

ORIGINAL ARTICLE

Analysis of Poisoning in Urban Setting: A Single Centre Study

Rakesh Bhadade^{1*}, Rosemarie deSouza², Surendra Gangawane³**Abstract**

Background: Poisoning are common emergencies associated with high mortality and morbidity in India. This study aims to analyse the pattern of poisoning, clinico-epidemiological features, course and outcome of patients and factors affecting the outcome.

Methodology: This was an observational, prospective study conducted at a tertiary care, teaching, public, urban hospital. We noted demographic profile, nature and class of poison, clinical manifestations, duration of stay in ICU and hospital, investigations, management and outcome. Association between qualitative variables was assessed by Chi-Square test, Fisher's exact test and Binary Logistic Regression.

Results: Among 250 patients mortality was 24%. Common agents of poisoning used were chemicals seen in 102 patients (41%), followed by pesticides (52 patients, 21%) and rodenticides (33 patients, 13%). Ventilator support was needed in 63 patients (25%) and mean hospital stay of patients was 3.7 days with range being 5-15 days. Deranged liver function test was present in 22 (41.51%) cases of rodenticides poisoning, Deranged renal function test was present in 44 (59.46%) cases of Chemicals.

Conclusions: Poisoning was predominant in unmarried young males from lower economic class. The most common type of poisoning was suicidal, route was oral and agent was chemicals. Vomiting and pain in abdomen were the most common clinical features. Chemical poisoning was highly associated with renal failure and aspiration chemical pneumonitis requiring ventilator support and high mortality. Chemical agent of poisoning, Intravenous route of poisoning, requirement of mechanical ventilation, duration of hospital stay were significantly associated with mortality.

Introduction

Poisoning is a global health problem. Poison is a substance that causes damage or injury to the body and endangers one's life due to its exposure by means of ingestion; inhalation or contact. Acute poisoning is defined as acute exposure (less than 24 hrs) to the toxic substance. Acute poisoning due to accidental and suicidal exposure causes significant mortality and morbidity throughout the world.¹

Acute poisoning forms one of the most common causes of emergency hospital admissions and it is the fourth common cause of mortality in India.² According to WHO more than three million poisoning cases with 251,881 deaths occur worldwide annually, of which, 99% of fatal poisonings occur

in developing countries, particularly among agricultural workers.³ Recent data from National Crime Bureau of India shows poisoning accounted for 7.50% of all causes of unnatural deaths in the year 2007.⁴ However, due to under reporting of poisoning cases and lack of updated database like Toxic Exposure Surveillance System (TESS) in India, the above mentioned figure may be considered as tip of an iceberg.⁵ Pattern of poisoning and agents used show diverse outline in different countries and also different regions within the country.⁶ Acute pesticide poisoning is one of the most common causes of intentional deaths worldwide.⁷ High

doses of analgesics, tranquillizers, and antidepressants are the commonly used agents for intentional poisoning in developed countries and pesticides are used commonly in Asian region for self poisoning particularly in rural areas.⁸⁻¹⁰ Also the factors contributing to the mortality and morbidity in poisoning patients vary to a great extent.^{6,9-12} Hence, there is a strong need for generating regional clinico-epidemiological data on poisoning, which will be helpful in planning the prevention and management of poisoning.

India, being a country of diversities, available literature mentions different states have their own poisoning patterns which definitely exert an impact on the clinical profile and treatment of the patients.¹¹⁻¹³ The pattern of poison varies region wise depending on variety of factors like availability of poison and ease of access, socioeconomic status, cultural and religious differences etc. As agriculture is the major profession in the rural part of India, studies have revealed that agricultural pesticides are the most commonly used poisoning agents for intentional poisoning in rural India however there is dearth of data from urban regions of India.^{9,11-14}

Pattern of poisoning in India shows regional differences due to variety of factors. Therefore periodic studies are necessary to understand the prototype of poisoning in each region so they will act as a useful planning tool for providing healthcare facilities to reduce the poisoning associated mortality.

