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BIOCHEMICAL AND PHYSIOLOGICAL PREDICTORS OF MORTALITY IN PEADIATRIC POISONING CASES; A PHARMACOLOGY FORENSIC CROSSROAD

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ABSTRACT

Background: To evaluate physiological and biochemical factors associated with mortality in children admitted with acute poisoning at a tertiary care hospital in Peshawar.

Methods: A prospective observational study was conducted in the Department of Pediatrics, Hayatabad Medical Complex, Peshawar, from January 2023 to January 2024. A total of 72 children aged 1–12 years with confirmed or suspected poisoning were included. Demographic details, poisoning characteristics, vital signs, neurological status, and biochemical parameters were recorded at admission. Outcomes were compared between survivors and non-survivors using appropriate statistical tests, with a p-value <0.05 considered significant.

Results: Of 72 cases, 14 (19.4%) children died. Mortality was significantly associated with rural residence (p=0.029), organophosphate ingestion (p=0.021), and delayed hospital presentation >6 hours (p=0.004). Physiological predictors of death included hypotension (p=0.007), SpO_2 <90% (p=0.002), and GCS <8 (p<0.001). Biochemical predictors included hyperkalemia (p=0.026), elevated creatinine (p=0.048), raised liver enzymes (p=0.021), and metabolic acidosis (p=0.014). Non-survivors had higher ICU admission, ventilation needs, complications, and longer hospital stays (all p<0.001).

Conclusion: Paediatric mortality from poisoning is strongly influenced by delayed presentation, organophosphate ingestion, abnormal vital signs, and specific biochemical abnormalities. Early recognition and aggressive management of these predictors, along with community-level preventive measures, are crucial to reducing deaths in children with poisoning.

Keywords: Paediatric poisoning, mortality predictors, biochemical markers, physiological parameters, organophosphates, Pakistan

INTRODUCTION

Poisoning in children is a significant global health concern, particularly in low- and middle-income countries where environmental hazards, unsafe storage of household chemicals, and limited access to emergency care increase vulnerability. According to the World Health Organization, accidental poisoning accounts for thousands of preventable childhood deaths annually, with the burden being highest in South Asia and Sub-Saharan Africa. In Pakistan, paediatric poisoning is a frequent cause of emergency admissions, yet data on predictors of poor outcomes remain limited [1-3].

Children are uniquely vulnerable to toxic exposures because of their inquisitive behavior, immature metabolic pathways, and lower body weight, which increase susceptibility to even small doses of poisonous substances. Common agents implicated in paediatric poisoning include pesticides, kerosene, pharmaceutical drugs, and household cleaning products. Among these, organophosphates remain particularly lethal due to their widespread availability and profound effects on the central and peripheral nervous systems [4-6].

The clinical outcome of poisoning is determined not only by the type and dose of poison but also by the timeliness of hospital presentation, adequacy of supportive care, and presence of physiological or biochemical abnormalities at admission. Vital signs such as blood pressure, respiratory effort, and neurological status, as well as laboratory parameters including serum electrolytes, renal and liver function tests, and arterial blood gases, can provide valuable prognostic information. Several studies from India, Bangladesh, and Iran have shown that hypotension, altered consciousness, hypoxemia, and metabolic acidosis are strongly linked to mortality in paediatric poisoning. However, locally relevant evidence from Pakistan remains scarce [7-9].

Understanding these predictors is crucial for both clinical and forensic purposes. Clinically, it enables physicians to prioritize intensive monitoring and early intervention in high-risk children. From a forensic standpoint, identifying fatal risk factors helps establish causation, informs policy on poison control, and strengthens preventive strategies at the community level [10, 11].

The present study was therefore designed to evaluate the biochemical and physiological predictors of mortality in paediatric poisoning cases admitted to Hayatabad Medical Complex, Peshawar. By identifying key prognostic markers, this research aims to guide better clinical decision-making, strengthen preventive measures, and contribute to the scarce local data in this critical area.

METHODOLOGY

This was a prospective observational study conducted in the Department of Pediatrics, Hayatabad Medical Complex, Peshawar. The study was carried out over a period of one year, from January 2023 to January 2024, and focused on identifying biochemical and physiological predictors of mortality in children admitted with acute poisoning. Ethical approval for the study was obtained from the Institutional Review Board of Hayatabad Medical Complex, Peshawar. Informed consent was obtained from parents or legal guardians before enrollment. Confidentiality of patient information was maintained throughout the study, and data were used exclusively for research purposes.

