

CONCENTRATION OF PCBS AND OH-PCBS IN PRESERVED UMBILICAL CORDS

Junzo Yonemoto¹, Junko Kawahara¹, Tatsuya Hattori², Tohru Matsumura², Seiichi Sugama³

¹National Institute for Environmental Studies, 16-2 Onogawa, Tsukuba, 305-8506 Japan, ²Idea Consultants Inc., 1334-5 Riemon, Ohigawa, 421-0212 Japan, ³National Center for Child Health and Development, 2-10-1, Okura, Setagaya, 157-8535 Japan

Introduction

In recent years, the prevalence of certain neurodevelopmental disorders such as learning disabilities, autism, attention deficit and hyperactivity disorders might be increasing¹. Evidence has been accumulating over several decades that industrial chemicals can cause neurodevelopmental damage and that subclinical stages of these disorders might be common². Much attention has been directed to fetal exposure to chemicals with possible neurodevelopmental effects as the developing human brain is much more susceptible to these chemicals than is the brain of adults³. PCB is one of these chemicals of concern because PCB and its metabolite are neurotoxic² and are still found in humans, especially in fish eating population such as Japanese at comparatively high concentrations.

In the present study, the concentration of PCB and its hydroxylated metabolites were measured in preserved umbilical cords from subjects of Seiku Birth Cohort (National Center for Child Health and Development, Tokyo, Japan) to examine the usefulness of preserved umbilical cords as a surrogate for monitoring fetal exposure to PCBs.

Materials and Methods

Subjects and sample collection

Subjects were participants of ongoing Seiku Birth Cohort (2003-; National Center for Child Health and Development, Tokyo, Japan). As a pilot study, 17 preserved umbilical cords of babies (6 males and 11 females; mean birth weight: 2955 ± 422g) were obtained from mothers (median age: 34.0) with informed consent. This study was approved by the Institutional Review Board Committees at the National Institute for Environmental Studies and National Center for Child Health and Development.

Analysis

Umbilical cord sample was ground into a fine powder with a multibeads shocker (Yasui Kikai, Tokyo, Japan) and was spiked with internal standards. PCBs and OH-PCBs were extracted with 25% ethanol/hexane, washed with distilled water and dehydrated with anhydrous sodium sulfate and then

concentrated by rotary evaporator. OH-PCBs were methylated by reaction with tetramethylsilyldiazomethane. The derivatized solution was concentrated and passed through activated silica-gel packed in a glass column. PCBs were eluted with hexane (Fraction 1) and then CH₃O-PCBs were eluted with 25% dichloromethane/hexane (Fraction 2) and concentrated. Identification and quantification of PCBs and CH₃O-PCBs were performed using GC (Agilent HP6890)- HRMS (Micromass AutoSpec-Ultima). PCB and OH-PCB congeners in samples were quantified using isotope dilution method to ¹³C₁₂-internal standards.

Results and Discussion

The weight of the samples obtained was so small (mean 0.27g dry weight) that the detection limit for OH-PCBs in preserved umbilical cords was 10pg/g dry weight in the present study. The concentrations of OH-PCBs and PCBs in preserved umbilical cords were shown in Fig. 1. The median levels of total TeCBs, PeCBs, HxCBs, HpCBs and OcCBs in the preserved umbilical cords were 330, 180, 510, 370 and 60.5 pg/g dry weight, respectively. Hydroxylated PCBs (OH-PCBs) were detected in all the preserved umbilical cord samples examined. The median level of total OH-PCBs was 451 pg/g dry weight (range 194- 879 pg/g). The predominant OH-PCBs detected were 4-OH-2,2',3,4',5,5'-hexachlorobiphenyl (4M146), 3'-OH-2,2',3,4,4',5'-hexachlorobiphenyl (3PM138) and 4-OH-2,2',3,4',5,5',6-heptachlorobiphenyl (4M187) followed by 4-OH-2,3,3',4,5'-pentachlorobiphenyl (4M107). These four OH-PCBs were also detected in human blood as predominant OH-PCBs⁴. The relative abundance of the predominant OH-PCBs in the preserved umbilical cords varies between individuals.

