대한임상독성학회지 2014:12(2):88~91
Volume 12, Number 2, December, 2014

Journal of The Korean Society
of Clinical Toxicology

증 례

피레스로이드 중독 이후 발생한 중증 뇌손상: 증례

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Fatal Brain Injury in Pyrethroid Poisoned Patient: Case Report

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Pyrethroids have been widely using insecticides. Although generally regarded as less toxic to mammals including humans, we report one fatal case of pyrethroid poisoning with severe brain injury.

Key Words: Poisoning, Pyrethroid, Brain injury

Introduction

Allethrin was the first pyrethroid identified in1949[1], since many pyrethroid-containing products have been used worldwide and intentional poisoning due to pyrethroid compounds are common[2,3]. Although generally regarded as less toxic to mammals including humans because humans and other mammals rapidly metabolize pyrethroid compounds to non-toxic substances[4], we experienced one fatal case of pyrethroid poisoning with severe brain injury.

Case

A 61-year-old man presented to our emergency department (ED) 5 hours after suicidal ingestion with 20 ml of original concentrated permethrin solution (Product name: Clear F, Ingredient name: permethrin 15 g/100 ml), which is one of the pyrethroid insecticides (Fig. 1). The formulation containing permethrin 25% is generally used after 100-fold dilution with water.

The patient had no past medical history. He was stuporous [Glasgow Coma Scale (GCS) 10] with severe irritability upon ED arrival, at which time his blood pressure, heart rate, respiratory rate, and body temperature were 167/85 mmHg, 105 beats/minute, 32 breaths/minute, and 37.4°C, respectively. His electrocardiogram showed sinus tachycardia (106 beat per minute) without any arrhythmic changes and chest AP showed no specific abnormality. He was intubated for airway protection and mechanically ventilated. Activated charcoal was administered and initial brain computed tomography (CT) to evaluate for brain parenchymal lesions was normal (Fig. 2A, B).

An initial arterial blood gas analysis revealed pH 6.970, pO_2 131.6 mmHg, pCO_2 14.5 mmHg, HCO_3 3.3 mmol/L, base excess -26.7 mmol/L, and lactate 5.36 mmol/L. Other laboratory data included sodium 137 mmol/L, potassium 6.9 mmol/L, blood urea nitrogen (BUN) 13 mg/dL, creatinine (Cr) 1.4 mg/dL, glucose

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투고일: 2014년 7월 15일 1차 심사일: 2014년 7월 15일
게재 승인일: 2014년 8월 14일

Fig. 1. The empty bottle of concentrated pyrethroid solution (20 ml) that patient ingested.

219 mg/dL and osmolar gap 7 mOsm/kg, respectively. And serum pseudocholinesterase was 19,399 U/L (reference range: 7,000~19,000) and initial urine analysis showed no paraquat, no benzodiazepine, and serum analysis didn't show any toxic materials. Despite supportive therapy including intravenous (IV) hydration and ventilator care, there was progressive metabolic acidosis (pH 6.878, pO_2 98 mmHg, pCO_2 41.9 mmHg, HCO_3 7.3 mmol/L, base excess -25.6 mmol/L, lactate 5.63 mmol/L on ED after 6 hours later) and oliguria (urine output checked less than 0.1 ml/kg/hour on ED after 6 hours later and this status lasted until his death) requiring hemodialysis. At once, we conducted continuous renal replacement therapy (CRRT).

Twelve hours after ED arrival, the patient suffered generalized tonic-clonic seizures, which were not controlled by treatment with IV lorazepam and phenytoin, but resolved with IV phenobarbital. IV midazolam was

