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Toxicology Study of Effect of Poison

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ABSTRACT:

Toxicology is the scientific study of poisons and their effect on living organisms. It encompasses a broad range of topics, from the effects of drugs and chemicals on human health to the impact of environment toxins on wildlife populations. The field of toxicology is crucial in understanding how toxic substances affect the body and how exposure to these substances can be prevented. The science of toxicology has been around for centuries. In ancient times, people were aware of the toxic properties of certain plants and animals and used this knowledge to create poisons for hunting and warfare. In modern times, toxicology has enolved into a sophisticated science that relies on advanced analytical techniques and a deep understanding of the mechanisms by which toxic substances affect the body.

In clinical practice, some patients might not be able or unwilling to provide a thorough history of medication and poison exposure. The aim of this study was to use toxicological analysis to examine the clinical characteristics of patients with acute poisoning whose exposure history was uncertain from a toxicological analysis perspective. [1]

KEYWORDS: Acute poisoning, toxic exposure, toxicological analysis, clinical manifestation.

I.INTRODUTION

Acute poisoning is a significant public health concern and is among the most prevalent conditions encountered in emergency departments (Eds). The risk of exposure to these poisons and drugs has increased in tandem with the rapid expansion of the chemical industry, the development of novel pharmaceuticals, and the greater accessibility of these substances to the general population. Furthermore, there is no definitive boundary for poisons or drugs; the distinction lies in the dosage magnitude, where substance surpassing the appropriate dosage are categorized as poisons. Due to the wide range and similarities of clinical manifestations among patients affected by poisoning, a through history of exposure, whether provided by the patients affected by poisoning, a through history of exposure, whether provided by the patient or by others, is an essential part of the diagnostic process for poisoning.

Nonetheless, clinicians may encounter challenges in obtaining precise exposure histories from certain patients. There are no epidemiological data on these patients in China; however, a study in South Korea found that 21.7% (97/446) of patients visited the ED for unknown poisoning

Toxicological analysis plays a crucial role in diagnosis and treatment, particularly in patients with suspected poisoning and uncertain exposure history. Nevertheless, the utilization of toxicological analysis in clinical practice remains uncommon due to number of issues, including the high expense of testing, the difficulty of accessing testing facilities, the length of time required for the testing procedure, and the low number of samples that are submitted for analysis. At present, establishing a dedicated toxicological analysis laboratory in each hospital is not feasible.

Nevertheless, the utilization of toxicological analysis in clinical practice remains uncommon due to a number of issues, including the high expense of testing, the length of time required for the testing procedure, and the low number of samples that are submitted fir analysis. At present, establishing a dedicated toxicological analysis laboratory in each hospital is not feasible. Nonetheless, the creation of a regional toxicological analysis service would be suitable.

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The toxicological analysis laboratory within the Institute of Poisoning at Nanjing Medical University operates as a regional toxicological analysis service would be suitable. The toxicological analysis laboratory within the creations of a regional toxicological analysis laboratory within the Institute of Poisoning at Nanjing Medical University operates as a regional center fir toxicological analysis. Consequently, the aim of study was to examine the clinical characteristics of acute poisoning patients who presented uncertain exposure histories but showed positive toxicological results. This endeavor is intended to provide insights to guide the clinical diagnosis of these patients. A poison is any substance that causes harm if it gets into the body. Almost any chemical can be a poison if there is enough in the body. [2]

Historical development

Environmental toxicology is a relatively young field, with its origins in the mid-20th century. The modern science of toxicology, on the other hand, was born in the early 19th century, and by the later decades of that century, some scientists had begun to consider the effects of toxic substances that had been released into the environment. But awareness of environmental pollutants did not increase markedly until the publication of American biologist Rachel Carson's Silent Spring in 1962. Despite strong opposition from the chemical industry, which felt that Carson's work unfairly attacked their products, Carson highlighted the environmental side effects from the use of pesticides such as DDT.
The book suggested that pollutants used in one area could quickly affect neighbouring areas and that the destruction of a particular part of the food chain upsets the balance of nature, leading to the destruction of an ecosystem. In 1969 scientist René Truhart coined the term *ecotoxicology* to describe the study of the toxic effects of pollutants on the biological components of ecosystems. Although narrower in scope, ecotoxicology played an important role in the development of environmental toxicology.

