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Clinical spectrum and outcomes of acute pyrethroid poisoning: a hospital-based prospective observational study.

Dr. Anand Acharya[1], Dr. Nageswar Rao Tokala[2*], K. Muni Kumar [3]

[1]Dean and Professor, Department of Pharmacology, Konaseema Institute of Medical Sciences and Research Foundation, Amalapuram, Andhra Pradesh, India

[2]Associate professor, Department of Pharmacology, Konaseema Institute of Medical Sciences and Research Foundation, Amalapuram, Andhra Pradesh, India.

[3]Assistant professor, Department of Pharmacology, Konaseema Institute of Medical Sciences and Research Foundation, Amalapuram, Andhra Pradesh, India

Abstract

Background

Pyrethroids are widely used synthetic insecticides considered relatively safe. However, acute poisoning can lead to significant neurotoxic and systemic complications, particularly in cases of oral ingestion. Understanding the clinical profile and outcomes is essential for early recognition and management. To assess the clinical profile, severity, and outcomes of patients presenting with acute pyrethroid poisoning.

Materials and Methods

A prospective observational study was conducted over 12 months at a tertiary care hospital. Sixty patients with confirmed acute pyrethroid poisoning were included. Data collected included demographics, mode and route of exposure, clinical manifestations, laboratory parameters, severity (assessed by Poison Severity Score), treatment, and outcomes. Continuous variables were expressed as mean ± standard deviation, and categorical variables as frequencies and percentages. Statistical analysis was performed using appropriate tests with significance set at $p < 0.05$.

Results

The mean age of patients was 32.5 ± 12.4 years, with a male predominance (63.3%). Oral ingestion was the most common route of exposure (83.3%), with suicidal intent in 63.3% of cases. Neurological manifestations were predominant, including tremors (75%), altered sensorium (30%), and seizures (20%). Gastrointestinal symptoms occurred in 60% of patients. According to Poison Severity Score, 53.3% had mild poisoning, 33.3% moderate, and 13.3% severe. ICU admission was required in 13.3% of cases. The mean hospital stay was 4.2 ± 1.8 days, and overall mortality was 3.3%.

Conclusion

Acute pyrethroid poisoning primarily affects young adults and presents predominantly with neurological symptoms. Most cases are mild to moderate and respond well to supportive care. Severe cases, though less common, require intensive monitoring. Early recognition and appropriate supportive management are crucial to reduce morbidity and mortality.

Recommendation

Early identification, prompt supportive management, and community education on safe pesticide handling can effectively reduce morbidity and prevent fatalities.

Keywords: - *Pyrethroid poisoning, Clinical profile, Neurotoxicity, Poison Severity Score, Acute pesticide exposure*
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Corresponding Author: *Dr. Nageswar Rao Tokala*
Email ID: *sandeshtokalaoct12@gmail.com*
Associate Professor, Department of Pharmacology, Konaseema Institute of Medical Sciences & Research Foundation, Amalapuram, Andhra Pradesh, India

Introduction

Pyrethroids are synthetic derivatives of natural pyrethrins, extensively utilized as insecticides in agricultural, domestic, and public health applications because of their

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potent insecticidal efficacy and comparatively lower mammalian toxicity than organophosphates and carbamates [1,2]. Although generally regarded as safe, acute exposure to pyrethroids can produce a wide clinical spectrum—from mild neurotoxic manifestations such as tremors and paresthesia to severe systemic complications including seizures, respiratory distress, and cardiovascular instability [3,4].

Based on their chemical structure, pyrethroids are classified into two types: Type I compounds, which lack an α-cyano group (e.g., permethrin), and Type II compounds, which contain this moiety (e.g., cypermethrin, deltamethrin). Each category exhibits distinct toxicokinetic and toxicodynamic behaviors. Type I pyrethroids primarily cause tremors, hyperexcitability, and fine fasciculations, whereas Type II compounds are associated with choreoathetosis, excessive salivation, seizures, and hypotension [5].

