

# A prospective study on lung parenchymal changes in ingestional poisoning

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## ABSTRACT

**Introduction:** The ingestion of poison constitutes a critical medical emergency necessitating immediate attention in the emergency department. Respiratory symptoms associated with ingested poisons may manifest through aspiration, cardiopulmonary effects, or direct lung toxicity resulting from alveolar epithelium injury. In the emergency setting, chest imaging, including chest radiographs and CT scans, is commonly employed to assess such symptoms. This study aims to observe and document radiological changes in lung parenchyma among cases of ingestional poisoning admitted to GGH Kakinada. **Material and Methods :** A prospective observational study was conducted, encompassing cases of ingestional poisoning admitted to GGH Kakinada from January 1st, 2023, to June 1st, 2023. **Results:** Our findings revealed a predominance of males (71.2%), with the most common age group being 31-40 years (36.6%). Paraquat emerged as the most frequently consumed poison (39.39%). Radiological changes were most prevalent in paraquat poisoning cases (66.67%), and the mortality rate was 39.39%. **Conclusion:** Paraquat poisoning demonstrates substantial and delayed lung involvement, likely linked to aspiration. All cases resulted in mortality. Early chest X-ray assessment is vital in the emergency department for prompt detection and intervention, anticipating respiratory symptoms in patients with radiological changes.

**KEYWORDS:** Ingestional poisoning, lung parenchyma, organophosphate, paraquat

## INTRODUCTION

The act of ingesting pesticides ranks as one of the most common methods of suicide worldwide, with ready availability, particularly in countries like India where agriculture is the dominant occupation. In developing nations, herbicide ingestional poisoning presents a significant public health concern, contributing to 14-20% of suicides globally.<sup>[1]</sup>

Poisoning incidents can manifest either through oral or inhalational exposure, with symptom onset varying depending on factors such as the poison's potency and an individual's susceptibility.<sup>[2]</sup> Notably, in cases of paraquat poisoning, a fatal dose is often defined as exceeding 25 ml.<sup>[3]</sup> Poison ingestion constitutes a medical emergency necessitating immediate attention in the emergency department. Respiratory symptoms associated with poison ingestion may arise from aspiration, cardiopulmonary effects, or direct lung toxicity, leading to alveolar epithelium injury. In the emergency setting, chest imaging, including chest radiographs and CT scans, is routinely conducted to assess these respiratory symptoms.<sup>[4]</sup> The identification of the specific poison responsible can facilitate targeted management, including the administration of specific antidotes or the understanding of the underlying mechanisms driving pulmonary symptoms.

The primary objectives of this study were to analyze radiological changes, determine whether respiratory distress was primarily attributable to lung parenchymal involvement or other systemic factors, and explore the progression of lung parenchymal changes in various poisoning cases. Similar investigations have examined radiological changes in different ingestional poisoning scenarios. In our research, we examined 11 types of ingestional poisoning cases, with paraquat standing out due to its high fatality rate and long-term complications. Paraquat primarily enters the body through the digestive tract, where it is predominantly absorbed in the jejunum and subsequently excreted via renal excretion.<sup>[5]</sup> Imaging modalities such as chest X-rays or CT scans must be promptly performed in the emergency department to assess the extent of lung involvement and guide further management, thereby reducing mortality and morbidity associated with lung complications.

In most poisoning cases, initial findings indicated consolidation, followed by the development of reticular changes. In paraquat poisoning, a notably high mortality rate of 50-90%

was observed, primarily attributed to progressive pulmonary damage resulting in respiratory failure. [6]

**MATERIALS AND METHODS**

A prospective observational study of ingestional poisoning cases admitted in GGH Kakinada from January 1<sup>st</sup>2023 to June 1<sup>st</sup>2023 were taken into the study.

A total of 56 patients of age group 10-60 years who have consumed poison and came to the emergency department and patients who were admitted in GGH Kakinada were included into the study. People with or without respiratory symptoms have been thoroughly followed. Radiological manifestations were also observed. Ethics approval and patient consent was taken.

The data has been meticulously analyzed and categorized into seven key aspects: 1) age, 2) gender, 3) type of poison, 4) radiographic changes, 5) period of changes that occurred, 6) most common symptoms, and 7) mortality.

