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MEDICO LEGAL EVALUATION OF ACUTE POISONING CASES IN HAPUR REGION - U.P., INDIA

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ABSTRACT
Acute poisoning is a common medico-social problem all over the world. Acute poisoning constitutes one of the main reasons why patients visit emergency department of hospitals. **Aims and objectives:** 1. To study the nature, pattern & magnitude of the morbidity and mortality due to poisoning. 2. To study the demographic profile of the poisoning cases in Hapur district. **Material and Methods** The study was conducted at Saraswathi Institute of Medical Sciences, Hapur & Government Hospital, Hapur from February 2014 to July 2015. There were 160 patients of acute poisoning admitted to the Department of Medicine / Emergency during the study period. After applying inclusion and exclusion criteria, 100 patients were chosen as study subjects**. Results** Out of 100, 64 (64%) were males and only 36 (36%) were females. Majority 70 (70%) of patients were married and 30 (30%) were unmarried. 56 (56%) of the patients belonged to rural area and 44 (44%) belonged to urban area. Farmer (38 cases, 38%), students (16 cases, 16%) and house wives (22 cases, 22%) were the main targets. Suicide was the most common mode of poisoning. in this study 96 out of 100 cases (96%) were suicidal**.** The most common agent encountered was Aluminum Phosphide 23 (23%). Majority 63 (63%) of patients presented within 2 – 4 hours of poisoning. 75 (75%) of patients out of 100 survived while 25 (25%) expired. **Conclusion** Knowledge of general pattern of poisoning in a particular region will help in early diagnosis and treatment of cases, thus decreasing the rate of mortality

KEYWORDS: Poisoning, aluminium phosphide, organophosphate.

1. INTRODUCTION
Acute poisoning is a common medico-social problem all over the world. Acute poisoning constitutes one of the main reasons why patients visit emergency department of hospitals. It consumes not only the valuable health service resources but also cause considerable morbidity and mortality.

Deliberate ingestion of pesticides has become one of the commonest methods of suicide globally. In advanced countries, it has been observed that poisoning deaths are mainly due to cleansing agents, detergents, paracetamol, carbon monoxide and other cosmetic products. In India, as agriculture is the main occupation, insecticides and other agrochemical fertilizers are used to a greater extent and the poisoning with such products are more common. In general accidental poisoning is more common in children and suicidal poisoning is more common in young adults. A study by Thomas et al, (2000) has shown an increasing trend of self-poisoning among young adults (the most productive group of the community).

Knowledge of general pattern of poisoning in a particular region will help in early diagnosis and treatment of cases, thus decreasing the rate of mortality and morbidity. Information available in our locality with regard to acute poisoning in adults is limited. Hence this present study was carried out with the objective to find out the pattern of acute poisoning in adults in Hapur, Uttar Pradesh, India.

Poison

The term "*poison*" is often used colloquially to describe any harmful substance particularly corrosive substances, carcinogens, mutagens, teratogens and harmful pollutants, and to exaggerate the dangers of chemicals. *Paracelsus* (1493–1541), the father of toxicology, once wrote: "*Everything is poison, there is poison in everything. Only the dose makes a thing not a poison*". The law defines "poison" more strictly. Substances not legally required to carry the label "*poison*" can also cause a medical condition of poisoning. Some poisons are also toxins, which is any poison produced by animals, vegetables or bacterium, such as the bacterial proteins that cause tetanus and botulism. A distinction between the two terms is not always observed, even among scientists. The derivative forms "toxic" and "poisonous" are synonymous

Chronic poisoning is long-term repeated or continuous exposure to a poison where symptoms do not occur immediately or after each exposure. The patient gradually becomes ill, or becomes ill after a long latent period. Chronic poisoning most commonly occurs following exposure to poisons that bioaccumulate, or are biomagnified, such as mercury, gadolinium, and lead.

Acute poisoning is exposure to a poison on one occasion or during a short period of time. Symptoms develop in close relation to the exposure. Absorption of a poison is necessary for systemic poisoning. In contrast, substances that destroy tissue but do not absorb, such as lye, are classified as corrosives rather than poisons.

