SYMPTOMATOLOGY OF DETRIMENTAL EFFECTS OF PESTICIDES – LITERATURE REVIEW

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SUMMARY – Farm workers chronically exposed to low levels of pesticides seldom show signs and symptoms of clinical significance. Pesticide poisoning can be acute and chronic. The primary targets of toxicity are the hematopoietic system, the cardiovascular system, the reproductive system and the nervous system. Pesticides can cause gene mutations and chromosomal aberrations in exposed individuals. Mild temporary symptoms of poisoning including headache, nausea, vomiting, dizziness, diarrhea, abdominal pain, myalgia, salivation, mental confusion, fatigue, etc., may quite frequently occur. It is essential to recognize detrimental effects of pesticides timely, thus enabling the earliest possible administration of appropriate treatment.

Key words: Pesticides – adverse effects; Pesticides – toxicity; Agricultural Workers Diseases – poisoning; Occupational Exposure – adverse effects

Introduction

Pesticides have been used daily for plant protection in rural areas. Besides their protective effect for the plants, they also have detrimental effects for animals and humans, especially if used inappropriately. There is a number of clinical statuses and symptoms associated with pesticide poisoning, accompanied by other vagal symptoms such as instability, fatigue, nausea, vomiting, headache, abdominal pain, myalgia, etc.1,2. When suspecting pesticide poisoning, a wide diagnostic work-up is to be done, including complete blood count, blood biochemistry, urine tests, esophagogastroscopey and ultrasound of the abdomen in case of gastric discomforts, x-ray, pulmonary function tests, electrocardiography in case of respiratory and/or cardiac problems, neural conductivity tests and magnetic resonance of the brain if required, Rey-Kim memory test, Mini Mental State Examination (MMSE), and in some cases psychoanalytical tests3,4. Exposure to pesticides causes numerous side effects that often proceed unnoticed or are related to other possible causes. Here is a review of the literature on pesticide detrimental effects.

Review of the Literature

We performed a systematic review of peer-reviewed publications identified through MEDLINE databases (searched through May 2007). The search term was pesticide, and the search was limited to clinical trials and articles in English. The search was extended by review of bibliographies from pertinent original reports of data and review articles. Unpublished trials and data presented only in abstract form were not included. Authors very often report numerous associated detrimental effects manifested by a number of symptoms such as malaise, weakness, abdominal pain, headache, dizziness, tightness, leg and back pain, anemia, nausea, vomiting, dizziness, blurred vision, tachycardia, tachypnea, salivation, miosis, elevated blood pressure, fasciculation, lethargy, etc. (Table 1).
Table 1. Symptoms noticed by clinicians as related to pesticide exposure

