Original Paper

Management of Toxicological Emergencies at Different Health Care Levels - A Comparative Study

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ABSTRACT

The proliferation of numerous poisonous substances due to rapid development in science and technology, coupled with the vast growth in industrial and agricultural sectors has substantially increased the incidence of poisoning in recent times. Today, a number of chemical substances, which were originally developed to protect agricultural products from rodents and pests, are at the forefront of suicidal ingestions. The aim of this retrospective comparative study is to analyze the characteristics of toxicological emergencies reporting at three different levels of health care centers-primary, secondary and tertiary - in order to find out the problems faced at each level with reference to their management, and to highlight the need to redress such problems to reduce the ever-increasing deaths due to poisoning.

Key Words: *poison; poisoning; agrochemicals; toxicological emergencies*

Introduction

A poison is any substance, which when administered to the body through any route, produces ill health, disease, or death. In India, there is ample legislation in the statute books dealing with poisons; sections 273-78, 284, 324, 326 & 328 of the Indian Penal Code deal with various offences relating to drugs and poisons.[1] As per Section 284 of the Indian Penal Code, a poisonous substance is any substance which if consumed, will endanger human life, or will be likely to cause hurt or injury to any person. The law also takes into cognizance the intention of the person who administers the poisonous substance. If the intention is to treat the person, or relieve his suffering, and poisoning occurs as a result of therapeutic misadventure, it may not amount to a crime; but if the intention is to cause hurt, disease or death of the person, it will amount to a criminal offence.[2] However, criminal poisoning still continues despite these legislations.

Medical Toxicology became a distinct subject in the early 1950s in the West in response to the proliferation and use of chemicals in every day life. In India, a Toxicology Laboratory was setup at the Medicolegal Institute, Bhopal, in 1984, following the Bhopal Gas Tragedy. In 1994, a National Poison Information Center was set up at the All India Institute of Medical Sciences, New Delhi. Many others followed in the succeeding years. Despite this, the spurt in the number of poisonous substances has greatly increased the difficulties faced by health care workers at various levels of Health Care Centers. The important reasons appear to be a lack of specially trained medical and paramedical staff, specific antidotes, and life-saving drugs; wrong/ improper history given by the victim or his relatives; and unavailability of effective analytical facilities.[3]

Acute poisoning is a medical emergency that poses a major health problem all over the world. Its exact nature, as well as the associated morbidity and mortality vary from place to place, and time to time. However, there are some common features. For instance, poisoning in the pediatric age group generally occurs due to accidental ingestion of commercial and household poisonous products, while among adolescents and adults, intentional self-poisoning is more common.[4] Knowledge of the general pattern of poisoning, as well as specific differences in various regions can help improve diagnosis and treatment of poisoning, thus leading to a decrease in

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morbidity and mortality. The present study examines and compares the management of acute poisoning at different health care levels, and stresses upon the importance of the need for proper undergraduate level, hospital-based training, as well as provision of refresher courses for qualified doctors and paramedical staff working at various levels of health care.

Materials and Methods

This retrospective study was conducted by the Department of Forensic Medicine and Toxicology, Government Medical College and Hospital, Chandigarh, India, in three important categories of the health care system prevalent in India:

1) Primary health care (PHC) level comprising primary health centers, private clinics, and general practitioners,
2) Secondary health care (SHC) level comprising district headquarter hospitals, and
3) Tertiary health care (THC) level comprising medical college hospitals.

All cases of suspected poisoning reporting to the Emergency Departments (EDs) of these health care institutions during the period January 2004 to December 2004 were included in the study. Detailed scrutiny of the departmental records was carried out to ascertain information pertaining to age, sex, and socioeconomic background of the victim, the nature of the poison suspected to have been consumed or exposed to, the time, place, route and quantity of intake, the time of admission to the health care facility, treatment given, the final outcome, etc.

