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Original Research Article

A Study of Effectiveness of Atropine and Pralidoxime in the Treatment of Organophosphorus Poisoning

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Abstract

Background and Objectives: Organophosphorus compound (OP) poisoning is a prevalent global issue, particularly in developing nations. Conventional treatment approaches involve resuscitation, the administration of the anti-muscarinic agent atropine, an acetyl cholinesterase reactivator (pralidoxime), and, if necessary, assisted ventilation. This study aimed to assess the effectiveness of adjunct pralidoxime therapy compared to atropine monotherapy in OP poisoning.

Methods: The study encompassed 134 patients, with 70 individuals receiving both atropine and pralidoxime (Group AP) and 64 receiving solely atropine (Group A). Key outcome measures included total hospitalization duration and mortality. Data were subjected to't' test analysis for hospital stay and Fisher's exact test for mortality.

Results: No significant disparity was observed in the duration of hospital stay between the two groups. Similarly, no noteworthy difference in mortality rates was detected between the groups. Notably, the addition of pralidoxime imposed a substantial economic burden.

Conclusions: The study suggests no substantial variance in the use of atropine alone versus the atropine-pralidoxime combination concerning morbidity and mortality in OP poisoning. However, the latter entails a higher economic burden, which may not be practical in resource-constrained countries like India. It is imperative to conduct a larger multicentric prospective study to definitively establish these findings.

Keywords: Organophosphorus, Atropine, Pralidoxime.

Introduction

In India, organophosphates (OP) serve as the most prevalent pesticides and constitute the leading cause of both accidental and intentional poisonings. Given the predominantly agrarian nature of the country, where pesticides are extensively utilized in farming, a substantial portion of the population has ready access to OPs, making them the predominant modality of poisoning.

Globally, organophosphorus pesticide intoxications are estimated at approximately 3,000,000 cases annually, resulting in around 300,000 deaths and casualties. Data from the National Poison Information Centre (NPIC) at the All India Institute of Medical Sciences, New Delhi, reveals that suicidal poisoning with household agents (OPs, carbamates, and pyrethrinoids) is the prevailing form of poisoning [1-3]. Managing such cases is challenging, with a case fatality rate exceeding 15%. In many rural areas of Asia, self-poisoning with organophosphorus pesticides poses a significant clinical and public health challenge, contributing to approximately 60% of the estimated 500,000 self-harm deaths in the region annually [4-7]. Given the high incidence of OP poisoning in rural India, it is imperative for healthcare professionals to comprehend the optimal treatment strategies.

Organophosphates function by inhibiting the acetylcholinesterase enzyme, leading to elevated acetylcholine levels and widespread cholinergic effects in nerve terminals, sympathetic ganglia, neuromuscular endplates, and specific CNS regions. Respiratory failure and lung injury constitute the primary causes of mortality in individuals exposed to toxic compounds. However, the clinical presentation varies based on factors such as the specific substances encountered, the quantity ingested or inhaled, the degree of toxicity, and the duration between exposure and hospital admission [8]. Standard treatment involves resuscitation, administration of the anti-muscarinic agent atropine,

an acetylcholinesterase reactivator like pralidoxime, and assisted ventilation if necessary [9]. While the efficacy of atropine in OP poisoning is well established, the use of pralidoxime remains a subject of significant debate within the medical community. The precise role of oximes in OP poisoning treatment remains unclear, with suggestions that they may confer benefits primarily to patients exposed to specific pesticides or individuals with moderate poisoning levels.

Oxime use is further complicated by the necessity for timely administration before acetyl cholinesterase enzyme aging, without which it proves ineffective. Late presentation to tertiary healthcare centres is a common issue, rendering the use of oximes non-productive in such cases. Even Cochrane reviews have concluded that current evidence is insufficient to determine whether oximes are harmful or beneficial in managing acute organophosphorus pesticide poisoning [10].

Given the high mortality incidence of OP poisoning in rural India, it was essential to assess the relative efficacy of adjunct pralidoxime therapy compared to treatment with parenteral atropine sulphate alone. This study aimed to compare the effectiveness of adjunct pralidoxime therapy versus therapy with atropine alone in OP poisoning.

Material and Methods

The study spanned duration of one year and adopted a retrospective approach based in a hospital setting. It involved consecutively admitted patients to an Indian tertiary care hospital during the study period, presenting with a history and clinical evidence of OP poisoning. Inclusion criteria comprised 134 patients with confirmed OP poisoning, while 31 cases were excluded due to insufficient clinical signs, presentation after 24 hours of ingestion, and loss to follow-up. The study encompassed 134 patients, with 70 individuals receiving both atropine and pralidoxime (Group AP) and 64 receiving solely atropine (Group A). Baseline parameters, including age, sex, time of presentation, and severity determined by the Peradeniya Organophosphorus Poisoning (POP) scale, were assessed in both groups. The primary outcome measures were total hospital stay and mortality.

