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Detection of Poison in Human Body by Chemical Analysis

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ABSTRACT:

This study presents a comprehensive analysis of poison detection in human samples collected from a morgue setting. Chemical analysis were used to detect poisons in the collected samples. This method allowed us to identify various poisons, such as biological and agricultural in the samples. The study employed specific chemical analysis techniques like chromatographic and spectrophotometric and examined the symptoms to determine if individuals had been exposed to natural toxins from plants like Datura. To ensure the accuracy of results, we cross-referenced our data with information from previously published studies. This comparison strengthened the validity of our findings. Utilizing advanced chemical analysis techniques such as chromatography and spectroscopy, we discerned two distinct categories of poisons: biological poisons (atropine, hyoscyamine, and scopolamine) and agricultural poisons (organophosphates). Additionally, detected organophosphates, highlighting the risk of exposure to toxic chemicals commonly used in agricultural poison, resulting in a range of symptoms from gastrointestinal distress to respiratory failure. These findings complement each other and underscore the complexity of poison exposure scenarios in the studied population. They hold pivotal importance for forensic investigations, toxicological assessments, and public health responses, emphasizing the indispensable role of comprehensive chemical analysis in elucidating the causes of poison-related fatalities or illnesses.

1. INTRODUCTION

The detection of poison in the human body through chemical analysis is a critical aspect of forensic and clinical medicine. This field of study plays a pivotal role in solving criminal cases, understanding the causes of unexplained illnesses, and ensuring the safety and well-being of individuals exposed to potentially toxic substances [1].

Poisoning incidents can occur due to a wide range of causes, including accidental exposure to hazardous materials, intentional acts of harm, occupational hazards, environmental contaminants, and even the misuse of prescription or over-the-counter medications. In each of these scenarios, the ability to accurately identify and quantify the presence of toxic substances in the body is paramount for providing appropriate medical treatment, conducting thorough investigations, and delivering justice when required [2].

Advancements in analytical chemistry and toxicology have greatly enhanced the ability to detect and analyze poisons in biological samples, such as blood, urine, tissues, and hair. These analytical techniques have become increasingly sophisticated, sensitive, and specific, allowing for the identification of a wide array of toxic compounds [3] .

Furthermore, the integration of cutting-edge instrumentation, such as mass spectrometry, gas chromatography, and liquid chromatography has revolutionized the precision and reliability of poison detection. These analytical tools enable researchers and forensic experts to detect trace amounts of toxins and their metabolites, even in complex matrices, with remarkable accuracy [4].

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This study explores the essential role of chemical analysis in detecting poisons within the human body. It delves into the various toxic substances that can be encountered, the methods and technologies employed for their detection, and the implications of poison identification in the realms of medicine, criminal investigation, and public health [5]. The objective of this study is to detect and analyze the presence of various poisons in the human body through chemical analysis, specifically focusing on samples collected from autopsies conducted on deceased individuals in a morgue.

2. METHODOLOGY

The methodology in our study involves detecting and analyzing poisons within the human body. Research emphasizes the importance of careful sample collection, preservation, preparation, and analysis using suitable techniques to ensure accurate and reliable results. Our main approach is to detect poisons through chemical analysis and interpret the findings. Additionally, this study enriches primary research with insights from published papers and existing research in the field, combining both primary experimentation and secondary data to thoroughly analyze the collected samples and their toxicological implications. This comprehensive approach enhances the depth and strength of our study's findings.

Sample Selection: This study involved the selection of five deceased individuals from the morgue, all of whom were under suspicion of having succumbed to death due to poisoning.

Procedure: This study procedure involved the detection of poisons in the human body through chemical analysis, with a particular focus on the collection of samples during autopsies and their subsequent analysis in a forensic laboratory utilizing chromatography and spectrophotometry techniques.

- The autopsy was done in the morgue where two senior doctors helped in samples collection from various organs after performing a post-mortem examination and afterward, all samples were labelled with unique identifiers to maintain traceability
- The collected samples were carefully packaged, sealed, and transported to the forensic laboratory for further analysis. While going to the forensic lab from the hospital, two police officers were also present who spotted us to make sure the organs were safely carried to the forensic lab.
- As part of the procedure, subjects, primarily family or relatives, who brought the dead body (deceased persons) to the morgue, were interviewed to gather information about the symptoms and the cause of death.

Sample Preparation:

- In the forensic lab, the collected samples were prepared for chemical analysis.
- Blood samples were centrifuged to separate the serum from the cellular components.
- Organ samples were homogenized and processed to obtain representative samples for analysis.

