Evaluation of Apache-2 Scoring System to Predict Mortality Rate in Aluminum Phosphide Poisoning

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ABSTRACT

Background: Aluminum phosphate is a commonly available chemical and its poisoning is associated with high incidence of mortality rate.

Objective: The objective of the study was to determine the clinical manifestations and prognosis of victims of wheat pill poisoning admitted in Intensive Care Units, of District Headquarter Hospital DG Khan, Pakistan.

Study Design: A prospective cohort study

Place & Duration of Study: By the Department of Forensic Medicine Department, Khyber Medical College, Peshawar, at Emergency Department in District Headquarter Hospital DG Khan, Pakistan; from October 2019 to April 2020.

Methodology: 19 cases where examined and followed-up. Sampling technique: included in study was non-probability convenient sampling on patients admitted with history of accidental or suicidal wheat pills poisoning. Symptomatic treatment was initially given for 2-3 hours in emergency ward. The patients were retained in CCU for 24-36hours before shifting to ward. Research tool (proforma) was designed for collection and interpretation of data. Acute Physiology and Chronic Health Evaluation Score 2 (APACHE-2) score was used for prognosis and recovery.

Result: Out of 19 victims of aluminum phosphide ingestion male/female ratio was 1:4,21% (n= 4) were males and 79% (n=15) were females. Higher incidence was found in females, age group 16–25 years (n= 09 victims). Overall mortality was very high; 13 (68%) whereas predicted mortality rate was slightly higher that is 71%.

Conclusion: The wheat pill was apoison of choice among teens and adults in Pakistan. APACHE scoring was slightly over estimating the mortality rate. Arrhythmia and metabolic acidosis were the major causes of death after wheat pills ingestion. Coconut oil was found effective in delaying the absorption.

Keywords: Poisoning, Arrhythmias, Metabolic acidosis, Wheat pills, APACHE-II, Female, Suicide.

INTRODUCTION

Poisoning was a major health problem with 84% fatality rate especially in rural areas of underdeveloped countries. Most of the poisons in rural areas were taken with suicidal intention[1]. Only 25-30% of victims reach hospitals[2].Wheat pill; a fast-acting insecticide which is cheap and easily available on stores and commonly use in houses for grain storage. Majority of the cases were reported from rural areaswhere agriculture is the leading industry.[3]

Phosphine gas liberated when wheat pill interacts with stomach hydrochloric acid. It damages mitochondria and causes cellular hypoxia. Phosphine mainly binds cytochrome oxidase and changes the valences of the haem component of hemoglobin. Thus, RBCs are unable to carry and transport Oxygen to the cells. When this oxygen deprived blood reaches organs specially the heart it causes cardiac necrosis.[4,5]The victim may present with a symptom of cardiac failure, arrhythmias, tremors, blurred vision, seizers, and eventually shock.[5]

Various studies have showed that mortality prediction **scores** such asAcute Physiology and Chronic Health Evaluation scores (APACHE II, APACHE IV), and Simplified Acute Physiology Score (SAPS III) are useful in predicting the prognosis of the patient who underwent critical care and helpful in decision making.APACHE-2 Scoring System was devised in 1980s for predicting the mortality rate of pre and post-surgical patients and chronic ill patients admitted in ICU[6]. It has 12 physiological indicators (min 0-71 max) Table 1. Higher score represents severity of disease and it is the additive score of all the indicators[7]. There has been little progress in our understanding of the characteristics of the poison and limited data is available. The purpose of this study was to study the profile of victims presenting to ICU with wheat pill poisoning and the course of disease. It will be helpful for doctors serving in emergencies to early diagnose the poisoning from its clinical manifestations and greatly help to reduce the mortality rate.

