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Original Research Article

Insecticide Poisoning in Manipur

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ABSTRACT

Background: Insecticide poisoning is a major problem in the developing world. In view of the very few studies carried out on insecticide poisoning in this part of the world, the present study was taken up to assess the existing problem by studying the pattern of insecticide poisoning in Manipur.
Materials and methods: Forty two cases of insecticide poisoning i.e. fifteen (15) cases of autopsy on insecticide poisoning and twenty seven (27) cases of insecticide poisoning coming to the emergency department of a tertiary care teaching hospital in Manipur during the period of 2011 to 2013 have been studied and samples collected from these cases were analysed using Thin layer Chromatography (TLC) and High Performance Liquid Chromatography (HPLC) and the findings of the study were analyzed.
Results: The age group of 21-30 years comprised 42.85% of the cases with a male: female ratio of 1.2:1. Married females (38.09%) were the most frequent victims of insecticide poisoning. Maximum no. of cases i.e., 41 (97.61%) in this study were suicidal in nature. Cypermethrin was the commonest agent amongst the individual insecticides (26.19%), and pyrethrum and synthetic pyrethroid group of insecticide was the most frequently involved insecticide in poisoning (40.47%) followed by organophosphates which comprised 26.19%.
Conclusion: The present study has provided an understanding of the pattern of insecticide poisoning in Manipur. This study has also observed an interesting fact like poisoning with an agent like endosulfan, the production, sale and use of which is banned in India since 2011, calling for a strict regulation by government for sale and use of highly toxic insecticides.

Key words: Insecticide, poisoning, pattern, Manipur

INTRODUCTION

Humans have utilized pesticides to protect their crops. The first known pesticide was elemental sulfur dusting used in ancient Sumer about 4,500 years ago in ancient Mesopotamia. The Rig Veda, which is about 4,000 years old, mentions the use of poisonous plants for pest control. [1] By the 15th century, toxic chemicals such as arsenic, mercury and lead were being applied to crops to kill pests. In the 17th century, nicotine sulfate was extracted from tobacco leaves for use as an insecticide. The 19th century saw the introduction of two more natural pesticides, pyrethrum, which is derived from chrysanthemums, and rotenone, which is derived from the roots of tropical vegetables. [2] Until the 1950s, arsenic-based pesticides were dominant. [3] Paul Muller discovered that Dichloro-Diphenyl-Trichloroethane (DDT) was a very effective insecticide. Organo-chlorines such as DDT were dominant, but they were replaced in the United States by organophosphates and carbamates by 1975. Since then, pyrethrin compounds have become the dominant insecticide. [3]

With the progress in the industrial and agricultural field, a vast number of insecticides have become available, which on exposure may lead to severe toxicity. The World Health Organization (WHO) and the United Nations (UN) Environment Program estimate that each year, 3 million workers in agriculture in the developing world experience severe poisoning from pesticides, about 18,000 of whom die. The latest estimate by a WHO task group indicates that there may be 1 million serious unintentional poisonings each year and in addition 2 million people are hospitalized for suicide attempts with pesticide. [4] The exact incidence of poisoning in India is not known but it is estimated that every year 7-10 million cases are reported, of which 10,000 die. [5] According to the National Crime Records Bureau (NCRB, 2012), every day there are 81 deaths in India due to poisoning and 32.30% suicide victims consumed poison of which insecticide comprised 16.1%. [6]

In north east India, due to the fact that agriculture being the major occupation, the use of insecticide is very common and so is the incidence of poisoning both accidental and suicidal. In Manipur also use of modern technology in agriculture and use of fertilizers and insecticides have increased manifolds in last 2-3 decades. A few studies have observed that suicidal insecticide poisoning is common in this State [7] and organophosphorus is found to be the commonest agent. [8]

Hence, in view of the very few studies carried out on insecticide poisoning in this State, the present study was taken up to specifically find out the existing problem by studying in detail the pattern of insecticide poisoning in Manipur.

