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ORIGINAL ARTICLE

Factors that generate an incidence of bipyridyl chloride intoxication in the "Hospital General Francisco de Orellana"

Factores que generan una incidencia de intoxicación por cloruro de bipiridilo en el "Hospital General Francisco de Orellana"

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ABSTRACT

Introduction: Bipyridyl or Paraquat is a herbicide with high toxicity potential. Its inhalation can cause damage to the lungs, intestines and kidneys, among other organs, depending on the route of entry.
Objective: To determine the factors that generate an incidence of bipyridyl chloride intoxication at the "Hospital General Francisco de Orellana".
Methods: The main objective of this research was. To determine the factors that generate an incidence of dipyridylium chloride poisoning in the hospital Francisco de Orellana in the period September 2022 - August 2023. The universe and the sample coincided from a non-probabilistic sample, so the selected population was 104 people.
Results: In the province of Orellana there is a serious problem in terms of self-inflicted intoxication in the population. This problem is frequently generated in rural areas and has a great influence on young men between 12 and 18 years of age, with 72,1 % of the total cases, the main cause being family problems with 40,4 %, followed by love relationships that have a certain relationship with depression, generating 26,9 % of the total cases. A 64,4 % of the population did experience involuntary exposure to herbicides, leaving 35,6 % to first-time users.
Conclusions: there is a great lack of information on herbicides in health centers, so awareness programs on this subject should be implemented.

Keywords: Bipyridyl Chloride; Suicide Attempts; Suicidal Behavior; Multiple Organ Failure; Risk Factors.

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RESUMEN

Introducción: el Bipiridilo o Paraquat es un herbicida con gran potencial de toxicidad. Su inhalación puede causar daño pulmonar, a los intestinos y los riñones, entre otros órganos según la vía de entrada.
Objetivo: determinar los factores que generan una incidencia de intoxicación por cloruro de bipiridilo en el "Hospital General Francisco de Orellana".
Métodos: El objetivo central de la presente investigación fue. Determinar los factores que generan una incidencia de intoxicación por cloruro de dipiridilio en el hospital Francisco de Orellana en el periodo septiembre 2022 – agosto 2023. El universo y la muestra coincidieron a partir de un muestro no probabilístico, por lo que la población seleccionada fue de 104 personas.
Resultados: en la provincia de Orellana existe una problemática grave en cuanto a intoxicaciones autolíticas en la población, esta problemática se genera con frecuencia en las zonas rurales y tiene mucha influencia en los jóvenes de entre 12 a 18 años del sexo masculino con el 72,1 % del total de los casos, siendo la principal causa los problemas familiares con un 40,4 %, seguido de las relaciones amorosas que tiene una cierta relación con la depresión, generando un 26,9 % del total de los casos. Un 64,4 % de la población si experimentó una exposición involuntaria a los herbicidas, dejando con un 35,6 % a personas primerizas.
Conclusiones: existe un gran déficit de información sobre los herbicidas por parte de los centros de salud por lo se deben implementar programas de concientización referente a este tema.

Palabras clave: Cloruro de Bipiridilo; Intentos Autolíticos; Conductas Suicidas; Falla Multiorgánica; Factores de Riego.

INTRODUCTION

The herbicide known as Paraquat, also marketed under the name Gramoxone, has been responsible for numerous cases, especially in the Ecuadorian agricultural context. This chemical, which belongs to the bipyridyl family, is an extremely dangerous organic compound. The World Health Organization (WHO) classified it in "Class II (moderately dangerous)" after discussing the safe use of pesticides at its world assembly.[1]

Paraquat poses significant risks due to its easy availability, the lack of information about its toxicity to users, and the potential harm it can cause to both the environment and human health if used inappropriately.

These adverse effects are often irreversible. Bipyridyl chloride is a non-selective herbicide that acts very quickly on contact with leaves and plants. It can be found commercially in liquid form. In humans, the lethal dose would be 10 to 50 ml of the concentrate orally.

Although the main organ affected by bipyridyl chloride is the lung (which can accumulate concentrations much higher than those present in the blood), this toxicant has an impact on several body systems, including a series of target organs that increases the probability of death. The body's response to this substance is uniform, regardless of the route by which it enters. Kidney damage occurs both from the direct toxicity of bipyridyl chloride and from the dehydration it can cause, since this decreases blood flow to the kidneys.[2]

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This problem regarding poisoning can occur in urban areas as well as in rural geography and is present in one or more people. In general terms, it can be considered as autolytic or accidental poisoning when it occurs frequently in a certain area and the clinical manifestations are common or chronic. However, intentional poisoning could be suspected when several cases of deliberate ingestion of bipyridyl chloride are recorded.(2)

At the Francisco de Orellana General Hospital, the many cases found are due to different factors, among which the most common are romantic relationships, followed by family problems and health problems, leaving a very low percentage due to involuntary poisoning or the misuse of herbicides.

