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To Determine Various Prognostic Factors in Aluminium Phosphide Poisoning and Role of Bicarbonate and Coconut Oil Lavage in Management of Aluminium Phosphide Poisoning

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Abstract: ***Introduction: The mortality in aluminium phosphide poisoning depends upon various prognostic factors and method of gastric lavage. Aims and Objectives: To determine various prognostic factors in patients of Aluminium phosphide poisoning and to study the role of bicarbonate & coconut oil lavage in management of Aluminium phosphide poisoning. Methods: The study was conducted in Department of Medicine, M. L. B. Medical College, Jhansi. A sample size of 100 patients were selected as per criteria. Results: In our study the mortality in patient lavage with KMNO4 (group B) 28 out of 50 (56%) was more as compared to patient lavage with coconut oil and bicarbonate (group A) 4 out of 50 (8%). Conclusion: Dosage of poison, time taken to reach hospital, ECG findings, trop I, serum lactate, creatinine, soda bicarbonate, blood pH are important prognostic markers in the mortality and morbidity in aluminium phosphide poisoning. Inotropic support, mechanical ventilation support, Glasgow coma scale and APACHE II scale also aids in the prognosis. Hence, lavage with coconut oil and soda bicarbonate is recommended.***

Keywords: aluminium phosphide, lavage, celphos, soda bicarb, kmno4, mortality

1. Introduction

Incidences of Aluminum poisoning are increasing, particularly in rural region of northwest and central India largely due to lack of awareness and poor regulation regarding the accessibility of this gravely toxic compound.
Mortality depends on - Dose of poison, Freshness of compound, vomiting soon after the ingestion, Time interval between the consumption of poison and initiation of resuscitative measures & Development of metabolic acidosis and refractory shock is the most important clinical evidence of severity.

On the basis of our study – the poor prognostic factors were – High APACHE II score, Low Glasgow coma scale, Presence of shock, ECG abnormalities, Acute renal failure, Need for vasoactive drugs, Use of mechanical ventilation, ARDS and aspiration pneumonitis development, Leukocytosis, Altered mental status & Low prothrombin rate.

Mortality is very high (40 - 100%) among such patients, as there is no specific antidote available. There is limited Indian data available on prognostic markers & predictors of mortality.

Hence, the purpose of the study was to study the patients with ALP poisoning and to identify the role of bicarbonate & coconut oil lavage in its management

2. Aims and Objectives

- To determine various prognostic factors in patients of Aluminium phosphide poisoning.
- To study the role of bicarbonate & coconut oil lavage in management of Aluminium phosphide poisoning.

3. Material and Methods

This study was conducted in the department of Medicine, MLB Medical College, Jhansi on 100 patients admitted to our hospital with history of ingestion of aluminium phosphide.

A pre - structured Proforma was filled up for the study. Each subject was given a thorough work up for history and physical examination to fulfil the inclusion and exclusion criteria. Routine haematological and biochemical investigations were carried out.

Age, sex matched heathy individual were taken as comparison groups.

Inclusion criteria:

- Patients who have consumed aluminium phosphide.
- Patients/relatives who have given written informed consent
- Patients of age >18yrs

Exclusion criteria:

- Patients with unclear diagnosis of poisoning.
- Patients with history of multiple drugs poisoning.
- Patients who have refused/ not given written informed consent.

Thereafter all the patients in the study were randomly divided into 2 groups:

- **Group A (50 cases) =** In patients of group A, Gastric lavage was done with coconut oil and Sodium Bicarbonate solution, additional intravenous Soda Bicarb infusion was given to maintain mild alkalosis (pH =7.45 & HCO3 - =30).
- **Group B (50 cases) =** In patients of Group B, Gastric lavage was done with plain water and KMnO4.

3. Results

The present study was conducted in the department of Medicine, MLB Medical College, Jhansi from March 2021to August 2022 on 100 patients admitted to our hospital with history of ingestion of aluminium phosphide. Full history was taken and clinical examination was done. The laboratory investigations were sent before the treatment was started. Patients were followed up.

Group A – Lavage with coconut oil and soda bicarbonate.
Group B – Lavage with KMNO4.

Table 1 (a): Distribution of cases according to dosage and mortality (Group A)

Dosage (tablet)	No. of cases (%)	Mortality (%)	p Value
<1	16 (32%)	0	< 0.0001
1-2	14 (28%)	0	
>2	20 (40%)	4 (20%)	
Total	50 (100%)	4 (8%)	

The chi - square statistics is 21.4919.

In our study, out of 50 patients of group A, 30 patients (60 %) had consumed < 2 tablets and none of them expired and 20 (40 %) patients consumed >2 tablets and 4 (20 %) of them expired. Maximum mortality (20 %) was seen in patients who has consumed >2 tablets. As the dose of poison increases mortality rate also increases and is statistically significant (p Value<0.0001).

Table 1 (b): Distribution of cases according todosage and mortality (Group B)

Dosage (tablet)	No. of cases (%)	Mortality (%)	p Value
<1	0	0	< 0.0001
1-2	35 (70%)	15 (42.85%)	
>2	15 (30%)	13 (86.67%)	
Total	50 (100%)	28 (64.76%)	

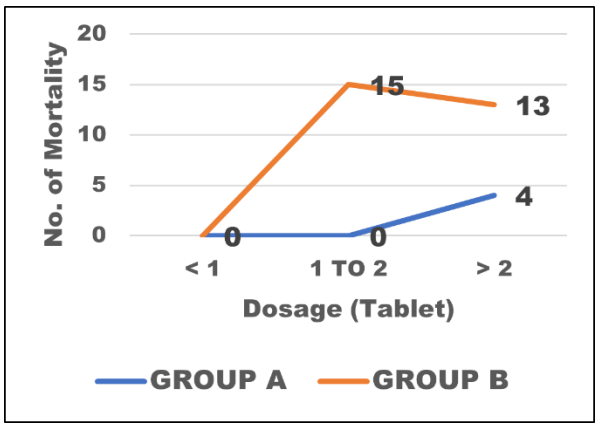
The chi - square statistics is31.0644.