DOSE

The amount of a chemical substance that gets into the body at one time is called the dose.

TOXICOLOGICAL TERMS AND DEFINITIONS

- Toxin -a poison of natural (biological) origin.
- Poison -a chemical that may harm or kill an organism.
- Toxic-having the characteristic of producing an undesirable or adverse health effect.
- Toxicity-any toxic effect that a chemical or physical agent might produce within a living organism.
- Hazard-is the likelihood that injury will occur in a given situation or setting: the conditions of use and exposure are primary considerations.
- Risk-is defined as the expected frequency of the occurrence of an undesirable effect arising from exposure to chemical or physical agent.

FORMULA OF TOXICOLOGY

RISK = HAZARD + EXPOSURE

TOXICOLOGY
The traditional definition of toxicology is "the science of poisons." As our understanding of how various agents can cause harm to humans and other organisms, a more descriptive definition of toxicology is "the study of the adverse effects of chemicals or physical agents on living organisms". Adverse effects may occur in many forms, ranging from immediate death to subtle changes not realized until months or years later. They may occur at various levels within the body, such as an organ, a type of cell, or a specific biochemical.

- Is the science dealing with: property,
  Action,
  Toxicity,
  Fatal dose,
  Detection,
  Estimation of poisons.

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- Derived from Greek word, toxikons and logos.
- Toxicology is the study of the adverse effects of xenobiotics.
- It also deals with foods and cosmetics for consumption both in alive or dead victims.

HISTORICAL ASPECTS OF TOXICOLOGY

- In the past it was mainly a practical art utilized by murderers & assassins.
- In ancient time (1500 BC) earliest collection of medical records contains many references and guidelines about poisons
- Dioscorides (50 AD) a Greek physician, classify poisons as animal, plant or mineral & recognizing the value of emetics
- Maimmonides (1135-1204 AD), wrote poisons and their antidote which detailed some of the treatments consideration to be effective
- Paracelsus (1493 AD), summarized his concept in the fallowing;
- All substances are poisons; there is none that is not a poison.
- The right dose differentiates a person from a remedy.

- Orifila (1787-1853 AD), Spanish physician who contributed to forensic toxicology by devising means of detected poisonous substances
- The 20th century- toxicology has now become much more than the use of poisons.[3]

POISONING

A poison is a substance capable of producing adverse effects on an individual under appropriate conditions. The term "substance" is almost always synonymous with "chemical" and includes drugs, vitamins, pesticides, pollutants, and proteins. Even radiation is a toxic substance. Though not usually considered to be a "chemical," most radiations are generated from radioisotopes, which are chemicals. Poison, in biochemistry a substance, natural or synthetic, that causes damage to living tissues and has an injurious or fatal effect on the body, whether it is ingested, inhaled, or absorbed or injected through the skin. Although poisons have been the subject of practical lore since ancient times, their systematic study is often considered to have begun during the 16th century, when the German-Swiss physician and alchemist Paracelsus first stressed the chemical nature of poisons. It was Paracelsus who introduced the concept of dose and studied the actions of poisons through experimentation.[4]

TYPES OF POISONING

1)Acute poisoning: It is caused by an excessive single dose or several doses of a poison taken over a short interval of time. e.g. Strychnine, potassium cyanide.
2)Chronic poisoning: It is caused by smaller doses over a period of time, resulting in gradual worsening. e.g. arsenic, phosphorus, antimony and opium.
3)Sub acute poisoning: Shows features of both acute and chronic poisoning
4)Fulminant poisoning: It is produced by a dose. In this death occur rapidly, sometimes without preceding symptoms.

