

PESTICIDE POISONING IN HUMANS

Pages with reference to book, From 251 To 255

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The ever increasing demand for more food production has been met by adoption of better crop protection measures. Since world war II synthetic chemicals/poisons have been extensively used for the control of agricultural as well as household and medical insect pests. These poisons which otherwise are employed for human benefit can also be called as economic poisons. Pesticides used for the control of different insect pests are the major component of such economic poisons.

Genocide - Terminal / Fatal

Suicide - High doses — Terminal / Fatal, Occasionally

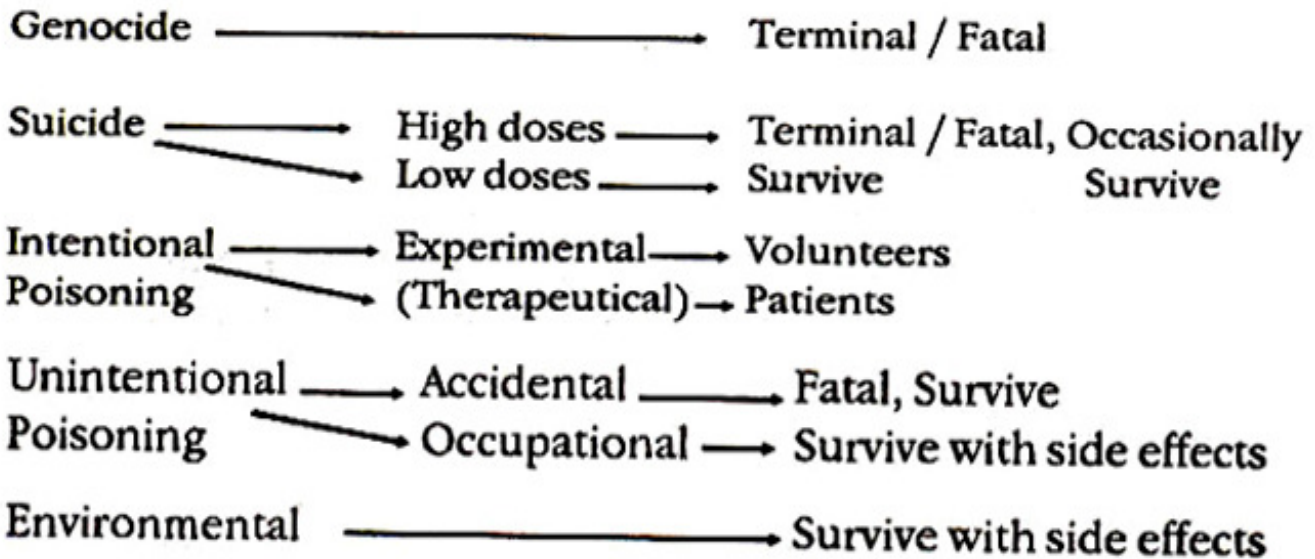
Low doses Survive Survive

Intentional - Experimental— Volunteers

Poisoning— (Therapeutical)- Patients

Unintentional Accidental Fatal, Survive

Poisoning — Occupational Survive with side effects



Environmental Survive with side effects

There is general concern on environmental pollution and the chronic effects of pesticides. It is impossible in today's society to avoid some sort of direct or indirect exposure to these chemicals. Contaminated diets are the main concern of the present day man throughout the world. The pesticides are used in one part of the world and then contaminated grains shipped and exported to the other part of globe. Similarly within a country the translocation of the food items (vegetables, fruits and grains) is on a massive scale. For example, survey of vegetables from markets far away from vegetable growing areas in Pakistan has revealed the presence of pesticide residues in many cases. Likewise the pesticides applied to crops can enter into the produce which when consumed by livestock can build up in milk and meat, eventually transferred into the human body. Moreover, contaminated raw vegetables and fruits can also be a source of pesticide residues found in human tissues.

The entry of these pesticides in the body is by three routes, firstly oral (ingestion or drinking), secondly dermal (through the body contact) and thirdly inhalation (fumes). Individuals exposed to pesticides can be categorized into two major groups, i.e., high and low risk' groups (Table I).

TABLE I.

High risk group.	
1.	Manufacturers (especially factory workers)
2.	Packers
3.	Transporters
4.	Neighbours (where pesticides are manufactured, stored and applied)
5.	Farmers/sprayers
Low risk group.	
1.	People who consume contaminated or treated food.
2.	People who are in the vicinity and may come in contact by accident.