In our study, out of 50 patients of group B, 35 patients (70 %) had consumed < 2 tablets and 15 (42.85 %) of them expired and 15 (30 %) patients consumed >2 tablets and 13 (86.67 %) of them expired. Maximum mortality (86.67 %) was seen in patients who has consumed >2 tablets. As the dose of poison increases mortality rate also increases and is statistically significant (p Value - <0.0001).

Table 1 (c): Comparison according to dosage

Dosage (tablet)	Group A Mortality	Group B Mortality	p Value
<1	0	0	< 0.001
1-2	0	15	
>2	4	13	
Total	4	28	

The chi - square statistics is22.9419.



As evident from this table, the mortality in patient's lavage with KMNO4 (group B) was more as compared to patient lavage with coconut oil and bicarbonate (group A) and is statistically significant (p Value<0.0001)

Table 2 (a): Type of tablet consumed (Group A)

Type of poison	No. of cases (%)	Mortality (%)	p Value
Fresh	29 (58%)	4 (19%)	< 0.000885
Exposed	21 (42%)	0	
Total	50 (100%)	4 (8%)	

The chi - square statistics is11.0419.

In Group A, 29 (58%) patients consumed fresh tablets of aluminium phosphide from which 4 patients (19%) expired while 21 (42%) patients had consumed exposed tablets from which none expired. Consumption of fresh tablets led to significantly high mortality rate and is statistically significant (p Value - 0.000885).

Table 2 (b): Type of tablet consumed (Group B)

Type of poison	No. of cases (%)	Mortality (%)	p Value
Fresh	38 (76%)	28 (73.68%)	< 0.00025
Exposed	12 (24%)	0	
Total	50 (100%)	28 (56%)	

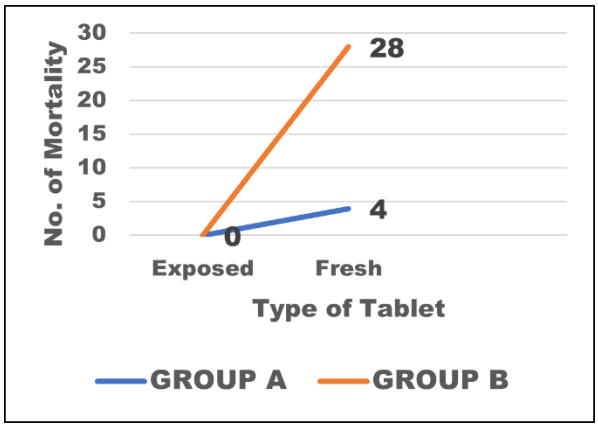
The chi - square statistics is17.7312.

In Group B, 38 (76%) patients consumed fresh tablets of aluminium phosphide from which 28 patients (73.86%) expired while 12 (24%) patients had consumed exposed tablets from which none expired. Consumption of fresh tablets led to significantly high mortality rate and is statistically significant (p Value - 0.00025).

Table 2 (c): Comparison according to type of tablet consumed

Type of tablet	Group A Mortality	Group B Mortality	p Value
Fresh	4	28	< 0.00085
Exposed	0	0	
Total	4	28	

The chi - square statistics is16.9419.



As evident from this table, the mortality in patient's lavage with KMNO4 (group B) was more as compared to patient lavage with coconut oil and bicarbonate (group A.) and is statistically significant (p Value - 0.000885).

Table 3 (a): Distribution of cases according to time taken to reach the hospital (Group A)

Duration (Hrs.)	No. of cases (%)	Mortality (%)	p Value
<2	7 (14%)	0	< 0.00001
2-6	32 (64%)	1 (16%)	
>6	11 (22%)	3 (18%)	
Total	50 (100%)	4 (8%)	

The chi - square statistics is48.2484.

In Group A, 39 (78%) patients reached the hospital within 6 hours of ingestion of poison from which 1 expired (2.56%).11 (22%) patients reached the hospital after 6 hours of ingestion of poison from which 3 expired (27.27%). Maximum mortality (27.27%) was seen when time taken to reach the hospital was >6 hours. As the time taken to reach the hospital increases the mortality rate increases. and is statistically significant (p Value <0.0001).

Table 3 (b): Distribution of cases according to time taken to reach the hospital (Group B)

Duration (Hrs.)	No. of cases (%)	Mortality (%)	p Value
<2	15 (30%)	5 (33.33%)	< 0.00001
2-6	15 (30%)	8 (53.33%)	
>6	20 (40%)	15 (75%)	
Total	50 (100%)	28 (56%)	

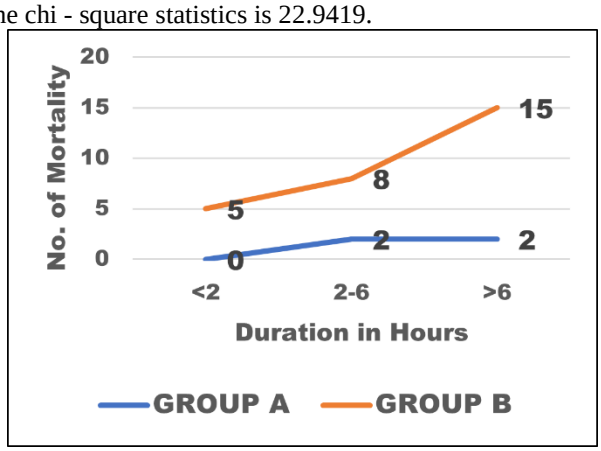
The chi - square statistics is28.112.