Results

During the time frame of the study, a total of 114306 cases reported to the ED of the three different levels of health care, the maximum being in the SHC (43%), while the PHC recorded the minimum number (11%). Likewise, the maximum cases of poisoning were recorded at the SHC (48%), and the minimum at the PHC (21%). However, the percentage of the poisoning cases in relation to the total cases reporting to each center was maximum at the PHC (13%), and minimum at the THC (5%), while the overall percentage of the poisoning cases was 7% (**Table 1**).

Table 1 Distribution of Cases Reporting to the ED

Level of Health Care Center	Total Admissions		Poisoning Cases	
	No.	%	No.	%
Tertiary Health Care	49464	43.27	2415	30.90
Secondary Health Care	52541	45.97	3767	48.20
Primary Health Care	12301	10.76	1633	20.90
Total	**114306**	**100**	**7815**	**100**

Of the total 7815 cases included in the study, 63% were males and 37% were females, the male: female ratio being 1.7: 1. People of the age-group 21-25 years accounted for the maximum percentage of cases (28%), followed by the age-group 26-30 years (20%), and 31-35 yrs (11%). Least percentage of cases was from the age group of 60 and above (1%), followed by the 51-60 years age group (2%). In all the age groups, males accounted for more than 60% cases (**Table 2**).

Table 2 Distribution of Cases as per Age and Gender

Age in Years	Male		Female		Total	
	No.	%	No.	%	No.	%
<10	280	75.68	90	24.32	370	04.74
10-15	321	62.81	190	37.18	511	06.54
16-20	794	61.93	488	38.06	1282	16.41
21-25	1383	64.21	771	35.79	2154	27.56
26-30	932	60.40	611	39.60	1543	19.74
31-35	491	59.81	330	40.19	821	10.51
36-40	300	61.10	191	38.90	491	06.28
41-50	271	67.58	130	32.42	401	05.13
51-60	90	64.29	50	35.71	140	01.79
>60	71	69.61	31	30.39	102	01.31
Total	**4930**	**63.08**	**2885**	**36.92**	**7815**	**100**

Table 3 Nature of Poisoning Agent Reported at Various Health Care Levels

Name of Poison	Cases							
	T. H. C.	S. H. C.	P. H. C.				Total	
	No.	%	No.	%	No.	%	No.	%
Agricultural Poisons								
Aluminium phosphide	249	10.31	531	14.10	388	23.76	1168	14.95
Zinc phosphide	80	03.31	140	03.72	80	04.90	300	03.84
Organochlorine compound	211	08.73	388	10.30	128	07.83	727	09.30
Organophosphate	110	04.56	231	06.13	116	07.10	457	05.85
Insect Repellents								
Ant repellent	28	01.16	51	01.35	18	01.10	97	01.24
Acid + Ant repellent	09	00.37	00	00	04	00.25	13	00.17
Cockroach repellent	49	02.03	19	00.50	11	00.67	79	01.01
Mosquito repellent	76	03.15	67	01.78	21	01.29	164	02.10
Sedative + Mosquito repellent	28	01.16	42	01.12	00	00	70	00.90
Miscellaneous	09	00.37	14	00.37	11	00.67	34	00.44
Cleaning Fluids								
Toilet cleaner (10% HCl)	71	02.94	109	02.89	44	02.69	224	02.87
Phenol derivative	226	09.36	241	06.40	89	05.45	556	07.11
Other Toilet cleaners	09	00.37	46	01.22	10	00.61	65	00.83
Savlon (Antiseptic)	18	00.74	27	00.72	00	00	45	00.58
Dettol (Antiseptic)	14	00.58	19	00.50	09	00.55	42	00.53
Pharmaceuticals								
Minoxidil (local prep)	09	00.37	17	00.45	00	00	26	00.33
Sedatives	211	08.73	296	07.85	68	04.16	575	07.36
Aspirin	19	00.79	34	00.90	00	00	53	00.68
Ayurvedic drugs	09	00.37	14	00.37	00	00	23	00.29
Combination of drugs	24	00.99	164	04.35	43	02.63	231	02.96
Nifedipine	28	01.16	41	01.09	05	00.31	74	00.95
Opioids	57	02.36	211	05.60	166	10.17	434	05.55
Alcohol	110	04.56	196	05.20	141	08.63	447	05.72
Alcohol + other drugs	96	03.98	102	02.71	26	01.59	224	02.86
Miscellaneous								
Plant poisons	37	01.53	24	00.64	48	02.94	109	01.40
Lime	11	00.46	15	00.40	22	01.35	48	00.61
Kerosene	108	04.47	99	02.62	38	02.33	245	03.14
Mercury	09	00.37	14	00.37	00	00	23	00.29
Hydrogen peroxide	14	00.58	11	00.29	00	00	25	00.32
Naphthalene balls	36	01.49	24	00.64	00	00	60	00.77
Petro/Other fumes	121	05.00	166	04.41	21	01.29	308	03.94
Unknown	329	13.62	414	10.99	126	07.72	869	11.12
Total	**2415**	**30.90**	**3767**	**48.20**	**1633**	**20.90**	**7815**	**100**

