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Neurological signs and symptoms in patients with chronic PCB poisoning (Yusho accident) for more than 36 years

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KEYWORDS
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Summary

Background: The existence of peripheral neuropathy after chronic exposure to polychlorinated biphenyls (PCBs) is still controversial because studies concerning the effects of PCBs on the peripheral nervous system are rare.
Objective: The purpose of this study was to determine the correlation between neurological signs and symptoms and the concentration of serum PCBs.
Materials and methods: Neurological data collected from the results of a nation-wide health examination of 450 male and 557 female Yusho victims (chronic PCB poisoning) exposed more than 36 years ago were compared with recent measurements of the serum PCB concentration and patterns.
Results: The frequency of sensory disturbance detected by neurological examination was significantly higher in the group of officially acknowledged victims (male, $P = 0.014$; female, $P = 0.001$) than in age-matched controls. Significant differences were not observed between the serum PCB patterns and the neurological findings, but the serum PCB concentration was significantly higher in the group with decreased tendon reflex in officially and non-officially acknowledged female Yusho victims (male, $P = 0.994$; female, $P = 0.014$).
Conclusion: These results suggest that the long half-life of PCBs and their accumulation in fatty tissue can lead to persistent mild impairment of the peripheral nervous system even long after exposure.

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1. Introduction

Although more than 36 years have passed since the contamination of rice bran oil with polychlorinated biphenyls (PCBs) occurred (the Yusho accident), the blood concentration of polychlorinated dibenzofurans (PCDFs), a derivative of PCB, in the blood of patients with Yusho is still higher than that in normal controls [1]. In general, it is considered that central and peripheral nerve involvement in Yusho victims is not common, but it is also well known that many symptoms such as numbness, sensory loss or paresthesia are often observed in Yusho patients. Further, a high incidence of distal symmetric sensory neuropathy in a group of dioxin-exposed workers has also been reported [2], which suggests the existence of subclinical involvement of the peripheral nervous system [3]. Therefore, we reviewed the correlation between the objective neurological findings and serum PCB concentration and PCB pattern using nationwide health examination data of Yusho victims 36 years after the first exposure.

2. Materials and methods

We determined the blood concentration of dioxin-like isomers from 1986 to 2002 in blood samples collected in a nationwide health examination of Yusho victims using a high-resolution gas chromatograph/high-resolution mass spectrometer (HRGC/HRMS) equipped with a solvent-cut large volume (SCLV) injection system. The accelerated solvent extraction (ASE) method was employed for the treatment of blood samples [1]. We collected the most recent data on serum PCB concentration, PCB pattern and subjective/objective neurological data from these patients, who included 1007 officially (OAY) and non-officially acknowledged (NOAY) Yusho accident victims (450 males, mean age 58.2 ± 17.6 years; 557 females, mean age 58.9 ± 16.9 years).

Data on subjective neurological symptoms were obtained by means of questionnaires and a clinical examination performed by a neurologist. An age-matched control group, which included 71 males (mean age 55.8 ± 19.9 years) and 66 females (mean age 64.3 ± 15.0 years), was selected from normal volunteers who visited the Brain Dock section of Omuta Rosai Hospital, National Chikugo Hospital and the Department of Neurology, Kyushu University Hospital.

Data obtained from patients and normal controls were analyzed using the χ^2 goodness of fit test and one-way analysis of variance (ANOVA). A P value < 0.05 was considered significant.

Table 1 Neurological symptoms observed in the officially and non-officially acknowledged (OAY and NOAY, respectively) victims of Yusho and the age-matched control group

Neurological complaint	Negative, *n* (%)	Positive, *n* (%)	Total	*P*-value
Headache				
OAY				
Male	191 (55.0)	156 (45.0)	347	<0.0001[a]
Female	121 (32.5)	251 (67.5)	372	<0.0001[a]
NOAY				
Male	55 (55.0)	45 (45.0)	100	<0.0001[a]
Female	53 (29.8)	125 (70.2)	178	<0.0001[a]
Control				
Male	61 (85.9)	10 (14.1)	71	–
Female	52 (78.8)	14 (21.2)	66	–
Numbness (subjective sensory disturbance)				
OAY				
Male	152 (43.8)	195 (56.2)	347	<0.0001[a]
Female	140 (37.6)	232 (62.4)	372	<0.0001[a]
NOAY				
Male	58 (58.0)	42 (42.0)	100	<0.0001[a]
Female	83 (46.6)	95 (53.4)	178	<0.0001[a]
Control				
Male	66 (93.0)	5 (7.0)	71	–
Female	60 (90.9)	6 (9.1)	66	–

Data were analyzed with the χ^2 test for independence.
[a] $P < 0.05$.