In Group B, 30 (60%) patients reached the hospital within 6 hours of ingestion of poison from which 13 expired (43%).20 (40%) patients reached the hospital after 6 hours of ingestion of poison from which 15 expired (75%). Maximum mortality (75%) was seen when time taken to reach the hospital was > 6 hours. As the time taken to reach the hospital increases the mortality rate increases and is statistically significant (p Value<0.0001).

Table 3 (c): Comparison according to the time taken to reach the hospital

Duration (Hrs.)	Group A Mortality	Group B Mortality	p Value
<2	0	5	< 0.00011
2-6	2	8	
>6	2	15	
Total	4	28	

The chi - square statistics is 22.9419.



As evident from this table, the mortality in patient's lavage with KMNO4 (group B) was more as compared to patient lavage with coconut oil and bicarbonate (group A.) and is statistically significant (p Value - 0.000115).

Table 4 (a): Distribution of cases according to Glasgow coma scale (Group A)

GCS	No. of cases (%)	Mortality (%)	p Value
3-6	0	0	< 0.00001
7-12	15 (30%)	4 (26%)	
13 - 15	35 (70%)	0	
Total	50 (100%)	4 (8%)	

The chi - square statistics is37.9053.

In Group A, 35 (70%) patients had GCS score between 13 - 15, out of which none died.15 patients (30%) had GCS between 7 - 12 out which 4 died (26%). It shows that as GCS decreases rate of mortality increases and is statistically significant (p Value <0.0001).

Table 4 (b): Distribution of cases according to Glasgow coma scale (Group B)

GCS	No. of cases (%)	Mortality (%)	p Value
3-6	6 (12%)	6 (100%)	< 0.000716
7- 12	22 (44%)	20 (90.9%)	
13 - 15	22 (44%)	2 (9.09%)	
Total	50 (100%)	28 (56%)	

The chi - square statistics is11.4462.

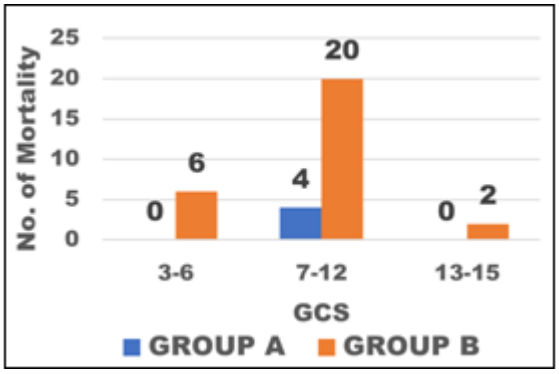
In Group B, 22 (44%) patients had GCS score between 13 - 15, out of which 2 patient (9%) died.22 patients (44%) had GCS between 7 - 12 out which 20 died (90.9%). Only 6 patients had GCS between 3 - 6 and all of them died (100%).

It shows that as GCS decreases rate of mortality increases and is statistically significant (p Value - 0.000716).

Table 4 (c): Comparison according to Glasgow Coma Scale

GCS	Group A Mortality	Group B Mortality	p Value
3-6	0	6	< 0.000011
7- 12	4	20	
13 - 15	0	2	
Total	4	28	

The chi - square statistics is 22.9419.



As evident from this table, the mortality in patient's lavage with KMNO4 (group B) was more as compared to patient lavage with coconut oil and bicarbonate (group A.) and is statistically significant (p Value - 0.000885).

Table 5 (a): Distribution of cases according to APACHE II Score (Group A)

APACHE II Score	No. of cases (%)	Mortality (%)	p Value
0 - 10	35 (70%)	0	< 0.00001
11-20	13 (26%)	3 (23%)	
21 - 30	2 (4%)	1 (50%)	
>30	0	0	
Total	50 (100%)	4 (8%)	

The chi - square statistics is115.3643.

In Group A, 48 (96%) patients had APACHE II score less than 20 out of which 3 died (6.25%).2 (4%) patients had APACHE II score > 20 out of which 1 died (50%). This shows mortality rate increases with increase in APACHE II score and is statistically significant (p Value <0.0001).

Table 5 (b): Distribution of cases according to APACHE II Score (Group B)

APACHE II Score	No. of cases (%)	Mortality (%)	p Value
0 - 10	19 (38%)	1 (5.26%)	< 0.0001
11-20	9 (18%)	5 (55.5%)	
21 - 30	19 (38%)	19 (100%)	
>30	3 (6%)	3 (100%)	
Total	50 (100%)	28 (56%)	

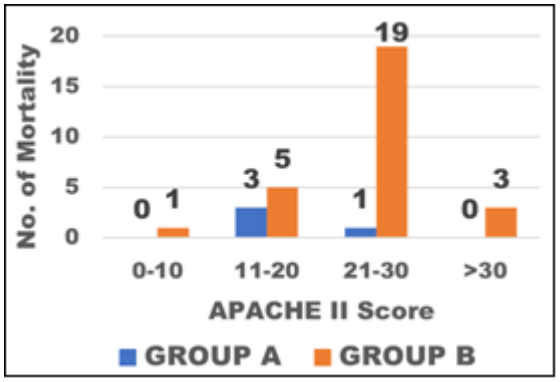
The chi - square statistics is 36.2166.

