

A Study on the Histopathological Changes in Cases of Pesticide Poisoning and Proposed Diagnostic Algorithm

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Abstract

Pesticide poisoning in developing world is a global public health problem. Incidences of poisoning are increasing with socio-economic hurdles. Often reporting and chemical examination of samples collected from viscera are difficult to precisely diagnose cases and therefore extensive studies on histopathological corroborations of vital organs such as stomach, liver and kidney is necessary along with socio-demographic data. The common autopsy findings were cyanosis in the lips, in the fingertips and nose. Histological findings in stomach revealed congestion, erosion of muscularis mucosa, submucosal petechial haemorrhages and necrosis. Liver shows congestion, sinusoidal dilation, degeneration of hepatocytes and haemorrhages. Kidney shows tubular necrosis and glomerular congestion. However, history of poisoning along with autopsy and histological findings are considered as strong evidence for acute organophosphorous poisoning.

Keywords: autopsy, histopathology, pesticide poisoning

Introduction

Deaths due to pesticide poisoning are an important public health issue. It is a concern to the forensic pathologist as consumption of pesticides and poisoning is a common issue in emergency admission at hospitals with a high prevalence for mortality. This is global problem with maximum cases reported from developing countries like India. Agricultural pesticide poisoning is a global problem with at least 250,000- 370,000 people getting affected each year [1].

In India, due to its easy availability, pesticide poisoning is the most common. Poisoning can occur due to suicidal or accidental ingestion. Suicidal pesticide poisoning is the most common method of self destruction. Accidental as well as homicidal poisoning by pesticide is also reported.

According to the Food and Agriculture Organization of the United Nations (FAO), pesticides are defined as any substance or mixture of substances intended in preventing, destroying or controlling any pest, including vectors of human or animal disease, unwanted species of plants or animals causing harm during or otherwise interfering with the production, processing, storage or marketing of food, agricultural commodities, wood and wood products or animal feedstuffs or which may be administered to animals for the control of insects, arachnids, or other pests in or on their bodies. The term includes substances intended for use as a plant-growth regulator, defoliant, desiccant or fruit- thinning agent or agent for preventing the premature fall of fruit and substances applied to crops either before or after harvest to protect the commodity from deterioration during storage and transport.

Pesticides are considered as either biodegradable which may be broken down by microbes or persistent pesticides which usually take years to be broken down and therefore accumulate in the food chain viz. DDT (dichloro-diphenyl-trichloroethane).

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Organophosphates affect the nervous system by disrupting the enzyme that regulates acetylcholine, a neurotransmitter. Most organophosphates are insecticides. They were developed during the early 19th century, but their effects on insects, which are similar to their effects on humans, were discovered in 1932. Some are very poisonous. However, they usually are not persistent in the environment.

There is a pressing need for meticulous study on autopsy findings in pesticide poisoning cases as common changes are often non-specific and depends on chemical examination of viscera for further diagnosis. In relation to the factors like decomposition, transport, non-availability of tests for all pesticides, postmortem alteration in chemical nature of poison etc., it is necessary to study the impact of poisoning on vital organs both for morphological and histopathological changes in order to establish diagnosis.

The aim of the present study is:

- To investigate the socio-demographic profile of the cases of death due to pesticide poisoning examined at autopsy in a tertiary care hospital morgue.
- To analyze the pattern of various poisoning deaths
- To study the morphological and histopathological changes in stomach, liver and kidney in death due pesticide poisoning
- To study the risk factors with special reference to socio-demographic determinants of suicide by pesticide poisoning

Materials and Method

In the present study all fatal cases of pesticide poisoning either admitted to the Emergency department of Burdwan Medical College & Hospital, or brought dead in the Police Morgue, in Department of Forensic & State Medicine Burdwan Medical College & Hospital. Burdwan, West Bengal, during February 2015 to January 2016 were evaluated. This cross sectional study is done which included total 268 cases of fatal pesticide poisoning.

Some pesticides with organophosphorous compounds have characteristics petroleum have a

characteristic petroleum or garlic like odour, which is helpful in establishing diagnosis. Further toxicological evaluation report of gastric content helped in confirming the type of pesticides. The age, sex, cause of ingestion, compound involved, time elapsed between ingestion and admission to the hospital, duration of hospital stay are recorded. A descriptive study was designed to explore the socio-economic profile of the fatal cases of poisoning.

