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Predicting In-Hospital Outcomes in Acute Organophosphorus Poisoning: A Comparative Study of the POP Scale and Glasgow Coma Scale at Rajshahi Medical College Hospital

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ABSTRACT: ***Background:*** Organophosphorus (OP) pesticide poisoning is a critical public health issue, particularly in rural Asia, contributing to a significant proportion of self-harm-related deaths. The Peradeniya Organophosphorus Poisoning (POP) scale and the Glasgow Coma Scale (GCS) are clinical tools that may aid in predicting patient outcomes in resource-limited settings. ***Aim:*** This study aimed to assess and compare the predictive value of the POP scale and GCS for in-hospital outcomes of acute OP poisoning patients at Rajshahi Medical College Hospital, Bangladesh. ***Methods:*** This prospective observational study included 200 patients with acute OP poisoning admitted to the Department of Medicine at Rajshahi Medical College from January to December 2021. Patients were evaluated using the POP scale and GCS at admission. Clinical management included standard atropine and pralidoxime protocols, with continuous monitoring for complications such as respiratory failure and seizures. The primary outcome measure was in-hospital mortality. Data was analyzed using SPSS version 26, with predictive accuracy evaluated through ROC and AUC analyses. ***Results:*** The study population had a mean age of 27.1 ± 12.8 years, with 57% males and 82% from rural areas. Suicidal intent accounted for 94% of poisoning cases. The overall in-hospital mortality rate was 14%, with seizure (19%) and respiratory failure (18%) as the predominant complications. There was a strong association between higher severity scores on the POP scale and GCS and increased mortality ($p < 0.001$). The POP scale showed an AUC of 0.934 (sensitivity 96.4%, specificity 80%), while the GCS demonstrated an AUC of 0.948 (sensitivity 100%, specificity 84%). ***Conclusion:*** Both the POP scale and GCS are valuable tools for predicting in-hospital outcomes in OP poisoning.

Keywords: Organophosphorus poisoning, POP Scale, Glasgow Coma Scale, In-Hospital Outcomes, Predictive Accuracy, Critical Care.

Article at a glance:

Study Purpose: *To compare the effectiveness of the POP scale and GCS in predicting in-hospital outcomes of acute OP poisoning cases.*

Key findings: *Both POP and GCS scores were strongly associated with mortality; GCS had slightly higher predictive accuracy than POP.*

Newer findings: *The study validates both tools in a Bangladeshi clinical context and highlights GCS's superior sensitivity (100%) for mortality prediction.*

Abbreviations: *POP – Peradeniya Organophosphorus Poisoning Scale, GCS – Glasgow Coma Scale, AUC – Area Under the Curve.*

INRODUCTION

Organophosphorus (OP) pesticide poisoning remains a significant clinical and public health concern, particularly in rural regions of Asia, contributing to approximately 60% of the 500,000 annual deaths from self-harm in this region.[1] OP pesticides are responsible for nearly 200,000 deaths per year, primarily due to their potent inhibition of

esterase enzymes, including acetylcholinesterase (AChE) and butyrylcholinesterase, leading to overstimulation of muscarinic and nicotinic receptors.[2, 3] The clinical manifestations of OP poisoning, such as autonomic, central nervous system (CNS), and neuromuscular symptoms, vary depending on the specific chemical structure of the OP compound and its metabolites.[4] The Peradeniya Organophosphorus Poisoning (POP) score, developed at the University of Peradeniya, Sri Lanka, in 1993, utilizes clinical parameters such as respiratory rate, pulse rate, pupil size, level of consciousness, seizure activity, and fasciculation to assess the severity of OP intoxication.[5] The POP score effectively predicts mortality, the need for ventilatory support, and atropine requirements.[6, 7] Additionally, the Glasgow Coma Scale (GCS), a neurological scale introduced by Teasdale and Jennett in 1974, provides a reliable measure of a patient's level of consciousness and has proven useful in predicting morbidity and mortality in acute OP poisoning.[8–13] In many healthcare settings in Bangladesh, a simple and effective clinical scoring system is urgently needed to prioritize limited resources for the most critical patients. Current management of OP poisoning often faces challenges due to inadequate psychological assessment, insufficient ICU infrastructure, and lack of standardized treatment protocols. The POP score and GCS, relying solely on clinical parameters, offer a practical approach for early severity assessment and clinical decision-making, particularly in resource-constrained environments.[14–16] This study aimed to evaluate the applicability of the POP scale and GCS in predicting in-hospital outcomes of acute OP poisoning in patients admitted to Rajshahi Medical College Hospital, Bangladesh. Early identification of high-risk patients using these clinical scoring systems could facilitate timely monitoring and intervention, potentially improving survival rates and reducing morbidity.

