Case Study

Two Cases of Methyl Bromide Poisoning in Termite Exterminators

Yuko YAMANO, Jun KAGAWA and Sumiko ISHIZU

Department of Hygiene and Public Health, School of Medicine,
Tokyo Women's Medical University

Key words: Methyl bromide poisoning, Termite exterminators

It was decided at the 4th meeting of the signatories to the "Montreal Protocol Regarding Restriction of Substances Destroying the Ozone Layer" in 1992 to freeze beginning in 1995 the production and consumption of methyl bromide (CH_3Br), which is mainly used as a plant quarantine fumigant and a soil fumigant¹⁾, and to totally abolish it by 2005²⁾. Methyl bromide has, however, continued to be used quite frequently, mainly due to a delay in the development of substitutes for it³⁾.

In the past, methyl bromide poisoning frequently occurred during the production of methyl bromide³⁾, harbor loading and unloading processes^{4,5)}, and grain import processes⁶⁾. In recent years, acute poisoning in these areas has decreased as a result of streamlining and meticulous supervision of these processes, and improvement in the environment⁷⁾. Nevertheless, methyl bromide poisoning still occasionally occurs in farmers engaged in soil fumigation and workers engaged in extermination of termites, in part because the chemical is not handled under adequate supervision^{7–10)}.

This is a case report of methyl bromide poisoning in Japanese workers engaged in extermination of termites. Although the poisoning was a result of occupational exposure, a definitive diagnosis was delayed in these cases.

I. Case presentation

Case 1: The patient was a 46-yr-old man who had been engaged in termite extermination work for about 15 yr. On the night of October 25 and into the morning of October 26, 1994, he was engaged with one of his colleagues in fumigation of a museum. The chemical that they used for fumigation consisted of a mixture of methyl bromide (85%) and ethylene oxide (13%). After fumigation, they took a nap in an adjacent room. Around 6:00 a.m. on October 26, the patient's colleague felt sick and did not get up. The patient inspected their equipment

for any leakage and removed the gas from the equipment. Since he had noted gas leakage, he repaired the equipment by applying tapes, etc. Around midnight on the same day, his colleague died of heart failure. The patient attended the postmortem examination conducted soon thereafter by the police, and while attempting to sign the documents related to the postmortem examination, he noticed tremors of the hands. Around 2:00 p.m., he developed myoclonus, slipped into a coma, and was admitted to the hospital. At first, his condition was considered to be of psychological origin, but since the symptoms did not improve, the hyperventilation syndrome was suspected. Around 4:30 p.m., he was transferred to the department of neurosurgery. At admission, he was found to be in a manic-depressive state, and it proved impossible to obtain a history. The generalized myoclonic convulsions became more severe and subsided with the administration of anticonvulsants. No abnormalities were noted on cranial CT or on routine laboratory testing. Subsequently, the patient again developed generalized myoclonic convulsions that responded to symptomatic treatment. On the 8th day of the illness, methyl bromide poisoning was suspected for the first time, considering his occupation. Therefore, the blood specimen obtained on the first day of the illness was examined and the plasma bromide concentration was determined to be $123.5 \mu\text{g/ml}$ (Fig. 1), much higher than the normal range ($3.7 \pm 1.5 \mu\text{g/ml}$)¹¹⁾. On the 10th day of the illness, the diagnosis of methyl bromide poisoning was confirmed. Hemodialysis was immediately instituted and performed three times, following which the plasma bromide concentration decreased to $7.8 \mu\text{g/ml}$. The patient's handwriting examined on the 10th day of the illness is shown in Fig. 2. Although he was right-handed, he developed tremors while attempting to write with his right hand. The only other symptom observed was mild tremor. Since February 2000, he has been resting at home and working occasionally.

Case 2: The patient was a 20-yr-old man who had been engaged in termite extermination work in Miyazaki prefecture and who fumigated works of art two or three times a year. Between September 27 and September 28, 1999, he was engaged in fumigation of a museum with a mixture of methyl bromide (85%) and ethylene oxide (13%). One hour after he started the work, he inhaled the gas when he removed the seal of the cylinder without wearing a gas mask. At first, he had subjective symptoms such as mild nausea and vomiting, which he attributed to a common cold; he therefore took some cold remedy. He remained asymptomatic during the following three days (between September 29 and October 1). On October 2, however, he developed dizziness, light-headedness and allophasia. While he was driving a car, he suddenly realized that he was driving in the opposite lane. He was transported to a nearby hospital by ambulance, but since