Poisoning cases with decomposed bodies were excluded from the study. History of poisoning, manner of death, type of exposure was recorded from autopsy findings in standard formats (PM report vide West Bengal form number 5372). Meticulous autopsy findings of all the cases were noted and analyzed along with histopathology of the vital organs namely stomach, liver and kidney.

Specimens collected for the study were stored in buckets with 10% buffered neutral formalin for the process of fixation. Histological slides were prepared according to standard laboratory protocols for Hematoxylin and eosin counter staining protocols. DPX mounted permanent slides were observed under compound digital microscope. Data was analyzed using 'SPSS software for WINDOWS' Descriptive statistics was applied wherein the mean, mode median and standard deviation and range of the values were noted. For inferential statistics hypothesis was tested using students-t test. Association was tested using non parametric tests like Chi square test. P value of less than .05 was considered statically significant.

The study was conducted after receiving approval from the clinical ethical committee, Burdwan Medical College & Hospital.

Results

In the present investigation of total 2423 unnatural deaths autopsied during the study period 351 cases were due to poisoning (14.38%). Out of those poisoning cases 268 were due to pesticide amounting to 76% of poisoning deaths. It was found in the present study that pesticide poisoning constituted 9.04% of all unnatural deaths (268 out of 2423).

a) Socio-demographic profile of the study:

As per distribution for age and occupation; it was found that out of 268 poisoning cases (n=268) 67.2% were male and among them 95.9% were in the age group of 20-29 years. Amongst the occupational distribution, agriculture (96.3%) is more susceptible.

As per distribution for sex and locality (n=268), 69.8% were from rural area. As per the distribution of sex and marital status of the studied population, 174 (96.7%) were married male.

As per the distribution of sex and educational status, out of 268; 153 (85%) were male and have completed secondary school education with females 76 (86.4%) as shown in table1. On contrast educational status below secondary education and for graduates the incidences are less.

As per distribution of study subjects according to frequency of admission in hospital, 81% of study population admitted in hospital and rests (19%) were not as shown in table2. According to the time of incidence most of the incidents (68.6%) occurred between 12 PM to 6 AM.

As per distribution of study subjects for the type of poison (n=268), it has been found that most of the cases (86.2%) were of organo phosphorous poisoning.

b) Post-mortem histological findings:

i) Stomach

The post-mortem histological findings as shown in figure 1 and 2 of the study subjects, the stomach haemorrhage were present among 93.65 % and among them 86.5% were from the cases of organophosphorus poisoning. Stomach congestion with mononuclear infiltration was present among 96.26% of cases and

among them 86% was shown in organophosphorus poisoning. Stomach necrosis was found among 95.55 % study population and among them 86.3% was present among organophosphorous poisoning. Erosion of lamina propria were present in 97.01 % cases and among them 86.2% were present in organophosphorous poisoning .4.6 % were present among aluminium phosphide poisoning cases.

ii) Liver

The post-mortem histological findings showed in figure 3 and 4 that 97.76 % have liver haemorrhages and among them 84.32% had been associated with with organophosphorus poisoning. Out of 268 poisoning cases, liver congestions were associated with 98.50% and among them 84.70% had poisoned with organophosphorus compounds. Bile pigments in the hepatocytes were presents among 96.3 % population and among them 83.58% have organophosphorus poisoning cases. Degeneration of hepatocytes were present in 97.76% of cases and among them 84.7 % were organophosphorus poisoning cases. Liver sinusoidal dilatations were present among 98.13 % of cases with associated liver steatosis among 97.10 % of cases.

iii) Kidney

The post-mortem histological findings as showed in figure 5 that kidney haemorrhages were associated with 98.5 % cases and 85.07% were presents among organophosphorus poisoning cases. The glomerular congestions were found among 98.13% cases. Tubular necrosis findings were presents among 97.76 %.

As per distribution of study subjects according to frequency of post-mortem histological findings among total poisoning cases (n=268) are summarized in table 3.