Hence, the present study was undertaken to explore the pattern of poisoning, clinical profile and outcome of patients presenting with poisoning in a tertiary care, teaching, public hospital in the urban city of Maharashtra, India. The Primary objectives being to study the pattern of poisoning, the

¹Associate Professor, ²Professor, ³Registrar, Department of Medicine T.N. Medical College & BYL Nair Ch Hospital, Mumbai, Maharashtra; *Corresponding Author
Received: 04.03.2019; Accepted: 15.04.2019

Table 1: General characteristics of study population

Parameter (N=250)	Mortality N (%)	p-value
Gender		
Male	31 (21)	0.331
Females	28 (26.7)	
Age (in years)		
18 to 30	23 (27.7)	0.622
31 to 40	15 (27.3)	
41 to 50	10 (19.6)	
51 to 60	5 (19.2)	
61 to 70	5 (21.7)	
71 & more	1 (8.3)	
Marital status		
Married	42 (22.1)	0.322
Unmarried	17 (28.3)	
Socioeconomic status		
Lower	36 (47.5)	0.888
Middle	17 (46.3)	
Upper	6 (28.6)	
Type of poisoning		
Suicidal	42 (22.7)	0.573
Accidental	17 (26.2)	
Route of poisoning		
Oral	51 (23.4)	0.013
Intravenous	1 (5.6)	
Skin	7 (50)	
Hospital stay (in days)		
<5	9 (18)	0.006
5-10	21 (17.8)	
11-15	19 (30.6)	
>15	10 (50)	
Mechanical ventilator		
Required	58 (92.1)	1.53x1/10 ⁴³
Not required	5 (7.9)	
Agent of poisoning		
Chemicals	35 (34.3)	0.000263
Pesticides	13 (25)	
Rodenticides	9 (27.3)	
Benzodiazepine overdose	1 (4.5)	
Others	1 (2.4)	

clinical presentation of the patients admitted with poisoning and secondary objectives were to determine the various agents (nature and class) used for poisoning and to determine the outcome of poisoning in these patients and factors affecting the outcome.

Materials and Methods

This was an observational, prospective study conducted after obtaining institute's Ethics committee approval (vide approval no. ECARP/2015/91 dated 30th September 2016). All patients admitted in a tertiary care, teaching, public hospital with poisoning during the study period of one and half year were enrolled in the study after obtaining

valid written informed consent from patient or from legally acceptable relatives. The data collected for each patient included were demographic profile of patients, nature and class of poison, clinical manifestations, time interval between poisoning and hospitalization, duration of hospital stay, stay in medical intensive care unit (MICU), investigations, management and outcome. The diagnosis of poisoning was based on history given by the patients or relatives, clinical examination and necessary biochemistry. Serum cholinesterase levels were done in organo-phosphorous poisoning by auto-analyser, whereas, enzyme multiplied immunoassay technique (semi-quantitative) was used for screening of substance abuse. Serum osmolality and increased anion gap due to its metabolite formate, were measured to diagnose methanol poisoning along-with the history of consumption, as Methanol detection by gas chromatography was not available in our hospital. Computer tomography (CT scan) was performed in all the cases of alleged methanol poisoning. All patients were assessed, investigated, and treated as per the existing practices without disturbing their routine protocol. Outcome was defined as death or survival. Post-mortem was carried out to ascertain the cause of death.

All patients admitted to the medical unit with history and clinical feature suggestive of poisoning, patients of age > 18 years, patients of either sex and in whom all the relevant history and data was available were included in the study; whereas, patients of food poisoning and adverse drug reaction were excluded.

Sample size was calculated as 246 with the prevalence of vomiting 80% based on the study by Rajasuriar R et al using the formula $n = Z^2 p (1-p)/d^2$, where n is the size of the sample; Z is the z statistics for the desired level of confidence; p is the estimate of expected proportion with the variable of interest in the population; d is the half width of the desired interval.¹⁴ However we enrolled 250 cases for the present study

Statistical Analysis

Qualitative data was represented in form of frequency and percentage. Association between qualitative variables was assessed by Chi-Square

test, with Continuity Correction for all 2 X 2 tables and by Fisher's exact test for all 2 X 2 tables where Chi-Square test was not valid due to small counts. In presence of small counts in tables with more than two rows and/or columns, adjacent row and/or Column data was pooled & Chi-Square Test reapplied. Continuity Correction was applied for all 2 X 2 tables after pooling of data. Quantitative data was represented using mean \pm SD, median, odds ratio, and 95% confidence interval. Comparison of Quantitative data measured between group categories, was done using unpaired t-test, if the data passed 'Shapiro-Wilk test Normality test' or by Mann-Whitney U test if the data failed 'Normality' test.

