Effects Of PCBs And Dioxins During Pregnancy And Breast Feeding On Growth And Development Of Newborn Infants. A Study Design And Preliminary Results.

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Abstract:
To estimate the risk of adverse health effects of PCBs and dioxins in utero and in human milk a study was designed comparing breast fed with formula fed infants. Growth and neurodevelopmental parameters are recorded during the first eighteen months of life and compared with PCB, dioxin, vitamin A and thyroid hormone levels in plasma and human milk. Preliminary results indicate good correlations between PCB levels in maternal plasma, cord plasma and human milk.

Introduction:
PCBs and dioxins are highly resistant, fat soluble pollutants which accumulate in the food chain. In western industrialized countries considerable concentrations of these pollutants have been found in cows milk, fish, meat and also in human milk.

In relative high exposure situations PCBs and dioxins may exert a wide spectrum of toxic lesions which are not the same for different animal species and man. Rodents show for instance hepatotoxicity and thymic atrophy while in man chloracne is the most prominent sign of exposure to these chemicals. In human infants growth retardation and neurodevelopmental delay have been described after chronic low dose exposure to PCBs in utero.[1,2,3] The mechanistic basis for these adverse health effects is not clear yet, but a possible role for thyroid hormone and vitamin A has been suggested.

From animal studies it became apparent that a disturbance of thyroid hormone and vitamin A metabolism is induced following perinatal exposure to coplanar PCBs.[4] For a child thyroid hormone and vitamin A are essential for normal growth and development.

In order to estimate possible adverse health effects of relatively high contaminated mothers milk a study was designed comparing breast fed with formula fed infants. In this study we focus on possible relations between PCB levels in cord plasma, PCB/dioxin intake via human milk and the infant's growth, neurological and psychomotor development during the first eighteen months of life. These parameters will be correlated to vitamin A and thyroid hormone levels in plasma and human milk. Effects of background exposition of specific PCB and dioxin congeners on growth and development of the human infant have not been studied yet.

Methods:

This study is part of a large cooperative survey on PCBs and dioxins in the Netherlands. In Rotterdam as well as in Groningen 200 healthy Dutch mothers and their term children (100 breast fed / 100 formula fed) take voluntarily part in the study. The children are examined on growth and neurodevelopment.

Maternal plasma is collected in the 36th week of pregnancy, child's plasma at 10 days, 3 months and 18 months after birth. Human milk is collected as a representative 24 hours sample at 10 days, 6 weeks and if possible 3 months after delivery. PCB and dioxin congeners are measured by capillary gas chromatography with electron capture and mass spectrometric detection.[5]

The outline of the Rotterdam research plan is summarized in tables 1 and 2.

Table 1
Biochemical parameters

	Human Milk	Maternal Plasma	Cord Plasma	Child Plasma
PCB 118,138,153,180	+	+	+	-
Dioxins (17 congeners)	+	-	-	-
Thyroid functions (TT3, TT4, TSH, FT4)	-	+	+	+
Vitamin A	+	+	+	+

Table 2
Neurodevelopmental follow-up

	10 days	3 months	7 months	18 months
-Neurological examination Prechtl/Touwen	+	-	-	+
-Psychomotor development Bayley Scales of Infant Development	-	+	+	+
-Visual Recognition Memory Fagan Infantest	-	+	+	-
-Weight, Height, Head circumference	+	+	+	+

Preliminary results:

In a pilot study we found considerable concentrations of PCB 138, 153, 180 in maternal plasma, cord plasma and human milk. There were significant correlations between PCB levels in maternal plasma and cord blood and between maternal plasma and human milk. The preliminary results of the main study are summarized in table 3.

Table 3
Mean levels of PCB 138,153 (ng/ml) in plasma and human milk.

	PCB 138 Mean	(SD)	PCB 153 Mean	(SD)
Maternal plasma (n=102)	0.65	(0.25)	1.00	(0.33)
Cord plasma (n=84)	0.14	(0.07)	0.21	(0.11)
Human milk (n=8)	0.08 $x10^3$	(0.03)	0.10 $x10^3$	(0.04)

There were significant correlations between PCB levels in maternal plasma and cord plasma (PCB 138:0.61 $p<0.001$, PCB 153:0.59 $p<0.001$) as well as between PCB 138 and PCB 153 (in maternal plasma 0.95 $p<0.001$, in cord plasma 0.98 $p<0.001$).

Table 4
Growth parameters in formula and breast fed infants correlated with cord plasma PCB 153 levels (ng/ml).

	Formula Fed n=18	Formula Fed n=9	Breast Fed n=32	Breast Fed n=25
PCB 153 level	<0,21 mean (SD)	≥0,21 mean (SD)	<0,21 mean (SD)	≥0,21 mean (SD)
weight (gr)				
birthweight	3449 (342)	3214 (487)	3434 (442)	3427 (492)
10 days	3532 (432)	3239 (423)	3616 (496)	3678 (510)
3 months	6152 (756)	5531 (516)	5956 (577)	6011 (711)
height (cm)				
10 days	52.8 (1.4)	50.8 (2.1)	52.2 (1.9)	52.3 (1.9)
3 months	61.5 (1.6)	60.0 (2.6)	61.1 (2.4)	61.4 (2.0)
head circ. (cm)				
10 days	35.6 (0.9)	34.8 (1.5)	35.5 (1.1)	36.0 (1.2)
3 months	41.2 (1.5)	40.1 (1.5)	40.6 (1.3)	41.0 (1.4)

Conclusions:

These preliminary data indicate accumulation of PCBs in Dutch mothers, prenatal load of their infants and contamination of human milk. At this moment we find no significant correlations between in utero PCB accumulation and human growth parameters at birth, 10 days or 3 months. Further data are being collected at this moment.

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