<table>
<thead>
<tr>
<th>Study author(s)</th>
<th>Pesticide</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ferraz et al.⁷</td>
<td>fungicide maneb*</td>
<td>plastic rigidity with cogwheel phenomenon, headache, fatigue, nervousness, memory complaints, sleepiness, postural tremor, cerebellar signs, bradykinesia</td>
</tr>
<tr>
<td>Youssef et al.⁷</td>
<td>ivermectin</td>
<td>fever, headache, weakness, nausea, epigastric pain, with no adverse physical or laboratory findings</td>
</tr>
<tr>
<td>Shenoy et al.⁸</td>
<td>ivermectin and diethylcarbamazine</td>
<td>fever, myalgia, headache, lethargy</td>
</tr>
<tr>
<td>London et al.⁹</td>
<td>organophosphate</td>
<td>dizziness, sleepiness, headache and a higher overall neurological symptom score</td>
</tr>
<tr>
<td>Parrón et al.¹⁰</td>
<td>pesticides in greenhouses</td>
<td>spontaneous abortion, depression, headache, tremor, paresthesia</td>
</tr>
<tr>
<td>Acuna et al.¹¹</td>
<td>methyl bromide</td>
<td>insomnia, headache, paresthesia, mood changes and loss of memory and concentration</td>
</tr>
<tr>
<td>Moulia-Pelat et al.¹²</td>
<td>ivermectin</td>
<td>myalgia, arthralgia, headache, asthenia, anorexia, vertigo, chills</td>
</tr>
<tr>
<td>Coutinho et al.¹³</td>
<td>ivermectin</td>
<td>fever, headache, weakness, myalgia</td>
</tr>
<tr>
<td>Misra et al.¹⁴</td>
<td>organophosphate pesticides</td>
<td>cognitive dysfunction</td>
</tr>
<tr>
<td>Ducorps et al.¹⁵</td>
<td>ivermectin</td>
<td>fever, pruritus, headache, arthralgia</td>
</tr>
<tr>
<td>Bauer et al.¹⁶</td>
<td>mercury and mercuric chloride</td>
<td>headache, nausea, mucosal irritation</td>
</tr>
<tr>
<td>Eysseric et al.¹⁷</td>
<td>chlorate poisoning</td>
<td>respiratory failure, vomiting, headache, stupor, arterial hypotension, cyanosed face and limbs, acute hemolysis, methemoglobinemia</td>
</tr>
<tr>
<td>Burgess¹⁸</td>
<td>phosphine-metamphetamine laboratory</td>
<td>dizziness, cough, headache, diarrhea</td>
</tr>
<tr>
<td>Panj et al.¹⁹</td>
<td>diethylcarbamazine-ivermectin</td>
<td>fever, headache, myalgia</td>
</tr>
<tr>
<td>Chodorowski et al.²⁰</td>
<td>finofrile</td>
<td>headache, nausea, vertigo, weakness</td>
</tr>
<tr>
<td>Yang et al.²¹</td>
<td>copper sulfate</td>
<td>gastrointestinal injury, hemolysis, methemoglobinemia, hepatorenal failure, shock</td>
</tr>
<tr>
<td>Satar et al.²²</td>
<td>carbofuran</td>
<td>nausea, vomiting, headache, weakness, dizziness, blurred vision, tachycardia, tachyphnea, salivation, miosis, elevated blood pressure, fasciculation</td>
</tr>
<tr>
<td>Abue Mourad²³</td>
<td>organophosphorus insecticides</td>
<td>eyes/face, itching/skin irritation, chest symptoms, increased leukocyte and platelet counts, decreased hemoglobin</td>
</tr>
<tr>
<td>Lu²⁴</td>
<td>pesticide</td>
<td>eye itchiness and blurring of vision, dizziness, headache, respiratory inhalation-vapors and mists</td>
</tr>
<tr>
<td>Ernstgard et al.²⁵</td>
<td>hexanal vapors</td>
<td>discomfort in the eyes and nose, solvent smell, headache</td>
</tr>
<tr>
<td>Guinay et al.²⁶</td>
<td>copper poisoning</td>
<td>malaise, weakness, abdominal pain, headache, dizziness, tightness in the chest, leg and back pain, anemia</td>
</tr>
</tbody>
</table>
Table 2. Incidence of particular symptoms in poisoning with certain pesticides

<table>
<thead>
<tr>
<th>Study author(s)</th>
<th>Pesticide</th>
<th>Incidence of particular symptoms</th>
</tr>
</thead>
</table>
| Agarwal\(^{22}\)       | organophosphorus poisoning       | vomiting 96.8%  
                        |                                                  | nausea 82.1%  
                        |                                                  | miosis 64.2%  
                        |                                                  | excessive salivation 61.1%  
                        |                                                  | blurred vision 54.7%  
                        |                                                  | giddiness 93.7%  
                        |                                                  | headache 84.2%  
                        |                                                  | disturbances of consciousness 44.2%  
                        |                                                  | sinus tachycardia 25.3%  
                        |                                                  | sinus bradycardia 6.3%  
                        |                                                  | depression of ST segments with T-wave inversion 6.3%  
                        |                                                  | hypertension 10.5%  
                        |                                                  | muscular twitching 2.1%  
                        |                                                  | albuminuria 12.6%  
                        |                                                  | azotemia 18.9%  
                        |                                                  | inhibition of acetylcholinesterase enzyme activity 78.9%  |
| Neuberger et al.\(^{23}\) | dioxin                           | sleep disturbance 44%  
                        |                                                  | headache 32%  
                        |                                                  | neuralgia 30%  |
| Gomes et al.\(^{24}\)   | long-term exposure to pesticides | conjunctiva irritation 47.3%  
                        |                                                  | watery eyes 52.2%  
                        |                                                  | blurred vision 63.3%  
                        |                                                  | dizziness 55.2%  
                        |                                                  | headache 63.7%  
                        |                                                  | muscular pain 61.1%  
                        |                                                  | weakness 76.6%  |
| Buchholz et al.\(^{25}\) | methomyl-contaminated salt       | nausea 95%  
                        |                                                  | dizziness 72%  
                        |                                                  | abdominal cramps 58%  
                        |                                                  | headache 52%  
                        |                                                  | vomiting 51%  
                        |                                                  | chills 48%  
                        |                                                  | diarrhea 46%  
                        |                                                  | light-headedness, disequilibrium 48%  |
| Bussaratid et al.\(^{26}\) | ivermectin                      | malaise 35%  
                        |                                                  | myalgia 30%  
                        |                                                  | drowsiness 30%  
                        |                                                  | pruritus 20%  
                        |                                                  | nausea/vomiting 20%  
                        |                                                  | dizziness 15%  
                        |                                                  | diarrhea 15%  
                        |                                                  | feeling of short breath 10%  
                        |                                                  | feeling of palpitations 10%  
                        |                                                  | constipation 5%  
                        |                                                  | anorexia 5%  
                        |                                                  | headache 5%  |
| Tsai et al.\(^{27}\)    | methomyl                         | general weakness 84%  
                        |                                                  | ataxia 82%  
                        |                                                  | dizziness 82%  
                        |                                                  | vomiting 80%  
                        |                                                  | sweating 75%  
                        |                                                  | floating sensation 71%  
                        |                                                  | headache 69%  
                        |                                                  | dyspnea 69%  
                        |                                                  | blurred vision 67%  |

