Organochlorine Pesticides and its Association with Preterm Deliveries: A Case Control Study from Agra

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ABSTRACT

In India preterm birth is the leading cause of death of newborns and this number is rising. Preterm birth is an increasingly widespread complex condition with multiple risk factors. Few environmental pollutants have been investigated for their potential to increase the risk for preterm birth. Pesticides have been the most intensively studied for their association with preterm birth. DDT has been examined more than any other pesticide in epidemiological studies of preterm birth because DDT is an environmentally persistent insecticide that biomagnifies in the food chain, with known disastrous reproductive consequences.

The purpose of this study was to compare organochlorine pesticide levels and oxidant/antioxidant status in trophoblastic placental tissue between women with preterm and full term deliveries. The results of this study support for an association between in-utero exposure to the OCPs, antioxidant status and reduction in birth weight and gestational age. Although further study is necessary to confirm these findings and efforts to reduce use of organochlorine pesticides are warranted

Keyworks: Preterm birth, Trophoblastic placental tissue, Organochlorine pesticides

1. INTRODUCTION

An estimated 15 million babies are born as pre-term babies every year. Around 1 million children die each year due to complications of preterm birth. India has the maximum number of preterm births with 3, 519, 100, almost 24% of the total number (Blencowe., 2012). Risk factors coupled with preterm birth and low birth weight include socioeconomic status, race/ethinicity, smoking and environmental contaminants (Farhang et al., 2005, Kumar S., 2006, 07, 08) Throughout the pregnancy period, women are exposed to a wide variety of foreign chemicals through lifestyle factors (smoking, drug abuse and alcohol consumption), maternal medication and also from occupational and environmental exposure (Nan 2001: Myllynen 2005). In addition, there is no barrier to prevent inflowing of these chemicals and they are circulated between mother and foetus by simple diffusion. These foreign chemicals are capable to alter the usual functions of placenta

(Kajiwara et al., 1996, Kumar S., 2004) like production and release of hormones and enzymes, nutrients transport, waste products and maturation; consequently upsetting the foetal development and lastly, at the terminal phase of placental life, i.e., delivery (Myllynen et al., 2005).

Presence of different organochlorines residues in placenta and their transplacentally transfer from mother to foetus have been already reported in several studies (Saxena et al., 1981). Such compounds are reported to be endocrine disrupters and capable of altering the hormonal balance by their antiandrogenic activities (Bustos et al., 1988). Studies have shown that organochorines have been associated with an increased risk of abortion, intrauterine growth retardation (IUGR), minor malformations, preterm, small-for-gestational-age babies; with endometriosis, cryptochildism and hypospadias in the newborn (Birnbaum et al., 1994; Olea et al., 1998; Hosie et al., 2000).

In addition to estrogenic activity, organochlorine insecticides also capable to induce lipid peroxidation, moderate oxidative stress and brings about changes in lipid composition and membrane activity (Catala & Cerruti, 1997; Koner et al., 1998). Organochlorines are also known to influence oxygen free radicals; OFRs (Hassoun et al., 1993); it has been reported that free radical generation in the trophoblastic placental tissue may have serious toxic effects and environment pollutants like organochlorines insecticides might be associated with it. Keeping in view the above, present study is proposed to investigate if there is any potential interaction of accumulating organochlorines insecticides residues in placental tissues of pregnant women with biomarkers of oxidative stress and antioxidant defence system.

2. MATERIALS AND METHODS

To obtain the status of the organochlorine pesticides levels and antioxidant enzyme activities in preterm and full-term deliveries and thus provide a comprehensive picture as to whether there exist any association between them, we measured the levels of some organochlorine pesticides, (Hexachlorocyclohexane) HCH and its isomers like α-HCH, β-HCH, γ-HCH, and δ-HCH, metabolites of (Dichlorodiphenyltrichloroethane) DDT such as p, p-DDE, p, p-DDT, o, p-DDT, o, p-DDT, p, p-DDD and total DDT and antioxidant enzymes glutathione (GSH). Lipid peroxidation, as evidenced by the formation of thiobarbituric acid reactive substances (TBARS), was assayed.

