A STUDY ON ACUTE PESTICIDE POISONING IN A TERTIARY CARE CENTER OF EASTERN NEPAL

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ABSTRACT

Acute pesticide poisoning is a significant public health concern in developing countries, including Nepal, where agriculture remains a major occupation. The easy accessibility and improper handling of pesticides contribute to both intentional and accidental poisonings. This study is intended to evaluate the clinical characteristics, treatment outcomes, and patterns of acute pesticide poisoning among patients presenting to the emergency department of a tertiary care center in Eastern Nepal. A descriptive cross-sectional study was done in the emergency department of a tertiary care center in Eastern Nepal during a defined study period. Data were collected using a structured proforma, including demographic details, type and route of poisoning, clinical presentation, management provided, and patient outcomes. Descriptive statistical techniques were employed to interpret the data. A total of 688 cases of acute pesticide poisoning were included. The majority of patients were young adults aged 15–30 years, with a higher prevalence among females. Organophosphates were the most commonly implicated agents (44.2%) followed by rodenticides and organochlorine. Most cases were intentional ingestion. Common symptoms included vomiting, altered sensorium, and respiratory distress. Supportive management, along with atropine and pralidoxime for organophosphate poisoning, was provided. The majority recovered with timely intervention, though 19.6% experienced complications and 6.3% mortality was recorded. Acute pesticide poisoning remains a prevalent and preventable health issue in Eastern Nepal, particularly among young individuals. Early recognition and prompt management are essential to improving outcomes. Strengthening regulation on pesticide sales, public awareness, and mental health interventions are critical to reducing the incidence of such poisonings.

KEYWORDS

Antidote, organophosphate, organochlorine, pesticides, rodenticides, self-poisoning

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INTRODUCTION

Pesticide poisoning is a major global health problem, particularly in low- and middle-income countries where agriculture is a primary occupation. In such settings, the widespread use of chemical pesticides, combined with inadequate regulation, poor storage practices, and limited public awareness, has led to a growing incidence of both intentional and accidental poisonings.[1] According to systemic review article by Boedeker *et al*,[2] the WHO has reported millions of cases of pesticide poisoning occur annually, with a significant proportion resulting in morbidity and mortality, especially in South Asia, and Nepal, being an agrarian country, is not exempt from this burden.[2] The easy availability of pesticides in rural and semi-urban areas, often without proper supervision or labeling, has contributed to their misuse. Intentional self-poisoning using pesticides have become a common method of suicide, particularly among young adults facing socioeconomic or psychological stress.[3] Emergency departments across Nepal frequently manage such cases, which often present with a wide range of clinical symptoms, from mild gastrointestinal discomfort to severe neurological and respiratory complications.

Despite the high incidence, there is limited data from Eastern Nepal on the clinical profile and outcomes of patients presenting with acute pesticide poisoning. Understanding local patterns, demographics, and treatment outcomes is essential for developing effective prevention strategies and optimizing clinical care.[4]

This research aimed to evaluate the demographic profile, categories of pesticides implicated, clinical features, and treatment outcomes among patients presenting with acute pesticide poisoning to the emergency department of a tertiary hospital in Eastern Nepal. The findings aim to contribute to better management protocols and public health policies targeting pesticide-related poisonings in the region.

MATERIALS AND METHODS

This was a descriptive, cross-sectional study conducted in the Emergency Department of Nobel Medical College Teaching Hospital (NMCTH), a tertiary care center located in Biratnagar, Eastern Nepal. The study was carried out over the course of a year, from January 1 to December 31, 2019. All patients presenting to the Emergency Department with a confirmed or suspected history of acute pesticide poisoning were included in the study.

Sample size was calculated for unknown population using the formula,

$n = Z^2 pq/e^2$

where, Z= 1.96 (Confidence Interval 95%),

p= 50% = 0.5,

q= 1-p = 0.5,

e = margin of error= 5% = 0.05.

Hence, total sample size was calculated as 385 but we included all eligible cases for the study and it was 688 cases in total during the study period.

