Carbamate Poisoning – An Autopsy Study

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Abstract

Acute poisoning is a cause of both morbidity and fatality in many parts of the world. Furadan, the organo-carbamate commonly available in Kerala, being used in plantain, tea, potato and carrot farms as insecticide are usually misused as an easy source of poison for suicide. This study was carried out on Twenty nine medico legal cases, brought with history of carbamate poisoning which were brought for autopsy during the period from January 2014 to June 2015. The main objectives of the study were to study post-mortem findings in Carbamate poisoning, clinical profile in Carbamate poisoning and histopathological changes in Brain, Heart, Lungs, Liver and Kidney due to Carbamate poisoning. Males (82.8%) outnumbered females and maximum cases were of age group 51-60 yrs (27.6%). Most of the victims were taken to hospital for treatment and died after admission (58.6%). Such studies of poisoning cases will help authorities for planning, prevention and treatment of these cases

Key Words: *Agriculture, Death, Furadan, Insecticide, Poisoning*

Introduction

Agriculture had always been a part of human civilization and involved domestication of plants and animals. From the archaeological evidences it is believed to have developed around 12,000 years ago, although earlier people began altering communities of flora and fauna for their own benefit.[1]Archaeological remnants indicates that rice was a part of the Indian diet as early as 8000 BC.[2]

The Food and Agriculture Organization (FAO) has defined pesticide as any substance or mixture of substances intended for 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, transport, or marketing of food, agricultural commodities, wood and wood products or animal feedstuffs, or substances that 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 agent for thinning fruit or preventing the premature fall of fruit. Also used as substances applied to crops either before or after harvest to protect the commodity from deterioration during storage and transport.[3]

The first known pesticide in history would have been sulfur dust used in Sumeria about 4500 years ago. In recorded history, nicotine sulfate extracted from tobacco leaves were used as an insecticide in the seventeenth century. During World War II, DDT (dichloro-diphenyl-trichloroethane) was the most effectively used agent against mosquitos, with high larvicidal and adulticidal properties. However, concern over its residues, magnification and ecological implications were voiced by researchers and practitioners. Above all, possibility of emerging resistance to DDT created concern among them, who advocated development of more desirable and effective substitutes. These include methoxychlor, DDD (Dichloro-diphenyl-dichloroethane), tetra-chloro diphenylethane (TDE) and others, but they also showed

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activity similar to that of DDT.[4]

The production of pesticides started in India in 1952 with the setting up of a plant for the production of BHC (Benzenehexachloride) near Calcutta, and India is a leading manufacturer of pesticides in Asia standing next to China and ranks twelfth globally.[5] There are 234 pesticides registered in India. Out of these, 4 are WHO Class Ia (Extremely Hazardous) pesticides, 15 are WHO Class Ib (Highly Hazardous) pesticides and 76 are WHO Class II (moderately toxic) pesticides, together constituting 40% of the registered pesticides in India.[6]

Agriculture in South India involves 127 million cultivators and 107 million agricultural laborers. Crop productivity in India mostly depends on the monsoons and as such is low and unpredictable. Monsoon-fed areas include more than 70% of the cultivated land in the country. A major chunk of the population (74.3%) is rural and 34.7% live below the international poverty level.[7] During the Green Revolution, to increase the productivity, high-yielding varieties of various crops were introduced. These varieties were significantly more susceptible to plant pests and diseases and, subsequently, the use of pesticides became more popular, increasing from 2,330 kilo ton during 1950–51 to 54,773 kilo ton in 1990–91 (Directorate of Plant Protection, 2002)[8]

The Government of Kerala has banned the sale of Red category pesticides such as Phorate, Thimet and Furadan in the State two years ago, the application of such chemicals is increasing in the state in an alarming rate as they are easily available over the counter at shops in the Kerala-Tamil Nadu border area and there are no government agencies at the border check-posts to monitor their transportation.[9] Because of the easy availability, case of accidental and suicidal poisoning by these pesticides are on the increase and most of them end fatally.

