

# Polychlorinated Biphenyl Residues in Maternal and Cord Blood in Tokyo Metropolitan Area

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## INTRODUCTION

A number of reports indicate that PCBs are ubiquitously present in the biota of Japan (Tatsukawa and Isono, 1971, Mizutani et al, 1972, Hidaka et al, 1972, Kobayashi et al, 1972), although physiological significance is not known at this present level found in the fauna. An exposure to this substance for the human neonate starts at the commencement of breast feeding, however, the first exposure takes place as early as sometime during fetal stage, as indicated by the few incidences of "black babies" delivered by mothers with or without overt symptoms during the outbreak of PCB poisoning in Japan (Funatsu et al, 1971, Yamaguchi et al, 1971). Lipophilic chlorinated hydrocarbons such as DDT and PCB tend to remain in biota for years, once they are emitted to nature in substantial amount, even after termination of actual application. The production of PCBs was banned in 1972 in Japan and its use in the open system has also been forbidden. This report is a part of our project to monitor certain environmental chemicals found in the tissues of residents in Tokyo metropolitan area.

## MATERIALS AND METHODS

Both maternal and cord blood was sampled at Tokyo University Hospital at the time of delivery during the period December, 1973 through February, 1974. Blood samples were taken in the blood container, pretreated with hexane and stored at 5°C in refrigerator until the time of analysis. For analysis of PCBs, we essentially followed the standard method recommended by the advisory committee for the Ministry of Health and Welfare (1972). Twenty g of whole blood in 50 ml centrifuge tube was shaken vigorously with 20 ml of ethanol. Five g of potassium hydroxide was added to this and heated at 90°C for one hour. After cooling, the content was extracted with three additional 20 ml portions of n-hexane. The hexane was washed three times with water, dried through the column of anhydrous sodium sulfate, and condensed

in K-D condenser to the volume of 1 to 2 ml. The condensed sample was purified by letting it pass through the column consisting of 2 g of Florisin, 3 g of silica gel and anhydrous sodium sulfate. PCBs were eluted from the column with hexane and initial 180 ml of fraction was collected. The eluate was concentrated to 1 ml, shaken vigorously with 1 ml concentrated sulfuric acid and then hexane layer was buffered with potassium hydroxide pellets prior to gas chromatography.

The gaschromatograph used was Shimazu GC 5 AP equipped with  $^{63}\text{Ni}$  Electron Capture Detector. The operative conditions for PCB analysis were as follows.

|                      |                                       |
|----------------------|---------------------------------------|
| column dimensions    | : 3 mm x 2m                           |
| column packing       | : 2% OV - 1 on Gas Chrom. Q<br>80/100 |
| column temperature   | : 200°C                               |
| detector temperature | : 250°C                               |
| Nitrogen flow rate   | : 60 ml/min.                          |

The quantification of PCB residues followed the method provided by Ugawa (1973). Total blood lipids were determined by a modified method of Bragdon, i. e. 3 g of samples were treated twice in Folch's solvent with a dispersing mixer; the filtered solution was shaken with 0.05% sulfuric acid; the lower layer was evaporated to dryness and the residue was weighed.

## RESULTS AND DISCUSSIONS

Our data is summarized in Table 1. The mean PCB level in adult blood (mother) obtained in our study (2.8 ppb) corresponds well to those reported by other workers in Japan (Inoue et al, 1974, Abe et al, 1974, Doguchi et al, 1975). On a whole basis, PCB levels in maternal blood are roughly threefold higher than those in cord blood. Because of its strong lipophilic tendency it was expected that PCBs were conveyed by the lipid fraction in the blood. Though the lipid levels in maternal blood were roughly twice as high as those in cord blood, the correction of the values to fat basis gave more or less similar results in terms of the concentration ratio between maternal and cord blood.

Gaschromatographic pattern of PCBs found in blood is fairly similar to the patterns noted in adipose tissues, namely closely resembling that of Kanechlor 500 and Kanechlor 600. The chlorine content of PCB residues in the present investigation is calculated roughly 53% which is very close to that of Kanechlor

500 (54.6%).

It is noteworthy that gaschromatographic patterns of PCB residues found in the samples of mother-baby pair are almost identical (Fig. 1), and this suggests that the placenta permits rather indiscriminate transmission of the organochlorine compounds of closely related chemical structure.