Chemical Analysis: The study employs suitable chemical analysis techniques, including but not limited to High-Performance Liquid Chromatography (HPLC) for the detection and quantification of chemicals or toxins, as well as spectrophotometry to measure the absorbance or emission of specific wavelengths associated with certain poisons, allowing for the precise quantification of various poison types within the collected samples.

Data Analysis: The data obtained was analyzed by chemical analysis, integrating insights from relevant secondary source data, and compared the results with known standards or reference values to identify the presence and concentration of poisons.

3. RESULTS & DISCUSSION

The finding of this study revolves around chemical analysis to detect and identify poisons in collected samples. These findings not only validate our primary research but also align with existing knowledge in poison detection and toxicology. By building on prior studies, this research advances our understanding of poison-related issues, highlighting the need for interdisciplinary collaboration and data synthesis to improve public health and safety regarding poison exposure. Thus, the study's results are tightly connected to our chemical analysis, reinforcing the importance of comprehensive poison research.

Identification of Biological Poisons: The chemical analysis, specifically the use of techniques like High-Performance Liquid Chromatography (HPLC) and spectrophotometry, played a crucial role in identifying

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the presence of biological poisons such as atropine, hyoscyamine, and scopolamine in the samples. The results of this analysis directly led to the confirmation of these naturally occurring toxins atropine, hyoscyamine, and scopolamine. The chemical analysis results were instrumental in correlating the presence of these biological poisons with the observed clinical symptoms, which included hallucinations, delirium, and physiological abnormalities [5]. This correlation validated the link between the detected toxins and the specific symptoms experienced by the subjects. These findings are consistent with previous research, as indicated by studies [7], which documented similar effects of these biological poisons.

Detection of Agriculture Poison: Similarly, the chemical analysis techniques utilized in this study were pivotal in detecting organophosphates in the samples. The results of chromatography and spectrophotometry confirmed the presence of these toxic agricultural chemicals, aligning with symptoms such as nausea, vomiting, and muscle weakness observed in the subjects. Agricultural poisons such as organophosphates, including Parathion, Chlorpyrifos, Diazinon, and Dichlorvos, are commonly used to control pests in farming [6].

Thus, the discussion demonstrates how secondary source data significantly enriches and validates the primary research conducted in this study. By drawing upon established findings from previous research, we gain a more comprehensive understanding of poison detection, its clinical manifestations, and potential treatment approaches. Chemical analysis is a fundamental aspect of this study, and its findings, which encompass the detection of both biological poisons (atropine, hyoscyamine, and scopolamine) and agricultural poisons (organophosphates) in samples collected from the morgue, significantly contribute to the existing body of knowledge on poison detection and poisoning cases. The techniques employed in this chemical analysis are supported by published results [7], and the identification of these toxic compounds utilized instrumentation analysis.

Previous research by Pillay, (2013) [4] has extensively documented the toxic effects associated with biological poisons found in specific plants like Datura stramonium. These plants contain tropane alkaloids, including atropine, L-hyoscyamine, and L-scopolamine, which can induce anticholinergic syndrome by inhibiting central and peripheral muscarinic neurotransmission. Adults, especially those with a history of polysubstance abuse, are particularly susceptible to voluntarily ingesting these plants for their hallucinogenic and euphoric effects, accounting for most reported cases. The presence of these substances in this study's samples aligns perfectly with the established knowledge of their toxicological effects. It further underscores the necessity for comprehensive investigations into the source of exposure, especially in cases where individuals may have ingested or come into contact with toxic plants or plant-derived substances. In our study, intentional ingestion of Datura stramonium (DS) seeds for their hallucinogenic effects resulted in coma, a critical factor associated with higher morbidity, consistent with previous studies.

Studies by Clark, (2016) [10] highlight severe outcomes such as respiratory failure and cardiovascular collapse following Datura consumption. The toxic effects typically manifest within an hour of ingestion and can persist for up to 24 to 48 hours due to delayed gastric emptying resulting from the anticholinergic effect. Additionally, children display unique susceptibility to atropine toxicity, as even small amounts can induce profound central nervous system disturbances. Notably, some individuals have recovered from doses exceeding 500 mg of atropine.

In a study conducted by Roberts et al., (2016) [11] the findings concerning anticholinergic poisoning resulting from the consumption of tropane alkaloid-containing plants were reported. These alkaloids act as competitive antagonists to muscarinic acetylcholine receptors, leading to paralysis of parasympathetic innervated organs. Acute psychosis or delirium can occur due to their effect on the central nervous system.

