ORIGINAL RESEARCH PAPER
Volume - 15 | Issue - 02 | February - 2026 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

AN OBSERVATION STUDY OF PROGNOSTIC FACTORS IN ALUMINUM PHOSPHIDE POISONING ADMITTED IN SMS MEDICAL COLLEGE AND HOSPITAL JAIPUR, RAJASTHAN

General Medicine

Dr. Suresh Kumar Post Graduate Student, Department of General Medicine, SMS Medical college, Jaipur, (Rajasthan)

Dr. RS Chejara Professor, Department of General Medicine, SMS Medical college, Jaipur, (Rajasthan)

Dr Mamraj Phogawat Senior Resident, Department of General Medicine, SMS Medical college, Jaipur, (Rajasthan)

ABSTRACT

Background: Aluminum phosphide (AlP) poisoning is a major public health concern in South Asia due to its high mortality and lack of specific antidote. This study evaluates prognostic factors influencing outcomes in AlP poisoning cases. **Methods:** A hospital-based observational study was conducted at SMS Medical College, Jaipur, India, from January 2023 to December 2024, involving 105 patients aged >18 years with confirmed AlP poisoning. Patients with unclear diagnoses, multisubstance ingestion, or chronic illnesses were excluded. Data on demographic, clinical, laboratory, and toxicological variables were collected, including APACHE-II scores, arterial blood gas, ECG, and serum electrolytes. Outcomes included mortality, ICU admission, and vasopressor requirements. Statistical analyses used Chi-square, unpaired t-tests, ANOVA, logistic regression($p<0.05$ significant). **Results:** The mortality rate was 82%, with 18% survival. Young adults (20–40 years, 56.2%) and males (66.7%) were predominantly affected. Common symptoms included nausea/vomiting (85.7%), abdominal pain (71.4%), and hypotension (52.4%). Metabolic acidosis (66.7%), ARDS (47.6%), and acute renal injury (39%) were frequent. Delayed admission (>4 hours) was associated with 100% mortality ($p=0.001$), while treatment within 2 hours improved survival ($p=0.001$). APACHE-II scores >20 predicted 96% mortality ($p=0.001$) and correlated with longer hospital stays ($r=0.73$, $p=0.001$). Higher tablet ingestion (2.87 vs. 1.05, $p=0.01$), fresh tablets ($p=0.01$), and absence of immediate vomiting ($p=0.01$) increased mortality. ICU admission (68.6%) and vasopressor use (55.2%) were common. **Conclusion:** AlP poisoning has a high mortality rate, driven by delayed admission, higher APACHE-II scores, and fresh tablet ingestion. Early intervention (<2 hours) and immediate vomiting improve survival. APACHE-II scoring is a reliable prognostic tool. Restricting AlP access and exploring novel therapies are urgent needs to reduce mortality.

KEYWORDS

Aluminum phosphide, poisoning, mortality, APACHE-II, prognostic factors, early intervention

INTRODUCTION

Aluminum Phosphide (AlP), commonly known as "wheat pill" or "rice pill," is a widely used rodenticide in agricultural countries like India, Pakistan, and Nepal to protect stored grains.[1] Its accessibility and high toxicity make AlP poisoning a significant public health issue in South Asia, contributing to numerous suicidal and accidental poisonings with mortality rates often exceeding 50%.[2] AlP, available as 3-g tablets (e.g., Celphose, Quickphos), releases lethal phosphine gas (PH_3) upon contact with stomach acid or atmospheric moisture.[3] This gas is rapidly absorbed, causing severe symptoms within minutes, including vomiting, resistant hypotension, metabolic acidosis, myocardial suppression, and acute respiratory distress syndrome (ARDS). No specific antidote exists, making aggressive supportive care critical for survival.[4]

Phosphine disrupts cellular function by inhibiting mitochondrial cytochrome c oxidase, inducing oxidative stress, and forming reactive hydroxyl radicals. This leads to lipid peroxidation, protein denaturation, and reduced ATP production, causing cell necrosis, particularly in cardiomyocytes, resulting in refractory myocardial depression and arrhythmias. ECG changes, such as ST segment alterations and bundle branch blocks, are common, alongside biochemical markers like elevated aspartate transaminase (AST), creatine phosphokinase-MB (CPK-MB), and lactate dehydrogenase (LDH).[5] Histopathology reveals myocytolysis and necrosis. Hypomagnesemia may exacerbate arrhythmias, with magnesium sulfate suggested as a therapeutic option. Experimental treatments, including N-acetylcysteine, melatonin, and coconut oil, show potential in mitigating oxidative damage but lack clinical validation.[6]