The occurrence and incidence of particular pesticide poisoning symptoms significantly vary depending on the pesticide applied (Table 2).

Discussion

Pesticides have been widely used in developing countries over years. Their effects to the environment and living beings are significant. Pesticide pollution is detrimental to human health. The effects can be seen on a short- or long-term basis and the symptoms can vary from headache to cancer\(^{34}\). Cytogenetic studies showed a significantly higher rate of chromosomal aberrations in the exposed group compared to the control group\(^{34}\). The primary targets of toxicity are the hematopoietic system (serum cholinesterase inhibition), the cardiovascular system (cardiovascular lesions, abnormalities in heart rate and increase in heart-to-body ratio, the reproductive system (placental morphology, fibrosis and hemorrhage, and inhibition of DNA synthesis in seminiferous tubules), and the nervous system (headache, muscle weakness, insomnia, dizziness, and impaired memory)\(^{35}\).

Pesticides are handled carelessly, and 92% of workers involved in the mixing, loading, and spraying of insecticides and fungicides used no protective clothing or equipment whatsoever. Some 62% of workers reported at least one illness associated with mixing or spraying pesticides. The most frequently reported symptoms were headache, nausea, vomiting, dizziness, skin irritation, and blurred vision. Only 21% of affected workers required medical care\(^{36,37}\). It has been noticed that numerous symptoms present in pesticide poisoning also appear with other numerous diseases and syndromes, but also independently as isolated symptoms. Therefore, pesticide poisoning symptoms should be borne in mind. Certainly, the basis of the diagnosis of pesticide detrimental effects is their application and, whenever possible, laboratory toxicological analysis of the poisoning. Very often, pesticide poisoning cannot be proven by laboratory methods, but the patient’s history and clinical examinations help in diagnosing the actual causes of the disease.

In mild cases of poisoning, abundant hydration will suffice, however, in more severe cases the treatment consists of mechanical ventilation, vasoactive amines, methylene blue, plasma exchange, exchange transfusion, and hemodialysis\(^{37}\). It is essential to recognize detrimental effects of pesticides timely, thus enabling the earliest possible administration of appropriate treatment.

Education of the users of pesticides and the community in general is essential to upgrade the awareness of the toxicity of these agents and to reduce the associated morbidity.

References

12. MOULIA-PELAT JP, NGUYEN LN, GLAZIOU P, CHANTEAU S, GAY VM, MARTIN PM, CARTEL JL. Safety trial of single-dose treatments with a combination of ivermectin


Sažetak

**SIMPTOMATOLOGIJA ŠTETNIH UČINAKA PESTICIDA – PREGLED LITERATURE**

*M. Titić, A. Panda, I. Jukić, A. Tonkic i Ž. Josipović-Jelčić*

Poljoprivrednici koji su kronično izloženi niskim razinama pesticida rijetko pokazuju klinički značajne znakove i simptome. Trovanje pesticidima može biti akutno i kronično. Primarna ciljna tkiva toksičnosti su krvotvorni sustav, kardiovaskularni sustav, reprodukcijski sustav i živčani sustav. Kod izloženih osoba pesticidi mogu uzrokovati mutacije gena i poremećaje kromosoma. Blaži, prolazni simptomi trovanja su često glavobolja, mučnina, povraćanje, omaglica, proljev, bolovi u trbuhu, bolovi u mišićima, salivacija, zbunjenost, umor itd. Od bitne je važnosti pravodobno prepoznati štetno djelovanje pesticida, čime se omogućava primjena odgovarajuće terapije što je ranije moguće.

**Ključne riječi:** *Pesticidi – štetni učinci, Pesticidi – toksičnost; Poljoprivrednici – otrovanje; Profesionalna izloženost – štetni učinci*