



Organochlorine Pesticides in Maternal blood, Cord blood and Placenta of Pregnant Women of different Dietetic Habits.

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ABSTRACT:

It is now a well-accepted fact that only organochlorine pesticides (OCPs) especially DDT, HCH and to some extent Aldrin / dieldrin and heptachlor play a vital role in the tissue accumulation of pesticides. It has been well established that pesticides, particularly the chlorinated hydrocarbons directly affect the fetuses and neonates as they get transferred through mothers' blood, cord blood, placenta and mother milk respectively. This has been confirmed in all the mammalian species that have been examined including humans. Taking above points into consideration, a continued surveillance on the levels of pesticide pollutants in human conception is an important task to ensure the well-being of the human pregnancy. It was, therefore, planned to conduct such as a study in Jaipur, the capital of Rajasthan and the pink city of India. Findings of this research work may provide base line data of the extent of pesticide contamination/exposure in women body, fetus and offspring. The data obtained from the above work may also provide some clues, possible reasons for abortions, premature deliveries, still births, some infant diseases and mortalities. The study is mainly concerned with the pesticides burden in the pregnant women and its transfer to Prenates, so it will require the analysis of pesticide residues in the (1) blood of pregnant women (2) in placenta and (3) cord blood using gas liquid chromatography. The results revealed the presence of isomers of HCH, heptachlor, DDT and its metabolites and Aldrin in mostly all the samples analyzed. Dietary habits of the mothers were found to play an important role in the body burden of lipophilic pesticide residues. Interestingly higher concentrations of organochlorine pesticides were found in pregnant women with non-vegetarian dietary habits than in those with vegetarian dietary habits. The OCPs residues present in the maternal blood indicate the pesticide burden in the human population, which in turn is a risk to human health. Secondly, this may be considered as an indication of the transfer of these chemicals from maternal to fetal circulation across the placenta which may pose various problems of management of prenatal health.

KEY WORDS:

Mother's blood, Organochlorine pesticides, Contamination, Residues, Gas Chromatograph, Placenta, Cord blood, Dietetic habits

INTRODUCTION

Pesticides are a broad group of chemicals used by men for the control of agricultural pests and various disease spreading vectors. Pesticides are an important factor in agricultural development and protection of public health India, since the tropical climate is very conducive to pest breeding. As a consequence, pests and plant diseases account for about 10%-20% loss in agricultural production in India. The loss amounts to approximately Rs. 6000 Crores annually (Time of India, 11.6.93) However, we have largely overlooked the darker side of these chemicals i.e. unwanted and unwarranted environment pollution caused by the indiscriminate use of pesticides, secondly their biocidal activity is not only registered to the target organisms but extends to non-target organisms as well. Therefore, today the pesticides and in particular insecticides are, perhaps the most ubiquitous of the potentially harmful chemicals encountered in the environment.

It is very unfortunate that many of these pesticides which proved to be injurious for human being are still being used in our country in quite higher quantities because of their cost benefit ratio. There is an urgent need to recognise the consumer's right to information about harmful effects of pesticides. At least 70% of the pesticides handled by the Indian farmer have been declared "excessively toxic" by World Health Organization. Unfortunately, pesticides are big money often banned in their country of origin stocks are dumped on eager to purchase developing nations. It is a known fact that one quarter of all pesticides exported by the United States are not registered for use in the US. They include cancelled or suspended pesticides because they may cause cancer or otherwise endanger human or the environment. A pesticide action group in Paraguay remarks. We do not understand how industrialised countries, producer of pesticides, they do not consume, can allow export to less developed countries. Perhaps we are more resistant human being" (Hindustan Times 3.11.90).

It has been well established that pesticides, particularly the chlorinated hydrocarbons directly affect the fetuses and neonates as they get transferred through placenta and mother milk respectively. This has been confirmed in all the mammalian species that have been examined including humans. It is also known that the female significantly reduced their body burden of pesticides during lactation. Therefore, the neonate would get exposed to them even if there is no immediate exposure of mothers to these toxic compounds.

Even more frightening studies indicate that right from the day our babies begin to suckle, they are taking the pesticides deposit in the breast milk and some ready made babyfoods too are similarly contaminated. "We are not only slowly poisoning ourselves but jeopardizing our future generation too" says toxicologist Dr. K.N. Mehrotra, president, Society of Pesticides, India in New Delhi [2].