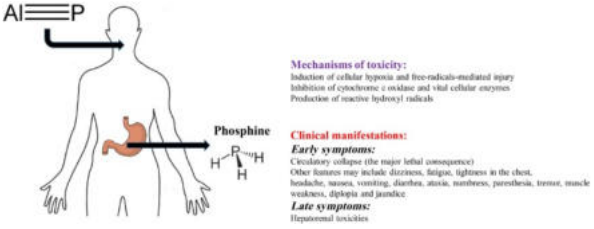


Fig. 1. Pathophysiology of aluminum phosphide (AlP) intoxication. After ingestion, AlP reacts with stomach acid and releases phosphine (PH_3) gas. PH_3 reaches the heart through the systemic circulation and causes myocardial cell death and arrhythmias.[7]

The absence of a definitive antidote necessitates supportive measures like intra-aortic balloon pumps or extracorporeal membrane oxygenation (ECMO).[7] Despite such interventions, mortality remains high (30–100%), even in advanced care settings.[8] AlP's easy availability and lack of regulatory control exacerbate its misuse, raising concerns about its potential as a chemical terrorism agent.[9] Prognostic tools like the Acute Physiology and Chronic Health Evaluation II (APACHE II) and Sequential Organ Failure Assessment (SOFA) scores are used to predict outcomes in AlP poisoning.[10]

This study evaluates prognostic factors, including personal, toxicological, clinical, and laboratory variables, to better predict mortality and guide management in AlP-poisoned patients admitted to SMS Medical College and Hospital, Jaipur.

Study Objectives was:

1. To assess the prognostic factors determining morbidity and mortality in ALP poisoning
2. To assess the clinical severity of ALP poisoning by using APACHE-II score.

Study Setting and Design

This hospital-based observational study was conducted in the Department of Medicine, SMS Medical College and Hospital, Jaipur, Rajasthan, India, from January 2023 to December 2024. The study universe comprised all patients admitted to the emergency department with aluminum phosphide (AlP) poisoning.

Sample Size

A sample size of 105 patients was calculated at a 95% confidence level with an alpha error of 0.05, expecting a significant predictor of mortality based on prior literature, with 80% study power.

Inclusion Criteria

- Patients aged >18 years who consumed AlP.
- Patients or relatives providing written informed consent.

Exclusion Criteria

- Patients with unclear poisoning diagnosis.
- Patients with multisubstance ingestion.

- Patients with pre-existing chronic illnesses.

ETHICAL CONSIDERATIONS

The study protocol was approved by the Institutional Research Review Board (RRB) and the Institutional Ethics Committee of SMS Medical College, Jaipur. Permissions were obtained from the Head of the Department of Medicine. Written informed consent was secured from participants after explaining the study's purpose, benefits, risks, and public health significance. A participant information sheet with contact details for the responsible investigator was provided. Participant identities were kept confidential through anonymous data entry, ensuring no disclosure in reports.

Study Tools

Data were collected using: General information schedule, Arterial blood gas (ABG) analysis, Electrocardiogram (ECG), Serum troponin I, Acute Physiology and Chronic Health Evaluation II (APACHE II) score, Liver function test (LFT), Complete blood count (CBC), Renal function test (RFT), 2D echocardiography and Serum electrolytes (Na+, K+).

Statistical Analysis

Qualitative data were expressed as percentages and proportions. Quantitative data were presented as mean ± standard deviation. Differences in proportions were analyzed using the Chi-square test, while differences in means were assessed with the unpaired t-test. For comparisons involving more than two means, ANOVA with post hoc tests was used. Logistic regression determined the effect of associated factors. Sensitivity, specificity, positive predictive value, negative predictive value were calculated. A p-value <0.05 was considered statistically significant.

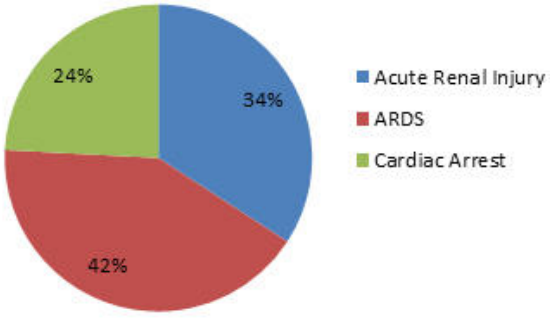
RESULTS & OBSERVATIONS

Demographic and Clinical Characteristics: Of 105 patients with aluminum phosphide (AlP) poisoning, 56.2% were aged 20–40 years, followed by 31.4% (>40 years) and 12.4% (<20 years). Males predominated (66.7%) over females (33.3%). Common symptoms included nausea/vomiting (85.7%), abdominal pain (71.4%), dyspnea (57.1%), hypotension (52.4%), and altered sensorium (38.1%). Most patients (42.9%) were admitted within 2–4 hours, 38.1% within <2 hours, and 19.0% after >4 hours.