In Group B, 28 (56%) patients had APACHE II score less than 20 out of which 6 died (21.43%).22 (44%) patients had APACHE II score > 20 and all of them died (100%). This shows mortality rate increases with increase in APACHE II score and is statistically significant (p Value <0.0001).

Table 5 (c): Comparison according to APACHE II Score

APACHE II Score	Group A Mortality	Group B Mortality	p Value
0 - 10	0	1	< 0.0025806
Nov-20	3	5	
21 - 30	1	19	
>30	0	3	
Total	4	28	

The chi - square statistics is4.9689.



As evident from this table, the mortality in patient's lavage with KMNO4 (group B) was more as compared to patient lavage with coconut oil and bicarbonate (group A.) and is statistically significant (p Value - 0.0025806).

Table 6 (a): Distribution of patients according to inotropic support given (Group A)

Inotropic support	No. of cases (%)	Mortality (%)	p Value
Yes	14 (28%)	4 (28%)	< 0.0001
No	36 (72%)	0	
Total	50 (100%)	4 (8%)	

The chi - square statistics is43.0045.

In Group A, 14 patients needed inotropic support from which 4 expired (28%) and 36 patients didn't need inotropic support and all of them survived. This shows that patients who need inotropic support had higher mortality rate. The above data is statistically significant (p Value<0.0001).

Table 6 (b): Distribution of patients according to inotropic support given (Group B)

Inotropic support	No. of cases (%)	Mortality (%)	p Value
Yes	33 (66%)	28 (84.84%)	< 0.00001
No	17 (34%)	0	
Total	50 (100%)	28 (56%)	

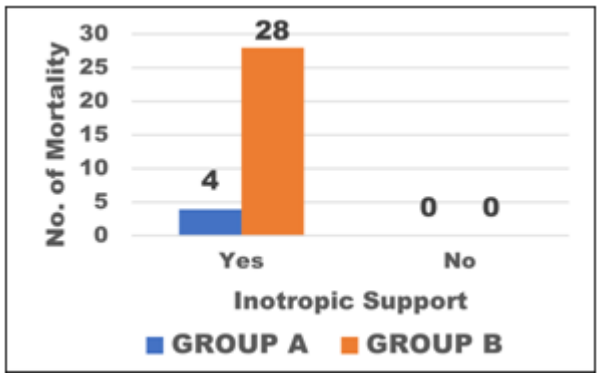
The chi - square statistics is32.2702.

In Group B, 33 patients needed inotropic support from which 28 expired (84.84%) and 17 patients doesn't need inotropic support and all of them survived. This shows that patients who need inotropic support had higher mortality rate. The above data is statistically significant (p Value<0.00001).

Table 6 (c): Comparison according to inotropic support given

Inotropic support	Group A Mortality	Group B Mortality	p Value
Yes	4	28	< 0.000001
No	0	0	
Total	4	28	

The chi - square statistics is17.3457.



As evident from this table, the mortality in patient's lavage with KMNO4 (group B) was more as compared to patient lavage with coconut oil and bicarbonate (group A.) and is statistically significant (p Value <0.0001)

Table 7 (a): Distribution of cases according to serum lactate levels on admission (Group A)

S. Lactate (mmol/l)	No. of cases (%)	Mortality (%)	p Value
<1.5	7 (14%)	0	< 0.000413
1.5 - 5.0	19 (38%)	0	
5.0 - 15	18 (36%)	2 (11%)	
>15	6 (12%)	2 (33%)	
Total	50 (100%)	4 (8%)	

The chi - square statistics is12.4713.

In Group A, 26 (52%) patients had serum lactate level below 5 on admission out of which none expired, 24 (48%) patients presented with serum lactate level > 5 out of which 4 expired (16.66%). This shows as the serum lactate level increases mortality increases. The above data is statistically significant.

Table 7 (b): Distribution of cases according to serum lactate levels on admission (Group B)

S. Lactate (mmol/l)	No. of cases (%)	Mortality (%)	p Value
<1.5	3 (6%)	0	< 0.000237
1.5 - 5.0	9 (18%)	2 (22.22%)	
5.0 - 15	36 (72%)	25 (69.44%)	
>15	2 (4%)	1 (50%)	
Total	50 (100%)	28 (56%)	

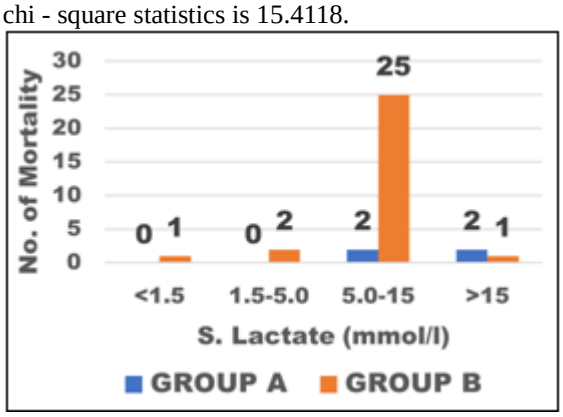
The chi - square statistics is13.5486.

In Group B, 12 (24%) patients had serum lactate level below 5 on admission out of which only 2 expired (16.66%), 38 (76%) patients presented with serum lactate level > 5 out of which 26 expired (68.42%). This shows as the serum lactate level increases mortality increases. The above data is statistically significant.

Table 7 (c): Comparison according to serum lactate levels on admission

S. Lactate (mmol/l)	Group A Mortality	Group B Mortality	p Value
<1.5	0	1	< 0.00001
1.5 - 5.0	0	2	
5.0 - 15	2	25	
>15	2	1	
Total	4	28	

The chi - square statistics is 15.4118.



