almost normal hemoglobin and erythrocyte values while their leukocyte counts were even above normal (the differences from control values were all significant at $p<0.01$ or $p<0.001$).

PCP treatment exerted a similar stimulatory effect on the immune response of mice to rat erythrocytes: on day 4 postimmunization, the mice treated with PCP at 50 μg/kg had, on average, 57.7±9.3 APC per 10^6 spleen cells *vs.* 19.2±3.3 APC in the untreated controls ($p<0.01$). Raising the PCP dose to 500 μg/kg did not lead to any appreciable further increase in the immune response, which suggests that the minimal dose (50 μg/kg) was sufficient for stimulating this response to the maximum.

In summary, PCP have been shown to exert well-defined antianemic, immunostimulating, and general adaptogenic effects. Such diverse effects of these polysaccharides can be explained only in the light of our concept that lymphocytes are universal growth regulators for cells of various types and stimulate regeneration, immune responses, and other adaptive processes [4,5].

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The Effect of Various Incorporated Doses of ^{131}I on Immunological Reactions of the Organism

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Translated from *Byulleten' Eksperimental'noi Biologii i Meditsiny*, Vol. 121, No. 6, pp. 664-666, June, 1996
Original article submitted May 19, 1995

Administration of radioisotope ^{131}I at 148 kBq/g body weight results in an inhibition of the primary immune response and in a decrease of proliferating activity of mouse lymphocytes in response to alloantigen stimulation. The number of antibody-producing spleen cells for immunization of mice with sheep erythrocytes diminished after administration of ^{131}I at 74 kBq/g animal weight.

Key Words: *lymphocyte; immunity; immune system;* ^{131}I

^{131}I enters the environment as a result of nuclear and thermonuclear tests, nuclear accidents, and industrial wastes [2]. With its high mobility the ^{131}I radioisotope easily enters the human organism with food when environmental pollution is present [3].

The high probability of ^{131}I entry into the human body calls for a study of its effect on different systems of the organism. There are few published data on the reaction of the immune system to various ^{131}I doses.

In addition, ^{131}I is widely used clinically, in particular, in the treatment of thyroid cancer [4]. It is thus necessary to study immune reactions to ^{131}I administration, which have a strong impact on the results of treatment in cancer patients.

This study was undertaken to examine immunological reactions of the organism in one-trial administration of the radioactive ^{131}I isotope at different doses.

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0007-4888/96/0006-0599$15.00

MATERIALS AND METHODS

The experiments were carried out on male first-generation hybrid mice (CBA×C57Bl/6) F_1 weighing 21-23 g. The radioactive ^{131}I isotope was administered one time intraperitoneally as sodium iodate with an activity of 37, 74, and 148 kBq/g body weight. Considering differences in weight, body volume and radioresistance, the administered activity was comparable to the total dose received by patients with thyroid cancer in clinical radiotherapy [4]. Immunological reactions were examined 30, 60, and 180 days after ^{131}I administration. Cellular immunity was assessed by determining the proliferative activity of spleen cells in response to alloantigen stimulation of singly-directed mixed lymphocyte culture (MLC) [1] and by the reaction of lymphocyte blasttransformation (RLBT) [5] in response to stimulation by polyclonal T-cell mitogens, phytohemagglutinin (Difco), and concanavalin A (Serva). Humoral immunity was studied using the proliferative activity of spleen cells in RLBT in response to stimulation by B-cell mitogens, *Escherichia coli* lipopolysaccharide (LPS, Difco) and laconos mitogen (Grand Island Biol. Company), as well as using the number of antibody-producing spleen cells on the 5th day after antigen administration [6]. The optimal concentration of mitogens was 30 μg/ml of cultivating medium for phytohemagglutinin, 12.5 mg/ml for concanavalin A, 40 μg/ml for LPS, and 10 μg/ml for laconos mitogen. Sheep erythrocytes were used as antigen, administered intraperitoneally to mice at 5×10^8 cells. Spleen cells of test and control F_1 hybrid mice served as reacting cells in MLC. Irradiated spleen cells of BALB/c mice were used as stimulators. Cells were cultured in RPMI-1640 medium (Serva) supplemented with human serum (5-10%), L-glutamine (2 mM, Serva), 2-mercaptoethanolamine (5×10^{-5} M, Sigma), and HEPES buffer (10 mM, Flow Lab.). ^3H-Thymidine was placed in each microplate well (Linbro)

TABLE 1. Proliferative Response of Spleen Cells and the Number of Antibody-Producing Cells (APC) for Incorporation of ^{131}I (*M±m*)