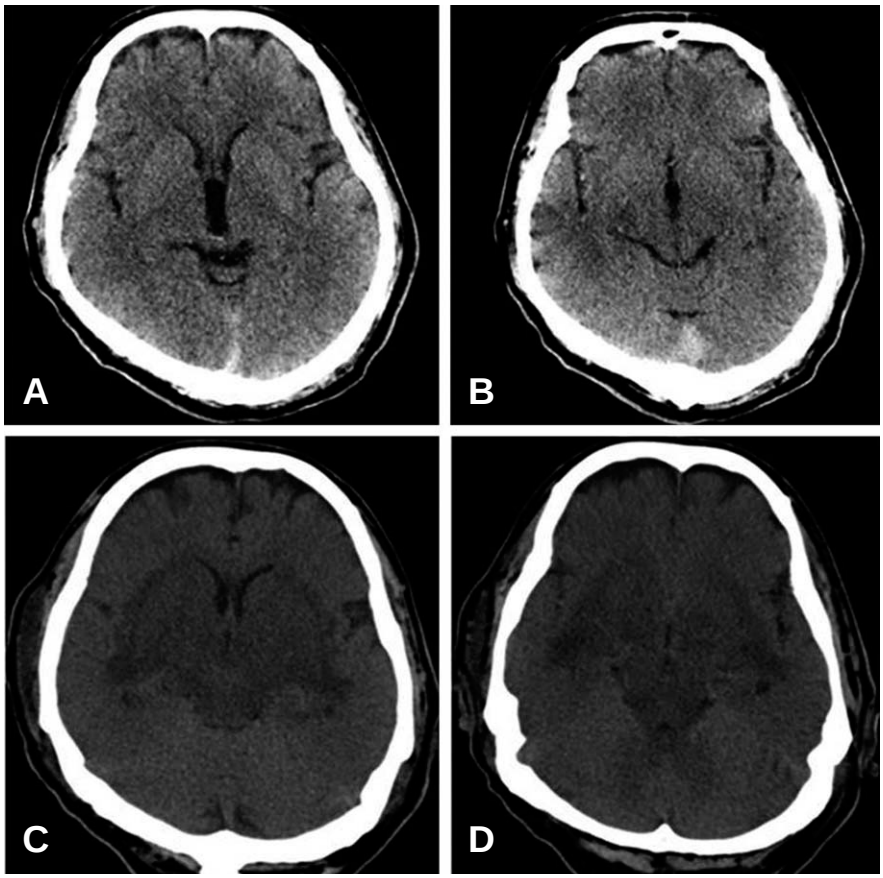

Fig. 2. (**A, B**) Initial brain CT image. (**C, D**) Follow-up brain CT 3 days after presentation. The images show brain swelling, a low-density lesion of bilateral deep gray matter and brain stem, and sulcus effacement.

used to control an additional seizure. First seizure episode lasted about total 50 minutes. Each intermittent seizure attacks lasted about 5 times within 5 to 10 minutes during the first episode. Other two episodes lasted within 5 minutes after first episode. Although metabolic acidosis was improved by CRRT (pH 7.125, pO_2 96.3 mmHg, pCO_2 32.2 mmHg, HCO_3 11.5 mmol/L, base excess -18.9 mmol/L, lactate 3.7 mmol/L showed after 4 hours later from CRRT), mental status of patient worsened to semicoma (GCS 4) with no papillary light reflex (PLR), gag reflex, or oculocephalic reflex. Although we did not use continuous electroencephalogram (EEG) monitoring, after using IV midazolam, there was no seizure activity. Vital signs were 119/63 mmHg, 92 beats/minute, 24 breaths/minute, and 37.7°C.

On hospital day 3, vital signs were 128/80 mmHg, 67 beats/minute, 24 breaths/minute, and 38.4°C, respectively and metabolic acidosis was not severe (base excess: -3.6 mmol/L and anion gap: 20 mmol/L) because CRRT was continued. However, he showed no mental recovery or PLR and follow-up brain CT was obtained to evaluate for possible brain parenchymal changes after the initially normal brain CT. There was brain edema including sulcus effacement and ischemic brain injury including a low density lesion of bilateral deep gray matter and brain stem area (Fig. 2C, D). Despite our continuous treatment, the patient died with multiple organ failure on hospital day 8.

Discussion

Synthetic pyrethroid is a structural derivative of naturally occurring pyrethrin, an extract from the Chrysanthemum cinerariaefolium flower[5]. Pyrethroids prolong the activation of the neuronal voltage-dependent sodium channel by binding to its open state and causing a prolonged depolarization[6]. This sodium channel hyperstimulation is a well-known neurotoxic mechanism of pyrethroids, and poisoned patients therefore sometimes present with confusion, irritability, and seizure. However, the mammalian voltage-dependent sodium channel has many isoforms[7], and pyrethroid is 2,250 times more toxic to insects such as the fly and mosquitoas compared to mammalian species[1]. Therefore, there have been few reports of severe toxic effects of pyrethroid poisoning[2].

However, in the case reported here, the patient showed status epilepticus and decreased mentation. Serum pseudocholinesterase and osmolar gap for screening organophosphate and toxic alcohol such as methanol, ethylene glycol were normal and initial urine analysis showed no paraquat and no benzodiazepine. Therefore, we could exclude main toxic materials. Also, repeat brain CT revealed cerebral edema and ischemic brain injury in deep gray matter and brain stem with the final outcome being the patient's demise. There has been thus far a case report on status epilepticus in type II pyrethroid poisoning[8], but no report of human brain edema and ischemic injury confirmed by CT scanning. Of course, we cannot overlook potential inactive ingredients like hydrocarbon poisoning[9]. Also, because CT was taken 3 days after admission and then there was no evidence of any organ dysfunction except for brain, we think that brain injury was not due to other organ dysfunction.

In conclusion, highly concentrated pyrethroid poisoning may be associated with fatal brain edema leading to death.

Declaration of interest

The authors report no conflict of interest.

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