ORIGINAL ARTICLE

Analysis of toxicoepidemiological, clinical and autopsy outcome of fatal poisoning cases in South India.

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ABSTRACT

Background: The insight into the trends and distribution of types of poisoning have paramount epidemiological importance to understand the fatality from different poisons in an area. It helps the clinicians, epidemiologists, and healthcare service enforcement agencies to develop appropriate measures and resource redistribution for different types of poisoning deaths.

Aim: analysis of demographic pattern and the of poisoning deaths. In addition, to understand the causes of death in fatal poisoning cases based on their clinical presentation and survival period in the hospital before death.

Materials and methods: A five-year record-based study on 866 number of fatal poisoning cases received for autopsy at the Forensic Medicine and Toxicology Department. The anonymous data regarding demographic details of the cases (age, sex, and anthropometric parameters), type of poison, period of survival, season of occurrence, geographic distribution, clinical presentation and the cause of death of the fatal poisoning cases were collected from the hospital case records, police inquest reports, toxicology/serological reports, pathological and autopsy reports. The relationship between the period of survival and the results of toxicology reports was established to identify the disparity between the clinical presentation and the toxicology outcomes after death. The data entry and analysis of quantitative data was done using Epidata v2.0.

Results: Out of the 426 number of studied cases, males were 64.50% and female were 35.50%. Majority of the cases were in their 2nd (31.45%) and 3rd (31.12%) decade of life and were from semi-urban (47%) and rural areas (36%). Around 58% of the cases were reported during the summer season. Agrochemicals (64.7%), plant poisons (13.17%) and rodenticide (10%) were the commonly used agents. Among agrochemical poisons organophosphorus compound (75.4%), monocrotophos (8.3%), carbamates (4.1%) were commonly observed. Among plant poison oleander (64.7%) and oduvan (8.5%) were commonly observed. Majority of poisoning were suicidal (93.66%) followed by accidental (6.10%). In 39.43% of cases the toxicological analysis reports were negative. The relationship between the period of survival and the results of toxicology reports were assessed. The maximum numbers of positive results were noted among the patients survived for 13-24 hours and less than six hours. The maximum numbers of negative results were noted among the patients survived for more than 72 hours. The history, clinical, and toxicology findings were matching only 37.08% of the cases.

Conclusion: Compared to the poisoning census of India, the prevalence of fatal poisoning in this area showed a decline during the study period (2013-2017). The toxicological analysis may report negative for a poison in cases hospitalised beyond 3 days. Not necessarily all cases the history, clinical and toxicological outcome would be match each other; the actual cause of death should be made based on autopsy findings.

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INTRODUCTION

Poisoning is an important global health hazard and a major cause of morbidity and mortality. As per the international program on chemical safety, WHO, more than eighty percent of acute poisoning occurs in the developing countries and with loss of 10.7 million years of Disability Adjusted Life Years (DALYs). Nearly, 1,00,000 people die every year due to the intentional ingestion of poisons. Pesticides cause the maximum deaths among the other poisons.[1] As per NCRB statistics 2018, Pondicherry had the second-highest suicide rate (33.3%) next to Delhi among the union territories in India. Among states, Maharashtra (13.4%) had the highest suicide rate among the Indian states followed by Tamilnadu (10.3%).[2] The region where this study was undertaken has the second-highest suicide rates (Pondicherry, Tamilnadu) in the country. The annual report from the Registrar General of India, among the suicides, poisoning was the commonly preferred method followed by hanging and thermal burns.[3] Various epidemiological, clinical and autopsy studies had been conducted to assess the mortality and morbidity due to poisoning. Many patients report to the hospital with an inadequate history of poison ingested, leading to difficulty in early diagnosis. Such patients are treated based on the toxidromes; however specific antidotes cannot be administered leading to an increase in the fatality. Detection of poison in toxicology analysis of autopsy samples in such cases would render important data. Standard protocols for collection of samples during an autopsy in suspected poisoning cases is of greater utility.[4] Hence, autopsy-based studies will provide important data to the clinicians thereby reducing the diagnostic errors so that mortalities can be reduced.[5]

