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Review Article

TOXICOLOGY LABORATORY AT HEALTH CARE INSTITUTE: AN ULTIMATE NEED

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ABSTRACT

Local Forensic Science laboratory serve their best, helps in detection of poison and solve many medico-legal cases, however the requirement of toxicology laboratory for health care institute differ in many ways. Treatment of poisoning of a patient is an emergency, but its analysis is time taking procedure in Forensic Science laboratory and is of no use for the treatment of the patient. The role of the Toxicology laboratory in the treatment of the poisoned patient can be made helpful by enabling the clinician to deal with the case of poisoning more effectively by correlating the clinical findings with the laboratory findings when situated in the Institute itself. It is also need of ours that the doctors specialist in Forensic Medicine & Toxicology should take the responsibility of diagnosis and management of poisoning cases, as in M.B.B.S curriculum the same is taught in Forensic Medicine & Toxicology only. In medico-legal cases, there is also chances of destruction of chain of evidence due to improper handling, destruction of time bound samples and time taking procedures.

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INTRODUCTION

Toxicology is the branch of medical science which deals with poisons with reference to their source, characters & properties, the symptoms & signs which they produce on human body, the lethal dose, nature of the fatal results, the remedial measures, the methods of their detection & estimation and autopsy findings. [1] In India facility of Toxicology Laboratory is lacking in health care institutes except very few. Toxicology laboratories are functional mainly in forensic science laboratories. Treatment of poisoning of a patient is an emergency, but its analysis is time taking procedure in Forensic Science Laboratory and is of no use for the treatment of the patient. The role of the Toxicology laboratory in the treatment of the poisoned patient can be made helpful by enabling the clinician to deal with the case of poisoning more effectively by correlating the clinical findings with the laboratory findings when situated in the Institute itself. Presently teaching and training of toxicological aspect of MBBS and MD students of Forensic Medicine & Toxicology is more theoretical oriented than practical. It is the need of hours that the doctors specialised in Forensic Medicine & Toxicology should take the responsibility of diagnosis and management of poisoning cases, as in M.B.B.S/ MD curriculum the same is taught in Forensic Medicine & Toxicology only.

History

Until the 1700s conviction associated with homicidal poisoning were based only on circumstantial evidences rather than the identification of the actual toxicant within the victim. In 1781, Joseph Plenic stated that the detection and identification of the poison in the organs of the deceased was the only true sign of poisoning. In 1813, Mathieu Orfila (considered the father of toxicology) published the first complete work on the subject of poisons and legal medicine. By 1918, the Medical Examiner's Office and Toxicology Laboratory was established in New York. The chief forensic toxicologist was Alexander O. Gettler who is considered as Father of American Toxicology. [2]

Historically the role of the clinical toxicology laboratory in treatment of the poisoned patient and post-mortem examination has been rather ill-defined. But, in this era of advancement and public awareness the burning time has come when requirement of Toxicology Laboratory has become an urgent need. Forensic Science Laboratory has been formed by central/state Government in every state. Local Forensic Science laboratories are serving their best, help in detection of poison and solve many medico-legal cases, however the requirement of toxicology laboratory for health care institute differ in many ways.

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Toxicology Laboratory situated at the health care institute can be helpful in the following ways

1. In diagnosis and treatment of suspected case of poisoning in clinical practice.
2. In medico-legal cases/postmortem examination, reduction in time consumption and destruction of chain of evidence.

In clinical treatment of poisoning case, since the clinical history is only rarely explicit in overdose/poisoning due to the frequently obtunded state of the patient and/or his reluctance to aid the physician, laboratory identification of the specific toxic agent(s) involved may play a vital role in the treatment indicated in these patients.

It is well known that India has a high incidence of poisoning, being the 4th most common cause of mortality in rural areas. Failure to preserve and dispatch the exhibit/samples in medico-legal cases at the earliest to the FSL, by the doctor concerned, renders him/her liable to be charged with causing destruction of evidence under sections 201-204 of the Indian Penal Code. [3]. There is also chances of destruction of chain of evidence due to improper handling, destruction of time bound samples and time taking procedures due to lack of toxicology laboratory at health institute.