MATERIALS AND METHODS

The study was conducted over a period of 2 years in the Forensic Medicine Department of tertiary care teaching hospital in Imphal. Forty two (42) insecticide poisoning cases brought to the emergency department and mortuary of the hospital were studied after obtaining approval from the Institutional Ethics Committee. Putrified bodies and cases of poisoning with other agents were excluded from the study. After recording a detailed history, gastric lavage fluid and blood samples were collected from the cases of insecticide poisoning reporting to the emergency department of the hospital. From the postmortem cases of known and suspected Insecticide poisoning, viscera like stomach and its contents, liver, kidneys, omental fats and blood were collected. Saturated saline solution was used as a preservative for the viscera.

The insecticide in the body fluid and viscera were detected by using Thin Layer Chromatography (TLC) and High Performance Liquid Chromatography (HPLC). For screening purpose, a small portion of each tissue and body fluid were mixed well and extraction with n-hexane as solvent was done, and then it was analyzed by using TLC and HPLC. And then all the remaining tissues were processed separately and extraction was done with n-hexane as solvent. Sample (body tissue or fluid) was extracted by physiochemical technique and detection of the insecticide was done by chromatographic methods i.e., TLC and HPLC. Results were observed by noting down the retention time when the absorbance was at peak. The findings were recorded and analysed using descriptive statistics to find out the mean, percentage and frequencies

RESULTS

It was observed that out of the total 30 cases of suspected poisoning brought for autopsy during the study period, 50% of the cases (15 cases) were constituted by insecticide poisoning; while 27 cases of insecticide poisoning were brought to the emergency department of the same hospital. As shown in Fig.1, 21-30 years of age was the most common age group i.e., 42.85% followed by 31-40 years (30.95%); the mean age being 30.1 years. As observed in Fig.2, twenty three (23) males and nineteen

(19) females were involved in insecticide poisoning in this study with a male: female ratio of ratio of 1.2:1. Married females (38.09%) were the most frequent victims of insecticide poisoning whereas unmarried males were the second most common (33.33%) as shown in Table 1. Rural population was more prone to insecticide poisoning which comprised 71.42% of the cases. Insecticide poisoning among literates constituted 37 (88.09%) cases (Fig 3). In the present study, it was observed that maximum number of the cases was due to alleged harassment by in-laws (33.33%) amongst the females followed by family problems (30.95%) as shown in Table 2. Maximum no. of cases i.e., 41 (97.61%) in this study were suicidal in nature. Only one case (2.38%) was accidental (Fig 4). In this study cypermethrin constituted the majority of the insecticide poisoning among the individual insecticides (26.19%) as shown in Fig 5. This study showed that the pyrethrum and synthetic pyrethroid group of insecticide was the most frequently involved insecticide in poisoning (40.47%) followed by organophosphates which comprised 26.19% as per the history and corroborative evidence (Table 3). However, out of the samples taken from fifteen (15) post mortem cases, insecticides could be detected in twelve (12) cases by either TLC or by HPLC, whereas, insecticides could be detected only from ten (10) cases out of twenty seven (27) from the emergency department (Table 4). HPLC graphs of dichlorvos, monocrotophos, cypermethrin and endosulfan are shown in Fig 6-9.