More scary studies have indicated that we have largely overlooked the darker side of these chemicals as OCPs are reported to be carcinogenic [2], [3] mutagenic [3],[4] teratogenic [4],[5] immunosuppressive [6],[7] create endocrine dysfunction such as hypothyroidism or high estrogenic activity [9],[9] disturb reproductive processes [10],[11] growth depressants [12],[13] induces several psychogenic and neurogenic abnormalities in adult stages [14],[15],

and are associated with abortions, premature deliveries, still births and infants with low birth weights [16]-[19]. OCPs have been in use in India nearly for a half century now. Even after having clear cut evidence suggesting that these chemicals have the ability to eliminate entire species from the planet, the annual consumption of pesticides in India is about 85,000 tons of which OCPs comprise the bulk [20]. Therefore, today OCPs are perhaps the most ubiquitous of the potentially harmful chemicals encountered in the environment and are still widely detected in humans despite the considerable decline in environmental concentrations [21-26]. It has been well established that pesticides, particularly the chlorinated hydrocarbons directly affect the fetuses and neonates as they get transferred through mothers' blood, cord blood, placenta and mother milk respectively. This has been confirmed in all the mammalian species that have been examined including humans. Taking above points into consideration, a continued surveillance on the levels of pesticide pollutants in human conception is an important task to ensure the well-being of the human pregnancy. It was, therefore, planned to conduct such as a study in Jaipur, the capital of Rajasthan and the pink city of India. Findings of this research work may provide base line data of the extent of pesticide contamination/exposure in women body, fetus and offspring. The data obtained from the above work may also provide some clues, possible reasons for abortions, premature deliveries, still births, some infant diseases and mortalities. The study is mainly concerned with the pesticides burden in the pregnant women and its transfer to Prenates, so it will require the analysis of pesticide residues in the (1) blood of pregnant women (2) in placenta and (3) cord blood using gas liquid chromatography. The results revealed the presence of isomers of HCH, heptachlor, DDT and its metabolites and Aldrin in mostly all the samples analyzed. Dietary habits of the mothers were found to play an important role in the body burden of lipophilic pesticide residues. Interestingly higher concentrations of organochlorine pesticides were found in pregnant women with non-vegetarian dietary habits than in those with vegetarian dietary habits. The OCPs residues present in the maternal blood indicate the pesticide burden in the human population, which in turn is a risk to human health. Secondly, this may be considered as an indication of the transfer of these chemicals from maternal to fetal circulation across the placenta which may pose various problems of management of prenatal health.

MATERIALS AND METHODS

101 pregnant women admitted to Zanana Hospital and Mahila Chikitsalya: attached to the Deptt. of obstetrics & Gynecology. S.M.S. Medical College, Jaipur (India) and two private hospitals "Sanjeevani Hospital" and " Meera Hospital", Bani Park, Jaipur are Included in the present study. In general, they had no history of any occupational or accidental exposure to pesticides. However, they were asked to fill up a questionnaire giving information about their health and relevant to the pesticide residue accumulation such as age, dietary habits, area of residence, parity, social status, accidental or occupational exposure to pesticides etc. according to WHO methodology [27] by interviewing the subjects at the time of collection of samples.

Sample Collection

Maternal blood, placenta and cord blood:

Five ml of maternal blood from each case was collected by venipuncture in pre-heparinized vials 4-8 hours before parturition and stored at -10°C in a deep freeze until analysed. A fraction of placental tissue was collected in acetone washed aluminium foil at the time of delivery and stored at the same temperature. Umbilical cord blood was collected by squeezing the cord into pre-heparinized vials. All the stored samples were analysed within 48 hours of their storage.

Extraction of Pesticide from Samples

Pesticides were extracted and separated from samples by liquid partition and column chromatography so that they could be analyzed by Gas Liquid Chromatography (GLC) and Thin Layer Chromatography (TLC) procedures. All reagents and chemicals used were of analytical grade and checked for any pesticide contamination. Specimens of maternal blood, placenta and cord blood were extracted and then cleaned by Florisil column as per the methodology given by Bush and his coworkers with little modifications according to the prevailing laboratory conditions [28].

Quantitative Estimation

Quantitative estimation of pesticide residues in all the extracts was done by HP 5890 series II gas chromatograph (GC) equipped with Ni 63 Electron capture detector (ECD) coupled to HP 3396A integrator. Glass coiled column (1.43 m x 4 mm L x I. D) was packed with Solid Support, Chromosorb 100/120 mesh size along with the Liquid phase: 1.5% OV-14±1.95% OV-210. Purified nitrogen (IOLAR-1) gas was used as the carrier gas and a known volume of sample was injected in the column with the help of the 10 µl Hamilton syringe. Different peaks of the samples were identified by comparing their retention times with those of standards. Quantitation of the samples were done by the data obtained from the integrator and were based on peak areas. Standards were obtained from Environmental Protection agency (EPA) U.S.A.

Recovery Analysis and Confirmation of Pesticide residues

Recovery analysis was done by fortification experiments and the percentage recovery was 95–98%. TLC was used for confirming the identity of the OCPs already detected by the GC. The pesticides for which the GC was standardized and were estimated were Aldrin, isomers of HCH (α , β & γ), metabolites of heptachlor (Heptachlor & Heptachlor epoxide) and DDT (DDE, DDD and DDT).