Demography of Toxicology

Global trends of Poisoning

Developing Nations

- Pesticide Poisoning
- Narcotic drugs poisoning

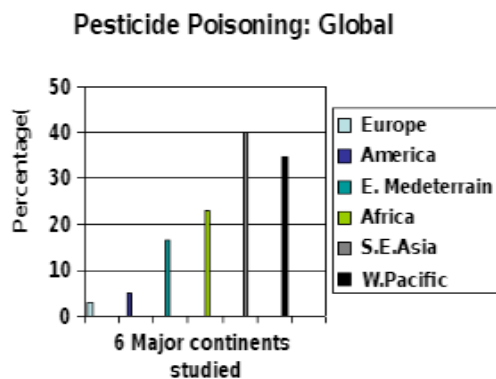
Developed Nations

- Sedatives
- Anti-depressants
- Harmful Chemicals

Table 1 Pesticide poisoning in Global Scenario

Name	% of pesticide poisoning cases	Name	% of pesticide poisoning cases
Europe	3.0	S.E Asia	40
America	4.9	W. pacific	34.8
East Medeterrian	16.5		
Africa	22.9		

Table No. 1 shows percentage of poisoning cases in various region of the world.



Studies in developed countries have demonstrated the annual incidence rates of acute poisoning in agricultural workers to be as much as 18.2 per 100 000 full time workers. World Health Organization (WHO) estimated 0.3 million people die every year due to various poisoning agents. Acute pesticide poisoning is one of the most common causes of intentional deaths worldwide. High doses of analgesics, tranquilizers, and antidepressants are the commonly used agents for intentional poisoning in industrialized countries and agriculture pesticides are used in Asian region for self-poisoning particularly in rural areas. Majority of pesticide exposure is seen more in middle and low income countries due to increased use of agrochemicals in agricultural sector. Table No. 2 shows trends of pesticide poisoning in India and neighbouring countries.[4]

Table 2 Trends of pesticide poisoning in India and neighbouring countries

% of poisoning cases	India	China	Japan	Pakistan	Bangladesh	Thailand	Malaysia
Pesticide	81	26	7	39	55	16	16
Other than pesticide	19	72	93	61	45	84	84

Table No 2 shows there is tremendous rise in pesticide poisoning cases due to easy availability of pesticides for crop protection. Their misuse has lead in rise of suicidal, homicidal and accidental poisoning cases in India. As compared to other developed countries like Japan, percentage of pesticide poisoning is more in India because in those countries use of pesticides is restricted. But percentage of pesticide poisoning cases is increased in countries like Bangladesh and Pakistan as similar as India because poverty and easy availability of pesticides.

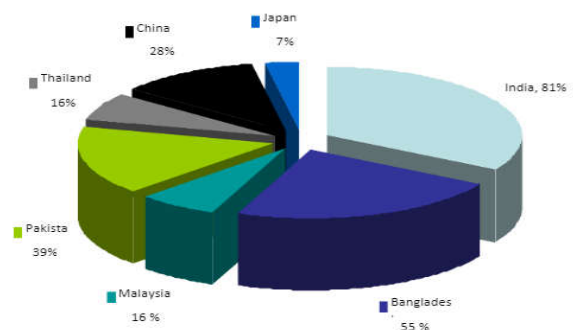


Fig 2: Trends of Pesticide Poisoning – India and Neighboring Countries
Source: WHO 2006 data compilation

The number of fatal poisoning cases received for toxicological analysis is constantly increasing. There is tremendous rise in the use of insecticide; pesticide and other potentially poisonous substances in last five-year for crop protection. Former use these insecticides, pesticides which were misused lead to suicidal, homicidal or accidental poisoning cases. In developed country sedative, tranquilizer and other synthetic drug are commonly misused. In India misuse of such drug is confined to big cities also. Misuse of insecticide/pesticide is very high in India. [5] It is estimated that more than 50,000 people die every year from toxic exposure in India. [6]

DISCUSSION

Problems Faced due to Absence of Toxicology Laboratory in Health care Institute

1. Difficulty in diagnosis of poisoning patients.
2. Difficulty in management (in deciding antidotes / drugs and their dose).
3. Time consumption in detection in medico-legal cases.
4. Chances of destruction of samples due to difficulty in maintaining chain of evidence.
5. Due to absence of dialogue among clinicians, forensic medicine experts and toxicologist it is not possible to maintain effective correlation amongst the findings of these three agencies.
6. Monitoring of level of different therapeutic drugs in the body of patients not possible.
7. Lack of information regarding quality of therapeutic drugs used in patients.
8. Lack of holistic concept of toxicology amongst doctors and paramedical staffs.
9. Difficulty in interpretation in medico-legal cases due to absence of correlation between post-mortem report and toxicology report.
10. Difficulty in conduction of research in toxicology especially in the patients.
11. Difficulty in developing medical toxicology as super specialty subject.