Data were collected prospectively using a structured proforma. The collected data included: socio-demographic information: age, gender, residence, occupation; circumstances of poisoning: accidental vs. intentional (suicidal/homicidal); route of exposure (oral, inhalational, dermal); type of pesticide involved: as per history and container identification, classified into organophosphates, carbamates, pyrethroids, etc.; clinical presentation: vital signs, symptoms (e.g., nausea, vomiting, miosis, respiratory distress), and physical examination findings, treatment modalities: decontamination (gastric lavage, activated charcoal), specific antidotes (e.g., atropine, pralidoxime), supportive therapy, ICU admission; and patient outcome: recovery, complications, and mortality.

Ethical clearance was obtained from the Institutional Review Committee (IRC) of Nobel Medical College Teaching Hospital. (IRC No: 235/2018) Informed written consent was taken from all participants or their guardians ahead of data gathering. Inclusion criteria included patients of all age groups and both sexes presenting with acute pesticide poisoning, cases with history or clinical features suggestive of pesticide ingestion or exposure within 24 hours, patients (or legally authorized representatives) who provided informed consent. Exclusion criteria were poisonings caused by other substances such as pharmaceuticals, household products, or animal bites, chronic pesticide exposure cases, patients with incomplete medical records or referred after receiving definitive treatment elsewhere. Anonymity and confidentiality were strictly maintained. Microsoft Excel was used for data entry, and the analysis was carried out with SPSS-17. Descriptive statistics such as frequency, percentage, mean, and standard deviation were used to summarize data. Chi-square test was applied to assess associations between

variables. P<0.05 was considered statistically significant.

RESULTS

The majority of poisoning cases in this study were among individuals aged 15–30 years (62.8%), with a mean age of 30.4 years (SD = 13.95). A clear female predominance was observed, with a female-to-male ratio of 1.66:1. Married and literate individuals accounted for 68.5% and 97.2% of the cases, respectively. In terms of occupation, home-makers comprised the largest group (43.6%), followed by students (28.8%).

Geographically, most patients were from Sunsari district (27.8%), followed by Morang (23.4%) and Jhapa (18.5%). Nearly all cases of deliberate self-harm (99%) were driven by suicidal intent and were primarily carried out at home. Regarding the source of poison, 77.8% of individuals obtained the toxic agents from local shops.

Organophosphate compounds, either alone or in combination, were the most commonly used poisons (44.2%), followed by rodenticides (29.4%) and organochlorine compounds (25.4%). Nearly half of the patients (48.5%) were referred from other healthcare facilities after receiving initial management. Among these referred cases, 44.2% had undergone gastric lavage prior to transfer, with organophosphate compounds accounting for 55% of the lavage indications.

The average time to hospital arrival was 5.02 hours (SD = 4.2), with 60.5% of patients presenting within 4 hours of ingestion. A significant portion of cases (69.2%) were reported during the night.

The average values of the triage vital signs in the survival and fatality groups are shown in the table 1 below:

The most commonly reported symptoms among poisoning cases were nausea, vomiting, abdominal pain, excessive salivation, and neurological manifestations. Over half of the patients presented with a history of nausea and vomiting. Neurological symptoms—such as unresponsiveness, disorientation, seizures, and excessive drowsiness—were observed in approximately 9% of cases.

Glasgow Coma Scale (GCS) scores at presentation indicated that 81.5% of patients had a GCS between 13 and 15, while 18.5% had a GCS score below 13, suggesting moderate to severe neurological impairment. Antidotal therapy was administered in 44.2% of cases, mainly for organophosphate poisoning. Intubation was required in 9.6% of patients, indicating the severity of certain cases.

Table 2: Complication Profile of Pesticide Poisoning Cases (n=135)

Complications	n (%)
Aspiration pneumonitis	12 (8.9)
Renal dysfunction	11 (8.1)
Electrolyte imbalances	37 (27.4)
Coagulopathies	17 (12.6)
Hepatic impairment	29 (21.5)
Cardiopulmonary arrest	13 (9.6)
Intermediate syndrome	16 (11.9)

Complications were noted in 19.6% of patients.