As evident from this table, the mortality in patient's lavage with KMNO4 (group B) was more as compared to patient lavage

Table 8 (a): Distribution of cases according to pH level on admission (Group A)

pH	No. of cases (%)	Mortality (%)	p Value
<7	4 (8%)	1 (25%)	< 0.00026
7.01 - 7.20	19 (38%)	2 (10.5%)	
>7.20	27 (54%)	1 (3.7%)	
Total	50 (100%)	4 (8%)	

The chi - square statistics is18.493.

In Group A, 23 (46%) patients presented with blood pH < 7.20 out of which 3 (6.5%) expired, 27 (54%) patients presented with blood pH between > 7.20 out of which 1 expired (3.7%).5 patients presented with severe metabolic acidosis pH <7.0 and all of them expired. This shows as the blood pH level decreases mortality increases. The above data is statistically significant.

Table 8 (b): Distribution of cases according to pH level on admission (Group B)

pH	No. of cases (%)	Mortality (%)	p Value
<7	1 (2%)	1 (100%)	< 0.00026
7.01 - 7.20	49 (98%)	27 (55.1%)	
>7.20	0	0	
Total	50 (100%)	28 (56%)	

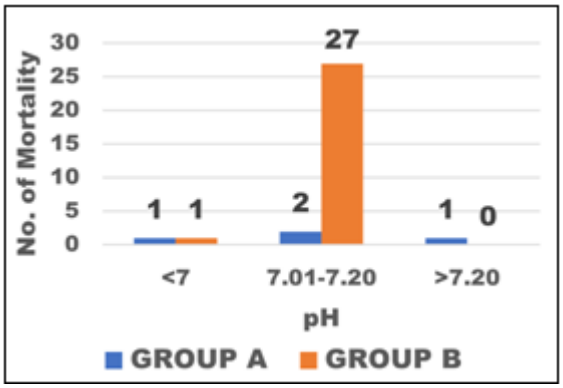
The chi - square statistics is29.3685.

In Group B, 50 patients presented with blood pH <7.20 out of which 28 (56%) expired, none had pH > 7.2. This shows as the blood pH level decreases mortality increases. The above data is statistically significant.

Table 8 (c): Comparison according to pH level on admission

pH	Group A Mortality	Group B Mortality	p Value
<7	1	1	< 0.00001
7.01 - 7.20	2	27	
>7.20	1	0	
Total	4	28	

The chi - square statistics is11.5691.



As evident from this table, the mortality in patient's lavage with KMNO4 (group B) was more as compared to patient lavage with coconut oil and bicarbonate (group A.) and is statistically significant (p Value 0.000031).

Table 9 (a): Distribution of patients according to ECG findings (Group A)

ECG finding	No. of cases (%)	Mortality (%)	p Value
Normal	31 (62%)	2 (6.4%)	< 0.000031
Abnormal	19 (38%)	2 (10.5%)	
Total	50 (100%)	4 (8%)	

The chi - square statistics is35.6492.

In Group A, 31 (62%) patients had no ECG abnormalities and 2 (6.4%) patients died, while 19 (38%) patients had abnormal ECG findings from which 2 (10.5%) patients died. This shows mortality is more in patient with abnormal ECG findings and is statistically significant (p Value 0.000031).

Table 9 (b): Distribution of patients according to ECG findings (Group B)

ECG finding	No. of cases (%)	Mortality (%)	p Value
Normal	17 (34%)	0	< 0.00001
Abnormal	33 (66%)	28 (84.84%)	
Total	50 (100%)	28 (56%)	

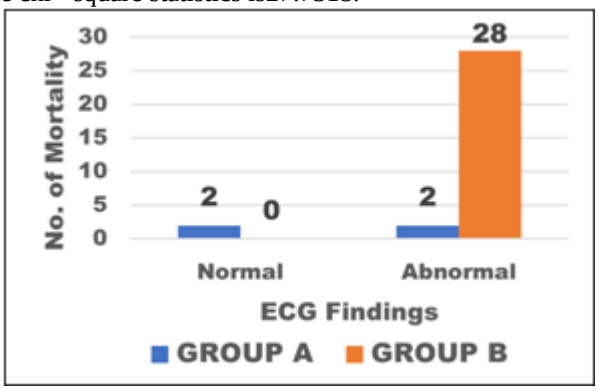
The chi - square statistics is14.6897.

In Group B, 17 (34%) patients had no ECG abnormalities and none of them died, while 33 (66%) patients had abnormal ECG findings from which 28 (84.84%) patients died. This shows mortality is more in patient with abnormal ECG findings and is statistically significant (p Value<0.0001).

Table 9 (c): Comparison according to ECG findings

ECG finding	Group A Mortality	Group B Mortality	p Value
Normal	2	0	< 0.000053
Abnormal	2	28	
Total	4	28	

The chi - square statistics is27.7315.



As evident from this table the mortality in patient's lavage with KMNO4 (group B) was more as compared to patient lavage with coconut oil and bicarbonate (group A.) and is statistically significant (p Value - 0.000053).

Table 10 (a): Distribution of patients according to Trop I findings (Group A)

Trop I	No. of cases (%)	Mortality (%)	p Value
Negative	15 (30%)	1 (20%)	< 0.00078
Positive	35 (70%)	3 (2.8%)	
Total	50 (100%)	4 (8%)	

The chi - square statistics is17.1598.

In Group A, 15 (30%) of patients did not had raised cardiac biomarker levels and troponin I was negative in them out of which 1 patient (20%) expired.35 patients had positive troponin I results and 3 (2.8%) expired. This demonstrates mortality increases in raised troponin and is statistically significant (p Value - 0.000078).