Poison is anything that kills or injures through its chemical actions. Most poisons are swallowed (ingested). But poisons can also enter the body in other ways:

- *By breathing*
- *Through the skin*
- *By IV injection*
- *From exposure to radiation*
- *Venom from a snake bite or insect bite*

Common types of acute poisonings

1) Acute aluminum phosphide poisoning (AAlPP) is a large, though under-reported, problem throughout the world, particularly in the Indian subcontinent. Aluminum phosphide (AlP), which is readily available as a fumigant for stored cereal grains, sold under various brand names such as *QuickPhos* and *Celphos*, is highly toxic, especially when consumed from a freshly opened container.[1,2] Death results from profound shock, myocarditis and multi-organ failure.[3] Aluminium phosphide has a fatal dose of 0.15 and 0.5 grams (0.0053 and 0.0176 oz).[4] It has been reported to be the most common cause of suicidal death in North India.

Mortality rates The mortality rates from AAlPP vary from 40 to 80 percent. The actual numbers of cases may be much larger, as less than five percent of those with AAlPP eventually reach a tertiary care center. Since 1992, when aluminium phosphide became freely available in the market, it had, reportedly, overtaken all other forms of deliberate poisoning, such as organophosphorus and barbiturate poisoning, in North India. In a 25-year-long study on 5,933 unnatural deaths in northwest India, aluminium phosphide poisoning was found to be the major cause of death among all cases of poisonings.

Mechanism of toxicity The toxicity of aluminium phosphide is attributed to the liberation of phosphine gas, a cytotoxic compound that causes free radical mediated injury, inhibits vital cellular enzymes and is directly corrosive to tissues. The following reaction releases phosphine when AlP reacts with water in the body:

$$AlP + 3\ H_2O \rightarrow Al(OH)_3 + PH_3, \text{ and}$$
$$AlP + 3\ HCl \rightarrow AlCl_3 + PH_3 \text{ (stomach)}$$

Signs, symptoms, and diagnosis After ingestion, toxic features usually develop within a few minutes. The major lethal consequence of aluminium phosphide ingestion is profound circulatory collapse, is reportedly secondary to these toxins generated, which lead due to direct effects on cardiomyocytes,[3] fluid loss, and adrenal gland damage.[5] The signs and symptoms are non-specific, dose dependent and evolve with time passing. The dominant clinical feature is severe hypotension refractory to dopamine therapy. Other features may include dizziness, fatigue, tightness in the chest, headache, nausea, vomiting, diarrhoea, ataxia, numbness, paraesthesia, tremor, muscle weakness, diplopia and jaundice.[6,7,8,9] If severe inhalation occurs, the patient may develop acute respiratory distress syndrome (ARDS), heart failure, arrhythmias, convulsion and coma. Late manifestations include liver and kidney toxicities.[6,8]

Diagnosis The diagnosis of AAlP usually depends on the clinical suspicion or history (self-report or by attendants). At some places, tablets of AlP are also referred to as "rice tablets" and, if there is a history of rice tablet ingestion, then it should be treated differently from other types of rice tablets that are made up of herbal products.[10] For a silver nitrate test on gastric aspirate, diluted gastric content can be positive.[5]

Management and outcome The management of AAlPP remains purely supportive because no specific antidote exists. Mortality rates approach 60%. Correction of metabolic acidosis is a cornerstone of treatment. The role of magnesium sulfate as a potential therapy in AlP poisoning may decrease the likelihood of a fatal outcome, and has been described in many studies.[3,9] After ingestion, removal of unabsorbed poison from the gut ("gut decontamination"), especially if administered within 1–2 hours, can be effective. Potassium permanganate (1:10,000) gastric lavage can decompose the toxin. All patients of severe AlP poisoning require

continuous invasive hemodynamic monitoring and early resuscitation with fluid and vasoactive agents.