A significant proportion of the cases (83%) were either discharged from ER or transferred to the ward or ICU for continued care. However, 6.3% of patients succumbed to poisoning and

Table 1: Triage variables of survivors and fatality groups

Triage Variables	Overall (n=688) Mean (Standard Deviation)	Survivors (n=571) Mean (Standard Deviation)	Fatalities (n=43) Mean (Standard Deviation)	Pearson chi-square (p-value)
Heart Rate (bpm)	90.46 18.14)	89.79 (17.27)	98.37 (26.83)	P<0.001*
Body Temperature (° F)	97.96 (0.47)	98.01 (0.37)	97.30 (1.08)	P<0.001*
Respiratory Rate (breaths per minute)	22.05 (3.51)	21.70 (2.91)	26.39 (7.05)	P<0.001*
Systolic Blood Pressure (mmHg)	114.01 (21.37)	116.25 (19.92)	88.37 (23.70)	P<0.001*
Diastolic Blood Pressure (mmHg)	71.28 (15.02)	72.95 (13.44)	51.16 (18.41)	P<0.001*
Oxygen Saturation (%)	94.79 (10.26)	96.19 (7.35)	75.35 (22.52)	P<0.001*

*statistically significant

its complications among which 1.2 % cases had mortality in ER. The remaining patients were either referred to higher centers, left against medical advice, were discharged on request, or absconded from care.

DISCUSSION

The objective of this study was to assess the demographic characteristics and clinical presentations of patients with pesticide poisoning who reported to the emergency department of a tertiary hospital in Eastern Nepal. Our findings shed light on the burden, patterns, and outcomes of pesticide poisoning in this region, which aligns with the increasing public health concern in many developing countries, including Nepal.

Young adults aged 15 to 30 years comprised the majority of the cases, with an average patient age of 30.4 years (SD = 13.95), similar to findings reported by Gyenwali *et al*,[5] Shah *et al*,[6] Agrawal *et al*,[7] Khanal *et al*,[8] Dewan,[9] Rao *et al*,[10] Kumar *et al*,[11] Murali *et al*,[12] Koulapur *et al*,[13] Rahul *et al*,[14] Prashar *et al*,[15] and Nabih *et al*.[16] This age group is particularly vulnerable due to socioeconomic pressures, relationship issues, unemployment, and impulsive behavior, making them prone to intentional self-harm.

The study found a higher proportion of female patients affected by acute pesticide poisoning, with a female-to-male ratio of 1.66:1. This aligns with findings from regional studies (Gyenwali *et al*,[5] Shah *et al*,[6] Agrawal *et al*,[7] and Chowdhary *et al*[17]), which suggest that young females are more likely to engage in self-poisoning as a method of attempted suicide. However, this trend is not universal, as several other studies (Khanal *et al*,[8] Dewan,[9] Rao *et al*,[10] Kumar *et al*,[11] Koulapur *et al*,[13] Rahul *et al*,[14] Prashar *et al*[15] and Nabih Z *et al*[16]) reported a male predominance in poisoning cases. These variations may reflect differences in socio-demographic factors, cultural contexts, mental health support availability, and gender-specific stressors across regions.

The majority of pesticide poisoning cases in this study were among married individuals (68.5%), a pattern consistent with findings by Shah *et al*,[6] Khanal *et al*,[8] Dewan,[9] and Koulapur *et al*.[13] This suggests that married individuals may experience significant psychosocial stress, which could increase their vulnerability to emotional distress and lead to impulsive or deliberate acts such as self-poisoning. The findings underscore the importance of addressing mental health and emotional well-being, particularly among married populations facing social or familial pressures.

In this study, a significant majority of patients (97.2%) were literate, which contrasts with the findings of Shah *et al*,[6] Dewan,[9] and Koulapur *et al*,[13] who reported a higher prevalence of poisoning cases among illiterate individuals. This discrepancy may reflect regional differences in educational access, awareness levels, or the role of education in coping with stress. It also suggests that literacy alone may not be protective against self-harm behaviors and highlights the need for targeted mental health education and support regardless of educational status.

In this study, the majority of poisoning cases were among home-makers (43.6%), followed by students (28.8%), a distribution similar to findings by Rahul *et al*.[14] However, other studies show varying occupational patterns Shah *et al*.[6] reported higher rates among the unemployed and farmers, Dewan.[9] identified students and home-makers as common groups, while A Prashar *et al*,[15] found farmers to be the most affected, followed by laborers and students. These differences likely reflect variations in regional socio-economic structures, occupational stressors, and accessibility to toxic substances. The predominance of home-makers and students in the present study may indicate underlying psychosocial stress, limited support systems, or emotional vulnerability in these groups, highlighting the need for targeted mental health interventions.