The allegedly consumed poisons comprised a wide range of products. These included agrochemicals, insect repellents, drugs, disinfectants and cleaning fluids, lime, mercury, etc. The commonest poisonous substance appeared to be aluminium phosphide (15%), followed by organochlorine compounds (9%), and sedative drugs (7%). Agrochemicals as a whole, were consumed by about 34% patients, followed by pharmaceutical drugs (27%), and cleaning fluids (12%). It was not possible to identify 11% of the substances allegedly consumed. Of the total cases of poisoning reporting to different health care levels, 29% were due to agrochemicals. However, health-care level-wise agrochemicals accounted for 44% of the total cases at PHC, 34% at SHC, and 27% at THC (**Table 3**).

The most common route of intake was ingestion (90%), while inhalation (4%) was the least common. The most preferred time for consuming the poisonous substances appeared to be night time (35%), followed by early evening (26%). The victim's home was the most preferred venue in 73% of the cases (**Table 4**).

The time lag between the consumption of the poisonous substance and admission to the Emergency Department of a hospital was less than 2 hours in the majority of the cases (53%). However, in about 8% of the cases, the time lag was more than 12 hours. Predictably, most of the admissions occurred in the evening and the night; the 7 PM- 3 AM time slot accounting for about 54% of the admissions. The least number of poisoning-related admissions occurred between 3 PM and 7 PM (7%). Maximum admissions (85%) occurred directly to a particular level of health care. With reference to health-care level-wise admissions, PHC recorded 95% direct admissions, while THC recorded 78%. Of the referred cases, 51% were from the PHC level, followed by 41% from general practitioners/ private clinics (**Table 5**).

Gastric lavage was performed in 72% patients on the whole; while health-care level-wise, it was performed in 75% patients at THC, 73% at SHC and 67% at PHC. Antidotes were administered to a total of 18% patients, while health-care level-wise they were administered to 20% patients at THC, 18% at SHC and 14% at PHC. Life-saving measures were employed in a total of 6% patients; 13% at THC, 4% at SHC, and 1% at PHC, respectively. ICU care was required in about 3% patients that included 7% at THC and 1% at SHC level, respectively. 81% of the patients recovered completely. 94% recoveries were recorded at the THC, 82% at the SHC and 61% at the PHC level. 7% of the total patients were recorded as those who left against medical advice (LAMA), of which the maximum n umber was from the PHC level (10%). Overall, fatal outcome was recorded in 2% of the patients, PHC level recording 1%, while the SHC level recorded 2% (**Table 6**).

