Original Article

Effects of Head Down Tilt on Some Neuro-psychological Parameters : A Preliminary Study

AK Sengupta, MNC Sastry, CG Roopa

Five healthy male volunteers between the age of 17-19 yrs were subjected to hypogravity condition, usirig six degree head down technique, for six hours. Speed of perception, visual vigilance, N 100 and P 300 were assessed using three paper-pencil psychological tests and Evomatic 4000 equipment respectively. Performance on the psychological tests at the beginning of the experiment was compared with that at the end of six hours. Neuropsychological parameters N 100 and P 300 were recorded at the beginning and at intervals of 2 hours. Hypogravity condition did not have any adverse effect on speed of perception whereas, adverse effect seen on attention and information processing time disappeared with passage of time.

Keywords : Hypogravity, Head-down-tilt, Evoked potential (N 100, P 300).

Soviet investigators[1,2] in their efforts to simulate hypogravity condition in the laboratory found that the best method to do so was by means of head down technique. This technique suggested by them has received considerable attention since then. According to them and others[1,2,3] with the head down approach, symptoms similar to the one experienced by cosmonauts in hypogravity condition occur more rapidly and are more pronounced than those seen with horizontal bed rest. This paper concernes itself with one such study conducted at Institute of Aerospace Medicine, Indian Air Force, Bangalore.

Materials and Methods

Sample : The sample consisted of 5 clinically healthy airmen ranging in age from 17 to 19 years, who volunteered to be the subjects for the study.

Variables Studied : The variables studied were speed of perception, visual vigilance and N 100 as well as P 300 (components of evoked potential).

Tests and Equipment : Three paper and pencil tests, viz., Digit Symbol Substitution Test, Perceptual Speed Test and Letter Cancellation Test were used to assess speed of perception and visual vigilance. Evomatic 4000, a highly sophisticated equipment was used to assess and record Event Related Potential[4,5] in the form of N 100 and P 300 values. This instrument records electrical activity of the brain in response to outside stimulation by means of a number of electrodes placed on the head. The record is in the form of curves with positive and negative waves. This activity has two components, one elicited by external stimuli occurring within 100 ms subsequent to the stimulus (N 100) and the other elicited by the processing of information (P 300). P 300 is a large positive wave that appears about 300 ms after the onset of a stimulus.

Procedure : The experiment was conducted in an air conditioned sound proof laboratory. Six degrees head down tilt technique was used for simulation of hypogravity condition. The experiment lasted for a duration of 6 hours. The psychological tests were administered at the beginning of the experiment and at the end of 6 hours. N 100 and P 300 values were recorded at the beginning and at intervals of two hours during the 6 hour period.

Results and Discussion

Tables I and II depict mean scores on psychological tests and neuropsychological parameters. The group as a whole showed an improvement in its performance in psychological tests involving perceptual speed and visual vigilance at the end of the experiment but the improvement was not statistically significant in perceptual speed test and letter cancellation test. The improvement, however, was significant in digit symbol substitution test (Table-I).

Latency of N 100 component increased considerably after 2 hours and continued to do so till the end of 4 hours. But, it came down almost to the basal level by the end of 6 hours.

Table - I Mean Scores (sec)in Psychological Test-Beginning and end of the experiment

Test	0 Hrs	6 Hrs	Mean Diff	't' Value	Level of Significance
Digit symbol substitution	37.60	40.40	2.80	2.89	0.01
Perceptual speed	83.60	94.00	10.40	1.79	NS
Letter cancellation	188.40	201.40	13.00	1.02	NS

Table - II Mean values for neuropsychological parameters during 6 hour period

Parameters	0 hr		2 hrs		4 hrs		6 hrs	
	Lat (ms)	Ampl (μv)	Lat (ms)	Ampl (μv)	Lat (ms)	Ampl (μv)	Lat (ms)	Ampl (μv)
N 100	82.5	7.8	87.6	5.6	90.24	5.56	80.32	7.2
P 300	309.2	11.5	322.3	7.5	359.00	10.00	308.50	10.1

This indicates that impairment of attention as a result of hypogravity condition started within two hours of the beginning of the experiment and continued for another two hours. However, due to habituation, probably, no impairment of attention was noticed at the end of 6 hours. The same was confirmed with the decrease in amplitude after 2 hours upto the end of 4 hours and resumption to the basal level at the end of 6 hours.

Latency of P 300 increased upto 4 hours starting from 2 hours but came down to the basal level at the end of 6 hours. As far as the amplitude of P 300 was concerned, a decrement was noticed at the end of 2 hours but the value came almost to the basal level by the end of 4 hours itself. This indicated an increase in stimulus evaluation time (information processing time) upto 2 hours and returning to the basal value at the end of 6 hours.

In addition to the above, it was found that few subjects complained of low backache, facial puffiness and nasal congestion which lasted for 30 min to 2 hours.

It is, thus, seen that the HDT technique is effective enough to induce hypogravity condition, and that it adversely affects attention and decision taking time within 2 hours. Such an adverse effect reduces gradually with the passage of time as one gets habituated to the new condition. This finding is similar to the ones reported by NASA[3] as well as Soviet scientists.

Conclusion

Hypogravity condition has no adverse effect on speed of perception. However, it affects attention and information processing time within the first two hours. Habituation effect takes over after that. Due to small sample size and duration of exposure to hypogravity condition, the findings should be viewed with caution.

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