1)Acute poisoning:

- Acute poisoning is a significant public health concern and is among the most prevalent conditions encountered in emergency departments (EDs).
- The risk of exposure to these poisons and drugs has increased in tandem with the rapid expansion of the chemical industry, the development of novel pharmaceuticals, and the greater accessibility of these substances to the general population.
- There are no epidemiological data on these patients in China; however, a study in South Korea found that 21.7% (97/446) of patients visited the ED for unknown poisoning.
- Poisonous substances are produced by plants, animals, or bacteria.

2) Chronic poisoning:

- Chronic exposure may not show symptoms until many years have passed.
- For example, long-term exposure to toxic gases can cause lung damage.
- Symptoms that may develop include shortness of breath and chronic wheezing.

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- Long-term radon exposure is a serious problem that can lead to lung cancer.

3)Sub acute poisoning:

- It is a biological effect that occurs when a chemical is repeatedly administered or the body is exposed to it over a period of days or weeks.
- To determine the effect of repeated administration and to establish doses for a longterm studies.
- These are studied to conducted after preliminary information is obtained from acute toxicity tests.

4)Fulminant poisoning

- It is a condition that occurs when someone ingests a toxic substance and experiences a sudden and severe reaction.
- It means something that happens suddenly and with great severity.
- Patients with FHF should be referred for liver transplant evaluation as soon as possible.
- Transplants outcomes for FHF are excellent, and patients with FHF are given priority over all forms of chronic liver disease.

EFFECT OF POISOINING

Poisoning is when exposure to a toxic substance makes you sick or harms you. Many different substances are toxic to humans. A few examples include heavy metals certain gases and even some plants you encounter while gardening. Poisoning often happens suddenly and accidentally. For example, a child might drink cough syrup, or you might splash a harsh cleaner into your eye.

POISON CONTROL NUMBER

In the U.S., the number to call for poison control is 1-800-222-1222. The call will automatically direct to a local poison control canter (there's one in every U.S. state and territory). When you call this number, an expert will answer and help you in real time. You'll talk with a doctor, nurse, pharmacist or other trained expert.

SYMPTOMS AND CAUSES OF POISONING

The signs and symptoms of poisoning vary according to:

- The amount and type of poison.
- Your age and overall health.
- How the poison gets into your body. For example, a poison that splashes into your eye causes eye-related symptoms.
- Swallowed poisons cause digestive symptoms.
- The duration of exposure (acute vs. chronic).
- Stomach pain.
- Loss of appetite.
- Blue lips and skin (cyanosis).
- Breathing difficulties.
- Loss of consciousness.[5]

METHODS

This was a retrospective and descriptive study from an institute of poisoning. Patient registration information and test reports spanning the period from April 1, 2020 to March 31, 2022, were obtained. Patients with uncertain exposure histories and who underwent toxicological analysis were included. Clinical manifestations and categories of toxics were analysed.

STUDY DESIGN AND SETTING

- This was a retrospective and descriptive study from the Institute of Poisoning at Nanjing Medical University.
- Patient registration information and test reports spanning the period from April 1, 2020, to March 31, 2022, were obtained from the toxicological analysis laboratory.
- The samples, including blood and urine, utilized for toxicological analysis were obtained from patients in the EDs of different hospitals in this region.

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INCLUSION AND EXCLUSION CRITERIA

The patients were included if they:

1) Had an uncertain exposure history

2) Underwent toxicological analysis

3) Had poisoning events evaluated by toxicologic.

EQUIPMENT FOR THE TOXICOLOGICAL ANALYSIS

The toxicological analysis equipment includes: headspace-gas chromatography (7697A-7890B, Agilent Technologies, USA), gas chromatography-mass spectrometer (7890B-7000D, Agilent Technologies, USA) and liquid chromatography-mass spectrometer (XEVO TQS-Micro, Waters, USA).[6]