Table 10 (b): Distribution of patients according to Trop I findings (Group B)

Trop I	No. of cases (%)	Mortality (%)	p Value
Negative	35 (70%)	13 (37.14%)	< 0.00078
Positive	15 (30%)	15 (100%)	
Total	50 (100%)	28 (56%)	

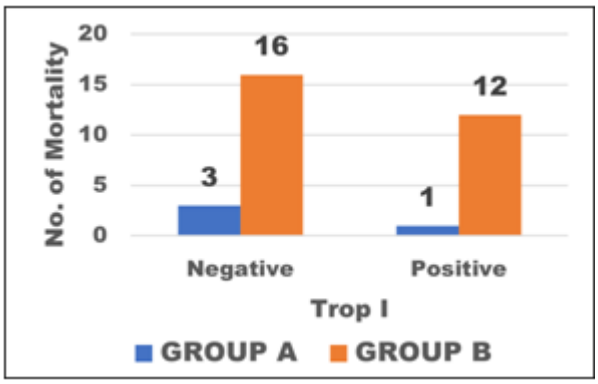
The chi - square statistics is26.6598.

In Group B, 35 (70%) of patients did not had raised cardiac biomarker levels and troponin I was negative in them out of which 13 patients (37.14%) expired.15 patients had positive troponin I results and all of them expired (100%). This demonstrates mortality increases in raised troponin and is statistically significant (p Value <0.0001).

Table 10 (c): Comparison according to Trop I findings

Trop I	Group A Mortality	Group B Mortality	p Value
Negative	3	16	< 0.003698
Positive	1	12	
Total	4	28	

The chi - square statistics is29.5684.



As evident from this table the mortality in patient's lavage with KMNO4 (group B) was more as compared to patient lavage with coconut oil and bicarbonate (group A.) and is statistically significant (p Value - 0.003698).

Table 11 (a): Distribution of patients according to need of mechanical ventilation (Group A)

Mechanical ventilation	No. of cases (%)	Mortality (%)	p Value
Yes	7 (14%)	4 (57%)	< 0.00001
No	43 (86%)	0	
Total	50 (100%)	4 (8%)	

The chi - square statistics is36.1597.

In Group A, only 7 patients needed mechanical ventilation during their hospital course and 4 patients (57%) expired. which demonstrates mortality increases in ventilated patients and is statistically significant (p Value<0.0001).

Table 11 (b): Distribution of patients according to need of mechanical ventilation (Group B)

Mechanical ventilation	No. of cases (%)	Mortality (%)	p Value
Yes	31 (62%)	28 (90.32%)	< 0.00086
No	19 (38%)	0	
Total	50 (100%)	28 (56%)	

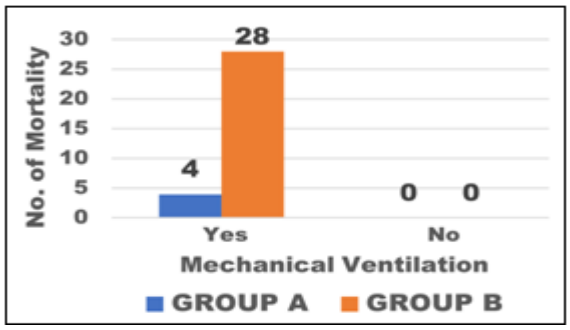
The chi - square statistics is14.6157.

In Group B, 31 patients needed mechanical ventilation during their hospital course and 28 patients (90.32%) expired which demonstrates mortality increases in ventilated patients and is statistically significant (p Value - 0.00086).

Table 11 (c): Comparison according to need of mechanical ventilation

Mechanical ventilation	Group A Mortality	Group B Mortality	p Value
Yes	4	28	< 0.003698
No	0	0	
Total	4	28	

The chi - square statistics is11.2974.



As evident from this table the mortality in patient's lavage with KMNO4 (group B) was more as compared to patient lavage with coconut oil and bicarbonate (group A.) and is statistically significant (p Value - 0.00049).

Table 12 (a): Distribution of cases according to serum bicarbonate levelson admission (Group A)

Serum bicarbonate (mEq/l)	No. of cases (%)	Mortality (%)	p Value
<5	7 (14%)	1 (14.2%)	< 0.00073
5-15	21 (42%)	3 (14.2%)	
>15	22 (44%)	0	
Total	50 (100%)	4 (8%)	

The chi - square statistics is9.6457.

In Group A, 28 patients (56%) had serum bicarbonate levels <15mEq/l on admission out of which 4 patients (14.28%) expired, 22 (44%) patients had serum bicarbonate levels between > 15mEq/l on admission out of which none expired. Maximum mortality rate was seen in patients with serum bicarbonate levels < 15mEq/l. This shows as the serum bicarbonate level decreases mortality increases. It is statistically significant (p Value - 0.00073).

Table 12 (b): Distribution of cases according to serum bicarbonate levelson admission (Group B)

Serum bicarbonate (mEq/l)	No. of cases (%)	Mortality (%)	p Value
<5	15 (30%)	6 (40%)	< 0.00069
5-15	18 (36%)	10 (55.56%)	
>15	17 (34%)	12 (70.59%)	
Total	50 (100%)	28 (56%)	

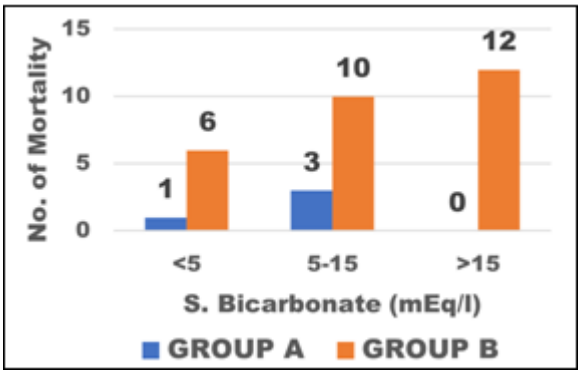
The chi - square statistics is18.657.

