Original Communication

Pattern of Histopathological Changes in Lungs, Liver and Kidneys in Cases of Organophosphate Insecticide Poisoning

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Abstract:
Histopathological studies of viscera inorganophosphate poisoning cases help the autopsy surgeon in finding out the secondary causes of death. Microscopy of three visceral organs, lungs, liver and kidneys of 40 cases of organophosphate poisoning were studied and the changes correlated with the duration of survival post consumption. By knowing the exact histopathological change in these organs it is easier to attribute the death to a failure of one of these organs as a consequence of organophosphate consumption. Knowing the rapidity of involvement of an organ is beneficial to the treating physician as well thereby helping him reduce the morbidity and hence mortality.
Keywords: Organophosphate poison,Histopathology, lungs, liver, kidneys,cause of death

Introduction:

Organophosphates constitute a heterogeneous category of chemicals specifically designed for the control of pests, weeds or plant diseases. Their application is still the most effective and accepted means for the protection of plants from pests, and has contributed significantly to enhance agricultural productivity and crop yields.[1]Their common availability renders organophosphate insecticidepoisoning a worldwide health issue with a high fatality rate, especially the suburban and rural population. Most of these pesticide poisoning and subsequent deaths occur in developing countries following a deliberate self-ingestion of the poison.[2]It is roughly estimated in India that 5 to 6 persons per lakh population die due to poisoning every year and the commonest cause of poisoning in India and other developing countries is organophosphorus compounds.[3]

In every centre carrying out medico legal work, autopsies of poisoning cases form a sizeable group and the autopsy surgeon is required to give his opinion regarding the final cause of death which in most cases can only be attributed after looking into the chemical analysis report from the Forensic Science Laboratory and the histopathological reports of the viscera sent to the Department of Pathology. In most of the cases death may occur immediately due to respiratory centre and muscle paralysis after consuming poison or may be delayed for days or weeks together. Delayed causes of death may be due to ARDS, respiratory paresis, liver failure and renal failure. In the latter cases the determination of exact cause of death may be difficult as external appearance may not give any clue and the internal examination may sometimes not reveal anything much on a gross examination. Histopathological examination can reveal such pathologies in major organs like lungs, liver and kidneys where the poison acts, gets absorbed and is finally eliminated. This study is being conducted with an aim to know the progressing effects of the insecticide on the organs and to give a much clearer opinion regarding the cause of death.

Materials and Methods:

This study was carried out in the Department of Forensic Medicine & Toxicology in collaboration with the Department of Pathology, JJM Medical College for a period

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of 1 year with a sample size of 40 cases. It was ensured that in all 40 cases of ingestion of organophosphate, the three organs, lungs, liver and kidneys were collected in 10% formalin and sent for histopathological examination to Dept of Pathology. The routine viscera were sent to the FSL for chemical analysis. Duration of survival in hours was noted in all cases. Cases which were treated in the hospital with a doubtful history of organophosphate consumption were excluded from the study.

Results:

The duration of survival post consumption has been divided into 3 categories: Those who survived for less than 24 hrs (<1 day), 24hrs to 72 hrs of survival (1-3 days) and more than 72 hrs of survival post consumption (>3 days).Of the 40 cases, 6 cases(15%) survived for a duration of less than 24 hrs,8 cases(20%) survived for a duration between 24 and 72 hrs and 26 cases(65%) survived for a maximum duration; i.e more than 72 hrs as shown in Table 1.

Table 1: Duration of survival of 40 cases

Duration of survival	No. of cases	Percentage of cases
<24 hrs	6	15%
24-72hrs	8	20%
>72 hrs	26	65%

Liver: Of the 40 specimens of liver sent for histopathological examination, congestion of the liver was observed in 21 cases(52.5%), followed by 8 cases(20%) showing fatty changes in the liver, 4 cases(10%) revealed centrilobular necrosis and 5 cases(12.5%) of alcoholic hepatitis and 2 cases(5%) of sinusoidal dilation of the liver as depicted in Table 2. All cases (6 cases-100%) which had a survival for duration of less than 6 hrs showed congestion of the liver.Cases with a survival between 24 hrs and 72 hrs showed a congestion of liver in 4 cases (50%), and 2 cases (25%) each showed fatty changes and alcoholic hepatitis. Cases with a survival beyond 72 hrs showed congestion in 11 cases (42.3), fatty change in 6 cases (23%), centrilobular necrosis in 4 cases(15.3%), alcoholic hepatitis in 3 cases(11.5%) and sinusoidal dilation of liver in 2 cases(7.69%) as shown in Table 3.

