

## A retrospective study on Agrochemical poisoning: Causes and effects

### ABSTRACT

A rise in the usage of pesticides in agriculture has coincided with an increase in the number of people who have been poisoned by them. Herbicides greater part are incessant agrochemical poisons, trailed by organophosphates. Numerous horticultural toxins, such as ethyl parathion and defoliant, have been banned in recent years. To discourage illicit use, they are combined with a coloring agent such as indigo carmine. Additionally, paraquat has a "stanching" ingredient. Organochlorines work through a completely different process. Whereas Organophosphates are anti-cholinesterase, while organochlorines are anti-cholinesterase. Meddling with the transmission of driving forces through nerve cells. Organochlorines give out a kerosene-like odor when people die. The presence of organochloride in the gut contents or offal is used to make the diagnosis. Organochlorines are resistant to putrefaction and can be identified long after a person has died. Suicidal, accidental, and homicidal poisonings have all been linked to paraquat. This poisoning is moderately caustic, and ulcers around the lips and mouth is frequent. The severe alterations in the lungs, especially after the sufferer has lived a few days, are the hallmark of paraquat poisoning. Algicides, aphicides, herbicide safeners, fertilisers, and other agrochemicals are less often seen. Most governments have enacted regulations to avoid unintentional poisonings from these substances. The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) was passed by the US government in 1962, while the Indian sovereignty proceeded The Insecticides Act in 1968. These laws, in addition via other things compel pesticide producers to include signal phrases on their labels to alert the public to their toxicity and associated dangers.

Keywords: agrochemical poisoning, pesticides, insecticides, toxicity.

### INTRODUCTION

Around 9000 BCE, early people are said to have started cultivating. In farming the chemicals used, expanded in tandem with the advancement of chemistry understanding. Synthetic substances are utilized in current horticulture for three principle reasons: to expand ranch creation (composts and related synthetics), to battle bugs (pesticides), and to save ranch items

(additives). Woefully, all three categories of actinic can lead to genuine harming in humans, owing to inappropriate labelling, depository, or utilize. The majority of pesticide poisonings occur in largely agricultural economies, where unsafe and dangerous working circumstances are created by a lack of sanitation, awareness, and proper control.<sup>(1)</sup>

Pesticide poisonings account for the largest majority of poisonings, despite the wide spectrum of chemicals used. According to the American Association of Poison Control Centers' (AAPCC) Toxic Exposure Surveillance System's 2002 annual report, there were 2,380,028 anthropoid poison subjection in the United States in 2002 alone (15). There were 96,112 pesticide submissions (4 percent of all exposures) and 10,632 fertilizer exposures (0.5 percent of all exposures), with 18 pesticide-related fatalities and one fertilizer-related fatality reported.<sup>(1)</sup>

### **Symptoms and Signs**

ACE inhibitors, such as organophosphorus pesticides, allow excess acetylcholine to accumulate at numerous nicotinic with muscarinic receptors all through significant body, together with the focal sensory system (CNS). Acetylcholine poisoning is the effect of this. MUCK (salivation, lacrimation, pee, poo, gastrointestinal pain, emesis) or DUMBELS (looseness of the bowels, pee, miosis, bronchospasm and bradycardia, emesis, lacrimation, salivation) are two abbreviations that can be utilized to recall the significant indications. Since a breakdown in porphyrin digestion and its development in the lacrimal organs, chromolachryorrhoea (crying of red or ridiculous tears) happens only sometimes. LD50 (lethal dosage; the amount of a substance required to kill a person) substance that kills 50% of a group of test subjects when given all at once. The toxicity of these chemicals in animals ranges from 1 to 50 mg/kg (severe pernicious) a concentration of greater than 5000 mg/kg (slight toxicity). Mixtures with a high harmfulness are chlorfenvinphos, diazinon, and methyl parathion, the above mentioned that aren't are chlorfenvinphos, diazinon, and methyl parathion. Malathion, acephate, and trichlorphon are all somewhat poisonous.<sup>(1)</sup>