2) Organophosphate poisoning results from exposure to organophosphates (OPs), which cause the inhibition of acetylcholinesterase (AChE), leading to the accumulation of acetylcholine (ACh) in the body. Organophosphate poisoning most commonly results from exposure to insecticides or nerve agents. OPs are one of the most common causes of poisoning worldwide, and are frequently intentionally used in suicides in agrarian areas. [11,12]There are around 1 million OP poisonings per year with several hundred thousand resulting in fatalities annually. Organophosphates inhibit AChE, causing OP poisoning by phosphorylating the serine hydroxyl residue on AChE, which inactivates AChE. AChE is critical for nerve function, so the irreversible blockage of this enzyme, which causes acetylcholine accumulation, results in muscle overstimulation. This causes disturbances across the cholinergic synapses and can only be reactivated very slowly, if at all. Paraoxonase (PON1) is a key enzyme involved in OP pesticides and has been found to be critical in determining an organism's sensitivity to OP exposure.

Signs and symptoms The health effects associated with organophosphate poisoning are a result of excess acetylcholine (ACh) present at different nerves and receptors in the body because acetylcholinesterase is blocked. Accumulation of ACh at motor nerves causes overstimulation of nicotinic expression at the neuromuscular junction. When this occur symptoms such as muscle weakness, fatigue, muscle cramps, fasciculation, and paralysis can be seen. When there is an accumulation of ACh at autonomic ganglia this causes overstimulation of nicotinic expression in the sympathetic system. The effects of organophosphate poisoning on muscarinic receptors are recalled using the mnemonic SLUDGEM (Salivation, Lacrimation, Urination, Defecation, gastrointestinal motility, Emesis, miosis). An additional mnemonic is MUDDLES: miosis, urination, diarrhea, diaphoresis, lacrimation, excitation, and salivation.[13] The onset and severity of symptoms, whether acute or chronic, depends upon the specific chemical, the route of exposure, the dose, and the individual's ability to degrade the compound, which the PON1 enzyme level will affect. Neurotoxic effects have also been linked to poisoning with OP pesticides causing four neurotoxic effects in humans: cholinergic syndrome, intermediate syndrome, organophosphate-induced delayed polyneuropathy, and chronic organophosphate-induced neuropsychiatric disorder.[14] These syndromes result after acute and chronic exposure to OP pesticides.

Diagnosis A number of measurements exist to assess exposure and early biological effects for organophosphate poisoning. Measurements of OP metabolites in both the blood and urine can be used to determine if a person has been exposed to organophosphates. Specifically in the blood, metabolites of cholinesterases, such as butyrylcholinesterase (BuChE) activity in plasma, neuropathy target esterase (NTE) in lymphocytes, and acetylcholinesterase (AChE) activity in red blood cells.[15] The most widely used portable testing device is the Test-mate ChE field test, which can be used to determine levels of Red Blood Cells (RBC), AChE and plasma (pseudo) cholinesterase (PChE) in the blood in about four minutes. This test has been shown to be just as effective as a regular laboratory test hence the portable ChE field test is frequently used by people who work with pesticides on a daily basis.

Treatment Current antidotes for OP poisoning consist of a pretreatment with carbamates to protect AChE from inhibition by OP compounds and post-exposure treatments with anti-cholinergic drugs. Anti-cholinergic drugs work to counteract the effects of excess acetylcholine and reactivate AChE. Atropine can be used as an antidote in conjunction with pralidoxime or other pyridinium oximes (such as trimedoxime or obidoxime). Significant advances with cholinesterases (ChEs), specifically human serum BChE (HuBChE) have been made. HuBChe can offer a broad range of protection for nerve agents including soman, sarin, tabun, and VX. HuBChE also possess a very long retention time in the human circulation system and because it is from a human source it does not produce any antagonistic immunological responses. HuBChE is currently being assessed for inclusion into the protective regimen against OP nerve agent poisoning.[16] One other agent that is being researched is the Class III anti-arrhythmic agents. Hyperkalemia of the tissue is one of the symptoms associated with OP poisoning. Class III anti-arrhythmic agents block the potassium membrane currents in cardiac cells, which makes them a candidate for become a therapeutic of OP poisoning.[17]

3) Hydrocarbons Poisoning Hydrocarbons (simple organic compounds consisting of hydrogen and carbon) are often present in the *oil, gas and kerosene*. Excessive exposure may result in hydrocarbon poisoning.