Table1: Distribution of study subjects according to their sex and educational status (n=268)

SEX	EDUCATIONAL STATUS			TOTAL
	< SECONDARY SCHOOL EDUCATION	SECONADARY SCHOOL EDUCATION	GRADUATE	
MALE	7(3.9%)	153(85%)	20(11.11%)	180
FEMALE	3(3.4%)	76(86.4%)	9(10.22%)	88
TOTAL	10(3.7%)	229(85.44%)	29(10.82)	268

Table2: Distribution of study subjects according to frequency of admission in hospital (n=268)

FREQUENCY OF ADMISSION IN HOSPITAL	NUMBER	PERCENTAGE
ADMITTED	217	81.0%
NOT ADMITTED	51	19.0%
TOTAL	268	100%

Table 3: Distribution of study subjects according to frequency of post-mortem histological findings (n=268)

Frequency of post-mortem histological findings	Present	Absent
Stomach haemorrhage	251(93.7%)	17(6.3%)
Stomach congestion with mono nuclear infiltration	258(96.3%)	10(3.7%)
Stomach necrosis	256(95.5%)	12(4.5%)
Erosion of lamina propria	260(97%)	8(3%)
Liver haemorrhage	262(97.8%)	6(2.2%)
Liver congestion	264(98.5%)	4(1.5%)
Bile pigment in the hepatocytes	258(96.3%)	10(3.7%)
Degeneration of hepatocytes	262(97.8%)	6(2.2%)
Liver sinusoidal dilation	263(98.1%)	5(1.9%)
Liver steatosis	260(97%)	8(3%)
Kidney haemorrhage	264(98.5%)	4(1.5%)
Glomerular congestion	265(98.9%)	3(1.1%)
Tubular necrosis	262(97.8%)	6(2.2%)

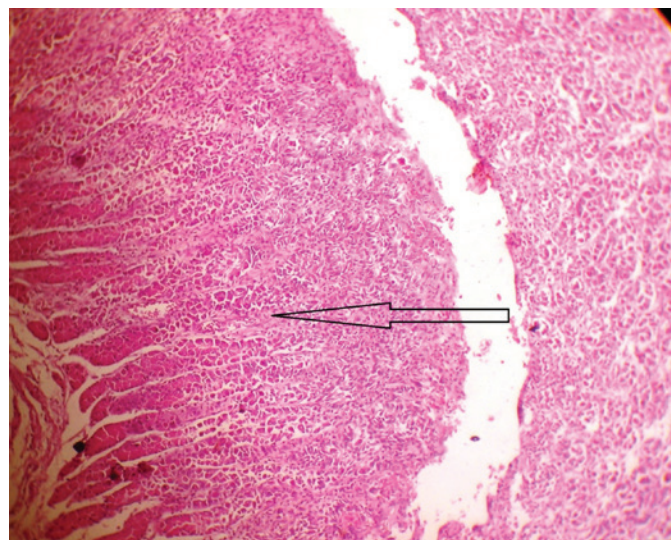


Figure 1-Intestine-40x: Congested intestinal mucosa with chronic inflammatory cell infiltration.

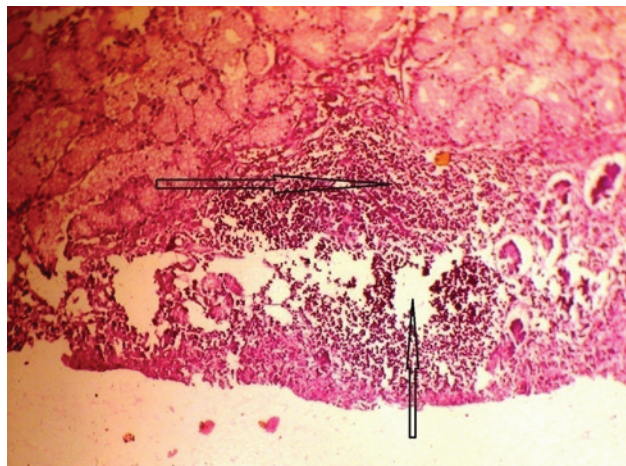


Figure 2-Intestine-40x: Ulcerated denuded mucosa with areas of necrosis & chronic inflammatory cell infiltration.