Laboratory and Severity Findings: Hypokalemia (49.5%) and hyponatremia (39.0%) were the most frequent electrolyte abnormalities, followed by hyperkalemia (20.0%) and hypernatremia (14.3%). Metabolic acidosis was observed in 66.7% of patients, with respiratory alkalosis in 33.3%. APACHE-II scores were 11–20 in 42.9%, 0–10 in 33.3%, and >20 in 23.8%, indicating moderate to severe illness.

Complications and Management

Figure 1: Complications in patients admitted with ALP Posioning



Acute respiratory distress syndrome ARDS (47.6%) was the most common complication, followed by acute renal injury (39.0%) and cardiac arrest (27.6%). These complications underscore the multi-organ toxicity of ALP poisoning. ICU admission was required for 68.6% of patients, and 55.2% needed vasopressor support, reflecting severe hemodynamic instability.

Mortality and Prognostic Factors:

The mortality rate was 82%, with only 18% survival. Higher APACHE-II scores correlated with increased mortality (p=0.001): 62.8% (0–10), 88.9% (11–20), and 96% (>20). Delayed admission (>4 hours) was strongly associated with mortality (X^2=31.6, p=0.001). APACHE-II scores >20 (OR=6.98, p=0.01) and metabolic acidosis (OR=2.33, p=0.2) were linked to poorer outcomes. Non-survivors had higher tablet ingestion (2.87 vs. 1.05, p=0.01), longer reporting time (2.27 vs. 1 hour, p=0.001), prolonged shock duration (9.12 vs. 6.75 hours, p=0.01), fresh AlP tablets (p=0.01), and absence of immediate vomiting (p=0.01). Early treatment (<2 hours) was associated with higher survival (X^2=31.6, p=0.001), with no survivors among those treated after 4 hours. Higher APACHE-II scores also correlated with longer hospital stays (r=0.73, p=0.001): 3.2 days (0–10), 5.8 days (11–20), and 8.5 days (>20).

Figure 2: Association of Mortality with APACHE-II Score

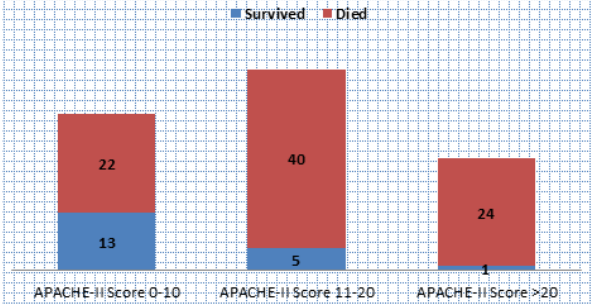


Figure 3: Association of Prognostic Factors with Mortality

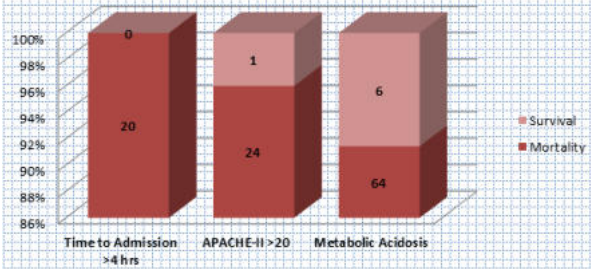
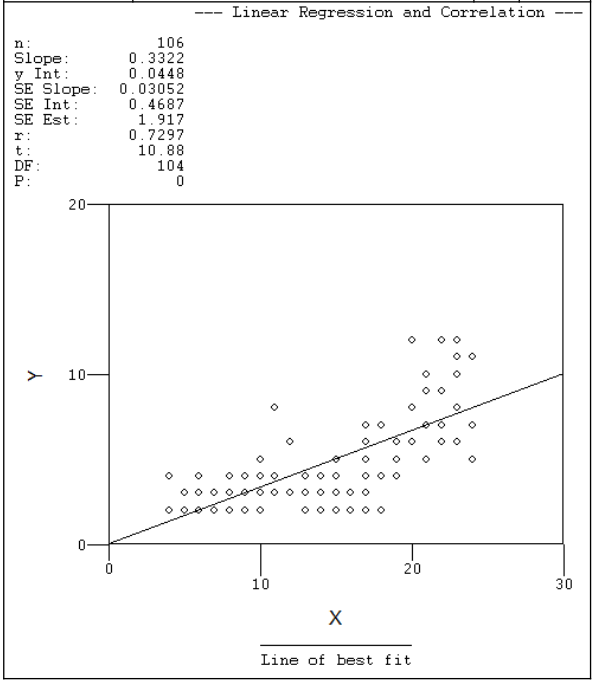