MATERIAL AND METHODS

This is a record-based study conducted on all fatal poisoning cases received for autopsy at the Department of Forensic Medicine and Toxicology during the period January 2013 to December 2017. This study is in accordance with the ethical guidelines laid down by the Institute Ethical committee and ICMR, and subsequent to the ethical clearance from the Institute Ethical Committee for Human studies (JIP/IEC/SC/2016/29/884). The anonymous data regarding demographic details of the cases age, sex, type of poison, period of survival, season of occurrence, geographic distribution, clinical presentation and the cause of death of the fatal poisoning cases were collected from the hospital case records, police inquest reports, toxicology/serological reports, pathological and autopsy reports. Prior written permission from the competent authority for accessing these case records was made in all studies cases. The relationship between the period of survival and the results of toxicology reports was established to identify the disparity between the clinical presentation and the toxicology outcomes after death. A total 426 number of cases were included in this study based on the availability of complete list of documents mentioned above. Records with insufficient data/doubtful opinion were excluded from the study. The data entry, documentation and analysis of quantitative data was done using Epidata v2.0 (EpiData Association, Denmark).

RESULTS

Around 4,225 autopsies were conducted during the study period. Out of 4225 cases, 426 autopsy cases of poisoning were studied. There was a declining of the cases during the study period (Fig. 1) of the 426 cases, males were 275 (64.50%) and female were 151 (35.50%). Majority of the population were from the semi-urban area (47%) followed by rural area (36%) and urban area (17%) (Chart1). The peak season for cases was during summer (58%) followed by winter (26%) and monsoon (16%) (Chart 2). Majority of the cases belong to age group 21-30 years (31.45%) followed by 31-40 years (21.12%). Around 3% of the cases were reported in age groups of 01-10 years and 71- 80 and 81-90 years. (Figure 2).

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Figure 1: Trend of fatal poisoning cases (n=426)

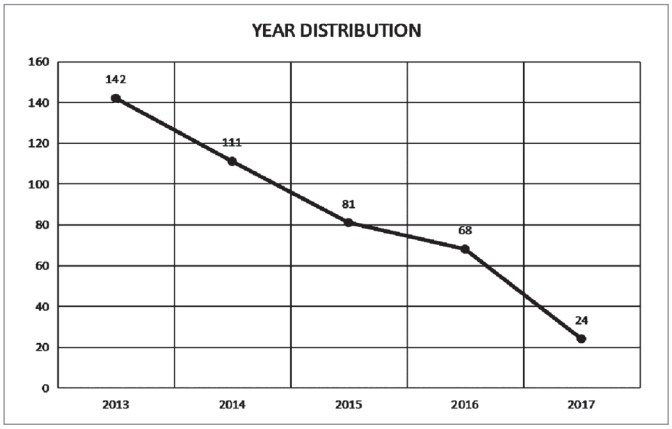


CHART 1: Regional Distribution of Poisoning Cases (n=426)

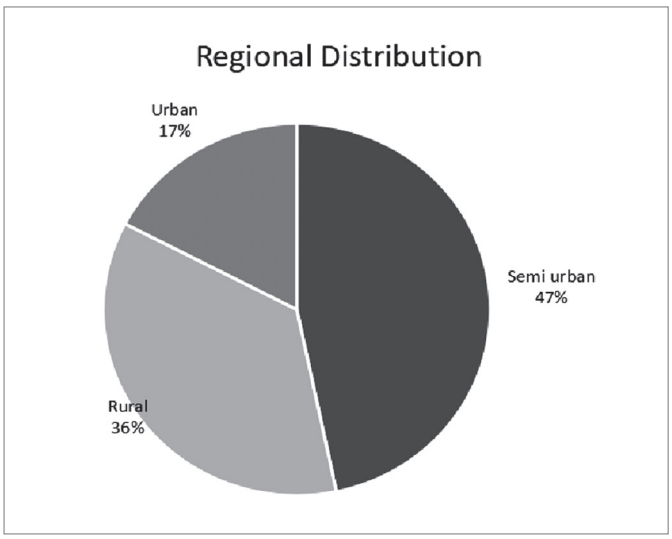


CHART 2: Seasonal Variation of Poisoning Cases (n=426)