Received March 22, 2001; Accepted July 10, 2001

Correspondence to: Y. Yamano, Department of Hygiene and Public Health, School of Medicine, Tokyo Women's Medical University, 8-1 Kawada-cho, Shinjuku-ku, Tokyo 162-8666, Japan

Fig. 1. Time course of bromide ion levels in plasma and urine.

no abnormalities were noted on admission, including on routine laboratory testing, methyl bromide poisoning was not diagnosed. The symptoms subsequently became worse, and the patient was transferred to the Japan Medical Association Hospital on the 4th day of the illness. On admission the patient was lucid, but dizziness, light-headedness, abasia, allophasia, decreased muscle strength in the upper and lower extremities, and glove and stocking anesthesia were noted. A history, with emphasis on occupational history, was obtained immediately. Methyl bromide poisoning was then suspected and hemodialysis performed. At the same time, the blood specimen obtained on the 1st day of the illness was analyzed and the plasma bromide concentration was found to be high ($75.5 \mu\text{g/ml}$; Fig. 1). Methyl bromide poisoning was confirmed on the 5th day. After hemodialysis, the plasma bromide concentration decreased to $27.0 \mu\text{g/ml}$ (Fig. 1). Subsequently the anesthesia and declined muscle strength improved, and the patient was discharged on the 21st day.

II. Discussion

Methyl bromide poisoning usually begins with non-specific symptoms, such as nausea, vomiting, dizziness,

tremors and convulsions. Moreover, no significant routine laboratory abnormalities are noted^(3, 7, 12, 13). The only diagnostic findings are high bromide ion levels in the blood and urine⁽¹⁾ so that it is often difficult to diagnose this condition without obtaining a meticulous occupational history or a history of exposure to the chemical^(3, 7).

In this report, although the cause of the poisoning was occupational in both cases, the diagnosis was greatly delayed (10th day of illness in Case 1 and 5th day of illness in Case 2).

The delay in diagnosis is believed to have been the result of how the cases were handled by the medical care providers, who had insufficient experience due to the fact that methyl bromide poisoning is not frequently encountered in a clinical setting. In both our cases, no routine laboratory abnormalities were noted, and although tremors (Fig. 2) and myoclonus^(3, 13-15), both characteristic symptoms of methyl bromide poisoning, were observed in Case 1, the symptoms were suspected to be of psychological origin because the patient first developed the tremor while attempting to sign a document related to the postmortem examination of his colleague conducted by the police. This was believed to contribute to the

Fig. 2. Writing sample of Case 1 showing the patient's name in Japanese *kanji*.

delay in diagnosis. In Case 2, even though neurological symptoms such as declined muscle strength and anesthesia which are known to occasionally develop in methyl bromide poisoning, were noted^{3, 13, 16, 17)}, methyl bromide poisoning was not suspected, and only symptomatic therapy was administered while the diagnosis remained unknown. When the patient's symptoms became worse, he was transferred to another hospital. Methyl bromide poisoning was suspected for the first time on the 4th day of the illness considering his occupation, and the diagnosis was confirmed on the 5th day. Much earlier inquiry into the occupation of the patient and history of use of methyl bromide fumigants might have allowed the physician to diagnose the condition based on the presence of symptoms in these patients. Ramazzini¹⁸⁾ reached the same conclusion regarding general poisoning.

There may be a long latent period between exposure and the development of symptoms in many cases of bromide methyl poisoning^{3, 4, 12)}. In our cases, the latent period was estimated to be one to three days. According to the review by Ishizu *et al.*³⁾ and Alexeeff *et al.*¹³⁾, methyl

bromide poisoning characteristically does not develop immediately after exposure. Although the latent period varies among reporters, the average latent period has been reported to be between 1 and 24 hr, whereas a long latent period of two and a half days has also often been reported.

Another possible reason for the delay in diagnosis is the limited knowledge of the patients themselves have regarding methyl bromide poisoning. If they had had adequate knowledge, the patients themselves, their families, or colleagues could have informed the physicians regarding their having been engaged in fumigation work. In the present cases, improper attention to safety precautions, such as failure to wear a gas mask and inappropriate sealing of the gas cylinders, were responsible for the exposure. Persons engaged in fumigation work are normally required to attend training sessions on the safety precautions that must be observed while handling chemicals organized by a Plant Protection Station, and they must acquire a license provided by the national government¹⁹⁾. Moreover, a supervisor holding a valid license is required to supervise the work. The license must be renewed every three years, and the licensees are obliged to take refresher lectures at the time of renewal of the license. Disastrous poisoning with fumigants has decreased dramatically since the introduction of this system⁷⁾ but since the same system has not been applied to persons engaged in termite extermination work, inappropriate education of these workers continues to be a cause for worry.