Table 4 Particulars of Poison Consumption

Route of intake	Cases							
	T. H. C.		S. H. C.		P. H. C.		Total	
	No.	%	No.	%	No.	%	No.	%
Ingestion	2144	88.77	3416	90.68	1463	89.59	7023	89.87
Inhalation	108	04.47	116	03.08	47	02.88	271	03.47
Parenteral	163	06.75	235	06.24	123	07.53	521	06.67
Total	**2415**	**30.90**	**3767**	**48.20**	**1633**	**20.90**	**7815**	**100**
Time of Intake								
Morning	491	20.33	861	22.86	372	22.78	1724	22.06
Afternoon	468	19.38	542	14.39	310	18.98	1320	16.89
Evening	551	22.82	1044	27.71	436	26.70	2031	25.99
Night	905	37.47	1320	35.04	515	31.54	2740	35.06
Total	**2415**	**30.90**	**3767**	**48.20**	**1633**	**20.90**	**7815**	**100**
Place of Intake								
Home	1754	72.63	2905	77.12	1042	63.81	5701	72.95
Work place	239	09.90	351	09.32	241	14.76	831	10.63
Party	172	07.12	119	03.16	77	04.72	368	04.71
Others	250	10.35	392	10.41	273	16.72	915	11.71
Total	**2415**	**30.90**	**3767**	**48.20**	**1633**	**20.90**	**7815**	**100**

Of the fatal cases, 54% were due to aluminium phosphide, followed by organochlorine compounds (18%), and organophosphates (14%). All in all, agrochemicals accounted for 85% of the deaths. No poison could be detected in 4% of the cases admitted and treated as suspected cases of poisoning. (**Table 7**).

Discussion

The effective management of toxicological emergencies is a challenge at every level of health-care system. Difficulties usually faced in the diagnosis and treatment of the various cases of poisoning reporting to primary health care hospitals are related to lack of specially trained medical and paramedical staff, specific antidotes, and life-saving drugs. However, the picture is not much better at the secondary or even tertiary care levels of the existing health care system in India, which are plagued by lack of effective diagnostic mechanisms in poisoning cases, with no signs of improvement. On the other hand, the incidence of poisoning is increasing day by day despite many legislations and strict punishments that have been brought into force for negligent handling of poisonous substances, suicidal attempts, and even homicidal cases. A relentless increase in the incidence of poisoning fatalities has been reported by many studies in this region over a period of time,[5-9] underscoring the fact that poisoning has become an important epidemiological, medicolegal and social problem.

The overall percentage of poisoning cases in our study was 7%, whereas Tüfekci, et al[10] reported it to be 2.4%, and Özköse[11] stated that it was 0.7% of all the ED admissions. Though apparently, more poisoning cases were reported to the SHC in relation to the other levels of health care centers in our study, the percentage of poisoning cases with respect to total cases reporting to the ED was maximum at the PHC level (13%), followed by the SHC (7%). This could be explained by the fact that since the PHCs cater essentially to a rural population as opposed to the SHCs and the THCs, do not get many cases of vehicular and industrial accidents.[12] Moreover, rural life being less stressful than the urban, cases of drug abuse, assaults, etc., are less common.

Males outnumbered females in our study, the male: female ratio being 1.7:1. This corresponds with the findings of other Indian studies in the field.[1,3,5,6] However, most of the studies in the West found have found a female preponderance, females sometimes accounting for more than three times the number of male victims.[13 - 16]

Adolescents and young adults in the age group of 16-30 years (64%) have been reported to be the most vulnerable category to poisoning deaths by many studies, and our findings are in conformity with this.[1,3,5,6] In fact,