Organophosphates (OPs) were the most frequently involved agents in pesticide poisoning cases in this study, accounting for 44.2%, which is consistent with findings from Nepal, India, and Bangladesh (Utyasheva *et al*,[3] Gyenwali et *al*,[5] Shah *et al*,[6] Agrawal *et al*,[7] Dewan,[9] Murali *et al*,[12] Prashar *et al*,[15] and Chowdhary *et al*[17]). This predominance is likely due to the easy and often unregulated access to OP compounds, which are widely used in agricultural settings, particularly in rural areas. Rodenticides and organochlorines were also frequently involved, representing 29.4% and 25.4% of the cases, respectively. However, some studies, such as those by Kumar *et al*[11] and Karunarathne *et al*,[18] found aluminium phosphide to be the most common, while Nabih *et al*.[16] reported a high proportion of unknown agents. These findings highlight significant regional differences in pesticide use patterns and stress the urgent need for stricter regulatory controls, improved labeling, and community-level education to reduce the risk of accidental and intentional poisoning.

In this study, a majority of poisoning cases (69.2%) presented during nighttime hours, a pattern also observed by Gyenwali *et al,*[5] Shah *et al,*[6] and Rahul *et al.*[14] This trend may suggest that emotional distress or impulsive behavior leading to self-poisoning often occurs during late hours when individuals are more isolated and have reduced access to immediate social or psychological support. The timing also poses challenges for timely medical intervention and underscores the importance of 24-hour emergency preparedness and mental health support services

In this study, nearly half of the poisoning cases (48.5%) were referred from other healthcare centers after receiving initial management, which aligns with findings by Dewan,[9] though Rao *et al.*[10] reported a lower referral rate of 11%. Among these referred patients, 44.2% had undergone gastric lavage prior to transfer, consistent with findings by Karki *et al.*[19] This reflects the continued use of gastric lavage as an initial decontamination measure in resource-limited settings, despite variations in technique and adherence to clinical guidelines. While some centers performed gastric emesis, others used nasogastric tubes, indicating a lack of standardized protocols. The relatively low mortality observed in the study may suggest potential benefit of early intervention and decontamination—particularly when patients present soon after ingestion and the toxic agent is known. However, this also emphasizes the need for evidence-based, uniform guidelines for gastric lavage to ensure both efficacy and safety in poisoning management across all levels of care.

The average time to hospital arrival following poisoning in this study was 5.02 hours (SD = 4.2), with 60.5% of patients presenting within the critical window of 4 hours post-ingestion. This finding is consistent with studies by Gyenwali *et al,*[5] Shah *et al,*[6] Dewan,[9] and Rao *et al.*[10] Early presentation is crucial in poisoning cases, as it allows timely initiation of decontamination procedures and supportive care, which can significantly improve clinical outcomes. The relatively prompt arrival observed in most cases may have contributed to the lower complication and mortality rates in the study, highlighting the importance of community awareness and efficient referral systems.

This study found that an overwhelming majority of poisoning cases (99%) were due to intentional self-harm or suicidal intent. This trend is consistent with findings from several other studies, including those by Utyasheva *et al,*[3] Gyenwali *et al,*[5] Dewan,[9] Koulapur *et al,*[13] Prashar *et al,*[15] and Nabih *et al.*[16] The high prevalence of suicidal poisoning highlights a serious public health concern, indicating widespread emotional distress and possible gaps in mental health support systems. It underscores the urgent need for community-based mental health interventions, suicide prevention strategies, and psychosocial support services to address the underlying causes and reduce the incidence of intentional poisonings.

The clinical features most commonly observed in this study—vomiting, excessive salivation, bradycardia, miosis, and altered sensorium—were particularly associated with organophosphate (OP) poisoning and are characteristic of a cholinergic toxidrome. These findings are consistent with the established pathophysiology of OP toxicity and align with prior studies on pesticide poisoning by Nabih *et al,*[16] and Laudari *et al.*[20] Recognition of these hallmark signs is critical for early diagnosis and timely initiation of appropriate antidotal therapy, especially in settings with high prevalence of OP exposure.