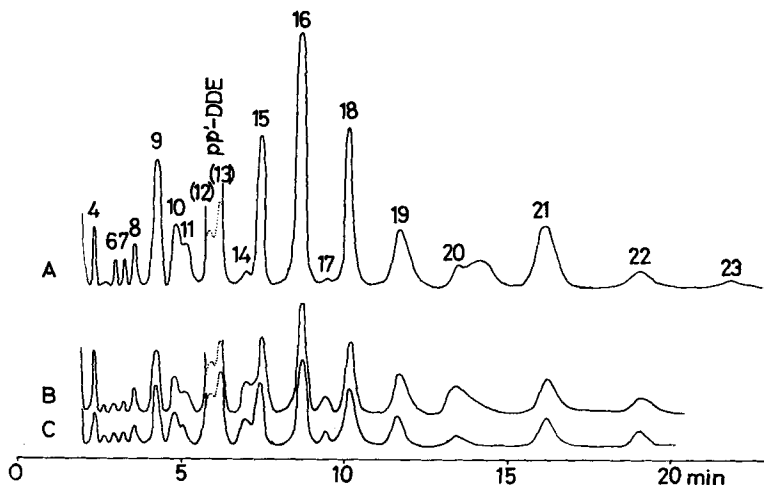


Figure 1: Gaschromatographic Patterns of PCB Residues.

A : Maternal blood  
B,C : Cord blood of twins

Narafu (1973) noted an excellent correlation (0.972) as regards the PCB levels between maternal and cord blood, however we failed to see such relationship (-0.046 on a fat basis ; -0.018 on a whole basis). It appears that this issue remains unsettled in the cases of other organochlorine compounds such as BHC and DDT. (O'Leary et al, 1970, Yamagishi et al, 1972).

#### SUMMARY

PCB levels were determined with maternal and cord blood sampled at the time of delivery. All of the twentyfour mothers selected for this experiment are residents of Tokyo Metropolitan area. Gaschromatographic

TABLE 1  
PCB Levels of Maternal and Cord Blood

| Case  | Wet Basis (ppb) |                  | Fat Basis (ppm) |                   |
|-------|-----------------|------------------|-----------------|-------------------|
|       | M.              | C.               | M.              | C.                |
| 1     | 3.5             | ---              | 0.42            | ---               |
| 2     | 2.6             | 1.5              | 0.18            | 0.31              |
| 3     | 2.0             | 0.9              | ---             | 0.23              |
| 4     | 3.3             | ---              | 0.35            | ---               |
| 5     | 3.9             | 0.3              | 0.41            | 0.06              |
| 6     | 4.5             | 1.6              | 0.53            | 0.33              |
| 7     | 1.6             | 0.7              | 0.25            | 0.13              |
| 8     | 2.4             | 0.7              | 0.30            | 0.14              |
| 9     | 2.1             | 0.9 <sup>#</sup> | 0.23            | 0.22 <sup>#</sup> |
|       |                 | 0.6 <sup>#</sup> |                 | 0.16 <sup>#</sup> |
| 10    | 4.2             | 0.6              | 0.57            | 0.17              |
| 11    | 0.3             | 1.4              | 0.05            | ---               |
| 12    | 3.0             | 0.9              | ---             | 0.22              |
| 13    | 1.8             | 1.2              | 0.29            | 0.24              |
| 14    | 1.4             | 0.8              | 0.19            | 0.13              |
| 15    | 1.0             | 0.4              | 0.14            | 0.06              |
| 16    | 1.9             | 0.8              | 0.28            | 0.25              |
| 17    | 2.9             | 1.3              | 0.39            | 0.24              |
| 18    | ---             | 1.2              | ---             | 0.36              |
| 19    | 3.6             | 1.2              | 0.43            | 0.17              |
| 20    | ---             | 0.8              | ---             | 0.22              |
| 21    | 2.6             | 3.3              | 0.65            | 0.35              |
| 22    | 7.6             | 0.3              | 0.80            | 0.08              |
| 23    | 1.8             | 1.6              | 0.23            | 0.49              |
| 24    | 3.5             | 0.8              | 0.43            | 0.21              |
| Av.   | 2.8             | 1.1              | 0.36            | 0.22              |
| S. D. | 1.5             | 0.6              | 0.18            | 0.10              |

#Twins

patterns of PCBs in cord blood closely resembled those of mothers. The cord blood in general showed lower PCB levels on both whole and fat basis than those in the maternal blood. No correlation was noticeable on statistical basis as regards the concentrations of PCBs between the cord blood and maternal blood. Our data suggests that the passage of PCBs through the placenta follows general patterns observed in other organochlorine insecticides.

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