QUALIFICATION FOR THE TOXICOLOGICAL ANALYSIS

- The toxicological analysis laboratory of the Institute of Poisoning at Nanjing Medical University holds dual accreditations from China National Accreditation Service for Conformity Assessment (CNAS) and China Metrology Accreditation (CMA).
- This laboratory is authorized to test and identify toxic substances.
- Analytical methodologies have been established and tested to identify more than 300 common toxins in 7 different categories, including pharmaceuticals, rodenticides, herbicides, pesticides, gaseous toxins, volatile substances (e.g., methanol), plant toxins (e.g., aconitine) and animal toxins (e.g., tetrodotoxin). We conducted a non-targeted screening of these 7 categories for each patient with an uncertain exposure history.
- The toxicological analysis laboratory can provide a test report within 24 h after receiving the sample. (FIG-1)

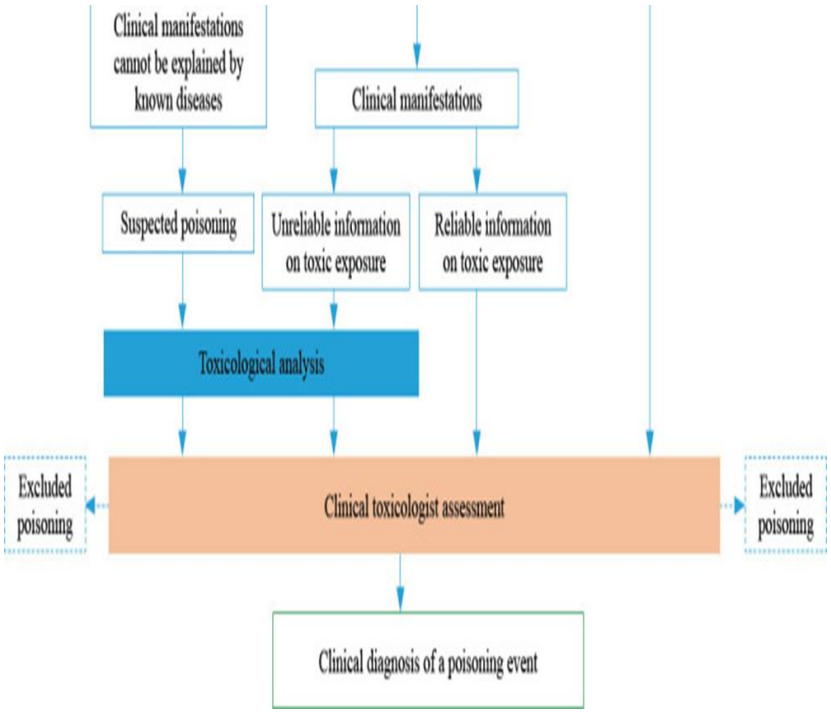

FIG:1 TOXICOLOGY ANALYSIS LABORATORY

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Statistical analysis

The statistical analysis was performed using SPSS (version 23.0, IBM Corp, Chicago, USA). The categorical variables are expressed as numbers (percentage) and compared with a Chi-square test or Fischer's exact test. Two-sided *P*-values <0.05 were considered as statistically significant.

Study population

A total of 758 patients were recorded. Of these, 464 cases with a definite history of exposure were excluded. Of the 294 cases with an uncertain history of exposure, 99 cases who had negative toxicological analysis results, and 195 cases with positive results (Figure 2).
There were no instances of shared names among these cases, and each of the 195 cases corresponded to a distinct individual. In the 195 cases with positive results, the uncertainty of exposure history was attributed to various factors, including disturbance of consciousness (62.6%), unwillingness to share information or uncooperative behaviour (13.8%), and lack of awareness regarding the poisoning (23.6%). During this period, the monthly count of such cases ranged from 1 to 22, with an average of 8 cases. Detailed demographic characteristics and exposure information are presented in Figure 2. [7]