Symptoms Hydrocarbon poisoning mainly affects the lungs and intestines and in severe cases, brain. Initially, children have cough and suffocation followed by symptoms of *asthma, vomiting,* and *intractable* cough.

Diagnosis Chest X-ray examination is the single most important diagnostic technique. In severe cases, within two hours after the inhalation of halogenated hydrocarbons signs of pneumonia can be displayed in the X-ray.

Treatment One should immediately notify poisoning emergency center, remove contaminated clothing and flush skin. Sober drink a small cup of milk for children, in order to dilute the swallowed substance and reduce stomach irritation

4) Snake bite is an injury caused by the bite of a snake. It often results in two puncture wounds from the animal's fangs. Most snake bites are caused by non-venomous snakes. Of the roughly 3,000 known species of snake found worldwide, only 15% are considered dangerous to humans.[18] The most common symptom of all snakebites is overwhelming fear, which contributes to other symptoms, including nausea and vomiting, diarrhea, vertigo, fainting, tachycardia, and cold, clammy skin.

5) Food Poisoning Foodborne illness, more commonly referred to as food poisoning, is the result of eating contaminated, spoiled, or toxic food. The most common symptoms of food poisoning include nausea, vomiting, and diarrhea. Although it's quite uncomfortable, food poisoning isn't unusual.

6) Insect Bites and Stings Bites often cause minor swelling, redness, pain, and itching. These mild reactions are common and may last from a few hours to a few days. Home treatment is often all that is needed to relieve the symptoms of a mild reaction to common stinging or biting insects and spiders

2. AIMS AND OBJECTIVES

Aims

Medico legal evaluation of acute poisoning cases in Hapur, region – U.P.

Objectives

1. To study the nature, pattern & magnitude of the morbidity and mortality due to poisoning.
2. To study the demographic profile of the poisoning cases in Hapur district.

To co-relate clinical diagnosis of poisoning cases with postpartum findings and chemical analysis report.

3. MATERIAL AND METHODS

The study was conducted at Saraswathi Institute of Medical Sciences, Hapur & Government Hospital, Hapur from February 2014 to July 2015. There were 160 patients of acute poisoning admitted to the Department of Medicine / Emergency during the study period. After applying inclusion and exclusion criteria, 100 patients were chosen as study subjects.

Sampling Frame

Study design: Hospital based prospective study.

Working Unit: All acute poisoning patient coming to Saraswathi Institute of Medical Sciences & Government Hospital, Hapur.

Respondent Unit

Close relatives of victim, victim himself and police records.

Sample Size

All acute poisoning cases coming to SIMS & Govt. Hospital, Hapur, during the period of February 2014 to July 2015.

Duration of Study

One and half year (February 2014 to July 2015).

Place of study

Saraswathi Institute of Medical Sciences, Hapur & Government Hospital, Hapur.

a) Emergency
b) Medicine OPD & wards.

Inclusion criteria

1. A known case of acute poisoning.
2. Patient with clinical signs and symptoms suggestive of various poisons.
3. Patient showing evidence of poisoning after being investigated

Exclusion Criteria:

1. Patient brought dead in emergency department.
2. Cases in which causes of poisoning is not known.
3. Patient on Ventilator.
4. Patient with double insecticidal/ multiple poisoning with other drug such as opioids, diazepam, barbiturates etc.
5. Patients who received partial treatment outside and referred later to our hospital.
6. Patients who abscondate and referred to higher centre.

Method of Collection of data

All patients who presented to emergency department with history of poisoning with known compound were taken as study subjects. A detailed history, clinical examination and relevant biochemical investigations were performed. Patients were included in the study if they had a history of pesticide ingestion as indicated by patient or relatives, the refereeing doctor, or the pesticide bottle. A thorough clinical examination was carried out with particular reference to vital parameters, pupil size, assessment of central nervous system, respiratory system, cardiovascular system. This examination took place during initial resuscitation and treatment of the patient.

