Original Article

White Blood Cell to Platelet Ratio as a Marker of Adverse Outcome in Organophosphate Poisoning: A Retrospective Cross-Sectional Survey

Aimen Malik[1], Muhammad Azam Awais[2], Saba Shafiq[3], Maria Aziz[4], Abrar Akbar[5], Abdur Rehman[6]

[1] Resident, Department of Emergency Medicine, Holy Family Hospital, Rawalpindi.
[2] House Officer, Department of Emergency Medicine, Holy Family Hospital, Rawalpindi.
[3] House Officer, Department of Anaesthesiology, Benazir Bhutto Hospital, Rawalpindi.
[4] Medical Officer, Department of Emergency Medicine, Holy Family Hospital, Rawalpindi.
[5] Assistant Professor, Medical ICU, Holy Family Hospital, Rawalpindi.
[6] House Officer, Department of Anaesthesiology, District Head-Quarter Hospital, Rawalpindi.

Author's Contribution
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Corresponding Author
Dr. Muhammad Azam Awais,
House Officer,
Department of Emergency Medicine,
Holy Family Hospital
Rawalpindi
Email: azam.m.awais@gmail.com

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Abstract

Introduction: Organophosphorus compounds are pesticides commonly used for agricultural purposes. However, by nature they are poisonous, and administration either accidental or intentional is a medical emergency requiring prompt evaluation and treatment, and can even lead to death. In addition due to the ease of their availability, they are commonly used for self-harm/suicidal purposes.

Many of the patients are initially managed at primary or secondary healthcare setups before being referred to tertiary care hospitals. The purpose of our study is to find a prognostic marker in the initial blood work of these patients.

Materials and Methods: A total of 46 patients were included in this retrospective cross-sectional survey conducted at the Department of Emergency Medicine, Holy Family Hospital, Rawalpindi. Data were collected from patient files using specific questionnaires. Outcomes were defined in terms of Emergency Department disposition. Data were analysed using SPSS v25. A univariate analysis, followed by Spearman's Correlation was used.

Results: Patients with a higher WBC to Platelet ratio had worse outcomes. The Spearman's rho correlation coefficient was calculated and a moderately strong correlation (rho = .458, $p < .001$) was found.

Conclusion: WBC to Platelet ratio is a hematological parameter determined to be most strongly correlated with adverse outcomes in Organophosphate Poisoning. It has a statistically significant stronger correlation than the WBC count alone. However, further extensive and focused studies are needed to corroborate these findings and substantiate them as a definite marker of prognostic significance.

Keywords: Organophosphate Poisoning; Emergency Medicine; ED; White Blood Cells; Emergency Care; Patient Outcome Assessment.

Introduction

Organophosphorus compounds are pesticides used for agricultural productivity and the control of deadly vector-borne illnesses.[1] These compounds can cause poisoning via inhalation, ingestion, and absorption through the skin. Organophosphate poisoning (OPP) is a medical emergency that needs prompt management and treatment.

Organophosphorus compounds work by inhibiting the enzyme acetylcholinesterase, which is present in the neuromuscular junctions and handle the degradation of the neurotransmitter acetylcholine. This leads to overstimulation of nicotinic and muscarinic receptors, causing a cholinergic crisis with the signs and symptoms of miosis, excessive lacrimation, salivation, bronchorrhea, emesis, abdominal cramps, etc.[2] Many patients need ICU care and ventilatory support because of the respiratory depression and pleural effusion caused by the compounds.

Early prediction of the prognosis of a patient with OPP is a complicated problem. People have conducted many studies on various factors that could predict the outcome of a patient with OPP. These include, but are not limited to; serum bicarbonate, APACHE II score, the development of pneumonia, comorbidities, long hospital stay, elevated creatinine, low GCS scores, low plasma cholinesterase levels, white blood cell (WBC) count, pH, serum creatinine.[3-8] A study by Dundar et al. investigated the prognostic value of the neutrophil-lymphocyte ratio.[5] Sumathi et al. investigated several factors, including serum amylase, lipase, and CPK.[9] The study by Tang et al. looked at the parameters available within a simple Complete Blood Count and investigated whether any could predict the severity of OPP.[10]

Locally, a study by Muley et al. looked at S. acetylcholinesterase, SpO2 at room air, GCS, and duration of exposure at presentation.[11] Meanwhile, Hiremath et al. looked upon plasma pseudocholinesterase as the indicator.[12] Mohite et al. also looked at several factors, with APACHE II score and GCS being the most prominent.[13] The study by Kumar et al. looked at blood parameters and found an elevated WBC count to be significant in predicting the severity of OPP.[14]