2.1 Patient's selection

Seventy pregnant women from Agra (India), after 28 weeks of gestational age attending antenatal clinic of local hospital was included for this study. All placenta samples were collected from healthy pregnant women; those didn't reported accidental/occupational exposure to organochlorine pesticides. Informed consent of all the subjects was taken and interview before sample collection. Case histories of the subjects, including maternal age, education, occupational, residential area

(rural/urban), socioeconomic status, dietary habit, smoking, alcohol consumption, parity, gestational age and use of drug during gestation, reproductive history, and past disease was recorded in the questionnaire. Neonatal birth weight and gender was also recorded; gestational age was computed as the number of weeks between the date of the last menstrual period and date of birth. A birth was classified as preterm if the gestational age of the newborns were assessed as 36 weeks or less and premature rupture if the amniotic membranes ruptured spontaneously 24 hr or more the onset of labor.

2.2 Collection of placental samples and processing;

We selected mainly trophoblastic placental tissue without sign of calcification, avoiding the deciduas basalis and chorionic plate in accordance with other recent studies (Osman et al., 2000; Lagerkvist et al., 1996). Placental tissues were collected during parturition. Approximately 20 gm of placental tissue were taken from each subject, collected in wide-mouthed, organochlorine insecticides free containers as coded samples and transported to Department of chemistry, Institute of basic sciences, Khandari campus, Agra immediately after collection in an ice container for organochlorines residue analysis and other biochemical assays.

An aliquot of homogenate was used for determination of malondialdehyde (MDA) last product of lipid peroxidation (Okhawa et al 1979) and determination of glutathione (GSH) (Jellow et al. 1974). Extraction of pesticide residues mainly for DDT and its metabolite and isomers of HCH was carried out as described by Saxena & Siddiqui (1981). Analysis was done in (AIRF-JNU, New Delhi.) on gas chromatograph equipped with ECD (electron capture detector) under the standardized conditions.

3. RESULTS

Seventy pregnant women (17-33 yrs) were involved in this study. On the basis of pregnancy outcomes the women were enrolled in two groups. First group belongs to the women with pre-term pregnancies (n=21) considered as study group and the second group consists of the women with full-term pregnancies (n=49), considered as control group. The socio-demographic and reproductive characteristics of the subjects are depicted in the Table 1.

The differences between Age, height, weight and no of children were not found statistically significant when compared using Student's t-test. The weight of the babies was found significantly lower in preterm babies as shown in Table 2. The levels of α-HCH, γ-HCH, δ-HCH and p, p-DDE were found significantly different in between two groups. α-HCH ($p<.0001$), γ-HCH($p<.005$) and p, p-DDE ($p<.0001$) were found significantly higher in study group and δ-HCH ($p<.005$) is higher in control group.

Table 1: Characteristics of the pregnant females from pre-term and full-term deliveries.

Characteristics of the subjects		Pre-term (n=21)	Full-term (n=49)
Age (Yrs)		24.52±3.51	25.57±4.00
Height (Cm)		154.34±3.90	155.37±6.20
Weight (Kg)		52.42±8.16	57.4±7.8
Number of child		2.06±1.16	1.54±1.01
Abode	Rural	47.6	38.7
	Urban	52.3	61.2
Addiction	Yes	23.8	28.5
	No	76.1	87.7
Pesticide exposure	No	85.7	85.7
	Yes	14.2	14.2
Source of drinking water	Pvt.	23.8	40.8
	Govt.	76.1	59.1

Values represent mean±SD or no. of subjects (%)

Table 2. Characteristics of the babies from pre-term and full-term deliveries

Characteristics of the babies		Pre-term (n=21)	Full-term (n=49)
Height (cm)		46.4±4.33	48.54±4.19
Weight (gm)*		2048.73±770.98	2731.81±350.09
Head circumference (cm)		31.34±.96	35.34±11.52
Gender	Male	57.1	63.2
	Female	42.8	36.7