Carbamates are esters of carbamic acid with an anticholinesterase action.[10] They are used as insecticides, fungicides, herbicides, nematicide and acaricide. They are effective by contact, ingestion or inhalation or any other routes through which it can reach the body.[11,12] Their carbamoyl and thiocarbamoyl structure account for their inhibitory action on cholinesterases.[10-12] Carbamates are available as Aldicarb (temic), Carbaryl (agrovin, agoryl, bangvin 50, caravet, hexavin, kevin 50, kilex carbaryl, sevin 50, sujacarb); Carbaryl+gamma BHC(sevidol); carbofuran(agrofuron 3g, furadan 3g, hexafuran, vegfru diafuran); Methomyl (lannate); Propoxur (baygon, protox bait); Triallate (avadex).

Material and Method

This descriptive study was conducted on all cases with history of Carbamate poisoning brought for autopsy at state medico legal institute during the study period.

The study was conducted for one and a half years duration from 1st January 2014 to 30th June 2015. General information regarding demographic profile, socioeconomic status etc. of each case were collected from relatives. During autopsy the macroscopic appearances of the organs were recorded in the proforma. Bits of tissues from brain, heart, lungs, liver and kidney were collected using sharp knife and were fixed in formalin. The tissues were processed in histokinete and embedded in paraffin wax, cut with a standard microtome and slides were prepared. After that slides were stained with eosin and haematoxylin. Microscopic study of each slide was made at this stage and all microscopic details were recorded in the proforma.

Samples were collected for chemical analysis which include-stomach and upper part of intestine with their contents, about 500g of liver and one half of each kidney. These samples were preserved in saturated saline and send to the chemical examiner's laboratory, Thiruvananthapuram for chemical analysis. Blood and urine, if available was also taken for chemical examination .The report of chemical analysis was collected and analysed for correlation with clinical findings.

The details of the hospital records were analysed with special reference to the clinical findings, laboratory investigation and period of survival. All these findings were compared with the histopathological changes noticed in the cases.

The collected data were statistically analysed in form of ratio & frequencies and compared with other studies.

Findings

In our study out of total 29 carbamate poisoning cases 82.8% were males and 17.2 % were females. In age group analysis maximum incidence was seen in age group of 51 to 60 years (27.6%), followed by 61-70 years (17.2%).

Present study showed that majority of the cases were farmers (41.4%), followed by manual labourers (27.6%), government servants (10.3%) and housewives (10.3%). One case was a student (3.4%) and two of them were unemployed (6.9%)

Among the 29 cases studied, 31% were graduates, followed by those having plus two qualifications (20.7%) and those studied up to tenth standard (20.7%). Cases who studied up to primary school level and high school level respectively constituted 13.8% each.

Majority of victims consumed furadan along with food (82.8%), whereas the rest consumed furadan mixing it with alcohol (10.3%), with formic acid (3.4%) and with aspirin tablets (3.4%).

Majority of the victims (58.6%) were taken to hospital for treatment and died after admission, while 24.1% of them were brought dead at the emergency department and 17.2% of them were seen dead.

Among the cases studied majority of cases (62.1%) had inter personal problems, while 31% had financial crisis and 6.9% had some unknown reasons for terminating their life.

Death occurred within 12 hours in 62.1% of cases, 41.4% died within one hour of consumption of poison. One victim died on the second day and two of them died on the third day. Eight victims (27.6%) survived more than three days

Among the cases studied 41.4% were not treated, whereas the rest of them (58.6%) were treated as inpatients which included 20.7% cases who needed ventilator support.

The major presenting symptoms were central nervous system symptoms like headache, dizziness, anxiety or convulsion (62.1%) and muscarinic symptoms like salivation (62.1%), followed by sweating (51.7%) and abdominal pain (51.7%).Nicotinic symptom like muscle fasciculation were found in 48.3% of cases. Shock was observed in 24.1% of cases. Froth at nostrils was observed in 31% of cases and lacrimation in 20.7%.

Impairment of plasma choline esterases levels were observed in 11 cases (37.9%). Liver function tests were impaired in 27.6% cases and renal functions were impaired in 20.7% cases.

The results of chemical analysis revealed furadan alone in 79.3% cases. Furadan along with ethyl alcohol were detected in 10.3% cases and furadan along with formic acid were detected in 3.4% cases. In 6.9% cases no poison were detected.

Apart from generalized cyanosis and congestion which were present in all cases, the violet sandy furadan particles were found in stomach in 82.8% cases. Miosis was observed in 58.6% cases and froth at nostrils in 32% cases. Unusual smell of stomach contents were observed in 27.6% cases.

