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Original article:

A cross sectional study of effects of organophosphorus pesticides on cardio respiratory parameters among farm labourers of North Maharashtra

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ABSTRACT :

Introduction: Organophosphorus compounds are organic compounds containing phosphorus, and are mainly present in pesticides used worldwide in agriculture. It is evident that the pesticides not only provide benefits to mankind in the field of agriculture by increasing the productivity and thereby the economy of the farmers but also produce undesirable and unwanted effects of it's usage which cannot be ignored.

Materials and Methods: A total 99 farm labourers of North Maharashtra area are recruited for this study as subjects. Written informed consent was taken before the procedure. A proper history taking with detailed occupational history and General examination is done previously. Their cardio-respiratory parameters like Peak Expiratory Flow Rate, Vital Capacity, Timed Vital Capacity, Heart rate, Blood pressure etc have been measured. This data is compared with the normal subjects. Test has not been conducted in case of females during their menstrual period.

Results: There is also a significant increase observed in the systolic blood pressure and pulse rate in cases as compared to controls in this study. But according to New York Heart Association for classification of Blood Pressure these values do not indicate that the subjects are suffering from high blood pressure or tachycardia. The Blood Pressure and Pulse rate are within normal limits.

Conclusion: Inappropriate use and improper handling of organophosphorous pesticides affects the Cardio-respiratory parameters if exposd for long term run. This can be prevented by educating the farmers and encouraging them to use the personal protective measures and to encourage them to use organic farming as an alternative.

INTRODUCTION:

Since many years all over the world the improper use of pesticides in fields has been on agenda. Appropriate and judicious use of pesticides is important for various reasons like cost saving and increasing production and thereby the economy of the farmers. Organophosphorus compounds are organic compounds containing phosphorus, and are mainly present in pesticides used worldwide in agriculture. It is evident that the pesticides not only provide benefits to mankind in the field of agriculture by increasing the productivity and thereby the economy of the farmers but also produce undesirable and unwanted effects of it's usage which cannot be ignored[1]. Indiscriminate use and improper handling of synthetic pesticides in agriculture have resulted into serious problems for human health in many developing countries[2]. The primary route by which pesticides enter the body are, accidental ingestion of pesticides mistaken for drink or flour, and through the respiratory tract when farmers enter into sprayed fields immediately

after spraying to collect firewood or animal feed, skin and eye contact with spray due to change in wind direction during spraying or through a leaking sprayer[3]. Organophosphates are absorbed from all sites including intact skin and lungs, and are hydrolysed as well as oxidised in the body and little is excreted unchanged[4]. Several earlier studies [5-8] have reported increased risk of respiratory problems, such as asthma, wheeze and chronic bronchitis among agricultural workers[9]. OP pesticides used by the agricultural workers inhibit the action of AChE, enzyme involved in the release of acetylcholine at the nerve endings[10], thus OP increases the cholinergic effects of acetylcholine in the body and depolarisation of neural transmission[11]. The respiratory centre know as the pre-Botzinger complex is situated in the ventrolateral medulla. It is composed of glutaminergic and muscarinic fibers. Excess acetylcholine can depress respiratory activity in these areas[12-13]. OP agents increase the work of breathing through an increase in pulmonary static and dynamic compliance and by causing obstruction of airways[14-16]. OPs have the tendency to cause interstitial edema, which is responsible for the decrease in pulmonary compliance and ventilation-perfusion (V/Q) mismatch[17-18]. OP exposure can have symptoms resulting from muscarinic, nicotinic and central effects; vomiting, abdominal cramps, diarrhoea, miosis, sweating, increased salivary, tracheobronchial and gastric secretions and bronchospasm; hypotension, muscle twitching, weakness, convulsion and coma[19]. We know that the cardiovascular system is closely associated with the respiratory system in delivering oxygen to the tissues hence we also assess the basic cardiovascular parameters to know the effects of OP compounds on the cardiovascular system[20]. Lack of Personal Protective Equipment (PPE) like safety masks, gloves, etc. during the aerial spraying of pesticides result in the entry of pesticides in the blood stream via respiratory tract through inhalation which can adversely affect the respiratory system[21]. So in this study we are trying to find out the ill-effects of unethical and inappropriate use of organophosphorous compounds on Cardiorespiratory parameters. Also the after-work hygiene practices, such as leaving work boots outside and changing promptly from work clothes, has also been found to affect pesticide levels in the homes of farm workers[22]. The chemicals used are volatile and the finely dispersed drops of aerosol sprays after spraying remain suspended in the air can be inhaled by the workers, producing irritant effects and airway narrowing[23]. So farmers can be taught about preventive measures while handling such compounds and after work hygiene practices. Farmers can also be taught about the importance of organic farming, which may benefit not only the farmers but also the general public[24].