Procedure 3 ml of plain blood was drawn and 5 micro ml of blood was centrifuged at 3000 rpm for 5 minutes. The serum of the patient was taken and added to the tube containing 1.55 ml of the reagent.

Data processing and analysis Information is collected on open ended semi – structural schedule and compiled analysis with the help of MS Excel software.

4. RESULTS

Following observations were made and recorded in tabular form. Table 1.

Age Group(In Years)	No. of Cases/ Percentage
<11	7
11 – 20	15
21 – 30	54
31 – 40	10
41 – 50	10
51 – 60	3
>60	1
Sex	
Male	64
Female	36
Marital Status	
Married	70
Unmarried	30
Residence	
Rural	56
Urban	44
Socio Economic Class	
Upper	6
Upper middle	10
Lower middle	20
Upper lower	37
Lower	27
Manner of Poisoning	
Accidental	4
Suicidal	96
Homicidal	0
Name of Poison	
Aluminum phosphide	23
Organophosphorus	21
Food Poison	12
Rat Poison	10
Insecticide	9
Alcohol	9
Snake Bite	6
Kerosene	5
Unknown poison	5
Time Interval(In hours) between duration from exposure and hospitalization	
< 2	9
2 – 4	63
>4	28

5. DISCUSSION

Most of the patients in this study were in the *young age group* and maximum number of patients (54%) was in the age group of 21 – 30 years followed by 15 per cent in 11-20 years age group. In the present study, youngest patient is 6 years old and oldest patient is 64 years old. Since most of the cases were suicidal in nature, the distribution pattern shows the mental vulnerability and impulsiveness of our youth. Similar patterns have been reported from other regions of India as well.[19,20,21]

The present study indicates that there was more number of *male poisoning* cases (64%) which is similar to the results found in other studies done in Eastern Uttar Pradesh and Rohtak of Haryana[22,23] and the other studies done by Sharma et.al (2002) and others (Dash et al., 2005; Singh et al., 1984) but contradict the study done by Pokhrel et.al (2008) in which incidence was high among females. The high incidence in case of males may be because they are more exposed to stress and strain due to financial difficulties, loss of job, discord at home and work place, etc.

An *early marriage* in the rural community along with its added familial responsibilities, social custom, limited resources etc., may be the factors responsible for married

males (56 cases, 37.33%) outnumbering unmarried males and this fact is evident from our study and also from other studies (Dash et al., 2005; Singh et al., 1984). In our study majority 70 (70%) of patients were married and 30 (30%) were unmarried. It shows that poisoning was more common in the *married group* irrespective of the sex. This is consistent with studies from Orissa[24] and Chandigarh[25], and shows that married persons may become victims of greater stress than single individuals in their day-to-day lives. The different causes of the stress culminating in poisoning ranged widely from marital and family discords to financial and job related problems to educational and other matters.

Based on the predominant agricultural background of the study population, a significant use of insecticides as poisons is not unusual in both urban and rural set ups. In the present study, 56 (56%) of the patients belonged to *rural area* and 44 (44%) belonged to urban area. Occupationally, many cases were found among agriculture (Farmer) (38 cases, 38%), students (16 cases, 16%) and house wives (22 cases, 22%) as these groups are more vulnerable groups and easily exposed to the poisoning agents. Poverty, inadequate income to run the family, monsoon failure was responsible for higher incidence of poisoning among laborers and farmers (Vinay et al., 2008). Factors like dowry, cruelty by the in-laws, family quarrels, maladjustment in married life and dependence of women on husband are responsible for the higher incidence of poisoning among house wives (Virendar et al., 2004). Failure in the exams or inability to cope up the high expectation from parents and teachers has increased the incidence of poisoning among students.

Most of the cases of poisoning belonged to the *Upper lower* (37%) and *Lower* (27%) *socio-economic group* signifying the fact that financial and social problems may have an important bearing in the daily lives of these groups.

