Fatal methyl bromide poisoning

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Methyl bromide was commonly used in fire extinguishers in aircraft engines and in submarines during the second world war. Now it is widely used as a fumigant insecticide in grain stores.^{1,2} Mortality after intoxication by methyl bromide vapour may be high,¹⁻³ and is often associated with convulsions, usually resistant to standard anticonvulsant chemotherapy.^{1,3-5} We wish to draw attention to the continuing risk of exposure to methyl bromide and offer fresh suggestions regarding the clinical management of severe methyl bromide poisoning.

Case report

A 68 year old scrapdealer discharged into the atmosphere several obsolescent aircraft engine fire extinguishers containing methyl bromide and then proceeded to scrap them. Several hours later he developed twitching of the arms, became ataxic, and presented to the outpatients clinic. On clinical examination he had painful, epileptiform tonic, clonic spasms of the face, trunk, and limbs. He was fully conscious during these episodes and gave a lucid history of the events leading up to his admission. Anti-convulsant treatment was started with diazepam in the first instance, after which phenytoin was added. As the standard regimen had no effect on convulsions, intravenous chlormethiazole and then nitrous oxide by inhalation were used, unsuccessfully. Accordingly, muscle paralysis was induced with pancuronium and positive pressure ventilation begun. Daily monitoring after withdrawal of the muscle relaxants was carried out and after seven days the generalised convulsions had ceased and ventilation was discontinued.

Complications during ventilation included a chest infection that yielded to treatment with physiotherapy and appropriate antibiotics and a supra-ventricular tachycardia that reverted without treatment. Serum bromide concentrations ranged between 27 mEq/l and 102 mEq/l (130-480 mg/100 ml) and an EEG showed centroencephalic spike discharges. On reversal of paralysis he was markedly ataxic with an

intention tremor and muscular fasciculation. There was some neurological improvement over the following week but during remobilisation he developed signs of deep vein thrombosis of the left calf. Despite anticoagulant treatment with heparin he collapsed and died 16 days after admission. Necropsy showed multiple pulmonary emboli with large emboli occluding both pulmonary arteries.

Discussion

Methyl bromide, a colourless liquid but gaseous at room temperature, enters the body either by inhalation through the skin or mucosa. After inhalation of a concentration more than 200 ppm (20 mg/100 ml) toxic effects are invariably noted. Concentrations of greater than 250 ppm (25 mg/100 ml) are associated with clinical signs including nausea and vomiting, pulmonary oedema, coma, and convulsions.¹ Neurological signs are associated with a high mortality. Long term sequelae include psychiatric disturbances and neurological deficits including optic atrophy.^{1,4,6} Proposed mechanisms of toxicity include methylation of the SH enzyme systems and other proteins⁷ and a direct toxic effect of methyl bromide on cells. This direct cytotoxic effect of methyl bromide on HeLa cells in vitro was reduced considerably by the presence of glutathione, whereas the products of hydrolysis of methyl bromide appeared not to cause cell damage,⁸ making the measurements of serum bromide and other metabolites of dubious relevance. There have been numerous reports of poisoning, often with only mild signs and symptoms, during the manufacture and in the handling of methyl bromide.^{4,9,10} There is some evidence of subclinical toxicity in agricultural workers, with minimal changes in serum transaminase and alkaline phosphatase but, more strikingly, EEG changes in 60% of those examined.¹¹ In a fatal case of poisoning in an adult after the accidental inhalation of methyl bromide discharged from a fire extinguisher, death was due to pulmonary oedema and exhaustion.¹² Rasthhaus and Landy have successfully used BAL (2,3-dimercapto-1-propanol) in severe methyl bromide poisoning in six patients.³ In our patient early positive pressure ventilation may

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have prevented the development of severe chemical pulmonary oedema, or reduced its effect. The many deaths described may have resulted from uncontrolled convulsions, usually resistant to standard anti-convulsant treatment. Convulsions from methyl bromide poisoning are effectively controlled with muscular paralysis and positive pressure ventilation, which should now be considered for use as first line treatment. The use of BAL and glutathione may be beneficial as adjuncts in the management of severe methyl bromide intoxication.³ The continued existence of methyl bromide containing extinguishers must be recognised and its continuing use in agriculture as a pesticide makes methyl bromide poisoning a diagnosis to be considered in resistant acute convulsions.

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