



Original Article

Diversity of Toxic Chemical Substances Based on Viscera Report of Autopsy Samples Collected at Rajshahi Medical College in 2019 and 2020

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Abstract

Objective: Investigation on autopsy samples is an urgent need to detect the presence of unwanted chemicals or toxins that could directly or indirectly cause death. This study was designed to analyze and explore the diversity of chemical substances that were found in the body of victims handled in the Department of Forensic Medicine & Toxicology (DFMT) at Rajshahi Medical College (RMC) in 2019 and 2020.

Materials and methods: The data were collected from the viscera report of the corresponding dead bodies submitted in DFMT at RMC for postmortem examination. Data analysis was performed using Microsoft Excel.

Results: The most prevalent toxic agent was organophosphorus compounds which are usually being used as pesticides worldwide. The next most frequently used chemical was aluminium phosphide, a well-known poison.

Conclusion: The findings of this study suggest producing and applying strict guidelines regarding supplying toxic chemical agents.

Keywords: Autopsy, viscera report, toxic chemicals, chemical analysis, organophosphorus compound, aluminum phosphide.

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Introduction

Any death usually is measured as homicide or suicide if someone is the unintended cause for the incident¹. Therefore, unnatural deaths should be classified and separated from that of the natural death. Distinguishing how someone died (by natural causes, accident, suicide, homicide, or an undetermined cause), referred to as the manner of death (MOD), is an important public health issue.¹ It requires the involvement of expert forensic

pathologists who are the authorized persons to perform postmortem examinations to reveal the actual cause of death. Recently, various toxic chemical substances are being used to commit suicide or to kill someone.

Analytical toxicology is the branch of toxicology that deals with the uncovering and evaluation of a variety of poisons in autopsy samples.² Age, weight, any disease or illness, and sensitivity to a specific chemical are the factors that influence the

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outcome of detection and quantification of a toxin and interpretation between detection and quantification.³ Sometimes, the outcome of a toxicological examination could be negative because of variation in quantity consumed, treatment given to eliminate or counter the toxicity, the time between consumption of toxins and collection of the sample, method availability, accuracy of the method used, and the staff who perform detection procedure.

However, the exploration of the diversity of chemical substances found in the viscera report may help to take a possible countermeasure that may help control the easy availability of those substances, leading to reducing the number of unnatural deaths. Thus, this study was designed to

analyze and explore the diversity of chemical substances that were found in the body of victims handled in the Department of Forensic Medicine & Toxicology (DFMT) at Rajshahi Medical College (RMC) in 2019 and 2020.

Materials and Methods

The data were gathered from the Department of Forensic Medicine & Toxicology (DFMT), Rajshahi Medical College (RMC), Rajshahi, Bangladesh. All of the information was leaked from the viscera report of the autopsy sample of the dead bodies, which were submitted in the DFMT for autopsy. Statistical analyses were performed in Microsoft Excel (version 2007).

Results

According to the result, the most frequently used toxic chemical compound was organophosphorus compounds in both 2019 (Table I) and 2020 (Table II). 72.31%, 60.87% samples were detected with organophosphorus compounds in 2019 and 2020, respectively. The second frequent chemical was aluminium phosphide (Table I and Table II). In 2019, 16.92% of samples were found to have aluminium phosphide (Table I), and 18.26% samples of 2020 were detected with aluminium phosphide (Table II). The next frequently detected chemical substance was alcohol. 6.15 % and 8.70% viscera reports among positive test reports were detected having alcohol (Table I and Table II). Calcium arsenate was found only in samples of 2019, and the frequency was 2.31% (Table I). The organochlorine *compound was detected in both years, and the frequencies were 1.54% and 0.87%, respectively* (Table I and Table II). Zinc phosphide was also detected in samples of both 2019 (0.77%) and 2020 (1.74%). Carbamate (4.53%), methyl salicylate (1.74%), benzodiazepine compound (0.87%), morphine (0.87%), polyurethane (0.87%) and diazepam 0.87% were detected only in autopsy samples of 2020 (Table II).

Table I: Diversity of toxic chemicals found in viscera reports of 2019.

Chemicals	Frequency	Percentage (%)
Organophosphorus compound (pesticide)	94	72.31
Aluminium phosphide (poison)	22	16.92
Alcohol	8	6.15
Calcium arsenate (poison)	3	2.31
Organochlorine <i>compound</i> (pesticide)	2	1.54
Zinc phosphide (poison)	1	0.77

Table II: Diversity of toxic chemicals found in viscera reports of 2020

Chemicals	Frequency	Percentage (%)
Organophosphorus compound (pesticide)	70	60.87
Aluminium phosphide (poison)	21	18.26
Alcohol	10	8.70
Carbamate (poison)	5	4.35
Zinc phosphide (poison)	2	1.74
Methyl salicylate	2	1.74
Benzodiazepine compound	1	0.87
Morphine	1	0.87
Organochlorine <i>compound</i> (pesticide)	1	0.87
Polyurethane	1	0.87
Diazepam	1	0.87

Discussion

This study explores the diversity of toxic chemical substances found in autopsy samples of dead bodies during postmortem examination performed in the Department of Forensic Medicine & Toxicology (DFMT) of Rajshahi Medical College (RMC). The DFMT of RMC handles all the dead bodies that require postmortem examination. As any unnatural deaths require a legal administrative procedure, all unnatural death events that occurred in the Rajshahi district must be submitted and recorded in DFMT of RMC unless there is an exception. Thus, this study explores the most authenticated data on the diversity of toxic chemical substances found in dead bodies as death-causing agents. This is the first study showing such data.