^{131}I dose, kBq/g weight	Index	Time after administration, days					
		30		60		180	
		control	test	control	test	control	test
37	Proliferative response						
	phytohemagglutinin	11.22±2.74	9.49±0.54	24.87±2.64	16.50±3.76	6.97±0.85	9.59±1.36
	concanavalin A	33.80±8.54	36.16±4.77	75.01±8.61	51.82±15.90	13.06±2.87	14.04±1.16
	alloantigens	40.86±7.54	53.12±3.63	61.54±12.86	54.52±11.54	44.39±6.36	71.73±11.61
	LPS	2.93±0.17	3.13±0.15	3.51±0.71	2.87±0.64	2.73±0.24	2.50±0.51
	laconos mitogen	16.63±2.36	17.79±1.17	10.01±1.43	7.14±1.31	7.54±0.95	9.35±1.04
	number of APC per 10^6 spleen cells	505.0±59.6	578.0±51.4	378.2±31.9	345.2±22.1	701.0±51.0	758.0±42.4
74	Proliferative response						
	phytohemagglutinin	15.55±1.80	15.21±2.63	6.01±0.90	6.30±0.83	9.94±0.91	12.17±1.05
	concanavalin A	28.71±3.80	32.34±3.76	16.78±2.69	15.87±2.45	17.57±1.85	18.43±1.68
	alloantigens	15.36±2.66	19.12±2.74	13.33±1.32	10.51±2.49	13.69±2.29	21.01±2.76
	LPS	3.88±0.26	4.38±0.56	2.51±0.31	2.89±0.25	3.03±0.16	3.57±0.40
	laconos mitogen	10.68±0.86	10.58±1.64	10.26±1.65	9.95±0.70	9.45±0.46	10.68±0.38
	number of APC per 10^6 spleen cells	444.0±40.8	429.7±34.3	452.5±22.4	497.2±48.1	565.4±37.3	221.0±25.9*
148	Proliferative response						
	phytohemagglutinin	5.69±0.47	7.03±0.46	5.61±0.49	5.02±0.49	10.26±1.62	11.51±2.70
	concanavalin A	13.54±2.16	13.59±1.53	8.19±0.82	10.23±0.52	10.34±1.39	23.91±2.22*
	alloantigens	18.62±5.50	13.32±3.07	29.91±4.98	32.78±4.30	26.90±2.65	11.28±2.03*
	LPS	2.79±0.30	3.07±0.36	2.71±0.25	3.11±0.28	3.50±0.35	3.38±0.53
	laconos mitogen	7.35±0.43	6.24±1.50	3.77±0.39	4.78±0.61	14.44±1.57	18.62±3.52
	number of APC per 10^6 spleen cells	606.0±33.9	281.1±37.0*	741.1±55.0	299.6±46.0*	782.8±62.9	441.7±95.8*

Note. Data on proliferative activity are given in stimulation indexes. *$p<0.05$ as compared to the control.

at 1 μCi 16 h prior to the end of incubation. The cell response was recorded by ^{3}H-thymidine incorporation in DNA of proliferating cells with calculation of the stimulation index according to the formula (cpm after stimulation)/(cpm in the control). The experimental series included 4-8 animals. Each variant was tested 4-6 times.

RESULTS

Administration of ^{131}I to test animals at 37 kBq/g body weight did not cause any changes in the immunological reaction of the organism 30, 60, or 180 days later. This was evidenced by the fact that the activity of spleen cells stimulated by T- and B-cell mitogens and alloantigens was maintained at the control level as well as by the unchanged primary immune response to sheep erythrocytes (Table 1).

No changes in proliferative activity of lymphocytes was found for mitogen and alloantigen stimulation after administration of ^{131}I at 74 kBq/g at all observation times. However, the calculation of the number of antibogy-producing spleen cells testified to depression of the primary immune response 180 days after ^{131}I administration.

Administration of ^{131}I at 148 kBq/g resulted in a decrease of the number of antibody-producing spleen cells 30, 60, and 180 days later. Proliferative activity caused by alloantigen stimulation of lymphocytes was also depressed 180 days after ^{131}I treatment. Proliferative activity of spleen cells in response to the stimulation by T- and B-cell mitogens was preserved at the control level for administration of ^{131}I at 148 kBq/g. An intensification of the proliferative response to concanavalin A stimulation was noted only 180 days after ^{131}I entry into the organism.

Thus, the humoral immune response was depressed 180 days after ^{131}I administration at 74 kBq/g and in all periods after ^{131}I incorporation at 148 kBq/g, this being manifested in a decreased number of antibody-producing spleen cells in test animals immunized by sheep erythrocytes. The dose of 148 kBq/g changed cellular immunity reactions 180 days after administration, as attested by the depression of spleen cell proliferative response to alloantigens in the singly-directed MLC.

Depression of the humoral immune response to sheep erythrocytes, the cellular immunity reaction in MLC, and the absence of a decrease of lymphocyte proliferative activity in response to mitogen stimulation may point to a disturbance of the differentiation of immunocompetent cells caused by ^{131}I, whereas their proliferative activity remains intact.

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