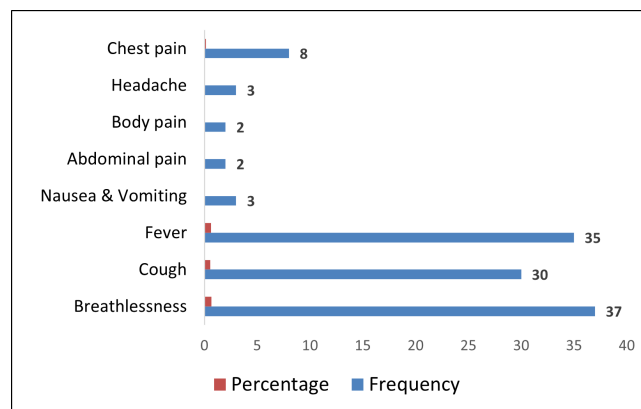
**RESULTS**

Results from the current study on poisoning cases reveal that males dominate the statistics, comprising 71.2% (47 cases). The age distribution highlights the most affected group as individuals between 31-40 years, representing 36.6% (24 cases), followed by those aged 21-30 years at 28.78%. The 51-60 years age group had minimal representation, with only one reported case. Table 1

	Frequency	Percentage
<b>AGE</b>		
<20	5	9
21-30	8	14
31-40	7	13
41-50	13	23
51-60	9	16
61-70	9	16
71-80	5	9
<b>Total</b>	<b>56</b>	<b>100</b>
<b>GENDER</b>		
Male	30	54
Female	26	46
<b>Total</b>	<b>56</b>	<b>100</b>

**Table 1: Demographic Characteristics of patients in the study**

Dry cough and shortness of breath were the most common symptoms across various poisoning cases, including paraquat, organophosphate, hydrocarbon, and prallethrin. Paraquat emerged as the most frequently ingested poison, with 39.39% of cases, followed by organophosphate at 21.21% and rat killer poison at 15.15%. [Figure 1 ]



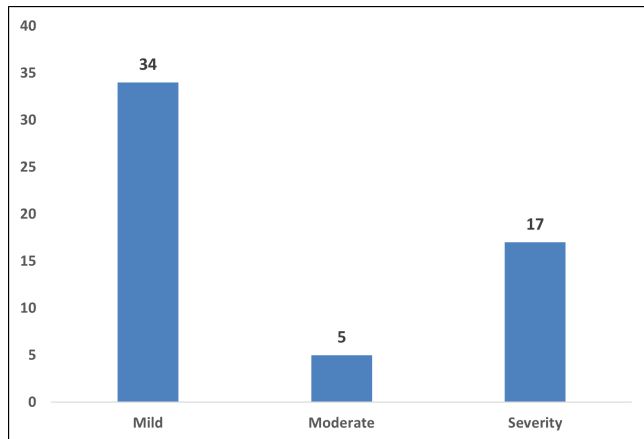
**Figure 1: Symptoms during admission**

Radiological changes were observed in 12 cases, with 66.67% (8 cases) attributed to paraquat poisoning. These changes included bilateral fibrosis in 4 cases, consolidations in 2 cases, ARDS in 1 case, and bilateral reticular opacities in 1 case. The remaining 4 cases, involving hydrocarbons, organophosphates, and prallethrin, exhibited consolidation as the predominant radiological presentation. In paraquat poisoning, radiological changes appeared between 8-16 days, while in other poisoning cases, changes occurred immediately. It's worth mentioning that in 3 cases, radiological changes were incidental findings without respiratory symptoms. Table 2

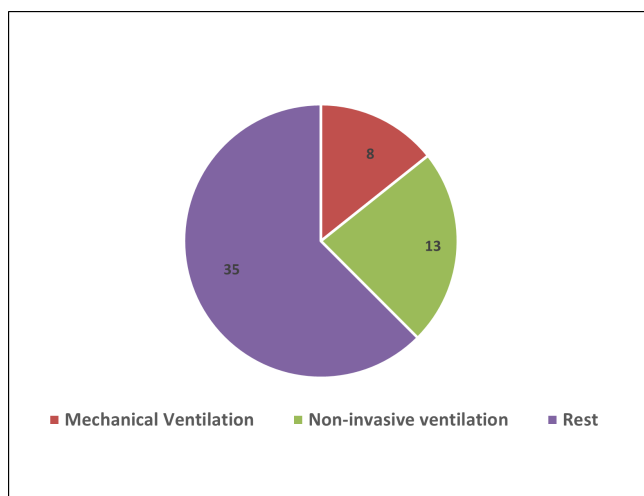
Type of Poisoning	Radiological Changes	Frequency
<b>Paraquat Poisoning</b>	Bilateral fibrosis	4
	Consolidation	2
	Ground glass appearance	1
	Bilateral reticular opacities	1
<b>Others (Hydrocarbons, Organophosphates, Prallethrin)</b>	Consolidation	4
<b>Total</b>		<b>12</b>