Table 1: Distribution of post mortem findings

Post-mortem appearances	**Frequency**	**Percentage**
Cyanosis	29	100
Congestion	29	100
Furadan particles in stomach	24	82.8
Miosis	17	58.6
Froth at nostrils	9	31
Unusual smell	8	27.6

Congestion was the major finding in liver, found in 86.2% cases. Liver was pale in 13.8% cases. 10.3% showed fatty changes, and one case each showed cirrhosis and sub capsular hemorrhage. The major microscopic change observed in liver was congestion in 86.2% cases. Foamy hepatocytes were observed in 48.3% cases. Macro vesicles were seen in 37.9% cases. Thirty one percent cases showed enlarged hepatocytes and 27.6% showed periportal fibrosis. Hepatocyte necrosis and inflammatory infiltrates were observed in 13.8% and 6.9% cases respectively.

Table 2: Macroscopic findings in liver

Findings	**Frequency**	**Percentage**
Congestion	25	86.2
Pallor	4	13.8
Fatty liver	3	10.3
Cirrhosis	1	3.4
Subcapsular haemorrhage	1	3.4

Macroscopically in 65.5% kidneys were congested. Cortical hemorrhages were observed in 48.3% of cases and prominence of cortico-medullary demarcation was observed in 37.9% cases. Pallor was observed in 34.5% cases. On histopathology examination, the major change observed was congestion in 65.5% cases. Tubular necrosis was observed in 48.3%, while 34.5% cases showed shrinkage of glomeruli. Red blood cell casts and inflammatory infiltrates were observed in 6.9% cases.

Table 3: Microscopic findings in kidney

Findings	**Frequency**	**Percentage**
Congestion	19	65.5
Tubular necrosis	14	48.3
Shrinkage of glomeruli	10	34.5
RBC cast in tubules	2	6.9
Inflammatory infiltrates	2	6.9

Photo 1: Violet sandy furadan particles mixed with stomach contents

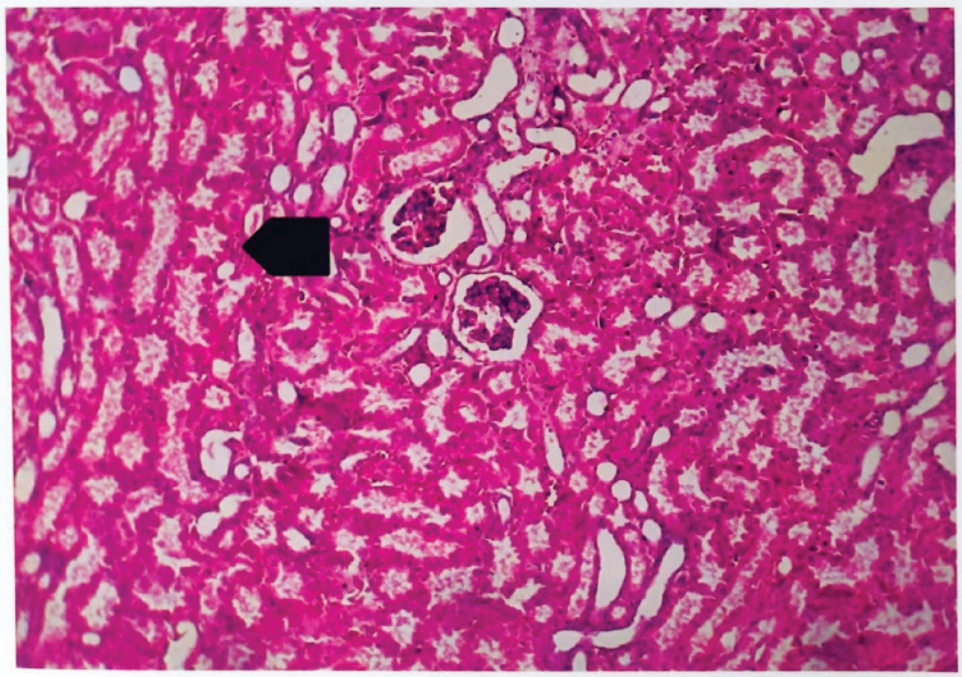

Photo 2: Microscopic picture of Kidney showing tubular epithelial damage and epithelial debris in lumen

On gross examination, heart showed congestion in 65.5% cases. Other findings observed were sub endocardial hemorrhages (34.5%) and flabbiness of myocardium (20.7%).Myocardial fibrosis (10.3%) , myocardial hemorrhage (7%). and sub epicardial petechial hemorrhages (7%) were also observed. Congestion of cardiac muscle were observed in 65.5% cases on histopathology. Two cases (6.9%) showed myocardial hemorrhage.