Paraquat poisoning poses a significant challenge in terms of treatment, as there are no specific pharmacological antagonists or chelating agents to counteract its toxic effects. However, therapeutic approaches have been developed and are used in the management of this poisoning. Some of the most common treatments are, Gastric adsorbents (these agents are used to treat acute Paraquat poisoning by attempting to reduce absorption of the compound in the gastrointestinal tract. However, their effectiveness may be limited in severe cases), Extracorporeal filtration (hemoperfusion or dialysis may be used to remove Paraquat from the circulatory system and reduce its concentration in the body. This approach may be beneficial in severe cases and may help to remove the toxicant more effectively) and for a treatment with the use of drugs (it is essential to use antioxidants in conjunction with anti-inflammatories, as part of the treatment to counteract the inflammation and excessive immune response that Paraquat can trigger in the body).(3)

It is important to note that Paraquat poisoning is serious and potentially fatal, and early and appropriate medical care is critical. Since there is no specific antidote, treatments focus on reducing the absorption of Paraquat, removing it from the body, and treating the toxic effects through pharmacological approaches.

Herbicide poisoning is a very common problem in the current population, especially in developing countries, where most cases are reported. According to the World Health Organization (WHO), it is estimated that around three million poisonings occur globally each year. These poisonings can be of two main types: accidental, related to agricultural activities, and deliberate, with the intention of suicide.(4)

Tragically, there are between 250,000 and 370,000 deaths related to pesticide poisoning every year worldwide. Shockingly, approximately 90 % of these deaths are the result of intentional use of these substances with some suicidal behavior or delusions.(4)

Of some pesticides that cause these poisonings, Paraquat stands out with a high rate of poisoning and mortality. Mortality rates associated with Paraquat vary in different regions, for example, in the United States a mortality rate of 54 % has been reported, in a developed country such as France it is 74 %, in Iran the mortality rate is between 43 and 55,2 %, and in populations that were thought to have a low rate of poisoning, such as China and Korea, it is found to be between 42,2 and 88,3 %. This problem is serious and underlines the need for preventive measures and awareness regarding pesticide use, as well as for providing adequate medical care in case of poisoning, especially in agricultural areas and rural communities. (4)

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The data provided by CIATOX (Toxicological Information and Advice Center) in Ecuador are extremely disturbing, as they show that Paraquat ranks third with a high mortality rate, and that it is the main cause of these poisonings. In Ecuador, a study was conducted in 2018 at the Quito Hospital reporting a higher prevalence of pesticide poisoning in the 18-29 age group, representing 74,6 % of cases. In contrast, in 2019 it is mentioned that health problems in agricultural workers are related to pesticide exposures in men aged between 18 and 48 years. These data underline the importance of effectively and urgently addressing the problem of pesticide poisoning in the country.[5]

In the health system, and health centers do not have drugs and facilities to treat poisoning by infection, tertiary hospitals can provide better management, but the time to get there can be hours or even days after the poisoning so this research aims to provide knowledge on how to better treat herbicide poisoning.[6]

Paraquat is a herbicide widely used by the population of Ecuador to protect crops. In the province of Napo, monthly cases of poisoning by this product are reported, most of which are the result of suicide attempts, since Paraquat is freely available and easily accessible, and is often stored improperly in homes. Farmers use it because of their concern for crop quality, which increases the predisposition to its use, both accidental and intentional.[6]

Paraquat poisoning can affect several body systems, including the liver, lungs, and kidneys, depending on the amount ingested. Symptoms and clinical picture vary depending on the severity of the poisoning and can sometimes lead to multi-organ failure and ultimately death. [6] Therefore, the objective of this research was to determine the factors that generate an incidence of bipyridyl chloride poisoning in the "Francisco de Orellana" hospital.

METHODS

Observational, descriptive and cross-sectional research that will allow different conclusions to be drawn on the incidence of poisoning due to the ingestion of bipyridyl chloride in the "Francisco de Orellana" hospital in the period September 2022 - August 2023. The universe and the sample coincided from a non-probabilistic sample, so the selected population was 104 people.

