Original Research Paper

The Study of CNS Manifestations in Aluminium Phosphide Poisoning

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Abstract

With rapid development in the field of science & technology and green revolution in the agricultural sector, the problem of acute aluminium phosphide poisoning leading to morbidity and mortality is spreading like a wild fire. Different disciplines of medical science are working on various aspects both from treatment as well as preventive point of view. Aluminium Phosphide is a very toxic, cheap, ideal suicidal and lethal protoplasmic poison involving all generations and organ systems of the body. Although its incidence was unknown before 1980 but now it has surpassed every other poisoning in India especially in the northern states and has created havoc with the human lives. Our study showed that males (1.94:1) are the major sufferer with high mortality rate (76%). The freshness of tablet and lack of specific antidote are directly related to its poor prognosis. Major CNS manifestations are dizziness (52%) and headache (44%). Loss of consciousness is only the terminal event and sufficient time is available to record the dying declaration. Magnesium sulphate has some role in its management.

Key Words: Aluminium Phosphide Poisoning, CNS Manifestations, Sensorium of the Patient

Introduction:

Aluminium phosphide, is in use as solid fumigant pesticide since the 1940s, has all the properties of an ideal fumigant such as cheap, cost effective, highly effective even with single application, handy, easy to transport, peculiar smell and lethal to the target species.

It is available as 3gms tablet and on coming in contact with water or hydrochloric acid (HCl) in stomach liberates inflammable, colourless phosphine gas having garlic or stale fish like pungent smell due to added impurities.

Less than 500 mg of an unexposed pellet of aluminium phosphide is fatal for an adult (usual being 150 - 500 mg for a 70 kg individual) and the fatal Period is one hour to four days but majority die within twenty-four hours. [1-4]

Mechanism of Action:

The exact mechanism of action is still not clear. It was assumed that aluminium phosphide produces non-competitive inhibition of cytochrome oxidase (a respiratory chain enzyme of mitochondria).

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DOR: 02.03.2015 DOA: 30.06.2015
DOI: 10.5958/0974-0848.2015.00068.8

Thus it will lead to diffuse cellular hypoxia and therefore acts as a protoplasmic poison. In a study by Nakakita et al [5] phosphine was found to be a potent inhibitor of ADP uncoupler and ion stimulated respiration but the exact target site was not detected. Price and Dance [6] heavily poisoned three species of stored beetles with phosphine and found that there was no inhibition of cytochrome system but the insect catalase was inhibited.

Cheufurka et al [7] found that phosphine was a strong inhibitor of mitochondrial respiration in the active state (state 3) than resting state (state 4).

It inhibited the uncoupled site and ion pumping state which could not be reversed by uncouplers suggesting that it is due to a direct effect on electron transport which is an important electro-chemical link between respiration and phosphorylation in mitochondria.

This inhibition is in the Ki range from 1.6 x 10^{-5} to 7.2 X 10^{-5}. It also causes changes in the dichroic spectra of haemoglobin suggesting a valency change in haem accompanied by confirmational changes in the prosthetic group. There is interaction of phosphine with the heam moiety of cytochrome oxidase (cytochrome-c), but it is yet to be determined whether it interacts with cytochrome a or a_3 or both.

After the ingestion of aluminium phosphide, phosphine is liberated in the stomach, which is absorbed into the circulation. Some of the parent compound, i.e. aluminium

phosphide itself, is also absorbed and is metabolised in the liver with a slow release of phosphine, accounting for prolongation of symptoms. The absorbed phosphine is oxidised slowly to oxyacids and excreted in urine as hypophosphite. It is also excreted in significant amount in unchanged form through lungs and can be detected by placing silver nitrate paper in the mouth. Phosphine produces widespread organ damage due to cellular hypoxia produced as a result of its binding to cytochrome oxidase. Acute cardiotoxicity is possibly related to the subcellular trans-membrane exchange of ions (Na, K, Mg and Ca) due to focal myocardial necrosis produced by phosphine. [1, 8]

It is a common concept that every coin has "two sides", a darker and another brighter. The doctors/scientists working in this field are facing the darker side. Doctors attending the court are facing battery of questions such as status of sensorium after its consumption and fitness to make dying declaration etc.

Present work will be a mild attempt to highlight these things.

Aims and Objectives:

The our study was conducted on 50 confirmed cases of aluminium phosphide poisoning admitted to Medicine department, Government Medical College, Amritsar from 01-10-2004 to 15-04-2006 to determine

1. The CNS manifestations.
2. State of sensorium in relation to dying declaration.
3. Relationship of freshness of aluminium phosphide tablets to mortality.