PESTICIDE CATEGORIES

These could include insecticides (used for the control of agricultural, medical veterinary and household insect pests), fungicides (used for the control of various fungal diseases), acaricides (used for the control of mites), rodenticides (used for the control of rodents), nematicides (used for the control of nematodes) and herbicides (used for the control of weeds). Whereas in the world herbicide comprise 56% of the total pesticides used, the situation in Pakistan is entirely different. In Pakistan almost 85% of all pesticides used are insecticides, followed by 6-7% of fungicides and herbicides. The insecticides can further be classified into four major groups or classes. First and the foremost is the persistent class of organochlorine. DDT, BHC, Dieldrin are the famous insecticides belonging to this class.

Organophosphorus insecticides are the other major group. These are less persistent and their primary mode of action is on the nervous system mainly inhibiting the acetyl cholinesterase enzyme. Malathion, methylparathion, diazinon, endosulfan, dimethoate, chlorpyrifos, monocrotophos are some of the important members of this class. Third group is carbamate insecticides based on the carbamic acid. The most recently developed and least persistent of these insecticides belong to pyrethroids which are derived from the chrysanthemum. In addition to the natural group of insecticides collectively called pyrethrins some synthetic pyrethroids are also available in the market. Cypermethrin, deltamethrin and fenvalerte insecticides available in Pakistan belong to this class. These insecticides have quick knock-down effects and are most commonly used against the flying insects (e.g., as aerosols for the control of household insects like flies, mosquitos, etc.). Herbicides usage in Pakistan is increasing and hence posing a direct or indirect danger to our community. Paraquat, diquat, diuron, metametron, phosalon, atrazine, 2,4-D and 2,4-T are the major herbicides in use. Similarly zinc phosphide, aluminium phosphide, warfarin, racumin, bromodialone, brodifacoum and strychnine are major pesticides used for the control of vertebrate pests.

PESTICIDE POISONING

Extensive, ill planned and improperly applied pesticides can pose danger to our ecosystem. These can be source of our food chain pollution and a possible health risk. Although whole world is concerned about the problems due to excessive use of pesticides, but situation in developing countries is alarming as compared to developed countries. Survey of acute poisoning among agricultural workers in four Asian countries revealed organophosphate compounds to be mostly responsible for poisoning². The pesticide poisoning in Malaysia was 53.6% of the total poisoning cases registered, in Sri Lanka 69.1%, in Thailand 22.7% with organophosphate insecticides and 25% with bipyridyls. In Indonesia copper

compounds were responsible for 23.4% of the cases and organophosphorus insecticides for 17.8%. In Afghanistan overall mortality rate was 6.2% due to accidental poisoning among children, organophosphorus insecticide poisoning alone was responsible for 50% of total deaths³.

PESTICIDES RESIDUES IN HUMANS

Organ chlorine residues are detected in measurable concentrations in various tissues of human beings because of the worldwide pollution of air, water, soil and foods. The concentrations vary from region to region according to chemical, climatic, socio-economic and geographic factors. Polluted air is carried over huge distances⁴ and some chemicals are found almost worldwide, e.g., hexachlorobenzene (HCB), which has been used as fungicide and is mainly emitted by chemical industries now⁵. In a study conducted in Karachi area by Mughal and Rehman⁶ more than sixty samples of human adipose tissue from the general population were analyzed for chlorinated compounds by colorimetric and chromatographic procedures. The average level of total DDT-equivalent was 25 ppm, total benzene hexachloride (BHC) was 0.48 ppm and dieldrin was 0.047 ppm. Values varied widely and the frequency distribution was positively skewed. The tendency towards lower concentrations in females was due, perhaps, to their greater fatty pool distribution of residues. The concentration of p,p -DDD, an intermediary of DDT metabolism, was definitely higher in autopsy as compared to biopsy material due, probably, to post-mortem anaerobic microbial metabo Krawinkel⁷ conducted a survey monitoring the organochlorine concentrations in human blood and fat tissue of patients of the Sandeman Provincial Hospital in Quetta, Balochistan (Table II).

TABLE II. Median maximum levels of chlorinated hydrocarbons in blood and fat tissues in Quetta and West Germany (ug/l).