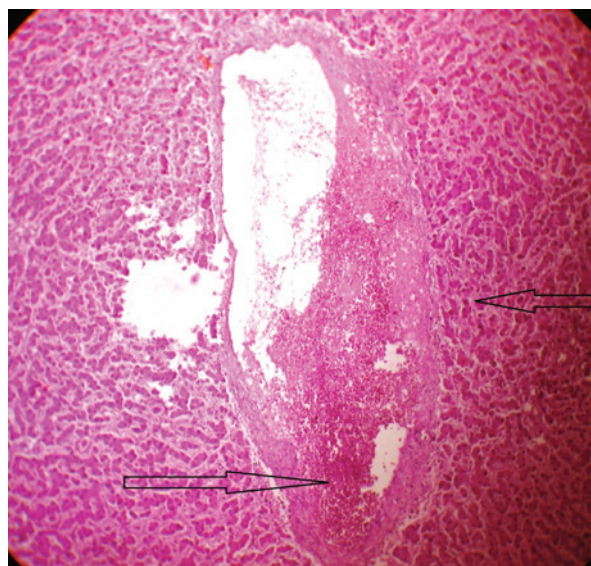


Figure 3-Liver-40x: Dilated congested central vein with areas of hemorrhage and chronic inflammatory cell infiltration in sinusoids

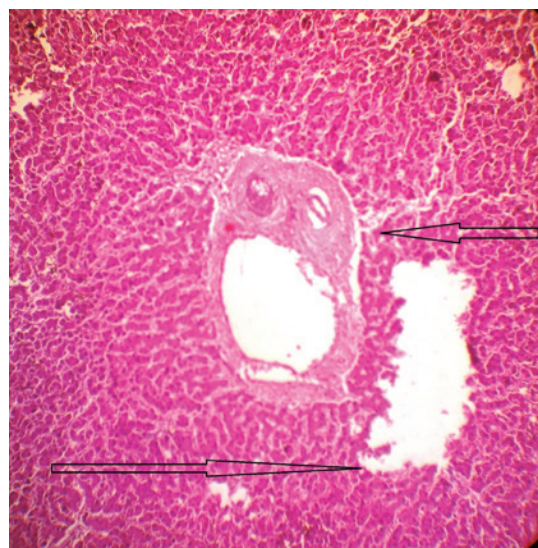


Figure 4-Liver-40 x: Dilated portal vein with periportal inflammation and areas of edema

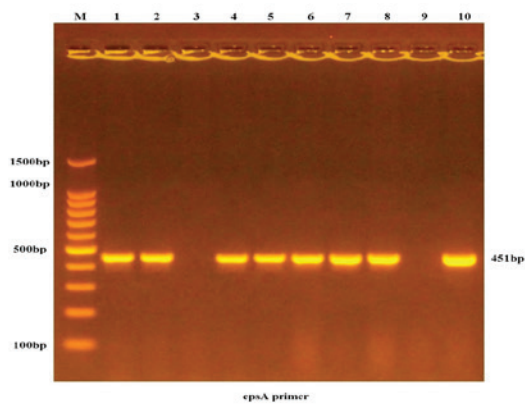


Figure 5-Kidney-40 x: Dilated and congested blood vessels with areas of hemorrhage and chronic inflammatory cell infiltration

Discussions

In the present investigation of total 2423 unnatural deaths autopsied during the study period 351 cases were due to poisoning (14.38%). Out of those poisoning cases 268 were due to pesticide amounting to 76% of poisoning deaths. It was found in the present study that pesticide poisoning constituted 9.04% of all unnatural deaths (268 out of 2423) which was consistent with earlier studies [2].

In the present study poisoning deaths were higher as 67.2 % in males than female deaths 32.8 %. Males are exposed to stress, strain and occupational hazards to a greater extent when compared to females because they are bread earners.

In the present study higher incidence of death due to poisoning was found in young age group (20 to 29 years) followed by 30 to 39 years of age which was also observed in previous studies^[3]. Stress of the modern lifestyle, family problems, financial problems and failure in the exams could be explained as major causes of suicidal poisonings^[3, 4].

Increased farming activity like spraying of pesticides contributed for maximum number of poisoning cases at rural areas (69.8%). Illiteracy or less education, less availability of immediate treatment may be causes of such poisoning. The most commonly affected age group was 20 to 29 years. Poverty, unemployment, early marriage are some of the major stress factors responsible for higher incidence of deaths in these rural areas.

Organophosphorus compounds were the most commonly used poisons, because of their wide used in agriculture Thus results of the present study were consistent with the previous studies, except for some differences in the kinds of poison preferred [5, 6 and 7]. Trends of the poisons seem to be a function of need and availability of specific substances.