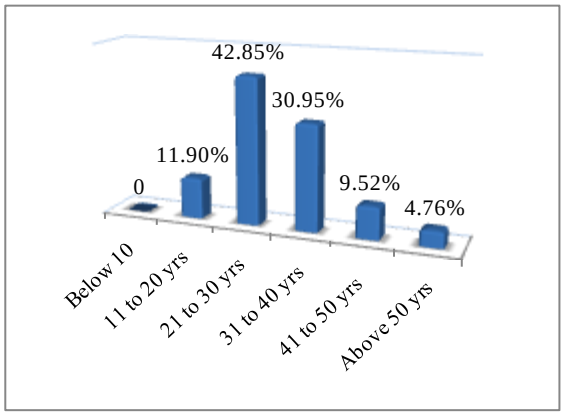

Fig 1. Showing the age incidence

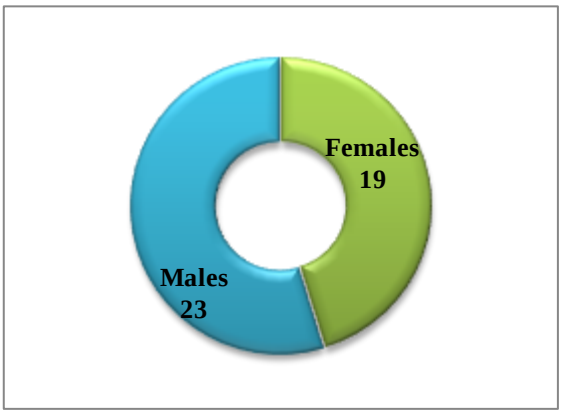

Fig.2. Sex incidence

Table 1: Showing the marital status of the victims

Marital status	Male (%)	Female (%)	Total no. of cases (%)
Married	9 (21.42)	16 (38.09)	25 (59.52)
Unmarried	14 (33.33)	3 (7.14)	17 (40.47)
Total	23 (54.76)	19 (45.23)	42 (100)

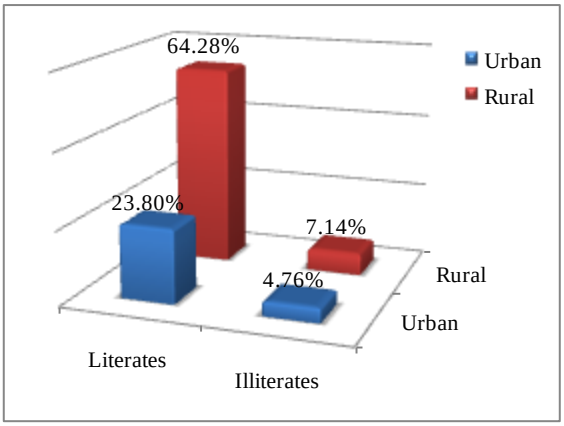

Fig.3. Rural-urban variation and literacy

Table 2: Predisposing Factors

Factors	No. of cases	Percentage
Family problems	13	30.95
Harassment by in-laws	14	33.33
Failed love affairs	5	11.90
Psychiatric illness	6	14.28
Unknown causes	4	9.52
Total	42	100

