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EMERGENCY MEDICAL TREATMENT GUIDE

METHYL BROMIDE VAPOR EXPOSURE RESULTING FROM TREATED FIELD VAPOR

SYNONYMS: Bromomethane, monobromomethane (Brand names: *Brom-O-Gas, Bro-Mean, MBC Soil Fumigant, MeBrom, MetaBrom, Meth-O-Gas, Pic-Brom, Terr-O-Gas, Tri-Con*)

USE: Agricultural pesticide applied for soil treatment

APPEARANCE and PHYSICAL FORM: Methyl bromide (CH_3Br, bromomethane, CAS no. 74-83-9) is a colorless, odorless gas at normal temperature.

ADVERSE EFFECTS: Methyl bromide is a central nervous system depressant and may cause a variety of effects including psychic, motor and gastrointestinal disturbances. Methyl bromide can cause skin, eye, and respiratory irritation.

CLINICAL EFFECTS:
The signs and symptoms of methyl bromide exposure vary according to the degree and duration of the exposure. Human experience has shown that acute fatal intoxication can result from exposure to methyl bromide vapors of 300 to 400 ppm. Harmful effects have been seen at exposure concentrations of 100 ppm and greater. The symptoms generally increase in severity with increasing exposure concentrations and may vary according to the circumstances of the exposure and individual susceptibility. A latency period of 2 to 48 hours generally occurs between exposure and onset of symptoms. Clinical effects may include:

- Dizziness and headache
- Skin, eye, and respiratory irritation.
- Lack of appetite, nausea, vomiting and abdominal pain
- Listlessness, weakness, slurring of speech and staggering gait.
- Blurring of vision, double vision, and temporary blindness.
- Mental confusion, mania, tremors and epilepsy type convulsions.
- Rapid respiration , severe pulmonary edema, cyanosis, pallor and collapse.
- Coma, lack of reaction and death from pulmonary or circulatory collapse

ACUTE EXPOSURES

In low exposures, the clinical effects are generally limited to mild neurological symptoms and GI disturbances with recovery in a few days.

In moderate exposures, more extensive neurological symptoms and disturbed function are seen. Recovery may be prolonged for weeks or months with persisting symptoms and/or disturbed function.

Severe poisoning exposures also involve a latency period and similar initial findings as seen for low and moderate exposures. Development of disturbed speech and gait, in coordination, psychic disturbances and tremors that may develop to convulsions Recovery can be protracted with persisting neurological disorders. Kidney damage in humans has been reported at high concentrations.

REPEATED EXPOSURES

Low level repeated exposures have produced a syndrome of repeated numbness in the hands and legs, impaired superficial sensation, muscle weakness, unsteady gait and absent or reduced distal tendon reflexes. Exposure to airborne concentrations in the range of 150 ppb to 300 ppb or lower but for extended periods can produce the same symptoms as above but with increased severity and may include cough, bronchspam and other respiratory symptoms.

DIFFERENTIAL DIAGNOSIS

As noted, the breadth of local and systemic effects can vary widely. The differential diagnosis may include vertigo of central and peripheral origin, cerebral vascular accident; viral gastroenteritis, acute abdomen; viral or bacterial pneumonia, cardiopulmonary edema, adult respiratory distress syndrome, chemical pneumonitis; optic neuritis, ischemic optic neuropathy, temporal arteritis; new onset atrial fibrillation, myocardial infarction.

SPECIAL TESTS

Serum bromide levels can be used to document that exposure did occur. However, turn around time for bromide levels is often sufficiently long to only be helpful in retrospect, and initial levels do not correlate well with the clinical course. Baseline laboratory studies should include CBC, glucose, electrolytes, liver and kidney functions, ECG, and chest xrays. Pulse oximetry may be helpful.