Binary Logistic Regression was used to assess between Outcome as dependent variable and a set of independent (Predictor) variables. Results were graphically represented where deemed necessary. Appropriate statistical software, including but not restricted to MS Excel, PSPPP version 1.0.1 was used for statistical analysis. An alpha value (p-value) of < 0.05 was used as the cut-off for statistical significance.

Results

During the study period, 250 patients were analyzed, out of them, 145 (58%) were males and 105 were females and 3 females were pregnant. The most common age group amongst study population was 18 to 30 years (83 patients, 33.2%). 185 patients (74%) presented with suicidal type of poisoning while 26 % (65 patients) presented with accidental poisoning. The most common route of poisoning amongst study population were oral ingestion (87.2 %, 218 patients). Common agents of poisoning used were chemicals seen in 102 patients (41%), followed by pesticides (52 patients, 21%) and rodenticides (33 patients, 13%). The demographic and other study parameters and their association with mortality are mentioned in Table 1. Sixteen % (40 pts) of the patients presented to the hospital within 3 hours of poisoning and 72% (180 pts) of patients presented between 3-6 hours. Ventilator support was needed in 63 patients (25%) and mean hospital stay of patients was 3.7 days with range being 5-15 days. MICU stay varied from 1 day (22 patients) to 4 or more days

Table 2: Clinical presentation of various poisoning

Clinical features	No. (%)
Vomiting, pain in abdomen	70 (28)
Vomiting, breathlessness, headache	55 (22)
Vomiting, pain in abdomen, altered sensorium	38 (15.2)
Vomiting, altered sensorium	32 (12.8)
Vomiting, headache	29 (11.6)
Altered sensorium	16 (6.4)
Pain in abdomen	10 (4)
Total	250

(116 patients) (Table 1).

The most common clinical features amongst study population were vomiting (80.7%) and pain in abdomen (47.3%) followed by altered sensorium (36.7%) and breathlessness (22%) (Table 2).

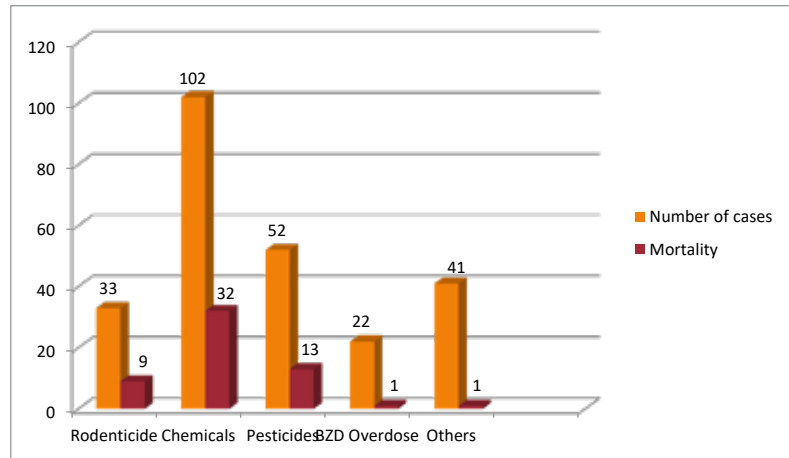
Ventilator support was required in 38 (60.32%) patients of chemical poisoning, 11 (17.46%) cases of rodenticides, 12 (19.05%) cases of pesticides, Deranged liver function test was present in 22 (41.51%) cases of rodenticides poisoning, 15 (28.30%) cases of pesticides, 13 (24.53%) cases of chemicals, 2 (3.7%) cases of BZD Overdose and 1 (1.8%) case of others (nail paint, seeds, multivitamin) poisoning. Deranged renal function test was present in 9 (12.16%) cases of rodenticides, 18 (24.32%) cases of pesticides, 44 (59.46%) cases of Chemicals, 2 (2.7%) cases of BZD Overdose and 1 (1.3%) case of others poisoning.

