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COMPUTED TOMOGRAPHY DEMONSTRATION OF BRAIN DAMAGE DUE TO ACUTE SODIUM MONOFLUOROACETATE POISONING

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ABSTRACT

The case reported developed an acute brain syndrome, including cerebellar signs, shortly after the ingestion of sodium monofluoroacetate. After insiduous improvement of the clinical symptoms, the patient remained with an "end-stage" cerebellar ataxia for 18 months following the acute intoxication. The development of brain atrophy, proven by computed tomography, is considered to represent a direct influence of sodium monofluoroacetate on the brain and to reflect the unique disturbances in cellular metabolism of glucose.

INTRODUCTION

Sodium monofluoroacetate (SMFA) was introduced as a rodenticide and reported on by Kalmbach (4). The laboratory number "1080" is widely used to represent the compound. It is one of

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the most potent poisons for all mammals, including men. Its lethal dose for man, extrapolated from animal studies is about 5 mg/kg and is comparable to that of strychnine (8). Since the introduction of SMFA, cases of human poisoning have been expected (3).

CASE REPORT

A previously healthy 15 year old female attempted suicide by SMFA-ingestion. Thirty minutes after the ingestion she complained of nausea, vomiting and abdominal pain. One hour later a grand mal seizure occurred. Physical examination on admission to the hospital revealed tachycardia (150/min) and profuse sweating. She was disoriented to place and time and showed signs of psychomotor agitation. During the next four hours a progressive deterioration of her consciousness level occurred with three additional grand mal seizures, and she became comatose.

The biochemical profile was within normal limits. A lumbar tap showed a clear liquid, with normal opening pressure and no abnormality of sugar, protein or cell-contents. No traces of SMFA were found in the gastric juice, blood or urine samples taken shortly after admission. The computed tomography (CT) scan of the brain was considered normal (Figure 1).

The patient was treated with phenytoin 300 mg/day, pentothal 1.3 g/day intravenously for five days, and glycerol monoacetate 0.1 ml/kg intramuscularly hourly, in addition to fluid replacement.

A slow improvement began on the third day after the poison ingestion and during the following two weeks the patient became progressively alert. Neurological examination established severe cerebellar dysfunction. Repeated CT examination of the brain revealed a moderate diffuse brain atrophy with widening of the basal cysterns, quadrigeminal cystern, interhemispheric fissure, lateral ventricles and the third ventricle (Figure 2).

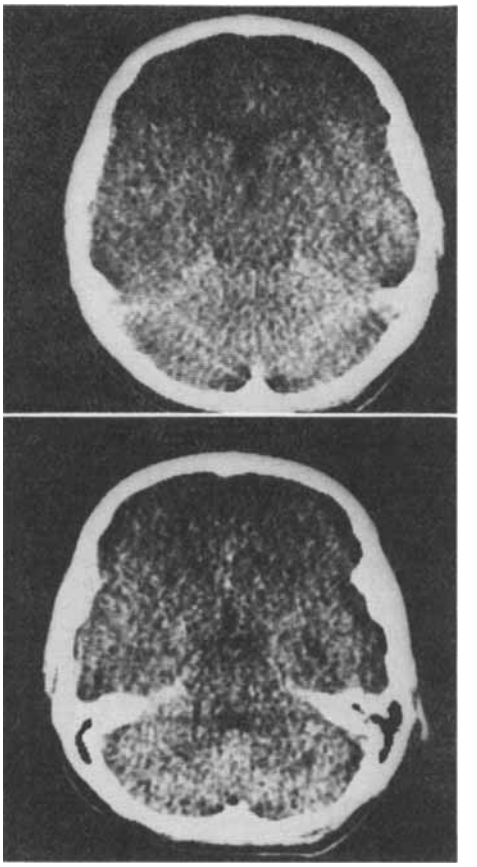

FIGURE 1: Non-enhanced CT scan of the brain, performed ten hours after the ingestion of SFMA.

During the following 18 months, the patient was examined neurologically because of complaints of memory disturbances and depressive behavior. These complaints slowly disappeared. A moderate cerebellar ataxia remained, despite improvement of the cerebellar dysfunction. An additional follow-up CT scan of the brain was evaluated as unchanged from the previous examination (Figure 3).