Aims and Objectives

To assess and compare the predictability of POP (Peradeniya Organophosphorus Poisoning) scale and GCS (Glasgow Coma Scale) for in-hospital poor outcome (death) of acute OPC (Organo Phosphorus Compound) poisoning patients.

MATERIALS AND METHODS

This prospective observational study was conducted in the Department of Medicine at Rajshahi Medical College, Rajshahi, from January 2021 to December 2021, involving patients with acute organophosphorus compound (OPC) poisoning admitted to various units of the department. A purposive sampling method was used, and a total of 200 patients were included. Ethical approval was obtained from the Rajshahi Medical College ethical committee, and informed consent was secured from all participants. The inclusion criteria encompassed patients with a history of exposure to OPC within the previous 24 hours, as indicated by patients, relatives, or referring doctors. Exclusion criteria included patients with concomitant illnesses (e.g., asthma, COPD) that might alter respiratory effort, those who consumed other poisons along with OPC, patients previously treated outside RMCH (except for gastric lavage), individuals under 15 years, pregnant patients, and those with alcohol consumption or drug abuse history alongside OPC poisoning. Upon arrival, patients were assessed using a structured proforma capturing demographic data, clinical examination findings, oxygen saturation (SpO2), and electrocardiogram (ECG) results. Clinical parameters were evaluated using the Peradeniya Organophosphorus Poisoning (POP) scale and the Glasgow Coma Scale (GCS) to categorize the severity of poisoning. Standard treatment protocols were followed, including atropine administration until signs of complete atropinization were achieved and maintenance infusion was continued. Pralidoxime was administered to those presenting within 24 hours of ingestion and was discontinued after 72 hours or post-extubation, whichever was prolonged. Continuous monitoring included respiratory failure signs, arrhythmias (clinically and via ECG), seizures, and other vital parameters. Critical patients and those with respiratory failure received immediate ICU referrals. Patients were observed for an additional 24 hours post-atropine discontinuation before discharge, with ICU patients monitored for 24 to 48 hours upon transfer to the general ward. In hospital outcome was defined as good (recovery) and poor (death). Data were analyzed using SPSS version 26, presenting categorical variables as frequency (percentage) and continuous variables as mean ± standard deviation. Associations between variables were determined using the chi-square test, with a p-value of less than 0.05 considered statistically significant. Predictive values were analyzed by ROC and AUC analysis.

RESULTS

Demographic and Etiological Characteristics:

The study included 200 participants with a mean age of 27.1 ± 12.8 years. The majority were young, with 55.5% in the 15–24 age group, followed by 23.0% in the 25–34 age group. Males comprised 57% of the cohort, and most patients (82%) were from rural areas. Notably, the poisoning was predominantly suicidal (94%), with accidental cases accounting for only 6% (Table 1).

Table 1: Distribution of the Participants According to Demographic and Etiological Characteristics (n= 200)

Variables	Frequency	Percentage
15-24	111	55.5
25-34	46	23.0
35-44	19	9.5
45-54	14	7.0
55-64	6	3.0
>65	4	2.0
mean±SD	27.1±12.8	
Gender		
Male	114	57
Residence		
Rural	164	82
Nature of poisoning		
Suicidal	188	94
Accidental	12	6

Data expressed as frequency, percentage and mean±SD

In-Hospital Complications and Treatment Outcomes

76% of the sample developed no complications. Among the patients with several complications, seizure (19%) and respiratory failure (18%) were more predominant (figure 1). Additionally, figure showed that out of 200 patients, 172 recovered while 28 died, reflecting a predominantly favorable outcome overall (figure 2).