**External findings:** In lethal intoxications with organophosphorus pesticides, signs of suffocation are typical. The face is congested, and the lips, nose, fingers, and acral regions of the extremities are cyanosed. The odor spread out from the body has been portrayed like garlic-or lamp oil like, with it is attributable to the way that organophosphates are disintegrated on a lamp oil substrate.. The lips and nostrils are frequently stained with frothy,

red stains, and the pupils may be constricted. To prevent parathion (E605®) from discolouring, a colouring ingredient called indigocarmine is applied. Accidentally ingesting it or using it as a poison in a criminal act. The lips and oral mucosa become bluish greenish in hue as a result of this. The use of indigo carmine, on the other hand, is not universally accepted. In India, for **example, this tradition** is not observed in China or numerous other Asian countries. A fascinating topic. The presence of a sign (albeit in less sophisticated mortuaries) is worth noting. Bluebottles and other insects, as well as flies, die quickly after being stung. At an autopsy, alight on a cadaver that has been opened.<sup>(1)</sup>

**Internal findings:** Aggravation of gastric mucosa is seen and it might also seem haemorrhagic, and the stomach substance are oftentimes shrouded in a sleek, greenish filth. The mucus sheet of the respiratory system is clogged, and frothy haemorrhagic exudate fills the airway channels. Congestion, haemorrhagic pulmonary oedema, and subpleural petechiae might be seen in the lungs. The brain is bloated, and there is visceral congestion all everywhere.<sup>(1)</sup>

**Post-mortem biochemistry:** Organophosphorus pesticides bring down the degrees of AChE and butyrylcholinesterase (BChE, otherwise called pseudocholinesterase or type 2 ChE). The appraisal of their levels can help in an assortment of ways. The process of determining the principle of demise. AChE is primarily prevalent in red blood cells. Whereas BChE is usually found in cells, motor endplates, and grey matter, Plasma, white matter, liver, heart, and pancreas are some of the organs that are affected. The physiological role of the BChE's function is uncertain, but it is known that it hydrolyzes succinylcholine, hence it is of interest to anesthesiologists.<sup>(1)</sup>

### **Histopathology findings:**

The straight portions of the renal tubules of the kidneys have epithelial necrosis. Plasma granulation, hyperchromatosis of the nuclear wall, chromatin clumping, and a reduction in marginal nucleoli can all be seen in the epithelia of the remaining renal cortical sections. Henle loop epithelia and collecting tubule epithelia seem enlarged.<sup>(1)</sup>

### **Organochlorine poisoning**

Nonselective insecticides are organochlorine pesticides. With molecular weights ranging from 300 to 550 D, CNS agonists, and moderate volatility, they're cyclic in nature.<sup>(1)</sup>

## Signs and symptoms

Organochlorines have a completely different mode of action than organophosphates and carbamates. Organochlorines impact sodium channels with sodium conductance across neuronal layers through following up on axonal layers. Organochlorines also affect acetylcholine, noradrenaline, and serotonin metabolism. The aminobutyric acid-mediated chloride channels in the CNS appear to be inhibited by lindane and cyclodienes. As a result, therefore, it's not unforeseen that the significant side effects of organochlorine harming are CNS-related, like dizziness, confusion, shortcoming, disturbance, and hyperesthesia or paraesthesia of the lips and face.<sup>(1)</sup>

## Post-mortem findings

**External findings:** The pupils are dilated and the conjunctivae are congested. A kerosene-like odour might be coming from the mouth and nose. This is due to the fact that Most organochlorines are water insoluble and must be dispersed while solutions in organic solvents with a kerosene-like odour. Fine white foam around the lips and nostrils, which may or may not be haemorrhagic, is a typical sign of pulmonary oedema paired with respiratory distress, and cyanosis can be noticed on the face, ears, nail beds, and other regions.<sup>(1)</sup>

**Internal findings:** The respiratory mucosa seems clogged, and the respiratory passageways are filled with effervescent mucus that may or may not be stained accompanied by blood. Petechial haemorrhages in the subpleural and sub pericardial spaces are frequent. Pneumoedema is seen in the lungs, which seem big and bulky. Organochlorines irritate the gastrointestinal system, causing congestion in the mucosa of the oesophagus, stomach, and colon. The stomach contents have a kerosene-like odour to them. The visceral organs are swollen and clogged. On sliced portions of the liver, hepatic necrosis can be seen.<sup>(1)</sup>