Suicide was the most common mode of poisoning in this study and is comparable to other studies[5] and suggests that suicide by using poisons has increased because of their easy availability in the market and also there is a general belief that poison terminates life with minimal suffering. [6]In our present study, almost all i.e. 96 out of 100 cases (96%) were suicidal and only 4 (4%) cases were accidental and none has been reported to be homicidal.

In this study the most common agent encountered is *Aluminum Phosphide* 23 (23%), followed by organophosphorate 21 (21%) and food poison 12 (12%). However, in 5% of cases the poison was unknown. Studies from other parts of India have reported organophosphates 21 (21%) and other pesticides as common causes of poisoning. Recently, there has been an increasing trend in the incidence of aluminium phosphide poisoning in *North India*, may be due to its easy availability, absence of specific antidote and high fatality rate. In an earlier study, aluminium phosphide was found to be the most common cause of acute poisoning in India [26] followed by organophosphates and other agents. This is evident from other studies done in north India by Bajaj et al (1988) and others (Sagar et al., 1993; Lall et al., 1994; Singh et al., 2004). In contrast, the incidence of organophosphorus was found to be high in in South India (Adalkha et al., 1988; Jaiprakash et al., 2011; Jesslin et al., 2010; Vinay et al., 2008; Ramesha et al., 2009).

In our study, majority 63 (63%) of patients presented within 2 – 4 hours of poisoning and nearly 28 (28%) were brought after 4 hours of poisoning. Only 9 (9%) of patients could be brought within 2 hours. Average duration from exposure to hospitalization was 2.5 hours.

According to World Health Organization (WHO), globally more than three million of acute poisoning cases with 2, 20,000 deaths occur annually (WHO 1999). It has been estimated that, in India five to six persons per lakh of population die due to acute poisoning every year (Narayana Reddy, 2010). In our study 75 (75%) of patients out of 100 survived while 25 (25%) expired. Knowledge of general pattern of poisoning in a particular region will help in early diagnosis and treatment of cases, thus decreasing the rate of mortality.

6. SUMMARY

Data on acute poisoning in adults is scarce in our locality. We observed poisoning was common among productive age group (20-30 years) that produces a huge socioeconomic burden on the society.

- Total number of cases was 100, out of them 64 (64%) were males and only 36 (36%) were females.
- Majority 70 (70%) of patients were married and 30 (30%) were unmarried.
- In the present study, 56 (56%) of the patients belonged to rural area and 44 (44%) belonged to urban area.
- Farmer (38 cases, 38%), students (16 cases, 16%) and house wives (22 cases, 22%) were the main targets.
- Most of the cases of poisoning belonged to the Upper lower (37%) and Lower (27%) class.
- Suicide was the most common mode of poisoning. in this study 96 out of 100 cases (96%) were suicidal
- The most common agent encountered was Aluminum Phosphide 23 (23%).
- Majority 63 (63%) of patients presented within 2 – 4 hours of poisoning

75 (75%) of patients out of 100 survived while 25 (25%) expired.

7. CONCLUSION

North India is predominantly an agricultural region and therefore, Aluminium Phosphide (pesticide) was found to be the most common cause for acute poisoning with high mortality, due to its high fatality rate. Poison prevention

strategies can be implemented at various levels as follows:

 Strict implementation of pesticide act, so that import, manufacture, sale, transport, distribution and use of pesticides can be under the supervision of the government.
 Poison information centre should be created in each district throughout the country. It will benefit the common man in timely diagnosis and treatment.
 All hospitals should have separate toxicological unit exclusively dealing with clinical poisoning cases.
 Primary health centre should be upgraded to provide immediate effective treatment to poisoning.
 Educating NGO's, village head and other volunteers about the first aid treatment of poisoning at household level.
 Persons with psychosocial problems should be identified at the earliest and should be referred for psychiatric counseling.
 Health education to adolescents at school and college level about poisoning and its first aid treatment.
 Strict implementation of anti-dowry law, marriage counseling and women empowerment will help in decreasing the day to day tension in married life and decrease the incidence of poisoning among house wives.

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