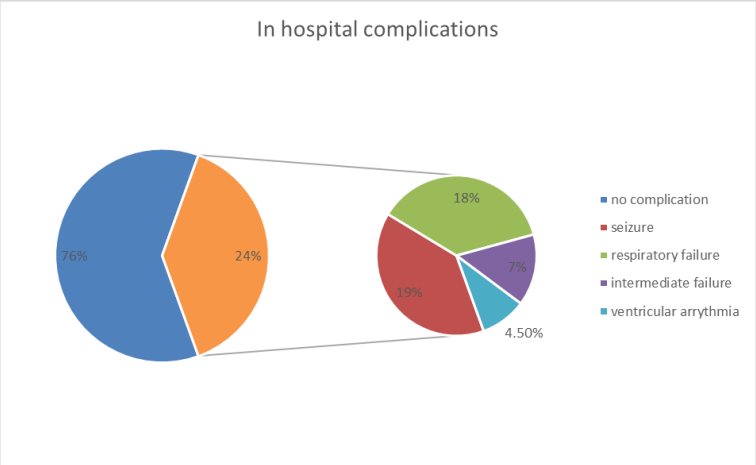

Figure 1: Distribution of the Participants According to in Hospital Complications (n=200)

Association of POP Scale and GCS with In-Hospital Outcome

There was a significant association between the severity of poisoning, as measured by both the Peradeniya Organophosphorus Poisoning (POP) scale and the Glasgow Coma Scale (GCS), and patient outcomes. For the POP scale, 91.7% of patients with a mild to moderate score (0–7) recovered ($p < 0.001$). For GCS, 94.1% of patients with mild to moderate scores (12–15) recovered ($p < 0.001$). More severe scores of both scales showed increased percentage of poor outcome (death) (Table 2)

Table 2: Association Between POP Scale and GCS Category and in Hospital Outcome (n=200)

Scales	In hospital outcome		P value
	Recovered (172)	Death (28)	
POP scale			
Mild to moderate (0-7)	165 (91.7%)	15 (8.3%)	**<0.001**[a]
Severe (8-11)	7 (35%)	13 (65%)	
GCS			
Mild to moderate (12-15)	160 (94.1%)	10 (5.9%)	**<0.001**[a]
Severe (≤8)	12 (40%)	18 (60%)	

a= chi square test

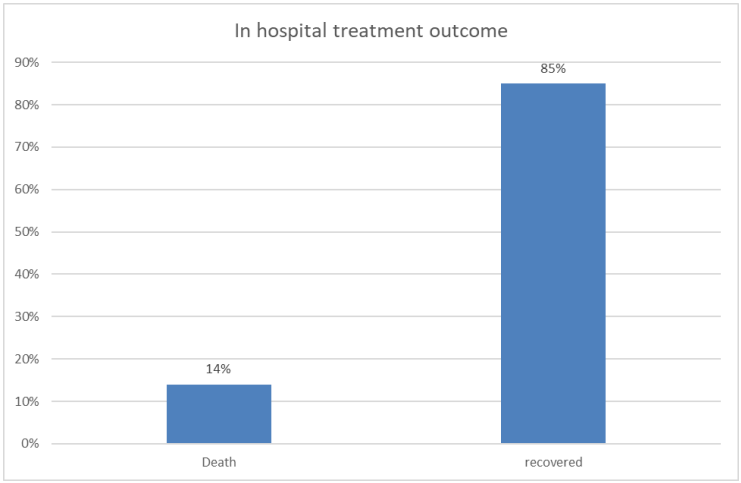

Figure 2: Distribution of the Participants According to in Hospital Treatment Outcome (n=200)

Predictive Accuracy of the POP and GCS Scores:

Both scales demonstrated excellent predictive accuracy for in-hospital mortality. The POP scale had an area under the curve (AUC) of 0.934 (95% CI: 0.9–1.0) at a cutoff of 4.5, with a sensitivity of 96.4% and specificity of 80%. The GCS score showed an AUC of 0.948 (95% CI: 0.9–1.0) at a cutoff of 12.5, with a sensitivity of 100% and specificity of 84% (Figure 3 and Table 3)

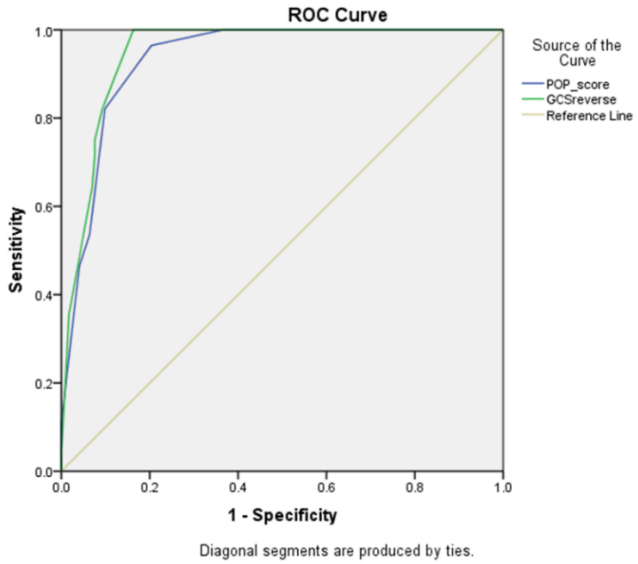

Figure 3: AUC for POP Score and GCS Score in Predicting in Hospital Outcome (Death) in Patients with Acute Organophosphorus Poisoning