The mortality rate in the present study was 24% (59 patients) and survival rate was 76% (191 patients). The parameters which show significant association with mortality are route of poisoning (skin), more days of hospital stay, need for mechanical ventilation (Table 1). Figure 1 depicts agents of poisoning and its significant association with mortality ($p=0.000263$).

Binary Logistic Regression test was applied between 'Outcome' as dependent variable and a set of independent (Predictor) variables and it interpreted that, agent of poisoning (Overall), use of other agents for poisoning and deranged renal function were statistically significant predictors of mortality (Table 3).

Discussion

In India acute poisoning is one of the most common causes of emergency hospital admissions and of mortality.



Chemicals (Methanol, Phenyl, kerosene, Diesel, Corrosives), others (Nail Paint, Seeds, Multivitamins)

Chi-Square Test	Value	df	p-value	Association is-
Pearson Chi-Square	21.409	4	0.000263	Significant

Fig. 1: Agent of poisoning and its association with mortality**Table 3: Binary logistic regression between 'outcome' as dependent variable and a set of independent (predictor) variables**

Outcome	Internal Value
Died	1
Survived	0

Variables in the Equation

Variables	B	S.E.	Wald	p-value	Exp(B)
Age (years)	-0.013	0.010	1.663	0.197	0.987
Sex (Female)	0.237	0.339	0.492	0.483	1.268
Marital status (Married)	-0.656	0.411	2.546	0.111	0.519
Socioeconomic class	-	-	2.533	0.639	-
Socioeconomic class (Lower)	-0.854	0.628	1.852	0.174	0.426
Socioeconomic class (middle)	-0.816	0.704	1.344	0.246	0.442
Type of poisoning (Suicidal)	-0.124	0.371	0.113	0.737	0.883
Agent of poisoning	-	-	13.001	0.000263	-
Agent of poisoning (Chemicals)	0.693	0.536	1.670	0.196	1.999
Agent of poisoning (Others)	-2.713	1.137	5.690	0.017062	0.066
Agent of poisoning (BZD overdose)	-19.795	19947.861	0.000	0.999	0
Agent of poisoning (Pesticides)	-0.145	0.578	0.063	0.802	0.865
Route	-	-	2.426	0.297	-
Route (Oral)	-1.018	0.654	2.426	0.119	0.361
Route (IV)	16.964	19947.861	0.000	0.999	23289282.49
Renal Function (Deranged)	0.812	0.387	4.411	0.035708	2.252
Liver Function (Deranged)	-0.327	0.428	0.584	0.445	0.721
Constant	1.183	1.058	1.249	0.264	3.263

B – Coefficient for the constant in the null model (also called "Intercept"), S.E. – Standard error around the coefficient for the constant, Exp (B) – Exponentiation of the B coefficient, Wald-statistical test, BZD: Benzodiazepines.

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	232.194	0.151	0.228

There are many regional differences in the pattern of poisoning and the factors contributing to the mortality and morbidity in India. For that reason periodic region wise studies are necessary to formulate standard protocol for prevention, management and reduction of poisoning associated mortality.

In the present study, 250 poisoning patients were studied during eighteen months of study period. Amongst the study population there was young male predominance with common age group being 18 to 30 years (33.2%) and 31 to 40 years (22%). This finding is in agreement with the study conducted by Patil et al that resembles the age pattern of poisoning which was found by other

researchers.¹⁵⁻²⁰ Studies mention that people of this age group are suffering from stress of the modern lifestyles.¹⁵⁻²⁰ Higher suicidal rate was found among males (107 cases, 57.8 %) than females (78 cases, 42.16 %) which were similar with other studies done by Sharma et al and others but contradict the study done by Pokhrel et al in which incidence was high among females.¹⁸⁻²² In the current study, 76% of study population was married males while 24 % were unmarried. This finding is in accord with the study conducted by Maharani B et al in which married males (56 cases, 37.33%) outnumbered unmarried males and this fact is evident also from other studies.¹⁸⁻²²