At the molecular level, pyrethroids exert their toxic effects by modulating neuronal voltage-gated sodium channels, leading to prolonged depolarization, repetitive firing, and neuronal hyperexcitability. Type II agents additionally interfere with chloride channel conductance, thereby amplifying neurotoxicity [5]. Despite representing a smaller fraction of pesticide-related hospital admissions compared to organophosphate poisoning, the incidence of pyrethroid toxicity is increasing, particularly in regions with extensive agricultural and household pesticide usage [1–5].

Given these emerging trends, understanding the clinical profile, severity spectrum, and treatment outcomes of acute pyrethroid poisoning is vital for timely recognition, effective management, and prevention of complications. Comprehensive documentation of such cases can provide crucial insights into the toxicological patterns of these widely used compounds and aid in shaping appropriate public health and clinical strategies.

Aim

To study the clinical profile, severity, and outcomes of patients presenting with acute pyrethroid poisoning.

Objectives

To document the demographic characteristics (age, sex, occupation) of patients with acute pyrethroid poisoning.

To identify the common clinical manifestations and laboratory abnormalities associated with pyrethroid poisoning.

To classify the severity of poisoning using standard clinical scoring systems (e.g., Poison Severity Score).

To assess treatment modalities, hospital course, and patient outcomes, including recovery, complications, and mortality.

To analyze the correlation between the type of pyrethroid compound, route/amount of exposure, and clinical severity.

Material and Methods

Study Design and Setting

This study followed a prospective observational design and was conducted over a 12-month period, from January 2024 to December 2024, at the Konaseema Institute of Medical Sciences and Research Foundation (KIMS&RF), Amalapuram, Andhra Pradesh. KIMS&RF is a 750-bed tertiary care teaching hospital situated in the Konaseema delta region. It serves a large rural and semi-urban community and includes dedicated emergency, intensive care, and toxicology units that frequently manage pesticide-related poisoning cases. This environment ensures a steady inflow of acute toxic exposure cases, making it an appropriate setting for the present study.

Study Population

The study included 60 consecutive patients who presented with features consistent with acute pyrethroid poisoning. Participants were recruited from the emergency department and inpatient wards. Eligibility was confirmed through clinical history, identification of the product/container, and supportive clinical features. Individuals with mixed pesticide ingestion, chronic exposure, or pre-existing neurological or cardiovascular illnesses that could distort clinical assessment were excluded.

Sources and Methods of Participant Selection

All patients presenting within 24 hours of exposure to a known pyrethroid compound were screened. Patients who met the inclusion criteria were enrolled consecutively

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until the required sample size was reached. This method minimized selection bias by ensuring that every eligible patient was included without preferential selection.

Inclusion Criteria

Age ≥ 12 years.

Acute ingestion, inhalation, or dermal exposure to pyrethroid insecticides.

Presentation within 24 hours of exposure.

Exclusion Criteria

Co-ingestion with other pesticides or drugs.

Pre-existing neurological or cardiovascular disorders that could confound clinical assessment.

Chronic pyrethroid exposure.

Data Collection Procedures

Data were collected using a structured proforma designed for this study. It captured demographic details such as age, sex, and occupation; exposure characteristics including the type of pyrethroid compound, route of exposure (oral, dermal, or inhalational), estimated quantity, and the intent behind exposure. Clinical information was recorded systematically, covering neurological symptoms (tremors, seizures, altered sensorium), gastrointestinal manifestations (nausea and vomiting), cardiovascular findings (tachycardia and hypotension), respiratory symptoms (dyspnea or bronchospasm), and dermatological changes. Laboratory investigations included complete blood count, liver and renal function tests, serum electrolytes, and arterial blood gases when indicated. Severity was graded using the Poison Severity Score. Treatment details, need for ICU care, ventilatory support, complications, length of hospital stay, and final outcomes were documented. All assessments were performed by the attending physicians, and the recorded information was cross-verified by the study investigators to ensure accuracy and consistency.