## Researches and facts

As of October 2019, 318 pesticides were enlisted for use in India, 18 of which were very (Class IA) or exceptionally (Class IB) dangerous, as per WHO poisonousness measures. Several prohibitions were enacted throughout the study period, despite the fact that several very dangerous chemicals were still available. We zeroed in our quantitative examinations on long-lasting boycotts in Kerala (of endosulfan) and across the country (of 14 different synthetic compounds) in 2005 and 2011(of endosulfan). Pesticides were used in 441,918

recorded suicides in India between 1995 and 2015, according to NCRB statistics, with 90.3 percent of those occurring in 11 of the 29 states. After the 2011 endosulfan boycott, Pesticide suicides (RR 0.52, 95% CI 0.49–0.54) and all out suicides broadly (0.90, 0.87–0.93) were measurably lower than anticipated. After the 2011 ban of 14 pesticides, there was a under the anticipated incidence of pesticide suicides (0.45, 0.42–0.49) in Kerala, but no change in the already falling trend in overall suicides (1.02, 1.00–1.05). In 2010, the endosulfan ban had a similar effect: pesticide suicides were fewer than predicted (0.79, 0.64–0.99), be that as it may, there was no adjustment of the declining pattern of in general suicides (0.97, 0.93–1.02). Following the restrictions, there was no sign of a drop in horticultural yield.<sup>(2)</sup>

### **Post-mortem Findings of organophosphorus poisoning due to organophosphorus insecticides**

Population-based studies have found possible links between organophosphorus pesticide exposure and serious health effects such as cardiovascular disease, negative effects on the male reproductive system and nervous system, dementia, and an increased risk of non-lymphoma Hodgkin's.

Furthermore, prenatal organophosphate exposure has been linked to shorter gestational periods and neurological abnormalities in offspring.<sup>(3)</sup>

DDT is still used or is being reintroduced in a few countries for public health reasons. DDT is also utilised as a solution in a variety of solvents. It's a common chemical, and it's thought that every living thing on the planet has a DDT body load, which is mostly deposited in fat. DDT with its metabolite p,p-dichlorodiphenyldichloroethylene (DDE) have also been shown to have endocrine disrupting and carcinogenic properties. DDT and DDE exposure in pregnancy has been linked to neurodevelopmental consequences in offspring. Furthermore, DDE has been linked to hepatic lipid abnormalities in rats in a recent research.<sup>(3)</sup>

One of the most prevalent ways for people to commit suicide is Pesticide self-poisoning, according to the World Health Organization. Through improved pesticide control, it is also the most avoidable way of suicide. 1 Despite a drop in pesticide poisoning deaths from about 260 000 to 160 000 per year over the last two decades, more than 150 000 persons die each year from purposeful pesticide consumption, accounting for around 20% of the worldwide suicide burden. 2 The decrease in fatalities is thought to be attributable to tighter regulations

and greater **agricultural mechanization**, which has resulted in a reduction in the number of agricultural employees.<sup>(4)</sup>

### **Cases of acute pesticide poisoning in children**

Acute pesticide poisoning (APP) has as of now been recognized as a significant issue in Tanzania, just as in other creating and created countries. According to the World Health Organization (WHO), environmental factors account for approximately 30% of the worldwide burden of disease in children, with pesticides being a major contribution. Different examinations from South Korea, South Africa, Canada, Turkey, and India have tracked down proof of APP in kids. Pesticides were shown to be responsible for around 35 percent of instances of childhood poisoning in South Africa and 47 percent in Canada in 2007. Pesticide drift and unattended empty pesticide containers are two more probable causes of exposure in this age group. At the point when pesticides are available in the groups of pregnant and breastfeeding moms, their children and babies might be presented to them through in-utero placental exchange. Youngsters may likewise be presented to pesticides through unsafe kid work, like showering pesticides in the field, cleaning their folks' defiled work clothing, or getting back to the fields to work in the wake of splashing. If young children follow their parents to work, they may be exposed to pesticide as a result of maternal employment with it.<sup>(5)</sup>

### **Clinical Consequences**

The significant variance in mortality between OP and carbamate insecticides implies that toxicokinetics and/or dynamics differ for chemicals that are typically treated in the same way [16]. Significant variation within a toxicological class has clinical consequences, such as the requirement being a more sophisticated risk assessment for solitary patients and even unique treatment procedures for particular drugs. Previous research on the relative toxicity of only three OP insecticides (chlorpyrifos, dimethoate, and fenthion) revealed significant differences in toxicity time, pesticide kinetics and dynamics, and mechanism of death. Previous research on the corresponding toxicity of only three OP insecticides (chlorpyrifos, dimethoate, and fenthion) revealed significant differences in toxicity time, pesticide kinetics and dynamics, and mechanism of death. Clinicians will be able to better triage and manage patients if they have a better knowledge of the variables that are linked to greater mortality. While this study

only looked at variations in case fatality, additional research is needed to learn more about the clinical course of high-risk poisoning.<sup>(6)</sup>