In Group B, 33 patients (66%) had serum bicarbonate levels < 15mEq/l on admission out of which 16 patients (48.48%) expired, 17 patients (34%) had serum bicarbonate levels > 15mEq/l on admission out of which 12 patients (70.59%) expired. Maximum mortality rate was seen in patients with serum bicarbonate levels >15mEq/l. This shows as the serum bicarbonate level decreases mortality increases. It is statistically significant (p Value - 0.000069).

Table 12 (c): Comparison according to serum bicarbonate levelson admission

Serum bicarbonate (mEq/l)	Group A Mortality	Group B Mortality	p Value
<5	1	6	< 0.00047
5-15	3	10	
>15	0	12	
Total	4	28	

The chi - square statistics is 14.6153.



As evident from this table, the mortality in patient's lavage with KMNO4 (group B) was more as compared to patient lavage with coconut oil and bicarbonate (group A.) and is statistically significant (p Value - 0.00047).

Table 13 (a): Distribution of cases according to serum creatinine (Group A)

Serum Creatinine (mg/dL)	No. of cases (%)	Mortality (%)	p Value
0.5 - 1.4	23 (46%)	1 (4%)	< 0.000061
1.5 - 2.0	19 (38%)	2 (10.5%)	
>2.0	8 (16%)	1 (12.5%)	
Total	50 (100%)	4 (8%)	

The chi - square statistics is26.4315.
In Group A, 42 (84%) patients had serum creatinine level < 2.0 mg/dL, out of them 3 died (7.14%), 8 (16%) patients had serum creatinine level between > 2.0mg/dL, out of them 1 died (12.5%). Maximum mortality rate was seen in patients with serum creatinine level >2.0mg/dL. This shows as the serum creatinine level increases mortality increases which is statistically significant. (p Value - 0.00006).

Table 13 (b): Distribution of cases according to serum creatinine (Group B)

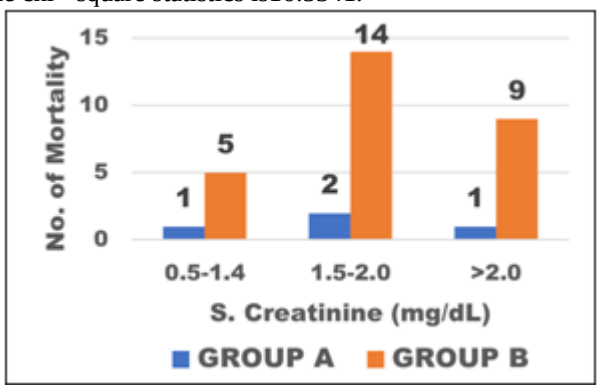
Serum Creatinine (mg/dL)	No. of cases (%)	Mortality (%)	p Value
0.5 - 1.4	25 (50%)	5 (20%)	< 0.000061
1.5 - 2.0	16 (32%)	14 (87.5%)	
>2.0	9 (18%)	9 (100%)	
Total	50 (100%)	28 (56%)	

The chi - square statistics is17.6452.
In Group B, 41 (82%) patients had serum creatinine level < 2.0 mg/dL, out of them 19 died (46.34%), 9 (18%) patients had serum creatinine level between > 2.0mg/dL, out of them 9 died (100%). Maximum mortality rate was seen in patients with serum creatinine level >2.0mg/dL. This shows as the serum creatinine level increases mortality increases which is statistically significant (p Value - 0.000671).

Table 13 (c): Comparison according to serum creatinine

Serum Creatinine (mg/dL)	Group A Mortality	Group B Mortality	p Value
0.5 - 1.4	1	5	< 0.00056
1.5 - 2.0	2	14	
>2.0	1	9	
Total	4	28	

The chi - square statistics is16.5341.



As evident from this table the mortality in patient's lavage with KMNO4 (group B) was more as compared to patient lavage with coconut oil and bicarbonate (group A.) and is statistically significant (p Value - 0.00056).

Table 14: Distribution of patient according to Outcome

Group	No. of cases	Mortality	%	p Value
Group A	50	4	8	0.000173
Group B	50	28	56	
Total	100	32	32	

The chi - square statistics is 14.1026

The above data is statistically significant (p Value 0.000173).

4. Discussion

The present study entitled "Prognostic markers in aluminium phosphide poisoning and role of bicarbonate & coconut oil in its management" was carried out in the Department of Medicine, MLB Medical College, Jhansi from March 2021to August 2022 on 100 patients admitted to our hospital with history of ingestion of aluminium phosphide.

Out of the 100 ALP poisoning patients, 49 had taken 1 - 2 tablets and 15 (30.61%) of them expired. Mortality rate increased as the number of tablets taken by the patients increased. Maximum mortality (48.57%) was seen in patients who had consumed more than 2 tablets.

In our study of 100 patients, 67 patients consumed fresh tablets of aluminium phosphide from which 32 patients (47.76%) expired while 33 patients had consumed exposed tablets from which no patient expired. Consumption of fresh tablets led to significantly high mortality rate

Time between ingestion of tablet of aluminium phosphide and visit to the hospital was another factor that affected the mortality. In our study maximum patients (69) reached the hospital within 6 hours of ingestion of poison from which 15 expired (21.74%). Maximum mortality (54.84%) was seen when time taken to reach the hospital was >6 hours (17 out of 31 patients expired). As the time taken to reach the hospital increases the mortality rate also increases.