In the viscera report, organophosphorus compounds, aluminium phosphide, alcohol, calcium arsenate, organochlorine *compound*, zinc phosphide, carbamate, methyl salicylate, benzodiazepine compound, morphine, polyurethane, and diazepam were detected (Table I and II).

Organophosphorus compounds are well known as pesticides and chemical warfare nerve agents³. The toxic effects of these chemicals were recognized first in 1930s when they were established for use

as chemical warfare agents.⁴ Organophosphorus compounds are known to induce toxicity by inhibition of acetylcholinesterase, resulting in an accumulation of acetylcholine and the continued stimulation of acetylcholine receptors.⁵ Thus, these are also known as anticholinesterase agents. Carbamates are also known as anticholinesterase agents, but they are less toxic compared to organophosphorus compounds, thus are mainly being used as home herbicides and insecticides.⁶ Polyurethane is a polymer composed of organic units joined by carbamate (urethane) links.

Aluminium phosphide is an inexpensive, effective, and frequently used pesticide.⁷ It is usually used for cereal preservation.⁸ Unfortunately, in recent days, it has been one of the most familiar causes of poisoning among agricultural pesticides.⁷ It is popular day by day to commit suicide⁷. It produces deadly phosphine gas when it comes in contact either with atmospheric moisture or with hydrochloric acid in the stomach.⁷ The way of aluminium phosphide toxicity comprises cellular hypoxia due to the effect on mitochondria, inhibition of cytochrome C oxidase, and generation of vastly reactive hydroxyl radicals.⁸

Alcohol poisoning is the result of alcohol overdose. Alcohol overdose occurs when the level of alcohol increases in the bloodstream. Signs of alcohol overdose include mental confusion,

difficulty remaining conscious, vomiting, seizure, trouble breathing, slow heart rate, clammy skin, dulled responses such as no gag reflex (which prevents choking), and extremely low body temperature. Alcohol consumption poses a serious threat to human health and is responsible for causing more than 200 diseases.^{9, 10} Alcohol consumption is known to induce 3.3 million deaths yearly worldwide.^{9, 10} Of all deaths worldwide, 5.9% are due to alcohol use, a figure higher compared to the deaths from HIV infection (2.8%) and tuberculosis (1.7%).¹¹ However, alcohol overdose is known to induce permanent brain damage or death. But, the death due to alcohol overdose is usually unintentional and due to a lack of knowledge of overdose consequences.

Calcium arsenate is an arsenic-containing compound that was primarily developed as a pesticide and as a germicide. The adverse health effects that are linked with arsenic exposure take account of developmental anomalies, cardiovascular and peripheral vascular disease, diabetes, neurologic and neuro-behavioral disorders, portal fibrosis, hematologic disorders, hearing loss, and numerous cancers.¹² However, the final consequence of arsenic poisoning is coma and death. The acute minimal lethal dose of arsenic in an adult human is estimated to be 1 mg/kg/day.¹³

Organochlorine compounds are synthetic pesticides and are being used throughout the world.¹⁴ Organochlorine compounds are well known to induce numerous toxic effects on human health, including endometriosis, infertility, cancer of the reproductive system, developmental toxicity, neurotoxicity, and immunotoxicity.¹⁵

Zinc phosphide is a dark grey, crystalline compound. It is being used effectively as a rodenticide against different small mammals, including field mice, rats, mice, and squirrels.¹⁶ Zinc phosphide poisoning is possible to occur generally through suicide or by accident.¹⁶ Once ingested into the body, it transforms into phosphine gas which mixes into the blood and then is caught up by the liver and lungs (Doğan et al., 2014).¹⁶ Till now, there is no known antidote

currently known.¹⁶ The rate of mortality due to zinc phosphide poisoning is almost 37–100%.¹⁷

Methyl salicylate is an external analgesic accessible in over-the-counter (OTC) medicines that give temporary relief from minor body aches and muscle and joint pain linked with backache, arthritis, strains, sprains, and bruises. It can be detected in topical pain medicines, which contain multiple external analgesic active ingredients. Acute salicylate poisoning is common from overdose, causing morbidity and mortality.¹⁸

Compounds of benzodiazepines (BZDs) structural class are used as hypnotics, anxiolytics, anticonvulsants, and muscle relaxants.¹⁹ Diazepam is one of the drugs of BZD class. Generally, BZDs are safe as they have a large therapeutic index. Its misuse may happen by self-medication or by increasing the therapeutic dose for entertaining purposes.¹⁹ Actual risk develops when patients combine these medicines with other substances like alcohol.¹⁹ An analogous fatal relation can occur with opioids.¹⁹

Morphine, which originated naturally from the poppy plant, is a pain medication of the opiate family. The general route of taking this medicine is oral or intramuscular, but it has a history of taking with smoke.²⁰ It acts directly on the central nervous system (CNS) to elevate the sense of pleasure and relaxation, and this is the cause of abusing this drug.²⁰ An overdose of morphine can cause asphyxia leading to death by respiratory depression.

Conclusion

Overall, the chemicals found in the viscera report are mostly used for agricultural purposes, including eradicating pests, insects, and rodents, and few are well frequently used prescription medicine nowadays. This study suggests taking steps that will inhibit the easy availability of these substances that may work as a potential countermeasure against unnatural deaths. Continuous exploration of such data will help to detect further abusive substances easily.

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