Since the import of grains is expected to increase in Japan in the future, the number of methyl bromide poisoning cases may increase. Therefore, more careful attention and monitoring are needed with respect to management of the health of workers, management of the work environment, management of work procedures, education regarding hygiene and health, and measures for securing emergency medical attention. At the same time, more information regarding the poisoning must also be given to medical care providers.

Acknowledgments: We are grateful to Dr. Kazushige Sugawara of Iwate Prefectural Kuji Hospital, Dr. Masatsugu Numata of Miyazaki City and County Medical Association Hospital, and Dr. Fumihiko Ohmori of Ohmori Clinic for provision of data and comments regarding the cases, as well as to the medical technologist, Ms. Tomoko Tokutake of the Department of Hygiene and Public Health, Tokyo Women's Medical University for her assistance in analyzing the bromide concentrations in the biological samples.

References

- 1) Noyaku Yoran 2000, Plant Protection Division, Agricultural Production Bureau, Ministry of Agriculture, Forestry and Fisheries, and Japan Plant Protection Association.

- 2) Handbook for the International Treaties for the Protection of Ozone layer. The Montreal Protocol, Fifth edition, 2000: 42–43.
- 3) Ishizu S. Methyl bromide intoxication. In: Ishizu S. Methyl bromide poisoning. Japan Fumigation technology Association, 1989: 26–98.
- 4) Yamano Y, Ishizu S, Kagawa J, et al. Acute methyl bromide poisoning in the crew of imported timber carrier. *J Science of Labour* 1994; 70: 436–440.
- 5) Nakagawa M, Yasuhara T, Terai Y, et al. Two cases of methyl bromide poisoning. *JTOM* 1999; 47: 652–655.
- 6) Deschamps FJ, Turpin JC. Methyl bromide intoxication during grain store fumigation. *Occup Med* 1996; 46: 89–90.
- 7) Yamano Y, Ishizu S, Kagawa J. Methyl bromide poisoning. *Occup Health J* 2000; 23: 18–23.
- 8) Hustinx WN, van de Laar RT, van Huffelen AC, et al. Systemic effects of inhalational methyl bromide poisoning: a study of nine cases occupationally exposed due to inadvertent spread during fumigation. *Br J Ind Med* 1993; 50: 155–159.
- 9) Langard S, Rognum T, Flotterod O, Skaug V. Fatal accident resulting from methyl bromide poisoning after fumigation of a neighbouring house; leakage through sewage pipes. *J Appl Toxicol* 1996; 16: 445–448.
- 10) Ishizu S, Kato N, Morinobu S, et al. Cases of severe methyl bromide poisoning residing above a warehouse. *Jpn J Ind Health* 1988; 30: 54–60.
- 11) Yamano Y, Ito I, Nagao N, et al. A simple determination method bromide ion in plasma of methyl bromide workers by head space gas chromatography. *Jpn J Ind Health* 1987; 29: 196–201.
- 12) Hine CH. Methyl bromide poisoning. A review of ten cases. *J Occup Med* 1969; 11: 1–10.
- 13) Alexeeff GV, Kilgpre WW. Methyl bromide. *Residue Rev* 1983; 88: 101–153.
- 14) Prockop LD, Smith AO. Seizures and action myoclonus after occupational exposure to methyl bromide. *Journal of the Florida Medical Association*. 1986; 73: 690–692.
- 15) Obeso JA, Viteri C, Martinez Lage JM, et al. Toxic Myoclonus. *Adv Neurol* 1986; 43: 225–230.
- 16) De Haro L, Gastaut JL, Jouglard J, et al. Central and peripheral neurotoxic effects of chronic methyl bromide intoxication. *J Toxicol Clin Toxicol* 1997; 35: 29–34.
- 17) Cavalleri F, Galassi G, Ferrari S, et al. Methyl bromide induced neuropathy: A clinical, neurophysiological, and morphological study. *J Neurol Neurosurg Psychiatry* 1995; 58: 383.
- 18) Ramazzini B. *De morbis artificum diatriba*. 1713
- 19) Manuals for classes for examinations of supervisors of the works involving specific chemicals and specialized courses for supervisors of the plant quarantine fumigation works. Notification from the Director of the Agricultural Production Bureau, Ministry of Agriculture, Forestry and Fisheries, 1976.