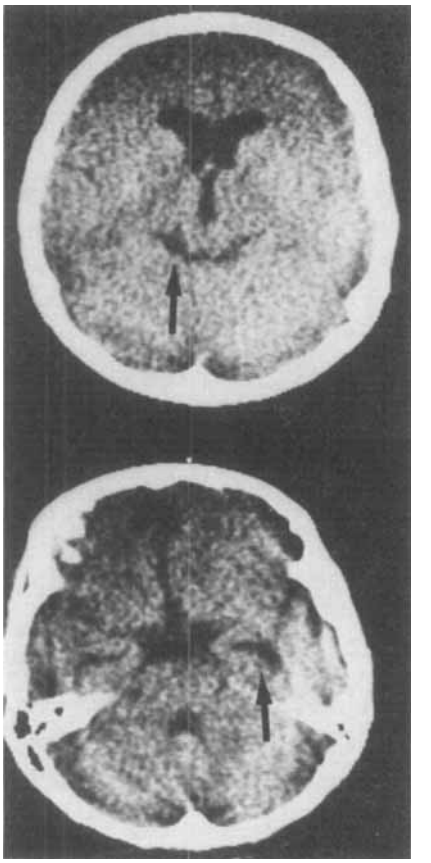

FIGURE 2: CT performed one week later. Moderate brain atrophy. Widening of the interhemispheric fissure, lateral ventricles, basal cysterns and third ventricle. Widened quadrigeminal cystern (upper arrow). The lower arrow indicates the enlarged temporal horn, becoming visible. No changes from these findings were noted in further follow-up CT scans.

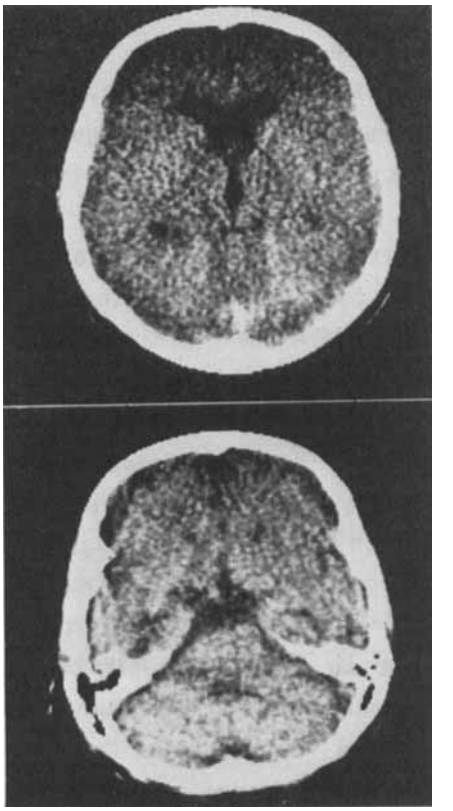

FIGURE 3: CT performed 18 months after the ingestion of SFMA. Enlargement of the basal cysterns, lateral ventricles and third ventricle, which show a different shape from Figure 2, due to a different angulation of the patient's head.

DISCUSSION

The toxicity of SMFA is apparently not due to its fluoride content, as the clinical toxicity and pathological findings are quite distinct from those in fluoride poisoning. SMFA interferes with citrate metabolism in the Krebs cycle by inhibition of

aconitase succinate dihydrogenase (1, 2), the enzyme responsible for catalysing succinate metabolism (5, 6, 7, 10). The resulting build-up of citrate secondarily inhibits glucose metabolism by inhibiting phosphofructokinase. The result is a reduction of energy supply, loss of cellular respiration and cellular death (7, 10).

Clinical manifestations occur after a characteristic latent period of 30 minutes to 2-1/2 hours. This is the time required for hydrolysis of the SMFA and its translocation and cell penetration. According to the clinical responses, animals have been categorized into four groups (3): In group I (rabbit, goat, horse, spider, monkey), central nervous system action is not observed, death being always due to cardiac effects with ventricular fibrillation. In Group II (cat, pig, rhesus monkey), both the heart and the central nervous system are affected, death usually resulting from respiratory failure during convulsions, and occasionally due to ventricular fibrillation (11, 12). In Group III (dog, guinea pig), epileptiform convulsions predominated, with death due to cessation of respiratory activity following running movements indistinguishable from strychnine poisoning (13). In group IV (rat, hamster), respiratory depression was the main feature with delayed bradycardia (14).

Human poisoning with SMFA reflects the clinical picture of group II. Initially, nausea and mental apprehension appear, followed by grand mal convulsions, depressed consciousness and eventually coma (3, 8, 15). The cardiovascular effects, which often result in death, may be ventricular tachycardia and fibrillation. In patients surviving the ictal period, no mental or behavioral disturbances or neurological deficits were found (3, 8), except in one case (15). This patient's disabilities (grand mal, spastic tetraplegia, cortical blindness, and divergent squint), were not a result of direct action of the SMFA on the central nervous system but were attributed to the prolonged anoxia of the brain.

Antidote therapy is unsuccessful due to the abrupt and severe onset of toxicity. The best antidote is glycerol monoacetate (9). Its administration is 0.1 to 0.5 ml/kg hourly dose. Cardiac glycosides must be avoided (8).

Our case had clinical features (tachycardia, grand mal seizures, psychomotor agitation, deterioration of consciousness) typical for acute SMFA poisoning. The patient's breathing was undisturbed, even during the comatous state, and the brain did not suffer hypoxia. However, diffuse brain atrophy had been established on the CT follow-up. The predominant clinical manifestation after regaining consciousness was a severe cerebellar syndrome. The most reasonable cause of this is massive death of brain neurons during the acute phase of the poisoning. The process most probably involved the posterior fossa structures, causing the cerebellar syndrome. The transient memory disturbances and the depressive behavior of the patient were other clinical evidence of the brain condition.

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