ACCUMULATION PROFILES OF ORGANOCHLORINE PESTICIDES AND PBDEs IN MOTHER'S -BLOOD, -BREAST MILK, -PLACENTA AND -UMBILICAL CORD: POSSIBLE TRANSFER TO INFANTS

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Introduction

In Japan, usage of organochlorine pesticides (OCPs) has been banned several decades ago. However, due to their persistent and lipophillic nature, these halogenated aromatic hydrocarbon compounds still found to occur in humans at considerable concentrations[1]. In general, OCPs produce neuro toxic, carcinogenic, reproductive disorder and various adverse effects in humans. Their impacts have been recognized as deadly, since these chemicals are accumulate in animal fat, magnify in the human food chain and do not break down. They cause a variety of serious short and lifelong health effects, especially impacting children and pregnant women. OCPs have been detected in food stuffs and in human tissues in Japan[1-3]. Polybrominated diphenyl ethers (PBDEs) are considered to new Era chemical as they were used in electrical appliances and in industrial purpose. Disposal and eradication of old electrical appliances and industrial waste tend to produce PBDEs at greater extent. PBDEs are persistent, lipophillic, ubiquitous and produce spectrum of detrimental effects to humans. PBDEs have been detected in biological samples[4] and humans[5] in Japan.

Over the last 10 to 20 years, the attention of the scientific community has switched from the health problems related to the human exposure to relatively high amounts of usually well-defined pollutants to the problems related to the chronic exposure to low doses of chemicals and multiple contaminations. The progresses realized in the analytical chemistry brought forth the possibility of detecting and measuring compounds present at trace levels.

Trans-placental transfer of organic contaminants has been observed in bats. Reports also made available that placental transfer of toxic contaminants to the unborn fetes. The gravity of the toxic contaminants problem is reflected in the fact that human infants are exposed to significant levels of OCPs and PBDEs concentrations through placental transfer even while in the womb. This exposure continues on to exposure through mother milk and finally through foods, water and air. On the other hand, for infants, lactation-transfer and trans-placental transfer are considered to critical pathways as indicated above and therefore, analysis of OCPs and PBDEs in mother's tissues such as blood, breast milk, placenta and umbilical cord will provide some clear trend. Considering those facts, in the present study we analyzed blood, breast milk, placenta and umbilical cord from 10 nursing mothers from Japan. This study not only provides the current contamination status in women/humans but also reveals possible trans-placental and trans-lactation transfer of OCPs and PBDEs to the infants.

Materials and Methods

Ten young mother tissues (age range 23 to 35) were obtained from volunteers with consent during delivery and biopsies performed at Shimomura OBGY Clinic, Fukuoka, Japan. They have been living in Fukuoka and the surrounding area, which is a highly industrialized region in the western part of Japan. All mothers were asked by their obstetrician or midwife to volunteer for this study. Among 10 mothers 4 of them come for first delivery and 6 of them came for second delivery. The

blood (c.a., 15-mL) were collected in glass bottle with PTFE coated cap. Approximately 15-g of breast milk, umbilical cord blood and placenta were collected, was obtained in same kind of glass bottles. Immediately after collection, all tissues were stored at -20°C prior to analysis.

For chemical analysis, placenta were homogenized with Na_2SO_4 spiked with internal standards such as $^{13}C_{6\text{-}12}$-labeled OCPs, and $^{13}C_{12}$-PBDEs and Soxhlet extracted with dichloromethane (DCM) for 16-h. Rest of cleanup and analysis of biological tissues were similar to those of our earlier study[7]. For blood and breast milk the analytical methods have been described elsewhere[5,6]. The identification and quantification was performed using high resolution gas chromatography-high resolution mass spectrometry (HRGC-HRMS)[5,6,7]. Methods blank samples were also analyzed for every 8 sample batch. The blank doesn't contain quantifying amount of any target contaminants. The lipid contents in the sample were determined from the aliquot of crude extract by gravimetric method.

Results and Discussion

Contamination profiles of OCPs were in the order of DDTs (p,p'-DDE is predominant) followed by HCHs (β-HCH is predominant), chlordanes (trans-nonachlor is predominant), HCB, cyclodienes (dieldrin is predominant) and mirex (Table 1). Mother milk contained elevated

Table 1. Median (ranges) concentrations (pg/g lipid) of organochlorine pesticides in mothers tissue.