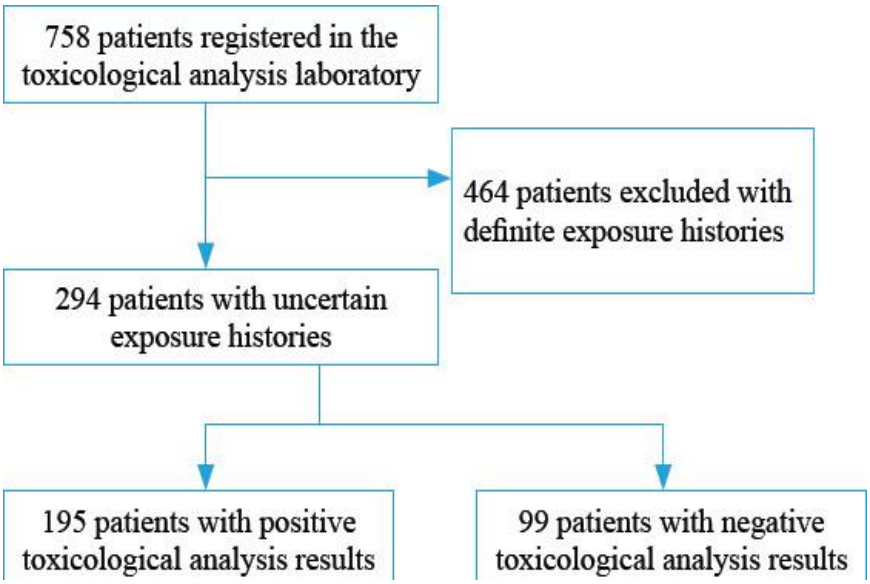

FIG:2 TOXICOLOGY ANALYSIS STUDY OF POPULATION

DIAGNOSIS AND TESTS

- ❖ Experts at a poison control centre or other healthcare providers diagnose poisoning. Diagnosis may take place over the phone and/or in person.
- ❖ If you or someone you're with has a suspected poison exposure, don't wait for symptoms to appear. Take action right away:

- Do first aid.
- Call 911 (or your local emergency service number) in certain cases, or call poison control at 1-800-222-1222.

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TREATMENT OF POISONING

- ❖ Poison control or your healthcare provider decides the best treatment in each case of poisoning. In many cases, at-home care is enough to help you recover. Some people need care at a hospital to recover.
- ❖ Treatments vary widely according to the type of poison and how it affects you. Possible treatments include:

- First aid measures (described above) and monitoring.
- Rest, IV fluids, antidotes and/or medications at the hospital.
- Activated charcoal and stomach pumping to prevent the poison from absorbing into your bloodstream. This should only be used in the hospital and not on your own.
- Supportive care, like mechanical ventilation, to help your body function while the poison clears from your system.
- Induced vomiting (rare). NEVER induce vomiting unless poison control or a trained, qualified healthcare provider tells you to do so.
- Chelation therapy. This is a form of treatment that uses medicine to remove metals in your body so they don't make you sick.

PREVENTION

- ❖ Most types of poisoning are preventable (and you can reduce the risks of many others). This is especially important if there could be a risk to children in or around your home.
- ❖ Here are some tips:

- ❖ Install a carbon monoxide detector in your home and change the batteries yearly.

- ❖ Keep cleaners, soaps and household or cleaning chemicals where children can't reach them.
- ❖ Keep all medications out of reach of children. Prescription medications should always be kept secured in a locked storage place.
- ❖ Talk to your healthcare provider about appropriate doses for medication. Always ask your provider before taking any new medication.
- ❖ "Over the counter" doesn't mean it's automatically safe. Talk to your healthcare provider about safe dosing of over-the-counter drugs, too.
- ❖ Keep cleaners and chemicals in their original packaging with the labels on them. This helps avoid confusion. It also lets you know what's in a substance if you need to call for help.
- ❖ NEVER mix cleaning products or household chemicals. The results can be deadly.
- ❖ Don't touch or eat unfamiliar plants you encounter outdoors. If you're traveling in an unfamiliar area, do some research to know about plants and animals to avoid.