However, most of them require special blood tests not easily available outside tertiary care hospitals. The purpose of our study, however, is to find a parameter that is included in the history of the initial blood work when a patient comes into the A and E departments. Many a time someone managed such patients at primary or secondary healthcare setups, and referred them to specialized care hospitals, as the prognosis could not be determined, therefore it cannot be decided what level of care is required. This is a pragmatic course of action as patients may require Intensive Care. However, most of the time it leads to unnecessary or overenthusiastic referrals, adding costs to patient care and burdening staff at tertiary care hospitals. Çiçek et al. used WBC count to mean platelet volume ratio as a novel prognostic indicator in ST-elevation myocardial infarction.[15] Celik et al used the same for dry eye disease.[16] Mo et al. used this ratio as a diagnostic indicator for rectal cancer.[17]

Thus, in this study, we look for a strong prognostic factor hidden within the initial Complete Blood Count, focusing on the WBC to platelet ratio. If significant, physicians can use them to improve management at primary and secondary health care setups, while avoiding unnecessary referrals to tertiary setups. This will reduce the strain on tertiary setups and save the patients from needless worry.

Materials and Methods

This was a cross-sectional study conducted at the Department of Emergency Medicine, Holy Family Hospital. Following Ethical approval from the Ethical Review Board of Rawalpindi Medical University, files of Organophosphate Patients between Feb 2021 and September 2021. Records of 106 patients were examined. Incomplete files were discarded. A total of 46 patients were recruited based on the Inclusion and Exclusion Criteria.

Inclusion Criteria:

1. History of oral exposure to organophosphate poisoning.
2. Patients older than 10 years of age.
3. Clinical Diagnosis of Organophosphate Poisoning.

Exclusion Criteria:

1. Exposure to toxins and chemicals other than organophosphates.
2. Multiple poisoning.
3. Patients with co-morbid conditions like chronic lung diseases, heart failure, chronic kidney disease, liver cirrhosis, etc.
4. Chronic Medication Use.

For the collection of data, a questionnaire containing the following variables was used: age, gender, medical history (hypertension, diabetes, heart failure, chronic obstructive pulmonary disease [COPD], chronic kidney disease [CKD], and liver cirrhosis), blood tests

(WBC count, haematocrit, platelet count, plasma cholinesterase [pChE], urea, nitrogen, serum creatinine, serum amylase, and albumin) and blood gas analysis (pH, partial pressure of oxygen and carbon dioxide, base excess and lactate) within 24 hours after admission to the Medical Emergency. These data were collected by two experienced physicians and transferred to Excel spreadsheets.

Statistical Analysis:

Socio-demographic characteristics were described in terms of frequencies and percentages between males and females. A univariate analysis (Nonparametric test) was used to explore the significant associations between laboratory findings and the Emergency Department fate of these patients. The Spearman correlation coefficient was calculated to find the strength of the relationship between measured characteristics and disposition. Following correlation analysis, a regression analysis was performed to assess which laboratory parameters could effectively predict the ED fate of the patients. Data were analysed using IBM SPSS v.25.0 (IBM, Armonk, U.S.). A two-tailed $p < .05$ was considered statistically significant.

Results

Demographics

The study included a total of 46 patients, with ages ranging from 12 to 42 years (M =22.8, SD = 7.29), with the majority being formed by females 30(65.2%). Out of 46 participants, 13(28.3%) were married, while 33(71.7%) were unmarried. 37% belonged to rural background. Most participants (84.8%) had taken the rodenticide poison. Table no.1 shows the gender-wise distribution of socio-demographic details.

Table 1: Characteristics of Patients by Gender Distribution

		Female		*Male*	
		Number	Percentage	Number	Percentage
Rural or Urban	Rural	10	21.7%	7	15.2%
	Urban	20	43.5%	9	19.6%
Marital Status	Married	9	19.6%	4	8.7%
	Unmarried	21	45.7%	12	26.1%
Type of OP Poisoning	Insecticide	6	13.0%	1	2.2%
	Ratpill	24	52.2%	15	32.6%
Past Psychiatric History	No	29	63.0%	16	34.8%
	Yes	1	2.2%	0	0.0%

Factors affecting ED Disposition of Patients

Out of the 46 patients, 27 were discharged, 15 were admitted to the ward, 3 were intubated and shifted to the ICU and 1 patient died in the Emergency Department as shown in Table 2.