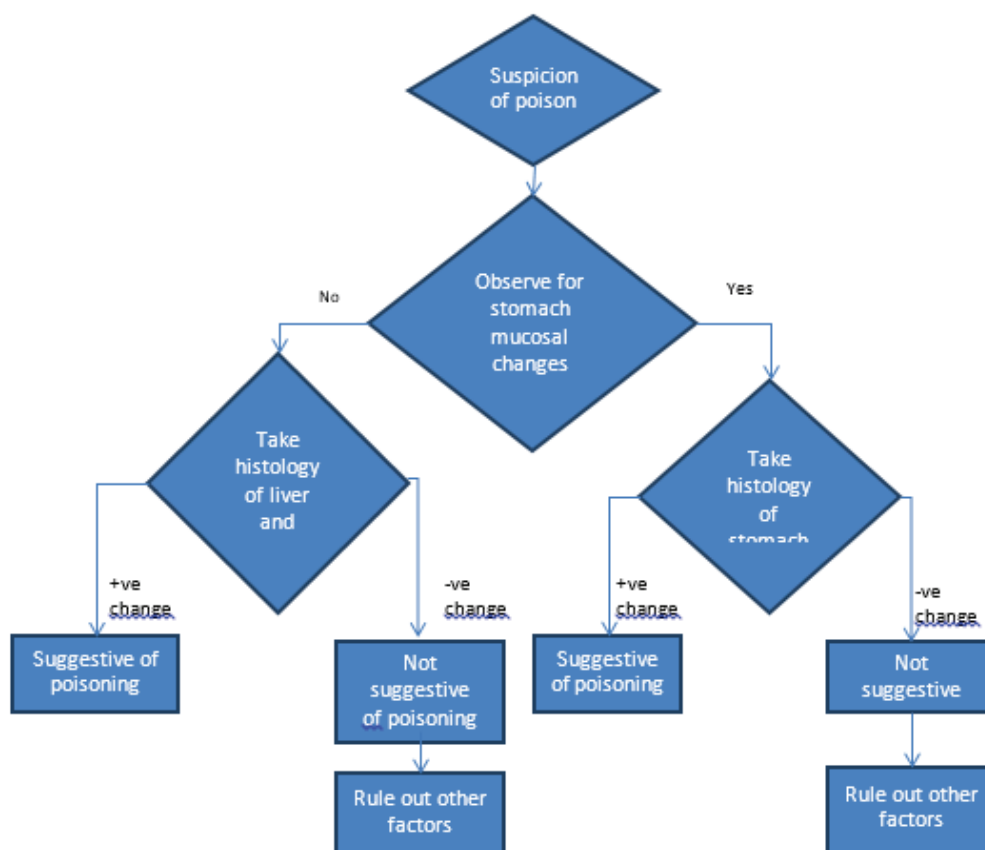
The common autopsy findings were cyanosis in the lips, in the fingertips and nose. All the internal organs were congested in 100% of cases. Dissection revealed congestion of the mucous membrane of stomach with scattered submucosal petechial haemorrhages (98.3% cases).

Histological corroborations in stomach revealed congestion, erosion of muscularis mucosa, submucosal petechial haemorrhages and necrosis. Liver shows congestion, sinusoidal dilation, degeneration of hepatocytes and haemorrhages. Kidney shows haemorrhages, tubular necrosis and glomerular congestion.

Conclusion

It was found in the present study that pesticide poisoning fatal cases constituted 9.04% of all unnatural deaths (268 out of 2423). Meticulous autopsy findings including histopathological corroborations of stomach, liver and kidney is the central consideration of the

present study to establish acute poisoning fatal cases. This is necessary because often reporting and chemical examination of viscera is difficult due to several technical problems, whereas histology is readily available in all hospitals because they have pathology centre even in the subdivision levels. The findings of the present investigation will supplement the methods commonly available to establish the cause of death in poisoning specially pesticide poisoning in a setup where resources of analytical work are not easily available. The methodical findings in order to diagnose acute poisoning cases may be represented through the following flowchart.



Therefore, thumb rule for diagnosing acute poisoning cases from histopathological considerations may be stated as follows:

History of poisoning + autopsy including triad of positive finding of histology = strong evidence of acute

pesticide poisoning.

Therefore, thumb rule for diagnosing acute poisoning cases from histopathological considerations may be stated as follows:

Triad of positive findings of histology = +ve finding of stomach histology
+
+ve finding of liver histology
+
+ve finding of kidney histology

History of poisoning + autopsy including triad of positive finding of histology = strong evidence of acute pesticide poisoning.

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