Table 4: Macroscopic findings in heart

Findings	Frequency	Percent
Congestion	19	65.5
Sub endocardial hemorrhage	10	34.5
Flabby myocardium	6	20.7
Myocardial fibrosis	3	10.3
Hemorrhage in myocardium	2	6.9
Sub epicardial petechial hemorrhage	2	6.9

Lungs showed congestion in all cases. Oedema was observed in 41%, consolidation in 34.5% and emphysematous changes in 24% of cases. Microscopic examination of lungs revealed congestion in 34.5%, hemorrhage in 44.8% and oedema in 41.4% and shock lung in 24.1% cases.

Gross examination of brain showed congestion and oedema in 93% of cases. Sub arachnoid hemorrhage was observed in one case Histopathological examination of brain showed congestion in 93.1% cases and oedema in 75.6% cases.

Shock lung was not observed in cases that survived for less than 24 hours. It was observed in 7 cases, one among them survived for more than one day but died within two days, two cases survived for more than two days but died within three days and four among them survived for more than five days.

Lung consolidation was observed in 10 cases (34.4%), out of which all cases survived for more than two days. Eight among them survived more than 3 days and four of them survived more than 5 days.

Acute tubular necrosis of kidneys were observed in 14 cases (48.3%). Ten cases among them survived for more than 48 hours. It was not detected in any case that survived for less than an hour.

Sub endocardial haemorrhage was observed in 10 cases (34.4%). Among them 7 cases had gone into circulatory shock during treatment. Three of the cases with sub endocardial haemorrhage succumbed to death before reaching hospital and hence the data could not be assessed.

Conclusion

Carbamate poisoning is acquiring the status of a special clinical entity because of its increased incidence in south India. Although Furadan is banned in kerala, the preparation is available over the counter in nearby states and is traded illegally across borders. The present study is to find out the relation between clinical, autopsy and histopathological findings in fatal cases of carbamate poisoning.

The results of present study are summerised as follows

1. It was found that 27.6% of the victims belonged to the age group of 51-60 years.
2. The majority of victims were males 82.8% and the rest were females 17.2%
3. Analysis of victims according to their occupation revealed that majority (41.4%) of them was farmers.
4. Among the victims 31% of them were graduates
5. Majority of the victims consumed furadan along with food (82.8%) and 10.3% consumed furadan mixed with alcohol
6. Most of the victims were taken to hospital for treatment and died after admission (58.6%)
7. All cases were suicidal and inter personal problems were the major triggering factor ending up in suicide (62%)
8. Death occurred within 12 hours in 62% cases where 41% died within one hour of consumption of poison

9. Major presenting symptoms were central nervous system symptoms 62.1% and muscarinic symptoms 62.1%
10. Impairment of plasma cholinesterase level was observed in 38% cases. Liver function tests were impaired in 27% cases and renal functions were impaired in 20% cases
11. The results of chemical analysis revealed furadan in 79.3% cases and no poison was detected in 6.9% cases
12. On post mortem examination violet sandy furadan particles were found in stomach in 24 cases (82.8%). Among them 12 cases had undergone stomach wash.
13. Gross examination of liver showed congestion 86.2% cases. Microscopically liver showed congestion (86.2%), foamy hepatocytes (48.3%) and macro vesicles (38%)
14. Macroscopic examination of kidneys showed congestion in 65.5% cases, cortical hemorrhages in 48% and on microscopy congestion was observed in 65.5% followed by tubular necrosis in 48.3%.
15. Heart showed congestion 65.5% cases and sub endocardial hemorrhage in 34.5% cases. Microscopy showed congestion in 65.5% cases
16. Pulmonary congestion was observed in all cases and oedema was observed in 41% cases
17. Gross examination of brain showed congestion and oedema in 93% cases. Microscopy revealed oedema in 75.6% cases

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