Treatment Protocol

Management was primarily supportive, including gastric decontamination if the patient presented early, intravenous fluids, anticonvulsants for seizures, oxygen therapy for respiratory compromise, and monitoring of vital parameters. Specific antidotes are not available for pyrethroid poisoning.

Bias Control Measures

Several measures were taken to reduce bias.

Selection bias was minimized by enrolling all consecutive eligible patients.

Information bias was reduced by using a standardized questionnaire and cross-checking exposure history with containers brought by relatives.

Observer bias was controlled through uniform clinical assessment protocols applied by trained clinicians.

Statistical Analysis

Data were analyzed using SPSS version 25. Continuous variables were expressed as mean ± SD. Categorical variables were summarized as frequencies and percentages. For group comparisons, the student's t-test was used for continuous variables because they followed a normal distribution, while the Chi-square test was applied for categorical variables. A p-value <0.05 was considered statistically significant.

Ethical Considerations

This study received approval from the Institutional Ethics Committee of KIMS&RF. and written informed consent was obtained from all patients or their legally authorized representatives.

Results

Participant Flow

A total of 68 patients presented to the emergency department with suspected pesticide poisoning during the study period. Of these, 63 patients had confirmed pyrethroid exposure based on history or container evidence. Three were excluded because of mixed pesticide ingestion (n = 2) and delayed presentation beyond 24 hours (n = 1). Finally, 60 eligible patients were enrolled and analyzed.

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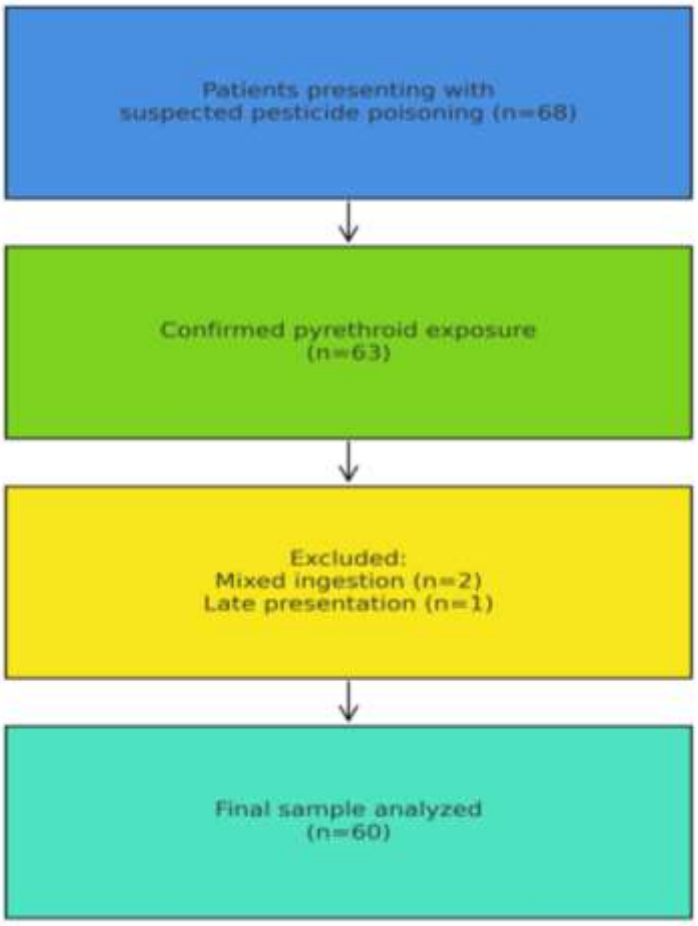

Figure 1: Participant Flow Diagram

Demographic Characteristics

The mean age of participants was 32.5 ± 12.4 years, and males constituted 63.3% (38/60) of the sample. Most individuals were from rural areas (42/60; 70%) and engaged in occupations with routine pesticide exposure, including agricultural field work (58.3%), daily-wage labour (25%), domestic workers (10%), and others (6.7%). Suicidal ingestion accounted for 63.3% (38/60) of exposures..Demographic profile of patient is as per table 1