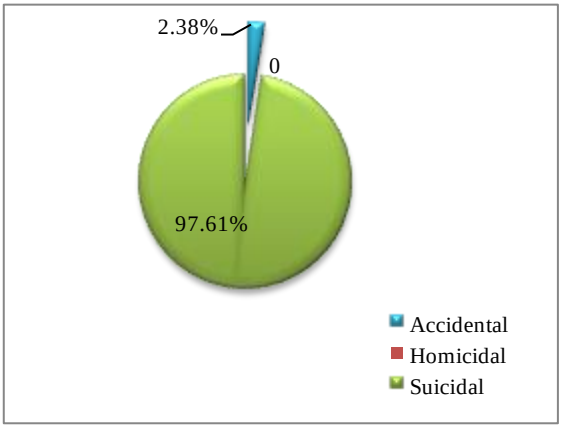

Fig. 4 Nature of poisoning

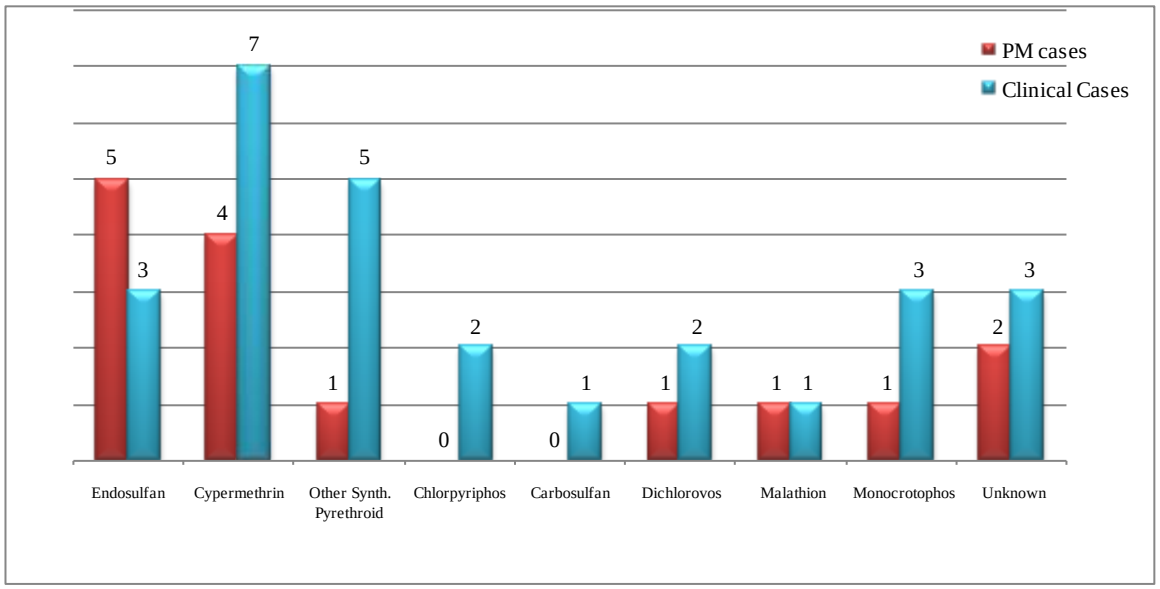

Fig.5. Types of insecticides as per history and corroborative evidence

Table 3. Incidence of insecticides by major groups:
(As per history and corroborative evidence)

	No. of cases (%)	**PM (%)**	**Clinical (%)**
Organochlorine:	8 (19.04)	5 (11.90)	3 (7.14)
Organophosphates	11(26.19)	3 (7.14)	8 (19.04)
Pyrethrum and synth. Pyrethroids	17 (40.47)	5 (11.90)	12 (28.57)
Carbamates	1 (2.38)	0 (0)	1(2.38)
Inorganic insecticides	0 (0)	0 (0)	0 (0)
Unknown	5 (11.90)	2 (4.76)	3 (7.14)
Total	42	15(35.71%)	27(64.28%)

Table no. 4: Detection of Insecticides by TLC/HPLC

	Post mortem cases(n=15)	**Clinical cases (n=27)**
	12 positive cases detected as	10 positive cases detected as
Endosulfan	5	2
Cypermethrin	4	3
Other Synth. Pyrethroid	0	1
Chlorpyrifos	0	2
Carbosulfan	0	0
Dichlorvos	1	0
Malathion	1	1
Monocrotophos	1	1

