Journal of Forensic and Legal Medicine 56 (2018) 16–20

Contents lists available at ScienceDirect

Journal of Forensic and Legal Medicine

journal homepage: www.elsevier.com/locate/yjflm

Paraquat poisoning calls to the Malaysia National Poison Centre following its ban and subsequent restriction of the herbicide from 2004 to 2015

Yin-Hui Leong*, Adilah Mohamed Ariff, Halilol Rahman Mohamed Khan, Noor Afiza Abdul Rani, Mohamed Isa Abdul Majid

National Poison Centre of Malaysia, Universiti Sains Malaysia, 11800, Minden, Penang, Malaysia

ARTICLE INFO

Keywords:
Paraquat poisoning
Effect of ban
Demographics
Trend analysis

ABSTRACT

This study analyses the incidences and patterns of paraquat poisoning from calls received at the Malaysia National Poison Centre (NPC) since 2004 following the ban of the herbicide (2004–2006) and subsequent restriction up to year 2015. Related reported cases to the centre over twelve years (2004–2015) were retrieved and studied in respect to socio-demographic characteristics, mode and type of poisonings, exposure routes and location of incident. Ages of poisoned victims range from 10 months old to 98 years with males being intoxicated more frequently than females (ratio male to female = 2.7). The age group mainly involved in the poisoning was 20–39 years. The most common mode was intentional (62.8%) followed by unintentional (36.9%). Among the 1232 reported cases, suicidal poisoning was the highest (57.2%); accidental poisoning (30.8%) and occupational poisoning (3.3%). The findings showed an upward trend of suicidal poisoning over the years, clearly emphasizing the need for more stringent and effective enforcement to ensure the safe use of paraquat.

1. Introduction

Paraquat (1,1′-dimethyl-4,4′-bipyridinium dichloride) is a non-selective herbicide widely used worldwide since the 1960s. It was first registered in the United States (US) in 1964 and is currently approved for use in nearly 90 developed and developing countries, including Malaysia.[1] It is a fast-acting broad-spectrum contact weed-killer which is very rain fast and is deactivated on contact with soil. However, ingestion of the concentrated formulation is extremely toxic to humans with no specific antidote or effective treatment.[2] Paraquat is the most highly acute toxic herbicide and has caused more deaths worldwide than any other herbicidal agent[3] with mortality rate ranging from 60 to 70%.[4] The lethal dose (LD50) of paraquat in humans is 20–40 mg paraquat ion/kg of bodyweight, which is 5–10 mL of a paraquat product with a 30% concentration.[5] Extensive studies have shown that acute ingestion of 7–8 mL of 30% w/v paraquat causes damage to the lungs, heart, kidneys, adrenal glands, central nervous system, etc. leading directly to death[6,7] and exposure via inhalation, ocular, or skin contact can cause severe effects including pulmonary fibrosis, pulmonary edema, erythema, dermatitis, ulceration of the mouth, and brain damage.[8] In 2011, a National Institutes of Health (NIH) study found that people who use paraquat as a herbicide were 2.5 times more likely to develop Parkinson's than non-users.[9] A meta-analysis of more than 100 studies similarly found a two-fold increased risk of Parkinson's with paraquat exposure[10] while those with a certain genetic variant (individuals lacking glutathione S-transferase T1, or GSTT1) may face a particularly increased Parkinson's risk by 11-fold.[11]

Paraquat is banned in 32 countries, including the 27 countries of the European Union.[7] Paraquat is also severely restricted or restricted in at least 10 other countries, i.e. Columbia, Philippines, Indonesia, US, Sri Lanka, etc. Since 2006, Malaysia permits the sale of paraquat with reduction of the active ingredient to 13% along with several restrictions on its usage imposed by the Malaysia Pesticide Board. In this paper, we study the paraquat poisoning incidence in association with several socio-demographic factors (gender, age group, ethnicity and states in Malaysia), mode and type of poisoning, routes of exposure and other variables from poisoning calls received by the National Poison Centre (NPC) in the country from 2004 to 2015. The outcome and the impact of the Malaysian legislative change on paraquat poisoning occurrence which underwent two different phases of initial ban and subsequent reversal with restricted use are discussed.

2. Methods

2.1. Data source

The establishment of the NPC in 1994, the sole poison information centre in Malaysia, is a culmination of the Integrated Drug and Poison

* Corresponding author.
E-mail address: yinhui_leong@yahoo.com (Y.-H. Leong).

https://doi.org/10.1016/j.jflm.2018.03.007
Received 21 June 2017; Received in revised form 5 January 2018; Accepted 5 March 2018
Available online 06 March 2018
1752-928X/

Information Service (IDPIS) research activities since 1980s. IDPIS is one of the main reference point for healthcare professionals and members of the public to obtain assistance in managing poisoning cases particularly information on toxicity and poisoning risks. The NPC provides a 24/7 poisoning consultation and handles 4000–6000 poisoning and drug enquiries, mainly via telephone calls annually. The calls are from nationwide including states in East Malaysia (Sabah and Sarawak). Calls are manned by pharmacists and health scientists trained in toxicology with expert consultants available to handle more complex cases. Case details sought from the caller include the enquirer's name and organization, patient's demographic details, descriptions of the drug or poison involved, route of exposure, mode and symptoms of poisoning, treatment already provided and necessary queries about the patient. All calls to the NPC are recorded in a Voice Logging and Recording System. The recorded audio is retrievable for documentation, training, and auditing purposes. A customized web-based data entry using cloud management application is created and used for data collection and data storage. Terminology and classifications of data collection used in the NPC adheres to the INTOX tools[12] developed by the International Programme on Chemical Safety (IPCS), World Health Organization (WHO).