It is a quantitative study because it involves a series of procedures where a chronological order is followed to validate certain assumptions. Each phase is important for the sequence and steps cannot be omitted, maintaining a strict order, although the possibility of redefining some phase is allowed. It begins with the delimitation of an idea, which, once delimited, leads to the formulation of objectives and research questions. Hypotheses are derived from the questions, and variables are defined. A plan is established to test the hypotheses, which resembles a map that guides the research. Then, cases or units of measurement are chosen for the variables in a specific context, which includes place and time. The measurements are analyzed and linked, using statistical methods, and conclusions are drawn regarding the hypotheses raised.[6,7]

Methods such as inductive-deductive and analytical-synthetic were used. The inductive method allowed the research to find common factors in the population that generate the same cases and phenomena in the same population. The analysis is a procedure of mentally breaking down into parts and ordering what has been studied, and therefore allowing a better understanding of the behavior of each part, and the Synthesis is a combination of the parts already analyzed to reach common ends.[8]

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For data collection, surveys were developed as an information instrument regarding the factors that indiscriminately cause bipyridyl chloride poisoning. To tabulate the information, Excel programs were used (to generate a database with all the possible answers in the survey carried out), and the Jamovi statistical tool (to generate the tables that help us better understand the results). The reliability generated by this application is a Cronbach's Alpha of 0.7.

The information was processed through Excel where a database was created, which was tabulated in the Jamovi technological tool for tables and graphs, which allowed a better understanding of the information.

The principles of medical ethics and the postulates of the Declaration of Helsinki were taken into account.

RESULTS

The people most affected by bipyridyl chloride poisoning are between 12 and 18 years of age, accounting for 64,4 % of the total number of poisoned people; followed by 23,1 % of those poisoned by people over 25 years of age; and finally, 12,5 % of those poisoned by people between 19 and 25 years of age at the Francisco de Orellana General Hospital.

Table 1. Bipyridyl chloride poisoning by age.

Age	Absolute Frequency	% of total	% accumulated
From 12 to 18	67	64,4	64,4
19 to 25	13	12,5	76,9
Over 25	24	23,1	100

Fountain: Authors

The factors that cause bipyridyl chloride poisoning affect males more, accounting for 72,1 % of all cases; and females, accounting for 27,9 % of all cases at the Francisco de Orellana General Hospital.

Table 2. Bipyridyl chloride poisoning by sex.

Sex	Absolute Frequency	% of total	% accumulated
Female	29	27,9	27,9
Male	75	72,1	100 %

Fountain: Authors

Bipyridyl chloride poisoning affects singles the most, with a figure of 70,2 %, which is closely related to what we were able to see previously, that said poisoning is caused by children aged 12 to 18, most of whom are single; followed by 16,3 % by couples in free union, these being the two most relevant causes of death in this section.

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Table 3. Bipyridyl chloride poisoning by marital status.

Marital status	Absolute Frequency	% Of Total	% Accumulated
Single	73	70,2	70,2
Married	5	4,8	75,0
Divorced	9	8,7	83,7
Free Union	17	16,3	100

Fountain: Authors

There are more cases of bipyridyl chloride poisoning in indigenous people, with 58,7 %, since, according to research, we have come to conclude that this product is used more in communities far from urban areas; secondly, the mestizo ethnic group is also affected by this poisoning, with 32,7 % of the total; and finally, but no less worrying, we have seen cases in Montubio people with 5,8 % and Afro-Ecuadorians with 2,9 % of the total number of poisoned people.

Table 4. Bipyridyl chloride poisoning by race or ethnicity.

Race/Ethnicity	Absolute Frequency	% Of Total	% Accumulated
Indigenous	61	58,7	58,7
Mestizo	34	32,7	91,3
Montubio	6	5,8	97,1
Afro-Ecuadorian	3	2,9	100

Fountain: Authors

Rural areas are the areas that generate the most cases of bipyridyl chloride poisoning, with 80,8 % of the total, since this product is widely used by communities; and urban areas generate 19,2 % of poisonings in the Francisco de Orellana General Hospital.

Table 5. Bipyridyl chloride poisoning by area of residence.

Area of Residence	Absolute Frequency	% of Total	% Accumulated
Rural	84	80,8	80,8
Urban	20	19,2	100

Fountain: Authors

The population, being very familiar with the product since it is used frequently, understands that it is a herbicide, with a 95,2 % reliability rate.

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Table 6. What do you understand by Herbicides?