- ❖ Take food saftey measures like cooking meat to the proper temperature and rinsing fruits [8]

CLASSIFICATION

Toxicology is broadly divided into different classes Depending on:

I. Research methodology
II. Socio-medical
III. Organ/specific effects

I. Based on research methodology

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Descriptive toxicology

- Descriptive toxicology deals with toxicity tests on chemicals exposed to human beings and environment as a whole

Mechanistic toxicology

- Mechanistic toxicology this deals with the mechanism of toxic effects of chemicals on living organisms
- This is important for rational treatment
- Facilitation of search for safer drugs (e.g. Instead of organophosphates, drugs which reversibly bind to cholinesterase would be preferable in therapeutics).

Regulatory toxicology

- studies whether the chemical substances has low risk to be used in **living systems**, Examples:
- encompasses the collection, processing and evaluation of epidemiological and experimental toxicology data to permit toxicologically based decisions
- Food and drug administration regulates drugs, food, cosmetics medical devices & supplies in USA
- Environmental protection agency regulates pesticides, toxic chemicals, hazardous wastes and toxic pollutants in USA
- Occupational safety and health administration regulates the safe conditions for employees in USA authority
- DACA (now FMHACA)- regulates drugs, food, cosmetics and medical devices & supplies in Ethiopia

PREDICTIVE TOXICOLOGY

- Predictive toxicology studies about the potential and actual risks of chemicals /drugs
- This is important for licensing a new drug.

II. Based on specific socio-medical issues

OCCUPATIONAL TOXICOLOGY

- It deals with chemical found in the workplace
- E.g. – Industrial workers may be exposed to these agents during the synthesis, manufacturing or packaging of substances
- Agricultural workers may be exposed to harmful amounts of pesticides during the application in the field.

Environmental toxicology

- This deals with the potentially deleterious impact of chemicals, present as pollutants of the environment, to living organisms

ECOTOXICOLOGY

- Ecotoxicology has evolved as an extension of environmental toxicology
- It is concerned with the toxic effects of chemical and physical agents on living organisms, especially in populations and communities with defined ecosystems

CLINICAL TOXICOLOGY

- Clinical toxicology deals with diagnosis and treatment of the normal diseases or effects caused by toxic substances of exogenous origin.

FORENSIC TOXICOLOGY

- Forensic toxicology closely related to clinical toxicology
- It deals with the medical and legal aspects of the harmful effects of chemicals on man, often in post mortem material, for instance, where there is a suspicion of murder, attempted murder or suicide by poisoning

ANIMAL AND PLANT TOXICOLOGY

- Deals with the diagnosis and treatment of harmful effects of animals and plants.

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III. Based on the organ/system effect

- Cardiovascular toxicology
- Renal toxicology
- Central nervous system toxicology
- Gastrointestinal toxicology
- Respiratory toxicology, etc

ROUTE OF POISONING

- Oral route – the GIT is the most important route of absorption, as most acute poisonings involve ingestions
- Dermal route – lipid solubility of a substance is an important factor affecting the degree of absorption through the skin
- Inhalational route – toxic fumes, particulate and noxious gases may be absorbed through the lungs
- Intramuscular route – unreliable and varied from patient to patient
- Intravenous route – is the most reliable and provides the most rapid clinical response Rectal route – is generally considered to produce erratic absorption.

CONCLUSION

- In recent years there, has been growing concern about the potential health effects of exposure to chemicals such as bisphenol A (BPA), phthalates, and perfluorinated compounds (PFCs), which are commonly found in plastics, food packaging, and other consumer products.
- Through toxicological studies, scientists have been able to demonstrate the harmful effects of these substances and advocate for their regulation or removal from products.
- Toxicology also plays a critical role in environmental protection. Through studies of the effects of pollutants on ecosystems, toxicologists can identify the sources of contamination and develop strategies to reduce or eliminate them.
- In conclusion, toxicology is a critical field of study in today's world. It helps us understand the potential risks associated with exposure to various substances and supports the development of safe products and practices.
- As we continue to face new environmental and health challenges, toxicology will play an increasingly important role in protecting the health and well-being of people and the planet.
- The clinical manifestations of acute poisoning in patients with an uncertain exposure history are diverse and nonspecific, and toxicological analysis plays a pivotal role in the diagnosis and differential diagnosis of these patients.[9]

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