A retrospective study by Senarathna et al.,(2017)[12]identified adolescents presenting with severe anticholinergic symptoms, emphasizing the importance of educating this age group about the risks associated with recreational plant use. Physostigmine was found to be beneficial in both the diagnosis and management of patients intoxicated with these substances.

In one case studied by Balme et al., (2010)[13] a young boy developed respiratory failure secondary to acute respiratory distress syndrome after ingesting Datura seeds. His condition deteriorated, ultimately resulting in

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refractory hypoxemia and death. Diagnosis can be challenging, but chemical analysis through gas chromatography-MS (GC-MS) can detect traces of atropine, although a direct correlation between dose, plasma concentration, and clinical effects remains elusive.

The study's results include the detection of organophosphates in the samples, a discovery that resonates with prior research on pesticide and insecticide poisoning cases. These chemicals, extensively employed in agriculture, are well-documented for their toxicity to humans. Previous studies have underscored the health risks associated with exposure to these substances, encompassing both acute symptoms and potential long-term effects (Kulkarni,2016)[8]

This finding underscores the persistent concern surrounding organophosphate exposure in agricultural settings, emphasizing the critical significance of implementing stringent pesticide safety measures. It reinforces the necessity for vigilant monitoring and the rigorous regulation of pesticide use to safeguard the health and well-being of both farm workers and the general population. As highlighted by Peter et al. (2010)[14], Organophosphates are a class of toxic chemicals that were identified through chemical analysis in the laboratory These compounds are commonly found in pesticides and insecticides used in agricultural practices. The chemical analysis conducted in the study revealed the presence of organophosphates in the collected samples, shedding light on potential exposure to these hazardous chemicals. Globally, organophosphate poison exhibits mortality rates ranging from 2 to 25%, with fenitrothion, dichlorvos, malathion, and trichlorfon being the most commonly involved insecticides in fatal cases. Respiratory failure stands out as the most common cause of death.

In a study conducted by Peter & Cherian (2018)[15], Organophosphates are notorious for their toxicity to humans. They exert their toxic effects by inhibiting the activity of acetylcholinesterase (AChE), a vital enzyme responsible for breaking down the neurotransmitter acetylcholine. When AChE is inhibited by organophosphates, acetylcholine accumulates, leading to overstimulation of both nicotinic and muscarinic receptors in the peripheral and central nervous systems. According to Alexandre et al., (2012) globally, an estimated 3,000,000 people are exposed to organophosphate or carbamate agents annually, resulting in up to 300,000 fatalities. In the United States, more than 8,000 reported exposures to these agents occurred in 2008, leading to fewer than 15 deaths. Typically, toxicity arises from accidental or intentional ingestion or exposure to agricultural pesticides. Other potential sources of organophosphate toxicity include the ingestion of contaminated fruit, flour, or cooking oil, as well as wearing contaminated clothing. Chemical analysis stands as a pivotal cornerstone of this study, playing a critical role in advancing our understanding of poison-related cases. It is essential to recognize its significance in the context of existing literature.

Thus, chemical analysis serves as a cornerstone of this study, not only reaffirming established knowledge regarding the toxic effects of poisons but also yielding invaluable insights into their manifestation and clinical outcomes. In essence, it significantly enriches our understanding of poison-related cases. The finding of the chemical analysis ensured that both biological and agricultural poisons were identified, providing a holistic understanding of poison exposure in the studied population. This comprehensive approach allowed for accurate identification and quantification of various poison types within the collected samples. In essence, the findings of this study are a direct outcome of the chemical analysis conducted, emphasizing the indispensable role of advanced analytical techniques in uncovering the presence of poisons and their correlation with clinical symptoms. These results not only validate the primary research but also build upon existing knowledge in the field of poison detection and toxicology.

4. CONCLUSION

In conclusion, the study's primary results, achieved through meticulous chemical analysis, provide a critical understanding of the presence of poisons in the collected morgue samples. These findings encompass two distinct categories of poisons, each with its unique implications. Firstly, the detection of biological poisons such as atropine, hyoscyamine, and scopolamine highlights potential exposure to naturally occurring toxins linked to plants like Datura and belladonna. These toxins induce symptoms like hallucinations and delirium, underscoring the need to address cases involving these poisonous plants. Secondly, the presence of organophosphates,

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representing agricultural poisons, underscores the risk of exposure to chemicals found in pesticides and insecticides used in farming. The variety of associated symptoms accentuates the importance of recognizing agricultural chemical exposure. These primary findings hold vital significance for forensic investigations, toxicological assessments, and public health responses, offering valuable insights into poison-related cases and their implications.

Conflict of Interest

The author(s) declares no conflict of interest.

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