol to accumulating formic acid. Headaches, dizziness, vomiting, periodic breathing and coma with respiratory failure can ultimately lead to death.

3.2. Local effects

Methanol can cause mild irritation when after contact with the eyes, skin and upper respiratory tract, which can manifest as redness of the eyes and tearing, coughing, and degreasing and inflammation of the skin.

3.3. Eyes

Visual disturbances are generally noticed shortly after the onset of metabolic acidosis. Retinal oedema with vascular congestion, blurred edges of the pupil, dilated, unresponsive pupils and blurred vision are characteristic and can lead to blindness.

3.4. Possible consequences

Depending on the amount of methanol absorbed, individual susceptibility and the delay in starting treatment, visual disturbances may either regress or progress to irreversible impairment or blindness (optic neuropathy). Methanol poisoning can cause polyneuropathy in the extremities and permanent motor dysfunction like Parkinson's syndrome.

4. Measures

4.1. Self-protection for first aiders

There is no danger from patients who have been exposed to methanol. Patients should be removed from the danger zone immediately.

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.

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 methanol 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 their own cleaning. If liquid methanol has been exposed and clothing is contaminated, it must be removed and securely wrapped.

Patients who have been exposed to a concentration of 1000ppm or more and patients with extensive skin exposure should be treated in the same way as patients who have swallowed methanol.
Rinse affected skin and hair with water for at least 15 minutes. Protect eyes while rinsing.
In the event of methanol exposure, rinse the eyes with water or neutral saline solution for at least 15 minutes. Remove any contact lenses, if possible, without causing additional harm to the eye. Continue other important supportive measures during this time.

Patients who have ingested methanol or been exposed to a concentration of 1000ppm or more, and patients with extensive skin exposure, should be transported immediately to a hospital with intensive care facilities.

All patients requiring treatment for methanol poisoning should be examined by an ophthalmologist.

4.4. Initial (antidote) treatment (preclinical or clinical)

If the patient is conscious, an adult should immediately consume 0.7g of ethanol/kg body weight in the form of alcoholic beverages, e.g. 150ml of whisky or brandy.

Do not induce vomiting if methanol has been swallowed. Only if a significant dose of methanol was ingested less than 30 minutes ago should immediate gastric lavage be considered.

4-methylpyrazole (fomepizole), a synthetic and potent inhibitor of alcohol dehydrogenase, is widely considered the antidote of choice:
Immediate intravenous infusion of an initial dose of 15mg/kg body weight in 5% glucose over 30 to 60 minutes. Early administration of 4-methylpyrazole is very likely to reduce the frequency of necessary dialysis treatments.

If 4-methylpyrazole is not available, intravenous infusion of 0.6g ethanol/kg body weight over 30 minutes is an alternative treatment option. If the patient has already ingested ethanol, this ethanol dose must be modified so that the blood ethanol level does not exceed 100 to 130mg/dl (21.7 to 28.2mmol/l).

In symptomatic patients with proven acidosis, the administration of folinic acid (1 mg/kg body weight, but no more than 50mg) or intravenous folic acid (1mg/kg body weight up to 50mg per dose) may also be considered to promote the breakdown of formic acid. This administration can be repeated every 4 hours depending on the clinical and laboratory course of intoxication (target value for methanol concentration in the blood <20mg/dl).

If there are signs of hypoxia, administer humidified oxygen. In the event of respiratory insufficiency, perform endotracheal intubation or alternative airway management. If this is not feasible, perform a coniotomy if necessary.

4.5. Further procedure and treatment

Patients who have ingested methanol or been exposed to a concentration of 1000ppm or more and patients with extensive skin exposure:

In addition to medical history, physical examination and vital signs, the blood concentration of methanol should be determined – and, if ethanol has been administered, that of ethanol as well.
Routine laboratory tests should include a complete blood count, glucose, pH and electrolyte measurements, and renal function tests. Formiate measurement may be considered. Formiate concentrations after methanol intoxication correlate with blood pH and the anion gap.
Measurement of the anion gap [sodium - (bicarbonate + chloride); normal 12+2 mmol/l] and administration of sodium bicarbonate in the event of metabolic acidosis.

Continue treatment with either 4-methylpyrazole (10mg/kg body weight every 12 hours for up to 3 doses, further dosage depending on the methanol concentration in the blood) or ethanol (0.1g ethanol/kg body weight/hour to maintain an ethanol blood concentration between 1.0 and 1.5g/l). When administering ethanol orally, a target ethanol level of 0.5 to 1 per mille alcohol should be maintained for at least 24 hours.

Hemodialysis

If the methanol concentration in the blood is higher than 500mg/l or if there are already signs or symptoms of metabolic acidosis or visual disturbances, hemodialysis should be started. The 4-methylpyrazole or ethanol dosage should be adjusted accordingly.

Patients with probable systemic exposure or patients who have developed serious symptoms should be monitored for an appropriate period and undergo repeated follow-up examinations until toxic damage can be ruled out.

Treatment with hemodialysis and 4-methylpyrazole or ethanol should be continued until the methanol concentration in the blood is less than 200mg/l and the blood pH is normal.

All patients who require treatment for methanol poisoning should be examined by an ophthalmologist.

4.6. Biomonitoring

Biomonitoring with determination of the methanol concentration in the urine can be performed to estimate the systemic dose absorbed after exposure.

4.7. Discharge of the patient / instructions for further rules of conduct

Asymptomatic patients who have not ingested methanol, have been exposed to a concentration of less than 1000ppm, have not had extensive skin exposure and show no signs of toxic effects of methanol after an appropriate follow-up period may be discharged under the following circumstances:

- Information and recommendations for patients with instructions for further action were provided verbally and in writing. 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 methanol.
- The attending physician has been informed that regular contact between the patient and the physician is possible in the following 24 hours.
- Heavy physical work should be avoided for the next 24 hours.

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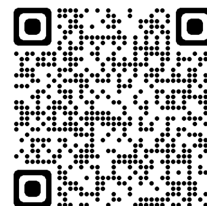

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