METHODOLOGY:

Number of subjects 99

Inclusion criteria:

1. Male and female adults aged between 20 and 45 years, working at least 6 hours a day, with OP exposure of at least 6 months.
2. Individuals of both sexes are included.
3. Individuals who do not have any abnormal findings ascertained by his / her history and clinical examination and who do not complain of any symptoms are included.

Exclusion criteria:

1. Individuals with history of any medical & psychiatric conditions with the potential to influence study procedure including history of or present traumatic brain injury, neurological disorder are excluded.
2. Individuals under the influence of any medication are excluded.
3. Individuals with history of diabetes mellitus, old history of koch's spine in childhood, history of thyroid disorder, sleep apnea, Chronic obstructive pulmonary diseases are excluded.
4. Individuals with history of substance abuse are excluded.
5. Individuals with family history of attention deficit hyperkinetic disorder, schizophrenia, bipolar disorders are excluded.

The farm labourers of North Maharashtra area are recruited for this study as subjects. Written informed consent was taken before the procedure. A proper history taking with detailed occupational history and General examination is done previously. Their cardio-respiratory parameters like Peak Expiratory Flow Rate, Vital Capacity, Timed Vital Capacity, Heart rate, Blood pressure etc have been measured. This data is compared with the normal subjects.
Test has not been conducted in case of females during their menstrual period.

RESULTS:

A total of 99 subjects in each group, case and control, were taken according to sample size calculation. Their age, height and weight were found to be almost similar in both groups. Respiratory and cardiovascular parameters of subjects in both the groups were measured and then compared.

It has been observed in the study that there is significant difference ($p<0.05$) in Forced Expiratory Volume 1 (FEV1), Forced Expiratory Volume 1/Forced Vital Capacity ratio (FEV1/FVC), Peak Expiratory Flow Rate (PEFR), Maximum Voluntary Ventilation (MVV), between the cases and the control groups, as given in table no.1.

The Mean Forced Vital Capacity (FVC), in the cases (3.0723) is slightly lower than that of the controls (3.2615), as given in chart no.1. But this value is not of significance, hence the Forced Vital Capacity has not been found to be significantly changed in this study.

The Mean Forced Expiratory Volume 1 (FEV1), in the cases (2.6713) is lower than that of the controls (3.1002), as given in chart no.2. This decrease in cases as compared to controls is significant. Hence in this study the Mean Forced Expiratory Volume 1 has been found to be significantly changed.

The Mean Forced Expiratory Volume 1/ Forced Vital Capacity (FEV1/FVC) ratio in cases (82.3731) is lower than that of the controls (94.7041), as given in chart no.3. This decrease in cases is significant, and hence the difference in FEV1/FVC ratio is found to be significantly changed in this study.

The Mean Peak Expiratory Flow Rate (PEFR) in cases (5.9639) is lower than that of the controls (7.6078), as given in chart no.4. This decrease is significant, and hence the difference in Peak Expiratory Flow Rate is found to be significantly changed in this study.

The Mean Maximum Voluntary Ventilation (MVV) in cases (93.9495) is lower than that of controls (123.5455), as given in chart no.5. This decrease is significant, and hence the difference in Maximum Voluntary Ventilation is found to be significantly changed in this study.

There was also a significant difference ($p<0.05$) observed in this study in systolic blood pressure, and pulse rate, as given in table no.2. But the findings in this study do not suggest that the subjects have high blood pressure or pulse rate[25].

TABLE 01.