	Mother blood (n=10)	Umblical Cord blood (n=10)	Placenta (n=10)	Mother milk (n=10)
Lipid(%)	0.85 (0.49-1.2)	0.19 (0.075-0.35)	3.6 (3.3-4.3)	3.3 (1.7-4.4)
o,p'-DDT	520 (300-1,700)	1,200 (300-1,800) [5]*	71 (40-160)	940 (500-2,800)
p,p'-DDT	3,800 (1,400-6,700)	3,500 (960-13,000)	430 (150-1,300)	7,400 (3,100-13,000)
o,p'-DDE	250 (110-440)	LRL	55 (32-77) [7]*	340 (170-660)
p,p'-DDE	73,000 (38,000-260,000)	110,000 (26,000-510,000)	12,000 (7,200-72,000)	120,000 (81,000-350,000)
o,p'-DDD	LDL	LDL	52 (29-74) [4]*	54 (27-82) [6]*
p,p'-DDD	LRL	LDL	150 (65-520)	160 (63-660)
trans-Chlordane	LRL	LDL	120 (93-170)	140 (88-230) [8]*
cis-Chlordane	LRL	LDL	98 (73-130)	190 (120-380) [9]*
trans-Nonachlor	11,000 (7,200-20,000)	8,000 (5,700-21,000)	2,000 (1,200-4,000)	25,000 (16,000-34,000)
cis-Nonachlor	1,200 (860-2,700)	970 (570-2,400)	230 (130-390)	2,800 (1,800-4,600)
Oxychlordane	5,400 (2,800-12,000)	5,000 (3,000-11,000)	980 (570-2,200)	11,000 (6,300-20,000)
Heptachlor	LDL	LDL	LDL	LRL
cis-Heptachlor epoxide	1,200 (680-2,700)	1,500 (860-3,000)	220 (120-460)	2,000 (1,000-4,200)
trans-Heptachlor epoxid	LDL	LDL	LDL	LDL
Aldrin	LDL	LDL	LDL	LDL
Dieldrin	1,600 (970-3,000)	2,200 [1]*	410 (280-700)	2,300 (1,300-3,500)
Endrin	LDL	LDL	LRL	LRL
HCB	9,700 (5,900-17,000)	17,000 (6,100-38,000)	1,900 (1,300-3,100)	11,000 (6,200-15,000)
Mirex	620 (330-1,500)	430 (170-650)	120 (61-190)	720 (300-1,200)
α-HCH	290 (240-390) [4]*	1,700 (1,300-7,400) [7]*	71 (56-78)	160 (130-260) [7]*
β-HCH	33,000 (12,000-180,000)	49,000 (9,400-110,000)	7,700 (3,800-27,000)	52,000 (27,000-280,000)
γ-HCH	350 (220-800)	1,500 (790-3,400) [6]*	120 (90-210)	180 (110-790) [9]*
δ-HCH	LDL	LDL	LDL	LDL

LDL & LRL = Less than Detection Limit and Less than Reporable Limit
*the value in the bracket indicate number of samples detected.

concentrations followed by umbilical cord blood, mother blood and placenta. Elevated concentration in mother milk suggests that their greater partition efficiency. Greater concentrations of OCPs in milk also comprehend their lactation-transfer to infants. Besides, higher levels in umbilical cord and placenta also attribute trans-placental transfer of OCPs to the fetus. Overall, the results clearly showed that accumulation of OCPs by child seems significant.

Elevated DDTs in women considered to be a critical due to their transfer to the infants at greater proportion. DDE levels in blood serum samples were associated with increased risk of premature delivery, of small-for-gestational-age size at birth, and with reduced height at age 7. Since HCHs were not listed in dirty dozen (12 UNEP POPs) but their contamination in humans explains their source from atmospheric transport from source countries because in Japan HCHs banned in early 1970's. Third predominant contamination by chlordanes is of further concern due combination of chlordane with PCBs showed more negative profound effect on the hand skill index in infants who exposed organochlorines through trans-placental and lactation. On the other hand, the fertile woman showed lower birth weight of the children. Studies has illustrate an association between dietary intake of organochlorine contaminated fish and both low birth weight for infants born to exposed women and reduction of the menstrual cycle length.

Individual data of 10 mothers, the contamination pattern is similar in all 4 tissues (data not shown). Particularly, mother blood and milk had similar contamination pattern and umbilical cord blood and placenta showed similar contamination pattern.

Table 2. Median (ranges) concentrations (pg/g lipid) of PBDEs in mother's tissue.

PBDEs	Mother blood (n=10)	Umblical Cord blood (n=10)	Placenta (n=10)	Mother milk (n=10)
#28-TriBDE	61 (36-180)[8]*	LDL	13 (8.9-29)[9]*	63 (29-230)
#47-TeBDE	320 (190-730)	LDL	88 (50-140)	440 (210-1000)
#100-PeBDE	110 (45-330)	LDL	20 (12-35)[9]*	160 (65-430)
#99-PeBDE	120 (58-180)	LDL	27 (14-43)	110 (65-230)
#153-HxBDE	500 (200-690)	LDL	65 (37-98)	430 (280-780)
#183-HpBDE	(83,130)[2]*	LDL	(21-28)[3]*	36 (16-110)[9]*
#197-OBDE	320 (310-800)	LDL	49 (36-130)	170 (82-210)
#207-NBDE	450 (310-800)	LDL	62 (50-110)	120 (53-300)
DeBDE	1700 (1300-4500)	LDL	320 (250-560)	370 (170-770)

LDL = Less than Detection Limit or one to two times higher than blank samples

*the values in the bracket indicates number of samples detected.