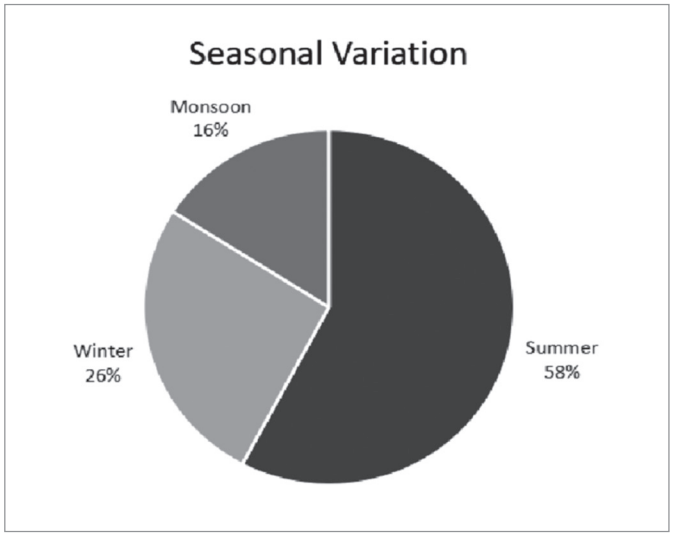


Figure 2: Age distribution of fatal poisoning cases. (n=426)

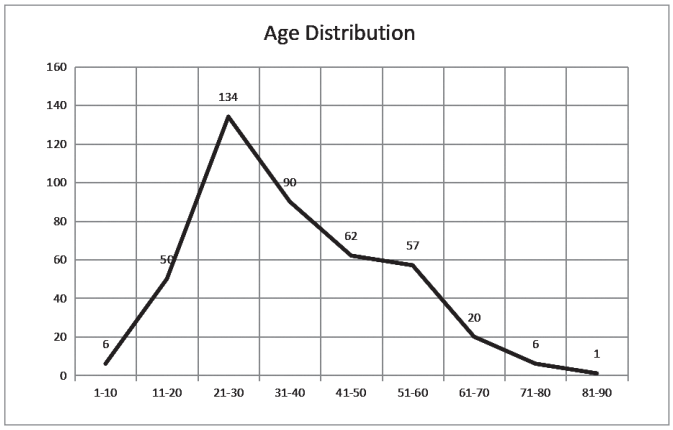
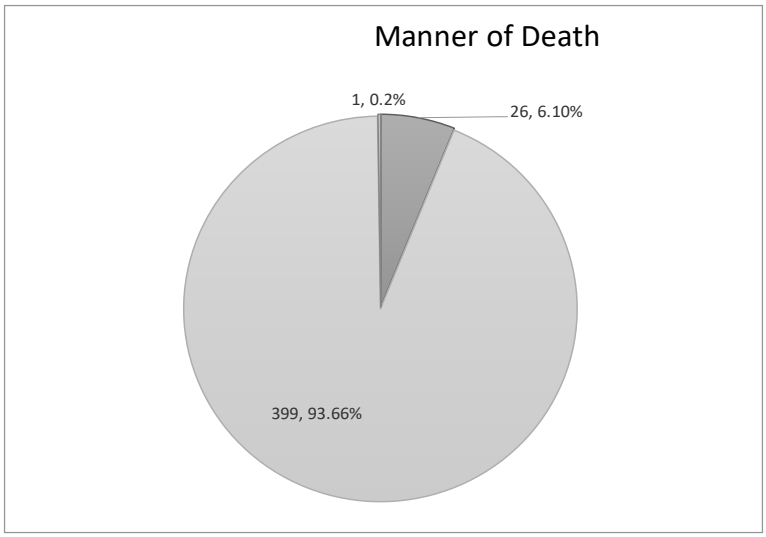


Figure 3: Manners of poisoning deaths. (n=426)



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Among 426 cases, majority of poisoning were suicidal 399 (93.66%) followed by accidental 26 (6.10%). A case of Insecticidal homicidal poisoning was reported. (Figure 3)

Among 426 cases, the toxicological analysis was positive in 258 cases (60.56%). In 168 cases (39.4%) the toxicological analysis did not detect any poison. In the positive toxicological analysis, 64.7% were agrochemical compounds followed plant poisons (13.17%), rodenticides (10%) and other poisons (6.3%) (Table 1). Among the agrochemical poisons, the most common were organophosphorus compound (75.4%) followed by monocrotophos (8.3%). Among the plant poisons, oleander (64.70%) Cleistanthus ***collinus (8.82%)*** were most common (Table 2)

