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Commentary

# Occupational Chlorfenapyr Poisoning: Clinical Implications and Research Value under Hidden Risks

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## DESCRIPTION

With the widespread application of the novel insecticide chlorfenapyr in agriculture, its toxic effects are increasingly entering the clinical purview. Previous reports primarily focused on oral poisoning cases. However, a systematic analysis conducted by the team from Qilu Hospital of Shandong University on four cases of occupational poisoning at a chlorfenapyr production factory in Shandong Province in 2024 provides valuable practical evidence for understanding the clinical characteristics, diagnostic approaches, and treatment strategies of chlorfenapyr poisoning caused by occupational exposure. The research value of this study extends beyond case summaries, providing significant insights into the prevention and control of occupational poisoning as well as clinical diagnosis and treatment.

The core contribution of this study lies in revealing the "covert" characteristics of occupational chlorfenapyr poisoning. Unlike the gastrointestinal symptoms such as nausea and vomiting commonly associated with oral poisoning, the early symptoms in occupationally exposed individuals are highly atypical: Among the four patients, two only exhibited excessive sweating and fear of heat, and one (patient 3) even had no obvious discomfort, being admitted to the hospital only due to positive toxicological test results. The other patient (patient 4) remained asymptomatic throughout. This characteristic of "starting with asymptomatic or mild symptoms" is closely related to the mechanism by which chlorfenapyr needs to be metabolized by the liver into its active metabolite, bromopyrrole nitrile, to exert toxicity the presence of an incubation period greatly increases the difficulty of early identification. Patient 1 was initially misdiagnosed as having "heatstroke," which precisely reflects the dilemma of early diagnosis in occupational poisoning. The research team keenly captured this difference and emphasized the necessity of "occupational history collection+toxicological testing," for the providing major guidance for clinicians to avoid missed diagnoses.

The combined application of toxicological testing and imaging examination is another highlight of this study. Through dynamic monitoring of chlorfenapyr and its metabolite bromopyrrole nitrile using liquid chromatography-tandem mass spectrometry, the study found a significant correlation between blood drug concentration and disease severity: The initial chlorfenapyr concentration in the most severely poisoned patient 2 reached 0.392 μg/mL, far exceeding that of other cases. Moreover, the "rebound" phenomenon observed in the fluctuation of bromopyrrole nitrile concentration suggests the possibility of tissue re-release of toxins, providing a laboratory basis for the timing of blood purification therapy. Magnetic Resonance Imaging (MRI) examination visually demonstrated the damage to the central nervous system caused by poisoning: Patients 1 and 2 with obvious symptoms showed abnormal white matter signals in bilateral cerebral hemispheres, brain stem, cerebellum, and other regions, and the extent of lesions was synchronized with disease progression, confirming the targeted damage characteristics of chlorfenapyr to high-energy-consuming organs. This correlation analysis of "toxicant concentration-imaging changes-clinical symptoms" not only enhances the objectivity of diagnosis but also establishes a quantitative indicator for evaluating prognosis.

The study also revealed the practical shortcomings in the prevention and control of occupational poisoning. The temperature in the workshop involved was above 38°C, with ventilation relying solely on industrial fans, and protective equipment consisting of non-disposable protective clothing- high temperature environments accelerate skin absorption, and rudimentary protection is difficult to block the inhalation of dust or steam, creating conditions for toxicant accumulation. It took Patient 3 (16 weeks) and Patient 2 (12 weeks) to develop symptoms, indicating that the cumulative toxicity of long-term low-dose exposure cannot be ignored. This finding has a warning significance for occupational health supervision: Safety standards for the production environment of new pesticides, upgrades to protective measures, and regular occupational health monitoring urgently need to be strengthened.

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Of course, the limitations of the study should also be viewed objectively. The sample size of 4 cases is relatively small and derived from the same incident, which may be influenced by specific environmental factors (such as workshop temperature, toxicant concentration). The universality of the conclusions requires further support from more data; the longest follow-up period is only 3 months, which is insufficient to assess long-term neurological or organ damage; the specific mechanism of "rebound" of bromopyrrole and the optimal intervention timing still require further clarification through toxicokinetic studies. However, these limitations do not diminish its value against the backdrop of scarce research on chlorfenapyr poisoning; this study presents the first systematic clinical overview of occupational exposure, laying a basic framework for subsequent research.

Overall, this study, anchored in clinical cases, not only reveals the specificity of occupational chlorfenapyr poisoning but also verifies the synergistic effect of multidisciplinary approaches in diagnosis and prognostic assessment. It not only provides clinicians with a diagnostic and treatment pathway of "occupational history-toxicant detection-MRI", but also puts forward requirements for improving the occupational health protection system. With the increasing application of chlorfenapyr, the value of such research will become increasingly prominent-only by facing up to its hidden risks can early prevention and control, as well as precise treatment, be achieved, safeguarding the health bottom line of the occupational population.