Table 2: ED Disposition of Patients

	Number	*Percent*
Discharged	27	58.7
Admitted to Ward	15	32.6
Intubated and sent to ICU	3	6.5
Died	1	2.2
Total	46	100.0

A nonparametric correlation analysis was performed, and a statistically significant effect of WBC to Platelet ratio (($p<0.01$) on the Emergency Department Fate of the patients. The Spearman's rho correlation coefficient was calculated and a moderately strong correlation (rho = .458, $p < .001$) was found. Thus, those patients who had an elevated WBC/Platelet ratio were more likely to suffer and have a worse ED outcome. Table 3 outlines the correlation between various lab parameters.

Table 3: Correlation between laboratory parameters and ED Disposition

	Fate	*WBC/Platelet*	*HB*	*Na*	*K*	*Cl*	*WBC*	*Platelet*
Fate	1.000							
WBC/Platelet	.458**	1.000						
HB	-0.020	0.076	1.000					
Na	0.241	.359*	.340*	1.000				
K	-0.206	-0.071	0.052	-0.250	1.000			
Cl	0.280	0.156	-.322*	.397**	-0.032	1.000		

WBC	.311*	.601**	0.016	0.125	-.421**	-0.121	1.000	
Platelet	-0.170	-.422**	0.038	-0.260	-.338*	-.368*	.378**	1.000

***. Correlation is significant at the 0.01 level (2-tailed).*

**. Correlation is significant at the 0.05 level (2-tailed).*

Regression Analysis

Considering the correlation between WBC/Platelet ratio with patient outcome, an ordinal logistic regression was performed. Outcomes were ordered, with discharged being the lowest order (=1) and died being the highest or worst (=4). The Chi-Square likelihood for the model fit was statistically significant, allowing for a better overall prediction by the final model than the simple intercept model, as shown in Table 4 below.

Table 4: Model Fitting Information

Model	*-2 Log Likelihood*	*Chi-Square*	*df*	*Sig.*
Intercept Only	86.427			
Final	77.262	9.165	1	0.002

Link function: Logit.

The analysis of the Parameter Estimates shows an Estimate of 36.452 with a significance level of .004, meaning that for 1 unit increase in the WBC/Platelet Ratio, we would expect a 36.5 increase in the log odds of having a worse outcome. This indicates that as WBC/Platelet Ratio increases, the probability of a worse outcome increases.

Table 5: Parameter Estimates

Parameter		*B*	*Std. Error*	*Hypothesis Test*			*Exp (B)*
				Wald Chi-Square	df	Sig.	
Threshold	[Fate=1]	2.533	0.8491	8.901	1	0.003	12.593
	[Fate=2]	4.879	1.1055	19.479	1	0.000	131.543
	[Fate=3]	6.390	1.4218	20.198	1	0.000	595.857
WBC to Platelet		36.452	12.8930	7.994	1	0.005	678 E^15
(Scale)		1[a]					

Dependent Variable: Fate Model: (Threshold), WBC to Platelet

a. Fixed at the displayed value

For Goodness-of-Fit, the Pearson Chi-Square was statistically significant, indicating that the distribution of outcomes was as predicted by the analysis and that the probability of those outcomes was statistically significant.

Table 6: Goodness-of-Fit

	Chi-Square	*df*	*Sig.*
Pearson	173.372	131	0.008

Link function: Logit.

Discussion

When compared with most of the studies in the rest of the world, our study showed an anomaly regarding the gender ratio. Our study showed a majority of the patients being female while a vast majority of studies showed a male-dominant gender ratio.[3,18-21] However, recent studies have shown a similar gender ratio to our study.[4,22] Regional factors such as religious, cultural, financial, and social scenarios may affect the gender ratios, and further research into this aspect is required.

The principal focus of our study was to detect any prognostic factors hidden in common basic hematological parameters. A raised WBC-platelet ratio showed the strongest and most significant correlation with a worse outcome in our study. A raised WBC count is a marker of inflammation, so it makes sense that it might be a predictor of worse outcomes. Anormallikleri et al. showed raised WBCs to be a predictor of worse outcomes.[23] Similarly, studies by Wu et al. and Ke et al. both showed raised WBCs in OPP patients to be a predictor of worse outcomes.[6,7] In 2018, Kumar et al. showed that WBC counts on admission can be used as a prognostic marker in patients with OP poisoning.[14] While this is in line with the results of our study, the WBC to Platelet ratio has been shown to have a stronger and more significant association with worse outcomes.