The POP scale criteria were as follows: pupil size (>2 mm (0), <2mm(1), pinpoint (2)), respiratory rate (<20/minute (0), >20/minute (1), >20/minute with central cyanosis (2)), heart rate (>60/minute (0), 41-60/minute (1), <40/minute (2)), fasciculation (none (0), present, generalized, or continuous (1), present, generalized, and continuous (2)), level of consciousness (conscious and rationale (0), impaired response to verbal commands (1), no response to verbal commands (2)), and seizures (absent (0), present (1)).

The analysis involved unpaired’t’ tests for data comparison and Fisher's exact test for mortality. The data underwent thorough tabulation, analysis, review, and evaluation.

Results

The predominant demographic in both groups comprised individuals aged 21 to 30 years. The distribution of age and gender is outlined in Table 1. The preeminent proportion of patients in both groups sought medical attention within a duration of 6 hours. Severity, as assessed by the POP score, revealed that the majority of patients exhibited mild severity, as indicated in the corresponding table. The average duration of hospital stay and the mortality rate demonstrated similarity between the two groups (Table 2). Baseline parameters such as age, gender, time of presentation, and severity were comparable between both groups, as elucidated in Tables 1 and 2. Significantly, the cost burden was notably elevated in the group receiving pralidoxime, as depicted in Table 3.

Table 1: Demographic parameters of study population

Age Group	Group AP	Group A	p Value
12-20 Years, n	16	14	0.91
21-30 Years, n	27	29	
31-40 Years, n	8	8	
>40 Years, n	19	13	
Total, n	70	64	
Mean Age (Years)	31.68 ± 14.25	30.23 ± 11.60	
Gender			
Male, n	27	25	0.85
Female, n	43	39	

Table 2: Clinical parameters of study population

Time till presentation	Group AP	Group A	p Value
< 6 hours, n	34	31	0.81
6-12 hours, n	18	15	
> 12 hours, n	18	18	
Mean ± SD (hours)	8.1 ± 7.9	8.6 ± 7.2	
Severity			
Mild (0-3), n	29	26	0.38
Moderate (4-7), n	19	17	
Severe (8-11), n	22	21	
Mean ± SD, n	5.90 ± 2.75	6.05 ± 2.45	
Duration of hospital stay Mean ± SD (in days)	3.45 ± 2.12	3.28 ± 1.81	0.15
Mortality, n (%)	10 (14.28)	9 (14.06)	0.94

Table 3: Additional Cost of Treatment in study population

Additional Cost of Treatment	Group AP	Group A	p Value
	4000-7000 Rs	-	<0.05

Discussion

Organophosphates represent a class of pesticides frequently employed and are associated with significant morbidity and mortality.

In our investigation, the mean age in group A was 31.68 ± 14.25, while in group B, it was 30.23 ± 11.60. The highest incidence occurred in the 21-30 years age group in both cohorts, aligning with findings by Salame et al and Raddi et al [11,12]. The prevalence of female patients was higher in both groups, consistent with the observations made by Chaturvedi et al [13].

A majority of patients presented within 6 hours of exposure in both groups, with mean durations of 8.1 ± 7.9 hours in group A and 8.6 ± 7.2 hours in group B. Symptom severity in both groups was comparable, with the majority falling into the mild subgroup according to the severity scale as per the POP (Pesticide Poisoning) scale.

Hospital stays did not exhibit significant differences between the two treatment groups. De Silva et al, in a similar study, concluded that the clinically assessed outcomes were comparable between the two groups [14]. Since its discovery in 1956 by Wilson and colleagues, pralidoxime has been a crucial element in the management of organophosphorus poisoning. Our study suggests that adjunct pralidoxime therapy did not confer appreciable benefits in terms of mortality and hospital stay duration when compared with atropine monotherapy. Our findings align with results observed in studies reported by Duval et al, De Silva et al, and Chabra et al [14-17].

Conclusion

No substantial disparity was observed in the utilization of atropine alone compared to the atropine-pralidoxime combination concerning both morbidity and mortality in OP poisoning. Instead, the latter approach imposes a more considerable economic burden, which may not be feasible in economically disadvantaged countries such as India. Nevertheless, to arrive at a conclusive determination, there is a necessity for a comprehensive multicentric prospective study on a larger scale.

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