Table 1: Demographic characteristics of patients (n=60)

Parameter	Number (%) or Mean ± SD
Age (years)	32.5 ± 12.4
Sex (M:F)	38:22
Rural/Urban	42:18
Mode of exposure	Suicidal: 38 (63.3%) Accidental: 22 (36.7%)
Route of exposure	Oral: 50 (83.3%) Dermal: 8 (13.3%) Inhalation: 2 (3.3%)

Clinical Features

Neurological symptoms formed the major part of the clinical picture. Tremors were seen in 75% of patients, while 30% presented with altered sensorium. Seizures

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occurred in 20%, and all of these were linked to Type II pyrethroid ingestion. Gastrointestinal complaints, mainly nausea and vomiting, appeared in 60% of cases. Cardiovascular findings included tachycardia in 40% and hypotension in 10%. Respiratory symptoms such as dyspnea or bronchospasm were noted in 13.3%, and dermatological manifestations—chiefly burning sensations or erythema—were recorded in 16.7% of patients.

Table 2: Clinical manifestations of acute pyrethroid poisoning (n=60)

Clinical Feature	Number (%)
Tremors	45 (75%)
Nausea/Vomiting	36 (60%)
Altered sensorium	18 (30%)
Seizures	12 (20%)
Tachycardia	24 (40%)
Hypotension	6 (10%)
Dyspnea/Bronchospasm	8 (13.3%)
Dermatological manifestations	10 (16.7%)

Laboratory Abnormalities

Laboratory findings showed the following patterns: Leukocytosis (>11,000/mm³) was present in 28.3% (17/60) of patients. Mild hyponatremia (<135 mmol/L) occurred in 20% (12/60). Hypokalemia (<3.5 mmol/L) was observed in 11.7% (7/60). Mildly elevated liver enzymes (AST/ALT > 2× ULN) were seen in 10% (6/60) of patients, mostly in moderate to severe cases. Serum creatinine elevation was noted in 5% (3/60), but none required dialysis. Arterial blood gases, done only in symptomatic cases, showed respiratory alkalosis in 6.7% (4/60) patients with hyperventilation. These findings were generally transient and improved with supportive care.

Correlation Between Pyrethroid Type / Route / Amount and Severity

Type II pyrethroid ingestion was significantly associated with severe poisoning (Pearson Chi-square = 7.82, p = 0.02). Oral ingestion showed a strong association with moderate-to-severe symptoms (Chi-square = 6.11, p = 0.04). Consumption of estimated larger quantities (>50 mL) correlated with higher Poison Severity Scores (Chi-square = 8.53, p = 0.01). These associations indicate that chemical subtype, route of exposure, and ingested amount influence poisoning severity.

Severity of Poisoning

Severity was assessed using the Poison Severity Score (PSS):
Mild: 32 patients (53.3%) – primarily tremors, nausea, vomiting.
Moderate: 20 patients (33.3%) – altered sensorium, tachycardia, mild hypotension.
Severe: 8 patients (13.3%) – seizures, respiratory distress, or hypotension requiring ICU admission.

Treatment and Outcomes

All patients received supportive care, including intravenous fluids, antiemetics, and anticonvulsants where indicated. 8 patients (13.3%) required ICU admission and ventilatory support. The mean hospital stay was 4.2 ± 1.8 days. There were 2 deaths (3.3%), both in patients with severe Type II pyrethroid ingestion and early-onset seizures.

Table 3: Treatment and outcomes (n=60)

Parameter	Number (%) or Mean ± SD
Supportive care only	52 (86.7%)
ICU admission	8 (13.3%)
Ventilatory support	8 (13.3%)
Mean hospital stay (days)	4.2 ± 1.8
Mortality	2 (3.3%)

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Discussion

Acute pyrethroid poisoning is becoming an increasingly recognized cause of pesticide-related hospital admissions in developing countries where these compounds are widely used in agriculture and household settings [6,7]. In this study, most patients were young adults, and the male predominance reflected greater occupational and domestic exposure among working-age men [8,9]. The oral route accounted for most exposures, largely due to suicidal ingestion, a pattern consistent with national trends showing easy accessibility of pesticides and rising self-poisoning episodes in low- and middle-income regions [10,12]. Accidental dermal and inhalational exposures occurred less frequently and were mainly linked to spraying activities and unsafe household handling practices [6,11].