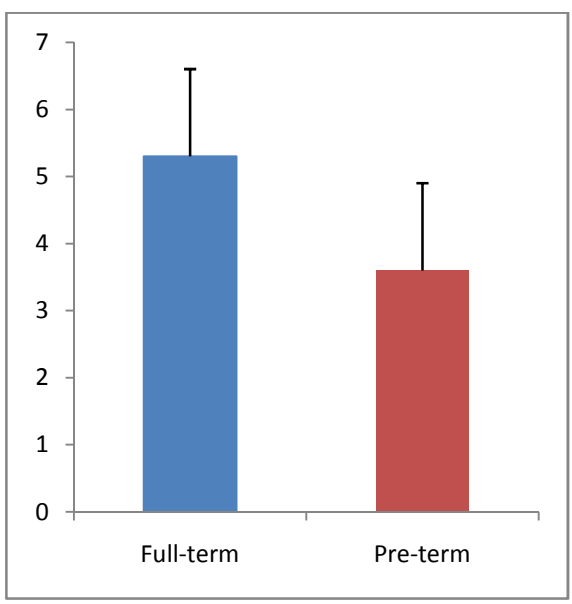
Values represent mean±SD or no. of subjects (%)

Table 3. Organochlorine pesticides in the placenta of the females from pre-term and full-term deliveries

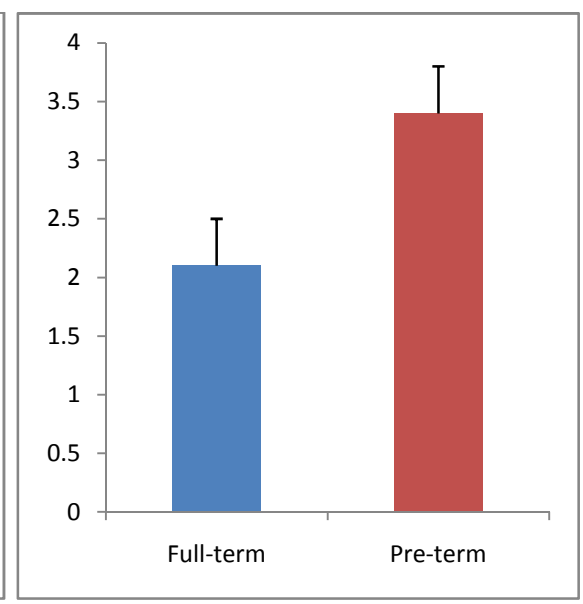
Name of pesticides	Pre-term (n=11)	Full-term (n=14)
α-HCH*	42.06±21.1	26.64±6.7
β-HCH	61.06±42.4	47.62±33.8
γ-HCH**	12.99±7.0	9.72±2.6
δ-HCH**	32.02±40.5	49.66±0
p, p-DDE*	55.88±28.4	12.64±6.9
p, p-DDT	ND	ND
o, p-DDT	ND	ND
p, p-DDD	ND	ND

Results are in ppb *p<.0001, **p<.005

Fig. Biochemical indices in the placenta of the females from pre-term and full-term deliveries



GSH level µmol/gm protein



MDA level µmol/h/gm fresh tissue

4. CONCLUSION

The trends of the data obtained from 70 cases, indicates that the socio-demographic, obstetrical, and reproductive history as confounders of the preterm delivery was closely matched between the two groups of women. Our study showed some epidemiologic support for an association between in utero exposure to the OCPs, antioxidant status and reduction in birth weight and gestational age. Furthermore, pesticides level was significantly higher, along with alterations in the oxidative stress parameters in placental tissue with the preterm delivery than those of the full term delivery. Placental OCPs levels with some of the selected parameters of oxidative stress suggests the pesticide-induced preterm delivery in women of the present study through the modulating the oxidant/antioxidant status in placental tissue. There is a need to increase and improve research in this area to provide the knowledge for preventive strategies to minimize the risk of preterm birth as a result of environmental exposures.

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