

## CASE REPORT

# Presentation and Treatment of cholinergic Crisis in the setting of Carbamate poisoning

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## Abstract

The case details the acute onset of muscarinic poisoning with associated symptoms and long-term complications, as a new readily available suicide tool that clinicians should be keen to, combined with the appropriate treatment so lifesaving therapy may be urgently administered along with future mental health therapy.

## KEYWORDS

critical care medicine, neurology, pharmacology, toxicology

## 1 | INTRODUCTION

Carbofuran, a carbamate cholinesterase inhibitor, is a frequently used highly potent systemic pesticide in the agricultural industry.<sup>1,2</sup> Due to its widespread use around the world, it has been implicated in the toxic contamination of air, food, and water sources with harmful effects on both humans and wildlife.<sup>2,3</sup> In addition, carbofuran has been implicated as a leading suicidal agent, amounting to 56.2% of suicides committed with a pesticide and 17.5% of all suicides in rural areas.<sup>4</sup> The compound can be inhaled, ingested, and absorbed dermatologically displaying high cholinergic toxicities including vomiting, excessive salivation, diarrhea, and may result in death from respiratory failure.<sup>3-5</sup> The present study includes a case report of a 51-year-old Asian man who suffered severe carbofuran toxicity following ingestion of a contaminated mixture and the herein management and treatment of the patient through appropriate antidotal pharmacology.<sup>5</sup>

## 2 | CASE REPORT

A 51-year-old Asian man was hospitalized after he was found convulsing all over the body and foaming at the mouth approximately 30 minutes following a suicide attempt by carbofuran insecticide ingestion. Upon admission to the local hospital, physical examination revealed drowsiness, contracted pupils, bradypnea, and sweating. ECG revealed sinus bradycardia of 50-60 beats per minute. Blood pressure measured at 160/100 mmHg. No abnormalities were seen on cerebral CT. The patient had no reported history of prior seizure, neurological diseases, or substance abuse. The patient's blood was taken and sent to Ho Chi Minh Regional Center of Forensic Medicine for further toxicological analysis. Carbofuran in the blood and his predominant parasympathetic symptoms indicated organic carbamate-toxic cholinergic syndrome. An airway was placed, and he was treated with atropine. The patient was closely monitored by medical staffs in the hospital for arising cholinergic symptoms. Clinically, cases

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of carbamate poisoning may have predominately parasympathetic symptoms. Acetylcholine asserts a similar effect as a depolarizing neuromuscular blocker at nicotinic receptors, which if severe could lead to flaccid paralysis. The treatment plan consisted of close monitoring for symptoms involving heart rate, respiratory rate, and ABC followed by administration of atropine accordingly. Fortunately, the patient made tremendous recovery without any complication and was discharged the following week. The patient acknowledged this incident as his first attempted suicide. Upon a month follow-up, the patient did not report any adverse events or any similar cholinergic symptoms and has sought long-term psychiatric therapy.

### 3 | LABORATORY FINDINGS

Arterial blood gas revealed respiratory acidosis with a 7.0 pH, 80 mmHg PaCO<sub>2</sub> (N = 35-45 mmHg), 15 mEq/L HCO<sub>3</sub> (N = 22-28 mEq/L), and a 295 mmHg PaO<sub>2</sub>/FiO<sub>2</sub> ratio (N = 400-500 mmHg). Blood lactate measured at 80 mg/dL (N = 4.5-19.8 mg/dL). Urine was negative for Heroin toxin. Liver, kidney, and heart enzymes were normal.

For toxicological analysis, 2 ml of patient's blood was collected and packed into the light blue top tube. Gas chromatography-mass spectrometry and gas chromatography-liquid spectrometry were chosen as the laboratory modalities. The test was sensitive to the following chemicals:

Acetaminophen, Amitriptyline, Amobarbital, Atenolol, Barbitol, Bromazepam, Caffeine, Carbamazepine, Carbofuran, Chlorpyrifos, Codeine, Chloroquine, Clozapine, Cyanophos, Chlorpheniramine, Dextromethorphan, Diazepam, Diazinon, EPN, Fenobucarb, Flurazepam, Fipronil, Hexobarbital, Ibuprofen, Imipramine, Lidocaine, Malathion, Metoprolol, Metronidazole, Midazolam, Morphine, Nadolol, Nitrazepam, Nifedipine, Olanzapine, Papaverin, Permethrin, Pentobarbital, Phenobarbital, Phenytoin, Prazepam, Primidone, Promethazine, Propranolol, Tetrahydropalmatine, Thiopental.