Pesticide		Blood		Fat tissue	
		Quetta	W. Germany	Quetta	W. Germany
4,4 -DDT	Median	0.61	0.13	0.87	0.09
	Maximum	4.83	0.38	10.10	0.42
4,4 -DDE	Median	8.58	2.40	4.76	0.90
	Maximum	32.61	6.50	81.83	4.30
a-HCH	Median	0.08	0.004	0.06	0.002
	Maximum	1.88	0.018	4.08	0.035
B-HCH	Median	1.39	0.33	0.89	0.13
	Maximum	6.05	1.70	21.05	0.40
r-HCH	Median	0.29	0.035	-	0.005
	Maximum	0.56	0.31	0.42	0.27

Data source: Krawinkel et al. (1989).

Results of the analysis for HCH, DDT and DDE showed that there is a great range of interindividual differences whereas the HCH- and DDT/DDE- values each are concordant in the individual samples; probands with high concentrations of DDT/DDE in blood also have higher levels of DDT/DDE in fat tissues, high levels of DDT are associated with high levels of DDE. The concentration of pesticide-residues was not correlated with age or sex of the patients. The role of organochlorines as pathogenic agents is questioned as no obvious symptoms of chronic intoxication of man have been reported excluding all other pathogenetic impacts. Pesticide residues in man extremely vary from country to country, even from region to region^{6,9,12}. Krawinkel⁷ further observed that except the median for r-HCH in fat tissue the median concentrations of all pesticides are much higher in Quetta than in

Germany. The fact that no HCB was detected in any sample from Quetta is interesting. HCB is not applied locally and the global spread of HCB in the air alone does not cause a contamination of human blood and fat tissue as it could be suspected from the findings of other investigators¹³. Farvar¹⁴ reported that in 1970 in rural areas of Guatemala, where DDT spraying for malaria control has been carried on for some fifteen years, total DDT in human mother's milk was found to be from 0.3 to 12.2 ppm. These figures suggest that Guatemalan infants were drinking from the breast at least 15 and perhaps nearly 500 times more than the acceptable daily intake of DDT established by the World Health Organization. Iranian samples of human milk obtained from areas sprayed by malaria eradication teams showed DDT concentrations of 0.4 to 2.5 ppm, which is 8 to 50 times higher than the permitted levels in cow's milk sold in the United States¹⁵. In 1976 an epidemic of poisoning due to water-wettable powder of malathion occurred among 5,350 spraymen.

OCCUPATIONAL POISONING INCIDENTS

In, 1970 mixers and 1,070 supervisors in malaria control programme in Pakistan. During the entire epidemic there were five deaths, but they occurred before special study began and details were not available. Three brands of malathion were in use which differed substantially in (a) toxicity to rats, (b) content of isomalathion and (c) the degree of inhibition of cholinesterase produced in spray men who applied them. Elimination of use of two more toxic preparations and special instructions on proper safety measures halted the epidemic. A major poisoning accident occurred in Multan in 1972 when workers with improper clothing were unloading a consignment of phorate under extreme summer conditions became ill and seven of them died. In the other instance survey of 200 employees of the Department of Plant Protection, associated with the flying and engineering unit of their aerial section, for cholinesterase activity in their blood showed that nearly 50% of them possessed low enzyme activity¹⁶.

ACCIDENTAL POISONING INCIDENTS

The examples of accidental pesticide poisoning around the world are innumerable. In Pakistan there is lack of scientific information on the subject. Except the following reported cases most cases appear as reports in the press which need verification before acceptance and quotation. In summer of 1984 an epidemic of endrin poisoning occurred in Talagang District Auock. Acute convulsions were recorded in 194 affected persons in 18 villages. 70% cases were in the children of 1-9 years of age. Nearly 10% (19 out of 194) patients died. The epidemiology of the Talagang outbreak suggested that a shipment of food (possibly sugar) was contaminated en route to the city¹⁷. Some simple reported examples from throughout the world¹⁸ show how vulnerable and at what risk we are. For example a man ate food accidentally seasoned with as much as 15-30 ml of a powder allegedly mistaken for monosodium glutamate later identified as lindane (rBHC). Four members of a family were poisoned after they have treated their living quarters by heating a pesticide dust on a hot plate. There was only one application. The symptoms of poisoning appeared six months later. The wife of an agricultural scientist used a small amount of a 10% granular formulation of aldicarb to treat the soil around rose bush at her home. Twenty-four days later, she showed the symptoms of poisoning after eating the 4 to 6 terminal leaves of a mint plant growing nearby to the rose bush. More than 150 school boys had to be treated for poisoning when they entered the cornfield near their school which had been sprayed with pesticides the previous day. The tragedy of Bhopal in India is still fresh in our minds. More than 2,000 people died after exposure to the fumes of methyl isocyanate gas leaked from the pesticide manufacturing plant of union carbide.