While serum acetylcholine levels have been used to diagnose and stratify patients[9], a definite association between the severity of OPP and serum AChE levels

has yet to be shown.[24,25] Commonly used clinical tools such as APACHE II and SAPS II seem to predict prognostic value.[26] Their correct estimation requires multiple laboratory tests, many of which are unavailable at primary and secondary care setups. Similar is the case in which biochemical parameters have been identified as independent prognostic factors, such as serum amylase and lactate.[9,27]

WBC-platelet ratio is a factor that is not extensively studied. While looking at the results of the study by Dundar et al., we can see that the patients requiring mechanical ventilation have a significantly higher WBC-platelet ratio.[5] This is clearly in line with our results. We can see a similar scenario when looking at the results of the study by Dong et al.[8] However, neither of these authors focused on this parameter during their study. So, we cannot comment on whether these results were of significant value.

A complete blood count is often the most readily available test in any healthcare setup and is also the one in which the results are available the quickest. Thus, the WBC-platelet ratio is a valuable first-line hematological parameter that can predict the prognosis of a patient with OPP.

Several factors limited this study: first, the small sample size taken from a single healthcare setup being one of them. Second, as this is a cross-sectional survey, all inherent limitations of such a study design are present here. Third, while it excluded patients with comorbidities, we made the assessment on history and examination. We could not assess subclinical disease, which may affect haematological parameters under assessment. A large multi-centre study, or case series, can tackle these limitations.

Conclusion

WBC to Platelet ratio is a hematological parameter determined to be most strongly correlated with adverse outcomes in Organophosphate Poisoning. It has a statistically significant stronger correlation than the WBC count alone. However, further extensive and focused studies are needed to corroborate these findings and substantiate them as a definite marker of prognostic significance.

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References

1. Naughton SX, Terry A V. Neurotoxicity in acute and repeated organophosphate exposure. Toxicology. 2018 Sep 1;408:101–12. DOI: 10.1016/j.tox.2018.08.011
2. Hulse EJ, Haslam JD, Emmett SR, Woolley T. Organophosphorus nerve agent poisoning: managing the poisoned patient. Br J Anaesth. 2019 Oct 1;123(4):457–63. DOI: 10.1016/j.bja.2019.04.061
3. Sun IO, Yoon HJ, Lee KY. Prognostic factors in cholinesterase inhibitor poisoning. Med Sci Monit. 2015 Sep 28;21:2900–4. DOI: 10.12659/msm.894287
4. Acikalin A, Dişel NR, Matyar S, Sebe A, Kekec Z, Gokel Y, et al. Prognostic factors determining morbidity and mortality in organophosphate poisoning. Pakistan J Med Sci. 2017 May 1;33(3):534–9. DOI: 10.12669/pjms.333.12395
5. Dundar ZD, Ergin M, Koylu R, Ozer R, Cander B, Gunaydin YK. Neutrophil-lymphocyte ratio in patients with pesticide poisoning. J Emerg Med. 2014;47(3):286–93. DOI: 10.1016/j.jemermed.2014.01.034
6. Ke X, Zhi S, Zheng D, Hong G, Zhao G, … ML-Z lao D, et al. Analyses on relevant factors of the prognosis of patients with acute organophosphate poisoning. europepmc.org. Available from: 25916443
7. WU X, MENG J, LI Y, LI C, … HL-J of P, 2017 undefined. Prognostic factors and prognostic value of acute organophosphorus pesticide poisoning. pesquisa.bvsalud.org. Available from: https://pesquisa.bvsalud.org/portal/resource/pt/wpr-792684
8. Dong N, Liu J, Wang Z, Gao N, Pang L, Xing J. Development of a practical prediction scoring system for severe acute organophosphate poisoning. J Appl Toxicol. 2020 Jul 1;40(7):889–96. DOI: 10.1002/jat.3950
9. Sumathi M, Kumar S, Shashidhar K, Takkalaki N. Prognostic significance of various biochemical parameters in acute organophosphorus poisoning. Toxicol Int. 2014 Jul 1;21(2):167–71. DOI: 10.4103/0971-6580.139800
10. Tang Y, Hu L, Hong G, Zhong D, Song J, Zhao G, et al. Diagnostic value of complete blood count in paraquat and organophosphorus poisoning patients. Toxicol Ind Health. 2018 Jul 1;34(7):439–47. DOI: 10.1177/0748233718770896
11. Muley A, Shah C, Lakhani J, Bapna M, Mehta J. To identify morbidity and mortality predictors in acute organophosphate poisoning. Indian J Crit Care Med. 2014 Jan 1;18(5):297–300. DOI: 10.4103/0972-5229.132488
12. Hiremath P, Rangappa P, Jacob I, Rao K. Pseudocholinesterase as a predictor of mortality and morbidity in organophosphorus poisoning. Indian J Crit Care Med. 2016 Oct 1;20(10):601–4. DOI: 10.4103%2F0972-5229.192052
13. Mohite P, Anjankar A, Academy SP-J of I, 2018 undefined. Organo phosphorus poisoning: prognostic value of GCS score & other clinical indicators in assessing the final outcome. indianjournals.com. DOI: 10.5958/0974-0848.2018.00035.0
14. Kumar S, Agrawal S, Raisinghani N, Khan S. Leukocyte count: A reliable marker for the severity of organophosphate intoxication? J Lab Physicians. 2018 Apr;10(02):185–8. DOI: 10.4103/jlp.jlp_100_17
15. Çiçek G, Açıkgöz S, Yayla Ç, … HK-C, 2016 undefined. White blood cell count to mean platelet volume ratio: a novel and promising prognostic marker for ST-segment elevation myocardial infarction. journals.viamedica.pl. DOI: 10.5603/cj.a2016.0001
16. Celik T. Assessment of Neutrophil-to-Lymphocyte Ratio and Platelet-to-Lymphocyte Ratio in Patients with Dry Eye Disease. Ocul Immunol Inflamm. 2018 Nov 17;26(8):1219–22. DOI: 10.1080/09273948.2017.1340486