In the present study, poisoning was seen in all socioeconomic groups; however, it was more commonly seen with lower economic class (154 patients, 61%). This finding is in conformity with other studies which mention lower socioeconomic status contributed 20-64% of the poisoning study population.²⁰⁻²⁴

In the present study, the most common route of poisoning amongst study population were oral (87.3 %) followed by intravenous (7.3%) and skin (5.3%), similar results were seen in other studies. In the current study, 74% of study population had suicidal type of poisoning, while 26 % had accidental poisoning. This finding is in concurrence with the study conducted by Maharani B et al in which among 150 cases, intentional poisoning was found among 148 cases (98.66%).⁵² In our study 72% of patients presented between 3-6 hours. This delayed presentation could be due to the fact that majority of these cases were referrals and hence a lot of time could have lapsed during the transport. This highlights that the outcome in these patients depends on multiple factors and time interval between poisoning and presentation to the hospital is one of them. Literature mentions very high mortality in cases admitted later than 5 hours.^{19,20}

In the present study, the most common agent of poisoning amongst study population were Chemicals (40.8 %), followed by pesticides (20.8%) and rodenticides (13.2%), BZD overdose (8.8%) and others agents (16.4%) (Nail paint, seeds, multivitamin). Similar observations were made in some studies however in majority of the studies from rural areas pesticides were

the commonest agent of poisoning.¹⁸⁻²⁸ Drugs taken for poisoning were paracetamol, oral hypoglycemic agents, benzodiazepines, antiepileptic, antipsychotic drugs and mixture of tablets (polypharmacy). In our study most of the patients were from urban areas, and hence were less exposed to agrochemical fertilizers/compounds. Household cleaning products like phenol, bleaches, kerosene and their derivatives are stored in most houses and easy availability of such products makes them responsible for higher incidence of poisoning. Similarly in the study conducted by Patil et al demonstrated highest frequency of poisoning occurred with household products followed by pesticides.¹⁵ Malangu N et al reported that household chemicals were responsible for the highest number of accidental poisoning.²³ Prajapati et al also reported household chemicals as the second most common toxic agents abused in poisonings in Ahmadabad with the highest mortality.²⁴ Several studies reported that amongst pesticides organophosphates and aluminium phosphide were the most common causes of poisoning.²⁵⁻²⁷ In spite of existing laws methyl alcohol sometimes does find access into the society and citizens consume it and present to hospitals with various life threatening symptoms. There were 22 pts of methanol poisoning which was associated with high mortality of 81% (18 pts). After ingestion, methyl alcohol is metabolized by alcohol dehydrogenase to formaldehyde and subsequently to formic acid. Toxic effects of these metabolites usually manifest after 12-24 h of ingestion. Initial symptoms are nausea, vomiting, headache, dizziness and visual disturbances ranging from blurred vision to permanent blindness.²⁸ In present research, CT scan was performed in all the cases of alleged methanol poisoning, which demonstrated mixed bilateral putaminal hemorrhagic necrosis and subcortical white matter lesions with peripheral contrast enhancement. Hence, the pattern of poisoning in a region depends upon various factors such as availability, cost and access to toxic agents.

In the present study, the most common clinical features amongst study population were vomiting

followed (80.7 %) followed by pain in abdomen (47.3%) altered sensorium (36.7 %) and breathlessness (22%). Other presenting symptoms were difficulty in breathing, hematemesis, and seizures. Patients referred after delayed admissions were presented with shock and ARDS. This finding is in accord with the similar findings in the literature.^{15,20,24} In this study deranged liver function test was present in 22 (41.51%) cases of rodenticides poisoning, followed by pesticides (28.30%) and chemicals (24.53%). It is found that rodenticides have high specificity for liver toxicity as compared to other agents of poisoning.^{24,27}

Chemical poisoning was highly associated with renal failure as deranged renal function test was found in 44 (59.46%) cases of chemical poisoning. Toxic acute tubular necrosis was evident on postmortem biopsy findings of patients died of chemical poisonings. Also in chemical poisoning 38 (60.32%) patients required ventilator support which was due to aspiration chemical pneumonitis, as was seen in postmortem study. The most of study population had ICU stay of 4 days (47.3%) followed by 3 days (87.3 %) and 2 days (22%). 3 pregnant females delivered normally and both mother and baby were healthy on a follow-up visit after 3 months.