**Table 2: Observed Radiological Changes in ingestional poisoning**

Among the 56 cases, 34 cases were mild, 5 cases were moderate, and 17 cases were severe with 8 cases requiring mechanical ventilation and 13 cases requiring non-invasive ventilation. An overall mortality rate of 39.39% was observed. Figures 2 and 3 Notably, 100% mortality was observed in paraquat poisoning cases, accounting for all 26 deaths. The remaining poisoning cases were discharged within 7-14 days.



**Figure 2: Distribution of Patients based on Oxygen requirement**



**Figure 3: Distribution of Patients based on Oxygen requirement**

## DISCUSSION:

The demographic focus of our study aligns with Halesha B.R. et al.'s research, predominantly involving individuals between 30 and 40 years of age.<sup>[7]</sup> Radiological changes were observed in 12 cases in our study, with a significant proportion (66.67%) attributed to paraquat poisoning. Specifically, bilateral fibrosis was identified in four cases, consolidations in two, ARDS in one, and reticular opacities in another case. This study highlights the progression from radiological changes to fibrosis and reticular opacities in paraquat

poisoning, likely a consequence of free radical-induced lung injury.<sup>[8]</sup>

A notable variance was observed in the onset of symptoms based on the type of poisoning. While hydrocarbon, organophosphate, and prallethrin poisoning showed immediate consolidation, paraquat-induced changes manifested within 8-16 days. This pattern of delayed symptom onset in paraquat poisoning is critical for clinical considerations. In contrast, the study by Kumar S et al demonstrated the immediate effects of pulmonary edema, septal congestion, and pulmonary hemorrhage.<sup>[9]</sup>

Further, Im JG et al. observed early radiological changes, including thickening of the alveolar walls by oedema, hemorrhage, and inflammatory cells.<sup>[10]</sup><sup>[11]</sup> JA Vale et al. reported a timeline ranging from days to weeks for fibrotic changes in paraquat cases, while Dinis-Oliveira RJ et al. noted the emergence of ARDS within 24-48 hours post-ingestion.<sup>[12]</sup> In line with our findings, Wenwen Sun et al. observed a consolidation pattern in CT scans of organophosphate poisoning cases.<sup>[13]</sup>

Our study's mortality rate (39.39%) notably contrasts with Delirrad M et al. findings where the mortality varied between 50% and 90%, and in cases of intentional self-poisoning with concentrated formulations, mortality approached 100%.<sup>[3]</sup> The 100% mortality rate in our paraquat poisoning cases underscores the severity of lung involvement and subsequent multi-organ failure.<sup>[11]</sup>

The management strategy in our study avoided high-flow oxygen in paraquat cases to mitigate free radical-induced lung injury, a crucial distinction from Siphon D et al.'s approach, where high-flow oxygen potentially exacerbated conditions.<sup>[14]</sup> Elspeth J Hulse et al and YJ Wu et al highlighted the risks of aspiration pneumonia in organophosphate poisoning, leading to serious respiratory complications.<sup>[15]</sup><sup>[16]</sup>

Our findings underscore the importance of prompt identification of the poisoning agent and its specific impact on the respiratory system, which can significantly alter both the treatment approach and patient outcomes. The pulmonologist's role in the emergency department is pivotal, particularly in ingestion poisoning cases, where rapid and targeted management can be lifesaving.

## CONCLUSION

The current study emphasizes that lung involvement is predominantly associated with paraquat poisoning cases, with radiological changes appearing progressively within 8-16 days. The stark 100% mortality rate observed in paraquat poisoning underscores its severity. The immediate onset of radiological changes in other poisoning cases raises suspicion of aspiration, particularly evident in the common involvement of lower lobes. Notably, individuals with radiological changes but lacking initial respiratory symptoms eventually developed respiratory issues. This underscores

the critical role of early detection and intervention, prompting the recommendation for chest X-rays in all ingestional poisoning cases in the emergency department to facilitate timely identification of lung involvement and improve outcomes.

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