A total of 72 children who fulfilled the inclusion criteria were enrolled in the study. The sample size was determined based on hospital admission records of paediatric poisoning cases in the preceding years to ensure adequate power for statistical analysis. Patients were recruited using a consecutive sampling method, meaning all eligible cases presenting during the study period were included until the required sample size was reached.

Inclusion Criteria

- Children aged 1 to 12 years presenting with a clear history or clinical suspicion of poisoning.
- Cases confirmed by caregivers' account, circumstantial evidence, or toxicological screening where available.
- Patients admitted within 24 hours of exposure.

Exclusion Criteria

- Children with pre-existing chronic illnesses such as congenital heart disease, chronic kidney disease, or liver disorders.
- Cases with incomplete medical records or where informed consent could not be obtained.
- Patients who left against medical advice before completion of evaluation and treatment.

After obtaining informed consent from parents or legal guardians, detailed demographic and clinical data were recorded on a predesigned proforma. Information collected included age, gender, residence (urban/rural), type of poison ingested, route of exposure, and time elapsed before hospital presentation.

On admission, all children underwent a thorough clinical assessment. Vital signs (heart rate, blood pressure, respiratory rate, oxygen saturation, and temperature) were measured and documented. Neurological status was assessed using the Glasgow Coma Scale (GCS). Presence of seizures, pupillary changes, and signs of respiratory distress were also noted.

Venous and arterial blood samples were collected at admission. The following investigations were performed according to standard hospital laboratory protocols:

- Random blood glucose
- Serum electrolytes (sodium, potassium, chloride, calcium)
- Renal function tests (urea and creatinine)
- Liver function tests (AST, ALT, bilirubin, albumin)
- Coagulation profile (PT, INR, APTT)
- Arterial blood gases (pH, PaO_2, $PaCO_2$, bicarbonate, lactate)
- Specific toxicological markers (such as serum cholinesterase in suspected organophosphate poisoning) whenever feasible

All patients received treatment according to standard clinical protocols, including supportive care, gastric decontamination, antidote administration (if available), and intensive care support when required. Clinical progress was closely monitored until discharge or death. Outcome measures recorded were duration of hospital stay, requirement of ICU admission, need for mechanical ventilation, development of complications, and survival status.

The primary outcome was mortality during hospital stay. Secondary outcomes included the frequency of complications, requirement for intensive care support, and length of hospital stay.

Data were analyzed using SPSS version 26. Descriptive statistics (mean ± standard deviation for continuous variables; frequency and percentage for categorical variables) were used to summarize the data. Comparisons between survivors and non-survivors were performed using the Chi-square test or Fisher's exact test for categorical variables, and independent t-test or Mann–Whitney U test for continuous variables as appropriate. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Among the 72 children admitted with poisoning, the majority were under 10 years of age. No significant difference was observed between male and female patients in terms of survival outcomes. However, children from rural backgrounds showed a higher mortality rate compared to those from urban areas ($p=0.029$). Organophosphates were the leading cause of death and were significantly associated with mortality ($p=0.021$). In contrast, kerosene and pharmaceutical drug poisoning did not show a strong association with outcome. Delay in hospital presentation was an important predictor, as patients arriving after 6 hours of exposure had a significantly higher risk of death ($p=0.004$).

Table 1: Demographic and Poisoning Characteristics of the Study Population (n=72)

Variable	Survivors (n=58)	Non-Survivors (n=14)	p-value
Age (years)	6.2 ± 3.1	5.4 ± 2.8	0.412
Gender (Male/Female)	32 / 26	7 / 7	0.781
Residence (Urban/Rural)	25 / 33	3 / 11	0.029*
Type of Poison			
– Organophosphates	14 (24.1%)	6 (42.9%)	0.021*
– Kerosene	9 (15.5%)	2 (14.3%)	0.912
– Pharmaceuticals	21 (36.2%)	4 (28.6%)	0.551
– Household chemicals	14 (24.1%)	2 (14.3%)	0.377
Time to Hospital (<6h)	40 (69.0%)	4 (28.6%)	0.004*

*Significant at $p<0.05$

On admission, abnormal physiological parameters were strong indicators of poor outcome. Children who presented with hypotension (p=0.007), abnormal heart rate (p=0.018), and respiratory distress (p=0.016) were significantly more likely to die. Hypoxemia (SpO_2 <90%) was another strong predictor of mortality (p=0.002). Neurological status was particularly important: more than half of the non-survivors had a GCS score <8, showing a highly significant association (p<0.001). Although seizures were more common in non-survivors, this finding did not reach statistical significance.