Table 2: Histopathological changes in the liver in 40 cases

HPE findings	No. of cases	Percentage of cases
Congestion	21	52.5%
Fatty changes	8	20%
Centrilobular necrosis	4	10%
Alcoholic hepatitis	5	12.5%
Sinusoidal dilation	2	5%

Table 3: Comparing the changes in the liver with the duration of survival

HPE findings	Duration of Survival		
	<24 hrs	**24hrs-72 hrs**	**>72 hrs**
Congestion	6	4(50%)	11(42.3%
Fatty changes	0	2(50%)	6(23%)
Centrilobular necrosis	0	0	4(15.3%)
Alcoholic hepatitis	0	2(50%)	3(11.5%)
Sinusoidal dilation	0	0	2(7.69%)
Total	6	8	26

Lungs: As shown in Table 4,of the 40 specimens sent, congestion of the lungs was observed in all cases. Associated with congestion, 2 cases showed changes of bronchopneumonia and remaining 38 cases revealed necrosis of epithelium with formation of hyaline membrane. Congestion of the lungs was seen in all cases which had a survival upto 72 hrs. Cases with a survival beyond 72 hrs showed congestion in 26 cases (100%). Necrosis of epithelium, with formation of hyaline membrane was observed in 38 cases (95%), changes of bronchopneumonia in 2 cases (5%) as described in Table 5.

Table 4: Histopathological changes in the lungs in 40 cases

HPE findings	No. of cases	Percentage of cases
Congestion	40	100%
Suggestive of ARDS	38	95%
Changesof bronchopneumonia	2	5%

Table 5:Comparing the changes in the lungs with the duration of survival

HPE findings	Duration of Survival		
	<24 hrs	24-72 hrs	>72 hrs
Congestion	0	0	26
Suggestive of ARDS	0	0	38
Changes of bronchopneumonia	0	0	2

Kidneys: Of the 40 specimens sent, congestion of both the kidneys was observed in all cases. Associated with congestion, features such as necrosis, degeneration and regeneration of tubular epithelium suggestive of acute tubular necrosis were observed in 34 cases and tabulated in Table 6. Congestion of the kidneys was seen in all cases which had a survival upto 24 hrs. Congestion associated with necrosis, degeneration and regeneration of tubular epithelium was observed in 8 cases (100%) within duration of survival of 24-72 hrs and 26 cases (100%) beyond duration of 72 hrs survival as shown in Table 7.

Table 6: Histopathological changes in the kidneys in 40 cases

Microscopic changes	No. of cases	Percentage of cases
Congestion	40	100%
Suggestive of ATN	34	85%

Table 7: Comparing the changes in the kidneys with the duration of survival

HPE findings	Duration of Survival		
	<24 hrs	24-72 hrs	>72 hrs
Congestion	40	+	+
Suggestive of ATN	0	8	26

+ indicates congestion was associated with features suggestive of ATN

Discussion:

It is interesting to note in the present study that the deliberate ingestion of Organophosphate with suicidal intention is more common in males (65%) compared to that of females (35%) and is consistent with the studies conducted by SrinivasRao et al[4], Gannur DG et al[5], Agarawal et al[6], contrary to the studies conducted by Chataut J et al[2], Paudyal BP et al[7].

The histopathological findings in the liver in the present study were compared with the findings of the study conducted by Seema SS & Tirpude BH[8]. As depicted in Table 8, congestion of the liver was appreciated in a maximum number of cases in both the studies, 52.5% in the present study and 46.51% in the comparative study, followed by fatty changes in the liver of 20 % of cases in the present study compared to 34.88% centrilobular necrosis of the liver was seen in 10% of cases in the present study compared to 9.30% in the comparative study. The microscopic feature least seen in the present study was the sinusoidal dilation of the liver amounting to 5% and the microscopic feature least seen in the comparative study was alcoholic hepatitis of 2.33%.

Poison and toxin which are released during metabolism and hemolysis results in organ failure as a consequence of ARDS in lungs, Centrilobular necrosis in the liver and acute tubular necrosis of the kidneys. Release of cytokines such as activated macrophages and activated neutrophils results in formation of hyaline membrane resulting in a stiff lung.

Bronchopneumonia may be attributed due to aspiration.

Table 8: Comparison between two studies on the HPE findings in the liver

HPE findings	Present study	Seema SS& TirpudeBH study
Congestion	52.5%	46.51%
Fatty changes	20%	34.88%
Centrilobular necrosis	10%	9.30%
Alcoholic hepatitis	12.5%	2.33%
Sinusoidal dilation	5%	6.98%

Conclusion:

In the present study which mainly concentrates on the histopathological findings it is to be noted that all the organs (lungs, liver and kidneys) sent for histopathological examination showed some effects of the poison ingested.

The liver is the main organ for detoxification of poison and the kidneys are the main organs of excretion of the poison and this fact was evident from the congestion appreciated in these organs. Features such as ARDS secondary to ingestion was observed in all cases with a survival beyond 72 hrs. Features in the kidneys involving the tubules (degeneration, regeneration and necrosis) were appreciated in almost all cases.

Through this study, the confusion among the autopsy surgeon regarding the final cause of death is minimised. A clearer and specific opinion regarding the cause of death can be opined in all cases showing features of ARDS, and death can be opined as respiratory failure as a result of organophosphate poisoning, and in cases showing acute tubular necrosis, the cause of death can be opined as acute renal failure as a result of organophosphate poisoning. Knowing the rapidity of involvement of an organ is beneficial to the treating physician as well thereby helping him reduce the morbidity and hence mortality.

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