Advantages of toxicology laboratory in health care institute

1. Quick and accurate diagnosis in poisoning patients.
2. Selection of appropriate antidote / drugs / other therapeutic measures in appropriate dose / manner.
3. Less time shall be consumed in reporting in medico-legal cases.
4. Chain of evidence can be easily maintained.
5. Dialogue among clinicians, forensic medicine experts and toxicologist can be easily established and result can be interpreted after holistic information and discussions.
6. Level of different therapeutic drugs in different body fluids can be monitored regularly which shall be helpful in better management of the patients.
7. Quality of different therapeutic drugs can be easily checked.
8. Doctors and paramedical staffs shall have holistic concept of toxicology which shall help them to manage the patient in better way.
9. In medico-legal case forensic evidences may be interpreted in better way.
10. More useful, truthful and holistic research work shall be conducted for the betterment of science and society.
11. It shall be helpful in designing better academic curriculum.

Role of Toxicology Laboratory in treatment of Poisoned Patient

The modern hospital based toxicology Laboratory can play an important role in the evaluation of drug monitoring and poisoning. It can provide diagnostic and prognostic data relevant to treating drug level and an alleged acute poisoning. In order to appreciate the nature and extent of this role, several essential elements necessary to an acute care toxicology service

should be considered. When an ongoing and effective dialogue between clinician and toxicology laboratory staff is established, and a broadly based analytical approach is applied to the analysis of the appropriate biological fluid, a dynamic and viable toxicology service will result.

The first area involves monitoring drugs that are utilized in the treatment of well-defined disease states. One can ensure the proper use of medications on a routine basis in a well-defined patient population by testing blood specimens. This is no small task. Single analyses are relatively expensive, so properly batching specimens to provide high through-put can be more effective and economical. The results of the analyses ensure compliance or suggest changes in therapy. In some situations, some degree of data interpretation by the toxicologist may be required by the attending clinician. The many problems involved in therapeutic drug monitoring, as a function of analytical methods, patient and clinician needs, and cost-effectiveness, have been the subject of much discussion, and need no further comment here.[7]

Further, those involved in a toxicology service can recognize that analyses related to therapeutic drug monitoring and acute poisoning which are not mutually exclusive. The same personnel, equipment and analytical techniques used in one area can be applied to the other. Their basic difference is in the scope and 'kinetics' of the analytical procedures. In cases of acute poisoning, the analytical scope is by design much broader, utilizing techniques that may require more individual analytical expertise to facilitate analysis. This may, in fact, require a prudent initial investment in more experienced personnel. Since similar techniques and equipment can be utilized in both areas, significant economies can be realized if the laboratory serves both functions.[8]

In the present era of Industrialization, where air, water, food pollution and adulteration is very common with harmful fumes, gases, chemicals etc., sign and symptoms of which mimics with the natural course of diseases, rather than exact sign and symptoms of poisoning, the Toxicology laboratory can perform a tremendous task by helping the clinician about the exact diagnosis and treatment.

Role of Toxicology Laboratory Medico-legal cases/post-mortem examination

Today, toxicology has been expanded to include a diverse range of interests including evaluation of the risks involved in the use of food additives, pesticides and cosmetics, and studies concerned with occupational poisonings, environmental pollution, the effects of radiation, and biological and chemical warfare. However, it is the forensic toxicologist who has held the title of toxicologist for the longest period of time.

The complete investigation of the cause or causes of sudden death is an important civic responsibility. Establishing the cause of death rests with the medical examiner, pathologist, but success in arriving at the correct conclusion frequently is dependent upon the combined efforts of the pathologist and the toxicologist. The cause of death in cases of poisoning cannot be proven beyond contention without toxicological analysis which establishes the presence of the toxicant in the tissues and body fluids of the deceased.

Many drugs or poisons do not produce any characteristic pathologic lesions and mimics signs and symptoms of natural course of diseases, therefore their presence in the body can be demonstrated only by chemical methods of isolation and identification. If toxicological analyses are avoided, deaths due to poisoning may be erroneously ascribed to some entirely different cause, or poisonings may be designated as the cause of death without any definite proof. Such erroneous diagnoses may have significant legal and social consequences.

Often the toxicologist is able to furnish valuable evidence concerning the circumstances surrounding a death. For example, by demonstrating the presence of ethanol in victims of automotive or industrial accidents, or the presence of carbon monoxide in fire victims. The degree of carbon monoxide saturation of the blood may indicate whether the deceased died as a result of the burns or was dead before the fire started, since arson is commonly used to conceal homicide.