Based on a conservative data from 108 different countries it is evident that Between 2010 and 2014, Every year, over 110,000 people die from pesticide poisoning, accounting for 13.7 percent of all suicides worldwide. A sensitivity research that takes into account India's under-reporting of suicides yielded a higher estimate of 168,000 pesticide self-poisoning fatalities each year, or 19.7% of all suicides globally. Suicides caused by pesticide self-poisoning account for 0.9 percent of all suicides in low- and middle-income countries in Europe and 48.3 percent in low-and center pay nations in the Western Pacific.<sup>(7)</sup>

### **Retrospective study**

Intentional poisoning was the most prevalent method of poisoning (64.60 percent), followed by accidental poisoning (34.40 percent), and unexplained poisoning (0.40%). (1 percent). Rodenticides (17.06 percent), organophosphates (6.26 percent), carbamates (4.95 percent), and others got the most calls among family pesticides (26.23 percent) (4.86 percent). In the horticultural pesticides classification, organophosphates (9.79%) were the most well-known, trailed by aluminum phosphide (9.65%), organochlorines (9.31%), pyrethroids (3.87%), herbicides, weedicides, and fungicides (3.20%), ethylene dibromide (2.82%), and others (1.70 percent). The data analysis shows that residential pesticide poisoning is more common than agricultural pesticide poisoning, emphasising the significance of boosting public awareness and teaching people about safe pesticide use and prevention programmes.<sup>(8)</sup>

A total of 141 nations were covered, with 157 publications covering 58 of them and statistics from the WHO Mortality Database covering another 83. The recovered papers announced around 740,000 yearly instances of UAPP, with 7446 passings and 733,921 non-lethal cases. On this premise, we gauge that around 385 million occurrences of UAPP happen worldwide every year, with roughly 11,000 passings. In light of a worldwide cultivating populace of around 860 million, pesticide harming influences around 44% of ranchers every year. In terms of non-fatal UAPP, southern Asia has the highest estimated number of cases, followed by south-eastern Asia and east Africa.<sup>(9-15)</sup>

## **Case fatality of agricultural pesticides**

As per a review, harming killed 2299 patients (66%). Case casualty rates went from 0% (many medications) to 418 percent (paraquat). Between 2008 and 2011, the three most hazardous substances (paraquat, dimethoate, and fenthion) were prohibited. Since 2013, the five most lethal agents (profenofos, propanil, fenobucarb, carbosulfan, and quinalphos) have had a patient casualty pace of 72%–86%. Overall case mortality from pesticide poisoning has decreased steadily (from 105 percent in 2002–06 to 37 percent in 2013–19), owing primarily to pesticide restrictions. There was also a slight decrease in case fatality for non-banned insecticides.<sup>(4)</sup>

The decrease in case deaths from non-banned pesticide poisonings suggests that medical care has improved over time. Pesticide danger classifications and regulation should be based on human evidence on acute toxicity. We think that a global standard for pesticide registration should comprise a case fatality rate of less than 5% following self-poisoning, which would avoid numerous lives and have a significant impact on worldwide suicide rates.<sup>(4)</sup>

## **Retrospective study**

Another retrospective study shows that, The most normal reason for harming in grown-ups were pesticides, with a 63 percent (95 percent CI 63 percent to 64 percent) incidence, while random specialists were the most well-known reason for harming in youngsters, with a 45.0 percent (95% CI 43.1 percent to 46.9 percent) frequency among those introducing to clinics. Pesticide harming was generally normal in North India (79.1%, 95% CI 78.4 percent to 79.9%), trailed by South (65.9%, 95% CI 65.3 percent to 66.6 percent), Central (59.2%, 95% CI 57.9% to 60.4 percent), West (53.1 percent, 95% CI 51.9 percent to 54.2 percent), North East (46.9%, 95% CI 41.5 percent to 52.4 percent), and East (46.9%, 95 (38.5 percent , 95% CI 37.3 percent to 39.7 percent ). Poisoning from pesticides is the most prevalent kind of poisoning in adults, whereas poisoning from various agents is the most common cause of poisoning in children.<sup>(10)</sup>

## **Conclusion**

This review article demonstrates various aspects and types of agricultural poisoning along with the post-mortem findings. Various statistics in respect to different countries along with

facts involved are discussed. Certain retrospective studies are also discussed to provide an overview and knowledge of the topic.

#### **COMPETING INTERESTS DISCLAIMER:**

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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