MEDICAL ASPECTS OF METHYL CHLORIDE

BY

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British medical literature contains few references to methyl chloride, and only brief mention is made of it in textbooks on toxicology. This substance is of interest to the medical profession for several reasons: (1) on account of its toxic properties; (2) the symptomatology of poisoning by it is varied and liable to be overlooked and to be ascribed to other causes; (3) it has an extensive use as a refrigerant: it has been so used for many years, chiefly on the Continent and in America. Owing to the recent extension of the use of domestic refrigerators in this country methyl chloride is now in common use here. On land, installations are to be found in hospitals, hotels, and in a large number of shops, more especially in those of butchers, fishmongers, and grocers. In one new building in London over seventy machines are in use. One firm among several manufacturers of these plants has supplied over seven thousand installations in this country. It is therefore possible that toxic cases may be more frequent than formerly. The object of this paper is to set out the available information and to place on record a fresh case of poisoning.

Methyl chloride was discovered by Peligot and Dumas in 1835; it has the chemical formula CH_2Cl_2 , with a molecular weight of 50.474. It is a non-corrosive gas, and is usually supplied compressed into cylinders. It is colourless both in the gaseous and in the liquid state. The boiling point is -24°C . It possesses only a very faint, sweet, chloroform-like odour, and is non-irritating to the eyes and to the respiratory tract.

REFRIGERANT PROPERTIES

In medical practice it is used as a local analgesic in cases of neuralgia and neuritis, when it is sprayed on the affected part, producing intense cold by evaporation. Its inhalation causes narcosis, and this property was investigated in 1879 by a committee of the British Medical Association, who used an alcoholic solution, and reported a mild narcotic effect.

Commercially, as stated above, it has extensive use as a refrigerant, and it is reported from America that there are 75,000 domestic plants in use in one city. It was used as early as 1895 in the French Navy, and is now to be found in a great number of British mercantile ships. It may be of interest to enumerate some of the advantages this substance possesses as a refrigerant as compared with the more usual agents such as CO_2 , SO_2 , and NH_3 , from a list made by J. B. Churchill.

(a) It is non-corrosive to metals used in refrigerating systems, and does not decompose into a corrosive when it comes into contact with moisture accidentally introduced.

(b) It does not form an explosive mixture with air under ordinary conditions, and is stable at any temperature in the system.

(c) It is only moderately inflammable, and is of relatively low toxicity compared with some other refrigerants.

(d) It decomposes when in contact with an open flame, but yields no toxic substance.

(e) It is non-irritating to the eyes and lungs, enabling servicing of equipment to be carried out without annoyance to persons occupying premises where it is in use.

(f) It does not injure foods, flowers, or textiles when they are exposed to its vapour by leaks.

These properties account for the popularity of methyl chloride as a refrigerant. The dangers of fire or explosion

are small. The main consideration is the danger to the life and health of human beings. This arises (apart from the question of exposure during manufacture incurred by workers in the industry) from leaks in domestic or other plants, owing to the fact that its odour is so slight as not to be noticeable. In this connexion it is interesting to note a proposed patent in which aldehyde shall be added so as to produce a lachrymatory effect, thus indicating slight leaks.

TOXIC EFFECTS

Toxic effects are produced usually by unnoticed leaks taking place in enclosed or ill-ventilated places. If the leak is a slow one and the gas becomes diffused and diluted in the atmosphere its existence may never be appreciated; but at higher concentrations toxic symptoms arise. A concentration of 10 to 20 per cent. is said to be anaesthetic. The gas is slowly excreted, so that the effects of small amounts may become cumulative and cause symptoms only after some days.

It is considered by one German observer that individual susceptibilities occur. The following is the report of a case which came under my own observation.

On October 26th, 1932, several men were working in the cold store in the fore part of a ship. A small supply pipe of the methyl chloride refrigerating plant was accidentally broken across, allowing the escape of gas for about thirty minutes before the break was seen and plugged. No ill-effect was noticed by any of the men until five hours later. F. A., aged 40 years, felt sick and giddy, and noticed a mustard-like taste in his mouth. He went home, and was violently sick all night. The following day he was admitted into a local hospital in a state of collapse, with pallor and slight cyanosis. He felt giddy, and had a burning sensation in his mouth and throat. The pulse was 80 and the temperature normal. Vomiting ceased in twenty-four hours, and in three days he was discharged, normal in all respects. He resumed work, and is now in good health. The space in which these men were working was an enclosed one, ventilated by an open-top hatch with no through current of air. One other man had slight sickness and giddiness, but did not cease work.

In recent years nearly a hundred cases have been reported from abroad. Gerbo, in 1914, gave a record of two cases in ice machinists, and in 1923 Roth reported a further ten cases from Germany. In 1921 Schwartz recorded one fatality in ten cases among workers in the industry. Baker notes twenty-one cases with no deaths from America; and in Chicago, since 1928, twenty-nine cases are reported with ten deaths. Several isolated cases have been noted from European countries, with one fatality. The onset of symptoms is gradual in the milder cases; but in those of greater severity unconsciousness may be present at the commencement, and is usually accompanied by convulsions and delirium.

CASES ILLUSTRATING A MILD ATTACK

I am able to record four cases reported to me from this country illustrating the symptoms of a mild attack.

Case 1.—A young man while doing research work inhaled concentrated gas in an enclosed chamber. His main symptom was violent vomiting. As he developed nothing further he returned to work after a week, and is now in good health.