METHODOLOGY

The study design was a prospective cohort study. The patients, who presented with a history of wheat pill ingestion at Emergency Department of DHQH DG Khan, were enrolled. A total of 19 victims with a history of wheat pill/s ingestion irrespective of age and gender were included in the study, and their information was collected on a specially designed tool i.e. proforma chart table. The total duration of the study was from October 2019 to April 2020. The sampling technique was non-probability convenient sampling.The diagnosis was based

on history of consumption of wheat pills and all those individuals with history of wheat pill ingestion were included while those who were not permanent resident of DG Khan, Pakistan were excluded from the study. All victims with history of wheat pills were treated symptomatically.Laboratory test shows silver nitrate breath test positive. Where liberated phosphine gas turns $AgNO_3$ soaked filter paper black (confirms wheat pill poisoning). Diseased specific (Observed) mortality rate Mº was determined by calculating total number of deaths due to Aluminum Phosphide ingestion during study period per number of victims of other poisons admitted in the hospital during the same period. We have distributed our patients in to three categories depending upon the severity of APACHE score (Table-3). Age and hospital stay were given numerical values.

Patient Management: In all suspected cases of wheat pill poisoning, gastric lavage with coconut oilwas initially done within half hourand then shifted to intensive care unit for monitoring. Symptomatic treatment and fluid therapy were initiated. Despite routine lab investigations; ABGs, PCO2 and blood pH were also monitored after every six hours.If pH less than 7.35 then alkaline therapy ($NaHCO_3$) was started to correct metabolic acidosis. For gastric irritability,metoclopramideand magnesium oxide were administered. Antiarrhythmic drugs amiodarone& inotropic (i.e. Dopamine &Dobutamine) support were started to correct hypotension.

APACHE-2 score was used for the evaluation of patient's health, prognosis of the treatment and hospital stay.Maximum score is 71. Higher the score predicted mortality rate will also be higher. Score over 35 predicts 80% mortality whereas score of 25 predicts mortality rate 50%.Increasing score is associated with increasing risk of hospital death. APACHE 2 score has twelve physiological variables (table 1). Patients age and health condition were given numerical values for calculation. Mean and Standard deviation was calculated for quantitative variables and for qualitative variables frequencies and percentages were calculated. Glasgow coma sale (GCS) and the total length of hospital (ICU) stay also calculated. Data was analyzed on SPSS 23.Observed mortality ratewas calculated by dividing total deaths due to aluminum phosphide ingestion in ICU by total admissions in that year (study period) X 1000. Expected Mortality Rate (M∈) was calculated by dividing the observed deaths (M°)(due to aluminum phosphide) in ICU by the mortality predicted by the APACHE II. Qualitative variables comparison was tested by chi-square. Student two tail test was used for critical value. Value less than 0.05 (P-value) was considered statistically significant.

Table No. 1. APACHE-2 SCORING CHART

S.NO	Physiological variable	APACHE 2 Score		
		0	2	5
1.	Temp (C)	36-38.4	32-33.9	<34
2.	Mean Blood Pressure	110/70>	90/60>	60/40>
3.	Heart rate	70-109	55-69	<39
4.	Resp rate	12-24	6-9	<5
5.	Oxygen saturation	>90%	>55%	<55%
6.	Arterial pH (mean)	7.33	7.25	7.15
7.	Na+ (mEq/l)	>130	>111	<110
8.	K+ (mEq/l)	3.5>	2.5>	`<2.5
9.	S.Creatinine (mg/dl)	<1.4	<2.5	>2.5
10.	Haemocrit (%)	30-45	30-29.9	<20
11.	WBC	3-14	1-2.9	<1
12.	Glasgow coma scale	15/15	12/15	<11

Table No 2.   AGE IN YEARS

Age	<10	10-15	16-20	21-25	26-30	31>
Score	2	3	4	5	6	7
Onset -Hospital Stay (Hours)	<2 hour	<3 hour	<6 hour	<12 hour	<24 hour	<30 hour
Score	5	4	3	2	1	1

RESULTS

From our study results, it was evident that out of 19 reported cases, females constituted 11 (57%) mortality. Overall mortality was 68% n=13(Table 3). Most common symptoms were vomiting 17(89%), hypotension 14(73%) arrhythmias (62%), followed by anxiety (61%), confusion, metabolic acidosis (57%), and respiratory distress (44%).

Patient who consumed more than one tablet and arrived late (i.e.3-6hrs) did not survive. All the victims, who did not survive had significantly reduced bicarbonates levels. Arterial Blood Gasses of victims who did not survive were pH 6.96 ± 0.086, PaO2 mmHg 92.88 ± 1.6, PaCO2 mmHg 31.42 ± 2.23, HCO3 mEq/lL 10.09 ± 1.58 7, Anion gap mEq/L 23.50 ± 2.44.