17. Mo C, Hu Z, Qin S, Chen H, … LH-J of clinical, 2020 undefined. Diagnostic value of platelet-lymphocyte ratio and hemoglobin-platelet ratio in patients with rectal cancer. Wiley Online Libr. 2019 Apr 1;34(4). DOI: 10.1002/jcla.23153
18. Ali P, Anwer A, Bashir B, Jabeen R, … HH-… LUMH, 2012 undefined. Clinical pattern and outcome of organophosphorus poisoning. lumhs.edu.pk. Available from: https://www.lumhs.edu.pk/jlumhs/Vol11No01
19. Ahmed SM, Das B, Nadeem A, Samal RK. Survival pattern in patients with acute organophosphate poisoning on mechanical ventilation: A retrospective intensive care unit-based study in a tertiary care teaching hospital. Indian J Anaesth. 2014 Jan;58(1):11–7. DOI: 10.4103/0019-5049.126780
20. Tagwireyi D, Ball DE, Nhachi CFB. Poisoning in Zimbabwe: A survey of eight major referral hospitals. J Appl Toxicol. 2002;22(2):99–105. DOI: 10.1002/jat.832
21. Ramesha KN, Rao KBH, Kumar GS. Pattern and outcome of acute poisoning cases in a tertiary care hospital in Karnataka, India. Indian J Crit Care Med. 2009 Jul 1;13(3):152–5. DOI: 10.4103/0972-5229.58541
22. Adinew GM, Asrie AB, Birru EM. Pattern of acute organophosphorus poisoning at University of Gondar Teaching Hospital, Northwest Ethiopia. BMC Res Notes. 2017 Apr 4;10(1). DOI: 10.1186/s13104-017-2464-5
23. Anormallikleri L. Emergency laboratory abnormalities in suicidal patients with acute organophosphate poisoning. Türk Biyokimya Dergisi [Turkish Journal of Biochemistry–Turk J Biochem]. 2010;35(1):29-34. DOI: 10.1.1.1089.8036
24. Tsai J-R, Sheu C-C, Cheng M-H, Hung J-Y, Wang C-S, Chong I-W, et al. Organophosphate Poisoning: 10 Years of Experience in Southern Taiwan; Organophosphate Poisoning: 10 Years of Experience in Southern Taiwan. 2007; DOI: 10.1016/s1607-551x(09)70385-7
25. Aygun D, Doganay Z, Altintop L, Guven H, Onar M, Deniz T, et al. Serum acetylcholinesterase and prognosis of acute organophosphate poisoning. J Toxicol - Clin Toxicol. 2002;40(7):903–10. DOI: 10.1081/clt-120016962
26. Sungurtekin H, Gürses E, Balci C. Evaluation of several clinical scoring tools in organophosphate poisoned patients. Clin Toxicol. 2006 Apr 1;44(2):121–6. DOI: 10.1080/15563650500514350
27. Tang W, Mm R, Chen Q, Chen S, Shao X, Gao J, et al. Independent prognostic factors for acute organophosphorus pesticide poisoning. rc.rcjournal.com. 2016; DOI: 10.4187/respcare.04514