BASF Chemical Emergency Medical Guidelines

Methanol (CH_3OH) C 1

Information and recommendations for doctors at hospitals/emergency departments

- **Exposed or intoxicated patients do not pose a significant risk of secondary contamination.**
- **Ingestion of 10-15 ml methanol can cause severe systemic toxic effects, in particular irreversible blindness and central nervous system depression concomitant with metabolic acidosis. Dosage of approximately 1 ml methanol/kg body weight may result in death.**
- **Methanol is slightly irritating when it comes in contact with the eyes, skin, and upper respiratory tract causing redness and lacrimation of the eyes, coughing, and defatting and inflammation of the skin.**
- **Inhalation exposure to a concentration above 1000 ppm and prolonged or extensive skin contact may result in significant systemic toxic absorption of methanol.**
- **Methanol intoxication can be treated by inhibiting the formation of toxic metabolites. This can be achieved by the administration of 4-methylpyrazole (fomepizole) or ethanol. If conscious after ingestion of methanol and if not already done, the adult patient should immediately drink alcoholic beverages containing about 0.7 g ethanol/kg body weight, e.g. 150 ml of whiskey/brandy. Alternatively, or if the patient's consciousness is impaired, 4-methylpyrazole or ethanol should be administered intravenously.**
- **Correct metabolic acidosis. Determine methanol blood concentrations (if analytical method is immediately available). Collect urine sample for biomonitoring analysis. If the methanol concentration is greater than 500 mg/l or if already signs or symptoms of metabolic acidosis or visual disturbances are present, consider hemodialysis. Adjust 4-methylpyrazole or ethanol doses.**

1. Substance information

Methanol (CH_3OH), CAS 67-56-1
Synonyms: carbinol, methyl alcohol, wood alcohol, wood spirit
Methanol is, at room temperature, a clear, colorless, volatile and flammable liquid (boiling point 65°C, 116°F, respectively). Its mild alcohol odor can be perceived at a threshold concentration of 5 to 100 ppm. Methanol is soluble in water.
Methanol is widely used as a solvent, as an antifreeze fluid, as a fuel and as an intermediate in the manufacture of formaldehyde, acetic acid and methyl esters.

2. Routes of exposure

Inhalation

Inhalation is a relevant route of industrial exposures. Methanol's odor and irritant properties generally provide adequate warning of hazardous concentrations. Methanol is slightly heavier than air and may cause asphyxiation in poorly ventilated, low-lying, or enclosed spaces.

Skin/eye contact

Methanol can cause slight irritation to the skin and the eyes. **Methanol is well absorbed through the intact skin.**

Ingestion

Ingestion of methanol results in severe systemic intoxication. Severe signs or symptoms of intoxication may be preceded by an asymptomatic latent period.

3. Acute health effects

Ingestion of 0.1 g methanol/kg body weight or more should be considered as severe, ingestion of more than 1 g methanol/kg body weight as potentially lethal. Inhalation exposure to concentrations of more than 1000 ppm or prolonged or extended skin exposure may also cause systemic toxicity. Three stages are usually distinguished:

1. Narcotic stage	**Until up to 8 hours after methanol intoxication, symptoms of inebriation as in ethanol intoxication, but to a lesser degree, might occur**: slight central nervous system depression, confusion, ataxia. Gastrointestinal irritation may result in nausea, vomiting, and epigastric pain.
2. Latent period	**Patients with - even severe - methanol intoxication are often asymptomatic during a latent period between 6 and 36 hours after exposure.**
3. Acidosis/neurotoxicity	The severity of methanol poisoning symptoms is proportional to **anion gap metabolic acidosis** resulting from oxidation of methanol to formic acid which accumulates. Headache, dizziness, vomiting, periodic respiration, and coma with respiratory failure eventually leading to death may occur. **Visual disturbances become evident soon after onset of metabolic acidosis. Congested and edematous retina, blurred edges of the optic disc, dilated, unreactive pupils, and dim vision are characteristic and may result in blindness.** Pancreatic injury may result in severe abdominal pain.
Local effects	Methanol is slightly irritating when it comes in contact with the eyes, skin, and upper respiratory tract causing redness and lacrimation of the eyes, coughing, and, defatting and inflammation of the skin.
Potential sequelae	Depending upon the absorbed methanol dose, the individual's susceptibility, and the time at which treatment began, the visual disturbances may either recede or proceed to irreversible visual impairment or blindness (optic neuropathy). Limb polyneuropathy or permanent motor dysfunction, similar to parkinsonism, may follow methanol poisoning.