Table 5 Reporting Details at the Various Health Care Levels

Time lag in Hours (Admission)	Cases							
	T. H. C.		S. H. C.		P. H. C.		Total	
	No.	%	No.	%	No.	%	No.	%
<2	1273	52.71	2084	55.32	813	49.79	4170	53.36
2-4	551	22.82	791	21.00	411	25.17	1753	22.43
4-6	138	05.71	262	06.96	156	09.55	556	07.12
6-12	171	07.08	370	09.82	143	08.76	684	08.75
>12	282	11.68	260	06.90	110	06.74	652	08.34
Total	**2415**	**30.90**	**3767**	**48.20**	**1633**	**20.90**	**7815**	**100**
Time of Admission								
7 AM-11 AM	270	11.18	452	12.00	180	11.02	902	11.54
11 AM-3 PM	358	14.82	411	10.91	331	20.27	1100	14.06
3 PM-7 PM	341	14.12	519	13.78	167	10.23	1027	13.14
7 PM-11PM	809	33.50	1226	32.55	473	28.97	2508	32.09
11 PM-3 AM	566	23.44	811	21.53	339	20.76	1716	21.96
3 AM-7 AM	71	02.94	348	09.24	143	08.76	562	07.19
Total	**2415**	**30.90**	**3767**	**48.20**	**1633**	**20.90**	**7815**	**100**
Type of Admission								
Direct	1893	78.38	3216	85.37	1556	95.28	6665	85.28
Referred	522	21.62	551	14.63	77	04.72	1150	14.72
Referring hospital								
a) PHC	*272*	*52.11*	*314*	*56.99*	*00*	*00*	*586*	*50.96*
b) Distt. Hosp	*89*	*17.05*	*00*	*00*	*00*	*00*	*89*	*07749*
c) Private Hosp	*161*	*30.84*	*237*	*43.01*	*77*	*100*	*475*	*41.30*

Table 6 Management Details at Different Health Care Levels

Treatment Given	Cases							
	T. H. C.		S. H. C.		P. H. C.		Total	
	No.	%	No.	%	No.	%	No.	%
Gastric Lavage	1813	75.07	2736	72.63	1094	66.99	5643	72.21
Antidotes	492	20.37	673	17.87	228	13.96	1393	17.82
Life Saving Measures	311	12.88	117	03.18	16	00.98	444	05.68
ICU Care	166	06.87	41	01.09	00	00	207	02.65
Intravenous Fluids	1683	69.69	2692	71.47	1257	76.98	5632	72.06
Symptomatic Measures	2415	100	3767	100	1633	100	7815	100
Total	**2415**	**30.90**	**3767**	**48.20**	**1633**	**20.90**	**7815**	**100**
Outcome								
Discharged	2270	94.00	3088	81.98	989	60.56	6347	81.21
LAMA	106	04.39	242	06.38	169	10.34	517	06.61
Referred	00	00	356	09.45	458	27.61	814	10.42
Death	39	01.62	81	02.15	17	01.04	137	01.75
Total	**2415**	**30.90**	**3767**	**48.20**	**1633**	**20.90**	**7815**	**100**

Table 7 Poisoning Mortality at Various Health Care Levels

Poison	Deaths							
	T. H. C.		S. H. C.		P. H. C.		Total	
	No.	%	No.	%	No.	%	No.	%
Aluminium phosphide	25	53.19	40	52.63	09	64.29	74	54.02
Organochlorine compound	08	17.02	13	17.11	03	21.43	24	17.52
Organophosphate	07	14.89	11	14.47	01	07.14	19	13.87
Kerosene	02	04.26	03	03.95	00	00	05	03.65
Phenol derivative	01	02.13	04	05.26	00	00	05	03.65
Acid	02	04.26	02	02.63	00	00	04	02.92
No poison detected	02	04.26	03	03.95	01	07.14	06	04.38
Total	**47**	**34.31**	**76**	**55.48**	**14**	**10.22**	**137**	**100**

the age group of 21-30 years was the most prone to poisoning, accounting for a percentage of 47%. Yedida Bentur et al[13] observed that in the case of females, the peak age was 15-20years, while in males it was beyond this range. Özköse[11] found that 64% of patients in his study were below the age of 25years. Previous studies by our department have indicated that this particular age group is also the most involved in vehicular accidents, burn injuries, etc.[7,12] Frustration and depression arising out of stresses of modern-day life appear to be responsible for the maximum involvement of the younger age groups in suicidal and parasuicidal behaviour. Teenagers, between 15-20yrs of age, also formed a significant group (16%). Failure in examinations, jilted love, scolding/ humiliation by peers and parents, inability to live up to the expectations of others, etc., are some of the main reasons for suicidal attempts by these young adults. Hawton et al[17,18] and Taylor[19] found that the most common problems faced by teenagers were those related to personal relationships, difficulties in adjustment with

parents accounting for most of the cases, followed by relationship problems with friends. Many other studies have reported similar trends.[20-22]

