K15 An Imidacloprid Insecticide Fatal Poisoning: Gas Chromatography/Mass Spectrometry (GC/MS) Detection in Alternative Biological Matrices

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Learning Overview: After attending this presentation, attendees will better understand the chloronicotinoid compounds, including its intended uses, toxic effects, and, because of its availability in certain communities, its use as a suicide modality.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by stressing the importance of scene investigation, autopsy findings, and toxicology results to determine the cause of death in imidacloprid (pesticide) intoxication.

Imidacloprid (1-(6-chloro-3-pyridylmethyl)-N-nitroimidazolidin-2-ylideneamine) is a neonicotinoid insecticide in the chloronicotinyl nitroguanidine chemical family, rapidly and almost completely absorbed after ingestion. It is subsequently metabolized to 6-chloronicotinic acid, which is conjugated with glycine, then eliminated or reduced to guanidine. About 70% to 80% of an administered dose is excreted unchanged in the urine and 20% to 30% in feces. Imidacloprid acts on the Central Nervous System (CNS) as an agonist at the nicotinic acetylcholine receptor. It causes initial stimulation followed by fatigue of the agonized neurons and ultimately interferes with the transmission of neuronal impulses. Insecticide products containing imidacloprid are used worldwide; therefore, occasionally, accidental intoxication or intentional self-intoxication occurs throughout the world. Despite the original belief that imidacloprid has low mammalian toxicity, there is increasing evidence that imidacloprid may cause heart, kidney, and other organ damages and even death in addition to gastrointestinal irritation and neurological symptoms.

Case: A 55-year-old man was found dead lying prone on the grass near his summerhouse. No signs of traumatic injury were on the body surface and the parents denied serious systemic disorders. A plastic bottle of insecticide containing a little quantity of thick, white liquid was in the kitchen, while close to the body there were traces of this substance, apparently vomited by the victim. A medicolegal autopsy was required. The man's length was 171cm and he weighed 79kg. There were no signs of traumatic injury on the body. His face showed congestion, and there was some viscous, white fluid in his mouth. A fluid material with the same organoleptic features was at a section in the upper airways, esophagus, in the stomach (ca. 300cc), and in the duodenum. No other macroscopic alteration of the inner organs was observed. Microscopic examinations revealed pulmonary edema, fragmentation of myocardial fibers, and slight pancreatic hemorrhage. Full scan GC/MS analyses were performed on an Agilent® 6890 GC coupled 5973 inert mass spectrometer, previous liquid-liquid extraction of the biological specimens by organic mixture solvents (n-heptane; 1,2-dichloroethane; dichloromethane; 2-propanol) at pH 1.5. Both imidacloprid (IMI) and its metabolite 6-chloronicotinic acid (6-CNA) were quantified: the retention time was respectively 11, 14, and 5.64 minutes, while the ions spectrum was 211, 126, 99 (IMI) and 214, 170, 140 (6-CNA). For the detection of the metabolite, the derivation procedure BSTFA-1% TCMS was needed. Analytical results showed: inferior vena cava blood (IMI: 35µg/ml; 6-CNA: 0.6µg/ml), femoral blood (IMI: 55µg/ml;6-CNA: 0.76µg/ml), urine (IMI: 14µg/ml; 6-CNA: 0.79µg/ml), vitreous humor (IMI: 18µg/ml; 6-CNA: 0.11µg/ml), abdominal adipose tissue (IMI: 28µg/g; 6-CNA: 0.39µg/g), and Total Gastric contents (IMI: 105mg; 6-CNA: 5.1mg).

Discussion: Acute toxicity is generally measured by LD50 and LC50 but these values are unknown for imidacloprid. Hence the presence of this substance in the plastic bottle and its distribution in all the alternative biological matrices here analyzed suggest an uncommon fatal intoxication of imidacloprid. Regarding the manner of death, no farewell letter was near the cadaver and the parents denied any kind of trouble so difficult as to explain suicide. However, the thorough scene investigation coupled with external examination and autopsy are in accordance with an intentional ingestion of pesticide.

Imidacloprid, Alternative Biological Matrices, Suicide