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PESTICIDE POISONING – AN EPIDEMIOLOGICAL AND HISTOPATHOLOGICAL STUDY

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ABSTRACT:

The objectives of this hospital based cross-sectional study were to evaluate the socio-demographic profile, manner of death and histopathological changes in the lungs, liver and kidneys of individuals who died of pesticide poisoning. All fatal cases of pesticide poisoning from February 2011 to January 2012 were evaluated. Socio-demographic profile, type of exposure and manner of death were recorded for each of the cases. Autopsy was performed with detailed internal and external examinations. Random portion of Lung, Liver and Kidney were collected and fixed in 10.0% Formalin. Hematoxylin and Eosin stained sections were examined and findings recorded.

The total number of deaths due to fatal pesticide poisoning was 9.6%. Highest frequency of poisoning (23.4%) was seen in the age group 20 - 29 years. The peak time of consumption of poisoning was between 6.00am and 12.00noon. The manner of poisoning was suicidal in majority of the cases. Histological findings indicated that congestion was the most common histopathological change; being observed in 60.0%, 66.0% and 74.0% of cases of liver, lung and kidney respectively. Histopathological features are supportive in establishing the diagnosis but further studies with larger sample size may be more illuminative in explaining the histopathological changes occurring due to these chemicals.

Keywords: Pesticide poisoning, histopathology, lung, liver, kidney

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INTRODUCTION:

Acute poisoning by Pesticide compounds is a major global clinical problem, with thousands of deaths occurring every year. Most of these pesticide poisoning and subsequent deaths occur following an intentional self ingestion of the poison [1]

The potential adverse impact on human health from pesticides exposure is likely to be higher due to easy availability of highly hazardous products, and low risk awareness. Overexposure to pesticides can occur because of easy access, lack of adequate labeling and during mixing and spraying of pesticides.. Spray operators and bystanders can be affected [2]. Hospital- based studies from five major hospitals across Nepal in 1999-2000 showed that OP (organophosphorus) compounds were the most common forms of poisoning [3]. The increasing use of various pesticides for insect control has attracted much attention to extensive investigations on the toxic actions of pesticides [4]. Hence in the present study, we evaluated whether any specific histopathological changes occur in the lung, liver and kidney of individuals who died of pesticide poisoning.

The objectives of the study were to find out the Proportion of individuals who died of Pesticide poisoning out of the total number of unnatural deaths which were subjected to Medico legal autopsy at the police morgue of the hospital. Their social and demographic profile and manner of death; whether it was suicidal, homicidal or accidental. To find out if there was any specific morphological and histopathological alteration in the lung, liver and kidney in those individuals who died due to pesticide poisoning.

MATERIALS AND METHODS:

This was a hospital based cross sectional prospective study and was commenced after approval by Institutional Ethical Committee. All fatal cases of pesticide poisoning either admitted to the Emergency department or brought dead to the Police Morgue, in Department of Forensic & State Medicine of the hospital during February 2011 to January 2012 were evaluated. Decomposed bodies and death due to other disease condition were excluded from the study. Detailed history was taken from inquest report and from relatives of the deceased. Further toxicological evaluation reports confirmed the type of pesticides. Socio-demographic profile, type of exposure and manner of death were recorded for each of the cases. Autopsy was performed with detailed internal and external examinations. Random portion of Lung, Liver and Kidney were collected and fixed in 10% formalin and sent for Histopathological evaluation. Hematoxylin and eosin stained sections were examined and the findings recorded. Statistical evaluation was done by appropriate statistical method.

RESULTS:

The total numbers of autopsies carried out from February 2011 to January 2012 were 2131. Among all these, the total number of deaths due to fatal pesticide poisoning was 205 (9.6%). Of these, 177 (86.3%) were Hindus and 28 (13.7%) were Muslims. Age range varied from 1 to 80 years whilst the highest frequency of poisoning (23.4%) was seen in age group 20-29 years old. 86.8% of deceased were married. Gender distribution of the victims indicated 140 (68.3%) males and 65 (31.7%) females. A total of 161 (78.5%) were from the rural areas and 44 (21.5%) were from the urban areas. Out of the 205 fatalities, 157 (76.6%) received initial treatment in the emergency department before death and the remaining 48 (23.4%) were brought dead to the morgue. The peak time of consumption of poisoning was between 6.00am and 12.00noon. (Time wise distribution of poison intake is shown in Table-1).

Organo-phosphorus pesticides were the major poison chemical used as shown in Table 2.

Table 1: Time Wise Distribution of Poison Intake

Groups	Time Periods	Number (%) of victims
A	12.01 a.m.-6.00 a.m.	47 (22.9%)
B	06.01 a.m.-12.00noon	94 (45.9%)
C	12.01 p.m.-6.00 p.m.	39 (19.0%)
D	6.01 p.m.-12.00 midnight	25 (12.2%)
	TOTAL	205 (100.0%)

Table 2: Distribution According to Type of Poison Consumed

Pesticide Used	Number of Cases
Organo-phosphorus	160 (78.0%)
Carbamates	25 (12.2%)
Organo-chlorine	16 (7.8%)
Miscellaneous	4 (2.0%)
TOTAL	205 (100.0%)

The major manner of poisoning was suicidal in 187 (91.2%) cases, followed by accidental in 14 (6.8%) cases and homicidal in 4 (2.0%) of cases. Fifty of the 187 cases of organo-phosphorous poisoning were chosen after excluding any other associated illness. Random sections from Lung, liver, and kidney were taken for histopathological evaluation. It was seen that congestion was the most common gross and histopathological change; being observed in 60.0%, 66.0%, 74.0% of cases of liver, lung and kidney respectively. Details of predominant histopathological findings are presented in Table 3.