As a result, the patient's blood contains the presence of Carbofuran and Midazolam. To follow up with the result, a Cholinesterase Abbott test was ordered and an amount of 1416 L of cholinesterase was found (N = 4389 U/L - 10 928 U/L).

### 4 | DISCUSSION

Carbamate is an acetylcholinesterase inhibitor compound that can be used as an insecticide in agriculture or mass poisoning

by terrorists. Reducing the amount of acetylcholinesterase (AChE) will result in the increase of acetylcholine, leading to increased neurotransmitter signaling. As a competitive antagonist of acetylcholine, atropine is a standard treatment for this case. By binding to the muscarinic receptors, atropine blocks acetylcholine from binding to the same receptors therefore decreasing symptoms.<sup>7</sup> Classic parasympathetic symptoms from carbamate are emphasized through the mnemonic "DUMBBELS," which stands for defecation, urination, miosis, bronchospasm, emesis, lacrimation, and salivation, as seen in this patient's case.<sup>6</sup>

According to American Association of Poison Control Centers (AAPCC), most carbamate poisoning takes place in rural Asia areas due to the lack of proper industry control of pesticide usage. It is often used for intentional self-harm and accounts for approximately 200,000 fatalities per year.<sup>6</sup> Suicidal intention or accidental consumption were suspected to be the primary causes for carbamate poisoning in this patient's case. Patients typically display poisoning symptoms within 5-45 minutes depending on exposure dose and toxicity of the given compound following ingestion with a duration of less than 24 hours.<sup>7,8</sup>

Based on the clinical symptoms, as well as the result from the toxicological tests, a diagnosis of carbamate poisoning was made. The best indications of carbamate poisoning are the presence of the classical "DUMBBELLS" parasympathetic symptoms upon physical examination. A confirmatory toxicology blood test can then be used to identify the responsible chemicals. The treatment of carbamate poisoning consists of anticholinergic compound atropine and oximes. However, the administration of oximes in carbamate poisoning is controversial due to its acetylcholinesterase reactivating effect, thus may cause potential toxicity of oximes in conjunction with carbamate.<sup>7</sup>

### 5 | CONCLUSION

To the best of our knowledge, this is a rare and interesting case in which a person is poisoned with carbamate. Family physicians, emergency medicine doctors, and neurologists should be aware of this potential adverse event resulting from the excess stimulation of nicotinic and muscarinic receptors at the neuromuscular junctions and highly recommend administering anticholinergic agents in patients presenting with symptoms indicating a cholinergic crisis.<sup>1,3,5</sup> Delay in diagnosis and treatment may potentially lead to endocrine abnormalities, reproductive disorders, and oncogenic disorders.<sup>5</sup> Carbofuran's combined lethal effects and common usage mandate a pressing need toward administering rapid, and effective diagnosing measures and treatment options as the immediate recovery outcome, long-term health effects, and organ donor status of the patient are dependent on this duality of therapy.

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## CONFLICT OF INTEREST

The authors declare that they have no competing interest. None of the authors have any conflict of interest, financial, or otherwise.

## AUTHOR CONTRIBUTION

HHN, AK, and TL contributed equally to the conception and design of the study; analysis, and interpretation of the manuscript. HN and AV contributed to data collection and revising the manuscript. All authors approved the final manuscript and agree to be accountable for all aspects of the works.

## ETHIC STATEMENT

This case report was approved by the Internal Review Boards (IRB) in Vietnam, as well as Department of Public Health, Board of Medicine in Vietnam. The patient has signed the consented form and followed IRB guidelines/protocol in Vietnam. The authors and their associated institutions endorse the COPE (Committee on Publication Ethics) guidelines and will pursue cases of suspected research and publication misconduct (eg, falsification, fabrication, plagiarism, inappropriate image manipulation, redundant publication). In

such cases, we will follow the processes set out in the COPE flowcharts.

## DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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