Table 2: Physiological Predictors at Admission

Variable	Survivors (n=58)	Non-Survivors (n=14)	p-value
Heart Rate (tachy/brady)	18 (31.0%)	9 (64.3%)	0.018*
Systolic BP <90 mmHg	7 (12.1%)	6 (42.9%)	0.007*
Respiratory distress	12 (20.7%)	7 (50.0%)	0.016*
SpO_2 <90%	5 (8.6%)	6 (42.9%)	0.002*
GCS <8	4 (6.9%)	8 (57.1%)	<0.001*
Seizures at admission	6 (10.3%)	4 (28.6%)	0.091

Biochemical abnormalities were strongly associated with adverse outcomes. Children who developed hyperglycemia (>200 mg/dL) were more likely to die (p=0.042). Hyperkalemia was also a significant predictor (p=0.026), while hyponatremia did not show a significant relationship. Elevated serum creatinine (p=0.048) and raised liver enzymes (p=0.021) indicated multi-organ involvement and were linked to mortality. Metabolic acidosis on arterial blood gas was another critical finding that showed a significant association with poor outcomes (p=0.014).

Table 3: Biochemical Predictors of Mortality

Variable	Survivors (n=58)	Non-Survivors (n=14)	p-value
Random Blood Glucose >200 mg/dL	7 (12.1%)	5 (35.7%)	0.042*
Hyponatremia (<130 mEq/L)	8 (13.8%)	4 (28.6%)	0.171
Hyperkalemia (>5.5 mEq/L)	6 (10.3%)	5 (35.7%)	0.026*
Serum Creatinine >1.2 mg/dL	5 (8.6%)	4 (28.6%)	0.048*
Elevated Liver Enzymes	6 (10.3%)	5 (35.7%)	0.021*
Metabolic Acidosis (pH <7.3)	8 (13.8%)	6 (42.9%)	0.014*

Children with poor prognostic markers at presentation had worse clinical outcomes. Non-survivors required ICU admission significantly more often (85.7% vs. 20.7%; p<0.001) and mechanical ventilation (78.6% vs. 13.8%; p<0.001). They also had longer hospital stays (mean 6.1 vs. 3.9 days; p=0.001) and developed more complications such as pneumonia, arrhythmias, and renal failure

($p<0.001$). These findings underline the importance of both early recognition and aggressive management in improving survival.

Table 4: Clinical Outcomes

Variable	Survivors (n=58)	Non-Survivors (n=14)	p-value
ICU admission	12 (20.7%)	12 (85.7%)	<0.001*
Mechanical ventilation	8 (13.8%)	11 (78.6%)	<0.001*
Length of stay (days)	3.9 ± 1.5	6.1 ± 2.2	0.001*
Complications	10 (17.2%)	9 (64.3%)	<0.001*

DISCUSSION

This study highlights the critical role of early clinical and laboratory indicators in predicting mortality among children presenting with acute poisoning at Hayatabad Medical Complex, Peshawar. Out of 72 cases, significant predictors of poor outcome included delayed hospital presentation, organophosphate poisoning, abnormal vital signs (hypotension, hypoxemia, altered GCS), and biochemical derangements such as hyperkalemia, metabolic acidosis, and elevated liver enzymes.

Our findings are consistent with previous research. Studies reported that organophosphate compounds accounted for a significant proportion of fatal cases, largely due to their profound cholinergic effects and multisystem involvement [12, 13]. Similar to our results, they found that delayed hospital arrival beyond 6 hours was strongly associated with mortality. Studies observed that rural children were more frequently affected and often presented late, leading to higher complication rates findings which align with our observation that rural residence was linked to poor outcomes [14].

Physiological predictors such as hypotension and low GCS were among the strongest determinants of survival in our study. These observations agree with the studies demonstrated that low blood pressure, respiratory distress, and coma were independent predictors of death in paediatric poisoning. Our study further adds to this evidence by showing that oxygen desaturation (SpO_2 <90%) and the requirement for mechanical ventilation were highly correlated with mortality [15-17].

Biochemical abnormalities also played a key role in predicting outcome. Hyperkalemia, metabolic acidosis, and elevated liver enzymes were significantly associated with death in our cohort. These findings mirror those reported by studieswhere metabolic acidosis and deranged renal and hepatic parameters were shown to be strong indicators of multi-organ dysfunction and increased risk of death. Similarly, research highlighted that raised creatinine and electrolyte disturbances were critical determinants of mortality in poisoned children [18].