Table 3: Histopathological Features in Liver, Lung and Kidney in OP Poisoning

Microscopic features in liver	**No. of cases (n = 50)**	**Percent**
Congestion	30	60.0
Microvacoualization	26	52
Hydropic degeneration	22	44
Mononuclear infiltration	24	48
Micro & macro-vesicular steatosis	22	44
Bile pigment in the cytoplasm	12	24
Sinusoidal dilation	5	10
Centrilobular necrosis	8	16
Hemorrhage	10	20
Patchy necrosis	7	14
Microscopic features in lung	**No. of cases**	**Percent**
Congestion	33	66
Edema	31	62
Hemorrhage	31	62
Collapse of Alveoli	22	44
Alveolar thickening	16	32
Alveolar wall disturbance	6	12
Dilated capillaries	8	16
Microscopic features in kidney	**No. of cases**	**Percent**
Glomerulus congestion	37	74
Intraparenchymal congestion	32	64
Tubular degeneration	16	32

DISCUSSION:

In the present study, organo-phosphorus poison (monocrotophos, dimethoate) was the most common type of poison consumed for both homicidal and suicidal purposes. Studies from other regions have also reported organophosphates [5] as common causes of poisoning.

In the present study the highest numbers of deceased (23.4%) were in the age group of 20–29 years followed by 15.1 per cent in below 20 years age group. Since most of the cases were suicidal in nature, the distribution pattern illustrates the psychological vulnerability in this age group. Similar patterns have been reported in a number of other studies. [5-8]

Males (68.3%) outnumbered females (31.7%) in this study. As males are major bread earners in Indian society, possibly they suffer from stress due to financial difficulties. This was the reason that is given in other studies where male were preponderant. [5, 9]

Suicide (91.2%) was the most common mode of poisoning in this study. Poisoning was more common in the married group irrespective of the gender. This is comparable with other studies, and shows that married persons may become victims of greater stress than single individuals in their day-to-day lives. The different causes of the stress culminating in poisoning ranged widely from marital and family discords to financial and job related problems to educational and other matters. [5, 9, 10]

Organophosphates act as irreversible cholinesterase inhibitors. The inhibition of cholinesterase activity leads to the accumulation of acetylcholine at synapses, causing overstimulation and subsequent disruption of transmission in both the central and peripheral nervous systems. [11] This leads to hyper secretion and paralysis of respiratory muscles. Liver is the organ where bioactivation and detoxification of OP compounds takes place. But they are eliminated primarily through kidneys [12]. Thus the lung, liver and kidney were selected for Histopathological evaluation. Very few studies are available about organophosphorus compounds causing histopathological changes of various organs in humans [13]. However, many studies have been conducted in past on animals and humans to assess the effect of different types of pesticides on the histology of cells and tissues [14-19].

In present study we found several histopathological changes in victims of fatal pesticide poisoning. Seema S. Sutay [13] studied the pattern of histo-pathological changes of liver in poisoning. Out of a total of 78 cases affecting liver organophosphorous was the poison used in 43 of the cases. According to the author congestion was seen in 20 (46.5%) and fatty changes in 15 (34.9%) cases; centrilobular necrosis in 4 (9.3%), and

Sinusoidal dilatation in 3 (7.0%) cases. In another study by G. Lemercieret al [14], the effect of Soman, a powerful organophosphorus (OP) cholinesterase inhibitor, was investigated in the central nervous system (CNS) of Wistar rats, the surviving rats exhibited neuronal changes similar to those of hypoxic encephalopathy. Studies on the Effects of OP compounds on pancreas have also been published. [15]

Another study [16] in year 2010 in Jarzouna, Tunisia shows Impact of dieldrin on liver morphological and biochemical parameters on the liver of Wistar rats. The dieldrin effect on rats was tested after a single intraperitoneal injection of two doses: 3 and 6 mg/kg and observations were made 4 days later. Histological examination of the liver of dieldrin-treated animals revealed cytoplasmic vacuolation, focal necrosis and nuclear enlargement of hepatocytes.

Congestion of the liver and other vital organs, in gross and microscopic pathology examination were observed in most of our cases.

In liver, common microscopic finding were portal and sinusoidal congestion (60%), microvacoualization (52%), hydropic degeneration (44%) and mononuclear infiltration (48%), micro & macro-vesicular steatosis (44%).These findings differ in percentage compared to the study by SS Sutay. [13]

In the lung microscopy, congestion of alveolar capillary walls was the most common finding in our study (73.3%), followed by interstitial oedema, hemorrhage and alveolar wall thickening. No data is available on Histo-Pathological changes in lung in OP poisoning. Studies on aluminum phosphide poisoning are available. [17, 18]

Major histopathological findings of the kidney showed glomerular and interstitial congestion. Satar S et al [19] studied the ultrastructural effects of acute organophosphate compound methamidophos poisoning on rat kidney and found no ultrastructural changes.

CONCLUSION:

Pesticide poisoning is a major health problem in rural Bengal leading to significant fatalities. Adult married males constitute the highest number of victims and suicide is the most common mode of poisoning. Diagnosis of poisoning is based on characteristic clinical features and history of exposure to a known OP compound. Chemical analysis is done to confirm the diagnosis. Histopathological features are supportive in establishing the diagnosis but further studies may be more illuminative in explaining the histopathological changes occurring due to these chemicals.

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