Glasgow coma scale was also an important predictor of prognosis. In our study majority of the patients (57) had GCS score between 13 - 15, out of which 2 (3.51%) died.37

patients had GCS between 7 - 12 out which 24 died (64.86%). Only 6 patients had GCS between 3 - 6 out of which 6 died (100%) showing that low GCS score at admission was associated with significant high mortality.

Another important predictor of prognosis was APACHE II score. Out of 100 patients in our study, 54 patients had APACHE II score less than 10 out of which 1 died (1.85%).22 patients had APACHE II score between 11 - 20 out of which 8 died (36.36%), 21 patients had APACHE II score between 21 - 30 out of which 26 died (95.24%). Maximum mortality (100%) was seen in patients with APACHE II score >30 (3) and all of them expired showing high APACHE II score was associated with fatal outcome.

Need for inotropic support during course of hospital stay in aluminium phosphide patients was also an important prognostic factor. In our study 47 patients needed inotropic support (nor adrenaline, dobutamine) from which 32 patients expired (68.08%).53 patients didn't need inotropic support and all of them survived. Chug SN et al (1991) showed poor response to dopamine infusion and continuous increase in its dose as a poor prognostic indicator in patients of aluminium phosphide poisoning.

Need for mechanical ventilation was also a significant prognostic factor in patients of aluminium phosphide poisoning. In our study of 100 patients, 38 patients needed mechanical ventilation during the hospital course and 6 of them survived (84.21% mortality).

Acute kidney injury was also one of the important predictors of mortality in cases of aluminium phosphide poisoning. In our study 48 patients had serum creatinine level <1.5 mg/dl, out of them 6 died (12.5%), 35 patients had serum creatinine level between 1.5 - 2mg/dl, out of them 16 died (45.71%). Maximum mortality (58.82%), 10 out of 17 patients was seen with serum creatinine level > 2mg/dl.

Presence of shock and increase in blood lactate levels was associated with grave prognosis in aluminium phosphide patients. In our study 38 patients had blood lactate level below 5mmol/l on admission out of which only 2 expired (5.26), 54 patients presented with blood lactate level between 5 - 15mmol/l out of which 27 expired (50%).8 patients had blood lactate level >15mmol/l on admission and 3 of them expired (37.5%). Presence of shock and severe lactic acidosis were poor prognostic factors in most of the studies in patients of aluminium phosphide poisoning.

Metabolic acidosis on admission was also one of the most important predictors of mortality. In our study 27 patients presented with blood pH >7.20 out of which 1 expired (37.03%), 68 patients presented with blood pH between 7.01 - 7.20 out of which 29 expired (42.65%).5 patients presented with severe metabolic acidosis pH <7.0 and 2 of them expired (40%).

Aluminium phosphide toxicity primarily affects the cardiac and vascular tissue manifesting as profound and refractory hypotension, electrocardiographic (ECG) abnormalities myocarditis, subendocardial infarction or pericarditis. In our study, 48 patients had no ECG abnormalities and 2 of them died (4.16%), while 52 patients had abnormal ECG findings, out of which 30 patients (57.69%) expired. All survivors had initial ECG of normal sinus rhythm or sinus tachycardia. ECG abnormalities included rhythm disturbances, ST - T changes and conduction defects.

Presence of myocarditis as evident by elevation of cardiac biomarkers as troponin I was also one of the poor prognostic markers. In our study of 100 patients, troponin I was negative in 50 patients out of which 13 expired (26%), while 50 patients had positive troponin I results and 19 of them expired (38%). Hence elevation of troponin I was associated with significantly high mortality.

Presence of metabolic acidosis was an important predictor of mortality in patients of aluminium phosphide. In our study 38 patients had serum bicarbonate levels >15mEq/l on admission out of which 12 patients (31.58%) expired, 37 patients had serum bicarbonate levels between 5 - 15mEq/l on admission out of which 13 patients (35.13%) expired.20 patients presented with serum bicarbonate levels < 5mEq/l from which 7 patients (35%) expired.

In our study out of 50 patients (Group A) whose gastric lavage was done with soda bicarbonate along with coconut oil and intravenous replacement with sodium bicarbonate till metabolic acidosis was partially corrected (pH>7.2), 4 (8%) patients expired.

Out of 50 patients (Group B), whose gastric lavage was done with plain water/KMnO4 along with replacement with sodium bicarbonate till metabolic acidosis was partially corrected (pH>7.2), 28 (56%) patients expired.

There was a significant difference in mortality rate in group A & B, 28% (28/50) of the patients expired, whose gastric lavage was done with plain water and KMNO4, whereas only 8% (4/50) patients expired whose gastric lavage was done with soda bicarbonate and coconut oil, indicating a better response and favourable outcome.

Early arrival, resuscitation, diagnosis, decreasing absorption and formation of phosphine (by intensive gastric lavage with aliquots of coconut oil and soda bicarbonate), intensive monitoring and supportive therapy, complete replacement of intravenous sodium bicarbonate resulted in favourable outcomes and mortality was significantly decreased.

5. Conclusion

According to our study, dosage of poison, time taken to reach hospital, ECG findings, trop I, serum lactate, creatinine, soda bicarbonate, blood pH are important prognostic markers in the mortality and morbidity in aluminium phosphide poisoning. Inotropic support, mechanical ventilation support, Glasgow coma scale and APACHE II scale also aids in the prognosis.

The mortality in cases lavage with KMNO4 was more as compared to cases lavage with coconut oil and bicarbonate irrespective to the various prognostic markers.

So, we recommend lavage with coconut oil and soda bicarbonate.

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