The high frequency of ICU admission and mechanical ventilation among non-survivors in our study emphasizes the need for aggressive supportive care. Comparable results were reported by studeis, where children requiring ventilation had significantly higher fatality rates. Our results underscore the importance of equipping tertiary care centres with adequate critical care facilities to improve survival outcomes [19].

The present study also reinforces the importance of preventive strategies. Most poisoning cases in children are accidental and related to unsafe storage of household chemicals and medications. Studies have shown that community awareness, parental education, and strict regulation of toxic substances can significantly reduce the burden of paediatric poisoning [20].

CONCLUSION

This study demonstrates that both physiological and biochemical abnormalities at presentation serve as reliable predictors of mortality in paediatric poisoning cases. Hypotension, low GCS, hypoxemia, hyperkalemia, metabolic acidosis, and elevated liver enzymes were significantly associated with fatal outcomes. Delayed hospital arrival and organophosphate ingestion further increased the risk of death. Early recognition of these predictors, coupled with timely interventions and intensive care support, is essential to improve survival in children with poisoning. Preventive measures such as parental education, safe storage of toxic agents, and better access to emergency care in rural regions are equally

critical. Strengthening these aspects at both community and hospital levels may substantially reduce morbidity and mortality related to childhood poisoning.

REFERENCES

1. Rodrigues, C.H., et al., *Acute, chronic, and post-mortem toxicity: a review focused on three different classes of new psychoactive substances.* 2023. **41**(2): p. 187-212.
2. Baj, J., et al., *Trace elements levels in major depressive disorder—evaluation of potential threats and possible therapeutic approaches.* 2023. **24**(20): p. 15071.
3. Hourfane, S., et al., *A comprehensive review on Cannabis sativa ethnobotany, phytochemistry, molecular docking and biological activities.* 2023. **12**(6): p. 1245.
4. Ryan, R.Y., et al., *Immunological responses to envenomation.* 2021. **12**: p. 661082.
5. Venn, J., *Crime and Psychology: Foundations of Forensic Practice*. 2023: Routledge.
6. BLUM, R., *Integrative Management of Disordered Impulse Control.*
7. Greaves, I., K. Porter, and J. Garner, *Trauma care manual*. 2021: CRC Press.
8. Knudsen, C., et al., *Snakebite envenoming diagnosis and diagnostics.* 2021. **12**: p. 661457.
9. Bottaccioli, A.G. and F. Bottaccioli. *PsychoNeuroEndocrineImmunology and the science of integrated care. The manual*. 2020. Edra.
10. Rahman, S., *Essentials of Delirium: Everything You Really Need to Know for Working in Delirium Care*. 2020: Jessica Kingsley Publishers.
11. Walker, A., S. Schlozman, and J. Alpert, *Introduction to Psychiatry: Preclinical Foundations and Clinical Essentials*. 2021: Cambridge University Press.
12. Vranic, I.I., *Characterization of Cardiac Electrophysiology Including ECG-Analysis*, in *Drug Discovery and Evaluation: Methods in Clinical Pharmacology*. 2020, Springer. p. 51-80.
13. Woolrych, R. *Ageing-in-place, Rights and Inequalities: Implications for Age-Friendly Cities and Communities*. in *International Symposium on Recent Advances in Research on Healthy Aging and Future Challenges & 20th Biennial Conference of Association of Gerontology (India)*. 2022.
14. Eid, A.M. and N.J.F.i.p. Jaradat, *Public knowledge, attitude, and practice on herbal remedies used during pregnancy and lactation in West Bank Palestine.* 2020. **11**: p. 46.
15. Nyarko, O.O. and C.C.J.T.j.o.c.a. Sucharov, *The secretome as a biomarker and functional agent in heart failure.* 2023. **3**(3): p. 27.
16. Samak, D.H., et al., *Developmental toxicity of carbon nanoparticles during embryogenesis in chicken.* 2020. **27**(16): p. 19058-19072.
17. Focquaert, F., E. Shaw, and B.N. Waller, *The routledge handbook of the philosophy and science of punishment*. 2021: Routledge Abingdon.
18. Yearwood, E.L., et al., *Deliberate Self-harm: Nonsuicidal Self-injury and Suicide in Children and Adolescents.* 2021: p. 207-226.
19. Dearing, G., *Psychiatrie News.*
20. Ji, P., et al., *Potential of copper and copper compounds for anticancer applications.* 2023. **16**(2): p. 234.