What do you understand by Herbicides?	Frequencies	% Of Total	% Accumulated
Kill Weeds	99	95,2	95,2
Help the soil	1	1,0	96,2
Generate More Production	4	3,8	100

Fountain: Authors

69,6 % of the entire population is familiar with herbicides, as they are widely used in the agricultural field; 23,1 % use herbicides occasionally; and 17,3 % use them at least once a year, concluding that residents do frequently use herbicides in the agricultural work field in Orellana. The population is aware that herbicides are very dangerous for human consumption, validating this with 94,2 %; and 5,8 %, which is a small part of the population, are unaware of their danger.

Among the factors that generate an incidence of herbicide poisoning, the most predominant are family problems with 40,4 % of the total population studied and which affect young people between 12 and 18 years of age the most, as we find out in table 1; closely followed by love disappointments or relationship problems with 26,9 %; with 17,3 % depression is also the cause of some herbicide poisonings; and finally economic problems with 13,5 % and 1,9 % serious illnesses or physical disability.

Regarding the level of information, 34,6 % of the population is well informed about the risks of herbicide poisoning; 51,9 % are aware and would be willing to learn more about the risks; and finally, there are people who would not be willing to learn about the risks, with a result of 13,5 % of the total population.

The majority of the population does have the intention of dying, since 55,8 % of the population studied responded that close relatives were those who sought medical help without their authorization; 10,6 % did not seek help by their own means; leaving 33,7 % who thought things through and sought immediate help.

The survey revealed that 64,4 % of the population had experienced involuntary exposure to herbicides, since they are widely used in agriculture and as we have seen, there is not much training in the proper handling of these herbicides; leaving 35,6 % of people who were first-time users or had never experienced such involuntary exposure.

95,2 % of the population wants to know more about safe handling, the risks and health problems caused by these poisonings, leaving the remaining 4,8 % who are undecided and disagree with implementing educational talks.

DISCUSSION

The study found that most of the patients were male, aged in the first three decades of life, from rural areas of the Francisco de Orellana province. According to the WHO, about 703,000 people commit suicide every year by ingesting Paraquat, which is the fourth cause of death in the age group of 12 to 25 years, 70 % of these fatal accidents occur in low- and middle-income countries and most of these cases occur in rural areas of a given geographic area.

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Although the current study observed higher poisoning rates in rural areas, possibly due to the poor living conditions and low economic status of farmers, poverty and lack of employment may also be linked to suicidal tendencies in these communities.[8]

In our research, which is related to WHO studies, we concluded that most patients ingested the substance for suicidal purposes, which is consistent with the fact that around 20 % of all suicides are committed by herbicide poisoning; on the other hand, it was also discovered that there are people in the communities who have already suffered involuntary poisoning at some period of time, but these poisonings are usually mild due to the amount of the toxic ingested; the route of poisoning has a lot of influence, as most involuntary cases are through the skin.

There is a deficit of awareness programs, training, information on irrigation, prevention and good management of herbicides by the Ministry of Health, according to the results of the research by Caseley JC.,[9] which agrees that there are no social training programs on the subject, thus generating a prevalence of these cases and continuing to claim more victims in the entire population.

Regarding clinical characteristics, it was found that a large number of patients had moderately severe poisoning, with digestive involvement. In terms of the route of poisoning, the most common was oral, and no significant differences were found in this circumstance. This contrasts with what has been observed in other studies, such as that of de Ocampo Reyes, Pacheco Alaniz,[10] where it is reported that the majority of poisoned patients presented acute digestive damage after ingesting the herbicide orally.

CONCLUSIONS

There is a large lack of information on herbicides from health centers. We have implemented awareness programs on this topic, giving educational talks, handing out posters and information on the proper handling of the product, the compounds that cause damage to the body, possible involuntary poisoning and the factors that most influence suicides.

Conflicts of interest
The authors declare that there are no conflicts of interest.

Author contribution
JOFA: Conceptualization, Data Curation, Methodology, Project Management, Validation, Writing - original draft, Writing - review and editing.
JFHCh: Conceptualization, Data Curation, Methodology, Project Management, Validation, Writing - original draft, Writing - review and editing.
PEGM: Conceptualization, Formal Analysis, Research, Methodology, Resources, Software, Supervision, Validation, Visualization, Writing - original draft, Writing - review and editing.
CVHT: Conceptualization, Formal Analysis, Research, Methodology, Resources, Software, Supervision, Validation, Visualization, Writing - original draft, Writing - review and editing.

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