

A survey on changes of multiple humoral factors in Antarctic expedition members

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Abstract Since Changes of cardiac function, electroencephalogram findings, immune responses as well as the personality of the Antarctic expedition members had been reported by our group, the underlying contribution of behavior and physiological changes would be further studied in this time. Samples were taken, under standardized procedures, on the same individual at different time such as (A) before leaving to Antarctica (B) 2 weeks after arrival at Great Wall Station (C) 12.5 months after arrival (D) after returning back to Beijing for a break (summer-over member) (E) after returning back to Beijing for a long break (winter-over member).

Results showed that a prominent increase of urinary Noradrenaline (NE) in Antarctica (B) decreased at (C), and returned to the normal range in comparison with (A) and (D). The increase of urinary Adrenaline was even greater than that of NE at Antarctica (B). It indicated that an rather early response in activation of sympathetic system, especially the adrenal glands, gradually lowered down as time went on.

Plasma and urinary cortisol also increased significantly at Antarctica (B), but sustained for a long time even after returning back to Beijing. Both parameters are closely related to stress syndrome.

Plasma Tryptophan decreased significantly at Antarctica (B). Some even sustained after returning to Beijing (E). Whether or not, such changes might correlated to the change of 5-HT metabolism in brain, in turn to show some effect on psychological or mental disturbances, which should be carefully evaluated.

Serum MDA, the peroxidation product, increasing together with the findings of decreased RBC SOD activity, the scavenger for O_2^- , and increased plasma glucuronidase, the lysozyme released from damage of lysosome membrane, strongly indicated the presence of cellular damage by increasing O_2^- production and membrane peroxidation and with damage of lysosome unduly. Severe cold and extensive ultraviolet exposure should be considered carefully.

The significances of the above findings were discussed and the possible preventive or therapeutic measures have been suggested. Since the destruction of the ozonelayer might increase the extent of ultraviolet radiation, it is worth to further investigate the biological damage effect of ultraviolet in Antarctica.

Key words humoral factors, Antarctica, expedition member

1 Introduction

Studies of the hormone and other humoral factors in man under extreme environmental condition are important because of their underlying contribution to behaviour and physiological health. Antarctica is an enormous sleeping white continent of extreme winds, low temperatures, snow storms and is continuously dark in winter. There are no trees, leaves or berries, except the mosses, lichens and algae. Antarctica has no indigenous population, and instead it hosts about thousands of people in scattered base camps. Living and working in such extreme and isolated area expose the human physiology to many influences (Xue, 1991; Deng, 1991; Yu *et al.*, 1991; Xue and Feng, 1991).

In 1984 China constructed the Great Wall Station and dispatched her first Antarctic research expedition to conduct scientific investigation in the area of King George Island. Since then a series of human physiological and psychological researches have been carried out.

Our previous studies showed that under the Antarctic circumstance of ice and snow and isolation from the world, the Antarctic expedition member's cardiac function was enhanced in compensatory way in a while followed by decline in the summer at Great Wall Station (Xue *et al.*, 1989). The immune function decreased after residing in Antarctica and recovered when returning back (Yu and Deng, 1991). The changes of the personal character and psychological behaviour of some members were also found especially in winter (Xue *et al.*, 1990).

In this study the changes of urinary catecholamine, plasma and urinary cortisol, plasma Tryptophan and urinary 5-HIAA were selected to be studied, and also some parameters related to the cellular peroxidation were estimated in Chinese Antarctic expedition members.

Sixteen expedition members, male 13, female 3, aged from 27—61 years (average 39 years). 8 summer over and 8 winter over. All passed the routine health examination in the qualified hospital.

Blood and urine samples were taken from these members before their leaving for Antarctica (November 1991, Beijing), 2 weeks (December 1991, summer, Great Wall Station) and 12.5 months (December 1992, after winter, Great Wall Station) after their staying in Antarctica, and after their returning back to Beijing (summer-over member, March 1992; winter-over member, January 1993). The date for blood sampling was constant, and only urine was collected in winter.