Among other poisons and drugs, formaldehyde in five cases followed by benzodiazepine and its derivatives reported in three cases. Therapeutic drugs like propranolol, phenytoin, diclofenac, folic acid were also reported. In few cases combination of poisons were noted. Anesthetic drugs such propofol and rocuronium bromide was reported. Cases were also reported for hydrocarbons (kerosene). (Table 3)

The correlation between the period of survival and the results of the toxicological analysis report were studied. Cases with a prolonged period of survival had negative results in their toxicological analysis reports. (Figure 4)

Table 1: Overall prevalence of fatal poisoning cases confirmed from toxicology reports. (n=426)

Chemical analysis reports	Frequency
Agrochemical poisons	167
Plant Poisons	34
Rodenticide	28
Other poisons	17
Ethyl Alcohol	10
Phenol	2
Negative	168
Total	426

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Figure 4: Correlation between the period of survival and the toxicological analysis reports

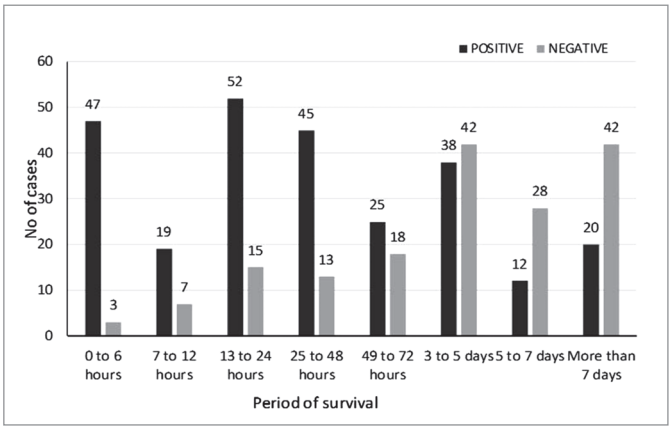

Table 2: Showing reported poisoning cases from agrochemical and plant poisons.

Agrochemical Poisons (n=167)	Frequency
Organophosphorus Compound	126
Monocrotophos	14
Organophosphorus compound with alcohol	12
Carbamate	7
Phorate	3
Methyl Parathion	1
Paraquat	1
Penthoate	1
Quinolphos	1
Triazophos	1
Plant Poisons(n=34)	
Oleander	22

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Cleistanthus Collinus	3
Plant alkaloids	3
Cardiac Glycosides	3
Pyrethrin	2
Abrus Precatorius	1

Table 3: Showing reported group of therapeutic agents & miscellaneous toxins poisoning cases.

Poisons/toxins/drugs (n=17)	Frequency
Formaldehyde	5
Benzodiazepine Derivatives	3
Benzodiazepine + Ethanol	1
Benzodiazepine + Propanolol	
Barbiturate + Ethanol	
Diclofenac+ Ethanol	
Folic acid	
Kerosene	
Resorcinol + Paraphenylene diamine (Super Vasmol)	
Nitrobenzene	
Propofol + Rocuronium Bromide	

The correlation of cause of death from clinical report and autopsy report is shown in Table 4. Out of the 426 cases, the history, clinical, and toxicology findings were matching only for 37.08% of the cases. In clinical reports cause of death attributed to poisoning was 236 cases, while 158 cases reported for poisoning as cause of death in autopsy report. In clinical records 50 cases were suspected to be alleged poisoning, of those 40 cases reported for of poisoning as cause of death in autopsy report. In brought dead cases, 42 cases suspected to be of poisoning based on history, clinical presentation. Among those 38 cases reported as poisoning as cause of death in autopsy. Around 190 cases the correlation of clinical findings and history with autopsy reports and chemical analysis were unconstructive for concluding to a specific poison.

Table 4: Correlation of cause of death from clinical report and autopsy report.

