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The Impact of Antarctic Environment on the Reproductive Physiology and Immunity

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Abstract

The changes in the hormonal levels and immune system of human subjects were studied during and after acclimatization in Antarctica. Blood samples were collected and plasma separated and preserved at -20°C. The Plasma samples were analysed for Hb,, TLC, DLC and for the levels of various hormones like TSH, LH, PSH, PRL, Cortisol and Testasterone. No significant changes were found in the percentage of various cell types and total number of lymphocytes after one month from the start of the expedition. It was interesting to find that there was a relative decrease in the number of total lymphocytes and various cell types after 3 months of stay in Antarctica.

The levels of hormones like TSH, PRL and Cortisol were not found to change after a stay of three months but there was a significant increase in the levels of luteinizing hormone and there was relative increase in the levels of FSH. The levels of male hormone testasterone were found lower than the control in the last months of stay in Antarctica. Such a study was carried out for the first time in an Indian expedition and shows that there are important implications of such effect of Antarctic environment on various parameters of human health.

Introduction

Immunity and physiology (in particular, reproductive physiology) are the two thrust areas in understanding the parameters for human health and it is important to understand the effects of the adverse climate of Antarctica on these two systems. The elucidation of special features of the development of immunity was a proposal by Russians in 1975 Antarctic expedition and in the same year Australians included the study of human health and medicine as an important area of study in Antarctica. Till now, however, few studies have been published. This paper reports the study undertaken during the 9th Indian Antarctic Expedition to understand the changes occurring at the hormonal levels and in immunity before and during the journey and after a stay of three months in Antarctica.

Materials and Methods

Collection of Plasma

Peripheral venous blood was drawn once every 25-30 days from 15 human males at 8.00 a.m. in heparinised vials and centrifused at 800 g for 20 min. Plasma thus collected was stored at -20°C.

Blood smear

A blood droplet welling up from the finger tip was smeared on a glass slide with a coverslip at an angle of 45°. Dried the smear and labelled it (subject's name and date). Smears were stained according to Leishman after 24 hr and differential lymphocyte counts were recorded.

Materials

Enzyme immunoassay buffer : 10 mM phosphate buffer saline with 1% BSA. Cortisol, various hormone antibodies, Penicillinase conjugates, Penicillin, V, "H-Testasterone were all gifted by Dr. G.L. Kumari, NIH-FW, New Delhi. TSH and PRL immunoassay kits were obtained from Serono diagnostics, Switzerland.

Extraction of steroids from plasma

To 500 µl of plasma diluted to 2 ml with assay buffer, 10 ml of HPLC grade diethyl ether was added and mixed gently. Aspirated the diethyl ether and dried the residue Added l-5 ml of assay buffer and vortexed for one min. Let it stand for at least one hour and samples were analysed for testosterone and Cortisol. To a second portion of plasma (25µl), 625µl of 10 mM PBS was added and heated at 60°C for 30 min. 100µl of sample was taken for measuring Cortisol.

Hormone assays

Enzyme immunoassay for Cortisol was performed according to the method of Shrivastava *et al.,* (1988). Thyroid stimulating hormone (TSH) and Prolactin (PRL) were analysed in plasma sample using serono serozyme kit, (Rattle *et al.,* 1984). Human luteinizing hormone (LH) and Follicle Stimulating Hormone (FSH) were estimated by ELISA using 2nd antibody coated 96 well plates. HLH and hFSH antibody, hLH- and hFSH- Penicillinase conjugate were used according to the method standardized in the laboratory of Dr. G.L. Kumari, NIH-FW, New Delhi.