In Antarctica an aliquot of collected blood samples were centrifuged and the plasma was obtained. Serum and erythrocyte were separated from another aliquot of blood. 24hr urine was collected (added HCl to keep $\text{pH} < 3$) and total volume was recorded. Aliquot of urine and blood samples were stored frozen at -20°C . All samples were returned to Beijing (transported by air) for analysis.

Urine Adrenaline (E) and Noradrenaline (NE) were estimated by radio enzymtic and spectrophotofluorometric method. Plasma and urine Cortisol (C) determination were performed by means of the radioimmunoassay. Plasma Tryptophan (Trp) was measured

by spectrophotofluorometry. Urinary 5-Hydroxy-3-indoleacetic acid (5-HIAA) was extracted by ether and measured by spectrophotofluorometry. Plasma β -glucuronidase determination was measured by colorimeter using phenol phthalein glucuronide (sodium) as substrate. Serum Malondialdehyde was measured by spectrofluorometric method. Erythrocyte Superoxide Dismutase (SOD) activity was estimated by inhibitory assay of pyrogallol self-oxidizing.

2 Results

2.1 Changes of urinary catecholamine content

Results showed that after arrival in Antarctic urinary NE and E increased, and NE resumed normal after winter and after-return. But E kept high level all along (Table 1).

Table 1. Changes of urinary catecholamine ($\bar{X} \pm SD$)

	① Before arriving Antarctica	② 2 weeks after arriving Antarctica	③ 12.5 months after arriving Antarctica	④ After return from Antarctica
Noradrenaline $\mu\text{g}/24\text{h}$	35.82 ± 8.26 (7)	$52.54 \pm 22.70^*$ (7)	$22.92 \pm 12.06^{\Delta\Delta\Delta}$ (7)	$30.80 \pm 9.80^{\circ}$ (5)
Adrenaline $\mu\text{g}/24\text{h}$	8.28 ± 4.42 (7)	$18.11 \pm 5.01^{***}$ (7)	$10.76 \pm 4.15^{\Delta\Delta}$ (6)	$15.56 \pm 7.73^{\circ}$ (5)

Compared with ① * $p < 0.05$ *** $p < 0.001$ (number = number of subject)
 Compared with ② $\Delta\Delta p < 0.01$ $\Delta\Delta\Delta p < 0.001$
 Compared with ③ $^{\circ} \text{NS}$

2.2 Changes of plasma and urinary cortisol

Both plasma and urinary cortisol increased 2 weeks after arrival in Antarctica and remained high level except the urinary cortisol of the summer-over members when they returned (Table 2).

Table 2. Changes of plasma and urinary cortisol ($\bar{X} \pm SE$)

	① Before arriving Antarctica	② 2 Weeks after arriving Antarctica	③ 12.5 months after arriving Antarctica	④ After return (summer over)	⑤ After return (winter over)
Plasma $\mu\text{g}\%$	7.82 ± 0.37 (16)	$19.11 \pm 2.18^{***}$ (9)		$17.33 \pm 1.76^{***}$ (6)	$20.17 \pm 2.86^{***}$ (6)
Urine $\mu\text{g}/24\text{h}$	64.0 ± 5.6 (12)	$98.2 \pm 5.8^{***}$ (11)	$85.3 \pm 8.7^*$ (7)	50.5 ± 7.8 (8)	$147.5 \pm 7.5^{***}$ (6)

Compared With ① * $p < 0.05$ *** $p < 0.001$ (number)

2.3 Changes of plasma tryptophan and urinary 5-HIAA

Plasma Trp decreased 2 weeks after arrival in Antarctica and remained low level after return to Beijing (Table 3).