Cause of death in clinical reports	Poisoning as cause of death in Autopsy report
Poisoning (236)	158
Awaiting autopsy (50)	40
Brought-in-dead cases with h/o poisoning (42)	38

DISCUSSION

We analysed a few factors of poisoning and chiefly the toxicology reports. There was a declining of the cases during the study period. The percentage of the poisoning deaths to total deaths reported in our institute showed a variation from 18.32% (2013) to 4.31% (2017), which is not consistent to study done in Chandigarh.[10] This may be attributed to the underreporting by the government agencies or at the grass root levels due to various administrative or technical reasons. Most of the cases were in the age group 21-30 years, gradually reducing with an increase in age. The study coincides with other studies conducted in parts of India like Bangalore, Mumbai, Berhampur, Ajmer, Uttarakhand, Chandigarh. [5-10] This could be due to factors like unemployment, love failures, family disputes, dowry harassment. Cases occurred commonly in the semi-urban region and is consistent with studies of Dash SK et al and Mathur RK.[7,8] The possible explanation could be our institution gets referral cases from other hospitals and Primary Health Centre. Majority of the cases were reported during the summer season that was similar to other studies done by Dash SK et al and Mathur RK. [7,8] The poisoning during the summer months are reasoned by family issues during vacation, water scarcity and financial loss in agriculture.

In our study, 64.7% of the reports were positive for agrochemical poisons that is consistent to studies conducted in Southern and Eastern part of India.[5,7,9] Since the majority of the population from the semi-urban

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and rural area, which are predominantly agricultural lands, there is easy access to the agrochemical poisons. Around 13.17% of reports positive for plant poisons. Oleander and ***Cleistanthus collinus*** were the common plants used and are similar to the study conducted by Dash SK et al (7.5%).[7] Around 44.1% of the plant poisons were reported in the rural population. Thus, maybe due to the knowledge of the rural population about the toxic nature of these plants and its easy availability. A 25-year Study in Chandigarh had reported that common poisons used was barbiturate in the early 1970s then OPC in the 1980s and after 1980's rat killer poison.[11] Studies in industrialized areas by Singh A et al, Zaheer MS et al showed the prevalence of rodenticide poison. [10,12] Rodenticides reported in 10% of positive reports. Among urban population, rodenticides were commonly used agents for poisoning. This is due to the rodent menace in households and unregulated sales of various rodenticide formulations available in the open market in the cities. Ethyl alcohol was detected along with other poisons. People mix alcohol with poison during ingestion to make the poison more palatable and to counteract the offensive odour of such poisons. Household poisons like phenol and supervasmol (hair dye) reported similar to the study conducted by Patil A. [6]

Therapeutic drugs like benzodiazepine and its derivatives were the commonly used agents in our study. However, therapeutic drugs were the most common agents used in European countries in contrast to agrochemicals used in Asian and South Asian countries. [13-15] Uncommon agents like propranolol, folic acid, formaldehyde, diclofenac, resorcinol were the notable cases in our study. Anaesthetic combinations like propofol and rocuronium bromide deliberately used by health care personnel.

The correlation between the period of survival and results of the toxicological analysis reports were studied at varying intervals. The maximum positive reports were noted in 13 to 24 hours interval and within six hours, and this may be due to the poisons or active compounds of the poisons remaining in the circulation during metabolism. The maximum negative results were noted with longer periods of survival i.e. from 72 hours onwards. This is due to the active metabolism and elimination of most of the poisons occur within 72 hours. Limited and conventional testing facilities at the regional forensic science laboratories leads to failure of detecting novel poisons and metabolites of various therapeutic drugs may be the important reason for most of the negative results in the toxicological analysis. A study by Tyagi A et al states, that lack of standard protocol for sample collection and testing combined with inadequate testing capabilities were the major reasons for negative results in most of the cases.[16]

CONCLUSION

A decline in the number of poisoning cases was observed during the study period. The toxicological analysis may report negative for a poison in cases hospitalised beyond 3 days. Not necessarily all cases the history, clinical and toxicological outcome would be match each other; the actual cause of death should be made based on autopsy findings. Majority of the poisoning cases presenting to emergency medicine lack vital information on the nature of the poison ingested. This may have medicolegal implications for the law enforcing officers in their investigation. Establishing toxicology unit with the poison control centre and creating awareness programs about the fatality of agrochemical compounds could lessen the fatality. The existing infrastructures of regional forensic science labs could be upgraded accordingly to accreditation for the number of samples tested. National level standard operating procedures for sample collection and testing procedure need to be addressed.

Limitations of study

There was lack of quantitative toxico-analysis data in majority of poisoning deaths. Hence poisoning effects of some of therapeutic drugs and substances of abuse presumed empirically and was unable to confirm whether their presence in toxicological reports was due to antemortem therapeutic levels or toxic levels.

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