Concentrations of PBDEs were several orders lesser than OCPs (Table 2). On the whole, mother's blood recorded elevated PBDEs followed by mother milk and placenta. While umbilical cord blood showed concentrations equal to blank levels. Only few samples showed one or two times higher than blank conecntrations. DeBDE was predominant contaminant in tissues followed by NBDE-207, HxBDE-153, TeBDE-47, and OBDE-197.

Homologue wise in general the following pattern were suitable for mother blood (DeBDE>OBDEs>NBDEs>HxBDEs>TeBDEs>PeBDEs>HpBDEs>TriBDEs>DiBDEs), mother milk (TeBDEs>HxBDEs>DeBDE>PeBDEs>OBDEs>NBDEs > TriBDEs>HpBDEs>DiBDEs), placenta (DeBDE>TeBDEs>NBDEs>OBDEs>HxBDEs> PeBDEs>HpBDEs>TriBDEs>DiBDEs). These results prevailed that partition of PBDEs were different in mother milk than mother blood and placenta. In contrast to the OCPs concentrations, PBDEs in various tissues of same mothers were differed**.** However, congener profiles composition was similar in tissues of same individual.

To evaluate of transfer to the infants, the ratio of OCPs and PBDEs from individual mother's blood to mother milk or placenta or umbilical cord blood in lipid basis were calculated and averaged ratio from 10 mother tissues were shown in Figure 1&2. The transfer ratio of OCPs was different in between individuals and in between tissues. In general, individual mother milk transfer ratio was greater followed by umbilical cord and placenta. The lower brominated diphenyl

ethers tend to transfer from mother blood to mother milk while octa- to decabrominated diphenyl ethers not transfers to mother milk. One plausible explanation probably restricted membrane transfer of larger molecular weight (MW) higher brominated diphenyl ethers such as octa-, nona- and decabrominated diphenyl ethers with MW of 801.4, 879.3 and 959.2, respectively.

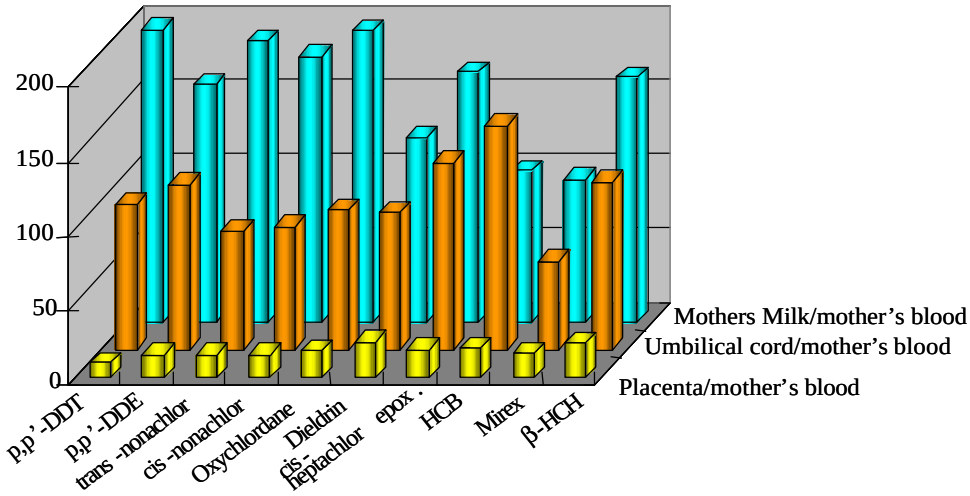

Figure 1. Transfer ratio (%) of OCPs (lipid weight) from mother's blood to mother milk or placenta or umbilical cord blood.

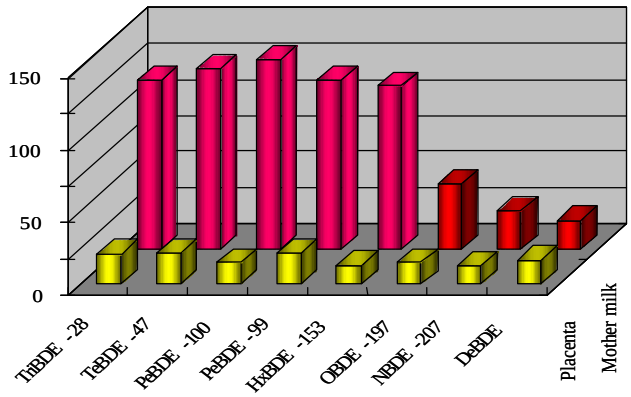

Figure 2. Transfer ratio (%) of PBDEs (lipid weight) from mother's blood to mother milk or placenta.

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