There is no such antidote available in the market. It is very fast acting produces phosphine gas that causes tachypnea and asphyxia terminally leading to death.

All patients were symptomatically treated 16% (3 out of 19) discharged within 24 hours but 84% (n=16) retained for 2-3 days. 07 patients needed ventilator support and couldn't manage to survive. The survival rate (prognosis) was not much in the absence of antidote, only 03 (15.7%) survived. Survival rate depends upon many factors including lesser amount of ingestion (half tablet or expired tablets) (n=5), early arrival (n=7), 50% male survived whereas only 27.3 % female able to combated the effects.

All patients admitted needed inotropic support. APACHE score was also useful in predicting mortality rate in ICU admitted poisoning patients. In our study we distributed our patients in three categories depending upon severity of score as shown in Table 4.

Table No 3. M/F RATIO

Total Patients (19)	Age Group Year	Mean Age Year	Male to Female Mortality Ratio	Overall Mortality Case68 %
Male 4 (21%)	12-30	22 ± 2.44		02 (50%)
Female 11 (68.6%)	12-25	18 ± 1.45	1:4	11 (57%)

Table No. 4. APACHE SCORE OBSERVED SCORE

Score	Mortality	
	Observed (M°)	Expected($M\in$)
11-20	16% (n=3)	10%
21-30	26% (n=5)	26%
31-40	58% (n=11)	56%

DISCUSSION

Aluminum phosphide is a highly poisonous substance. Medical critics still say if a patient with suspected aluminum phosphide poisoning survived then either it was not aluminum phosphide or the poison was already exposed to moisture[9]. In literature the reported mortality

of this compound varies from 55-90%[10]. In Northwest India aluminum phosphide was found to be the most common suicidal poison[11]. Many countries such as Iran, Malaysia and New Zealand have banned its domestic sale. In the European countries its supply is restricted under 1998 pesticide act [9,10,11].

The tendency of suicide among females was higher than males. Out of 12 females n=9 (75%) were young females under 25 years. Our results favor the findings of Kadu et al., 2020; & Khan, 2016, where young female's percentage was 77% and 81%[12,13]. Khan MJ et al determined organo-phosphorus as a primary poison of choice which was inconsistent with our findings and Kadu et al., 2020. We found that wheat pill poisoning was the poison of choice among local populations of India and Pakistan communities [12,13].

In our study 16 (84%) victims ingested wheat pills to commit suicide,the manner of administration was inline with the findings of Sadia et al and Qureshi MA et al[14.15]. We have found no case of homicidal wheat pill poisoning our finding favors the results of Qureshi MA et al but slightly differ with Sadia et al study conducted in Sargodha where she found in 5% cases it was administrated with homicidal intention [14,15]. Most of the patient reached hospital within 2-3 hours after ingestion, we found that gastric lavage with coconut oil prevent further absorption and useful in the early management of poisoning. Qurashi MA results also showed similar findings[15]. Out of 13 admitted cases only 3 survived. Beside all possible systematic support 10 died. Autopsy report showed left ventricular myocardial infraction. Our findings favor findings of Shazia et al in Peshawar. Moreover, these researchers reported that mortality rate is higher and reached up to 70% was also reported in study of by Ghazi, 2013 and Rehman, 2020 studies [16,17, 18].

APACHE-2 with high values more than 35 in our study showed high mortality rate which were inconsistent with and Ahmad et al., 2020 and Peres et al., 2020, studies conducted internationally [19-20]. The observed values are lesser than expected values of APACHE-2. Peres et al., 2020 and Slima et al., 2020; had also found higher risk of mortality rates when poisoning cases reported and admitted in ICU [20-21].

CONCLUSION

Aluminum phosphide is a very fast acting poison and poison of choice among young females. The drug causes permanent multi-organ damage, leading to death. APACHE-2 score is

helpful in predicting the prognosis of the admitted patients in ICU. There is a need of follow-up studies and to design active management algorithms for wheat pill poisoning management.

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