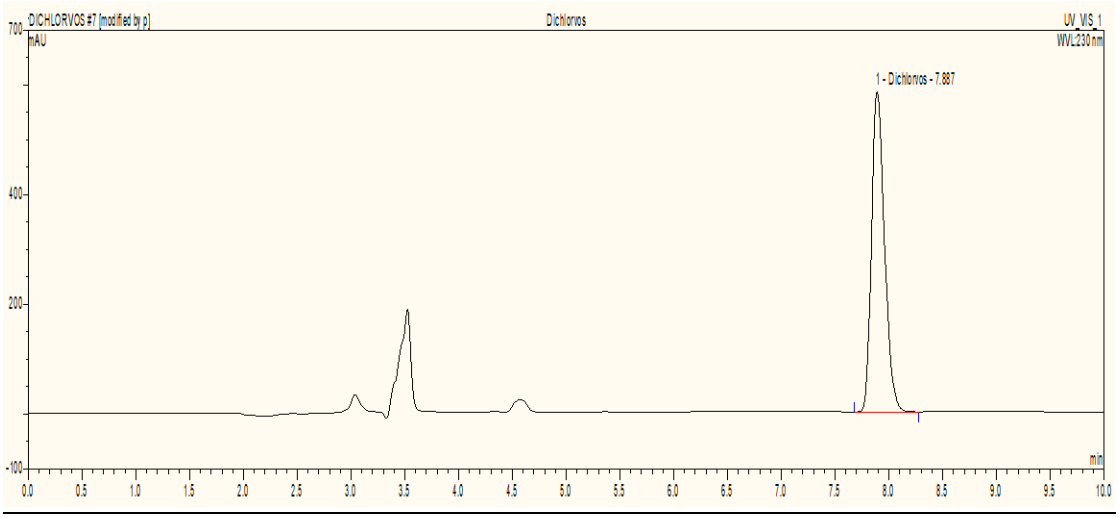

Fig 6. HPLC graph of Dichlorvos

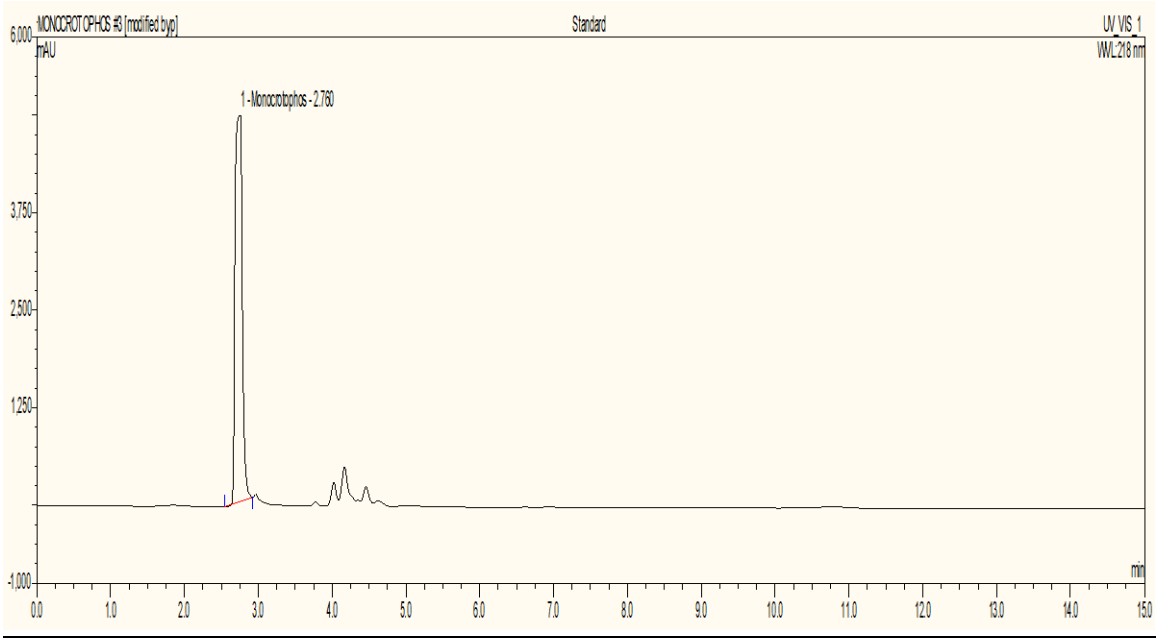

Fig 7. HPLC graph of Monocrotophos

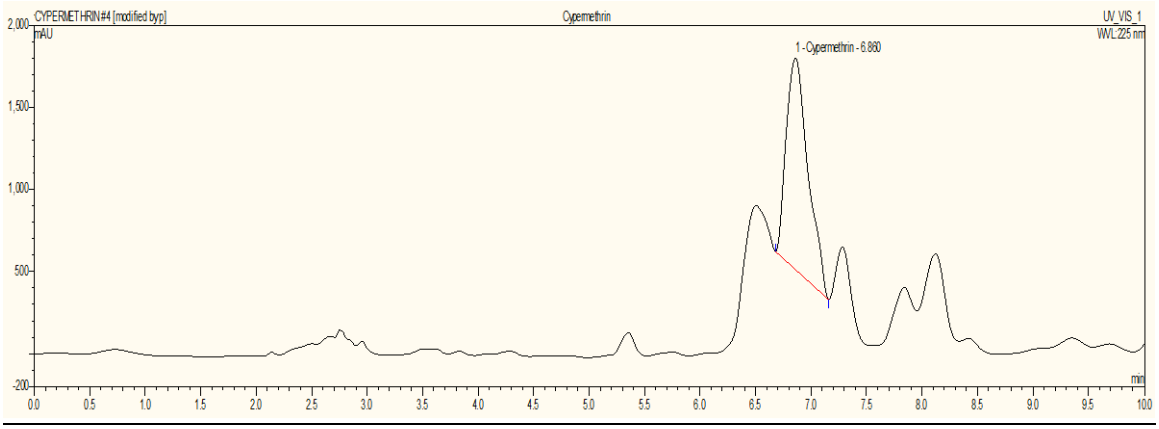

Fig 8. HPLC graph of Cypermethin

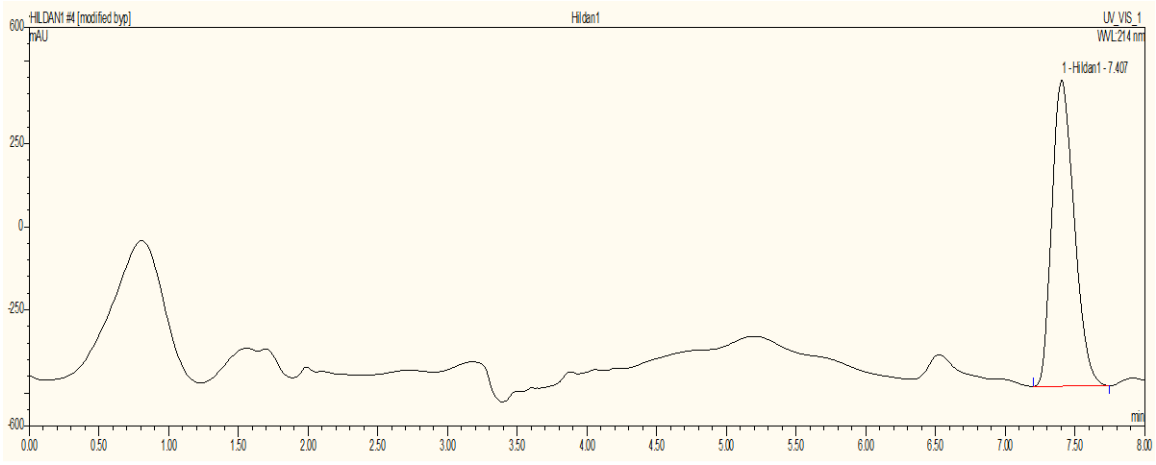

Fig 9. HPLC graph of Endosulfan

DISCUSSION

In a study by Batra et al., [9] it was observed that insecticides were responsible for 55.4% of fatal cases. Similarly, in our study, it was found that out of thirty (30) cases of postmortem done for poisoning in the study period, insecticides accounted for 50 % of the fatal poisoning cases. This high

incidence of insecticide poisoning could be attributed to unregulated and easy availability of insecticides in the market coupled with increased awareness among the farmers about use of modern technology including fertilizers and insecticides in agricultural farms.

In this study, the age group of 21-30 years was the most common age group i.e., 42.85% followed by 31-40 years (30.95%). This finding is in concurrence with the findings of Bhattarai et al. [10] who found that the maximum number of patients was between the ages of 20-40 (70.2%). The finding of this study is also in agreement with the finding of Liu et al. [11] where the majority (69.7%) of fatality was due to poisoning and was between the ages of 20-49 years. This age group is the most active age and more prone to stressful life.