Neurological features—tremors, altered sensorium, and seizures—formed the core clinical picture. These manifestations align with the known toxicodynamic mechanism in which pyrethroids prolong sodium channel opening and trigger repetitive neuronal firing [6,7]. Type II compounds, because of the α-cyano structure, exert stronger neurotoxic effects through additional chloride channel interference, explaining their stronger association with convulsions and severe central nervous system involvement [8,9]. Gastrointestinal symptoms such as nausea and vomiting were common yet short-lived, while cardiovascular and respiratory findings appeared mainly in moderate and severe cases. These systemic effects likely represent autonomic dysregulation caused by sustained neuronal hyperexcitability. The overall pattern of predominantly mild-to-moderate toxicity corresponds closely with published evidence showing that severe systemic effects are relatively uncommon [8,10,12].

Severity grading showed that most patients had mild or moderate poisoning, while severe cases formed a small proportion. ICU admission was primarily needed in patients with seizures or respiratory compromise. The observed mortality rate of 3.3% is in line with prior reports where prompt supportive care contributed to favourable outcomes [9,10,12]. Treatment remained entirely supportive, as no specific antidote is available. Early gastric decontamination, intravenous fluids, seizure control, and respiratory support formed the backbone of management, and timely recognition of complications remained crucial [6,8,9].

The findings also draw attention to important public health concerns. Although pyrethroids are marketed as safer than organophosphates, intentional ingestion or consumption of larger quantities can lead to serious neurotoxicity. Strengthening pesticide regulation, ensuring safer storage practices, and incorporating routine mental-health screening in high-risk communities are essential steps to reduce the burden of such poisonings [10–12]. The predominance of mild clinical presentations and the low mortality rate further indicate that early medical attention results in good outcomes. The strong association between Type II compounds and severe manifestations provides a valuable clinical cue for early risk stratification and more vigilant monitoring.

Generalizability

The findings are most applicable to settings with similar demographic profiles, pesticide usage patterns, and health-care infrastructure. Since the hospital caters largely to rural and semi-urban communities where pyrethroid use is widespread, the clinical patterns observed here may reflect those seen in comparable regions across India and other low- and middle-income countries. However, generalizability to populations with different exposure levels, occupational patterns, or health-care access should be approached with caution.

Conclusion

Acute pyrethroid poisoning predominantly affects young adults, often resulting from suicidal ingestion, and is characterized mainly by neurological symptoms such as tremors, altered sensorium, and seizures. Most cases are mild to moderate in severity and respond effectively to prompt supportive care, while severe cases require intensive monitoring and ventilatory support. Mortality remains low when timely management is instituted. The findings highlight the generally favorable prognosis of pyrethroid toxicity but emphasize the need for heightened clinical awareness to ensure early recognition and intervention. Preventive strategies, including public education and stricter control over pesticide accessibility, are essential to reduce the incidence and severity of such poisonings.

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Limitations

The study is limited by its single-centre design and relatively small sample size, which restricts broader extrapolation. The type and quantity of pyrethroid ingested were based partly on patient or relative reports, which introduces the possibility of recall inaccuracies. Laboratory confirmation of specific compounds was not available for all cases, and long-term neurological or psychological outcomes could not be assessed due to the short follow-up period. These factors limit the depth of toxicological characterization.

