PCB - effects on mammalian reproduction

By

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Like many other chlorinated hydrocarbons PCB enhances the hepatic metabolism of sex steroids such as testosterone and estradiol (Peakall 1967, Nowicki and Norman 1972). It might therefore be suspected that the occurrence of PCB in animals would disturb the sexual functions and, perhaps, cause a decrease of the procreative ability of the animals, resulting in a continued decrease of the number of individuals per generation. From this point of view we have studied some sexual functions in mice of the NMRI-strain, given PCB in amounts corresponding to those found in wild life (Jensen et al. 1969, Jensen and Odsjö 1972).

1. Length of the estrous cycle.

The occurrence of heat in female animals is dependent upon the amount of estrogens circulating in the body. Consequently, a change in the catabolism of these hormones could be suspected to change the regular reappearing of heat periods. Therefore, we have studied the estrous cycle in mice by means of daily vaginal smears before and after one single intraperiotoneal injection of PCB (Clophen A 60, 20 mg/kg body weight). As seen from the following table the mean length of the estrous cycle increases upon administration of PCB (Örberg et al. 1972).

Length of the estrous cycle before and after one single injection of PCB (20 mg/kg body weight)

	Number of animals	Total number of cycles studied	Mean length in days Before injection	Mean length in days After injection	Analysis s	Analysis p
Control animals	24	96	5.6	5.6	1.81	0.04
Experimental animals	12	48	5.5	6.8		

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However, in the natural state PCB mainly enters the animals in food and water. For this reason we have given mice PCB orally, dissolving the drug in peanut oil. Mice happen to have a fancy for peanut oil and, consequently they consume the oil portions immediately and completely. The dose was 0.025 mg PCB/day/ /animal, approximately corresponding to 5 ppm in the food, and the experiments lasted for 62 days. The controls were given the corresponding volume of the peanut oil vehicle.

The results are given in the following table (Örberg and Kihlström 1972).

Effects of ingested PCB (0.025 mg/day/animal for 62 successive days) upon the length of the estrous cycle

	Number of animals	Total number of cycles studied	Mean length, days	Analysis	
				t	p <
Control animals	14	120	6.6	3.79	0.0005
Experimental animals	11	69	8.7		

The observed prolongation of the estrous cycle implies a prolonged interval between the short periods of sexual receptivity in females, probably resulting in a decreased number of pregnancies per individual.

2. Frequency of implanted ova

2.1. Females ingesting PCB as adults

The process of implantation of fertilized ova in the uterus demands a very subtle balance between progesterone and estradiol. This balance might be disturbed by an increased metabolism of these steroids. For this reason we counted the number of corpora lutea and implanted embryos in females ingesting 0.025 mg PCB/day/animal during 62 days before being mated and also during early pregnancy until being sacrificed on day 8-10 of pregnancy. The results given below (Örberg et al. 1972) show a decreased frequency of implanted ova in the treated animals.

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Frequency of implanted ova in females ingesting PCB (0,025 mg/day/animal)

	Number of animals	Number of corpora lutea	Number of ova implanted	Per cent of ova implanted	χ^2	p <
Control animals	22	288	250	87	5,60	0,025
Experimental animals	23	313	249	80		

2,2 Males and females sucking PCB-containing milk

It is well known (Harris 1965 and others) that the sex steroids present during the early postnatal period determine the development of the sexual functions and thus influences the reproductive ability of the adult animal. Sucking of PCB-containing milk during this period, possibly resulting in an increased catabolism of steroids, could therefore be deleterious to the sexual activity in the adults. In order to tackle this question we reared 20 different litters of mice. On the day of parturition ten mothers were given 50 mg PCB/kg body weight intraperitoneally and the ten remaining mothers the corresponding volume of the oil vehicle. The injections were repeated once a week throughout the period of lactation. When reaching sexual maturity the young animals coming from these litters were mated according to the scheme in the table below. The pregnant females were sacrificed on day 10-12 of pregnancy and the number of corpora lutea and placentae counted. The experiments are still going on, Consequently, the results in the following table are preliminary. When mating a control animal with an experimental one no effects upon the frequency of implantation have been observed so far. However, when both the animals of the couple had been sucking PCB-containing milk there is a significant decrease in the frequency of implanted ova.

Frequency of implanted ova in animals having sucked PCB-containing milk

Paired animals Male	Female	Number of pairs	Number of corpora lutea	Implanted ova Number	Per cent	Analysis χ^2	p <
Control	Control	16	211	199	94	-	-
Experimental	Control	17	216	200	93	0,27	0,7
Control	Experimental	19	240	219	91	1,13	0,3
Experimental	Experimental	21	262	191	73	35,57	0,0005

Thus, even small doses of PCB, given for short periods, may cause a decrease in the number of youngs per litter in mice.

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References

Harris, G. W. Endocrinol, 75, 627, 1967.
Jensen, S. and Odsjö, T., Personal communication 1972.
Jensen, S., Johnels, A. G., Olsson, M. and Otterlind, G. Nature 224, 247, 1969.
Nowicki, H. G. and Norman, A. W., Steroids 19, 85, 1972.
Peakall, D. B., Nature 216, 505, 1967.
Örberg, J. and Kihlström, J. E. In manuscript. 1972.
Örberg, J., Johansson, N., Kihlström, J. E. and Lundberg, C. Ambio 1, 148, 1972.

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