Statistical Analysis

The calculations are based on biological statistics and values are expressed as mean± standard error (S.E.). The difference in the pesticide residue levels between different groups was

analyzed with the help of student t test. Significance between the residue levels of different groups was judged at 5 % and 1% levels.

OBSERVATIONS

Table.1: Concentration of organochlorine pesticides in maternal blood, cord blood and placenta of 101 pregnant women of different dietetic habits (ppb).

S. No.	Organochlorine pesticide compounds	Maternal Blood		Cord blood		Placenta	
		Veg.	Non-Veg.	Veg.	Non-Veg.	Veg.	Non-Veg.
		45 Cases Mean \pm S.E.	56 Cases Mean \pm S.E.	45 Cases Mean \pm S.E.	56 Cases Mean \pm S.E.	45 Cases Mean \pm S.E.	56 Cases Mean \pm S.E.
1.	α -HCH	58.1 \pm 9.81 (n=40)	113.4 \pm 24.02* (n=48)	59.3 \pm 11.84 (n=36)	98.5 \pm 16.77 (n=48)	72.1 \pm 11.14 (n=41)	90.9 \pm 15.11 (n=54)
2.	γ -HCH	24.0 \pm 6.42 (n=27)	54.8 \pm 12.47 (n=46)	24.0 \pm 7.22 (n=25)	37.8 \pm 9.61 (n=42)	32.2 \pm 5.64 (n=30)	40.7 \pm 16.75 (n=47)
3.	β -HCH	42.8 \pm 8.46 (n=30)	78.8 \pm 26.92 (n=34)	47.48 \pm 10.7 6 (n=25)	121.8 \pm 67.03 (n=28)	57.5 \pm 11.25 (n=31)	123.6 \pm 56.07 (n=33)
4.	Heptachlor	586.5 \pm 102. 25 (n=30)	2036.1 \pm 695.7 0 (n=38)	838.5 \pm 186. 00 n=27)	1059.3 \pm 163.4 3 (n=46)	724.4 \pm 196. 81 (n=26)	859.9 \pm 135.38 (n=33)
5.	Aldrin	95.2 \pm 15.79 (n=37)	145.7 \pm 45.45 (n=49)	67.4 \pm 13.91 (n=43)	106.1 \pm 19.47 (n=48)	142.5 \pm 33.8 4 (n=32)	121.9 \pm 20.26 (n=49)
6.	Heptachlor epoxide	553.9 \pm 116. 85 (n=31)	735.4 \pm 136.92 (n=43)	580.5 \pm 167. 17 (n=26)	780.6 \pm 143.85 (n=37)	749.6 \pm 169. 07 (n=20)	754.1 \pm 208.95 (n=36)
7.	DDE	43.9 \pm 7.44 (n=40)	77.7 \pm 16.12 (n=52)	38.7 \pm 8.97 (n=35)	50.6 \pm 8.45 (n=50)	36.6 \pm 5.94 (n=38)	145.8 \pm 76.23 (n=49)
8.	DDD	25.8 \pm 9.00 (n=17)	103.7 \pm 67.55 (n=21)	72.6 \pm 25.41 (n=15)	226.1 \pm 183.71 (n=15)	65.9 \pm 22.87 (n=10)	35.0 \pm 11.78 (n=15)
9.	DDT	29.8 \pm 10.18 (n=27)	33.2 \pm 5.37 (n=34)	18.1 \pm 9.49 (n=24)	17.9 \pm 4.27 (n=27)	44.3 \pm 14.70 (n=30)	65.5 \pm 27.35 (n=34)
10.	Σ HCH	92.6 \pm 14.79 (n=45)	187.5 \pm 34.28* (n=56)	94.8 \pm 18.36 (n=41)	178.6 \pm 46.62 (n=55)	132.3 \pm 18.7 6 (n=43)	193.2 \pm 42.74 (n=56)
1	Σ Heptachlor	932.3 \pm 170.	1578.7 \pm 249.4	929.6 \pm 204.	2000.7 \pm 769.7	953.3 \pm 171.	1327.0 \pm 240.71

1.		71 (n=41)	7* (n=51)	36 (n=36)	0 (n=53)	21 (n=36)	(n=45)
1 2.	Σ DDT	69.5±10.19 (n=44)	139.3±32.65 (n=53)	74.8±19.88 (n=39)	55.3±8.50 (n=56)	80.3±17.29 (n=43)	187.4±77.97 (n=54)

* Statistically Significant P < .01

Σ HCH-total HCH

Σ Heptachlor-Total Heptachlor

Σ DDT-Total DDT

n-no of positive samples

ND-not detected

Table.1 shows the concentration of organochlorine pesticides in maternal blood, cord blood and placenta of 101 pregnant women of different dietetic habits (ppb). Dietary habits of the mother were found to play an important role in the body burden of lipophilic pesticide residues. Interestingly higher concentrations of organochlorine pesticides were found in pregnant women with non-vegetarian dietary habits than in those with vegetarian dietary habits. Concentration of α -HCH, total heptachlor, and total HCH were found to be significantly higher in the maternal blood of the mothers with non-vegetarian habits when compared with the mothers with vegetarian habits. In cord blood and placenta, has a general trend of high residue levels was observed in the women with non-vegetarian habits but no statistically significant difference was found.