Table 3: Comparison of Predictive Value of POP and GCS Scales in Predicting in Hospital Outcome (Death) in Patients with Acute Organophosphorus Poisoning (n=200)

Scale	AUC (95%CI)	Cut off	Sensitivity	Specificity	P value
POP scale	0.934 (0.9-1.0)	4.5	96.4%	80%	**0.001**
GCS scale	0.948 (0.9-1.0)	12.5	100%	84%	**0.001**

DISCUSSION

The present study evaluated the predictive accuracy of the Peradeniya Organophosphorus Poisoning (POP) scale and the Glasgow Coma Scale (GCS) for in-hospital outcomes of patients with acute organophosphorus (OP) poisoning at Rajshahi Medical College Hospital, Bangladesh. The findings indicated that both clinical scoring systems are effective tools for assessing the severity of OP poisoning and predicting mortality, particularly in resource-limited settings. The demographic profile of the study population revealed that OPC poisoning predominantly occurs among younger, male (57%) individuals, with a mean age of 27.1 years. These findings are consistent with previous studies indicating a higher prevalence of OPC poisoning among young adults, likely due to socio-economic stressors and occupational exposure, especially in rural communities.[1, 11, 14, 16–18] Male predominance was almost always inevitably found in all articles.[11, 13, 17] The predominance of suicidal intent (94%) aligns with global and regional trends where pesticide self-poisoning is a major method of suicide, particularly in low- and middle-income countries.[2, 17–19] In terms of clinical outcomes, 76% of the patients did not develop complications, while seizures (19%) and respiratory failure (18%) were the most common complications among those affected. Complications varied among several international and national researches.[20] The in-hospital mortality rate was 14%, which is comparable to similar studies conducted in Bangladesh and neighboring countries.[9, 16] The strong association between higher severity scores on the POP scale and GCS and poor outcomes underlines the utility of these tools in clinical practice. Specifically, the POP scale demonstrated a significant correlation between severe scores (8–11) and mortality (65%), and the GCS showed a similar pattern with severe scores (≤8) correlating with a 60% mortality rate. These findings reinforce the conclusions of earlier studies that identified both the POP scale and GCS as reliable predictors of clinical outcomes in OPC poisoning.[5-7, 11-14, 16, 17, 20, 21] The Receiver Operating Characteristic (ROC) analysis highlighted the robust predictive performance of both scales.

The POP scale demonstrated an area under the curve (AUC) of 0.934 with a sensitivity of 96.4% and specificity of 80% at a cutoff of 4.5. Unfortunately, one study found a higher cut-off with near to similar sensitivity and specificity.[7] The GCS outperformed slightly with an AUC of 0.948, achieving 100% sensitivity and 84% specificity at a cutoff of 12.5. Unfortunately, in a couple of studies, GCS was found to have a cut off of 6 but the corresponding sensitivity and specificity were rather low than the present study.11, 21 These high AUC values indicate excellent discriminatory power of both tools in predicting in-hospital mortality, suggesting their potential use as early triage tools in emergency settings.[8, 22] An important observation in this study was the delayed hospital presentation among patients who eventually died, highlighting the critical role of early intervention. The mean time interval from OP ingestion to hospital admission was significantly longer in patients with poor outcomes, underscoring the need for prompt medical attention to improve survival rates. The lack of adequate ICU facilities and delays in receiving critical care further emphasize the need for effective initial assessment tools like the POP scale and GCS to optimize resource allocation and prioritize high-risk patients. Overall, this study supports the integration of the POP scale and GCS into routine clinical assessment protocols for OP poisoning, particularly in settings with limited access to advanced laboratory diagnostics. By facilitating early and accurate risk stratification, these tools can help guide clinical decision-making, improve patient management, and ultimately enhance survival outcomes.

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