Results and Discussion

Analysis of various parameters in the plasma samples collected at various time intervals during the journey and stay in Antarctica revealed interesting information on the changes occurring in the physiology of reproductive system and immune system. There was relative decrease in the percentage of various types of lymphocytes (like T- & B-cells, data not shown) and in the total number of lymphocytes after three months of stay in Antarctica but there was no significant change in the above parameters after a month from the start of the expedition (Table 1). The exact cause of the decrease in TLC and DLC is not clearly understood at this stage of study. In addition to the stressful conditions of Antarctica like cold, isolation, polar light regime and changes in the earth's magnetic field which may all be affecting the brain-pituitary complex, the other reason may be that in the pollutant free atmosphere of Antarctica the immune system is coming to a resting stage where the level of TLC and DLC are lower than when the human subjects were in India. It has currently been substantiated in humans as well as in animals that during stress as well as during the

Table 1: The Status of **Immune Parameters in the Plasma** of **Human Subjects at Various Time Intervals in Antarctica**

Immune Parameters	Control	I Month	II Month	III Month
Hb. (g%)	12.0	11.0	12.8	12 0
TLC(per mm^3 blood)	8200	6700	6400	5000
DLC (%),				
P	68	64	68	65
L	27	24	22	22
E	3	4	3	4
M	2	1	2	1

* The values obtained are mean of the values obtained from 10 human subjects for Hb and 15 human subjects for TLC and DLC, P: Polymorphonuclear cells, L: Lymphocytes, E: Eosinophils and M: Monocytes.

adaptation process a cascade of events take place which originate in the central nervous system and affect the immune system and human health in general (Mirrakhimov *et al.,* 1979; Nair & Bajaj,1988; Reed,1986 and Khansari *et al.,* 1990).

The levels of hormones like TSH, LH, FSH, PRL, Cortisol and Testasterone were analysed in the plasma samples collected at various time intervals in Antarctica and the results obtained are shown in Table 2. There were no significant changes in the levels of hormones like TSH, PRL. The levels of Cortisol were found to increase with respect to controls, however, all the values obtained were within the limits of standard values obtained in normal human subjects. Probably this indicates a very effective and efficient adaptive mechanisms which prevents drastic & damaging rise in serum Cortisol. Interestingly the levels of LH increased significantly by the second month and it further increased by the third month of stay in Antarctica. The levels of other gonadotropic hormone FSH were relatively increased by the third month but not significantly. The levels of male hormone Testasterone were found lower than the normal in last two months of stay in Antarctica but this decrease in Testasterone is not comparable with the respective increase in the levels of LH. How these changes are governed and what physiological and psychological significance they have is the important question in front of us. Studies done in far north have revealed that an important role is played by the hormones in adaptive changes in homeostatic systems supporting life (Mirrakhimov *et al.,* 1979). Palumbo *et al.,* (1990) have shown that there is dramatic suppression of immune response at the time of ovulation implicating important interactions between immune and endocrine compartments in physiological control of reproductive function. During the adaptation, the organism receives a mass of new impulses from the external environment, which considerably modifies the functional status of the regulatory sections of the nervous and endocrine system (Khansari *et al.,* 1990 & Turck & Cambell, 1979). The conditions encountered in Antarctica may all be affecting the brain pituitary complex causing the changes in the hormone and immune parameters. Further studies on this subject in Antarctica are recommended to establish the importance of above changes taking place in the physiology of human subjects.

Table 2: The Levels of Hormones in the Plasma of Human Subjects at Various Time Intervals in Antarctica***

Hormone	Control	I Month	II Month	III Month
LH	192.20	211.60	573.33	700.00
(ng/ml)	(160-280)	(180-230)	(240-1000)	(500-900 & higher)
FSH	260.32	295.00	400.82	541.12
(ng/ml)	(240-400)	(250-500)	(220-700)	(240-800)
T	285.57	205.70	120.87	165.71
(ng/l00ml)	(200-340)	(100-340)	(100-200)	(110-240)
PRL	9.80	11.00	11.34	11.80
(ng/ml)	(6-14)	(8-13)	(9-13)	(7-13)
TSH	2.61	1.95	2.61	2.16
(µl.U./ml)	(2.35-3.10)	(1.65-2.40)	(1.7-3.8)	(1.7-2.4)
CORTISOL	63.25	68.50	106.93	109.86
(ng/ml)	(55-86.50)	(57.50-102.50)	(62.5-192)	(62-187)

*The values given above are mean of the values obtained from 15 human subjects.
**The values in the parentheses are the range of values obtained.

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