Table 1 Linear analysis of APACHE-II Score with Length of Hospital Stay

APACHE-II Score- X Axis	Average Hospital Stay (days)- Y Axis	r	P value
0-10	3.2	0.73	0.001
11-20	5.8		
>20	8.5		



Higher APACHE-II scores correlated with longer hospital stays (r=0.73, p=0.001). Average stays were 3.2 days (0-10), 5.8 days (11-

20), and 8.5 days (>20), indicating increased resource utilization in severe cases.

Table 2 Summary of Study outcomes

Characteristics	Survivors (n=19)	Non-survivors (n=86)	P
Age (years)	22.25 ± 8.82	25.7 ± 7.12	0.07
Male	13	57	0.9
Female	6	29	
No. of Tablets Ingested	1.05 ± 0.8	2.87 ± 0.07	0.01
Time Interval in Reporting (hours)	1 ± 0.5	2.27 ± 0.78	0.001
Duration of Shock (hours)	6.75 ± 6.53	9.12 ± 7.3	0.01
Status of ALP Tablets			
Fresh	1	74	0.01
Old	18	12	
Immediate Vomiting			
Yes	11	8	
No	8	78	0.01
APACHE -II			
<20	18	62	
>20	1	24	0.01

- Non-survivors had higher tablet ingestion (2.87 vs. 1.05, p=0.01), longer time to reporting (2.27 vs. 1 hour, p=0.001), and prolonged shock duration (9.12 vs. 6.75 hours, p=0.01).
- Fresh ALP tablets (p=0.01) and absence of immediate vomiting (p=0.01) were associated with higher mortality.
- APACHE-II scores >20 were significantly linked to non-survival (p=0.01).

DISCUSSION

This study at SMS Medical College, Jaipur, analyzed prognostic factors in 105 aluminum phosphide (AlP) poisoning cases, revealing an 82% mortality rate. Young adults (20–40 years, 56.2%) and males (66.7%) were predominantly affected, consistent with prior studies (Anbalagan et al., 2023; Mohanchand et al., 2017)[11-12]. Common symptoms included nausea/vomiting (85.7%), abdominal pain (71.4%), dyspnea (57.1%), hypotension (52.4%), and altered sensorium (38.1%), aligning with Kandeel et al. (2024) and Louriz et al. (2009)[13-14].

Delayed hospital admission (>4 hours) was linked to 100% mortality (p=0.001), while treatment within 2 hours improved survival (p=0.001). Immediate vomiting was associated with better outcomes (p=0.01). Higher APACHE-II scores (>20) predicted 96% mortality (p=0.001) and longer hospital stays (r=0.73, p=0.001), supporting its prognostic utility (Banderas-Bravo et al., 2017)[15]. Metabolic acidosis (66.7%) showed a weaker association with mortality (p=0.2). ARDS (47.6%), acute renal injury (39%), and cardiac arrest (27.6%) were frequent, with 68.6% requiring ICU admission and 55.2% needing vasopressors. Hypokalemia (49.5%) and hyponatremia (39%) were common but not directly tied to mortality. Fresh AlP tablets and higher ingestion (2.87 vs. 1.05 tablets, p=0.01) increased lethality.

CONCLUSION

AlP poisoning exhibits high lethality (82% mortality) due to multi-organ toxicity. Early admission (<2 hours), lower APACHE-II scores, and immediate vomiting predict survival. APACHE-II scoring is reliable for triage, while metabolic acidosis, ARDS, and cardiac complications worsen prognosis. Fresh tablets and higher doses exacerbate outcomes. Rapid intervention, restricted AlP access, and public awareness are critical. Future research should explore antioxidants or antidotes to reduce mortality.

Recommendations

- **Restrict AlP Access**: Enforce regulations to limit fresh AlP tablet availability.
- **Public Awareness**: Educate communities on AlP risks and early symptoms.
- **Early Intervention**: Ensure treatment within 2 hours to enhance survival.
- **APACHE-II Scoring**: Use routinely for triage and prognosis.
- **Intensive Care**: Prioritize ICU and vasopressor support for severe cases.

