

Rare Instance of Neonicotinoid Compound Ingestion Leading To Fatality - A Case Report

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Abstract

Though suicidal poisoning is commonly seen with organophosphates, carbamates, and phosphides, there are instances where newer compounds have been used. Neonicotinoids represent a modern category of insecticides developed to reduce human toxicity and damage to the environment. Nevertheless, although these insecticides are known to have low toxicity to vertebrates, their accumulation and excessive use can elevate the risk of exposure and toxicity. One such case of consumption of neonicotinoid compound ingestion leading to complications and later death is being presented here to promote awareness regarding these newer compounds.

Keywords: Autopsy; Neonicotinoid; Thiomethoxam; Solvent poisoning.

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Introduction:

Suicidal poisoning with insecticides is widespread globally due to their ready accessibility, particularly prevalent among the farming communities. Organophosphates, carbamates, and phosphides are responsible for the highest number of poisoning-related fatalities in our environment. Because of the significant toxicity of these compounds, new insecticides known as neonicotinoids (synthetic analogues of nicotine) have been developed.¹ Neonicotinoids represent a modern category of insecticides that

postsynaptic nicotinic acetylcholine esterase receptors. It presents comparatively minimal risk to non-target organisms and the environment yet demonstrates precise targeting of insects. Neonicotinoids have limited ability to cross the blood-brain barrier, thereby decreasing the risk of toxicity in mammals. Nevertheless, although these insecticides have low toxicity to vertebrates, their accumulation and excessive use can elevate the risk of exposure and toxicity.²

Case Report:

A 75-year-old man ingested a neonicotinoid compound (thiomethoxam) following an argument with his wife over his drinking habits. He was admitted to the hospital immediately after and remained hospitalized for a week, receiving appropriate treatment. Despite efforts, he tragically passed away on the seventh day of admission due to complications from the poisoning. At autopsy, Postmortem staining was fixed over the back of the chest and abdomen.

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Rigor mortis was appreciated throughout the body.

Internal examination and histopathology findings revealed the following:

The pleural cavity contained approximately 200 ml of yellow-coloured fluid. The lungs showed edema and consolidation in places, with cut-section revealing frothy exudate mixed with blood (Figure 1). Histopathology confirmed lobar pneumonia. The heart weighed 280 grams, with patent coronary arteries and an intact aorta. Patchy interstitial fibrosis was noted in the myocardium. The gastrointestinal system showed the stomach containing 200 ml of yellow fluid with a distinct odour, and the mucosa appeared congested and haemorrhagic at some places (Figure 2). The liver exhibited mild microvesicular steatosis and portal triaditis. Incidentally, a tumor mass was found in the left kidney, (Figure 3). Histopathology confirmed renal cell carcinoma of the papillary type.



Fig.1 Lung on cut section showing frothy exudate with blood.

Blood and viscera sent for chemical analysis. However, the insecticide was not detected in the chemical analysis, likely due to the patient having received treatment for a week prior to the samples being taken. On perusal of history, autopsy findings, hospital case



Fig.2 Stomach mucosa showing congestion and haemorrhage.



Fig.3 The left kidney showed a tumour mass (Right in the picture)

records and histopathology report, cause of death was attributed to respiratory failure as a result of pneumonic consolidation of lungs consequent upon consumption of neonicotinoid insecticide.

Discussion:

There are three generations of neonicotinoids, with thiamethoxam belonging to the second generation. However, most human toxicity data are primarily available for poisoning by

imidacloprid, which is part of the first generation of neonicotinoids.² Izuru Yamamoto originally coined the term "neonicotinoid" to distinguish imidacloprid and similar insecticides as novel active compounds that target nAChRs (nicotinic acetylcholine receptors), differentiating them from traditional nicotine-based insecticides.³ Human toxicity of these insecticides is usually extrapolated from animal studies, the reliability on the same remains uncertain. Therefore, further research into acute intoxications involving this class of insecticides is necessary.

Symptoms of neonicotinoid poisoning in humans appear to be less severe compared to insects, primarily due to their lower affinity for human nicotinic receptors and inability to cross the blood-brain barrier. The clinical presentation is well-documented for intoxication with imidacloprid, the oldest neonicotinoid insecticide. A significant study conducted in Texas from 2000 to 2012, involving 1142 patients exposed to neonicotinoids, identified key symptoms including eye irritation, dermatitis, nausea, vomiting, corrosive oral mucosal lesions, dizziness, hypertension, and tachycardia. Additionally, the French Toxicity Co-ordination Committee analyzed 428 cases of imidacloprid exposure between 1999 and 2012, noting that more than 27% involved children under 5 years old. This study contributed to a better understanding of symptomatology based on the severity of intoxication.¹

Vinod et al reported a case where initial symptoms within two hours of ingestion of thiamethoxam included nausea, vomiting, agitation, and multiple episodes of generalized tonic-clonic seizures. The patient progressed to coma, hypotension, renal failure, metabolic acidosis, and rhabdomyolysis, ultimately resulting in a fatal outcome 36 hours after ingestion.⁴

The solvents utilized in neonicotinoid insecticide formulations can significantly contribute to the symptoms of poisoning. While not all solvents used in neonicotinoid insecticides are identified, many of them include N-methylpyrrolidone. Ingesting a substantial quantity of this substance irritates the upper gastrointestinal tract, leading to oral ulceration, nausea, vomiting, dysphagia, odynophagia, and abdominal pain.⁵

Management of acute neonicotinoid insecticide poisoning is mainly symptomatic and supportive. In case of coma and respiratory distress, intubation and assisted ventilation associated with hemodynamic support are required. The presence of solvents in liquid neonicotinoid formulas makes the activated charcoal and gastric lavage or vomiting ineffective, due to the risk of inhalation pneumonia.

Respiratory, cardiovascular and certain neurological presentations (dyspnea/apnea, coma, tachycardia, hypotension, mydriasis and bradycardia) are symptoms of severe neonicotinoid intoxication. Biochemical abnormalities and rhabdomyolysis have been reported as potentially serious complications that might lead to mortality. The numbers of neonicotinoid poisonings have increased in the last decade, given that neonicotinoid insecticide is highly used.⁶

Conclusion:

Neonicotinoids are known to act quite selectively on insects, but they can be toxic to humans as well. Several cases of acute intoxication with such insecticides, sometimes severe, resulting in death, are being reported in the literature. Hence, this case is being presented to highlight that even these newer insecticides could cause death in certain cases either due to their effect or due to solvent poisoning and doctors should be aware of the same.

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