In this study, 9.6% of patients required intubation and 3.1% required intensive care unit (ICU) admission. These rates are comparatively lower than those reported by Gyenwali *et al*[5] (41.3% ICU admission), Shah *et al*[6] (88.33%), and Rao *et al*[10] (27% intubation), but higher than Agrawal *et al.*[7] (0.5%). The need for mechanical ventilation and ICU care was primarily observed in patients with severe organophosphate poisoning and was closely linked to delayed hospital presentation and lower Glasgow Coma Scale (GCS) scores at admission. Prompt recognition, early initiation of treatment—including atropine and pralidoxime—were associated with improved clinical outcomes. These findings emphasize the importance of timely intervention and early risk stratification to reduce the need for critical care and improve prognosis in acute pesticide poisoning cases.

In this study, complications were observed in 19.6% of poisoning cases, which is notably higher than the 2.9% complication rate reported by Dewan.[9] This discrepancy may be due to differences in the severity of poisoning, type of toxic agents involved, timing of hospital presentation, or variability in the quality of initial management. The higher complication rate in the present study highlights the need for early recognition of high-risk cases, standardized treatment protocols, and strengthened emergency response systems to reduce morbidity associated with acute

pesticide poisoning.

Comparison of triage vital signs between survivors (n = 571) and non-survivors (n = 43) demonstrated notable physiological variations, which could potentially act as key predictors of prognosis in cases of acute poisoning.

- **Heart Rate (HR):** The mean heart rate was elevated in patients who did not survive (98.37 bpm) compared to those who did (89.79 bpm), suggesting increased sympathetic drive or physiological stress in more severe cases.
- **Body Temperature (BT)**: Individuals who succumbed to poisoning exhibited a lower average body temperature (97.30°F) than survivors (98.01°F), which may be indicative of systemic compromise, such as shock or inadequate tissue perfusion.
- **Respiratory Rate (RR):** Fatal cases showed a markedly elevated respiratory rate (26.39 breaths/min) compared to survivors (21.70 breaths/min), suggestive of respiratory distress or metabolic acidosis.
- **Systolic Blood Pressure (SBP):** Fatalities had significantly lower systolic blood pressure (88.37 mmHg) compared to survivors (116.25 mmHg), indicating hemodynamic instability.
- **Diastolic Blood Pressure (DBP):** A similar trend was observed with diastolic pressure, lower in fatalities (51.16 mmHg) than survivors (72.95 mmHg), further suggesting circulatory compromise.
- **Oxygen Saturation (SpO_2):** Mean oxygen saturation was substantially lower in fatalities (75.35%) than in survivors (96.19%), indicating severe respiratory impairment, likely due to aspiration, respiratory depression, or toxin-related pulmonary dysfunction.

These results highlight the vital role of prompt triage and evaluation of vital signs in the management of poisoning cases. Abnormal parameters—particularly hypotension, tachypnea, hypoxia, and hypothermia—may serve as early warning signs for clinical deterioration and should prompt immediate intervention and intensive monitoring. These results are consistent with previous findings by C-F Hsu *et al*[21] and Sontakke *et al*[22] further validating the prognostic significance of initial vital signs in acute poisoning.

The mortality rate in this study was 6.3%, which falls within the range reported by similar tertiary care-based studies in South Asia—such as Gyenwali *et al*[5] (3.8%), Shah *et al*[6] (1.66%), Agrawal *et al*[7] (10.14%), Dewan[9] (9.2%), Prashar *et al*[15] (6.4%), Nabih *et al*[16] (4.2%), Lamsal[23] (6.8%) and Ghimire *et al*[24] (5.3%). While comparable, this fatality rate underscores the ongoing challenges in managing acute pesticide poisoning, particularly in rural settings. Delayed hospital presentation, lack of pre-hospital care, limited public awareness, and insufficient emergency infrastructure continue to be major contributors to adverse outcomes. The findings emphasize the urgent need for community education, faster referral mechanisms, and improved rural healthcare capacity to reduce mortality associated with poisoning.

Acute pesticide poisoning continues to pose a significant public health burden in Eastern Nepal, with a predominance of young adults and a high rate of intentional ingestion. Organophosphates remain the most commonly implicated agents. Timely accesses to emergency care and provision of supportive management have shown favorable outcomes in most cases. However, the observed morbidity and mortality underline the need for stricter pesticide regulation, public awareness campaigns, and strengthened mental health support systems to mitigate the incidence and consequences of pesticide poisoning.

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Limitations: This study has several limitations that should be acknowledged: Single-center design, Hospital-based sample, recall bias, lack of toxicological confirmation and limited follow-up.

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