REFERENCES

1. Nakhaee S, Mehrpour O, Balali-Mood M. Does N-acetyl cysteine have protective effects in acute aluminum phosphide poisoning? Indian J Crit Care Med 2017; 21: 539.
2. Mehra A, Sharma N. ECMO: A ray of hope for young suicide victims with acute aluminum phosphide poisoning and shock. Indian Heart J 2016; 68: 256– 7.
3. Oghabian Z, Mehrpour O. Treatment of aluminium phosphide poisoning with a combination of intravenous glucagon, digoxin and antioxidant agents. Sultan Qaboos Univ Med J 2016; 16: e352–
4. Dr.Rambabu Singh Dr. Prateek Saxena* Dr. Shweta Shrivastava Demonstrator, Department of Pathology,GMC,Datia; Dr. Vijay Kumar PROGNOSTIC MARKERS IN ALUMINUM PHOSPHIDE POISONING AND ROLE OF BICARBONATE AND COCONUT OIL IN ITS MANAGEMENT DOI : 10.36106/ijsr
5. Arshia Berry1, Garima Singh2, Simran Jeet Kaur3 and Kumud Bala4* ALUMINIUM PHOSPHIDE: TOXICITY MECHANISM AND CREDIBLE TREATMENTS DOI: 10.13140/RG.2.2.36553.54889
6. Knaus WA, Draper EA et al.APACHE II: A severity of disease classification system.Critical Care Medicine 1985, 13 (10): 818-29The APACHE II calculator is created by QxMD.
7. Antidotes for aluminum phosphide poisoning – An update - Scientific Figure on ResearchGate. Available from: https://www.researchgate.net/figure/Pathophysiology-of-aluminum-phosphide-AlP-intoxication-After-ingestion-AlP-reacts_fig1_328573656 [accessed 7 Aug 2025]
8. Taghaddosinejad F, Farzaneh E, Ghazanfari-Nasrabad M, Eizadi-Mood N, Hajihosseini M, Mehrpour O. The effect of N-acetyl cysteine (NAC) on aluminum phosphide poisoning inducing cardiovascular toxicity: a case–control study. SpringerPlus 2016; 5: 1948.
9. Hashemi-Domeneh B, Zamani N, Hassanian-Moghaddam H, Rahimi M, Shadnia S, Erfantalab P, et al. A review of aluminium phosphide poisoning and a flowchart to treat it. Arhiv za Higijenu Rada i Toksikologiju 2016; 67: 183– 93.
10. Singh Y, Joshi SC, Satyawali V, Gupta A. Acute aluminium phosphide poisoning, what is new? Egypt J Int Med 2014; 26: 99.
11. Anbalagan LC, Pannu AK, Bhalla A, Dhibar DP, Sharma N. Prognostic significance of poison-related factors and consumption patterns in acute aluminum phosphide poisoning. Turk J Emerg Med 2023;23:88-95.
12. Mohanchand R, Hasija PK, Pradhan AB, Pahwa RS. PROGNOSTIC FACTORS IN ALUMINIUM PHOSPHIDE POISONING. Med J Armed Forces India. 1997 Oct;53(4):274-276. doi: 10.1016/S0377-1237(17)30753-0. Epub 2017 Jun 26. PMID: 28769511; PMCID: PMC5531131.
13. Kandeel, Fatma Shaban; Amin, Safaa Abdelzaher; El-Ebiary, Ahmad Abdelsattar; Elfeky, Ahmed Kamal; and El-khalek, Soha Hamid Abd (2024) "Predictors of Acute Aluminum Phosphide Intoxication Outcome," Menoufia Medical Journal: Vol. 37: Iss. 4, Article 1. DOI: https://doi.org/10.59204/2314-6788.1151
14. Louriz M, Dendane T, Abidi K, Madani N, Abouqal R, Zeggwagh A. Prognostic factors of acute aluminum phosphide poisoningIndian J Med Sci 2009; 63: 227– 34.
15. Banderas-Bravo ME, Arias-Verdú MD, Macías-Guarasa I, Aguilar-Alonso E, Castillo-Lorente E, Pérez-Costillas L, et al. Patients admitted to three Spanish intensive care units for poisoning: type of poisoning, mortality, and functioning of prognostic scores commonly used. *Biomed Res Int* 2017; **2017**: 5261264.