Recommendations

Based on the present study, it is recommended that healthcare professionals maintain a high index of suspicion for pyrethroid poisoning in patients presenting with unexplained neurological or gastrointestinal symptoms, especially in agricultural regions. Early diagnosis, prompt decontamination, and vigilant supportive management significantly improve outcomes. Training of emergency physicians and peripheral healthcare workers in recognizing and managing pesticide toxicity should be prioritized. At the community level, awareness programs focusing on the safe handling, storage, and disposal of insecticides are crucial. Regulatory authorities should enforce restrictions on over-the-counter sales and promote mental health screening to prevent intentional self-poisoning incidents.

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Abbreviations

PSS – Poison Severity Score
ICU – Intensive Care Unit
SD – Standard Deviation
IQR – Interquartile Range
SPSS – Statistical Package for the Social Sciences
CNS – Central Nervous System
RBC – Red Blood Cell
WBC – White Blood Cell
ABG – Arterial Blood Gas
GI – Gastrointestinal

Source of funding

The study had no funding.

Conflict of interest

The authors declare no conflict of interest.

Author contributions

HP-Concept and design of the study, results interpretation, review of literature and preparing first draft of manuscript. Statistical analysis and interpretation, revision of manuscript. **HM**-Concept and design of the study, results interpretation, review of literature and preparing first draft of manuscript, revision of manuscript.**RST**-Review of literature and preparing first draft of manuscript. Statistical analysis and interpretation.

Data availability

Data available on request

Author Biography

Dr. Anand Acharya, MBBS, MD (Pharmacology), currently serves as Dean and Professor, Department of Pharmacology, at Konaseema Institute of Medical Sciences & Research Foundation (KIMS&RF), Amalapuram, Andhra Pradesh, India. A distinguished academician and medical education leader, he has been instrumental in developing KIMS&RF from its formative years into a premier medical institution with over 200 undergraduate and 100 postgraduate seats.

With more than 18 years of teaching and administrative experience, Dr. Acharya has held multiple key positions including Vice Principal, Principal, Chief Warden, Member Secretary of Institutional Ethics and Animal Ethics Committees, and is an approved PhD Guide under Dr. YSR University of Health Sciences, Vijayawada. His notable contributions to institutional growth include enhancing academic standards, clinical material utilization, research infrastructure, and postgraduate training quality.

Dr. Acharya has completed several prestigious national faculty development programs such as the Revised Basic Course Workshop (rBCW), Advance Course in Medical Education (ACME), and National Teacher Training Course (NTTC, JIPMER). He also serves as a Coordinator

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for Pharmacovigilance and Materiovigilance Programs under IPC–PvPI and MoHFW, Government of India.

A prolific researcher, he has authored and co-authored over 80 scientific publications in national and international indexed journals covering a broad spectrum of topics including toxicology, pharmacovigilance, antimicrobial resistance, endocrinology, and clinical pharmacology. His recent research includes landmark long-term studies on pyrethroid, paraquat, and chlorpyrifos poisoning, antimicrobial resistance trends, and predictors of treatment outcomes in dermatological emergencies.

Dr. Acharya's professional interests encompass clinical pharmacology, toxicology, rational drug use, pharmacovigilance, and medical education technologies. He continues to mentor postgraduate and undergraduate research scholars while actively contributing to curriculum development, ethics governance, and institutional academic advancement.**ORCID iD**: https://orcid.org/0009-0000-7967-9092

Dr. T. Nageswararao is currently serving as an Associate Professor of Pharmacology at Konaseema Institute of Medical Sciences and Research Foundation, Amalapuram, East Godavari District, Andhra Pradesh, India. He holds a doctoral degree in Medical Pharmacology from the prestigious Index Medical College and Research Institute, Madhya Pradesh. With over 16 years of teaching experience in various medical institutions, Dr. Nageswararao has made significant contributions to the field of pharmacology. His academic work includes nine research publications in reputed national and international journals, including one article indexed in PubMed. His dedication to research and education continues to enrich the academic and clinical landscape of medical pharmacology. ORCID iD:https://orcid.org/0009-0005-1638-6897

K. Muni Kumar is an Assistant Professor of Pharmacology at the Konaseema Institute of Medical Sciences & Research Foundation (KIMS&RF), Amalapuram, Andhra Pradesh, India. He has 12 years of teaching experience in medical institutions and is currently pursuing a PhD in Pharmacology at Chettinad Hospital & Research Institute, Chettinad Academy of Research and Education, Kelambakkam, Tamil Nadu (603103).