DISCUSSION

Dietary habits of the mother were found to play an important role in the body burden of lipophilic pesticide residues. Interestingly higher concentrations of organochlorine pesticides were found in pregnant women with non-vegetarian dietary habits than in those with vegetarian dietary habits (Table.1). Concentration of α -HCH, total heptachlor, and total HCH were found to be significantly higher in the maternal blood of the mothers with non-vegetarian habits when compared with the mothers with vegetarian habits. In cord blood and placenta, a general trend of high residue levels was observed in the women with non-vegetarian habits but no statistically significant difference was found. The significant difference in the levels of pesticides in the two groups may result from high DDT and BHC values in mutton, eggs and chicken [29],[30] which are common in non-vegetarian meals. The results of our findings are in accordance with the results reported by Siddiqui in 1982 from Lucknow. He reported that residue levels of HCH, p, p'-DDD, Aldrin, p, p'-DDE in mothers' blood, cord blood and placenta were significantly higher in the mothers with non-vegetarian habits [31].

CONCLUSION

It is quite clear from the foregoing discussion, that in all over the world Indian mothers have got the significant and may be highest body burden of OCPs. This is because in the third

world countries such as India, because of the cost - benefit ratio OCPs are still the major pesticides used in agriculture and public health sector. This is in accordance with the findings of Dale and his coworkers (1965) that the Indians have got the highest body burden of OCPs [45]. The present study directly reflects the national scene of magnitude of pesticide pollution which signifies the distribution and accumulation of non-biodegradable lipophilic pesticides in pregnant women on one side and subsequently the vulnerability of the successive generation from its very inception in the womb of the mother on other side. The so called "placental barrier" which separates the maternal compartment from the fetal compartment must be regarded as an epithelial membrane of lipid character, i.e. a lipid sieve through which lipophilic non-polar substances are able to penetrate according to their concentration gradient and degree of lipophilicity. A physiological state like pregnancy, no doubt helps mother in fighting against the increasing burden of environmental pollutants like persistent organochlorine pesticides. During the state as evident from the present investigation, the mothers appreciably reduce their body burden of pesticides at the expense of intoxication of their own developing baby in the womb through cord blood during the gestational period. Starvation stress caused an increase in the cord blood concentrations of DDT and its metabolites, calls for a strict regulation in time to take meals and a balance between calorific intake and energy requirement of the mother during pregnancy to avoid mobilization of fat depots resulting into mobilization of stored residues of OCPs [46].

It can be concluded that the magnitude of pesticide pollution is quite high to contaminate the food and environment and as a result toxicant reach the human body through various sources mainly through the absorption from the gastrointestinal tract via contaminated food chain. From there, they are further circulated in maternal blood, cord blood stored in milk and placental tissue of the women [28,30]. Since, the pesticides are reported to be carcinogenic, mutagenic, teratogenic, immunosuppressive, induces endocrine dysfunction and high estrogenic activity, disturb the reproductive processes, growth depressants, induces several psychogenic and neurogenic abnormalities in adult stages and are also reported to be associated with abortions, premature deliveries, still births, low birth weight consequences are obvious on the mother and the developing baby. It poses various problems of management of neonatal nutrition and health. It calls for suggestions like special care in nutrition and in the environment of mother throughout the life and especially during pregnancy and lactation. It would be advisable for a woman to avoid the consumption of fatty food stuffs and heavily polluted working environment. In the light of our findings stricter regulations may be discussed and such measures have to be weighed against the benefits of the use of pesticides. Present findings on obstetric toxicology of pesticides particularly in relation to distribution of pesticidal pollutants in pregnant women may finally lead to a better understanding of the influence of chemicals on fetal development and provide grounds for further studies on placental toxicology as related to pesticide pollution in India. In the end, it must be emphasized that there is a rising protest that pesticides are destroying harmless wild life and endangering the health of man himself. The battle against the harmful insects would be much less costly and more efficient, and the problem of contamination of the environment

by toxic materials would be vastly reduced, if insect activities are controlled by natural means. The use of pest-specific predators; parasites or pathogens; sterilization of insects with the help of radiations; trapping insects using insect attractants like pheromones; use of juvenile hormones or hormone inhibitors may therefore be suggested as alternate ways of pest control.

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