4. Actions

Initial treatment	Patients exposed to methanol do not pose a significant risk of secondary contamination.
After ingestion	**If conscious and if not already done, the adult patient should immediately drink alcoholic beverages containing about 0.7 g ethanol/kg body weight, e.g. 150 ml of whiskey/brandy.** **Do not induce emesis. If the patient consciousness is impaired or if a large dose has been ingested less than 30 minutes before evaluation of the patient's condition, consider immediate gastric lavage with a small-bore tube**. **4-methylpyrazole, a synthetic alcohol dehydrogenase inhibitor, is often considered as first-line treatment:** **If not already done, immediate intravenous infusion of the loading dose of 15 mg/kg body weight over 30 min.** Early administration of 4-methylpyrazole probably obviates the need for treatment by hemodialysis. **If 4-methylpyrazole is not available, intravenous infusion of 0.6 g ethanol/kg body weight represents an alternative treatment option.** If the patient has concurrently ingested ethanol, then the ethanol loading dose must be modified so that the blood ethanol level does not exceed 100 to 130 mg/dl (21.7 to 28.2 mmol/l). If symptomatic, administer IV leucovorin 1 mg/kg bodyweight once (up to 50 mg/dose) followed by IV folic acid 1 mg/kg bodyweight (up to 50 mg/dose) once every 4 hours for 6 doses, to enhance the metabolism of formic acid. If asymptomatic, administer folic acid only. If signs of hypoxemia are present, humidified supplemental oxygen should be administered. 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.

After inhalation or skin/eye contact	Patients exposed only to methanol vapor who have no evidence of skin or eye irritation do not need decontamination. All others require decontamination. Patients who are able and cooperative may assist with their own decontamination. If the exposure involved liquid methanol and if clothing is contaminated, remove and double-bag the clothing. **Treat patients exposed to an airborne concentration of 1000 ppm or greater and patients with prolonged or extended skin exposure similarly to those having ingested methanol. 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. **Assure that exposed or irritated eyes have been irrigated with plain water or saline for at least 15 minutes**. If not, continue eye irrigation during other basic care and transport. Remove contact lenses if present and easily removable without additional trauma to the eye.
Further evaluation and treatment	**Patients who have ingested methanol or have been exposed to an airborne concentration of 1000 ppm or greater and patients with prolonged or extended skin exposure:** **To the standard intake history, physical examination, and vital signs add, measure methanol - and if administered ethanol, ethanol blood concentrations.** Routine laboratory studies should include a complete blood count, blood glucose, pH and electrolyte determinations and renal function tests. Consider measurement of formate. Plasma formate levels in methanol intoxication correlate with blood pH and serum anion gap. **Calculate the anion gap [sodium-(bicarbonate+chloride); normal 12±2 mmol/l]. Administer sodium bicarbonate in case of metabolic acidosis**. **Continue treatment with either 4-methylpyrazole (10 mg/kg body weight every 12 hours for 3 doses, further doses dependent on methanol blood concentrations) or ethanol (0.1 g ethanol/kg body weight/hour, maintaining ethanol blood concentration between 1.0 and 1.5 g/l).**
Hemodialysis	**If the methanol blood concentration is greater than 500 mg/l or if already signs or symptoms of metabolic acidosis or visual disturbances are present, start hemodialysis. Adjust 4-methylpyrazole or ethanol doses.** **Patients who have possible systemic exposure or who develop serious signs or symptoms should be observed for a minimum of 24 hours and reexamined frequently before confirming the absence of toxic effects.** **Treatment by hemodialysis and with 4-methylpyrazole or ethanol should be continued until blood methanol concentration is less than 200 mg/l and blood pH is normal.** All patients requiring treatment for methanol intoxication should be examined by an ophthalmologist.
Patient release/ follow-up instructions	**Asymptomatic patients**, who have not ingested methanol, exposed to an airborne concentration of **less than 1000 ppm** and without prolonged or extended skin exposure as well as **patients with a blood methanol concentration of less 200 mg/l and normal blood pH** may be discharged in the following circumstances:

a) The evaluating physician is experienced in the evaluation of individuals with methanol 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 methanol.
d) Site medical is notified, so that the patient may be contacted at regular intervals in the 24-hour period following release from the emergency department.
e) Heavy physical work should be precluded for 24 hours.

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