In current study, 76% patients recovered while death occurred in 24%. Kondle et al demonstrated overall hospital mortality in poisoning cases was 8.94%.¹⁶ Khosya S et al in recent study found 20% mortality.¹¹⁹ Mortality rate in various studies varies from 3.3% to 24%.^{15-20,24-27} Chemical poisoning with methanol, kerosene, diesel, phenyl were associated with high mortality in 35 (34.31%) cases followed by pesticides in 13 (25%) patients. High mortality in our study is due the very high mortality seen in methanol poisoning patients and also most of the patients were referred and they presented late. In the current study chemical agent of poisoning (0.000263), Intravenous route of poisoning (0.013), requirement of mechanical ventilation (1.53x1/10⁴³) duration of hospital stay (0.006) were significantly associated with mortality. Significant predictors of mortality by Binary Logistic Regression test were agent of poisoning (Overall), use of other agents for poisoning and deranged renal function.

Anthony et al also mentions duration of hospital stay, ventilator requirement, type of poison and the quantity, comorbid conditions, as some of the major determinants of outcomes in patients with poisoning.²⁰ Similar findings were echoed in other studies as well.^{21,24-27}

The present study was not without limitations as it was prospective observational single centre study. For better validations of results and generalization of findings randomized controlled study at multiple sites (urban/rural) done in future will help in formulating national and regional standard protocols for prevention and management of poisoning in India.

To conclude from the study, in the urban city of Maharashtra, Poisoning was predominant in unmarried young males (18-30 years) from lower economic class. The most common type of poisoning was suicidal, oral route of poisoning was mainly observed. The most frequent agent of poisoning was Chemicals (phenol, bleaches, kerosene and their derivatives) followed by pesticides. Vomiting and pain in abdomen were the most common clinical features. Chemical poisoning was highly associated with renal failure and aspiration chemical pneumonitis requiring ventilator support while rodenticides lead to deranged liver functions. Overall mortality in the current study was 24% with chemical poisoning were associated with high mortality followed by pesticides. Chemical agent of poisoning, Intravenous route of poisoning, requirement of mechanical ventilation, duration of hospital stay were significantly associated with mortality and agent of poisoning and deranged renal function were predictors of mortality.

In urban areas education and

awareness of the general population regarding chemical poisoning with household chemicals is essential to reduce the incidence of poisoning. Authorities should take initiatives in preventing and controlling such mishaps and strict execution of law for sale and usage of these chemicals. Identifying early symptoms of suspected poisoning, effective early management, recognizing nature of poisoning and suspected complication like in case of chemical poisoning with aspiration pneumonia keeping ventilator ready in ICU will help in reduction of morbidity and mortality. Implementation of effective preventive strategies, counselling, formulating standard management protocol, prompt and specific effective treatment will go a long way to win battle against poisoning in India.