TREATMENT

There is no specific antidote to methyl bromide. Treatment is supportive. Treat hypotension, seizures, cardiac dysrhythmias and coma with conventional therapies. In adults, bronchospasm is treated with bronchodilator medications. In the elderly especially, consider the avoidance of cardiac sensitizing agents, to reduce the risk of dysrhythmia. In children with respirator symptoms, consider aerosolized racemic epinephrine. If necessary, remove person to

fresh air and provide ventilator support.

REFERENCES

Gosselin, R.E., Smith, R.P. Hodge, H.C. (1984) Clinicatl Toxicology of Commercial Products. 5th edition. Williams and Wilkins. Baltimore. MD. p. 282.

USEPA, Ambient Water Quality Criteria Document: Halomethanes p. C-24 (1980). EPA 440/5-80-051.

Braker, W. and Mossman, A. (1984). Matheson Gas Data Book 6th edition. p. 457.

TOXICOLOGY BACKGROUND

Undiluted methyl bromide:
The general population would not come in contact with undiluted methyl bromide since it is a vapor at normal temperatures. Handling of liquid methyl bromide may cause dermatitis and severe itching of the skin. In the eyes, the liquid can cause severe corneal burns.

Airborne methyl bromide vapor:

Exposure to airborne concentrations of methyl bromide vapor may occur offsite of a field during or immediately after treatment with methyl bromide.

Laboratory Animal Inhalation Neurotoxicity Studies.

In an acute neurotoxicity study, male and female Sprague-Dawley rats were exposed via inhalation for six hours to methyl bromide at concentrations of 0, 30, 100 or 350 ppm. Neurobehavioral effects were observed only in the 350 ppm exposed group, were limited to the three-hour post-exposure assessment and included decreased arousal, body temperature and motor activity, drooping or half-shut eyelids, piloerection and other functional changes. No findings were seen in follow-up observations made 7 and 14 days after exposure. The No Observed Adverse Effect Level (NOAEL) was 100 ppm.

In a subchronic neurotoxicity study, male and female Sprague Dawley rats were exposed to methyl bromide concentrations of 0, 30, 70 or 140 ppm for 13 weeks. The NOAEL was 30 ppm for female rats and 70 ppm for male rats. Decreased motor activity was seen in female rats exposed to 70 ppm for 13 weeks.

A developmental neurotoxicity study via the inhalation route was conducted with methyl bromide where pregnant female rats were exposed for 6 hours/day to 0, 5, 25 or 50 ppm methyl bromide during pregnancy and lactation. There were no effects seen in the pregnant females. Effects in the offspring were seen at 50 ppm only and included low body weight, developmental delays and decreased motor activity early in the study. The NOAEL for offspring was 25 ppm.

Reproductive Function Studies.

In a reproduction study, male and female rats were exposed to methyl bromide by inhalation at concentrations of 0, 3, 30 or 90 ppm through two-generations. The No Observable Adverse Effect Level for systemic toxicity was 30 ppm while the NOAEL for reproductive and developmental effects was 3 ppm.

Developmental Toxicity Studies.

Pregnant female rats were exposed by whole body inhalation to methyl bromide vapor concentrations of 20 or 70 ppm for 6 hours per day through the entire pregnancy. The NOAEL was 70 ppm for both effects on the pregnant animals and developmental toxicity.

The developmental toxicity of methyl bromide was also evaluated in a non-rodent species. Sexually mature virgin female New Zealand White SPF rabbits were impregnated and exposed by whole body inhalation to methyl bromide vapor for 6 hours per day during days 7-19 of gestation. Exposure levels were 20, 40 and 80 ppm. The NOAEL for maternal toxicity and fetal/developmental toxicity in this study was 40 ppm. Significant toxicity was seen in the pregnant animals at the 80 ppm concentration in which some fetal findings were seen.

Carcinogenicity Testing.

Lifetime inhalation bioassays were conducted in 2 strains of rats and one strain of mice. Methyl bromide has been shown to not cause cancer in animal studies following long-term inhalation. Chronic effects were limited to changes in nasal epithelia. Two-years of dietary administration of methyl bromide to rats also did not cause any evidence of a cancer effect.