Approximately three fourths of the victims reporting to Primary and Secondary Health Care levels were from lower socio-economic strata of the society. This group with lesser accessibility to resources than their counterparts from higher strata, together with other difficulties arising out of larger families, higher illiteracy, ignorance, and blind belief in superstitions, etc., may be some of the factors responsible for increased susceptibility to serious outcome in poisoning cases in this category.[7]

In our earlier studies,[23,24] the percentage of married female victims was almost the same in both the upper and the lower socio-economic strata. A similar picture emerged here also. It has been reported that in the case of the married female, urbanization of the society has not reduced her woes in this part of the world. Harassment by her husband and in-laws for dowry/failure to beget children, particularly a male child, etc., have only worsened the situation.

The route and time of intake suggest that the consumption of poison is dependent on convenience, as the majority of cases involved ingestion (90%), followed by the parenteral route (7%); the late evening or night hours were chosen for ingestion in 61% cases; and the most favoured venue was the victim's own home. Some studies from other countries have reported inhalation to be the second most favored route, after ingestion.[25-26] Though a significant proportion of victims (54%) in this study received treatment within two hours, a delay of 6 to 12 hours, and more than 12 hours was recorded in 7.5% and 9% cases respectively. The vast rural population with relative lack of transportation facilities could be responsible for the greater time lag in these cases, as these were mostly referred cases from Primary Health Care to Tertiary Health Care Levels.

Aluminium phosphide (15%), organochlorine compounds (9%), and organophosphates (6%) have emerged as "poisons of choice" for suicides. This may be attributed to the belief by the lay public of the certainty of an almost painless death with these agents, besides the fact that these substances are easily available and relatively inexpensive.[9] Presenting features, however, vary in accidental and the suicidal poisoning, and our observations are in conformity with other studies.[27]

The problems faced by the doctors working in the Casualty and Emergency departments of various health care level hospitals, as well as the patients reporting to these hospitals have contributed to the significant mortality rate in poisoning cases, as evident from the following observations:

1. The patient, who has intentionally consumed some poisonous substance, or his relatives, may not provide proper history regarding the poisonous substance to avoid harassment by the police. They may try to disguise the case as an episode of illness/gastroenteritis, etc. This deliberate, uncooperative attitude by the patients and/or their relatives causes difficulties in effective diagnosis and treatment.
2. Most of the time, Primary Health Care Level hospitals suffer from acute shortage of specific antidotes and life saving drugs. Infrastructural facilities like emergency care and life support systems are also lacking in most of these hospitals.
3. The absence of a specialized toxicology wing, even in a tertiary care hospital, is the rule rather than the exception, which leaves the doctors with no access to specialized information that can help in the correct diagnosis or treatment of poisoning cases. On arriving at a govt. dispensary/hospital, the patient first comes in contact with the Emergency Medical Officer or a General Duty Medical Officer, who usually has little knowledge of the various manifestations of specific poisons, and the means to diagnose and treat them. Even when a proper history is given, and the brand name of a product is revealed, the doctor on duty may not be aware of the exact chemical constituents of the alleged product.

In view of the above, we recommend that:

1. Specialized Toxicology Centers equipped with analytical laboratories, and related medical facilities should be established on the lines of trauma care systems
2. Regular refresher courses should be conducted for medical officers working in the Primary and Secondary Health Care Centers as part of Continuing Medical Education programs to update their knowledge regarding toxicological emergencies.
3. The government should provide adequate funds so that, as and when various antidotes and life saving drugs at different health care levels get used up, they can be replenished immediately. Furthermore, ways must be devised to generate funds by the health-care centers themselves.

4. Various health-care centers need to organize mass education programs to create awareness among the general public about toxicological hazards, and the importance of furnishing proper history to the doctor in case of a mishap must be emphasized to minimize mortality in poisoning.

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