Investigation Prior to Toxicological Analysis

Before starting a toxicological analysis, the toxicologist should have the following information: age, sex and weight of the deceased; the approximate time of ingestion or exposure to the toxicant; prior drug use by the deceased; and, if applicable, any symptoms displayed prior to death or medications administered by professional personnel during treatment for the intoxication. It should be kept in mind that unless empty prescription vials or containers of toxic material are found in close proximity to the patient, clinical symptoms prior to death are seldom indicative of intoxication. A recent review of clinical impressions of intoxicated patients compared to laboratory findings revealed that in only 59% of the cases, were the drugs suspected found. In 35% of these cases, additional drugs were present. In 39% of the cases, drugs other than those suspected of inducing the observed intoxication were present. In only 2% of the cases were drugs or toxicants not detected. [9]

Specimens and their Collection

Probably no other area causes as much disturbance to the smooth working relationship between the pathologist and toxicologist as the type and quantity of specimen collected and submitted for analysis. Often the quality and quantity of such specimens vary tremendously in similar cases. In health care institute where autopsies and toxicological testing are performed in the same building, problems of this nature can be dealt with easily. However, there seems to be an inverse relationship between the quality of specimens and the distance between the autopsy and the laboratory, which often cripples the effectiveness of Toxicological finding reports where specimens are sent to a central laboratory for examination. [10]

Absent/Negative Fsl Report

As the forensic team/forensic laboratory personnel is usually not the first responder at the scene of crime, the lack of mandatory procedures may very well lead to destruction or contamination of evidence. The integrity of the evidence collected can further be impacted if a strict chain of custody is not followed. Often, the FSL receives quantities that are much less than those prescribed for optimal analysis [11]. This makes it impossible to re-test the samples in case of any doubt on the authenticity of the test result and also seriously affects the chances of detection of poison. Further, there are neither any

rules nor a time frame prescribed for the samples to be sent to the FSL, the test and the receipt of the report. This, combined with the limited number of FSL in the country often leads to situations where the FSL report is not brought on record even years after the samples have been sent to such labs. Even though the courts in the recent years have come down heavily on the prosecution and the investigating agencies for not making sure that the FSL report is brought on record [12], in the absence of any legislation in place, none can be held accountable for such a lapse. These disparities can be easily handled if toxicology laboratory is integrated with the health institute.

Role of Forensic Toxicologist in the Management of Poisoning cases in causality Department of a Hospital

At present the diagnosis and treatment of poisoning cases is essentially the domain of clinicians. But as clinicians are reluctant to deal with the legal aspects of poisoning cases and as they actually may not do satisfactorily, poisoning cases having legal implications are in part dealt by specialists in forensic medicine. Many of the unnatural deaths, where post-mortem examination of the dead body is performed, are cases of deaths due to poisoning or where some poison is an associated factor in the circumstances of death. Only a medico-legal expert can be well conversant with all the aspects of a huge number and types of poisons available these days to deal these cases. Whereas a physician is taught mainly about diagnosis and treatment of only some of the poisons during post-graduation training.

The subject of Toxicology is mainly a part of undergraduate/post-graduation curriculum in Forensic Medicine and Toxicology. As recommended by the experts, the teaching of the subject to undergraduate/post graduates includes every aspects of poison like properties, clinical signs & symptoms in the patients with differential diagnosis of different poisons, fatal dose and fatal period toxicological testing methods, general management and specific treatment including different anti dotes, post-mortem appearances in the dead body and of course different medico-legal aspects of poison cases.

But the dark side of the whole picture is that in most of the post graduate medical institutions, the teaching in Forensic Medicine & Toxicology is mostly theory oriented and the post graduate students are not exposed to the poison cases without which a pseudo toxicologist is produced and the vast study in theory during post-graduation becomes useless without practical training in dealing poison cases. As felt by experts, the subject of forensic medicine and its teaching in our country has been very much neglected and is still being neglected without giving any thought to improve the status of the subject including practical approach in dealing with toxicology cases.

CONCLUSIONS AND SUGGESTIONS

Keeping in-view, the increasing number and types of poisons these days, this is a field where a doctor as toxicologist can work a lot from the point of view of patient care, diagnosis, treatment and prevention including legal implications. If this happens then we specialists will no longer be called "doctors of the dead" as most people think today but will be known as toxicologists.

It is high time that we do something in the management of poison cases coming to emergency departments. [13]

I feel the Following steps need to be taken

1. Advance toxicology laboratory should be established in Forensic Medicine & Toxicology department of every medical institute.
2. The specialist of Forensic Medicine & Toxicology should take over the responsibility of diagnosis and management of patients of poisoning.
3. Teaching and training of MBBS and MD students in respect to medical toxicology should also be oriented towards practical.
4. Separate Medical Toxicology wing should be created in every Medical Institutes with facilities of clinical and analytical toxicology.

And I am sure, many valuable human lives can be saved by streamlining the existing services in the management of poisoning casualties.

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