The present study has shown that twenty three (23) males and nineteen (19) females were involved in insecticide poisoning in this study. Males marginally (54.76%) outnumbered females with ratio of 1.2: 1. This in agreement with finding of Liu et al. [11] (male: female=1.7: 1) and Das [12] (male: female=1.14:1). However, Bhattarai et al. [10] found that in female (54%) poisoning is more common. In this study, married females (40.47%) were the most frequent victims of insecticide poisoning. If only overall marital status is seen, married persons were involved more in insecticide poisoning (59.52%) as compared to 40.47% unmarried persons. Bhattarai et al. [10] also found similar results with married persons with an incidence of 74.5%. Similar findings i.e., higher incidence (64.4%) of married persons in poisoning were also seen by Dhatterwal and Singh. [13] The reasons for higher incidence of married females could be attributed to marital disharmony, financial problems, etc.

Rural population was more prone to insecticide poisoning which comprised 71.42%; Insecticide poisoning among literates constituted 88.09% of the cases. This is in accordance with a study by Batra et al. [9] who found that, 83% of poisoning was with rural residence. The reason for this high incidence of insecticide poisoning in rural areas could be due to the fact that agricultural farming population resides mostly in rural areas. In this study it was also found that literates are more involved in insecticide poisoning which could be attributed to the fact that literate persons use more technology and pesticides in farming making themselves more prone to insecticide exposure.