Material & Methods:

The diagnosis of aluminium phosphide poisoning was based on reliable history of ingestion, circumstantial evidences such as the production of the remaining tablets/empty container by the relatives, garlic/decaying fish like odour. Our study consists of 50 cases of aluminium phosphide poisoning which were confirmed by **'silver nitrate filter paper test'** with gastric lavage of the patient. [9, 10]

Results:

In our study of 50 cases males (66%) outnumbered females (34%) with 1.94:1 ratio, more common in married 68% (46% males & 22% females) than non-married 32% (20% males & 12% females) with ratio of 2.1:1 and mostly cases (86%) were of suicidal poisoning. No case of homicidal poisoning was recorded in our study and the mortality rate was 76%.

The minimum period between ingestion of poison and death was observed to be 3 hours 5 minutes and maximum period was 27 hours 50 minutes and mean survival time period was 4 hours 56 minutes in our study. The majority of cases (63.16%) expired within 1-6 hours.

The major CNS manifestations in our study of aluminium phosphide poisoning were dizziness 52% and headache 44%. Convulsions were seen only in 08% patients. (Table1)

Patients were closely monitored for the state of consciousness. (Table 2) In present study 38 patients expired and 12 survived. Out of 38 expired patients two remained conscious till death while maximum cases (44.44%) lost consciousness between 2-4 hrs. and 27.78% cases lost consciousness between 4-6 hrs.

Only 13.89% lost consciousnesses between 0-2 hrs. So majority of cases remained conscious for many hours.

In this study we also observed that 76% of the patients died after ingesting 'fresh' tablets of aluminium phosphide. 24% patients who took 'exposed' tablets survived.

In our study 42 patients were treated with magnesium sulphate but only 12 patients who had taken exposed tablets survived. Out of 12 patients 10 patients had changes in their ECG. These changes were successfully reverted with magnesium sulphate therapy.

Discussion:

Regarding the CNS manifestations and sensorium of individuals in aluminium phosphide poisoning Cases Our study was consistent with the study by Kalra et al [11] where majority of patients were restless throughout the period of hypotension although their sensorium was clear till the end. Our study was also comparable with other studies by Chopra et al [12] and Gupta [13] where only 25% and 24% cases respectively were admitted with altered sensorium.

But our study is not consistent with the findings of Khosla [14] in which 40% cases were admitted in delirious state and expired. The possible reasons for this difference could be due to difference in number of patients studied, dose and freshness of the tablet, early admission to the hospital. So unconsciousness is only the terminal event and literature on shock clearly indicates that sensorium remaining clear in all forms of shock till the terminal stage.

In present study a direct positive correlation between the freshness of aluminium phosphide tablets consumed and mortality rate was found. Our findings are similar to Chopra et al [12] who observed that the only factor which predicted a poor prognosis was the ingestion of 'unexposed' tablets.

Chugh et al [15] also reported that patients with history of ingestion of fresh

aluminium phosphide compound had florid clinical symptoms and high mortality rate (80%). It is clear from various studies that exposed tablets are less potent than unexposed tablets because the atmospheric moisture reacts with aluminium phosphide to release phosphine, thus decreasing the toxicity of the tablet.

In our study 42 patients got magnesium sulphate therapy but only 12 patients who had taken exposed tablets survived. Out of 12 patients 10 patients had changes in their ECG. These changes were successfully reverted with magnesium sulphate therapy, consistent with Chugh et al study. [16] The loading of magnesium sulphate dose schedule significantly brought down the mortality rate irrespective of the dose consumed.

So it was suggested that hypomagnesaemia might be responsible for high mortality of patients of aluminium phosphide poisoning and its correction has beneficial effect on management and ultimate favourable outcome of the illness.

Siwach et al [17] studied 30 non survivors of aluminium phosphide poisoning and similar number of age and sex matched controls. Magnesium content was estimated in different organs. It was observed that magnesium content was not significantly different between controls and patients who were not given magnesium sulphate. Rather magnesium levels were significantly high in patients who got treated with magnesium sulphate.

So hypomagnesaemia treated with magnesium sulphate therapy suggested by various workers does not really exist.

Conclusion:

Aluminium phosphide is a protoplasmic deadly poison. Mortality rate is directly proportional to freshness of the tablet. Loss of consciousness is the terminal event and sufficient time is available to record the dying declaration. Lack of specific antidote is the biggest lacuna in its management.

Magnesium sulphate has some role in the management of acute poisoning. Carelessness in storage could lead to accidental exposure and immediate first aid can be life-saving.

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Table 1: CNS Manifestations in Aluminium Phosphide Poisoning

CNS manifestations	Cases	Percentage
Headache	22	44%
Convulsions	04	08%
Dizziness	26	52%

Table 2: Time Elapsed between Loss of Consciousness and Intake of Poison

Time elapsed between loss of consciousness and intake of poison	Cases (%)
0-2 hrs	05 (13.9)
+2-4hrs	16(44.4)
+4-6hrs	10(27.8)
+6-8hrs	02(5.6)
More than 8hrs	03(8.3)
Total	36(100)