Table 3. Changes of plasma tryptophan ($\bar{X} \pm SD, \mu\text{g/ml}$)

	① Before arriving Antarctica	② 2 weeks after arriving Antarctica	③ After return (summer-over member)	④ After return (winter-over member)
Winter-over member	11.29 ± 1.73 (7)	9.36 ± 1.91** (7)		7.88 ± 1.48** [△] (7)
Summer-over member	12.79 ± 3.08 (5)		9.60 ± 1.70* (5)	

Compared with ① *p < 0.05 **p < 0.01 (number)

Compared with ② [△]p < 0.05

Urinary 5-HIAA increased in member only after winter at Antarctica. (Table 4)

Table 4. Changes of Urinary 5-HIAA ($\bar{X} \pm SD, \text{mg}/24\text{h}$)

	① Before arriving Antarctica	② 2 weeks after arriving Antarctica	③ 12.5 months after arriving Antarctica	④ After return (summer-over member)	⑤ After return (winter-over member)
Winter-over member	3.91 ± 1.60	4.43 ± 1.49	8.29 ± 4.32*		3.82 ± 1.24 [△]
Summer-over member	4.24 ± 2.89			3.22 ± 0.79	

*Compared with ①: p < 0.05 (number = 7) Self compare

[△]Compared with ③: p < 0.05

2.4 Changes of MDA and SOD

Preliminary result showed that serum MDA increased and RBC SOD activity decreased after spending in Antarctica (Table 5).

Table 5. Changes of blood MDA and SOD ($\bar{X} \pm SE$)

		RBC-SOD-Activity (U/g. Hb)	Serum MDA (nmol/ml)
Summer-over member	Before arriving Antarctica (6)	6569.5 ± 304.5	0.93 ± 0.09
	After return (6)	5401.9 ± 309.9**	1.67 ± 0.24*
Winter-over member	Before arriving Antarctica (6)	6090.0 ± 220.1	1.13 ± 0.10
	After return (6)	5707.4 ± 244.5	1.72 ± 0.08*

Compared with before arriving Antarctica *p < 0.05 **p < 0.01 Self compare

(The samples got in Antarctica were not examined because of haemolysis)

2.5 Changes of plasma β -glucuronidase

Plasma β _g increased and remained high level after return to Beijing (Table 6).

Table 6. Changes of Plasma β -glucuronidase [$\bar{X} \pm SE, \mu\text{g}/(\text{ml} \cdot \text{h})$]

Before arriving Antarctica	2 weeks after arriving Antarctica	After return (summer-over member)	After return (winter-over member)
4.98 ± 0.55 (16)	9.24 ± 1.34** (7)	8.42 ± 0.67** (8)	8.08 ± 1.60* (6)

Compared with before arriving Antarctica *p < 0.05 **p < 0.01 (number)

3 Discussion

The psychological isolation with one's own family, friends for a long time, and physiological adaptation to such extreme environmental changes might be a realistic problem to face among the Antarctic expedition members.

There is a prominent increase of urinary nonadrenaline and adrenaline at two weeks after arriving to Antarctica, some with rather prolonged effect. It is enough to explain the changes observed in cardiovascular system, immune system and electroencephalogram. The more increase of adrenal-content in urine might be also important contribution to behaviour changes (Robert, 1984).

Selye recognized that the cortisol is an adaptative hormone in facing the "stress", and it existed for a longer period, so it was with our case.

Emotional instability with anxiety, depression, sleep disturbances was seen in our members. Cortisol and adrenaline might play some role in it together (Kendall, 1984), with the possible role of 5-HT metabolism changed in brain making us to partially realize such possible linkage. Because Trp is capable of penetrating into brain to synthesize 5-HT. The decrease of plasma Trp may lead to the decline of brain 5-HT, which might play a role in the express of depression syndrome (Hoes, 1982), especially in winter over member. Urinary 5-HIAA decreased after winter may be explained.

If so, the intervention of L-Trp or supplement of related food might be valuable (milk and banana are rich in Trp). The suitable blocker on the stress signal transduction pathway might be valuable too.

The presence of cellular damage, proved by the results obtained from studies of MDA, SOD, β_2 (the damage of lysosome membrane led to the release of lysozyme and the increase of β_2) is convincing enough. Therefore, the protective measure on cold exposure or ultraviolet radiation or other stress should be considered and carefully controlled in order to avoid such events, and the routine intake of some anti-oxidant should be undertaken.

All results, although some are preliminary, even with some speculation, are enough to be utilized in explaining the possible relationship between the physiological and psychological responses of the members and their humoral changes.

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