References

- Narayana Reddy KS. Toxicology, General consideration. In: Narayana Reddy KS (Ed.). *Essentials of Forensic Medicine and Toxicology* 2010: 446-65.
- Unikrishnan B, Singh B, Rajeev A. Trends of acute poisoning in south Karnataka. *Kathmandu Univ Med J* 2005; 3:149-54.
- WHO Guidelines for poison control. Available from <http://www.who.int/ipcs/publications/training/poisons/guidelines>.
- Accidental Deaths and Suicides in India 2008. New Delhi: National Crime Records Bureau Ministry of Affairs; 2009. Available from: <http://ncrb.nic.in/ADSI2008/suicides>.
- Centres for disease control. Toxic exposure and surveillance system. Available from: <http://www.cdc.gov/mmwr/preview/mmwrhtml/su5301a74.htm>
- Hempstead K. Manner of death and circumstances in fatal poisoning: Evidence from New Jersey. *Inj Prev* 2006; 12:44-48.
- Konradsen F, Dawson AH, Eddleston M, Gunnell D. Pesticide self-poisoning: thinking outside the box. *Lancet* 2007; 369:169-70.
- McClure GM. Suicide in children and adolescents in England and Wales 1970-1998. *Br J Psychiatry* 2001; 178:469-74.
- Eddleston M. Patterns and problems of deliberate self poisoning in the developing world. *QJM* 2000; 93:715-31.
- Chan YC, Fung HT, Lee CK, Tsui SH, Ngan HK, Sy MY et al. A prospective epidemiological study of acute poisoning in Hong Kong. *Hong Kong J Emerg Med* 2005; 12:156-61.
- Srinivasa V, Kavya ST, Madhumathi R, Dudhwewala A. Profile of poisoning in a tertiary care hospital. *Intern Jour of Basic Med Sci* 2012; 3:2.
- SrinivasRao Ch, Venkateswarlu V, Surender T, Eddleston M, Buckley NA. Pesticide poisoning in south India: opportunities for prevention and improved medical management. *Trop Med Int Health* 2005; 10:581-8.
- Banerjee I, Tripathi SK, A Sinha Roy. Clinico-epidemiological profile of poisoned patients in emergency department: two and half year's single hospital experience. *Int J Crit Illn Inj Sci* 2014; 4:14-17.
- Rajasurair R, Awang R, Hashim SBH, Rahmat HRBH. Profile of poisoning admissions in Malaysia. *Hum Exp Toxicol* 2007; 26:73-81.
- Patil A, Peddaward R, Verma VCS, Gandhi H. Profile of Acute Poisoning Cases Treated in a Tertiary Care Hospital: a Study in Navi Mumbai. *Asia Pac J Med Toxicol* 2014; 3:36-40.
- Raghu K, Shreevani P, Kumar S, Gopal S, Shaik MV, Ahmed B et al. Incidence and Outcome of Poisoning Patients in a Tertiary Care Teaching Hospital. *Asian Journal of Pharmacology and Toxicology* 2015; 3:23-6.
- Erickson TB, Thompson TM, Lu JJ. The approach to the patient with an unknown overdose. *Emerg Med Clin North Am* 2007; 25:249-81.
- B. Maharani, N. Vijayakumari. Profile of poisoning cases in a Tertiary care Hospital, Tamil Nadu, India. *J App Pharm Sci* 2013; 3:91-94.
- Khosya S, Meena SR. Current Trends of Poisoning: An Experience at a Tertiary Care Hospital Hadoti Region, Rajasthan. India. *J Clin Toxicol* 2015; 6:298.
- Anthony L, Kulkarni C. Patterns of poisoning and drug over dosage and their outcome among in-patients admitted to the emergency medicine department of a tertiary care hospital. *Indian J Crit Care Med* 2012; 16:130-35.
- Sharma BR, Harish D, Sharma V, Vij K. Poisoning in Northern India: Changing trends, causes and prevention thereof. *Med Sci Law* 2002; 42:251-7.
- Pokhrel D, Pant S, Pradhan A, Mansoor. A Comparative retrospective study of poisoning cases in central, zonal and district hospitals. *Kathmandu University Journal of Science, Engineering and Technology* 2008; 1:40-48.
- Malangu N, Ogunbanjo GA. A profile of acute poisoning at selected hospitals in South Africa. *South Afr J Epidemiol Infect* 2009; 24:14-6.
- Prajapati T, Prajapati K, Tandon R, Merchant S. Acute Chemical and Pharmaceutical Poisoning cases Treated in Civil Hospital, Ahmedabad: One Year study. *Asia Pac J Med Toxicol* 2013; 2:63-7.
- Jaiprakash H, Sarala N, Venkatarathnamma PN, Kumar TN. Analysis of different types of poisoning in a tertiary care hospital in rural south India. *Food Chem Toxicol* 2011; 49:248-50.
- Srinivasa BS, Manuprakash SK, Ara SS, Kumar SR, Prasannakumar DG. Socio-demographic profile of poisoning in children admitted to a tertiary hospital. *Indian J Child Health* 2016; 3:238-240.
- Indu TH, Raja D, Ponnusankar S. Toxicoepidemiology of acute poisoning cases in a secondary care hospital in rural South India: A five-year analysis. *J Postgrad Med* 2015; 61:159-62.
- Singh Y, Jain G, Singh DK. Methyl alcohol poisoning causing Putamen necrosis. *Indian J Crit Care Med* 2014; 18:698-99.