Variable	Group	Mean	SD	T-statistics	P- value	Significance
FVC	Case	3.07	0.81	1.82	0.0699	Not Significant
	Control	3.26	0.64			
FEV1	Case	2.67	0.67	5.09	0.0000	Highly Significant
	Control	3.10	0.51			
FEV1/FVC	Case	82.37	13.71	9.14	0.0000	Highly Significant
	Control	95.70	4.73			
PEFR	Case	5.96	2.14	6.63	0.0000	Highly Significant
	Control	7.61	1.23			
MVV	Case	93.95	29.93	7.81	0.0000	Highly Significant
	Control	123.55	22.94			

FVC- Forced Vital Capacity

FEV1- Forced Expiratory Volume 1

FEV1/FVC- Forced Expiratory Volume 1/Forced Vital Capacity

PEFR- Peak Expiratory Flow Rate

MVV- Maximum Voluntary VentilationP value> 0.05 means are not significant, P value < 0.001, then means are highly significant if p value <0.05 then means are significant

TABLE 02.

Variable	Group	Mean	SD	T-statistics	P- value	Significance
SBP	Case	127.43	7.09	8.96	0.0000	Significant
	Control	120.32	3.48			
DBP	Case	80.63	2.35	3.44	0.0007	Not Significant
	Control	79.15	3.56			
PULSE RATE	Case	80.28	6.07	0.69	0.4893	Significant
	Control	79.47	9.89			

SBP: Systolic Blood Pressure
DBP: Diastolic Blood Pressure

DISCUSSION:

Organophosphorous compounds includes Dyflos,Echothiopte,Malathione, Fenthione. Fenthione is most toxic with addition of copper sulphate. These substances block the activity of enzyme cholinesterase and thereby increase the ongoing cholinergic activity. Patients present with cholinergic crisis. The effects could be Muscarinic or Nicotinic. The muscarinic effects could be Sialorrhoea, Bronchospasm, bronchorrhoea leading to hypoxia and pulmonary edema, increased gastrointestinal motility with diarrhoea, bradycardia. Nicotinic effects could be Fasciculations, N-M weakness, Miosis. . Indiscriminate use and improper handling of synthetic pesticides in agriculture have resulted into serious problems for human health in many developing countries The subjects in this study had been continuously exposed to pesticides in fields for many hours daily. Most of them did not use any protective equipment as well, and were thus directly exposed to the chemicals.

A total of 99 subjects in both control and case groups were taken each. Males and females have been included in the same group. Their anthropometric measurements were taken before hand. The age, weight and height of all the subjects in both the groups are almost similar. The complete medical history and surgical history was taken and clinical examination was done.

The respiratory findings in this study have shown significant differences among both groups. The Forced Expiratory Volume 1 (FEV1) shows significant ($p<0.05$) decrease among cases as compared to controls in this study. The Forced Vital Capacity (FVC) does not show any significant decrease, thus it is not shown to be significant in this study. The Forced Expiratory Volume 1/Forced Vital Capacity ratio (FEV1/FVC), Peak Expiratory Flow Rate

(PEFR), Maximum Voluntary Ventilation (MVV) are also observed to be significantly reduced in cases as compared to controls in this study. The Peak Expiratory Flow rate however was seen to be reduced in both, the cases as well as control groups but it is reduced much more in cases group.

There is also a significant increase observed in the systolic blood pressure and pulse rate in cases as compared to controls in this study. But according to New York Heart Association for classification of Blood Pressure these values do not indicate that the subjects are suffering from high blood pressure or tachycardia. The Blood Pressure and Pulse rate are within normal limits.

There is also no significant increase in diastolic blood pressure. This difference in the cardiac parameters in the cases and controls could also be due to increased physical activity in fields by the cases as compared to the controls. Apart from that, no significant changes are seen in the cardiovascular parameters in the cases as compared to the controls in this study.

LIMITATIONS:

The study was focused on two different groups like Farmers and general public not doing farming, instead the comparision should have been done between farmers who are practicing organic farming and those who are not practicing organic farming. Secondly, since most of the farmers use wood fire (chullas) for cooking food in their houses , so they are indirectly exposed to smoke at their houses. This could also affect their respiratory parameters. If the study was done for a long term period it could have shown us the highly significant changes in the cardiac parmeters of the cases also

CONCLUSION:

Inappropriate use and improper handling of organophosphorous pesticides affects the Cardio-respiratory parameters if exposd for long term run. This can be prevented by educating the farmers and encouraging them to use the personal protective measures and to encourage them to use organic farming as an alternative. This is an important measure, which is beneficial not only to the farmers but also to the general population which is exposed to farm products that have been sprayed with pesticides.

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