PESTICIDE TOXICITY, SYMPTOMS AND TREATMENT

TABLE III. Pesticide tolerance limits in man.

Pesticide	Rats oral LD 50 mg/kg	Man max.* tolerance mg/man/day for n-days	Accidental and** international poisoning but recovered mg/kg	Safe occupational intake limit mg/kg/day
Aldicarb	0.8	-	0.05	-
Atrazine	3000	-	-	1.4
Azinphosmethyl	11.16	20,20	-	0.03
BHC	88.200	-	86	0.07
Captan	17,000	-	-	0.07
2,4-D	390-1000	5,1	100	1.4
DDT	500-2500	1400,1	1500	-
Dieldrin	38-47	-	120	0.0175
Malathion	1000	16,47	1000	-
Methyl bromide	56.64	600,1	328	8.6
Parathion-methyl	14.5	22,28	-	0.029
Paraquat	100-150	-	100	0.014
Phosalone	35	14,1 hour	-	-
Phosphine	8.9	-	100	0.057
Pyrethrum	500-900	0.75%	Face covered with patchtest powder	0.7
Toxaphene	69-240	70,10	10	0.07

*Applied doses with no visible ill effects.

**Acute exposure; the amounts in body not known.

Toxicity rating (LD50-mg/kg)

Highly toxic 2

Moderately 50-200

Less toxic 500

Data source: Hayes (1982)

Table III gives the amount of pesticide which was either accidentally consumed and the patients survived or deliberately given to volunteers and no ill-effects were observed. It also gives the values or limits which are supposed to be safe for the pesticide workers. Of course individuals would differ in susceptibility.

TABLE IV. Effects and symptoms of accidental or intentional pesticide poisoning.

Pesticide	Symptoms	Treatment
Aldicarb	Nausea, vomiting, diarrhoea, involuntary urination, pinpoint pupils, muscle fasciculations and troubled breathing	Atropine
Atrazine	Dermal contact of blisters, pain, swelling and redness	Codeine, prednisone and application of 0.25% acetic acid
Azinphos-methyl	Headache, tightness in chest excess salivation, vomit, blurred vision	Artificial respiration, atropine, pralidoxime chloride, decontamination of body
BHC	Malaise, faintness, dizziness, collapse, convulsions, foaming, mouth biting, nausea and vomiting	Fits controlled by barbitu and sedative
Captan	Urticaria and eczema	Symptomatic if needed
2,4-D	Deep coma with muscle hypotonia, relaxation of sphincters, loss reflexes, hypotension, impairment of memory and change in colour visions	Garlic lavage, symptomatic of treatment, diaeresis and quinidine sulfate
DDT	Perspiration, headache, vomiting, hyperesthesia of mouth and lower part of face, dizziness, objective disturbance of equilibrium, tremor of extremities, confusion, malaise, fatigue	As for BHC
Dieldrin	Convulsion, rise in body temperature	Chlorpromazine, phenobarbital, chloral hydrate
Malathion and parathion-methyl	Unconsciousness, marked flaccidity of limbs, convulsions, prolonged, sometimes gradual worsening illness in the absence of initial, anoxic brain damage	As for azinphos-methyl
Methyl-bromide	Malaise, headache, visual disturbance, nausea, vomiting, later CNS manifestation including numbness ataxia, tremor, myoclonus, exaggerated deep reflex, convulsions	Diazepam, clonazepam
Paraquat	Facial paralysis, absence of abdominal reflexes, anorexia, chest pain, jaundice, tachycardia and myocarditis	No specific treatment, forced diuresis, gut lavage
Phosalone	Inhibition of plasma cholinesterase	As for malathion
Phosphine	Saver susternal and upper abdominal pain, intolerable burning sensation of body, vomiting and loss of consciousness	Resuscitation, massive garlic lavage using solutions of potassium permanganate and magnesium sulfate
Pyrethrum	Pallor, intermittent convulsions and vomiting	Syrup of ipecac
Toxaphene	Nausea, mental confusion, jerking of arms and legs, convulsions	Symptomatic treatment, mannitol, metachloramide, diazepam

Table IV gives the symptoms which appeared after accidental or intentional exposure to larger amounts of pesticides. The treatment given is the one which was administered to these individuals and they recovered. In addition to the medical symptoms the laboratory studies on rats and other primates have shown that long term exposure to pesticides can lead to mutagenic, teratogenic, carcinogenic and

hepatotropic effects.

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