In the present study, it was seen that maximum numbers of the cases were due to alleged harassment by in-laws (33.33%), family problems (30.95%) and psychiatric illness (14.28%). Dhatterwal and Singh [13] also observed that marital disharmony, particularly in the situation of early marriage in rural areas of India lead to more suicides by poison. The reason of high incidence in unmarried males could be due to unemployment, failed career, etc.

Maximum no. of cases i.e. 41 (97.61%) in this study were suicidal in nature and only one case (2.38%) was accidental. Similar findings were seen by Dhatterwal and Singh [13] where they observed that the maximum cases (96.2%) were suicidal, 2.4 % of the cases as accidental and 1.4% were homicidal in manner. Insecticides as an option for suicidal agent could be due to easy and unregulated availability of cheap and highly toxic insecticides in the market. In this study, poisoning with some highly toxic banned insecticides like endosulfan was also encountered.

The present study showed that Cypermethrin constituted the majority of the insecticide poisoning among the individual insecticides (26.19%). Endosulfan contributed to 19.04%. Other insecticides were monocrotophos (9.52%), dichlorvos (7.14%), other synthetic pyrethroids (14.28%) and unknown insecticides (11.90%). However, Bhattarai et al. [10] in a study found that Methacid (methyl-parathion) was the most commonly used organophosphorus compounds in 32 (68%) patients. Bharath et al. [14] also found in his

study that organophosphate compounds were the commonest (74.10%), followed by organochlorine compounds (2.39%) and Carbamate (1.39%). High incidence of synthetic pyrethroids like cypermethrin could be due to increased use of household insecticides as insect repellent in almost all household today.

The present study also showed that the pyrethrum and synthetic pyrethroid group of insecticide was the most frequently involved insecticide in poisoning (40.47%) followed by organophosphates which comprised 26.19% and organochlorines (19.04%). This is somewhat different from the findings of Das [12] who found that carbamates were the most common insecticide group followed by organophosphates and organochlorines. In a study in Portugal, Teixeira et al., [15] it was observed that among the pesticides, organophosphorus insecticides represent 63% of the total positive cases, quinalphos being the most important organophosphorus insecticide present in 32 of the 111 positive cases. This study shows a pattern of higher incidence of pyrethrum and synthetic pyrethroid compound abuse, which could be due to continuing lifestyle changes and increased use of household insect repellents. But organophosphates showed continuous high incidence as a study by Jamil [16] also showed that organophosphorus insecticide poisoning was by far the commonest in the study and was responsible for the majority of fatal cases.

Out of samples taken from fifteen (15) post mortem cases, insecticides could be detected in twelve (12) cases by either TLC or by HPLC, whereas, insecticides could be detected only from ten (10) cases out of twenty seven (27) from the emergency department. The reason for lower rate of detection of insecticides from samples taken from emergency department i.e., living persons could be because most of the cases were referred from lower health centres in the districts where primary treatment like gastric lavage were already done.

In a study done by Kumar et al., [17] of the total muscle and liver tissue samples, 34 (13.38%) muscle and 36 (14.17%) liver samples were found to contain endosulfan residues. From the viscera obtained from fifteen (15) post mortem cases, various insecticides could be detected either by TLC or HPLC in twelve (12) cases. Maximum were from stomach and its contents and from omental fats. Similar findings were seen by Akgur et al. [18] who studied post mortem distribution of organophosphate insecticides in human autopsy tissues viz. fat, liver and blood following suicide. In all the cases, organophosphorus was present. The concentration of organophosphorus was highest in fat and least in blood.

CONCLUSION

Insecticide poisoning is a major problem in developing world in general and India in particular. It is an easily available and cheap tool for committing suicides. The present study has provided an understanding of the pattern of insecticide poisoning in Manipur. This study has also observed an interesting fact like poisoning with an agent like endosulfan, the production, sale and use of which is banned in India since 2011, calling for a strict regulation by government for sale and use of highly toxic insecticides. The government, NGOs and media can play a big role in imparting knowledge and awareness about safe use and storage of insecticides. Use of alternatives like organic or natural herbal based insecticides may be encouraged.

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