A retrospective case-control study to investigate the association between fetal OH-PCBs exposure and neurodevelopmental disorders is now underway as it was reported that OH-PCBs disturbed thyroid hormone homeostasis in experimental animals⁵ and human newborns⁶.

References

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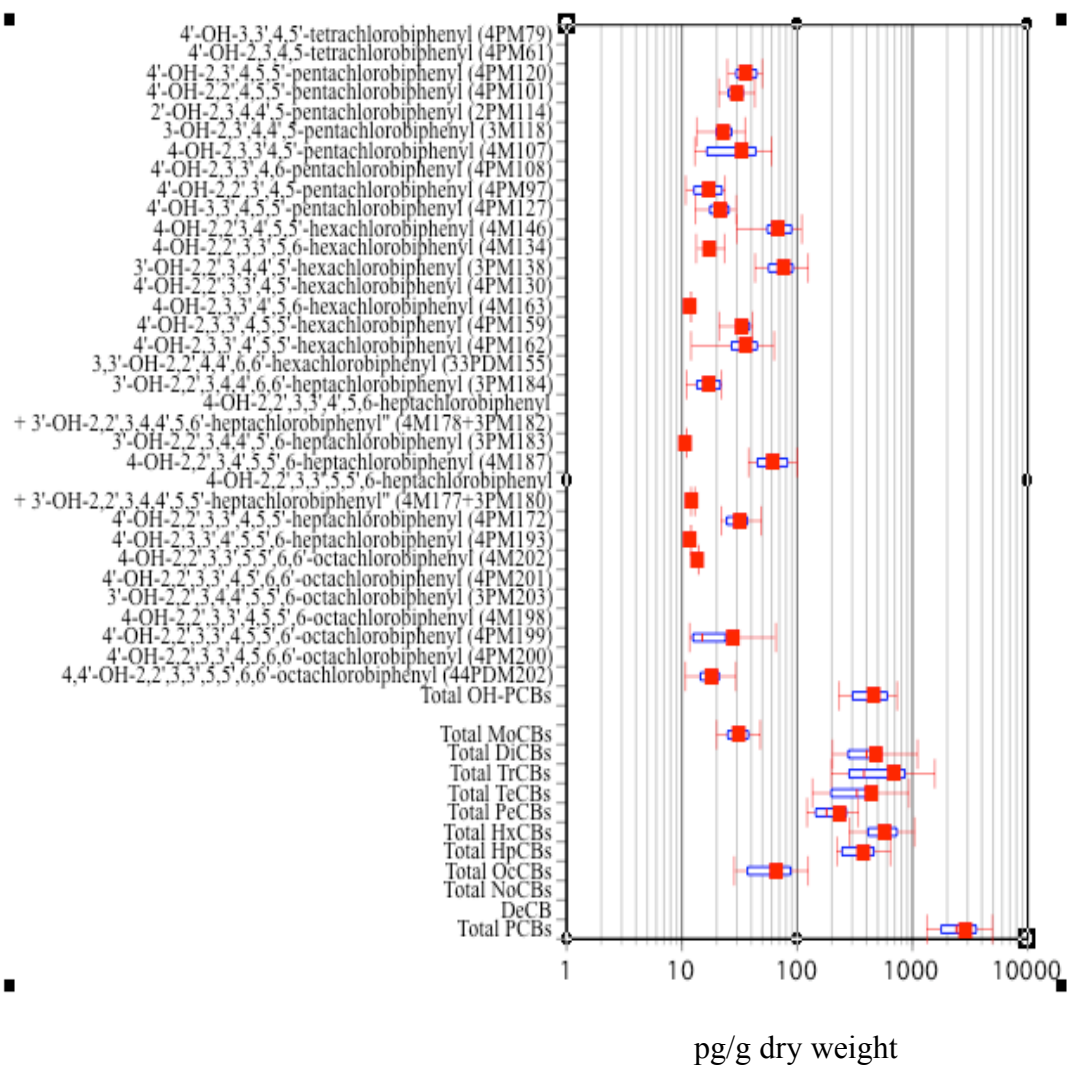


Fig 1. Concentration of PCBs and OH-PCBs in preserved umbilical cords