THYROID HORMONE LEVELS IN YOUNG MEN PRENATALLY EXPOSED TO POLYCHLORINATED BIPHENYLS AND DIBENZOFURANS

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Introduction

Polychlorinated biphenyls (PCBs) and dibenzofurans (PCDFs) are persistent environmental pollutants that induce a broad spectrum of toxic effects in mammals [1]. One aspect of these compounds is their effect on thyroid hormone levels during development[2,3] and in adult animals[4,5]. Total intakes of PCBs, PCDDs and related chemicals from the breast milk were found negatively correlated with the levels of serum thyroxine (T_4), triiodothyronine (T_3) in breast-fed babies in Japan[6]. In this study, we investigated the relationships between the levels of serum T_4, T_3, and thyroid-stimulating hormone (TSH) from 62 young men prenatally exposed to high levels of PCBs and PCDFs, as compared to these from 60 unexposed control subjects.

Materials and Methods

The children's degree of sexual maturation was assessed by physical examination and rated Tanner score 1 (prepubertal) to 5 (sexually mature) according to their physical secondary sexual characteristics using a slightly modified version of the staging criteria described by Tanner[7]. Testicular and penial sizes and pattern of pubertal hair were assessed by a physician not aware of the child's exposure status. Testicular volume was measured by manual palpation and compared to a standard-sized orchidometer[8], and the length of penis was measured at room temperature from the base at the pubis, with pubic fat reclined and the tape measure pressed firmly to the pubic bone, to the tip of the penis. Blood samples (n = 122) were taken from the young men by standard puncture of a cubital vein. Blood samples were centrifuged shortly after sampling, and serum was stored at -20°C until analysis. TSH and total T_3 were determined with an immunoluminometric assay. Total T_4 was measured by in-house RIA methods[9].

Results and Discussion

Age, Tanner status, testicular size, penial length, body height and weight were not statistically different between exposed and control men (Table 1). No significant differences in the concentration of T_4, T_3, and TSH were observed between exposed and control men (Table 2). However, the levels of T_4 and T_3 were negatively associated with TSH in control groups (r^2 = 0.1788 and 0.258; P = 0.0034 and 0.0003, respectively). But no such association was observed in exposed groups (Table 3). In other laboratory mammals study found that exposure to TCDD or PCBs results in increased glucuronidation and biliary clearance of T_4 and decreased serum T_4 levels[10]. It has been shown that hydroxylated metabolites of PCBs, PCDDs, and PCDFs

competitively inhibit T_4 binding to transthyretin (TTR), but not to thyroxine-binding globulin (TBG) [11]. The hydroxylated metabolites of polyalogenated aromatic hydrocarbons (PHAHs) might be effective inhibitors of thyroid hormone sulfation in which may associated with regulating free hormone concentrations in the fetus[12]. Our results indicated that after maternal exposure to PCBs and PCDFs may have implication for young men's thyroid hormone homeostasis and development indirectly. Further studies are needed to identify which types of PCBs and PCDFs are involved in causing disruption of endocrine system, and which pathways are responsible for these effects.

Acknowledgment

We thank Mr. Eng-Jun Chen for thyroid hormone assay. This study was funded by grants from the United States Environmental Protection Agency, Star Grant # R 038759 (GHL); and The National Science Council of Taiwan, ROC grant # NSC 86-2314-B 006-117 (YLG).

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Table 1. Age and physical examination between young men prenatally exposed to PCBs/PCDFs and unexposed controls.

Category	Control (n = 62)	Exposed (n = 60)	*P* values
Age (yrs)	12.3 ± 1.9	12.6 ± 1.9	n.s.
Body Weight (kg)	42.3 ± 13.1	42.4 ± 12.9	n.s.
Body height (cm)	150.1 ± 13.2	148.6 ± 13.6	n.s.
Tanner status	2.08 ± 1.30	2.02 ± 1.18	n.s.
Right testicular size	9.15 ± 7.37	8.30 ± 7.04	n.s.
Left testicular size	9.67 ± 7.95	8.95 ± 7.32	n.s.
Penial length (cm)	6.20 ± 2.49	5.53 ± 2.01	n.s.

Table 2. Serum hormone levels between PCB/PCDF-exposed young men and unexposed controls.

Category	Control (n=62)	Exposed (n=60)	*P* values
Thyroxine (T_4, μg/dl)	8.88 ±1.77	9.30 ±1.90	0.2774
Triiodothyronine (T_3, ng/dl)	121.5 ±31.1	131.5 ±32.3	0.1272
T_3/T_4	0.0137 ±0.0023	0.0142 ±0.0022	0.2734
Thyroid-stimulating hormone (TSH, mIU/ml)	2.02 ±1.14	2.15 ±1.40	0.6201

Table 3. Correlation parameters of serum thyroid hormone levels between PCB/PCDF-exposed young men and unexposed controls.

Correlation	Control		Exposed	
	R values	*P* values	*R* values	*P* values
T_4 vs. T_3	0.7682	< 0.0001	0.7623	<0.0001
T_4 vs. TSH	-0.4225	0.0034	0.0657	n.s.
T_3 vs. TSH	-0.5075	0.0003	0.0374	n.s.