2.2. Data search strategy

This study is a retrospective review of poisoning cases, specifically pesticide poisoning referred for consultation to the NPC from 1 January 2004 to 31 December 2015. Records were extracted where the substance code was “paraquat” and related calls were manually reviewed for inclusion. A poisoning event sometimes prompts several calls to the NPC (e.g. a call from a member of the public, from a triage nurse, from a doctor). Subsequent calls are termed ‘Communication 2 or more’. Identified subsequent calls or duplicate cases are normally excluded after specific consideration is taken into account after which important summary of the case progression is documented.

2.3. Statistical analysis

Descriptive analyses and multiple logistic regression were performed in this study using the Statistical Package for Social Sciences (SPSS) version 18.0. The adjusted odds ratio (AOR) and 95% confidence interval (CI) were calculated to examine the association between demographic variables (gender, age group, race, states) and incident categories (unintentional vs intentional) of paraquat cases. P-value less than 0.05 was considered as statistically significant.

3. Results

For the study period (2004–2015), a total of 41,216 poisoning cases were referred for consultation to the NPC of which 11,837 cases were due to pesticide poisoning. Poisoning cases from pesticides can be grouped into five categories (Fig. 1). Among herbicides poisoning cases, paraquat was the second largest reported group after glyphosate (Table 1). The number of paraquat poisoning cases may be higher in fact as there were 663 cases where the identity of the herbicide(s) could not be confirmed. Overall, the number of paraquat poisoning cases has shown an increased trend over the 12 years (Fig. 2). A decline of 27% in 2012 is noticeable due to the six months pause of 24-h service provision by the NPC.

The general demographic characteristics of subjects involved in paraquat poisoning are shown in Table 2. Ages involved ranged from less than 1 year (10 months) to 98 years. Age group that was mainly involved in the poisoning was 20–49 years (57.2%). More males were involved than females (ratio male to female = 2.7). Among the three prime races in Malaysia, Indians accounted for most of the paraquat poisoining cases (35.6%). Most of the cases (24%) were reported from the Perak state which has extensive oil palm plantation. The common mode of poisoning (incident category) was intentional (62.8%) and unintentional (37.2%). Among the 1232 reported paraquat poisoning incidents, suicidal poisonings (under intentional poisoning category) was the highest (57.2%), followed by accidental (30.8%) and occupational (3.3%) poisonings which are classified under unintentional poisoning category. The number of suicidal poisoning was observed to have increased over the reporting years (Table 3). One abortion attempt with ingestion of paraquat is reported in this study. Almost all the cases were acute (98.8%) and chronic (0.5%), unknown (0.6%) and acute on chronic (0.1%). In general, the commonest route of exposure was ingestion (88.6%), followed by inhalation (4.8%), cutaneous (3.6%) and ocular (2.3%) routes. Less common exposure routes (< 1.0%) were via injection and mucosal. The location of incidents were mainly at home (85.5%), and only 8.2% were reported at the workplace. Location of workplace included agricultural/horticultural sites (93.1%) and factories (4%).

In the multiple logistic regression analysis (Table 4), selected study variables were assessed as predictors of paraquat incidents. Gender, age, race and states in Malaysia were adjusted for the odds ratio estimation. Gender, age and race were related significantly to the poisoning incidents. Females are 1.83 times more likely to be involved in intentional paraquat poisoning than males. Population in the age groups of 15–19 and 20–29 were found 2.35 and 1.96 times more likely to involve in paraquat cases intentionally compared to those age 60 and above. Additionally Indians and Chinese were conspicuously more involved in intentional paraquat poisoning than the Malays.

4. Discussion

From the results, preponderance of males was found to corroborate other pesticide poisoning studies.[13] In contrast, Korean females were intoxicated by paraquat more frequently than males (57.1% vs 42.9%, respectively) as has been reported.[14] In fact, there are evidence to suggest that women's occupational health risks are more likely to be under-estimated.[15,16]

In this study, the common mode of poisoning was intentional followed by accidental in consonance with other literature reports.[13,14] According to the WHO,[17] self-poisoning with agricultural pesticides is a major contributor to the global burden of suicide and it is particularly prevalent in South Asia, South East Asia and China.[18] Gunnell et al.[19] estimated that agricultural pesticides poisoning was used in approximately one-third of the world's suicides, accounting for an estimated 260,000 deaths per year. Easy availability and largely careless storage of pesticides could be responsible for poisoning in households as well as in the fields. The occurrence of suicidal poisoning due to pesticide varies considerably between regions, from 0.9% in low- and middle-income countries in the European region to 48.3% in low- and middle-income countries in the Western Pacific region.[18]

Intentional paraquat poisoning was most common in the age group of 20–29 years accounting for 191 cases (25.3%), followed by the age group of 30–39 years (21.2%) and 40-19 age group (13.5%). Commonly, intentional paraquat poisoning involved adults of working age (20–49 years). Of 1232 cases, there were 75 incidents (6.1%) involving children below 15 years and > 75% were unintentional poisoning. All of the 44 incidents involving children below the age of 10 years were due to accidental poisoning. A number of studies on childhood poisoning due to pesticides are documented.[20,21] In the study of Peshin et al.,[13] the age group mainly involved in pesticides poisoning are 18–35 years. Hwang et al.[14] reported that the mean (standard deviation, SD) age of paraquat intoxicated patients in Korea was 42.9 year (SD = 14.6).

In the present study, the highest incidence of suicide was observed among male (68.1%) and of Indian descent (56.6%). Our results showed that the ratio of suicidal poisoning in relation to men and women was 2:1 and corresponds with the national statistic showing higher ratio of suicidal behaviour in men than women.[22] Our results are also comparable with the findings by Aishvarya et al.[23] in which, the