Case 2.—A fitter liberated a large amount of gas into an unventilated space in which he was working. He became violently sick with nausea, but returned to work in three days, having recovered.

Case 3.—A workman on a ship, while repairing some leaking joints, remained tightening them up for several hours in a badly ventilated space. He had violent sickness and nausea, and was well in six days.

Case 4.—While a vessel was at sea an engineer liberated most of the charge into a confined space without ventilating it, and had severe vomiting, but made a good recovery.

SYMPTOMATOLOGY

The symptoms as collected from various records may be stated to be as follows.

The onset is one of progressive drowsiness and apathy, going on to stupor, with nausea, vomiting, and abdominal pain. Muscular tremors may be present, and may be followed by tonic convulsions with marked cyanosis. Ocular signs and symptoms may be prominent. The pupils are usually dilated. Ptosis and nystagmus have been noted, also amblyopia. The temperature nearly always rises, and deaths with high pyrexia have occurred. The pulse and respiration rates are increased.

Renal Symptoms.—Anuria lasting twenty-four to forty-eight hours is usual in the more severe cases, and albuminuria occurs in about 50 per cent. The urine has always been found to be acid, and acetone and diacetic acid may be present. Baker observed formic acid in his cases, but other observers have not found this to be the universal rule. Hyaline and granular casts are sometimes seen.

The blood pressure is lowered, and the blood picture is one of primary anaemia, with a moderate leucocytosis. The cause of death is apparently respiratory paralysis. Sequelae have been noted, and chiefly affect the nervous system: ataxia, insomnia, vertigo, and dim vision, which persist for some months. Post-mortem examinations were performed on the fatal American cases, and the main findings consisted of petechial haemorrhages in the pleura, epicardium, and endocardium. Marked congestion of the lungs and kidneys was found, as well as early fatty changes in the liver. Chemical examination was negative.

DIFFERENTIAL DIAGNOSIS

The diagnosis rests on a history of exposure to the gas and on the symptoms detailed above, the predominating symptoms being nausea and vomiting, with drowsiness and a confused mental state of several days' duration.

The condition has chiefly to be distinguished from food poisoning, in which diarrhoea might be expected to be a more prominent symptom, and, in the case of botulism, consciousness to the end. The case recorded by me was thought to be one of coal-gas poisoning. Carbon monoxide poisoning shows a subnormal temperature, and has the spectroscopic bands of carboxyhaemoglobin in the blood. Poisoning by the heavy metals must be considered, and the evidence sifted in the absence of a clear history. Certain diseases of the nervous system, particularly encephalitis and meningitis, enter into the differential diagnosis. In this connexion it is of interest to note that the cerebro-spinal fluid in methyl chloride poisoning is fairly normal, especially the cellular content, but has been found under pressure in a few instances.

TREATMENT

The treatment of the condition consists, first, in getting the patient into the fresh air and in commencing the early administration of oxygen. Alkalis should be given freely. It may be necessary to control convulsions, but on no account should chloral or chloroform be used for this. As a powerful cardio-respiratory stimulant coramine in large doses is indicated. The patient should be kept in bed until the temperature and pulse are normal and all acute nervous symptoms have abated. The anaemia may have to be treated. The gas is oxidized slowly, and the aim of the treatment is to hasten oxidation.

SUMMARY

1. Attention is drawn to the increased use of methyl chloride as a domestic refrigerant.

2. The signs and symptoms of poisoning and observations gathered from several observers are described.

3. A case occurring in this country is placed on record and the different diagnosis is discussed.

A bibliography is appended from which further information can be derived.

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Clinical Memoranda

RELATION BETWEEN EPILEPSY AND
CONGENITAL SYPHILIS

The following is a report of a pedigree which appears to be of some interest from the point of view of the much-discussed relation between epilepsy and congenital syphilis. Much has been written on the subject, and very divergent views expressed. Some authors go so far as to say that all cases of "idiopathic" epilepsy are ultimately traceable to syphilis, while others suppose, on the other hand, that there is no connexion whatever, and that any apparent relation is merely a coincidence. Mott,¹ for instance, says: "Because there are stigmata of syphilis on the body of a juvenile epileptic it does not necessarily follow that there is a causal connexion . . . it may be coincidence." He says also: "The question whether syphilis of the parents can modify the germ-plasm so as to render it biologically unstable, whereby a slight excitation suffices to produce a fit . . . is one that cannot be satisfactorily answered."

The weight of opinion is in favour of the view that congenital syphilis may result in pathological and local changes in the brain responsible for epileptic attacks, and that it may also so influence the germ-plasm that epilepsy results, even when the affected individual shows no other signs of congenital syphilis.

DESCRIPTION OF PEDIGREE

First Generation (I):

1. Male, 60 years. Denies syphilis. Has history of phthisis. Wassermann and Meinicke negative.
2. Female, 58 years. Wife of above. Had course of injections six years ago. No history of infection. Wassermann and Meinicke strongly positive.

Second Generation (II):

1. Male, 32 years. Always healthy. Has hypospadias, otherwise normal. Married six years; no children. Wassermann and Meinicke negative.
2. Wife of above. Healthy.
3. Male, 30 years. Always healthy. Married four years; one child; no miscarriages. Wassermann and Meinicke negative.
4. Wife of above. Healthy.
5. Male, 28 years. Always healthy. Married seven years, one child; no miscarriages. Wassermann and Meinicke negative.