His scholarly work focuses on rational pharmacotherapy, toxicology, and pharmacovigilance, with nine peer-reviewed publications in national and international journals, including one PubMed-indexed article. His academic interests include experimental pharmacology, drug safety, and evidence-based therapeutics. ORCID iD: https://orcid.org/0009-0000-1536-8711

References

1.Shafer TJ, Meyer DA, Crofton KM. Developmental neurotoxicity of pyrethroid insecticides: critical review and future research needs. Environ Health Perspect. 2005;113(2):123–136.

2.Bradberry SM, Cage SA, Proudfoot AT, Vale JA. Poisoning due to pyrethroids. Toxicol Rev. 2005;24(2):93–106.

3.Ray DE, Fry JR. A reassessment of the neurotoxicity of pyrethroid insecticides. Pharmacology & Therapeutics. 2006 Jul;111(1):174-193. DOI: 10.1016/j.pharmthera.2005.10.003. PMID: 16324748.

4.Scheepers LD, Freercks R, Merwe EV. Acute cypermethrin and other pyrethroid poisoning - An organophosphate-like poisoning: A case report and review. Toxicol Rep. 2023 Jun 29;11:107-110. doi: 10.1016/j.toxrep.2023.06.013. PMID: 38187114; PMCID: PMC10767630.

5.Vijverberg HP, van den Bercken J. Neurotoxicological effects and the mode of action of pyrethroid insecticides. Crit Rev Toxicol. 1990;21(2):105-26. doi: 10.3109/10408449009089875. PMID: 1964560.

6.Ray DE, Forshaw PJ. Pyrethroid insecticides: poisoning syndromes, synergies, and therapy. J Toxicol Clin Toxicol. 2000;38(2):95-101. doi: 10.1081/clt-100100922. PMID: 10778904.

7.Soderlund DM, Bloomquist JR. Neurotoxic actions of pyrethroid insecticides. Annu Rev Entomol. 1989;34:77-96. doi: 10.1146/annurev.en.34.010189.000453. PMID: 2539040.

8.Ramchandra AM, Chacko B, Victor PJ. Pyrethroid Poisoning. Indian J Crit Care Med. 2019 Dec;23(Suppl 4):S267-S271. doi: 10.5005/jp-journals-10071-23304. PMID: 32021002; PMCID: PMC6996658.

9.Knaak JB, Dary CC, Zhang X, Gerlach RW, Tornero-Velez R, Chang DT, Goldsmith R, Blancato JN. Parameters for pyrethroid insecticide QSAR and PBPK/PD models for human risk assessment. Rev Environ Contam Toxicol. 2012;219:1-114. doi: 10.1007/978-1-4614-3281-4_1. PMID: 22610175.

10.Naeem B, Saleem J, Haider Naqvi ASA, Kausar S, Arshad A, Kumar K, Khalid A, Kumar P. Systematic

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review of clinical manifestations, management and outcome following accidental ingestion of liquid mosquito repellent vaporiser in children. BMJ Paediatr Open. 2024 Mar 30;8(1):e002476. doi: 10.1136/bmjpo-2023-002476. PMID: 38555100; PMCID: PMC10982783.

11.Poole ND, Schaffer DH. Pyrethrin and Pyrethroid Toxicity. [Updated 2024 Aug 11]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK606124/

12.Mathew R, Jamshed N, Aggarwal P, Patel S, Pandey RM. Profile of acute poisoning cases and their outcome in a teaching hospital of north India. J Family Med Prim Care. 2019 Dec 10;8(12):3935-3939. doi: 10.4103/jfmpc.jfmpc_832_19. PMID: 31879639; PMCID: PMC6924236.

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